Management Plan

Port Honduras Marine Reserve

2012 – 2017

Completed by the Toledo Institute for Development and Environment
For the Belize Fisheries Department

PORT HONDURAS MARINE RESERVE

GOAL

"the sustainable management of coastal ecosystem functions and natural resource values for the benefit of present and future generations of Southern Belize, within the wider ridge to reef landscape"

TIDE Advisory Board, 2011

…promoting the sustainable use of the biological resources and the identification and development of integrated conservation and development activities related to the ecosystems and species associated with the reserve, and compatible with ecosystems functions and services for the buffer communities.

OBJECTIVES

- To promote sustainable marine resource use for the continued benefit of all users
- To ensure continued sustainable resource extraction through effective management mechanisms for the benefit of traditional fishing communities
- To promote community stewardship of the marine resources through effective communication, education and outreach
- To provide a sustainable recreational and tourism environment that will enhance the economic and social benefits of the area
- To engage in effective research and monitoring within PHMR to guide and inform management decisions

TIDE Advisory Board, 2011

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Acknowledgments

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Integrated Protected Areas and Landscape Management in the Golden Stream Watershed

1. INTRODUCTION

1.1 Background and Context

The Mesoamerican Reef is the largest contiguous reef system in the western hemisphere, spanning 1000km from the tip of the Yucatan in Mexico to the Bay Islands of Honduras (Wilkinson & Souter 2008). The largest portion of the Mesoamerican Reef System is located within Belizean waters, running parallel to the coastline. In the south of Belize, where Belize waters meet those of Guatemala and Honduras, lies the Gulf of Honduras. This semi-enclosed bay, bordered by Southern Belize, Guatemala and Honduras, is considered a critical nursery and feeding area for many coastal and reef species. Within southern Belize, an area of these rich coastal waters has been designated as a marine protected area – the Port Honduras Marine Reserve (Map 1). Covering an area of 160 square miles (100,000 acres / 414 km^2), the borders of the Marine Reserve extend along the coastline from just south of the Rio Grande River to north of the mouth of the Monkey River, and East to the edge of the eastern edge of the Snake Cayes. The Marine Reserve was established to protect the physical and biological resources of the Port Honduras region, and provides protection for mid-lagoonal reefs, unique in Belize, with characteristics of both inshore reef and offshore barrier reef environments. It also encompasses important seagrass beds and surrounds over 138 mangrove cayes, supporting an important fishery for the local traditional users.

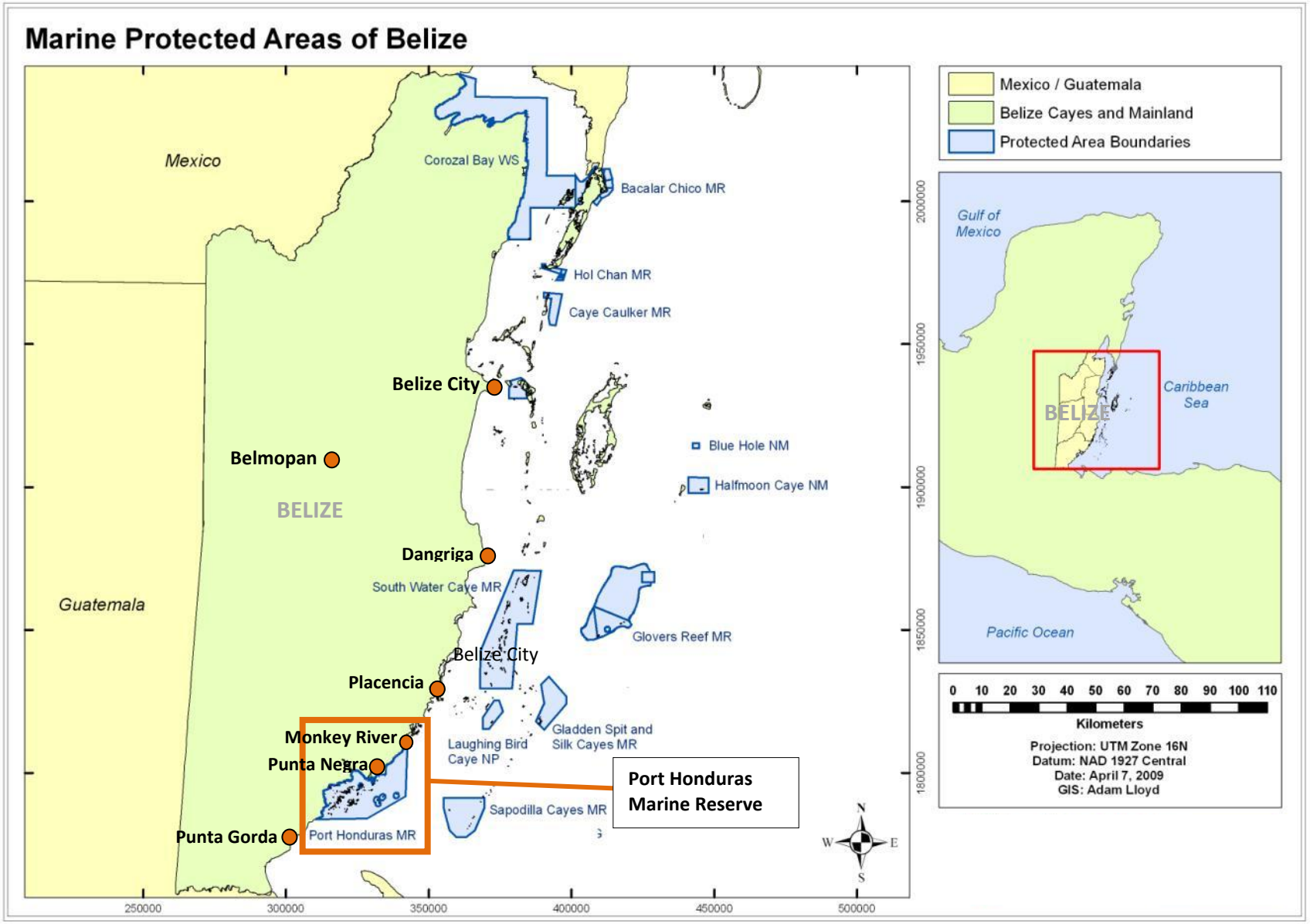
SITE INFORMATION

Size: Total: 100,000 acres (40,468 ha)
Preservation Zone: 0.805km radius around Middle Snake Cayes
Conservation Zones I, II and III: 0.805km radius around West and South Snake Cayes, East Snake Caye and West Cane Caye
General Use Zone: 93,731, acres (37,932 ha)
Statutory Instrument: SI 9 of 2000 (Order)
SI 18 of 2000 (Regulations)
IUCN Category: IV
Management Authority: Fisheries Department
Co-Management Partner: Toledo Institute for Development and Environment
Contact Email: info@tidebelize.org
Website: www.tidebelize.org

Location: Port Honduras Marine Reserve is located directly offshore, in the coastal waters of southern Belize, extending from Monkey River at its northern extent, to beyond the Rio Grande in the south

Uses: Extractive and non-extractive – fishing, tourism, education and research
Management Plan: In revision (2011)
Biodiversity information: TIDE - ongoing and long term research, Rapid Environmental Assessments lead by TNC; (1993 and 1994) and incorporating earlier work by Coral Caye Conservation. Ongoing work on goliath grouper, sharks and rays (R. Graham / WCS); independent researchers
Visitor Facilities (2009): Ranger's Station / Visitors Centre (Abalone Caye), Tide Office (Punta Gorda)
Visitation (2008): 771 visitors
On-site Staff (2009): 1 site manager, 5 rangers, 2 biologists

As an integral part of the Maya Mountain Marine Corridor, the Port Honduras Marine Reserve focuses on the conservation of marine biodiversity, with connectivity to the landscape through the six watersheds that empty into it. This landscape includes the coastal wetlands, the matrix of private protected areas managed under TIDE and Ya'axché Conservation Trust, and the mosaic of mangrove, lagoon and savannas of Payne's Creek National Park.



Map 1: Location of Port Honduras Marine Reserve within Belize

Port Honduras Marine Reserve was designated in 2000, and is considered to be equivalent to IUCN Category IV. The area is divided in to three zones, as described in the Fisheries Order (SI 9 of 2000), with its associated regulations (SI 18 of 2000). 95% of the Marine Reserve is legislated as a General Use Zone, where commercial, subsistence and recreational fishing activities are permitted; 4% is designated as a Conservation Zone, where "no-take" recreational activities are allowed; and the remaining 1% is designated as a Preservation Zone where no activities are permitted. In addition, the use of gill nets, long lines and beach traps is prohibited anywhere within the Marine Reserve.

IUCN Category IV

"Habitat/Species Management Area: protected area managed mainly for conservation through management intervention.

Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species."

(www.unep-wcmc.org)

The Toledo Institute for Development and Environment (TIDE) has been granted co-management responsibility by the Government of Belize, in partnership with the Fisheries Department. TIDE was founded in 1997 to meet the growing environmental and development needs of the Toledo District. TIDE's focus is to enable community based forest, marine and coastal conservation in the Maya Mountain Marine Corridor, while developing viable economic alternatives for residents that do not rely on resource extraction.

TIDE has grown from its inception as a local, grassroots response to manatee poaching and marine degradation, to a leading non-government organization in Belize, with an annual budget of approximately US$1.7 Million. Since 2003, reasonably consistent monitoring of the key habitats and species within the Marine Reserve has taken place, and data has been collected and analyzed, towards increasing effective management of the marine protected area.

1.2 Purpose and Scope of Plan

Port Honduras Marine Reserve was designated for the preservation and sustainable use of biological resources and the Management Plan serves as a working document to provide a 5-year framework for the strategies and activities to achieve the goals of maintaining coastal ecosystem functions and natural resource values, including the water quality and nursery habitats of the Port Honduras area. The Plan accommodates traditional fishing practices of the fringing communities, and provides for a managed access regime, while facilitating and promoting a diversification into other income-generating activities. It also allows for the identification and development of other economic activities compatible with the overall goals of the Marine Reserve, for increased socio-economic benefit for stakeholders.

The management plan has been developed following national guidelines (National Protected Areas Policy and System Planning Plan, 2005), and the outputs from the Maya Mountain Marine Corridor Conservation Action Plan (TIDE, 2009). There has been extensive stakeholder input, through meetings

with staff at TIDE, the Port Honduras Marine Reserve Advisory Committee, representative stakeholders, members of the buffering communities and the Fisheries Department of Belize. It has also taken into account planning for the adjacent Southern Belize Reef Complex system, stretching north from the Sapodilla Cayes Marine Reserve to South Water Caye Marine Reserve.

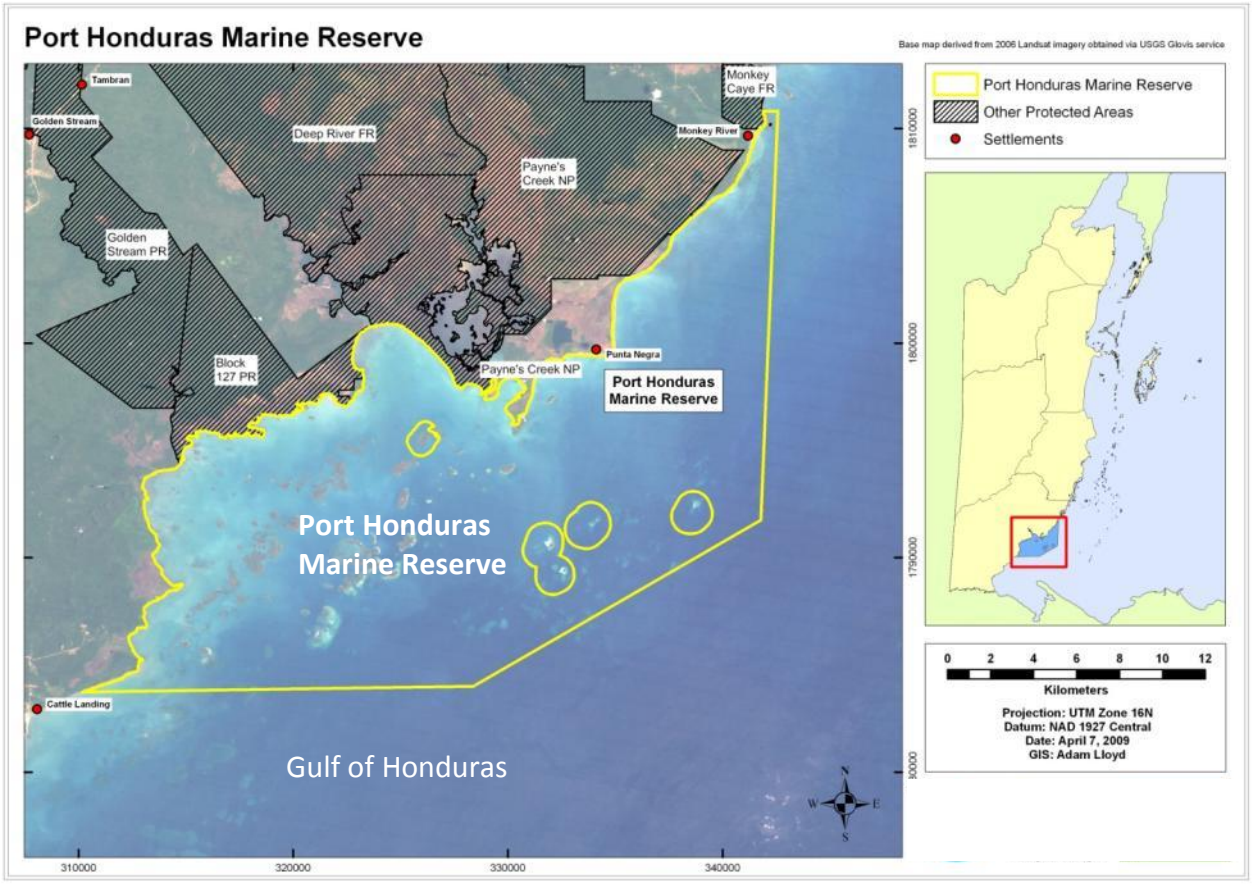
The Plan is structured in three parts. The Current Status provides information on the national and regional context of the Marine Reserve, with information on the physical and biological aspects of the area, documents the current uses and highlights management problems. The Conservation Planning section summarises the conservation target and threats and details specific management strategies for the maintenance of biodiversity and ecosystem functions. The Management Planning section defines the goals and objectives of management for the Marine Reserve, the management programmes and strategies in place for the coming five years, and integrates a monitoring and evaluation format.

The Management Plan is considered a living document, to be reviewed, update and re-submitted annually by TIDE and the Fisheries Department, allowing information to be added and strategies amended as appropriate, reflecting changes in the socio-economic and biodiversity context of the marine protected area.

2. CURRENT STATUS

2.1 Location

Port Honduras Marine Reserve is situated in the southern coastal waters of Belize. It is a semi-estuarine system that stretches from Monkey River in the north to Rio Grande bar in the south, and extending approximately 8 kilometers out to sea, beyond the East Snake Cayes (Map 2).



Map 2: Port Honduras Marine Reserve

Access

The Marine Reserve lies adjacent to the southern coastal wetlands and is generally accessed by boat, either from Punta Gorda, Punta Negra or Monkey River. There is also direct access from the coastline through a series of seasonal footpaths and logging trails.

Communities Adjacent to Port Honduras Marine Reserve

3 population centers lie near or adjacent to Port Honduras Marine Reserve:

- Punta Gorda (south of the mpa boundary)
- Monkey River (adjacent to the mpa boundary)
- Punta Negra (adjacent to the mpa boundary)

2.2 Global and Regional Context

Port Honduras Marine Reserve (PHMR) is part of the Mesoamerican Reef (MAR), which stretches for more than 1,000 km (600 miles) parallel to the coast of Belize, Guatemala, Honduras and Mexico. One of the most diverse ecosystems on earth, the MAR is considered outstanding on a global scale, and a priority for conservation action, stabilizing and protecting coastal landscapes, maintaining coastal water quality, sustaining species of commercial importance, and providing employment in the fishing and tourism industries to more than a million people living in coastal areas in the three countries (Global Environment Facility, 2001).

Belize has an estimated 1,420 km² of reef within its waters - 5.5% of the reefs of the Wider Caribbean (World Resources Institute, 2004). The Barrier Reef, to the east of the Marine Reserve, is included on a list of the 18 richest centers of endemism and has been highlighted as one of the most threatened by human impacts (Roberts et al., 2002).

Belize is one of the areas highlighted as having the lowest anthropogenic impacts, with its small population and relatively low coastal development rate. However impacts are increasing – whilst once highlighted for its pristine reefs, Belize has more recently been shown to have a percentage live coral cover that is slightly lower than the average for the Caribbean (AGGRA /McField, et al., 2008 (ed. Wilkinson et al., 2008)). Recent quantitative data on fish populations comparing 2002 and 2008 observations in the adjacent Southern Belize Reef Complex indicate a staggering decline in populations of larger reef fish such as grouper, snapper, and triggerfish (Mumby, 2009), increasing the relative importance of Port Honduras Marine Reserve's designated no-take areas and the effective management of the General Use Zone, within the National Protected Areas System.

The Marine Reserve contains assemblages of regionally important ecosystems of importance for several species of global conservation concern, among them the critically endangered staghorn and elkhorn corals (A*cropora cervicornis* and *Acropora palmata*), hawksbill turtle (*Eretmochelys imbricata*) and goliath grouper (*Epinephelus itajara*) The area also protects the endangered green and loggerhead turtles (*Chelonia mydas* and *Caretta caretta*), and contributes towards the regional viability of important commercial species, including the queen conch (*Strombus gigas*) and spiny lobster (*Panulirus argus).* The mangroves of the cayes and coastal habitats are also important for sport fish species, (contributing to local coastal economies) and as nursery areas for many commercial marine species of economic importance.

Belize has been a signatory to a number of regional and international conventions. In 1983, Belize signed the **Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region** (the 'Cartagena Convention') with the primary objective being protection of the ecosystems of the marine environment, following recognition of the regional importance of the reef system, the majority of which lies within Belizean waters (Table 1).

International Conventions and Agreements of Relevance to Port Honduras Marine Reserve	
Convention on Biological Diversity (Rio de Janeiro, 1992) Ratified in 1993	To conserve biological diversity to promote the sustainable use of its components, and encourage equitable sharing of benefits arising from the utilization of natural resources. ***Port Honduras Marine Reserve provides an important and integral part in the national protected areas system, protecting biodiversity, threatened species and unique ecosystems, as per Belize's commitment under the CBD.***
Alliance for the Sustainable Development of Central America (ALIDES) (1994)	Regional alliance supporting sustainable development initiatives. ***Initiatives within the stakeholder communities of the Port Honduras Marine Reserve are targeted at facilitation of sustainable economic and environmental development, with the support of Fisheries Department and TIDE.***
Central American Commission for Environment and Development (CCAD) (1989)	Regional organization of Heads of State formed under ALIDES, responsible for the environment of Central America. Initiated Mesoamerican Biological Corridors and Mesoamerican Barrier Reef Systems Programmes. ***Data gathered through monitoring initiatives for the Port Honduras Marine Reserve have been shared regionally in the past through MBRS.***
Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena de Indias, Colombia, 1983)	Regional convention with the objective of protecting the marine environment of the Wider Caribbean through promoting sustainable development and preventing pollution. ***Port Honduras Marine Reserve is an important and integral part in the National Protected Areas System, protecting biodiversity and threatened species, as per Belize's commitment under this Convention.***
Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972)	The World Heritage Convention requires parties to take steps to identify, protect and conserve the cultural and natural heritage within their territories. ***Whilst the Port Honduras Marine Reserve is not part of the World Heritage Site, it is intrinsically interconnected to the health of the Belize Barrier Reef Reserve System World Heritage Site under the Convention. However, it should be noted that this WHS has recently been placed on the list of sites in Danger (WHS, 2009).***
International Convention for the Protection and Conservation of Sea Turtles for the Western Hemisphere (December 21st, 1997)	To protected and conserve sea turtle species of the Western Hemisphere. ***Port Honduras Marine Reserve protects important feeding areas for sea turtles, including the Critically Endangered hawksbill, and works in collaboration with caye owners for nest protection and monitoring.***
The UN Convention on the Law of the Sea (1982)	The Law of the Sea Convention defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.

Table 1: International Conventions and Agreements of Relevance to Port Honduras Marine Reserve

Belize has been party to the **UN Convention on Biological Diversity (CBD)** since 1993 when it ratified the treaty (CBD, 2010). The main objectives of the CBD are to promote the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilization of genetic resources (CBD, 2010). More specific goals of the CDB relevant to Port Honduras Marine Reserve include:

- promoting the conservation of the biological diversity of ecosystems, habitats and biomes;
- promoting sustainable use and consumption, by encouraging use of products derived from sources that are sustainably managed;
- addressing threats to biodiversity related to the pressures of habitat loss, land use change and degradation, and unsustainable water use;
- addressing challenges to biodiversity from climate change, and pollution;
- maintaining the capacity of ecosystems to deliver goods and services that support sustainable livelihoods, local food security and health care, especially of poor people

(CBD, 2010)

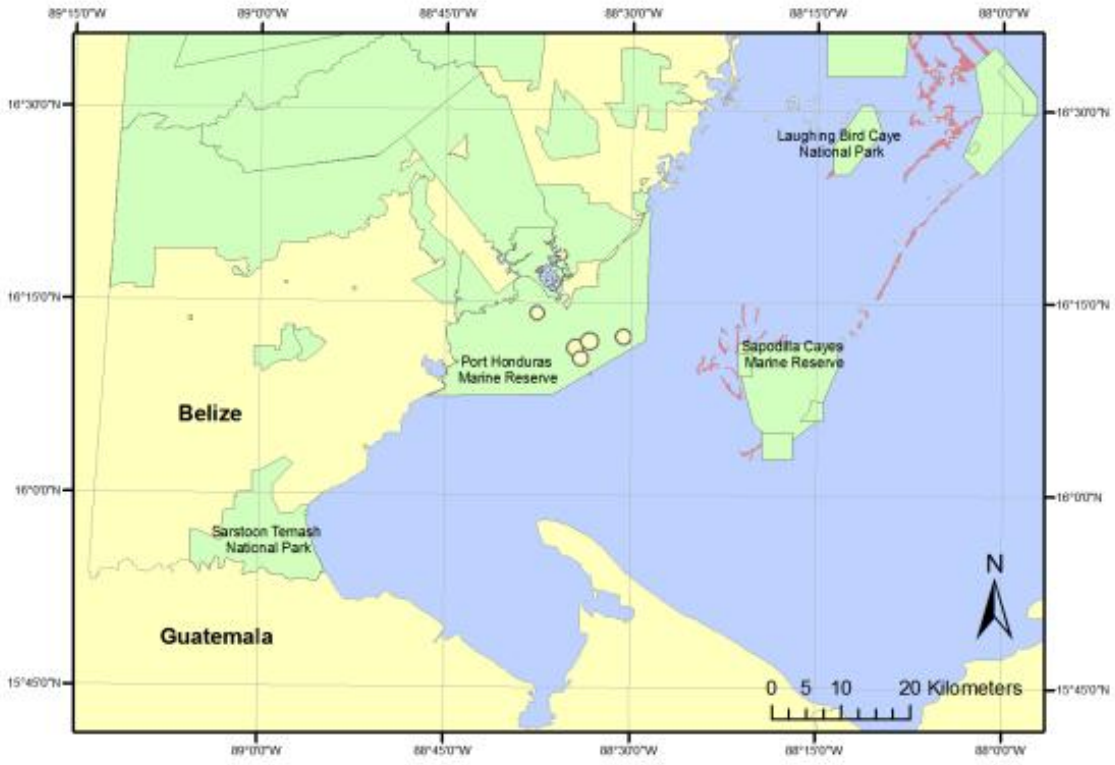
All of these goals are reflected in TIDE's vision and mission statements, and within their active conservation and community outreach Programmes. TIDE's management of Port Honduras Marine Reserve addresses the goals of conservation through ongoing protection of biodiversity within the marine protected area and ongoing assessment of the status of key species and ecosystems. Management strategies promote sustainable use of marine resources through enforcement of catch size limits, open and closed seasons for commercial species, and patrolling for the use of destructive or illegal fishing gear and illegal activities. The sustainable management of fisheries and tourism within Port Honduras Marine Reserve is a critical goal for TIDE and directly related to maintaining the capacity of ecosystems to provide services that sustain local livelihoods.

Other regional initiatives have also been implemented consistent with the goals of the United Nation's Convention on Biological Diversity's International Coral Reef Initiative. With the recognition of the increasing threats to the overall health of the reef system, the Governments of Mexico, Belize, Guatemala and Honduras (the four countries bordering the Mesoamerican Reef) committed themselves in June 1997 through the Tulum Declaration to the development of a 15-year Action Plan – the **Mesoamerican Barrier Reef System Project** - for the conservation and sustainable use of the coral reef system shared by these four nations. This initiative, adopted by the Heads of State in June 1999, and ratified by Belize in 2000, is supported by the **Central American Commission on Environment and Development** (CCAD), which works to harmonize environmental policies within the region. This has also brought a level of standardization to management and monitoring practices across the region, and thus provided investment into increasing management effectiveness. This is also

Whilst Port Honduras Marine Reserve is not one of the seven protected areas that combine to form Belize's World Heritage Site (WHS - the Belize Barrier Reef Reserve System World Heritage Site), it is important in the maintenance of the WHS designated under the **UNESCO World Heritage Site Convention** in 1996. The justification for designation as a World Heritage Site is the outstanding natural

system consisting of the largest barrier reef in the Western Hemisphere, and illustrating a range of classic examples of reefs through fringing, barrier and atoll reef types (UNESCO, 1996). The protection of ecosystems within the Port Honduras Marine Reserve helps to protect the southern portion of the barrier reef system, including the Sapodilla Cayes Marine Reserve (which lies approximately 25km west of the Port Honduras Marine Reserve, at the tip of the Belize Barrier Reef) from nutrient / agrochemical pollution and sediment that would otherwise flow offshore. The mangroves and seagrass beds within Port Honduras Marine Reserve also serve as important nursery and feeding habitats for reef fish and commercial species such as the queen conch and Caribbean spiny lobster, providing recruits for the barrier reef system.

Belize is also a signatory to the **Ramsar Convention on Wetlands**, an international convention to protect the ecological character of signatory countries' wetlands and to plan for sustainable use of these important ecosystems (Ramsar, 2006). Belize signed the treaty in August 1998 and currently has two sites designated as Wetlands of International Importance, including Sarstoon Temash National Park (Map 3). Although Port Honduras Marine Reserve is not designated as a Ramsar site itself, there is important connectivity with the coastal wetlands of Sarstoon Temash National Park, which lie approximately 15 miles south of the southern boundary of the Marine Reserve. The National Park was designated as a Wetland of International Importance under the Ramsar Convention in October 2005 (Ramsar, 2010). the coastal wetlands included in the marine protected area contribute towards the Convention's overall goals of the planning and promotion of "wise use", or "sustainable use", of all of the wetlands under the signatories' control (Ramsar, 2008).



Map 3: Location of Sarstoon Temash National Park (RAMSAR site) in relation to Port Honduras Marine Reserve, Southern Belize

2.3 National Context

2.3.1 Legal and Policy Framework

Legal Establishment

Port Honduras Marine Reserve is a national protected area, established in 2000 (SI 9 of 2000) under the **Fisheries Act** (1948 (1983 amendment)) with regulations established at the same time (SI 18 of 2000). The area is designated as 'Marine Reserve' under the mandate of the Fisheries Department to "....afford special protection to the aquatic fauna and flora of such areas and to protect and preserve the natural breeding grounds and habitats of aquatic life to allow for the natural regeneration of aquatic life in areas where such life has been depleted" (Fisheries Department, 1983). Most of the 138 cayes within Port Honduras Marine Reserve are National Lands. The seabed of the marine continental shelf is considered national land.

The coastal area of Belize is predominantly in the hands of private owners. A 1939 law reserved one-chain (20m) of water frontage as public land. However, much of the land along the coast was privately titled before the law was passed.

The Marine Reserve is currently managed under a co-management regime shared between the Fisheries Department and Toledo Institute for Development and Environment, with zoned multiple use, incorporating areas open for extractive use and closed, no-take areas, regulated under a zoning system that is embedded within the Statutory Instruments (SI 9 and 18 of 2000). There are a series of rules and regulations within the statutory instruments that guide all activities within the protected area – both tourism-related and commercial fishing practices.

PORT HONDURAS MARINE RESERVE

SI 9 of 2000

ALL THAT PORTION of the Caribbean Sea comprising of General Zones, Conservation Zones and Preservation Zones and more fully described as follows:

A. GENERAL USE ZONE

Commencing at a Point A lying South East of Monkey River Village having scaled UTM coordinates 341 784 East 1 810 803 North; thence in a general easterly direction to a Point B having scaled UTM coordinates 342 573 East 1810 803 North; thence in a general southerly direction to a Point C having scaled UTM coordinates 341 784 East 1 791 754 North; thence in a general south-westerly direction to a Point D having scaled UTM coordinates 328 384 East 1 784 002 North; thence in a westerly direction to a Point E south of the Rio Grande River Mouth having scaled UTM coordinates 3 10 122 East 1 783 740 North; thence in the direction of the coastline contour back to the point of commencement.

B. CONSERVATION ZONES

(i) East Snake Caye 0.805-kilometers (half a mile) radius around the Caye scaling UTM coordinates:

Northern point	338 588.85 East 1 793 101.35 North
Eastern point	339 545.54 East 1 792 120.74 North
Southern point	338 517.10 East 1 791 140.13 North
Western point	337 632.16 East 1 792 096 82 North

(ii) West and South Snake Cayes 0.805-kilometers (half a mile) radius around the Cayes having an overlap and scaling at UTM coordinates:

Northern point	331 868.09 East 1 791 666.31 North
North-eastern point	332 489.94 East 1 791 164.04 North
Eastern point	332 705.19 East 1 789 944.26 North
South-eastern point	332 800.00 East 1 788 533.14 North
Southern point	331 915.92 East 1 788 270.05 North
South-western point	331 389.74 East 1 788 628.81 North
Western point	330 767.89 East 1 789 968.18 North
North-western point	330 983.15 East 1 791 331.47 North

***(iii) Wild Cane Caye 0.88805 kilometers (half a mile) radius around the* Caye scaling UTM coordinates:**

Northern point	325 984.43 East 1 796 019.26 North
Eastern point	326 582.36 East 1 795 445.24 North
Southern point	325 888.76 East 1 795 134.32 North
Western point	325 410.42 East 1 795 397.41 North

C. PRESERVATION ZONES

Middle Snake Cayes 0.805 kilometers (half a mile) radius around the Cayes scaling UTM coordinates:

Northern point	333 709.72 East 1 792 599.08 North
Eastern point	334 809.91 East 1 791 498.89 North
Southern point	333 709.72 East 1 790 398.69 North
Western point	332 633.44 East 1 791 498.89 North

National Framework

Belize has an impressive record of establishing protected areas, with a total of 94 marine and terrestrial reserves, spawning aggregation sites, crown reserve cayes supporting important bird colonies, archaeological reserves, and recognized private reserves (NPAPSP, 2005). Almost 2,000,000 acres are designated for conservation (including sustainable resource use) – either as national or private protected areas.

The national objectives for conservation revolve around the protection, conservation and rational use of Belize's natural resources within the context of sustainable human development. These objectives are supported by the National Protected Areas Policy and System Plan (NPAPSP, 2005), which was developed following a full review of the national protected areas system in 2005. The Policy was accepted by Cabinet in January 2006.

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

> *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.*
>
> **NPAPSP Statement, 2005**

Port Honduras Marine Reserve is an important component of Belize's strategies for conservation of the marine environment. Whilst the entire Barrier Reef system and associated coral reef structures do not have full protected status within Belize, there are 13 marine protected areas within the system. Eight of these, including Port Honduras Marine Reserve, are designated as Marine Reserves and administered under the Fisheries Department; the remaining five are administered under the Forest Department, and include two Natural Monuments, two Wildlife Sanctuaries and a National Park (Table 2). A serial designation of specific conservation sites also protects identified spawning aggregation sites within Belize, important for maintaining the viability of many commercial species.

Marine Protected Areas in Belize				
Protected Area	**Mgmt. / Co-mgmt**	**IUCN Category**	**SI**	**Area (Acres)**
Bacalar Chico 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. / SACD	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

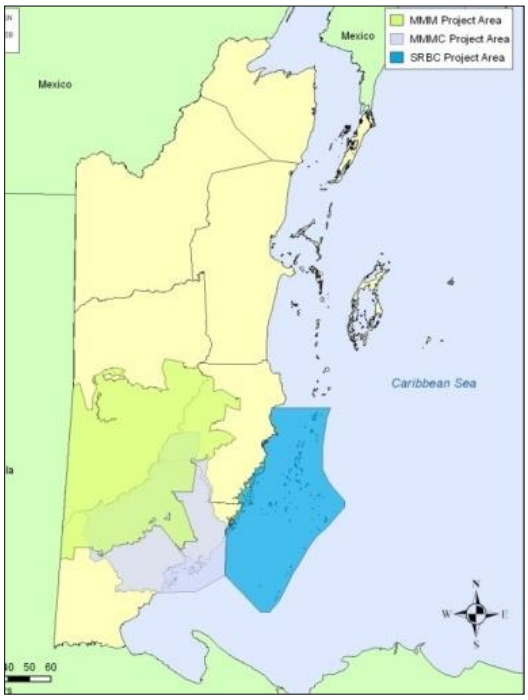
Table 2: Marine Protected Areas is Belize

National Planning at System Level

Under the National Protected Areas Policy and System Plan, the Government of Belize seeks to increase management effectiveness through grouping protected areas into system level management units, transcending site-level administrative categories.

Three system-level units are currently being established to increase management effectiveness by reducing overlap and maximizing on synergies – the Maya Mountains Marine Corridor, the Southern Belize Reef Complex and the Maya Mountains Massif (Table 3; Map 4).

System Level Management Units
Maya Mountains Massif
Maya Mountains Marine Corridor
Southern Belize Reef Complex



Map 4: System Level Planning Units

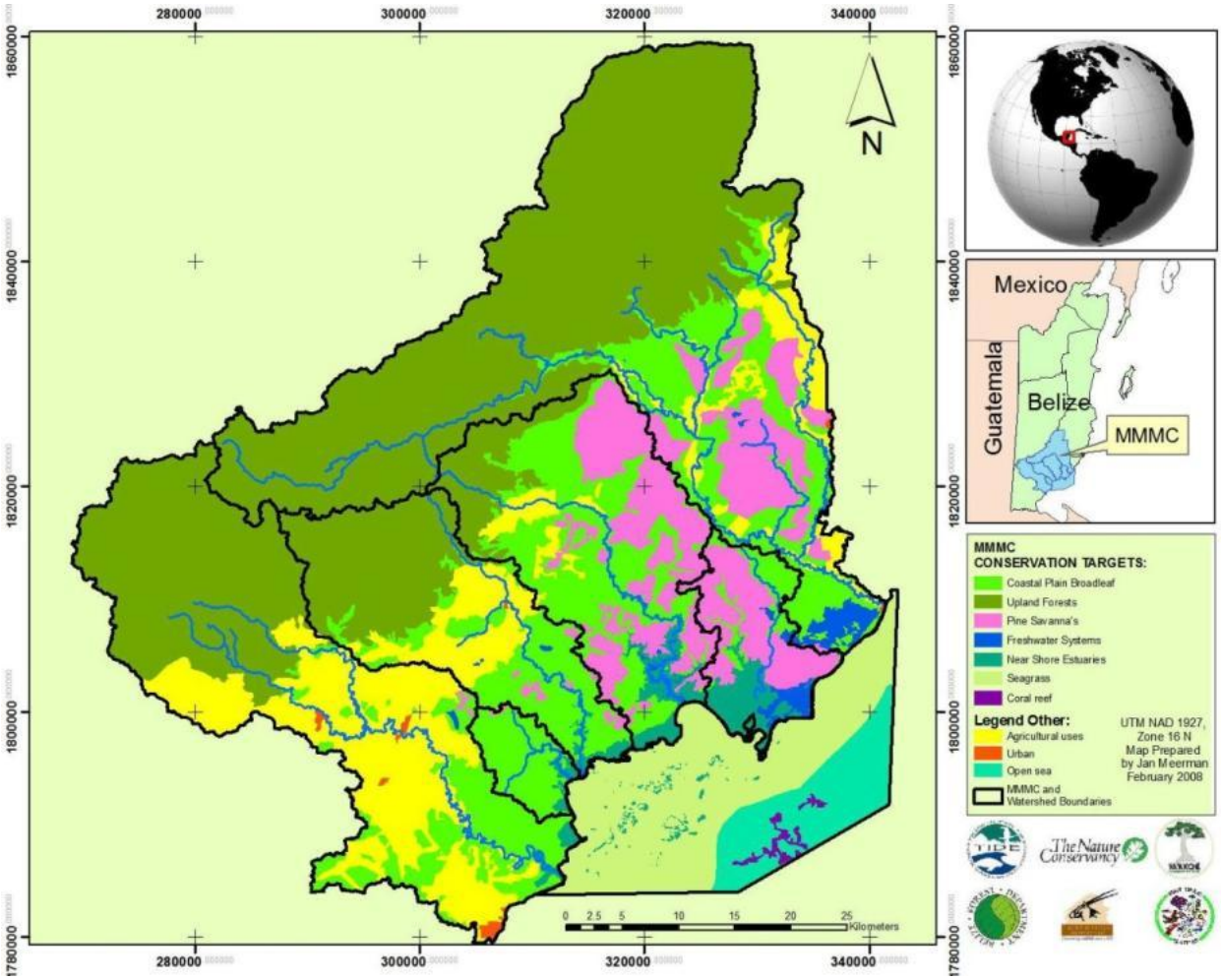
System Level Management Unit	Protected Areas
Maya Mountain Marine Corridor *Total number of pas: 10* *Total pa area: 619,933 acres* *Total landscape area:729,630 acres* *Total seascape area:100,000 acres*	***Port Honduras Marine Reserve,*** Bladen Nature Reserve, Cockscomb Basin Wildlife Sanctuary, Columbia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

Table 3: System Level Management Units

Conservation Planning initiatives for these system level management units recognize that resources exist in a larger landscape beyond the boundaries of the protected areas themselves, and set out discrete goals and objectives at system rather than site-level, increasing management effectiveness through the development of mechanisms for collaboration for surveillance and enforcement and biodiversity monitoring, education, outreach, and management.

The Maya Mountains Marine Corridor

The Maya Mountain Marine Corridor forms a significant part of Belize's component of the Mesoamerican Biological Corridor. It stretches from the Maya Mountains ridge through the watersheds of the Toledo District to the Gulf of Honduras (including the Port Honduras Marine Reserve). The corridor itself is a mosaic of landscapes and cultures, an interdependent and biologically significant area that encompasses approximately 739,650 land acres and the 100,000 acres of Port Honduras Marine Reserve. It includes more than forty-three distinct ecosystems that support threatened species, fulfill human needs, contribute to natural disaster mitigation and climate change adaptation, and are broadly classified as upland forests, coastal plain broadleaf forests, pine savannas, freshwater systems, near shore estuaries, seagrass beds, mangroves, and coral reefs.



Map 5: The Maya Mountain Marine Corridor

Port Honduras Marine Reserve forms part of the eastern-most component of the Maya Mountain Marine Corridor (MMMC), encompassing near shore estuaries, seagrass beds, mangroves, and coral reef ecosystems (Map 5).

The Southern Belize Reef Complex

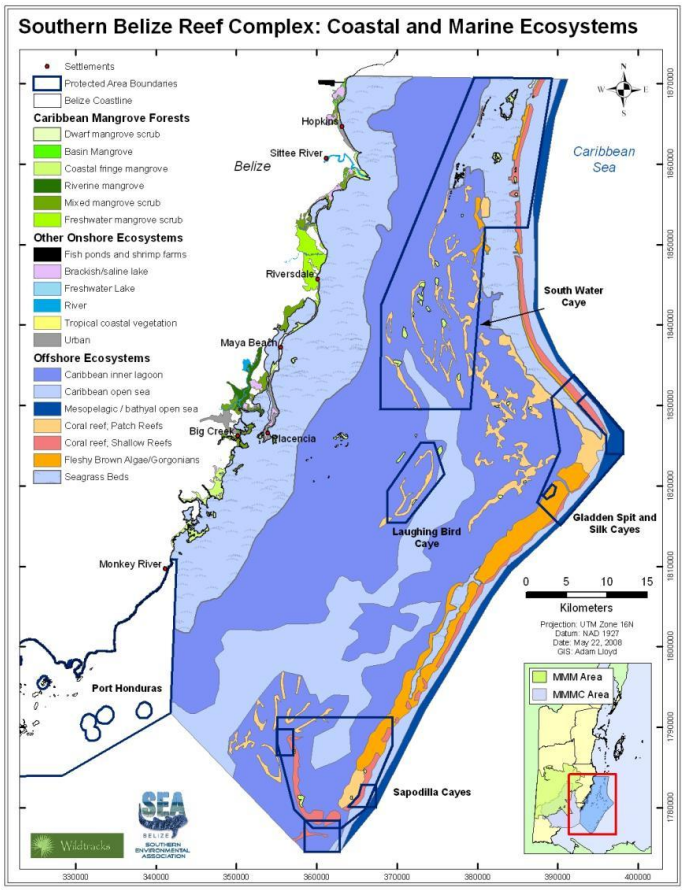
The **Southern Belize Reef Complex** (SBRC) is contiguous with the northern boundary of Port Honduras Marine Reserve and stretches northwards to the northern boundary of South Water Caye Marine Reserve and south-eastwards from the coastline of Belize to the Sapodilla Cayes and the outer reef (Map 6). It encompasses four marine protected areas – Sapodilla Cayes Marine

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

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

Reserve, Gladden Spit and Silk Cayes Marine Reserve, South Water Caye Marine Reserve and Laughing Bird Caye National Park. This area is characterized by the variety of reef structures, important cross-shelf habitat linkages and an assemblage of ecosystems considered possibly the most biodiverse in the region.

Three of the Marine Reserves form part of the serial nomination of seven sites that are recognized as components of the Belize Barrier Reef System - World Heritage Site, representing classic examples of fringing, faro and barrier reefs. Also covered within the scope of the SBRC are four legally protected critical spawning aggregation sites – the three sites within the Sapodilla Cayes Marine Reserve, and Gladden Spit, the largest aggregation known in the Mesoamerican Reef ecoregion.



Map 6: Southern Belize Reef Complex

Within the SBRC, the estuarine and coastal areas are considered important for the West Indian manatee, whilst the sandy beaches have a history of use as nesting sites for all three marine turtle species. The near shore mangrove nursery areas and seagrass are regionally important for recruitment for a significant number of the commercial marine species. These resources are an integral part in the support of the cultural traditions of the coastal fishing communities.

Being adjacent to the SBRC, TIDE works in close collaboration with SEA, particularly with the role Port Honduras Marine Reserve plays in filtering water before it reaches the Belize Barrier Reef and Sapodilla Cayes.

Legal Framework

Contributing to the conservation framework of Belize are a number of laws designed to protect wildlife and national heritage. The **Fisheries Act** (1948, revised 1983, and currently being overhauled (2011)), administered under the Fisheries Dept, is the principal governing legislation to regulate the fishing industry, and is directly concerned with maintaining sustainable fish stocks and protecting the marine and freshwater environments. It also provides protection for nesting turtles and nest sites. Marine turtles themselves have been given protection since the original Fisheries Ordinance in 1940. The **Environmental Protection Act** (1992) was developed under the Department of the Environment, under

the Ministry of Natural Resources, with the aim of ensuring that development initiatives within Belize are planned for minimum environmental impact – important in the context of Port Honduras Marine Reserve, with privately owned / leased cayes located within the Marine Reserve.

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

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

The **Mines and Minerals Act** (1989) and the **Petroleum Act** (1991), regulate the exploration and extraction of all non-renewable resources, including petroleum. These Acts also control activities such as dredging, prospecting and drilling. Whilst dredging activities have the potential to impact the Marine Reserve, of more immediate concern is that Port Honduras Marine Reserve lies within two oil concession areas - Blue Creek Exploration Ltd. and Island Oil Belize Ltd.

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

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

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

Significant fragmentation exits in decision making, with these different Acts falling under different Ministries. This is being addressed through the **National Protected Areas Policy and System Plan** (NPAPSP, 2005), currently guided by the National Protected Areas Secretariat, which is itself guided by the National Protected Areas Technical Committee (NPATC). More recently, the Policy Coordination & Planning Unit of the Ministry of Natural Resources and the Environment has been tasked to strengthen the NPATC and ensure a greater level of inter-departmental communication and coordination.

2.3.2 Land and Sea Tenure

Port Honduras Marine Reserve is a national protected area, included in Belize's territorial waters (Maritime Areas Act of 1992), with Fisheries Department as the legally mandated management authority. The seabed is national land (as are the majority of the 138 cayes within Port Honduras Marine Reserve), and thus any construction, such as piers, marinas, and seawalls, needs to be permitted by Fisheries Department and licensed by Lands Department. Any mining, including beach sand mining or dredging activities, and oil exploration / drilling activities, require permission from Fisheries Department and a license from the Geology & Petroleum Department.

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

The coastal area adjacent to the Marine Reserve is predominantly in the hands of private owners, and while a 1939 law reserved one-chain (20m / 66ft) of water frontage as public access, much of the land was privately titled before the law was passed.

2.3.3 Evaluation of Protected Area

Biological Importance

The area protected by the Port Honduras Marine Reserve provides one of the richest and most critically important habitats within Belize. It incorporates four distinct ecosystems: coastal and tidal wetlands, marine lagoonal habitats comprised of mangroves and seagrass beds, mangrove islands with associated shallow banks, and the Snake Cayes fringing reef system (Sullivan et al. 1995). The coastline of dense mangrove and 138 small offshore mangrove cayes, some surrounded by fringing reefs, serve as critical nursery and feeding areas for a variety of species, including the West Indian manatee (*Trichechus manatus*). The area also supports fifteen species of international concern, including four rated as Critically Endangered – staghorn and elkhorn corals (*Acropora cervicornis and A. palmata*), the goliath grouper (*Epinephelus itajara*), and the hawksbill turtle (*Eretmochelys imbricate*). Extensive surveys of these habitats have revealed a rich matrix of ecosystems, including the high biodiversity of the coral reef within the Marine Reserve. Over 118 finfish species have been recorded, six of which were observed only at sites around the Snake Cayes (Sullivan et al. 1995, Harborne 2000, Robinson et al. 2004).

Port Honduras Marine Reserve **Species of International Concern**	
Critically Endangered	
Staghorn Coral	*Acropora cervicornis*
Elkhorn Coral	*Acropora palmata*
Hawksbill Turtle	*Eretmochelys imbricata*
Goliath Grouper	*Epinephelus itajara*
Endangered	
Loggerhead Turtle	*Caretta caretta*
Green Turtle	*Chelonia mydas*
Nassau Grouper	*Epinephelus striatus*
Star Coral	*Montastraea annularis*
Star Coral	*Montastraea faveolata*
Vulnerable	
Rainbow Parrotfish	*Scarus guacamaia*
Queen Triggerfish	*Balistes vetula*
Hogfish	*Lachnolaimus maximus*
Cubera Snapper	*Lutjanus cyanopterus*
Mutton Snapper	*Lutjanus analis*
West Indian Manatee	*Trichechus manatus*
	IUCN, 2011

Two different finfish populations have been identified in Port Honduras Marine Reserve - near-shore estuarine species, and those associated with the reef (Sullivan et al., 1995). Important biological resources afforded protection by Port Honduras Marine Reserve include commercially important finfish such as snappers and groupers, in addition to the Caribbean spiny lobster (*Panulirus argus*), and the queen conch (*Strombus gigas*), both very important to the buffer communities (Punta Gorda, Punta Negra, Monkey River and the Cayes) and the economy of Belize (Foster, 2010a).

Port Honduras Marine Reserve also encompasses 138 mangrove cayes resting on shallow carbonate banks, arranged in three lines, parallel to the shore, and separated by deep channels, running parallel to the cayes (Heyman & Kjerfve, 1999). A total of 61 stony coral species have been observed in the waters of Belize, with eight unusual coral sightings on the reefs of the Snake Cayes (Fenner, 1999).

Local and National Importance

Port Honduras Marine Reserve is one of the largest protected areas in Belize, and encompasses more small coral cayes (approximately 138 cayes) than any other protected area in the country. It is of national importance for the services it provides, in particular as the key link between the coastal and marine ecosystems and the terrestrial protected areas and upland watersheds of the landscape / seascape of the Maya Mountain Marine Corridor (MMMC). The ecosystems within the Marine Reserve, particularly the extensive mangroves and seagrass beds, act as nursery areas for commercially important marine species and as adult habitat and feeding areas. Additionally, these coastal ecosystems provide protective buffer services for the Southern Belize Reef Complex (including the Sapodilla Cayes Marine Reserve) by altering the flow of sediment and agrochemicals from terrestrial sources.

The location of Port Honduras Marine Reserve at the foot of the Maya Mountain Marine Corridor (MMMC) results in it serving as the vital link between terrestrial protected areas and upland watersheds, and the coastal and marine ecosystems (including the Belize Barrier Reef). The extensive mangroves and seagrass beds remove land-based nutrients, sediment and other pollutants from the water column, allowing clean, clear water to flow out to the reefs of the Snakes Cayes and the Belize Barrier Reef System (Valiela et al. 2001). The MMMC is itself part of the Mesoamerica hotspot, which whilst only covering 0.5% of the world's land surface; houses 7% of its biological diversity (Miller et al., 2001). One study has found 594 genera and 1,040 species of organisms occur in coastal Belize, with an additional 634 genera and 1,302 species in the marine areas (Jacobs & Castaneda, 1998).

Port Honduras Marine Reserve also plays a critical role for the buffer communities of Punta Gorda, Punta Negra and Monkey River, and the Toledo District as a whole providing a range of ecosystem services to the surrounding communities. The intact mangroves along the coastline provide protection against storms and hurricanes and reduce the impact of the waves on the coastline. The presence of mangroves reduces storm surge inundation of seawater on land and reduces the potential physical damage to houses and other infrastructure during storm events. Furthermore, mangroves limit the daily erosion that would otherwise occur due to the natural flow of the seawater and tides along the coastline, and they reduce the flow of land-based nutrients, sediment and pollution into the sea (Valiela et al. 2001). The complex root systems of mangroves provide an ideal nursery habitat for juvenile fish and invertebrate species, and mangroves have been shown to significantly increase the survivorship of juvenile reef fish species (Mumby et al., 2004).

Port Honduras Marine Reserve as a whole is a valuable asset to the Toledo District, and provides many services in addition to shoreline protection. The Marine Reserve supports the commercial and sport fishing industries by enhancing finfish, conch and lobster populations, contributing towards the long-term sustainability of these activities. One of the main goals of the protected area is to increase and stabilize the ecosystems and populations of key species upon which the local fishing industry depends. The theory behind the establishment of No-Take Zones and marine protected areas is to provide a refuge to enable species to reach maturity and reproduce, thus contributing to the population. As the

population increases 'spill-over' into the General Use Zone within the protected area will help to sustain fisheries, and as such benefit local communities. The fisheries of the Port Honduras Marine Reserve, particularly queen conch and spiny lobster, are an important food and income source for the local communities.

Ecosystem Services of Port Honduras Marine Reserve	
Regulation	Protection of the coastline from storm surges and waves Reduction of ongoing beach erosion on cayes within the reserve, and the coastline Providing coral, a major component in the formation of beaches and cayes Seagrass plays an important role in stabilizing the substrate and settling turbidity in the water before it reaches the reef
Recruitment	No-take zones within the protected area ensure viable populations of commercial species for subsistence and commercial fishing
Cultural	Coral reefs are important resources for tourism and recreation Aesthetic appreciation and recreation opportunities for local communities
Support	Coral reefs and mangroves play an important role in the cycling of nutrients Coral reefs, seagrass beds and mangroves within the protected area provide ecosystems necessary for different life stages of commercial and non-commercial species Coral reefs are among the most productive habitats, producing 2,000 decagrams of carbon per square meter per year
Adapted from UNEP-WCMC, 2006	

Table 4: Ecosystem Services of Port Honduras Marine Reserve

Commercial fishing provides local residents with direct revenue generation and provision of an important source of protein. A 2009 study on the socioeconomic impacts of the Marine Reserve on local communities found that 59% of the local population consumes locally caught seafood at least twice a week (Padilla Plaza & Ferguson III, 2010). The sport fishing potential of the area attracts tourists from all over the world, not only benefiting the local tour guides, but also helping to sustain the hotels, guest houses and restaurants and a range of other local businesses in the stakeholder communities. Port Honduras Marine Reserve also attracts tourists for a variety of other reasons, including snorkelling, SCUBA diving, kayaking and bird watching. The protected area has great potential to attract tourism to the region and to directly and indirectly impact the community by providing alternative sources of income - it is estimated that 28% of the population from the buffer communities is employed, directly or indirectly, in the tourism industry (Padilla Plaza & Ferguson III, 2010). TIDE operates a sister organization, TIDE Tours, that actively trains and employs local residents to guide marine and terrestrial tours within the Marine Reserve, and the surrounding areas. Communities also benefit from recreational

uses of the Marine Reserve, such as recreational and sport fishing, kayaking, swimming, snorkelling and trips to the beach.

In addition to the services coastal and marine ecosystems provide in terms of fisheries and pollution mitigation, these ecosystems also play a significant role in the global carbon cycle. Not only do marine ecosystems represent the largest long-term sink for carbon but they also store and redistribute approximately 93% of the Earth's carbon dioxide (CO_2) (Nellemann et al., 2009). The ocean's vegetated habitats, in particular mangroves, salt marshes and seagrasses, cover less than 0.5% of the seabed, but account for more than 50%, possibly as much as 71%, of all carbon storage in ocean sediments (Nellemann et al. 2009). Blue (marine) carbon sinks and estuaries are estimated to capture the equivalent of up to half of the emissions from the entire global transport sector (Nellemann et al., 2009). Preventing further loss and degradation of these ecosystems and promoting their recovery on a global scale could contribute to offsetting 3–7% of current fossil fuel emissions in the next twenty years (Nellemann et al. 2009). The extensive mangrove and seagrass coverage protected within the Marine Reserve could play a significant contribution to the Belize efforts in the fight against global climate change.

Port Honduras Marine Reserve also contributes to the protection and enhancement of populations of species of both national and international concern. In the waters surrounding the Snake Cayes, near-shore fringing reefs provide habitat for reef organisms. These are unique in Belize as mid-lagoonal reefs, with characteristics of both inshore reef and offshore barrier reef environments. These reef areas underwent extensive bleaching in 1998, losing up to 40% of coral cover, but have since recovered, suggesting some level of resilience to climate change.

Nationally, the primary commercial species of concern within the protected area include the Caribbean spiny lobster (*P. argus*) and the queen conch (*S. gigas*). The queen conch is not yet endangered, but listed under CITES as a commercially threatened species (CITES, 2010). Other species of national and international importance that gain protection through the existence of the Marine Reserve include, but are not limited to, West Indian manatee (*Trichechus manatus*), goliath grouper (*Epinephelus itajara*), Nassau grouper (*Epinephelus striatus*), hawksbill turtle (*Eretmochelys imbricata*), elkhorn coral (*Acropora palmata*).

2.3.4 Socio-Economic Context

Belize has a low population currently estimated at approximately 307,900 (Figure 1; CIA, 2010), of which 51.2% are urban dwellers (UN, 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. Much of the remaining country is less suited to habitation, with swampy lowlands and steep terrain in the Maya Mountains.

Figure 1: 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

It is a country of many ethnic cultures, with Mestizo, Creole, Maya and Garifuna being the major population groups (Figure 2). There is an ongoing emigration to the United States – generally those from urban areas who have completed secondary school or have professional training. There is also a significant influx of Central American refugees – primarily from Guatemala and Honduras – with an estimated 20% of heads of households being born outside of Belize (2010 Poverty assessment data).

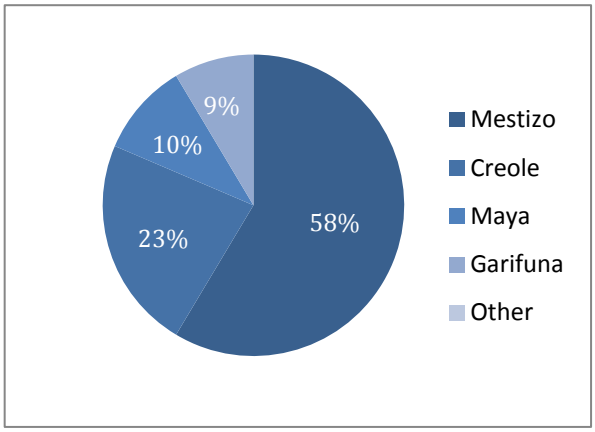


Figure 2: Belize Demographic Statistics

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. There is also an increasing reliance on the developing tourism industry, which is rapidly becoming the major foreign exchange earner, with over 840,000 tourists arriving in Belize in 2008 (Belize Tourism Board (BTB), 2009).

The fishing industry has had a significant impact on the viability of the commercial fish stocks of the marine reserve, and provides employment for over 2,759 fishers in Belize (Fisheries Department, 2010). Fishing techniques vary, with the more southerly communities using hand lines for finfish, with a switch to free-diving for spiny lobster and queen conch at the opening of lobster and conch seasons. Fishermen tend to be between 15 and 35 years of age, often with limited education. Alternative job opportunities in the coastal communities are limited, with many fishermen leaving primary school to go directly into fishing (FAO, 2005).

State of National Capture Fisheries (2007)

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

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

Conch production volume decreased by almost 17% from 314.7 tonnes (692,302.5 lbs) in 2006 to 261.3 tonnes (574,756.1 lbs) in 2007, when quotas were developed to ensure greater sustainability. As a result, conch meat production exceeded its historical peak (2007), with 334 MT (734,600lbs) produced in 2010 (Fisheries Department, 2011). The queen conch is not yet endangered, but listed under CITES as a commercially threatened species (CITES, 2010).

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

From: Ministry of Agriculture and Fisheries: Annual Report 2007

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

The developing tourism industry, one of the fastest growing sectors in Belize, is rapidly becoming the major foreign exchange earner, with over 840,000 tourists arriving in Belize in 2008 (BTB, 2009; Figures 3 and 4). Tourism is the third ranking productive sector in Belize, contributing 28.2% (Bz$816.3mn) in 2009, with projections suggesting that this will increase to 31.4% (Bz$1,601.2mn) by 2020. The tourism sector provided an estimated 34,000 jobs in 2009, 28.3% of total national employment or 1 in every 3.5 jobs. This is predicted to increase to 53,000 jobs, 31.6% of total employment (1 in every 3.2 jobs) by 2020 (WTTC, 2010).

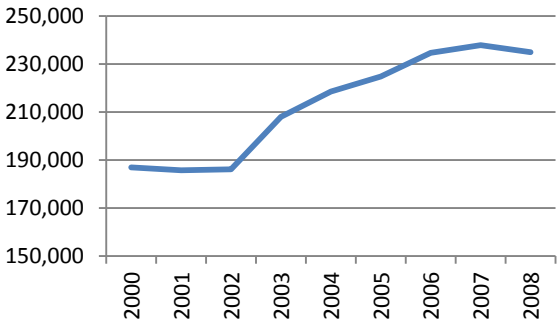


Figure 3: Belize International tourism arrivals (2000 – 2008) (BTB, 2009)

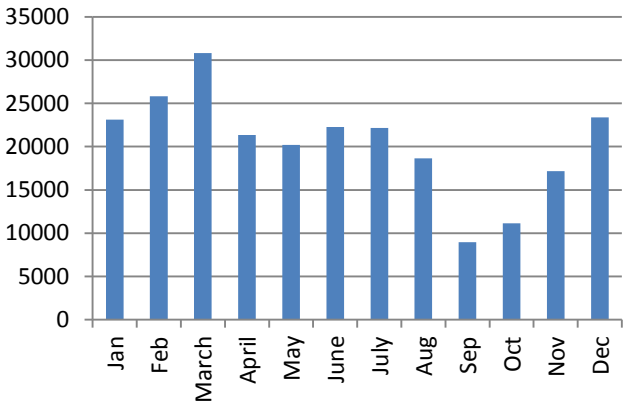


Figure 4: Belize International tourism arrivals per month (2008) (BTB, 2009)

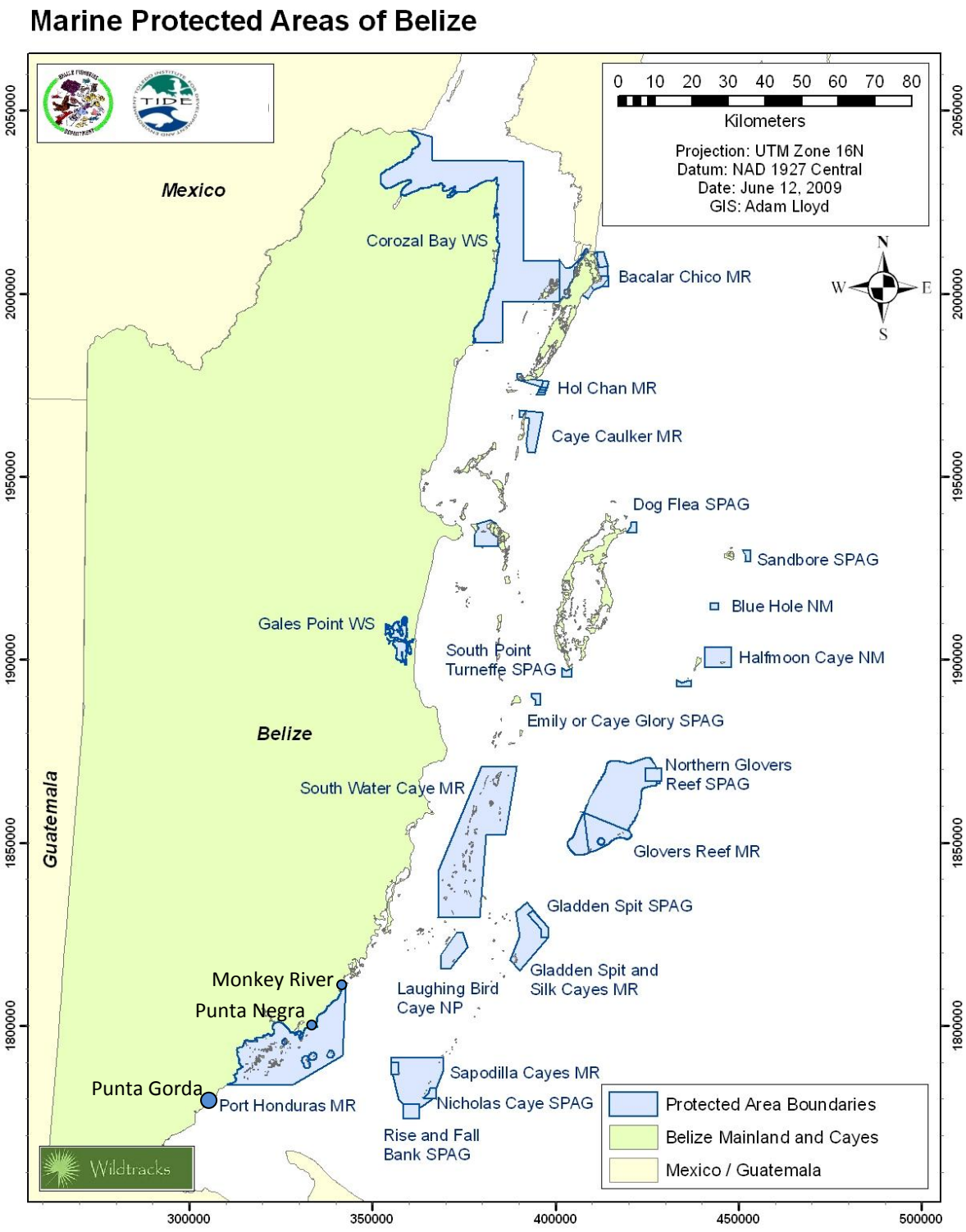
Port Honduras Marine Reserve is located within the Toledo District. Toledo has only a limited service-based economy, and many residents earn their income and livelihoods from subsistence agriculture, small-scale fisheries, ecotourism and agro-forestry. Other sources of income are derived from jobs within the public sector such as teaching or within the public sector, and with the high number of non-governmental organizations (NGOs) and foundations within the area. Despite the extensive natural resources of the Toledo District, the tourism industry has remained small with limited eco-tourism ventures, hotels and restaurants, and much of the infrastructure required to support large-scale tourism is still absent from the district.

Toledo is gaining some attention from large-scale investors with interests in mechanized agriculture, aquaculture, logging, mineral exploration and renewable energy. While these ventures can bring positive impacts to the district in terms of jobs and investment, they also have the potential to have severe negative and long-term environmental impacts if poorly regulated.

Three communities have been identified as major stakeholders in the protected area, through fishing or tourism, and a basic stakeholder analysis identifies stakeholder interests and impacts (Tables 5 and 6; Map 7). Key stakeholders of the Port Honduras Marine Reserve include local fishers, tour guides, tour operators, hotel and restaurant owners, local residents, recreational users of the protected area, tourists, local and national politicians and large-scale investors.

Belize Stakeholder Communities of the Port Honduras Marine Reserve				
Community	**Location (UTM) Distance (km)**	**Distance from Boundary**	**Population (approx.)[1]**	**Population Component**
Monkey River	E16 341187 N18 09691 (23 km)	Directly borders reserve	200[1]	Fishers, farmers, tourism (including fly fishing
Punta Negra	E16 334998 N17 99698 (22.5km)	Directly borders reserve	18[2]	Fishers, farmers, guiding
Punta Gorda	E16 306862 N18 80471 (50km)	4km	5,255[2]	Fishers, guides. District administrative centre
[1] CSO, 2000 estimate [2] Perez, 2009				

Table 5: Belize Stakeholder Communities of Port Honduras Marine Reserve



Map 7: Port Honduras Marine Reserve: Principal Stakeholder Communities

In addition, due to its location in relation to Belize, Guatemala and Honduras, a significant but so far unquantified number of private tour groups and fishermen from the two neighboring countries also use the natural resources of the PHMR.

Different stakeholders have different interests in PHMR related to the benefits or detriments they feel it has on their livelihoods, with some supporting its existence, while others being antagonistic, feeling it has had detrimental effects on their livelihoods. In 2004 and 2009, two studies were conducted within the communities that buffer PHMR and with the local fishers (sport and commercial fishers) regarding the socio-economic impact that Port Honduras Marine Reserve has had on their lives. The 2004 study found that 84% of respondents said PHMR had no impact on their livelihoods since its establishment in 2000 (Collins, 2004). The 2009 study, however, showed only 64% of household respondents said that PHMR had had no impact on their livelihoods since its establishment (Padilla Plaza & Ferguson III, 2010).

The 2009 study also found that Punta Negra has faced significant impacts since the establishment of PHMR, partially due to the presence of the community within the marine reserve. Though they were still able to fish within 95% of PHMR, the residents of Punta Negra felt that regulation of specific destructive gears, such as the banning of gill nets, was severely limiting to income generation (Padilla Plaza & Ferguson III, 2010). Twenty years ago the community consisted of around 40 households. This had dropped to 9 households by the 2009 study (Padilla Plaza & Ferguson III, 2010), most of the population loss being due to the migration of fishers to urban areas to seek alternative income (Padilla Plaza & Ferguson III, 2010).

In contrast, Port Honduras Marine Reserve has had a positive effect on many stakeholders' livelihoods in other communities. The Toledo District has seen an increase in tourism over the last few years, directly benefitting local tour guides, tour operators, hotels and restaurants within the area, some of which can be attributed to the existence of the Marine Reserve, with activities such as fly-fishing, snorkelling and SCUBA diving. It is estimated that 28% of the population from the buffer communities is employed directly or indirectly, in the tourism industry (Padilla Plaza & Ferguson III, 2010). TIDE operates a sister organization, TIDE Tours, that actively trains and employs local residents to guide marine and terrestrial tours within the Marine Reserve, and the surrounding areas.

Along with the Belize Tourism Association, TIDE has trained 30 commercial fishers as licensed tour guides and sport fishers between 2003 and 2005. In general, this has permitted diversification of income in the coastal communities, with 7% of the trained fishers interviewed in 2004 working solely as tour guides for sport fishing expeditions, and a further 33% earning an income from a combination of commercial and sport fishing (Collins, 2004). In 2005, it was estimated that tour guides generated an estimated annual profit of Bz$514,719 (US$237,359) (Coleman & Diamond, 2005). Inclusion of the primary private fly fishing company, El Pescador, increases the total revenue generated using the Port Honduras Marine Reserve to Bz$1,391,000 (over US$695,000) (Coleman & Diamond, 2005).

Table 6: Stakeholder Analysis for Port Honduras Marine Reserve				
Stakeholder	**Influence or Impact of Port Honduras Marine Reserve on Stakeholder**		**Influence or Impact of Stakeholder on Port Honduras Marine Reserve**	
Community Stakeholder Monkey River, Punta Negra, Punta Gorda	▪ Management of reef, other ecosystems and species for fisheries and tourism ▪ Shifting income base from fisheries dependency to tourism and associated opportunities, with increased economic benefits ▪ Focus of TIDE on education, awareness and alternative livelihoods for fishermen, associated with the protected area ▪ Management and protection of marine resources in perpetuity for future generations ▪ Exclusion from traditional fishing areas	+ + + + - 	▪ Cooperation and collaboration towards effective protected area management ▪ Greater awareness amongst community stakeholder – particularly youth – of the importance of reef and environmental services they provide ▪ Adoption of reef tourism Best Practices through awareness and alternative livelihood training ▪ Illegal fishing within the No-Take zones ▪ Anchor damage to coral and seagrass ▪ Tourism impacts in heavy-use areas	+ + + - - -
Commercial Fishermen (Belize)	▪ Protection of fish, lobster and conch resources within the Conservation and Preservation Zones ensuring continued viability of fishery ▪ Focus of TIDE on education, awareness and alternative livelihoods for fishermen, associated with the protected area ▪ Exclusion from traditional fishing areas	+ + -	▪ Some support for effective management of MPA ▪ In some areas, low level of cooperation and some open antagonism towards protected area ▪ Illegal fishing within the Conservation and Preservation Zones ▪ Fishing impacts within protected areas (including damage to coral)	+ - - -
Commercial Fishermen (Guatemala and Honduras)	▪ Protection of fish, lobster and conch resources within the Conservation and Preservation Zones ensuring continued viability of fishery ▪ Exclusion from fishing (illegally) in Belize waters	+ -	▪ Very low level of cooperation or openly antagonistic towards protected area ▪ Illegal fishing within the No Take Zones ▪ Illegal fishing impacts within protected areas (including damage to coral)	- - -
Tour Guides (including sport fishing guides and tour boat captains) (Belize)	▪ Benefit from having Port Honduras Marine Reserve as an adjacent venue for snorkeling, dive and sports fishing related tourism ▪ Benefit from training opportunities associated with TIDE and Port Honduras Marine Reserve ▪ Employment in marine-based tourism initiatives ▪ Income from using Port Honduras Marine Reserve for tourism	+ + + +	▪ Support the conservation goals of the Marine Reserve ▪ Provide interpretation for visitors, facilitating overall visitor appreciation ▪ If well trained, assist with visitor management within the protected area through in-depth briefings ▪ If poorly trained, can result in poor visitor management and increased impact on corals and associated fauna, anchor damage etc.	+ + + -

Table 6: Stakeholder Analysis for Port Honduras Marine Reserve (cont.)				
Stakeholder	**Influence or Impact of Port Honduras Marine Reserve on Stakeholder**		**Influence or Impact of Stakeholder on Port Honduras Marine Reserve**	
Local / National / International Tour Operators	▪ Benefit from having Port Honduras Marine Reserve as a venue for marine-associated tourism ▪ Income from using Port Honduras Marine Reserve as a tourism destination	+ +	▪ Provide marketing at a local, national and international level, and send visitors to Port Honduras Marine Reserve ▪ Support the conservation goals of the Marine Reserve ▪ Provide a financial sustainability mechanism for management of the protected area ▪ Increase the potential for exceeding the carrying capacity of the protected area	+ + + -
Hotels / Resorts	▪ Benefit from having Port Honduras Marine Reserve as a venue for guests	+	▪ Provide accommodation for visitors to the MPA ▪ Increase awareness and knowledge of the MPA ▪ Negative impacts to the environment if unregulated	+ + -
BTIA	▪ Benefit from having Port Honduras Marine Reserve as a tourism attraction	+	▪ Provide national and international marketing of Port Honduras Marine Reserve ▪ Support the conservation goals of the Marine Reserve	+ +
Local NGOs	▪ Support sustainable fishing practices ▪ Support sustainable employment opportunities ▪ Educate local communities about conservation	+ + +	▪ Generally support the conservation goals of the Marine Reserve	+
General Belize Public	▪ Maintenance of access to fish, lobster and conch ▪ Environmental services ▪ Cultural and aesthetic appreciation ▪ Increased awareness through education	+ + + +	▪ Support of the general public will strengthen the position of protected area ▪ Lack of support may increase chances of dereservation	+ -
Visitors: Tourists	▪ Enjoy Port Honduras Marine Reserve as a tourism destination ▪ Benefit from education and awareness opportunities	+ +	▪ Entrance fee contributes towards the goal of sustainability ▪ Provide marketing nationally and internationally by word of mouth, if happy with level of product ▪ Presence deters illegal fishing within the No Take zones ▪ Negatively impact marine and terrestrial environments	+ + + -
Visitors: Researchers	▪ Benefit from being linked to Port Honduras Marine Reserve ▪ Benefit from access to a protected marine environment ▪ Benefit from historic baseline information on past research activities within protected areas	+ + +	▪ Conservation management benefits from data gathered ▪ Greater knowledge of marine and terrestrial environments and species within area ▪ Benefit from increased research activity within area ▪ Presence deters illegal fishing within the No Take zones ▪ Possible impact of research activities on marine environments	+ + + + -

Table 6: Stakeholder Analysis for Port Honduras Marine Reserve (cont.)				
Stakeholder	**Influence or Impact of Port Honduras Marine Reserve on Stakeholder**		**Influence or Impact of Stakeholder on Port Honduras Marine Reserve**	
Sailboat Charter Companies	▪ Benefit from protection of Port Honduras Marine Reserve as a destination	+	▪ Support the conservation goals of Port Honduras Marine Reserve ▪ Impacts of sewage and detergent, bilge water. grey water and oil ▪ Visual impact of non-traditional sailing boats ▪ Anchor damage on mooring sites ▪ Potential for grounding on the reef ▪ Lack of compliance to rules and regulations due to limited awareness	+ - - - - -
Belize Fisheries Department	▪ Part of Belize's marine protected areas system, for maintenance of commercial species ▪ Provides fisheries management for fishing Industry ▪ Generates revenue for the Fisheries Department	+ + +	▪ Provides staff, fuel and training for surveillance and enforcement of Port Honduras Marine Reserve	+
Government of Belize	▪ Provides finance for fisheries management for the fishing Industry ▪ Provides environmental services ▪ Port Honduras Marine Reserve included within the National Protected Areas System Plan - assists in fulfilling Belize Government's commitment to the conservation of natural resources, CCAD and CBD ▪ Income generation of significant foreign revenue ▪ Provides employment opportunities in stakeholder communities	+ + + + +	▪ Political support (currently being strengthened through the NPAPSP) ▪ Lack of political support ▪ Uncertainty of long term future commitment	+ - -

Table 6: A basic Stakeholder Analysis of Port Honduras Marine Reserve

2.4 Physical Environment

2.4.1 Climate

The climate of Central America is controlled by the interaction between the easterly trade winds and the central mountain ridge (Nieuwolt, 1977). The mountains divide the region into a dry subtropical Pacific coast to the west and a humid, tropical, east-facing Caribbean coast, with climate largely being dictated by the interaction of easterly trade winds with the ridge (Portig, 1976). The trade winds pick up moisture from the warm sea surface, converging with continental air masses where the inversion layer is weakened by turbulence and mixing with humid lower winds as they approach the coast of Central America (Heyman & Kjerfve, 1999). Because of these interactions, rainfall is very high on the eastern coast of Central America, including Belize, during the summer and autumn months (Heyman & Kjerfve, 1999). Rainfall is further enhanced by tropical storm events between June and November every year as Belize lies within the hurricane belt (Portig, 1976). In addition, on a more local scale, the Maya Mountains within Southern Belize reach 1120m, further influencing the rainfall in the area (Heyman & Kjerfve, 1999). As a result of all of these factors, rainfall in southern Belize averages between 3000 to 4000 mm each year (Table 7), higher than 90% of the rest of Central America (Heyman & Kjerfve, 1999).

Rainfall

There is significant variation in precipitation throughout the year in southern Belize. During 2008, the average monthly precipitation for Punta Gorda was 320 mm (Figure 5; Table 7).The driest months are from February to April with rainfall ranging from 40-70mm per month, whilst in the wettest months (June through to September) rainfall frequently exceeds 400mm per month and often in excess of 700mm (Heyman & Kjerfve, 1999).

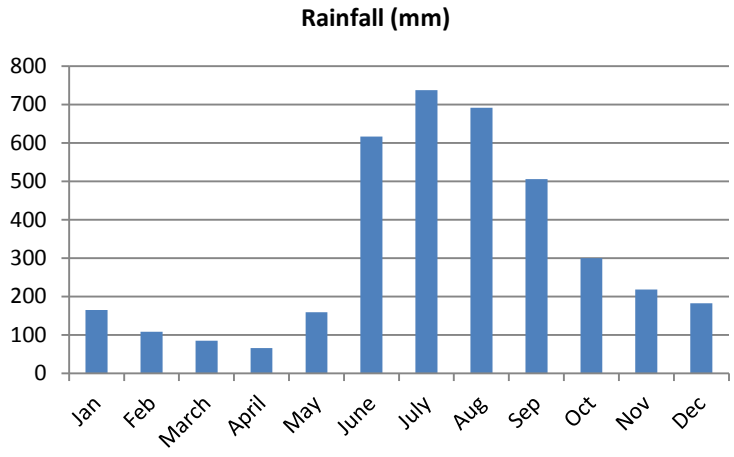


Figure 5: Monthly precipitation data for Punta Gorda, Southern Belize for Belize during 2008 (www.climate-charts.com)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	Total
Precipitation (mm)	165	108	85	66	159	617	738	692	506	300	218	182	320	3836
Max Air Temp (°C)	28.3	28.7	30.1	31.7	32.2	31.7	30.8	31.6	31.7	30.3	29.8	28.8	30.5	-
Min Air Temp (°C)	18.4	19	19.8	21	22.1	23	22.8	22.6	22.7	22	20.8	19.8	21.1	-
Mean Air Temp (°C)	23.5	24.5	25.9	27	28.1	28.2	27.8	27.9	28	27.7	26.2	25	26.7	-

Table 7: Monthly precipitation data for Punta Gorda, Southern Belize and maximum, minimum and mean air temperature for Belize during 2008 (www.climate-charts.com)

Air Temperature

Seasonal variation in air temperature is minimal in southern Belize due to the strong maritime influence (Nieuwolt, 1977). Historically, air temperature during the cooler months (November to March) averages 24 °C and 28.7 °C during the warmer months (July to September) (Heyman & Kjerfve, 1999; Table 7; Figure 6). The combination of high temperatures and high rainfall makes the climate in southern Belize exceptionally hot and humid, with average humidity of 80% throughout the year (Heyman & Kjerfve, 1999).

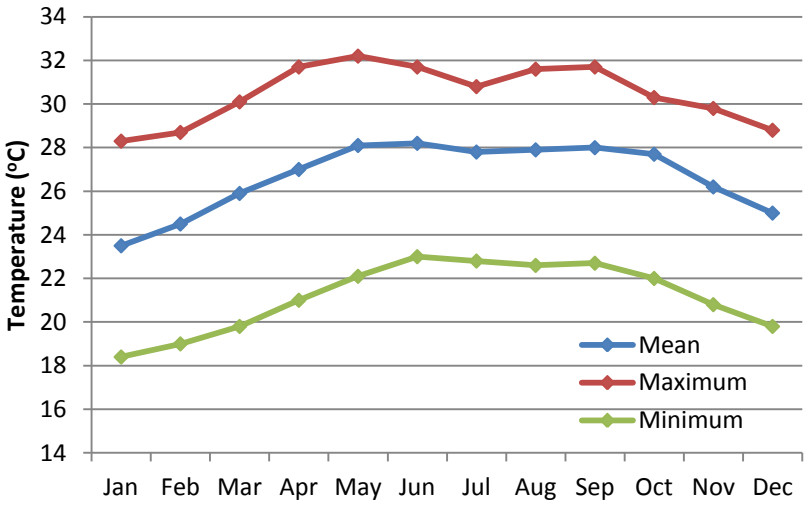


Figure 6: Mean, Maximum and Minimum Monthly Temperatures for Belize during 2008.

Weather Systems

Belize is affected by three very distinct seasonal weather systems: trade winds, northers and tropical storms. All three have an influence on the rainfall and temperature patterns, on the sea level, and on the currents around the Port Honduras Marine Reserve itself.

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

Tropical Storms: Originating in the Atlantic Ocean over warm, tropical waters, tropical storms affect Belize every year. 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). They move westward towards the Caribbean, gathering strength until they hit land. Tropical storms and hurricanes impact Belize on a regular basis. However, few storms reach the southernmost part of Belize. Large areas of coastline and inland areas were stripped of their vegetation and many homes and buildings were damaged or destroyed. The Government of Belize estimated damage to be approximately US$66.2 million (Avila, 2001).

The hurricane season stretches from the month of June through November, with historical records identifying nine hurricanes and two tropical storms that have passed within a 50-km radius of Port Honduras Marine Reserve (Table 8; Figure 7; NHC, 2011).

Name	Cat.	Year	Date Passed PHMR
Not named	H1	1918	25th August
Not named	H1	1934	15th June
Not named	H1	1941	28th September
Not named	TS	1943	22nd October
Not named	H1	1945	3rd October
Abby	H1	1960	14th July
Francelia	H2	1969	3rd September
Laura	TS	1971	21st November
Fifi	H2	1974	19th September
Mitch*	H2	1998	29th October
Iris	H4	2001	9th October

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

Table 8: Hurricanes affecting Port Honduras Marine Reserve (<50km radius) (www.nhc.noaa.gov)

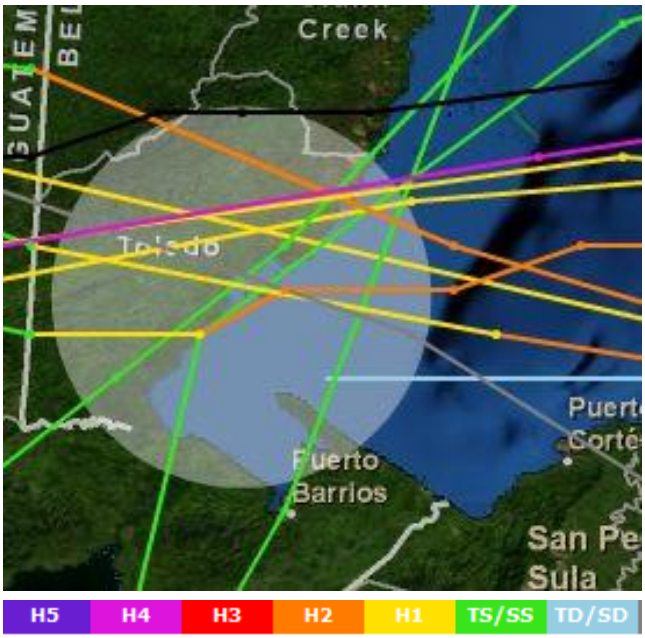


Figure 7: Port Honduras Marine Reserve: Tropical Storms / Hurricanes within a 50km of the Marine

Whilst many hurricanes have very focused paths of destruction, their effects are wide ranging, particularly at sea. As well as the physical and mechanical damage to the coral, hurricanes also stir up the water, increasing turbidity and can reduce water clarity for a significant time after the storm event itself. Water clarity can be further reduced following tropical storms by the associated heavy rainfall, which can exacerbate erosion and increase sediment transport from the mainland via the rivers.

Hurricanes can also result in major changes to the shapes and sizes of cayes and sandbars within the marine reserve, as well as causing damage to infrastructure on the cayes (CEDRA, 2001). The most recent extreme hurricane impacts have been from Hurricane Mitch (1998) and Hurricane Iris (2001). In late October, 1998, shortly after peak bleaching temperatures, Hurricane Mitch swept across the Gulf of Honduras, to then stop 400km east of the southern coastline for 2 days,

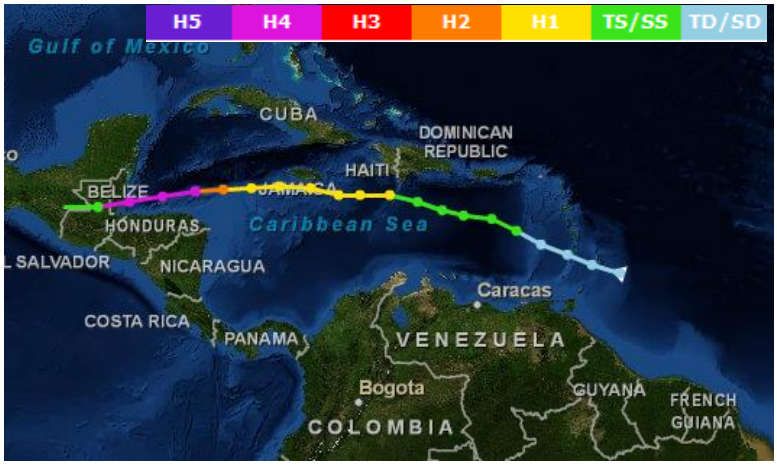


Figure 8: Port Honduras Marine Reserve: Hurricane track: Hurricane Iris (www.csc.noaa.gov, 2011)

adjacent to the Bay Islands of Honduras. Even though it did not hit Belize directly, its proximity did tremendous damage. Hurricane Iris made landfall near Monkey River, slightly to the north of the Marine Reserve on the 9th October, 2001 (Figure 8). The area of impact was relatively small, with hurricane force winds extending out for only 30km – but the 140mph winds and the associated storm surge of 14 feet resulted in significant devastation in the coastal areas.

2.4.2 Geology

Coastal ecosystems persist throughout the geological record, but the physical location of these systems migrates with changes in the land-sea margin and changes in sea level. Understanding the coastal geology of southern Belize is critical to understanding the history and development leading to the present configuration of coastal ecosystems that occur today as well as change likely to occur in the future with changes in sea level. The geological processes influencing southern Belize can be understood by breaking the continental margin and shelf into three components: the coastal margin, the near-coast shelf and channels, and the offshore reef tract (Sullivan et al., 1995). The continental margin of Belize forms one of the sides of a deep oceanic basin that makes up the northwest Caribbean region of the Tropical Western Atlantic. This basin is surrounded by the Cayman Ridge and Trough System to the east, the Nicaraguan Rise to the southeast, and by Cuba to the north.

The geology of coastal Belize is complex, and reveals a history of rock strata formed from terrestrial and marine sediments altered by tectonics. The basement structure of the continental margin of Belize is characterized by groups of aligned rift blocks that trend approximately parallel to the coast but that diverge north-eastward (Sullivan et al. 1995). Early in the Mesozoic (65-248 million years ago) the orogenic phase occurred, characterized by block faulting in northern Central America and accompanied by deposition of continental red beds. This faulting progressed into Guatemala, Belize and Western Honduras and it is during this period that the development of the north-western Caribbean occurred, opening a rift between the Yucatan peninsula and Honduras, creating the Gulf of Honduras (Sullivan et al. 1995). During the late Cretaceous period, marine red beds, siltstone and shale, detrital limestone and some reef-like carbonate rocks were deposited over much of Guatemala, Belize and Yucatan (Sullivan et al. 1995).

In the Cenozoic era (65 million years ago to the present), deltaic detritus and carbonates accumulated in restricted marine embayments of eastern Guatemala and southern Belize. The streams of southern Belize drain the Maya Mountains, but they flow across a relatively flat and narrow coastal plain into swamps and small lagoons before entering the sea. The coastal and tidal wetlands serve as an efficient sediment trap, thus, large quantities of terrigenous material probably do not reach the Port Honduras Marine Reserve. The sedimentation regime may have changed little since the early Cretaceous times when development of the platform began (Dillon & Vedder 1973).

2.4.3 Bathymetry

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

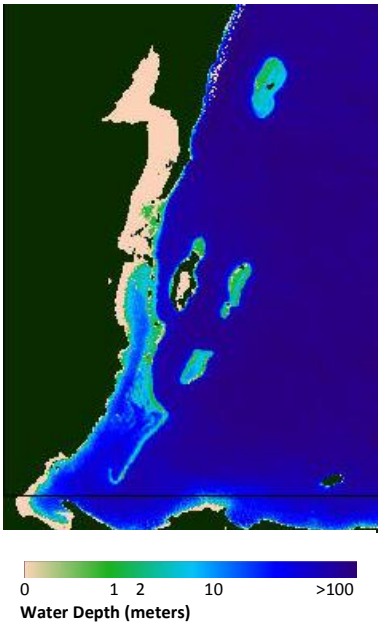


Figure 9: Water Depth (SeaWiFS, 1999)

The barrier reef complex has been divided into three provinces based on their community distribution and geomorphic characteristics: Northern, Central, and Southern Provinces (Figure 9; Burke, 1982). The reserve area lies well within the Southern Province, which extends for about 59 km from Gladden Spit to the Sapodilla Cayes and is distinguished by shallow-water reefs, which occur as fringes around the cayes. The depth of the water over these reefs is less than 5 m, forming exposed reefs during low tides. The Marine Reserve lies in a coastal basin with estuarine characteristics, into which six watersheds flow. Although much of the Reserve waters exceed 5m in depth, two shallow banks run parallel to the shore, providing a base for many of the cayes, and which act as sediment traps, preventing much of the riverine sediment from reaching the coral reefs (Sullivan et. al., 1995). Close inshore the water are generally quite turbid, beyond the shallow banks the water has far greater clarity.

The waters of the Marine Reserve exhibit pronounced haloclines – layering of waters with different concentrations of salinity. This vertical layering of the water column is particularly pronounced in areas where the rivers enter the Bay, with the less dense surface waters from the rivers lying on top of the denser seawater. Mixing of these layers is limited by the shallow banks, protecting the inshore waters from significant offshore wave-action, and salinity can vary from freshwater to over 30 ppt.

2.4.4 Tides and Water Movement

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

The marine and coastal systems in the Gulf of Honduras are controlled by three factors (Heyman & Kjerfve, 1999). Firstly, the bifurcation of the northerly Cayman Current leads to a cyclonic counter-current gyre and a resulting 1 to 2 knot southerly current just west of the Belize Barrier Reef (Figure 10); secondly, the high precipitation in the watersheds leads to significant runoff of sediment and freshwater between June and September, which drives gravitational currents and lowers water transparency (the resulting surface current flows east between Punta Manabique and the Sapodilla Cayes); and, thirdly, deep, clear, nutrient-rich oceanic waters occasionally enter the Gulf of Honduras from the Caribbean Sea, with deep currents flowing contrary to prevailing surface current (Heyman & Kjerfve, 1999). In contrast, the mixed, primarily semidiurnal tide is of limited importance in southern Belize with a range of only 20 cm (Kjerfve, 1981).

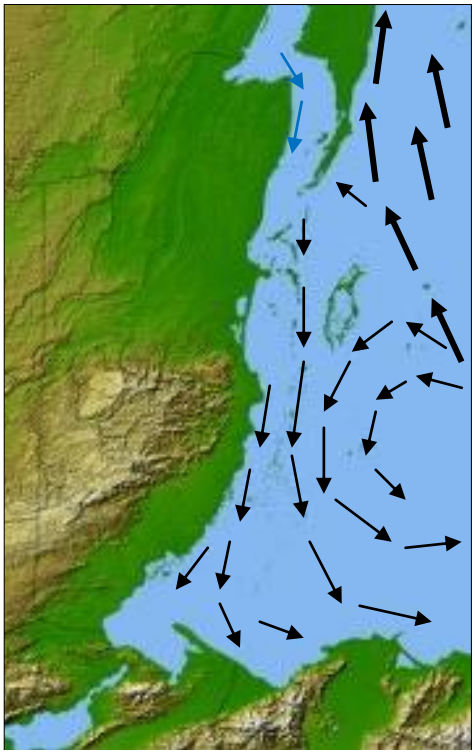
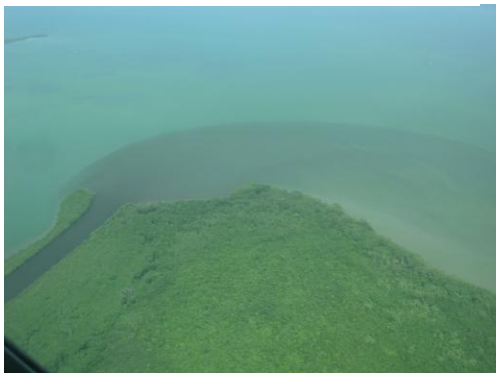


Figure 10: Currents of the Belize Reef (after Ezer et al., 2005)

Port Honduras Marine Reserve is primarily estuarine in character, and during the rainy season, the water column becomes highly stratified, with fresh, often very turbid water at the surface, and freshwater plumes frequently extending as far as the Snake Cayes (Foster, 2010a). River plumes, from these watersheds have a significant impact on Port Honduras Marine Reserve. Prevailing southward directed winds and currents transport river plumes along the coast towards the south (Heyman & Kjerfve, 1999). As a result of the river plumes, Port Honduras Marine Reserve is seasonally brackish, and highly sensitive to upland activities that alter sedimentation rates and surface water flow (Heyman & Kjerfve 1999).



River plume entering the Port Honduras Marine Reserve

Monkey River: This trend is most evident at Monkey River when during the rainy season with light easterly trade winds, the red–orange surface plume of Monkey River extends 1 km to the north, 3–5 km to the east, and more than 15 km to the south and southeast, near the Snake Cayes (Heyman & Kjerfve, 1999). The river carries a high load of granitic sands, which form a submarine fan and contribute to the maintenance of the siliceous sand beach, which extends south to Punta Ycacos (Heyman & Kjerfve, 1999).

Deep River: The plume from Deep River extends seaward 2–5 km during the wet season and usually veers south into the large bight formed at the southern end of the river mouth (Heyman & Kjerfve,

1999). During the dry season, however, surface plumes from Deep River and Ycacos generally extend less than 0.5 km, with higher salinities ranging between 29‰ and 36‰ (Heyman & Kjerfve, 1999).

Ycacos Lagoon: The Ycacos Lagoon is bounded to the east by a thin strip of sand between Punta Negra and Monkey River. During the rainy season, a hydrologic head develops in the lagoon, pushing 10–15 intermittent canals through the granitic sand berm and releasing dark brown, tannin-stained fresh water to the coast (Heyman & Kjerfve, 1999).

Golden Stream: The river plume from Golden Stream extends eastward but is difficult to distinguish from the Middle River plume and the turbid inshore coastal waters of southern Port Honduras (Heyman & Kjerfve, 1999).

Rio Grande: The plume from Rio Grande is characteristically reddish brown and more distinct from slate-coloured turbid inshore waters than the other rivers and during the rainy season the plume can extend 4–6 km due east (Heyman & Kjerfve, 1999).

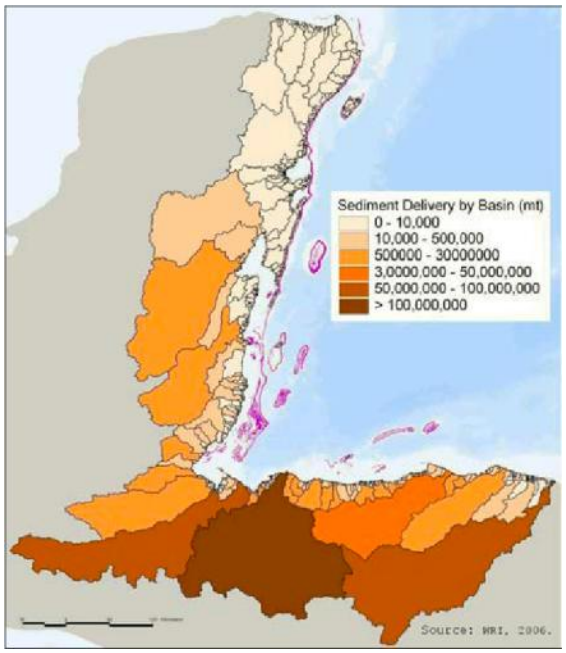
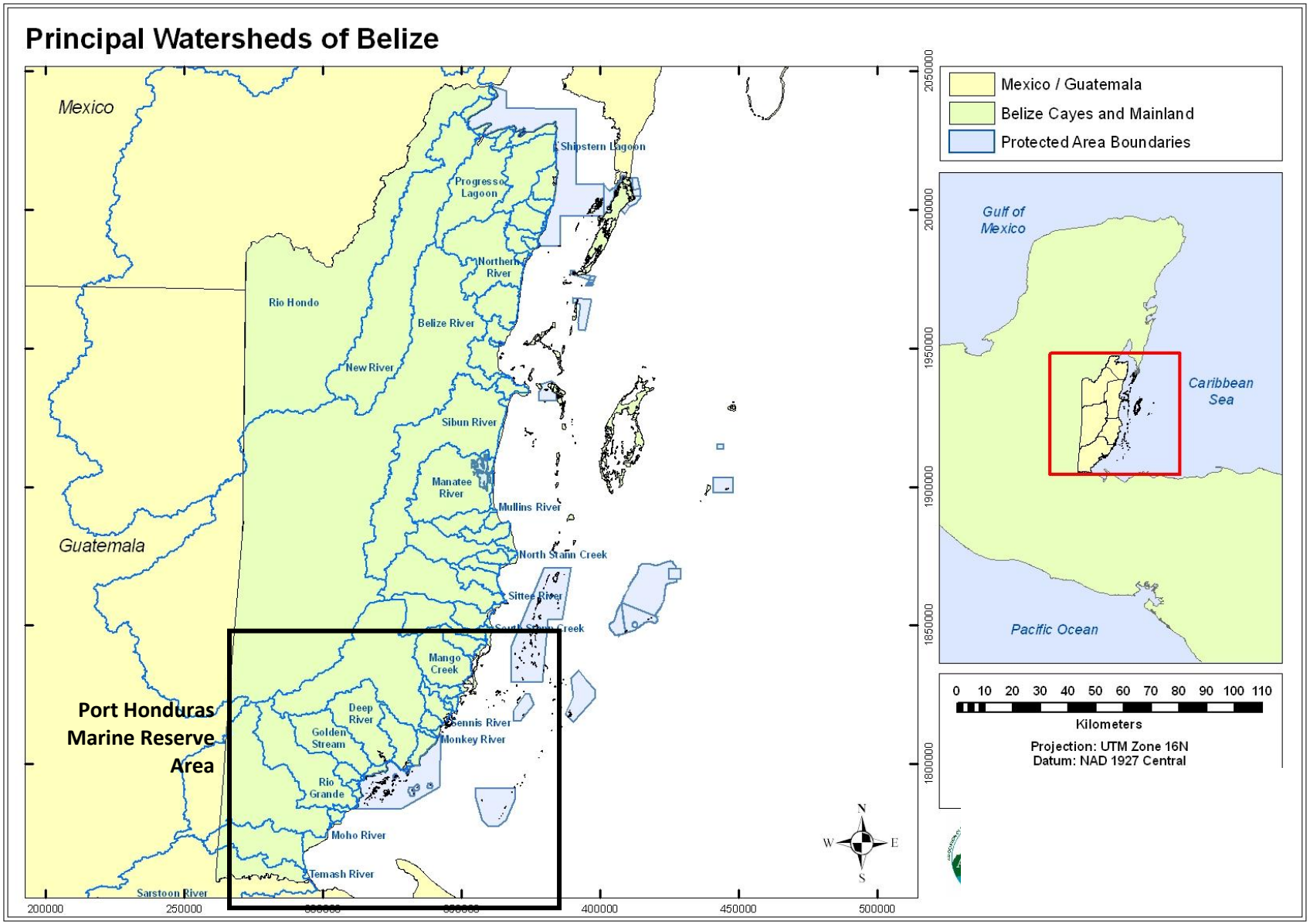


Figure 11: Sediment Delivery by Watershed Basin (Burke et al. 2006)

Sedimentation and agrochemical contamination from mainland watersheds have been highlighted as perhaps one of the greatest impacts on the Belize reef, after climate change. Port Honduras Marine Reserve lies east of five major watersheds originating in Belize - Deep River, Golden Stream, Indian Hill Lagoon, Middle River, Monkey River, Punta Ycacos Lagoon, and the Rio Grande (Figure 11, Map 8), which drain some of the principal banana growing areas of southern Belize. Following storm events, the increased sediment load of these rivers is also accompanied by an increased pesticide load, as rain washes agrochemicals from the watersheds into the rivers, and from there into the sea. This is overshadowed by the watersheds emptying into the Gulf of Honduras from Guatemala and Honduras (particularly the Ulua, Motagua, Patuca and Aguan) where land use change has removed much of the natural vegetation from the formerly forested slopes (Burke et al., 2006).

Sediment core analysis of two sites within the Belize reef system (Turneffe Atoll and Sapodilla Cayes), indicate that watershed runoff onto the reef has increased relatively steadily over time, consistent with historical and current land use trends. Sediment supply to the reef is greater in the south, with greater urgency for action to reduce runoff impacts (Carilli et al., 2009).



Map 8: Watersheds of Belize

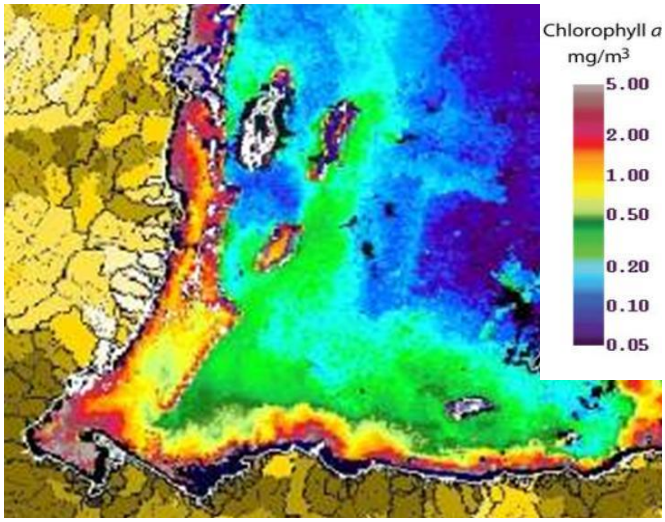


Figure 12: SeaWifs Chlorophyll α. After Shank et al. 2010/ Soto et al. 2009

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

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

SeaWifs ocean colour images also shows that a large pulse of river water extends from the Guatemalan and Honduran rivers, stretching as far north as Gladden Spit, and even out as far as Glover's Reef Atoll, during these storm events (Figure 12; Soto et al., 2009; WRI/ICRAN, 2006; Andrefouet et al., 2002). Connectivity was tracked using the proxy of weekly mean chlorophyll-a concentrations, derived from satellite imagery over a nine-year period. These studies indicated that Honduran river plumes, particularly that of the Ulu´a River, reached the southern part of the Belize Reef 61% of the time. This provides further support for WRI studies on the origins of impacting watershed run-off on the Mesoamerican Reef (WRI, 2006).

2.4.5 Water Quality

The water quality parameters of temperature, salinity, dissolved oxygen, turbidity and pH are important components of the biological monitoring programme for Port Honduras Marine Reserve. Variations in these parameters can greatly affect the health of the ecosystem and organisms within it. For example, an increase in water temperature can initiate a bleaching response in hard and soft corals (Brown, 1997, Fitt et al., 2001) and may affect the metabolism of many fish and invertebrates, especially during their early life stages (Munday et al., 2008). Changes in salinity can affect reproduction and physiological responses in many organisms including fish and corals (Vermeij et al., 2006; Koenig et al., 2007), and the level of dissolved oxygen in the water column determines the numbers of organisms it can support (Dubinsky & Stambler, 1996).

Water quality has been monitored across Port Honduras Marine Reserve since 1998 (although some year's data collection was more consistent than others). Currently, water quality is assessed on a

monthly basis at 17 sites across the Marine Reserve. Data for temperature, salinity, pH, conductivity and dissolved oxygen are collected using a YSI water quality meter, with a probe that is placed in the water at a depth of approximately 0.50 – 1.00 metres and left for 1 minute to adjust. The results are then recorded from the screen. Vertical visibility (turbidity) is estimated using a secchi disk, lowered into the water from the side of the boat. Monitoring shows that regular freshwater input from rivers can affect even the most distant sites of PHMR (the Snake Cayes) through changes in salinity and sedimentation. Dissolved oxygen content has improved throughout 2009 and has been at a consistent level for the last six months of that year.

Water Temperature

Within Port Honduras Marine Reserve, water temperature is monitored at a number of sites across the marine protected area. Water temperature varies with season and across years (Table 9, Figure 13). Despite the variations among sites, a clear pattern can be seen in water temperature over the years with October to February being the coldest period (when winds are frequently from the north) and May to September the warmest period. In comparison to 2008, water temperature was, on average, higher for the majority of 2009.

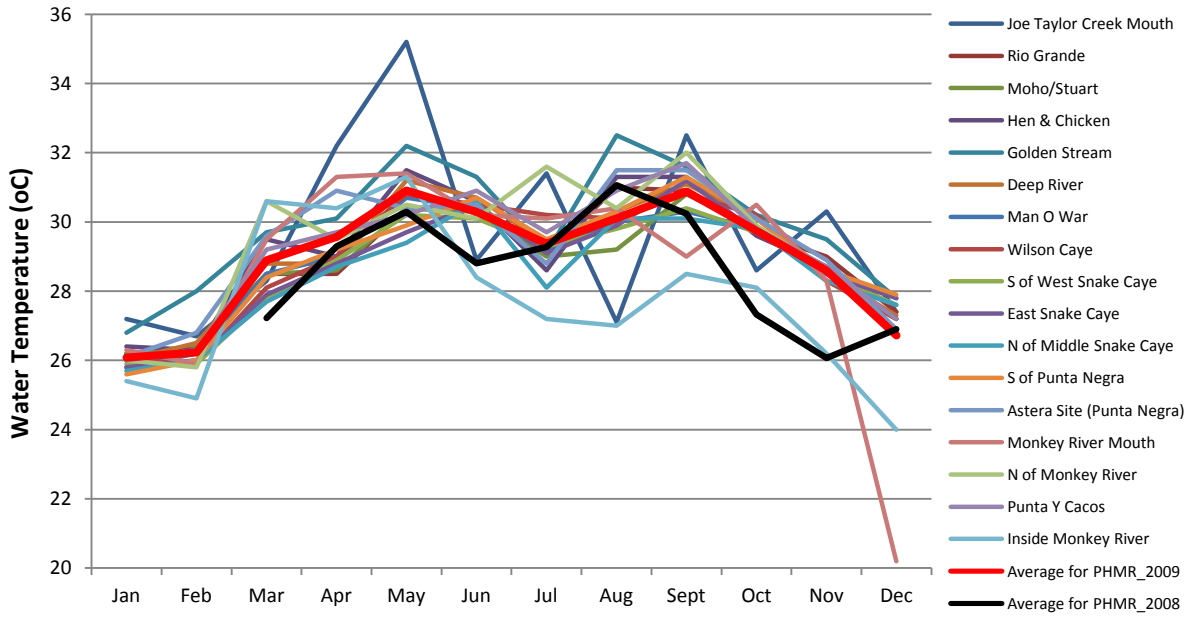


Figure 13: Water temperature at sites across PHMR during 2009. Also shown is the average water temperature each month in PHMR for 2008 and 2009.

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Joe Taylor Creek Mouth	27.2	26.7	28.3	32.2	35.2	28.9	31.4	27.1	32.5	28.6	30.3	27.4
Rio Grande	26.2	26.3	28.5	28.5	30.4	30.3	29.1	31.0	30.9	29.7	29.0	27.4
Moho/Stuart	26.2	26.4	28.5	28.6	30.4	30.3	29.0	29.2	30.8	29.8	28.7	27.2
Hen & Chicken	26.4	26.3	29.5	29.0	31.5	30.6	28.6	31.3	31.3	29.6	28.7	26.8
Golden Stream	26.8	28.0	29.7	30.1	32.2	31.3	29.1	32.5	31.6	30.2	29.5	27.8
Deep River	26.0	26.5	28.8	28.8	31.2	30.7	29.4	30.3	31.1	30.1	28.5	27.3
Man O War	25.8	26.2	28.5	29.0	30.7	30.4	29.2	30.0	30.3	29.8	28.6	27.2
Wilson Caye	26.0	25.9	28.1	29.0	30.8	30.5	30.2	30.1	30.8	30.2	28.3	27.2
S of West Snake Caye	25.9	25.9	27.8	28.9	30.2	30.1	29.3	29.8	30.4	29.7	28.5	27.6
East Snake Caye	25.8	26.0	27.9	28.8	29.7	30.5	29.1	29.9	31.2	29.7	28.5	27.8
N of Middle Snake Caye	25.7	26.0	27.7	28.7	29.4	30.6	28.1	30.1	30.1	29.8	28.3	27.6
S of Punta Negra	25.6	26.0	28.4	29.2	29.9	30.7	29.5	30.3	31.3	30.1	28.6	27.9
Astera Site (Punta Negra)	26.1	26.8	29.6	30.9	30.4	30.5	28.8	31.5	31.5	30.1	28.9	26.9
Monkey River Mouth	26.3	25.9	29.5	31.3	31.4	30.2	30.1	30.4	29.0	30.5	28.3	20.2
N of Monkey River	26.0	25.8	30.6	29.5	30.5	30.1	31.6	30.4	32.0	29.9	28.6	26.8
Punta Ycacos	26.0	26.3	29.2	29.7	30.2	30.9	29.7	30.9	31.7	29.8	28.7	27.2
Inside Monkey River	25.4	24.9	30.6	30.4	31.3	28.4	27.2	27.0	28.5	28.1	26.2	24.0
Average – 2009	26.1	26.2	28.9	29.6	30.9	30.3	29.4	30.1	30.9	29.8	28.6	26.7
Average – 2008	N/D	N/D	27.2	29.3	30.3	28.8	29.3	31.1	30.2	27.3	26.1	26.9

Table 9: Monthly sea water temperature (^{o}C) at sites within Port Honduras Marine Reserve (PHMR) during 2009. Also shown are average values across PHMR for each month during 2009 and 2008. N/D denotes no data available.

Salinity

Salinity varies among sites and years within PHMR due to the strong influence of the seven watersheds that flow into the areas. Data are shown for the years where a full 12 month data set is available (Table 10; Figure 14). Salinity shows some variation between sites, in particular between those sites close to a river outflow and those sites at the cayes to the eastern edge of the reserve, furthest from the sources of freshwater. An obvious pattern in salinity is evident over the year with June to October having the lowest salinity values, coinciding with the rainy season.

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Joe Taylor Creek Mouth	32.9	32.7	30.8	34.1	30.8	22.5	22.6	22.6	17.0	27.2	20.0	20.0
Rio Grande	32.8	33.6	33.2	33.2	32.4	30.7	24.3	28.9	33.0	30.0	34.0	30.0
Moho/Stuart	33.1	30.0	33.6	34.2	31.5	30.4	27.3	29.3	33.0	35.0	35.0	35.0
Hen & Chicken	32.7	33.1	33.8	34.1	33.3	32.2	26.8	21.4	25.0	35.0	34.0	32.0
Golden Stream	32.8	32.5	33.8	34.4	33.0	27.1	23.5	20.2	20.0	34.0	20.0	25.0
Deep River	32.8	32.0	34.0	35.2	33.2	28.7	29.6	26.4	29.0	32.0	35.0	35.0
Man O War	32.9	33.7	34.7	35.2	34.2	32.6	27.3	28.6	30.0	33.0	35.0	35.0
Wilson Caye	33.2	32.6	34.7	35.2	33.2	32.8	29.2	30.8	30.0	33.0	34.0	36.0
S of West Snake Caye	33.2	33.6	34.5	34.8	34.0	31.1	30.0	29.2	31.0	35.0	35.0	35.0
East Snake Caye	33.5	33.8	34.0	35.4	35.1	31.0	30.2	29.4	31.0	35.0	35.0	35.0
N of Middle Snake Caye	33.6	33.8	34.4	35.4	35.5	31.3	29.3	28.2	30.0	32.0	35.0	35.0
S of Punta Negra	33.5	33.8	34.7	35.6	35.2	34.2	29.0	28.0	30.0	29.0	35.0	32.0
Astera Site (Punta Negra)	33.6	33.7	35.0	35.6	35.0	29.6	29.6	29.1	30.0	30.0	33.0	36.0
Monkey River Mouth	31.4	26.0	35.1	33.2	30.7	28.4	29.7	28.4	0.0	29.0	28.0	5.0
N of Monkey River	33.4	33.4	2.6	35.7	36.3	31.7	27.0	27.9	20.0	34.0	34.0	15.0
Punta Ycacos	33.2	33.8	35.1	35.8	34.6	31.2	28.6	28.0	20.0	34.0	35.0	36.0
Inside Monkey River	0.1	1.1	2.6	4.2	1.3	0.1	0.1	0.1	0.0	5.0	0.0	0.0
Average -2009	31.1	30.8	30.4	33.0	31.7	28.6	26.1	25.7	24.1	30.7	30.4	28.1
Average - 2008	N/D	N/D	36.0	N/D	35.7	26.4	24.5	32.0	30.3	29.8	31.1	31.2

[1] Data are shown for the years where a full 12 month data set is available

Table 10: Monthly salinity (ppt) at sites within Port Honduras Marine Reserve (PHMR) during 2009. Also shown are average values across PHMR for each month during 2009 and 2008. N/D denotes no data available.

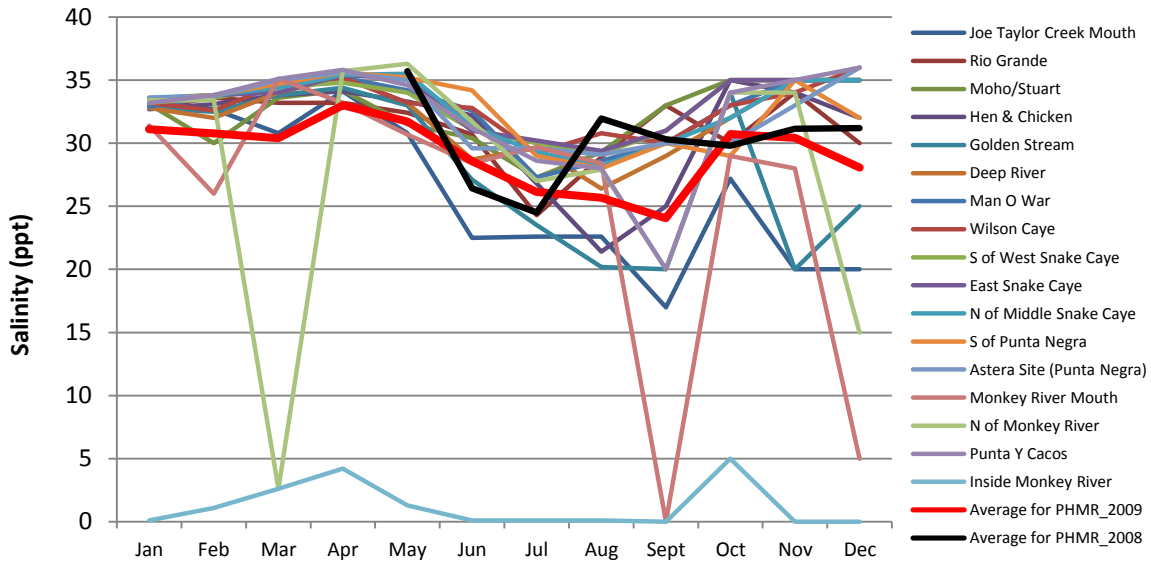


Figure 14: Salinity at sites across PHMR during 2009. Also shown is the average salinity each month in PHMR for 2008 and 2009.

Dissolved Oxygen

Dissolved oxygen concentrations within PHMR can vary significantly between years. For example, between 2008 and 2009, there were large differences in the concentration of dissolved oxygen in the water column, possibly due to varying air and water temperatures throughout the years. In 2009, January to April saw a large increase in dissolved oxygen concentrations at all sites across the Marine Reserve, whilst from May to December, concentrations remained fairly stable at approximately 6mg per litre (Table 11, Figure 15).

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Joe Taylor Creek Mouth	2.9	3.9	5.5	9.7	3.3	7.7	8.0	7.1	7.4	7.4	7.4	6.4
Rio Grande	2.8	4.2	4.3	9.1	7.2	7.3	7.3	7.8	7.2	6.3	6.6	7.6
Moho/Stuart	2.8	4.1	4.0	9.1	7.5	7.2	7.3	6.4	7.1	6.6	7.1	7.1
Hen & Chicken	2.9	4.1	3.8	8.9	7.3	6.6	7.6	7.1	7.1	6.7	7.1	7.2
Golden Stream	2.6	3.9	3.5	8.3	7.1	8.0	6.9	8.4	8.2	5.7	8.5	6.4
Deep River	3.0	4.1	6.6	8.7	7.0	7.5	7.2	6.5	7.5	5.7	6.0	6.9
Man O War	3.0	3.9	6.7	8.7	7.6	7.5	7.1	6.9	7.0	6.3	6.3	7.4
Wilson Caye	3.1	4.0	6.9	8.5	7.6	7.3	7.2	7.2	6.7	5.8	6.8	7.2
S of West Snake Caye	3.2	4.0	6.8	8.5	7.7	7.2	6.3	6.9	6.9	7.6	7.4	7.6
East Snake Caye	3.1	4.1	6.9	8.5	7.8	7.4	7.0	7.3	7.2	7.2	6.9	6.9
N of Middle Snake Caye	3.1	4.0	6.8	8.7	7.6	7.5	7.4	7.2	7.0	7.5	7.1	7.6
S of Punta Negra	3.2	4.0	4.1	8.7	7.6	7.4	7.4	7.1	6.9	6.8	6.8	7.1
Astera Site (Punta Negra)	3.0	3.8	4.0	10.3	8.0	6.9	6.4	7.2	7.1	6.3	6.7	7.2
Monkey River Mouth	3.0	3.8	3.5	8.6	7.1	6.9	11.1	7.7	6.4	7.5	7.1	7.5
N of Monkey River	3.0	3.5	3.5	9.1	7.4	7.0	7.2	6.2	6.9	6.8	6.3	7.0
Punta Ycacos	3.2	3.9	3.6	9.3	7.2	7.4	7.0	6.9	7.9	5.9	6.6	7.2
Inside Monkey River	2.9	3.6	3.5	7.6	6.1	6.6	6.1	6.6	5.8	6.3	6.6	6.7
Average -2009	3.0	3.9	4.9	8.8	7.1	7.3	7.3	7.1	7.1	6.6	6.9	7.1
Average - 2008	N/D	N/D	5.9	4.9	5.0	5.3	4.8	5.7	3.5	3.2	2.1	2.3

Table 11: Monthly dissolved oxygen concentrations (mg/l) at sites within Port Honduras Marine Reserve (PHMR) during 2009. Also shown are average values across PHMR for each month during 2009 and 2008. N/D denotes no data available.

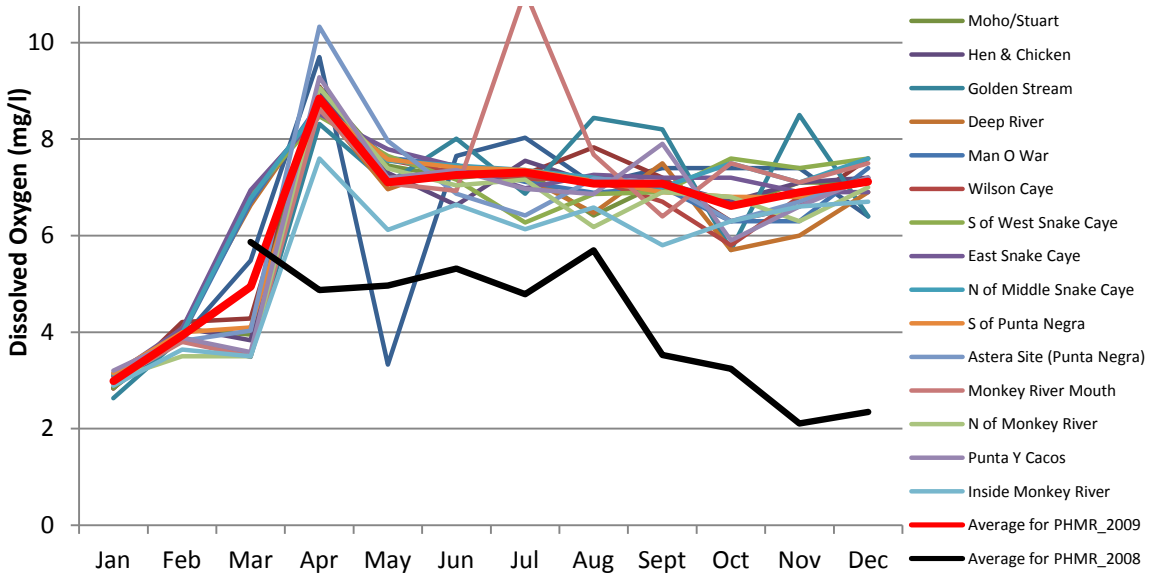


Figure 15: Dissolved oxygen concentrations at sites across PHMR during 2009. Also shown is the average dissolved oxygen each month in PHMR for 2008 and 2009.

Turbidity (Vertical Visibility)

Port Honduras Marine Reserve is a notoriously turbid environment and during 2009 turbidity (measured as vertical visibility) was highly variable among sites and among months (Table 12, Figure 16). The lowest visibility (highest turbidity) at all sites was observed during June and July at the onset of the rainy season, when sediment laden freshwater outflow into the reserve is likely to be highest. March and November were both periods of high visibility at the majority of sites, which may be linked to lower rainfall and/ or less wind during these periods.

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Joe Taylor Creek Mouth	40	50	75	100	80	60	30	80	300	100	390	175
Rio Grande	260	600	1100	1200	400	470	80	750	800	400	650	780
Moho/Stuart	130	500	550	400	400	450	230	820	800	400	500	550
Hen & Chicken	170	250	150	300	200	190	180	350	250	250	210	250
Golden Stream	80	50	100	150	160	85	75	100	200	150	200	100
Deep River	120	250	200	200	200	550	130	450	600	200	150	150
Man O War	240	300	700	450	500	560	150	550	500	300	400	250
Wilson Caye	500	550	1100	900	600	650	190	700	600	350	1000	350
S of West Snake Caye	510	700	800	1000	800	730	350	1400	600	650	1200	1150
East Snake Caye	600	900	1500	1200	1500	750	480	1550	900	750	1200	1355
N of Middle Snake Caye	590	600	1350	1000	1200	680	255	1300	850	700	1250	1200
S of Punta Negra	400	400	1050	700	600	580	220	750	780	550	1225	1125
Astera Site (Punta Negra)	180	50	150	150	160	120	200	150	350	200	100	150
Monkey River Mouth	200	100	700	100	80	60	50	50	120	100	100	50
N of Monkey River	400	130	150	300	210	170	200	75	100	350	300	75
Punta Ycacos	300	200	400	300	520	330	220	550	220	300	500	200
Inside Monkey River	100	150	150	150	30	50	50	20	20	100	120	20
Average – 2009	284	340	601	506	449	381	182	567	470	344	559	466
Average – 2008	N/D	N/D	N/D	N/D	N/D	N/D	225	N/D	552	430	449	387

Table 12: Monthly vertical visibility (cm) at sites within Port Honduras Marine Reserve (PHMR) during 2009. Also shown are average values across PHMR for each month during 2009 and 2008. N/D denotes no data available.

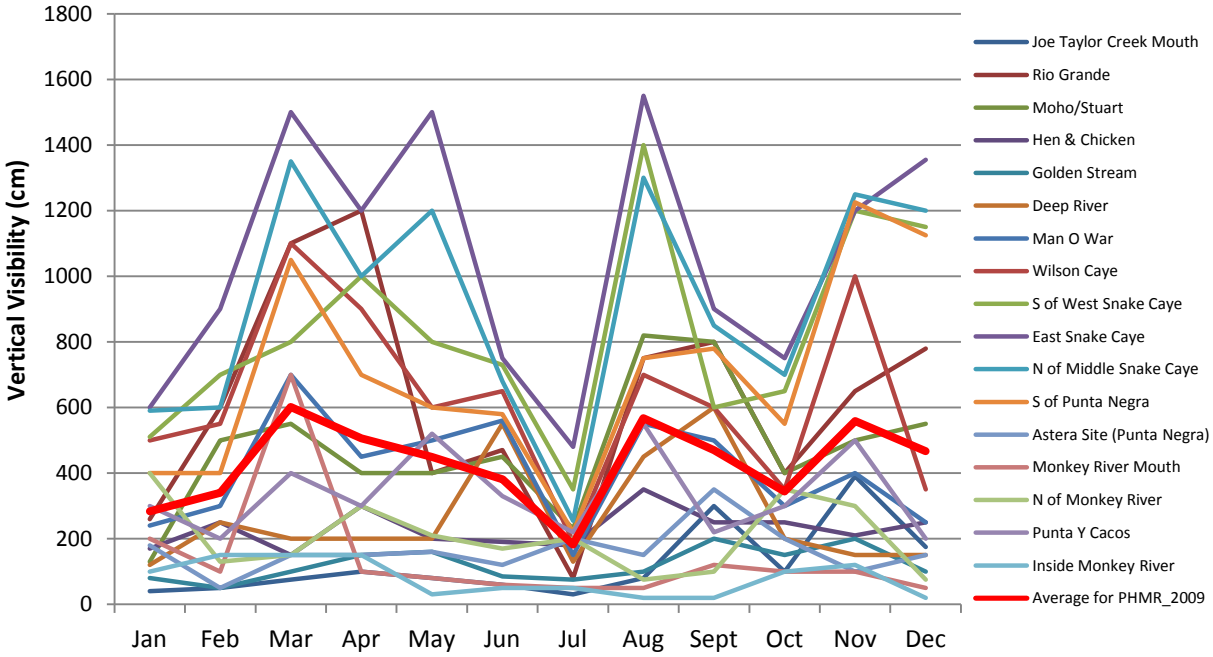


Figure 16: Vertical Visibility at sites across PHMR during 2009. Also shown is the average vertical visibility each month in PHMR for 2009

Water contamination is derived primarily from land-based sources. An assessment of risks from land-based sources of pollution highlighted the fringing reefs of Port Honduras Marine Reserve as at high risk from runoff from mainland agricultural areas (Figure 17). This is manifested in the form of sediment-laden river plumes rich in nutrients (effluents) that extend throughout the Marine Reserve, with the potential to cause algal blooms and coral death (WRI, 2005). Definitive research to characterize the effects of pesticides and nitrate and phosphate nutrients from agriculture and aquaculture areas is underway through WWF, focusing on identifying and mitigating agrochemical impacts in Belize, both on terrestrial and marine ecosystems, with concerns associated with the use of agrochemicals on the banana and citrus plantations and shrimp farms in the Toledo area, to the north west of the Marine Reserve. There have also been growing concerns, given prevailing water

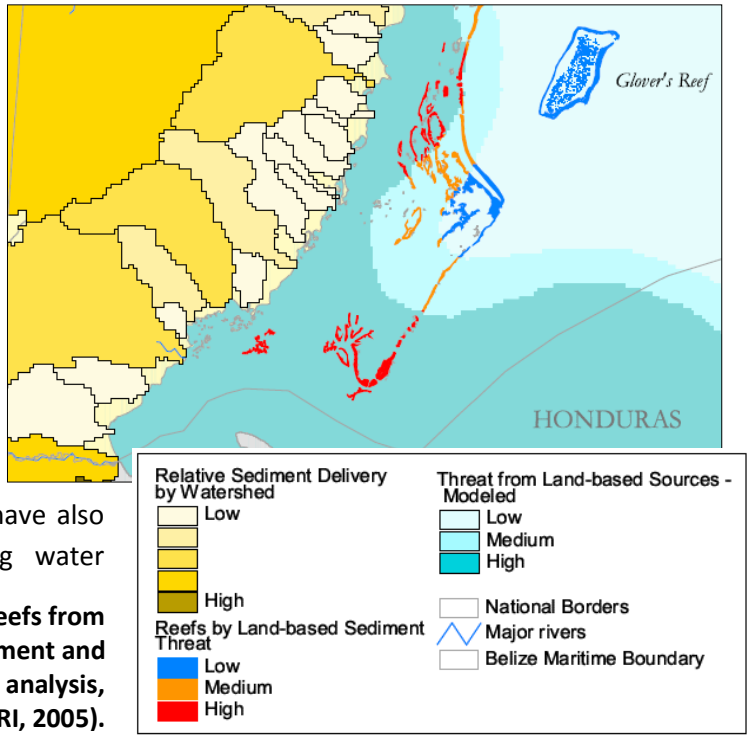


Figure 17: Modeled threats to coral reefs from watershed-based sources of sediment and pollution. From: Reefs at Risk in Belize analysis, World Resources Institute (WRI, 2005).

currents, that the vast banana and pineapple plantations in Honduras are introducing pesticide and nitrification pollutants in the Belize Reef system.

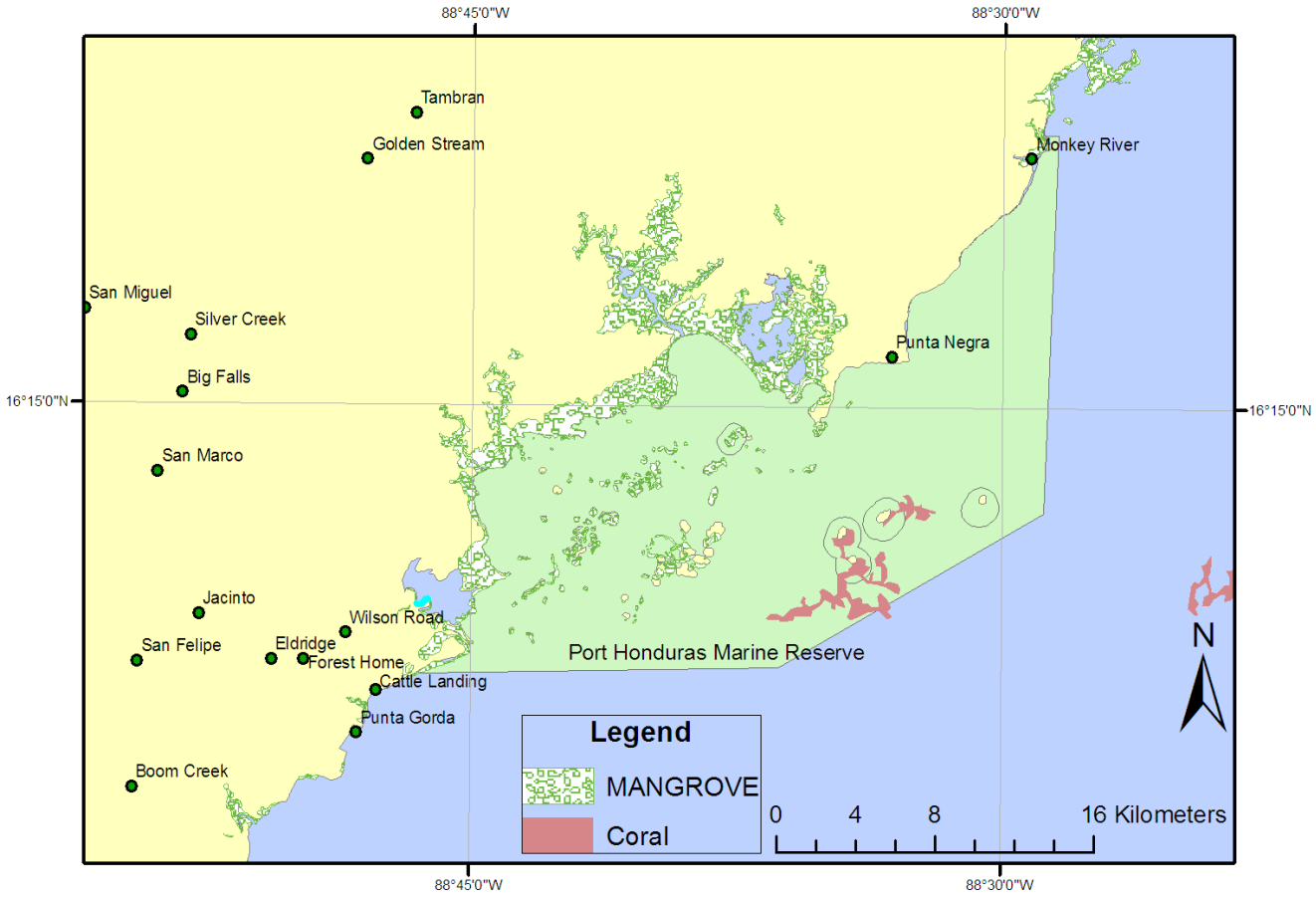
2.5 Biodiversity of Management Area

Port Honduras Marine Reserve is considered important in its protection of significant fisheries, mangrove communities, coastal and tidal wetlands, birds, manatees, sea turtles and reef. The coastline is fringed by mangroves, which provide important ecosystem functions, including the provision of high levels of organic input to the system, the filtering of water as it enters the Marine Reserve, and the provision of an important habitat for prop root communities.

The Marine Reserve does not include the 138 cayes lying within the overall area, the majority of which remain undeveloped and provide important mangrove habitats for fish nurseries. Some are used by birds for nesting – magnificent frigatebirds, brown pelicans, and sooty terns among them, and hawksbill turtles are known to use the beaches of the Snake Cayes as nesting sites. Some mangrove clearance has taken place, posing sedimentation threats to the reserve. The extensive sea-grass beds surrounding many of the cayes (and being part of the reserve) are considered to provide critical nursery habitat for many commercial and non-commercial marine species, and important feeding grounds for the West Indian manatee. In the waters surrounding the Snake Cayes, near-shore fringing reefs provide habitat for reef organisms. These are unique in Belize as mid-lagoonal reefs, with characteristics of both inshore reef and offshore barrier reef environments. These reef areas underwent extensive bleaching in 1998, losing up to 40% of coral cover, but have since recovered.

2.5.1 Ecosystems

Port Honduras Marine Reserve lies within the relatively shallow waters of the coastal shelf and is primarily estuarine in character, the result of the seven major watersheds that flow into it (Heyman & Kjerfve 1999). It incorporates four distinct ecosystems: coastal and tidal wetlands, marine lagoonal habitats comprised of mangroves and seagrass beds, mangrove islands with associated shallow banks, and the Snake Cayes fringing reef system (Map 9; Sullivan et al. 1995). These ecosystems are home to many species of commercial importance, such as the Caribbean spiny lobster (*P. argus*) and the queen conch (*S. gigas*), which also provide considerable economic benefits to the buffer communities (Punta Gorda, Punta Negra, Monkey River and the Cayes) and to the economy of Belize (Foster, 2010a). These ecosystems are also home to a number of threatened species of international concern, including the critically endangered goliath grouper (*Epinephelus itajara*), hawksbill turtle (*Eretmochelys imbricata*), and elkhorn coral (*Acropora palmata*), endangered Nassau grouper (*Epinephelus striatus*) and the vulnerable West Indian manatee (*Trichechus manatus*).



Map 9: Extent of coral and mangrove ecosystems within Port Honduras Marine Reserve, Southern Belize

Coastal Inter-tidal Mangroves: These mangroves are mostly found at the mouths of rivers and are mostly red mangroves (*Rhizophora mangle*). Further back are found the scrub mangroves, which inhabit large pounded basins and play a vital role in filtering upstream erosional products and release organic matter brought down through the watershed, which is necessary for high coastal productivity.

The Lagoon Waters including the Inner Cayes: There are over 130 mangrove cayes in the Port Honduras area, which appears to offer protection to the estuarine area allowing a gradual gradation from the fresh to the salt water.

The Offshore Banks: Benthos environment within the lagoons that are covered with mud, patch reefs or seagrass beds.

Snake Cayes Fringing Reef: The Port Honduras has a series of drop-offs that proceed seaward to a channel 25-30 meters in depth running between Port Honduras and the southern barrier reef at Sapodilla Caye. Two parallel lines of shallow banks, 1-2 meters deep, and mangrove islands occur in mid and outer Port Honduras, breaking the deep areas of the embayment into restricted basin. The Snake Cayes lie in the deep offshore channels. Reef and hard bottom communities are found around the Snake

Cayes area, associated with the cayes where the water quality is more conducive - salinity, turbidity, and nutrients levels - to coral reef development. However, corals that are tolerant to some levels of sedimentation and freshwater influence such as *Siderastrea radians* and *Oculina diffusa* are found in the flow influence zone of Deep River.

2.5.2 Flora

The dominant terrestrial vegetation type in Port Honduras Marine Reserve is littoral forests, mangroves and seagrasses. Mangroves are salt tolerant species that are found within the intertidal zone of the shore bordering the coastal lagoons and estuaries, as well as on the cayes distributed throughout the reserve. Mangroves are a critical component of coastal habitat that provide important ecosystem functions such as nursery and feeding areas and shoreline protection from storms and erosion. The dominant species on the cayes and majority of the mainland is the Red Mangrove (*Rhizophora mangle*), with Buttonwood (*Conocarpus erectus*), White Mangrove (*Laguncularia racemosa*) and Black Mangrove (*Avicennia germinans*) appearing sporadically along sections of the mainland coast within the Reserve (Avila et al. 2005). Littoral vegetation is found only on the beach that stretches from Monkey River to Punta Ycacos and on a few of the cayes. Small patches of littoral forest exist between Deep River and Golden Stream. Littoral forests are important feeding and nesting grounds and also provide shoreline protection.

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

During the conservation planning process, littoral forests, mangroves, seagrass beds and coral reef communities were identified as conservation targets. Where an ecosystem/habitat is specified all species associated with the ecosystem are included as part of the conservation target.

2.5.3 Fauna

Port Honduras Marine Reserve harbours a number of globally threatened species (critically endangered, endangered or vulnerable), with effective protection within the area being an important contribution in the maintenance of global populations. These include the critically endangered hawksbill turtle, goliath grouper and elkhorn coral, as well as the endangered Nassau Grouper, loggerhead and green turtles, and the West Indian manatee. Also managed within the Marine Reserve are a number of important commercial species, including the queen conch and Caribbean spiny lobster.

Port Honduras Marine Reserve **Species of international Concern**	
Critically Endangered	
Staghorn Coral	*Acropora cervicornis*
Elkhorn Coral	*Acropora palmata*
Hawksbill Turtle	*Eretmochelys imbricata*
Goliath Grouper	*Epinephelus itajara*
Endangered	
Loggerhead Turtle	*Caretta caretta*
Green Turtle	*Chelonia mydas*
Nassau Grouper	*Epinephelus striatus*
Star Coral	*Montastraea annularis*
Star Coral	*Montastraea faveolata*
Vulnerable	
Rainbow Parrotfish	*Scarus guacamaia*
Queen Triggerfish	*Balistes vetula*
Hogfish	*Lachnolaimus maximus*
Cubera Snapper	*Lutjanus cyanopterus*
Mutton Snapper	*Lutjanus analis*
West Indian Manatee	*Trichechus manatus*
	IUCN, 2011

Initial surveys identified approximately 70 species of fish from 32 families were identified in the coastal zone of Port Honduras (Sullivan, et al., 1996). Of these, 59 were identified to the species level and eight more to genus or family level. Almost 40 species had commercial value - primarily snapper (*Lutjanidae*), grunt (*Haemulidae*), and mojarra (*Gerreidae*) families. The rest were small or non-palatable species that are associated with seagrass habitats - anchovies (*Engraulidae*), pipefish (*Sygnathidae*), filefish (*Sciaenidae*), small wrasses (*Labridae*), gobies (*Gobiidae*), and puffers (*Tetraodontidae*). Fish density, biomass, and species number were notably higher in shallow waters and in dense seagrass than in other bottom types located in deeper waters.

Most of the commercial species of finfish and shellfish in Belize were represented in the plankton tow. The circulation patterns and hydrographic features of the water mass will impact the type of plankton community as well as the distribution of fish larvae to potential recruitment sites. Port Honduras is an important fish nursery ground, and provides habitat for many species inhabiting seagrass-mangrove-coral reef complexes (Sullivan, et al., 1996). The sheltered areas, abundant seagrass beds, and mangrove cayes provide food and refuge for small fish. The high turbidity prevailing in this area may also favor juvenile fish survival, as visibility may reduce predator ability to catch their prey.

Coral Reef

Coral Health: On a regional level, two-thirds of wider Caribbean reefs are said to be at risk from human activities (Burke & Maidens, 2004), a figure that has probably increased since that assessment. In general, reefs in Belize are perceived to be at slightly lower risk, due in part to the small human population, and relatively low levels of coastal development, and were once considered amongst the better reefs of the Caribbean. However, now they are generally on a par with, or slightly below, the rest of the Caribbean, with impacts from a combination of disturbance events (primarily hurricanes) and chronic stressors, leading to declining coral cover and increases in macro-algae (McField et al., 2008 (ed. Wilkinson et al., 2008)). There has been a general ecological shift towards algal dominance on reefs in recent years, attributed to several impacts including a combination of coral diseases (black, white and yellow band diseases), overfishing, the population crash of the herbivorous long-spined sea urchin *Diadema antillarum* and other environmental stressors such as, sedimentation and pollution (Liddell et al., 1986; Aronson et al., 1998). Overfishing of the herbivorous fish has also played a role in the decline of reef health, but more recently, global climate change (with increasing sea temperatures and UV levels) has been identified as the biggest contributing factor (Aronson et al., 2006), overlying all other stresses.

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

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

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

Diseases: Coral disease outbreaks are one of the single most devastating disturbances to coral reefs in the Caribbean and MAR in the recent past. Disease has always been a natural process in regulating populations, but the recent increased magnitude of disease and resultant mortality may be unique in the last several thousand years. Diseased organisms tend to thrive in higher temperatures, and some may also benefit from increased ultraviolet (UV) radiation. Both stressors (temperature and UV) may render host organisms more vulnerable to disease.

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

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

Healthy Reefs for Healthy People Initiative, 2007

No global bleaching event was recorded before 1979 (McField et al., 2007), with the Belize Barrier Reef experienced mass coral bleaching for first time in 1995 (McField, 1999). Since then, major bleaching events have been recorded with increasing frequency - in 1995, 1998, 2005, 2008 and 2009 - and are thought to be accentuated by increased acidification resulting from higher CO_2 levels (Anthony et al., 2008). The first bleaching event in 1995 resulted in large-scale bleaching of hard corals in Belize, especially *Montastraea annularis,* with bleaching of *Agaricia agaricites, Agaricia tenuifolia, Madracis* spp., and *Porites porites* also reported (McField, 2000), with partial mortality reported in 10% of corals throughout the country. Although data about the effect of the 1995 bleaching event is not available for Port Honduras Marine Reserve, the corals within the park would have undoubtedly followed the same trends, and been impacted by the bleaching, potentially resulting in the macroalgae dominated reef from 2003 onwards.

Coral reef, whether the patch reefs of the banks or the fringing reef of the Snake Cayes, provides a 3-dimensional habitat for fish and invertebrates. Live coral cover is a useful measure for coral reef health, and is used both nationally and throughout the wider MAR region. The average percent cover of live coral across sites in the Marine Reserve has increased between from less than 7% in 2003 to over 14% in 2009, indicating an increase in the health of the coral reefs (Foster / TIDE, 2009; Figure 18), despite national trends of decreasing coral cover. This may be the result of natural resiliency, which may be of benefit in the maintenance of coral cover in the face of climate change. Coral cover was shown to decline slightly between 2008 and 2009; however, this was not significantly different to the cover observed in 2008. Macroalgal cover showed a large increase between 2008 and 2009 indicating a possible decline in reef health. Associated with the low density of reef fish at many sites, an increase in macroalgal cover is a cause for concern

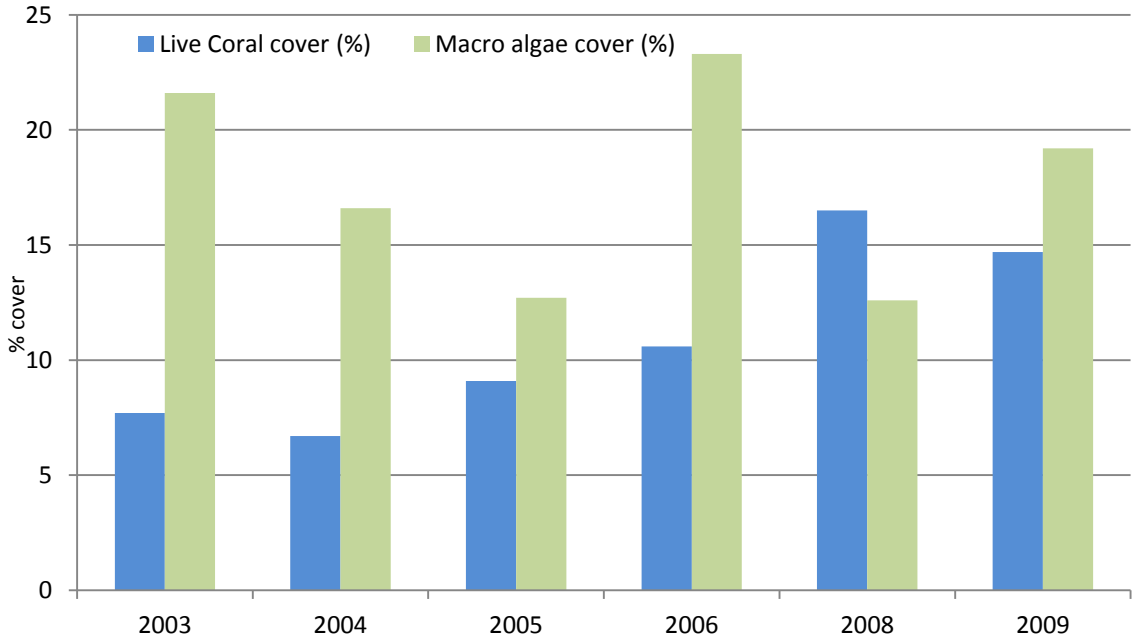


Figure 18: Average percent cover of live coral across sites in PHMR between 2003 and 2009.

Macroalgae cover fluctuated between 2003 and 2009 but has not shown any significant increase or decrease (Figure 18). A decline in macroalgal cover was observed between 2003 and 2005; however this was not maintained beyond 2006, possibly as a result of a region-wide mass coral bleaching event during 2005, increasing coral mortality and allowing macroalgal cover to increase in subsequent years. Given the decline in reef fish density in the Marine Reserve since 2003 (particularly grazers such as the parrotfish), macroalgal cover is unlikely to decline significantly until reef fish density increases. Low macroalgal cover is essential to allow space for settlement of coral recruits to the reef (Foster / TIDE, 2009).

Coral bleaching was observed at all six sites within PHMR during October 2009 while conducting national bleaching monitoring surveys coordinated by the Belize Coral Reef Monitoring Network. (Figure …), with three sites showing severe bleaching. The two most severely affected sites were East Snake Caye 2 and Middle Snake Caye, two of the shallowest sites surveyed. The site at Frenchman Caye was least affected by bleaching, with less than 10% of colonies exhibiting signs of bleaching. The percent of colonies affected by bleaching (pale, partial and whole) was notably less than that observed during the surveys 12 months previously in October 2008, 18% versus 48%, respectively (Figure 19). The lower number of colonies affected by bleaching in the October 2009 surveys suggests that bleaching was not as severe as in 2008, which was surprising given the higher water temperatures in 2009 compared to 2008 (Foster / TIDE, 2009).

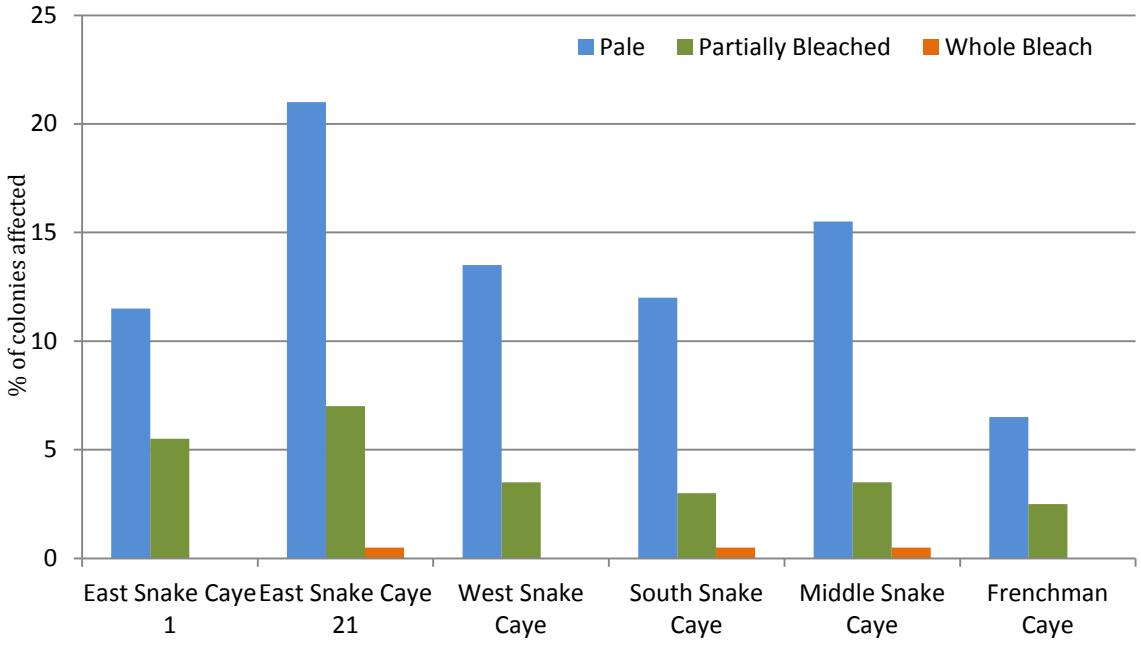


Figure 19: Percent of colonies affected by bleaching at sites within PHMR in October 2009.

An additional survey was conducted in mid-December 2009 that identified a reduction in the severity of bleaching and the number of colonies affected compared to the October 2009 survey (Figure 20). In December, the most severely affected sites were East Snake Caye 1 and East Snake Caye 2, with

approximately 16% of colonies showing bleaching. The percent of colonies affected by bleaching (pale, partial and whole) was lower than that observed during the October surveys, 11% versus 18%, respectively, indicating that the reefs are recovering from this bleaching event. Despite East Snake Caye 2 showing the highest level of bleaching during the December surveys, it was also the site showing the most recovery, with a decline from 57% of affected colonies in October to 15.5% of colonies affected in December (Foster / TIDE, 2009). The least affected site was South Snake Caye, with less than 6% of colonies exhibiting signs of bleaching.

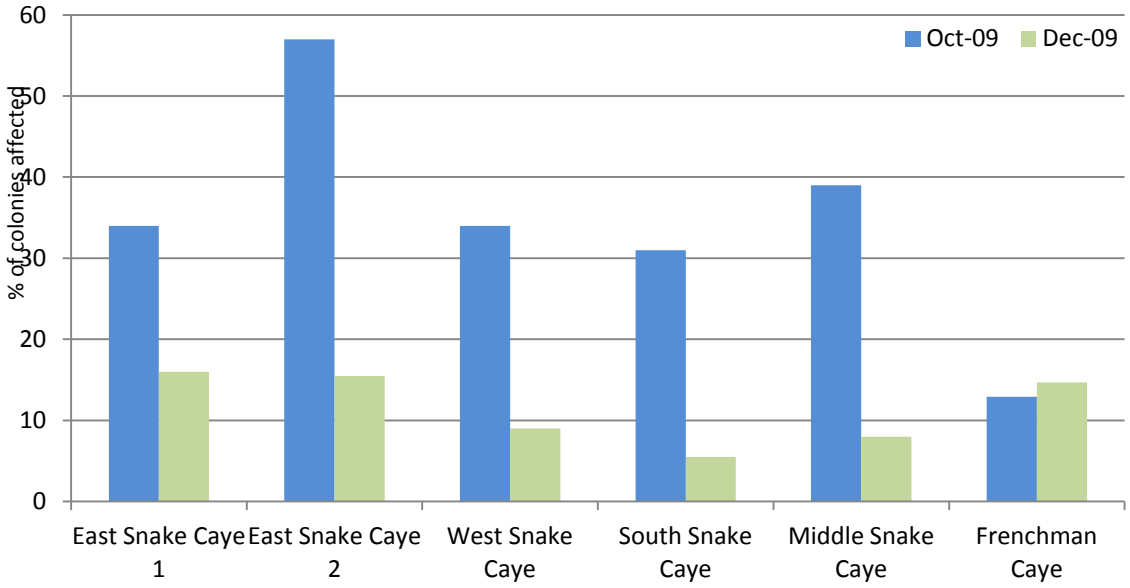


Figure 20: Percent of colonies affected by bleaching (pale, partial and whole bleach) at sites within PHMR in October and December 2009.

Reef Fish

Reef fish density declined at all sites in Port Honduras Marine Reserve between 2003 and 2009 (Figure 21). The largest decline was observed between 2003 and 2004, with little sign of recovery since. Increased fishing pressure within the Marine Reserve may have caused the decline in abundance as these reef species have become targeted more as the populations of traditional commercial species (e.g., snapper

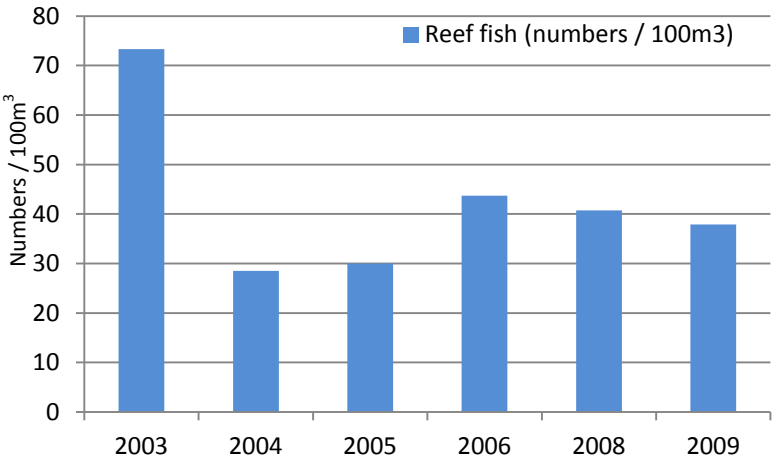


Figure 21: Average reef fish density across sites in PHMR between 2003 and 2009.

and grouper) have declined. The recent legislation banning fishing of herbivorous fish species will help to alleviate some of the pressure, and also assist in maintaining coral cover. Herbivorous fish, such as parrotfish, provide a fundamental role in maintaining the balance between coral and algal cover on reefs (Mumby et al. 2006) and maintaining healthy fish stocks is a key component in preventing phase shifts to algal dominated reefs (Hughes et al. 2007). A considerable decline in population numbers can be sufficient to allow a rise in macroalgal cover and subsequent decline in coral cover and reduced coral recruitment (Aronson and Precht 2000; Lirman 2001; Jompa and McCook 2002). The introduction of new regulations during 2009 prohibiting fishing of herbivorous species may have a positive impact on the fish populations within PHMR, and combining this with an increase in the no-take zones within PHMR would be a positive next step in enhancing fish populations and the associated coral reefs.

Commercial Species

The conch and lobster fisheries form the two most important components of the capture fisheries in Belize, with production representing over 90% of total capture fisheries production in 2008, and an export value of Bz$20.30 million (Ministry of Agriculture and Fisheries, 2009[1]). Lobster landings peaked in 1981 at 2,204,622 lbs, but fell to 457,680 lbs in 2006, with 511,389 lbs harvested in 2008 (tails and head meat combined), with a market value of Bz$13.8 million (Ministry of Agriculture and Fisheries, 2009).

It is significant to note that the general trend of total national lobster production over the period from 1981 to 2008 is a decline of almost 24%, and there are concerns for the continued sustainability of the lobster fishing industry if revised management mechanisms are not put in place. There has been continued optimism that lobsters are being harvested at a sustainable level (Gillet, 2003), there is also concern that the average size per lobster appears to be declining, and the catch per fisherman is no longer sufficient to support a fisherman and his family (anecdotal reports, Monkey River community meeting, 2011).

As with lobster, national conch landings have declined significantly, peaking at 1,239,000 lbs in 1972, and subsequently declining by over 50% to 574,756 lbs in 2008 (Ministry of Agriculture, 2008). It has been suggested that the maximum sustainable yield for this species was reached in 2006, with the steep decline of 17% observed in 2007 serving as an indication of the “maturity” of the fishing industry, and the possible overfishing of this fishery resource (Ministry of Agriculture and Fisheries, 2007).

Even as far back as 1996, there was evidence that fishing pressure was too high, with the national population consisted primarily of juveniles, resulting in recommendations for capping of the number of fishermen. Strict regulations and quotas are now being implemented towards more sustainable use of this resource, and an increase in production was noted in 2008 (Ministry of Agriculture and Fisheries, 2009), though the number of fishermen has still not been capped.

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

The two major fisheries species of PHMR, queen conch and spiny lobster, have shown minimal recovery since the implementation of the monitoring program in 2003 and 2004. There are indications that the populations may be improving slowly, however comparison of numbers between no-take zones and general use zones, and monitoring times are highly variable.

During the conservation planning process, littoral forests, mangroves, seagrass beds, coral reef communities, commercial and recreational species and large marine vertebrates were identified as conservation targets. Where an ecosystem/habitat is specified all species associated with the ecosystem are included as part of the conservation target.

2.5.4 Past and Present Research

Past Research

A number of studies have been conducted in and around the Port Honduras area since the 1960's (Stoddart, 1960; High, 1966; Wetland & Pukey 1971; Perkins, 1983; Zisman, 1992). However, studies focusing directly on Port Honduras only began in 1990 with the Critical Habitat Survey. This study highlighted Port Honduras Marine Reserve as an area of unique bio-geographical occurrence in Southern Belize.

Under the PACA Project the Port Honduras / Punta Ycacos area was the subject of two “rapid ecological assessments” (REAs) lead by The Nature Conservancy’s (TNC) Florida and Caribbean Marine and Conservation Science Centre and included participation from the Government of Belize, NGOs, and Community Based Organizations (CBOs) participation. The first REA was conducted in May 1993, and focused on the mangrove communities and tidal wetlands of the areas around the Punta Ycacos (or Still Water) Lagoon that drains into Port Honduras Marine Reserve but is actually within the Payne’s Creek National Park. This work was conducted by ground truthing a SPOT Satellite imagery of the area.

In 1994, a second REA was conducted within the Port Honduras itself addressing, to a varying extent, the areas of oceanography and coastal hydrology, fisheries, benthic community ecology, and some further mangrove studies. The assessment of the Gulf of Honduras benthos was assisted by Coral Caye Conservation (CCC) which led the expedition for the area surrounding the Snake Cayes. The results of both REAs, including the assessment of the Snake Cayes area, are documented in the report "Site Characterization for Integrated Coastal Management: Ecology, Oceanography, and Geography of Port Honduras, Belize - a proposed marine protected area" (Sullivan et al. 1995), and the fish species list is included (Annex 4).

Other research conducted in the Port Honduras include: a number of papers drafted by W.D. Heyman of TNC on seagrass and mangrove productivity studies (Heyman 1996); an assessment of climate and hydrology of Port Honduras (Heyman & Kjerfve 1999), and a survey of the perceptions of fishers who use Port Honduras (Heyman and Hyatt, 1996). W. D. Heyman produced a dissertation as partial

fulfilment of the requirements for the Degree of Doctor of Philosophy in the Marine Science Programme at the University of South Carolina (Heyman 1996). Dr. Heather Mckillop has done more than a decade worth of research on the archaeology of Port Honduras.

Present Research

The present research being conducted within Port Honduras Marine Reserve includes the biological monitoring Programme. The Biological Monitoring Programme for the Port Honduras Marine Reserve, established in 2004, has continued to grow and expand, and now provides an ecosystem-based approach to the management and conservation of the natural resources within PHMR, based on the TIDE Monitoring Plan (Foley, 2011). At present, the monitoring programme incorporates the following activities:

- Water quality (temperature, salinity, dissolved oxygen, conductivity and turbidity) is measured at 17 sites across PHMR on a monthly basis
- *Strombus gigas* and *Panulirus argus* populations are surveyed at 16 and 12 sites, respectively, at the start and end of the closed seasons
- Benthic cover, coral health and reef fish populations are assessed twice a year at eight sites
- Seagrass beds (species percent cover, density, grass height, grazing evidence) are assessed at two sites on a quarterly basis
- Mangrove community structure and productivity are surveyed at one site on an annual basis.
- Bleaching surveys are conducted when necessary in conjunction with the Belize Coral Reef Monitoring Network

Since January 2009, a fisheries stock assessment has been implemented for all finfish species, *S. gigas* and *P. Argus* populations, utilising catch landings at local markets in Punta Gorda and Monkey River and the Rio Grande Fisheries Cooperative in Punta Gorda. In addition,

Moreover, as of 2008, an adaptive management approach has been adopted for PHMR and the data collected during past and current surveys are being analysed and fed back into the management of the reserve in order to assist in prioritising Monitoring and Research areas and activities. The analysis of the data and incorporation of the information into management has led to a more integrated approach to the conservation of PHMR, and is greatly assisting in the revision of the Management Plan for the reserve. Furthermore, with intermittent data sets extending as far back as 1995, when Sullivan et al (1995) completed their first surveys, a detailed picture of changes within the ecosystems and populations of PHMR is being constructed, with a view to assessing the effectiveness of PHMR and its no-take zones. The Biological Monitoring Programme is critical to the management and conservation of the ecosystems and populations within PHMR. Regular data collection allows any changes or fluctuations from baseline trends to be identified and investigated further, if required.

In addition to the biological monitoring Programme, research is being conducted within PHMR by a variety of national and international researchers. Queen conch and spiny lobster population studies are conducted annually by the Fisheries Department of Belize. Dr Rachel Graham (Wildlife Conservation Society) continues to monitor and research Goliath Grouper and whale shark populations and movements within Port Honduras Marine Reserve and the Mesoamerican region. Dr Will Heyman and students from his research group at Texas A&M University in Texas continue to conduct a variety of studies within PHMR related to mangroves, fisheries and GIS aspects. Dr John Bruno and students from his research group at South Carolina University, and Dr Les Kaufman and Dr Burton Shank from Boston University, continue to conduct research within PHMR, most recently under the Conservation International Marine Managed Areas Science Programme.

2.6 Cultural and Socio-Economic Values of Management Area

2.6.1 Commercial Use

Residents of Monkey River, Punta Negra, Punta Gorda and nearby communities and the Port Honduras cayes use the Port Honduras Marine Reserve for small-scale commercial fisheries, mainly for Caribbean spiny lobster (*Panulirus argus*), queen conch (*Strombus gigas*) and some finfish species. In 2005, the total annual value of the PHMR fishery was estimated at BZ$889,906.00 (Coleman & Diamond 2005). The most productive fishery within PHMR in economic terms is for lobster, (caught with nets, traps and by diving) generating an estimated BZ$506,638.00 per year (57% of the total value of the PHMR fishery) (Coleman & Diamond 2005). Lobsters are caught mainly on the deep-water banks associated with the Snake Cayes.

Historically, lane snappers have been the most abundant fish caught in Port Honduras Marine Reserve (Coleman & Diamond 2005), and a fisheries stock assessment of PHMR conducted by TIDE from 2009 to the present has shown that this is still the case (Figure 22). Mutton snapper, silk snapper, snook, dog snapper and goliath grouper are also listed within the top ten finfish species caught within Port Honduras Marine Reserve.

1996 Baseline: Ten years ago, the most productive fishery in economic terms was for lobster, generating an estimated 50,000 pounds (BZ$900,000) per years (Heyman and Hyatt, 1996). The lobster are caught with nets, traps and by diving, mainly on the deep-water banks associated with Snake Cayes, but are also within Port Honduras. Approximately 97% of surveyed local fishers in 2000 believed that populations were declining and blamed over fishing, lobster nets, out of season fishing, and transboundary fishing incursions as causes for the apparent decline (Heyman and Hyatt, 1996).

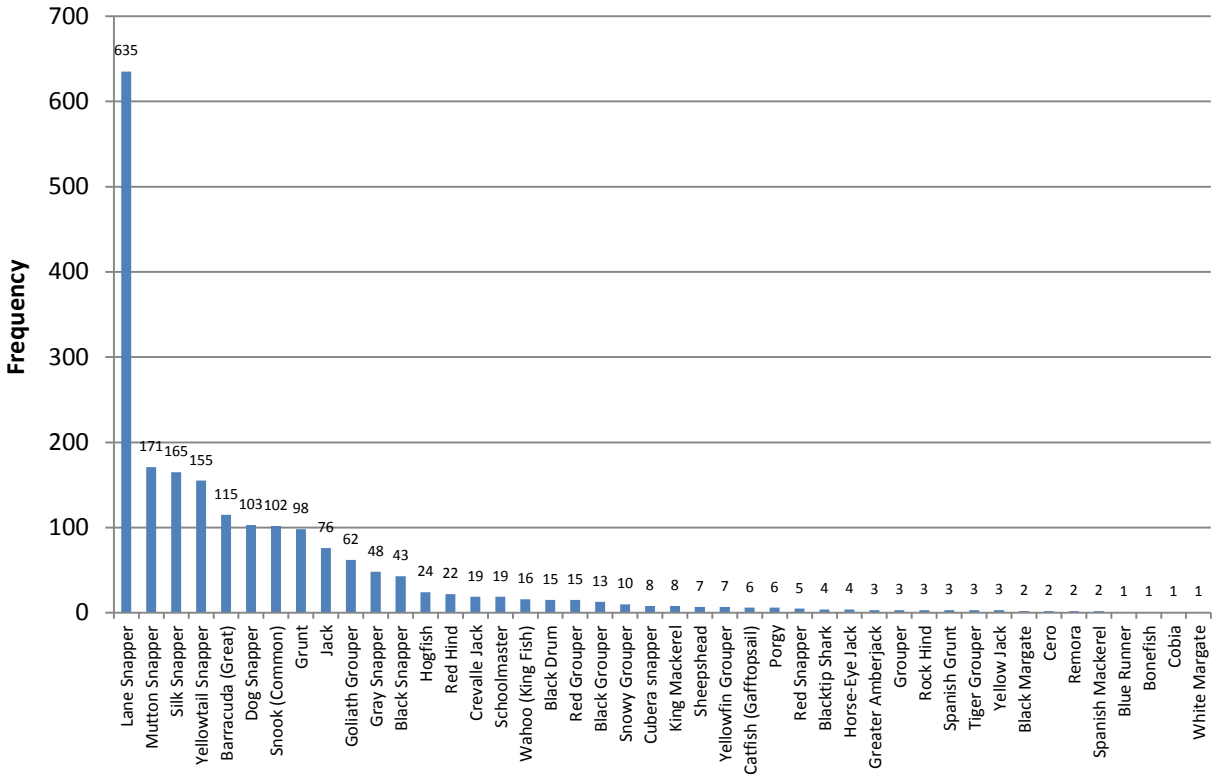


Figure 22: Frequency of finfish species landed by fishers from the Port Honduras Marine Reserve, March 2009 to June 2010.

Lane snappers were the most abundant fish caught in Port Honduras and the most selected local fish for the table. Nearly 95,000 pounds were landed annually, largely with hand lines. According to fishermen surveys, an estimated 150,000 pounds of mackerel and jack, caught largely with gill nets, were also harvested annually from Port Honduras (Heyman and Hyatt, 1996). There was also a significant catch of barracuda, snook and Goliath grouper ('jewfish') from Port Honduras. At that point, fishers believed that snook had been drastically depleted by gill nets near river mouths and along the coast (Heyman and Hyatt, 1996). Goliath grouper were still relatively abundant, but their mean size at harvest had fallen sharply. These fish reached local markets but were also shipped to Belize and often exported illegally depending on quantity and harvest times.

Conch were targeted by local fishers but catches were reported to have declined to a small fraction of their former abundance. Local fishers again cited transboundary incursions (often out of season and undersized) in Belizean territorial waters as the cause.

Trends

Conch: The average number of conch observed in PHMR gradually increased between 2004 and 2008, but showed a decline between 2008 and 2009 (Figure 23). Initially, no difference was observed in the numbers of conch between the general use zone and no-take zones; however, since 2008 numbers of conch in the no-take zones have been higher. The results do not show any significant increases in the numbers of conch over the years, or any significant differences in the numbers of conch between the zones. However, there are positive signs that the no-take zones may be having an effect and any increase in the area of this zone during 2010 would further benefit the conch population in PHMR (Foster / TIDE, 2009).

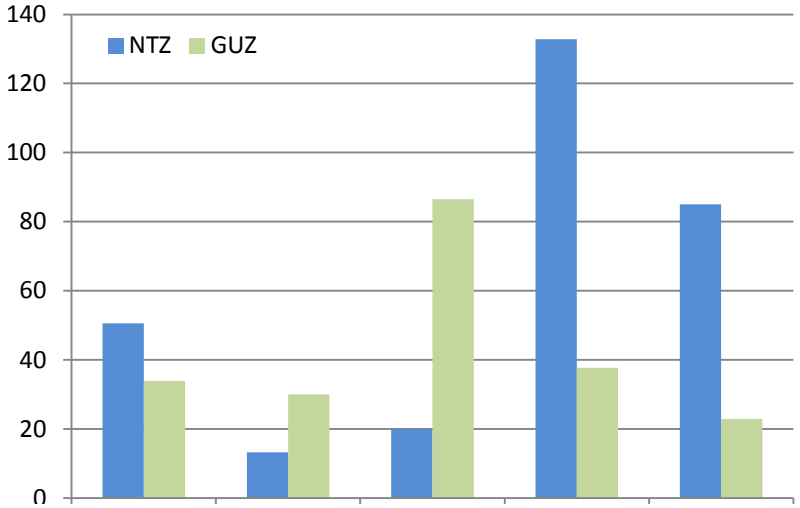


Figure 23: Average numbers of conch (+ 1 SE) across sites surveyed in PHMR between 2004 and 2009 in the General Use Zones (GUZ) and No Take Zones (NTZ).

Lobster: The average number of lobsters observed in PHMR gradually increased between 2003 and 2009, with a slight decline between 2006 and 2008 (Figure 24). The numbers of lobsters observed in the no-take zones are marginally higher than that observed in the general use zones, but this difference is not statistically significant. In addition, the results do not show any significant increases in the number of lobsters in PHMR since 2003 indicating that the no-take zones are having minimal effect on the lobster population.

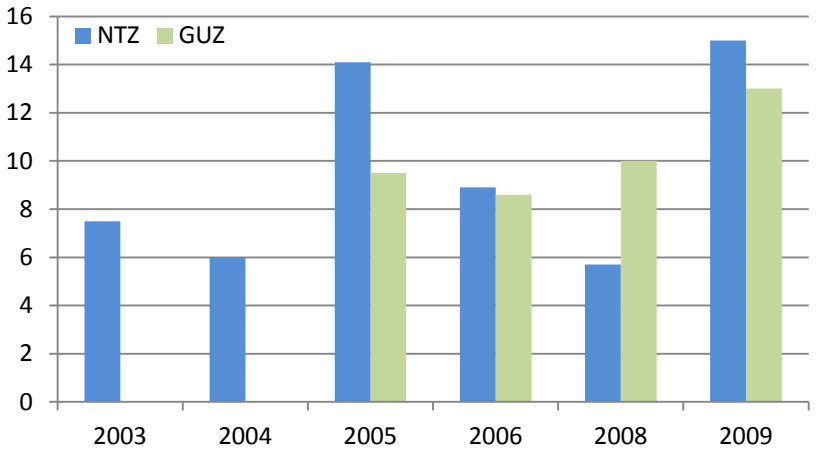


Figure 24: Average numbers of lobster (+ 1 SE) across sites surveyed in PHMR between 2003 and 2009 in the General Use Zones (GUZ) and No Take Zones (NTZ).

2.6.2 Archaeological Sites

The Port Honduras Marine Reserve and surrounding area has been the subject of archaeological investigation for over 30 years by Dr. Heather Mckillop (Louisiana State University). Several archaeological sites have been identified and reported in her numerous publications (McKillop 1984, Jackson & McKillop 1987, McKillop 2005, Seidemann & McKillop 2007). These include a trading post at Wild Cane Caye, settlements at Frenchman's Caye, salt production ponds at Stingray Lagoon of Punta Ycacos, and underwater sites of Green Vine Snake Caye and Pork-and-Doughboy Point.

2.6.3 Recreation and Tourism Use

Overview of the Tourism Industry in Belize

The developing tourism industry, one of the fastest growing sectors in Belize, is rapidly becoming the major foreign exchange earner, with over 840,000 tourists arriving in Belize in 2008 (BTB, 2009). Tourism is the third ranking productive sector in Belize, contributing 28.2% (Bz$816.3mn) in 2009, with projections suggesting that this will increase to 31.4% (Bz$1,601.2mn) by 2020. The tourism sector provided an estimated 34,000 jobs in 2009, 28.3% of total national employment or 1 in every 3.5 jobs. This is predicted to increase to 53,000 jobs, 31.6% of total employment or 1 in every 3.2 jobs by 2020 (WTTC, 2010).

Overnight tourism in Belize shows a distinct seasonality, with the majority of visitors arriving in the first quarter of the year. The lowest months are September and October, the main tropical storm season (Figure 25).

Port Honduras Marine Reserve attracts primarily day visitors providing employment opportunities for local guides and tourism developments on the mainland. There are also a smaller number of visitors accessing PHMR through "barefoot" boat charters. In addition to visitors from Belize, the Marine Reserve also receives visitors from the neighboring countries of Guatemala and Honduras, particularly during the Easter holiday.

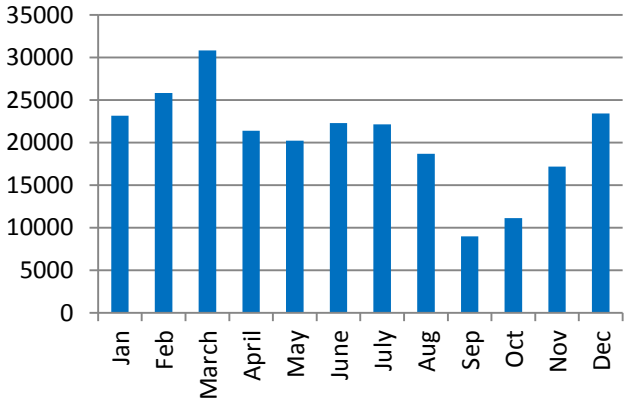


Figure 25: Belize International tourism arrivals per month

Recreation, Tourism, and Existing Use of Port Honduras Marine Reserve

In managing the Port Honduras Marine Reserve, priority is given to the preservation of biodiversity and ecosystem function. Recreation and tourism occupations are promoted as an alternative non-extractive use of the resources for income generation and based on the promotion of ecologically sound practices.

Present usage of Port Honduras Marine Reserve for tourism and recreation is currently low impact compared with similar nearby locations such as Sapodilla Cayes Marine Reserve and Placencia, which are extensively used for tourist purposes. The areas of high tourism activity and future potential have been identified as Frenchman's Range to Moho Caye, South Snake Caye and West Snake Caye, New Haven and Punta Ycacos Lagoon (Avila et al., 2005). Present tourism and recreational usages of Port Honduras Marine Reserve include key site specific activities.

The primary area for snorkelling and SCUBA diving activities in Port Honduras Marine Reserve is on the fringing reefs around the northern and southern points of West Snake Caye. Other good snorkelling and diving areas can be found on the patch and fringing reefs associated with the outer cayes. Visibility however is sometimes poor due to the large amount of freshwater input from the watersheds during high rainfall.

Kayaking is popular within the Marine Reserve, focused on the Snake Cayes and the Moho and Rio Grande Rivers. Private sailing boats use the waters of southern Belize, and the potential for an increase in sailing is high when considering both the general worldwide trend of increasing popularity. The close proximity of the Port Honduras Marine Reserve makes the area a popular sailing destination from Rio Dulce, Guatemala, and marina facilities at Orange Point, Punta Gorda, and Placencia Village.

Two cruise ships carrying between 20 and 85 passengers currently visit the cayes within Port Honduras Marine Reserve on a regular basis with landings off West Snake Caye and Punta Gorda Town. One company markets its cruise as an eco-tourism tour and offers natural history educational lectures on board.

Sport fishing is defined for management purposes as catch and release or tag and release fishing of target species, whereas recreational fishing is extractive fishing for enjoyment and consumption but not subsistence. Sport fishing has gained in popularity in Belize since the establishment of PHMR in 2000, and PHMR is now regarded as one of the prime fly fishing sites where the 'grand slam' can be achieved. Healthy stocks of targeted species (tarpon, permit, and bonefish) are prevalent in PHMR. A resource valuation study conducted in 2005 found that fly-fishing guides out of Punta Gorda generated an estimated annual profit of $237,359 US (Coleman & Diamond 2005). Despite the findings of Coleman & Diamond (2005), Padilla Plaza & Ferguson (2010) found no fishers working exclusively as sports fishers, while 17% of respondents worked both as commercial and sports fishers simultaneously. In 2009, the percentage of trained guides supported solely through sport fishing was demonstrated to have fallen to 0%, with only 17% of respondents practicing sport and commercial fishing simultaneously (Padilla Plaza

& Ferguson III, 2010). This decline from 2004 to 2009 may be due to the domination of the industry by a small number of key guides/tour operators.

Swimming, sunbathing and general relaxation are common activities enjoyed by both local residents and tourists within PHMR, with the majority of these activities taking place on the cayes. Fourteen of the cayes in Port Honduras Marine Reserve have higher elevation areas suitable for on-land visitation. Attractive beach areas are accessible on West Snake Caye, Abalone Caye, South Snake Caye, and Moho Caye. West Snake Caye, with over 190 feet of shifting beach, is the most frequently visited.

The value of Port Honduras Marine Reserve in terms of its natural abundance of flora and fauna has been underestimated in the past. However, in more recent years specific nature oriented tours, e.g., manatee sighting, have become more widely available. Specific sites of interest include the mouth of the Deep River, with its aesthetic beauty, numerous orchids, bird life, and manatees; the nesting sites of frigates, herons, white ibis, pelican and brown bodies at Bird Caye; and manatee watches within Punta Ycacos lagoon. Trips up Monkey River, Moho River and Rio Grande have become well established in the past ten years with tours operating out of Placencia and Punta Gorda, and local tour guides.

2.6.4 Educational Use

Past, Present and Potential Education Use for PHMR

Education use in TIDE has been a priority from the beginning, and has evolved into an active and successful Programme that reaches everyone in the Toledo district, from children to elders. TIDE engages buffer communities in education and outreach activities through the Environmental Education and Outreach (EEO) Programme, seeking to enable people to become active custodians of the natural resources in and around their communities. The Programme activities are developed to heighten the awareness and understanding of adults and children in local communities of natural resource protection and sustainable use. The EEO Programme is highly interactive and promotes activities that connect leaders, teachers and the wider community to a variety of learning experiences such as classroom presentations, team sports, community outreach and field trips.

EEO is a dynamic programme that is focused on producing positive change in its recipients, borne out of the need to protect critical marine and terrestrial ecosystems, that if destroyed could further impoverish the communities of the Toledo District. Through environmental education, TIDE seeks to create awareness and knowledge of critical ecosystem, leading to reduced threats to the natural resources within PHMR and surrounding areas.

The target audiences for the EEO are principals and administrators, teachers, young people, community leaders and community members. Each is individually significant to the EEO Programme.

- ***Principals and administrators***
    - Principals and administrators are supportive of TIDE's EEO Programme and recognise that the Programme helps schools to promote environmental awareness and responsibility among young people.

- ***Teachers***
    - Teachers are one of TIDE's primary partners in the EEO Programme and form a critical link between TIDE and the younger generations.

- ***Youths***
    - The participation of youths in TIDE's environmental education and outreach Programmes is done through the Freshwater Cup junior football tournament, summer camp activities and school presentations.

- ***Community Leaders***
    - Community leaders are an integral part of TIDE's EEO, and form the link between TIDE and the communities.

TIDE has established a number of educational programmes for both adults and children that have been very successful in raising awareness of marine conservation and getting community members involved in environmental projects, enforcement activities and the monitoring Programme. The most recent Programme is the Community Stewards Programme, which has seen 15 participants selected from the buffer communities of Monkey River, Punta Negra, Punta Gorda, and San Marcos, brought together each month to receive training and information regarding the management of TIDE's three protected areas and the Maya Mountain Marine Corridor. The training has included terrestrial and marine ecosystems, computer skills, fire management, marine laws and terrestrial laws, GPS handling training, communication skills and an educational exchange with protected areas in Guatemala. In addition, the Stewards have been educated about the threats faced by the ecosystems of the Toledo district, the benefits of conserving these ecosystems for future generations and how to convey this to their communities. Through feedback from current participants, the Programme has provided them with a wealth of information on PHMR and TIDE's other protected areas. However, the information was much more detailed than previously provided which has enabled the stewards to further understand the reasoning behind TIDE's work and the laws that are in place within the protected areas. The Programme has provided the Stewards with a sense of pride and ownership of the natural resources, and provided them with the

knowledge, skills and tools to increase awareness about conservation within their communities. Furthermore, the Stewards feel empowered to educate other community members on how they too can play a role.

A more long-running Programme that incorporates adults and children in conservation activities is the Freshwater Cup, which takes place every year. Adults and children from within the buffer communities of TIDE's protected areas are invited to form a soccer team and in order to enter the league each team must also submit plans for an environmental project related to marine, terrestrial or freshwater conservation. Each project is assessed by TIDE and the teams receive guidance in the implementation of these projects. In the past, projects have included beach and underwater cleanups and planting of trees along the riparian buffer zone. To successfully compete in the league, the environmental projects must be underway prior to the start of the soccer league. Teams compete in the adult and junior leagues throughout May and June, and the Programme culminates in a grand final at the end of June. First, second and third place teams from each league win cash prizes for their respective communities or schools and prizes in recognition of their environmental projects. The Freshwater Cup Programme has won international recognition from UNESCO and funding from the Social Investment Fund for the 2009 Programme.

Since 2007, TIDE have also organised an annual Youth Conservation Contest, with local organisations being invited to participate in the contest, which focuses on a different theme each year (e.g., coral reefs in crisis, climate change, importance of biodiversity). Each organisation must select a candidate, a final year student from any school within Belize, and assist that candidate in preparing a short sketch and presentation related to the theme of the event. All candidates are invited to Punta Gorda for the contest, which is held in the local Parish Hall. Each candidate performs on stage and judges, selected by the various organisations participating, score the students based on various criteria. First, second and third place winners are awarded a scholarship for college. Each year, over 350 people from local communities turn out to watch the students perform and also to learn about different environmental problems and projects that are affecting the marine environment in Belize.

3. ANALYSIS OF CONSERVATION TARGETS AND THREATS

3.1 Conservations Targets

3.1.1 Identification of Conservation Targets

Four conservation targets were identified during the CAP planning for the Maya Mountain Marine Corridor Conservation Action Strategy as directly related to Port Honduras Marine Reserve:

- Coral reef communities
- Near shore estuaries
- Seagrass beds
- Large marine vertebrates

An additional target is also included to ensure full coverage of biodiversity within the marine protected area:

- Commercial and recreational species

These conservation targets form the basis for conservation planning for Port Honduras Marine Reserve. A justification is given for each conservation target, and identification of the key nested species, communities and ecological systems (Table 13).

Conservation Target	Justification for Target	Species, Communities or Ecological Systems represented by target
Conservation Target 1 Coral reef communities	Coral reef communities are an important ecosystem within PHMR, with a rich diversity providing habitat, feeding areas, and shoreline protection, as well as enhancing tourism, and supporting many endangered species	Coral reef communities and all associated reef species (reef fish, gorgonians, sponges, etc)
Conservation Target 2 Commercial & Recreational species	Commercial species provide an important livelihood for local fishers, recreational species are very important for tourism, some of these species are endangered	Conch, lobster, commercial finfish (grouper, snapper, snook, etc), recreational species (permit, bonefish, tarpon), sea cucumber, sharks
Conservation Target 3 Littoral forests/sandy beaches/Mangroves (near shore estuaries)	Littoral forests and mangroves are important nursery, nesting and feeding areas, and provide critical coastal functions (e.g., prevention of erosion, storm damage, trapping sediment from rivers). Beaches are important nesting areas for turtles and they are also an important tourism attraction	Littoral forest sp., mangroves, sandy beaches, turtles (nesting), migratory bird species.
Conservation Target 4 Seagrass beds	Seagrass beds are an important habitat within PHMR, providing feeding and nursery areas that support turtles, manatees, and juveniles of many fish and invertebrate species. In addition, seagrass beds play a crucial role in filtering sediment from water.	Seagrass beds, manatees, turtles, juvenile fish and invertebrate species
Conservation Target 5 Large marine vertebrates	Large marine vertebrates are important key stone species within PHMR, playing crucial roles within the food chain attracting tourism. Some large invertebrates are endangered species	Dolphins, whales, sharks, turtles, manatees,

Table 13: Conservation Target selection and justification for Port Honduras Marine Reserve

3.1.2 Assessment of Conservation Target Viability

In order to assess the status of conservation targets over time and to determine if the management strategies and actions are working, each target is assigned a viability ranking based on a number of criteria (Walker & Walker, 2005).

- **Size** is a measure of the target's area or abundance, based on the minimum requirement needed to ensure survival after natural disturbance.

- **Condition** is an integrated measure of community composition, structure and biotic interactions (e.g., structure, population components etc.).

- **Landscape context** is an integrated measure of two factors – key elemental processes that sustain the species or ecosystem, and connectivity.

Each target is designated a current rating (Table 14) and the goal that is hoped to be achieved within the time frame of the five year management plan. Indicators are selected that can be used to measure progress (Table 15).

Conservation Target	Size	Condition	Landscape Context	Overall Viability Rating
Coral Reef Communities	Fair (2.5)	Fair (2.5)	Poor (1.0)	Fair (2.0)
Commercial and Recreational Species	Fair (2.5)	Poor (1.0)	Fair (2.5)	Fair (2.0)
Littoral forests/sandy beaches/Mangroves (near shore estuaries)	Good (3.5)	Good (3.5)	Good (3.5)	Good (3.5)
Seagrass beds	Very Good (4)	Very Good (4)	Good (3.5)	Very Good (3.8)
Large marine vertebrates	Fair (2.5)	Poor (1.0)	Fair (2.5)	Fair (2.0)

Overall Viability Rating

Very Good: Viability criteria at or above desired future status
Good: Viability at or above minimum threshold for biological integrity
Fair: Viability criteria at or above a minimum restorable level
Poor: Viability criteria below minimum restorable status (probably unrecoverable)

Table 14: Matrix for Viability Ranking for Selected Conservation Targets (based on TNC CAP)

Only one target, seagrass beds, rates as **Very Good**, and one target rates as **Good** – Littoral Forest /Sandy Beach / Mangroves. The remaining three targets rate as **Fair**.

Conservation Target	Current Rating	Goal	Justification for Rating, Goal and Indicator
Conservation Target 1 Coral reef communities	**Fair (2.0)**	**Good**	**Goal**: To return coral reef ecosystems in PHMR to a healthy state providing a range of functions and services.
			Indicators: % coral cover, % macroalgal cover; reef fish density;
Conservation Target 2 Commercial & recreational species	**Fair (2.0)**	**Good**	**Goal**: To return abundance of commercial and recreational species to optimum by reducing fishing pressure in PHMR.
			Indicators: Numbers of patrols where illegal fishing is reported in PHMR; number and size of fish species recorded during market and underwater surveys.
Conservation Target 3 Littoral forests/ sandy beaches/ Mangroves (near shore estuaries)	**Good (3.5)**	**Good**	**Goal**: To maintain littoral forests and mangroves in a healthy state to ensure they perform critical functions by preventing illegal deforestation and clearing along the coastline and cayes within PHMR. To maintain healthy beaches, free of debris, for turtle nesting and tourists in PHMR.
			Indicators: Extent of intact mangroves and littoral forests along coast and on cayes within PHMR; number of turtle nests on beaches within PHMR.
Conservation Target 4 Seagrass beds	**Very good (3.83)**	**Very good**	**Goal**: To maintain healthy seagrass beds throughout PHMR to ensure they perform critical functions, including as nursery areas and feeding grounds.
			Indicators: Extent and health of seagrass beds within PHMR.
Conservation Target 5 Large marine vertebrates	**Fair (2.0)**	**Good**	**Goal**: To return numbers of large marine vertebrates to optimal levels by reducing fishing and hunting pressure, and habitat loss within PHMR.
			Indicators: Numbers of patrols where illegal fishing is reported in PHMR; number of large marine vertebrates per species recorded during monitoring surveys within PHMR.

Table 15: Conservation Targets Assessment – goal and indicator for viability rating

3.2 Threats to Biodiversity

As well as issues such as unsustainable fishing, common to all the marine protected areas in Belize, Port Honduras Marine Reserve also faces a number of impacts outside the control of the site-level and management body. The greatest impacts come from climate change, a major overarching threat facing the majority of marine protected areas of the Caribbean today, as is evidenced by increased incidence of mass coral bleaching over the past 20 years. More localised impacts have also been identified during the MMMC (2008).

Threats to Port Honduras Marine Reserve

- **Hunting/Fishing pressure**
- **Climate change – temperature**
- **Land use change in the watershed**
- **Coastal development (including dredging and land clearance)**
- **Habitat destruction from mangrove loss**
- **Human population increase, expanding human settlements and local migration**
- **Destructive fishing practices**
- **Diseases affecting coral reef communities**
- **Agrochemical contamination of water**
- **Oil exploration / extraction**

Maya Mountain Marine Corridor

This suite of high ranking threats has direct impacts on the ecosystems of the MMMC. For example, wildfires not only change the character and species composition of forests, but they also initiate erosion and the leaching of nutrients thus affecting streams, rivers and ultimately, Port Honduras Marine Reserve.

Under the Status of Protected Areas assessment, TIDE identified the four highest threats for Port Honduras Marine Reserve as:

- Climate Change
- Transboundary Fishing Incursions
- Overfishing / Unsustainable fishing practices
- Inappropriate land use / Unsustainable development

Also included within this assessment as a growing threat are invasive species – focused on the lionfish (Walker and Walker, 2010).

Rating Critical Threats

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

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

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

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

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

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

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

Threats to biodiversity of Port Honduras Marine Reserve / 1				
Climate Change	***Status:***	***Historical***	***Active***	***Potential***
	Conservation Target(s): All			
	Threats (*Direct*)*:* ▪ Reduced live coral cover ▪ Erosion of beach ▪ Reduction in extent of littoral forest, herbaceous beach vegetation and mangrove ▪ Ecological shifts in benthic communities ▪ Reduced biodiversity ▪ Reduced coral growth rates			
	Source (Indirect Threat)***:*** ▪ Increased water temperatures ▪ Increased storm events / hurricanes ▪ Sea level rise ▪ Changes in currents ▪ Ocean acidification ▪ Removal of herbivorous species through illegal fishing practices			
	Area	***4***	Climate change is a global phenomenon, and is affecting biodiversity throughout the Marine Reserve	
	Severity	***3***	The impacts of climate change are currently being felt at PHMR through increased bleaching and storm events, and it is expected that the severity and frequency of these events will increase over the coming years	
	Urgency	***3***	Although the effects of climate change are occurring over an extended time period the cumulative effect of this stressor poses significant risk to a wide range of species and ecosystems	
	Management Goal: Continue to implement adaptive management strategies that focus on identifying and maintaining resilient ecosystems ***Management Strategies:*** **Strategy 1:** Identify resilient coral species and areas within PHMR **Strategy 2:** Identify coral recruitment sources for PHMR, and identify mechanisms to ensure that these are adequately protected, if necessary **Strategy 3:** Identify and understand water currents critical for coral and fish recruitment **Strategy 4:** Ensure adequate protection of key herbivores for maintenance of live coral cover and ecological functions **Strategy 5:** Reduce local anthropogenic threats through community engagement and awareness programmes, and effective enforcement **Strategy 6:** Work closely with national and international partners to monitor climate change effects and identify appropriate national and regional management strategies and responses			

Threats to biodiversity of Port Honduras Marine Reserve / 2				
Unsustainable Fishing Pressure	***Status:***	***Historical***	***Active***	***Potential***
	Conservation Target(s): Coral Reef Communities, Commercial and Recreational Species; Large Marine Vertebrates			
	Threats (*Direct*)*:* ▪ Reduced commercial / recreational fish populations ▪ Reduced coral reef health (reduced herbivorous fish populations) ▪ Regime shifts and disruption of the trophic structure			
	Source (Indirect Threat)***:*** ▪ Low income in local stakeholder fishing communities ▪ Increase in the number of fishermen ▪ Traditional occupation ▪ Poor fishing practices (fishing out of season, harvesting of undersized product, use of gill nets) ▪ Market for illegal product (out of season / undersized) in Belize and transboundary ▪ Small size of zones for spill-over effect ▪ Increasing fishing pressure and market demand from Jamaica and other CARICOM nations, and Guatemala and Honduras			
	Area	***4***	Unsustainable marine resource extraction occurs across the General Use Zone	
	Severity	***2***		
	Urgency	***3***	It is happening now	
	Management Goal: Maintain sustainability of the commercial, recreational and subsistence species ***Management Strategies:*** **Strategy 1:** Ensure PHMR has the human resources, equipment and training for effective surveillance and enforcement, with effective data management **Strategy 2:** Investigate and implement managed access and other mechanisms for increasing benefit for traditional users **Strategy 3:** Strengthen collaboration between TIDE and Fisheries Department, with clear designation of roles and responsibilities **Strategy 4:** Collaborative enforcement (fishermen, TIDE, Fisheries Dept., SEA Coastguard, BDF, Police Dept. Customs etc.) against transboundary incursions both within and outside the MPA **Strategy 5:** Collaborate with SEA to strengthen Special Enforcement Team **Strategy 6:** Increase awareness of best fishing and tourism practices among immediate resource users **Strategy 7:** Support initiatives to strengthen the judiciary system and increase penalties for infractions			

Threats to biodiversity of Port Honduras Marine Reserve / 2	
Unsustainable Fishing Pressure	**Strategy 8:** Increase capacity and skills of staff for arrest procedures and handling of evidence **Strategy 9:** Identify and implement mechanisms to reduce local dependence on marine resources, targeting those communities most impacting the Marine Reserve **Strategy 10:** Continue to work closely and lobby with Government at the national level to develop and implement effective mechanisms towards a sustainable fishing industry **Strategy 11:** Collaborate with WCS to increase awareness of non-consumptive (tourism and ecosystem) value of elasmobranchs (sharks and rays)– targeted at fishermen in stakeholder communities

<table>
<tr><th colspan="5">Threats to biodiversity of Port Honduras Marine Reserve / 3</th></tr>
<tr><td rowspan="7">Transboundary Fishing Incursion</td><td>Status:</td><td colspan="2">Historical</td><td>Active</td><td>Potential</td></tr>
<tr><td colspan="5">Conservation Target(s): Coral Reef Communities, Commercial and Recreational Species; Large Marine Vertebrates</td></tr>
<tr><td colspan="5">Threats (Direct):
▪ Reduced commercial / recreational fish populations
▪ Reduced coral reef health (reduced herbivorous fish populations)
▪ Regime shifts and disruption of the trophic structure</td></tr>
<tr><td colspan="5">Source (Indirect Threat):
▪ Proximity to Honduras and Guatemala
▪ Political interference and lack of political support to address transboundary issues
▪ Low income in fishing communities of neighbouring countries
▪ Increase in the number of transboundary fishermen
▪ Transboundary market for illegal product (out of season / undersized / non traditional)</td></tr>
<tr><td>Area</td><td>3</td><td colspan="3">Avoid some areas, as rangers are active, so across less than 50%</td></tr>
<tr><td>Severity</td><td>2</td><td colspan="3"></td></tr>
<tr><td>Urgency</td><td>3</td><td colspan="3"></td></tr>
<tr><td colspan="5">Management Goal: Address transboundary fishing incursions as a management strategy towards sustainability of the commercial and recreational species

Management Strategies:

Strategy 1: Investigate and implement managed access and other mechanisms for increasing benefit for local traditional users

Strategy 2: Strengthen collaboration with Immigration Department towards more effective control of transboundary incursions

Strategy 3: Strengthen collaborative enforcement (fishermen, TIDE, SEA, Fisheries Dept., Coastguard, BDF, Police Dept. Immigration Department, etc.) against transboundary incursions both within and outside the MPA

Strategy 4: Collaborate with SEA to strengthen Special Enforcement Team

Strategy 5: Engage NGOs and Government agencies in Guatemala and Honduras through TRIGOH to seek assistance in addressing transboundary issues

Strategy 6: Support initiatives to strengthen the judiciary system and increase penalties for infractions</td></tr>
</table>

<table>
<tr><th colspan="5">Threats to biodiversity of Port Honduras Marine Reserve / 4</th></tr>
<tr><td rowspan="6">Inappropriate land use / Unsustainable development (including coastal and cayes)</td><td>Status:</td><td>Historical</td><td>Active</td><td>Potential</td></tr>
<tr><td colspan="4">Conservation Target(s): All targets</td></tr>
<tr><td colspan="4">Threats (Direct):
▪ Reduced extent of littoral forest, mangroves and herbaceous beach vegetation
▪ Erosion of sandy beaches
▪ Reduced viability of nesting turtles populations
▪ Reduced viability of nesting bird populations
▪ Reduced viability of coral reef
▪ Reduced populations of commercial and non-commercial marine species
▪ Increased nutrients, sediment and pollutants in marine environment
▪ Potential destruction of seagrass beds
▪ Reduction / pollution of freshwater lens</td></tr>
<tr><td colspan="4">Source (Indirect Threat):
▪ Agricultural development
▪ Clearance of riverbanks
▪ Infrastructure development (residential tourism, research, etc.)
▪ Increased resource use and demand
▪ Inadequate / unplanned water management practices
▪ Increased pollutants (fertilizer, herbicide, insecticides, sewage etc.)
▪ Dredging
▪ Sedimentation
▪ Financial and political incentives
▪ Lack of direct management control over cayes
▪ Lack of land use planning for southern Belize</td></tr>
<tr><td colspan="4"><table>
<tr><td>Area</td><td>4</td><td>Water quality impacts (including sediment) affect</td></tr>
<tr><td>Severity</td><td>2</td><td></td></tr>
<tr><td>Urgency</td><td>3</td><td></td></tr>
</table></td></tr>
<tr><td colspan="4">Management Goal: To maintain water quality and ecosystems in the Port Honduras Marine Reserve through advocating for optimal land use management and best practices

Strategy 1: Engage land owners, agricultural/caye developers, residents and users in riverine, littoral forest, mangrove and beach vegetation areas in best management practices, protection and restoration

Strategy 2: Work closely with developers, DOE, Forest Department, etc. to ensure effective monitoring of environmental impacts and enforcement of all relevant policies and regulations for development activities and compliance with guidelines and ECPs within and adjacent to the Marine Reserve and the wider MMMC (eg. dredging of sand, mangrove clearance, water quality impacts)</td></tr>
</table>

Threats to biodiversity of Port Honduras Marine Reserve / 4	
Inappropriate land use / Unsustainable development (including coastal and cayes)	**Strategy 3:** Lobby for inclusion of national cayes within the Marine Reserve **Strategy 4:** Collaborate with Coastal Zone in the development and implementation of the Coastal Zone Plan for the southern region **Strategy 5:** Strengthen the water quality monitoring programme for PHMR and adjacent watersheds

Threats to biodiversity of Port Honduras Marine Reserve / 5

Invasive Species
Lionfish

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

Conservation Target(s): Commercial and Recreational Species; Coral Reef Communities; Large Marine Vertebrates

Threats (*Direct*)*:*

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

Source (Indirect Threat)*:*

- Invasive species (lionfish)

Area	***4***	Lionfish have are starting to increase exponentially since first being reported
Severity	***1***	Whilst it is not completely known the extent of impact that could be caused by lionfish it is thought that they could have a significant impact on local fish populations
Urgency	***3***	Lionfish have increased from a single report in 2010 to current densities. This trend is expected to continue, at least over the next few years

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

Management Strategies:

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

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

Strategy 3: Develop and implement a monitoring plan for lionfish within the Marine Reserve

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

Strategy 5: Develop a market for lionfish, in collaboration with local stakeholders

3.2.2 Prioritizing Threats

The assessment results for the priority threats are then compared and ranked in terms of their impact (Table 15).

Threat	Area	Severity	Urgency	Total AxSxU	Rank
Climate Change	4	3	3	**36**	**1**
Transboundary Fishing Incursions	4	2	3	**24**	2
Unsustainable Fishing Pressure	4	2	3	**24**	**2**
Inappropriate Land Use /Unsustainable Development	4	2	3	**24**	**2**
Invasive Species - Lionfish	4	1	3	**12**	**3**

Table 16: Results of Threat Assessment

The highest rated threat is **Climate Change,** with the recognition that this cannot be addressed directly, but more through planning for resilience and reduction of other threats. Three second highest threats hold equal ranking (Table 16). **Transboundary Fishing Incursions** and **Unsustainable Fishing Pressure** are both considered to have similar effects on the marine protected area and its resources (most specifically, the commercial marine species). Also rated at the same level is **Inappropriate Land Use / Unsustainable Development**, both in the coastal / cayes area, and in the watersheds. Currently of a lesser threat is that of the Lionfish, the primary **Invasive Species** within the marine environment, though this is predicted to increase in numbers and impact, so may be ranked higher in a future assessment.

The key strategies have been identified, and those affecting three or more of the Conservation Targets have been extracted as high priority, cross-cutting strategies (Table 17).

	Targets				
Strategy	Coral Reef Communities	Near shore Estuaries	Seagrass Beds	Large Marine Vertebrates	Commercial / recreational Species
Ensure PHMR has the human resources, equipment and training for effective surveillance and enforcement, with effective data management					
Collaborative enforcement (fishermen, Fisheries Dept., SEA Coastguard, BDF, Police Dept., Immigration Dept., Customs etc.) against transboundary incursions both within and outside the MPA					
Reduce local anthropogenic threats through community engagement and awareness programmes, and effective enforcement					
Identify and implement mechanisms to reduce local dependence on marine resources, targeting those communities most impacting the Marine Reserve					
Work closely with developers, DOE, Forest Department, etc. to ensure effective monitoring of environmental impacts and enforcement of all relevant policies and regulations for development activities and compliance with guidelines and ECPs within and adjacent to the Marine Reserve and the wider MMMC (eg. dredging of sand, mangrove clearance, water quality impacts)					
Work closely with national and international partners to monitor climate change effects and identify appropriate national and regional management strategies and responses					
Strengthen the water quality monitoring programme for PHMR and adjacent watersheds					
Support initiatives to strengthen the judiciary system and increase penalties for infractions					
Work with national partners in the development and implementation of a comprehensive action plan for lionfish management (eg. Ecomar)					
Identify and understand water currents critical for coral and fish recruitment					
Increase awareness of best fishing and tourism practices among immediate resource users					
Continue to work closely and lobby with Government at the national level to develop and implement effective mechanisms towards a sustainable fishing industry					
Engage NGOs and Government agencies in Guatemala and Honduras through TRIGOH to seek assistance in addressing transboundary issues					
Investigate and implement managed access and other mechanisms for increasing benefit for traditional users					
Ensure adequate protection of key herbivores for maintenance of live coral cover and ecological functions					
Collaborate with WCS to increase awareness of non-consumptive (tourism and ecosystem) value of elasmobranchs (sharks and rays)– targeted at fishermen in stakeholder communities					

Table 17: Priority cross cutting strategies

4. MANAGEMENT PLANNING

4.1 Management and Organizational Background

Port Honduras Marine Reserve was officially declared through Statutory Instrument 9 of 2000 and has, since its inception, been co-managed by the Fisheries Department of the Government of Belize and the Toledo Institute for Development and Environment. TIDE has the day-to-day management responsibilities for the Marine Reserve and conducts the majority of the enforcement, patrols and monitoring, with guidance and logistical and financial support from the Fisheries Department.

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

Mission Statement, Fisheries Department

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

Ecosystems Management Unit

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

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

The Ecosystems Management Unit is one of four units under the Fisheries Administrator (the others being the Aquaculture and Inland Fisheries Unit, the Capture Fisheries Unit, and Administration), and includes the Protected Area Management Programme. Under this mandate, the Fisheries Department is able to establish and manage the marine reserves in Belize (including Port Honduras Marine Reserve). The Protected Areas Management Programme is specifically in charge of the management of the Marine Reserves, under the Marine Protected Areas Coordinator.

The Fisheries Department has established a co-management partnership with the Toledo Institute of Development and Environment (TIDE), which has taken on the lead management

role, being responsible for the majority of activities and associated costs for the marine protected area.

Management of Port Honduras Marine Reserve is led by the TIDE Marine Manager, who is supported by an on-site manager based from Abalone Caye for daily operations, and reports to the TIDE Programme Manager. The PHMR staff also includes four full-time and one temporary ranger. These personnel are responsible for the day-to-day management of the Marine Reserve, supported by the other TIDE Programme areas such as Research and Monitoring and Environmental Education and Outreach.

The Toledo Institute for Development and Environment (TIDE) was established in September 1997 as a grassroots initiative in response to growing concerns over manatee poaching, illegal fishing, degradation of the marine environment, illegal logging, destructive farming methods and other types of unsustainable development. Conservation planning for the Maya Mountain Marine Corridor (MMMC) (formerly known as the Maya Mountain Marine Areas Transect (MMMAT)) in 2002 and 2008, has helped to provide a framework for the strategic direction of the organization, with TIDE's mission being "to foster community participation in resource management and sustainable use of ecosystems within the Maya Mountain Marine Corridor of southern Belize for the benefit of present and future generations" - a central tenet of the organization.

Toledo Institute for Development and Environment

Vision: TIDE is an effective leader in ecosystems management and biodiversity conservation that fosters community development and empowers communities to sustainably manage and use the natural resources in the Toledo District of Belize.

Mission: To foster community participation in resource management and sustainable use of ecosystems within the Maya Mountain Marine Corridor of southern Belize for the benefit of present and future generations.

TIDE is a leader in developing and implementing innovative programmes to prevent habitat and biodiversity loss with a focus on facilitating alternative and environmentally friendly opportunities for local residents to earn a living. The organization is led by a committed Board of Directors and works closely with local, national, regional and international partners. TIDE's Board of Directors consists of seven members,

TIDE Board of Directors

Chair:	Gabriel Roches, Retired Public Officer
Vice-Chair:	Alistair King, President, Fabrigas, Inc
Treasurer:	Eric Moore, Ministry of Works
Director:	Anselmo Cruz, Red Cross Director
Director:	Alexander "Sonny" Garbutt, Monkey River Village Council
Director:	Marie Aleman, Community Representative
Director:	Kamela Palma, Belize Ambassador to the UK
Director:	Darwin Garbutt, PHMR Advisory Board
Director:	Dale Gomez, PCNP Advisory Council

and an Advisory Board comprised of thirteen members specifically for the Marine Reserve, to advise on management concerns (Table 18).

Name	Organization/community
Mr. Rob Hyron Mr. Dennis Garbutt Mr. Alex Leonardo	Belize Tourism Industry Association Tour Guide Association
Ms. Paula Williams	Punta Negra Village Council
Mr. George Ramirez	Rio Grande Fisherman Cooperative
Mr. Lyndon Rodney Mr. Victor Vasquez	Fisheries Department Alternate
Dr. Phillip Morgan	University of Belize
Mrs. Celia Mahung Mr. Seleem Chan	TIDE
Darwin Garbutt	Monkey River Fisherman Association
Mrs. Delly Martinez	Rep. to the Area Representative

Table 18: Advisory Board members

The organization undertakes a wide range of tasks from law enforcement to community outreach and biodiversity monitoring. The primary focus of TIDE has been on the coastal communities of Monkey River, Punta Negra and Punta Gorda, but in more recent years it has expanded to include an increasing number of inland communities whose activities also have an impact on the watersheds that empty into Port Honduras Marine Reserve. TIDE works with each community to promote sustainable development and build local capacity to facilitate responsible management and a sense of ownership of the natural resources.

Since its inception, TIDE has grown in strength, and it grown to be an award winning, non-governmental organization registered with the Government of Belize that manages a budget of over US$ 1 million and a staff of 26 full-time and 10 part-time employees, including rangers, administrative, outreach, and science staff.

TIDE Organizational Chart

TIDE has the following **Guiding Principles**, outline in its Strategic Plan 2007-2012:

In pursuing TIDE's vision, mission and objectives, the Board, Administration and Staff shall:

1. Aspire to achieve the highest level of leadership in protected areas management.
2. Engage and support stakeholder communities in an open and participatory process that is inclusive of their voices.
3. Integrate environmental policies and legislation, and support positive actions.
4. Foster individual and collective commitment to conservation, sustainable development and TIDE's mission.
5. Ensure that access to, and use of resources is transparent and accountable.
6. Develop an effective and accountable administrative structure and process.
7. Foster a sense of pride in the protection, preservation and sustainable use of the environment.

4.2 Review of Previous Management Programmes

The first management plan was prepared for Port Honduras Marine Reserve in 1998, before the marine protected area was established, and was considered more a proposal for the management of the Marine Reserve than an actual management plan. It did, however, set out a series of clear objectives, and has been used to guide management of the protected area, incorporating regulations that are laid down by law in the Statutory Instrument.

An assessment of management effectiveness was conducted in March, 2009, focusing on the objectives of the individual management programmes and objectives of the original draft management plan. The review suggested that of the 31 objectives identified within the 1998 management plan, 46% have been implemented successfully, 32.2% have resulted in an improvement in the situation (partial implementation), 22.6% showed no change and 3.2% (one objective (Objective 3: Prevention/mitigation of effects from oil prospecting within PHMR area) showed a decrease in status. (Tables 19 and 20).

Table 19: Summary of Success of Activities Identified from the previous Management Plan

	Succeeded	Improved	No Change	Worse
Total No. Objectives (of 31)	13	10	7	1
% of total	42%	32.2%	22.6%	3.2%
% +ve change	74.2%			
% -ve change or no change			25.8%	

Table 20: Past Management Plan Programme Rating Table					
Programme	**Total no. Objectives**	**Succeeded**	**Improved**	**No Change**	**Worse**
Resource Management and Protection	4	1	1	1	1
Research and Monitoring	10	5	3	2	0
Human Use	4	1	3	0	0
General Management and Infrastructure	3	2	0	1	0
Administration	10	4	3	3	0

The strongest area of implementation would appear to be Research and Monitoring, with 50% of objectives being considered to have been successfully implemented, and a further 30% partially implemented. Whilst there are no significantly weak areas, Resource Management and Protection has a lower rating than the other management Programmes – though still has 50% of the objectives showing an improvement or success.

A 2006 assessment of the management effectiveness of Port Honduras Marine Reserve focused on Biophysical, Socioeconomic and Governance indicators (Cho-Ricketts, 2006). Overall, the results suggested that TIDE was satisfactory in their management of the Marine Reserve and the implementation of the 1998 management plan. However, a number of areas for improvement were identified, particularly the need to establish financial sustainability, highlighted as a number one priority for the organisation. In addition, strengthening was identified as needed in the areas of education / awareness, outreach and enforcement, and being critical in communication with local stakeholders. Stakeholder support was rated as high, with 93% of stakeholders surveyed in 2006 (Cho-Ricketts, 2006) and 91% in a 2009 survey (Padilla Plaza & Ferguson III, 2010) supporting TIDE management of the marine protected area.

In 2009, Port Honduras Marine Reserve was included within a national management effectiveness assessment, under the National Protected Areas Policy and System Plan framework. Management effectiveness was evaluated through the **Monitoring Package for Assessing Management Effectiveness of Protected Areas** (Walker and Walker, 2010), based on sixty of the sixty-four indicators divided between seven different indicator categories (Young et. al. 2005):

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

- Overall, Port Honduras Marine Reserve was considered to rate as **VERY GOOD** in terms of management effectiveness, averaging a score of 75.8% across the national Indicator Categories (Table 21).
- Four Indicator Categories rated as **VERY GOOD**
- The strongest Indicator Category was identified as Governance
- The weakest Indicator Category was identified as Management Planning, which rated as **GOOD**, scoring 66.7% - an Indicator area being strengthened through the process associated with the production of this management plan.

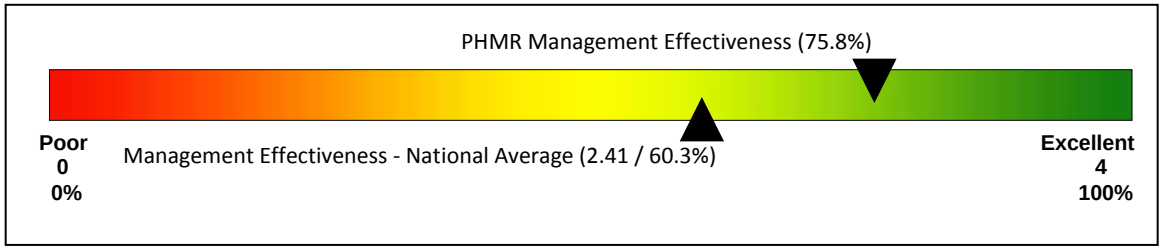
Table 21: Indicator Categories

Indicator Category	Average Score 2009	Average % 2009
1. Resource Information	2.91	72.7
2. Resource Administration, Management and Protection	3.11	77.7
3. Participation, Education and Socio-Economic Benefit	2.92	72.9
4. Management Planning	2.67	66.7
5. Governance	3.50	87.5
6. Human Resources	3.13	78.1
7. Financial and Capital Management	3.13	78.1
Overall	**3.03**	**75.8%**

Poor: 0 – 25%	**Fair:** >25% - 50%	**Good:** > 50% - 75%	**Very Good:** > 75%

Of the 60 National Indicators assessed, seventeen showed particular strength, scoring 4, whilst only three scored 1, demonstrating areas that would benefit from significant strengthening. The overall management effectiveness of Port Honduras Marine Reserve as assessed in mid-2009 was rated as **VERY GOOD,** with an overall Management Effectiveness of score of 3.03 out of 4.00 (75.8%) (Walker and Walker, 2009).

Weaknesses
1.9 Traditional Knowledge (Incorporation of..)
2.9 Visitor and Tourism Management Activities
6.6 Human Resource Assessment



4.3 Management Goals

The overall goal for management of the Port Honduras Marine Reserve is:

"the sustainable management of coastal ecosystem functions and natural resource values for the benefit of present and future generations of Southern Belize, within the wider ridge to reef landscape"

TIDE Advisory Board, 2011

…promoting the sustainable use of the biological resources and the identification and development of integrated conservation and development activities related to the ecosystems and species associated with the reserve, and compatible with ecosystems functions and services for the buffer communities.

A number of objectives have been identified to meet the management goal for Port Honduras Marine Reserve:

- To promote sustainable marine resource use for the continued benefit of all users
- To ensure continued sustainable resource extraction through effective management mechanisms for the benefit of traditional fishing communities
- To promote community stewardship of the marine resources through effective communication, education and outreach
- To provide a sustainable recreational and tourism environment that will enhance the economic and social benefits of the area
- To engage in effective research and monitoring within PHMR to guide and inform management decisions

TIDE Advisory Board, 2011

Whilst this management plan is specifically for the Port Honduras Marine Reserve, it seeks to contribute towards more holistic management of the area. The goal and objectives are aligned with other relevant planning outputs. As a Marine Reserve, Port Honduras Marine Reserve was established under the Fisheries Act, which states that the purpose of a marine protected area is to:

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

The management goal of the marine protected area is also aligned with the wider vision for the Maya Mountains Marine Corridor:

> *For the Maya Mountain Marine Corridor to continue to be a place of national importance to Belize and international importance to the greater Gulf of Honduras because of its environmental, economic and geopolitical significance.*
>
> ***A collective Vision for the Maya Mountain Marine Corridor, Belize CAP Workshop, 2008***

A series of goals were developed for the entire Maya Mountain Marine Corridor in 2008, through a fully participatory Conservation Action Planning process. A number of these goals are both directly related to the PHMR action plan as well as general goals for TIDE and its increasing success in environmental preservation (Annex 5).

Whilst this management plan is specifically for the Port Honduras Marine Reserve, compatibility with plans for the larger coastal basin (including Payne's Creek National Park, Sapodilla Cayes Marine Reserve and the wider Southern Belize Reef Complex) have been considered in the development of management strategies to ensure holistic management of the area.

4.4 Management Constraints and Limitations

Both the internal and national evaluations identified a number of areas considered as management constraints or limitations:

- Enforcement
- Human Resource Management
- Stakeholder Involvement in Management Decisions
- Community Outreach and Awareness

Enforcement

Illegal fishing remains a continuing problem within PHMR and there is particular concern for incursions into the Conservation Zones surrounding the Snake Cayes. In addition, illegal fishing by foreign nationals (mainly from Honduras and Guatemala) continues to be a problem for Marine Reserve staff, and the perceived threat of foreign fishers within the Marine Reserve by local communities continues to be an area of contention. Budget limitations for fuel and high staff turnover severely constrain the activities that can be conducted within PHMR and these limitations are fully exploited by illegal fishermen. Patrolling is limited by budget, and whilst training is ongoing, the high staff turnover of rangers results in qualifications and skills being lost. The leniency seen towards noncompliant fishermen has frustrated Reserve staff, reducing motivation, though this is currently being addressed by the development of more stringent prosecution procedures.

Recommended Management Actions:

- Increase staff numbers
- Increase fuel allowance for patrol activities
- Increase salary and/or food allowance for reserve staff
- Continued collaboration with BDF and Belize Coastguard to supplement patrols during peak fishing times
- Continued / increased communication/outreach with fishermen in buffer communities
- Improved communications system
- Improved accessibility and transport (with 2 patrol boats and crews active in the area)

Personnel Management

The previous high rate of staff turnover, particularly within reserve staff, is a serious constraint to the achievement of management objectives, resulting in a lack of long term continuity in the implementation of management policies and a continued loss of revenue through repeatedly training new staff members. High staff turnover is considered to be partly a result of the isolated work conditions, and limited salary and food allowance for reserve staff. This is of particular

concern in areas of enforcement, where an element of training is required to ensure staff has the capacity to implement activities within these programmes. Whilst the level of training is considered good, the turnover results in a constant need for further training as new staff come on-board. Staff motivation is also a significant problem, especially with the isolation and antagonism from the fishermen. Improvement of communications between the fishing community, and their participation in monitoring activities may assist in relieving some of these pressures and increasing staff motivation, with improved relations between staff and fishermen.

The situation has improved in the last two years with the employment of a new Marine Manager in early 2008 and a reduction in reserve staff turnover during 2009 and 2010. However, reserve staff morale is still considered low (TIDE, 2011).

Recommended Management Actions:

- Greater support for reserve staff
- Review of salary and food allowance for reserve staff
- Review reserve staff contract to ensure repayment of training costs if staff member resigns within first 12 months of work
- Continued increased and improved communication with local fisherman within buffer communities of PHMR

Stakeholder Involvement in Management Decisions

The Port Honduras Marine Reserve Advisory Committee is currently active and functional, with representatives from all major stakeholders. Active participation of stakeholders on the committee has declined in recent years and a review of members should be conducted to ensure good representation from within the communities, businesses and town council.

Traditional fishers are increasingly involved in management activities, particularly since the establishment of the Community Stewards Programme. However, many fishers feel they could benefit more by assisting with monitoring and research activities and being employed as community researchers. This avenue requires further exploration over the next two to three years.

Recommended Management Actions:

- Review list of members of the PHMR Advisory Committee and the Terms of Reference for the committee and amend for improved representation and increased effectiveness
- Ensure visible results from recommendations arising from community consultations, and feedback on areas of concern
- Increase stakeholder participation in management decisions and management, monitoring and research activities

Community Outreach and Awareness

One of the main areas of weakness within the management of PHMR is the lack of understanding of TIDE and PHMR objectives by the surrounding communities. While education Programmes and activities for children and youths are good, there is limited successful outreach to adults within the communities.

4.5 Management Strategies

A number of management strategies have been identified within the legislation and are being implemented by TIDE to assist in effective management of the Marine Reserve. These include the use of management zones to regulate use – both extractive and non-extractive (Annex 2). It also sets out the requirements for fishing licenses and dive boats, fees, mechanisms for monitoring of fish catches, and offences and penalties (Annex 1). In addition, TIDE has a number of standard rules that apply across all management zones.

Legislated Management Strategies (SI 18 of 2000)

ESTABLISHMENT OF ZONES AND RULES FOR ZONES

- Establishment of zones.
- Rules for General Use Zone.
- Rules for Conservation I Zone.
- Rules for Conservation II Zone.
- Rules for Preservation Zone.
- Rules for Special Management Area.

COMMERCIAL FISHING, RESEARCH, SPORT FISHING LICENSES AND REGISTRATION OF DIVE BOATS

- Commercial Fishing Licenses.
- Research Licenses.
- Sport fishing Licenses.
- Registration of dive boats.

GENERAL

- Licenses not transferable.
- Duration and renewal of licenses.
- Cancellation of licenses.
- Condition of licenses.
- Duty to report accidents or damage to property.
- Non-liability of Government.
- Application of Fisheries Regulations.
- Opening days of Reserve.
- Admission fees.
- Prohibition of certain acts.
- Fisheries Administrator may designate certain areas.
- Rendering fish catch information to rangers.
- Establishment of fishery officers.
- Offences and Penalties.

SI 18 of 2000

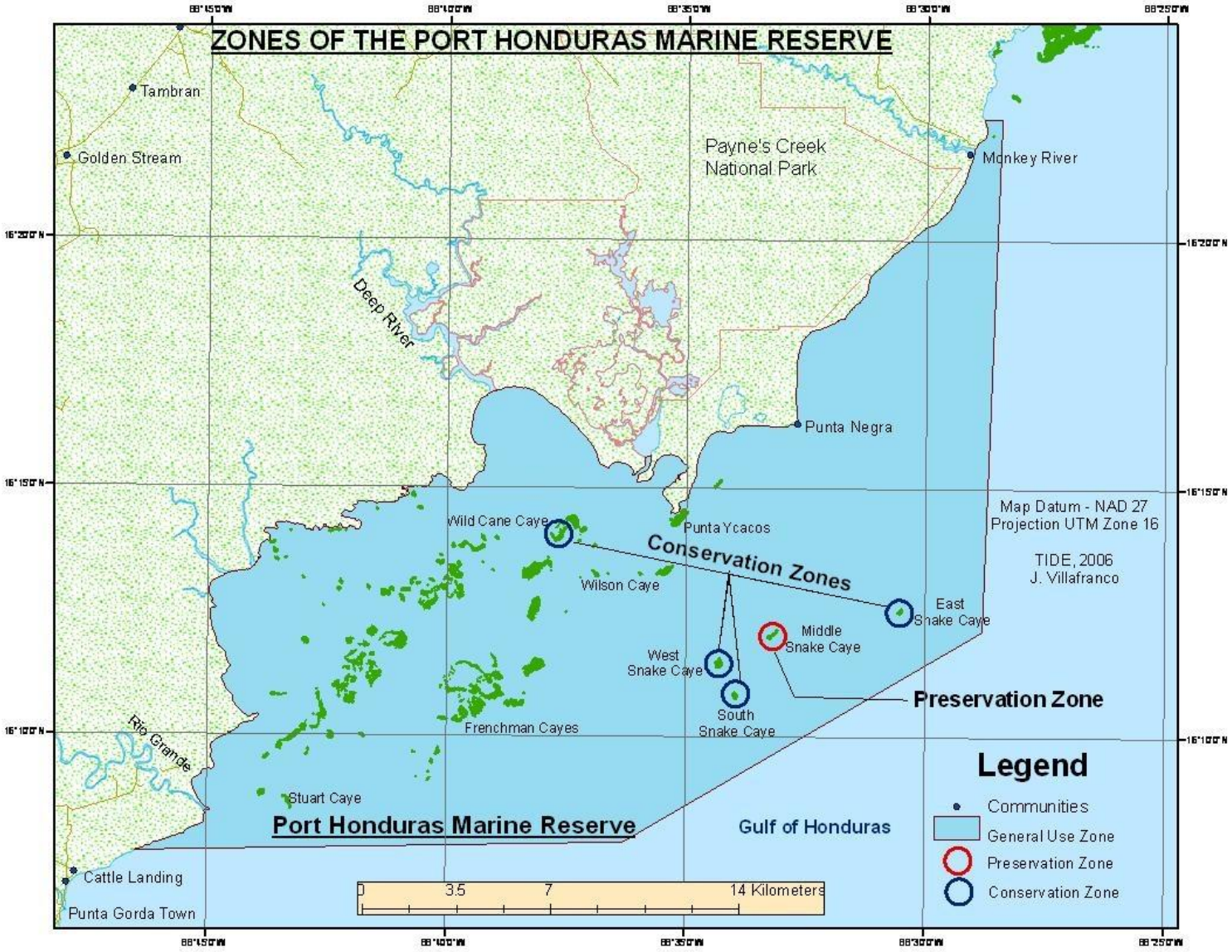
4.5.1 Management Zones

Four zones are legislated within the Statutory Instrument (SI 9 of 2000), following the recommendations of the previous management plan:

- General Use Zone (GUZ)
- Conservation I Zone (CIZ)
- Conservation II Zone (CIIZ)
- Preservation Zone (PZ)

With provision for the establishment of a Special Management Area.

Despite being legislated with the ability to establish four management zone types (General, Conservation, Preservation and Special Management), Port Honduras Marine Reserve is actually divided into three main zones for management purposes (Map 10). The largest zone, the General Use Zone, covers 95% of the Marine Reserve and provides opportunities for established uses and activities under a stringent monitoring scheme. Regulated extractive activities such as commercial, sport, recreational and subsistence fishing are permitted within this area. However, fishers are required to have a valid license, and gear restrictions are in place (the use of gill nets, beach traps and long lines is prohibited).



Map 10: Management Zones of Port Honduras Marine Reserve

The Conservation Zone covers 4% of the Marine Reserve area and incorporates East Snake Caye, West Snake Caye, South Snake Caye and Wild Cane Caye and extends half a mile out from each caye. The Conservation Zone provides an area free from commercial fishing to prevent fishery stock from over-exploitation, provides an undisturbed area for recruitment of species, and enhances the value of the area for recreational and tourism activities. No-take recreational activities, such as SCUBA diving, snorkelling and kayaking, are permitted within this zone. "Catch and release" sport fishing is also allowed within the Conservation Zone, but only with a valid license. The third zone is the Preservation Zone which covers approximately 1% of the reserve and incorporates Middle Snake Caye, extending half a mile out from the island. Entry in to the Preservation Zone is strictly prohibited except in an emergency or with prior written permission from the Fisheries Administrator. The Preservation Zone provides an area within the marine reserve that is preserved in an entirely natural state and protects areas of particularly fragile habitat or with threatened or rare species.

General Use Zone (GUZ)

The General Use Zone allows for the sustainable management of existing uses, with the focus being on commercial fishing and recreational activities. This zone lies outside the more critical protection zones, and is relatively accessible to local fishers, who use part of the area for commercial fishing. The existence of a number of fishing banks and nearby replenishment areas make the GUZ a valuable and potentially fertile fishing grounds.

Objective: To provide opportunities for established uses and activities (fishing for conch, lobster and finfish; recreational activities etc.) to be continued in a sustainable manner under a stringent monitoring scheme.

The **General Use Zone** shall be restricted to those with the appropriate fishing license for any of the following, namely a commercial, sport, subsistence and recreational fishing license. Fishermen shall apply for a license to fish in accordance with these Regulations.

Rules for General Use Zone.

- Only residents of Port Honduras who have special licences to fish shall be allowed to fish in this zone solely for subsistence purposes, and such fishing shall be determined by the terms and conditions of each resident's license.
- No person shall be permitted to use long lines or gill nets in the Port Honduras Marine Reserve.
- No person shall be permitted to use or erect beach traps.
- No person shall, within the Port Honduras Marine Reserve, cast or drag any anchor in any manner that may damage coral reef formation.
- Fishermen catching lobster shall preserve such lobster while in the Marine Reserve within its carapace but not as fillet.

SI 18 of 2000

Additional Regulations for the General Use Zone:

- Spear fishing is also not permitted within the marine protected area.
- No clearing of mangroves without the approval of the Forest Department.
- No collection of flora and fauna except with permission from the relevant permitting authority.
- All proposed tourism development must go through the EIA process.

Key Enforcement and Monitoring Needs: Intensive patrols are required to check for fisher compliance, specifically on fishing gear, catch sizes etc. These patrols will also deter potential incursions into the other zones, and transboundary incursions.

Many cayes lie within this Zone, the majority being mangrove cayes, and many with some degree of clearing and development, mostly to accommodate temporary fishing camps while others are occupied periodically. The tenure status of these occupied cayes is uncertain but it is estimated that the majority have no legal status. As the development trend will continue since the area has high recreational potential, TIDE should use the EIA process as a tool that can assist in guiding sound development in this zone. The clearance of mangroves should be addressed through the existing permit system from the Forest Department. TIDE coordinates with DoE and Forest Department in regulating these activities.

Conservation Zones (CIZ and CIIZ)

The Conservation Zones I and II encompass examples of all representative habitats of the protected area. It is a non-extractive zone, maintained to provide baseline conditions to allow

monitoring, research, education and limited recreational activities. The Conservation Zones that include the Snake Cayes were determined based on the value of their fringing reef system; whilst the Conservation Zone around Wild Cane Caye was based on its archeological value as a Maya site. The Conservation Zones serve as replenishing and nursery areas for commercial species extracted from the General Use Zone, and provide habitats for threatened species such as the Morelets Crocodile, West Indian manatee, sea turtles and many bird species

Objectives: To provide undisturbed areas free from all fishing and collecting for recruitment of species to adjacent areas, that will also allow research and education to provide a baseline to monitor the ecological status of unprotected areas; and to provide a representative sample of certain habitats within the protected area.

Rules for Conservation I Zone.

- There shall only be non-extractive recreational activities in the Conservation I Zone.

Rules for Conservation I and II Zone.

- No person shall engage in water-skiing and jet skiing within this zone.
- Sport fishing in the Conservation II Zone shall only be carried out under a license issued in accordance with these Regulations and such fishing shall only be carried out on a catch-and-release basis.
- No person shall engage in spear fishing with the Conservation II Zone.
- No person shall engage in commercial, recreational and subsistence fishing within the Conservation II Zone.
- No person shall engage in trawling, setting nets or traps within the Conservation II zone.
- No person shall engage in water-skiing and jet skiing within the Conservation II zone.
- No person shall secure a boat to the seabed of the Conservation I and II zones except by means of a mooring that is officially designated for this purpose, (save in the case of an emergency where life and property are endangered), or with the prior, written permission of the Reserve Manager.
- All divers in the Conservation I and II zones shall adhere to the following rules:
  - divers shall register with the Reserve Manager prior to entering the Conservation zones
  - charter dives shall first obtain a licence in the form prescribed as Form VI of the Schedule before operating in the Conservation zones and all dive
  - boats shall fly the "divers down flag" when they have divers in the water;
  - Only certified scuba divers, or divers undergoing a training course conducted by a recognized instructor shall be allowed to use scuba equipment in areas of the Reserve where diving is permitted.
  - Dive guides shall be required to explain the rules of the Reserve to all divers within the Reserve.
  - All boats which need to operate in these zones shall first obtain registration from the Fisheries Administrator in accordance with these Regulations.
- For the purpose of this Regulation "divers down flag" means a flag with a white diagonal stripe upon a red background.
- All motor boats are to observe the low-wake-boat-way when approaching snorkelers or divers.

SI 18 of 2000

Additional Regulations for Conservation I and II Zones:

- All educational activities require approval and coordination of the managing body.
- No disturbance of the natural habitat.
- No clearance of mangroves without the approval of the Forest Department.
- No collection of flora and fauna except with permission from the relevant permitting body.
- All proposed tourism development must go through the EIA process.
- Visitors/tourists should steer clear of the main boat access routes.

Key Enforcement and Monitoring Needs: Enforcement against illegal fishing and fishing camps, and transboundary incursions, with both day and night patrols. Enforcement of recreational and tourism regulations, and monitoring of tourism impacts. Coordination with residents within the marine protected area for assistance in surveillance.

Preservation Zone (PZ)

The establishment of the Preservation Zone around Middle Snake Caye was based on its ecological importance and fauna, and the fact that it is one of the few know colony nesting sites for migratory sooty terns in Belize. The Preservation Zone constitutes the strictest protection. This area is closed to all visitors and extractive users, including researchers, except under special permission.

Objectives: To provide areas within the Marine Reserve that are preserved in an entirely natural state; to protect areas of particularly fragile habitat or with threatened or rare species.

Regulations

- Subject to subregulation (2) below, no person shall engage in commercial fishing, sport fishing, diving or any other water activity within the Preservation zone.
- No vessel shall be permitted within the Preservation zone except in cases of emergency or where written permission has first been obtained from the Fisheries Administrator.
- This area is reserved for special projects. Fishing and other activities may or may not be allowed depending on the status of the area in the management plan.

SI 18 of 2000

Regulations:

- Access is restricted except to research needed by the Marine Reserve when it cannot be accommodated in the other zones.
- Strictly no extraction even for research.
- No habitat disturbance of any kind.
- No fishing of any type.
- No recreational or tourism activities.

Key Enforcement and Monitoring Needs: The primary potential impact will be from tourism boat traffic accessing the nearby Deep River area.

4.5.2 Potential Changes in Zonation during the timescale of the Management Plan

The results of the PHMR monitoring Programme from 2003 to 2009 demonstrate that the 5% no take area (Conservation Zone and Preservation Zone) within the marine reserve is ineffective in enhancing the populations of commercial species and reef fish species within the reserve (Foster, 2010b). Neither conch or lobster populations showed a significant increase in the six year period for 2003 to 2009 and furthermore, reef fish populations showed a significant decline in abundance over the same period (Foster 2010b). Despite this trend, sessile benthic species showed significant improvements over the same six year period (Foster 2010b).

One explanation for the difference in recovery of the commercial and reef fish species compared to the sessile benthic species, is the mobility of these species. Reef fish are highly mobile species, and lobster and conch can also move considerable distances, meaning that the small area of no take zone within Port Honduras Marine Reserve would appear to only a limited affect on the recovery of these populations (Foster, 2010b). The half mile radius no take areas that currently extend around the Snake Cayes and Wild Cane Caye, are limited in the area they enclose. In addition, there is limited connectivity between the series of areas that combine to form the Conservation Zone. As a result reef fish, conch and lobster species do not have to travel great distances before they enter a general use area and are exposed to fishing pressures. Even daily migration patterns for food, or movements among nursery and adult grounds can result in an individual frequently entering a general use zone, thereby increasing its risk of being caught prior to reaching sexual maturity (Foster, 2010b).

Recommendations for a minimum MPA size, specifically designated as a no take area, range from 4-20km in diameter to effectively conserve biodiversity (Salm, 1984; Friedlander et al., 2003; Shanks et al., 2003). In addition, studies have shown that many species utilise seagrass beds, mangroves and coral reefs at various stages of their life history (Acosta & Robertson, 2003, Roberts et al. 2003, Mumby 2006). Thus, an increase in the no-take area of PHMR would ensure inclusion of a larger area of each of these key habitats, thereby protecting connectivity between functionally linked habitats (McLeod et al., 2009). Based on the results of the PHMR monitoring Programme and information from the scientific literature, it is recommended that the no take area within PHMR be increased to incorporate between 20-30% of the reserve area (Bohnsack et al., 2000; Day et al., 2002; Airame et al., 2003; and Fernandes et al., 2005) and be greater than 5km in diameter. A number of options were presented to stakeholders (Annex 4), the preferred option being an increase to 15% of no take area, focused on the Snake Cayes (Map 11).

Map 11: Preferred option for increased no take zone

4.5.3 Managed Access

Overview: Port Honduras Marine Reserve is managed as an open access fishery, without a mechanism in place to limit the catch and/or number of fishermen. As a result, there are too many fishermen chasing too few fish. The fisheries become unsustainable, and fishermen struggle to make a living off the resource that is available to them. To address this situation, the Government of Belize and TIDE are implementing a system of managed access in Port Honduras Marine Reserve.

There are three key elements of the managed access initiative:

- The unsustainable increase in the number of fishermen will end through a system of managed access licenses
- Monitoring will be strengthened so there is a better scientific basis for making management decisions
- There will be incentives for increased collaboration among Government of Belize, TIDE, and fishermen in the stewardship of the resource

After these first-steps are initiated and a comprehensive impact assessment conducted, the Government and TIDE will consider whether additional measures, such as catch limits for key commercial species and quotas, need to be included in the regime.

Managed access will be implemented in Port Honduras Marine Reserve and Glover's Reef Marine Reserve in 2011. The Government of Belize has stated its intention to use managed access for fisheries management in all Belize's marine reserves.

Rational for Managed Access: Studies over the past ten years and production figures show that the main commercial fishery species of Belize are fully exploited, and could probably face overexploitation very soon. The steady rise in the number of fishermen over the last 10 years has increased fishing pressure, and therefore it is harder for each fisherman to make a living.

Fishermen are forced to compete with each other during a "race to fish" when lobster and conch season opens. Fishermen sometimes have to go out in dangerous conditions, and find there is less and less product each season. Managed access will eliminate the unsustainable growth in fishermen. Under managed access fishermen are expected to directly benefit from their good stewardship and compliance with regulations. Enforcement, monitoring, and accountability for fishermen and managers will all improve. Managed access is included within the management regulations or enabling legislation of the marine reserves since their inception, and within the revision of the Fisheries Act.

Managed Access and Sustainable Fisheries: Fishermen in PHMR rely on fisheries for their livelihoods; they understand the need to be good stewards. But under the current system a fisherman will not leave a lobster for later because anyone else can take it. There are no incentives for fishermen to postpone their catch even though that means there will be greater abundance in the future. Under managed access fishermen can coordinate and plan their fishing. With managed access, a group of fishermen can decide to reduce their own effort in return for future benefits. Similarly, with managed access fishermen can restrict their fishing activities in an area knowing that they will benefit from an improvement in the state of the stock.

Managed access creates a climate where fishermen can commit to better management of their fishery. The objective of managing access is to enable fishermen to adopt measures that will give them higher net profits for their effort. Managed access reduces the number of fishermen so there is more fish for each fisherman.

To achieve this goal, stock levels must be restored to their higher, historical level so that catch rates are higher and the amount of excess effort, such as long working hours, can be reduced. Managed access also creates an opportunity for fishermen to be full partners in making management decisions for the fisheries. The long-term benefits are healthy stocks, a healthy ecosystem, and economically viable fisheries.

Community Fisheries: The Port Honduras Community Managed Access Committee will enable fishermen to fully participate in the decisions and policy for managed access areas. The committee will:

- Develop, review and finalize criteria that will be utilized to screen applications for managed access licenses. They will develop and present policies related to managed access fisheries to the Fisheries Department and Ministry of Agriculture and Fisheries for consideration and approval.
- Also responsible for screening and approving applications for consideration.
- Assist in the public awareness of managed access license policy to all stakeholders. Assist in conducting outreach to government, fishermen associations, cooperatives, etc., to promote and advocate managed access.
- Help design and implement governance plans, including monitoring and enforcement.
- Help design and implement communications plans.
- Review and finalize design and implementation plan for managed access
- Participate in workshops with cooperatives to build capacity for managed access and catch shares.

Managed Access Policy and Timeline: The Belize Fisheries Department has indicated at three to five year timeline for implementing managed access in the entire network of Belize's marine protected areas. Port Honduras and Glover's Reef are the initial projects. The implementation of limited access licensing and the managed access monitoring regime at these sites will occur in 2011. The Fisheries Department is considering the application of catch limits for specific fisheries in managed access areas. The impact of managed access in Port Honduras and Glover's Reef Marine Reserves will be evaluated through implementation and operations to adapt the policy as needed, and develop a strategy for expanding managed access to other marine reserves and fisheries.

A comprehensive policy for managed access has been developed in a partnership process between the Government of Belize, NGOs, and fishermen. This included over 60 consultations with fishermen (including cooperatives), community leaders (such as the Punta Gorda Town Council), and fishery scientists and experts.

4.5.4 Limits of Acceptable Change

A study of the carrying capacity of PHMR was conducted in 2005 (Avila et al. 2005), with a review of the relevant literature detailed interviews with the management team of TIDE, meetings with opinion leaders (tourism stakeholders), focus groups sessions in Punta Gorda, Monkey River and Punta Negra, and a site inspection of the Reserve inclusive of the TIDE ranger station on Abalone Caye and other popular recreation areas on the Reserve.

The assessment looked at ecological concerns as they relate to recreational activities in the marine protected area. Major threats to the marine ecosystem within Port Honduras Marine Reserve from recreational activities include anchor damage to reef colonies, accidental boat groundings on coral reefs, touching by divers/snorkelers, standing and dragging of equipment on live coral colonies, cutting down of mangrove to accommodate coastal and caye developments, and increased fishing. Recreational opportunities were identified as: Manatee Watching, Fly Fishing, Boating, Swimming and Snorkelling, SCUBA Diving, Beach Access, Sailing, Hand Line Fishing, Bird Watching, Mayan Archaeology Site Visiting/Exploring, Picnicking and Camping, and Kayaking and Canoeing.

It was recommended that, due to the fragile nature of the ecological and physical characteristics of the area combined with access constraints, infrastructure such as accommodations, food service, transportation, interpretative centres, shopping, and tour operations should continue to be concentrated in the coastal settlements of the mainland (Monkey River, Punta Negra, and New Haven and Punta Gorda Town). This will ensure that local stakeholders in the zone of influence will benefit from tourism and other initiatives in the Marine Reserve.

The following activities were recommended within the Marine Reserve: Manatee Watching (at five sites), Fly Fishing (at three sites), Boating(at six sites) , Swimming and Snorkelling (at two sites), SCUBA Diving (at three sites), Beach Access (at four sites), Sailing (at six sites), Hand Line Fishing(at six sites), Bird Watching (at two sites), Mayan Archaeology Site (at one sites), Picnicking and Camping (at two sites), and Kayaking and Canoeing (at five sites).

4.6 Management Programmes and Objectives

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

Five general Management Programmes are identified under the National Protected Areas Policy and System Plan framework (NPAPSP, 2005; Table 22).

A. Resource Protection Programme
B. Research and Monitoring Programme
C. Environmental Education and Outreach Programme
D. Infrastructure Management Programme
E. Administration Programme

The conservation strategies outlined for Port Honduras Marine Reserve in the conservation planning section of this management plan are integrated into the management Programmes, contributing towards the adaptive management process. In 2008, TIDE was one of six organisations that signed a charter to develop and implement a Conservation Action Strategy (CAS) for the Maya Mountain Marine Corridor (MMMC), spanning approximately one million acres of land and 1000 acres of seascape. The other organisations included the Government of Belize's Forest and Fisheries Departments, Ya'axché Conservation Trust (a local non-governmental organisation), and two international organisations, Fauna & Flora International and The Nature Conservancy. Through extensive consultation with local communities and other stakeholders, this strategy identified the greatest threats to the biodiversity of the area and formulated a five year integrated plan for addressing these threats. The strategies of the Conservation Action Plan for the Maya Mountains Marine Corridor (of which PHMR is a component) are also integrated, to ensure that the PHMR fulfils its role in the seascape, assisting Fisheries Department and TIDE in ensuring the long-term conservation of the MMMC.

Also referred to during the development of the Programme is the conservation planning for the Southern Belize Reef Complex - system-level planning for the southern reef adjacent to PHMR, with a scope ranging from Belize's southern border in the south to encompass Sapodilla Cayes Marine Reserve, Gladden Spit and Silk Cayes Marine Reserve, Laughing Bird Caye National Park and South Water Caye Marine Reserve.

Table 22: Port Honduras Marine Reserve Management Programmes				
Resource Protection Programme	**Research and Monitoring Programme**	**Environmental Education and Outreach Programme**	**Infrastructure Management Programme**	**Administration Programme**
Surveillance and enforcement ▪ Patrols ▪ Zoning, boundaries and Regulations ▪ Staff ▪ Collaboration ▪ Reporting ▪	Research Programme	Community Participation / Capacity Building ▪ Community Stewardship Programme ▪ Junior Stewardship Programme ▪ Community Researchers ▪ TIDE Scholarship Programme	Staff facilities and maintenance	Finance ▪ Financial Management ▪ Financial Sustainability
Marine Resource Management ▪ Managed Access ▪ Management of Conservation Targets ▪ Addressing threats	Monitoring Programme	Sustainable Development	Visitor facilities and maintenance	Human Resource Management
	Communication and Collaboration	Environmental Education / Outreach	Transportation	Communication and Liaison
		Visitor management ▪ Visitor education and interpretation ▪ Tourism Best Practices		

4.6.1 Resource Protection Programme

The Resource Protection Programme focuses on ensuring the maintenance of healthy, functional ecosystems, through direct management of the marine environment, surveillance and enforcement and direct biodiversity management interventions. This Programme falls under the responsibility of the Marine Manager and rangers. Two sub Programmes have been identified under this Programme:

- **Surveillance and Enforcement**
- **Marine Resource Management**

Programme Goal

To protect the physical and biological resources of Port Honduras through protecting and enhancing key species, habitats and ecosystem functions and services.

Objective 1: To preserve the value of the area for fisheries, through the protection and enhancement of habitats utilised by commercially important species.

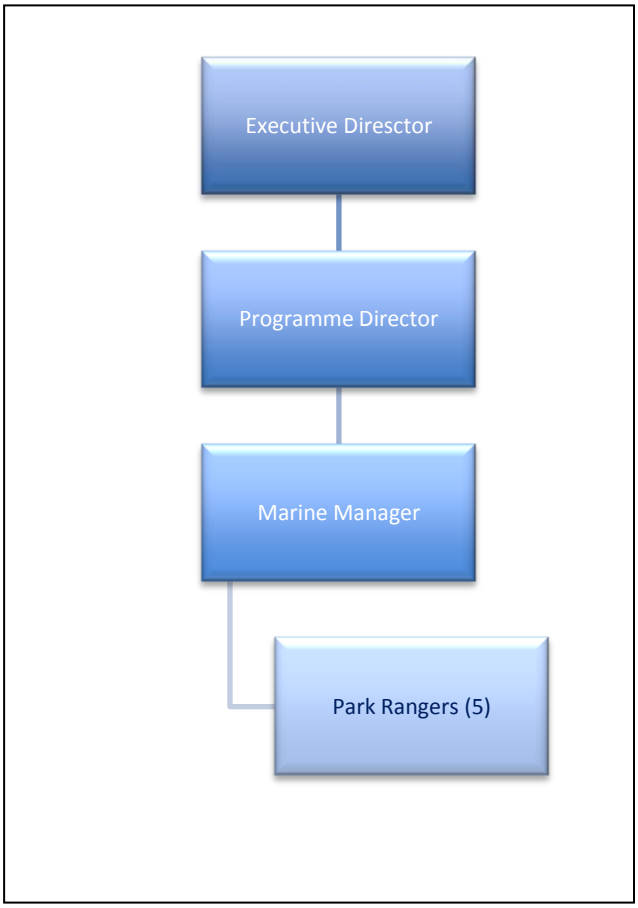
Objective 2: To reduce fishing pressure in the PHMR by 30% by eliminating illegal fishing and illegal fishing methods.

Objective 3: To maintain diverse and healthy fish populations in the rivers of the MMMC.

Objective 4: By 2018, increase commercial species (conch, lobster, snapper, grouper) and parrotfish to viable population levels

Objective 5: By 2015, increase shark numbers by 15% based on 2006 levels, and the population of large (>110cm) Goliath Grouper by 15%, in PHMR based on 2006 levels.

Objective 6: By 2010, have nest monitoring and protection in place for 25% of all known marine turtle nests in PHMR



The **Surveillance and Enforcement Sub-Programme** for Port Honduras Marine Reserve is focused on supporting and upholding the Marine Reserve legislation (Figure 24), and ensuring fishing and tourism rules and regulations are enforced. This is achieved through a number of Programme areas:

- **Patrols**
- **Zoning, boundaries and Regulations**
- **Staff**
- **Collaboration**
- **Reporting**

Specific activities identified to address limitations under this Programme include:

- Increased surveillance and enforcement presence in the area, with a second, larger boat, larger motors and establishment of a second base and surveillance team on West Snake Caye
- Improved demarcation of boundaries
- Implementation of management activities for specific conservation targets, as highlighted under the Conservation Planning section
- Identification of specific management strategies for addressing climate change
- Identification and implementation of carrying capacities for both fishermen and tourists
- Implementation of effective mechanisms for management of lionfish and other invasive species within the MPA and adjacent waters
- Ensure visitor infrastructure such as mooring buoys are effective in reducing tourism boat impacts
- Greater role in enforcement of tourism regulations, in collaboration with BTB
- Addressing impacts from illegal fishing outside the marine protected area
- Engagement of Guatemala and Honduran NGOs towards addressing transboundary issues

Surveillance and enforcement is complicated by the constant presence of transboundary impacts. Incursions by Honduran and Guatemalan fishermen, with traditionally different fishing seasons for lobster and conch, and less sustainable fishing practices (taking undersized product, fishing in restricted areas and with restricted gear, in closed seasons, and fishing without licenses (or with licenses but resident in Guatemala)) provide added areas of conflict that need to be addressed.

CORAL:

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

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

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

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

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

LOBSTER (*Panulirus argus*):

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

MARINE TURTLES:

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

NASSAU GROUPER:

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

GRAZERS:

- No person shall take in the waters of Belize, buy, sell, or have in his possession any grazer (of the genera *Scarus* and *Sparisoma*, commonly known as parrotfish) and *Acathuridae* Family, commonly known as surgeonfish and tangs

FISH FILLET

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

SEA CUCUMBER:

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

GENERAL

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

Figure 24: Fisheries Legislation Regulations

The **Marine Resource Management** sub-Programme has three sub-Programmes:

- **Managed Access**
- **Management of Conservation Targets**
- **Addressing threats**

This addresses strategies such as mechanisms for management of the traditional fishery and specific activities for the management of conservation targets, as highlighted under the Conservation Planning section. It also addresses threats to the viability of biodiversity within the Marine Reserve.

Identified Conservation Targets

- Coral reef communities
- Near shore estuaries
- Seagrass beds
- Large marine vertebrates
- Commercial and recreational species

Primary Threats

- Climate change
- Transboundary fishing incursions
- Overfishing / Unsustainable fishing practices
- Inappropriate land use / Unsustainable development
- Invasive species

Of particular concern is management to address the future impacts of climate change, primarily through site-level interventions to reduce secondary pressures.

Also of importance is the need to address the increasing numbers of lionfish, an invasive species that has the potential to impact commercial fish populations.

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A. Resource Protection Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Surveillance and Enforcement									
Patrols			1	2	3	4	5		
Ensure PHMR has the human resources and equipment for effective surveillance and enforcement	Have 7 staff; Needs; 2 additional staff, 1 25ft vessel and engine	Adequate human resources and equipment for effective surveillance and enforcement						Program and Marine Managers	Second patrol boat and crew, second base on West Snake Caye reduced staff turnover
Conduct daily patrols and surveillance to enforce rules and regulations of the reserve to prevent illegal activities	Ongoing Need to evaluate patrol strategies	Daily scheduled and random patrols of PHMR to prevent illegal activities						Marine Manager	
Disseminate rules and regulations to key user groups on a regular basis	Currently using local and national media to disseminate information;	Users are adhering to the rules and regulations of the reserve						Marine Manager	Need to increase national coverage and communication Radio shows, consultation meetings, presentations in schools, face to face communication with fishermen and tour guide
Strengthen visitor management, and enforcement of visitor rules and regulations	Not all visitors report to the ranger station in PHMR	Effective visitor management, with enforcement of tourism rules and regulations						Marine Manager	Collaboration with BTB / tourism police to capture 100% of visitation to the park
Ensure enforcement of research regulations within protected area in coordination with Fisheries Department	Ongoing	Effective enforcement of research rules and regulations						Marine Manager	Need to ensure Fisheries Department communicate with TIDE regularly regarding research permits granted
Ensure effective surveillance and reporting of illegal development activities within the Marine Reserve	Ongoing	Effective surveillance and reporting of illegal development activities within the Marine Reserve						Marine Manager	Collaboration with DoE and Forest Department

A. Resource Protection Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Surveillance and Enforcement									
Patrols			1	2	3	4	5		
Ensure effective surveillance and reporting of illegal development activities within the Marine Reserve	Ongoing	Effective surveillance and reporting of illegal development activities within the Marine Reserve						Marine Manager	Collaboration with DoE and Forest Department
Sensitize the judicial system, as well as retailers (food industry) to impacts of illegal fishing within PHMR and the wider MMMC	Not started	Judicial and retail sectors sensitized to impacts of illegal fishing						Program and Marine Managers	Meeting with department officials, site visits to PHMR and fish camps, include magistrates in patrols
Zoning, Boundaries and Regulations									
Ensure effective demarcation of MPA boundaries, for visual recognition of boundaries at all points by fishermen	Preservation and conservation zones completely demarcated. General Use zone needs additional buoys.	MPA boundaries effectively demarcated						Marine Manager	Utilizing demarcation buoys and signage to reinforce regulations and integrity of the mpa. Community divers to assist with installation of buoys
Investigate the feasibility of amending the boundaries and zones of the PHMR	Ongoing	Decision reached on feasibility of amending the boundaries and zones						Executive Director, Project Manager, Marine Manager	Stakeholder participation is key in this process
Staff									
Build capacity of rangers	Ongoing	Rangers have the capacity for effective surveillance and enforcement						Marine Manager	Special constable training, law enforcement and chain of custody training, training in boat handling and engine maint., navigation skills, boarding procedures, new fisheries regulation, public relations, first aid, oxygen provider, ranger exchanges, tourism regulations

A. Resource Protection Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Surveillance and Enforcement			1	2	3	4	5		
Staff									
Ensure all PHMR staff are aware of the rules and regulations of the MPA	Completed	All PHMR staff are aware of the rules and regulations of the MPA						Marine Manager	
Provide incentives to maintain qualified, committed and experienced rangers	Ongoing	Reduced staff turnover, with retention of skilled rangers						Executive Director, Project Manager, Marine Manager	Upgrade and upkeep of Abalone Ranger Station, financial and non-financial incentives, food allowance, phone access
Collaboration			1	2	3	4	5		
Maintain strong collaborative partnership between TIDE and Fisheries Department towards effective enforcement – application of laws and regulations	Ongoing	TIDE and Fisheries Department collaborating effectively in areas of enforcement – application of laws and regulations						Executive Director, Project Manager, Marine Manager	Political interference
Continue collaboration with EDF and Fisheries Department towards managed access	Ongoing	EDF is working with TIDE and Fisheries Dept to implement managed access within PHMR						Executive Director, Project Manager, Marine Manager	Political interference
Increase collaboration between rangers and resource users towards increased management effectiveness	Ongoing	TIDE is implementing mechanisms to engage natural resource users towards collaboration in effective management						Marine Manager	Willingness of resource users to collaborate
Strengthen collaborative enforcement against incursions, both within and outside the MPA	Ongoing	TIDE collaborating effectively with partners to reduce incursions						Marine Manager	Fishermen, TIDE, Fisheries Dept., SEA Coastguard, BDF, police dept etc. Focused primarily on transboundary incursions

A. Resource Protection Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Surveillance and Enforcement									
Collaboration			1	2	3	4	5		
Strengthen collaboration with Belize Tourism Board for effective enforcement of tourism legislation within PHMR	Not started	TIDE collaborating effectively with BTB for effective enforcement of tourism Legislation within PHMR						Executive Director, Marine Manager	Limited tourism police in Toledo
Strengthen partnership with Immigration Department, with more effective integration into patrols, to address transboundary incursions	Not started	TIDE collaborating effectively with Immigration Department in addressing transboundary incursions						Executive Director, Marine Manager	Willingness of the Immigration Department to participate
Reporting			1	2	3	4	5		
Maintain patrol log book for PHMR	Ongoing	Patrol log book for PHMR is up to date						PHMR Rangers	
Produce quarterly reports, and submit to Fisheries Department and TIDE	Not started	Quarterly reports are produced and submitted to Fisheries Department						Marine Manager, Marine Biologist	TIDE already submit monthly reports to Fisheries Dept.
Produce Annual Report and submit to Fisheries Department	Ongoing	Annual reports are produced and submitted to Fisheries Department						Marine Manager	
Continue to develop and implement effective mechanisms to ensure a sustainable fishing industry in Belize in collaboration with the Fisheries Department	Ongoing	TIDE is implementing effective mechanisms to ensure a sustainable fishing industry in Belize						TIDE Executive Director, Fisheries Dept, EDF	Eg. Managed Access, quotas and other mechanisms

A. Resource Protection Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Marine Resource Management									
Managed Access			1	2	3	4	5		
Investigate and implement managed access for increasing gain for traditional users within PHMR	Not started	TIDE is implementing managed access						TIDE Executive Director, Marine Manager	In collaboration with EDF. Ensure effective community consultation and buy-in, initiate special licenses and catch shares, train fishers to collect and report catch data
Management of Conservation Targets									
Coral			1	2	3	4	5		
Designate and enforce specific mooring sites and boat access channels to reduce mechanical impacts on corals by boats	Ongoing	Specific mooring sites and boat access channel markers are installed to reduce physical damage to reef						Marine Manager	Need additional mooring sites
Ensure adequate protection of key herbivores to maintain live coral cover and ecological functions	Ongoing	Effective surveillance and enforcement ensures a reduction in illegal harvesting of herbivores						Marine Manager, PHMR Rangers	Tied into increased awareness
Mangroves / Littoral Forest / Sandy Beaches			1	2	3	4	5		
Protect nesting and roosting bird populations through engagement of caye owners / developers, control of visitor access and effective surveillance and enforcement	Not started	Nesting and roosting bird populations have greater protection						TIDE Executive Director, Marine Manager, PHMR Rangers	Engagement of caye owners
Investigate potential for including nationally-owned cayes within the mpa	Not started	Key littoral forest / mangrove are included within mpa						TIDE Executive Director	Coastal Zone Planning / Land Use Planning

A. Resource Protection Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Management of Conservation Targets									
Mangroves / Littoral Forest / Sandy Beaches			1	2	3	4	5		
Work with Forest Department and DoE to ensure remaining mangrove is left intact	Not started	EIAs are reviewed and recommendations submitted. Mangrove regulations are enforced						TIDE Executive Director, Marine Manager	In collaboration with DoE and Forest Department
Commercial and Recreational Species			1	2	3	4	5		
Identify and implement mechanisms to reduce local dependence on marine resources, targeting those communities most impacting the Marine Reserve	Not continuous	Mechanisms are identified under the Community Development Programme						TIDE Executive Director, Project Manager, Marine Manager	In collaboration with relevant Government departments
Collaborate with WCS to increase awareness of non-consumptive value of sharks (tourism and ecosystem) – targeted at fishermen in stakeholder communities	Ongoing	Stabilized shark population stabilize						Marine Manager, Education and outreach Coordinator	
Addressing Threats									
Development			1	2	3	4	5		
Develop and promote guidelines and best management practices among staff, resource users, visitors and caye owners / leaseholders and residents in PHMR and the wider southern reef	Started, needs additional information	Staff, resource users, visitors and caye owners / leaseholders and residents are						Marine Manager, Education and Outreach Coordinator	Develop / adopt 'Best Practice Guidelines' To advise on wastewater management, chemical use and storage, etc.

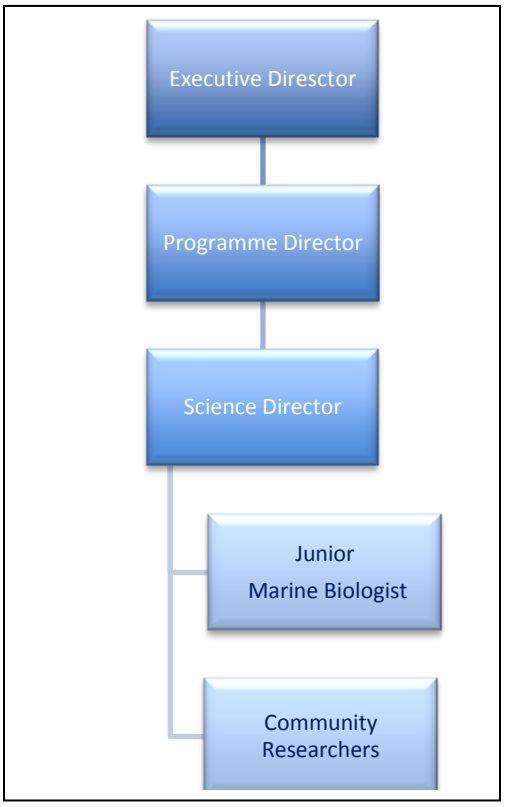
A. Resource Protection Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Addressing Threats									
Development			1	2	3	4	5		
Collaborate with Forest Dept and DoE to ensure compliance with development legislations in PHMR	TIDE is now a member of the NEAC and is able to inform decision making	EIAs are reviewed and recommendations submitted						Marine Biologist, Project Manager	Including dredging of sand/coral, clearance of mangroves, water quality and sedimentation
Transboundary Fishing Incursions			1	2	3	4	5		
Engage NGOs in Guatemala and Honduras through TRIGOH to seek assistance in addressing transboundary issues	TIDE currently chairs TRIGOH							Executive Director	Political will of Guatemala and Honduras to create new laws and enforce existing laws for trans-boundary fisheries management
Oil exploration / extraction / transport			1	2	3	4	5		
Lobby for exclusion of marine protected areas – including PHMR - from oil exploration concession areas	TIDE is a member of APAMO that is lobbying for no oil exploration in MPAs	PHMR excluded from oil exploration area						Executive Director	Political will of GOB
Lobby for creation / adoption of navigation and oil exploration / extraction standards as needed, and enforce all such regulations	Not started; Revisit the MarPol convention	Oil exploration / extraction and transhipment standards are in place and enforced						Executive Director	Working with Geology and Petroleum and Port Authority
Oil exploration / extraction / transport			1	2	3	4	5		
Work with local and national partners to develop an oil spill response plan for mitigation of oil /chemical spills within the PHMR wider southern reef area	An oil spill plan already exists for Belize	An oil spill response plan is in place						Executive Director	GOB needs the resources to implement the plan

A. Resource Protection Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Addressing Threats									
Waste Management			1	2	3	4	5		
Ensure effective waste management through design and implementation an effective waste management plan for Abalone Caye rangers station	Not started	Waste management is effective for Abalone Caye						Executive Director, Project Manager, Marine Manager	High cost of environmentally friendly waste management system.
Implement effective mechanisms for the management of lionfish within PHMR	Not started	Lionfish numbers are reduced within PHMR						Marine Manager	Seek ongoing collaboration from local stakeholders
Invasive Species			1	2	3	4	5		
Work with national partners in the development and implementation of a comprehensive action plan for lionfish management	Started through ECOMAR							Executive Director, Marine Manager	Willingness of partners to network and develop and implement plan.
Strengthen stakeholder awareness, support and involvement in lionfish removal and management especially at key target areas such as sites with high juvenile fish abundance	Started, but needs strengthening							Executive Director, Project Manager, Marine Manager	Investigate potential for regular lionfish removal by eradication teams comprised of local stakeholders
Invasive Species			1	2	3	4	5		
Develop a market for lionfish, in collaboration with local stakeholders	Not started							Project Manager, Marine Manager	Stakeholders need to change the perception that lionfish meat is poisonous

4.6.2 Research and Monitoring Programme

The Research and Monitoring Programme provides ongoing information on the state of the marine resources, to provide information for adaptive management, to assist in prioritising monitoring and research activities, and to inform management decisions. This Programme falls under the responsibility of the Science Director, and consists of four sub programmes:

- **Research Programme**
- **Monitoring Programme**
- **Staff**
- **Communication and Collaboration**



The Program provides information on which to base an ecosystem-based approach to the management and conservation of the natural resources within Port Honduras Marine Reserve. TIDE has a strong and comprehensive monitoring programme, with effective data collection, data management, and preparing and dissemination of reports.

Programme Goal

To implement a clearly documented research and monitoring program that supports ecosystems planning and management in the Port Honduras Marine Reserve and the wider Maya Mountain Marine Corridor.

Key Objectives

- To monitor viability of conservation targets and water quality
- To provide information on the ridge to reef connectivity of the Maya Mountain marine Corridor
- To effectively assess success of no take areas, managed access and PHMR as a whole in maintaining viable populations of key conservation species
- To identify sites/coral species resilience and develop recommended adaptations for climate change

- To establish comprehensive datasets and effective data management and analysis for providing information for informing adaptive management strategies and assessing the management effectiveness of the marine protected area

- To improve engagement of stakeholders of PHMR through involvement in research and monitoring activities within the Marine Reserve, to build capacity improve support for conservation activities.

- To improve capacity and ability of staff, rangers and community researchers to conduct research and monitoring within PHMR

The Research and Monitoring Programme is focused on providing an integrated approach to the conservation of the marine resources of Port Honduras Marine Reserve. With intermittent data sets extending as far back as 1995, when the first surveys were completed (Sullivan *et al.*), a detailed picture of changes within the ecosystems and populations of the Marine Reserve is being constructed, with a view to assessing the efficacy of PHMR and its No-Take zones. Analysis of *S. gigas* and *P. argus* population data, for example, has highlighted inconsistent and minimal differences in abundance between populations within the General Use Zone and No-Take Zones, suggesting that the No-Take Zones are having limited effects on enhancing these fisheries. As a result, consultations have taken place with stakeholders and resource users of the Marine Reserve to assess the possibility of increasing the No-Take Zones, and identify where the new areas should be located.

The Program relies heavily on the assistance of community researchers, with training provided in the skills required to participate in Programme activities.

The **Monitoring Programme** incorporates the following activities to achieve its objectives:

- Water quality (temperature, salinity, dissolved oxygen, conductivity and turbidity), at 17 sites across PHMR on a monthly basis (to be increased).
- Sediment content (not yet implemented - 2011)
- *S. gigas* and *P. argus* populations are surveyed at 16 and 12 sites respectively, at the start and end of the closed seasons.
- Benthic cover, coral health and reef fish populations are assessed twice a year at 8 sites.
- Seagrass beds are assessed at 2 sites on a quarterly basis
- Mangrove community structure and productivity are surveyed at one site on an annual basis.
- Fisheries stock assessment is implemented for all finfish species, *S. gigas* and *P. argus* populations, utilising catch landings at local markets in Punta Gorda and Monkey River, and the Rio Grande Fisheries Cooperative in Punta Gorda.
- Sea Turtle Monitoring Programme – in-water and nesting
- Sea bird monitoring (monthly – not yet implemented-2011)
- West Indian manatee (opportunistic sightings - not yet implemented-2011)
- Habitat mapping
- Sea cucumber (6 sites - not yet implemented-2011)

Summary of TIDE's Monitoring Programs: 2011/12 (J. R. Foley, 2011)

1. Water Quality Monitoring Program:

Background: TIDE has been implementing a marine and freshwater quality monitoring program with varying degrees of continuity since 1998. In 2011, TIDE's Research and Monitoring Department committed to expanding its Water Quality Monitoring Program to include both new sites and new parameters, and has coordinated its marine and freshwater quality monitoring programs, with the aim of demonstrating interconnectivity between land and sea and creating a more comprehensive picture of the impacts of terrigenous runoff on the marine ecosystems in PHMR. This information informs "Ridge-to–Reef" management of the natural resources TIDE protects. In addition to the existing 17 marine sites within PHMR, an additional 10 sites have been placed in strategic locations in and outside the reserve.

Considerable effort and investment has gone into building TIDE's capacity to conduct nitrate and phosphate nutrient analysis of all marine and freshwater monitoring sites, including developing a comprehensive and revised Water Quality Monitoring Manual (Russell, 2011), arranging repair of previously damaged equipment, assessment of new equipment needs and purchase, methods development, staff training in laboratory skills, and training in analysis and interpretation. Nutrient analysis is now being incorporated alongside pH, temperature, salinity, dissolved oxygen, turbidity and rainfall data at both marine and riverine sites.

Additionally, discussions have begun on coordinating the respective water quality monitoring programs of TIDE, Ya'axche and SEA, with the aim of producing the first regional level ridge-to-reef water quality monitoring effort for southern Belize. Objectives of this include coordinating monitoring dates, comparing readings of respective equipment to ensure calibration, standardisation of sampling methods across all three organisations, sharing of laboratory facilities to reduce error in sample processing, sharing of water quality data between organisations, and coordinated reporting. Regional data analysis capacity building is to be achieved through the development of the Environmental Research Institute's (ERI's) central online database facility, which is still in its infancy, but aims to become the central clearing house and analysis engine for all environmental research in Belize. This will enable the use of regional level solutions to regional level impacts.

Objectives:

- To establish baseline water quality conditions including normal ranges of seasonal variation and periodic fluctuations.
- To use temporally large datasets to recognize trends in water quality, and through analysis of this data, to determine which trends are of natural occurrence and which result from anthropogenic, catchment specific activities.
- To use this information to support a "management-informed-by-research" approach in conserving the natural environment for the present and future users of PHMR, PCNP, and TPPL.

Methodology:

Parameters Measured

Marine

- Water Temperature
- Salinity
- pH
- Dissolved Oxygen
- Total turbidity (Vertical Visibility)
- Nitrate-Nitrogen
- Orthophosphate-Phosphorus

Freshwater

- Water Temperature
- Salinity
- pH
- Dissolved Oxygen
- Total turbidity (Vertical Visibility)
- River Discharge Rate
- Nitrate-Nitrogen
- Orthophosphate-Phosphorus

Weather station parameters (for use in both marine and freshwater data analysis):

- Air Temperature
- Rainfall
- Weather
- Wind Direction
- Humidity
- Atmospheric Pressure

Water Temperature: Measured at the surface, 5m, 10m and 15m depth at all marine sites (depth permitting) at each site using a YSI550A sensor.

Salinity: Salinity refers to the amount of salt in the water, and is currently measured with a refractometer, with plans to replace this with an electronic sensor when funds become available, so that salinity readings can be taken at multiple depths. Further details of exact procedures can be found in Russell 2011.

pH: pH is a measure of acidity. It is measured with a YSI 63 sensor, at the surface, 5m, 10m and 15m (depth permitting). Further details of exact procedures can be found in Russell 2011.

Dissolved Oxygen: Dissolved oxygen (DO) is oxygen that is dissolved in water and is essential for most plants and animals that live in water. Equipment used to monitor is the YSI 550A. Further details of exact procedures can be found in Russell 2011.

Turbidity: The term "turbidity" refers to the "cloudiness" of water. Equipment used to monitor turbidity is a Secchi Disk or Secchi Tube (for river samples, and marine samples where the depth of the water is insufficient for the Secchi Disc to get descend deep enough to no longer be visible).

Nitrate–Nitrogen: Nitrogenous compounds (e.g. nitrites, nitrates & ammonia) are essential components of life. Nitrogen is recycled continually by plants and animals, and is found in protein in the cells of all living things. Excess nitrate is introduced into a body of water typically as runoff from various sources when it rains. Sources include agricultural fertilizer, livestock, unmanaged or partially managed sewage, animal wastes (including fish and bird waste), aquacultural waste, and discharges from car exhausts and industrial waste (Cushion 2004). In excess amounts they can cause significant water quality problems. Method for analysis is the Cadmium Reduction Method (Method 8039 from Hach Procedures Manual) (Russell, 2011).

Phosphate-Phosphorus: Phosphate in water bodies comes from fertilizers, pesticides, wastes from laundries, industry, and cleaning compounds that are leached into the water. Phosphate also occurs naturally from solid or liquid wastes such as human and animal wastes (one human body releases approximately 0.5kg of phosphorus per year (The Hach Company 2006)) and phosphate-rich rocks. TIDE tests for ortho (reactive) phosphate because it is the form which plants utilize; therefore, the most cost effective way of gauging eutrophication (The Hach Company 2006). Method for analysis is the PhosVer3 Ascorbic Acid Method (Method 8048 from Hach Procedures Manual) (Russell 2011).

2. Lobster Monitoring Program

Background: Lobster is one of PHMR's most valuable resources, accounting for 57% of the commercial value of the entire fishery in PHMR (Robinson et al. 2003). Thus, the livelihood of many fishermen depends on the sustainability of this crustacean. Acosta & Butler (1997) determined that the monitoring of benthic habitats in combination with lobster populations is important, due to the densities of different size classes of spiny lobster being linked to the distribution of benthic habitats. Lobster larvae are widely dispersing, spending much time in the open ocean, thus making it more difficult to set priority conservation areas.

Objective:

- To monitor size, distribution and relative abundance across different management zones in and outside the reserve, at the beginning and end of the Lobster closed season (February 15th – June 14th), in order to determine the effectiveness of TIDE's management and enforcement efforts relating to lobster, and to identify problem areas relating to both illegal fishing and enforcement gaps.

An extensive baseline study of the ecosystems and commercial species within PHMR was undertaken in 2003 by Robinson et al. (2004) and since then a comprehensive monitoring program has been in force. Over time, the monitoring program has gradually been extended to include additional sites and activities both inside and outside the no take zones and it now provides an ecosystem-based approach to the management and conservation of the natural resources within PHMR. As of 2008, the data collected during past and current surveys are being analysed on a regular basis and fed back into the management of the reserve in order to assist in prioritising monitoring and research programs. The analysis of the data and incorporation of the information into management has led to a more integrated approach to the conservation of PHMR.

Methodology: Caribbean Spiny Lobster (*Panulirus argus*) and Spotted Lobster (*Panulirus guttatus*) populations are surveyed at 19 sites within the Port Honduras Marine Reserve twice a year, immediately before and after the closed season from February 15 to June 14. Seven sites are located in the **General Use Zone (GUZs)**, 8 in the **No-Take Zones (NTZs)** and four sites **outside the reserve (OUTs)**. At each site, either two 30 minute timed swims are conducted simultaneously by two diver pairs or a 60 minute timed swim is conducted by a single diver pair. For each lobster located, species, sex, maturity (tar spot, eggs) and carapace length are recorded. The number of sites surveyed in each zone varies between monitoring periods and years for a number of reasons (resources, weather, visibility). To allow comparisons to be made between the zones and years, average numbers of lobster are used in the statistical analysis.

3. Conch Monitoring Program

Background: The Queen Conch (*Strombus gigas*) is the second most valuable fishery in southern Belize (Heyman & Hyatt 1996). The Queen Conch has been over fished severely and harvested illegally, and the fishery has been in danger of becoming unprofitable, as evidenced by the move of some fishers into the Sea Cucumber market. There is a need to monitor size distribution and relative abundance across different management zones in and outside the reserve, in order to determine the effectiveness of TIDE's management and enforcement efforts relating to conch, and to identify problem areas. This will improve patrolling through better informed, targeted patrols, and improve fisheries management through awareness of the impact of conch extraction on size, abundance and distribution of conch.

Objective:

- To monitor size, distribution and relative abundance across different management zones in and outside the reserve, at the beginning and end of the Conch closed season (July 1st – September 30th), in order to determine the effectiveness of TIDE's management and enforcement efforts relating to Conch, and to identify problem areas relating to both illegal fishing and enforcement gaps.

Methodology: The Conch closed season runs from July 1st to September 30th each year**.** Monitoring takes place twice each year just before the conch season closes in June, and shortly before it opens again in September.

Data are collected from 20 sites as of 2011. Sixteen (16) sites are monitored inside the reserve and four (4) outside the reserve. This is in order to enable cross-comparison between areas inside **No Take Zones (NTZs)** where extraction of conch is not permitted, areas in the **General Use Zone (GUZs)**, where size and season restrictions are in place, and areas **outside the reserve (OUTs)**, where regulations equal to those inside the GUZ are in place but enforcement is not carried out by TIDE. These four new sites were chosen based on knowledge of where local fishermen seek conch outside the reserve.

At each site, where possible (i.e. depth and habitat permitting), five 50 x 2 meter belt transects are laid parallel to one another and at least 5 meters apart. All queen conch (*Strombus gigas*) encountered on the transects are measured and data regarding species, maturity (adult or juvenile), shell length and lip thickness are recorded.

Milk conch (*Strombus costatus*) were also recorded until June 2011 in anticipation of it becoming commercially viable (Robinson et al. 2004), but this has now been discontinued as this species is still not considered to be harvested commercially, and therefore it is felt that monitoring of this species does not warrant the extra time, effort, cost and analysis it requires.

Data are analysed for species density (conch per hectare) and shell length before and at the end of the closed season. This provides information on the impact of extraction during the open season on the different management zones in and out of the reserve. This in turn enables recommendations to be made regarding management effectiveness in the different zones.

4. Sea Cucumber Monitoring Program

Background: Sea cucumber monitoring is one of the most recent additions to TIDE's Research and Monitoring Program. This represents the first sea cucumber monitoring effort in Belize. Implementation has been in response to the issuing of sea cucumber fishing licenses to fishers that use PHMR. No baseline data on fishery carrying capacity has been done prior to extraction of sea cucumbers, and therefore there is no knowledge of the ecological function within the reserve or the impacts of their extraction on associated ecosystems. Very little is known within Belize about sea cucumbers, as they were not until very recently a commercially valuable product. That has now changed as a result of dwindling stocks of more traditional commercial species, driving some of the more entrepreneurial local fishers to explore the market in foreign exports.

Objective:

- To monitor size, distribution and relative abundance across different management zones in and outside the reserve, at the beginning and end of the Sea Cucumber closed season (July 1st – December 31st), in order to determine the effectiveness of TIDE's management and enforcement efforts relating to Sea Cucumber, and to identify problem areas relating to both illegal fishing and enforcement gaps.

Sea cucumbers hold little to no commercial value in Belize, yet fetch high prices in Asia. Asian buyers are now exploring sea cucumber fisheries worldwide in an effort to meet the huge demand in China and Southeast Asia. Local fishers in Belize are probably unaware of the mark up in value once sea cucumbers reach their export destination, and are therefore likely selling their product for far less than it goes for in Asia. Furthermore, Belizean fishers and the Belize Fisheries department are not yet familiar with which species are highly commercially valuable, and so currently all sea cucumber species are being harvested unnecessarily without distinction in value.

There is potential for addressing a number of ecological and socioeconomic objectives as a result of this monitoring program, including sustainable polyculture, which could alleviate pressure on wild populations, mitigate impact of shrimp farm effluent, and provide livelihoods for PHMR buffer communities that allow them to maintain a cultural connection to the ocean. This is the first year that sea cucumbers have ever been harvested in PHMR, and therefore time is of the essence to understand their ecological role and current and potential socioeconomic role before sea cucumbers become yet another overfished species. A partnership with Dr. Steve Cross of the University of Victoria in Canada will potentially bring significant funding into this program in the near future. Details about this will be available in the coming months.

Methodology: Currently, sampling is being collected at the start and end of the sea cucumber season (1st July – 31st December) at six sites in PHMR, using a technique based on that of Amesbury & Kerr (1996). First, different habitats in PHMR are stratified to determine habitats suitable for sea cucumbers in PHMR. Then, within those stratifications, monitoring sites are determined randomly. A 11.28m line (area of a circle = πr^2 → $400m^2/\pi = 127.32$; $\sqrt{127.32} = 11.28m$) is attached to a central pole , and two divers swim the line around the pole in a "radar sweep" trajectory covering $400m^2$ of habitat in the process. When sea cucumbers are encountered, they are identified to species level, length is measured while being careful not to touch the specimen (which might cause it to retract), and then the specimens are brought up to the boat to be weighed, and then returned to the locations they were found. Number of each species of sea cucumber per hectare is calculated to acquire population density of key species. Mean length and weight are calculated to determine mean sizes in different management zones.

5. ***Sedimentation Monitoring Program***

Background: Seven major watersheds drain into PHMR, contributing extensive amounts of fresh water into this coastal lagoonal environment. The resilience of adjacent marine ecosystems and the ecological and economic goods and services that they support is therefore directly dependent of the continued health of these associated watersheds. There is a need to improve understanding of the degree to which the respective watersheds draining into PHMR are contributing to sedimentation rates within the reserve. This will supplement the existing turbidity reading activities to allow inferences to be made regarding the impact of anthropogenic activities such as gravel mining and plantation agriculture on marine habitats in the reserve. In future, funding permitting, stable

Objectives:

- Determine sedimentation rates throughout PHMR to better understand the sedimentation load trends stemming from watersheds draining into PHMR.
- Supplement turbidity readings acquired using the Secchi Disc with measurements of the rate of sedimentation over time.
- In future, should funds become available, stable isotope analysis can be conducted on the samples to determine potential specific origins of anthropogenic contaminants contained within the sediment. This should allow more accurate inferences to be made regarding activities and sites of particular concern.

isotope analysis of organic material in the sediment samples, as well as contaminant analysis will enable specific sources of contamination to be pinpointed. This will in turn improve management decisions relating to the areas under TIDE's protection. TIDE began conducting sedimentation monitoring in October 2011.

Methodology: TIDE's sedimentation methodology is based on Method 3.4 "*Methodology to Assess Sediment Deposition"* in the MBRS manual, with some modifications made to suit the specific habitats found in PHMR. The use of tube traps as described below is a simple and inexpensive method to address these research questions, creating a volume of still and protected water into which sediments fall and remain, thus providing an undisturbed record of sedimentation.

Tube traps (cylindrical, ~5cm diameter x 30cm long) are secured to stakes at 1m above the substrate, and at least a couple of meters below the surface of the water in calm areas and deeper at more exposed sites. At the end of each month (approximately every 30 days) traps are capped underwater and brought to the laboratory. Any small organisms and other large non- sediment material are removed from the sample with tweezers and a Buchner funnel. Samples are filtered by pouring through a Whatman glass fibre filter using a funnel. Samples are rinsed several times to remove salt and other impurities, by running distilled water gently through the filter. Sediment plus organic material is dried in the filters in a drying oven at 70°c until a constant weight is obtained. Samples are weighed, then incinerated to remove organic material and reweighed. Sedimentation rate is calculated as mg of sediment per cm^2 per day. The sediment weight is the total weight minus the filter weight and organic material weight, and the area of the trap opening is πr^2 (r = radius in cm).

6. Benthic Cover and Coral Health

Background: Coral reefs are an essential component of the Port Honduras Marine Reserve and the health of coral reef habitats has a significant influence on the vertebrate and invertebrate populations that inhabit them. Most importantly, healthy coral reefs, in conjunction with seagrass and mangrove habitats, support larger populations of species compared to unhealthy reefs.

Objective:

- To assess benthic cover, live coral cover and coral health.

Methodology: A total of 8 sites within the Port Honduras Marine Reserve are surveyed twice a year to assess benthic cover, live coral cover and coral health. To assess benthic cover and estimate live coral cover, a minimum of five 30 meter point intercept transects are conducted at each site. The transects are laid parallel to one another at a minimum of five meters apart and benthic cover is recorded every 25cm (coral and algae are recorded to species level if possible). To assess coral health, a minimum of 50 colonies (hermatypic coral species) are surveyed at each site. Each coral colony surveyed has to be >10cm in diameter and measurements of height, width, length, mortality (recent and old), disease and bleaching are recorded.

7. Reef Fish Abundance

Background: Reef fish are essential components of a healthy coral reef ecosystem. Herbivorous fish maintain areas free from macroalgae to enable settlement of coral recruits, while other species maintain the balance between the trophic levels within the ecosystem.

Objectives:
- To determine changes over time in reef fish abundance, in order to inform management decisions relating to PHMR.

Methodology: A total of 8 sites within PHMR are surveyed twice a year to assess adult and juvenile fish abundance. At each site, fish abundance is assessed through a 30 minute rover diver swim, where all fish species encountered are recorded. In addition, eight, 30 x 2 meter transects are laid across the reef and the number and approximate size of adult fish and juvenile fish encountered on the transect are recorded.

8. Fisheries Stock Assessment

Background: The original concept for a fisheries stock assessment of PHMR was devised by TIDE and TNC with guidance from Louisiana State University in 2007, in order to determine optimal commercial and sport fishing exploitation of the stocks. Various methodologies were considered and discussed during 2008 and in January 2009, the first funding was received from TNC to conduct data collection. Data has been collected consistently since January 2009 to the present and will continue to be collected through June 2010.

Objectives:
- To determine the carrying capacity of commercial and sport fishing in Port Honduras Marine Reserve
- To determine the CPUE of fishing activities in PHMR
- To estimate the amount of catch being exported from PHMR to Guatemala and Honduras.

Methodology: Catch landing surveys are conducted once a week at Monkey River Village (1 researcher), Punta Gorda market (2 researchers) and Rio Grande Fisheries Cooperative (1 researcher) by community researchers.

In addition, catch landings are surveyed on foreign vessels within PHMR on four consecutive days each month by TIDE's Junior Marine Biologist and a Community Researcher. These surveys entail full days out on the water, for four consecutive days, so to save on fuel the researchers stay over at the station on Abalone Caye. The surveys are conducted on the boats to try to obtain a figure of the amount of catch being exported from PHMR to Guatemala and Honduras. Researchers are provided with a scale, measuring board, calipers, towel, data sheets and pencils.

For each fisherman surveyed the following information is recorded, where possible: date/time, boat name/number, crew size, area fished, hours fishing, names of fishermen, gear type, depth fished and if the total catch is recorded and measured during the survey (some may have previously been sold). During all surveys in the field and markets, conch, lobster and all finfish species are recorded and measured. For finfish, fork length and tail length are also recorded where possible. For lobster, carapace length, tail length, segment width, sex and reproductive stage are also recorded where possible. For conch, shell length, lip width, lip thickness and maturity are recorded where possible.
All data collected are entered into a database which converts lbs/oz to kgs and inches to cm, and information for finfish regarding the scientific name and family are also entered.

9. Seagrass Monitoring

Objectives:

- To measure change in seagrass distribution, species composition and abundance over time:

Background: The importance of seagrasses and their role in coastal marine ecosystems has been realized much later than for coral reefs and other more studied environments, probably due to being aesthetically less impressive to the untrained eye. Closer inspection has revealed them to be vital to the resilience of associated ecosystems due to their role in species and energy interconnectivity. Seagrasses are critically important habitats for the fulfillment of many natural cycles, from the production of oxygen, to their function as nursery habitat for juvenile reef fish, as well as their coastal protection capacity through wave energy attenuation and their ability to mitigate the impacts of anthropogenic activities on land by absorbing large quantities of agrochemicals and sewage inputs that find their way into coastal waters via watersheds. These attributes also work their way into multiple socioeconomic benefits, by limiting impact of man's activities on the reefs which support their livelihoods, and more directly through modern economic activities such as sport fishing. Furthermore, seagrasses are important habitat for a number of marine mega-fauna species, including endangered sea turtle species and the locally renowned manatee.

Seagrass beds are threatened by a number of anthropogenic stressors. They are highly vulnerable to bottom trawling activities for harvesting of shrimp and other benthic species, as well as the tendency in tourism zones to remove seagrass adjacent to beaches for aesthetic purposes. Eutrophication, which can cause algal blooms, prevents light from penetrating to the sea floor, thereby interrupting photosynthesis and causing mass die-offs of these benthic, oxygen-producing plants. Subsequent anaerobic bacterial composition of the decaying plant matter can lead to hyper-anoxia in the benthic zone, in turn causing widespread death of many other benthic species. As the plant matter decays, the structure of the seafloor can become unstable, leading to mass resuspension of sediments, and subsequently an overall reduction in water quality. Loss of nursery habitat for juvenile reef species leads to fewer reef fish, nutrient-loaded coastal runoff reaching normally oligotrophic waters surrounding reef habitats and degrading coral reefs, and an increase in coastal erosion.

PHMR is very fortunate in that extensive seagrass beds remain in excellent condition, largely due to relatively low trawling pressure, minimally impacted associated watersheds, and low tourism pressure. It is important to understand their role in maintaining the health of the overall marine ecosystem and the ecological and socioeconomic goods and services that they support, in order to advocate for their protection and improve the management of this habitat and the organisms that depend upon them for their survival.

Methodology: The following parameters are measured:

- ***Distribution*** via position of seagrass relative to permanent transect (from the shore outward, with three 50m cross transects)
- ***Species composition*** via collection along permanent transect
- ***Abundance*** via measurements of cover, canopy height, density, & biomass

Seagrass is monitored at two sites on a quarterly basis in conjunction with Seagrass Net. At each site, three permanent transects are surveyed and measurements of seagrass species, percent cover, density, canopy height and grazing are recorded in 12 random quadrats placed along each transect. Seagrass specimens and sediment samples are collected from each transect. Temperature and light loggers are deployed at the shallowest and deepest transects, continuously recording data in between sampling periods.

10. Mangrove Monitoring

Objectives:

- To monitor changes in mangrove health at key sites in PHMR, to improve management and protection for continued function as nurseries, sediment settling and coastal protection.

Background (adapted from Cushion et al. 2004): Mangroves perform a vital ecological role by providing habitat for a wide variety of species and the dominant vegetation type within PHMR is the mangrove, Red Mangrove (*Rhizophora mangle*) being the most abundant. The importance of these communities to the ecological functioning of PHMR cannot be stressed enough, especially in terms of habitat for commercially valuable species (e.g. permit, snook, lobster, snappers, jewfish, etc). Many species, though not permanent mangrove inhabitants, make use of mangrove areas for juvenile habitat, foraging, breeding, and other activities. Mangrove canopies and aerial roots offer a wealth of habitat opportunities to many species of estuarine invertebrates. Barnacles, sponges, mollusks, segmented worms, shrimp, insects, crabs, and spiny lobsters all utilize mangrove prop roots as habitat for at least part of their life cycles. Additionally, mangrove roots are particularly suitable for juvenile fishes.

In terms of productivity, mangrove litter contributes greatly to local fisheries in terms of nutrition. Mangrove productivity is affected by both direct impacts, such as clearing, and indirect impacts such as pollution and hydrological interference. Baffling by mangrove root systems provides a physical trap for fine sediment with loads of heavy metals and other toxicants.

Current threats to mangroves in PHMR include upstream development, encroachments (fishing camps, housing, squatting on the coast and cayes) and clearing for development. Through the maintenance of an appropriate level of mangrove productivity, it will be possible to maintain the ecological integrity of the mangrove ecosystem.

Methodology: An annual assessment of mangrove health is undertaken at East Snake Caye during July. Community composition (species, tree height and diameter) is recorded for 3 plots within the mangrove. In addition, productivity of each plot is estimated by collecting leaf litter over a one month period.

B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
General									
Ensure the Research and Monitoring Programme is equipped and staffed for effective programme management and strategy implementation	Programme is equipped and staffed, but equipment requires maintenance or replacement	The Research and Monitoring Programme is equipped and staffed for effective programme management and strategy implementation						Science Director	The Programme is to be allocated a dedicated boat. Equipment is repaired / replaced as necessary (see Infrastructure Management Programme).
Ensure adequate baseline data is available for management decisions	Adequate baseline exists for the majority of monitoring targets. New targets still require a baseline.	Adequate information is available for input to management decisions						Science Director	Particularly in areas such as water quality (particularly upriver pollution sources), climate change adaptation, limits of acceptable change, that are not yet fully addressed
Review the current Research and Monitoring activities and revise where necessary	Currently under revision	Effective Research and Monitoring outputs are providing input into adaptive management decisions						Science Director	Continued monitoring of national indicators; addition of external monitoring sites and monitoring for climate change
Ensure all staff (particularly rangers) are fully engaged, and understand the reasons behind research and monitoring, and can articulate major research and monitoring outputs (state of reef, state of fish resources etc.)	Needs to be improved	PHMR staff (particularly rangers) are fully engaged and have a good understanding of the reasons behind research and monitoring						Science Director Marine Manager	Relevant staff members are aware of, and can articulate, major research and monitoring outputs (state of reef, state of fish resources etc.)
Review and evaluate the PHMR management plan on an annual basis, and revise if necessary	The PHMR management plan is completed	The PHMR management plan is reviewed and evaluated on an annual basis,						Science Director	based on findings from the research and monitoring programme, and updated / revised when necessary

B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
General									
Identify new monitoring sites outside the mpa boundary	Sites have been identified, monitoring not yet implemented	PHMR has identified new monitoring sites to provide data from inside and outside the MPA boundaries for comparison, to identify mpa effectiveness in conserving marine resources						Science Director	Sites in proposed extension and new NTZ. Outside MPA boundary OAK
Increase knowledge of resource use and occupancy – status of cayes (private property / leasehold),	Some data is available for the cayes, but not all	TIDE has increased knowledge of resource use and occupancy – status of land (private property / leasehold),						Programme Manager	
Strengthen visitation data collection	Limited data is available on visitation	TIDE has increased knowledge of visitation						Marine Manager	
Strengthening of data collection on extractive use of the area (legal and illegal)	Data available on legal extractive use (catch landing data)	TIDE has increased knowledge of data collection on extractive use of the area (legal and illegal)						Science Director	
Integrate monitoring and research results into the adaptive management process	Monitoring and research results are effectively integrated into the adaptive management process	Monitoring and research results are effectively integrated into the adaptive management process						Project Manager	

B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
General									
Investigate feasibility of installing dedicated Research and Monitoring building for the Programme	Planned for the 2nd / 3rd year	A dedicated building has been constructed for the Research and Monitoring Programme						Science Director	
Research Programme									
General			1	2	3	4	5		
Identify priority research activities in the PHMR, and identify partners / locate funding for implementation	Ongoing	TIDE has identified priority research activities in the PHMR, and engaged partners / located funding for implementation						Science Director	Including seabirds, nesting turtles (possibly turtles in the water), baseline for sea cucumbers, and integration of climate change
Continue to update baseline species lists for fish, corals, birds and other vertebrates and invertebrates of the protected area	To be started	Baseline species lists for fish, corals, birds and other vertebrates and invertebrates of the protected area are maintained and updated as necessary						Science Director	
Consult with Fisheries Dept. to develop a mechanism to ensure effective communication between Fisheries Department and TIDE during the process of granting research permits	TIDE is not always included within the permitting process	Research permits are granted through a process of liaison and collaboration between Fisheries Dept and TIDE						Executive Director	In collaboration with Fisheries Department

B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Research Programme									
General			1	2	3	4	5		
Develop a written agreement for research use of the area, including rules, regulations and guidelines, to be signed by all researchers using the Marine Reserve	No such agreement exists	A written agreement exists for research use of the area, including rules, regulations and guidelines, signed by all researchers using the Marine Reserve. To include the current data sharing agreement.						Science Director	In collaboration with Fisheries Department to avoid situations such as past research on Sooty Terns, which provided results but also resulted in the Sooty terns abandoning the nesting caye.
Ensure all research conducted within Port Honduras Marine Reserve is conducted in accordance to the rules and regulations and agreed research protocols, including research conducted by TIDE and its research partners	No such agreement exists	Effective surveillance and enforcement of research guidelines and regulations is in place, ensuring minimal impacts from research activities						Marine Manager PHMR Rangers	In collaboration with Fisheries Department. Training of rangers in rules and regulations
Investigate the feasibility of and mechanisms involved for hosting student research groups	Currently conducting volunteer programme feasibility study	TIDE is effectively hosting student research groups and has increased its income as a result						Science Director	International student research groups are seen as a potential income earning mechanism, though would need a supporting network
Applied Research			1	2	3	4	5		
Assess the diversity and abundance of shark species within PHMR, in collaboration with the SBRC initiative	No current baseline	TIDE has baseline knowledge of the diversity and abundance of shark species within PHMR,						Science Director	In collaboration with SEA / SBRC / WCS TIDE is collaborating towards knowledge at seascape level

B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Research Programme									
Applied Research			1	2	3	4	5		
Identify areas with / without resilience to climate change within PHMR in the context of the wider seascape	TIDE is in the process of identifying resilient reefs within PHMR…any reef that is in PHMR needs to be relatively resilient to survive	TIDE has identified resilient areas within PHMR in the context of the wider seascape						Science Director	In collaboration with SEA / SBRC
Identify coral recruitment sources for PHMR, and identify mechanisms to ensure that these are adequately protected, if necessary	Not the highest priority	TIDE has identified coral recruitment sources for PHMR, and mechanisms to ensure that these are adequately protected, if necessary						Science Director	Regional collaboration
Characterize water currents critical for larval dispersal (for coral and fish recruitment) at PHMR	Not yet implemented	TIDE has knowledge of water currents critical for larval dispersal (for coral and fish recruitment) at PHMR, and has developed management decisions based on this information						Science Director	
Provide opportunities for UB and other Belize students to assist with research activities	Ongoing	UB students projects are assisting TIDE in addressing identified research gaps						Science Director	With integrated training to ensure data accuracy and analysis

B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Monitoring Programme									
General			1	2	3	4	5		
Continue to integrate community researchers into the Monitoring Programme activities	Ongoing	Community researchers continue to be integrated into Monitoring Programme activities						Programme Manager Science Director Marine Manager Education and Outreach Officer	Turtle watch program will foster community development in Punta Negra
Identify mechanisms to maintain the motivation and engagement of community researchers	Ongoing	Community researchers continue to be engaged and active, over the long term activities						Development Director	Through involvement in projects, with training, stipends and other incentives
Ensure mechanisms are in place for easy access to monitoring data and quarterly and annual data summaries	Ongoing	Monitoring data and quarterly and annual data summaries are easily accessible						Science Director	Data is on central server, organized and accessible to those who need it
Integrate monitoring of limits of acceptable change indicators within the monitoring framework	Not	Limits of acceptable change indicators are integrated within the monitoring framework, and effectively monitored						Science Director	
Develop Limits of Acceptable Change monitoring framework and integrate into monitoring activities	A start was made, but needs review and revision	A Limits of Acceptable Change monitoring framework has been developed and is integrated into monitoring activities						Science Director	

B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Monitoring Programme									
Water Quality Monitoring			1	2	3	4	5		
Conduct monthly water quality monitoring at multiple sites inside PHMR, outside the MPA, and at freshwater sites in the MMMC watersheds	Ongoing, but sites outside MPA currently monitored, and would like to also include other parameters – nutrients, agrochemicals and heavy metals	Water quality is monitored accurately and consistently, and results are used to inform management decisions						Science Director	
Deploy and monitor 3 sediment traps at 6 sites in PHMR	Implementation to start in 2011	Information on of the level of sedimentation within PHMR from the estuaries to the Snake Cayes, and variation in sedimentation over the wet and dry seasons, to inform management decisions						Science Director	
Monitor in-water nutrient levels and relative algal growth on a regular basis to monitor anthropogenic impacts, particularly in high visitor-use areas	To be implemented in 2011	In-water nutrient levels and relative algal growth are monitored on a regular basis, particularly in high visitor-use areas, and results inform management decisions and actions						Science Director	To be incorporated into limits of acceptable change. To include water by Abalone Caye
Implement effective water quality monitoring of agro-contaminants at mouth of Monkey River during storm events	No rapid response mechanism in place	TIDE and Monkey River have an understanding of the impacts on the water quality of the Monkey River						Science Director	

B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Monitoring Programme									
Coral and Reef Fish									
Monitor coral and reef fish twice a year in GUZ, NTZ, & outside reserve - 8 sites in total = 5 GUZ, 5 NTZ, 5 Outside	Ongoing at 8 sites within MPA, new sites to be implemented in 2011	Coral and reef fish are monitored accurately and consistently, and results are used to inform management decisions						Science Director	
Conduct bleaching surveys during critical periods	Ongoing	Bleaching surveys are conducted during critical periods						Science Director	Usually August through February. ECOMAR funding
Monitor fish landings through the cooperatives	TIDE is engaging Rio Grande Cooperative in monitoring of fish landings – just starting	Effective collection of fish landing data						Science Director	Fisheries Dept should also have long term data from the cooperatives Also to be integrated into Managed Access agreements
Marine Turtles									
Map all nesting beaches indicating species, number of nests, reproductive success and monitor nests from June to October	Programme being launched in 2011. Nesting beaches to be mapped in 2011	Nesting beaches have been mapped and nesting / reproductive success data collected on an annual basis						Science Director	Volunteer programme Share data with ECOMAR
Conduct in-water turtle surveys monthly within PHMR	Programme being launched in 2011. Nesting beaches to be mapped in 2012	In-water turtle surveys are conducted monthly within PHMR						Science Director	. Share data with ECOMAR Volunteer programme
West Indian Manatees									
Conduct manatee sightings surveys monthly within PHMR	Current monitoring is opportunistic	Manatee sightings surveys are conducted monthly within PHMR						Science Director	Volunteer Programme Share data with the Marine Mammal Stranding Network

B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Monitoring Programme									
West Indian Manatees									
Respond to manatee stranding reports as an active member of the Marine Mammal Stranding Network	Ongoing	TIDE participates as an active member of the Marine Mammal Stranding Network						Science Director	Activities include necropsies and calf rescue Share data with the BMMSN
Sea Cucumbers									
Conduct an assessment of Sea cucumber populations and distribution within PHMR	In 2011	TIDE has knowledge to effectively manage sea cucumbers within the MPA						Science Director	Number and size, growth rate and reproductive cycle of the sea cucumber (OAK)
Ecosystems									
Update habitat map of PHMR and surrounding areas (within 4km of reserve boundary) to include critical areas/nursery grounds	Ongoing	Habitat map of PHMR and surrounding areas is updated, and includes critical areas/nursery grounds						Science Director	OAK Including mapping of buffer area within 4km of reserve boundary
Map extent of critical littoral forests of Southern Belize	No capacity to map – only ground truth	Map of critical littoral forests of Southern Belize, to assist improved management						Science Director	Information to assist where procurement and protection are identified as necessary
Map and assess identified fish nursery habitats within PHMR	To be started	Fish nursery habitats within PHMR are mapped and assessed						Science Director	OAK
Monitoring of Impacts									
Develop and implement rapid assessment mechanisms for impacts such as ship groundings, hurricane / earthquake damage, disease outbreaks, oil spills etc.	Ongoing	Rapid assessment mechanisms are in place and implemented when required						Science Director	With engagement of staff and stakeholders,

B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Monitoring Programme									
Monitoring of Impacts									
Ensure post impact assessments are conducted and reports produced and disseminated for all impact events – eg. earthquakes, hurricanes, boat groundings	Ongoing	Post impact assessments are conducted and reports disseminated						Science Director	
Monitor run-off from the central and southern coastal plain, and northern Honduras / Guatemala during extreme storm events using remote sensing information (NOAA website / SERVIR, ICRAN-MAR to assess impacts on PHMR	Not started	Run-off from the central and southern coastal plain, and northern Honduras / Guatemala is monitored during extreme storm events using remote sensing information						Science Director	
Monitor presence and density of lionfish population	Opportunistic	Monitoring of presence and density of lionfish population is ongoing						Science Director	
Staff									
Ensure sufficient, trained staff for effective implementation of the Programme activities	Ongoing capacity building	TIDE has sufficient, trained staff for effective implementation of the Programme activities						Science Director	Open Water, Advanced Rescue and Dive Master SCUBA, Oxygen Provider, EFR (CPR & First Aid), Dive Incident Emergency Response/ Evacuation. Training in coral, sea fan, algae and sponge ID, seagrass, conch and lobster and mangrove monitoring
Continue to strengthen the research and monitoring programme through engaging and training community researchers	38 community researchers have been trained since 2004							Science Director	

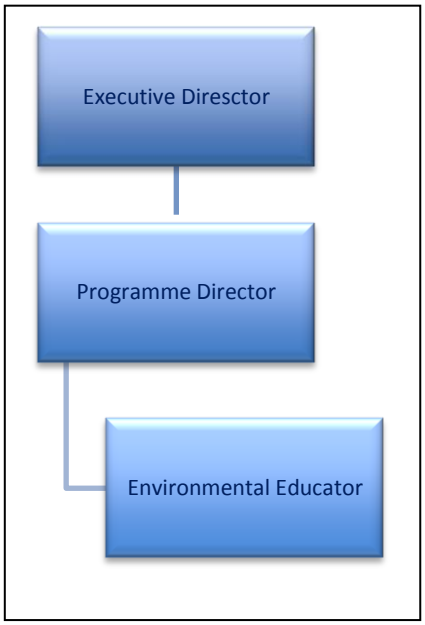
B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Staff									
Provide incentives for maintaining good staff	Ongoing	Research and Monitoring Programme staff remain committed for the long term, with low turnover						Executive Director	DAN Insurance
Communication and Collaboration									
Ensure close liaison and collaboration with Fisheries Department for effective coordination of monitoring activities that feed into national data	Ongoing	Monitoring activities that feed into national data are conducted in close liaison with Fisheries Department						Executive Director Science Director	
Ensure results of monitoring and research outputs are available to staff of PHMR and to other Directors / Managers	Ongoing	Information from Research and Monitoring activities is shared effectively between all areas of TIDE for strategy integration and greater adaptive management effectiveness						Science Director	
Effective communication, collaboration and information sharing of information with other marine management / research partners	Ongoing	TIDE has effective communication, collaboration and information sharing with other marine management / research partners						Executive Director Science Director	SEA, Fisheries Department, other MPA co-management agencies
Use available forums for dissemination of results	Ongoing	TIDE effectively disseminates its results to a wide range of stakeholders						Executive Director Science Director Education and Outreach Officer	e.g. stakeholder visits, workshops, conferences, school visits, tour guide meetings etc.

B. Research and Monitoring Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Communication and Collaboration									
Participate in Coral Monitoring Network Meetings and Spawning Aggregation Working Group Meetings	Ongoing	TIDE actively participates in Coral Monitoring Network Meetings and Spawning Aggregation Working Group Meetings						Science Director	
Participate in Belize Sea Turtle Monitoring Network and Marine Mammal Stranding Network meetings	Ongoing	TIDE actively participates in Belize Sea Turtle Monitoring Network and Marine Mammal Stranding Network meetings						Science Director	
Attend national and international conferences & workshops	Ongoing	TIDE is effectively represented at relevant national and international conferences & workshops						Executive Director Science Director	
Produce Annual State of the Park monitoring output report for submission to Fisheries Department	Ongoing	An Annual Report summarizing the Research and Monitoring outputs of PHMR is submitted to the Fisheries Department						Science Director	

4.6.3 Environmental Education and Outreach Programme

The Education and Outreach Programme guides TIDE in engagement of and communication with its stakeholder communities. This is achieved through a number of important sub-programmes:

- **Community Participation / Capacity Building**
- **Sustainable Development**
- **Environmental Education**
- **Visitor Management**



Community Participation / Capacity Building Sub-Programme

This sub-programme seeks to assist communities to develop, both as fishing communities and in alternative livelihoods. It also encourages community engagement and participation in TIDE activities.

Programme Goal

To provide mechanisms and options through which communities within the MMMC can become involved in ecosystems management and sustainable use of the resources.

Objectives

- To build the capacity of the Advisory Council and Board of Directors in NGO governance through training and exchange visits to international NGO's
- To support supplemental livelihood projects previously identified by PHMR buffer communities during past assessments

Community Participation

Community Stewards

TIDE focuses on integrating participation from Fishermen, Community Researchers and Tour Guides into TIDE management activities through the Community Stewards Programme which teaches participants about the relevant legislations, ecology, whys and wherefores of protected area management, and provide greater understanding. Radios are provided to each Community Steward as a safety back-up and, unlike the previous Community Ranger Programme, participants are not required to report illegal activities. TIDE is repeating the

Community Stewards programme in the Monkey River community, increasing the number of people engaged and involved from this community, considered particularly important in view of the community interest in the extension of the Marine Reserve, and TIDE's wish for them to take on more responsibility. It is also planned to extend this mechanism of building Community Stewardship to the high school in PG, with the creation of an Environmental Stewards / Junior Stewards Programme.

Capacity Building

Strengthening Effective Participation in Governance

TIDE recognizes the need for ongoing capacity building of its Board members and Advisory members, through structured meetings, capacity building activities and trainings, and the development of a Board Policy and Procedures Manual.

Mentoring

TIDE works closely with the fishing associations, and actively acts as a mentor to the Toledo Fisherman Association, providing continued support and facilitating exchange visits to strengthen the capacity of the association as a participating partner in fisheries management, and increase engagement of cooperative members. Institutional strengthening activities include providing assistance for implementation of the association's strategic plan, and identifying specific joint projects for collaborative implementation.

TIDE Scholarship Programme

For many, education is the barrier to being able to seek alternatives to fishing or other natural resource extraction. TIDE, in identifying this, has an ongoing **Scholarship Programme** focused on providing an opportunity to continue education beyond primary school. The Programme currently supports fourteen students (2010), ten attending Toledo Community College, two at Independence High School and two at Julian Cho Technical High School. These students come from the communities that TIDE works with, including Punta Gorda Town, Monkey River, and Punta Negra.

Sustainable Development Sub-Programme

Strengthening Community Alternative Livelihood Options

TIDE strengthens community livelihood option through targeted projects that fall within its remit that will reduce pressure on the natural resources, strengthen sustainable development and/or contribute towards alternative livelihoods. The organization works with the communities to identify specific, community-driven projects that fill identified needs, locating funding for these community efforts.

Identified initiatives include:

- Location of new / alternative markets for fishers, providing greater value for products.
- Providing a link between restaurants and fishers.
- Providing materials and labours for rehabilitation of the fish market in Punta Gorda – also a place for distributing fisheries management messages / education
- Establishment of a barber shop in Punta Gorda
- Establishment of Mangrove Honey Production Apiary in Monkey River
- Establishment of 2 Seaweed farms (1 in Punta Negra for Women's Group and 1 in Monkey River)
- Installation of a freezing facility for traditional fishermen in Monkey River
- Construction of a Multipurpose Centre in Punta Negra, where women can cater for tourists, sell crafts etc.
- Development of resource center and library in Monkey River and Punta Negra
- Provide a boat and engine to Punta Negra to facilitate community access
- Construct a dock at Punta Negra
- Assist communities in developing Community Development Plans

Strengthening Tourism in Monkey River

TIDE recognizes Monkey River as a major stakeholder in the Port Honduras Marine Reserve, and works towards assisting the community in promotion of tourism, as a contribution to alternative incomes and reduction of pressure on the natural resources. Past and future initiatives include:

- Identifying and developing mechanisms to facilitate day tourism focused on the Monkey River, through partnering with Tour Operators in Placencia, and through lobbying with BTB to promote Monkey River as a tourism destination.
- Investigating options for management of sports fishing for tourism within Port Honduras Marine Reserve.

Environmental Education / Outreach Sub-Programme

Programme Goal:

To create environmental awareness highlighting the significance of the Port Honduras area in terms of its biodiversity and management needs at the same time strengthening local capacity to assist in long-term protection to support conservation and sustainable resource use through education and research.

Objective 1
To implement an educational Programme to promote conservation through sustainable resource use;

Objective 2
To implement a comprehensive interpretative Programme;

This is achieved through a series of activities:

Schools Education and Training Program

- Summer teacher training camps for local educators organized in collaboration with Ministry of Education, NGOs, CBOs.
- Information package on marine conservation targets.
- Marine and coastal ecology workshops and resource materials.
- Outreach presentations.
- Educational field trips for local schools.
- Camping organized in collaboration with NGOs, Youth groups etc.
- Distribution of posters, booklets etc.
- Network with national academic institutions to promote field studies and workshops.

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Fisheries Education Program

- Outreach presentations to fisheries co-operatives, associations and local fishing communities.
- Local training programs in monitoring and surveillance.
- Fisher's training in alternative skills such as sport fishing, tour guiding etc.
- Education extension services to regional NGOs (distribution of materials and networking).
- Promote local fishermen as guest speakers at seminars and on media shows.
- Special Events involving fishermen e.g. TIDE weekend; Manatee protection week etc.

Public Education Program

- Catalyze participation in international and national events such as International year of the Reef, Earth Day, Beach Clean-up Day etc.
- Production and sale of educational materials such as posters, field guides etc.
- Scheduled seminars, talks, and presentations.
- Dissemination of audiovisual material on responsible practices produced.
- Involvement of locals within the research and monitoring projects.
- Quarterly newsletters

TIDE's strategies are aimed at reaching a wide cross section of the Toledo population with environmental messages. The program activities reach urban, rural, adult and children populations.

Target audience:

- Educators in reserve and buffer area
- Students in reserve and buffer area
- Local fishermen in reserve and buffer areas
- General public
- Regional NGOs

An Environment Education and Outreach (EEO) critical review was also conducted to provide recommendations on how to further promote stakeholder ownership and sustainable use of resources and to increase participation in the protected area management process. This process was completed in April 2008 with outputs being integrated into this management plan, and addresses the outreach work of TIDE and how this organization provides information to communities about the work it does.

Visitor Management

The majority of the mechanisms used for effective visitor management involve education and awareness – of both the visitor and the tour guides, with an emphasis on Tourism Best Practices.

C. Environmental Education and Outreach Programme											
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
General											
Restructure the EEO Program	Within the workplan for 2010 - 2013	The EEO Program has been established						Environmental Educator	
Develop an Education Outreach Strategy to complement the TIDE Strategic Plan to ensure that EEO is mainstreamed in all aspects of TIDE's programming	Within the workplan for 2010 - 2013	An Education Outreach Strategy has been developed, with EEO strategies mainstreamed in all aspects of TIDE's programming						Environmental Educator	Aligned with the strategic plan
Ensure TIDE has the staff to support Environmental Education Outreach to PHMR communities	TIDE has adequate staff	TIDE has the staff to support Environmental Education Outreach to PHMR communities						Operations Manager	Ability to retain trained staff
Ensure TIDE has the necessary tools to support Environmental Education Outreach to PHMR communities	Ongoing	TIDE has the necessary tools to support Environmental Education Outreach to PHMR communities						Program Manager	2 laptops, 2 powerpoint projectors, 1 camera, 1 vehicle,
Community Participation											
Replicate the "Community Stewards Program" in Monkey River Village.	Funding has been located to replication the Community Stewards Programme	10 community participants have completed the Community Stewards Programme and are fully engaged in biodiversity management						Program Manager	Community members willingness to participate
Organize and conduct the annual TIDE freshwater cup (Senior, Junior & Female) football and environmental tournament.	Ongoing	The TIDE freshwater cup (Senior & Junior) football and environmental tournament continues as an annual event						Environmental Educator	Community members willingness to participate

C. Environmental Education and Outreach Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Stakeholder Engagement									
Organize TIDE Annual Summer Camp	Ongoing	The TIDE Annual Summer Camp continues as an annual event						Environmental Educator	Parents willingness to send children to camp
Organize TIDE Weekend	Ongoing	Successful participation of primary stakeholders in event						TIDE weekend Committee (Operations Manager)	Participation of NGOs and Stakeholders
Participate in national and international environmental awareness events	Ongoing	TIDE increases awareness of national and international environmental awareness events through participation						Environmental Educator	Participation of Schools and Communities
Capacity Building									
Build the capacity the Board of Directors in NGO governance through training and exchange visits to international NGO's	Ongoing	The Board of Directors have the capacity to effectively provide guidance to management of PHMR						Executive Director	Will be strengthened through the development of the Board Policy and Procedures Manual
Conduct a board development seminar (Including parliamentary procedures training) contracting the services of a consultant with international expertise in board development.	In progress	The Advisory Council and Board of Directors have completed a Board development seminar, and have increased capacity to effectively provide guidance to management of PHMR						Executive Director	This should be open to other NGO boards in Belize

C. Environmental Education and Outreach Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Capacity Building									
Ensure structured Board meetings are held on a regular basis	Ongoing	Board meetings are well structured, achieve their objectives, and are held on a regular basis						Executive Director	Commitment of Board members to attend meetings
Build the capacity of the Advisory Council for its role in management of PHMR	Ongoing	The Advisory Committee has the capacity to effectively provide input to management of PHMR and represent the local stakeholders						Executive Director	Commitment of Advisory Council members to attend trainings
Ensure structured Advisory Council meetings are held on a regular basis	Ongoing	Advisory Council meetings are well structured, achieve their objectives, and are held on a regular basis						Executive Director	Commitment of Advisory Council members to attend meetings
Hold bi-annual BOD/Advisory council joint meetings	Ongoing	2 bi-annual BOD/Advisory council joint meetings are held						Executive Director	Commitment of Advisory Council and BOD members to attend meetings
Provide mentoring and support for the fishing associations in the TIDE stakeholder communities	Ongoing	Fishing Associations using PHMR and the adjacent marine resources are more engaged and more effective in promoting sustainable resource use						Environmental Educator	Rio Grande Fishing Cooperative Monkey River fishermen Association
Sustainable Development									
Support supplemental livelihood projects previously identified by PHMR buffer communities during past assessments	Ongoing	TIDE partners with communities to support specific supplemental livelihood projects						Program Manager	Inability to fundraise for program

C. Environmental Education and Outreach Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Sustainable Development									
Conduct customer service training for community members	In Workplan	Community members have increased capacity in customer services						Environmental Educator	Punta Gorda, Punta Negra and Monkey River
Conduct public relations training for community members	In Workplan	Community members have increased capacity in public relations						Environmental Educator	Punta Gorda, Punta Negra and Monkey River
Conduct small business management training for community members	In Workplan	Community members have increased capacity in small business management						Environmental Educator	Punta Gorda, Punta Negra and Monkey River (KFW)
Support Tour guide training for 10 persons from PHMR buffer communities	In Workplan	10 community members have been trained as tour guides						Environmental Educator	Punta Gorda and Punta Negra
Assist with product development and marketing plan for traditional and cultural activities	In Workplan	Community based traditional industries and cultural activities are better marketed						TIDE Tours Manager	Interest and motivation of key stakeholders
Provide opportunities for craft training from natural resources	In Workplan	Increased income diversification from local craft production						Environmental Educator	Interest and motivation of key stakeholders
Environmental Education and Outreach									
Conduct 34 community meetings annually in MMMC communities to educate principal resource users on the n impacts of resource use.	Ongoing	Community meetings are held within the PHMR on a regular basis						Environmental Educator	Inadequate planning of meetings

C. Environmental Education and Outreach Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Environmental Education and Outreach									
Develop and implement a pilot "Junior Environmental Stewardship Program"	In workplan	20 children have completed the Junior Environmental Stewards Programme annually and are fully engaged in biodiversity management						Environmental Educator	Field visits, incentives for participants and schools
Conduct 36 School visits annually to MMMC communities' schools to educate school age children on the use of the natural resources in the MMMC.	Ongoing	36 School visits are conducted annually to MMMC communities' schools to educate school age children on the use of the natural resources in the MMMC.						Environmental Educator	18 schools
Conduct 16 field trips to Protected areas in MMMC on an annual base.	Ongoing	16 field trips are conducted to Protected areas in MMMC on an annual base.						Environmental Educator	Permission from parents and schools for students to participate
Educational Field Trips for teachers/community leaders to PA's. (3 trips/yr)		3 Educational Field Trips for teachers/community leaders to PA's per year						Environmental Educator	Interest in field trips
Host 24 local radio shows annually	Ongoing	24 local radio shows hosted annually by TIDE						Environmental Educator	Willingness to participate in radio shows
Host 4 National Radio Show hosted annually	Ongoing	4 National Radio Show hosted annually						Environmental Educator	Finance

C. Environmental Education and Outreach Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Visitor Management									
Develop and implement an effective 'Limits of Acceptable Change' programme for effective tourism management	A programme has been developed but needs significant strengthening of indicators before it can be implemented	A strong 'Limits of Acceptable Change' programme is being implemented, and guides visitor management						Environmental Educator Science Director	Needs revision and funding for implementation
Ensure tour guides are trained in Tourism Best Practices	Ongoing	All tour guides are using Tourism Best Practices						Environmental Educator	Including waste disposal
Provide information on Tourism Best Practices to the tourism stakeholders	Sustainable Tourism Master plan is in progress	Tour operators, tour boat captains and tour guides are aware of Tourism Best Practices						Environmental Educator	Main focus of Master plan is not on Toledo District
Ensure information is available for visitors at Abalone Caye to inform them of Tourism Best Practices	Sustainable Tourism Master plan is in progress	Visitors to PHMR area aware of Tourism Best Practices						Environmental Educator	Limited presence at Abalone Caye
Provide access to interpretive information for visitors	Information needs updating especially with Managed Access	Visitors learn about PHMR, its ecosystems and species						Environmental Educator	Human and financial resources

4.6.4 Infrastructure Management Programme

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

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

The Fisheries Department office is located in Belize City. The TIDE office is located in Punta Gorda. Both are well equipped as administrative headquarters. A Ranger Station is located on Abalone Caye, and is in good condition.

D. Infrastructure Programme										
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Ensure all Programme Directors / Managers are fully equipped for effective implementation of their programme areas	Ongoing	All Programme Directors / Managers are fully equipped for effective implementation of their programme areas							
Ensure current on-site staff facilities are maintained / improved for high staff satisfaction	Ongoing	On-site staff facilities are maintained / improved for high staff satisfaction							
Ensure visitor facilities are adequate for visitation levels and for maintaining high visitor satisfaction (picnic tables, barbecue grills, bathrooms)	Ongoing	Visitor facilities are adequate for visitation levels and for maintaining high visitor satisfaction (picnic tables, barbecue grills, bathrooms)							
Ensure sufficient mooring buoys are installed for visitation requirements	Ongoing	Sufficient mooring buoys are installed for visitation requirements							
Maintain and replace office equipment as necessary for ensuring effective operations	Ongoing	Office equipment is maintained and replaced as necessary for ensuring effective operations							
Identify equipment gaps and locate funds for equipment	Ongoing	Equipment gaps are identified and locate funds for equipment							
Ensure TIDE has sufficient vehicles, boats and motors for effective operations	Ongoing	TIDE has sufficient vehicles, boats and motors for effective operations							

D. Infrastructure Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Ensure Abalone Caye is adequately equipped for surveillance and enforcement activities and good communications	Ongoing	Abalone Caye is adequately equipped for surveillance and enforcement activities and good communications							
Ensure PHMR has an operational and fully equipped boat and engine for surveillance and enforcement activities	Ongoing	PHMR has an operational and fully equipped boat and engine for surveillance and enforcement activities							
Ensure all facilities / equipment / transport have adequate insurance	Ongoing	All facilities / equipment / transport have adequate insurance							

4.6.5 Administrative Programme

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

TIDE's Administration Programme is centralized in Punta Gorda, and focuses on the management of the MMMC land/seascape, including Port Honduras Marine Reserve. As a larger NGO, TIDE has developed an Administrative and Financial Policies and Procedures Manual to ensure that all staff and members of the Board of Directors are aware of the administrative procedures, financial processes and policies of the organization.

Activities fall under three sub-programmes:

- **Finance**
- **Human Resource Management**
- **Communication and Collaboration**

E. Administration Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
General									
Review and upgraded organizational structure, administrative policies and procedures, and operating processes	In work plan	Organizational structure, administrative policies and procedures, and operating processes have been reviewed and revised						Executive Director	
Finalize co-management agreement between Fisheries Depart. and TIDE	Ongoing	TIDE has an effective co-management agreement with Fisheries Department for PHMR						Executive Director	PA systems Act needs to be revised
Maintain and strengthen ongoing communications with Fisheries Department	Ongoing	Effective, ongoing communication with Fisheries Department						Executive Director	
Preparation of annual work plan and budget by each Park Manager, Biologist and Administrator	Ongoing	Annual work plans and budgets are submitted by each programme manager						Program Manager	Staff turnover (If occurred)
Ensure operational plans / work plans are based on the management plan	Ongoing	Operational plans / work plans are based on the management plan						Program Manager	
Ensure monitoring and evaluation of operational plans / work plans on a quarterly basis	Ongoing	Monitoring and evaluation of operational plans / work plans takes place on a quarterly basis						Program Manager	
Ensure monitoring and evaluation of management plan on a annual basis	Ongoing	Monitoring and evaluation of management plan takes place on a annual basis						Program Manager	
Prepare State of the Park report every 5 years	Ongoing	State of the Park report is prepared every 5 years						Science Director	Staff turnover, inconsistent data

E. Administration Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
General									
Prepare report on output of monitoring data every 5 years	2003 – 2008 report	A report on output of monitoring data is produced every 5 years						Science Director	Inconsistent Data
Prepare Annual TIDE Report	Ongoing	An Annual TIDE Report is produced each year						Development Director	
Produce monthly, quarterly and annual reports for Fisheries Department, and submit to Fisheries Department	Ongoing	Monthly, quarterly and annual reports are produced for Fisheries Department, and submit to Fisheries Department						Marine Manager Science Director	Inconsistent data from field
Finance									
Seek funding to fully implement TIDE's Business Plan	Ongoing	TIDE's financial sustainability plan is being effectively implemented						Executive Director Development Director	Business plan needs revision
Ensure external auditing of annual accounts	Ongoing	Annual accounts are produced and audited Audit reports						Accountant Executive Director	Funding to prepare external audit
Seek to reduce variable costs through strategic partnerships in all programme areas	Ongoing	TIDE has developed cost effective strategic partnerships						Executive Director	Willingness of partners to collaborate
Assess and plan for potential liability issues	Ongoing (Insurance for staff and assets)	TIDE has planned for liability issues						Executive Director	Funding to continue insurance

E. Administration Programme								
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Human Resources								
Ensure there are sufficient staff for the effective management of PHMR	Ongoing	There are sufficient staff for the effective management of PHMR						Executive Director	Staff turnover
Hold full staff meetings three times a year	Ongoing	Full staff meetings are held three times a year						Executive Director	
Hold Administration Meetings every two weeks	Ongoing	Administration Meetings are held every two weeks						Executive Director	
Institutional strengthening of staff based on annual needs assessment	Ongoing	Institutional strengthening of staff based on annual needs assessment						Executive Director	Based on availability of funds
Develop conflict resolution mechanisms and in-house skills for dealing with public use conflicts	Not started	Staff have conflict resolution mechanisms and in-house skills for dealing with public use conflicts						Executive Director	Based on availability of funds
Ensure all TIDE employees are familiar with organizational policies and procedures	Ongoing	All TIDE employees are familiar with organizational policies and procedures						Operations Manager	
Conduct an annual evaluation of staff performance and ensure that recommendations are implemented	Ongoing	An annual evaluation of staff performance and ensure that recommendations are implemented						Executive Director	

E. Administration Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Human Resources									
Continue encouraging participation of local stakeholders through Community Stewardship and Research programmes	Ongoing	Local stakeholders assist TIDE in implementation of activities through Community Stewardship and Research programmes						Environmental Educator Program Manager	Community members willingness to participate
Ensure staff have sufficient administrative training for effective general management, fundamental accounting, budget and proposal / work plan preparation and implementation	Ongoing	Staff have sufficient administrative training for effective general management, fundamental accounting, budget and proposal / work plan preparation and implementation						Executive Director	Based on availability of funds and training opportunities
Ensure staff are trained in conflict resolution, consensus building, public relations and communications skills	Ongoing	Staff are trained in conflict resolution, consensus building, public relations and communications skills						Executive Director	Based on availability of funds and training opportunities
Ensure Staff are familiar with health and safety and emergency plans (Including boarding procedures, boating handling etc)	Hurricane emergency plans only	Staff are familiar with health and safety and emergency plans						Executive Director	Needs to address other safety issues
Review of salary & food allowance for reserve staff	Ongoing	Salary & food allowance for PHMR staff has been reviewed						Program Manager	Based on available funds

E. Administration Programme									
Management Actions	**Present Status**	**Desired Status**	**Year**					**Responsible Party**	**Limitations/Requirements**
Communication and Collaboration									
Ensure all staff working in PHMR have adequate insurance for their roles	Ongoing	All staff working in PHMR have adequate insurance for their roles						Operations Manager	Based on available funds
Identify and implement mechanisms for informing community stakeholders of reserve activities and management decisions affecting them	Ongoing	Community stakeholders are fully informed of reserve activities and management decisions affecting them						Environmental Educator	Community involvement/participation
Ensure fishermen and tour guides operating in the Port Honduras Marine Reserve are kept informed of reserve activities and management decisions affecting them	Ongoing	Fishermen and tour guides operating in the Port Honduras Marine Reserve are kept informed of reserve activities and management decisions affecting them						Environmental Educator Marine Manager	
Strengthen links with other organizations and Government agencies involved in marine protected areas management	Ongoing	Effective communication with other organizations and Government agencies involved in marine protected areas management						Executive Director Science Director	Shared vision for specific mission
Maintain and update TIDE website and social media outputs on an ongoing basis	Ongoing	TIDE website and social media outputs are maintained and updated on an ongoing basis						Development Director Environmental Educator	

4.6.6 Management Policies

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

An Emergency Plan is in place, including a Hurricane Preparedness Plan to ensure protection of life and property during hurricane events, particularly with the exposed nature of Abalone Caye to oncoming storms.

TIDE has developed an Administrative and Financial Policies and Procedures Manual to ensure that all TIDE staff and members of the Board of Directors are aware of the administrative procedures and policies of the organization.

4.7 Timeline, Evaluation and Review

The Management Programme matrices form the basis of an implementation plan, 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.

Monitoring and evaluation are integral components of any management system and annual evaluations of protected area management are recommended. In the development of this management plan, the action areas are relatively specific, simplifying the process of monitoring success of implementation, and providing a mechanism for continual tracking of management activities, through annual review by the Fisheries Department, and by the TIDE Board members and management staff of the Toledo Institute of Development and Environment. An evaluation framework has been developed from the programme tables (Table 23).

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

Example: Tracking of Management Action Implementation							
Management Actions	**Present Status**	**1st Year**	**2nd Year**	**3rd Year**	**4th Year**	**5th Year**	**Desired Status**
Ensure PHMR has the human resources and equipment for effective surveillance and enforcement	Have 7 staff; Needs; 2 additional staff, 1 25ft vessel and engine						Adequate human resources and equipment for effective surveillance and enforcement
Conduct daily patrols and surveillance to enforce rules and regulations of the reserve to prevent illegal activities	Ongoing Need to evaluate patrol strategies						Daily scheduled and random patrols of PHMR to prevent illegal activities
Disseminate rules and regulations to key user groups on a regular basis	Currently using local and national media to disseminate information;						Users are adhering to the rules and regulations of the reserve
Strengthen visitor management, and enforcement of visitor rules and regulations	Not all visitors report to the ranger station in PHMR						Collaboration with BTB / tourism police to capture 100% of visitation to the park
Ratings: 1: Not started 2: Started, but some limitations to implementation				3. Ongoing but behind schedule 4. On schedule			

Table 23: Evaluation Framework for tracking implementation output

4.8 Financing

TIDE acquires most of its funds for management through private donors, foundations, international NGO's and fees charged to visitors that enter the reserve. All fees that are collected by TIDE are sent to the Fisheries Department and from this a percentage is returned to TIDE for use in further management of the reserve. The Fisheries Department is to provide support in various ways including assisting with patrols and providing additional training and reserve support where possible.

In 2007, TIDE developed a business plan to assist in guiding its path towards financial sustainability. The Plan:

- addresses cost management and income generation;
- Involves the design and implementation of cost-saving and revenue-generation strategies;
- Brings about an improved enterprise-wide ability to achieve organization goals and objectives.

The Plan recommends a number of strategies for achieving financial sustainability:

1. Establish TIDE Tours as the principal adventure and eco-tourism provider in Southern Toledo District by taking advantage of the natural and cultural wealth in the region. Capitalize on the special amenities which TIDE is uniquely positioned to offer tourists in the PAs. Use TIDE Tours to promote alternate livelihoods through training and employment, and the economic development of the Toledo region.

2. Develop an organic cacao agro-forestry plantation on acreage on the TIDE private lands. A cacao operation would train and employ a cohort of the community in the sustainable, organic agro-forestry cacao industry. The plantation will serve as a demonstration project and training resource which illustrates the viability and profitability of organic agro-forestry to encourage more sustainable practices.

3. A membership and fundraising program targeting visitors to the PAs; as well as clients of TIDE Tours, participants in special events, and visitors to Toledo. TIDE's membership will serve as a pool of small donors as well as a global advocacy group

TIDE is currently working on a three year time frame, with estimated costs for each of the three years, broken down by focal areas (Figure 26). Of the different expenditure areas, the non-research costs for Port Honduras Marine Reserve are the highest, contributing 39% to the total annual budget for TIDE. This reflects the high costs involved in surveillance and enforcement activities, with patrol fuel being an increasingly expensive commodity.

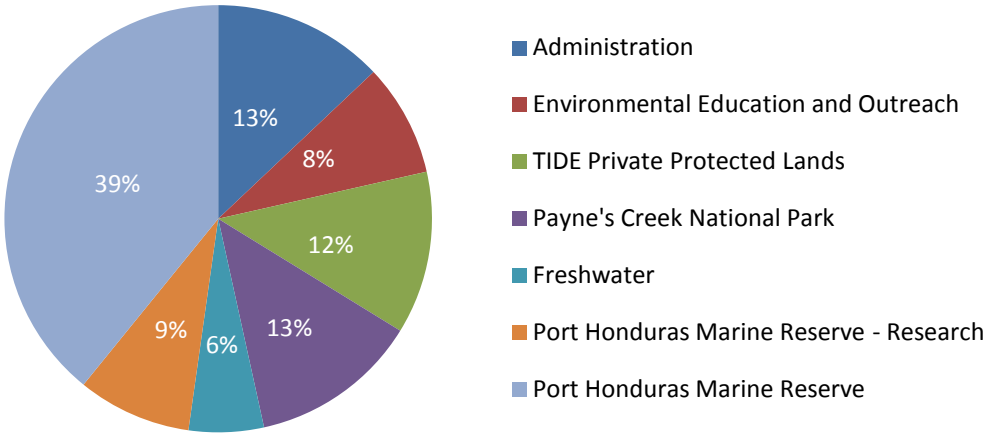

Figure 26: Budget breakdown for 2010 (TIDE).

In total, Port Honduras Marine Reserve represents 48% of TIDEs annual budget for 2010. A breakdown of expenditures in 2008 shows that salaries make up 47% of all expenditures, with two other areas – Professional Fees (19%) and Surveillance / Patrol costs (13%) also contributing significantly to expenditures (Figure 27).

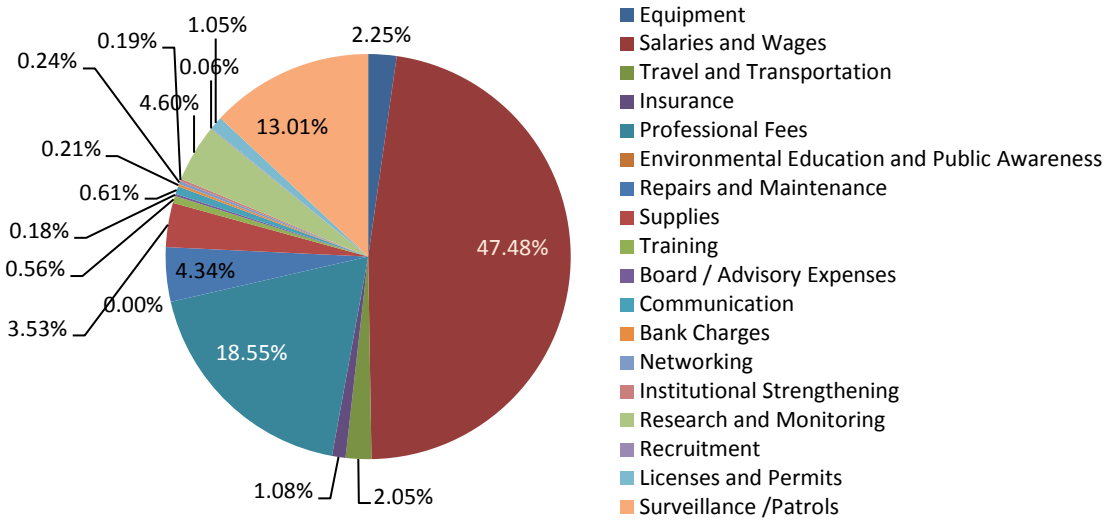

Figure 27: Expenditure breakdown for Port Honduras Marine Reserve, 2010 (TIDE)

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ANNEXES

Annex 1: Fisheries (Port Honduras Marine Reserve) Regulations

Annex 2: Fisheries (Port Honduras Marine Reserve) Order

Annex 3: Reef fish list

Annex 4: Potential Changes in Zonation during the timescale of the Management Plan

Annex 5: Goals and Objectives of the Maya Mountains Marine Corridor

Annex 1: Fisheries (Port Honduras Marine Reserve) Regulations

CHAPTER 210

FISHERIES PORT HONDURAS MARINE RESERVE REGULATIONS

ARRANGEMENTS OF REGULATIONS

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PART II
ESTABLISHMENT OF ZONES AND RULES FOR ZONES

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

PART IV
GENERAL

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14. Duration and renewal of licences.
15. Cancellation of licences.
16. Condition of licences.
17. Duty to report accidents or damage to property.
18. Non-liability of Government.
19. Application of Fisheries Regulations.
20. Opening days of Reserve.
21. Admission fees.
22. Prohibition of certain acts.
23. Fisheries Administrator may designate certain areas.
24. Rendering fish catch information to rangers.
25. Establishment of fishery officers.
26. Offences and Penalties.

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FORM II

FORM III

FORM IV

FORM V

FORM VI

CHAPTER 210

FISHERIES (PORT HONDURAS MARINE RESERVE) REGULATIONS

(Section 13)

18 of 2000.
Ch. 174.

[19th February, 2000.]

1. These Regulations may be cited as the **FISHERIES (PORT HONDURAS MARINE RESERVE) REGULATIONS**

Short title.

2. In these Regulations, unless the context otherwise requires,

Interpretation.

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

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

CAP. 4.
CAP. 210.

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

"Reserve" means the Port Honduras Marine Reserve declared under the Fisheries (Port Honduras Marine Reserve) Order;

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

"Fishery Officer" means any technician, conservation officer, assistant fisheries officer or fishery officer employed by the reserve;

"Schedule" means the Schedule to these Regulations;

Schedule

"Sport fishing" means catch and release;

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

"subsistence fishing" means fishing conducted by those who reside within the Reserve for the purpose of consuming the fish caught but not for selling such fish.

PART II
ESTABLISHMENT OF ZONES AND RULES FOR ZONES

Establishment of Zones

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

(a) the General Use Zone;

(b) the Conservation I Zone;

(c) the Conservation II Zone;

(d) the Preservation Zone;

and a Special Management Area.

(2) The description of the above Zones shall be as set out in the Schedule of the Fisheries (Port Honduras Marine Reserve) Order.

Rules for Zones

4. (1) The General Use Zone shall be restricted to those with the appropriate fishing licence for any of the following, namely a commercial, sport, subsistence and recreational fishing licence. Fishermen shall apply for a licence to fish in accordance with these Regulations.

(2) Only residents of Port Honduras who have special licences to fish shall be allowed to fish in this zone solely for subsistence purposes, and such fishing shall be determined by the terms and conditions of each resident's licence.

(3) No person shall be permitted to use long lines or gill nets in the Port Honduras Marine Reserve.

(4) No person shall be permitted to use or erect beach traps.

(5) No person shall, within the Port Honduras Marine Reserve, cast or drag any anchor in any manner that may damage coral reef formation.

(6) Fishermen catching lobster shall preserve such lobster while in the Marine Reserve within its carapace but not as fillet.

Rules for Conservation I Zone

5. (1) There shall only be non-extractive recreational activities in the Conservation I Zone.

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

Rules for Conservation II Zone

6. (1) Sport fishing in the Conservation II Zone shall only be carried out under a licence issued in accordance with these Regulations and such fishing shall only be carried out on a catch-and-release basis.

(2) No person shall engage in spear fishing with the Conservation II Zone.

(3) No person shall engage in commercial, recreational and subsistence fishing within the Conservation II Zone.

(4) No person shall engage in trawling, setting nets or traps within the Conservation II zone.

(5) No person shall engage in water-skiing and jet skiing within the Conservation II zone.

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

(7) All divers in the Conservation I and II zones shall adhere to the following rules:

Form VI Schedule

(a) divers shall register with the Reserve Manager prior to entering the Conservation zones;

(b) charter dives shall first obtain a licence in the form prescribed as Form VI of the Schedule before operating in the Conservation zones and all dive boats shall fly the "divers down flag" when they have divers in the water;

(c) only certified scuba divers, or divers undergoing a training course conducted by a recognized instructor shall be allowed to use scuba equipment in areas of the Reserve where diving is permitted;

(d) dive guides shall be required to explain the rules of the Reserve to all divers within the Reserve:

(e) all boats which need to operate in these zones shall first obtain registration from the Fisheries Administrator in accordance with these Regulations.

(8) For the purpose of this Regulation “divers down flag” means a flag with a white diagonal stripe upon a red background.

(9) All motor boats are to observe the low-wake-boat-way when approaching snorkellers or divers.

Rules for Preservation Zone

7. (1) Subject to subregulation (2) below, no person shall engage in commercial fishing, sport fishing, diving or any other water activity within the Preservation zone.

(2) No vessel shall be permitted within the Preservation zone except in cases of emergency or where written permission has first been obtained from the Fisheries Administrator.

Rules for Special Management Zone

8. (1) This area is reserved for special projects. Fishing and other activities may or may not be allowed depending on the status of the area in the management plan.

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

Commercial fishing licenses Form I Schedule

9. (1) Any person who is desirous of fishing within the Reserve shall apply to the Fisheries Administrator for a commercial fishing licence in the prescribed form set out as Form I of the Schedule hereto.

Form II Schedule

(2) The Fisheries Administrator may within fourteen (14) days of the receipt of an application under this regulation grant a fishing licence in the prescribed form set out as Form II of the Schedule hereto.

Form I Schedule

(3) Upon the expiry of a fishing licence granted under these Regulations, the licence holder may apply to the Fisheries Administrator for a renewal of

(4) A fee of ($50.00) shall be payable upon the receipt of a fishing licence or for the renewal of the same.

Research licenses Form II Schedule

10. (1) Any person who is desirous of conducting research shall within the Reserve apply for a licence to do so to the Fisheries Administrator in the prescribed form set out as Form III of the Schedule hereto.

(2) The Fisheries Administrator may within fourteen (14) days of the receipt of an application under this Regulation issue or grant a licence in writing to conduct research.

(3) The Fisheries Administrator shall set conditions for research licences issued under these Regulations.

(4) *(a)* A fee of Bz. $500.00 shall be payable upon the receipt of a research licence or for the renewal of same.

(b) The Fisheries Administrator may waive or vary at his discretion the fee payable for a research licence.

Sport fishing licenses Form IV Schedule

11. (1) Any person who is desirous of conducting sport fishing within the Reserve shall apply to the Fisheries Administrator or the Reserve Manager for a fishing licence in the prescribed form set out as Form IV of the Schedule.

Form V Schedule

(2) The Fisheries Administrator or the Reserve Manager, as the case may be, may grant a fishing licence in the prescribed form set out as Form V of the Schedule hereto.

(3) A fee of Bz $20.00 per month for Belizeans or Bz. $50.00 per month for non-Belizeans shall be payable upon receipt of a sport fishing licence.

(4) The licensee shall not kill any fish caught under a sport fishing licence.

Registration of dive boats Form VI Schedule

12. (1) Any boat operator who is desirous of conducting sport fishing within the Reserve shall apply to the Fisheries Administrator for registration in the prescribed form set out as Form VI of the Schedule hereto.

(2) A fee of Bz $100.00 shall be payable upon registration of the boat.

(3) Boat registration under this regulation shall expire on the 31st December next after the date of issue.

PART IV
GENERAL

Licenses not transferable

13. Licences issued under these regulations shall not be transferable.

Duration and renewal of licenses

14. Licences issued under these Regulations, unless otherwise stated, shall be valid for a period of one year from the date of issue and may be renewed for like period upon payment of the fees specified in these regulations.

Cancellation of licenses

15. The Fisheries Administrator may cancel any licence granted under these regulations if the licence holder breaches any conditions of the licence or contravenes any provision of these regulations or the Fisheries Regulations.

Condition of licenses

16. In issuing a licence under these regulations, the Fisheries Administrator may attach conditions to such licences, as the case may be, having due regard to the nature of the licence and the need to protect the environment and natural resources.

Duty to report accident or damage to property

17. Any person involved in an accident which involves personal injury or damage to property or to the environment within the Reserve shall report such accident to the person in charge of the Reserve or to any officer of the Reserve or to the Fisheries Administrator as soon as possible or at least within twelve (12) hours of the occurrence of the accident.

Non-liability of Government

18. The Government shall not be liable for any personal injury or damage to property occurring within the Reserve.'

Applications of Fisheries Regulations

19. Notwithstanding the provisions of these regulations, the Fisheries Regulations, shall apply within the Reserve.

Opening days of the Reserve

20. The Reserve Office shall be open daily to the public between the hours of 8:00 a.m. to 4:00 p.m.

Admission Fees

21. (1) For all water recreational activities, excluding sports and recreational fishing, fees shall be as follows:

(a) Swimmers/Snorkelers $8.00 per person per day;

(b) Scuba $20.00 per person per week

(2) No fees shall be payable by Belizeans and foreign children below twelve years of age.

Prohibition of certain acts CAP 210

22. Without prejudice to the activities prohibited by the Fisheries Act and the penalties prescribed therein, no person shall-

(a) remove, damage or have in his possession any flora, fauna or part thereof except under a licence issued by the Fisheries Administrator;

(b) deposit any material in or on the waters of the Reserve, except in the case where a licence to do so has been issued by the Fisheries Administrator;

(c) deface or tamper with any sign, buoy or notice which is installed in the Reserve.

Special Development Areas

23. (1) The Fisheries Administrator may designate certain areas as special development areas.

(2) No person shall within the Reserve engage in water activities outside of the designated areas.

Fish caught may be weighed upon request

24. All commercial, recreational, subsistence, and sport be fishermen shall render the weight of fish caught within the Reserve to the Reserve Rangers upon request.

Establishment of Fishery Officers

25. Any person employed (technician, conservation officer, Assistant Fisheries Officer or Fisheries Officer) by the Reserve for the purpose of management of the Reserve shall be a "Fishery Officer" for the purpose of upholding the Reserve regulations as well as the Fisheries Regulations.

Offences and Penalties

26. (1) Any person who contravenes any of the provisions of these Regulations is guilty of an offence and liable on summary conviction to a fine not exceeding two thousand dollars or to imprisonment for a period not exceeding six months, or to both such fine and period of imprisonment.

(2) Not withstanding subregulation (1) above, any person who damages corals shall pay a fine not exceeding ten thousand dollars, or some other higher penalty based on the assessed damage not exceeding one million dollars.

Commencement

27. These regulations shall come into force on the 25th day of January, 2000.

Non-liability of Government

MADE by the Minister of Agriculture, Fisheries and Cooperatives this 25th day of January, 2000.

(DANIEL SILVA)
Minister of Agriculture, Fisheries and Cooperatives
Minister responsible for Fisheries

_____

Please see Fisheries Subsidiary Act for the Schedule:

Form I. Application for a commercial fisher's licence or renewal thereof
Form II. Fisherman's licence
Form III. Application for a licence to conduct research or scientific investigation within the Port Honduras Marine Reserve
Form IV. Application for sport fishing licence to fish in Port Honduras Marine Reserve
Form V. Sport fishing licence
Form VI. Application for boat registration for operation in the Port Honduras Marine Reserve

Annex 2: Fisheries (Port Honduras Marine Reserve) Order

CHAPTER 210

FISHERIES (PORT HONDURAS MARINE RESERVE) ORDER
ARRANGEMENT OF PARAGRAPHS

SCHEDULE I

CHAPTER 210

9 of 2000.
Ch. 174.

FISHERIES (PORT HONDURAS MARINE RESERVE) ORDER

(Section 14)

[5th January, 2000.]

Short title.

1. This Order may be cited as the

FISHERIES (PORT HONDURAS MARINE RESERVE) ORDER .

Declaration of Marine Reserve Schedule I CAP. 210.

2. The area known as "Port Honduras", as more fully described in Schedule I to this Order is hereby declared to be a Marine Reserve for the purpose of the Fisheries Act.

Map of Marine Reserve Schedule II.

3. A map of the said area is set out in Schedule II to this Order, and the said map may be seen at the office of the Fisheries Administrator, Fisheries Department, Belize City.

Commencement.

4. This Order shall come into force on the 25th day of January, 2000.

MADE by the Minister of Agriculture, Fisheries and Cooperatives this 25th day of January, 2000.

(DANIEL SILVA)
Minister of Agriculture
Fisheries and Cooperative

SHEDULE I (Paragraph 2)

PORT HONDURAS MARINE RESERVE

ALL THAT PORTION of the Caribbean Sea comprising of General Zones, Conservation Zones and Preservation Zones and more fully described as follows:-

A. GENERAL USE ZONES

Commencing at a Point A lying South East of Monkey River Village having scaled UTM coordinates 341 784 East 1 810 803 North; thence in a general easterly direction to a Point B having scaled UTM coordinates 342 573 East 1810 803 North; thence in a general southerly direction to a Point C having scaled UTM coordinates 341 784 East 1 791 754 North; thence in a general south-westerly direction to a Point D having scaled UTM coordinates 328 384 East 1 784 002 North; thence in a westerly direction to a Point E south of the Rio Grande River Mouth having scaled UTM coordinates 3 10 122 East 1 783 740 North; thence in the direction of the coastline contour back to the point of commencement.

B. CONSERVATION ZONES

(i) ***East Snake Caye*** 0.805-kilometers (half a mile) radius around the Caye scaling UTM coordinates:

Northern point	338 588.85 East 1 793 101.35 North
Eastern point	339 545.54 East 1 792 120.74 North
Southern point	338 517.10 East 1 791 140.13 North
Western point	337 632.16 East 1 792 096 82 North

(ii) ***West and South Snake Cayes*** 0.805-kilometers (half a mile) radius around the Cayes having an overlap and scaling at UTM coordinates:

Northern point	331 868.09 East 1 791 666.31 North
North-eastern point	332 489.94 East 1 791 164.04 North
Eastern point	332 705.19 East 1 789 944.26 North
South-eastern point	332 800 East 1 788 533.14 North
Southern point	331 915.92 East 1 788 270.05 North
South-western point	331 389.74 East 1 788 628.81 North
Western point	330 767.89 East 1 789 968.18 North
North-western point	330 983.15 East 1791 331.47 North

(iii) ***Wild Cane Caye*** 0.88805 kilometers (half a mile) radius around the Caye scaling UTM coordinates:-

Northern point	325 984.43 East 1 796 019.26 North
Eastern point	326 582.36 East 1 795 445.24 North
Southern point	325 888.76 East 1 795 134.32 North
Western point	325 410.42 East 1 795 397. 41 North

C. PRESERVATION ZONES

Middle Snake Cayes 0.805 kilometers (half a mile) radius around the Cayes scaling UTM coordinates:

Northern point	333 709.72 East 1 792 599.08 North
Eastern point	334 809.91 East 1 791 498.89 North
Southern point	333 709.72 East 1 790 398.69 North
Western point	332 633.44 East 1791 498.89 North

Annex 3: Reef Fish Species List

Port Honduras Marine Reserve (Snake Cayes, 1990 - 1998): Fish Species			
Family	**Species**	**Common name**	**IUCN**
Acanthuridae	*Acanthurus bahianus*	Ocean surgeonfish	
	Acanthurus chirurgicus	Doctorfish	
	Acanthurus coerulus	Blue tang	
Albulidae	*Albula vlupes*	Bonefish	
Apogonidae	*Apogon bintatus*	Barred Cardinalfish	
	Apogon lachneri	Whitestar cardinalfish	
	Apogon maculatus	Flamefish	
	Apogon townsendi	Twospot cardinalfish	
	Apogon stellatus	Conchfish	
Aulostomidae	*Aulostomus maculatus*	Trumpetfish	
Balistidae	*Balistes vetula*	Queen triggerfish	**VU**
	Balistes capriscus	Gray triggerfish	
	Cantherdermis sufflamen	Ocean triggerfish	
	Cantherhines macrocerus	Whitespotted filefish	
	Cantherhines pullus	Orangespotted filefish	
	Canthidemis sufflamen	Ocean triggerfish	
	Melichthys niger	Black durgon	
	Monocanthus tuckeri	Slender filefish	
	Xanthichthys ringens	Sargassum triggerfish	
Batrachoides	*Batrachoides gilberti*	Large eye toadfish	
	Sanopus barbatus	Bearded toadfish	**VU**
	Sanopus greenfieldorum	Whitelined toadfish	
	Sanopus splendidus	Splendid toadfish	**VU**
Belonidae	*Ablennes hiannes*	Flat needlefish	
	Strongylura notata	Redfin needlefish	
	Tylosurus crocodilus	Houndfish	
Bothidae	*Bothus lunatus*	Peacock flounder	
Carangidae	*Caranx batholomaei*	Yellow jack	
	Caranx crysos	Blue runner	
	Caranx hippos	Crevalle jack	
	Caranx latus	Horse-eye jack	
	Caranx lugubris	Black jack	
	Caranx ruber	Bar jack	
	Decapterus macarellus	Mackerel scad	
	Elagatis bipinnulata	Rainbow runner	
	Trachinotus falcatus	Permit	
	Trachinotus goodei	Palometa	
Carangidae	*Trachinotus falcatus*	Permit	
	Trachinotus goodei	Palometa	
Carcharhinidae	*Carcharhinus perezi*	Caribbean Reef Shark	
	Negaprion brevirostris	Lemon shark	

Port Honduras Marine Reserve (Snake Cayes, 1990 - 1998): Fish Species			
Family	**Species**	**Common name**	**IUCN**
Centropomidae	*Centropomus undecimalis*	Common snook	
Chaenopsidae	*Emblemariopsis dianae*	Orangeflag blenny	
Chaetodontidae	*Chaetodon aculeatus*	Longsnout butterflyfish	
	Chaetodon capistratus	Foureye butterflyfish	
	Chaetodon ocellatus	Spotfin butterflyfish	
	Chaetodon sedentarius	Reef butterflyfish	
	Chaetodon striatus	Banded butterflyfish	
Cirrhitidae	*Amblycirrhitus pinos*	Red-spotted hawkfish	
Clinidae	*Acanthemblemaria spinosa*	Spinyhead blenny	
	Chaenopsis ocellata	Bluethroat pike blenny	
	Emblemaria pandionts	Sailfin blenny	
	Lucayablennius zingaro	Arrow blenny	
	Malacoctenus boehlkei	Diamond blenny	
	Malacoctenus macropus	Rosy blenny	
	Malacoctenus triangulatus	Saddled blenny	
	Ophioblennius atlanticus	Redlip blenny	
Congridae	*Heteroconger halis*	Garden eel	
Dasyatidae	*Dasyatis americana*	Southern stingray	
Echeneidae	*Echeneis neucratoides**	Whitefin sharksucker	
Elopidae	*Megalops atlanticus*	Tarpon	
Ephippidae	*Chaetodipterus faber*	Atlantic spadefish	
Exocoetidae	*Hirundichthys speculiger*	Mirrorwing flyingfish	
Gerreidae	*Eucinostomus lefroyi*	Mottled mojarra	
	Gerres cinereus	Yellowfin mojarra	
Ginglymostomidae	*Ginglymostoma cirratum*	Nurse shark	
Gobiidae	*Coryphopterus dicrus*	Colon goby	
	Coryphopterus eidolon	Pallid goby	
	Coryphopterus galucofraenum	Bridled goby	
	Coryphopterus lipernes	Peppermint goby	
	Gnatholepsis personatus	Masked goby	
	Gnatholepsis thompsoni	Goldspot goby	
Gobiidae	*Gobionellus saepepallens*	Dash goby	
	Gobiosoma dilepsis	Orangesided goby	
	Gobiosom evelynae	Sharknose goby	
	Gobiosoma genie	Cleaning goby	
	Gobiosoma horsti	Yellowline goby	
	Gobiosoma illecebrosum	Barsnout goby	
	Gobiosoma oceanops	Neon goby	
	Gobiosoma prochilos	Broadstripe goby	
	Lophogobius cyprinoides	Crested goby	
Gramistinidae	*Gramma loreto*	Fairy basslet	
	Gramma melacara	Blackcap basslet	
	Liopropoma rubre	Peppermint basslet	
Haemulidae	*Anisotremus surinamensis*	Black margate	
	Anisotremus virginicus	Porkfish	

Port Honduras Marine Reserve (Snake Cayes, 1990 - 1998): Fish Species			
Family	**Species**	**Common name**	**IUCN**
Haemulidae	*Haemulon album*	White margate	
	Haemulon aurolineatum	Tomtate	
	Haemulon carbonarium	Caesar grunt	
	Haemulon chrysargyreum	Smallmouth grunt	
	Haemulon flavolineatum	French grunt	
	Haemulon macrostomum	Spanish grunt	
	Haemulon melanurum	Cottonwick	
	Haemulon parra	Sailor's choice	
	Haemulon plumieri	White grunt	
	Haemulon sciurus	Bluestriped grunt	
	Haemulon striatum	Striped grunt	
Hemiramphidae	*Hemiramphus brasiliensis*	Ballyhoo halfbeak	
Holocentridae	*Holocentrus adscensionis*	Squirrelfish	
	Holocentrus coruscus	Reef squirrelfish	
	Holocentrus rufus	Longspine squirrelfish	
	Sargocentron coruscum	Reef squirrelfish	
	Sargocentron vexillarium	Dusky squirrelfish	
	Myripristis jacibus	Blackbar squirrelfish	
	Neoniphon marianus	Longjaw squirrelfish	
Inermiidae	*Emmelichthyops atlanticus*	Bonnetmouth	
	Inermia vittata	Boga	
Kyphosidae	*Kyphosus sectatrix*	Bermuda chub	
Labridae	*Bodianus pulchellus*	Spotfin hogfish	
	Bodianus rufus	Spanish hogfish	
	Clepticus parrae	Creole wrasse	
	Doratonatus megalepis	Dwarf wrasse	
	Halichoeres bivittatus	Slippery dick	
	Halichoeres cyanocephalus	Yellowcheek wrasse	
	Halichoeres garnoti	Yellowhead wrasse	
	Halichoeres maculipinna	Clown wrasse	
	Halichoeres radiatus	Puddingwife	
	Hemipteronotus novacula	Pearly razorfish	
	Lachnolaimus maximus	Hogfish	**VU**
	Thalassoma bifasciatum	Bluehead wrasse	
	Xyrichtys martinicensis	Rosy razorfish	
	Xyrichtys spendens	Green razorfish	
Lutjanidae	*Lutjanus analis*	Mutton snapper	**VU**
	Lutjanus apodus	Schoolmaster	
	Lutjanus cyanopterus	Cubera snapper	**VU**
	Lutjanus griseus	Grey Snapper	
	Lutjanus jocu	Dog snapper	
	Lutjanus mahogani	Mahogany snapper	
	Lutjanus synagris	Lane Snapper	
	Ocyurus chrysurus	Yellowtail snapper	
Malacanthidae	*Malacanthus plumieri*	Sand tilefish	

Port Honduras Marine Reserve (Snake Cayes, 1990 - 1998): Fish Species			
Family	**Species**	**Common name**	**IUCN**
Mobulidae	*Manta birostris*	Atlantic manta	
	Mobula hypostoma	Devil ray	
Monacanthidae	*Cantherhines macrocerus*	Whitespotted filefish	
	Aluterus scriptus	Scrawled filefish	
	Aluterus schoepfi	Orange filefish	
Muglidae	*Mugil curema*	White mullet	
Mullidae	*Mulloidiochthys martinicus*	Yellow goatfish	
	Pseudopeneus maculatus	Spotted goatfish	
Muraenidae	*Enchelycore carychroa*	Chestnut moray	
	Gymnothorax funebris	Green moray	
	Gymnothorax miliaris	Goldentail moray	
	Gymnothorax moringa	Spotted moray	
	Gymnothorax vicinus	Purplemouth moray	
Myliobatidae	*Aetobatus narinari*	Spotted eagle ray	
Ogcocephalus	*Ogcocephalus nasutus*	Shortnose batfish	
Ophicthidae	*Myrichthys breviceps*	Sharptail eel	
Opisthognatidae	*Opistognathus aurifrons*	Yellowhead jawfish	
	Opistognathus macrognathus	Banded jawfish	
	Opistognathus whitehurstii	Dusky jawfish	
Ostraciidae	*Acanthostracion polygonia*	Honeycomb cowfish	
	Acanthostracion quadricornis	Scrawled cowfish	
	Lactophrys bicaudalis	Spotted trunkfish	
	Lactophrys triqueter	Smooth trunkfish	
Pempheridae	*Pempheris schomburgki*	Glassy sweeper	
Pomacanthidae	*Holacanthus ciliaris*	Queen angelfish	
	Holacanthus tricolor	Rock beauty	
	Pomacanthus arcuatus	Grey angelfish	
	Pomacanthus paru	French angelfish	
Pomacentridae	*Abudefduf saxatilis*	Sergeant major	
	Abudefduf taurus	Night sergeant	
	Chromis cyanea	Blue chromis	
	Chromis insolata	Sunshinefish	
	Chromis multilineata	Brown chromis	
	Microspathodon chrysurus	Yellowtail damselfish	
	Stegastes diencaeus	Longfin damselfish	
	Stegastes adustus[2]	Dusky damselfish	
	Stegastes leucostictus	Beaugregory	
	Stegastes partitus	Bicolor damselfish	
	Stegastes planifrons	Threespot damselfish	
	Stegastes variabilis	Cocoa damselfish	
Priacanthidae	*Priacanthus arenatus*	Bigeye	
	Priacanthus cruentatus	Glasseye snapper	
Rhincodontidae	*Rhincodon typus*	Whale shark	

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

Port Honduras Marine Reserve (Snake Cayes, 1990 - 1998): Fish Species			
Family	**Species**	**Common name**	**IUCN**
Scaridae	*Scarus coelestinus*	Midnight parrotfish	
	Scarus coeruleus	Blue parrotfish	
	Scarus guacamaia	Rainbow parrotfish	
	Scarus iserti	Striped parrotfish	
	Scarus taeniopterus	Princess parrotfish	
	Scarus vetula	Queen parrotfish	
	Sparisoma atomarium	Greenblotch parrotfish	
	Sparisoma aurofrenatum	Redband parrotfish	
	Sparisoma chrysopterum	Redtail parrotfish	
	Sparisoma rubripinne	Yellowtail parrotfish	
	Sparisoma radians	Bucktooth parrotfish	
	Sparisoma viride	Stoplight parrotfish	
Sciaenidae	*Equetus acuminatus*	Highhat	
	Equetus punctatus	Spotted drum	
	Equetus umbrosus	Cubbyu	
	Odontoscion dentex	Reef croaker	
Scombridae	*Scomberomorus regala*	Cero	
Scorpaenidae	*Scorpaena plumieri*	Spotted scorpionfish	
Serranidae	*Alphestes afer*	Mutton hamlet	
	Cephalopholis fulvus	Coney	
	Cephalopholis s cruentatus	Graysby	
	Epinephelus adscensionis	Rock hind	
	Epinephelus guttatus	Red hind	
	Epinephelus itajara	Goliath grouper	
	Epinephelus morio	Red grouper	
	Epinephelus striatus	Nassau grouper	EN
	Hypoplectrus aberrans	Yellowbelly hamlet	
	Hypoplectrus chlorurus	Yellowtail hamlet	
	Hypoplectrus gemma	Blue hamlet	
	Hypoplectrus gummingatta	Golden hamlet	
	Hypoplectrus guttavarius	Shy hamlet	
	Hypoplectrus indigo	Indigo hamlet	
	Hypoplectrus nigricans	Black hamlet	
	Hypoplectrus puella	Barred hamlet	
	Hypoplectrus unicolor	Butter hamlet	
	Mycteroperca bonaci	Black grouper	
	Mycteroperca interstitialis	Yellowmouth grouper	**VU**
	Mycteroperca rubra	Comb grouper	
	Mycteroperca tigris	Tiger grouper	
	Mycteroperca venenosa	Yellowfin grouper	
	Paranthias furcifer	Creole-fish	
	Rypticus saponaceus	Greater soapfish	
	Serranus baldwini	Lantern bass	
	Serranus flaviventris	Twinspot bass	
	Serranus tabacarius	Tobaccofish	

Port Honduras Marine Reserve (Snake Cayes, 1990 - 1998): Fish Species			
Family	**Species**	**Common name**	**IUCN**
Serranidae	*Serranus tigrinus*	Harlequin bass	
	Serranus tortugarium	Chalk bass	
Sparidae	*Calamus bajonado*	Jolthead porgy	
	Calamus calamus	Saucereye porgy	
Sphyraenidae	*Sphyraena barracuda*	Great Barracuda	
	Sphyraena picudilla	Southern sennet	
Sphyrnidae	*Sphyrna mokarran*	Great hammerhead	
Syngnathidae	*Cosmocampus elucens*	Shortfin pipefish	
	Hippocampus erectus	Northern seahorse	**VU**
Synodontidae	*Synodus intermedius*	Sand diver	
Synodontidae	*Synodus saurus*	Bluestriped lizardfish	
Tetraodontidae	*Canthigaster rostrata*	Sharpnose puffer	
	Chilomycterius antennatus	Bridled burrfish	
Tetraodontidae	*Chilomycterius antillarum*	Web burrfish	
	Diodon holocanthus	Balloonfish	
	Diodon hystrix	Porcupinefish	
	Sphoeroides spengleri	Bandtail puffer	
	Sphoeroides testudineus	Checkered pufferfish	
Triglidae	*Prionotus ophyras*	Bandtail searobin	
Tripterygiidae	*Enneanectes altivelis*	Lofty triplefin	
	Enneanectes atrorus	Blackedge triplefin	
Urolophidae	*Urolophus jamaicensis*	Yellow stingray	

Annex 4: Potential Changes in Zonation during the timescale of the Management Plan

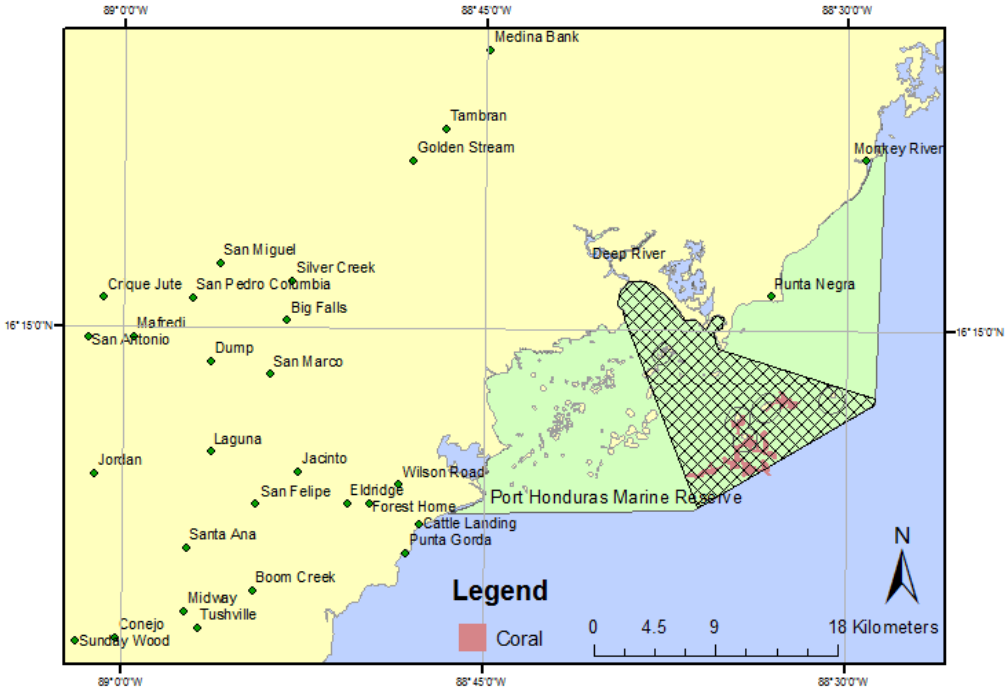
The results of the PHMR monitoring Programme from 2003 to 2009 demonstrate that the 5% no take area (Conservation Zone and Preservation Zone) within the marine reserve is ineffective in enhancing the populations of commercial species and reef fish species within the reserve (Foster 2010b). Neither conch or lobster populations showed a significant increase in the six year period for 2003 to 2009 and furthermore, reef fish populations showed a significant decline in abundance over the same period (Foster 2010b). Despite this trend, sessile benthic species showed significant improvements over the same six year period (Foster 2010b).

One explanation for the difference in recovery of the commercial and reef fish species compared to the sessile benthic species, is the mobility of these species. Reef fish are highly mobile species, and lobster and conch can also move considerable distances, meaning that the small area of no take zone within PHMR has only a limited affect on the recovery of these populations (Foster 2010b). The half mile radius no take areas that currently extend around the Snake Cayes and Wild Cane Caye, are limited in the area they enclose. In addition, they are spread apart from one another. As a result reef fish, conch and lobster species do not have to travel great distances before they enter a general use area and are exposed to fishing pressures. Even daily migration patterns for food, or movements among nursery and adult grounds can result in an individual frequently entering a general use zone, thereby increasing its risk of being caught prior to reaching sexual maturity (Foster 2010b).

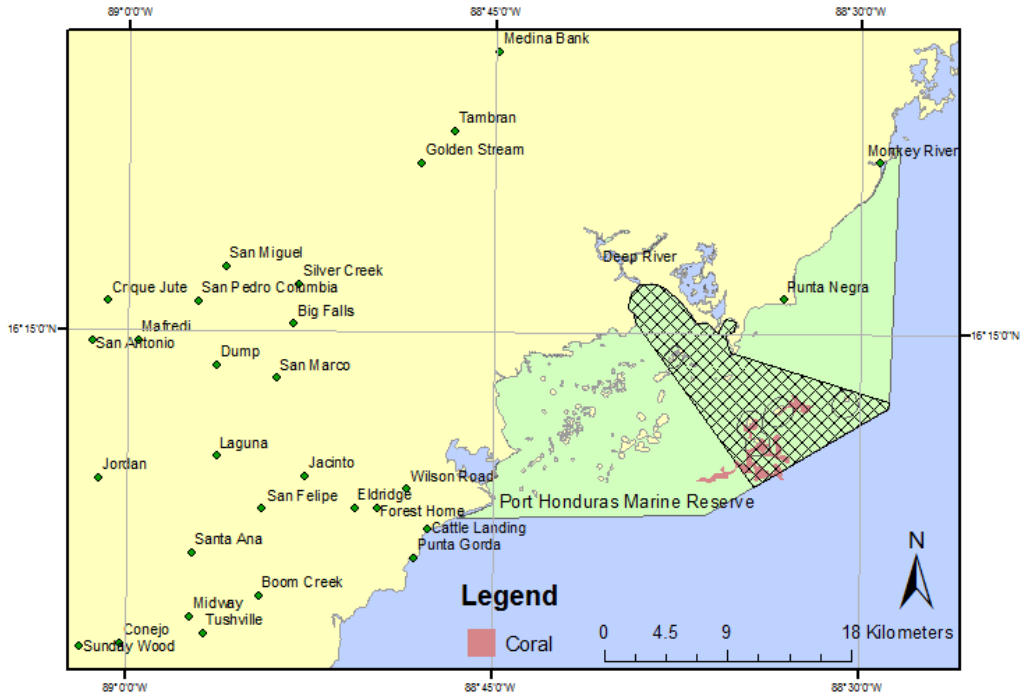
Based on information from the scientific literature, recommendations for a minimum MPA size, specifically designated as a no take area, range from 4-20km in diameter to effectively conserve biodiversity (Salm 1984, Friedlander et al. 2003, Shanks et al. 2003). In addition, studies have shown that many species utilise seagrass beds, mangroves and coral reefs at various stages of their life history (Acosta & Robertson 2003, Roberts et al. 2003, Mumby 2006). Thus, an increase in the no-take area of PHMR would ensure inclusion of a larger area of each of these key habitats, thereby protecting connectivity between functionally linked habitats (McLeod et al. 2009). Moreover, specific studies have also demonstrated the success and benefits of long-term no take areas. A decrease in macroalgal cover and an increase in live coral cover, attributed to the recovery of herbivorous fish populations, has been observed at sites within the Exuma Cayes Land and Sea Park, Bahamas (Mumby & Harborne 2010). Populations of the Caribbean spiny lobster, *Panulirus argus,* located on patch reefs within Conservation Zones (no take areas) at Glovers Reef showed significant increases over a five year period from 1996 to 2001 (Acosta & Robertson 2003).

Based on the results of the PHMR monitoring Programme and information from the scientific literature, it is recommended that the no take area within PHMR be increased to incorporate between 20-30% of the reserve area (Bohnsack et al 2000, Day et al 2002, Airame et al 2003 and Fernandes et al 2005) and be greater than 5km in diameter. Below are some recommendations

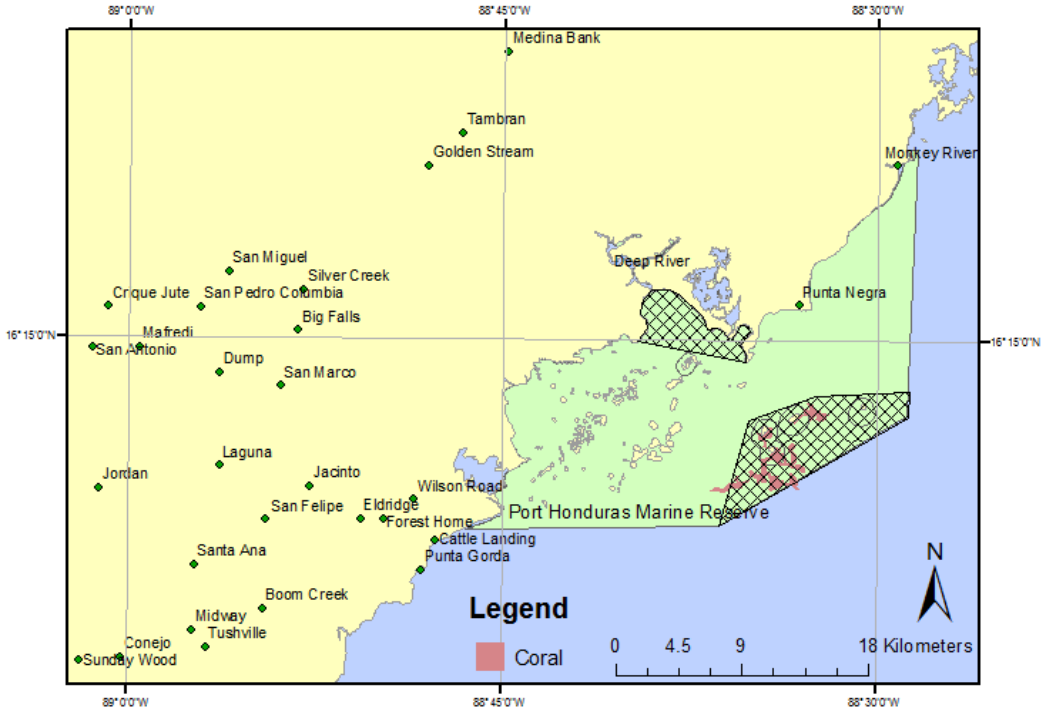
for the placement of the new no take areas, based on information regarding ecosystem presence and community suggestions during consultations in 2010. Ideally, a move to extend the no take zones within PHMR should be completed during 2011.



Port Honduras Marine Reserve showing a possible extension to the no take zone (hatched area) that will incorporate 32% (133km^2) of the reserve area.



Port Honduras Marine Reserve showing a possible extension to the no take zone (hatched area) that will incorporate 25% (105km^2) of the reserve area.



Port Honduras Marine Reserve showing a possible extension to the no take zone (hatched area) that will incorporate 20% (83km^2) of the reserve area.

Port Honduras Marine Reserve showing a possible extension to the no take zone (hatched area) – that will incorporate 15% of the reserve area - the option preferred by the majority of the stakeholders

Annex 5: Goals and Objectives of the Maya Mountains Marine Corridor

Maya Mountains Marine Corridor: Objectives and Strategic Actions	
Objective	**(COASTAL PLAIN BROADLEAF) By 2013, overall gain is limited to 10% more than rate in 2008 in acreage of livestock ranching in the coastal plain broadleaf forest within the MMMC**
Strategic action	Develop baseline data to detemine acreage of land under livestock ranching in the MMMC
Strategic action	Consult and engage farmers and policy decision makers in the development of a best management practices guide to livestock ranching in order to minimize environmental impacts
Strategic action	Advocate for the development of a livestock ranching policy and legislation in order to minimize environmental impacts
Strategic action	Implement Best Management Practices Guide for livestock ranching to minimize environmental impacts
Objective	**(COASTAL PLAIN BROADLEAF) By 2017, increase the size of broadleaf forest within the coastal plain of the MMMC by 10%**
Strategic action	Revision of forest licenses to include forest regeneration activities
Strategic action	Provide incentives to land owners to maintain their land forested (for various ecological purposes)
Strategic action	Encourage and support farmers into agroforestry for the benefit of restoring ecological connectivity
Objective	**(COASTAL PLAIN BROADLEAF) By 2017, restore connectivity among ecosystems in the MMMC by 20% (from fair to good)**
Strategic action	Develop public awareness campaign on the plight of the White-lipped Peccary
Strategic action	Encourage farmers into agroforestry in Golden Stream, Indian Creek, San Marcos, Big Falls, Medina Bank, San Miguel, and Silver Creek
Strategic action	Create community conservation areas specifically geared towards connectivity and biological corridors
Strategic action	Encourage and support reforestation (amendment of existing laws)
Objective	**(COASTAL PLAIN BROADLEAF) By 2018, 20% of existing agricultural lands have been rehabilitated through sustainable forestry and agroforestry practices in Trio, Medina Bank, San Marcos, San Pedro Columbia, San Pablo, Golden Stream, IC, SC, BF and SM**
Strategic action	Encourage and support farmers into agroforestry for the benefit of restoring ecological connectivity
Strategic action	Public awareness/outreach programs on the various benefits of agroforestry practices

Maya Mountains Marine Corridor: Objectives and Strategic Actions	
Objective	**(CORAL REEF) Based on 2008 fishing levels, reduce the fishing pressure by 30% by the year 2010 in PHMR**
Strategic action	Determine 2008 fishing levels (all users) in the PHMR
Strategic action	Implement a special fishing license for traditional (10yrs) users only
Strategic action	Compulsory CPUE monitoring of all fishers within the PHMR
Strategic action	Develop and institute alternative livelihoods programs for PHMR fishers
Objective	**(CORAL REEF) By 2010, eliminate illegal fishing (undersized and out of season catch, fishing in non-extractive zones) in PHMR and in the rivers of the MMMC**
Strategic action	Increase enforcement, vigilance, and coordination at all points of the fishing industry from extraction to commercialization
Strategic action	Sensitize the judicial system, as well as retailers (food industry) to impacts of illegal fishing within the MMMC
Strategic action	Institute compulsory seizure of all gears related to the 2nd offences
Objective	**(CORAL REEF) By 2010, eliminate the use of illegal fishing gear (gillnets, long-line, trawling, scuba, explosive, chemical and spearfishing) in PHMR and in the rivers of the MMMC**
Strategic action	Motivate stakeholders (communities, fishers, tourism sector, town councils, coops) to support legislation revision and Government to adopt them
Strategic action	Strengthen management of the PHMR
Objective	**(CR KEA-COMMERCIAL SPECIES DENSITY) By 2018, increase commercial species (conch, lobster, snapper, grouper, parrotfish, shark) levels from "poor" to "good" based on 2008 levels**
Strategic action	Establish 2008 commercial species population levels
Strategic action	Mapping key habitat (nursery, reproduction, feeding, etc.) for commercial species
Strategic action	Increase the area of the no-take zone from 5% to 20% in the PHMR
Strategic action	Establish/revise size classes for commercial species (conch, lobster, snapper, grouper, parrotfish, sharks)
Strategic action	Strengthen management of the PHMR (2)
Strategic action	Establishment of a monitoring mechanism for commercial species

Maya Mountains Marine Corridor: Objectives and Strategic Actions	
Objective	**(FAJINA) By the year 2012, the Mayan villages within the MMMC will have strengthened functional Alcalde Systems comparable to what was in place 30 years ago**
Strategic action	Passage of an Alcaldes System Act, enshrined in the Constitution of Belize – recognition of the Alcalde System under the Laws of Belize
Strategic action	Identify the mutual roles between the Alcalde System and Village Council, with a view to harmonizing these roles
Strategic action	Regular/frequent meetings of the village Alcalde Teams
Strategic action	Capacity building and empowerment for the Toledo Alcaldes Association
Strategic action	Prepare (draft) community development plans that incorporates a set of guidelines and principles premised on Mayan norms and values, and the empowerment of young people, for Mayan villages within the MMMC
Objective	**(FAJINA) By the year 2012, the three villages within the MMMC that currently do not practice fajina, will observe the quarterly fajina practices and tradition along with the already existing ones**
Strategic action	Conduct an assessment to determine why the three villages are not practicing fajina and if they would want to revive the system
Strategic action	The Toledo Alcaldes Association engages the community leaders of the three villages, and promotes the re-formation of fajina
Strategic action	Develop and conduct a public awareness program focusing on the Fajina system and related Mayan customary and traditional practices
Strategic action	Conduct training programs on leadership, etc.
Objective	**(FRESHWATER - 1&2) Re-establish 66ft setback on banana farms along Monkey River and Citrus farms along the Rio Grande and Golden Stream along x number (20 %) of river and stream miles –find out what cutoff, 3rd order streams?) of river miles by 2013.**
Strategic action	Conduct research into ideal riverine buffer size in order to prevent direct spraying and leaching of pesticides into rivers
Strategic action	Work with Banana-Growers association, Citrus Growers Association, Lands Department, Agriculture Department to implement the re-establishment of a 66 ft (or similar) riverine buffer
Strategic action	Education and awareness campaign to create appreciation of riparian buffers
Strategic action	Lobby with EU (through local representative) to have riparian buffers pushed from the consumer side (this seems to be implemented already but only using grass, not trees or shrubs, we need to verify this or move from this)
Strategic action	Collect water samples and start a water quality baseline recording pesticides
Strategic action	Develop Indexes of Biological Integrity (IBI) and other biological/ecological parameters in order to be able to measure success.

Maya Mountains Marine Corridor: Objectives and Strategic Actions	
Objective	**(FRESHWATER SYSTEMS - 3) Reduce over all use of pesticides (specific?) (based on quantity sold) with 25% every 5 year period.**
Strategic action	Collect water samples and start a water quality baseline recording pesticides
Strategic action	Conduct research into ideal riverine buffer size in order to prevent direct spraying and leaching of pesticides into rivers
Strategic action	Lobby with EU (through local representative) to have riparian buffers pushed from the consumer side (this seems to be implemented already but only using grass, not trees or shrubs, we need to verify this or move from this)
Strategic action	Education and awareness campaign to create appreciation of riparian buffers
Strategic action	Work with Banana-Growers association, Citrus Growers Association, Lands Department, Agriculture Department to implement the re-establishment of a 66 ft (or similar) riverine buffer
Objective	**(FRESHWATER SYSTEMS - 4) Prevent clearance of more than 10% of present (2007 assessment) of 66ft buffer riverine habitat (linear distance) within the MMMC**
Strategic action	Work with Banana-Growers association, Citrus Growers Association, Lands Department, Agriculture Department, and Department of the Environment to implement this regulation.
Strategic action	Investigate potential conflicts with Matahambre agricultural systems caused by attempts to reduce riverine deforestation
Strategic action	In order to set standards for the amount of river shore and coastal protection (by a vegetation buffer), map current extend of coastal and riverine clearing
Objective	**(FRESHWATER SYSTEMS - 5) Prevent further degradation and clearing of coastal fringe mangroves and associated nursery zones.**
Strategic action	Procure more coastal mangrove habitat based on the background research
Strategic action	Design easements as a means to protect key habitats on private lands
Strategic action	Work with Punta Negra owners to safeguard ecological functioning of mangrove in this area.
Strategic action	Create viability figures for turtles and turtle nesting sites within the MMMC
Strategic action	Research MMMC coastline for nursery habitat, turtle nesting and similar and identify key areas
Strategic action	Research importance of Punta Negra area for nursery zones, turtle nesting

Maya Mountains Marine Corridor: Objectives and Strategic Actions	
Objective	**(FRESHWATER SYSTEMS - 6) Prevent further degradation of littoral forests in the MMMC.**
Strategic action	Research importance of Punta Negra area for ecological functions of the littoral forest.
Strategic action	Work with Punta Negra owners to safeguard ecological functioning of littoral forests in this area
Strategic action	Research remainder of MMMC coastline for migratory species, turtle nesting and similar and identify key areas.
Objective	**(FRESHWATER SYSTEMS - 8) Implement Hicatee recovery plan by 2009**
Strategic action	Conduct study to establish the current Hicatee population and population dynamics
Strategic action	Based on population size and population dynamics modify current regulations dealing with hicatee fishing and possession
Strategic action	Develop hicatee as a community resource valuable to the community (currently it is a "common" resource)
Strategic action	Increase enforcement of laws and regulations as they pertain to the Hicatee
Strategic action	Increase enforcement capacity in order to enforce laws and regulations as they pertain to the Hickatee
Strategic action	Strengthen interagency cooperation (with regard to Hicatee protection)
Strategic action	Involve community members in enforcement and monitoring of Hicatee laws and regulations
Strategic action	Pay above market value to hunters for live hickatee in mark and recapture efforts
Objective	**(FRESHWATER SYSTEMS -7) Restore viable breeding hickatee population in Rio Grande by 2018**
Strategic action	Conduct study to establish current Hickatee population and population dynamics
Strategic action	Research the location of key habitats for the reproduction of the Hicatee
Strategic action	Create community buy-in and co-management for the establish a Hickatee protection zone
Strategic action	Research options of a Hicatee captive breeding program
Objective	**(LARGE MARINE VERTEBRATES) By 2010, increase the shark population by 10?% (or to "good" viability rating) based on 2008 levels in PHMR**
Strategic action	Define 2008 shark population levels in PHMR
Strategic action	Establish a national shark policy and legislation limiting catch by size, species, gear type and finning
Strategic action	Develop a PHMR public education/awareness program on shark ecology
Strategic action	Promote the enforcement of shark legislation
Strategic action	Conduct a 2011 shark assessment to determine levels

Maya Mountains Marine Corridor: Objectives and Strategic Actions	
Objective	**(LARGE MARINE VERTEBRATES) By 2015, increase the population of large (>110cm) Goliath grouper by 50% in PHMR based on 2008 levels**
Strategic action	Define 2008 Goliath grouper population
Strategic action	Establish a national Goliath grouper policy and legislation limiting catch by size and gear type
Strategic action	Public education/awareness (2)
Strategic action	Enforcement of grouper legislation
Objective	**(PINE SAVANNAS) Eliminate anthropogenic wildland fires within the PCNP, DRFR, GSCP and BNR by 2012.**
Strategic action	Via the Fire Learning Network (FLN) planning process, develop and implement an integrated fire management strategy and plan for the key areas of the MMMC (involving government agencies, NGO's, communities, and private sector)
Strategic action	Secure funding for the implementation of the integrated fire management strategy and plan for the key areas of the MMMC
Strategic action	Formalize agreements among key resource management agencies and stakeholders (inter-agency coordination) for the efficient execution of the integrated fire management strategy and plan
Objective	**(PINE SAVANNAS) Eliminate the hunting of Yellow-headed Parrots within the Pine Savannas of the PCNP, DRFR, GSCP and BNR by the year 2012.**
Strategic action	Influence the Forest Department and Ministry of Natural Resources to revise and strengthen the wildlife laws and regulations, in order to increase fines & penalties for infractions
Strategic action	Establish strategic alliances with NGO's and local governments (e.g., Alcaldes & village council) and promote inter-agency coordination to support the Forest Department in the effective enforcement of wildlife laws and regulation
Strategic action	Improve the effective enforcement of wildlife laws and regulations through deputizing Alcaldes, Rangers, etc., as Game Wardens
Strategic action	Create avenues for and awareness of viable income generating activities (avi-tourism activities – birding tours, etc.)
Objective	**(PINE SAVANNAS) With the effective participation of all stakeholders, by the year 2012, develop a land use policy and plan for the MMMC.**
Strategic action	Influence the Ministry of Natural Resources to appoint a Regional Land Advisory Council (representing all stakeholders) that would be charged with establishing guidelines for developing a land use policy and plan for MMMC
Strategic action	Secure funding to develop the MMMC land use policy and plan
Strategic action	Build the capacity of MMMC communities and CBO's in land resource planning and management in order that they may meaningfully participate in the proposed land use policy and planning process

Maya Mountains Marine Corridor: Objectives and Strategic Actions	
Objective	**(PS KEA-SPECIES COMPOSITION/STRUCTURE) By 2020, the normal stand structure (species & age composition) for Caribbean Pine is re-established to conditions comparable to 50 years ago within the Pine Savannas of the PCNP, DRFR, GSCP, BNR and SBFR.**
Strategic action	Develop and implement an integrated fire management strategy and plan (including prevention, pre-suppression and suppression of wildfires, etc.) for the key areas of the MMMC (involving government agencies, NGO's, communities, and the private sector)
Strategic action	Institute sustained forest management wherever there is resource use & extraction (logging concessions, extraction of palmetto seeds, etc.) within the MMMC
Strategic action	Develop and institute a monitoring and evaluation protocol for Caribbean Pine stand dynamics (e.g., set up plots to see how the stand dynamics are evolving, and if we are achieving the desired stand structure, species & age composition)
Strategic action	Secure funding for the implementation of the integrated fire management strategy and plan for the key areas of the MMMC (2)
Objective	**(SUSTAINABLE FISHING) By 20xx, establish a diversified sustainable fishing (tourism, commercial, sport, export, local sales, aquaculture) economy for z families that brings in $XXXX per family**
Strategic action	Conduct a socio-economic study of coastal communities of the MMMC (2)
Strategic action	Develop and institute certification of product (fish cards)
Objective	**(SUSTAINABLE FISHING) By 20xx, x% of fishers from Monkey River to Punta Gorda can achieve y standard of living by utilizing sustainable fishing practices**
Strategic action	Define target group (commercial, sport, subsistence, recreational fishers)
Strategic action	Conduct a socio-economic study of coastal communities of the MMMC
Objective	**(UPLAND FORESTS) By 2013, increase the population size of white lipped peccary in the MMMC by reduction in #s of white lipped peccary killed by 50%**
Strategic action	Develop baseline data of White-lipped Peccary population within the MMMC
Strategic action	Increase protection status for the white-lipped peccary for example by establishing a closed season for hunting
Strategic action	Enforce existing hunting/wildlife legislation
Strategic action	Develop public awareness campaign on the plight of the White-lipped Peccary
Strategic action	Develop sustainable economic livelihood alternatives re: peccary rearing (yeah right, keep on dreaming) (Comment: Need to align with existing projects)
Strategic action	Cross sectoral dialogue/collaboration on hunting issues

Maya Mountains Marine Corridor: Objectives and Strategic Actions	
Objective	**(UPLAND FORESTS) By 2013, reduce illegal hunting in the MMMC by 20%**
Strategic action	Develop sustainable economic livelihood alternatives in the MMMC
Strategic action	Enforcement of existing hunting/wildlife legislation (increase patrols)
Strategic action	Public Awareness Campaign on hunting issues
Strategic action	Cross-sectoral collaboration/dialogue on hunting issues
Strategic action	Increase protection status for game species (closed seasons for hunting)
Objective	**(UPLAND FORESTS) By 2018, reduce the number of jaguars killed as a result of human/animal conflict and hunting per year to less than one jaguar in the MMMC**
Strategic action	Develop baseline data to determine jaguar population density in the MMMC
Strategic action	Develop baseline data to determine the number of jaguars killed per year in the MMMC through collaborative efforts between partners
Strategic action	Offer a compensation scheme for livestock and domestic animals lost to Jaguar predation
Strategic action	Subsidize electric fences in an effort to prevent Jaguar predation of livestock
Strategic action	Outreach to farmers and community members on ways to reduce Jaguar - People conflicts