St. Herman's Blue Hole National Park

Management Plan

2016 – 2020

FOREST DEPARTMENT • BELIZE

BELIZE AUDUBON SOCIETY

Belize Audubon Society

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St. Herman's Blue Hole National Park

We would like to thank …

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Introduction

Background and Context

St. Herman's Blue Hole National Park is an important component of the National Protected Areas System. Located on the Hummingbird Highway only 12 miles southeast of Belmopan, Belize's capital city, , it is easily accessible. This accessibility, combined with the scenic beauty of the clear waters of the karstic sink hole and the impressive geological features of the cave systems, makes the 574.5 acre protected area a popular recreational site, particularly for school groups. It is an important component in the National Protected Areas System notjust forits educational potential, but also for its representation of karstic limestone features in Belize, as characterised by both the sink hole and the St. Herman's cave system, lying within a tropical forest landscape known for its excellent birding.

Two limestone-loving tropical broad-leaf forest ecosystem types are protected within St. Herman's Blue Hole National Park – **Tropical evergreen seasonal broad-leaved lowland hill forest on steep karstic terrain** and **Tropical evergreen seasonal broad-leaved lowland hill forest on rolling karstic terrain**. Both ecosystems are in various stages of succession following hurricane impacts in 2010 from Hurricane Richard. The forest contains the representative species expected from a low human-impact tropical forest.

SITE INFORMATION

Size: 574.5 acres (233 ha)
Statutory Instrument: SI 109 of 1986
IUCN Category: III
Management Authority: Forest Department
Co-management Partner:
Belize Audubon Society (BAS)
Contact E-mail: base@btl.net
Web site: www.belizeaudubon.org

Location: The National Park is located on the Hummingbird Highway, 12 miles southeast of Belmopan

Uses: Non-extractive – tourism, education and research

System-Level Unit: Maya Mountains Massif

Visitation (2014): 20,765 visitors (including school groups)

On-site Staff (2015): 1 site manager, 4 site rangers, supported by BAS administrative staff and programme support staff

SPECIES OF INTERNATIONAL CONCERN

Endangered:

Yucatan Black Howler	*Alouatta pigra*
Geoffroy's Spider Monkey	*Ateles geoffroyi*
Sabrinus Rainfrog	*Craugastor sabrinus*
Baird's Tapir	*Tapirus bairdii*
Yaxnik	*Vitex gaumeri*

Vulnerable

Cerulean Warbler	*Dendroica cerulea*
Great Curassow	*Crax rubra*
Leprus Chirping Frog	*Eleutherodactylus leprus*
Mahogany	*Swietenia macrophylla*
Mexican cedar	*Cedrela odorata*

IUCN, 2015

At least ten species of international concern are known to be present in the National Park, including two endangered primate species - the Yucatan black howler monkey (*Alouatta pigra*) and Geoffroy's spider monkey (*Ateles geoffroyi*). It is home to approximately 280 species of birds including game species such as the great curassow and crested guan (BAS SHBHNP Checklist).

The outstanding geological features of St. Herman's Cave and the Crystal Cave (also known as Mountain Cow Cave) are complemented by their archaeological importance, with their use by the Maya during the Classic Period, demonstrated by the presence of sacrificial sites, pottery vessels, spears and torches in the cave system. The National Park's unique geological features, archaeological history and biodiversity provide a variety of educational opportunities, making it a nationally important educational resource for schools across Belize. Its accessibility and the fact that St. Herman's cave is one of only two caves in Belize that can be entered easily without a permit or guide, has led to it being a popular tourism destination for both national and international visitors, with over 20,765 visitors to the protected area in 2014 (including school groups).

The management regime for St. Herman's Blue Hole National Park is considered to be equivalent to the international IUCN ***Category III: A protected area managed primarily to protect specific outstanding natural features and their associated biodiversity and habitats*** (Forest Department / Walker et al., 2012). In keeping with its national designation as a National Park, St. Herman's Blue Hole is a non-extractive protected area, with the management goal:

> *To conserve natural and cultural resources for ecosystem values, education, and recreation through collaboration with relevant stakeholders.*

This is to be achieved through the following four objectives:

1. Protect and preserve the karst landscape of the Maya mountain foothills, maintaining biodiversity, and environmental services

2. Provide recreation and education opportunities for Belizean and international visitors in a manner that is compatible with the natural and cultural environment

3. Secure biological , social and financial sustainability of the protected area

4. Engage communities, direct and indirect stakeholders towards reducing impacts and increasing participatory stewardship

Legislative responsibility for the National Park is held by the Forest Department, of the Ministry of Forestry, Fisheries and Sustainable Development, and the area is managed through a collaborative partnership with the Belize Audubon Society (BAS). Protection of the caves and

Maya artefact lies under the mandate of the Institute of Archaeology (IoA), of the National Institute of Culture and Heritage (NICH).

Purpose and Scope of Plan

St. Herman's Blue Hole National Park is one of seven protected areas managed by Belize Audubon Society (BAS), and is a component of the system-level Maya Mountain Massif national management unit. This five year management plan has been developed to provide guidance to Belize Audubon Society and the Forest Department, the co-management partners, towards effective management of St. Herman's Blue Hole National Park within the framework of the National Protected Areas System Plan, the co-management agreement and the vision and mission of Belize Audubon Society.

Belize Audubon Society

VISION

The Belize Audubon Society is a national conservation leader and development partner that inspires people to live in harmony with and benefit from the environment.

MISSION

The Belize Audubon Society is a non-governmental, membership-based organization dedicated to the sustainable management of our natural resources through leadership and strategic partnerships with stakeholders for the benefit of people and the environment.

St. Herman's Blue Hole National Park was designated as a National Park in 1986, under the National Park Systems Act of 1981, Chapter 215, Laws of Belize, Revised as the National Protected Areas System Act, 2015), for:

> *"....the protection and preservation of natural and scenic values of national significance for the benefit and enjoyment of the general public"*

These objectives, along with its location in the Maya Mountains Massif system-level planning unit, bring certain criteria to be taken into consideration during the development of the management plan. The management context has evolved - since the development of the first management plan in 1993 (BAS / Mackler et al., 1993), the protected area has developed, the status of the resources has changed, and the knowledge base has improved significantly from the interim years of data collection.

The programmes in this Management Plan address the current status of the National Park, and reflect the more participatory approach to management being adopted in Belize today. It includes general information on the physical and biological attributes of the protected area, defines the goals and objectives, documents the current uses and management issues, summarises conservation planning outputs, outlines specific management programmes, sets in place the means for measuring management effectiveness, and recommends an implementation schedule and projected costs.

In line with the National Protected Areas Policy and System Plan, this Management Plan has been prepared with the input of the various stakeholders of the protected area through meetings with the BAS staff and Board, a series of workshops with key stakeholders, and

interviews with a wide variety of individuals, particularly management staff and the tourism sector. It seeks to conserve the resources of the protected area whilst increasing economic benefit through tourism, and increasing its educational benefit as a school trip destination. The management programmes are based on the best available data, with the integration of conservation planning strategies, and fit within the scope of the regulations that govern the protected area.

This management plan is designed to provide a framework for both broad management activities and more specific research and monitoring activities over the next five years. It is recommended that detailed operational plans be developed on an annual basis by Belize Audubon Society, based on this management plan, with an annual review of implementation success, allowing for adaptive management over this time frame.

1. Current Status

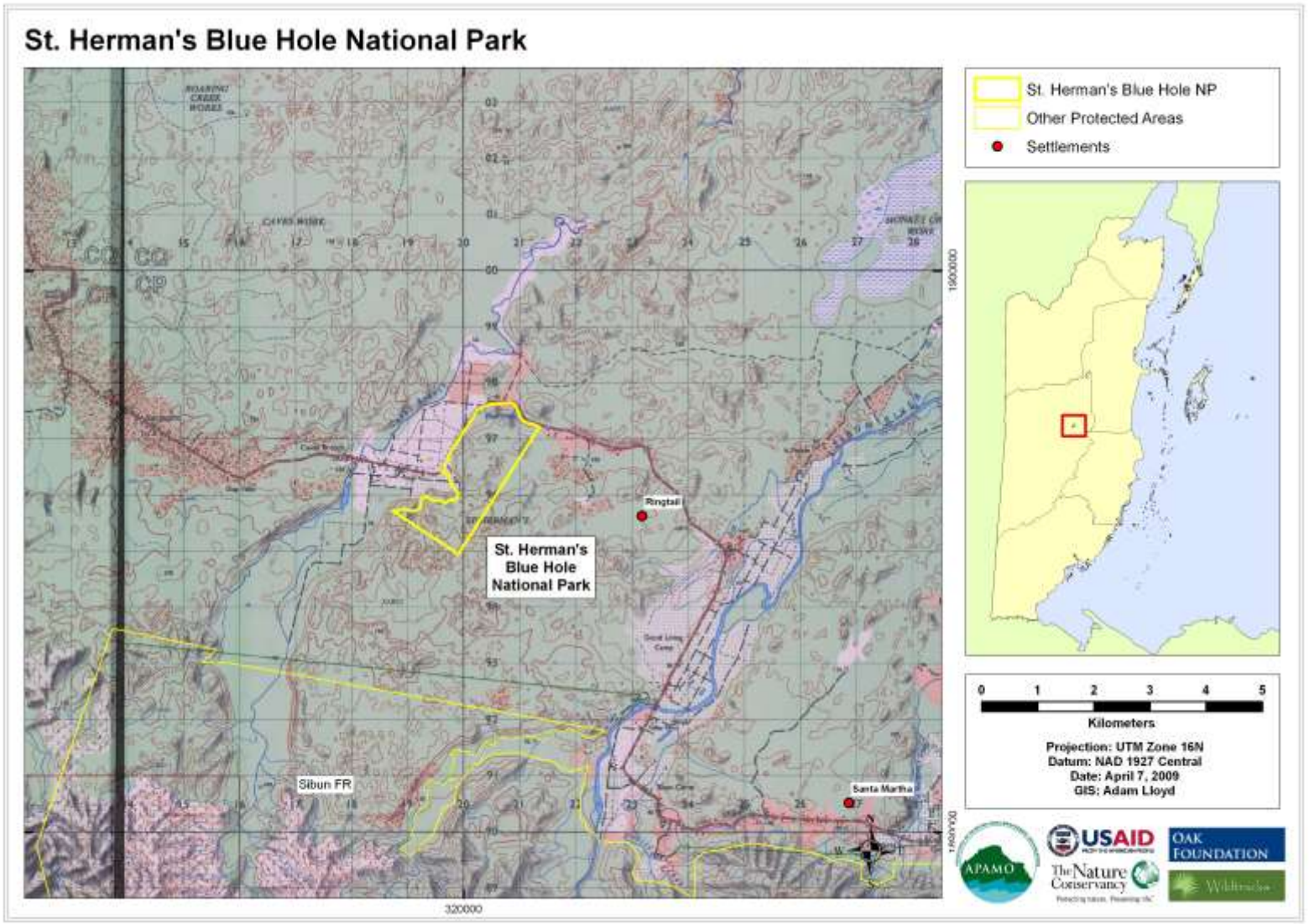
1.1 Location

St. Herman's Blue Hole National Park, part of the larger Maya Mountains Massif system-level planning unit, lies is located at UTM 318285 E, 1899170 N (17˚8'.48.477"'N; 88˚41'.25.130"'W), 12 miles (19.3 km) southeast of Belmopan, in Cayo District (Map 1). It is one of twenty national protected areas which, combined, form the Maya Mountains Massif system level unit. SHBHNP is part of the foothills of the Maya Mountains, but is not directly contiguous with the protected areas of the Maya Mountains Massif. However, it still retains physical forest connectivity with the Massif through the Sibun Forest Reserve, which lies 2.4 km to the south.

SHBHNP has developed in a shifting landscape of forest clearance for agricultural development, focused primarily on citrus. The protected area lies on a forested ridge between two valleys, each with a flowing river (Sibun River and its tributary, the Caves Branch), the resulting rich alluvial soils leading to agricultural development of the two floodplains.

Access to the National Park is by road, with increasing tourism visitation from both local and international visitors. It is easily accessible for day trips from Belmopan, and lies on the primary road used to access central and southern Belize, and is therefore frequently used as a stopping point.

There are no permanent settlements within the National Park, but a number of communities exist adjacent to the area (Ringtail, 2km to the east, Armenia, approximately 5.5km to the northwest, and St. Margaret's Village approximately 20 miles to the east). A number of well-established tourism facilities are located adjacent to the protected area, such as the Caves Branch Jungle Lodge.



Map 1: St. Herman's Blue Hole National Park: General Location

1.2 Regional Context

St. Herman's Blue Hole National Park lies within Mesoamerica, a region highlighted as a world 'hotspot for species diversity' (Conservation International, 2003), ranking second only to the tropical Andes in terms of diversity and endemism (CEPF, 2004). Despite contributing only one percent to the world's terrestrial land area, Mesoamerica is thought to have seventeen percent of all known terrestrial species, with the highest diversity recorded globally for reptiles and second highest for amphibians (CEPF, 2004). As a result, it is considered critical for the preservation of the biodiversity of the Western Hemisphere. This species richness and diversity is due in part to the geological history of the area, forming a transition zone between three biogeographically distinct regions – the Nearctic, Neotropical and the Caribbean. Each of these three brings a unique assemblage of plants and animals, resulting in its particularly rich biodiversity, with components of all three regions being represented within the Central American land bridge. The bridge has enabled movement of species between the North and South American regions since the late Pliocene, and is also of vital importance today to migratory bird species, both as a corridor and as an over-wintering location.

Mesoamerica has suffered from an alarming rate of deforestation, with as much as two thirds of the forest having been converted within the last 50 years into agricultural land that has then been degraded by unsustainable agricultural practices and cattle-farming. Belize, with its relatively large areas of natural forest vegetation still intact, current low human population density and the network of natural ecosystems within the national protected areas system, is considered regionally important in its role in maintaining viable populations of many species threatened throughout their ranges. It provides a critical landscape function within Mesoamerica as one of only a few remaining large, intact, contiguous forest blocks within the region.

Through the Central American Environmental Agenda (Plan Ambiental de la Region Centroamericana (PARCA)), several regional endeavours have been agreed upon to help balance environmental concerns and development, starting with the creation of the Central American Commission for Environment and Development (CCAD) in 1989, the Convention for the Conservation of Biodiversity and Protection of Priority Wilderness Areas in Central America (developed at the XII Central American Summit, in Managua, 1992), and the Regional Alliance for Sustainable Development (ALIDES) (1994) (Table 1). The Government of Belize reaffirmed its commitment to these regional initiativesat the First Mesoamerican Congress on Protected Areas in Managua (2003) through the signing of the Managua Declaration (Ministry of Natural Resources, 2003)

One of the Programmes supported by the Regional Alliance for Sustainable Development is the Mesoamerican Biological Corridor Programme (MBCP), one of the most important regional programmes to have been implemented in recent years, and focused on establishing corridors

of natural vegetation throughout Central America to link protected areas, with the goal of retaining sufficient natural vegetation cover to allow gene flow between protected areas both within and between countries. A central concept of the programme is sustainable development - combining conservation and the sustainable use of biodiversity within the framework of economic development.

Under these regional initiatives, two large blocks of tropical forest within Belize have been highlighted as regionally important – one of these being the Maya Mountains Massif. St. Herman's Blue Hole National Park lies in the northern foothills of the MMM, and is one of twenty national protected areas that comprise the Maya Mountains Massif. As one of the largest remaining contiguous blocks of forest in Central America, the MMM is recognized for its role in maintenance of nationally and regionally important ecosystem services – particularly water supply.

Several key reports have been produced in the last ten years on the biodiversity of Belize – the Protected Areas System Analysis and associated Gap Analysis, the National Protected Areas System Plan (NPAPSP, 2005), the identification of Key Biodiversity Areas (Meerman, 2007), the National Protected Areas System Rationalization report (Walker et al., 2012) and the National Stocktaking Report (Walker et al., 2015) among them. Each of these assessments highlight the critical importance of the Maya Mountains Massif as one of three national priority areas for maintaining these high levels of biodiversity. The functioning ecosystems and intact natural vegetation with relatively few human impacts; the range of ecosystems over an altitudinal gradient, with connectivity from mountain ridge to the coastal areas and the Belize Barrier Reef; and the importance of the environmental services – the watershed and carbon sequestration functions, the hydrological processes – all add to the importance of these protected areas. The Maya Mountains Massif is also recognised for its importance under regional ecoregional planning (TNC).

Until recently, the Maya Mountains Massif was considered to be maintaining the full range of natural processes and disturbance regimes, and to be functioning within the range of acceptability, with minimal human intervention. Threats to the integrity of the area are, however, increasing exponentially, with pressures for natural resources, gold, and land driving inhabitants from communities bordering the Massif, particularly from Guatemala, to enter Belize through much of the remote Chiquibul and Columbia River forest regions, and harvest the natural resources to the point of near local extinction.

St. Herman's Blue Hole National Park, as an integral component of the Maya Mountains Massif, assists Belize in the fulfilment of regional and global commitments committed to by Belize under a number of agreements and conventions (Table 1).

International Conventions and Agreements of Relevance to St. Herman's Blue Hole National Park	
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. ***St. Herman's Blue Hole National Park provides an important and integral part in the national protected areas system, protecting biodiversity and threatened species, as per Belize's commitment under the CBD.***
Alliance for the Sustainable Development of Central America (ALIDES) (1994)	Regional alliance supporting sustainable development initiatives. ***Initiatives within the stakeholder communities adjacent to St. Herman's Blue Hole National Park, and the tourism sector using the protected area, include facilitation of sustainable economic and environmental development, with the support of the Forest Department.***
Central American Commission for Environment and Development (CCAD) (1989)	Regional organisation of Heads of State formed under ALIDES, responsible for the environment of Central America. Initiated the Mesoamerican Biological Corridors and Mesoamerican Barrier Reef Systems Programmes. ***St. Herman's Blue Hole National Park forms part of the Maya Mountains Massif, a regionally important, forested node within the Mesoamerican Biological Corridors initiative.***
Convention on the Conservation of Biodiversity and the Protection of Priority Wilderness Areas in Central America (Managua, 1992)	To conserve biological diversity and the biological resources of the Central American region by means of sustainable development. ***Belize Audubon Society's initiatives with the key stakeholder Community (Armenia) and the local tourism sector are targeted at facilitation of sustainable economic and environmental development based on tourism use of, and benefit from, the protected area***
Convention on the Conservation of Migratory Species of Wild Animals	To protect migratory species. ***St. Herman's Blue Hole National Park has been demonstrated to be an important waypoint in the migration routes of many North American bird species, such as warblers, as shown by ongoing monitoring***
United Nations Framework Convention on Climate Change (New York, 1992)	***Belize is identified by the 1994 National Inventory as a net remover of CO_2, as a result of the high percentage of natural vegetation cover, including that of St. Herman's Blue Hole National Park***
Convention on the Protection of Archaeological, Historical and Artistic Heritage of American Nations (Santiago, 1976)	To protect the Archaeological heritage of signatory countries. ***St. Herman's Blue Hole National Park protects many caves containing important archaeological artefacts.***

Table 1: International Conventions and Agreements of Relevance to St. Herman's Blue Hole National Park

1.3 National Context

1.3.1 Legal and Policy Framework

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

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

St. Herman's Blue Hole National Park is a national protected area defined by Statutory Instrument 109 of 1986 under the **National Protected Areas System Act** (1981, revised as the **National Protected Areas System Act** in 2015). The protected area is currently managed by the Belize Audubon Society through a five-year co-management agreement with the Forest Department (Ministry of Forestry, Fisheries and Sustainable Development). It forms part of the National Protected Areas System, which provides critical environmental services for Belize, such as water catchment, watershed protection and erosion prevention.

History of establishment

St. Herman's Blue Hole National Park has historically been an important recreational site for local families, travelling there to swim in the refreshing water of the Blue Hole, and as early as 1965, St. Herman's Cave was recognized as a potential tourism destination. The Government of Belize acquired a portion of the site in the early 1960's, and the rest in the 1970's. The basic infrastructure – steps and a handrail facilitating access to the Blue Hole, was installed at the site in 1972 by the Ministry of Trade and Industry (at that time in charge of National Parks and Conservation). The site was declared a National Park by the Minister of Natural Resources in Statutory Instrument No. 109 on November 23rd, 1986, for the "protection and preservation of natural and scenic values of national significance for the benefit and enjoyment of the general public." From that point on, day-to-day management became the responsibility of Belize Audubon Society.

Site Status

St. Herman's Blue Hole is designated as a National Park - one of five distinct categories of protected area under the mandate of the Forest Department (Ministry of Forestry, Fisheries and Sustainable Development) (Table 2). The purpose of a National Park is "protection of nationally important recreation areas," with the "protection and preservation of natural and scenic values of national significance for the benefit and enjoyment of the general public."

In keeping with its designation, SHBHNP is a non-extractive protected area, with use being restricted to tourism, research and education.

Categories of Protected Areas in Belize			
Category	**Legal Foundation***	**Purpose**	**Activities Permitted**
Nature Reserve	National Parks System Act, 1981	To protect biological communities or species, and maintain natural processes in an undisturbed state.	Research, education
National Park *St. Herman's Blue Hole*	**National Parks System Act, 1981**	**To protect and preserve natural and scenic values of national significance for the benefit and enjoyment of the general public.**	**Research, education, tourism**
Natural Monument	National Parks System Act, 1981	To protect and preserve natural features of national significance.	Research, education, tourism
Wildlife Sanctuary (1)	National Protected Areas System Act, 2015	To protect nationally significant species, biotic communities or physical features.	Research, education, tourism
Wildlife Sanctuary(2)	National Protected Areas System Act, 2015	To protect nationally significant species, biotic communities or physical features whilst allowing for sustainable traditional use, following an accepted sustainable use plan.	Research, education, tourism, sustainable traditional use extraction
Forest Reserve	Forests Act, 1927	To protect forests for management of timber extraction and/or the conservation of soils, watersheds and wildlife resources.	Research, education, tourism, sustainable extraction
Marine Reserve	Fisheries Act, 1948	To assist in the management, maintenance and sustainable yield of fisheries resources	Sustainable extraction, research, education, tourism

* The National Parks System Act of 1981 has now been revised as the National Protected Areas System Act of 2015

Table 2: Categories of Protected Areas in Belize

The management regime of St. Herman's Blue Hole National Park was originally aligned with IUCN designation ***Category II: A protected area managed primarily for ecosystem protection and recreation.*** This is defined as:

> ***"Natural areas of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation detrimental to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible."***

With the following management objectives

1. To protect natural and scenic areas of national and international significance for spiritual, scientific, educational, recreational or tourist purposes;

2. To perpetuate, in as natural a state as possible, representative examples of physiographic regions, biotic communities, genetic resources, and species, to provide ecological stability and diversity;

3. To manage visitor use for inspirational, educational, cultural and recreational purposes at a level which will maintain the area in a natural or near natural state;

4. To eliminate, and thereafter prevent, exploitation or occupation detrimental to the purposes of designation;

5. To maintain respect for the ecological, geomorphologic, sacred or aesthetic attributes which warranted designation; and

6. To take into account the needs of indigenous people, including subsistence resource use, in so far as these will not adversely affect the other objectives of management.

In the more recent National Protected Areas System rationalization process, it was suggested that the protected area be realigned as:

Category III: A protected area managed primarily to protect specific outstanding natural features and their associated biodiversity and habitats.

Primary Objective: To protect specific outstanding natural features and their associated biodiversity and habitats.

Other Objectives:

- To provide biodiversity protection in landscapes or seascapes that have otherwise undergone major changes;
- To protect specific natural sites with spiritual and/or cultural values where these also have biodiversity values;
- To conserve traditional spiritual and cultural values of the site.

This is based on it being too small to qualify fully for Category II – it would qualify well, however, for Category III – Geological features with high visitation (Walker, 2012).

National Planning Strategies

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

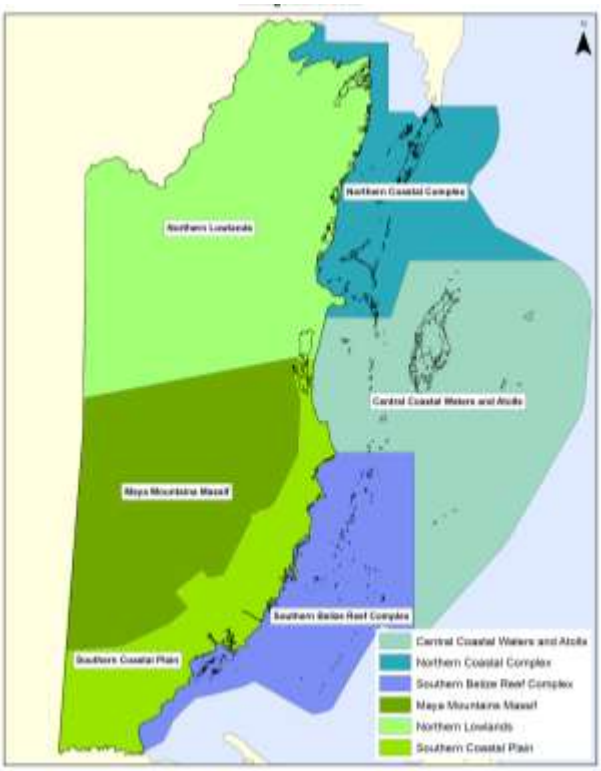
The overall goals of both the National Biodiversity Strategy and the NPAPSP reflect the national objectives - ecological and economic sustainability over the long term, with the development of human and institutional capacity to effectively manage the biodiversity resources within Belize. A primary focus is to ensure benefits for local communities – whether through water security, access to tourism opportunities, linked livelihood diversification opportunities or access for sustainable resource extraction.

As a move towards decentralized management of these resources, there is a strong focus on co-management partnerships (such as that between BAS and the Forest Department), community-based participation and equitable benefit from conservation efforts.

Under the NPAPSP, government seeks to increase management effectiveness through grouping protected areas into system-level management units, with improved communication and collaboration between protected areas in similar landscapes and facing similar threats within each unit (Map 2).

Three of the six defined system-level units have been, or are currently being established to increase management effectiveness of protected areas by reducing overlap and maximizing on

synergies – the Southern Belize Reef Complex, the Maya Mountains Marine Corridor and the Northern Belize Coastal Complex. St. Herman's Blue Hole National Park is one of twenty protected areas that, together, form the Maya Mountains Massif, transcending site-level administrative categories



Map 2: System-level management units (Rationalization report, Walker et al., 2012)

MMM Vision Statement

The Maya Mountains Massif of Belize and Guatemala is internationally recognized for its exceptional natural and cultural values. This vast, contiguous forest and complex of watersheds, contributes to national development, regional cooperation and international conservation. The Massif is managed as an exemplary model of integrated management that maintains ecological integrity and preserves cultural heritage for future generations.

Conservation Action Planning Workshop
19th June, 2007

Protected Areas of the Maya Mountains Massif

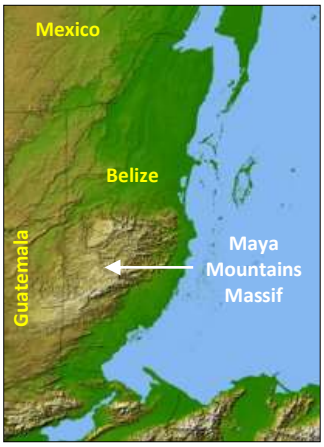
National Protected Areas

Chiquibul National Park
Billy Barquedier National Park
Nojkaaxmeen Eligio Panti National Park
Five Blues National Park
Mayflower Bocawina National Park
St Herman's Blue Hole National Park
Bladen Nature Reserve
Tapir Mountain Nature Reserve
Thousand Foot Falls Natural Monument
Actun Tunichil Muknal Natural Monument
Victoria Peak Natural Monument
Cockscomb Basin Wildlife Sanctuary
Chiquibul Forest Reserve
Columbia River Forest Reserve
Manatee Forest Reserve
Maya Mountain Forest Reserve
Mountain Pine Ridge Forest Reserve
Sibun Forest Reserve
Sittee River Forest Reserve
Vaca Forest Reserve

Archaeological Reserves, Private Protected Areas

Barton Creek Archaeological Reserves
Cahal Pech Archaeological Reserves
Caracol Archaeological Reserves
Caves Branch Archaeological Reserves
Nohoch Cheen Archaeological Reserves
BFREE property (PPA)
Hidden Valley property (PPA)
Jaguar Creek properties (PPA)

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, towards increasing management effectiveness through the development of mechanisms for collaboration for surveillance and enforcement, biodiversity monitoring, education, outreach, and management.



Map 3: The Maya Mountains Massif

The **Maya Mountains Massif** (MMM) forms the prominent, elevated area to the south west of Belize (Map 3). Whilst SHBHNP was not included as part of the original definition of the Maya Mountains Massif, it is geologically located in the northern foothills of the MMM, and is included in the current national MMM system-level planning unit (Walker et al., 2012). As such, management strategy development for St. Herman's Blue Hole National Park needs to take into account the MMM vision, as well as the MMM goals and objectives for system-level management. Whilst these are now outdated and in need of revision, they are still important in ensuring that St. Herman's Blue Hole National Park is managed not only for its site-level significance, but also for its contribution to national conservation goals and commitments.

Legal Framework

The conservation framework of Belize is supported by a number of laws designed to protect wildlife and national heritage within the country. The **National Parks System Act** (1982), revised as the **National Protected Areas System Act** (2015) is responsible for the establishment and management of protected areas (including St. Herman's Blue Hole National Park). The Forest Act (1927; Revised 2000) establishes and administers the Forest Reserves. It is also responsible for enforcement of laws pertaining to illegal logging. The **Wildlife Protection Act** (1982) addresses the need to protect wildlife resources, whether within or outside protected areas. Both the National Parks System Act and the Wildlife Protection Act are currently being revised.

The **National Institute of Culture and History Act** (1999, Revised 2000) protects caves and artefacts, with NICH having the mandate to protect and manage these resources, through the Institute of Archaeology.

Whilst the above are the legislative Acts most relevant to St. Herman's Blue Hole National Park, there are others that are also of some relevance. The **Environmental Protection Act** (1992) was drawn up under the Department of the Environment to ensure that development initiatives within Belize are planned for minimum environmental impact – "to promote the preservation and improvement of the environment, the rational use of natural resources, and the control of pollution". With the National Park's location in an agricultural landscape of citrus farms, there

are concerns of agrochemical pollution that can be addressed to some extent through this Act, and through the **Pesticide Control Board.** The **Fisheries Act** (1948), administered by the Fisheries Department (Ministry of Forestry, Fisheries and Sustainable Development), is the principal governing legislation to regulate fishing in both marine and freshwater environments, downstream from the protected area (the protected area itself is non-extractive).

The **Mines and Minerals Act** (1989) and the **Petroleum Act** (1991) regulate the exploration and extraction of all non-renewable resources, including petroleum. St. Herman's Blue Hole National Park lies within the BCH International petroleum concession (Geology and Petroleum, 2014), though the area is considered of relatively low interest to oil prospecting companies.

Financial sustainability is partially addressed at Government level through the development of a funding mechanism to assist management and development activities within protected areas – the Protected Areas Conservation Trust (**PACT Act**, 1996, revised 2015), through a 'conservation tax' of Bz$7.50 levied on non-residents as they leave the country. Belize Audubon Society, as the co-management partner, is eligible to apply for funding from the Trust, and has received funding in the past.

There is currently significant fragmentation in decision making, with these different Acts falling under different Ministries. This is being addressed through the **National Protected Areas Policy and System Plan** (NPAPSP, 2005), under which a single directive body – the National Protected Areas Secretariat (NPAS) – has been established. NPAS includes representatives from different Ministries to facilitate bridging of communication gaps, to reduce some of the significant problems for protected areas that have occurred in the past. And the PACT Act?

1.3.2 Land Tenure

As a National Park, St. Herman's Blue Hole is national land, designated as a protected area under the National Parks Act (revised as the National Protected Areas System Act, 2015), under the mandate of the Forest Department (Ministry of Forestry, Fisheries and Sustainable Development). Any activity within the protected area needs to be approved by both the Forest Department, as the management authority, and Belize Audubon Society, as the co-management organization.

The National Park was originally part of a much larger parcel of private land owned by the Caribbean Investments Limited (C.I.L.). Whilst C.I.L. has sold or leased significant portions of its land, with further portions being forfeited to the Government of Belize in lieu of taxes, land directly adjacent to the protected area still remains in private ownership. 2.4km to the south, the Sibun Forest Reserve forms the nearest point of the Maya Mountains Massif block of contiguous protected areas.

There have been recent concerns over the accuracy of the surveyed boundaries, leading to resurveying and updated mapping in 2014 to reduce potential future conflict with adjacent landholdings and mitigate the risk of encroachment by adjacent agricultural areas and logging concessions.

1.3.3 Evaluation of Protected Area

Global Importance

St. Herman's Blue Hole National Park contributes to Belize's commitments under the Convention on Biological Diversity, and to the global protection of karst landscapes.

The National Park, whilst too small to support minimum dynamic areas of the ecosystems within its boundaries, does contribute towards the maintenance of viable populations of at least ten threatened species of international concern, recognized under the IUCN Redlist as Critically Endangered, Endangered or Vulnerable (Table 3; IUCN, 2015). This includes two species of primate (the Yucatan black howler monkey and Geoffroy's spider monkey), and Baird's tapir.

St. Herman's Blue Hole National Park Species of International Concern	
Endangered	
Yucatan Howler	*Alouatta pigra*
Geoffroy's Spider Monkey	*Ateles geoffroyi*
Sabrinus Rainfrog	*Craugastor sabrinus*
Baird's Tapir	*Tapirus bairdii*
Yaxnik	*Vitex gaumeri*
Vulnerable	
Cerulean Warbler	*Dendroica cerulea*
Spanish Cedar	*Cedrela odorata*
Leprus Chirping Frog	*Eleutherodactylus leprus*
Large-leaved Mahogany	*Swietenia macrophylla*
Mexican cedar	*Cedrela odorata*

Table 3: Species of International Concern (IUCN, 2015)

The recognition of the importance of karst landscapes as a conservation target by the IUCN World Commission on Protected Areas in 1997, and the increasing need for its protection, has led to an evaluation of karstic scenery and its protection throughout Central America (Kueny and Day, 2002). The region contains a significant proportion of the global karstic limestone, stretching from the Yucatan Peninsula to Panama, with 18% under some form of protection. (Belize has 68% of its total karst landscape falling within protected areas), however these karst areas are fast becoming eroded as they come under increasing pressure.

National Importance

Despite its small size, St. Herman's Blue Hole National Park plays a key role in education and raising awareness, encouraging the general public to explore the natural environment, providing an important destination for tour guides, and supporting tourism income in the local communities, as well as for tour guides further afield in western and central Belize.

Ecosystem Services of the Protected Areas

Ecosystem Services of St. Herman's Blue Hole National Park	
Regulation	Water Regulation: The forest cover of the Sibun watershed, part of which lies within the SHBHNP, regulates the timing and magnitude of runoff, flooding, and aquifer recharge.
	Erosion Regulation: Retention of forest cover on the steep slopes prevents excessive soil erosion and sedimentation of rivers and creeks, assisting in prevention of sedimentation impacts downstream.
	Ecosystem Regulation of Natural Hazards: The forest cover of SHBHNP provides protection against natural hazards, anchoring soils against landslides in tropical storm events, and providing a buffering flood control function.
	Climate regulation: Changes in land cover have affected regional and local climates, generally negatively. Tropical deforestation has tended to reduce local rainfall. St. Herman's Blue Hole National Park retains its natural vegetation cover, and assists in mitigation of some of the climate change effects.
	Pollination: Pollination is a critical ecosystem function for the reproduction of most plants, including crops. There is established but incomplete evidence of a global decline in the abundance of pollinators which, whilst rarely resulting in complete failure to produce seed or fruit, more frequently results in lower seed and fruit production. Viability of pollinators is essential to the long term existence of plant species (and therefore biodiversity in general) of St. Herman's Blue Hole National Park., and of the agricultural crops in the adjacent area.
Recruitment	Game Species Reservoir: The forest acts as a reservoir for game species such as great curassow, white-tailed deer and collared peccary
Cultural	Recreation and Tourism: The scenic beauty of the forests, Blue Hole and caves of St. Herman's Blue Hole National Park are important as recreational and tourism resources. However, many naturally occurring features of the landscape (e.g., cave systems) can be easily degraded as resources for recreation without careful management.
	Education: St. Herman's Blue Hole National Park is critical in its role as an educational resource, improving national awareness and appreciation of the ecosystems and ecosystem services provided by biodiversity and natural areas.
Support	The broadleaf forest of SHBHNP and the rest of the MMM plays an important role in the cycling of nutrients

(Adapted from Millennium Ecosystem Assessment, 2005)

Table 4: Ecosystem Services of St. Herman's Blue Hole National Park

1.3.4 Socio-Economic Context

Belize has a low population currently estimated at approximately 356,994 (Figure 1; SIB, 2014), of which approximately 44.7% are urban dwellers (SIB, 2014). Population densities are low, with just over 15.5 persons per sq. km. (SIB, 2010), concentrated mostly within the northern plain, southern coastal plain, Belize Valley and Stann Creek Valley, with much of the remaining country being swampy lowlands and steep terrain - less suited to habitation. It is a country of many ethnic cultures, with Mestizo, Creole, Maya and Garifuna being the major population groups (Figure 2).

Figure 1: Belize Demographic Statistics

Population (SIB, 2014)	356,994
Population density (2010)	15.5/sq. km.
Annual growth rate (2010)	1.9%
Birth rate (2010)	24.3 per 1000
Mortality rate (2010 est.)	5.9 per 1000
Life expectancy (2010)	73.7
Below Poverty level (2009)	41.3%
Literacy rate (2010)	79.7%
Unemployment rate (2008)	11.1%
GDP (2013)	Bz$3.2 billion
GDP (per capita, 2011)	Bz$8,952 per capita

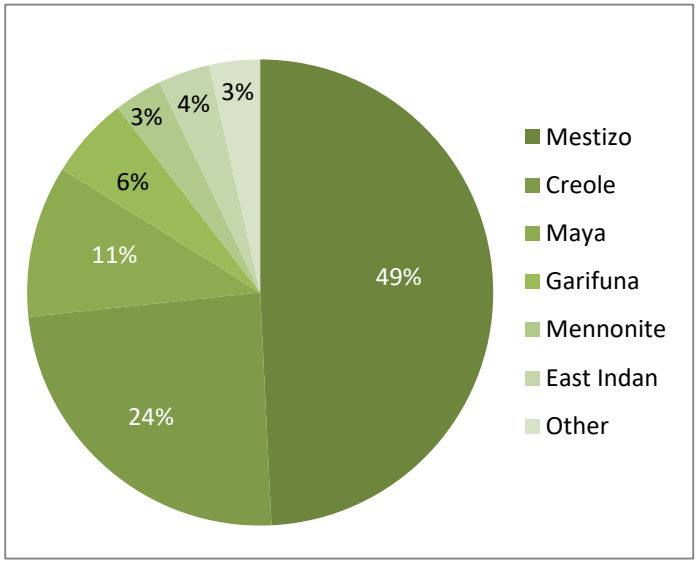


Figure 2: Belize Demographic Statistics (SIB, 2010 Census)

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

Armenia Village

Armenia Village, the closest significant settlement, is predominantly an immigrant community with a population of approximately 1,395 (SIB, 2010). It was established in the 1980's by Central American immigrants, primarily from El Salvador and Guatemala, fleeing conflict and poverty elsewhere in the region, and migrating to the community in search of improved work opportunities. The original settlers first squatted on private land owned by Caribbean Investments Limited (C.I.L.), creating small–scale slash-and-burn farms until the Belize Government, under pressure from the settlers, acquired an adjacent piece of land, and Armenia was formally established. Belize is seen as a transit point for migrants wishing to

move north to Mexico, and on to the United States, and discussions in southern and central Belize (community consultations, 2014) suggest that a steady flow of Central American migrants have been crossing the border, settling in southern communities, moving on to communities in the Stann Creek District, then on to Armenia, before moving further north. Armenia has the advantage of being close to Belmopan, improving employment opportunities. It also lies close to the citrus farms based one alluvial soils, providing further work opportunities.

The current population is primarily Hispanic (82% of the 41 households surveyed; BAS data, 2014), with 73% of households established between in the last 20 years ago (41% in the last ten years). 9% of households are Creole, with a number of Ketchi and East Indian from southern Belize.

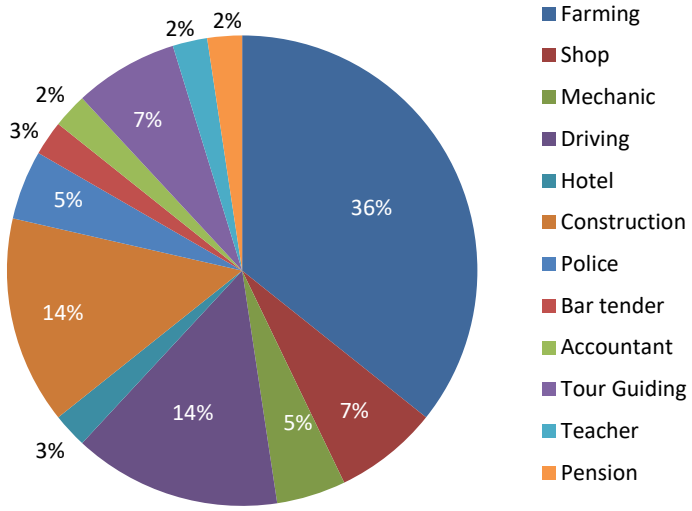


Figure 3: Profile of Armenia – Economic Context

The community is based on agriculture - approximately 36% of households have a primary income from farming (Figure 3) - and employment in Belmopan. Construction and driving are the second most frequent occupations, providing 28% of the households surveyed with their primary income, with community support (shop keepers, builders and mechanics, and including police and teachers) providing an income for approximately 34% of households. Three respondents listed tour guiding as the primary income for the household.

St. Margaret's Village

St. Margaret's Village is more established than Armenia, and is predominantly hispanic (92% of households), with 42% of households established between 11 and 20 years ago,

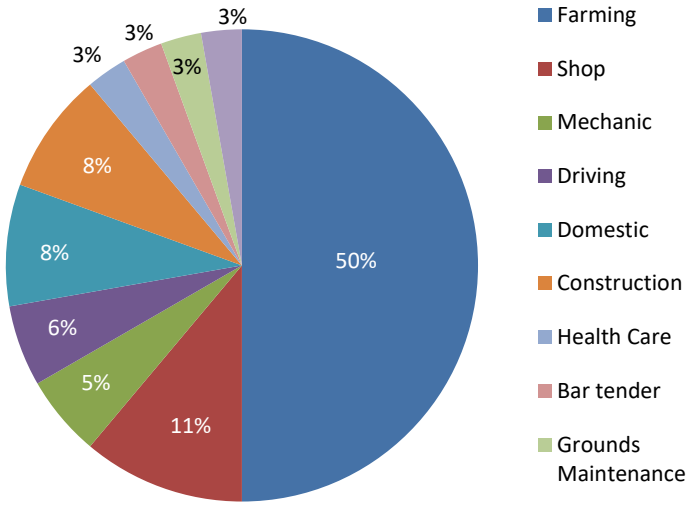


Figure 4: Profile of St. Margaret's Village – Economic Context

and a further 18% of the households being established more recently. The community is based on agriculture - approximately 50% of households have a primary income from farming, with community support (shop keepers, builders and mechanics) providing an income for approximately 24% (Figure 4). Only one respondent listed tour guiding as the primary income for the household, whilst 7 indicated that they are involved in the tourism industry. 8% of the community has a primary income earned from domestics, but women are considered important for their contribution to income generation for their families in only 37% of the households.

Ringtail

Ringtail, the closest community to the National Park, was established through land grants in 1985 as part of a Government of Belize initiative to promote cacao production in the area. Whilst the project was unsuccessful and never produced cacao, several families still reside in Ringtail, focusing primarily on citrus (McReynolds, 2003).

Key Stakeholder Communities of St. Herman's Blue Hole National Park				
Community	**Location (UTM) Distance (km)**	**Population (approx.)**	**Population components**	**Comments**
Armenia	E16 0314231 N18 97677 (5 km west)	1,395	Predominantly Hispanic /Mestizo	Primarily Hispanic / Mestizo immigrant community. Local tour guides are based from SHBHNP, providing on-site tours.
Ringtail	E16 0322522 N18 96967 (1.5 km east)	186	Mixed	Established as a farming community, based on land grants from the Government of Belize, and focused on citrus
St. Margaret's Village	E16 0328693 N18 90326 (18 km east)	1,136	Predominantly Hispanic /Mestizo	Primarily Hispanic / Mestizo immigrant community of Guatemalan and Salvadoran. A number of tour guides utilise SHBHNP.
Census data, 2014				

***Table 5:** Key Stakeholder Communities of St. Herman's Blue Hole National Park*

The immediate landscape around St. Herman's Blue Hole National Park is one dominated by citrus and tourism. The **citrus industry** is one of four primary agricultural sectors in Belize (citrus, banana, sugar and shrimp), and is investigating certification through the Citrus Growers Association to improve its international market competitiveness, through

improvement of its social and environmental footprint, focusing on better management of agrochemicals, reduction of effluent and protection of riparian and mangrove buffers. This is supported by revisions to the Environmental Protection legislation, requiring large agricultural initiatives (over 500 acres) to submit Environmental Impact Assessments before starting development, and regulating pesticide use and effluent output. Citrus farms adjacent to SHBHNP are generally established on leased land, resulting in limited incentives for farmers to invest in long term cost-saving mechanisms (such as building the soil), with a preference for short term benefits from use of agrochemicals.

The **tourism industry** is the number one foreign exchange earner – with over one million visitors travelling to Belize in 2014. Over 321,220 of these were overnight visitors, and almost 968,131 arrived through cruise ship visitation (Central Bank / BTB, 2015). Tourism in Belize is primarily natural- and cultural-resource based, with visitors focusing on the cayes, coastal communities and coral reef (particularly snorkelling, diving and sport fishing), and inland protected areas such as St. Herman's Blue Hole National Park. Tourism expenditure in Belize exceeded Bz$639 million in 2012 – predominantly from the overnight sector, which contributed 86.4% (Bz$552.2 million) of total tourism expenditures, despite representing only a fraction of the total number of tourists (BTB, 2013). The tourism industry accounts for 28% of direct employment, and also supports restaurants, transport providers (including water taxi services and internal airline companies), boat captains, tour operators and a number of other service providers (BTB, 2013).

Tourism visitation to the protected areas of the National Protected Areas System is an important financial contribution to the effective management of these sites. St. Herman's Blue Hole National Park, one of the most accessible of the terrestrial protected areas, has shown a significant increase in visitation of over 75% since 2006 (BAS data, 2015), attracting 17,411 visitors (5,190 local and 12,221 international) in 2014 (BAS data, 2015), with entrance fees currently being re-invested into protected area management. The knock-on benefits for communities are evident in the adjacent rural communities, such as Armenia, providing opportunities for employment supported by tourism.

The National Park is also an important **educational destination.** In addition to the tourism visitation, the protected area also recorded visitation of 2,530 students, accompanied by 187 teachers and 637 parents (BAS data, 2014).

Stakeholder Analysis for St. Herman's Blue Hole National Park				
Stakeholder	**Influence or Impact of St. Herman's Blue Hole National Park on Stakeholder**		**Influence or Impact of Stakeholder on St. Herman's Blue Hole National Park**	
Community Stakeholder Armenia St. Margaret's Village	▪ Protection of biodiversity ▪ Provides a destination for tourism as an income diversification / alternative livelihood option ▪ Protection of natural resources for the enjoyment and education of future generations ▪ Assists in protection of watershed vegetation cover for Sibun River ▪ Exclusion from potential hunting and natural resource harvesting areas	+ + + -	▪ Medium to high level of cooperation and interest from the community ▪ Potential for recreational use ▪ Potential for illegal hunting and other extraction impacts within protected areas once local resources have been exhausted	+ + -
Community Stakeholder Ringtail	▪ Protection of biodiversity ▪ Provides a destination for tourism as an income diversification / alternative livelihood option ▪ Protection of natural resources for the enjoyment and education of future generations ▪ Assists in protection of watershed vegetation cover for Sibun River ▪ Exclusion from potential hunting and natural resource harvesting areas ▪ Limits agricultural expansion	+ + + + - -	▪ Medium to high level of cooperation and interest from the community ▪ Potential for recreational use ▪ Potential for illegal hunting and other extraction impacts within protected areas once local resources have been exhausted ▪ Potential for agricultural incursions into protected areas	+ + - -
Tour Guides	▪ Benefit from having St. Herman's Blue Hole National Park as an important tourism destination ▪ Benefit from the management of tourism access and maintenance of site ▪ Benefit from training opportunities associated with St. Herman's Blue Hole National Park ▪ Employment in cave-based tourism initiatives ▪ Income from using St. Herman's Blue Hole National Park for tourism	+ + + + +	▪ Support the conservation goals of St. Herman's Blue Hole National Park ▪ 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 impacts on fragile cave formations.	+ + + -

Stakeholder Analysis for St. Herman's Blue Hole National Park (cont.)				
Stakeholder	**Influence or Impact of St. Herman's Blue Hole National Park on Stakeholder**		**Influence or Impact of Stakeholder on St. Herman's Blue Hole National Park**	
Local / National Tour Operators	▪ Benefit from having St. Herman's Blue Hole National Park as a major venue for forest, bird and cave-based tourism ▪ Income from using St. Herman's Blue Hole National Park as a tourism destination	+ +	▪ Provide marketing at a national level, and send visitors to St. Herman's Blue Hole National Park ▪ Support the conservation goals of St. Herman's Blue Hole National Park ▪ Provide a financial sustainability mechanism for management of the protected area ▪ Increase the potential for exceeding the carrying capacity of the protected area	+ + + -
International Tour Operators	▪ Benefit from having St. Herman's Blue Hole National Park as a venue for natural history / adventure-associated tourism ▪ Income from using St. Herman's Blue Hole National Park as a tourism destination	+ +	▪ Provide marketing at an international level, and send visitors to Belize, who may visit SHBHNP ▪ Support the conservation goals of SHBHNP ▪ Provide a financial sustainability mechanism for management of the protected area ▪ Increase the potential for exceeding the carrying capacity of the protected area	+ + + -
BTIA / BTB	▪ Benefit from having St. Herman's Blue Hole National Park as a part of Belize's tourism destination	+	▪ Provide national and international marketing of St. Herman's Blue Hole National Park ▪ Support the conservation goals of St. Herman's Blue Hole National Park	+ +
General Belize Public / Citrus / Cacao Farmers	▪ Provides catchment forest cover, with protection of watershed functionality and of steep slopes ▪ Benefit from ecosystem services of SHBHNP, particularly pollination, for local farmers ▪ Limits agricultural expansion (however, much of the terrain is unsuitable)	+ + -	▪ Use of agrochemicals – agrochemical deposition in upper watershed, with pollution of water and change in chemical chemistry, impacting geological formations and cave organisms ▪ Alteration of stream flow as rainfall decreases as a result of climate change, preventing migration of species such as the Mountain Mullet that require the ridge to coast linkage ▪ Not openly supportive of the protected area	- - - -

Stakeholder Analysis for St. Herman's Blue Hole National Park (cont.)				
Stakeholder	**Influence or Impact of St. Herman's Blue Hole National Park on Stakeholder**		**Influence or Impact of Stakeholder on St. Herman's Blue Hole National Park**	
Loggers	▪ Benefit from protection of replenishment stock of commercial species ▪ Excluded from extracting logs from the protected area	+ -	▪ Illegal extraction of logs from SHBHNP ▪ Logging roads increase ease of access for illegal hunters ▪ Increased impacts of soil erosion in the Caves Branch watershed	- - -
Visitors: Tourists	▪ Enjoy St. Herman's Blue Hole National Park as a tourism destination ▪ Benefit from education and awareness opportunities	+ +	▪ Entrance fee contributes towards the financial sustainability ▪ Provide marketing nationally and internationally by word of mouth, if happy with level of product ▪ Presence deters illegal activities within the National Park ▪ Negatively impact sensitive / fragile environments	+ + + -
Institute of Archaeology	▪ Two significant cave systems contributing to protection of caves in Belize ▪ Archaeological artefacts in caves ▪ Accessibility of St. Herman's cave builds awareness and appreciation of caves in Belize	+ + +	▪ Have the legal mandate for management of caves in Belize ▪ Have the technical knowledge for effective cave management and monitoring ▪ May have a financial interest in Crystal Cave (retention of entrance fees)	+ + -
Government of Belize	▪ Contributes towards national CBD and Millennium targets for maintenance of forest cover ▪ Provides environmental services towards the health of the nation of Belize ▪ SHBHNP included within the National Protected Areas System ▪ Income generation of foreign revenue as a contributing factor towards Belize's attraction as a tourism destination ▪ Provides employment opportunities in stakeholder communities	+ + + + +	▪ Political support for management (currently being strengthened through the NPAPSP and co-management agreement) ▪ Lack of political support for, and understanding of, link between conservation / protected areas and socio-economic well-being ▪ Uncertainty of long term future commitment to maintenance of protected areas	+ - - -

1.4 Physical Environment of Management Area

1.4.1 Climate

Belize lies within the outer tropical geographical belt, with a noticeable variation in average monthly rainfall and temperatures. It can be divided into two climatic regimes – subtropical in the northern lowlands / central inland areas, and tropical in the southern Stann Creek and Toledo regions. Prevailing winds are easterly, from the Caribbean. St. Herman's Blue Hole National Park lies at the boundary of the Maya Mountains and the northern plain, with a climate influenced by coastal winds channelled up the Stann Creek Valley to the east, and the inland climate of central Belize plain to the west.

The protected area lies within the 2,032 – 2,540mm annual rainfall belt (80 to 100 inches a year). Continuous climate data sets are available from Middlesex, 21 km south east, at the eastern end of the Stann Creek valley, and Belmopan on the northern plain, 13 km to the north west. Both lie within different rainfall belts (Middlesex is, on average, 20mm per year wetter than Belmopan). Of the two, Middlesex is thought to have a more comparable climate, being in the same valley, and not being influenced by the heat derived from the urban environment of Belmopan (Figure 5).

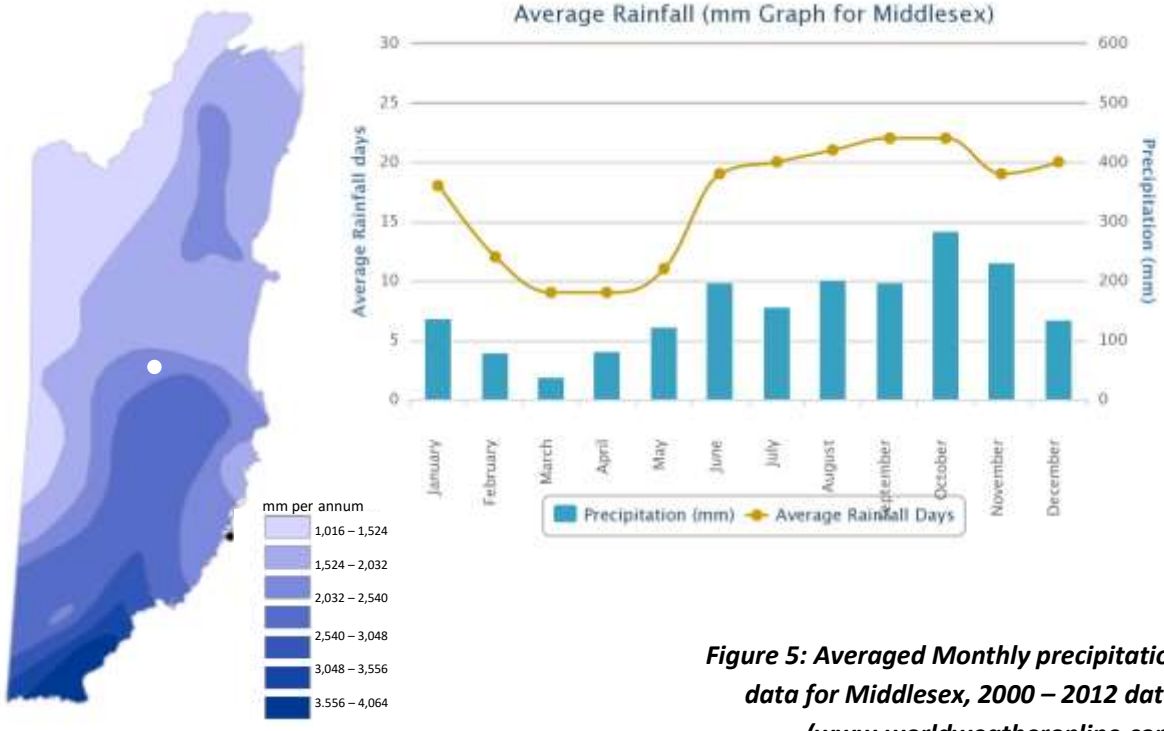


Figure 5: Averaged Monthly precipitation data for Middlesex, 2000 – 2012 data, (www.worldweatheronline.com)

The total averaged annual rainfall at Middlesex for the period 2000 to 2012 is reported as 1,864mm. There is significant variation in precipitation throughout the year, with a pronounced dry season stretching from December through to the end of June. Minimum monthly rainfall average falls to 37.5mm in March, the driest month, followed by a wetter season (July to December) with maximum average monthly rainfall in the region of 84mm in October (data from 2000 to 2012, www.worldweatheronline.com). The majority of the rain falls within the hurricane season, particularly between September and December, associated with passing tropical storms (Figure 5; Table 6).

Historical data from the Caves Branch River (Hummingbird Highway) monitoring station is available from the 1950's to the 1970's, with a mean annual precipitation of 2,360mm (…significantly greater than the more recent 2000 – 2012 records at Middlesex, and supporting the predictions for reduced rainfalls for the region. Wet season conditions during that period dominated from June to November – a month earlier than the current July to December wet season months.

Air temperature fluctuates throughout the year from a minimum average monthly low of 20°C to a high of 32°C, based on 2000 – 2012 data. Daily averages show greater variation – in 2014, the daily low was recorded as 16°C (January, 2014), with highs of 35°C in April (Figure 6; Table 6).

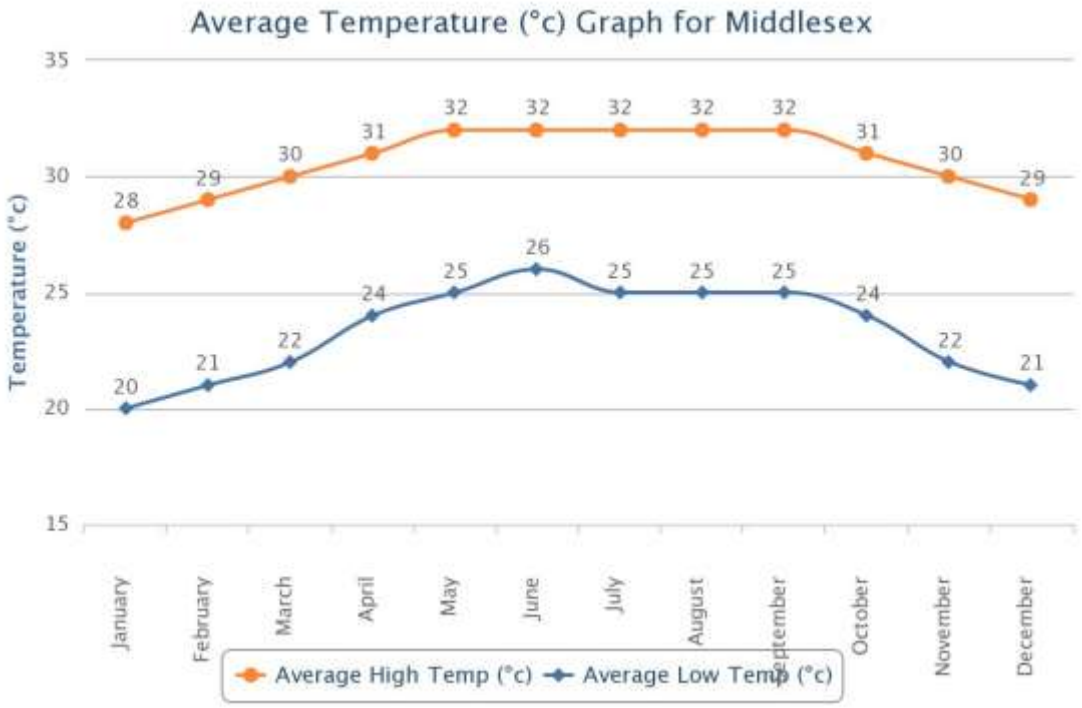


Figure 6: Averaged Monthly temperature for Middlesex, 2000 – 2012 data (www.worldweatheronline.com)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	Total
Precipitation (mm)	138.1	79.7	37.5	81.1	124	197.7	155.8	201.8	197	284.9	232.5	134.3	155.4	1,864.4
Max Air Temp (°C)	28	29	30	31	32	32	32	32	32	31	30	29	30.7	-
Min Air Temp (°C)	20	21	22	24	25	26	25	25	25	24	22	21	23.3	-
Mean Air Temp (°C)	25	26	27.5	28.5	29	28.5	28.5	28.5	27.5	26	25	25	27	-

Table 6: Monthly precipitation, and maximum, minimum and mean air temperature data for Middlesex, 2000 – 2012 (www.worldweatheronline.com)

- ***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

Weather Systems: Belize is affected by three very distinct seasonal weather systems: trade winds, cold fronts (northers) and tropical storms. All three have an influence on the rainfall and temperature patterns in the St. Herman's National Park area.

Name	Cat.	Year	Date Passed SHBHNP	Distance from SHBHNP
Not named	H2	1982	12th October	42 km north
Not named	H1	1906	14th October	36 km east
Not named	TS	1918	26th August	33 km south
Not named	TS	1921	17th June	10 km north
Not named	TS	1931	16th August	Direct
Not named	TS	1934	6th May	4 km north
Not named	TS	1945	31st August	24 km north
Gilda	TS	1954	27th September	27 km south
Hattie	H4	1961	31st October	18 km south
Anna	TS	1961	24th July	48 km s.west
Greta	H2	1969	19th September	14 km north
Richard	H1	2010	25th October	37 km east

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

Table 7: Hurricanes Affecting St. Herman's Blue Hole National Park (<50km) (www.nhc.noaa.gov)

Tropical Storms: Belize is located in an area of high tropical storm activity, and is affected by tropical storm events most years. Originating in the Atlantic Ocean over warm, tropical waters, these storms are non-frontal, developing highly organized circulations, and ranging in scale from tropical depressions and tropical storms (with sustained wind speed < 74 mph) to hurricanes (with sustained wind speeds > 74 mph). They move westward towards the Caribbean, gathering strength as they cross open water, until they hit land. The hurricane season stretches from June through November, with historical records identifying four hurricanes and eight tropical storms that have passed within a 50-km radius of St. Herman's Blue Hole National Park (Table 7; NHC, 2015).

St. Herman's Blue Hole National Park is somewhat sheltered from tropical storm impacts by its location at the upper end of the Sibun River Valley, with low hills between it and the coast to the east. However, despite this protection, it has still had significant impacts from hurricanes passing to the north, and with predictions for stronger hurricanes in the future, it will continue to be affected. Hurricane Hattie (1961) is reported to have flattened the forest, with "no trees left standing in the entire area" (McReynolds / Scott, 2003). Hurricane Richard (2010), also caused significant tree fall, particularly on the steep karstic slopes. Hurricanes play a major role in the structural development of forests in Belize (that of St. Herman's Blue Hole National Park being no exception), reflecting the perturbation-dependence of forests that lie within the Atlantic hurricane belt. This has resulted in the general term "hurricane climax forest", with a species composition influenced by the cycle of natural disturbance from these tropical storms. Reports suggest that impacts of Hurricane Richard in 2010 reduced the number of larger vertebrates present in the National Park (stakeholder consultations, 2014), though this may also have been a reflection of the increased difficulty of observation and reduced visibility in the impacted forest. It also impacted visitation and local tourism opportunities, with the protected area being closed for several months whilst hurricane impacts were addressed and trails were re-opened.

Northers

Northers affect the country from October through to April (with the highest frequency in December, January and February). These northerly air masses move down from North America, bringing cooler temperatures and, on occasions, heavy rain and winds. These have little effect on the St. Herman's Blue Hole National Park area other than the reduction in temperature, possibly reducing herptile activity during the coldest days and nights.

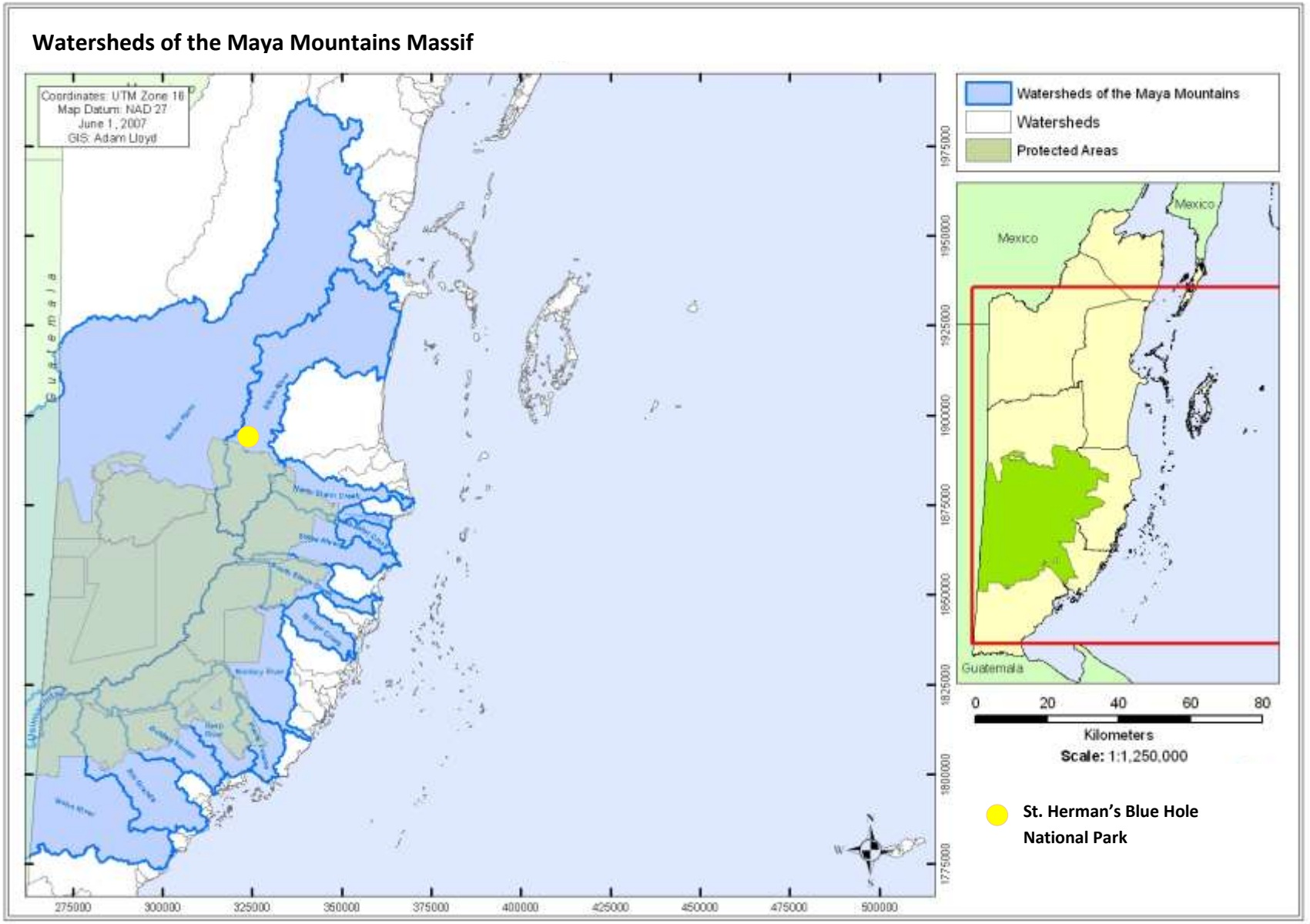
1.4.2 Hydrology

St. Herman's Blue Hole National Park lies on a limestone ridge between two valleys, with the Sibun River flowing to the east of it, and the Caves Branch tributary to the west (Map 4). The protected area lies primarily in the water catchment area of the Caves Branch tributary, in the mid-reaches of the Sibun Watershed, and part of the Central Watershed Region of Belize. The landscape of alkaline limestone karst has characteristic disappearing streams that flow underground through cave systems. Whilst there is no surface water flowing within the protected area itself (except sheet flow during peak rainfall, or the water of the Blue Hole), there is a perennial underground river.

The undifferentiated limestone bedrock of the Caves Branch Cave System includes multiple karst components – cliffs, karst windows into collapsed cave systems, cave chambers and conduits that conduct water flow through the system, flowing from the flat karst field of the adjacent river valley, and from drainage from the non-karstic Maya Mountains to the south. The surface and subsurface systems are interconnected, and flow and drainage patterns through the cave system reflect the varying rainfall, flow of water off the hill slopes, and the capacity of the interconnected conduits to contain and manage the water flow - but eventually, all the water flows into the Sibun River system.

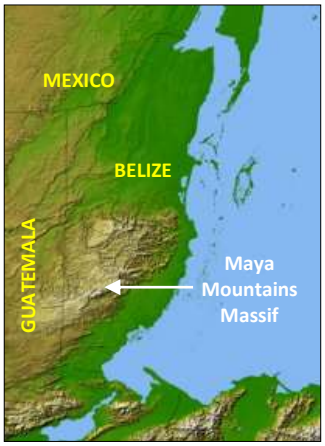
The headwaters of Caves Branch consist of many small, fast flowing streams that drain the granite-based, acidic Maya Mountains to the south of the protected area, from a maximum elevation of 960m, that join to form the Caves Branch. This then splits into two tributaries, one of which, the Blue Hole River, the main branch of the Caves Branch tributary (Chladek, 2011), disappears into a sinkhole in the mid-reaches, flowing underground through the protected area. The river flows through a succession of caves, including Petroglyph Cave, St. Herman's cave, and then onto the Blue Hole cenote – a characteristic karstic feature. Here, it is exposed as a result of a collapsed cave roof, allowing sunlight down into the water (Zisman, 1996). It flows on, underground once more, to re-emerge above ground at the Jaguar Paw Cave, where it re-joins the Caves Branch tributary (Chladek, 2011) on the flat coastal plain, flowing more slowly, and joining the Sibun River. The lower reaches of the river meander across the alluvial coastal plain, with the formation of ox-bow lakes and abandoned channels over time, to flow into the Caribbean Sea. Discharge through the Blue Hole is perennial, but baseflow during the dry season is estimated at about 1 m^3 s, with wet-season discharges increasing to over 15 m^3 s (Day, 1992).

The Sibun River has the reputation of being the fastest river to rise in Belize after heavy rains, and the most frequent to flood (Wright, 1959). During storm events (usually once or twice a year) the river inundates the flood plain, covering the lower-lying valleys between the karst hills with water up to a meter or so in depth, spreading up to 1 km from the river. This deposits large volumes of silt on the floodplain, providing a deep, rich soil that has attracted agriculture to the area in both Maya and present times.



Map 4: Location of St. Herman's Blue Hole in relation to watersheds of the Maya Mountains Massif

1.4.3 Geology



Map 5: The Maya Mountains Massif

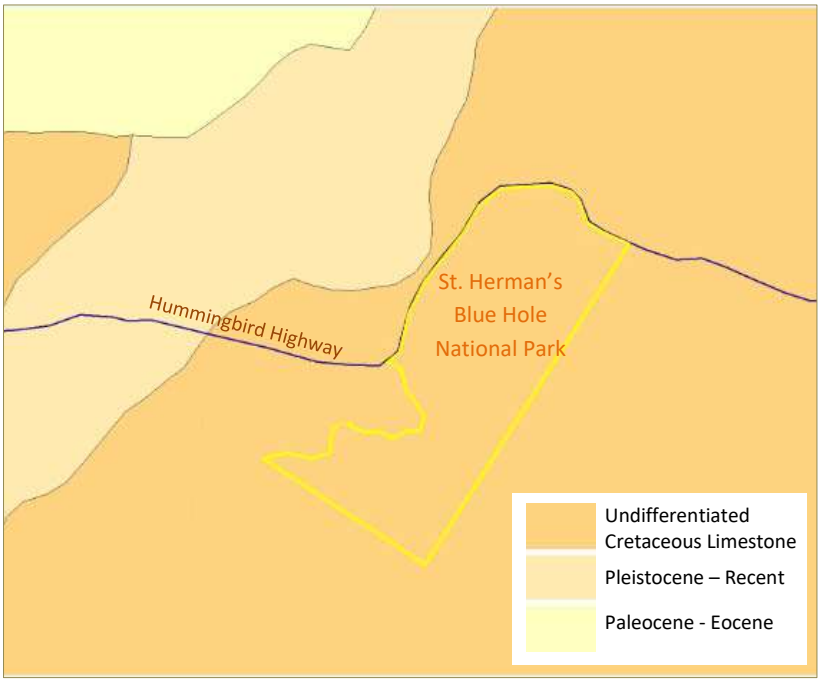
> *"The IUCN World Commission on Protected Areas has recognized karst landscapes as important targets for designation as protected areas."*
>
> ***Kueny et al., 2002.***

St. Herman's Blue Hole is located in the karst foothills of the Maya Mountains Massif, the upland, forested block in south-west Belize (Map 5). The Maya Mountains Massif area has been shaped by tectonic uplift, sedimentation and erosion. Remnants of the Cretaceous limestone that once blanketed the Maya Mountains can still be seen in the highly karstic eastern and northern margins of the plateau – including in the St. Herman's Blue Hole National Park area. Here, the rugged limestone topography of steep hills is characteristically pocked by vertical-sided sinkholes, arches, underground streams and caves. Surface water is scarce, especially during the dry months, resulting in the presence of a vegetation type adapted to seasonally drier conditions. Smaller streams that emerge as springs within the hill slopes then disappear underground again after flowing a short distance – another characteristic of this limestone topography.

Karst Landscape

…a landscape underlain by limestone with characteristic cliffs, ridges, fissures, caves, and sinkholes caused by erosion of limestone by water.

The geology of the Maya Mountains Massif includes the meta-sediments of the Santa Rosa Group, some of the oldest rocks in Central America, deposited in the Carboniferous and Permian Periods some 225 to 350 million years ago (Ower, 1928; Dixon, 1956; Bateson and Hall, 1977). In early Triassic times (195 to 230 million years ago), these metasediments were subjected to tectonic uplift along two major fault systems – the Northern Boundary Fault to the northern edge of the Mountain Pine Ridge area, and the Little Quartz Ridge / Bladen Fault to the south of the Chiquibul Forest area. This uplift was accompanied by granite intrusions, clearly visible in the Mountain Pine Ridge area today. In the early Cretaceous Period the entire mountain range was submerged beneath oceanic waters, and dense layers of fossiliferous limestones were deposited over the entire area (Dixon 1956; Wright et al. 1959). The beginning of the Tertiary Period (65 million years ago) saw renewed tectonic uplift, which has shaped the present topography, resulting in the formation of an upland plateau that dips gently to the west. Weathering of the limestone capping and erosion by stream action has exposed the underlying granite in some areas such as the Mountain Pine Ridge.



Map 6: Geology of St. Herman's Blue Hole National Park

Since the uplift of the Maya Mountains Massif in the Tertiary Period, much of the Cretaceous limestone has been eroded from the northern and eastern slopes of the Maya Mountains, and the bedrock has been deeply incised by streams. However, remnants of the Cretaceous limestone that once blanketed the Maya Mountains can still be seen in the highly karstic eastern and northern margins of the plateau – including the St. Herman's Blue Hole National Park area.

Within the cave, the environment is generally stable - with darkness, high humidity and a relatively constant air temperature similar to the annual average surface values. The large heat capacity of the rocks dampens the variations in temperature of the incoming air and water, reducing the amplitude of temperature fluctuations. Despite this apparent stability, cave systems are actually subject to change, often in response to external environmental conditions. The caves are directly connected to the surface through cave entrances and dense networks of small fractures in the carbonate rocks. They therefore cannot be considered independently from the soil and vegetation cover overlying the karstic area.

Karstic features of St. Herman's Blue Hole National Park include the ***Blue Hole,*** a karst window formed through the collapsed of a cave rook in the Caves Branch system, and well described in the caving literature (Miller, 1977, 1981, 1983, 2006; Day, 1992; Day et al., 1987). Water flow into the Blue Hole is largely from the upstream Petroglyph Cave segment of the Caves Branch system via St. Herman's Cave (Miller, 1983, 2006; Day et al., 1987), and flow out of the Blue Hole is underground via a downstream phreatic loop in the Caves Branch cave system,

While the latter is set within the polje border hills, at an apparent surface
catchment area upstream from the Blue Hole is about 90 km2

St. Herman's Cave

The best known cave in the system is St Herman's Cave. Nearly half a mile long, this popular cave has three known entrances.

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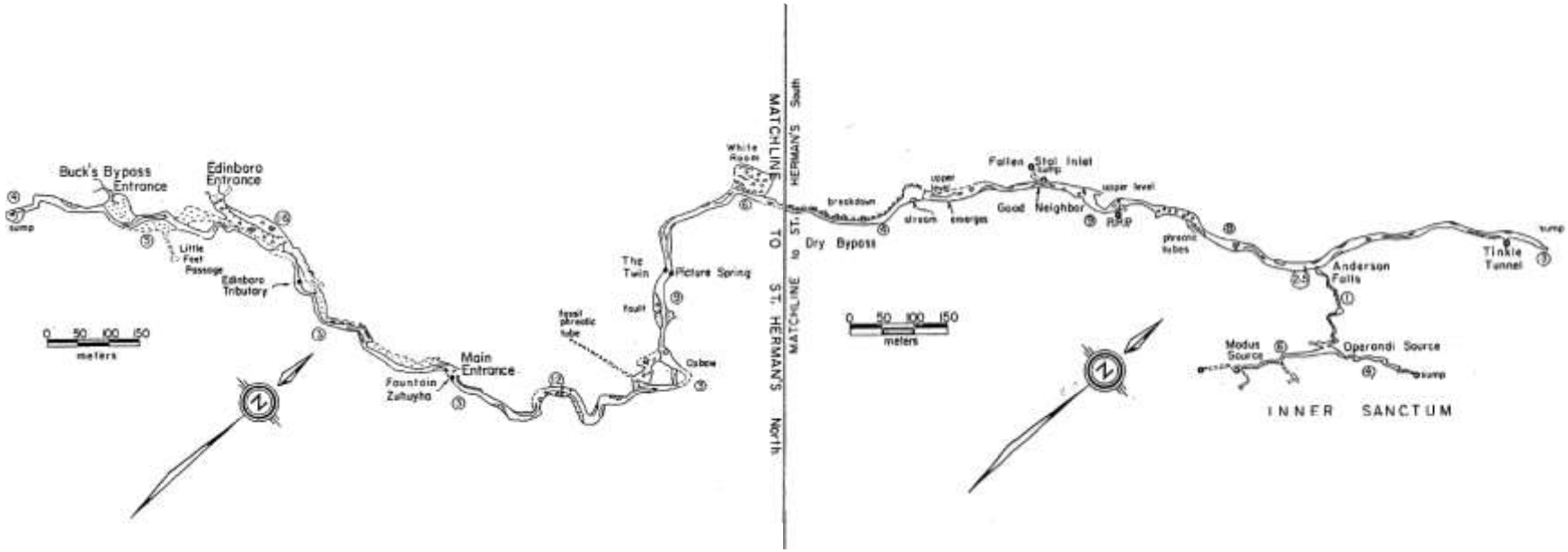

Map…: St. Herman's Cave (Miller, 1981; Mapped by P Ireland, L. McNatt, T. Miller and S. Shawcross (1976 / 1977)

Crystal Cave (Mountain Cow Cave)

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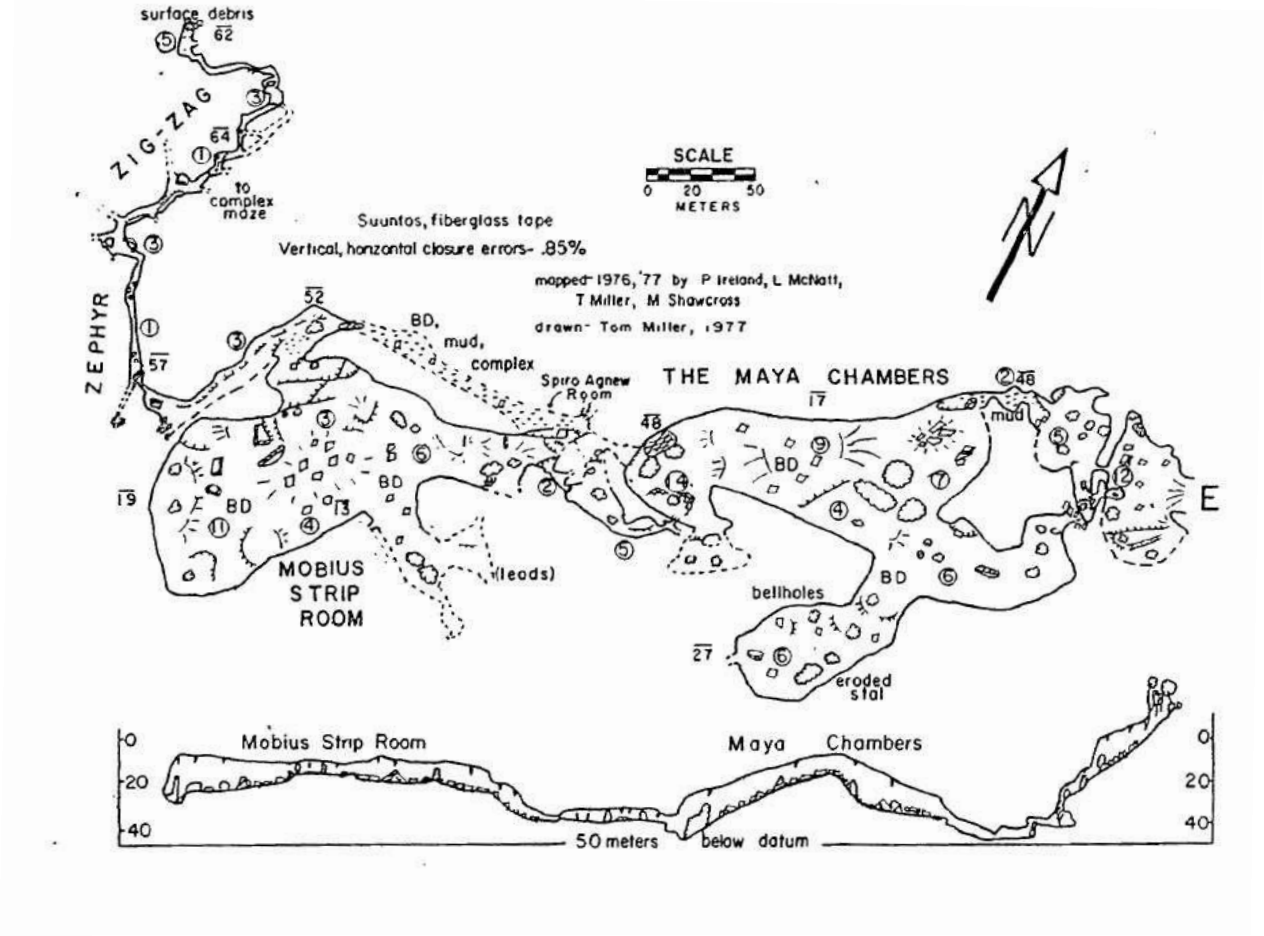


Map…: Mountain Cow Cave (Crystal Cave) (Miller, 1981; Mapped by P Ireland, L. McNatt, T. Miller and S. Shawcross (1976 / 1977)

1.5. Biodiversity of Management Area

1.5.1 Ecosystems

Two closely related forest ecosystems occur within SHBHNP: ***Tropical evergreen seasonal broad-leaved lowland forest, well drained, on rolling karstic hills*** and ***Tropical evergreen seasonal broad-leaved lowland forest, well drained, on steep karstic hills,*** differing primarily on the gradient of the hills on which they occur, and the relative abundance of drought-tolerant species. These forest types occur at elevations below 500m on limestone hills, in areas with annual rainfall of less than 2500mm. Both these ecosystems are characterised by exposure to pronounced dry seasons, differing in species composition from wetter forests further south, at similar elevation but with less pronounced dry season.

Forest canopy cover in the Park was reportedly totally lost from the devastating impacts of Hurricane Hattie in 1961, and has been impacted to a far lesser degree by subsequent storm events – most recently by Hurricane Richard in 2010. Despite these dramatic events, protected area's forests have an impressive stature – standing up to 25-30+m in height, and with the structure of mature forest.

Tropical evergreen seasonal broad-leaved lowland forest, well drained, on rolling karstic hills
Coded: **IA2a(1)(a)K-r** (UNESCO Ecosystem Classification)

Area of coverage within SHBHNP: 450 acres

Percentage national coverage within the NPAS: 31.8%

Percentage of national PA coverage within SHBHNP: 1.5%

Description: This forest type occurs on rolling limestone hills, and often over flatter areas in the valleys between the slopes. Colluvial deposition of limestone in such areas results in higher soil fertility, supporting a taller forest stature than on the slopes themselves. In areas close to slash and burn agriculture, particularly in the Ringtail area, the forests on these slopes are extremely vulnerable to fire during the dry season, when milpa fires can escape and spread up the hillsides, flare up on the exposed hilltops and remove the forest cover, leaving the slopes more vulnerable to erosion.

National importance: This ecosystem currently does not meet the national target for protection (60%). This national target, higher than the global target of 10% representation per ecosystem, is a reflection of its best use for watershed protection and protection

Trees commonly associated with Tropical evergreen seasonal broad-leaved lowland forest, well drained, on rolling karstic hills

Attalea cohune
Brosimum alicastrum
Calophyllum brasiliense
Cedrela odorata
Crysophila stauracantha
Cupania belizensis
Desmoncus orthacanthos
Guarea glabra
Hirtella americana
Lysiloma acapulcense
Manilkara zapota
Matayba oppositifolia
Pimenta dioica
Pouteria amygdalina
Protium copal
Sabal mauritiiformis
Sebastiana tuerckheimiana
Spondias radlkoferi Stemmadenia donnell-smithii Tabebuia guayacan
Trophis racemosa
Vitex gaumeri
Zuleania Guidonia

of steep slopes. The intact forest cover in SHBHNP is particularly important in the maintenance of the quality of the cave environments, regulating water flow through the system.

Tropical evergreen seasonal broad-leaved lowland forest, well drained, on steep karstic hills
Coded: **IA2a(1)(a)K-s** under the UNESCO Ecosystem Classification.

Area of coverage within SHBHNM: 214 acres

Percentage national coverage within the NPAS: 70.5%

Percentage of national PA coverage within SHBHNP: 0.2%

Description: There is significant species overlap between this forest type and its counterpart, which occurs on less steep slopes. There are however some noticeable differences in relative abundance of some species – on the forests on steeper slopes there is a higher abundance of trees and shrubs tolerant of drier conditions – reflecting the generally thinner and better drained soils. Species such as *Bernoullia flammea, Ceiba aesculifolia, Dracaena americana, Metopium brownie* and *Plumeria rubra* are found in higher desities on these steeper slopes and hilltops than on the forests of less steep gradients. Because of the drier conditions in this forest during the dry season, it is even more vulnerable to anthropogenic fire than the forests of rolling karstic hills.

The forest stature and structure on the steeper slopes differs from that on the less steep gradients – the overall canopy tends to be lower (albeit often with tall emergent reaching significant heights), and more broken – a reflection of the increased rate of tree and branch fall associated with the steep slopes, shallower soils and often greater exposure to wind.

Trees commonly associated with Tropical evergreen seasonal broad-leaved lowland forest, well drained, on steep karstic hills

Bernoullia flammea
Brosimum spp.
Bursera simaruba
Cedrela odorata
Ceiba aesculifolia
Clusia sp.
Coccoloba spp.
Crysophila stauracantha
Cupania belizensis
Dendropanax arboreus
Desmoncus orthacanthos
Dracaena americana
Heliconia spissa
Louteridium donnell-smithii,
Manilkara zapota
Metopium brownie
Pimenta dioica
Plumeria rubra
Pouteria campechiana
Pouteria reticulate
Protium copal
Pseudobombax ellipticum
Sapindus saponaria
Sebastiania tuerckheimiana
Swartzia cubensis
Vitex gaumeri

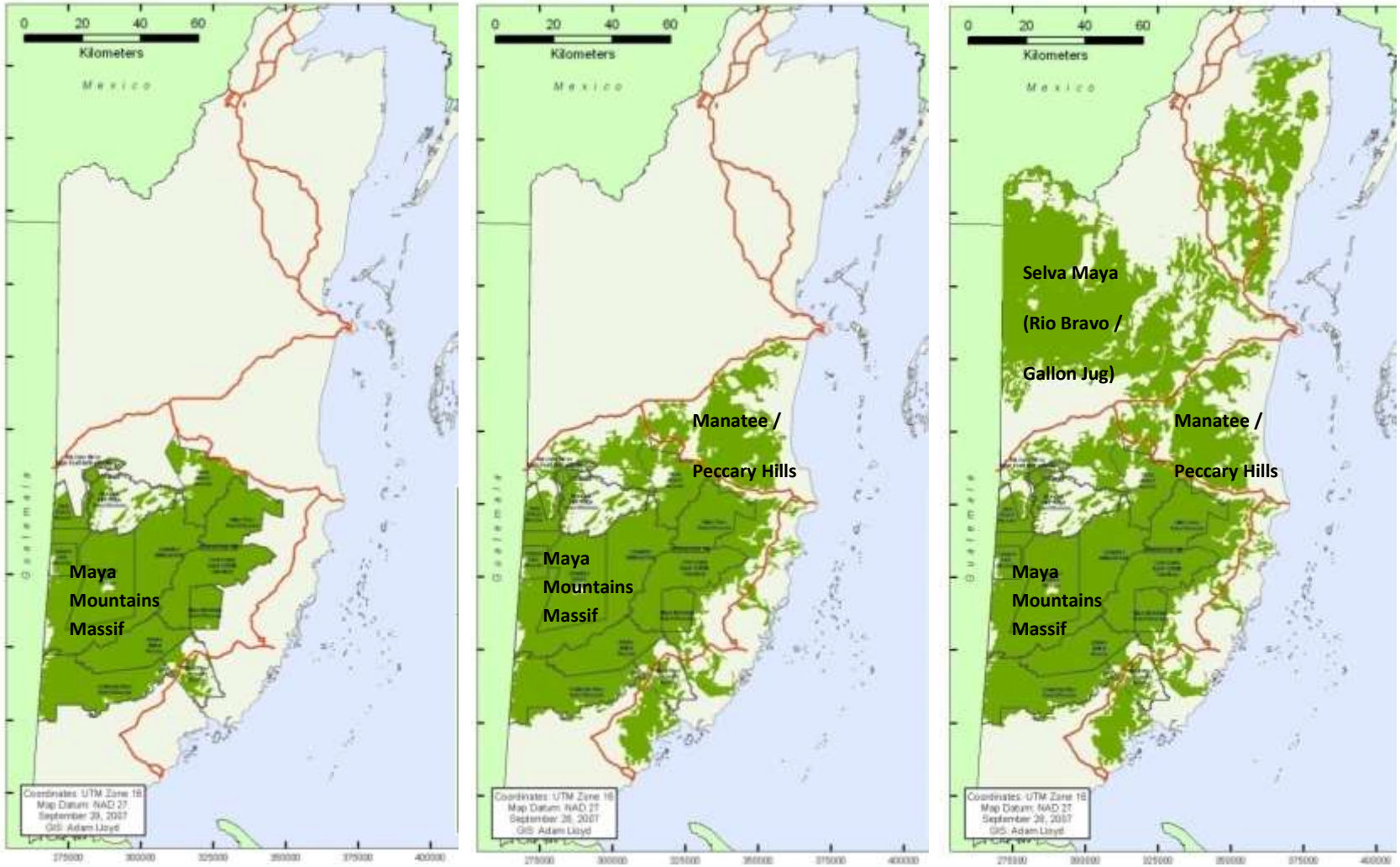
National importance: The importance of this ecosystem within SHBHNP is not so much for its biodiversity protection (as it only a 0.2 percent of the coverage within the National Protected Areas System), but its local value in the provision of critical ecosystem services. The primary ecosystem services values include watershed protection and steep slope protection / landslide prevention.

Fragmentation of Broadleaf Forest Connectivity

The importance of broadleaf forest connectivity is frequently highlighted as important for long term biodiversity viability - particularly for the larger, wide-ranging species that require large expanses of unfragmented forest for long term viability, indicative of the trophic integrity and health of the tropical forest ecosystem. Connectivity is also considered critical for building resilience to climate change. Whilst St. Herman's Blue Hole National Park currently has forest connectivity to the Maya Mountains Massif, the forest belt that provides this connectivity is not under legal protection, and therefore has no long term security. Even with long term security, bringing the National Park directly in contact with the Maya Mountains Massif, forest connectivity beyond this larger forest block is still not considered sufficient for long term viability of key species. Whilst the broadleaf forest ecosystems of the Massif are believed to be generally sufficient in scope to fulfill minimum dynamic area requirements for maintenance of most species in the area, in isolation, it is considered too small to maintain long-term viability for some landscape-scale species – including the jaguar.

Broadleaf forest connectivity from the Maya Mountains Massif outwards was investigated during system-level planning for the Maya Mountains Massif, both into the southern coastal plain and northwards into the Manatee / Peccary Hills node, and on from there into the Rio Bravo /Gallon Jug area of the Selva Maya. As this wss a binational project, and as biodiversity doesn't recognize borders, broadleaf forest connectivity was also examined with the Guatemalan Complex III: Reserva De Biosfera Montañas Mayas/Chiquibul, to the west of the Maya Mountains Massif. Connectivity westwards through Complejo III in Guatemala, then northwards towards the Selva Maya has effectively been lost, through large scale forest clearance for cattle.

The Massif plays a critical core protection area role within the Mesoamerica Biological Corridor and Wildlife Conservation Society's Corridor Initiative, and is now considered the only remaining viable linkage between the Selva Maya forests to the north and the Sierra de Las Minas Biosphere Reserve in southern Guatemala. With the rapid expansion of the human footprint in Cayo District north of the Massif, potentially viable biodiversity connectivity remains only to the north-east, through the Manatee Forest Reserve and the Runaway Creek and Peccary Hills private protected areas and the recently designated Peccary Hills National Park.



Contiguous Broadleaf Forest of the MMM for connectivity

Contiguous Broadleaf Forest allowing for connectivity across <50m non-broadleaf forest gaps

Contiguous Broadleaf Forest allowing across <100m non-broadleaf forest gaps

Map ..: Connectivity indicators for the Maya Mountains Massif (A. Lloyd, Based on: Meerman (2004). Belize Ecosystem Map

PRELIMINARY PLANT SPECIES LIST FOR BLUE HOLE NATIONAL PARK		
FAMILY	**SPECIES**	**COMMON NAME**
Acanthaceae	*Louteridium sp.*	
Anacardiaceae	*Metopium brownei*	Black Poisonwood, Chechem
	Spondias radlkoferi	Hogplum
Apocynaceae	*Stemmadenia donnell-smithii*	Cojeton, Horse balls
	Thevetia sp.	
Araceae	*Dieffenbachia oerstedii*	Leopard lily
	Philodendron sp.	Philodendron
	Philodendron tripartitum	Three-lobed philodendron
	Syngonium sp.	
Arecaceae	*Acrocomia aculeata*	Supa palm, coco-yol
	Attalea cohune	Cohune
	Bactris major	Pokenoboy - black fruit
	Chamaedorea sp.	
	Chamaedorea tepejilote	Pacaya
	Sabal mauritiiformis	Bay-leaf, Botan
	Schippia concolor	Mountain palmeto, Mis
Begoniaceae	*Begonia sericoneura*	Begonia
Bombacaceae	*Ceiba aesculifolia*	
	Ceiba pentandra	Ceiba / cotton tree
	Quararibea funebris	Guayabillo, Batidos
Bromeliaceae	*Aechmea sp.*	Bromeliad (red-flowering)
Burseraceae	*Bursera simaruba*	Gumbo limbo
	Protium copal	Copal
Cecropiaceae	*Cecropia obtusfolia*	Trumpet
	Cecropia peltata	Trumpet, Warumo
Dioscoreaceae	*Dioscorea sp.*	Chiny yam
Fabaceae	*Schizolobium parahyba*	Quamwood
Caesalpinioideae	*Enterolobium cyclocarpum*	Guanacaste, Tubroos
Mimosoideae	*Inga affinis*	Bri-bri
	Inga pinetorum	Tama-tama
	Leucaena leucocephala	Water wood, Xu-coc
Papilionoideae	*Gliricidia sepium*	Madre de Cacao
	Machaerium sp.	Tiger claw

PRELIMINARY PLANT SPECIES LIST FOR BLUE HOLE NATIONAL PARK		
FAMILY	**SPECIES**	**COMMON NAME**
Marantaceae	*Calathea sp.*	Waha leaf
Melastomataceae	*Miconia argentea*	White Maya
Meliaceae	*Cedrela odorata*	Mexican cedar
	Guarea glabra	Cramante
	Swietenia macrophylla	Mahogany
Moraceae	*Ficus sp.*	Fig
Passifloraceae	*Passiflora spp.*	
Piperaceae	*Piper spp.*	
Polygonaceae	*Coccoloba sp.*	
Rubiaceae	*Hamelia patens*	Polly red head, Ixcanan
Rutaceae	*Zanthoxylum sp.*	Prickly yellow
Sapotaceae	*Pouteria sp.*	
Sterculiaceae	*Guazuma ulmifolia*	Bay cedar, pixoy
Tiliaceae	*Trichospermum grewiifolium*	Balsa wood, Moho
Vitaceae	*Vitis tiliifolia*	Water vine

1.5.2 Fauna

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Mammals

Mammal data for St. Herman's Blue Hole National Park is limited, but surveys in adjacent areas with similar ecosystems within a 10km radius have provided a list of 61 potential species (TREES, 2014) that should occur in the protected area The species composition is expected to be representative of tropical broadleaf forests over karst elsewhere in central Belize – Five Blues National Park, Peccary Hills National Park, Runaway Creek private protected area, Manatee and Sibun Forest Reserves. Of these species, three (Yucatan black howler and Geoffroy's spider monkeys, and Baird's tapir) are listed as 'endangered' (IUCN, 2015). Two (jaguar and margay) are classified as 'lower risk / near threatened'. Three species are listed as 'data deficient' (the Neotropical river otter, red brocket deer and northern naked-tailed armadillo) - potentially at risk, but for which there is insufficient data on abundance and/or distribution to allow an assessment of viability.

Three of the non-Redlist species (jaguarundi, ocelot and margay) are listed in Appendix One of the Convention of International Trade in Endangered Species, with strict regulation of international trade, in recognition of their threatened populations. These three species are also highlighted in the provisional national list of critical species (Meerman, 2005). There are four Yucatan endemics recorded within the area - the Yucatan and Deppe's squirrels, Yucatan black howler monkey, and the Yucatan small-eared shrew.

The Yucatan black howler monkey is present in St. Herman's Blue Hole National Park. This species is restricted to a relatively small area of the Yucatan Peninsula, Belize, and the Petén of Guatemala. The howler monkey has historically been present throughout much of Belize, but suffered a precipitous population crash in the 1956/57 period from yellow fever, and subsequently from localized hunting pressure and the effects of Hurricane Hattie in 1961. Populations are now considered stable, with little hunting pressure from Belizean communities. They have, however, come under pressure recently from the impacts of Hurricane Richard in 2010. Damage to the forest canopy in the area was significant, and in the larger landscape, the Peccary Hills /Runaway Creek areas were also heavily impacted by post-hurricane fire, reducing and displacing populations.

The sub-species of Central American spider monkey (*Ateles geoffroyi yucatanenis*) is also restricted to this region, and is less widespread in Belize. This species was also affected by the yellow fever epidemic and hurricane impacts. *Ateles geoffroyi* is considered particularly vulnerable to human disturbance in Belize, requiring a large area of relatively undisturbed forest in order for viable populations to occur. Much of the population is restricted to the least disturbed hillslopes of the Maya Mountains, or to the Gallon Jug forest node in the west of Belize. This species is also established within the karst hills of the Peccary Hills area, spreading into northern Manatee Forest Reserve and Runaway Creek (private reserve).

With increasing habitat fragmentation and loss, the Belizean subspecies (*A. geoffroyi. yuctanensis*) has recently been upgraded in 2008 to Endangered, as the population is projected to decline by 50% over the next 3 generations (45 years) in the region, primarily due to habitat loss and fragmentation (IUCN, 2015). Whilst forest connectivity is of major concern for arboreal species such as these, *Alouatta pigra* (unlike *Ateles geoffroyi*)) has been reported swimming across rivers and crossing savannas with scattered pine trees in the Manatee Forest Reserve area (Gales Point resident, pers. com.). The erosion of forest connectivity along the Hummingbird Highway has affected connectivity for these primate populations between the Maya Mountains and the Peccary Hills / Manatee Forest block. The recent appearance of spider monkeys in St. Herman's Blue Hole National Park, however, suggests that sufficient connectivity exists at this time to maintain populations.

The paca, nine-banded and naked-tailed armadillos, collared peccary and white-tailed deer are favoured game species, and are under pressure, primarily from sport hunters, and hunters supplying the game meat trade in Belmopan and San Ignacio. St. Margaret's, in particular, has been identified as a favoured hunting area for hunters from San Ignacio, (community consultations, San Ignacio, 2014). There is also hunting by local hunters, with game species populations declining in areas adjacent to Armenia and St. Margaret's. A limited amount of illegal hunting activity has also been reported within the protected area, as access improves with the clearance of adjacent farmlands in Ringtail, and with the logging tracks created to the south of the protected area, associated with the logging concession.

All five of the cat species found in Belize – jaguar, puma, ocelot, margay and jaguarundi - have been reported from the St. Herman's Blue Hole National Park area. Whilst SHBHNP is not considered primary jaguar habitat, with its steep karst slopes and small size, the presence of this species is considered to be indicative of good forest connectivity. Baird's tapir (*Tapirus bairdii*), the largest herbivore present on the coastal plain, has also been recorded, generally in the lower, wetter areas. It is listed as Endangered (IUCN, 2004), but is thought to be widespread and relatively common in Belize, where it is seldom hunted. The main threat to this species is the increasing rate of habitat fragmentation and conversion to agriculture

Of the two peccary species recorded in Belize, only the collared peccary (*Tayassu tajacu*) still occurs within the St. Herman's Blue Hole area. White-lipped peccary (*Tayassu pecari*) are reported to have occurred throughout the area until extensive flooding (following Hurricane Greta, in 1978) combined with intensive hunting pressure, is thought to have caused the local extinction of this species – not just in St. Herman's, but throughout the broadleaf forest areas of Manatee Forest Reserve, south to Gales Point (community consultations, Armenia, 2014; community consultations, Gales Point, 2006). Coupled with the increasing fragmentation of forest habitat, and the increased traffic, hunting and clearance associated with the Hummingbird Highway, this species is unlikely to be able to recolonize the SHBHNP area without the maintenance of forest connectivity – and presence of this species would be indicative f good connectivity. St. Herman's Blue Hole National Park, itself, is too small to maintain a viable population of this species.

Two deer species have been reported from the St. Herman's Blue Hole landscape. The larger of the two, the white-tailed deer (*Odocoileus virginianus*), prefers the more open habitat of the farmland, and is favoured by hunters from adjacent communities. The smaller Central American red brocket (*Mazama temama*) is a forest species, rarely venturing into the open areas, so is confined to the broadleaf forest of the karst areas.

Several species of bat use the cave systems, roosting in holes, or "pots" in the ceiling carved out by their acidic urine eroding the limestone.

MAMMAL SPECIES OF THE SHBHNP LANDSCAPE
(After TREES, 2014; local consultation, 2015)

T	Common Name	Species Name	IUCN	CITES	Confirmed for SHBHNP
	Common Opossum	*Didelphis marsupialis*	LC		x
	Virginia Opossum	*Didelphis viginiana*	LC		x
	Greyish Mouse Opossum	*Tlacuatzin canescens*			x
	Water Opossum	*Chironectes minimus*	LC		
	Gray Four-eyed Opossum	*Pilander opossum*	LC		x
	Mexican Mouse Opossum	*Marmosa mexicana*	LC		
	Northern Naked-tailed Armadillo	*Cabassous centralis*	DD	III	
	Nine-banded Armadillo	*Dasypus novemcinctus*	LC		x
	Greater White-lined Bat	*Saccopteryx bilineata*	LC		
	Greater Fishing Bat	*Noctilio leporinus*	LC		
	Seba's Short-tailed Bat	*Carollia perspicillata*	LC		
	Sowell's Short-tailed Bat	*Carollia sowelleii*	LC		
	Silky Short-tailed Bat	*Carollia brevicauda*			
	Little Yellow-shouldered Bat	*Sturnira lilium*	LC		
	Great Fruit-eating Bat	*Artibeus lituratus*	LC		
	Pygmy Fruit-eating Bat	*Artibeus phaeotis*	LC		
	Toltec Fruit-eating Bat	*Artibeus toltecus*	LC		
	Thomas' Fruit-eating Bat	*Artibeus watsoni*	LC		
	Hairy Big-eared Bat	*Chiroderma villosum*	LC		
	Great Stripe-faced Bat	*Vampyrodes caraccioli*	LC		
	Little Yellow-eared Bat	*Vampyressa thyone*			
	Common Long-tongued Bat	*Glossophaga soricina*	LC		
	Underwood's Long-tongued Bat	*Hylonycteris underwoodi*	LC		
	Common Tent-making Bat	*Uroderma bilobatum*	LC		
	Elegant Myotis	*Myotis elegans*	LC		
	Maya Small-eared Shrew	*Cryptotis mayensis*	LC		
	Yucatan Squirrel	*Sciurus yucatenensis*	LC		x
	Variegated Squirrel	*Sciurus variegatoies*			
	Deppe's Squirrel	*Sciurus deppei*	LC		x

MAMMAL SPECIES OF THE SHBHNP LANDSCAPE (After TREES, 2014; local consultation, 2015)					
	Desmarest's Spiny Pocket Mouse	*Heteromys desmarestianus*	LC		
	Vesper Rat	*Nyctomys sumichrasti*	LC		
	Slender Harvest Mouse	*Reithrodontomys gracilis*	LC		
	Northern Pygmy Rice Rat	*Oligoryzomys fulvescens*	LC		
	Alston's Singing Mouse	*Scotinomys teguina*			
	Alfaro's Rice Rat	*Handleyomys alfaroi*	LC		
	Hispid Cotton Rat	*Sigmodon hipidus*			
	Hispid Pocket Gopher	*Orthogeomys hispidus*			x
	Mexican Porcupine	*Sphiggurus mexicanus*	LC	III	
	Central American Agouti	*Dasyprocta punctata*	LC		x
	Paca	*Cuniculus paca*	LC		x
	Gray Fox	*Urocyon cinereoargenteus*	LC		x
	White-nosed Coati	*Nasua narica*	LC		x
	Northern Racoon	*Procyon lotor*	LC		x
	Tayra	*Eira barbara*	LC		x
	Neotropical River Otter	*Lontra longicaudus*	DD		x
	Striped Hog-nosed Skunk	*Conepatus semistriatus*	LC		x
	Yucatan Black Howler Monkey	*Alouatta pigra*	EN	I	x
	Geoffroy's Spider Monkey	*Ateles geoffryi*	EN	II	x
	Kinkajou	*Potos flavus*	LC	III	x
	Northern Tamandua	*Tamandua mexicana*	LC	III	x
	Margay	*Leoparus weidii*	NT	I	x
	Jaguar	*Panthera onca*	NT	I	x
	Ocelot	*Leopardis pardalis*	LC	I	x
	Jaguarundi	*Puma yagouaroundi*	LC	I	x
	Puma	*Puma concolor*	LC	II	x
	Collared Peccary	*Pecari tajacu*	LC	II	x
	Red Brocket Deer	*Mazama americana*[1]	DD	III	x
	White-tailed Deer	*Odocoileus virginianus*	LC		x
	Baird's Tapir	*Tapirus bairdii*	EN	I	x
T: Recorded during mammal surveys at the Toucan Ridge Ecology and Education Society station (TREES), approximately 10km from SHBHNP, with similar ecosystem coverage					

[1] Synonym: *Mazama americana*

Birds

St. Herman's Blue Hole National Park has a bird fauna representative of lowland hill forest ecosystems, as well as incorporating some edge-species in the succession vegetation adjacent to the Hummingbird Highway and citrus fields. To date, more than 256 species have been confirmed for the area based on past work (BAS data, BAS SHBHNP staff, R. Martinez pers. com.,2015), with a further 36 provisional species waiting confirmation (Table…).

One species is globally endangered (the great curassow (*Crax rubra*), one is considered globally Vulnerable (cerulean warbler (*Dendroica cerulea*), and three are Near Threatened species (the great tinamou (*Tinamous major*), ornate hawk-eagle (*Spizaetus ornatus*) and painted bunting (*Passerina ciris*)). A fourth Near Threatened species, the orange-breasted falcon (*Falco deiroleucus*), is known to nest nearby, and is likely to venture into the area whilst foraging.

As well as a globally Endangered species, the great curassow is also a species of national concern. This large, showy game bird is identified as a high priority for effective species conservation management in the IUCN Cracid Action Plan, 2000 – 2004 (Brooks and Strahl, 2000). It has a regional distribution that stretches from Mexico southwards to Ecuador, though is restricted to forested areas. This species is becoming uncommon to rare through much of its range - and in parts is now locally extinct (Birdlife, 2005). Throughout the Neotropics, Curassow are heavily persecuted as game species, and populations in Belize are no exception, coming under significant hunting pressure (Belize is highlighted within the Cracid Action Plan as one of the few countries where hunting of this species is still legal).

The forest provides structure and food resource for migratory species, with 64 migratory species (summer and winter visitors, and transient species) listed as using the site, and 189 species considered as permanent residents. A number of raptors use the area, including the Near Threatened orange-breasted falcon, which nests within a mile of SHBHNP (R. Martinez, pers. com.). This species, while probably never very common, has in recent years seen a significant population decline regionally, and currently is thought to occupy only 4% of its historic breeding range, thought to be as a result of the combined factors of predation, habitat loss, human disturbance, and DDT (Peregrine Fund, date?). Orange-breasted falcons

BIRDS OF THE ST. HERMAN'S BLUE HOLE NATIONAL PARK					
Species		**Status**	**Habitats**	**TREES, 2014**	**SHBHNP**
Great Tinamou (NT)	*Tinamus major*	fP	BFL	C	x
Little Tinamou	*Crypturellus soui*	fP	SC	C	x
Thicket Tinamou	*Crypturellus cinnamomeus*	lP	BFL		x
Slaty-breasted Tinamou	*Crypturellus boucardi*	fP	BFL		x
Least Grebe	*Tachybaptus dominicus*	uP	WL		x
Bare-throated Tiger-Heron	*Tigrisoma mexicanum*	uP	WL,LA	U	x
Great Egret	*Ardea alba*	vP	LA	R	x
Cattle Egret	*Bubulcus ibis*	fV	SC	C	x
Black Vulture	*Coragyps atratus*	vP	SA,O	VC	x
Turkey Vulture	*Cathartes aura*	vP	SA,O	VC	x
King Vulture	*Sarcoramphus papa*	uP	O	O	x
Grey-headed Kite	*Leptodon cayanensis*	uP	BFM, BFL		x
Hook billed Kite	*Chondrohierax uncinatus*	uP	BFL		x
Swallow-tailed Kite	*Elanoides forficatus*	uS	BFL,O	R	x
White-tailed Kite	*Elanus leucurus*	rV	WL, SC		x
Double-toothed Kite	*Harpagus bidentatus*	rV	BFM, BFL, O		x
Plumbeous Kite	*Ictinia plumbea*	uS	BFL,O	C	x
Cooper's Hawk	*Accipiter cooperii*	rT	BFM, BFL		x
White Hawk	*Leucopternis albicollis*	cP	BFL, O		x
Common Black-Hawk	*Buteogallus anthracinus*	xP	SC, O		x
Great Black-Hawk	*Buteogallus urubitinga*	uP	BFL,O	R	x
Gray Hawk	*Asturina nitida*	fP	BFL,SC,O	C	x
Roadside Hawk	*Buteo magnirostris*	cP	SC,SA,O	C	x
Short-tailed Hawk	*Buteo brachyurus*	uP	BFM, BFL, O		x
White-tailed Hawk	*Buteo albicaudatus*	uP	SC, SA		x
Zone-tailed Hawk	*Buteo albonotatus*	uV	SC,SA		x
Black Hawk-Eagle	*Spizaetus tyrannus*	uP	BFL,O		x
Ornate Hawk-Eagle (NT)	Spizaetus ornatus	rP	BFL,O		x
Barred Forest-Falcon	Micrastur ruficollis	uP	BFL		x
Collared Forest-Falcon	*Micrastur semitorquatus*	uP	BFL		x
Laughing Falcon	*Herpetotheres cachinnans*	fP	SC,SA		x
Bat Falcon	*Falco rufigularis*	fP	SC,O		x
Plain Chachalaca	*Ortalis vetula*	cP	BFL, SC	O	x
Crested Guan	*Penelope purpurascens*	lP	BFL	R	x
Great curassow (EN)	*Crax rubra*	lP	BFL	R	x
Ruddy Crake	*Laterallus ruber*	lP	SC		x
Gray-necked Wood-Rail	*Aramides cajanea*	fP	LA	O	x

BIRDS OF THE ST. HERMAN'S BLUE HOLE NATIONAL PARK					
Species		**Status**	**Habitats**	**TREES, 2014**	**SHBHNP**
Scaled Pigeon	*Columba speciosa*	rP	BFM, BFL		x
Red-billed Pigeon	*Columba flavirostris*	uP	BFL	O	x
Short-billed Pigeon	*Columba nigrirostris*	vP	BFL	C	x
Mourning Dove	*Zenaida macroura*	uV	SC		x
Ruddy Ground-Dove	*Columbina talpacoti*	vP	SC	C	x
Blue Ground-Dove	*Claravis pretiosa*	uP	BFL	O	x
White-tipped Dove	*Leptotila verreauxi*	cP	BFL	C	x
Gray-fronted Dove	*Leptotila rufaxilla*	fP	BLF		x
Gray-chested Dove	*Leptotila cassini*	mP	BFL		x
Ruddy Quail-Dove	*Geotrygon montana*	uP	BFL		x
Olive-throated Parakeet	*Aratinga nana*	vP	BFL,SC	C	x
Brown-hooded Parrot	*Pionopsitta haematotis*	cP	BF	U	x
White-crowned Parrot	*Pionus senilis*	cP	BFL	C	x
White-fronted Parrot	*Amazona albifrons*	vP	BFL,SA	C	x
Red-lored Parrot	*Amazona autumnalis*	vP	BFL	C	x
Mealy Parrot	*Amazona farinosa*	lP	BFL		x
Squirrel Cuckoo	*Piaya cayana*	cP	BFL	C	x
Striped Cuckoo	*Tapera naevia*	fP	SC		x
Pheasant Cuckoo	*Dromococcyx phasianellus*	rP	BFL		x
Groove-billed Ani	*Crotophaga sulcirostris*	vP	SC	O	x
Barn Owl	*Tyto alba*	uP	SC		x
Vermiculated Screech-Owl	*Otus guatemalae*	uP	BFL, BFM		x
Spectacled Owl	*Pulsatrix perspicillata*	uP	BFL, BFM	O	x
Ferruginous Pygmy-Owl	*Glaucidium brasilianum*	lP	BFL,SC		x
Mottled Owl	*Ciccaba virgata*	cP	BFL	O	x
Common Paraque	*Nyctidromus albicollis*	rP	BFM, BFL		x
White-collared Swift	*Streptoprocne zonaris*	fP	O	C	x
Vaux's Swift	*Chaetura vauxi*	cP	O		x
Lesser Swallow-tailed Swift	*Panyptila cayennensis*	uP	O		x
Long-billed Hermit	*Phaethornis longirostris*	cP	BFM, BFL	C	x
Stripe-throated Hermit	*Phaethornis striigularis*	cP	BFL	C	x
Scaly-breasted Hummingbird	*Phaeochroa cuvieri*	uP	BFL	R	x
Wedge-tailed Sabrewing	*Campylopterus curvipennis*	cP	BFL		x
Violet Sabrewing	*Campylopterus hemileucurus*	uP	BFM	O	x
White-necked Jacobin	*Florisuga mellivora*	fP	BFL,LA	C	x
Green-breasted Mango	*Anthracothorax prevostii*	uP	SC		x
White-bellied Emerald	*Amazilia candida*	fP	BFL	C	x

BIRDS OF THE ST. HERMAN'S BLUE HOLE NATIONAL PARK					
Species		**Status**	**Habitats**	**TREES, 2014**	**SHBHNP**
Azure-crowned Hummingbird	*Amazilia cyanocephala*	vP	PFL		x
Rufous-tailed Hummingbird	*Amazilia tzacatl*	cP	SC,SA	C	x
Purple-crowned Fairy	*Heliothryx barroti*	mP	BFL		x
Ruby-throated Hummingbird	*Archilochus colibris*	uW	SC	U	x
Black-headed Trogon	*Trogon melanocephalus*	cP	BFL. PFL	O	x
Violaceous Trogon	*Trogon violaceus*	cP	,BFL	C	x
Collared Trogon	*Trogon collaris*	uP	BFM, BFL	R	x
Slaty-tailed Trogon	*Trogon massena*	cP	,BFL	U	x
Tody Motmot	*Hylomanes momotula*	fP	BFL	R	x
Blue-crowned Motmot	*Momotus momota*	cP	BFL	U	x
White-necked Puffbird	*Notharchus macrorhynchos*	uP	SC		x
White-whiskered Puffbird	*Malacoptila panamensis*	cP	BFM, BFL	R	x
Rufous-tailed Jacamar	*Galbula ruficauda*	fP	BFL	U	x
Collared Aracari	*Pteroglossus torquatus*	cP	BFL	C	x
Emerald Toucanet	*Aulacorhynchus prasinus*	uP	BFM	R	x
Keel-billed Toucan	*Ramphastos sulfuratus*	cP	BFL	VC	x
Black-cheeked Woodpecker	*Melanerpes pucherani*	cP	BFL	C	x
Golden-fronted Woodpecker	*Melanerpes aurifrons*	cP	SC	VC	x
Smoky-brown Woodpecker	*Veniliornis fumigatus*	fP	BFL	O	x
Golden-Olive Woodpecker	*Piculus rubiginosus*	cP	BFM, BFL		x
Chestnut-colored Woodpecker	*Celeus castaneus*	uP	BFL		x
Lineated Woodpecker	*Dryocopus lineatus*	cP	BFL		x
Pale-billed Woodpecker	*Campephilus guatemalensis*	cP	BFL	U	x
Rufous breasted Spinetail	*Synallaxis erythrothorax*	fP	SC	C	x
Scaly-throated Leaftosser	*Sclerurus guatemalensis*	uP	FM,BFL		x
Buff-throated Foliage-gleaner	*Automolus ochrolaemus*	cP	BFM, BFL		X
Plain Xenops	*Xenops minutus*	fP	BFL		x
Tawny-winged Woodcreeper	*Dendrocincla anabatina*	fP	BFL		x
Ruddy Woodcreeper	*Dendrocincla homochroa*	uP	BFL	U	x
Olivaceous Woodcreeper	*Sittasomus griseicapillus*	fP	BFL		x
Wedge-billed Woodcreeper	*Glyphorynchus spirurus*	fP	BFL	R	x
Northern Barred-Woodcreeper	*Dendrocolaptes sanctithomae*	fP	BFL, PFL		x
Ivory-billed Woodcreeper	*Xiphorhynchus flavigaster*	cP	BFL	O	x
Streak-headed Woodcreeper	*Lepidocolaptes souleyetii*	uP	BFL	R	x

BIRDS OF THE ST. HERMAN'S BLUE HOLE NATIONAL PARK					
Species		**Status**	**Habitats**	**TREES, 2014**	**SHBHNP**
Great Antshrike	*Taraba major*	lP	SC		x
Barred Antshrike	*Thamnophilus doliatus*	cP	SC	C	x
Dot-winged Antwren	*Microrhopias quixensis*	cP	BFL		x
Dusky Antbird	*Cercomacra tyrannina*	cP	SC		x
Black-faced Antthrush	*Formicarius analis*	cP	BFL		x
Yellow-bellied Tyrannulet	*Ornithion semiflavum*	fP	BFL		x
Greenish Elaenia	*Myiopagis viridicta*	fP	BFL	x	x
Yellow-bellied Elaenia	*Elaenia flavogaster*	vP	PFL,SA	x	x
Ochre-bellied Flycatcher	*Mionectes oleagineus*	cP	BFL		x
Sepia-capped Flycatcher	*Leptopogon amaurocephalus*	fP	BFL		x
Northern Bentbill	*Oncostoma cinereigulare*	cP	BFL		x
Slate-headed Tody-Flycatcher	*Poecilotriccus sylvia*	uP	SC		x
Common Tody-Flycatcher	*Todirostrum cinereum*	cP	SC,SA		x
Eye-ringed Flatbill	*Rhynchocyclus brevirostris*	uP	BFL		x
Yellow-olive Flycatcher	*Tolmomyias suphurescens*	cP	BFL		x
Stub-tailed Spadebill	*Platyrinchus cancrominus*	fP	BFL	x	x
Royal Flycatcher	*Onychorhynchus coronatus*	uP	BFL		x
Sulphur-rumped Flycatcher	*Myiobius sulphureipygius*	cP	BFL		x
Eastern Wood-Pewee	*Contopus virens*	cT	BFL		x
Tropical Pewee	*Contopus cinereus*	fP	BFL		x
Yellow-bellied Flycatcher	*Empidonax flaviventris*	fW	BFL		x
Least Flycatcher	*Empidonax minimus*	fW	SC		x
Vermilion Flycatcher	*Pyrocephalus rubinus*	cP	SA, SC		x
Bright-rumped Attila	*Attila spadiceus*	lP	BFL	x	x
Rufous Mourner	*Rhytipterna holerythra*	lP	BFL		x
Yucatan Flycatcher	*Myiarchus yucatanensis*	uP	BFL, SC		x
Dusky-capped Flycatcher	*Myiarchus tuberculifer*	cP	BFL	x	x
Great Crested Flycatcher	*Myiarchus crinitus*	fW	BFL		x
Brown-crested Flycatcher	*Myiarchus tyrannulus*	cS	BFL,PFL		x
Great Kiskadee	*Pitangus sulphuratus*	vP	SC	x	x
Boat-billed Flycatcher	*Megarynchus pitangua*	cP	BFL		x
Social Flycatcher	*Myiozetetes similes*	vP	SC	x	x
Streaked Flycatcher	*Myiodynastes maculatus*	lS	BFL		x
Sulphur-bellied Flycatcher	*Myiodynastes luteiventris*	cS	BFL	x	x
Piratic Flycatcher	*Legatus leucophaius*	cS	BFL		x
Tropical Kingbird	*Tyrannus melancholicus*	vP	PFL,SA	x	x

BIRDS OF THE ST. HERMAN'S BLUE HOLE NATIONAL PARK					
Species		**Status**	**Habitats**	**TREES, 2014**	**SHBHNP**
Couch's Kingbird	*Tyrannus couchii*	cP	PFL,SA		x
Eastern Kingbird	*Tyrannus tyrannus*	vT	BFL		x
Scissor-tailed Flycatcher	*Tyrannus forficatus*	uW	SC		x
Thrushlike Schiffornis	*Schiffornis turdinus*	cP	BFL	x	x
Cinnamon Becard	*Pachyramphus cinnamomeus*	cP	BFM,BFL		x
White-winged Becard	*Pachyramphus polychopterus*	uP	SC		x
Rose-throated Becard	*Pachyramphus aglaiae*	uP	BFL,PFL		x
Masked Tityra	*Tityra semifasciata*	cP	BFL	x	x
White-collared Manakin	*Manacus candei*	cP	BFL	x	x
Red-capped Manakin	*Pipra mentalis*	fP	BFL	x	x
White-eyed Vireo	*Vireo griseus*	cW	SC	x	x
Yellow-throated Vireo	*Vireo flavifrons*	fW	BFL	x	x
Red-eyed Vireo	*Vireo olivaceus*	cT	BFL		x
Yellow-green Vireo	*Vireo flavoviridis*	cS	BFL		x
Green Shrike-Vireo	*Vireolanius pulchellus*	cP	BFM,BFL		x
Tawny-crowned Greenlet	*Hylophilus ochraceiceps*	cP	BFL		x
Lesser Greenlet	*Hylophilus decurtatus*	vP	BFL	x	x
Green Jay	*Cyanocorax yncas*	uP	BFL,PFL		x
Brown Jay	*Cyanocorax morio*	vP	BFL,PFL	x	x
Purple Martin	*Progne subis*	cT	O		x
Gray-breasted Martin	*Progne chalybea*	cS	O		x
Northern Rough-winged Swallow	*Steigidopteryx serripennis*	cW	BFL,SA		x
Ridgeways Rough-winged Swallow	*Steigidopteryx ridgwayi*	cP	O		x
Barn Swallow	*Hirundo rustica*	cT	O		x
Band-backed wren	*Campylorhynchus zonatus*	uP	BFM, BFL		x
Spot-breasted Wren	*Thryothorus maculipectus*	vP	BFL	x	x
House Wren	*Troglodytes aedon*	cP	SC		x
White-bellied Wren	*Uropsila leucogastra*	cP	BFL, PFL		x
White-breasted Wood-Wren	*Henicorhina leucosticta*	cP	BFL	x	x
Nightingale Wren	*Microcerculus philomela*	cP	BFM, BFL		x
Long-billed Gnatwren	*Pamphocaenus melanurus*	fP	BFL		x
Blue-grey Gnatcatcher	*Polioptila caerulea*	cP	SC		x
Tropical Gnatcatcher	*Polioptila plumbea*	fP	BFL		x
Veery	*Catharus fuscescens*	uT	BFL		x
Gray-cheeked Thrush	*Catharus minimus*	uT	BFL		x

BIRDS OF THE ST. HERMAN'S BLUE HOLE NATIONAL PARK					
Species		**Status**	**Habitats**	**TREES, 2014**	**SHBHNP**
Swainson's Thrush	*Catharus ustulatus*	cT	BFL		x
Wood Thrush	*Hylocichla mustelina*	cW	BFL		x
Clay-colored Robin	*Turdus grayi*	cP	BFL,SC		x
White-throated Robin	*Turdus assimilis*	cP	BFL		x
Gray Catbird	*Dumetella caronlinensis*	cW	BFL, PFL		x
Tropical Mockingbird	*Mimus gilvus*	vP	SA		x
Cedar Waxwing	*Bombycilla cedorum*	uW	BFL		x
Blue-winged Warbler	*Vermivora pinus*	uW	BFL,SC		x
Tennessee Warbler	*Vermivora peregrina*	cT	BFL,SC		x
Northern Parula	*Parula americana*	oT	BFL,PFL		x
Yellow Warbler	*Dendroica petechia*	cW	SC	x	x
Chestnut-sided Warbler	*Dendroica pensylvanica*	cW	BFL,SC		x
Magnolia Warbler	*Dendroica magnolia*	cW	BFL,SC		x
Black-throated Green Warbler	*Dendroica virens*	fW	PFL,SC	x	x
Townsend's Warbler[2]	*Dendroica townsendi*	lX	BFL		X
Blackburnian Warbler	*Dendroica fusca*	fT	BFL		x
Yellow-throated Warbler	*Dendroica dominica*	fW	BFL,PFL		x
Bay-breasted Warbler	*Dendroica castanea*	fT	BFL		x
Cerulean Warbler (V)	*Dendroica cerulea*	uT	BFL		x
Black-and-white Warbler	*Mniotilta varia*	cW	BFL	x	x
American Redstart	*Setophaga ruticilla*	cW	BFM, BFL		x
Prothonotary Warbler	*Protonotaria citrea*	uT	BFL,LA		x
Worm-eating Warbler	*Helmitheros vermivorus*	uW	BFL		x
Ovenbird	*Seiurus aurocapillus*	fW	BFL		x
Northern Waterthrush	*Seiurus noveboracensis*	cW	LA	x	x
Louisiana Waterthrush	*Seiurus motacilla*	cS	LA		x
Kentucky Warbler	*Oporornis formosus*	cW	BFL		x
Common Yellowthroat	*Geothlypis trichas*	cW	SC		x
Hooded Warbler	*Wilsonia citrina*	cW	BFL	x	x
Wilson's Warbler	*Wilsonia pusilla*	cW	BFM, BFL		x
Golden-crowned Warbler	*Basileuterus culicivorus*	cP	BFL		x
Yellow-breasted Chat	*Icteria virens*	uW	SC		x

[2] New confirmed record for Belize, BAS / Lee Jone, 2015

BIRDS OF THE ST. HERMAN'S BLUE HOLE NATIONAL PARK					
Species		**Status**	**Habitats**	**TREES, 2014**	**SHBHNP**
Gray-headed Tanager	*Eucometis penicillata*	fP	BFL		x
Black-throated Shrike-Tanager	*Lanio aurantius*	uP	BFL		x
Red-crowned Ant-Tanager	*Habia rubica*	cP	BFL		x
Red-throated Ant-Tanager	*Habia fuscicauda*	vP	BFL	x	x
Summer Tanager	*Piranga rubra*	cW	BFL		x
Scarlet Tanager	*Piranga olivacea*	cT	BFL		x
Crimson-collared Tanager	*Ramphocelus sanguinolentus*	fP	SC		x
Passerini's Tanager	*Ramphocelus passerinii*	fP	SC		x
Blue-gray Tanager	*Thraupis episcopus*	cP	BFL,PFL		x
Yellow-winged Tanager	*Thraupis abbas*	cP	BFL		x
Scrub Euphonia	*Euphonia affinis*	fP	SC	x	x
Yellow-throated Euphonia	*Euphonia hirundinacea*	cP	BFL	x	x
Olive-backed Euphonia	*Euphonia gouldi*	cP	BFL		x
Golden-hooded Tanager	*Tangara larvata*	cP	BFL		x
Green Honeycreeper	*Chlorophanes spiza*	uP	BFM, BFL		x
Red-legged Honeycreeper	*Cyanerpes cyaneus*	cP	BFL		
Blue-black Grassquit	*Volatinia jacarina*	vP	SC	x	x
Variable Seedeater	*Sporophila americana*	cP	SC,SA		x
White-collared Seedeater	*Sporophila torqueola*	cP	SC	x	x
Thick-billed Seed-Finch	*Oryzoborus funereus*	cP	PFL,SC		x
Blue Seedeater	*Amaurospiza concolor*	lP	SC		x
Yellow-faced Grassquit	*Tiaris olivacea*	lP	SC		x
Green-backed Sparrow	*Arremonops chloronotus*	cP	BFL,SC	x	x
Orange-billed Sparrow	*Arremon aurantiirostris*	cP	BFM, BFL		X
Grayish Saltator	*Saltator coerulescens*	cP	SC		x
Buff-throated Saltator	*Saltator maximus*	cP	BFL		x
Black-headed Saltator	*Saltator atriceps*	cP	BFL	x	x
Black-faced Grosbeak	*Caryothraustes poliogaster*	cP	BFL		x
Rose-breasted Grosbeak	*Pheuticus ludovicianus*	cT	BFL		x
Blue-black Grosbeak	*Cyanocompsa cyanoides*	cP	BFL		x
Blue Bunting	*Cyanocompsa parellina*	fP	fP		x
Blue Grosbeak	*Passerina caerulea*	cT	SC		x
Indigo Bunting	*Passerina cyanea*	vT	SC		x
Painted Bunting (NT)	*Passerina ciris*	uT	SC		x
Eastern Meadowlark	*Sturnella magna*	cP	SA		x
Melodious Blackbird	*Dives dives*	vP	SC	x	x

BIRDS OF THE ST. HERMAN'S BLUE HOLE NATIONAL PARK					
Species		**Status**	**Habitats**	**TREES, 2014**	**SHBHNP**
Great-tailed Grackle	*Quiscalus mexicanus*	vP	WL		x
Bronzed Cowbird	*Molothrus aeneus*	cP	SC		x
Giant Cowbird	*Molothrus oryzivorus*	uP	SC		x
Black-cowled Oriole	*Icterus prosthemelas*	cP	BFL, PFL,SA		x
Orchard Oriole	*Icterus spurious*	cW	SC, WL		x
Yellow-tailed Oriole	*Icterus mesomelas*	fP	LA		x
Baltimore Oriole	*Icterus glabula*	cW	BFL		x
Yellow-billed Cacique	*Amblycercus holosericeus*	cP	BFL,PFL	x	x
Montezuma Oropendola	*Psarocolius montezuma*	cP	BFL	x	x
Great Blue Heron	*Ardea herodius*	cV	WL, LA	R	x
Snowy Egret	*Egretta thula*	oV	WL,LA	O	x
Little Blue Heron	*Egretta caerula*	vV	WL,LA		x
Green Heron	*Butorides virescens*	cP	LA	R	x
Yellow-crowned Night-Heron	*Nyctanassa violacea*	lP	LA		x
SPECIES TO BE CONFIRMED FOR ST. HERMAN'S BELUE HOLE NATIONAL PARK					
Species		**Status**	**Habitats**	**TREES, 2014**	**SHBHNP**
Broad-winged Hawk	*Buteo platypterus*	oT	O	R	
Red-tailed Kite	*Buteo jamaicensis*	uP	BFL	R	
Orange-breasted Falcon (NT)	*Falco deiroleucas*	uP	BFL		
Pale-vented Pigeon	*Columba cayennensis*	vP	BFL, PFL	O	
Crested Owl	*Lophostrix cristata*	uP	BFL	R	
Common Nighthawk	*Chordeiles minor*	fS	SA,O	R	
Canivet's Emerald	*Chlorostilbon canivetii*	uP	SA,SC	U	
Buff-bellied Hummingbird	*Amazilia yucatanensis*	lP	SC,SA		
Cinnamon Hummingbird	*Amazilia rutila*	lP	MF		
Ringed Kingfisher	*Ceryle torquata*	lP	LA		
Belted Kingfisher	*Ceryle alcyon*	fW	LA		
Amazon Kingfisher	*Chloroceryle amazona*	cP	LA		
Green Kingfisher	*Chloroceryle americana*	fP	LA	C	
American Pygmy Kingfisher	*Chloroceryle aenea*	uP	LA	O	
Red-vented Woodpecker	*Melanerpes pygmaeus*	fP	BFL		
Yellow-bellied Sapsucker	*Sphyrapicus varius*	uW	BFL		
Slaty Antwren	*Myrmotherula schisticolor*			U	
Black Phoebe	*Sayornis nigricans*	lP	LA		
Fork-tailed Flycatcher	*Tyrannus savanna*	cP	SA		

SPECIES TO BE CONFIRMED FOR ST. HERMAN'S BELUE HOLE NATIONAL PARK					
Species		**Status**	**Habitats**	**TREES, 2014**	**SHBHNP**
Gray–collared Becard	*Pachyramphus major*	rP	BFL		
Cliff Swallow	*Petrochelidon pyrrhonota*	cT	O		
Orange-crowned Warbler	*Vermivora celata*	lX	BFL, SC		
Swainson's Warbler	*Limnothlypis swainsonii*	uS	BFL		
Gray-crowned Yellowthroat	*Geothlypis poliocephala*	cP	PFL,SA		
Gray-throated Chat	*Granatellus sallaei*	uP	BFL		
Rose-throated Tanager	*Piranga roseogularis*	lP	BFL		
Hepatic Tanager	*Piranga flava*	lP	PFL		
Olive Sparrow	*Arremonops chloronotus*	cP	PFL, SA		
Chipping Sparrow	*Spizella passerina*	fP	PFL		
Savanna Sparrow	*Passerculus sandwichensis*	oW	SA		
Grasshopper Sparrow	*Ammodramus savannarum*	cP	SA		
Northern Cardinal	*Cardinalis cardinalis*	fP	PFL, SC		
Dickcissel	*Spiza americana*	cT	SC,WL		
Yellow-backed Oriole	*Icterus chrysater*	fP	PFL		
Hooded Oriole	*Icterus cucullatus*				

Status Legend

v = very common
c = common
f = fairly common
u = uncommon
o = occasional
l = local

P = permanent resident
S = seasonal resident
V = visitor
T = transient (migrant)
W = winter resident
X = one or two records only

Habitat Preferences Legend (Adapted from Jones and Vallely, 2001)

BFL	Lowland broadleaf forest
O	Overhead/aerial
PFL	Lowland pine forest
SC	Scrub, low second growth
SA	Savanna
WL	Wetland habitats with emergent vegetation
LA	Lagoons, ponds, rivers, streams

T: Recorded during mammal surveys at the Toucan Ridge Ecology and Education Society station (TREES), approximately 10km from SHBHNP, with similar ecosystem coverage

Herpetofauna

To date a total of 44 reptile and amphibian species have been recorded in the National Park. Despite sub-optimal weather conditions, a single two hour nocturnal survey, conducted during the management planning process, identified 15 species of herptiles (8 amphibians, 3 lizards and 4 snakes), an indication of the diversity and relative abundance of the herpetofauna of the Park. Based on its geographic location - juxtaposed on the edge of the Southern Uplands Biogeographic Region and adjacent to the Southern Lowlands – its vegetation, topography and rainfall, the Park can be expected to provide habitat for approximately 113 species of amphibian and reptile: 29 amphibians, 1 crocodilian, 7 freshwater turtles, 30 lizards and 46 snakes.

Despite its ready accessibility, surprisingly little work has been done on the herpetofauna of St. Herman's Blue Hole National Park, with a complete absence of specimen record data in national databases. Provisional lists of amphibian and reptile species in the National Park are presented by Chun, R. (2010) (though the listing of *Tantilla moesta* is however discounted, as this species is not recognized as occurring in Belize, and is considered a mis-identification). The unexpected inclusion of the jumping viper (*Atropoides mexicanus*) is not discounted – although it is rarely found at such low elevations in Belize, the species is easily recognizable, and the overall terrain is comparable with that with which this species is associated: steep karstic hills within the Maya Mountains.

The contribution of St. Herman's Blue Hole National Park to the long-term conservation of Belize's herpetofauna should not be underestimated. Whilst SHBHNP is too small on its own to retain viable populations of all herpetofaunal species potenitally occuring there, it should do so as long as forest connectivity is maintained with the protected areas of the Maya Mountains Massif. Whilst many of these species have relatively wide distributions in Belize, protection of geographically distant populations is perhaps one of the most important considerations in terms of insurance against the impacts of climate change – providing habitat protection from increasingly frequent hurricane impacts, protection of a wide array of the micro-climatic conditions tolerated by individual species, and indeed against the pathogens that can be susceptible to modest climatic variation (Kaiser K, Pollinger J., 2012).

To date, two amphibian species of conservation concern have been recorded within SHBHNP – the globally Endangered Sabrinus rain frog (*Craugastor sabrinus*) and the Vulnerable Leprus chirping frog (*Eleutherodactylus leprus*) (IUCN, 2015). The protected area is at the north-east limit for current known *Craugastor sabrinus* records, although its relative abundance at SHBHNP suggests that its actual range stretches further still. Important range extensions for two other species have recently been made at the nearby Toucan Ridge Ecology and Education Society (TREES) – the very rarely encountered caecilian (*Gymnopis syntrema*) and the near-threatened Dofleini's salamander (*Bolitiglossa dofleini*) (Kilburn, V. pers. com.). Given the relative proximity (approximately 10km), habitat overlap and connectivity, it is distinctly possible that these species also occur within SHBHNP.

The National Park is unlikely to encompass a population of the critically endangered Morelet's tree frog (*Agalychnis moreletii*), which in Belize has only been found at elevations of 300+m to date – higher than

the 200m ridges within SHBHNP. Nonetheless, given the habitat connectivity, future herpetological surveys in the National Park should include ridge-top searches of temporary pools and seepages in wet season – in order to increase the chances of detection if the species does occur there.

Given the geographic location, topography and vegetation of the Park, it is predicted that this will be one of the first sites where climate change impacts will afffect amphibian fauna. As drier warmer conditions of the nearby lowland agriculture push back into the foothills, conditions will become less favourable for amphibian species more sensitive to such shifts – such as the Craugastorid and Eleutherodactylid rain frogs, whch are already at or close to their north-easterly distributional limits.

The results of the Global Reptile Assessment have not yet been published, and the global conservation status of the majority (60%) of reptiles remains unknown. Of the reptiles recorded in the National Park to date, the false fer-de-lance (*Xenodon rhabdocephalus*) is amongst the least commonly species observed countrywide.

Amphibians and Reptiles of the St. Herman's Blue Hole National Park Landscape					
Species	**English Name**	**Red List**	**Recorded**	**Within 10km**	**Expected**
CAECILIANS					
Caeciliaidae	***Caecilians***				
Gymnopis syntrema		DD		x[4]	
SALAMANDERS					
Plethodontidae	***Salamanders***				
Bolitoglossa dofleini	Doflein's Salamander	NT		x[3]	
Bolitoglossa mexicana	Mexican Mushroom-tongue Salamander	LC		x[3]	x
Bolitoglossa rufescens	Common Dwarf Salamander	LC		x[3]	x
Oedipina elongata		LC			x
FROGS AND TOADS					
Rhinophrynidae	***Burrowing Toads***				
Rhinophrynus dorsalis	Burrowing Toad	LC	x[2]		x
Craugastoridae					
Craugastor chac	Chac's Rainfrog	NT		x[3]	x
Craugastor laticeps	Broad-headed Rainfrog	NT			x
Craugastor sabrinus	Long-legged Streamfrog	EN	x[1]	x[4]	x
Eleutherodactylidae	***Rain Frogs***				
Eleutherodactylus leprus	Leprus Chirping Frog	VU		x[3]	x
Leptodactylidae	***Southern Frogs***				
Leptodactylus fragilis	White-lipped Frog	LC			x
Leptodactylus melanonotus	Sabinal Frog	LC	x[1]		x

Amphibians and Reptiles of the St. Herman's Blue Hole National Park Landscape					
Species	**English Name**	**Red List**	**Recorded**	**Within 10km**	**Expected**
Bufonidae	***Toads***				
Chaunus marinus	Cane Toad	LC	x[2]	x[3]	x
Incilius valliceps	Gulf Coast Toad	LC	x[1]	x[3]	x
Hylidae	***Tree Frogs***				
Agalychnis callidryas	Red-eyed Tree Frog	LC	x[1]		x
Dendropsophus ebraccatus	Hourglass Tree Frog	LC	x[2]		x
Dendropsophus microcephala	Yellow Tree Frog	LC		x[3]	x
Scinax staufferi	Stauffer's Tree Frog	LC			
Smilisca baudinii	Common Mexican Tree Frog	LC	x[1]	x[3]	x
Smilisca cyanosticta	Blue-spotted Mexican Tree frog	NT	x[2]	x[4]	x
Tlalohyla loquax	Mahogany Tree Frog	LC			x
Tlalocohyla picta	Painted Tree Frog	LC	x[2]		x
Trachycephalus venulosus	Veined Tree Frog	LC	x[1]		x
Triprion petasatus	Yucatecan Casque-head Tree Frog	LC			x
Centrolenidae	***Glass Frogs***				
Hyalinobatrachium fleischmanni	Fleischmann's Glass Frog	LC			x
Microhylidae	***Narrow-mouthed Frogs***				
Gastrophryne elegans	Elegant Narrow-mouthed Toad	LC			x
Hypopachus variolosus	Sheep Frog	LC	x[1]		x
Ranidae	***True Frogs***				
Lithobates brownorum	Rio Grande Leopard Frog	LC	x[1]	x[3]	x
Lithobates vaillanti	Vaillant's Frog	LC		x[3]	x
CROCODILES					
Crocodylidae	***Crocodiles***				
Crocodylus moreletii	Morelet's Crocodile	LR			x
TURTLES					
Emydidae	***Marsh Turtles***				
Trachemys venusta	Meso-American Slider	LR			x
Geoemydidae	***Neotropical Wood Turtles***				
Rhinoclemmys areolata	Furrowed Wood Turtle	LR			x
Kinosternidae	***Mud Turtles***				
Claudius angustatus	Narrowbridge Musk Turtle	LR			x
Staurotypus triporcatus	Mexican Giant Musk Turtle	LR			x
Kinosternon acutum	Tabasco Mud turtle	LR			x
Kinosternon leucostomum	White-lipped Mud Turtle			x[3]	x
Kinosternon scorpiodes	Scorpion Mud Turtle	NT		x[3]	x

Amphibians and Reptiles of the St. Herman's Blue Hole National Park Landscape					
Species	**English Name**	**Red List**	**Recorded**	**Within 10km**	**Expected**
GECKOS					
Eublepharidae	***Eyelid Geckos***				
Coleonyx elegans	Yucatan Banded Gecko	LC		x[3]	x
Sphaerodactylidae	***Geckos***				
Sphaerodactylus glaucus	Dwarf Gecko	LC			x
Sphaerodactylus millepunctatus	Spotted Least Gecko	LC			x
Gekkonidae	***House Geckos***				
*Hemidactylus frenatus***	House Gecko				x
Phyllodactylidae					
Thecadactylus rapicauda			x[2]		x
LIZARDS					
Corytophanidae	***Casquehead Lizards***				
Basilicsus vittatus	Brown Basilisk		x[2]		x
Corytophanes cristatus	Smoothhead Helmeted Basilisk		x[1]		x
Corytophanes hernandezii	Hernandez's Helmeted Basilisk		x[2]		x
Laemanctus longipes	Eastern Casqueheaded Oguana	LC			x
Iguanidae	***Iguanas***				
Ctenosaura similis	Black Iguana	LC	x[2]		x
Iguana iguana	Green Iguana		x[2]	x[3]	x
Phrynosomatidae					
Sceloporus chrysostictus	Yellow-spotted Spiny Lizard	LC	x[2]		x
Sceloporus teapensis	Teapen Rosebelly Lizard	LC			x
Polychrotidae	***Anolis***				
Anolis biporcatus	Neotropical green anole				?
Anolis capito	Bighead Anole				x
Anolis lemurinus	Ghost Anole		x[1]	x[3]	x
Anolis pentaprion		DD			x
Anolis rodriguezii	Smooth Anole			x[3]	x
Anolis sagrei	Brown Anole				x
Anolis sericeus	Silky Anole				x
Anolis tropidonotus	Greater Scaly Anole				x
Anolis uniformis	Ghost Anole		x[1]	x[3]	x
Scincidae	***Skinks***				
Mabuya unimarginata	Central American Mabuya	LC		x[3]	x
Mesoscincus schwartzei		LC			x

Amphibians and Reptiles of the St. Herman's Blue Hole National Park Landscape					
Species	**English Name**	**Red List**	**Recorded**	**Within 10km**	**Expected**
LIZARDS					
Scincidae	***Skinks***				
Plestiodon sumichrasti	Sumichrast's Skink	LC			x
Sphenomorphus cherriei	Brown Forest Skink	LC		x[3]	x
Teiidae	***Ameivas***				
Ameiva festiva (Holcosus niceforoi)	Middle American Ameiva		x[2]	x[3]	x
Ameiva undulata (Holcosus undulatus)	Rainbow Ameiva	LC			x
Teiidae	***Ameivas***				
Aspidoscelis angusticeps	Yucatan Whiptail	LC			x
Xantusiidae	***Night Lizards***				
Lepidophyma flavimaculatum	Yellow-spotted Night Lizard	LC		x[4]	x
SNAKES					
Boidae	***Boas***				
Boa constrictor	Boa Constrictor		x[2]	x[3]	x
Colubridae	***Colubrid Snakes***				
Adelphicus quadrivirgatus	Middle American burrowing snake			x[3]	x
Amastridium veliferum	Rustyhead snake	LC		x[3]	x
Clelia clelia	Mussurana		x[2]		x
Coluber constrictor	Northern Black RAcer	LC			x
Coniophanes bipunctatus	Two-spotted Snake	LC			x
Coniophanes fissidens	White-lipped Spotbelly Snake				x
Coniophanes imperialis	Black-striped Snake	LC		x[3]	x
Coniophanes schmidti	Schmidt's Black-striped Snake	LC	x[2]		x
Conophis lineatus	Road Guarder	LC			x
Dendrophidion nuchale	Forest Racer				x
Dipsas brevifacies	Snail-eating Snake	LC	x[1]		x
Drymarchon melanurus	Texas indigo Snake		x[2]	x[3]	x
Drymobius margaritiferus	Speckled Racer		x[2]	x[3]	x
Ficimia publia	Blotched hooknose snake	LC			x
Imantodes cenchoa	Blunthead Treesnake		x[1]	x[3]	x
Lampropeltis triangulum	Scarlet Kingsnake		x[2]	x[3]	x
Leptodeira frenata	Rainforest Cat-eyed Snake	LC			x
Leptodeira septentrionalis	Banded Cat-eyed Snake		x[2]		x
Leptophis ahaetulla	Parrot Snake		x[2]		x
Leptophis mexicanus	Mexican Parrot Snake	LC	x[2]	x[3]	x

Amphibians and Reptiles of the St. Herman's Blue Hole National Park Landscape					
Species	**English Name**	**Red List**	**Recorded**	**Within 10km**	**Expected**
SNAKES					
Colubridae	***Colubrid Snakes***				
Masticophis mentovarius	Neotropical Whip Snake				x
Mastigodryas melanolomus	Dryad Snake	LC			x
Ninia sebae	Red Coffee Snake	LC	x[1]	x[3]	x
Oxybelis aeneus	Mexican Vine Snake			x[3]	x
Oxybelis fulgidus	Green Vine Snake		x[2]		x
Oxyrhopus petola	False Coral Snake				x
Pliocerus elapoides			x[2]		x
Pseudoelaphe flavirufa	Yellow-eyed Rat Snake		x[1]		x
Pseustes poecilonotus	Neotropical Bird Snake	LC			x
Scaphiodontophis annulatus	Guatemala Neckband Snake	LC		x[3]	x
Senticolis triaspis	Green Rat Snake	LC			x
Sibon nebulata	Clouded Snake				x
Sibon sanniola	Pygmy Snail-eating Snake	LC			x
Sibon sartorii	Terrestrial Snail Sucker		x[2]	x[3]	x
Spilotes pullatus	Chicken Snake			x[3]	x
Tantilla schistosa	Red Earth Centipede Snake	LC			x
Tantillita canula	Yucatán dwarf centipede-eater	LC			x
Thamnophis marcianus	Checkered Garter Snake	LC			x
Thamnophis proximus	Western Ribbon Snake	LC			x
Tretanorhinus nigroluteus	Orangebelly Swamp Snake				x
Xenodon rhabdocephalus	False Fer-de-Lance		x[2]	x[3]	x
Elapidae	***Coral Snakes***				
Micrurus diastema	Variable coral snake	LC	x[2]	x[3]	x
Micrurus hippocrepis	Mayan Coral Snake	LC	x[2]	x[3]	x
Viperidae	***Vipers***				
Atropoides mexicanus	Central American Jumping Pit Viper	LC	x[2]		?
Bothrops asper	Fer-de-Lance		x[2]		x

** Belize endemic*
*** introduced*

x[1] P. Walker, Site Visit, 2014
x[2] R. Chun, 2010
x[3] P. Walker, Mt. Margaret etc.
x[4] Toucan Ridge Ecology and Education Society (TREES)

Fish

The limestone landscape of St. Herman's Blue Hole National Park lies in the middle reaches of the Sibun Watershed, and is characterised by a lack of surface water – with the majority of water flow being through the cave systems that riddle the limestone bedrock. The one exception to this is at the Blue Hole, where the collapsed cave roof lets sunlight reach the water's surface.

The abundance and diversity of fish species in the area would appear to have declined over the years (community consultations, 2014; Z. Walker, pers. obs., 2014). The nature of the Blue Hole, with water entering and leaving through cave systems, may restrict the number of species that may colonise the area from downstream (as this would necessitate travelling through the cave system), though the presence of mountain mullet shows that connectivity through the caves is sufficient for fish migration upstream. Those species recorded upstream, in Caves Branch river are more likely to be able to colonise the Blue Hole, particularly after storm events, which may wash fish downstream.

Four species were recorded in the Blue Hole itself, and a further twelve species have been recorded from the upstream areas of Caves Branch (Greenfield et al. 1997). The largest fish observed in the Blue Hole is the mountain mullet (*Agnostomus monticola*) which forms uneven schools within the Blue Hole. The presence of this species is indicative of the connection of the St. Herman / Blue Hole river with the Lower reaches of the Sibun River. Adults live in the freshwater rivers and streams of the Sibun, spawning. The young, however, grow at sea, then travel far inland up the Sibun and Caves Branch, to spend all their adult life in tributaries of these rivers.

The generalist Mexican tetra (*Astyanax aeneus*) is also present in the Blue Hole, as is the northern checkmark cichlid (*Cichlasoma intermedium*). A troglobitic form of the catfish *Rhamdia laticauda* has been recorded from the caves.

Four generalists – the two-spot livebearer (*Heterandria bimaculata*), sleek mosquitofish (*Gambusia luma*), shortfin molly (*Poecilia mexicana*) and the alligator fish (*Belonesox belizanus*), whilst not recorded during the survey, would be expected to be present in the area. Six further species of cichlids have been recorded from the upper Caves Branch watershed, but not from St. Herman' Blue Hole itself. These include the Jack Dempsey (*Cichlasoma octofasciatum*), flase firemouth cichlid (*C. robertsoni*), yellowbelly cichlid (*C. salvini*), blue-eye cichlid (*C. spilurum*), rehead cichlid (*C. sysnspilum*) and the bay snook (Petenia splendidia) (Greenfied et al., 1997).

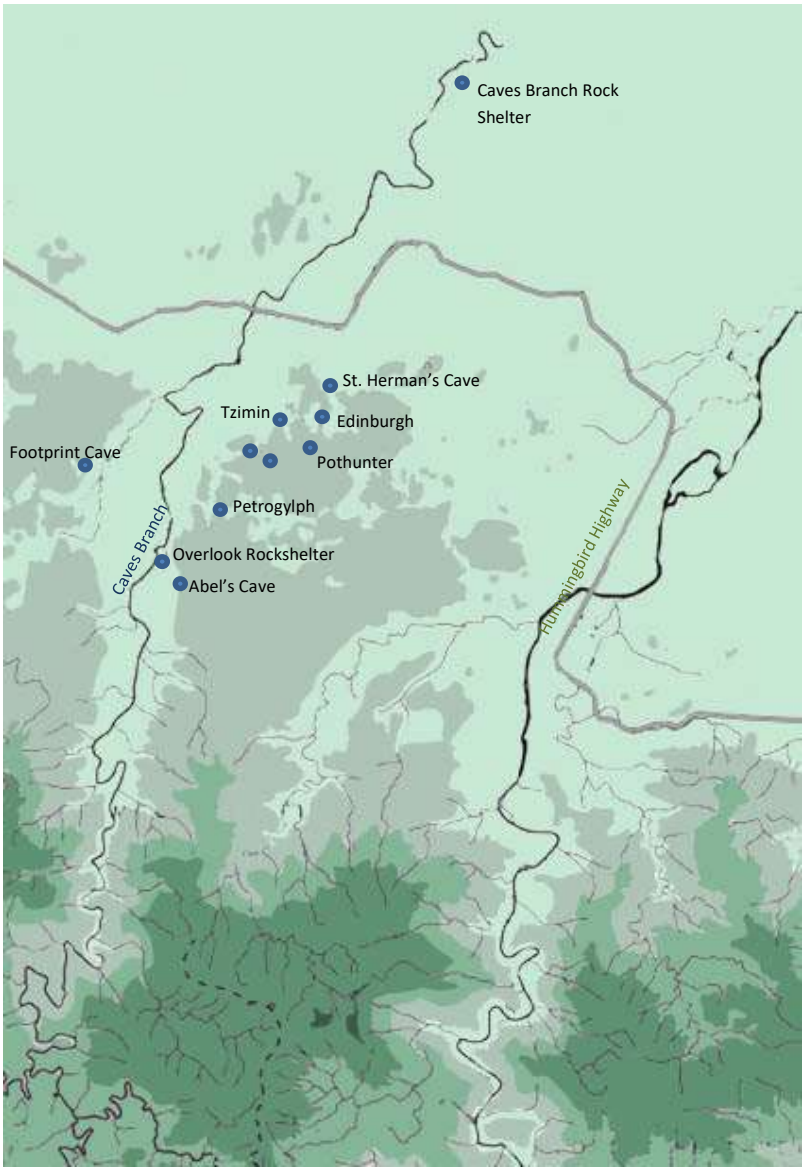
There is some concern as to the implications of the high level of recreational visitation on these species – particularly on the bottom-nesting cichlids, and there has been a decline in the diversity and number of cichlids observed in the Blue Pool. However, none of the species are considered endangered, and are well represented elsewhere in the system.

FISH SPECIES OF THE SHBHNP LANDSCAPE		Upper Sibun Watershed	Blue Hole
Common Name	**Species Name**		
Banded Tetra	*Astyanax aeneus*	*x*	*x*
Alligator Fish	*Belonesox belizanus*	*x*	
Sleek Mosquitofish	*Gambusia luma*	*x*	
Two-spot livebearer	*Heterandria bimaculata*	*x*	
Shortfin Molly	*Poecilia mexicana*	*x*	
Green Swordtail	*Xiphphorus helleri*	*x*	
Filespine Chulin	*Rhamdia laticauda*	*x*	*Cave*
Blackbelt Cichlid	*Cichlasoma intermedium*	*x*	*x*
Jack Dempsey	*Cichlasoma octofasciatum*	*x*	
False Firemouth Cichlid	*Cichlasoma robertsoni*	*x*	
Yellowbelly Cichlid	*Cichlasoma salvini*	*x*	
Redhead Cichlid	*Cichlasoma synspilum*	*x*	
Bay Snook	*Petenia splendida*		
Mountain Mullet	*Agnostoma manticola*	*x*	*x*

1.6 Cultural and Stakeholder Use of St. Herman's Blue Hole National Park

1.6.1 Historical Use of the Area

The archaeological features of the Cave's Branch valley have been studied in depth in the last twenty years, and indicate that from the start of the Middle-Late Formative period, small, stable communities existed on the fertile colluvium of the valley floor. These continued through the Late Classic period, growing in size and social complexity until the Late-Terminal Classic, when the valley was impacted by broader political and economic issues, with indications of a significant influx of migrants into the valley, followed by a sudden depopulation similar to the abandonment seen in other, at nearby centers (Wrobel et al., 2009). There is speculation that the valley was a strategic location in the link between the resource rich Maya Mountains and the major sites of Caracol and coastal trading routes to the east (Morton et al., 2012).



Map…: Sites of Archaeological Interest in the Caves Branch / St. Herman's Area (After Wrobel et al., 2009).

A number of structures have been identified within the valley – an elite residential complex (Davis, 1980), and a medium sized ceremonial centre (Baateelek). This latter is composed of at least 24 structures surrounding four plazas, and covering approximately 2.56 hectares. The few ceramics from Baateelek date the settlement as active in the Spanish Lookout Phase (670 – 900 A.D.). It is thought that this settlement was not occupied for any significant length of time.

The caves of St. Herman's Blue Hole National Park have a historical context, being considered the access to Xibalba …the underworld - by the Maya. Portals between the human world and the invisible world of gods. As such, they were the focus of their most sacred rituals, with continuity over an extended period of time (Wrobel et

al., 2009). Dripping water found in cenotes and caves were important in these rituals, being considered "virgin" and therefore pure for use in ritual ceremonies. The drip water is collected in 'ollas', with sherds of these vessels represent the most common type of pottery found in most caves.

The caves provide a relatively undisturbed historical record of Maya presence and ceremony with the presence of ceremonial pottery vessels, left as offerings. Pottery sherds from the Caves Branch area (from either the Caves Branch Rock Shelter and / or the Petroglyph Cave) were identified from the Preclassic Era (1800 B.C. to 200 A.D.), Early Classic pottery (200 A.D. to 600 A.D.), Late Classic (600 A.D. to 800 A.D.), though to the Terminal Classic / Early Post Classic (800 A.D. to 1100 A.D.). Whist neither of these caves is within the boundary of the National Park (the Rock Shelter is to the south, Footprint Cave to the and Petroglyph Cave to the north), they lie in the same karst outcrops, and can be considered as indicative of Maya activity in the area.

Thousands of freshwater jute shells (primarily *Pachychilus indiorum* with some *Pachychilus glaphyrus*, *Nephronaias ortmanni* and *Pomacea flagellata*) were found at the Caves Branch Rock Shelter, suggesting that these were plentiful during the Maya occupation of the area.

Petroglyphs (rock carvings) are also known from the area – both from the Caves Branch Rock Shelter and Petroglyph caves

Human remains have also been found in caves in the Caves Branch area – one large river cave contained at least 26 burials, of which 16 are infants (McNatt, 1996).

1.6.2 Recreation and Tourism Use

St. Herman's Blue Hole National Park was considered a local tourism destination even before its designation as a protected area. A popular bathing area, it also has built a reputation for being an accessible birding destination for day trips. With the opening of St. Herman's Cave, one of only a few cave systems in Belize that are accessible without a guide, the popularity of the protected area has increased.

> *"From the stunning sapphire-coloured water of the Blue Hole to the underground world of stalactites, stalagmites, and Maya history in St. Herman's cave, BHNP is full of recreational and environmental treasures."*
>
> ***St. Herman's Blue Hole National Park Business Plan, 2005***

Visitation figures have been maintained consistently by Belize Audubon Society since 2006. The general trend is for increased visitation, with a peak of 17,411 in 2014 (5,190 local visitors and 12,221 international Figure ..), particularly following the protected area's recovery from Hurricane Richard, and the opening of Crystal Cave as an alternative to Actun Tunichil Muknal during storm events.

Whilst international visitation has increased significantly over the past three years, local visitation has remained fairly static, ranging from 4,975 to 5,190 visitors.

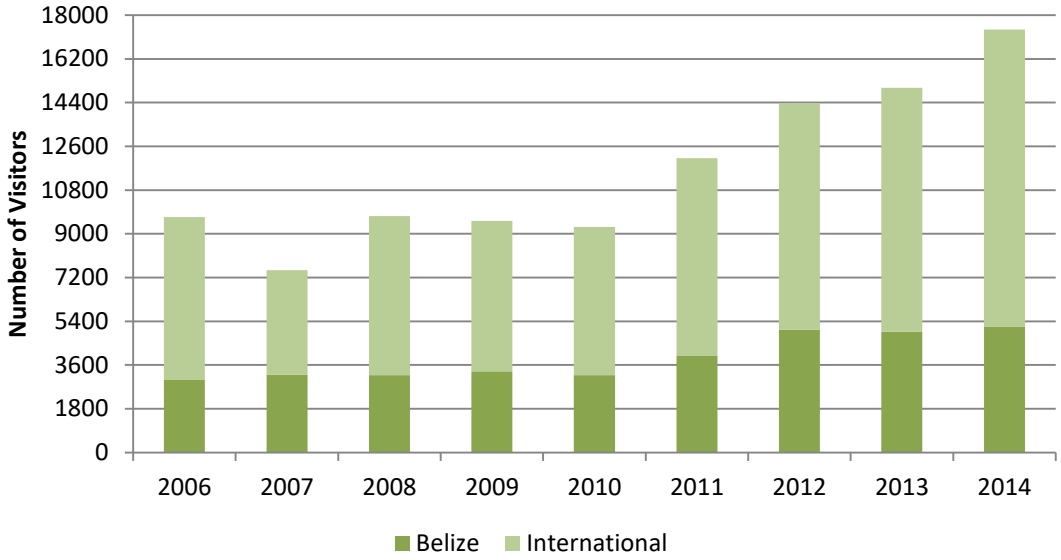


Figure ..: Annual Visitation to SHBHNP 2006-2012 (BAS 2015)

Both local and international visitation show similar trends throughout the year, with visitation peaking in March / April and July / August, and falling to a low in September / October. Peaks generally reflect traditional school holidays – Christmas, Easter and summer.

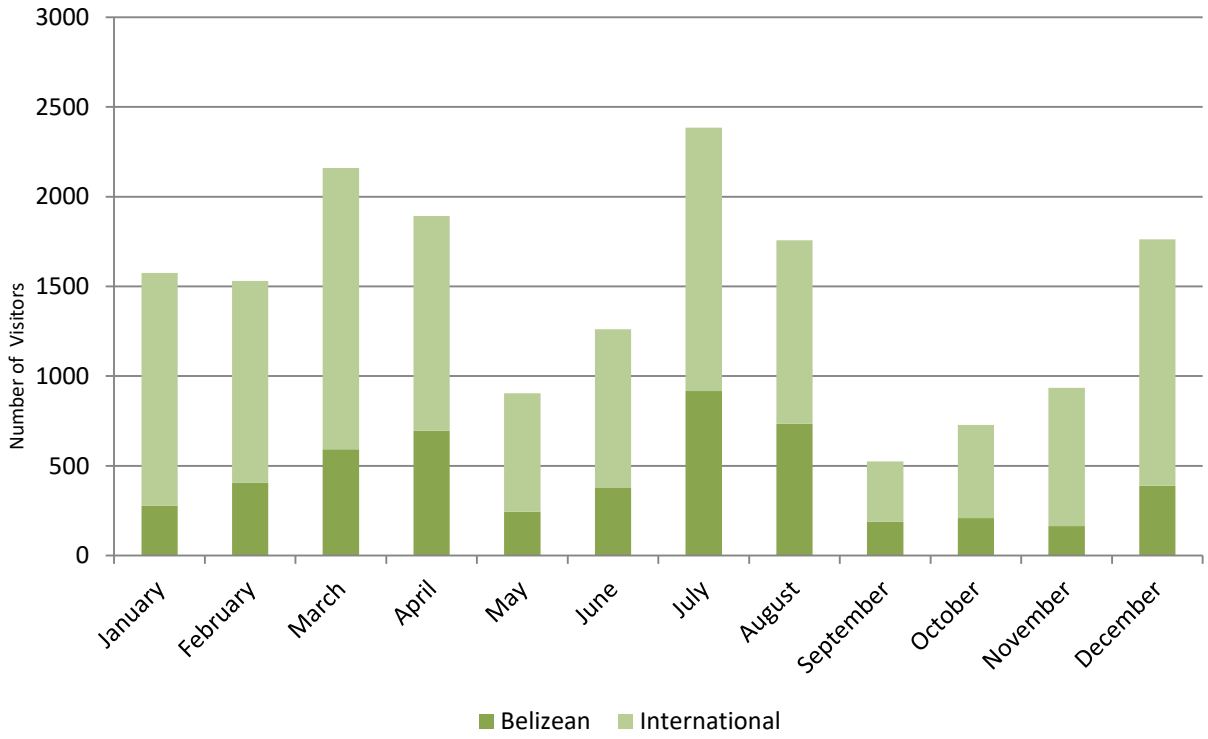


Figure …: Monthly Visitation (Belizean and international) to SHBHNP, 2014 (BAS, 2014)

1.6.3 Educational Use

Belize Audubon Society is in the process of developing an institutionalized Environmental Education Strategy based on the belief that "*education is at the heart of environmentally responsible development, and that environmental problems can only be effectively solved if there is a clear understanding of the environment and its processes*." (BAS Strategic Plan, 2014 – 2019 (draft). The focus of the strategy is to build a sense of stewardship in communities adjacent to the BAS protected areas. This is to be achieved by encouraging stakeholders, particularly communities and direct users, to participate in environmental awareness activities, increasing awareness and an appreciation of conservation and the environmental services and economic benefits that are associated with protected areas.

The National Park is particularly important in its role in national environment education efforts, it being a traditional destination for day trips for local families and schools from all over Belize. This role is recognized within the National Protected Areas System Plan, with the emphasis on St. Herman's Blue Hole as an essential component of Belize's mechanisms for raising awareness of natural resources, ecosystem services and cave environments.

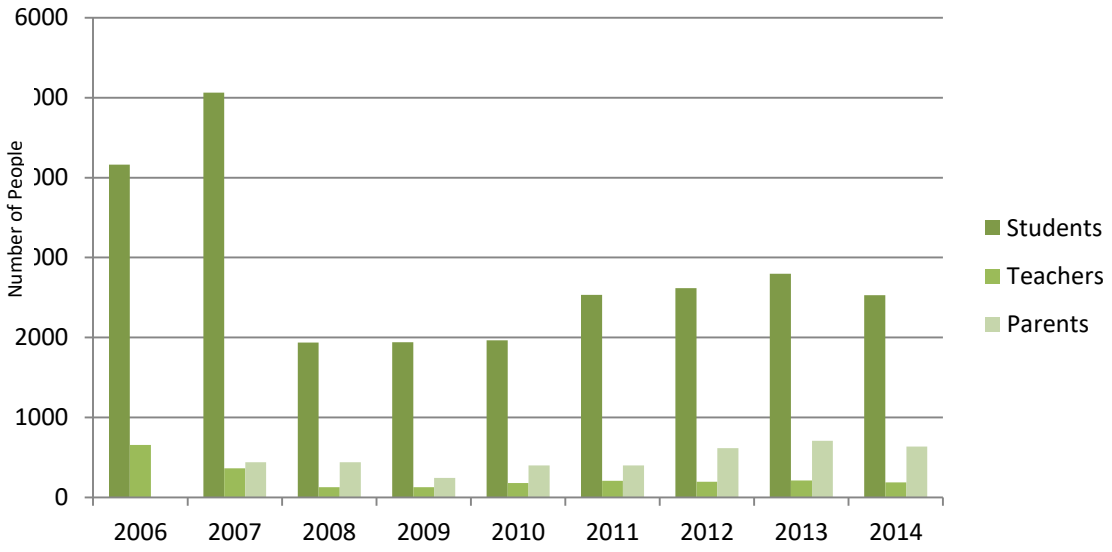


Figure ..: Annual School Visitation to SHBHNP 2006-2012 (BAS 2015)

St. Herman's Blue Hole National Park is particularly important for engaging schools – both students and teachers – for some this is the only opportunity they will have to link with the natural environment. The number of students visiting the protected area during the past four years has varied from a minimum of 2,530 to a maximum of 2,799 (Figure …). Schools are provided with a standardised educational tour by staff that covers the cave, the Blue Hole and the forest environment, imparting information. This is being supplemented in the future by the addition of a new Visitor's Centre, with increased space and plans for displays that improve the learning experience for students.

1.6.4 Natural Resource Use in the St. Herman's Blue Hole National Park Landscape

As part of the recent socio-economic assessment, the three stakeholder communities (Armenia, St. Margaret's and Ringtail) were assessed for their natural resource use – most specifically for consumption of game meat, harvesting of medicinal plants, collection of firewood for household use, and timber extraction (BAS data, 2014). (Note: Ringtail is not included in the comparative graphs as survey data was only available for two households).

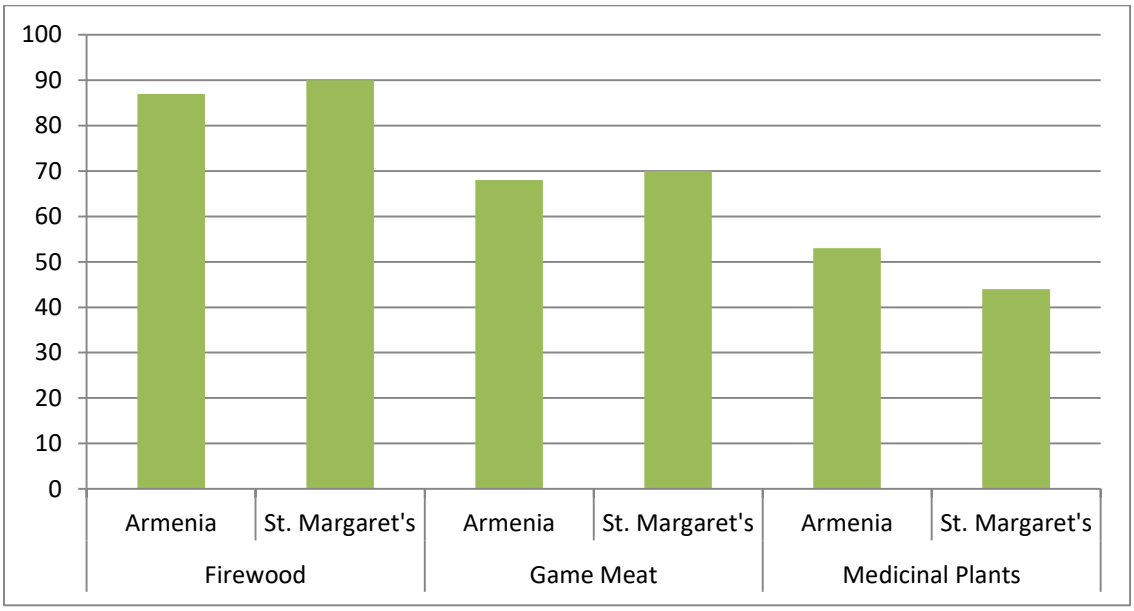


Table …: % households that use specific natural resources in stakeholder communities

Firewood

The majority of the households in the area collect firewood for household use – 90% of households in St. Margaret's, 87% in Armenia, and both households in Ringtail.

Game Meat

All three communities consume game meat (though this may be through purchase from hunters in the community rather than direct hunting), with St. Margaret's Village being the highest consumer - over 70% of households eat game meat, and the majority (65%) eat it at least twice a week. In comparison, in Armenia over 68% of households eat game meat, but generally eat it less frequently than respondents in St. Margaret's – on average, once a week. One of the two households surveyed in Ringtail eat game meat, but not on a regular basis. Communities generally hunt on their farms, or in forested areas adjacent to their specific community. Hunters also travel to the St. Margaret's / Five Blues area from San Ignacio to supply the game meat trade in western Belize (CBD community consultation, San Ignacio, 2014).

Game species most frequently hunted include…

Medicinal Plants

Medicinal plant harvest is still important in all three communities, though slightly higher in Armenia (53% of households) than in St. Margaret's (44% of households). Which plants?

2. Conservation Planning

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

2.1 Conservation Targets

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

2.1.1 Identification of Conservation Targets

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

These potential targets were then reviewed, combined or nested into a list of five conservation targets, each representing or capturing the array of ecological systems, communities and species of the National Park, incorporating those identified in the preliminary list as nested targets.

Conservation Targets for St. Herman's Blue Hole National Park

- Forest Ecosystems
- Caves
- Water Systems
- Game Species
- Archaeological Artefacts

Forest	
Justification	**Species / ecosystems nested in this target**
The tropical forest of the St. Herman's Blue Hole National Park is part of the **Petén-Veracruz Moist Forest** ecoregion, classed as 'Critical/ Endangered', based on the increasing rate of deforestation in the Mesoamerican region (World Wildlife Fund, 2001). In the National Park, the tropical broadleaf forests are represented by two ecosystems that cover 100% of the surface area. The forest is a critical component of the protected area, maintaining forest species of biodiversity value, cultural and touristic appeal. Overlying the karst rock, it is also critical in maintaining the integrity of the cave systems, and preventing soil erosion and landslides. Species-richness is high though many tree, vertebrate and invertebrate species occur at relatively low densities, resulting in large areas being needed for the support of viable populations, highlighting the critical importance of forest connectivity. The forest is hurricane-dependent – the species composition is composed of fast growing and resilient species adapted to cope with tropical storm damage. Whilst somewhat protected by the hill slopes of the Stann Creek Valley, the vegetation was reported to have been completely removed by Hurricane Hattie in 1961. More recently, it was heavily impacted in 2010 by Hurricane Richard, with significant tree falls and damage in places, and reduced sightings of wildlife populations. The forest is now recovering.	St. Herman's Blue Hole has two forest ecosystem types: **Tropical evergreen seasonal broad-leaved lowland forest, well drained, on rolling karstic hills** and **Tropical evergreen seasonal broad-leaved lowland forest, well drained, on steep karstic hills.** These two ecosystems are very similar, differing primarily on the gradient of the hills on which they occur and in the relative abundance of drought-tolerant species. Several IUCN red-listed and national species of concern are restricted to broadleaf forest habitats – the endangered Yucatan black howler (*Alouatta pigra*), the endangered sub-species of Central American spider monkey (*Ateles geoffroyi yucatanensis*), vulnerable great curassow (*Crax rubra*) and national species of concern - ocelot (*Leopardus pardalis*), margay (*Leopardus wiedii*) and jaguarundi (*Herpailurus yaguarundi*). The near threatened jaguar (*Panthera onca*), puma (*Puma concolor*), and the nationally vulnerable crested guan (*Penelope purpurascens*) are also represented by this target, as are a number of species presently considered national species of concern, such as collared peccary (*Tayassu tajacu*). This target also represents the forests and limestone-loving vegetation of the karst areas and the steep karstic landscape that are themselves an important geological conservation focus, as recognized by the IUCN World Commission on Protected Areas in 1997.

Caves	
Justification	**Species / ecosystems nested in this target**
The karst system of St. Herman's Blue Hole National Park is a landscape of rugged limestone topography - of steep hills, vertical-sided sinkholes, arches, underground streams and caves. There is global recognition of the importance of karst landscapes as a conservation target by the IUCN World Commission on Protected Areas in 1997, and the increasing need for their protection. In Belize, the karst landscape is recognised as an important geological conservation focus, and the associated caves are valued for the cultural value they represent, as ceremonial sites for the ancient Maya. St. Herman's Blue Hole National Park contributes towards Belize's commitments in ensuring representation of karst landscapes and ecosystems within its National Protected Areas System. The accessibility of the cave system, represented by St. Herman's Cave, provides Belize with an important opportunity to be able to raise awareness of the importance of caves and cave formations, particularly in the many school groups that visit the area.	The caves of the karst system provide ecosystems for cave-dwelling species - blind catfish, shrimps, and whip scorpions, and shelter for other species, such as for roosting bats and paca. The caves also harbour archaeological artefacts of cultural importance, represented under a separate target.

Water Systems	
Justification	**Species / ecosystems nested in this target**
Whilst St. Herman's Blue Hole National Park has little above-ground water flow, a well-established underground flow exists, linking the upper Caves Branch with St. Herman's Cave and the Blue Hole, then reconnecting with the Sibun River. The Blue Hole is a nationally important feature – one of the reasons for establishment of the National Park, and well known, attracting large number of local and international visitors annually. Whilst its physical structure has been maintained, its fish fauna has been impacted by the significant level of visitation, possibly through the disruption of nesting behaviour.	Fish species: Banded Tetra *Astyanax aeneus* Northern Checkmark Cichlid *Cichlasoma intermedium* Mountain Mullet *Agonostomus monticola* Filespine Chulin *Rhamdia laticauda*

Game Species	
Justification	**Species / ecosystems nested in this target**
The game species populations of the National Park appear to be recovering from the impact of Hurricane Richard, when compared with the forest in the adjacent landscape, where hunting is having significant impacts upon the populations. The relatively high population densities that are reported, and as deduced from qualitative observations of tracks, etc. during this survey are indicative of low hunting pressure from stakeholder communities. Hunting does still occur - identification of game species as a conservation target is largely to further prioritize the enforcement of the no-hunting regulations, and facilitate the measurement of success of the associated conservation actions. White lipped peccary, a good indicator of forest connectivity and low human impacts, has not been observed in or around SHBHNP for many years. It is presumed to still occur in western Sittee River Forest Reserve northwards into Southern Sibun Forest Reserve, but it is not known whether it is still present in northern Sibun, which has connectivity with SHBHNP. Hunting associated with logging activity south of the National Park will be a significant deterrent to the use of this area by white-lipped peccaries.	**Game Species** Great curassow *Crax rubra* Crested guan *Penelope purpurascens* Paca *Agouti paca* Nine-banded armadillo *Dasypus novemcinctus* Collared peccary *Tayassu tajacu* White-tailed deer *Odocoileus virginianus* Red brocket deer *Mazama americana* Baird's Tapir *Tapirus bairdii*

Archaeological Artefacts	
Justification	**Species / ecosystems nested in this target**
The caves of Belize, including those of the St. Herman's / Caves Branch area, held great cultural significance for the Maya. They are particularly important also in terms of providing a relatively undisturbed historical record of Maya presence and ceremony. Caves were thought to represent the entrance to the underworld, where the gods resided, and where the Maya began their journey through death. The Maya have left their mark in the St. Herman's / Caves Branch area, with the presence of ceremonial pottery vessels, left as offerings. Ollas (ceremonial pots for gathering virgin water for ceremonies, either from dripping speleotherms or from the Caves Branch river itself), and ceramic vessels containing food, water and incense to carry messages to the gods. Pottery shards from the Caves Branch area (from either the Caves Branch Rock Shelter and / or the Petroglyph Cave) were identified from the Preclassic Era (1800 B.C. to 200 A.D.), Early Classic pottery (200 A.D. to 600 A.D.), Late Classic (600 A.D. to 800 A.D.), though to the Terminal Classic / Early Post Classic (800 A.D. to 1100 A.D.) in both the sites. Whist neither of these caves is within the boundary of the National Park, they lie in the same karst outcrops, and are indicative of Maya activity in the area. Thousands of freshwater jute shells (primarily *Pachychilus indiorum* with some *Pachychilus glaphyrus, Nephronaias ortmanni* and *Pomacea flagellata*) were found at the Caves Branch Rock Shelter, suggesting that these might be plentiful. Petroglyphs (rock carvings) are also known from the area – both from the Caves Branch Rock Shelter and Petroglyph caves. Human remains have also been found in caves in the Caves Branch area.	▪ Ceramic vessels ▪ Ceremonial flints, bones, shells, obsidian ▪ Human burials ▪ Animal bones

2.2 Assessing Biodiversity Viability

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

- A means for determining changes in the status of each focal conservation target over time, allowing BAS to measure the success of its conservation strategies, compare the status of a specific focal target with future conditions, and compare regionally with other projects in Belize / Central America that focus on that target.

- A basis for the identification of current and potential threats to a target and identification of past impacts that require mitigating actions.

- A basis for strategy design and the foundation for monitoring.

Each Conservation Target was assessed using the following viability ratings:

- **Very Good** – The Indicator is considered to have an ecologically desirable status, requiring little or no intervention for maintenance.

- **Good** – The indicator lies within the acceptable range of variation, though some intervention is required for maintenance.

- **Fair** – The indicator lies outside the acceptable range of variation, and human intervention is required if the viability of the target is to be maintained.

- **Poor** – Restoration of the conservation target is increasingly difficult, and impacts may result in extirpation from the conservation area.

Forest: Conservation Target Assessment		
Current Rating	**Goal**	**Justification for Rating, Goal and Indicator**
GOOD	**GOOD**	***Justification:*** The forest of St. Herman's Blue Hole National Park has few anthropogenic impacts. It cannot be categorised as VERY GOOD as a small number of trees have been removed illegally along the southern-most boundary of the protected area, and along the Hummingbird Highway. Neither of these incursions has significantly altered the structure or species of composition of the forest, though there are concerns that the improved access – and from the clearance of the boundary line - will increase hunting pressure within the protected area. Whilst the forest was impacted by Hurricane Richard in 2010, this is considered a natural phenomenon and part of the natural, landscape context of the ecosystem. The forest has recovered much of its original structure.
		Goal: *St. Herman's Blue Hole National Park has a long-term, physical forest link to the Maya Mountains Massif, providing connectivity important for large species such as jaguar* ***Goal:*** *Between 2016 and 2020,anthropogenic impacts on the integrity of the forest of SHBHNP will be brought to and maintained at zero.*
		Indicators: ▪ *Number of illegal incursions impacting forest structure* ▪ *Number of trees removed illegally per annum* ▪ *Presence of forest connectivity with Maya Mountain Massif*

Caves: Conservation Target Assessment		
Current Rating	**Goal**	**Justification for Rating, Goal and Indicator**
Crystal Cave: FAIR **St. Herman's Cave: GOOD**	**Crystal Cave: FAIR** **St. Herman's Cave: GOOD**	***Justification:*** The two caves – St. Herman's and Crystal are currently being accessed by visitors, with visitor impacts limited to areas accessed by tourism – a small percentage of the total cave area in either cave. Visitor impacts can be seen throughout the accessed areas of the caves, primarily as a result of poor visitor management, with visitors moving away from designated pathways and touching geological features. This is considered to have been an increasing issue at Crystal Cave over the past 17 years, since it was first opened to the public. The pressure on the cave has increased significantly over the past three years through its use as a back-up by San Ignacio tour guides when flooding prevents access to Actun Tunichil Muknal. The dry cave systems show higher impacts, with visitors touching and impacting walls, displacement of artefacts and human remains from their original positions, and artefacts removed entirely, or broken. Whilst not as sensitive as Crystal Cave, the large numbers of unguided visitors to St. Herman's Cave has also resulted in significant impacts in the areas they are permitted to access, with issues of garbage, trampled ground and geological features. In St. Herman's Cave, some natural repair to formations may be feasible in the areas where water is flowing, if impacts are removed. The consensus is that it could be maintained at GOOD if improved visitor management is in place, with adequate signage, enforced rules and regulations, improved management of independent visitors, standardized, specific guide introductory talks that manage visitor expectations, prohibiting food in caves, ensuring a low visitor to guide ratio (for the Crystal cave, this is recommended as 5:1) and a reduced number of students to park ranger during school visits. There is recognition of the need to balance visitor access and safety with cave conservation, with responsibility falling not only on BAS, but also on the guides, to ensure improved visitor management. Also important is ensuring that all guides are well trained and experienced in the responsible use of caves, through site specific training, and site specific permits, creating good stewardship, with improved engagement and communication between guides and BAS staff. Community consultations suggest that increased visitor presence appears to have had an impact on species distributions in and around the caves. Bat distributions have been altered, with bats moving roost sites to further into the caves. Once abundant micromoths are reported to have disappeared from the Crystal Cave (Stakeholder meeting, 2014).

Caves: Conservation Target Assessment		
Current Rating	**Goal**	**Justification for Rating, Goal and Indicator**
Crystal Cave: FAIR **St. Herman's Cave: GOOD**	**Crystal Cave: FAIR** **St. Herman's Cave: GOOD**	***Goal:*** *By 2020, maintain and improve the status of the caves, with reduced impacts to geological structures and artefacts, from the 2015 baseline* ***Indicators:*** ▪ *BAS has written policies for visitor management at SHBHNP* ▪ *Agreed and implemented visitor : guide ratios* ▪ *Presence of Limits of Acceptable Change planning regulating management of path width etc.* ▪ *Number of unofficial short cuts / trail braiding in caves (with photographic baseline)*

Water System: Conservation Target Assessment		
Current Rating	**Goal**	**Justification for Rating, Goal and Indicator**
GOOD	**VERY GOOD**	***Justification:*** Water quality is considered GOOD, and is not thought to have changed significantly over the past few years. Local tour guides, however, have reported that some aquatic species have been impacted by activities either within the protected area, or outside. Some species abundances have changed - crayfish haven't been seen at the Blue Hole for several years and there is a lower density of fish than in previous years (community consultation, 2014). It is not certain whether this is due to nest disturbance from increased visitation, or from illegal fishing at night. Impacts in the buffer zone are thought to be minimal, but may result in nutrient and food resources being interrupted and increased sediment load in the water. Studies elsewhere in the Stann Creek Valley suggest that orographic deposition of agrochemicals in the upper watershed may be an issue, impacting the quality of the water. There are also concerns of the potential for dams both upstream and downstream of the protected area as a result of predicted decreases in rainfall that may impact the movement of fish and other aquatic organisms along the river course. There is a very heavy tourism impact in the Blue Hole, often with up to 60 people at a time, leading to cumulative impacts of suntan lotion, insect repellent etc., and localized contamination of the water. There are also thought to be some limited impacts from cave tubing. It is recognized that impacts within the protected area will also affect people downstream.
		Goal: *By 2020, maintain and improve the water quality and biodiversity of water systems within St Herman's Blue Hole National Park*
		Indicators: ▪ *Diversity of fish (number of species)* ▪ *Abundance of fish per species* ▪ *Presence / abundance of Tilapia within SHBHNP* ▪ *Water quality (nitrate, water level, water pollution, temperature, O_2 levels, E. coli).*

Game Species: Conservation Target Assessment		
GOOD	**GOOD**	***Justification:*** Whilst illegal hunting is not considered a significant impact on game species within the protected area, there are reports of extensive hunting outside, not only for subsistence purposes from the adjacent communities, but also commercial hunting from as far away as San Ignacio. This hunting pressure, coupled with the impacts of Hurricane Richard, has had an impact on game species within the protected area, though as the forest recovers from the storm damage, signs of game species are increasing. There are concerns with the increased accessibility for illegal hunting linked to the logging activities occurring adjacent to the protected area.
		Goal: *To maintain and improve current population levels of key game species*
		Indicators: ▪ *Number of patrol / monitoring reports of collared peccary per annum* ▪ *Number of patrol / monitoring reports of paca per annum* ▪ *Number of patrol reports / signs of illegal hunting per annum*

Archaeological Features: Conservation Target Assessment		
FAIR	**FAIR**	***Justification:*** There have been several historical incidents within the caves where formations have been affected and artifacts been tampered with, taking the condition of the caves from VERY GOOD to FAIR. This is considered to be the result of limited awareness of cave ecosystems by visitors and local buffer zone villagers, and targeted looting activities. Due to the irreversibility of damaged historical and cultural values, management is required to implement the necessary measures needed to maintain the current rating at good.
		Goal: *Between 2016 and 2020, there is no further degradation or disappearance of archaeological features*
		Indicators: ▪ *% artefacts damaged / moved per year (with photographic baseline)*

Conservation Targets – Current Ratings and Goals			
Conservation Target		**Current Rating**	**Goal**
Forest Ecosystems		GOOD	GOOD
Caves	Crystal Cave	FAIR	FAIR
	St. Herman's Cave	GOOD	GOOD
Water Systems		GOOD	VERY GOOD
Game Species		GOOD	GOOD
Archaeological Artefacts		FAIR	FAIR

2.3 Threats to Biodiversity

A threat assessment was conducted in 2014 for the conservation planning process, with input from a wide range of stakeholders – including protected area site management staff, researchers, and tour guides providing local and technical knowledge of the area.

2.3.1 Identified Threats

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

This assessment rated:

- The area affected by the threat
- The severity of the threat
- The urgency of actions

Key Threats impacting St. Herman's Blue Hole National Park

- Visitor Impacts
- Agrochemical Pollution
- Forest Fragmentation
- Illegal Hunting and Fishing
- Looting of Archaeological Artefacts
- Illegal Logging

Table ..: Prioritization of Identified Threats

Threat	Criteria Ratings			Total AxSxU	Rank
	Area	Severity	Urgency		
Visitor Impacts	2	3	3	18	1
Forest Fragmentation	3	2	2	12	2
Forest Fragmentation	3	2	2	12	2
Illegal Hunting and Fishing	1	2	3	6	3
Looting of Archaeological Artefacts	1	3	2	6	3
Illegal Logging / NTFP Extraction	1	1	3	3	4

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	Will not happen in > 10 years

Threats to biodiversity of St. Herman's Blue Hole National Park

Visitor Impacts	***Status:***	***Historical***	***Active***	***Potential***
	Conservation Target(s): Forest, Caves, Blue Hole,			
	Impacts: ▪ Increased visitor numbers, with related impacts of soil compaction on trails, increased garbage, pressure on fragile ecosystems, trail braiding ▪ Vandalism (including graffiti) on trees and in caves ▪ Unregulated education field project activities and impacts ▪ Use of suntan lotion, insect repellent and other in-water impacts by swimmers - reduced water quality ▪ Degraded geological cave features ▪ Breakage / removal or archaeological artefacts ▪ Distribution shifts of cave species ▪ Noise ▪ Disturbance of bottom-nesting fish nest sites in the Blue Hole			
	Sources of Impacts / Drivers: ▪ Limited enforcement of 'no litter' regulations by guides ▪ Limited capacity of PA staff to effectively monitor and enforce visitor regulations (number of staff / finance) ▪ Inadequate visitor management ▪ Insufficient visitor management infrastructure			
	Area	***2***	Visitor impacts are restricted to trail systems and a small percentage of two caves	
	Severity	***3***	Visitor impacts have been responsible for degraded geological features	
	Urgency	***3***	Visitors numbers are increasing, and visitor impacts are occurring on most days of the week	
	Management Goal: Maintaining cultural and biodiversity values by reducing visitor impacts ***Management Strategies:*** ***Strategy 1:*** *Improve visitor management infrastructure - increase regulatory, interpretive and directional signage* ***Strategy 2:*** *Develop a Limits of Acceptable Change plan for SHBHNP* ***Strategy 3:*** *Continue and increase surveillance of visitor activities with enforcement of National Park rules and regulations and National Institute of Culture and History Act* ***Strategy 4:*** *Implement water quality monitoring for key pollutants and E. coli levels in St. Herman's Cave and Blue Hole*			

<table>
<tr><th colspan="4">Threats to biodiversity of St. Herman's Blue Hole National Park</th></tr>
<tr><td rowspan="8">Adjacent Landscape Impacts: Forest Clearance / Fragmentation</td><td>Status:</td><td>Historical</td><td>Active</td><td>Potential</td></tr>
<tr><td colspan="4">Conservation Target(s): Forest, Water Systems, Game Species</td></tr>
<tr><td colspan="4">Impacts:
Changes in species composition and diversity with reduced forest connectivity, with disappearance of species requiring large, contiguous areas of forest (jaguar, tapir)
Degraded vegetation at edge of National Park with increasing edge effects and impacts from agricultural fires</td></tr>
<tr><td colspan="4">Sources of Impacts / Drivers:
High demand for farmland leading to forest clearance
Poor management of agricultural fires
Competitive, non-sustainable agricultural practices</td></tr>
<tr><td>Area</td><td>3</td><td colspan="2">Loss of forest connectivity will impact species composition throughout the National Park, as it becomes too small for minimum dynamic area for some wide ranging species. Increasing edge effects will reduce forest health</td></tr>
<tr><td>Severity</td><td>2</td><td colspan="2">The forest within the National Park will still survive, but with reduced long term viability</td></tr>
<tr><td>Urgency</td><td>2</td><td colspan="2">The forest connection is currently under private ownership, but discussions with the owner suggest that leaving it under forest cover is of mutual benefit</td></tr>
<tr><td colspan="4">Management Goal: Maintaining forest health and forest connectivity with the Maya Mountains Massif

Management Strategies:

Strategy 1: Investigate potential for developing a long-term easement / conservation covenant agreement with the current owner for maintenance of forest connectivity

Strategy 2: Build awareness of stakeholders of the importance of forest connectivity for forest health

Strategy 3: Build awareness and capacity in local communities for fire management in areas adjacent to the National Park</td></tr>
</table>

Threats to biodiversity of St. Herman's Blue Hole National Park

Adjacent Landscape Impacts: Agrochemical Pollution	***Status:***	***Historical***	***Active***	***Potential***
	Conservation Target(s): Water System, Caves, Forest Ecosystems			
	Impacts: ▪ Impacts on cave wildlife viability – especially invertebrates ▪ Impacts on cave formations with changes in water composition ▪ Poor water quality (not safe to drink) ▪ Reduced water quality and impacts on biodiversity health of aquatic organisms and amphibians ▪ Degraded geological cave features			
	Sources of Impacts / Drivers: ▪ Citrus industry - spraying of agrochemicals: insecticides and herbicides			
	Area	***4***	Indications are that agrochemicals are being deposited across the Maya Mountains Massif, including the hill tops of the Stann Creek Valley, and being washed into the river systems.	
	Severity	***1***	There is little information available on the effects, or knowledge of the level of dilution of agrochemical pollution within the water system	
	Urgency	***3***	Agrochemical use/pollution is ongoing in the landscape	
	Management Goal: Reduce scale of use of polluting agro-chemicals in the adjacent landscape below 2015 baseline ***Management Strategies:*** ***Strategy 1:*** *Liaise with the Pesticide Control Board and local farmers to determine which agro-chemicals are in use in the adjacent landscape, and on what scale* ***Strategy 2****: Develop and implement a water quality monitoring programme – to test creek and phytotelmic waters.* ***Strategy 3:*** *Collaborate with the Department of Agriculture, Citrus Growers Association and citrus farmers to identify mechanisms for reducing agro-chemical contamination of water bodies* ***Strategy 4:*** *Collaborate with PCB and farming community to replace use of red (extremely toxic) and yellow (highly toxic) labelled agro-chemicals with blue (moderately toxic) and green (slightly toxic) alternatives, and wherever possible only green-labelled ones.*			

Threats to biodiversity of St. Herman's Blue Hole National Park / 1

Illegal Hunting / Fishing

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

Conservation Target(s): Game Species, Forest Ecosystem

Impacts:

- Reduced viability of game species and fish populations, and associated impacts on trophic structure of area
- Potential long-term perturbation of forest structure and dynamics, with impacts on seed dispersers
- Likely long-term impacts on aquatic ecosystems due to reduced populations of larger fish species

Sources of Impacts / Drivers:

- Low income in communities adjacent to PA, and reliance on game meat and fish to supplement diet
- Limited capacity of PA staff to effectively monitor and enforce within PA (limited staff / finance)
- Increased access from land clearance in boundary areas and adjacent logging concessions for subsistence, recreational and commercial hunters
- Preference for game meat

Area	***1***	Hunting is thought to occur sporadically in the south-western areas of the National Park and is facilitated by (and possibly associated with) the logging activities near the National Park boundaries. The rating of 1 may be conservative
Severity	***2***	Any hunting within a small protected area will have a measurable but localized impact on game species / fish populations, but local extirpation of vulnerable species such as the great curassow and crested guan is thought unlikely.
Urgency	***3***	Hunting is occurring within the protected area, as determined by recent patrols. However, the National Park is generally well respected as a no-hunting area. However, as game species populations decline in other, adjacent areas, the pressure to hunt within the National Park is predicted to increase

Management Goal: By 2020, reduce all hunting and fishing within the National Park to zero.

Management Strategies:

Strategy 1: *Ensure boundaries are clear, maintained and well sign-posted*
Strategy 2: *Prioritise surveillance activities in key incursion areas*
Strategy 3: *Build capacity of staff for effective enforcement / prosecution of offenders*
Strategy 4: *Increase communication with, engage and build awareness of stakeholders believed to be responsible for the incursions*
Strategy 5: *Seek support from community leaders in addressing hunting incursions*
Strategy 6: *Ensure effective, no-tolerance enforcement of the laws with legal action and fines for all offenders*

<table>
<tr><th colspan="5">Threats to biodiversity of St. Herman's Blue Hole National Park</th></tr>
<tr><td rowspan="8">Looting of Archaeological Artefacts</td><td>Status:</td><td colspan="2">Historical</td><td>Active</td><td>Potential</td></tr>
<tr><td colspan="4">Conservation Target(s): Archaeological Artefacts</td></tr>
<tr><td colspan="4">Impacts:
▪ Removal of irreplaceable artefacts from Maya times
▪ Loss of knowledge of Maya culture from the caves of the National Park
▪ Loss of national heritage</td></tr>
<tr><td colspan="4">Sources of Impacts / Drivers:
▪ High demand and value for Maya artefacts on the illegal international market</td></tr>
<tr><td>Area</td><td>1</td><td colspan="2">Whilst there has been some looting, only a portion of the cave systems are accessed, with looting confined to localized areas</td></tr>
<tr><td>Severity</td><td>3</td><td colspan="2">Once a pot is stolen or broken, its value cannot be replaced</td></tr>
<tr><td>Urgency</td><td>2</td><td colspan="2">There is improved stewardship of the caves by both the BAS staff and the tour guides, but it is expected that at some point in the next three years, an attempt will be made to take pottery or pottery shards</td></tr>
<tr><td colspan="4">Management Goal: Reduce the incidence of illegal looting to zero

Management Strategies:

Strategy 1: Improve surveillance and enforcement of visitor activities in caves

Strategy 2: Improve visitor management infrastructure - increase regulatory, interpretive and directional signage

Strategy 3: Increase enforcement of National Park rules and regulations and National Institute of Culture and History Act

Strategy 4: Build capacity of staff for effective enforcement / prosecution of offenders

Strategy 5: Continue to build capacity of and engage tour guides for good stewardship of the caves and archaeological artefacts</td></tr>
</table>

<table>
<tr><th colspan="5">Threats to biodiversity of St. Herman's Blue Hole National Park</th></tr>
<tr><td rowspan="8">Illegal logging / NTFP extraction</td><td>Status:</td><td>Historical</td><td>Active</td><td>Potential</td></tr>
<tr><td colspan="4">Conservation Target(s): Forest Ecosystem</td></tr>
<tr><td colspan="4">Impacts:
▪ Changes in species composition with selective, illegal removal of species such as cedar, mahogany, xaté, wano etc.
▪ Increased access for hunting and other illegal activities
▪ Hunting by logging crews</td></tr>
<tr><td colspan="4">Sources of Impacts / Drivers:
▪ High demand for timber and timber products, both within Belize and for export
▪ Increasing value of timber
▪ Weak enforcement of logging policies and logging activities in adjacent areas</td></tr>
<tr><td>Area</td><td>1</td><td colspan="2">Illegal logging is very localised, being recorded in only a small portion of the National Park</td></tr>
<tr><td>Severity</td><td>1</td><td colspan="2">The scale of current illegal logging will have only a limited impact on the tree / herb species being selected – measurable but not substantial.</td></tr>
<tr><td>Urgency</td><td>3</td><td colspan="2">Illegal logging incursions have been reported in recent patrols in 2014 and will probably occur in 2015</td></tr>
<tr><td colspan="4">Management Goal: Reduce the incidence of illegal logging to zero

Management Strategies:

Strategy 1: Ensure boundaries are clear, maintained and well sign-posted

Strategy 2: Prioritise surveillance activities in key incursion areas

Strategy 3: Build capacity of staff for effective enforcement / prosecution of offenders

Strategy 4: Increase communication with, engage and build awareness of stakeholders believed to be responsible for the incursions

Strategy 5: Seek support from community leaders in addressing logging incursions

Strategy 6: Ensure effective, no-tolerance enforcement of the laws with legal action and fines for all offenders</td></tr>
</table>

2.3.2 Other Impacts

2.3.2 Prioritizing Threats

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

Table ..: Prioritization of Identified Threats

Threat	Criteria Ratings			Total AxSxU	Rank
	Area	Severity	Urgency		
Visitor Impacts	2	3	3	18	1
Forest Fragmentation	3	2	2	12	2
Agrochemical Pollution	4	1	3	12	2
Illegal Hunting and Fishing	1	2	3	6	3
Looting of Archaeological Artefacts	1	3	2	6	3
Illegal Logging / NTFP Extraction	1	1	3	3	4

The threat with the highest threat score is ranked as the highest threat. This places ***Visitor Impacts*** as an active threat, and as the highest priority, reducing the viability of key management targets of St. Herman's Blue Hole National Park – particularly of the fragile cave systems and impacting the archaeological artefacts.

Forest Fragmentation and ***Agrochemical Pollution*** are highlighted as the second highest threats, followed by illegal activities - hunting, fishing, looting and logging.

2.3.3 Strategies to Reduce Threats

The primary cross cutting mitigation strategies were identified during the threat assessment, and the targets each strategy addresses were identified (Table 24).

Key Cross-Cutting Strategies	**Forest Ecosystems**	**Caves**	**Water**	**Game Species**	**Archaeological Artefacts**	***Score***
Increase surveillance and enforcement of National Park rules and regulations						
Build capacity of staff for effective enforcement / successful prosecution of offenders						
Increase communication with, engage and build awareness of stakeholders believed to be responsible for the incursions						
Engage and seek support from community leaders in addressing threats						
Ensure effective enforcement of the laws with legal action and fines for all offenders						
Ensure boundaries are clear, maintained and well sign-posted						
Improve visitor management infrastructure - increase regulatory, interpretive and directional signage						
Develop a Limits of Acceptable Change programme for effective visitor management						
Continue to build capacity of tour guides for good stewardship of biodiversity, caves and archaeological artefacts						
Build awareness of stakeholders of the importance of forest connectivity for forest health and watershed protection						
Investigate potential for developing a long-term easement / conservation covenant agreement with CIL for maintenance of forest connectivity						
Collaborate with the Department of Agriculture, Citrus Growers Association and citrus farmers to identify mechanisms for reducing agro-chemical contamination of water bodies						
Implement water quality monitoring for key pollutants and E. coli levels in St. Herman's Cave and Blue Hole and phytotelmic pools						
Build awareness and capacity in local communities for fire management in areas adjacent to the National Park						

Table …: Cross-cutting Strategies

2.4 Monitoring of Success of Conservation Strategies

The series of indicators allocated to each conservation target, together with the indicators identified for the strategies developed to address key threats, provide a framework for site level monitoring.

Target Viability Assessment Indicators

- *Number of illegal incursions impacting forest structure*
- *Number of trees removed illegally per annum*
- *Presence of forest connectivity with Maya Mountain Massif*
- *BAS has written policies for visitor management at SHBHNP*
- *Agreed and implemented visitor : guide ratios*
- *Presence of Limits of Acceptable Change planning regulating management of path width etc.*
- *Number of unofficial short cuts / trail braiding in caves (with photographic baseline)*
- *Diversity of fish (number of species)*
- *Abundance of fish per species*
- *Presence / abundance of Tilapia within SHBHNP*
- *Water quality (nitrate, water level, water pollution, temperature, O_2 levels, E. coli).*
- *% of patrol reports that include sightings of collared peccary per annum*
- *% of patrol reports that include sightings of paca per annum*
- *Number of reports / signs of illegal hunting per annum*
- *% artefacts damaged / moved per year (with photographic baseline)*

Threat Indicators

- *% identified infrastructure and signage requirement in place for effective visitor management*
- *Number of visitor infractions requiring interventions per annum in relation to total number of visitors*
- *Limits of Acceptable Change plan*
- *Summary of water quality monitoring outputs per annum*
- *Long term easement / conservation covenant agreement*
- *% stakeholder awareness of ecosystem services of forests*
- *% farms with improved agricultural practices (re. agrochemical use) in adjacent agricultural areas*
- *% farmers trained in basic fire management*
- *% of boundary lines considered maintained in key areas*
- *% of patrol time spent in key incursion areas*
- *% of hunters / loggers active in the area who are considered to be successfully engaged*
- *% of community leaders who are considered to be successfully engaged*
- *Number of people arrested per annum*
- *% of arrests for illegal activities within SHBHNP, resulting in successful prosecution*
- *% of identified staff capacity building needs that have been addressed*
- *% of tour guides considered to be good stewards of the caves and archaeological resources*

2.5 Planning for Climate Change

2.5.1 Site Resilience Assessment

When planning management strategies for climate change, it is important to determine areas of protected area resilience and vulnerability, and to identify adaptive strategies that can assist in maintaining the viability of biodiversity and increase social resilience at both site and stakeholder community level. This assessment of the predicted implications of climate change has been conducted for St. Herman's Blue Hole National Park, based on the ***conservation targets*** identified during conservation planning, and on the ***environmental services*** provided by the protected area in question, identified in the management plan context.

The following assessment has been based on Belize's "***Guidelines for Integrating Climate Change Adaptation Strategies into Protected Areas Management Plans"*** management planning framework, and provides a mechanism for assessing the implications of climate change through a series of steps:

1. Understanding climate change projections for the National Park
2. Identifying vulnerability factors and resilience features
3. Identifying focal targets threatened by climate change
4. Assessing, rating and prioritizing the threat of climate change for each focal target
5. Situation Analysis and baseline
6. Development of adaptation objectives and strategies

Identification of the Primary Climate Change Elements

The primary climate change elements associated with St Herman's Blue Hole National Park and the associated landscape are identified as:

- Increased intensity of storms
- Decreased precipitation
- Increased air temperature
- Increased water temperature

Identified Resources of St Herman's Blue Hole National Park

An initial assessment was conducted of the primary resources important to the St. Herman's Blue Hole National Park (Table …). Also reviewed were the conservation targets identified during the preliminary conservation planning workshop.

Identified Resources of St Herman's Blue Hole National Park	
The Tourism Sector provides employment for local tour guides based on the values of the National Park. Local tour guides are regular users of the protected area, with two local guide companies based from the National Park headquarters itself.	
▪ St. Herman's Cave	The most accessible cave system in Belize, and the only one in Belize that can be visited without a tour guide. An important educational destination for school groups.
▪ Crystal Cave (Mountain Cow Cave)	Considered one of the most beautiful caves in Belize, and becoming more frequently accessed by tour guides in western Belize, who use it as an alternative when water levels are high at the Actun Tunichil Muknal site.
▪ 7 other caves	Whilst not open to the public, these caves are also important for their karstic characteristics, speleothems, troglodytic species, and the archaeological artefacts they contain.
▪ Caves Branch River	The primary tributary of the Caves Branch River flows through St. Herman's Cave, and on to the Blue Hole. Cave tubing in the clear waters of the cave is a popular activity with tour groups. The river is also an important habitat for several cave-dwelling species such as shrimps and catfish.
▪ Blue Hole	A popular, scenic, recreational swimming pool for both local and international visitors. A useful stopping point for groups travelling from the western Belize / Belize City to the coastal resorts in central / southern Belize.
▪ Healthy Forest	Easily accessible, scenic tropical forest, accessed through a series of well-maintained trails.
▪ Diverse Bird Species	Easily accessible birding destination with a rich variety of bird species.
Ecosystem Service: The health of the forest environment of the Maya Mountains Massif is critical to the social and economic health of many communities in Belize. The protection the forest provides for anchoring soil .	
▪ Forest	Steep slope protection of soils
	Watershed functionality and water security
	Supporting game species, acting as a replenishment zone for local hunters
	Flood water control for upper Sibun River, reducing vulnerability to flooding
▪ River	Provision of water to Sibun communities
	Importance for maintenance of extracted aquatic species – the mountain mullet, jute snails, cichlid fish species
	Maintenance of species of conservation concern downstream – including the critically endangered Central American River turtle

For each target, the impacts of the identified primary climate change elements (increased intensity of storms, decreased precipitation, increased air temperature and increased water temperature), were rated on a scale of 1 to 4 (Table ..). Ratings took into account taking into consideration factors such as the severity, scope, contribution and irreversibility of each climate change element

Rating		Description
Very High	**4**	The climate change element is (or is predicted to be) the major contributing factor to the reduced viability, or possible local extinction, of the target over the majority of its extent within the project area over the next 50 years, and cannot be reversed
High	**3**	The climate change element is (or is predicted to be) a significant contributing factor to the reduced viability of the target over a significant part of its extent within the project area over the next 50 years, but can be reversed at high cost or over a long time period
Medium	**2**	The climate change element is (or is predicted to be) a moderate contributing factor to the reduced viability of the target over part of its extent within the project area over the next 50 years, and can be reversed at moderate cost
Low	**1**	The climate change element is (or is predicted to be) a minor contributing factor to the reduced viability of the target in localized areas within the project area over the next 50 years, and will reverse naturally or at limited cost

Table …: Ratings for Prioritization of Conservation Targets

Predicted climate change element	***Conservation Targets***				
	Forest	***Caves***	***Water Systems***	***Game Species***	***Archaeological Artefacts***
Increased Intensity of Storms	High (3)	Medium (2)	Low (1)	Medium (2)	Low (1)
Decreased Precipitation	High (3)	Medium (2)	High (3)	Medium (2)	-
Increased Air / Water Temperature	Medium (2)	Medium (2)	Medium (2)	Low (1)	-
Averaged Rating	2.67	2.00	2.00	1.67	1.00
	Selected	Selected	Selected		

Three conservation targets were identified as at highest risk from climate change impacts, and were selected for the assessment:

- Tropical Forest
- Caves
- Water Systems

The climate change predictions for the St. Herman's Blue Hole National Park landscape were identified from recent literature and climate change models, and an assessment was conducted on the expected impacts on the selected conservation targets.

Climate Change Predictions (B2 Scenario) for the St. Herman's Blue Hole National Park and adjacent landscape			
	Current Status	**25 – 50 yrs**	**100 yrs**
Increased frequency of storms	Increased storm activity from 1999 onwards, with annual fluctuations. More storms during El Nina, fewer El Nino. Stronger storms (more Cat 4 / 5).		
Decreased Precipitation	Mean annual rainfall over Belize has decreased at an average rate of 3.1mm per month per decade since 1960 (UNDP)	Predicted annual rainfall decrease of approximately 10%, with increasing unpredictability. Ecological shifts up the altitudinal gradient of the Maya Mountains Massif may reduce the catchment functionality important for orographic rainfall, and for the maintenance of rivers in dry season. Significant changes in rainfall patterns are predicted.	Predicted decrease in precipitation of up to 26% by 2099 (IPCC, 2007), with significant fluctuations attributed to El Niño
Air Temperature	Mean annual temperature has increased in Belize by 0.45°C since 1960, an average rate of 0.10°C per decade. Average number of 'hot' days per year in Belize (days exceeding 10% of current average temperature) has increased by 18.3% between 1960 and 2003 (NCSP/UNDP).	Both seasonal and annual air temperatures are predicted to increase by approximately 2°C	Predicted mean annual temperature increase is 3.5° by 2099 (UNDP, 2009)

Climate Change Impacts	Management Features		
	Tropical Forest	**Caves**	**Rivers**
Increased frequency of storms	Whilst forests in Belize are adapted to be relatively resilient to tropical storm damage, the increased hurricane intensity will cause more damage, impacting forest stature and structure and will remove some species less tolerant of landscape scale impacts, with a decrease in biodiversity. Resilience to recover may well decrease, leading to a degraded forest ecosystem. Reduced forest cover on the steep karstic slopes will result in reduced soil moisture, increased soil erosion and increased fire risk. There will be an increased vulnerability downstream to flooding, with reduced water retention during storm events. Increased soil erosion will also reduce water clarity downstream, and has the potential to affect the health of the coral reef ecosystem offshore.	Increasingly strong tropical storm events will affect the forest structure overlying the karst cave systems, and may even remove the trees entirely. This would have significant impact on the external environment, with higher temperatures, and reduced water catchment, which in turn would have an effect on the cave environment. The potential for increasing storm runoff, with higher flood levels, is also an issue, with flooding of the cave system, impacts on the speleothems, and damage to archaeological artefacts. It will also result in mortality of cave dwelling, non-aquatic species unable to move out of the way of flood waters. Increased potential for flash floods due to storm events may have impacts on tourism use of the cave and sinkhole. Increased storm events will also lead to increased closure of other caves in western Belize, with greater tourism pressure on the Crystal Cave, as an accessible dry cave, and increased visitor impacts.	Increasing storm runoff during tropical storm events will cause increased soil erosion in the upper Caves Branch Valley, increasing the sediment load of the river before it enters the cave system. This will result in decreased aesthetic beauty of the water system within the National Park, with turbid water for a greater percentage of the time, and increased deposition of sediment within the cave and Blue Hole. Excessive storm runoff may also impact aquatic flora and fauna of both the cave system and the Blue Hole.

Climate Change Impacts	Management Features		
	Tropical Forest	**Caves**	**Rivers**
Decreased Precipitation	Whilst limestone forest is already adapted to drought condition, Decreased reliability of rainfall will impact both the forest tree species composition, with a shift towards more drought tolerant species, as well as an associated shift in forest fauna. Reduced rainfall will impact aquatic life, with potential to alter life cycles of species such as amphibians, which will be the first vertebrate taxa to show these impacts.	Decreased precipitation will lead to a decline in the water flowing through the Caves Branch system, with impacts on the aquatic troglodyte species. A reduction in precipitation in the external environment will lead to changes in the condensation or evaporation rates of water vapour, with the threat of significant desiccation, changing the ways in which cave structures evolve. This will also impact the relative humidity of the cave atmosphere, important in the development of speleothems.	Caves Branch is a perennial river supplied from the adjacent, non-karst Maya Mountains. Reduced rainfall will reduce the flow of the river during the dry season – at its most extreme, it is possible that some stretches of the river may almost dry up completely. The reduced precipitation and water availability may also lead to damming or diversion of the river course in the upper Caves Branch Valley, to ensure continued viability of the citrus plantations. This would reduce, or even block water flow through the cave system, resulting in the seasonal disappearance of the river in the cave and Blue Hole, with associated impacts on tourism and the aesthetic values of the National Park. There may also be downstream impacts if lower water levels and drought conditions lead to damming of downstream water flow. This would impact those species that require connectivity from sea to upper watershed, such as the mountain mullet.

Climate Change Impacts	Management Features		
	Tropical Forest	Caves	Rivers
Air Temperature	Increasing temperatures will take some forest species outside their tolerance zone, with general ecosystem shifts towards more drought tolerant species. SHBHNP may lose the humid end of the species spectrum. There may be a reduction of species diversity of water-reliant species such as amphibians... The increased fire risk may degrade or remove forest, particularly with matrix of forest / pine savanna.	An increase in the external air temperature will have an impact on the cave environment, particularly combined with decreased precipitation. Conditions in the caves in the dry season may become too hot and dry for some species, particularly near the mouths of the caves, leading them to move deeper into the cave system	

2.5.2 Climate Change-Related Threat Assessment

During the conservation planning workshops, a threat assessment was conducted highlighting the highest current anthropogenic threats to each of the key conservation targets. Potential threats that may evolve as a result of climate change were also identified (Table …).. The threats were then assessed using a series of ratings (Table…).

Key Conservation Target	Current Anthropogenic Threats	Potential Climate Change-Related Anthropogenic Threats
Tropical Forest	▪ Forest Clearance ▪ Forest Fragmentation ▪ Illegal Logging ▪ Agrochemical Pollution	▪ Clearance of adjacent forests for agriculture ▪ Increased potential for fires in boundary area ▪ Increased agrochemical pollution to counter emerging diseases and invasive pests associated with climate change ▪ Increasing human pressures on land in adjacent landscape as population migrates away from coastal areas as a result of sea level rise
Caves	▪ Visitor Impacts ▪ Forest Clearance ▪ Looting of Archaeological Artefacts	▪ Increased use of caves and associated tourism impacts during storm events that close other caving destinations ▪ Increased incidence of looting associated with deteriorating socio-economic conditions in adjacent communities as agricultural base deteriorates
Water Systems	▪ Agrochemical Pollution ▪ Forest Clearance	▪ Diversion of river or excessive extraction of water in upper Caves Branch Valley for irrigation ▪ Damming of river downstream to improve irrigation of agricultural areas ▪ Increased agrochemical pollution to counter emerging diseases and invasive pests associated with climate change

Ranking Criteria	Rating		Rating Definitions
Certainty: The certainty that the effect of Climate Change will occur or the cause of the described impact will affect the target	Very High	4	Confirmed
	High	3	Considered very probable but not confirmed
	Medium	2	Considered probable
	Low	1	Considered a limited probability, much debate
Severity: Level or damage to this key element, which can destroy it in **50 years**	Very High	4	Destroys the ecosystems or its production activities
	High	3	Seriously degrades the target
	Medium	2	Moderately degrades the target
	Low	1	Slightly impairs the target
Scope: Geographical coverage of the target that will be impacted in **50 years**	Very High	4	75% - 100% of the geographic coverage
	High	3	50% - 75% of the geographic coverage
	Medium	2	25% - 50% of the geographic coverage
	Low	1	<25% of the geographic coverage
Irreversibility: The impact is permanent or cannot be reversed naturally or through human action	Very High	4	Not reversible, even with human intervention
	High	3	Reversible but at high cost or very long term (> 100 yrs)
	Medium	2	Reversible with human intervention
	Low	1	Naturally reversible or with little human intervention and / or little cost

Table …: Rating Criteria for Assessing Climate Change Adaptation Threats per Target (after TNC)

Assessment of Climate Change Adaptation Threats					
	Certainty	***Severity***	***Scope***	***Irreversibility***	***Averaged Score***
Tropical Forest					
Clearance of adjacent forests for agriculture	***High (3):*** Some of the adjacent land is already under citrus. Much of the remaining forest is under private ownership (CIL), and current plans are for maintenance of forest cover. There are, however still some areas with a high likelihood of being converted to agriculture in the future	***Medium (2):*** Clearance of forest to the reserve boundary will increase edge effect and increase accessibility for illegal activities	***Medium (2):*** With predicted increases in population in the area as people move away from the coastline, the pressure for land will increase adjacent to the National Park, leading to clearance for agriculture	***High (3):*** Once forest has been cleared for agriculture, it would take significant time and/or effort to return it to forest	***2.50***
Increased potential for fires	***High (3):*** Increased drought conditions will also increase the risk of fire on the dry karst slopes.	***High (3):*** Fire will seriously degrade the forest structure and increase the edge effect in boundary areas. The predicted decreased rainfall and increased dry conditions could lead to fire damage on the karst slopes, and could significantly degrade forest viability in the long term	***Medium (2):*** Once started, fires may spread quickly, with the dry limestone conditions during drought periods.	***High (3):*** Reversible, but would require effective fire management, and engagement of farmers to minimise fire risk	***2.75***
Caves					
Increased use of caves and associated tourism impacts during storm events that close other caving destinations	***Very High (4):*** Already occurring in heavy storm events, when access to caves in western Belize is too dangerous. Crystal Cave is starting to be used as a substitute for Actun Tunichil Muknal	***High (3):*** Increased levels of largely unregulated tourism to the Crystal Cave has the potential to cause significant degradation of the cave features	***Low (1):*** Very little of the cave system is accessed for tourism (less than 25%), and only two of the nine caves of St. Herman's Blue Hole National Park are used for tourism	***Very High (4):*** Not reversible	***3.00***

Assessment of Climate Change Adaptation Threats					
	Certainty	***Severity***	***Scope***	***Irreversibility***	***Averaged Score***
Water Systems					
Diversion of river or excessive extraction of water in upper Caves Branch Valley for irrigation	***Low (1):*** Citrus farms are currently managed on leases, with owners reluctant to invest in permanent or long term infrastructure / operations	***High (3):*** Reduced water flow through the cave system and Blue Hole would reduce tourism appeal, affecting income of local tour guides, and impact aquatic species. Diversion of water away from the cave systems would be a significant impact on the cave species viability, and could result in local extinctions.	***Very High (4):*** Alteration of the natural flow could significantly impact all water systems within the National Park, and, by extension, the touristic and recreational appeal for visitors.	***Medium (2):*** Any barrier to water flow affecting the National Park and tourism incomes could be reversed through intervention strategies	***2.50***
Damming of river or excessive water draw downstream to improve irrigation of agricultural areas in the Sibun River Valley	***Low (1):*** Once past the Caves Branch area, the river is essential to too many people for any major alteration of flow to be considered acceptable	***Low (1):*** The scope of impacts would be largely outside the National Park – but may impact the migratory species within the Park - and is therefore assessed as a potential threat, but low	***Low (1):*** Whilst drawing excessive water from the river downstream could potentially have an impact on species that live downstream, it would not impact on water flow upstream.	***High (3):*** If drought conditions were to prevail in the Sibun Valley, agricultural development initiatives may include use of the river for irrigation, reducing the feasibility of reversing any irrigation schemes.	***1.75***

Ranked Outputs

The assessment provides a prioritisation for potential threats that may occur as a result of changes in climate, based on the level of impact they would have on the specific targets (Table …). The highest ranked threat is the predicted (and already occurring) increase in visitors using the caves, particularly the Crystal Cave, as wet caves in western Belize are closed more frequently and for longer in response to storm events.

Predicted reduced rainfall (both total annual rainfall and its reduced predictability) also raises concerns of increased water use in the adjacent landscape, and potential diversion of the upper Caves Branch River, before it enters St. Herman's Blue Hole National Park. Whilst perhaps not considered an immediate threat, the implications of any changes in water flow could have long term and significant impacts

Climate Change Related Threat	*Averaged Score*
Increased use of caves and associated tourism impacts during storm events that close other caving destinations	3.00
Increased potential for fires	2.75
Clearance of adjacent forests for agriculture	2.50
Diversion of river or excessive extraction of water in upper Caves Branch Valley for irrigation	2.50
Damming of river or excessive water draw downstream to improve irrigation of agricultural areas in the Sibun River Valley	1.75

Table …: Summary of Climate Change-Related Threat Assessment Outputs

2.5.3 Building Resilience to Climate Change

A series of climate change adaptation strategies were then developed based on the assessment outputs, and including performance indicators for measuring success of implementation.

Climate Change Adaptation Strategies: Tropical Forest					Indic
Goal	**Maintain the current extent and viability of tropical forest in St. Herman's Blue Hole National Park**				% of
Objective	**Reduce the identified potential anthropogenic impacts on the forest ecosystems of SHBHNP**				
Strategy	***Strategic Actions***	***Responsible Body***	***Complementary Activities***	***Timeline***	
Ensure maintenance of forest connectivity	▪ Develop a legal agreement with CIL for long term maintenance of forest in area identified as critical for forest connectivity	BAS	NPAPSP Rationalization Report	3 years	▪ Leg CIL ▪ Ma SH
Build capacity of local farmers for fire management	▪ Develop effective communication with and engagement of, farmers ▪ Provide training for local farmers and staff in effective fire management ▪ Ensure SHBHNP has fire-fighting equipment on site and accessible if fire becomes an increasing risk to the protected area,	BAS	National fire management initiative	2 years	▪ Pe co ▪ Nu fir ▪ Fir

Climate Change Adaptation Strategies: Caves					
GOAL	**Maintain the caves of St. Herman's Blue Hole National Park in the current state or better**				
OBJECTIVE	**Reduce climate change-related increased visitor impacts to the caves of St. Herman's Blue Hole National Park**				% of degra
Strategy	***Strategic Actions***	***Responsible Body***	***Complementary Activities***	***Timeline***	
Strengthen and implement identified visitor management strategies for the two accessed caves	▪ Demarcate access routes to avoid trail braiding and excessive damage ▪ Provide site-specific training for guiding of Crystal Cave ▪ Develop Special Permit system for guides using Crystal Cave, based on site specific training ▪ Enforce strict visitor : guide ratio for Crystal Cave ▪ Identify limits of acceptable changes for the cave systems ▪ Install physical barrier and signs to prevent people entering St. Herman's Cave beyond the 200 yard access area ▪ Develop baseline photos of current condition of cave features, trails and archaeological artefacts ▪ Increase surveillance and enforcement presence in the caves	BAS	Institute of Archaeology input on cave management	1 year	▪ Ro de ▪ Nu in t ▪ Nu issu ▪ Vis : vi ▪ Lim pla ▪ Phy He ▪ Fol

Climate Change Adaptation Strategies: Water Systems					
GOAL	**Maintain natural water flow through St. Herman's Blue Hole National Park**				
OBJECTIVE	**Ensure continued natural water flow through the National Park**				
Strategy	***Strategic Actions***	***Responsible Body***	***Complementary Activities***	***Timeline***	
Monitor water use and water use infrastructure in the upper Caves Branch Valley	▪ Include monitoring of water flow in the monitoring framework for St. Herman's Blue Hole National Park ▪ Annual assessment of status of upper Cave Branch (modification	BAS	Department of the Environment Department of Agriculture	Every Year	▪ Wa ▪ Str Cav He Par
Engage citrus farmers in discussions on watershed functionality and best agricultural practices	▪ Include irrigation, water catchment and importance of natural water flow in awareness and training for local citrus farmers ▪ Develop a response plan for implementation if there are plans for alteration of the water course in the upper Caves Branch Valley ▪ Encourage farmers to retain riparian vegetation along water courses in the upper Caves Branch Valley	BAS	Department of the Environment Department of Agriculture	3 years	▪ Aw ad ma ▪ Res wa up

3. Management Planning

3.1 Management and Organizational Background

Regulatory authority for SHBHNP lies with the Forest Department (Ministry of Foresty, Fisheries and Sustainable Development), supported by national legislation.

As with many national protected areas in Belize, site manangement lies with a co-management agency, with responsibilities presented in a co-management agreement. St. Herman's Blue Hole National Park is managed by Belize Audubon Society (BAS), a Non-Governmental Organization under a co-management agreement with the Forest Department. Over the years, since its establishment in 1969, BAS has grown from a small club of interested citizens to a leading conservation organisation within Belize, successfully co-managing seven national protected areas, despite limited resources. With a vision and a mission that reflects the need for sustainable management of natural resources and a balance between people and the environment, BAS focuses on providing not only protection for wildlife and the environment, but also benefits to people and the environment.

Belize Audubon Society

Vision: The Belize Audubon Society is a national conservation leader and development partner that inspires people to live in harmony with and benefit from the environment.

Mission: The Belize Audubon Society is a nongovernmental, membership-based organization dedicated to the sustainable management of our natural resources through leadership and strategic partnerships with stakeholders for the benefit of people and the environment.

The Belize Audubon Society is a membership organization guided by a multi-sectoral Board of Directors and led by the Executive Director. With over 40 staff, effective organizational management is achieved through a framework of internal policies and procedures.

Co-management

BAS has a five year co-management agreement with the Forest Department for St. Herman's Blue Hole National Park, as one of the seven protected areas managed by the NGO, and signed on December, 2013. Under this agreement, BAS is responsible for:

"the day-to-day management and administration of the protected area(s), preparation and implementation of management and operational plans for the protected area(s), and the management and development of the finances of the protected area(s), as detailed in the National Protected Areas Co-Management Framework.

a) Day-to-day management and administration of the protected area(s) shall include, but not be limited to, the following: staff recruitment and retention, staff supervision and development, expenditures and accounting, equipment and procurement, and management and financial audits with oversight provided by the Regulatory Agency.

b) The management and operational plans shall be developed as per the Management Plan template in conjunction with the Regulatory Agency.

c) The management and development of finances of the protected area(s) shall include, but not be limited to, the following: identifying and securing grant funding, and working to diversify financing mechanisms jointly with the Regulatory Agency and in partnership with other third parties.

The Forest Department (Government of Belize), as the regulatory agency, is responsible for:

"… providing management oversight with respect to the management of the protected area(s) and patrolling and law enforcement support.

a) Management oversight shall include, but not be limited to, the following: technical input in the development of protected area management and development plans, approval of management plans, training in legal proceedings and monitoring and evaluation of protected area management activities.

b) Patrolling and law enforcement support shall be in collaboration with the national law enforcement agencies and shall include the following: participation in protection patrols when requested by the Manager, including leading search, seizure and arrest operations when necessary; and the necessary support for the prosecution of offenses.

c) Financing support shall include to the extent possible, but not be limited to, the following: budget appropriations, project funding, and fiscal incentives such as tax exemptions."

In 2014, BAS revised its Strategic Plan for the organisation, to develop a "comprehensive roadmap setting the direction of BAS' work over the next five years, with a ten year outlook" (BAS Strategic Plan, 2014).

This focused on four focal areas, considered critical to the effectiveness of the organization:

- **Sustainable Natural Resources Management:** To continue to work toward improving the environmental integrity of key marine and terrestrial protected areas in Belize through effective, collaborative natural resources management.

    - ***Protected areas management***

- **Research and Monitoring:** To integrate science-based decision-making for adaptive management of protected areas and buffering environs

    - ***Sustained Monitoring Program for marine and terrestrial systems***
    - ***Integrate science-based decision-making for adaptive management***

- **Environmental Education and Awareness:** To develop and implement an environmental education strategy for BAS to build knowledge, skills, and experience that would help to create more environmentally responsible citizens

    - ***Environmental Education***
    - ***Community Outreach***

- **Organizational Development:** To strengthen the capacity of BAS to continue as a conservation leader and key development partner for the country of Belize.

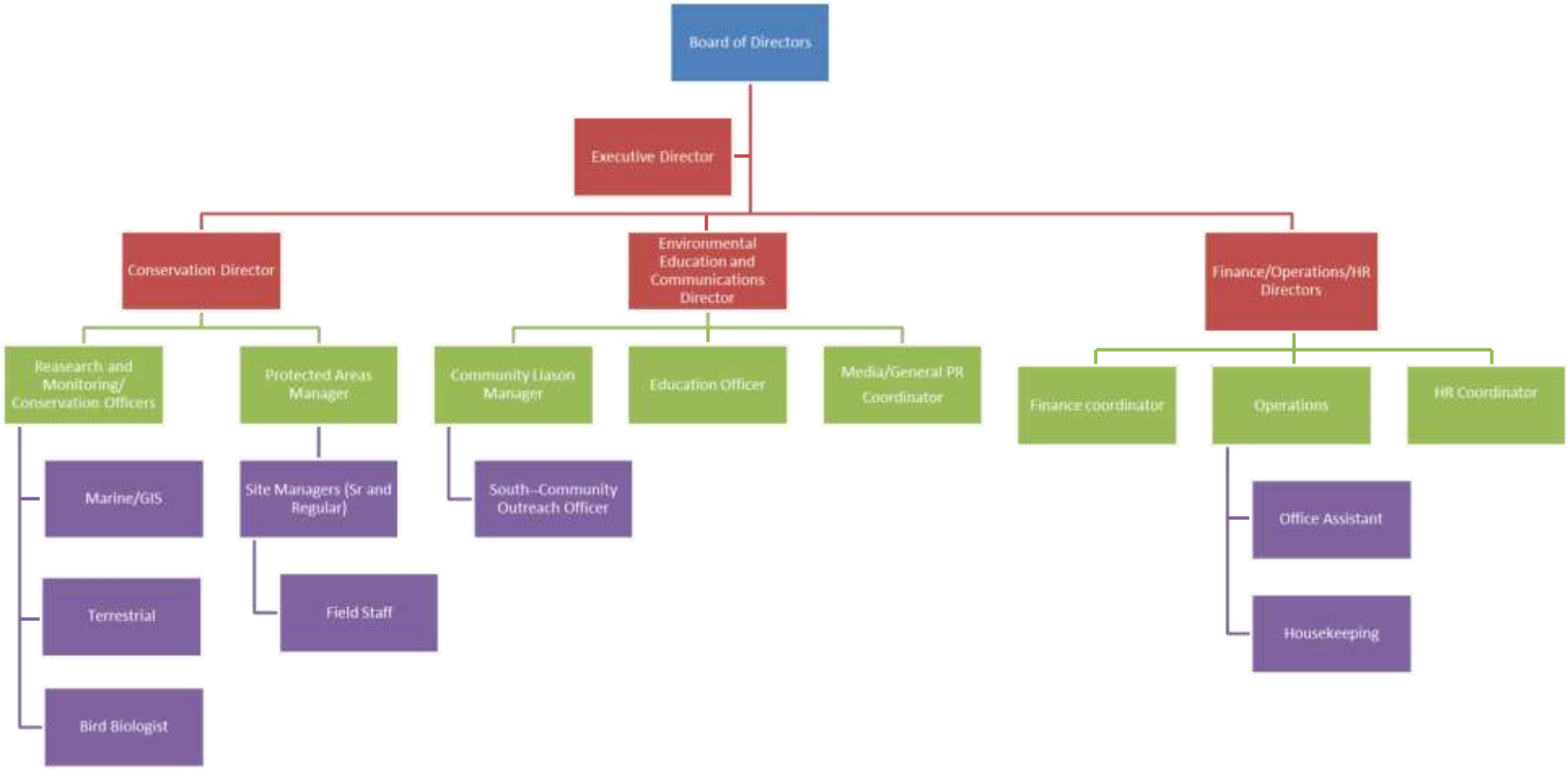
    - ***Improving Organizational Effectiveness***
    - ***Branding and Marketing of BAS***

Within this Strategic Plan, the management of St. Herman's Blue Hole National Park falls under the Sustainable Natural Resource Management Program, supported by the other Programmatic Areas (the Administration and Operations Unit, and the Environmental Education and Community Outreach Unit). The day-to-day management of the Belize Audubon Society is the responsibility of the Executive Director and senior management staff. The Executive Director oversees the Protected Area Directors, who are in turn responsible for the effective implementation of the programme activities at site level.

Management strategies and activities for the protected area are implemented by the Protected Area Manager (Cayo Parks), based from the BAS office in Belize City, with the support of the other Program managers (Environmental Education, Science and Administration). Day to day activities (staff supervision, patrolling, infrastructure maintenance and upkeep, fee collection etc.) are the responsibility of the -site Manager, supported by an assistant site manager and four park wardens. The site manager reports to the Protected Area Manager responsible for the Cayo Parks .

Belize Audubon Society

Organizational Diagram Request new OD



3.2 Review of Previous Management Plan

A draft management plan was developed for St. Herman's Blue Hole National Park in 1992 / 1993, but was never finalized nor approved by the Forest Department. This current management plan is the first revision since then.

The original plan included a number of discrete objectives and strategies that have been evaluated here to provide an indication of implementation success in the past twenty two years. Four primary objectives were identified for management of the protected area, and rated out of a possible total of 4, based on the level of achievement.

Objective	Score	Comments
1. Protect outstanding features of central Belize's karst landscape.	4	SHBHNP has remained a part of the National Protected Areas System and continues to protect a portion of Belize's karst landscape. It has been successfully managed by BAS since 1986.
2. Retain in perpetuity a portion of the Maya Mountains foothills ecosystem.	3	SHBHNP has remained a part of the National Protected Areas System and continues to protect a portion of the Maya Mountains foothills ecosystem. However, unless permanent forest connectivity can be achieved, the area of forest within SHBHNP is too small to be viable in isolation in the long term.
3. Provide recreation and education opportunities for Belizean and international visitors in a manner that is compatible with the natural and cultural environment.	3	SHBHNP has become a key destination for schools groups and tours, though there is a need for increased visitor management within the cave systems to prevent increasing visitor impacts.
4. Secure biological and social sustainability of the protected area through community development programs that benefit local people.	3	The tour guide sector is being successfully engaged and benefits from SHBHNP. However, the communities are not so well engaged, as their impact has been low in the past, and engagement has therefore not been a priority. Impacts are starting to increase, and there is no greater priority placed on engaging the communities in the next five years.
Average Score	**3.25**	
Scores *1: No change* *2. Implementation has started, but there are no successful outputs to date* *3. Partial success of implementation and outputs* *4. The objective and expected outputs have been successfully achieved*		

Comments:

Implementation of the four objectives achieved an average score of 3.25 out of 4.00 (81.3%), demonstrating both the achievements over the past years, but also those objectives that would benefit from further strengthening.
An assessment was also conducted of the implementation success of the four management programs presented in the original management plan:

- Resource Management and Protection Program
- Human Use Program
- Research and Monitoring Program
- Administration Program

The assessment was based on the same four point rating system, with the following summarized outputs:

Management Programs	Averaged Score out of 4	%
Resource Management and Protection Program	2.67	66.8
Human Use Program	3.10	77.5
Research and Monitoring Program	2.33	57.5
Administration Program	3.50	87.5
Averaged	**2.94**	**72.3%**

Comments:

- Overall, implementation of the strategies and achievement of outputs of the first management plan over the last twenty years has been moderately successful, though the original management plan itself has not been an active, living document, and has not guided management of the protected area during this period.
- The strongest area is identified as the Administration Program, with a rating of 3.50 out of 4.00 (87.5%), an indication of the strengthening of BAS's administrative structure, its increased focus on capacity building of its staff, restructuring of its financial administration and investment in its protected areas.
- The weakest area is identified as the Research and Monitoring Program, with a rating of 2.33 out of 4.00 (57.5%). There has been very limited focus on research activities within SHBHNP, partly due to its small size, and focus on human resource use as opposed to biodiversity conservation.

Full results are presented in Annex …

3.3 Management Goals

National Goals

Under the National Protected Areas Policy and System Plan, there is a move to standardize protected area categories with those of the global conservation community, following the IUCN system. This provides guidelines for activities that can take place within the protected areas, to be taken into account during the development of future goals and objectives.

St. Herman's Blue Hole National Park was originally defined as an IUCN Category II protected area – a "*National Park: protected area managed mainly for ecosystem protection and recreation*". However, based on its small size, its current limited security of connectivity to the Sibun Forest Reserve, it representation of important geological features (natural swimming pool and caves), and its high visitation, easy accessibility and importance as an educational resource, this was revised through the NPAPSP Rationalization process to align with Category III – a *Natural Monument: protected area managed mainly for conservation of specific natural features…*in this case the karst features of the National Park – with particular focus on St. Herman's Cave, Crystal Cave and the Blue Hole. St. Herman's Blue Hole retains its name as a National Park, under the National Protected Areas System, but aligned with IUCN Category III.

St. Herman's Blue Hole National Park	
CATEGORY II	National Park: protected area managed mainly for ecosystem protection and recreation
Definition	Natural area of land and/or sea, designated to: (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible. **IUCN Protected Area definitions**

St. Herman's Blue Hole National Park	
CATEGORY III	Natural Monument: protected area managed mainly for conservation of specific natural features
Definition	Area containing one or more specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance. **IUCN Protected Area definitions**

Management Plan Goal and Objectives

Following review of past SHBHNP management goals and objectives, their successes, past and present limitations, the current landscape context, the amended IUCN management categorization and the long-term vision of Belize Audubon Society for St. Herman's Blue Hole National Park, the following goal has been developed for the next five-year period

SHBHNP Management Goal

2015 – 2020

This is supported by a series of objectives focused on maintenance of environmental services, biodiversity and karst features, biological, social and financial sustainability and engagement and participation of communities.

SHBHNP Management Objectives

- Protect and preserve the karst landscape of the Maya mountain foothills, maintaining biodiversity, and environmental services
- Provide recreation and education opportunities for Belizean and international visitors in a manner that is compatible with the natural and cultural environment
- Secure biological , social and financial sustainability of the protected area

3.4 Management Strategies

A number of key factors are considered essential to the effective management of St. Herman's Blue Hole National Park:

- A **protected area manager** and **on-site manager** who have a clear vision of the long term goals of St. Herman's Blue Hole National Park, achieved through the implementation of the four Management Programmes, are able to share this vision with the support team, and are dedicated to seeing the 5-year Management Plan succeed.

- **A multidisciplinary support team** on five levels:

    - The first is of Programme Directors based in the Belize City HQ, experienced in the development of specific key programmes – education, research and monitoring, community liaison, funding, and administration - allowing the protected area director and on-site park manager to concentrate on the implementation of natural resource management programme.
    - The second are the staff based on-site – the Site Manager and field staff, who are involved in the physical implementation of the management actions.
    - The third are supporters from the stakeholder community / key stakeholders – primarily tour guides using the area
    - The fourth is the Protected Areas Manager within Forest Department (GoB)
    - The fifth is the Institute of Archaeology (NICH), which has legal authority over archaeological sites and caves

    The Site Manager must work closely with all five groups:

    - ensuring that there is close liaison with the Forest Department in the implementation of the four Management Plan programmes.
    - ensuring that protected area staff and Programme Directors share the same vision and work towards the same goals in the implementation of the individual programmes
    - ensuring that the goal of community participation is taken into consideration at all times, through close, continuous and fully transparent liaison with key stakeholders
    - ensuring that there is adequate communication and collaboration with the Institute of Archaeology for management and monitoring of the cave systems and archaeological artefacts

- **Institutional Leadership** in the form of Belize Audubon Society, for the development and implementation of the Management Plan, and to ensure continuity should there be changes in personnel during the 5-year management plan process.

- **A Strategic Approach and Measures of Success,** that serves as the foundation for evaluating the success of Management Plan implementation, allowing constant review

of the success of the management programmes, and flexibility for programme adaptation during the five year period covered by the Plan. It should always be remembered that circumstances change, new knowledge is gained and new threats may emerge, so conservation strategies need to evolve accordingly.

- **Adequate Funding** for the support of the implementation of Programme Activities under the Management Plan, and for the staff structure required to implement the Plan successfully

- **Collaboration with Key Partners,** both Government and non-Government, for support of the protected area and conservation goals and activities, and long term support from stakeholders, both local and non-local.

- **Continuity of Effort** over time – management planning should not only focus on the 5-year period of the Management Plan, but also beyond, to ensure the long term continuity of the National Park

As a key strategy for future implementation, this management plan has been developed:

- With an emphasis on the involvement and participation of local communities and stakeholders in management of the National Park
- As a platform for dialogue and a tool for conflict resolution
- As a mechanism to strengthen management through collaboration with stakeholders
- To ensure that tourism activities in the National Park are ecologically sustainable
- To address external impacts to the biodiversity of the protected area
- To address the need for equitable spread of opportunities.

3.4.1 LEGAL RESTRICTIONS UNDER THE NATIONAL PARKS SYSTEM ACT

The National Parks System Act of 1982 provides strict guidelines as to what can and can't be done within a National Park. The Act presents the legal framework for activities within the National Protected Areas System:

- no person shall be entitled to enter any national park except for the purpose of observing the fauna and flora therein and for the purpose of education, recreation and scientific research;
- no animal shall be hunted, killed or taken and no plant shall be damaged, collected or destroyed in a national park or nature reserve;
- No person shall, within any national park, nature reserve, wildlife sanctuary or natural monument, except as provided under section 7, or with the written authorisation of the Administrator-
  - permanently or temporarily reside in or build any structure of whatever nature whether as a shelter or otherwise;
  - damage, destroy or remove from its place therein any species of flora;
  - hunt any species of wildlife;

- remove any antiquity, cave formation, coral or other object of cultural or natural value;
- quarry, dig or construct roads or trails;
- deface or destroy any natural or cultural features or any signs and facilities provided for public use and enjoyment;
- introduce organic or chemical pollutants into any water;
- clear land for cultivation;
- graze domestic livestock;
- carry firearms, spears, traps or other means for hunting or fishing;
- introduce exotic species of flora or fauna;
- catch fish by any means whatsoever;
- do any other act which may be prohibited by any Order made by the Minister from time to time.

3.4.2 BELIZE STANDARDS FOR HEALTH AND SAFETY IN ARCHAEOLOGICAL RESERVES AND PARKS

Belize Bureau of Standards

Whilst St. Herman's Blue Hole National Park is managed under the Forest Department, not the Institute of Archaeology (NICH), the national standards for tourism activities, developed by the Sub-Committee for High Risk Tourist Activities, are still relevant. It should be noted that the Institute of Archaeology is the authority responsible for the monitoring and management of cave tourism in Belize. The Standards can be downloaded from the Bureau of Standards website (http://www.bbs.gov.bz/).

Relevant cave-related sections include:

3. Requirement

3.2 Liability

The very nature of Archaeological Reserves and Parks and related caving activities carry potential health and safety risks. Activities at these sites may involve climbing, swimming, cave tubing, kayaking etc. In order to mitigate risks - the following shall be observed:

3.2.1 All parties conducting tours at Archaeological Reserves and Parks shall be in possession of all appropriate licenses, permits and insurance, as required by relevant regulations.

3.2.2 Signage at the entrance of the Archaeological Reserves and Parks shall state in a prominent place that the Institute of Archaeology (or in this case, the Forest Department / Belize Audubon Society) is not liable for injuries or accidents that may occur due to any activity undertaken at the Reserves and Parks.

15. Additional Requirements for Caves

The Institute of Archaeology is responsible for the monitoring and management of cave tourism in Belize; hence all health and safety measures and standards must be in place to protect and enhance visitor experiences.

15.1 Tour Guide Licensing and Special Training

The Institute of Archaeology requires that all tour guides and tour operators involved in cave tourism will, in addition to the standard tour guide license obtained from the BTB, receive additional specialized training in order to be licensed and registered to conduct tours relating to any or all types of caves. Cave tourism is a unique and specialized adventure and recreational activity. In order to maintain international safety standards, specialized training and certification in swift water rescue must be completed for those cave sites that involve traversing water to ensure that Belize is adhering to internationally accepted safety criteria.

15.2 Equipment

All tour operators shall industry standard equipment required for their guests when conducting cave tours at Archaeological Reserves and Parks. Regular inspection of equipment shall be done periodically based on the need to ensure that all equipment remains in good working condition.

15.2.1 Type of Equipment

Equipment required to carry out any cave tour must include:

a) Life Jackets (US Coast Guard Type I, II or III for all caves with water such as ATM, Barton Creek, Blue Creek and Noh Mul Archaeological Reserve (Cave's Branch);
b) Tubes (for cave tours at ATM, Barton Creek, Blue Creek and Cave's Branch);
c) Flash Lights
d) Extra Batteries
e) Ropes
f) First Aid Kits and
g) Caving Helmets

Batteries must be replaced immediately if flashlights are dull, dimmed or do not provide adequate light. Batteries shall be disposed of in proper garbage containers and shall completely removed from the cave site.

15.2.2 Demonstration of Equipment

Prior to entering the cave, tour guides shall demonstrate to visitors the proper use of all equipment that will be used while touring the cave. All safety and liability policies shall also be explained to visitors before entering the cave.

15.2.3 Minimum Requirements for Equipment

The following are the minimum requirements for cave tubing equipment to be used at relevant Archaeological Reserves.

a) Certified Caving Helmets (technical specifications)
b) Tubes (technical specifications)
c) Headlamp (technical specifications)
d) Life Jackets (technical specifications)
e) Ropes (Diameter: 10.1 mm; Lengths: 60 & 70 m; Type: single rope; Weight: 66 g/m; UIAA falls: 7; Impact force: 8.2 kN; Elongation: - dynamic: 33.6 %, - static: 6.7 %; % sheath by weight: 42 %)
f) Adequate communication equipment. Hand held radios;
g) First Aid Kits for high risk activities.

(A full list of standards per equipment type is provided in Annex …)

15.3 Safety Guidelines for Cave Tours

a) All tour guides shall have a backup source of light and batteries for their guests in accordance with the Tour Group Ratios (see 15.6.1).
b) No one shall be allowed to explore cave passages by themselves or deviate from the prescribed cave routes.
c) Proper clothing and footwear shall be worn in caves in order to avoid cuts, slips, trips and falls.
d) Everyone venturing into any cave system shall be debriefed about the dangerous nature of caves and how to properly conduct themselves inside caves for their own safety.
e) All tour guides and tour operators shall ensure that they inform their guests about the physical nature of this activity and should stress that their guests must be in good physical condition to reduce chances of accidents.
f) All persons participating in adventure cave tubing shall wear a life jacket at all times during the cave tour. Children must be under their parents/guardians supervision at all times, provided they meet the requirements to do cave tubing.
g) Tour guides shall have the responsibility to properly supervise and control guests during caving activities.
h) Tour guides shall use the linked technique to float their guests through the cave. Free floating is not allowed.
i) Everyone entering any cave system shall wear a caving helmet in order to prevent head injuries.
j) Safety ropes shall be brought along in the event that anyone gets injured or needs assistance.
k) Every cave expedition shall include an emergency bag containing medical supplies, blanket, extra batteries, candles, matches, lights, snacks, water and dry clothes.

l) Prior to leaving for a cave expedition, a time shall be established for the return of the group with an officer of NICH at the point of entry.

m) All tour operators and guests shall take every precaution not to damage the integrity or in any way deliberately alter the natural environment of the Cave Systems.

n) No smoking is allowed within the caves.

o) Tour guides shall ensure that their guests are in close proximity and are not wondering around. Tour guides must always be in control of their tour group.

15.5 Food and Alcoholic Beverages

15.5.1 Food Consumption

In order to reduce the amount of waste being generated as well as to maintain the aesthetic value of our caves and park trails, the Institute of Archaeology encourages tour guides to limit food consumption in the caves and on trails and to remove all plastic water bottles taken on the cave tours and trail hikes.

15.5.2 Alcoholic Beverages

The Institute of Archaeology does not accept responsibility for any accident on the site due to the consumption of alcoholic beverages by any visitors.

15.6 Ratios and Intervals

15.6.1 Tour Group Ratios

Cave tour groups shall be limited to a maximum of 8 persons per tour guide for safety purposes and will also be guided by the BTB Tour Operators Regulations as it relates to cave sites.

15.6.2 Tour Group Intervals

Tour guides and tour operators shall take the responsibility to maintain appropriate time intervals between groups (at least 15 minutes between tours) in caves involving water so as to prevent overcrowding and conflicts when entering the water and during the tour.

15.7 Noise Levels

Tour guides shall be responsible and have consideration for other visitors at the site. Tour guides must strictly discourage loud noise (i.e. shouting) during the trail hike or during the cave tours. Loud noise usually causes wildlife to abandon the park, thus reducing the overall visitor's experience. Loud noise can also cause confusion among tour guides and visitors.

15.8 Site Closure and Water Level

15.8.1 Archaeological Sites may be declared "closed" under the below conditions:

15.8.1.1 For Caves: erosion, security threat, major accident(s), natural hazards, water quality, contamination;

15.8.1.2 For Maya temples: erosion, security threat, accident, natural hazards.

15.8.2 The unpredictable nature of Belize's rivers makes it almost impossible to give any tour operator a 24-hour lead-time as to what the river condition will be. Hence, the Institute of Archaeology will continuously monitor river level gauges, weather reports and contacts upriver to keep the cave site open and operational as long as possible within an acceptable safety margin.

15.8.3 In the event of any excessive rains that can produce flash flooding, caves will be closed and will remain closed until the Park Manager declares the "ALL CLEAR TO RESUME ACTIVITIES".

15.8.4 Once the site has been declared closed, the Park Manager shall immediately notify all ticketing centres about the status of the river, and visitors will have to be diverted to other destinations. Tour Operators and Guides may call the Cahal Pech Archaeological Reserve at 802-4206 from 6:00 am every morning to 6:00 pm to check on river conditions and to determine whether caves are open.

15.8.5 The Institute of Archaeology shall install additional signage/signs at the site to inform visitors of the park rules and regulations and current water conditions and warnings.

15.8.6 The Institute of Archaeology shall put in place a mechanism where tour operators and tour guides can get daily updates on the status of the sites to check on the condition of the river and to determine whether caves are open. All archaeological sites designated for tourism activities shall be fully equipped with radios and telephones where cellular service is available.

3.4.3 BAS VISTOR GUIDELINES

To assist in day-today management of the protected areas, Belize Audubon Society has developed a clear set of Visitor Guidelines to:

- ensure smooth implementation of visitor management activities
- minimize environmental and cultural impacts
- ensure maintenance of biodiversity and environmental services
- ensure visitor safety

General

- Visitors are required to purchase their park entrance tickets from a Belize Audubon Society staff at which time an orientation of the park will be provided.
- Be sure to adhere to the park's opening hours.
- The removal of flora and fauna from within the park is strictly prohibited.
- Minors must be accompanied by a responsible adult along trails, within caves and swimming areas.
- Immediately report to staff any violations or activities harmful to people or park resources.
- Operating hours > considering different opening times for birding activities that we are promoting? Later closing times for long days of summer for swimming? Night tours?

Hiking

- Please stay on established trails and steps.
- Leave valuables behind; take only what you need along trails.
- Be cautious along trails and steep terrains (trails can be slippery).
- Avoid standing on cliff edges and climbing on boulders
- Upon exiting the trails, kindly inform wardens of your safe return.

Caving

- Person/s entering the Mountain Cow Cave (Crystal Cave) **MUST** be accompanied by an approved guide and in possession of a hardhat and a flashlight or headlight with two (2) changes of batteries at all times.
- Tour groups are limited in size to eight (8) persons for St. Herman's Cave, five (5) persons for Crystal Cave, per authorized guide.
- Keep within caving path outlined by management and tour guides, avoid breaking, leaning, climbing or walking on any cave formation.
- Writing/etching/ carving on cave walls and structures is strictly prohibited.
- Access to St. Herman's Cave is prohibited beyond the 200 yards unless accompanied by an authorized tour guide.

Cave Tubing

- Cave tubing activities are conducted only by authorized guides.
- Guides are responsible for the safety of individuals within their parties.
- Cave tubing parties are not to exceed eight (8) individuals per authorized guide.
- Non-swimming individuals are to be equipped with floatation vests additional to prescribed tubes.

Swimming

- Visitors wishing to engage in swimming activities are to do so at their own risk. No life guards are on duty.
- No climbing or jumping from the face rock or any elevated point over-looking the Blue Hole.
- Please do not leave valuables unattended while swimming
- Please do not feed the fish

3.4.1 Management Constraints and Limitations

An overview of management effectiveness, conducted during management plan development and using the National Management Effectiveness Tool (Young et. al. 2005; adapted by Walker et al., 2010) highlights several areas in which management is constrained or limited. This is the third assessment for this protected area, the first two being completed in 2006 and 2010 as part of national assessments on the State of the National Protected Areas System. The results are presented in full in Annex …

Individual Indicators			
Indicator Category	**2006**	**2010**	**2015**
1. Resource Information	60.5	43.8	53.0
2. Resource Administration, Management and Protection	86.0	91.8	79.5
3. Participation, Education and Socio-Economic Benefit	61.5	67.8	56.3
4. Management Planning	65.0	62.5	40.0
5. Governance	83.3	79.3	95.0
6. Human Resources	89.3	68.8	82.3
7. Financial and Capital Management	75.0	78.3	81.3
Overall (%)	**74.4**	**70.3**	**69.5**

Table …: Management Effectiveness Outputs (2006, 2010, 2015)

Whilst outputs show an overall trend of decreasing management effectiveness for the protected area, from an average of 74.4% to 69.5 % (Table …), this is not considered very significant – many of these changes are associated with the increasing role of St. Herman's Blue Hole National Park within the National Protected Areas System, and therefore the increasing information requirements, resources, and human and technical capacity required for effective management. Two Indicator Categories have increased – Governance and Financial and Capital Management, both reflecting strengthening of BAS as an organization.

In 2006, SHBHNP was being managed at a very basic level, with ongoing trail maintenance, minimal surveillance and enforcement presence (with virtually zero human incursions), and limited visitor management - visitor access was limited to St. Herman's Cave, the Blue Hole and a simple trail system. Since then, the expectations for the protected area as an educational destination have increased, and the increasing recognition of Crystal Cave as a key tourism destination cave (as well as its use during storm events when other, wet caves are flooded out) has led to a need for tighter visitor management. Increasing awareness of liability issues, particularly associated with water-based activities, also strengthens the need for improved visitor management.

Resource Information

Management Effectiveness: *53%*

Resource information is based on the information requirements of the protected area for effective management. In 2006, basic maps of boundaries, ecosystems and trails were available, and sufficient for visitor management purposes. In 2010, however, with the development of SHBHNP as an educational destination, and the increasing need for information to guide management, Resource Information was identified as a weakness in relation to current need, with limited information on biodiversity, on the adjacent stakeholder communities, tourism sector and economic use and benefit.

Resource Administration, Management and Protection

Management Effectiveness: *79.5%*

Covering legal protection, surveillance and enforcement, guidelines and best management practices, and visitor management, St. Herman's Blue Hole National Park is considered to be operating at approximately 80% effectiveness. The weakest area is that of having written guidelines, best management practices and standard operating procedures to facilitate activities such as surveillance and enforcement and visitor management.

Participation, Education and Socio-Economic Benefits

Management Effectiveness: *56.3%*

The second weakest area of management – there has been no sustained effort until the 2014 / 2015 management planning process towards engaging and communicating with local stakeholder communities beyond a limited number of school visits and trips. This is reflected by the low rating for community recognition of protected area benefits. Capacity building of key stakeholders is also rated low, though this is being addressed through strategies targeted at building the capacity of local tour guides.

Management Planning

Management Effectiveness: *40%*

Whilst the goals and objectives for St. Herman's Blue Hole National Park are well defined, the protected area has been limited for many years by the lack of revision of the original management plan. Without the benefit of working within a strategic framework of medium to long term goals, implementation has been at a maintenance level, with reactionary, isolated strategy implementation to address specific threats or issues. The lack of a revised management plan also limits the effectiveness of annual evaluation, with no basis for measuring success other than against the stand-alone annual workplans.

Governance

Management Effectiveness: *95%*

Governance is a strong area, with the Belize Audubon Society operating under a signed co-management agreement with the Government of Belize. BAS itself is overseen by a Board of Directors, that guides the organizations based on the Articles of Association and clear policies and procedures. BAS is well respected in Belize and has good inter-organizational mechanisms for collaboration and communication – such as membership of APAMO.

Human Resources

Management Effectiveness: *82.3%*

St. Herman's Blue Hole National Park is considered to be moderately effective in terms of its staff presence, though there is a recognized need for more field staff to ensure more effective visitor management and improved visitor safety. There is continued capacity building of staff towards effective management of the site.

Financial and Capital Management

Management Effectiveness: *81.3%*

The majority of indicators rate as either three or four, suggesting that St. Herman's Blue Hole National Park has moderately good financial investment in infrastructure and equipment. The protected area generates approximately 60% of the required funds for current operational management activities. BAS has strengthened its financial management over the last five years. The weakest area is that of signage, with a need for more boundary and visitor management signs.

3.5 Management Programmes

The management programs exist as a part of an integrated overall management concept. To succeed, all parts of the whole have to be addressed and acted upon, as strategies of each management program support the others.

There are four programmes within the overall Management Strategy for St. Herman's Blue Hole National Park:

A. **Natural and Cultural Resource Management Program**
B. **Research and Monitoring Program**
C. **Environmental and Awareness Program**
D. **Administration Programme**

St. Herman's Blue Hole National Park Management Programs			
Natural and Cultural Resource Management	**Research and Monitoring**	**Environmental Education and Awareness**	**Administration**
Surveillance and Enforcement ▪ General surveillance ▪ Cave surveillance	**Baselines and Monitoring** ▪ Biodiversity ▪ Conservation Targets and Threats ▪ Socio-Economic	**Environmental Education** ▪ Nature School ▪ Community Outreach	**Salaries and Accounting**
Visitor Management and Safety ▪ General Visitor Management ▪ Visitor Management - Caves	**Measuring Success** ▪ Conservation Strategies ▪ Climate Change Adaptation Strategies ▪ Management Effectiveness Biodiversity Indicators	**Visitor Information** ▪ Interpretive Centre ▪ Displays in interpretive Centre Interpretive signs ▪ Brochures, booklets	**Human Resource Management** ▪ Capacity Building of staff
Fire Management			**Financial Sustainability** ▪ Entrance fees ▪ Concessions ▪ Rental ▪ Gift shop ▪ Donations
Management of Priority Conservation Targets ▪ Caves ▪ Forest Ecosystems ▪ Water Systems	**Collaboration and Communication** ▪ State of the Park reporting ▪ National Research Agenda	**Stakeholder Engagement** ▪ Participation ▪ Community leaders ▪ Tour Guides	**Communication and Liaison** ▪ Workshops / Meetings ▪ Collaboration ▪ Reporting ▪ Media / PR ▪ Formal Agreements
Site Infrastructure and Maintenance ▪ General infrastructure ▪ Cave infrastructure ▪ Infrastructure maintenance and equipment ▪ Equipment maintenance ▪ Site maintenance	**Research Infrastructure**	**Alternative Livelihoods and Income Diversification** ▪ Capacity building (tour guides) ▪ Strengthening women and youth groups	**Management Effectiveness** ▪ Management Effectiveness ▪ Management Plan assessment

Prioritizing activities within these programs is guided by the Conservation Planning outputs:

Priority Areas of Action for St. Herman's' Blue Hole National Park			
Priority	**Rank**	**Conservation Target**	**Primary Threat(s)**
High Priority	1	Caves	Visitor Impacts
	2	Forest Ecosystems	Forest Fragmentation
Medium Priority	3	Archaeological Artefacts	Visitor Impacts; Looting
	4	Water Systems	Visitor Impacts; Agrochemical Pollution
Lower Priority	5	Game Species	Hunting

Table …: Conservation Planning Outputs: Priority Strategic Areas

…and the leverage value of cross cutting strategies (Table …)

Highest Leverage

- Increase surveillance and enforcement of National Park rules and regulations
- Build capacity of staff for effective enforcement / successful prosecution of offenders
- Ensure effective enforcement of the laws with legal action and fines for all offenders
- Increase communication with, engage and build awareness of stakeholders believed to be responsible for the incursions
- Engage and seek support from community leaders in addressing threats
- Ensure boundaries are clear, maintained and well sign-posted
- Improve visitor management infrastructure - increase regulatory, interpretive and directional signage
- Develop a Limits of Acceptable Change programme for effective visitor management
- Continue to build capacity of tour guides for good stewardship of biodiversity, caves and archaeological artefacts
- Build awareness of stakeholders of the importance of forest connectivity for forest health and watershed protection
- Investigate potential for developing a long-term easement / conservation covenant agreement with CIL for maintenance of forest connectivity
- Collaborate with the Department of Agriculture, Citrus Growers Association and citrus farmers to identify mechanisms for reducing agro-chemical contamination of water bodies
- Implement water quality monitoring for key pollutants and E. coli levels in St. Herman's Cave and Blue Hole and phytotelmic pools
- Build awareness and capacity in local communities for fire management in areas adjacent to the National Park

Lowest Leverage

3.5.1 Natural and Cultural Resource Management Program

Program Goal: *The maintenance of healthy, functional ecosystems, protection of biodiversity, and intact geological and archaeological features, through surveillance and enforcement, visitor management and direct biodiversity management interventions where required, supported by essential infrastructure, equipment and maintenance.*

The Natural and Cultural Resource Management Program falls under the responsibility of the Protected Area Manager, Site Manager and field staff, and is administered under five primary sub-programs (Table …):

- Surveillance and Enforcement
- Visitor Management and Safety
- Management of Conservation Targets
- Site Infrastructure and Maintenance

Natural and Cultural Resource Management
Surveillance and Enforcement ▪ General surveillance ▪ Cave surveillance
Visitor Management and Safety ▪ General Visitor Management ▪ Visitor Management - Caves
Management of Priority Conservation Targets ▪ Fire Management ▪ Caves ▪ Forest Ecosystems ▪ Water Systems
Site Infrastructure and Maintenance ▪ General infrastructure ▪ Cave infrastructure ▪ Infrastructure maintenance and equipment ▪ Equipment maintenance ▪ Site maintenance

Table …: Sub-Programs of the Natural and Cultural Resource Management Programme

Program Limitations

1. Land tenure issues are a potential limitation in the Blue Hole area, with the car park being situated on private lands. This reduces long-term security for investment in infrastructure in this area.

   Recommendations:

   - Negotiate a long term lease or purchase of the land in question.

2. A key limitation identified in the 2015 assessment is that insufficient human resources are available in two areas:

   - for effective visitor safety management at the Blue Hole itself
   - for effective visitor management within the caves

   Effective visitor safety management at the Blue Hole: The Blue Hole is, to some extent, considered a sacrificial area in terms of its fish fauna, with visitation thought to be disrupting nesting patterns and reducing viability of the larger cichlid species. The Blue Hole's role in the national protection of these fish species is not considered critical, whereas its role in providing an opportunity to introduce Belizeans to their natural environment For this reason, strategies are focused more on addressing visitor safety issues and water quality rather than on maintaining the fish fauna.

Visitor Safety: Whilst there is always someone stationed at the Blue Hole car park, at current staffing levels there are seldom sufficient staff members available to station someone at the Blue Hole itself, except in months of peak visitation. With the increasing crowding, inherent dangers of children (and adults) associated with water and cliff faces, coupled with the need to better control visitor behavior in the Blue Hole environment to prevent further degradation to the sinkhole flora, a regulatory presence would greatly strengthen BAS's addressing of its responsibilities in this area.

Recommendations:

- Daily staff presence at the Blue Hole itself (not just the carpark), tasked with implementing visitor guidelines (e.g. no jumping, no feeding fish)
- Staff stationed at the Blue Hole should be trained in life-saving and First Aid / CPR and equipped with a flotation device, First Aid Kit and radio
- Clear, visible regulations posted by the Blue Hole on visitor access areas / restricted access areas, and best practices
- Improved visitor safety and satisfaction through maintenance of steps, improvement of visitor platform and other visitor infrastructure by the Blue Hole sinkhole
- Install showers, for removal of insect repellant and sun screen before entering the Blue Hole area

Effective visitor management within the caves:

St. Herman's Cave: The key issue in St. Herman's Cave is identified as visitors entering beyond the 200 yard access area, despite signs forbidding entry.

Crystal Cave: With increasing visitation, and with an increasing number of guides using the cave, the trail system within the cave is no longer distinct, with trail widening and braiding as different guides use different routes. This is impacting the cave environment and degrading the geological features, to the detriment of both the conservation target of protection of karst features and visitor enjoyment. Visitor safety is also an issue, with a potentially dangerous route.

General visitor behavior within both the caves is also an issue, with visitors sitting on geological features, touching formations and archaeological artefacts, and leaving garbage.

Recommendations:

- Staff presence at the mouth of both caves during visitor access times, regulating access, and reminding tour guides and visitors of rules and regulations
- Frequent patrols in caves during visitor access times to reinforce rules and regulations
- Staff stationed at caves should be equipped with first aid kit and radio, and trained in cave rescue and first aid
- Improved signage / barrier infrastructure/ fine system to prevent / discourage visitor access beyond the 200 yards

- Setting specific access times for St. Herman's, with tourists to be accompanied by ranger
- Develop and implement Limits of Acceptable Change for the Crystal Cave based on trail width, level of acceptable impacts on artefacts and formations, and identification of limits on number of site specific guides, and maximum number of visitors per day (ATM is 125 to 150)
- Ensuring that the caves are managed to the standards set by the Bureau of Standards in the **Standards for Health and Safety in Archaeological Reserves and Parks.**

To adequately man both the caves and the Blue Hole, it is recognized that SHBHNP would need to increase its number of staff by three, from the current six. This is particularly important during peak visitation months, and when SHBHNP receives the most school visits.

Conservation Priorities

A number of key strategies have been highlighted during the conservation planning process, for inclusion in the Natural and Cultural Resource Management Program:

- Strengthened surveillance and enforcement of National Park rules and regulations
- Ensured long-term maintenance of forest connectivity
- Strengthened visitor management and safety
- Improved capacity for fire management

Infrastructure Development

St. Herman's Blue Hole National Park plays a primary role in introducing students and other visitors to the natural resources of Belize. To fulfil this role effectively, the protected area has significant infrastructure upgrades planned and underway for 2015, among them the construction of a larger visitor centre – the Nature Centre. This will provide detailed, informative exhibits for effective interpretation and transmission of specific messages to students from primary to tertiary level institutions. It will also cater to local and international visitors, enhancing their visitor experience at the National Park, and provide a facility that encourages Belizeans to increase their use of the protected area.

Improved recreational facilities are being installed at the Blue Hole to facilitate visitor management, and minimize visitor impact. The current improvement of the swimming platform will enable BAS to cater for a larger number of visitors at any one time, reducing spread to the more fragile, naturally vegetated slopes.

As use of the area by school groups, tour groups and general visitors is increasing, the need for improved parking facilities has been identified, with the parking lot being extended.

Natural and Cultural Resource Management Program	
General	
Land Tenure	▪ Investigate mechanisms for securing land by the Blue Hole car park in the long term
Surveillance and Enforcement	
Surveillance and Enforcement *Illegal activities* *Logging (incl. bayleaf)* *Hunting* *Fishing* *Looting*	▪ Maintain effective demarcation and maintenance of protected area boundaries and adequate signage ▪ Ensure national shape file of the National Park is correct ▪ Ensure there is adequate information available for all stakeholders and users on the rules and regulations being enforced ▪ Implement strategic surveillance and enforcement activities to prevent illegal incursions and activities - 2 to 3 patrols per month ▪ Ensure effective, fair enforcement of the laws ▪ Collaborate with the Forest and Police Departments, Institute of Archaeology and Tourism Police for strengthened surveillance and enforcement within the National Park ▪ Ensure adequate field staff are available for effective surveillance and enforcement activities in SHBHNP ▪ Ensure all staff are aware of the rules and regulations of the pa, and trained for effective surveillance, enforcement and evidence management ▪ Ensure all staff are aware of the critical role they and the protected areas play in maintenance of environmental services, local livelihoods and biodiversity ▪ Ensure all staff are adequately equipped for surveillance and enforcement activities (uniforms, boots etc.) ▪ Improve radio communications for patrol safety ▪ Strengthen mechanisms to monitor and track incursions, including incorporation of GIS and identification of hotspot areas and times requiring increased enforcement effort / targeted patrols and implement patrols accordingly ▪ Conduct an annual overflight with LightHawk of SHBHNP and adjacent landscape ▪ Ensure all tour guides using SHBHNP are aware and supportive of regulations, guidelines and rationale for the National Park ▪ Seek support from community leaders in addressing community-originated hunting and logging incursions ▪ Increase community compliance for regulations of SHBHNP through improved awareness of the ecosystem services and economic benefits of the National Park to the communities
Visitor Management and Safety	
Visitor Management and Safety	▪ Ensure that the caves are managed to the Standards for Health and Safety in Archaeological Reserves and Parks. ▪ Inform all community members and visitors of rules and regulations when visiting SHBHNP through information dissemination (verbal and displayed) at entrances to pa ▪ Implement strategic surveillance to enforce SHBHNP visitor guidelines

Natural and Cultural Resource Management Program	
Visitor Management and Safety (continued)	
Visitor Management and Safety	▪ Ensure all cave-focused regulations and visitor guidelines are clearly displayed at the entrance to each cave ▪ Enforce BTB regulations for cave tubing and cave visitation to Crystal Cave in collaboration with BTB – guide:visitor ratios, equipment requirements, guide permits etc. ▪ Increase staff presence at cave mouths and in-cave patrols to encourage tour guide and visitor best practices, ensure visitor-guide ratios are enforced and groups keep to prescribed routes ▪ Develop and implement a site specific tour guide course and certification / permit for Crystal Cave, in collaboration with IoA and BTB ▪ Set limits on the number of tour guides and visitors using Crystal Cave in any one day / at any one time ▪ Develop and implement limits of Acceptable Change program for SHBHNP, with a particular focus on the caves and Blue Hole, and with participation of SHBHNP tour guides and IoA ▪ Re-evaluate open-access to St. Herman's Cave and develop organizational guidelines for improved management, based on visitor safety and appreciation, and outputs of re-evaluation ▪ Improved visitor management and safety at the Blue Hole, with on-site staff presence trained in life-saving and First Aid / CPR ▪ Ensure all trails have infrastructure for increased visitor management and safety Develop written policies for visitor management at SHBHNP based on Limits of Acceptable Change planning, national Standards for Health and Safety in Archaeological Reserves and Parks
Priority Conservation Targets	

Key Conservation Targets *Forest Ecosystems* *Water Systems* *Caves*	*General* ▪ Ensure staff are aware of and understand the conservation targets and the role of enforcement and surveillance in ensuring their effective management ▪ Ensure clear communication, liaison and collaboration between rangers and science staff for the effective management of conservation targets *Forest Ecosystems* ▪ Develop a legal agreement with CIL for long term maintenance of forest in area identified as critical for forest connectivity ▪ Build awareness of stakeholders of the importance of forest connectivity for forest health and ecosystem services ▪ Increase staff and community awareness of the issues associated with the illegal wildlife trade, particularly in primates and other animals, in collaboration with the Forest Department, though presentations in the local communities
Natural and Cultural Resource Management Program	
Priority Conservation Targets	

Key Conservation Targets *Forest Ecosystems* *Water Systems* *Caves*	*Water Systems* ▪ Liaise with the Pesticide Control Board and local farmers to determine which agro-chemicals are in use in the adjacent landscape, and on what scale ▪ Collaborate with the Department of Agriculture, Pesticide Control Board , Maya Mountain Cacao, Citrus Growers Association, farmers and other stakeholders to identify mechanisms for reducing agro-chemical contamination of water bodies ▪ Collaborate with Pesticide Control Board and farming community to replace use of red (extremely toxic) and yellow (highly toxic) labelled agro-chemicals with blue (moderately toxic) and green (slightly toxic) alternatives, and wherever possible only green-labelled ones. ▪ Develop a response plan for implementation if there are plans for alteration of the water course in the upper Caves Branch Valley ▪ Encourage farmers to retain riparian vegetation along water courses in the upper Caves Branch Valley ▪ Monitor river impacts – gravel mining, irrigation, use of fish poisons – both up and downstream *Caves* ▪ Continue to build capacity of and engage tour guides for good stewardship of the caves and archaeological artefacts ▪ Demarcate access routes in Crystal Cave to avoid trail braiding and excessive damage ▪ Implement in-cave surveillance patrols to enforce guide regulations and prevent visitor impacts in caves. ▪ Identify effective mechanisms for preventing unguided access beyond the 200 yrd point in St. Herman's Cave without a guide
Fire Management	
Fire Management	▪ Develop a fire management plan in collaboration with agencies already active in this area ▪ Train staff and local tour guides in fire management ▪ Ensure SHBHNP has fire-fighting equipment on site and accessible if fire becomes an increasing risk to the protected area, ▪ Develop effective communication with and engagement of local farmers in high fire risk areas adjacent to SHBHNP towards reducing fire risk ▪ Provide fire management training for farmers in high risk area (Ringtail)
Site Infrastructure and Maintenance	
Site Infrastructure, Equipment and Maintenance	▪ Maintain HQ site – buildings and landscaping – on an ongoing basis ▪ Upgrade / professionalise HQ office, equipment and furniture ▪ Maintain trail system (quarterly) and improve where necessary for improved visitor safety, education and satisfaction (e.g. handrails, steps, benches) ▪ Increase regulatory, interpretive and directional signage
Natural and Cultural Resource Management Program	

Site Infrastructure and Maintenance	
Site Infrastructure, Equipment and Maintenance	▪ Ensure SHBHNP has the equipment for effective site maintenance, with scheduled, proactive maintenance, and training in staff in best practices for equipment use ▪ Upgrade visitor management and safety infrastructure in caves (signs, thicker ropes replacing ribbons, reflectors…) ▪ Construct new Visitors Centre with educational displays, interpretive information. ▪ Construct showers near Blue Hole, for removal of sun cream and insect repellent before swimming (Note: would need to be situated to ensure the water does not drain into the Blue Hole) ▪ Upgrade restrooms ▪ Increase the number of picnic tables at both the HQ and Blue Hole entrance (6 at each) ▪ Modify current Warden House to accommodate at least two researchers
Reporting	▪ Maintain patrol log books for SHBHNP ▪ Produce patrol reports, as required by BAS and the Forest Department ▪ Produce annual reports as required by BAS and the Forest Department

3.5.2 Research and Monitoring Program

Program Goal: *The provision of accurate information to ensure effective, informed management of the National Park, and assessment of the effectiveness of the protected area in achieving its objectives*

The Research and Monitoring Program is centralized in the Belize City office, with the objective of integrating science-based decision-making for adaptive management of protected areas and buffering environs (BAS Strategic Plan, 2014). Its primary focus is on biodiversity conservation, particularly of birds and endangered species, with incorporation of species mapping and monitoring across all BAS protected areas, and scientific cooperation and data sharing as key strategic activities. A second focus is the development of a sustained biodiversity monitoring program for both marine and terrestrial systems.

For St. Herman's Blue Hole National Park, the Program is administered under four Sub-Programs:

- General
- Baselines and Monitoring
- Collaboration and Communication
- Research Infrastructure

Contribution to the National Research Agenda

As well as fulfilling the research and monitoring requirements of the individual protected areas, the BAS Research and Monitoring Program is also aligned to the research priorities of the National Environmental and Natural Resources Management

Research and Monitoring Programme
Baselines and Monitoring ▪ Biodiversity ▪ Conservation Targets and Threats ▪ Socio-Economic
Measuring Success ▪ Conservation Strategies ▪ Climate Change Adaptation Strategies ▪ Management Effectiveness Biodiversity Indicators
Collaboration and Communication ▪ State of the Park reporting ▪ National Research Agenda
Research Infrastructure and Equipment

Table …: Sub-Programs of the Research and Monitoring Programme

Key Strategic Goals

- Develop and institute a standardized biodiversity monitoring program and research guidelines for BAS staff and external researchers to ensure that researchers follow procedures and protocol to guide research and minimize disturbance in the protected areas
- Build structural and technical capacity for biodiversity research and monitoring to develop in-house biodiversity research and monitoring expertise/capacity, and ensure quality of data.
- Provide information towards addressing research priorities of

Research Agenda, developed by the Environmental Research Institute (University of Belize). Indicators developed for the monitoring and evaluation programme will also be able to inform this national initiative (Annex …).

Research and Monitoring Program
Baselines and Monitoring

Conservation Targets and Threats *Forest* *Caves* *Water System*	*Forest Ecosystems* ▪ Establish baseline of extent of forest ecosystems in SHBHNP. Re-assess every 5 years. ▪ *Tropical evergreen seasonal broad-leaved lowland forest, well drained, on rolling karstic hills* ▪ *Tropical evergreen seasonal broad-leaved lowland forest, well drained, on steep karstic hills.* ▪ Annual mapping of forest cover within the larger landscape surrounding SHBHNP, and rate of clearance (% cleared) (partner with LightHawk)/LIC ▪ Mapping of forest cover contiguous with SHBHNP (partner with LightHawk)/LIC ▪ Mapping of annual fire impacts within / contiguous with SHBHNP, and within the SHBHNP landscape/LIC/FD ▪ Establish baselines for primate populations of SHBHNP with annual re-assessment ▪ *Yucatan black howler monkey* ▪ *Central American spider monkey* ▪ Monitoring of presence of species requiring large areas of intact forest ▪ *White-lipped peccary* ▪ *Jaguar* ▪ *Baird's tapir* ▪ Continue structured monitoring of bird species of SHBHNP ▪ Establish a structured mammal monitoring protocol that aligns with other efforts in Belize ▪ Develop baseline for Limits of Acceptable Change for forest impacts – width of trails etc. *Caves* ▪ Establish a baseline for fish populations, bats and cave invertebrates in St. Herman's Cave and Crystal Cave and monitor change ▪ Develop baselines and monitor indicators developed during the Limits of Acceptable Change Programme development process *Water System* ▪ Establish a current baseline for fish populations (diversity and abundance) in the Blue Hole and monitor change ▪ Monitor water quality of the Blue Hole and St. Herman's Cave and phytotelmic water (nitrates, water level, water pollution, temperature, O2 levels, *E. coli*).
Research and Monitoring Program	
Monitoring of Conservation Targets and Threats	

Monitoring of Conservation Targets and Threats *Game Species* *Archaeological artefacts* *Socio-Economic*	*Water System* ▪ Establish baseline mapping of streams and rivers, and of activities impacting the SHBHNP watershed both upstream and downstream of SHBHNP – including barriers to water flow / fish movement ▪ Establish baseline mapping and database of land ownership, land use, farming activities and agro-chemicals use in the SHBHNP watershed *Game Species* ▪ Establish a structured mammal monitoring protocol that aligns with other efforts in Belize ▪ Maintain records of sightings (opportunistic and during structured monitoring) of collared and white lipped peccary, white tailed and brocket deer, armadillo, paca and great curassow *Archaeological Artefacts* ▪ Develop a pictorial baseline of artefacts and geological features against which to measure change in both St. Herman's and Crystal Cave, with annual monitoring of condition
Measuring Success	
Measuring Success *See Annex … for Success Indicators*	▪ Monitor indicators developed to measure success of conservation strategies ▪ Monitor indicators to measure success of climate change adaptation strategies ▪ Monitor biodiversity indicators for national management effectiveness reporting ▪ Monitoring of Limits of Acceptable Change indicators, once developed
Data Management	
Data Management	▪ Develop a secure data management system for baseline and monitoring data, research papers, references, socio-economic data etc.
Communication and Collaboration	
Communication and Collaboration	▪ Ensure biodiversity reports are submitted to the Forest Department as required ▪ Ensure research and monitoring results are available for adaptive management decision making within BAS ▪ Ensure information is available for use by the BAS Environmental Education and Awareness Programme ▪ Develop a secure data management system for baseline and monitoring data, research papers, references, socio-economic data etc. ▪ Provide information in an easy-to-access format on biodiversity monitoring outputs for tour guides and community members to incorporate into interpretative guiding ▪ Contribute information towards the National Research Agenda objectives (Annex …)
Research and Monitoring Program	
Communication and Collaboration	

Communication and Collaboration	▪ Contribute information on national indicator species identified under the management effectiveness framework ▪ Contribute water quality monitoring data, where relevant, to national hydrological monitoring and watershed initiatives ▪ Identify and engage international research institutions and independent researchers with the capacity and interest to answer specific research questions – particularly on the cave systems and ecology ▪ Collaborate with UB / ERI to provide opportunities for students to participate in biodiversity / socio-economic monitoring activities ▪ Provide opportunities for community stakeholder involvement in biodiversity / water quality monitoring ▪ Provide opportunities for tour guides to participate in Limits of Acceptable Change monitoring ▪ Strengthen cross linkages with other relevant organisations involved in karst / forest biodiversity research in Belize and the region
Research Infrastructure and Equipment	
Research Infrastructure and Equipment	▪ Investigate feasibility of altering Rangers House to accommodate two researchers ▪ Ensure SHBHNP has the equipment for effective biodiversity monitoring ▪ Ensure staff are trained in relevant biodiversity monitoring protocols

3.5.3 Environmental Education and Awareness

Environmental Education and Awareness
Environmental Education ▪ Nature School ▪ Classroom Presentations
Visitor Information ▪ Interpretive Centre ▪ Displays in interpretive Centre Interpretive signs ▪ Brochures, booklets
Stakeholder Engagement ▪ Community Outreach ▪ Participation ▪ Community leaders ▪ Tour Guides
Strengthening Livelihoods and Income Diversification ▪ Capacity building (tour guides) ▪ Strengthening women's groups - crafts

Table …: Sub-Programs of the Environmental Education and Awareness

Key Strategic Goals

- Inform the general public of the ecosystem services, community benefits and biodiversity protection provided by protected areas
- Encourage the involvement of local communities in the management of our protected areas
- Build capacity among community members, enabling them to actively participate in protected areas management
- Strengthen livelihoods associated with the protected area

Programme

Program Goal: *Building knowledge, skills, and experience to create more environmentally responsible citizens.*

BAS firmly believes that "education is at the heart of environmentally sustainable development" (BAS Strategic Plan, 2014), and that building awareness and understanding of the environment and the benefits communities receive from it will encourage better environmental stewardship. The BAS Environmental Education and Awareness Programme is focused primarily on two areas:

- Environmental Education
- Community Outreach
- Strengthening Livelihoods

Implementation of BAS's environmental strategy and the management of Environmental Education activities are centralized within the Belize City office and reaches out to communities buffering all BAS protected areas. For St. Herman's Blue Hole National Park, where negative impacts on the protected area are relatively low, the emphasis is on Environmental Education and the implementation of Nature School activities. It also provides an important location for BAS's Nature School programme, with over 2,700 students participating in outdoor activities that compliments the classroom-based presentations, giving hands-on experiences with nature, teaching environmental stewardship skills, fostering problem solving and critical thinking skills. It also supports the national curriculum standards. With its easy access to Belmopan, SHBHNP also provides a destination for the BAS Summer Camp activities.

Historically, BAS has not reached out comprehensively to its SHBHNP stakeholder communities, with socio-economic surveys demonstrating a limited knowledge of the presence and understanding of the role of St Herman's Blue Hole National Park, and limited communication or engagement. More recently, increased stakeholder engagement activities have been conducted through the Environmental Education programme and activities under the protected area and activities implemented by the site managers and staff, with an emphasis on continued engagement of school children through classroom presentations, tour guides, with their increased participation in planning for management of tourism activities at the protected area. Village leaders are also targeted, with increased information on environmental services provided by the protected area, and management issues.

Environmental Education	
Nature School	▪ Maximize use of SHBHNP for Nature School activities ▪ Ensure adequate facilities, equipment and human resources are available for effective management of Nature School activities at SHBHNP
Classroom Presentations	▪ Strengthen engagement of the local schools though improved communication with teachers ▪ Increase teacher awareness of basic environmental services concepts, biodiversity value and conservation, and St. Herman's Blue Hole National Park through presentations, site visits to SHBHNP, and opportunities to participate in management activities ▪ Increase engagement of students through regular presentations in schools, site visits to SHBHNP, open days and opportunities to participate in management activities ▪ Participate actively in school open days / community days with activities designed to engage community members ▪ Encourage buffer schools to visit SHBHNP twice a year as part of their science syllabus
Visitor Information	
Interpretive information	▪ Identify the target audiences and key messages, and develop engaging interpretive displays that address these ▪ Produce posters that highlight St. Herman's Blue Hole National Park, for distribution in local communities, schools and to local families ▪ Develop a series of interpretive experiences for visiting school groups at different levels, introducing key concepts and supported by interpretive material

Awareness also extends to informing visitors of the importance and roles of the protected area – its environmental services - and the benefits it provides in terms of community livelihoods and support, and of biodiversity protection. The presentation of interpretative information at SHBHNP is being strengthened in the next five years through the construction of the St. Herman's Blue Hole Nature Centre. This marks a significant turning point in the prioritization of the protected area as an educational focal point, with the opportunity to provide a facility that can effectively engage students and visitors towards improved stewardship of natural resources.

Environmental Education and Awareness Program	
Visitor Information	
Interpretive information	▪ Identify the target audiences and key messages, and develop engaging interpretive displays that address these ▪ Produce posters that highlight St. Herman's Blue Hole National Park, for distribution in local communities, schools and to local families ▪ Build capacity of staff to be able to implement school visits supported by equipment and materials for implementing interpretive experiences ▪ Produce leaflets and posters that highlight St. Herman's Blue Hole National Park, for distribution in other tourism destinations
Stakeholder Engagement	
▪ *Outreach and Engagement* ▪ *Participation*	▪ Increase local leader awareness of basic environment services concepts, biodiversity value and conservation, and St. Herman's Blue Hole National Park through presentations, and site visits to SHBHNP ▪ Strengthen engagement of the local community leaders though improved communication ▪ Strengthen mechanisms for ongoing, open communication with tour guides that use St. Herman's Blue Hole National Park, including quarterly meetings ▪ Increase communication with, engage and build awareness of stakeholders believed to be responsible for incursions ▪ Engage developing community groups – particularly youth and women's groups, and provide opportunities for active participation in management activities ▪ Investigate potential for provision of structured community service opportunities for local students and High School students from Belmopan ▪ Provide internship opportunities for UB students, assisting with baseline data development and biodiversity monitoring ▪ Engage land owners and farmers in the SHBHNP landscape in improved agricultural practices with reduced pesticide use ▪ Ensure tour guide participation in development of Limits of Acceptable Change criteria for trails and caves ▪ Provide opportunities for farmers to participate in training for improved fire management practices
Alternative Livelihoods and Income Diversification	

▪ *Capacity building* ▪ *Strengthening community groups*	▪ Assess communities for primary development needs, including needs for strengthening resilience for predicted climate change impacts ▪ Identify those priority areas where BAS can provide support ▪ Provide capacity building opportunities for tour guides in areas such as best practices, marketing, financial management, organizational management, First Aid / CPR ▪ Continue to build capacity of tour guides for good stewardship of biodiversity, the caves and archaeological artefacts ▪ Provide capacity building opportunities for youth and women's groups in the buffer communities – organizational management, conflict resolution etc.

3.5.4 Administration

Program Goal: *Ensuring that the necessary administration structure is in place for the support of management activities within SHBHNP and the adjacent area*

Organizational, financial and human resource administration is centralized at the Belize Audubon Society office in Belize City. Park-specific administration is also managed from here, as part of the Cayo Parks portfolio, though with frequent visits to the site by the protected area manager.

Site-level administration, the majority of fee collection activities and management of field staff is based from the office at St. Herman's Blue Hole National Park itself.

As part of its ongoing strategic goals for 2014 – 2019, BAS is seeking to improve financial sustainability and increase general awareness of and support for BAS's work.

Administration
Accounting
Human Resources ▪ Capacity Building of staff
Financial Sustainability ▪ Entrance fees ▪ Concessions ▪ Rental of headlights ▪ Gift shop ▪ Donations
Communication and Collaboration ▪ Workshops and Meetings ▪ Collaboration ▪ Reporting ▪ Media / PR ▪ Formal Agreements
Monitoring and Evaluation ▪ Management Effectiveness ▪ Management Plan assessment

Table …: Sub-Programs of the Administration Programme

Key Strategic Goals
▪ Improve organizational effectiveness
▪ Improve BAS' visibility and messaging across various target audiences to generate more support for BAS and its work.

Administration Program	
Accounting and Records	
▪ *Accounting and Records*	▪ Prepare timely financial and management accounts and submit monthly ▪ Prepare quarterly report on use of annual budget, for submission to Executive Director and funding agencies ▪ Prepare, as necessary, project budgets and financial reports ▪ Continue maintaining accurate staff records
Human Resources	
▪ *Staff Management* ▪ *Capacity Building* ▪ *Volunteers*	*Staff Management* ▪ Ensure there are sufficient staff for effective visitor and natural resource management and monitoring – at least critical, but preferably optimal level ▪ Develop formal Orientation Package for all permanent staff, specific to SHBHNP *Capacity Building* ▪ Develop and implement site level Human Resource Development plan to maximise on present staff abilities, identifying key trainings (e.g. Hospitality training, Green Laws training, presentation skills etc.) ▪ Build capacity of staff to understand the role SHBHNP plays in the landscape and NPAS ▪ Ensure that relevant staff are trained in simple accounting procedures, and use of computer ▪ Staff training in conducting visitor surveys and biodiversity monitoring *Volunteers* ▪ Provide a structured framework of activities for involvement of volunteers
Communication and Collaboration	

▪ *Communication*
▪ *Collaboration*
	Communication
	▪ Improve cross sectoral communication through a structured Communication Plan targeting
	  ▪ Local communities (leaders, women , students)
	  ▪ Tour Operators / tour guides
	  ▪ Adjacent landowners / farmers
	  ▪ Institute of Archaeology / NICH
	Collaboration
	▪ Establish multi-sector collaborations to better implement key conservation strategies targeting
	  ▪ Pesticide Control Board
	  ▪ Department of Agriculture
	  ▪ NGOs involved in management of fire and agrochemicals
	  ▪ Institute of Archaeology / NICH
	  ▪ Tour guides

Administration Program	
Emergency Planning	
▪ *Liability* ▪ *Hurricanes*	*Liability Risk* ▪ Assess liability issues at SHBHNP on an annual basis and integrate risk reduction, where feasible, into the annual workplan ▪ Ensure all staff have basic first aid training ▪ Ensure upkeep of all emergency and safety equipment ▪ Develop hurricane plan for SHBHNP, and update if and when necessary ▪ Ensure that all staff are aware of hurricane procedures before start of each hurricane season
Financial Sustainability	
▪ *Financial Sustainability*	▪ Conduct a financial review / cost-benefit analysis of past programme activities and outcomes ▪ Develop financial plan for SHBHNP for next five years to set course for economic sustainability – and implement
Planning and Reporting	
▪ *Planning* ▪ *Reporting* ▪ *Monitoring and Evaluation*	*Planning* ▪ Develop Operations Plan for forthcoming year, and submit each November *Reporting* ▪ Keep daily log of activities for SHBHNP, and prepare monthly report on enforcement activities, general situation report. ▪ Prepare site-level annual report as part of Cayo Parks reporting *Monitoring and Evaluation* ▪ Conduct annual management effectiveness assessment and submit to PA administration authority ▪ Re-evaluate management plan after 2½ years and 5 years ▪ Evaluation of workplan

3.5.5 Management Policies

Belize Audubon Society has a number of standard policies in place to assist management effectiveness, contained within the BAS Policy and Operations Manual (BAS, 2003, revised …). This includes well defined policies in the areas of transport, health and safety, community relations and advocacy, and also provides guidance on incident management and standard operating procedures.

3.6 Management Actions

Management action matrices have been combined within the six Management Programmes, for continuity. An annual workplan is developed by the protected area manager incorporating appropriate activities outlined under the framework of the management plan, and additional activities highlighted during the annual monitoring and evaluation process.

3.7 Monitoring and Review

Monitoring and review is essential in order to ensure that management is effective in achieving its objectives. This can be achieved through measuring success:

- Measuring Success:
    - measuring success in implementing the management actions
    - measuring success of the conservation strategies in addressing threats and increasing target viability.

Two matrices are used to facilitate this process:

- the Measures of Success of Implementation (whether the actions have been implemented successfully)
- the Measures of Success of Status (whether the actions, following implementation, have positively altered the status of the situation - i.e. been successful).

These matrices form the basis for the annual review of the management plan, so time should be taken to complete each one fully and as accurately as possible, using data from the monitoring programme. If this is maintained on an annual basis, then the handover should be a lot easier than has been in the past, should there be a change of manager.

Included is an example of the suggested structure for both matrices (Table … and Table …).

Table …: A. Natural Resource Management Programme - Implementation								
Measure of Success of Implementation								
N.B. It is important to note that the numerical values ascribed to the measures of success are not scores, but indicators of the stage of implementation		**1** No improvement on present status **2** Planning has started, but no implementation **3** Planning is completed, but no implementation **4** Implementation is started, but not yet completed **5** Implementation is completed or ongoing (continuous activities), activity has succeeded						**Comments:** Justification for Measure of Success score. Problems, concerns. Notes for inclusion in updated Management Plan
Management Activities		**Measure of Success**						**Comments:** Justification for Measure of Success score. Problems, concerns. Notes for inclusion in updated Management Plan
		Year						
Activity		**1**	**2**	**3**	**4**	**5**	**Desired Status**	
Surveillance and Enforcement								
A1	Maintain effective demarcation and maintenance of protected area boundaries and adequate signage						Survey lines are maintained. Boundary signs are in place and maintained	The newly opened survey lines have resulted in increased accessibility and increased incursions. This should be taken into account
A2	Ensure national shape file of the National Park is correct						Errors in the protected area shapefile have been corrected. This is reflected in the national (LIC) shapefile	New survey completed in 2014 – need to ensure that LIC has integrated the new shapefile into the NPAS shapefile
A3	Ensure there is adequate information available for all stakeholders and users on the rules and regulations being enforced						Stakeholders are fully aware of the location of the survey lines and the rules and regulations of the protected area	
A4	Implement strategic surveillance and enforcement activities to prevent illegal incursions and activities - 2 to 3 patrols per month						3 patrols (or more) are conducted per month to ensure illegal incursions are not occurring	Currently an average of one patrol every two months. Limited by limited personnel

Table ..: A. Natural Resource Management Programme - Status								
Measure of Success - Status								
It is important to document clearly the status of each Activity whilst developing Annual Operation Plans, as this allows highlighting of areas that need prioritization								
Management Activities		**Present Status (2015)**	**Status (2016)**	**Status (2017)**	**Status (2018)**	**Status (2019)**	**Status (2020)**	**Desired Status**
	Activity							
General Biodiversity Management								
A1	Maintain effective demarcation and maintenance of protected area boundaries and adequate signage	Survey lines are cleared. Some						Survey lines are maintained. Boundary signs are in place and maintained
A2	Ensure national shape file of the National Park is correct	Protected area has been resurveyed.						Errors in the protected area shapefile have been corrected. This is reflected in the national (LIC) shapefile from NPAS
A3	Ensure there is adequate information available for all stakeholders and users on the rules and regulations being enforced	Most stakeholders know that SHBHNP is a protected area, but are not familiar with the survey lines away from the road, and all the rules and regulations.						Stakeholders are fully aware of the location of the survey lines and the rules and regulations of the protected area

4.7 Timeline

A five year timeline provides guidance for implementation of the management plan, but should be considered adaptable, as the management context changes over the years. The timeline provides a framework against which implementation effectiveness can be measured. This ensures orderly and planned implementation of activities throughout management plan period (Table…).

The annual workplan is developed from the timeline by the Park Manager and Assistant Park Manager at the end of each year. This workplan also enables Belize Audubon Society to budget the outlay required for the coming year against activities the Society would like to achieve.

Natural and Cultural Resource Management Program						
Management Activity	**Notes**	**Year**				
		1st	**2nd**	**3rd**	**4th**	**5th**
Surveillance and Enforcement						
Maintain effective demarcation and maintenance of protected area boundaries and adequate signage	**Responsible:** Site Manager					
Ensure national shape file of the National Park is correct	**Responsible:** Cayo Parks Manager					
Ensure there is adequate information available for all stakeholders and users on the rules and regulations being enforced	**Responsible:** Site Manager					
Implement strategic surveillance and enforcement activities to prevent illegal incursions and activities - 2 to 3 patrols per month	**Responsible:** Site Manager					
Ensure effective, fair enforcement of the laws	**Responsible:** Site Manager, Cayo Parks Manager					
Collaborate with the Forest and Police Departments, Institute of Archaeology and Tourism Police for strengthened surveillance and enforcement within the National Park	**Responsible:** Cayo Parks Manager					
Ensure adequate field staff are available for effective surveillance and enforcement activities in SHBHNP	**Responsible:** Site Manager, Cayo Parks Manager					
Ensure all staff are aware of the rules and regulations of the pa, and trained for effective surveillance, enforcement and evidence management	**Responsible:** Site Manager					
Ensure all staff are aware of the critical role they and the protected areas play in maintenance of environmental services, local livelihoods and biodiversity	**Responsible:** Site Manager, Cayo Parks Manager					

Natural and Cultural Resource Management Program						
Management Activity	**Responsible Party**	**Year**				
		1st	**2nd**	**3rd**	**4th**	**5th**
Surveillance and Enforcement						
Ensure all staff are adequately equipped for surveillance and enforcement activities (uniforms, boots etc.)	Site Manager Cayo Parks Manager					
Improve radio communications for patrol safety	Site Manager Cayo Parks Manager					
Strengthen mechanisms to monitor and track incursions, including incorporation of GIS and identification of hotspot areas and times requiring increased enforcement effort / targeted patrols and implement patrols accordingly	Site Manager Cayo Parks Manager					
Conduct an annual overflight with LightHawk of SHBHNP and adjacent landscape	Site Manager Cayo Parks Manager					
Ensure all tour guides using SHBHNP are aware and supportive of regulations, guidelines and rationale for the National Park	Site Manager Cayo Parks Manager					
Seek support from community leaders in addressing community-originated hunting and logging incursions	Site Manager Cayo Parks Manager					
Increase community compliance for regulations of SHBHNP through improved awareness of the ecosystem services and economic benefits of the National Park to the communities	Site Manager Cayo Parks Manager					
Visitor Management and Safety						
Ensure that the caves are managed to the Standards for Health and Safety in Archaeological Reserves and Parks.	Site Manager Cayo Parks Manager					

Natural and Cultural Resource Management Program						
Management Activity	**Responsible Party**	**Year**				
		1st	**2nd**	**3rd**	**4th**	**5th**
Visitor Management and Safety						
Inform all community members and visitors of rules and regulations when visiting SHBHNP through information dissemination (verbal and displayed) at entrances to pa	Site Manager					
Implement strategic surveillance of caves to enforce SHBHNP visitor guidelines	Site Manager					
Ensure all cave-focused regulations and visitor guidelines are clearly displayed at the entrance to each cave	Site Manager					
Enforce BTB regulations for cave tubing and cave visitation to Crystal Cave in collaboration with BTB – guide:visitor ratios, equipment requirements, guide permits etc.	Site Manager					
Increase staff presence at cave mouths and in-cave patrols to encourage tour guide and visitor best practices, ensure visitor-guide ratios are enforced and groups keep to prescribed routes	Site Manager					
Develop and implement a site specific tour guide course and certification / permit for Crystal Cave, in collaboration with IoA and BTB	Site Manager Cayo Parks Manager					
Set limits on the number of tour guides and visitors using Crystal Cave in any one day / at any one time	Site Manager Cayo Parks Manager					
Develop and implement limits of Acceptable Change program for SHBHNP, with a particular focus on the caves and Blue Hole, and with participation of SHBHNP tour guides and IoA	Site Manager Cayo Parks Manager					

Natural and Cultural Resource Management Program						
Management Activity	**Responsible Party**	**Year**				
		1st	**2nd**	**3rd**	**4th**	**5th**
Visitor Management and Safety						
Re-evaluate open-access to St. Herman's Cave and develop organizational guidelines for improved management, based on visitor safety and appreciation, and outputs of re-evaluation	Site Manager Cayo Parks Manager					
Improved visitor management and safety at the Blue Hole, with on-site staff presence trained in life-saving and First Aid / CPR	Site Manager Cayo Parks Manager					
Ensure all trails have infrastructure for increased visitor management and safety	Site Manager Cayo Parks Manager					
Develop written policies for visitor management at SHBHNP based on Limits of Acceptable Change planning, national Standards for Health and Safety in Archaeological Reserves and Parks	Site Manager Cayo Parks Manager					
Priority Conservation Targets						
General						
Ensure staff are aware of and understand the conservation targets and the role of enforcement and surveillance in ensuring their effective management	Site Manager Cayo Parks Manager					
Ensure clear communication, liaison and collaboration between rangers and science staff for the effective management of conservation targets	Site Manager Cayo Parks Manager					
Forest Ecosystems						
Develop a legal agreement with CIL for long term maintenance of forest in area identified as critical for forest connectivity	Cayo Parks Manager BAS Executive Director					

Natural and Cultural Resource Management Program						
Management Activity	**Responsible Party**	**Year**				
		1st	**2nd**	**3rd**	**4th**	**5th**
Priority Conservation Targets						
Forest Ecosystems						
Build awareness of stakeholders of the importance of forest connectivity for forest health and ecosystem services	Site Manager Cayo Parks Manager					
Increase staff and community awareness of the issues associated with the illegal wildlife trade, particularly in primates and other animals, in collaboration with the Forest Department, though presentations in the local communities	Site Manager Cayo Parks Manager					
Water Systems						
Liaise with the Pesticide Control Board and local farmers to determine which agro-chemicals are in use in the adjacent landscape, and on what scale	Site Manager Cayo Parks Manager					
Collaborate with the Department of Agriculture, Pesticide Control Board , Maya Mountain Cacao, Citrus Growers Association, farmers and other stakeholders to identify mechanisms for reducing agro-chemical contamination of water bodies	Site Manager Cayo Parks Manager					
Develop a response plan for implementation if there are plans for alteration of the water course in the upper Caves Branch Valley	Cayo Parks Manager					
Encourage farmers to retain riparian vegetation along water courses in the upper Caves Branch Valley	Site Manager Cayo Parks Manager					
Monitor river impacts – gravel mining, irrigation, use of fish poisons – both up and downstream	Site Manager Cayo Parks Manager					

Natural and Cultural Resource Management Program						
Management Activity	**Responsible Party**	**Year**				
		1st	**2nd**	**3rd**	**4th**	**5th**
Priority Conservation Targets						
Caves						
Continue to build capacity of and engage tour guides for good stewardship of the caves and archaeological artefacts	Site Manager Cayo Parks Manager					
Demarcate access routes in Crystal Cave to avoid trail braiding and excessive damage	Site Manager Cayo Parks Manager (with participation of Tour Guides)					
Implement in-cave surveillance patrols to enforce guide regulations and prevent visitor impacts in caves.	Site Manager					
Identify effective mechanisms for preventing unguided access beyond the 200 yrd point in St. Herman's Cave without a guide	Site Manager Cayo Parks Manager					
Fire Management						
Develop a fire management plan in collaboration with agencies already active in this area	Site Manager Cayo Parks Manager					
Train staff and local tour guides in fire management	Site Manager Cayo Parks Manager Consultant					
Ensure SHBHNP has fire-fighting equipment on site and accessible if fire becomes an increasing risk to the protected area,	Site Manager Cayo Parks Manager					
Develop effective communication with and engagement of local farmers in high fire risk areas adjacent to SHBHNP towards reducing fire risk	Site Manager Cayo Parks Manager					
Provide ongoing fire management training for farmers in high risk area (Ringtail)	Site Manager Cayo Parks Manager					

Natural and Cultural Resource Management Program						
Management Activity	**Responsible Party**	**Year**				
		1st	**2nd**	**3rd**	**4th**	**5th**
Site Infrastructure and Maintenance						
Investigate mechanisms for securing land by the Blue Hole car park in the long term	Cayo Parks Manager Executive Director					
Maintain HQ site – buildings and landscaping – on an ongoing basis	Site Manager					
Upgrade / professionalise HQ office, equipment and furniture	Cayo Parks Manager					
Maintain trail system (quarterly) and improve where necessary for improved visitor safety, education and satisfaction (e.g. handrails, steps, benches)	Site Manager					
Increase regulatory, interpretive and directional signage	Site Manager Cayo Parks Manager					
Ensure SHBHNP has the equipment for effective site maintenance, with scheduled, proactive maintenance, and training in staff in best practices for equipment use	Site Manager Cayo Parks Manager					
Upgrade visitor management and safety infrastructure in caves (signs, thicker ropes replacing ribbons, reflectors…)	Site Manager Cayo Parks Manager					
Construct new Visitors Centre with educational displays, interpretive information	Site Manager Cayo Parks Manager					
Construct showers near Blue Hole, for removal of sun cream and insect repellent before swimming	Site Manager Cayo Parks Manager					
Upgrade restrooms	Site Manager					
Increase the number of picnic tables at both the HQ and Blue Hole entrance (6 at each)	Site Manager Cayo Parks Manager					
Modify current Warden House to accommodate at least two researchers	Site Manager Cayo Parks Manager					

Natural and Cultural Resource Management Program						
Management Activity	**Responsible Party**	**Year**				
		1st	**2nd**	**3rd**	**4th**	**5th**
Reporting						
Maintain patrol log books for SHBHNP	Site Manager					
Produce patrol reports, as required by BAS and the Forest Department	Site Manager Cayo Parks Manager					
Produce annual reports as required by BAS and the Forest Department	Site Manager Cayo Parks Manager					

4.9 Financing

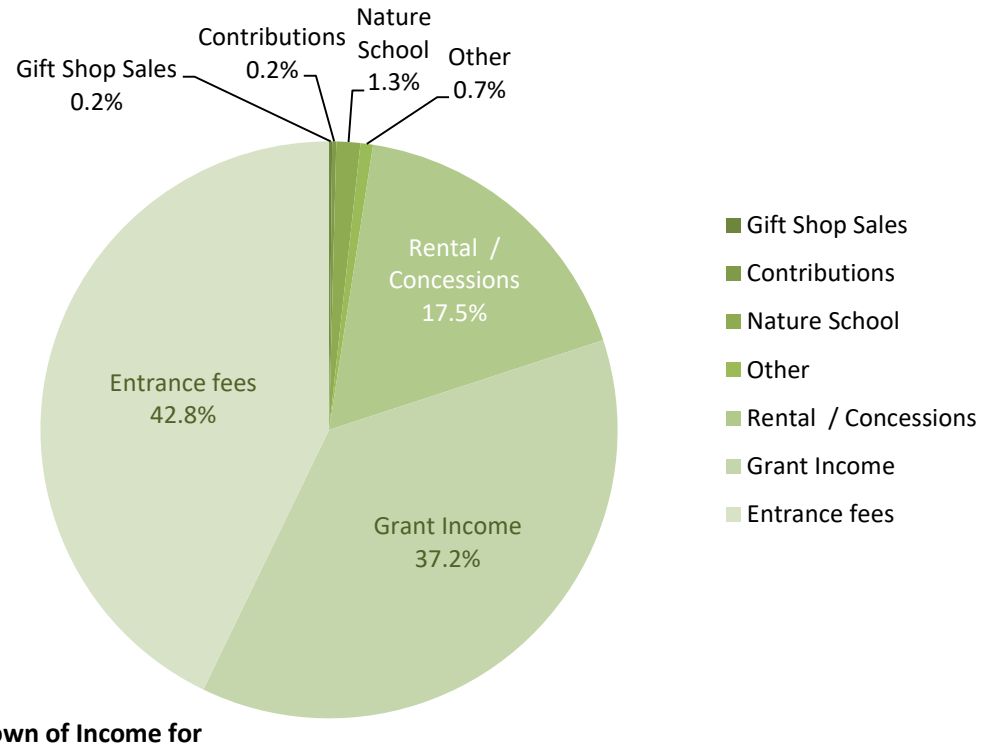
BAS faces ongoing challenges in securing the necessary finances to continue and further develop its management of the protected areas under its custodianship. As with most participants in the conservation process in Belize, BAS has developed the management of the parks under its mandate, its staff and as an institution, largely upon external grants and, more recently, with the re-investment of entrance fees. As the leading national environmental NGO, entrusted by the Government of Belize to manage some of the most prominent national protected areas, BAS has a good record of success in securing international funding to support its management of the parks.

Financial Assessment

This funding analysis uses income and expenditures in 2014 to provide a financial snapshot of total management costs across the different management programmes. This forms the basis for an Activity Based Cost analysis, to present a cost accounting of how BAS allocates its resources for St. Herman's Blue Hole National Park, and identify funding gaps and funding priorities. The protected area has an on-site staff team of six focused on site level activities, supported by management staff in Belize City active in other programme areas – education, awareness, community liaison and administration and finance. This off-site support is calculated at 7% of total organizational expenditures.

Income: In 2014, SHBHNP was able to generate the funds required for implementation of activities within the protected area, with a surplus of Bz$61,020.98. 42.8% of income in 2014 was derived from entrance fees, with a further 17.5% generated by concessions and equipment rental (including rental of tubing equipment and concessions for office space for local tour operators). Gift shop sales, income from the Nature School programme, donations and miscellaneous income (Other) also contributed 2.4% towards total protected area income (BAS data, 2015).

The income from entrance fees and other direct sources is supplemented by grant support from a variety of sources. In 2014 / 2015, this has been largely through a two-year, medium sized grant for "*Enhancing St Herman's Blue Hole National Park (SHBHNP) through new infrastructure, mapping and management planning*" from the Protected Areas Conservation Trust (PACT), a statutory body providing a financial mechanism for funding national protected areas. This project funding will permit St. Herman's Blue Hole National Park to fulfil its role within the National Protected Areas System as a focal destination for building awareness of the role and benefits of the National Protected Areas System and the environmental services they provide.

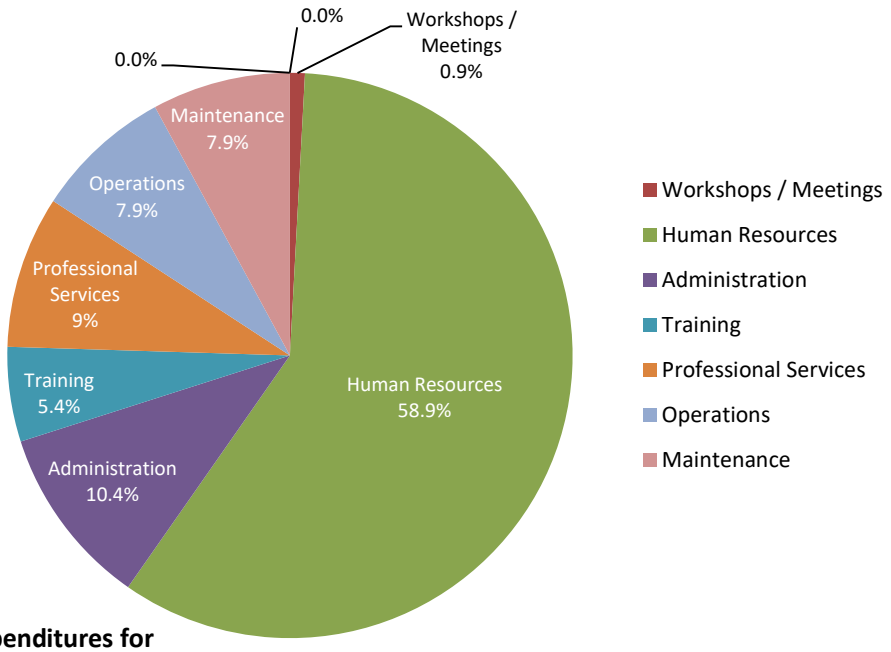


Breakdown of Income for

BAS is also able to access funds from international agencies for implementation of strategies across all BAS managed protected areas, with activities supported through inclusion of St. Herman's Blue Hole National Park in projects under the Research and Monitoring and Education and Awareness programmes. Belize Audubon Society has been able to maintain loyal donor support, with consecutive grants from a number of international donor agencies over the years.

Income for St. Herman's Blue Hole National Park contributed approximately 7% towards total BAS total income in 2014.

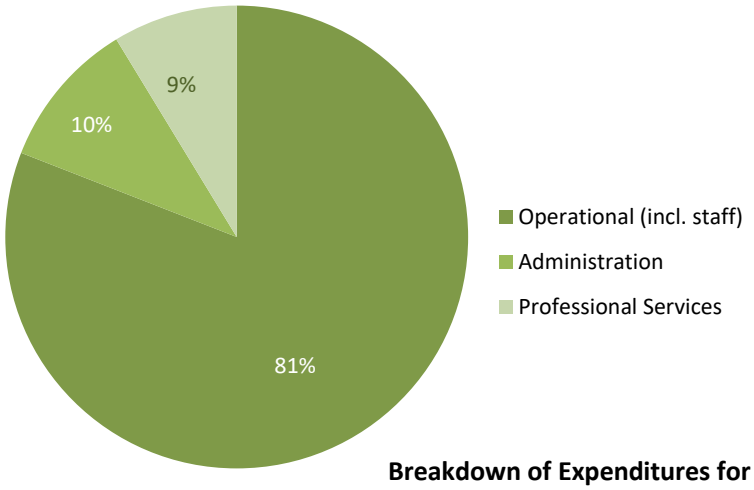
Expenditures: In 2014, total expenditure for St. Herman's Blue Hole National Park is estimated at approximately Bz$181.470 (exclusive of contributions to organizational audit, depreciation, bank charges and membership fees). A breakdown of site-specific expenditures for 2014 across eight general accounting areas shows that Almost 60% of funds are allocated to staff costs (salaries, social security, insurance and casual labour), with other expenses being relatively evenly spread between five other expenditure categories – Administration, Professional Services, Operations, Maintenance (of site, infrastructure, equipment and vehicles), and Training (BAS data, 2015).



Breakdown of Expenditures for

Operational Expenditures vs Investments: Operational expenditures are the recurring costs necessary to fund operations – salaries, equipment costs, maintenance activities and supplies, fuel etc. In 2014, approximately 69% of funding was allocated to operational costs, with a further 17% to administration and 5% for Capacity Building and Training.

Investment expenditure is contained within project expenditures, with projects (activities outside the general operational focus) contributing 9% towards total expenditures in 2014. This will increase significantly in 2015, with the construction of a new Nature Centre, and investment in improvements to key infrastructure – the Blue Hole visitors' deck and showers being two key examples. The 2015 budget breakdown reflects this increased focus in investment for the



Breakdown of Expenditures for

protected area, with approximately Bz$170,000 (45% of the 2015 Natural Resource Management Programme budget) allocated for infrastructure.

Personnel: With a Full Time Equivalent (FTE) staffing level of 6.08, St. Herman's Blue Hole National Park is operating below critical status, requiring an additional 1.08 FTE to meet the current operational commitments. Several activities are constrained due to limited staff availability – including critical surveillance and enforcement activities. This is being addressed to some extent through collaborative patrols with the Tourism Police Unit and the Belize Defence Force, though these collaborations would need significant strengthening as a long term solution, and would still not address rapid response to specific situations.

Under-staffing is also impacting management of visitors using the Blue Hole and St. Herman's Cave. The limited supervision in high risk and high fragility areas increases potential safety risks and visitor impacts on the environment and increasing impacts to the caves.

Optimal operations would require nine on-site staff to ensure effective visitor management and surveillance and enforcement. The increased focus on community engagement and presence in local schools and hosting of school trips from throughout Belize will also require increased staff time to ensure the key messages are being transferred effectively.

Programme Based Analysis

The activity based cost analysis is structured around the four management programmes:

- Natural Resource Management
- Research and Monitoring
- Education and Awareness
- Administration

It should be borne in mind that all programmes of a Management Plan are interconnected over space and time, supporting each other and forming a whole that is greater than the single parts. As such, management programmes cannot be considered individually, but must be seen in terms of a bigger picture – the integrated management of St. Herman's Blue Hole National Park, towards achieving the protected area vision.

In the financial planning process, expenditures and staff time (FTE) are allocated to specific programmes /programme areas, to provide an assessment of individual programme management costs, and assist

Critical (or 'Mission Critical'): The minimum level of operations and resources identified to meet the basic programme requirements and provide a basic level of protection of natural and cultural resources

Optimal: The ideal future state of operations if all necessary funds, personnel and other resources are

in the identification of cost drivers, funding gaps and priorities. Critical and optimal levels of operation for each programme have been determined, as has the current level of achievement, and the input required to reach both critical and optimal levels, providing the basis for the gap analysis.

Seven months of structured data on site staff time allocation has been established for St. Herman's Blue Hole National Park (October to April 2014). This demonstrates that the majority of staff time (60%) is spent on implementation of activities under the Natural Resource Management Programme. The other three programmes (Research and Monitoring, Education and Awareness and Administration) all use very little staff time – a total of 10.5%. 30% of staff time is spent on activities unrelated to the four programme areas, such as staff training and capacity building.

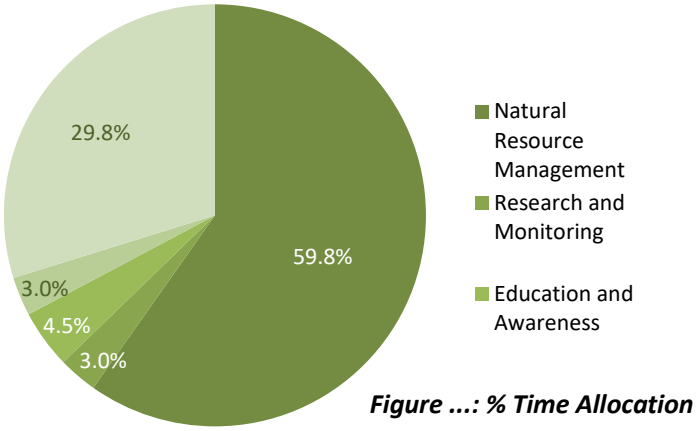


Figure ...: % Time Allocation per Programme Area

Metrics have also been created to measure effectiveness of outputs within each programme, based on the current, critical and optimal levels identified (Annex ..). Using this as a framework, the outputs of the financial planning process provide information on expenditure in relations to staff time, non-personnel expenditures and investments per programme area, for the year 2014. A % effort / effectiveness is allocated for each category – current, critical and optimal – to reflect the state to be achieved. For example:

Programme Metrics	Current Status	Mission Critical	Optimal State
Illegal incursions are reduced by 100% to 0 per year	30%	80%	100%

Example: SHBHNP was considered to be only 30% effective at addressing illegal incursions in 2014. Mission Critical status would be an 80% effectiveness level, reducing incursions, but being realistic in what can be achieved with limited staff and equipment. The optimal level would be 100%, with zero illegal incursions, based on sufficient staff and equipment, and a high level of engagement of local communities. Critical and optimal needs are then identified and a cost estimate calculated. The identified gaps can then be calculated between current expenditure and critical needs (the amount of additional funding required to meet minimal acceptable standards per programme), and between current expenditure and the optimal status (highlighting the additional resources for operations to be at an optimal level).

Notes:

- Contribution of SHBHNP to organizational expenditures is calculated at approximately 7%
- This assessment focuses primarily on site-specific activities and needs – not those covered by other BAS support programmes (e.g. the Research and Monitoring and Environmental Education and Awareness programmes)
- FTE includes only site-based staff – not the Protected Area Manager (who oversees two Cayo parks, including St. Herman's Blue Hole National Park), nor managers of centralized (Belize City-based) programmes (e.g. the Research and Monitoring and Environmental Education and Awareness programmes)
- Gaps are approximate, providing a starting point for planning, and have been calculated based on best available information. Changes in the operational context will result in changes in the scale of the gaps, and a need for reassessment of the situation.
- Infrastructure and maintenance are included under the Natural Resource Management Programme
- Costs associated with non-programme expenses, primarily for capacity building and training activities, are separated as "Other"

St. Herman's Blue Hole National Park: Summary (Bz$)										
	Current (2014)		Required per annum				Gap			
	Total		*Critical*		*Optimal*		*Critical*		*Optimal*	
	FTE	***Funds***	***FTE***	***Funds***	***FTE***	***Funds***	***FTE***	***Funds***	***FTE***	***Funds***
Natural Resource Management Program	3.57	150,081	5.00	210,000[1]	6.00	258,875[1]	1.43	59,919	2.43	108,794
Research and Monitoring Program	0.18	2,000	0.50	10,000[2]	0.75	25,000[2]	0.32	8,000	0.57	23,000
Environmental Education and Awareness Program	0.27	750	0.50	4,400	1.25	6,400	0.23	3,650	0.98	5,650
Administration	0.27	18,813.17	0.30	20,000	0.40	20,000	0.03	1,187	0.13	1,187
Capacity Building for staff	1.80	9,825	1.80	10,000	1.80	12,000	0.00	175	0.00	2,175
Total	**6.09**	**181,469**	**8.1**	**254,400**	**10.20**	**322,275**	**2.02**	**72,931**	**4.11**	**140,806**

[1] Additional to this is the approximately Bz$170,000 investment in infrastructure in 2014 / 2015

[2] Excludes the construction of accommodation for two researchers on site

Available: Based on 2014 expenditures

Critical: Considered the minimum for basic program requirements

Optimal: The ideal future state if funds were not an issue

FTE: Full time equivalent: the number of working hours that represents one full-time employee during a specific time period (one year), per programme requirement.

Financial Assessment: Natural Resource Management Programme

The Natural Resource Management Programme focuses on the protection and maintenance of the karstic formations, terrestrial and aquatic ecosystems and biodiversity of St. Herman's Blue Hole National Park. This is achieved through the implementation of surveillance and enforcement, visitor management and biodiversity / ecosystem conservation strategies. As SHBHNP increasingly important as a visitor destination, with predicted increased visitor management.

Program Goal: *The maintenance of healthy, functional ecosystems, protection of biodiversity, and intact geological and archaeological features, through surveillance and enforcement, visitor management and direct biodiversity management interventions where required, supported by essential infrastructure, equipment and maintenance.*

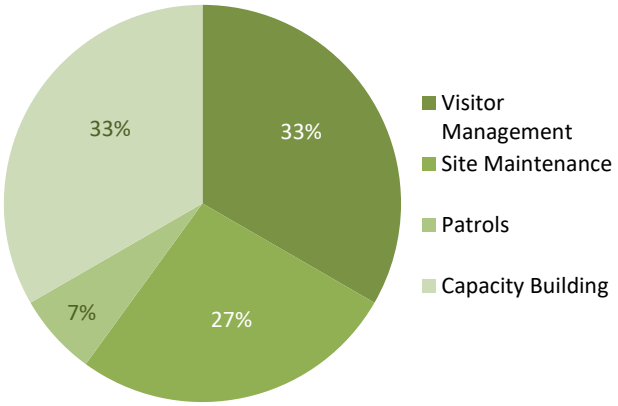
Key Programme Areas:

- Surveillance and Enforcement
- Visitor Management and Safety
- Management of Conservation Targets
- Site Infrastructure and Maintenance

Programme Goals:

- Illegal incursions are reduced by 100% to 0 per year
- Reduced potential risk to visitors, with zero accidents requiring medical care or resulting in legal action
- 0% of natural ecosystems within SHBHNP are impacted by fire
- Visitor impacts to geological formations and archaeological artefacts are reduced to as near zero as possible
- Forest connectivity with the Maya Mountains Massif is maintained
- Reduced water contamination from 2015 levels
- Infrastructure is adequate and appropriate for the level of use required

The 2014 assessment indicates that in terms of outputs, current staffing levels are not sufficient to achieve fully effective management of the protected area. Critically under-manned areas are



those associated with surveillance and enforcement presence, visitor risk management at the Blue Hole and in the caves, and management of visitor impacts in fragile cave environments.

Until recently, there have been very few illegal activities / incursions into the protected area, but clearance of survey lines and logging activity near the boundaries have improved access for illegal hunting and logging. Current surveillance and enforcement activities utilize only 7% of Natural Resource Management time (0.1FTE), and are considered to be at only 30% required implementation. They are therefore considered insufficient for effective management. Increasing surveillance activity is, however, currently constrained by the limited staff availability for patrols, with the need for staff presence in high visitor use areas for effective visitor management.

With the infrastructure investments planned and funded for 2015 (including a Nature Centre at the SHBHNP HQ and improved visitor facilities by the Blue Hole), the greatest remaining gaps are identified as the need for:

- three further field staff to enable increased number of patrols (an increase from one to three a month), active visitor management, reduced visitor impacts in fragile environments, and improved risk reduction at the caves and Blue Hole

- the development of a Limits of Acceptable Change program, site-specific guide training, and certification for guiding adaptive management of visitor impacts, particularly within the fragile Crystal Cave system, to be conducted with the participation of tour guides

- investment in the development of a Fire Management Plan, with staff training, training of volunteers, engagement of farmers for improved fire management practices and purchasing of equipment to be stationed at the SHBHNP HQ – particularly in view of the predicted increasing impacts of climate change, and the increasing proximity of cleared agricultural land

- Maintenance of forest connectivity with the Maya Mountains Massif

There are also other, less critical gaps identified under the conservation planning activities, including:

- improving agrochemical use practices in the adjacent landscape through engagement of farmers and land owners, and developing partnerships with the Pesticide Control Board and the Department of Agriculture.

If critical expenditures were met:	**If optimal expenditures were met:**
▪ Increased protection of biodiversity and improved long term biodiversity viability ▪ Reduced visitor impacts to cave formations and archaeological artefacts ▪ Reduced risk to visitors in high risk locations –	▪ Critical implications, plus: ▪ Reduced water contamination from 2015 levels

Blue Hole and caves ▪ Reduced risk of fire impacts to SHBHNP ecosystems ▪ Improved visitor satisfaction and increased visitation	

St. Herman's Blue Hole National Park: Natural Resource Management Programme (Bz$)										
	Available		Required				Gap			
	Total		Critical		Optimal		Critical		Optimal	
	FTE	Funds	FTE	Funds	FTE	Funds	FTE	Funds	FTE	Funds
Natural Resource Management Program	3.57	150,081	5.00	210,000[1]	6.00	258,875[1]	1.43	59,919	2.43	108,794

[1]This is exclusive of investment of approximately Bz$170,000 for infrastructure development, including construction of the Nature Centre, Observation Tower and Shower Block. Funds have been located for 2015 for this investment, leaving a balance of approximately: Critical: Bz$55,250 and Optimal: Bz$105,625.

St. Herman's Blue Hole National Park: Natural Resource Management Programme Metrics				
Programme Metrics	**Current Status**	**Mission Critical**	**Optimal State**	**Comments**
Illegal incursions are reduced by 100% to 0 per year	30%	80%	100%	Current patrols 1 per month. Critical 3 per month. Optimal 4 per month or more. Improved patrol equipment. Increased staff availability for patrols
Zero visitor accidents requiring medical care or resulting in legal action	40%	80%	100%	Need staff presence at Blue Hole / mouth of Crystal / St. Herman's Cave - limited by available human resources. Challenges addressed of management of self-guided visitors beyond 200 yards, SHC. Engaged tour guides using best practices.
Visitor impacts to geological formations and archaeological artefacts are reduced to as near zero as possible	40%	80%	100%	Implementation of cave visitation policies in Crystal Cave. Need surveillance and enforcement presence at Crystal / St. Herman's Cave - limited by available human resources. Challenging to monitor self-guided visitors beyond the 200 yards in SH Cave. Need Limits of Acceptable Change program, engaged tour guides using best practices, improved use of ropes, reflectors, signs etc. in caves.
0% of natural ecosystems within SHBHNP are impacted by fire	50%	70%	100%	Fire risk is reduced through increased fire awareness in the adjacent landscape. SHBHNP has the man power and a trained and engaged volunteer team of farmers and tour guides. Some manpower available from SHBHNP and tour guides for fighting fires. Need fire management plan, training, and equipment.
Forest connectivity with the Maya Mountains Massif is maintained	100%	100%	100%	Forest connectivity is currently through private land - need conservation easement or similar for legal maintenance and security of connectivity.
Reduced water contamination from 2015 levels	0%	20%	100%	Need increased awareness and use of best practices for agrochemical application in the adjacent landscape. Need to engage key farmers for improved application practices and improved maintenance of riparian vegetation, in the adjacent landscape.
Infrastructure is adequate and appropriate for the level of use required	50%	85%	100%	SHBHNP Nature Centre being constructed 2015. Improved visitor infrastructure to ensure improved education, safety and satisfaction of visitors - continued improvement of trail infrastructure, additional picnic tables

Financial Assessment: Research and Monitoring Programme

The Research and Monitoring Programme has not been a high priority focus of past management activities at St. Herman's Blue Hole National Park, and has focused primarily on birds. Key research and monitoring activities have been identified during conservation planning, which provides more structured, prioritised guidance for this programme.

Program Goal: *The provision of accurate information to ensure effective, informed management of the National Park, and assessment of the effectiveness of the protected area in achieving its objectives.*

Key Programme Areas:

- General
- Baselines and Monitoring
- Collaboration and Communication
- Research Infrastructure

Programme Goals:

- Baselines have been developed for management planning and conservation planning indicators
- Limits of Acceptable Change indicators have been established and are being monitored to measure visitor impacts
- Active, consistent and ongoing biodiversity monitoring programme is developed and being implemented to provide data on management plan and conservation plan indicators
- Data from monitoring of national indicators (Management Effectiveness species and National Research Agenda) is contributing towards national datasets
- Research needs have been identified and 100% addressed through partnerships with researchers and universities

The 2014 assessment reflects the limited focus on research and monitoring at St. Herman's Blue Hole National Park, with only 2% of site staff time being allocated to research and monitoring activities, and 0.8% of the 2015 budget. A comprehensive monitoring plan for St. Herman's Blue Hole can now be developed based on the guiding framework of the conservation planning and identification of key indicators.

The highest priority gaps identified are:

- development of a site-level monitoring plan that integrates baseline information and monitoring protocols for management planning, LoAC, conservation planning and national biodiversity and threat indicators

- capacity building of staff for implementation of the monitoring activities

- ensuring dissemination of the results of monitoring activities

If critical expenditures are met:	**If optimal expenditures were met:**
▪ SHBHNP will have an effective monitoring programme for priority indicators, providing information to guide adaptive management and measure success ▪ SHBHNP will be using information from monitoring of LoAC indicators to minimize visitor impacts on the cave systems and Blue Hole ▪ SHBHNP data is being disseminated to guides and used in educational activities to better inform and engage visitors ▪ BAS has an identified list of priority research	▪ Critical implications, plus: ▪ BAS will be contributing to national monitoring datasets ▪ BAS is addressing priority research needs through national, regional and international partnerships

St. Herman's Blue Hole National Park: Research and Monitoring Programme (Bz$)										
	Available		Required				Gap			
	Total		Critical		Optimal		Critical		Optimal	
	FTE	Funds	FTE	Funds	FTE	Funds	FTE	Funds	FTE	Funds
Research and Monitoring Program	0.18	2,000	0.50	10,000	0.75	25,000[2]	0.32	8,000	0.57	23,000

[2]Excludes construction of accommodation for two researchers on site

St. Herman's Blue Hole National Park: Research and Monitoring Programme Metrics				
Programme Metrics	**Current Status**	**Mission Critical**	**Optimal State**	**Comments**
Baselines have been developed for management planning and conservation planning indicators	20%	50%	100%	Critical: Water quality (including agrochemicals and *E. coli*), forest cover, mammals, birds, fish, reptiles and amphibians, cave species. Optimal: The above + weather station, plant species, invertebrates. Need staff time and basic equipment (including water quality monitoring equipment), training.
Limits of Acceptable Change indicators have been established and are being monitored to measure visitor impacts	0%	100%	100%	For both caves and trails. Need to establish photographic baseline record of cave features and artefacts. Need to develop and implement monitoring programme for LoAC indicators, monitoring equipment, training for staff.
Active, consistent and ongoing biodiversity monitoring programme is developed and being implemented by trained staff, providing data for adaptive management	20%	50%	100%	Bird monitoring is ongoing. Need staff training and equipment for accurate data collection for monitoring management plan / conservation plan / LoAC indicators. Need to ensure that the data is available for management decisions
Data from monitoring of national indicators (Management Effectiveness species and National Research Agenda) is contributing towards national datasets	5%	50%	100%	Little data being produced at the moment. Monitoring programme should include national indicators if they fit within the time and financial budget for the monitoring programme.
Dissemination of data	5%	50%	100%	Need to ensure there is a mechanism for disseminating the outputs to national monitoring programmes, tour guides, local communities
Research needs have been identified and addressed through partnerships with researchers and universities	10%	50%	100%	Development of baselines, information on caves and cave species. Adaptation of Ranger's House to provide accommodation for researchers.

Financial Assessment: Education and Awareness Programme

Whilst St. Herman's Blue Hole National Park is highlighted as important in its role in the National Protected Areas System for providing education and raising awareness, these activities have not been an ongoing focus of on-site protected area management activities in the past. Environmental education is managed centrally, from Belize City, and includes components such as the Nature School programme and Earth Day activities. However, with the increasing need to engage stakeholder communities, and to continue strengthening awareness through effective transmission of key conservation messages to school groups and the general public, implementation of site-level education and awareness activities will become more important in the coming five years.

Program Goal: *Building knowledge, skills, and experience to create more environmentally responsible citizens.*

Key Programme Areas:

- Environmental Education
- Community Outreach
- Strengthening Livelihoods

Programme Goals:

- 30% increased use of SHBHNP by Belizeans (families, general public, schools, students) as a vehicle for increasing awareness of basic environmental services concepts, biodiversity value, conservation and the National Protected Areas System
- 60% local community stakeholders surveyed recognize the role protected areas play in maintenance of ecosystem services
- 200% increase in implementation of SHBHNP-specific educational activities in community schools
- 200% increase in the number of local community students visiting the protected area
- Increased awareness of key concepts in at least 50% of visitors as a result of key messages transferred through interpretive information in the Nature Centre
- 100% of tour guides are site-certified and following best practices

Despite the large number of school visits, the 2014 assessment reflects a limited focus on site-level education activities at St. Herman's Blue Hole National Park, with only 4% of site staff time being allocated to site-level environmental education and awareness activities, and 0.3% of the 2015 budget.

The highest priority gaps identified are considered to be:

- Strengthening SHBHNP in its role of increasing awareness of basic environmental services concepts, biodiversity value, importance of conservation and maintenance of biodiversity and the National Protected Areas System, using the new Nature Centre as a vehicle

- increasing community engagement through improved communication with community leaders, teachers, community groups and activities in local schools

- strengthening of community livelihoods associated with the protected area – capacity building of tour guides, organizational strengthening of women and youth groups etc.

If critical expenditures are met:	**If optimal expenditures were met:**
▪ SHBHNP will have a significant, positive contribution to raising national awareness of biodiversity, ecosystem services and the value of the National Protected Areas System ▪ Adjacent communities and local stakeholders will be engaged and supportive of the protected area ▪ Strong, supportive tour guide sector supportive of BAS and SHBHNP management strategies ▪ International visitors will be engaged and financially supportive of BAS and conservation in Belize ▪ The next generation will be fully engaged as stewards of the natural environment	▪ Critical implications, plus: ▪ Community needs assessments highlight appropriate interventions that BAS can contribute towards or facilitate ▪ Agricultural sector is engaged towards reducing agrochemical pollution in the adjacent landscape

St. Herman's Blue Hole National Park: Environmental Education and Awareness Programme (Bz$)										
	Available		Required				Gap			
	Total		Critical		Optimal		Critical		Optimal	
	FTE	Funds	FTE	Funds	FTE	Funds	FTE	Funds	FTE	Funds
Environmental Education and Awareness Program	0.27	750.00	0.50	4,400	1.25	6,400	0.23	3,650	0.98	5,650

St. Herman's Blue Hole National Park: Environmental Education and Awareness Programme Metrics				
Programme Metrics	**Current Status**	**Mission Critical**	**Optimal State**	**Comments**
70% of local community stakeholders surveyed recognize the role protected areas play in maintenance of ecosystem services and human health	60%	75%	100%	Need to strengthen the links between SHBHNP and stakeholder communities, with increased activities to raise awareness. More meetings, more school activities, flyers distributed in the village, community open day. Part time education officer / community liaison -5 yr investment in community engagement
50% increased use of SHBHNP by Belizeans (families, general public, schools, students) as a vehicle for increasing awareness	60%	70%	100%	Focused on encouraging people to become conservation stewards, appreciating protected areas, Understand importance and role of SHBHNP and NPAS, basic environmental services concepts, biodiversity value, conservation and the National Protected Areas System. Quarterly meetings with teachers, open days, family days. Training of protected areas staff for interpretation / environmental education. Provide incentives for families to visit
200% increase in implementation of SHBHNP-specific educational activities in community schools	50%	75%	100%	Part time education officer / community liaison. Build capacity of staff. Need to increase frequency of activities in schools – develop awareness and environmental stewardship
200% increase in the number of local community students visiting the protected area	50%	75%	100%	Part time education officer / community liaison. Build capacity of staff. Need to increase meaningful visitation by schools to the area – structured interpretation,
Interpretive information in the Nature Centre results in increased awareness of at least 60% of visitors of key messages	25%	50%	100%	Need targeted key messages. Inspirational displays. Build capacity of staff for hospitality and interpretation. Pre and post visit surveys. Include provision for changing displays and encouraging repeat visits.
100% of tour guides are good stewards of the caves and follow best practices	10%	50%	100%	Need to continue engaging tour guides. Engage them in different activities to better manage cave system. Include them in management activities – see them as active partners

St. Herman's Blue Hole National Park: Environmental Education and Awareness Programme Metrics				
Programme Metrics	**Current Status**	**Mission Critical**	**Optimal State**	**Comments**
75% of illegal activities are mitigated through alternative livelihood for buffer zone communities, targeted on key impacting stakeholders.	20%	75%	100%	Discussion and community needs assessment, in liaison with education unit. Woman's group, farmers adjacent to St Herman's. Identification of livelihood options, provision of training.

Financial Assessment: Administration

Administration for St. Herman's Blue Hole National Park is managed at two levels – administration of site-level staff and activities, and centralized administration of the protected area as part of the BAS administrative portfolio, under its co-management agreement with the Belize Government.

Program Goal:

Key Programme Areas:

- Accounting
- Human Resource Management
- Financial Sustainability
- Communication and Collaboration
- Management Effectiveness

Programme Goals:

- SHBHNP has 100% of the staff required for effective management
- 100% of staff have the training required for effective implementation of the management plan
- SHBHNP is able to continue support of 100% of its operational costs
- 100% of visitors are aware that SHBHNP is part of the NPAS, and co-managed by BAS
- Management Effectiveness increases to 75% or above

The 2014 assessment reflects the current, comparatively limited focus on site-level education activities at St. Herman's Blue Hole National Park (as opposed to the current management of visiting school groups), with only 4% of site staff time being allocated to site-level environmental education and awareness activities, and 0.3% of the 2015 budget.

The highest priority gaps identified are considered to be:

- continued effective, accurate and transparent accounting
- ensuring staff continue to be provided trained to ensure effective implementation of the management plan

- maintaining and increasing financial sustainability of St. Herman's Blue Hole National Park

If critical expenditures are met:	If optimal expenditures were met:
▪ SHBHNP will continue to have effective and transparent accounting ▪ SHBHNP has sufficient staff for effective implementation of all programs of the management plan ▪ Staff have the training to ensure effective management	▪ Critical implications, plus: ▪ Stakeholders recognize SHBHNP as part of the NPAS and BAS as the co-management organization

St. Herman's Blue Hole National Park: Administration Programme (Bz$)										
	Available		Required				Gap			
	Total		Critical		Optimal		Critical		Optimal	
	FTE	Funds	FTE	Funds	FTE	Funds	FTE	Funds	FTE	Funds
Administration Program	0.27	18,813	0.30	20,000	0.40	20,000	0.03	1,187	0.13	1,187
Capacity Building	1.8	9,825	1.80	10,000	1.80	12,000	0.00	175	0.00	2,175

St. Herman's Blue Hole National Park: Administration Programme Metrics				
Programme Metrics	**Current Status**	**Mission Critical**	**Optimal State**	**Comments**
Maintain accurate accounting records	85%	100%	100%	BAS has good accounting procedures and maintain accurate accounting records.
100% of staff have the skills and capacity required for effective management of SHBHNP	80%	100%	100%	Almost 30% of man-hours were invested in capacity building in 2014 – training for surveillance and enforcement, bird monitoring and other training opportunities. Whilst this is of benefit, the high % of time may not be balanced well in the context of minimal patrols, limited staff and increasing needs of visitor management. For that reason, the FTE has been maintained at 1.80 and not increased, in the belief that the number of staff will increase.
SHBHNP has 100% of the staff required for effective management	60%	80%	100%	SHBHNP needs at least two more staff members to strengthen surveillance and enforcement / visitor management / risk reduction activities. A third, additional staff member will provide sufficient man-power to strengthen interpretive, education and awareness activities, and research and monitoring.
SHBHNP is able to continue supporting 100% of its operational costs	80%	80%	100%	Operational costs are currently covered largely by entrance fees. SHBHNP may need to locate additional funds if the national fee collection system is implemented.
100% of visitors are aware that SHBHNP is part of the National Protected Areas System, and co-managed by BAS	50%	80%	100%	Visitors are currently given an introduction that includes mention of BAS. Need to strengthen this (there is no data on visitor recognition of BAS, but there is low recognition in the stakeholder community of BAS's role in com-management of the protected area).
Management Effectiveness increases to 75% or above	10%	50%	100%	Current management effectiveness is assessed as 69.5% Implementation of the management plan will increase management effectiveness.

Annexes

Annex One	Assessment of success of previous management plan
Annex Two	2015 Management Effectiveness Score
Annex Three	Belize Standards for Health And Safety in Archaeological Reserves and Parks
Annex Four	Areas of alignment with the Natural Resource Management Research Agenda

1. Resource Management and Protection Program		
Objective	**Score**	**Comments**
1.1 A secure environment will be maintained for visitors.	3	Visitor security (primarily addressing theft, a major issue in the 1990's) has improved over the years, with a 24 hour presence, and the manning of a ranger post by the Blue Hole, and is no longer considered a major issue. There are, however, concerns for safety of visitors whilst swimming or caving, both potentially dangerous, as there are insufficient staff to station someone by the Blue Hole itself to prevent drowning, or by the entrance to the Crystal Cave. This could open the organization to liability issues.
1.2 The vegetative cover will be maintained.	4	The natural vegetation cover has been maintained, though seriously impacted by Hurricane Richard
1.3 The wildlife population will be protected.	3	With the increasing human footprint in the adjacent landscape and increased accessibility to the National Park (along logging trails, and along the newly opened boundary lines) the threat of hunting has increased, with increasing pressure on the wildlife populations
1.4 St. Herman's cave will be protected from looting, vandalism and overuse.	3	Surveillance of St. Herman's Cave is improved, though there are still issues with vandalism from time to time. There are concerns with the increasing, unregulated use of Crystal Cave
1.5 The Blue Hole will be protected from overuse, erosion, and pollution.	2	Infrastructure for access to the Blue Hole has improved protection of the surrounding vegetation and soils, but the number of visitors is impacting the aquatic biodiversity
1.6 The park will be protected from agrochemical runoff and drift.	1	No work has been done on reducing agrochemical runoff and drift, though it has been highlighted as a threat in the 2015 management plan
Average Score	***2.67***	
Scores *1: No change* *2. Implementation has started, but there are no successful outputs to date* *3. Partial success of implementation and outputs* *4. The objective has been successfully achieved*		

Annex One: Assessment of success of previous management plan

Comments:

- The Natural Resource Management Program achieved or partially achieved the majority of its objectives over the years, with an average score of 2.67 out of 4.00 (66.7%) for implementation and success of outputs.
- The strongest area of implementation success is maintenance of natural vegetation cover (Objective 1.2). – the values for which the protected area was first established.

- The weakest area of implementation has been addressing agrochemical pollution impacts (Objective 1.6).

2. Human Use Program		
Objective	**Score**	**Comments**
Recreation Sub-Program		
2.1 Recreation will be facilitated in a manner that is compatible with the natural and cultural environment	3	Generally, visitor management has improved over the years, though there still needs to be more control of visitor access to both St Herman's Cave and Crystal Cave, and to the Blue Hole
Tourism Sub-Program		
2.2 Visitors will be assisted in utilizing lodging, eating, and other facilities in the BHNP area.	3	Facilities are available in Armenia
2.3 Visitors will be assisted in being transported to BHNP.	3	Regular bus route
2.4 Local businesses, community groups, and other neighbors of BHNP will be assisted by having tourist business directed to them.	4	Local tour guides are organized and offering on-site guiding services. BAS has also worked to provide other groups (e.g. Women's groups) with opportunities, though with limited take-up by the groups.
2.5 International visitors will be assisted in having a cultural, as well as a natural history, experience.	4	Local tour guides ensure that tours cover cultural as well as natural history interpretation
Interpretation Sub-Program		
2.6 Visitors will have the opportunity to become oriented to park facilities and resources.	4	Visitors are provided with an orientation talk on arrival
2.7 Visitors will learn the importance of both the park and regional resources and why they deserve protection.	3	Some information is covered in the orientation talk, but a new Visitor Centre, to be built in 2015, will strengthen this considerably
Education Sub-Program		
2.8 An understanding and appreciation of BHNP's natural and cultural resources will be disseminated to neighbouring communities.	2	Socio-economic surveys of the stakeholder communities suggest that whilst there is an improving awareness of BHNP's resources, there needs to be more work within the communities to engage them further
2.9 BHNP will be integrated into the national environmental education effort.	3	SHBHNP is recognized in national assessments for its importance as an educational resource, and as a key destination for school trips. However, education

		activities in the stakeholder communities are limited

2. Human Use Program		
Objective	**Score**	**Comments**
Community Development Sub-Program		
2.10 The park will help provide employment and entrepreneurial opportunities for residents of surrounding communities	3	Local tour guides are organized and offering on-site guiding services. BAS has also provided other community groups (e.g. women's groups) with opportunities, though with limited take-up or commitment from the groups
Overall Average	***3.10***	
Scores *1: No change* *2. Implementation has started, but there are no successful outputs to date* *3. Partial success of implementation and outputs* *4. The objective has been successfully*		

Comments:

- The Human Use Program achieved or largely achieved the majority of its objectives over the years, with an average score of 3.20 out of 4.00 (80.0%) for implementation and success of outputs.
- The strongest area of implementation success is the provision of tourism services for visitors, with accommodation in Armenia, easy access from Belmopan, and on-site tour guides available to provide cultural and biodiversity interpretation (Objectives 2.4, 2.5 and 2.6)
- The weakest area of implementation has been engagement of local communities and developing an understanding of stewardship and sustainable use of the natural resources. There is still limited knowledge of SHBHNP and its role in maintenance of environmental services for adjacent communities. (Objective 2.8), despite BAS efforts.

3. Research and Monitoring Program		
Objective	**Score**	**Comments**
3.1 Park managers will obtain information they need for making informed management decisions.	3	There is only limited information available for management of SHBHNP, but this may be sufficient for management under the current management regime.
3.2 Baseline data will be acquired, so that future changes (due to succession or public use) in natural communities may be monitored.	2	Baseline data was not collected in the 1990's, so there is little available against which to compare changes in vegetation or public use from that time. Since then. Some baseline data has been collected, and is incorporated into the revised management plan. Visitation and Public Use data collection is improved.
3.3 Opportunities will be provided for training and educating Belizean researchers and scientists.	2	SHBHNP has not been marketed as a potential research site, with few studies being conducted in the National Park after its establishment. This is currently being addressed. It has recently been used as a focal site for ERI-UB training activities for protected area management planning and public use planning.
Average Score	***2.33***	
Scores *1: No change* *2. Implementation has started, but there are no successful outputs to date* *3. Partial success of implementation and outputs* *4. The objective has been successfully*		

Comments:

- The Research and Monitoring Program was the weakest of the Program areas, achieving an average score of 2.33 out of 4.00 (58.3%) for implementation and success of outputs.
- The strongest area of implementation success was the ensuring that information necessary for effective management was available to protected area staff – though this only scored 3 (Objectives 3.1)
- The weakest areas of implementation have been the developing of baselines for measuring success, and provision of research opportunities for Belize and international researchers (Objectives 3.2 and 3.3).

4. Administration Program		
Objective	**Score**	**Comments**
Administration Sub-Program		
4.1 Park managers will have the human, training, and financial planning resources they will need to support the other Management Programs of this plan	3	BAS has strengthened its organizational management over the years, resulting in improved human resources, skills training, capacity building and financial planning, providing park managers with the capacity for effective management. The Science and Education programmes have both evolved to be able to effectively support the protected area. An assessment of optimal human resource requirements suggests that SHBHNP does not currently have sufficient staff for effective management of the protected area.
4.2 Park managers will have the administrative support structures necessary to assure the satisfactory functioning of BHNP.	4	The BAS administrative support structure has strengthened significantly over the years.
Average Score	***3.50***	
Scores *1: No change* *2. Implementation has started, but there are no successful outputs to date* *3. Partial success of implementation and outputs* *4. The objective has been successfully*		

Comments:

The Administration Program has strengthened significantly over the years, with a score of 4.00 out of 4.00 (100%) for implementation and success of outputs. Whilst there is always room for further strengthening, BAS has established the policies and procedures, financial management processes and capacity building at both site and central levels to support protected area management.

Annex Two: 2015 Management Effectiveness Outputs

1. Resource Information	Score	Current Status	Recommendations
1.1 Inventory: Physical Environment	3	Have access to national maps from LIC, Cave mapping has been conducted but is with IoA…not available	▪ Liaise with LIC for access to mapping of caves within SHBHNP
1.2 Inventory: Biotic Environment	2	Bird checklist There is not much interest in SHBHNP from external researchers, and the knowledge gaps have not yet been identified A number of surveys have thought to have been conducted but data is not currently with BAS. E.g. Esselman fish survey, Miller bat survey Xaté survey	▪ Identify gaps through the conservation planning process ▪ Partner with researchers to address identified gaps ▪ Engage volunteers for baseline inventories (though there are concerns of data quality if volunteers are not knowledgeable in the field being inventoried). ▪ Repatriate survey data from previous research activities
1.3 Inventory: Cultural and Archaeological Resources	1	Some studies exist, but they are not lodged with Belize Audubon Society - possibly with IoA. Inventory of artefacts – not sure if one has been done for either cave. Possibly in Crystal Cave	▪ Liaise with IoA for copies of reports relevant to SHBHNP ▪ As a priority, conduct a photographic inventory of artefacts St Herman's and Crystal Cave ▪ Conduct photographic inventories of other caves of SHBHNP
1.4 Inventory: Social, Cultural and Economic Context	2	Just completed socio-economic assessment (2014) but needs analysing	▪ Analyse socio-economic assessment data and produce a written report ▪ Disseminate results to communities ▪ Repeat socio-economic assessment after 3 years
1.5 Inventory: Resource Use and Occupancy	2	Records are kept of number of visitors, but not necessarily of how many access Crystal Cave.	▪ Conduct a visitor survey to assess which activities are most popular – possibly through checklist of

		School visits are counted separately Have a list of tour guides / tour operators using SHBHNP, but it is not up to date	interests at desk ▪ Monitor how many visitors go to Crystal Cave
1. Resource Information	**Score**	**Current Status**	**Recommendations**
1.6 Inventory: Tenures and Claims	3	BAS has an issues with land ownership, with the Blue Hole carpark being located on private lands	▪ Investigate mechanisms for resolving land issue re. Blue Hole carpark
1.7 Site Assessment: Conservation Targets	3.5	BAS is currently identifying conservation targets through the management planning process (NOTE: This is now completed)	▪ Finalise management plan and conservation targets
1.8 Site Assessment: Systematic Threat Assessment	3.5	BAS is currently conducting a threat assessment through the management planning process (NOTE: This is now completed)	▪ Finalise management plan and threat assessment
1.10 Information Management System	3	Site manager reports integrated into management decisions. GPS. Have GIS, database of research that has been completed, but simple, basic. Needs to be updated, historical bird data Bird report Bird monitoring 2009 – 2011 report, 2012, 2013 2014 on e-bird Continue using volunteers for data entry Christmas Bird Count report National Audubon Improve the information management system More information availability at site – summarized.	

		Require researchers to summarize their studies outputs	
1.11 Environmental Monitoring Activities	2.5	Currently only monitoring birds IoA have verbally committed to assisting in development of a monitoring programme for the caves	▪ Set up biodiversity monitoring programme for SHBHNP based on conservation targets ▪ Establish biodiversity baselines through Rapid Ecological Assessments ▪ Integrate National Biodiversity Monitoring Programme targets into biodiversity monitoring programme ▪ Establish a water quality monitoring programme that also looks at agrochemical contamination
1.12 Scientific Research Activities	1	For individual parks, identified by the conservation target needed, based on the management plan Set up science system for SHBHNP	
1.13 Scientific Research Activities	1	See list that Dominique is going to send through	

Resource Administration, Management and Protection	**Score**	**Current Status**	**Strategies**
2.1 Legal: Legal Protection	4	SI 109 of 1986	
2.2 Legal: Boundary	3.5	Boundaries are legally defined. North of SH is well	Complete clearance of boundaries

Survey and Demarcation		defined by road and orchard – 50%. Need to be from Blue Hole backwards. Have funds to complete required boundaries.	
2.3 Legal: Registration, Permit and Approval Process	3	Good communication with FD over research permits… BAS is currently included in the approval process. IoA and Dept. of Geology and Petroleum (oil) may not include BAS in any permitting process. However whilst the legal representative of Government can provide the permit for mining or oil extraction, the prospector would still needs to have the relevant camping permits, permission to build roads and extract etc. from the Forest Department	Improve communication with IoA and Geology and Petroleum Department, particularly re. liaison, consultation and information on permit issues
2.4 Tenure Claim Conflict Resolution Activities	N/A	No claims within the PA. 10 acres between BH and SH on the road side. Not really an issue. Only concern is that half of the BH car park is on the property. Could be an issue if CIL decides to develop. Did surveys about 3 years ago, and interested in developing it. Might be interested in selling. BAS does not have a conflict resolution strategy	Investigate whether CIL would be willing to sell the 10.9 acres on the road side, or give to the protected area in lieu of equivalent taxes, to secure the land rights to the current parking area in the long term.
2.5 Guidelines and Best Management Practices	2	Best management practices do guide site management to a certain extent. Support and justify operations at the site. Have written policies and written and unwritten guidelines for visitors, school visits, and patrols. Not all guidelines are formally documented. Management is guided by the workplan. Best practices for tourism visitation have been identified, but are not formally presented	Development of: Visitor resource use plan and zoning Specific cave management best practices Best practices info for visitors and tour guides Documented SOPs for patrols and visitor management Guidelines for Nature School Programme

2.6 Protection: Surveillance Activities	3	Mostly on trails, but not out towards boundaries. Would find out about incursions if they happen from neighbours. Surveillance will expand to boundaries once cleared – improved accessibility. Also do Lighthawk once a year.	Continue partnership with LightHawk and annual aerial surveillance flight Increase surveillance activities to 2 to 3 per month Further strengthen partnerships within local communities
2.7 Protection: Enforcement Activities	4	However with a low incursion risk, BAS has never had to conduct enforcement activities. NOTE: Illegal logging and hunting has increased since this assessment, following the opening of a logging concession along the SHBHNP boundary	Ensure all protected area staff are trained for effective enforcement, handling of evidence, giving evidence in court
2.8 Visitor and Tourism Management Activities	3	Don't have a strategy, but are implementing tourism management activities	Development of a Visitor Strategy, to include: Visitor resource use plan and zoning Specific cave management best practices Best practices info for visitors and tour guides
2.9 Visitor and Tourism Monitoring Activities	3	BAS does implement some visitor monitoring, but limited by human resources. Use has grown significantly over the past 3 - 4 years, so greater management and monitoring is now becoming more important	Develop a Limits of Acceptable Change programme for the National Park Ensure resources (human and financial) are available for effective monitoring of tourism impacts

Participation, Education and Socio-Economic Benefits	Score	Current Status	Strategies
3.1 Communication Activities	3	There is no system in place for constant communication as BAS work is generally project based, and SHBHNP is not a high priority. The communities are only reached consistently through the schools. There is ongoing communication but not a communication strategy. There is however communication with tour guides, close stakeholders / neighbours.	Development of an SHBHNP info document outlining strategy and procedures for calling a community meeting, how information is disseminated to buffer communities and stakeholders – best mechanisms for reaching stakeholders Meetings twice a year with direct stakeholders (tour guides, women, St Herman's Association Committee)
3.2 Educational Activities	3.5	Implement educational activities, but there is not a specific strategy as to how it is handled. Underfunded. Not sufficient for management. Visitation comes to SHBHNP. 5,000 students per year can be handled. A lot of things are put into making sure trails and signs are in place. Evolving. Been largely opportunistic and project based	Special environmental days / special events focused on identified conservation targets and threats. Build capacity of site level staff for education Strengthen site staff capacity for interpretation for school visits – updated information, accurate Structure and align visits with the school curriculum or requests from the schools. Primary schools - exposure
3.3 Dissemination of Knowledge and Information	2	Have reached out to local community members who have direct impact on the PA. Once to twice a year go into schools. Immigrants moving into the area – so always an influx of new people who don't know about the PA. Armenia. Govt has taken private land and issued it to Armenia. The area behind Ringtail is being given as milpa land. This will soon come up to the southern boundary. Schools (site visits) are provided with information	Direct Stakeholders: Quarterly for reaching direct stakeholders working on site meeting best strategy – how to make it positive. Direct relations with stakeholders. Strengthening relationship Provide information related to the park – fliers, radio ads Meet community leaders twice a year. BAS Nature school programme in school – give it more structure. Go into school at the beginning of

		about BAS and SHBHNP. Tour guides - importance of St Herman's, rules and regulations of site. Not really reached out to other stakeholders. BAS is a park where fees could be increased to generate more revenue…recommended in the fee policy.	the year and liaise with school.
3.4 Participation: Level of Participation in Management	2	BAS history leads to caution in this area..do consult with tour guides and respond to their concerns. Curriculum development – how can teachers provide input for improvement of visits. Starting and will be through this planning.	Twice a year informal meetings – consultation and feedback mechanisms…develop partnerships with users for maintenance – team building, ownership Twice yearly meetings with leaders…informing High level meeting once a year– IoA, FD, BTB, Tourism Police, BDF(?)
3.5 Participation: Local Actors Leading Protected Area Management	N/R	Can be difficult to interpret. Decisions are made in Belize City, as this is how BAS has evolved. It isn't a requirement of the previous co- management agreement. The new co- management agreement clearly states the need for community participation. A balancing act. Their involvement is important, and need their feedback, as this ensures success, but at the same time, listening, but making the decision based on best info available. Org like BAS tend to see the local communities as the impactors, but it is often the tourism that impacts the PA more. Visitor management and activities are the primary concerns. Could be an ideal visitor information / place. Tourism is a large part of SHBHNP, so local actors are the tour operators. Whenever BAS changes	

		implementation of a decision made may affect the tour operators financially – important to involve stakeholders much more in management decisions. A tour operator working group may work as a mechanism for ensuring tour operators are informed and involved in decision. Would like to see local communities providing food on site. Tour operators are gaining a lot of SHBHNP…need to reach out to them. Think they should pay more!! **Not relevant**	
3.6 Participation: Volunteer Activities	3	Have a volunteer programme, but not for SHBHNP. Logistics and accommodation are a problem. Involvement of high schools / sixth forms. Small projects at site. Tour operators assisted in cleaning cave. Volunteers with fire management. Opportunistic Historically, there were volunteers at SHBHNP, housed at Ringtail.	Identify volunteer needs… research…basic inventories, tourism management / information, increase site level maintenance and upkeep. Two levels… international with skills National… Overnight facilities for volunteers
3.7 Participation: Strength of Social Capital	2	Tour operators have a fair level of capacity, but most community members have limited capacity.	Build further capacity in tour guide organization, Part of BAS community programme Partner with other organizations to strengthen capacity building of organizations Identify possible groups…
3.8 Participation: Capacity Building	1	Do not build capacity in the SHBHNP. May need to involve in small capacity building projects. Will be small in scale. Goal is to reach a 3.	Empower / build capacity of tour guides for lobbying. Build advocacy role, supporters of BAS to strengthen the management. Endorsement of management plan / process. Building capacity – ethics, business / marketing,

			Enhance community capacity to be able to organize
3.9 Benefits: Socio-Economic Benefits Programme	3	Working with tour guides – e.g. Inland Tours. Food concession from Armenia. Bringing direct benefits.	Need to analysis socio-economic data first Identify skill set d ideas from socio-economic survey Partnering with tour guides – formal written agreements / contracts Fast food concession Not alternative livelihoods
3.10 Benefits: Extent of Local Economic Benefits	2	A few people – the concession lady, tour guides, mostly through cave tubing activity. May only ever make it to a 4. If introduce more ideas, then benefits will increase.	
3.11 Benefits: Recognition of Protected Area Benefits	1	Immigrant population – rapidly changing. Don't often reach out to them to broadcast these messages. Armenia has a tight knit community structure	Two populations…Maya and Hispanic. Nature school programme On-site education activities Armenia and St. Margaret's Ringtail more individual landowners Targeting landowners – focusing on Ringtail… wanting to expand, land use change CPBL…encourage them towards certification. Dialogue with WWF? However, citrus farms are leased, so may not be willing to invest

Management Planning	**Score**	**Current Status**	**Strategies**
4.1 Management Plan	1	No management plan	Finalise the 2015 – 2020 management plan

Implementation			
4.2 Operational Plan Implementation	2	Management team develops work plans that correlate with the budget. No management plan (yet…but soon! Watch this space!)	
4.3 Regulations and Zoning Implementation	2	Have unwritten zoning and structuring. E.g. signs that say no access. Primitive areas, birding areas – something to look at during management planning.	
4.4 Long-Term Management Needs Identified	2	Identified in the strategic plan (being developed)	
4.5 Programme Monitoring and Evaluation	1	No site specific monitoring and evaluation of BAS programmes. But will be included in the new strategic plan	
Management Planning	**Score**	**Current Status**	**Strategies**
4.1 Management Plan Implementation	1	No management plan	Finalise the 2015 – 2020 management plan
4.2 Operational Plan Implementation	2	Management team develops work plans that correlate with the budget. No management plan (yet…but soon! Watch this space!)	
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4.4 Long-Term Management Needs Identified	2	Identified in the strategic plan (being developed)	
4.5 Programme Monitoring and Evaluation	1	No site specific monitoring and evaluation of BAS programmes. But will be included in the new strategic plan	

Governance	**Score**	**Current Status**	**Strategies**
5.1 Protected Area Objectives	4	Have clear objectives – 2 developed during METT process	
5.2 Co-Management Arrangements	4	Signed in January 2014.	
5.3 Administrative Autonomy	3	Based on co-management agreement requirements	
5.4 Operating Procedures: Advisory Committee	N/A	New co-management agreement does not specify the need for an Advisory Committee. Need a communication plan, and outreach, but not an Advisory committee. Not relevant	
5.5 Operating	4	Just finalized amendments to AoA	

Procedures: Board			
5.6 Inter-organizational Mechanism	4	With all but Institute of Archaeology – cave policy. Still not fully communicational. Discussed training of cave monitoring and cave policy. They prefer to take over. Have regular communication with Associate Park Director – at technical level. Higher up is more difficult	
Governance	**Score**	**Current Status**	**Strategies**
5.1 Protected Area Objectives	4	Have clear objectives – 2 developed during METT process	
5.2 Co-Management Arrangements	4	Signed in January 2014.????	
5.3 Administrative Autonomy	3	Based on co-management agreement requirements	
5.4 Operating Procedures: Advisory Committee	N/A	New co-management agreement does not specify the need for an Advisory Committee. Need a communication plan, and outreach, but not an Advisory committee. Not relevant	
5.5 Operating Procedures: Board	4	Just finalized amendments to AoA	
5.6 Inter-organizational Mechanism	4	With all but Institute of Archaeology – cave policy. Still not fully communicational. Discussed training of	

		cave monitoring and cave policy. They prefer to take over. Have regular communication with Associate Park Director – at technical level. Higher up is more difficult	

Human Resources	Score	Current Status	Strategies
6.1 Site Manager Preparation	3	Mr. Lino…has a lot of knowledge in monitoring of caves (was stationed at ATM, and before then at Half Moon).	
6.2 Site Manager Availability	4	Lives on-site	
6.3 Administrative Staff Availability	3	Arvin – 60 – 75%	
6.4 Technical, Scientific, and Professional Staff Availability	3	Darice and Dominique does on-site training to allow delegation of duties. 25 – 50%, but gap is filled by skills transfer to staff Amanda goes once a quarter to every site	
6.5 Operations Staff Availability	3	Have: 5 staff – short by one 4+Mr. Lino + 1 casual labour Need a minimum of 1 more staff member, ideally 2 to 3. Will need one for manning gift shop 2 staff at gate entrances Maintenance, enforcement, education, visitor management, research. Time sheets for breakdown.	
6.6 Human Resource	4	Do an annual assessment / performance evaluation	

Surveys		at the end of the year and training and resource needs. Time sheets show human resource increase is needed	
6.7 Training and Development	3	Informal and opportunistic, based on human resource assessments / performance evaluations. Site-level training needs identification. Have some constants – first aid, ranger training, environmental education, customer service. Allocate funds for HR training 2 general staff meetings – try to include a training in this as well Continue capacity building of programme managers	
Financial and Capital Management	**Score**	**Current Status**	**Strategies**
7.1 Funding Adequacy	3	Assuming that can keep entrance fees	
7.2 Revenue Generation	3	Reviewed articles to set up a business arm and revenue streams. Revamping gift shops and rentals / concessions. SHBHNP generates between 60 to 75% of revenue, 5 staff no projects. Gift shop with rental equipment (flash lights)…start looking this as a business…internal paradigm shift. Expect 15 – 20,000 per annum profit Architectural rendering of Nature Centre from Arvin Concessions, gift shop, rentals Need framework for concession (FD asked for a framework)	

7.3 Financial Management	4	There is a financial manual, but may be revised. Operationalized, but not Board endorsed. Changed	
7.4 Infrastructure Adequacy	3	By end of 2015, will have new visitor centre. Rest room, nature centre, parking lot. Expanding swim deck, replacing railing, changing rooms, adequate accommodation for rangers. But not in good condition. Will be replaced by the end of the year. Tower is condemned. Proposing a successional forest treehouse structure to replace this. Current one is not really useful. Additional product for visitors. Accommodation for research / volunteer space More significant no entry point for end of cave	
7.5 Equipment Adequacy	3	Wear and tear replacement of equipment Better communication for patrols - radios / satellite phone Research equipment – binoculars, GPS, camera, etc. Patrol equipment – backpacks, waterproof books etc. accessories Liability – under tour guides. Individual visitors don't have guides. Have liability on the old ticket Need liability on the new ticket. Signs, waiver, maintenance of steps, good orientation, infrastructure to deal with. Staff are insured by BAS	

7.6 Internal Access Adequacy	4	Boundaries are clearly defined and provide access Training in navigation and GPS but need more	
7.7 Signage Adequacy	2	Needed: Main entrance sign, more regulation signs – cave and Blue Hole, education signs, need more boundary signs. Need on south and west. Barricade to block entrance to place where people who jump into Blue Hole Note…need staff by the hole when there are people there	
7.8 Maintenance Adequacy	4	Take good care of their things	

Annex 3: BELIZE STANDARDS FOR HEALTH AND SAFETY IN ARCHAEOLOGICAL RESERVES AND PARKS

Belize Bureau of Standards

Whilst St. Herman's Blue Hole National Park is managed under the Forest Department, not the Institute of Archaeology (NICH), the national standards for tourism activities, developed by the Sub-Committee for High Risk Tourist Activities, are still relevant. It should be noted that the Institute of Archaeology is the authority responsible for the monitoring and management of cave tourism in Belize. The Standards can be downloaded from the Bureau of Standards website (http://www.bbs.gov.bz/). Relevant cave-related sections include:

3. Requirements

3.2 Liability

The very nature of Archaeological Reserves and Parks and related caving activities carry potential health and safety risks. Activities at these sites may involve climbing, swimming, cave tubing, kayaking etc. In order to mitigate risks - the following shall be observed:

3.2.1 All parties conducting tours at Archaeological Reserves and Parks shall be in possession of all appropriate licenses, permits and insurance, as required by relevant regulations.

3.2.2 Signage at the entrance of the Archaeological Reserves and Parks shall state in a prominent place that the Institute of Archaeology (or in this case, the Forest Department / Belize Audubon Society) is not liable for injuries or accidents that may occur due to any activity undertaken at the Reserves and Parks.

15. Additional Requirements for Caves

The Institute of Archaeology is responsible for the monitoring and management of cave tourism in Belize; hence all health and safety measures and standards must be in place to protect and enhance visitor experiences.

15.1 Tour Guide Licensing and Special Training

The Institute of Archaeology requires that all tour guides and tour operators involved in cave tourism will, in addition to the standard tour guide license obtained from the BTB, receive additional specialized training in order to be licensed and registered to conduct tours relating to any or all types of caves. Cave tourism is a unique and specialized adventure and recreational activity. In order to maintain international safety standards, specialized training and certification

in swift water rescue must be completed for those cave sites that involve traversing water to ensure that Belize is adhering to internationally accepted safety criteria.

15.2 Equipment

All tour operators shall industry standard equipment required for their guests when conducting cave tours at Archaeological Reserves and Parks. Regular inspection of equipment shall be done periodically based on the need to ensure that all equipment remains in good working condition.

15.2.1 Type of Equipment

Equipment required to carry out any cave tour must include:

a) Life Jackets (US Coast Guard Type I, II or III for all caves with water such as ATM, Barton Creek, Blue Creek and Noh Mul Archaeological Reserve (Cave's Branch);
b) Tubes (for cave tours at ATM, Barton Creek, Blue Creek and Cave's Branch);
c) Flash Lights
d) Extra Batteries
e) Ropes
f) First Aid Kits and
g) Caving Helmets

Batteries must be replaced immediately if flashlights are dull, dimmed or do not provide adequate light. Batteries shall be disposed of in proper garbage containers and shall completely removed from the cave site.

15.2.2 Demonstration of Equipment

Prior to entering the cave, tour guides shall demonstrate to visitors the proper use of all equipment that will be used while touring the cave. All safety and liability policies shall also be explained to visitors before entering the cave.

15.2.3 Minimum Requirements for Equipment

The following are the minimum requirements for cave tubing equipment to be used at relevant Archaeological Reserves.

a) Certified Caving Helmets (technical specifications)
    i. Ergonomic dome shape;
    ii. Adjustable suspension system;
    iii. Headlamp clips;
    iv. Fiberglass or hardened plastic with interior insulation.
b) Tubes (technical specifications)
    i. Heavy duty gauge 30 PVC;

ii. Double welded to avoid blow-outs;
iii. Preferable with safety chamber;
iv. Tube size for adults: 104.14 – 111.76 cm (41–44 inches);
v. Tube size for children: 78.74 – 83.82 cm (31-33 inches);
vi. Rubber in the tubes

c) Headlamp (technical specifications)
i. Four LED;
ii. Must be waterproof with adequate lighting;
iii. Extended battery life;
iv. Extra batteries;
v. Adjustable strap.

d) Life Jackets (technical specifications)
i. Wrap around lockable straps;
ii. Vertical adjustment;
iii. Sleeveless;
iv. US Coast Guard Type I, II or III.e) Ropes (Diameter: 10.1 mm; Lengths: 60 & 70 m; Type: single rope; Weight: 66 g/m; UIAA falls: 7; Impact force: 8.2 kN; Elongation: - dynamic: 33.6 %, - static: 6.7 %; % sheath by weight: 42 %)

e) Ropes (Diameter: 10.1 mm; Lengths: 60 & 70 m; Type: single rope; Weight: 66 g/m; UIAA falls: 7; Impact force: 8.2 kN; Elongation: - dynamic: 33.6 %, - static: 6.7 %; % sheath by weight: 42 %)

f) Adequate communication equipment. Hand held radios;

g) First Aid Kits for high risk activities.
i. First Aid Guidance Notes;
ii. First Aid Scissors;
iii. 20ml Eye Wash Pod;
iv. 1,25 Micropore Tape;
v. 5 x 5cm Non Adherent Dressings x 2;
vi. Size E Tubular Support Bandage x 1 (Leg & Knee);
vii. 7.5cm Conforming Bandage;
viii. No 7 Finger Bandage;
ix. No 8 Medium Bandage;
x. No 16 Eye Bandage;
xi. Triangular Bandage;
xii. Latex Finger Cots x 2;
xiii. Resusciade;

xiv. 30GM Cetrimide Antiseptic Cream;
xv. Safety Pins x 11;
xvi. Alcohol Free Wipes x 6;
xvii. Yellow Clinical Waste Bag;
xviii. Fabric Plasters x 10;
xix. Waterproof Plasters x 10;
xx. Blister Plasters x 6;
xxi. Splinter Forceps/Tweezers;
xxii. Pair of Medium Vinyl Gloves x 1 (Size can be changed if required);
xxiii. Emergency Whistle;
xxiv. Emergency Penlight;
xxv. Emergency Foil Blanket; and
xxvi. 6" Emergency 12 Hour Lightstick.

15.3 Safety Guidelines for Cave Tours

a) All tour guides shall have a backup source of light and batteries for their guests in accordance with the Tour Group Ratios (see 15.6.1).
b) No one shall be allowed to explore cave passages by themselves or deviate from the prescribed cave routes.
c) Proper clothing and footwear shall be worn in caves in order to avoid cuts, slips, trips and falls.
d) Everyone venturing into any cave system shall be debriefed about the dangerous nature of caves and how to properly conduct themselves inside caves for their own safety.
e) All tour guides and tour operators shall ensure that they inform their guests about the physical nature of this activity and should stress that their guests must be in good physical condition to reduce chances of accidents.
f) All persons participating in adventure cave tubing shall wear a life jacket at all times during the cave tour. Children must be under their parents/guardians supervision at all times, provided they meet the requirements to do cave tubing.
g) Tour guides shall have the responsibility to properly supervise and control guests during caving activities.
h) Tour guides shall use the linked technique to float their guests through the cave. Free floating is not allowed.
i) Everyone entering any cave system shall wear a caving helmet in order to prevent head injuries.

j) Safety ropes shall be brought along in the event that anyone gets injured or needs assistance.
k) Every cave expedition shall include an emergency bag containing medical supplies, blanket, extra batteries, candles, matches, lights, snacks, water and dry clothes.
l) Prior to leaving for a cave expedition, a time shall be established for the return of the group with an officer of NICH at the point of entry.
m) All tour operators and guests shall take every precaution not to damage the integrity or in any way deliberately alter the natural environment of the Cave Systems.
n) No smoking is allowed within the caves. and
o) Tour guides shall ensure that their guests are in close proximity and are not wondering around. Tour guides must always be in control of their tour group.

15.5 Food and Alcoholic Beverages

15.5.1 Food Consumption

In order to reduce the amount of waste being generated as well as to maintain the aesthetic value of our caves and park trails, the Institute of Archaeology encourages tour guides to limit food consumption in the caves and on trails and to remove all plastic water bottles taken on the cave tours and trail hikes.

15.5.2 Alcoholic Beverages

The Institute of Archaeology does not accept responsibility for any accident on the site due to the consumption of alcoholic beverages by any visitors.

15.6 Ratios and Intervals

15.6.1 Tour Group Ratios

Cave tour groups shall be limited to a maximum of 8 persons per tour guide for safety purposes and will also be guided by the BTB Tour Operators Regulations as it relates to cave sites.

15.6.2 Tour Group Intervals

Tour guides and tour operators shall take the responsibility to maintain appropriate time intervals between groups (at least 15 minutes between tours) in caves involving water so as to prevent overcrowding and conflicts when entering the water and during the tour.

15.7 Noise Levels

Tour guides shall be responsible and have consideration for other visitors at the site. Tour guides must strictly discourage loud noise (i.e. shouting) during the trail hike or during the cave tours.

Loud noise usually causes wildlife to abandon the park, thus reducing the overall visitor's experience. Loud noise can also cause confusion among tour guides and visitors.

15.8 Site Closure and Water Level

15.8.1 Archaeological Sites may be declared "closed" under the below conditions:

15.8.1.1 For Caves: erosion, security threat, major accident(s), natural hazards, water quality, contamination;

15.8.1.2 For Maya temples: erosion, security threat, accident, natural hazards.

15.8.2 The unpredictable nature of Belize's rivers makes it almost impossible to give any tour operator a 24-hour lead-time as to what the river condition will be. Hence, the Institute of Archaeology will continuously monitor river level gauges, weather reports and contacts upriver to keep the cave site open and operational as long as possible within an acceptable safety margin.

15.8.3 In the event of any excessive rains that can produce flash flooding, caves will be closed and will remain closed until the Park Manager declares the "ALL CLEAR TO RESUME ACTIVITIES".

15.8.4 Once the site has been declared closed, the Park Manager shall immediately notify all ticketing centres about the status of the river, and visitors will have to be diverted to other destinations. Tour Operators and Guides may call the Cahal Pech Archaeological Reserve at 802-4206 from 6:00 am every morning to 6:00 pm to check on river conditions and to determine whether caves are open.

15.8.5 The Institute of Archaeology shall install additional signage/signs at the site to inform visitors of the park rules and regulations and current water conditions and warnings.

15.8.6 The Institute of Archaeology shall put in place a mechanism where tour operators and tour guides can get daily updates on the status of the sites to check on the condition of the river and to determine whether caves are open. All archaeological sites designated for tourism activities shall be fully equipped with radios and telephones where cellular service is available.

Annex Four: Areas of alignment with the Natural Resource Management Research Agenda
▪ **Determine the impacts, including cumulative impacts, of different land-use practices and industries on Belize's natural resources and hydrology** ▪ **Assess changes in land-use and land cover** ▪ **Assess degradation of key ecosystems and areas of importance across Belize (broadleaf forests, riparian forests, corridors, wetlands, savannas)** ▪ **Determine the impacts, including cumulative impacts, of various industries, especially agriculture, oil, mining, tourism, alternative and/or renewable energy and other land use practices on ecosystems, water resources and other ecosystem services**
Baseline ▪ Detailed mapping of ecosystems, land use in SHBHNP landscape – agricultural areas and use, tourism facilities, private reserves, other protected areas, communities, hydrology (including any dams, diversions, irrigation etc.) and connectivity ▪ Agrochemical use in the SHBHNP landscape – type, frequency, application mechanism, area covered, flow path of water run-off ▪ Water contamination levels (nitrates / phosphates, water level, water pollution, temperature, O_2 levels, *E. coli*) after first heavy rains (June / July) ▪ Establishment of Limits of Acceptable Change indicators for the National Park *Monitoring* ▪ Updating of ecosystem and land use mapping in SHBHNP landscape and identification of changes ▪ Assess water contamination levels on a quarterly basis, and after first heavy rains (June / July) ▪ Agricultural practices and agrochemical use *Indicators* ▪ % of SHBHNP under forest cover ▪ Presence of forest connectivity with Maya Mountain Massif - Map of forest cover between SHBHNP and Sibun FR ▪ Water quality (nitrate, water level, water pollution, temperature, O2 levels, E. coli) ▪ Agrochemical application (type and quantity) in the SHBHNP landscape ▪ % farms with improved agricultural practices (re. agrochemical use) in adjacent agricultural areas - type, frequency, application mechanism, area covered
Based on various development scenarios, conduct or reappraise land-use modeling to incorporate climate change considerations and determine the future state of the natural resource base in country
Accounting for climate change impacts, determine how and to what extent various land use practices exacerbate the impact of natural disasters

Baseline ▪ One year baseline for rainfall ▪ One year baseline for waterflow through SHBHNP *Monitoring* ▪ Monitoring of weather parameters ▪ Monitoring of water depth and flow through SHBHNP *Indicator* ▪ Average water depth ▪ Annual water flow
Quantify the impact of increased anthropogenic fires, within the climate change context, to broadleaf and savanna forests *Baseline* ▪ Mapping of current fire impact areas inside SHBHNP and in contiguous landscape ▪ Mapping of high fire risk area inside and contiguous with SHBHNP *Monitoring* ▪ Monitoring of fires within the SHBHNP landscape – cause, time frame, area burnt *Indicator* ▪ % of SHBHNP affected by fire ▪ % of SHBHNP landscape affected by fire ▪ Number of farmers completing fire management training ▪ % farmers trained in basic fire management ▪ Percentage of farmers considered to be engaged for fire management ▪ Presence of fire-fighting equipment at SHBHNP
Quantify the impact of hydroelectric dams on riverine systems and communities
Baseline ▪ Detailed mapping of water systems and presence of barriers (including hydroelectric dams) *Monitoring* ▪ Monitoring of water depth and flow through SHBHNP *Indicator* ▪ Water depth ▪ Annual water flow
Determine how social, political and economic factors affect the natural resource base
Determine how social, political and economic factors affect the following: forest cover, wildlife population status, commercial timber species, soil productivity, water resources and non-timber forest products; and identify those factors that have the most impact on these.

Baseline ▪ Annual number of incursions (hunting, fishing, logging, looting) ▪ Community recognition of ecosystem services of SHBHNP (socio-economic survey) *Monitoring* ▪ Monitoring of illegal incursions into SHBHNP ▪ Monitoring of impact of local and national political decisions *Indicator* ▪ Number of illegal incursions (hunting, fishing, logging, looting) per year ▪ % of community members considered aware of ecosystem services per community ▪ Number of incidents of political support for SHBHNP per year ▪ Number of incidents of negative political impacts on SHBHNP per year
Investigate the role of natural resources and the environment in sustaining livelihoods
Baseline ▪ Number of tour guides using SHBHNP ▪ Number of other community members benefiting from SHBHNP (e.g. Women's Groups) ▪ Populations of communities downstream of SHBHNP (Census data) ▪ Number of people employed by BAS at SHBHNP *Monitoring* ▪ Annual assessment of number of tour guides using SHBHNP ▪ Annual assessment of number of family members supported by tour guides using SHBHNP ▪ Annual assessment of number of other community members benefiting from SHBHNP (e.g. Women's Groups) ▪ Populations of communities downstream of SHBHNP *Indicator* ▪ Number of tour guides using SHBHNP ▪ Number of family members supported by tour guides using SHBHNP ▪ Number of other key community members benefiting from SHBHNP (e.g. Women's Groups) ▪ Populations of communities downstream of SHBHNP ▪ Number of people employed by BAS at SHBHNP
Determine the value of ecosystems and biodiversity
Conduct cost-benefit analyses of sustainable use or maintenance of the following: ecosystem services including carbon storage, those that are important for agriculture and for protection against natural disasters, water resources, protected areas, game spp., species of conservation concern and forest products vs. their unregulated and/or uncontrolled extraction (Justification: want to be able to present different scenarios for use)
Determine return on investment for the use and/or maintenance of ecosystem services (Justification: need to address issues of carbon trade and biodiversity offsets and whether they it actually pays to market these)
Establish baseline and comprehensively assess readiness and feasibility for REDD+ (Develop national level allometric equations to assess biomass of ecosystem types of Belize)

Baseline ▪ Income generated by SHBHNP per year ▪ Number of people supported by SHBHNP (through BAS employment or employment in tour guide industry), and value, for baseline year ▪ Evaluation of ecosystem services, including carbon storage, and species of conservation concern ▪ Mapping of agricultural value of land in SHBHNP and in SHBHNP landscape ▪ Mapping of slope in SHBHNP and in SHBHNP landscape *Monitoring* ▪ Annual assessment of income generated by SHBHNP ▪ Annual assessment of number of people supported by SHBHNP *Indicator* ▪ Number of tour guides using SHBHNP ▪ Number of family members (dependents) supported by tour guides using SHBHNP
Assess the impacts of climate change on terrestrial ecosystems, ecosystem services and communities
Assess the effectiveness of mitigation and adaptation strategies being implemented
Conduct studies to assess the vulnerability, adaptability and resilience of human populations, ecosystems, ecosystem services and species to climate change
Assess the influence of climate change on ecosystem range/extent
Baseline ▪ Income *Monitoring* ▪ Annual assessment of income generated by SHBHNP ▪ Annual assessment of number of people supported by SHBHNP *Indicator* ▪ Number of tour guides using SHBHNP ▪ Number of family members (dependents) supported by tour guides using SHBHNP
Assess the impact of legal and illegal extraction of natural resources
Assess the effectiveness of management, including enforcement activities, in maintaining the ecological integrity of Belize's PAs
Investigate population and spatial dynamics, and assess long term viability of populations of game species, various species of conservation concern, commercial timber species, major NTFPs in the context of legal and illegal extraction
Determine the types, source, level and cumulative impacts of pollutants on environmental services to communities, ecosystems and biodiversity
Determine the source and level of pollutants (including sewage, heavy metals and industrial scale agrochemicals) and establish the degree and distribution of pollutants from these sources across the greater landscape

Investigate the rate and extent to which water systems can recover from contaminants
Investigate the links between pollutants and human health
Determine the impacts of invasive species, diseases and pest species on various natural resources