2018

Management Plan (2018-2023) Volume One

LAUGHING BIRD CAYE NATIONAL PARK

BACKGROUND, TECHNICAL SECTIONS & APPENDICES

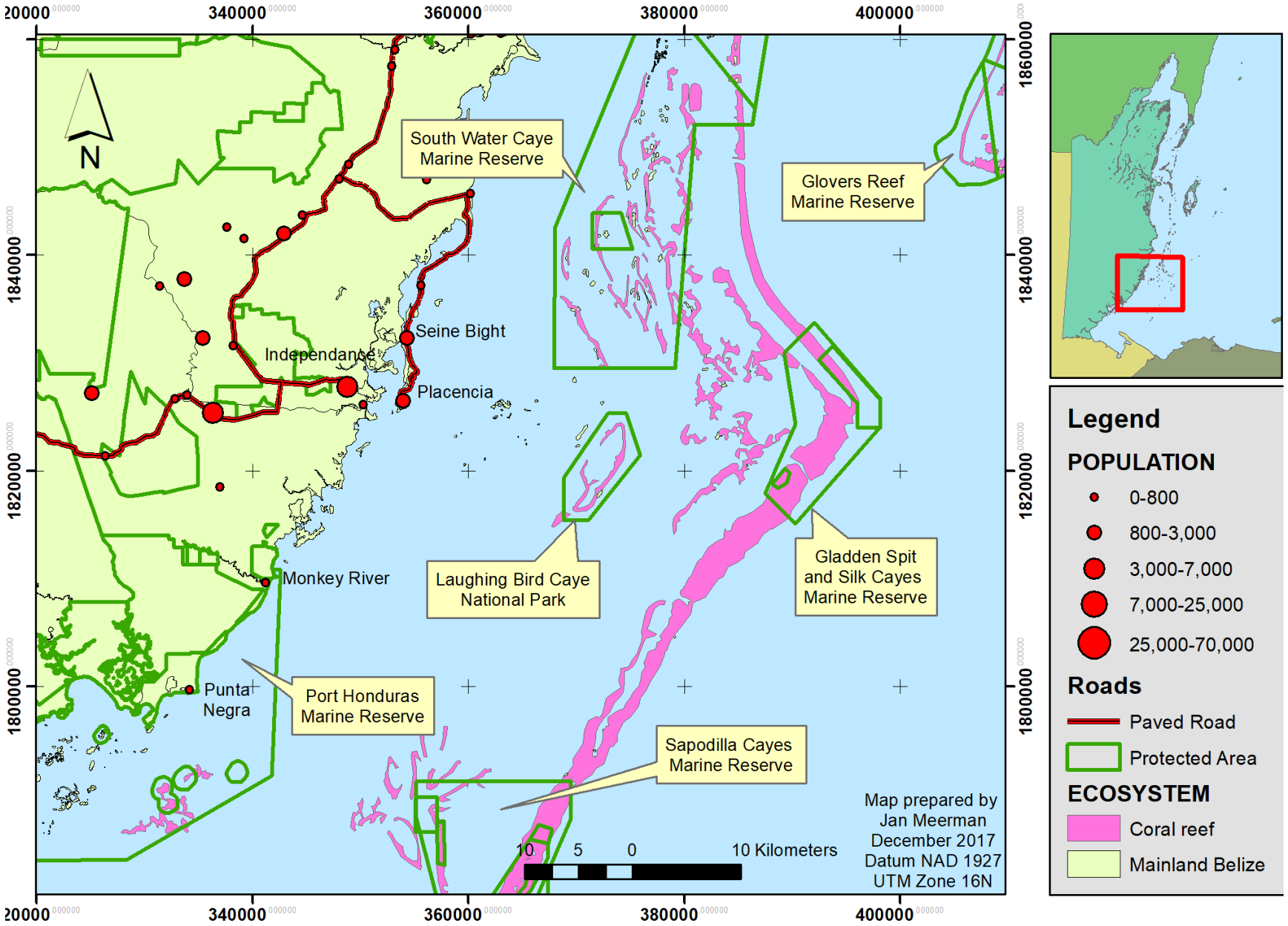
SEA
BELIZE
SOUTHERN ENVIRONMENTAL ASSOCIATION

Protected Area Data Sheet		
Date	July 18, 2018	
Name of Protected Area	Laughing Bird Caye National Park	
Location of Protected Area	Southern Belize Reef Complex (Stann Creek District)	
Date of establishment	1991	
Size of Protected Area	Acres: 10,119 (Hectares: 4,095)	
Land Tenure	Laughing Bird Caye – national land	
Management Authority	Southern Environmental Association	
Affiliations / Partnerships with other organizations	Government of Belize (under Co-Management Agreement)	
Number of Staff	Permanent: 16	Temporary: 12
Annual Budget (BZ$) for management of protected area	c. BZ$110,113.23 (This is the average for 2017-2018)	
Designation	National Park – IUCN Category II World Heritage Site	
Reasons for Designation	To protect the unique biodiversity associated with the Laughing Bird Caye faro, and to manage, protect and promote the sustainable use of the National Park for the benefit of present and future generations.	
Brief Details of Past Funding	Mix of donor agency, private donation and funding via domestic sources (e.g., PACT), private foundations (e.g., Oak) and international conservation organizations, plus self-generated income.	
Brief Details of Present Funding	As above	
Brief Details of Future Funding	Self-generated income prioritized, supplemented by donor/charitable support.	
List the primary protected area objectives		
1. Protect and maintain the natural and scenic values of Laughing Bird Caye National Park;		
2. Provide environmentally sustainable, well-managed recreational opportunities for local, national and international visitors;		
3. Increase awareness of the marine ecosystems and conservation benefits of Laughing Bird Caye National Park, to promote a supportive environment for effective management;		
4. Act as a model of co-management, as part of the Belize barrier Reef System World Heritage Site, and within the framework of the system-level management of the Southern Belize Reef Complex;		
5. Provide opportunities for economic benefit for local stakeholder communities.		
List the top two most important threats to the protected area (and indicate why these were chosen)		

Removal of vegetation – has the potential to reduce the viability of Bird Colonies of the National Park.
Sedimentation – has the potential to reduce the viability of coral reefs within the National Park.
List the top two critical management activities
Resource mobilization strategy – ecotourism to give secure/reliable budgetary underpinning to sustain conservation management programmes.
Minimize visitor use impacts on the National Park by implementing carrying capacity management recommendations.

Name/s of assessors and people consulted: Osmany Salas, Valentino Shal, Dr. Robin Coleman, and Jan Meerman in consultation with senior SEA administrative and field staff.

Contact details: Arreini Palacio-Morgan, Executive Director, SEA, Placencia Village, Stann Creek District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South Water Caye
Marine Reserve
Glovers Reef
Marine Reserve
Seine Bight
Independance
Placencia
Monkey River
Laughing Bird Caye
National Park
Gladden Spit
and Silk Cayes
Marine Reserve
Punta
Negra
Port Honduras
Marine Reserve
Sapodilla Cayes
Marine Reserve
10 5 0 10 Kilometers
Map prepared by
Jan Meerman
December 2017
Datum NAD 1927
UTM Zone 16N
Legend
POPULATION
0-800
800-3,000
3,000-7,000
7,000-25,000
25,000-70,000
Roads
Paved Road
Protected Area
ECOSYSTEM
Coral reef
Mainland Belize

ACKNOWLEDGEMENTS

Special appreciation goes to the staff members of the Southern Environmental Association and, in particular, the Executive Director, Arreini Palacio-Morgan, for going beyond the call of duty to support our work throughout the management planning process.

Thank you also to Deidra Mahler for providing us with information that was needed for the management plan, as well as for sharing her extensive knowledge pertaining to the LBCNP's science and management operations.

Special mention goes to Petrona Coy and the rest of SEA's office and field staff for providing other relevant information that was required.

We extend our appreciation to the various LBCNP stakeholders, in particular fishermen and tour guide representatives, who contributed some of their valuable time to share their ideas, views, concerns and aspirations pertaining to the management of the LBCNP. Your dynamic participation at the various meetings was invaluable to the planning effort, and resulted in the updating of the LBCNP management plan for the next five years and beyond.

And last but certainly not least, we extend our gratitude to the Protected Areas Conservation Trust for its financial support.

Thank you,

praxi5 Advisory Group Ltd.

Contents

Tables:

Figures:

ACRONYMS

AGRRA	Atlantic and Gulf Rapid Reef Assessment
CARICOMP	Caribbean Coastal Marine Productivity
CBD	Convention on Biological Diversity
CCC	Coral Caye Conservation
CCAD	Comision Centroamericana para el Desarollo
CCRE	Caribbean Coral Reef Ecosystems
CEDAM	Conservation, Education, Diving, Awareness and Marine Research
DOE	Department of the Environment
ECP	Environmental Compliance Plan
EIA	Environmental Impact Assessment
FAMRACC	Forest and Marine Reserves Associations of Caye Caulker
FOLBC	Friends of Laughing Bird Caye
FOSC	Swallow Caye Wildlife Sanctuary
FON	Friends of Nature
GSSCMR	Gladden Spit and Silk Cayes Marine Reserve
IA	Institute of Archaeology
IPOA	International Plan of Action
IUCN	International Union for Conservation of Nature
LAMP	Long-term Atoll Monitoring Program
LBCNP	Laughing Bird Caye National Park
MBRS	Mesoamerican Barrier Reef Systems
MFFSD	Ministry of Forestry, Fisheries and Sustainable Development
MMAS	Marine Managed Areas Science
MPA	Marine Protected Areas
NHC	National Hurricane Center
NOAA	National Oceanic and Atmospheric Administration
NPASP	National Protected Areas Policy and System Plan
NTA	No Take Area
PA	Protected Area
PACT	Protected Areas Conservation Trust
TAMR	Turneffe Atoll Marine Reserve
TASA	Turneffe Atoll Sustainability Association
TNC	The Nature Conservancy
RZ	Replenishment Zone
SBRC	Southern Belize Reef Complex
SEA	Southern Environmental Association
SPAG	Spawning Aggregation
TIDE	Toledo Institute for Development and Environment
UNESCO	United Nations Educational, Scientific and Cultural Organization
WRI	World Resources Institute
WRISCS	Watershed-Reef Interconnectivity Scientific Study

1. INTRODUCTION

1.1. Background and Context

Laughing Bird Caye National Park was established in 1991 under the National Parks System Act (SI 167 of 1991) to provide protection from increasing tourism impacts. The National Park was later expanded to include the entire faro (SI 94 of 1996)(Appendix 1), in response to requests from conservationists and tour operators, who recognized the need for greater regulation to conserve the unique nature and exceptional integrity of the Laughing Bird faro. The National Park covers 10,119 acres (approximately 4,095 ha) and is located on the shallow reef platform of the Atlantic coast of Mesoamerica, in lagoonal waters sheltered by the longest barrier reef in the Western Hemisphere, the Mesoamerican Reef System.

The Mesoamerican Reef System stretches approximately 1,000 km from the Yucatan to the Bay Islands in Honduras. The Mesoamerican Reef has been identified as one of 233 ecoregions with biodiversity and representational values considered outstanding on a global scale, and has been recommended several times as a priority area for conservation (Olson & Dinerstein, 1998; Roberts, 2001, Kramer and Kramer, 2002). The Belize Barrier Reef is the largest component of this Mesoamerican Reef System, and possibly the least impacted reef complex in the Atlantic–Caribbean area (UNESCO, 1996).

The Laughing Bird Caye National Park (LBCNP) itself has been designated as one of seven marine protected areas of the Belize Barrier Reef Reserve System World Heritage Site, in recognition of the uniqueness of its contribution to Belize's reef system. It was designated:

> **"*To protect the unique biodiversity associated with the Laughing Bird Caye faro, and to manage, protect and promote the sustainable use of Laughing Bird Caye National Park for the benefit of present and future generations*".**
>
> (Friends of Laughing Bird Caye/ TIDE (2000))

In keeping with its designation as a National Park, LBCNP is a completely no-take area (NTA) – also referred to as a Replenishment Zone (RZ) – and is recognized for supporting extraordinarily high biological diversity. The Park provides nursery and feeding habitats for at least twenty-five species of international concern, recognized under the IUCN Red List as Critically

Endangered, Endangered or Vulnerable (IUCN, 2017), including nine species of coral, three species of turtle, twelve species of fish and the vulnerable West Indian manatee. The faro (or shelf atoll) itself is home to a wide variety of unique habitats, and hosts a number of endemic species. Laughing Bird Caye has also historically provided nesting sites for hawksbill and green turtles, critical to the survival of these species within the region. Historically, the National Park also supported a nesting colony of laughing gulls, after which the Caye and National Park were named.

The Southern Environmental Association (SEA), a non-governmental organization, has been granted co-management responsibility of the LBCNP by the Government of Belize, in partnership with the Forest Department. SEA was established in November 2008 following the merger of two conservation organizations: Friends of Nature and the Toledo Association for Sustainable Tourism and Empowerment. The mission of SEA is to:

> **"Continuously work towards improving stewardship and the environmental integrity of key marine areas in Southern Belize through effective, collaborative protected areas management, community involvement, and strategic partnerships for the benefit of all stakeholders".**

1.2. Purpose and Scope of Plan

Laughing Bird Caye National Park was designated under the National Parks System Act, which was repealed and replaced by the National Protected Areas System Act No 17 of 2015, for:

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

The purpose of the management plan is to provide a framework for the sustainable use of the LBCNP's natural resources and to provide guidance to SEA and the Forest Department towards effective management of the national park.

The first management plan for the LBCNP was developed in 2000 (Friends of Laughing Bird Caye/TIDE, 2000). Over the years, the management plan has been revised based on the expansion of the knowledge base with the most recent plan being the 2011-2016 LBCNP Management Plan (Wildtracks, 2011). The 2011-2016 Management Plan provides very detailed information on the physical and biological aspects of the Park. This five-year (2018-2022) Management Plan serves to update the 2011-2016 plan by incorporating new knowledge on

environmental and socio-economic trends, and emerging management issues based on literature reviews, a Rapid Ecological Assessment, field visits to the site and a series of meetings and workshops with stakeholders.

The Management Plan was developed based on the national Guidelines for Development of a Management Plan (National Protected Areas Policy and System Plan (NPASP), 2005). The plan has three main sections. The Current Status section includes information on the national, global and regional context of the Park, as well as the physical and biological attributes and cultural and socio-economic values. The Conservation Planning section summarizes the process and results of identifying and prioritizing conservation targets. The Management Planning section defines the management goals of the Park and outlines specific management programmes and objectives including the means for measuring management effectiveness.

The Management Plan has been developed using a participatory approach and prepared with the input of the various stakeholders through meetings with SEA staff, a series of workshops with key stakeholders, and interviews with a wide variety of individuals, including fishermen, the tourism sector, management staff and researchers.

The Management Plan is a document that is to be reviewed and evaluated annually by SEA and the Forest Department to allow for modification in strategies and actions which reflect changes within and near the Park.

2. CURRENT STATUS

2.1. Location

Laughing Bird Caye National Park lies in the general area of UTM 384 549 N, 1859 762 W (16˚26.59'N; 88˚11.85'W), 12 miles (19.3 km) east of Placencia, in the Stann Creek District (Figure 1). The protected area has developed around Laughing Bird Caye, a 1.4 acre (0.57 ha) long and narrow sand and shingle caye measuring 1,400 feet long and between 20 and 120 feet in width (427 m long and between 6.1 m and 36.6 m wide), that sits on an elongated ridge of the most southerly of Belize's coral faro formations. The Laughing Bird Faro rises out of deep water, with the Victoria Channel to the east and the inner lagoon to the west, and encloses a central lagoon area.

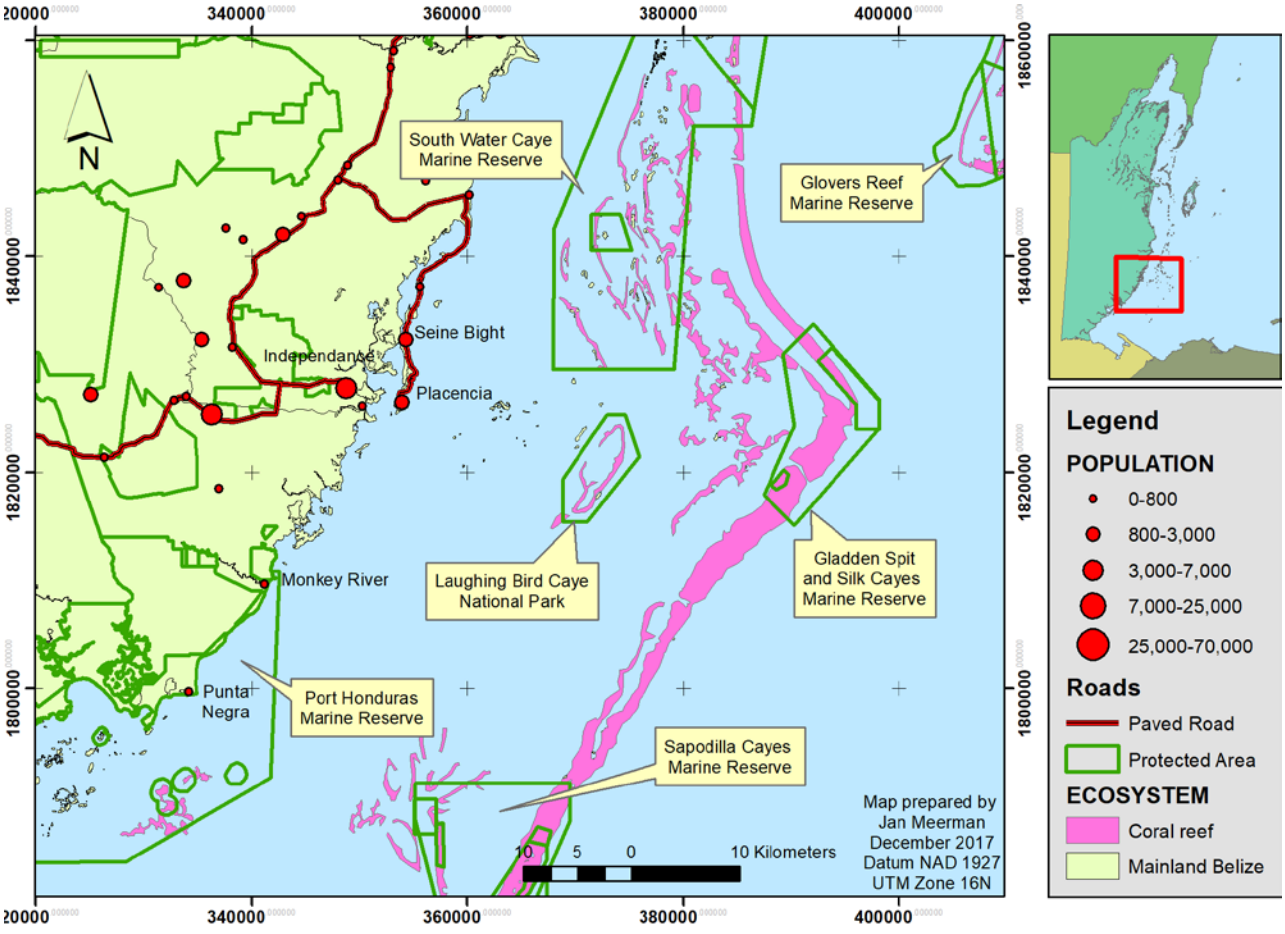

Figure 1: Laughing Bird Caye National Park: General Location

Access to LBCNP is by sea, with increasing tourism visitation from coastal communities on mainland Belize. Boats originate primarily from Placencia –

traditionally a fishing village that now also functions as a significant centre for tourism and coastal development. Cruise ships and smaller live-aboards also use the waters near Placencia during the tourist season, taking advantage of the deep Victoria Channel. The live-aboards and have used Laughing Bird Caye.

2.2. Global and Regional Context

Laughing Bird Caye National Park is part of the Mesoamerican Reef System (MAR), which stretches for more than 621.4 miles (1,000 km) along the coast of Belize, Guatemala, Honduras and Mexico. One of the most diverse ecosystems on earth, the MAR is considered outstanding on a global scale, and a priority for conservation action – stabilizing and protecting coastal landscapes, maintaining coastal water quality, sustaining species of commercial importance, and providing employment in the fishing and tourism industries for more than a million people living in coastal areas (Global Environment Facility, 2001).

The National Park contains assemblages of regionally important ecosystems of remarkable biodiversity and beauty, as well as of great scientific value, and importance for many species of global conservation concern, among them the critically endangered Elkhorn and Staghorn corals (*Acropora palmata* and *Acropora cervicornis*), Hawksbill Turtle (*Eretmochelys imbricata*) and the Goliath Grouper (*Epinephelus itajara*). The area also protects endangered green turtle (*Chelonia mydas*). As a non-extractive protected area, it also contributes towards the regional viability of important commercial species, including the Queen Conch (*Strombus gigas*) and Spiny Lobster (*Panulirus argus*) (Table 1).

Belize has an estimated 1,420 km² (142,000 ha) of reef within its waters - 5.5% of the reefs of the Wider Caribbean (World Resources Institute, 2004). The Belize Barrier Reef is included on a list of 18 richest centres of endemism and has been highlighted as one of the most threatened by human impacts (Roberts *et al.*, 2002). The recent Mesoamerican Reef Report Card (McField *et al.*, 2018) shows that of the 94 sites studied along the Belize Barrier Reef, only 12% of sites are in good condition, while 29% are in fair condition; 59% of the sites are in poor or critical condition. However, the Southern Belize Reef Complex, within which LBCNP is located, has seen an overall improvement of reef health compared to the previous Report Card. The 2018 results are as follows: 12% live coral cover, 22% fleshy macroalgae cover, 2,002 g/100m² commercial fish, and 4,194 g/100m² herbivorous fish. This is the only reef sub-region in Belize that is in good condition with a Reef Health Index of 3.8. The Southern Barrier Reef Complex also has the highest RHI in the entire Mesoamerican Reef region

(Mesoamerican Reef Report Card, 2018). See Section 2.3.1 for more information about the Southern Belize Reef Complex.

Table 1: Laughing Bird Caye National Park – Species of International Concern

LBCNP Species of International Concern	
Critically Endangered	
Staghorn Coral	*Acropora cervicornis*
Elkhorn Coral	*Acropora palmata*
Goliath Grouper	*Epinephelus itajara*
Hawksbill Turtle	*Eretmochelys imbricata*
Endangered	
Green Turtle	*Chelonia mydas*
Nassau Grouper	*Epinephelus striatus*
Boulder Star Coral	*Montastraea annularis*
Star Coral	*Montastraea faveolata*
Great Hammerhead	*Sphyrna mokarran*
Vulnerable	
Lamarck's Sheet Coral	*Agaricia lamarcki*
Loggerhead Turtle	*Caretta caretta*
Pillar Coral	*Dendrogyra cylindrus*
Elliptical Star Coral	*Dichocoenia stokesii*
White Grouper	*Epinephelus flavolimbatus*
Snowy Grouper	*Hyporthodus niveatus*[1]
Hogfish	*Lachnolaimus maximus*
Cubera Snapper	*Lutjanus cyanopterus*
Montastraea coral	*Montastraea franksi*
Yellowmouth Grouper	*Myctoperca interstitialis*
Rough Cactus Coral	*Mycetophyllia ferox*
Whale Shark	*Rhincodon typus*
Whitelined Toadfish	*Sanopus greenfieldorum*
West Indian Manatee	*Trichechus manatus*
Near Threatened	
Queen Triggerfish	*Balistes vetula*
Marbled Grouper	*Dermatolepis inermis*
Mutton Snapper	*Lutjanus analis*
Rainbow Parrotfish	*Scarus guacamaia*

The global importance of Laughing Bird Caye National Park was recognized in 1996, when it was designated as one of seven components of the Belize Barrier Reef System - World Heritage Site (UNESCO, 1996) (Table 2). The designation was based on the **Convention Concerning the Protection of World Culture and Natural Heritage representative of the Belize Barrier Reef Reserve System** under criteria (iii), based on the classic examples of fringing, barrier and

atoll reef types, and on the pristine nature of the mangrove and caye vegetation communities.

Table 2: Seven Protected Areas of the Belize Barrier Reef World Heritage Site

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

In 2009, however, Belize's World Heritage Site was placed on the List of World Heritage in Danger, following an assessment of the state of the seven marine protected areas and of the human impacts affecting them, triggered by reports of mangrove clearance for development in the adjacent South Water Caye Marine Reserve, as well as approvals for petroleum exploration near the World Heritage Site. Belize has made considerable progress towards achieving the desired state of conservation such as the adoption of the Draft Forest (Protection of Mangroves) Regulations; the implementation of the Integrated Coastal Zone Management Plan, and the passage of legislation instituting an indefinite moratorium on offshore oil exploration and development within Belize's World Heritage Site and territorial sea. In 2018, Belize was removed from the Danger List.

Belize has been a signatory to a number of regional and international conventions. In 1983, Belize signed the **Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region** (the "Cartagena Convention") with the primary objective being protection of the ecosystems of the marine environment, following recognition of the regional importance of the Mesoamerican Barrier Reef System (MBRS), the majority of which lies within Belizean waters (Table 3). Conservation of this National Park is also a step towards fulfilling Belize's international commitments under the **Convention on Biological Diversity**, signed in 1992, and the **International Convention for the Protection and Conservation of Sea Turtles for the Western Hemisphere**, signed in 1997.

Table 3: International Conventions and Agreements of Relevance to Laughing Bird Caye National Park

International Conventions and Agreements of Relevance to LBCNP	
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. ***Laughing Bird Caye 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 of LBCNP are targeted for facilitation of sustainable economic and environmental development, with the support of the Forest Department and SEA.***
Central American Commission for Environment and Development (CCAD) (1989)	Regional organization of Heads of State formed under ALIDES, responsible for the environment of Central America. Initiated Mesoamerican Biological Corridors and Mesoamerican Barrier Reef Systems Programmes. ***Data gathered through monitoring initiatives at LBCNP have been shared regionally in the past through MBRS.***
Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena de Indias, Colombia, 1983)	Regional convention with the objective of protecting the marine environment of the Wider Caribbean through promoting sustainable development and preventing pollution. ***LBCNP is an important and integral part in the National Protected Areas System, protecting biodiversity and threatened species, as per Belize's commitment under this Convention.***
Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972)	The World Heritage Convention requires parties to take steps to identify, protect and conserve the cultural and natural heritage within their territories. ***LBCNP has been accepted as one of seven sites that together comprise Belize's World Heritage Site under the Convention. However, this WHS has recently been placed on the list of 'sites in danger' (WHS, 2009).***
International Convention for the Protection and Conservation of Sea Turtles for the Western Hemisphere (December 21, 1997)	To protected and conserve sea turtle species of the Western Hemisphere. ***LBCNP protects important feeding and nesting areas for sea turtles, including the Critically Endangered hawksbill.***

2.3. National Context

2.3.1. Legal and Policy Framework

Legal Establishment

Laughing Bird Caye National Park is a national protected area, defined by Statutory Instrument 94 of 1996 under the **National Parks System Act** (1981). The area is designated as a 'National Park' under the mandate of the Forest Department (Ministry of Fisheries, Forestry, the Environment and Sustainable Development). In keeping with its designation, LBCNP is a non-extractive protected area, with use being restricted to tourism, research and education.

Purpose of a National Park

To protect and preserve natural and scenic values of national significance for the benefit and enjoyment of the general public.

Activities Permitted:

Tourism, Research, Education

The National Park designation is considered to be equivalent to the IUCN designation ***Category II: A protected area managed primarily for ecosystem protection and recreation*** (NPAPSP, 2005; IUCN, 1994).

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."

The National Park is currently managed by the Southern Environmental Association, through a co-management agreement with the Forest Department. The caye is divided into two zones. The first is the Recreational Zone, including the visitor infrastructure, and the second is a 'no-entry' Preservation Zone that encompasses the naturally vegetated northern tip of the caye. Access is restricted to reduce disturbance to the bird and marine life. See Volume Two Section 1.5 for carrying capacity guidelines related to these zones.

National Framework

Belize has an impressive record of establishing protected areas, with a total of 103 protected areas within the National Protected Areas System (NPASP, 2015). 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 guided by the updated National Protected Areas System Plan (NPASP, 2015).

The overall goals of both the National Biodiversity Strategy and the NPASP 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. The management of these resources has also been largely decentralized, with a strong focus on co-management partnerships (such as that between SEA and the Forest Department), community-based participation and equitable benefit from conservation efforts.

Box 1 **NPASP Statement, 2015**

The National Protected Areas System Plan reflects the Constitution of Belize and is founded on the need to ensure that biodiversity conservation becomes an important and integral part of national social and economic development. The guiding principle is to ensure that the potential contribution of the protected areas system to national development and poverty alleviation is maximized, thereby putting it on a sound and rational footing.

Laughing Bird Caye National Park is an important component of Belize's strategies for conservation of the marine environment. Whilst the entire Barrier Reef and associated coral reef structures do not have full protected status within Belize, there are 14 marine protected areas within the national system (Figure 2). Nine of these are designated under Fisheries Department as Marine Reserves, the remaining five (including Laughing Bird Caye National Park) being under the Forest Department (Table 4). The Fisheries Department has also established 11 protected Spawning Aggregation Sites – the majority of the sites known within Belize waters, and a further 2 have seasonal protection for Nassau Grouper.

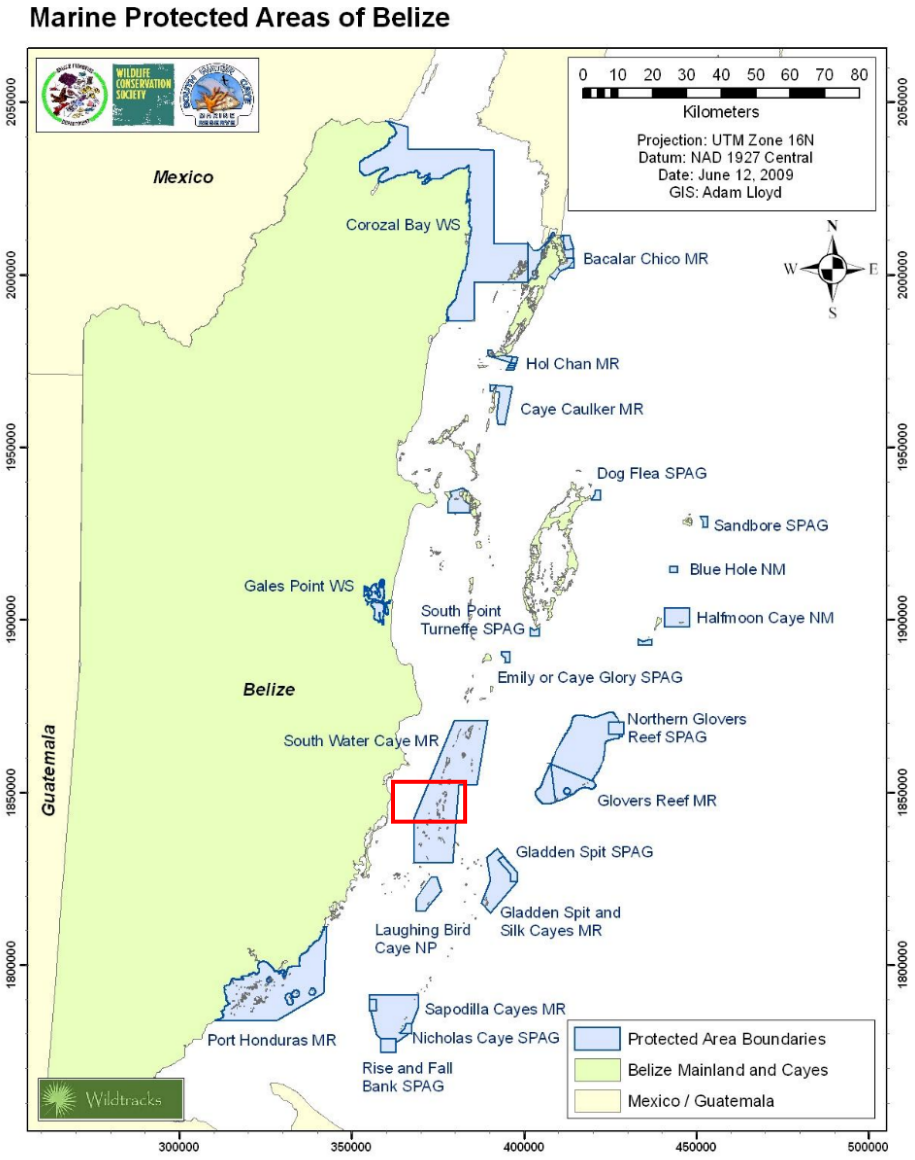

Figure 2: Marine Protected Areas in Belize

Table 4: Marine Protected Areas in Belize

Marine Protected Areas in Belize				
Protected Area	**Mgmt. /Co-mgmt.**	**IUCN Category**	**SI**	**Area (Acres)**
Bacalar Chico National Park & Marine Reserve	Fisheries Dept.	IV	88 of 1996	15,765.8
Blue Hole Natural Monument	Forest Dept. /BAS	III	96 of 1996	1,023
Caye Caulker Marine Reserve	Fisheries Dept./ FAMRACC	VI	35 of 1998	9,670.2
Corozal Bay Wildlife Sanctuary	Forest Dept.	IV	48 of 1998	180,508.5
Gladden Spit and Silk Cayes Marine Reserve	Fisheries Dept./SEA	IV (VI recommended)	95 of 2003	25,978.3
Glover's Reef Marine Reserve	Fisheries Dept.	IV	70 of 1996	86,653
Half Moon Caye Natural Monument	Forest Dept. /BAS	II	30 of 1982	9,771
Hol Chan Marine Reserve	Fisheries Dept.	II	57 of 1987	3,813
Laughing Bird Caye National Park	Forest Dept. /SEA	II	94 of 1996	10,119
Port Honduras Marine Reserve	Fisheries Dept. / TIDE	IV	9 of 2000	100,000
Sapodilla Caye Marine Reserve	Fisheries Dept./ SEA	IV	117 of 1996	38,594
South Water Caye Marine Reserve	Fisheries Dept.	IV	118 of 1996	117,875
Swallow Caye Wildlife Sanctuary	Forest Dept. /FOSC	IV	102 of 2002	8,972
Turneffe Atoll Marine Reserve	Fisheries Dept./TASA	IV	Fisheries Act (Rev. 2012)	325,412

National Planning Strategies

Under the National Protected Areas System Plan, the Government of Belize seeks to increase management effectiveness through grouping protected areas into system level management units. Laughing Bird Caye National Park is one of four protected areas (along with South Water Caye Marine Reserve, Gladden Spit and Silk Cayes Marine Reserve and Sapodilla Cayes Marine Reserve) that together form the Southern Belize Reef Complex, transcending site-level administrative categories (Figure 3). Also covered within the scope of the SBRC are four legally protected critical spawning aggregation sites – the three sites within the Sapodilla Cayes Marine Reserve, and Gladden Spit, the largest aggregation known in the Mesoamerican Reef ecoregion.

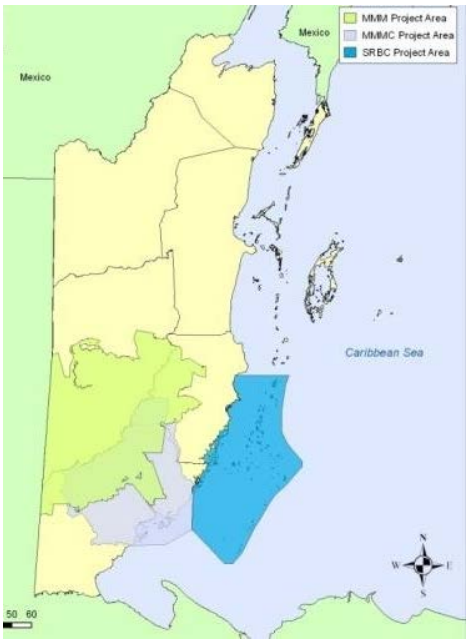

Figure 3: System Level Planning

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

Two other such system-level units are currently being established to increase management effectiveness by reducing overlap and maximizing on synergies – the Maya Mountains Massif and the Maya Mountains Marine Corridor (Table 5; Figure 3).

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

Table 5: System level Management Units

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

The Southern Belize Reef Complex

The **Southern Belize Reef Complex** (SBRC) stretches southwards from the northern boundary of South Water Caye Marine Reserve to the northern boundary of Port Honduras Marine Reserve, and south-eastwards from the coastline of Belize to the Sapodilla Cayes and the outer reef (Figure 4). This area is characterized by the variety of reef structures, important cross-shelf habitat linkages and an assemblage of ecosystems considered possibly the most biodiverse in the region. The SBRC is of great scientific value and importance for many species of conservation concern, including the critically endangered hawksbill turtle *(Eretmochelys imbricata)* and goliath grouper (*Epinephelus itajara*), and the endangered green turtle (*Chelonia mydas*) (IUCN, 2017).

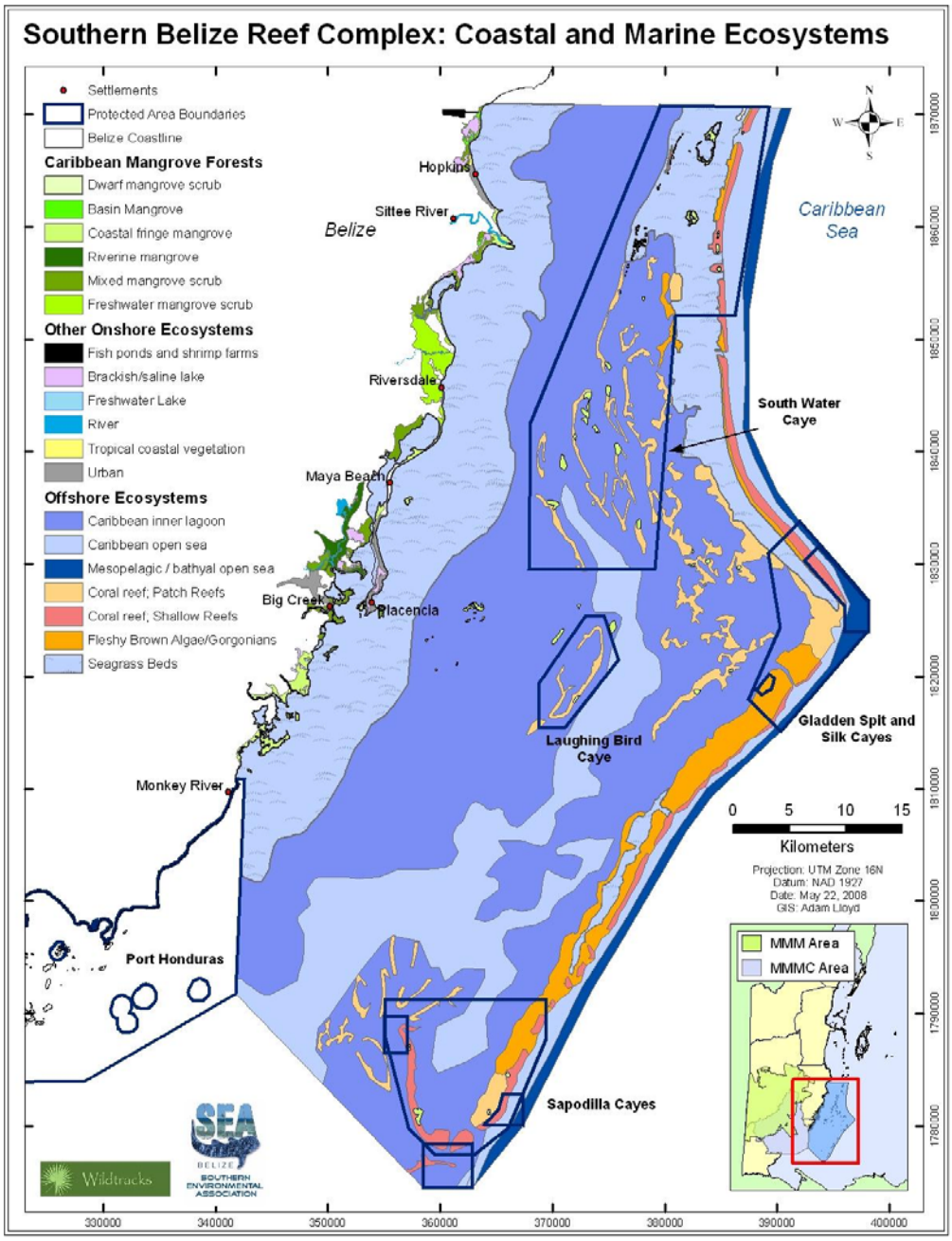

Figure 4: Southern Barrier Reef Complex

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

As part of the Southern Belize Reef Complex, management of Laughing Bird Caye

National Park needs to be aligned to the SBRC vision, with the SBRC goals and objectives for system level management being incorporated into the management planning process.

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 Protected Areas System Act** (2015), is responsible for the establishment and management of protected areas (including Laughing Bird Caye National Park). This Act provides for "the maintenance of coordinated management of a system of protected areas that is representative of internationally agreed categories, effectively managed, ecologically based, consistent with international law, and based on best available scientific information and the principles of sustainable development for the economic, social and environmental benefit of present and future generations of Belize". The Act repeals the National Parks System Act (CAP 215, Revised Edition 2011) and amends the Fisheries Act (CAP 210, Rev Ed 2011) and the Forests Act (CAP 213, Rev Ed 2011).

The **Wildlife Protection Act** (CAP 220, Revised Edition 2010) falls under the Forest Department, and addresses the need to protect wildlife resources, primarily terrestrial wildlife, but also a number of marine species (West Indian Manatee and dolphins).

Also developed under the Ministry of Natural Resources are the **Forest (Protection of Mangrove) Regulations** (SI 52 of 1989, revised 2010), which provide for the protection of mangroves, with restrictions on mangrove alteration and/or clearance. Before granting a permit for mangrove alteration, Belize law requires the Forest Department consider whether the project will adversely affect the conservation of the area's wildlife, water flow, erosion and values of marine productivity, and to find either 'that the proposed alteration will not significantly lower or change water quality' or that the degradation of water quality is in the "larger and long-term interest of the people of Belize" (Chapter 213, Section 5.5, Belize's Forest Act).

The **Fisheries Act** (CAP 210, Rev Ed 2011), administered by the Fisheries Department (MFFSD), is the principal governing legislation to regulate the fishing industry, and is directly concerned with maintaining sustainable fish stocks and protecting the marine and freshwater environments. It also provides protection for nesting turtles and nest sites. Marine turtles themselves have been given protection since the original Fisheries Ordinance in 1940.

The **Mines and Minerals Act** (CAP 226, Rev Ed 2011) and the **Petroleum Act**

(CAP 225, Rev Ed 2011) regulate the exploration and extraction of all non-renewable resources, including petroleum.

The **Petroleum Operations (Maritime Zone Moratorium) Act** of 2017 was enacted effective December 29, 2017. This Act imposes an indefinite moratorium on the exploration for and exploitation of petroleum and other petroleum operations in the maritime zone of Belize.

Whilst the above are the pieces of legislation directly relevant to Laughing Bird Caye National Park, there are others that are also of relevance. The **Environmental Protection Act** (CAP 328, Rev Ed 2011) was drawn up under the Department of the Environment (DoE) with the aim of ensuring that development initiatives within Belize are planned for minimum environmental impact. In the context of Laughing Bird Caye National Park, this is particularly important when ensuring that the impacts on the protected area from development in adjacent areas are minimized – particularly dredging.

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

The Port Authority is mandated to ensure the safety of navigational channels, through the installation of navigational aids (**Belize Port Authority Act**, CAP 233, Rev Ed 2011), and installation and maintenance of demarcation buoys. It also has a role in the registration of boats and monitoring of vessels using navigational channels and the removal of boats from the reef, when groundings occur.

Attempts at conservation financing for protected areas are partially addressed at Government level through the development of a funding mechanism to assist in management and development activities within protected areas – the Protected Areas Conservation Trust (**PACT Act**, CAP 218, Rev Ed 2015), through a ”conservation tax” of BZ$7.50 levied on non-residents as they leave the country, and a portion of cruise passenger “head tax”. The Southern Environmental Association, as the co-management partner, is eligible for funding from the Trust, and has received funding in the past.

There is currently significant fragmentation in decision making, with these different Acts falling under different Ministries. This is being partially addressed through the implementation of the **National Protected Areas System Plan** (NPASP, 2015), currently guided by the National Protected Areas Secretariat, and passage of the National Protected Areas System Act (see above), which repealed and replaced the National Parks System Act.

2.3.2. Land and Sea Tenure

Laughing Bird Caye National Park is included in Belize's territorial waters (Maritime Areas Act, CAP 11, Rev Ed 2011)). A single caye, Laughing Bird Caye, which is national land, lies within the National Park. The seabed is national land and thus any activities need to be licensed by the Lands Department. Any mining, including beach sand mining, or dredging activities require a license from the Geology and Petroleum Department.

2.3.3. Evaluation of Protected Area

2.3.3.1. Biological Importance

Laughing Bird Caye National Park encompasses the entire Laughing Bird Faro, with fringing reefs and a central lagoon dominated by hardy species that can tolerate varying levels of salinity and turbidity, conditions that may provide greater resilience to climate change. This increases the MPA's importance within the marine protected areas system, contributing towards the long-term viability of coral reefs in Belize.

The National Park is one of four protected areas that form the Southern Belize Reef Complex (SBRC), which stretches southwards from the northern boundary of South Water Caye Marine Reserve to the northern boundary of Port Honduras Marine Reserve, and south-eastwards from the coastline of Belize to the Sapodilla Cayes and the outer reef. This area is characterized by its variety of reef structures, important cross-shelf habitat linkages and an assemblage of ecosystems considered possibly the most biodiverse in the region. The SBRC is of great importance for many species of conservation concern, including the critically endangered hawksbill turtle and goliath grouper, and the endangered green turtle (IUCN, 2017). The caye itself provides critical nesting beaches for hawksbill turtles.

2.3.3.2. Economically Important Species

Laughing Bird Caye National Park is a completely protected no-take area and thus plays an important role in maintaining a healthy fishery, particularly for

the Caribbean Spiny Lobster (*Panulirus argus*) and Queen conch (*Strombus gigas*), two invertebrate species of commercial importance fished extensively throughout Belize. The conch and lobster fisheries form the two most important components of the capture fisheries in Belize, with production representing over 90% of total capture fisheries production in 2008, and an export value of Bz$20.30 million (Ministry of Agriculture and Fisheries, 2009). Lobster landings peaked in 1981 at 2,204,622 lbs, but fell to 457,680 lbs in 2006, with 484,891 lbs harvested in 2014/15 season (Belize Fisheries Department, 2015).

It is significant to note that the general trend of total national lobster production is a decline, and there are concerns for the continued sustainability of the lobster fishing industry even though the general decline seems to be leveling off.

As with lobster, national conch landings have declined significantly, peaking at 1,239,000 lbs in 1972, and subsequently declining by over 50% to 574,756 lbs in 2008. The 2015-2016 conch season produced 794,369 pounds indicating an increase in production. It has been suggested that the maximum sustainable yield for this species was reached in 2006, with the steep decline of 17% observed in 2007 serving as an indication of the "maturity" of the fishing industry, and the possible overfishing of this fishery resource (Ministry of Agriculture and Fisheries, 2007). Even as far back as 1996, there was evidence that fishing pressure was too high, with the national population consisted primarily of juveniles, resulting in recommendations for capping of the number of fishermen. Strict regulations and quotas are now being implemented towards more sustainable use of this resource, and an increase in production was noted in 2008 (Ministry of Agriculture and Fisheries, 2009), though the number of fishermen has still not been capped.

Laughing Bird Caye National Park is well known throughout Belize for its high densities of mature adult conch. SEA has conducted significant monitoring of conch both within and outside the National Park and has demonstrated that there are greater densities of adult conch within the park when compared to sites located outside the protected area (Finch *et al.*, 2008). Old data on conch densities support this, with a density of 197.53 conch/hectare recorded within the National Park, and only 11.11 conch/hectare outside (SEA, 2008), indicating a distinct reserve effect for conch within LBCNP. More detailed analysis of size distribution of conch within the marine protected area boundaries showed that conch located within the park were larger and had thicker lips than conch located in other areas. It also appears that the average lip thickness of conch within the MPA has increased from 2005 to 2008 - the only SEA managed marine protected area to show this trend.

Finfish are also extracted from the areas around the marine protected area, mostly by spear guns and hand lines, and in general provide an important

component of the community level catch. Much of this catch is sold in local markets and directly to hotels rather than through the co-operatives, or more recently, to Jamaican buyers, for export. The targeted export species include groupers (*Epinephelus* spp. and *Mycteroperca* spp.), snappers (*Lutjanus* spp. and *Ocyurus* spp.), hogfish (*Lachnolaimus maximus*), king mackerel (*Scomberomorus cavalla*), great barracuda (*Syhyraena barracuda*), and jacks (*Alectis* spp., *Caranx* spp. and *Trachinotus* spp.) (FAO, downloaded 2010). Snappers are reported to make up the largest single family of fish that are exported, with whole fish and fish fillet exports totaling 113,500 lbs in 2001, and dropping to 52,316 lbs in 2006, (Belize Fisheries Dept., 2002; Ministry of Agriculture and Fisheries, 2007) - a drop of approximately 44% over five years.

Species harvested for local consumption include grunts (Haemulidae), mullets (Mugilidae), porgies (Sparidae), triggerfish (Balistidae), and tarpon. Data from Laughing Bird Caye National Park from 2004 to 2010 show a steady increase in numbers of parrotfish (2011 management plan), since their protection under the Fisheries legislation, though it is interesting to note that the number of encounters remains higher outside the protected area than inside. Other species, such as snapper, are steadily decreasing.

Except for the whale shark (for which there is a complete ban on fishing under the Fisheries Act), there is the general recognition in Belize that sharks, in general, are under pressure from over-fishing. Sharks have a close stock-recruitment relationship, long recovery times in response to over-fishing, produce few offspring and take long to reach sexual maturity, resulting in low biological productivity. This, in combination with complicated patterns of size/sex segregation and seasonal migration, raises national concerns about the sustainability of the shark fishery, particularly at the current unregulated fishing levels. The Belize Fisheries Department is developing a National Plan of Action for the shark fishery following the guidelines of the International Plan of Action for the Conservation and Management of Sharks (IPOA – Sharks), which is designed to achieve the conservation and sustainable use of shark species through the protection of the marine environment (ecosystems and biodiversity), with the minimization of by-catch, waste and discard, and through the adoption of selective and environmentally safe fishing practices. Shark fishing is conducted in the waters adjacent to LBCNP, and sharks are caught as by-catch in traditional long-line fishing in the deeper channels to the west and east of the protected area. Common species caught include bull, hammerhead, nurse, and reef and lemon sharks. The dried shark fins and salted or frozen shark meat is being exported through the co-operatives, or illegally sold directly to buyers in various coastal ports in Guatemala and Honduras.

2.3.4. Socio-Economic Context Update

Belize has a rich diversity of peoples, languages and cultures and has the distinction of being the only country in Central America whose official language is English. The total land area is almost 22,700 km^2 with the population estimated to be around 387,879 inhabitants (Figure 5). Belize is also home to the second largest barrier reef in the world with more than 100 small cayes located offshore.

Population and Social Indicators	
Area (sq.km.)	22, 860
Adult literacy rate, 15 and up (percent), 2010	75.1
Human development index (rank), 2014	101
Population (thousands), Sep. 2015	378
Unemployment rate, September, 2016	11.1
GDP per capita, (current US$), 2015	4,698
Life expectancy at birth (years), 2014	73.7
Access to improved water sources (% of population), 2012	99.3
Under-five mortality rate (per thousand), 2013	17
Poverty (%of total population), 2009	42

Figure 5: Belize National Demographics
Source: World Bank, 2018

The region in which Belize now exists was once part of the Maya civilization which was at its height between 250–900 A.D. The descendants of this civilization are now subdivided into three ethnic groups – the Yucatec Maya of the north and west, the Mopan and Q'eqchi Maya of the south. The northern coastal fishing communities are based on the Mestizo culture, being settled in the 1850's by refugees from the Caste War of Yucatan, Mexico. Communities in central Belize, particularly those of the Belize River Valley, are predominantly Creole, founded by descendants of slaves brought to Belize direct from Africa, or via the West Indies, to work in the logging industry in the late 1700/early 1800s. The southern coastal communities are more Garifuna based (descendants of Black African/Carib), being settled by refugees who sailed from St. Vincent in the Caribbean to the coast of northern Honduras, southern Guatemala and southern Belize.

There was a significant influx of Central American refugees during the late 1980's when countries in the region were going through civil wars. Most of those immigrating to Belize come primarily from Guatemala, El Salvador and Honduras. Many Guatemalans and Hondurans also come to Belize as seasonal workers in the banana and citrus industries based in the Stann Creek District.

Many of course, don't return to their home country but rather settle in Belize permanently.

Belize has a small open economy that is supported primarily by natural resources with major sectors being agriculture (citrus, sugar, bananas, fisheries), manufacturing (including petroleum) and tourism (tertiary sector). The mining/petroleum sector enjoyed a robust but short growth over the period 2006 to 2011 having discovered oil in commercial quantities in 2005. Since the start of petroleum extraction in 2006 the value of exports rose from BZ$77.0 million to BZ$203.2 million in 2008. Oil production however has now levelled off and is rapidly declining. Over the last 30 years Belize's economy has been slowly shifting over from "traditional" commodity exports to service exports. For instance, oil and tourism went from 1% of total exports at the time of Independence to approximately 60% thirty years later in 2010 (Thomas & Thomas, 2012).

Tourism is now one of the main engines of growth in the Belizean economy and the principal source of foreign exchange. It is estimated that more than 14% of the employed labour force is related to or driven by this particular sector. In 2015, the overnight tourism industry experienced an overall growth of 6.2% or 19,900 over 2014. Cruise tourism has also become an important feature of the overall industry. In 2015, there was a total of 957,975 cruise passenger arrivals recorded. This was only slightly lower compared to 2014 (BTB, 2018). Overnight tourism also shows a distinct seasonality, with the majority of visitors arriving in the first quarter of the year. The lowest months are September and October, the main tropical storm season.

Placencia, the main departure point for tours to GSSCMR, started as a small fishing community with 10 hotels (with 58 beds) in 1988, and has since developed into a major tourism destination, with 155 hotels (with 1,416 beds (BTB, 2016) today. Reef based tourism now provides substantial employment opportunities for local guides, tour operators and tourism developments on the mainland. In 1994, tourism in Placencia provided an estimated 19 people with direct employment, steadily increasing to 429 in 2008. By 2016, an estimated 1,399 persons were working in the tourism industry in Placencia clearly indicating a significant shift from fishing to a tourism-based economy. Placencia accounts for 12.9% of the BZ$245 million generated by the accommodations sector nation-wide.

Belize's fisheries sector (capture fisheries) contributes significantly to the economy of Belize. In 2012, the sector brought in approximately BZ$29 million to the local economy. Most of the benefits go to coastal fishing communities who

are active in harvesting marine resources. While fishing is prohibited within Laughing Bird Caye National Park, the fishing sector does have a significant impact on the viability of the commercial fish stocks of the marine protected area.

There seems to be a decline in the overall contribution of the fisheries sector to the national economy. In 2012, fisheries contributed about 2.9% to Belize's Gross Domestic Product (GDP) which is significantly lower when compared to 5% in 2003. Figures released by the Belize Fisheries Department reveal a 0.45% decline in the total lobster production for Belize for 2014 – 2015 season when compared to that of the 2013-2014 season. In 2017, the fisheries sector produced approximately 1,648,434 lbs of seafood products including conch and lobster. The Spiny Lobster remains as one of the top marine exports for Belize, with earnings for the 2017-2018 season amounting to an estimated BZD$11.4 million. This represents a total of 958,490.27 pounds of lobster head meat, lobster tail and whole lobster. According to the Fisheries Department lobster production has remained relatively stable over the past 28 years within the production range of 400,000 – 600,000 pounds of lobster tails. Most of the production is exported to United States of America. Total fishery earnings (export and local) were BZ$25.95 million in 2011 and BZ$15.1 million in 2017 (Belize Fisheries Department, 2018).

The majority of the fishers that use the area adjacent to Laughing Bird Caye National Park originate from the mainland communities of Riversdale, Seine Bight (including Maya Beach), Placencia, Independence and Monkey River, the northern coastal community of Sarteneja, and to a lesser extent, Copper Bank and Chunox.

Laughing Bird Caye is one of the few closest cayes to the central Belize coastline with beach rather than mangrove, and is therefore ideally situated for tourism. Placencia, the main departure point for tours to Laughing Bird Caye, started as a small fishing community with ten hotels (with 58 beds) in 1988, and has since developed into a major tourism destination. Reef based tourism now also provides substantial employment opportunities for local guides and tourism developments on the mainland. Placencia is just one of a number of communities that have been identified as major stakeholders in the protected area, directly through tourism, or more indirectly through its impacts on commercial fishing.

A basic stakeholder analysis identifies stakeholder interests and impacts (Table 6).

Table 6: Stakeholder Communities of Laughing Bird Caye National Park

Stakeholder Communities of Laughing Bird Caye National Park				
Community	**Location (UTM) Distance (km)**	**Population (approx.)**	**Population components**	**Comments**
Placencia (including Riversdale)	E16 03653894 N18 26544] (16 km west)	1,753	Predominantly Creole	Historically a fishing community – now a primarily tourism based economy. Main promoter and user of Laughing Bird Caye National Park. (Includes Riversdale).
Sarteneja	E16 0378750 N18 29500 (210 km north)	1,824	Mestizo	Largest fishing community, concentrating on lobster and conch throughout Belize waters using traditional sail boats. Largest number of fishermen utilizing the SBRC.
Independence	E16 0348723 N18 27872 (20 km west)	4,014	Mixed primarily Creole	Primarily a residential area for employees in Placencia and Big Creek, and in the citrus industry. Some tourism, mostly associated with Placencia, and a small number of fishermen, who target the areas around LBCNP.
Seine Bight	E16 0363200 N 18 64680 (20 km west)	1,310	Garifuna	Historically a fishing community – now moving towards a tourism- based economy. Traditionally used LBCNP as a camp for fishing trips and for cultural activities associated with the Dugu ceremony. Now use Buttonwood Caye.
Hopkins	E16 0363200 N18 64680 (25 km north)	1,610	Garifuna	No traditional or recent use of LBCNP, but benefits from participation in SEA educational activities, focused on the National Park
Belize Housing and Population Census Country Report, 2010.				

Table 7: Stakeholder Analysis for Laughing Bird Caye National Park

Stakeholder Analysis for Laughing Bird Caye National Park				
Stakeholder	**Influence or Impact of Laughing Bird Caye National Park**		**Influence or Impact of Stakeholder on Laughing Bird Caye**	
Community Stakeholder Hopkins, Sittee River, Seine Bight, Riversdale, Placencia, Monkey River, Independence, Sarteneja	• Management of reef for tourism and as a fisheries source area • Providing stakeholders with an option to shift income base from fisheries dependency to tourism, with increased eco-nomic benefits • SEA, as co-management agency, focused on education and awareness for schools and local residents associated with the protected area • Protection of reef resources in perpetuity for future generations • Exclusion from traditional fishing areas • Environmental services – coastal protection and climate regulation	+ + + + - +	• Active cooperation and collaboration of tourism stakeholders towards effective protected areas management • Reduced impact of reef tourism activities through adoption of Best Practices by tourism stakeholders through awareness • Illegal fishing within the National Park • Anchor damage to coral and seagrass	+ + - -
Commercial Fishermen	• Protection of fish, lobster and conch resources within the National Park ensuring continued viability of fishery • Exclusion from traditional fishing areas	+	• Support for effective management of protected area (southern communities) • Illegal fishing within the National Park • Anchor damage to reef	+ - -

Stakeholder Analysis for Laughing Bird Caye National Park				
Stakeholder	**Influence or Impact of Laughing Bird Caye National Park**		**Influence or Impact of Stakeholder on Laughing Bird Caye**	
Tour Guides (including tour boat captains)	• Benefit from having Laughing Bird Caye National Park as a major venue for snorkeling and dive- associated tourism • Benefit from training opportunities associated with Laughing Bird Caye National Park • Employment in reef-based tourism initiatives • Income from using Laughing Bird Caye National Park for tourism	+ + + +	• Support the conservation goals of Laughing Bird Caye National Park • Provide interpretation for visitors, facilitating overall visitor appreciation • Assist with visitor management within the protected area through in-depth briefings • If poorly trained, can result in poor visitor management and increased impact on corals and associated fauna, anchor damage etc. • Impact behaviour of fish through feeding • Anchor damage to coral and seagrass • Illegal fishing impacts within National Park from overnight sail charters	+ + + - - - -
Local / National Tour Operators	• Benefit from having Laughing Bird Caye National Park as a major venue for dive and snorkeling-associated tourism • Income from using Laughing Bird Caye National Park as a tourism destination	+ +	• Provide marketing at a national level, and send visitors to Laughing Bird Caye National Park • Support the conservation goals of Laughing Bird Caye National Park • Contribute to the financial sustainability mechanism for management of the protected area through visitation • Increase the potential for exceeding the carrying capacity of the protected area	+ + + -
International Tour Operators	• Benefit from having Laughing Bird Caye National Park as a venue for dive and snorkeling-associated tourism • Income from using Laughing Bird Caye National Park as a tourism destination	+ +	• Provide marketing at an international level, and send visitors to Belize, who may visit Laughing Bird Caye National Park • Support the conservation goals of Laughing Bird Caye National Park • Contribute to the financial sustainability mechanism for management of the protected area • Increase the potential for exceeding the carrying	+ + + -

Stakeholder Analysis for Laughing Bird Caye National Park				
Stakeholder	**Influence or Impact of Laughing Bird Caye National Park**		**Influence or Impact of Stakeholder on Laughing Bird Caye**	
BTIA	• Benefit from having Laughing Bird Caye National Park as a tourism destination • Benefit from global recognition of Belize as having a World Heritage Site, based on the pristine and unique value of the Belize Barrier Reef – including LBCNP	+ +	• Providing national and international marketing of Laughing Bird Caye National Park • Support the conservation goals of Laughing Bird Caye National Park	+ +
General Belize Public	• Maintenance of commercial fisheries stocks (fish, lobster and conch stocks) • Benefit from global recognition of Belize as having a World Heritage Site, based on the pristine and unique value of the Belize Barrier Reef – including LBCNP • Environmental services – coastal protection and climate regulation • Cultural and aesthetic appreciation • Increased awareness through education	+ + + + +	• Support of the general public will strengthen the position of protected area • Lack of support may increase chances of de-reservation or degradation	+ -
Visitors: Tourists	• Enjoy Laughing Bird Caye National Park as a tourism Destination for leisure • Benefit from education and awareness opportunities	+ +	• Entrance fee contributes towards the goal of sustainability • Provide marketing nationally and internationally by word of mouth, if happy with level of product • Presence deters illegal fishing within the National Park • Negatively impact marine and terrestrial environments	+ + + -

Stakeholder Analysis for Laughing Bird Caye National Park				
Stakeholder	**Influence or Impact of Laughing Bird Caye National Park**		**Influence or Impact of Stakeholder on Laughing Bird Caye**	
Visitors: Researchers	• Benefit from being linked to the Southern Environmental Association and Laughing Bird Caye National Park • Benefit from access to a virtually pristine reef environment and relatively unique faro structure • Benefit from historic baseline information on past research activities within protected areas	+ + +	• Conservation management benefits from data gathered, greater knowledge of marine and terrestrial environments and species within area • Benefit from increased research activity within area • Benefit from increased presence, deterring fishing incursions • Possible impact of research activities on marine environments	+ + + -
Sailboat Charter Companies	• Benefit from protection of Laughing Bird Caye National Park as a major destination • Income from using Laughing Bird Caye National Park as a tourism destination	+ +	• Support the conservation goals of Laughing Bird Caye National Park • Impacts of sewage and detergent, bilge water. grey water and oil • Anchor damage on mooring sites • Potential for grounding on the reef • Lack of compliance to rules and regulations due to limited awareness • Subsistence fishing within National Park	+ - - - - -

Stakeholder Analysis for Laughing Bird Caye National Park				
Stakeholder	**Influence or Impact of Laughing Bird Caye National Park**		**Influence or Impact of Stakeholder on Laughing Bird Caye**	
Government of Belize	• Provides fisheries management for fishing Industry	+	• Political support through the national protected areas system plan and legislation	+
	• Provides environmental services for the social and economic benefit of Belize	+	• Lack of political support for and understanding of conservation	-
	• Laughing Bird Caye National Park included within the National Protected Areas System Plan - assists in fulfilling Belize Government's commitment to the conservation of natural resources, and international conventions and agreements (CCAD, CBD, and MBRS)	+	• Uncertainty of long term future commitment especially in regards to financing of management	-
	• Income generation of significant foreign exchange	+		
	• Provides employment opportunities in stakeholder communities	+		
	• Collects taxes from business in the tourism sector who use the protected area as a tourism destination			

2.4. Physical Environment of Management Area

2.4.1. Climate

Whilst Laughing Bird Caye National Park lies only 10.6 miles (17 km) south east of Placencia, it has a distinct climate that differs from the mainland. Meteorological, oceanographic, and biological conditions have been recorded within the adjacent South Water Caye Marine Reserve, at Carrie Bow Caye (34 km to the north), since 1993, following its selection as a long-term monitoring site, under the Caribbean Coastal Marine Productivity (CARICOMP) - one of the longest continuous programs of its type. Principal parameters recorded are land-sea-water temperatures, water salinity (conductivity), dissolved oxygen, solar radiation, tides, wind direction and speed, and rainfall (Caribbean Coral Reef Ecosystems (CCRE), 2002), providing data that is also applicable to Laughing Bird Caye National Park.

Rainfall

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

Air Temperature

Annual air temperatures on Carrie Bow Cay average 27.1°C, fluctuating throughout the year from a minimum of 23.5°C in January, during the cold fronts, and a maximum in September of 29.2°C (CCRE, 2005).

Weather Systems

Belize is affected by three very distinct seasonal weather systems: trade winds, northers and tropical storms. All three have an influence on the rainfall and temperature patterns, on the sea level, and on the currents around the Laughing Bird Caye National Park itself.

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

strength until they hit land.

The hurricane season stretches from the month of June through November, with historical records identifying eleven hurricanes and nine tropical storms that have passed within a 31.1- mile (50-km) radius of Laughing Bird Caye National Park (Table 8; NHC, 2017). Whilst many hurricanes often have very focused paths of destruction, their effects are wide ranging, particularly at sea. As well as the physical and mechanical damage to the coral, hurricanes also stir up the water, increasing turbidity and can reduce water clarity for a significant time after the storm event itself. Water clarity can be further reduced following tropical storms by the associated heavy rainfall, which can exacerbate erosion and increase sediment transport from the mainland via the rivers.

Hurricanes can also result in major changes to the shapes and sizes of cayes. During Hurricane Hattie, rubble and shingle were deposited at the northeast and southwest ends of Laughing Bird Caye, and along the southeast shore (Stoddart, 1963). The most recent extreme hurricane impacts at Laughing Bird Caye National Park have been from Hurricane Mitch (1998) and Hurricane Iris (2001).

In late October 1998, shortly after peak bleaching temperatures, Hurricane Mitch swept across the Gulf of Honduras. The storm then stopped for 2 days adjacent to the Bay Islands of Honduras 150 miles (244 km) south west of Laughing Bird Caye 16 miles (25 km) to the east of Laughing Bird Caye, at Gladden Spit. The storm tide reached 9.2 feet (2.8 m), with up to 29% of coral colonies showing signs of mechanical damage (FoN, 1999). In 2001, Hurricane Iris passed almost directly over Laughing Bird Caye, with waves of between 13.1 feet (4 m) and 18 feet (5.5 m) above normal, however the mechanical damage from Iris was estimated at less than 1%. As with Hurricane Mitch, the event occurred shortly after a period of unusually high water temperatures, the increased hurricane activity being correlated with the same high water temperatures that caused the bleaching event. Survey sites at the adjacent Gladden Spit area reported a 58% incidence of coral bleaching, with no significant increase in bleaching following the hurricane. The most recent hurricanes, Richard (2010) and Earl (2016), passed to the north of the caye with minimal impact.

Table 8: Hurricanes Affecting Laughing Bird Caye National Park (< 31.1 mile or <50km radius) (www.nhc.noaa.gov)

Name	Cat.	Year	Date Passed near LBCNP
Not named	H1	1906	13 October
Not named	H1	1918	25 August
Not named	TS	1934	4 June
Not named	TS	1934	8 June
Not named	TS	1938	11 October
Not named	H2	1941	28 September
Not named	TS	1943	22 October
Not named	H1	1945	4 October
Abby	H1	1960	15 July
Anna	H2	1961	24 July
Francelia	H3	1969	3 September
Laura	TS	1971	20 November
Fifi	H2	1974	19 September
Gert	TS	1993	17 September
Kyle	TS	1996	11 October
Mitch*	H5	1998	28 October
Iris	H4	2001	9 October
Matthew	TS	2010	25 September
Richard	H1	2010	25 October
Harvey	TS	2011	20 August
Earl	H1	2016	4 August

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

2.4.2. Geology

The Belize continental shelf underlies the entire coastline of Belize and extends seaward 9.3 – 24.9 miles (15-40 km) from the coast. It is a complex underwater platform of Pleistocene limestone rock that ends abruptly on top of the first of three northeast-southwest escarpments that lie off the coastline. The first escarpment runs parallel to the coast, dropping off to the east to a depth of about 0.6 miles (1 km). An extensive reef system has developed upon the rim of this escarpment, forming the Belize Barrier Reef (Rath, 1996), sheltering the lagoon

to the west. Cayes dot this platform, some formed on mangrove peat, others from coral outcrops and sand deposition.

In the Laughing Bird Caye area, and north to the Pelican Cayes of South Water Caye Marine Reserve, the shelf structure reaches its maximum complexity with a narrow outer platform and a maze of patch reefs, faros and pinnacles. There are varying thoughts on the formation of the faros. Some have theorized that the faros are the result of karstic processes. The more recent theory, however, is that when the area was exposed in the early Pleistocene era, (2.5 – 1.8 million years ago), rivers flowed across the delta on the exposed coastal shelf, depositing silica sediment, producing a series of rhomboid-shaped topographically high areas that later became major sites for late Pleistocene coral colonization, and limestone deposition. The current faros, including the Laughing Bird faro, are thought to have grown on these carbonate mounds, reaching a thickness of 42.7 feet (13 m), above the thick underlying Pleistocene limestone base rock. This has resulted in the unusually steep-sided faro or rhomboid reef, with angles of 50-80°, established over the last 9,000 years, with a growth rate estimated at 4.6 feet/millennium (1.4 meters/millennium). The dense networks of branching corals act as a physical barrier, trapping sediments and forming the faro walls.

2.4.3. Bathymetry

Belize has an extensive maritime area of 3861.0 square miles (10,000 square km) (Hartshorn *et al.*, 1984). Unique to this area is a 155.3 mile (250 km) long barrier reef that extends from the tip of the Yucatan Peninsula southward into the Gulf of Honduras (Burke, 1982). Seaward of the reef crest are three coral atolls: Glover's Reef, Lighthouse and Turneffe Islands Atolls.

The barrier reef complex has been divided into three provinces based on their community distribution and geomorphic characteristics: Northern, Central, and Southern Provinces (Burke, 1982). The protected area lies within the Southern Province, which extends for about 36.7 mile (59 km) from Gladden Spit to the Sapodilla Cayes and is distinguished by shallow-water reefs, which occur as fringe around the cayes. The depths of the water over these reefs are less than 16.4 feet (5 m) forming exposed reefs during low tides. Depth contours for the inner lagoon increase from 32.8 to 131.2 feet (10 to 40 m) toward the center of the lagoon. Outside the main barrier, the reef slopes gradually from 32.8 to 164.0 feet (10 to 50 m) (Figure 6).

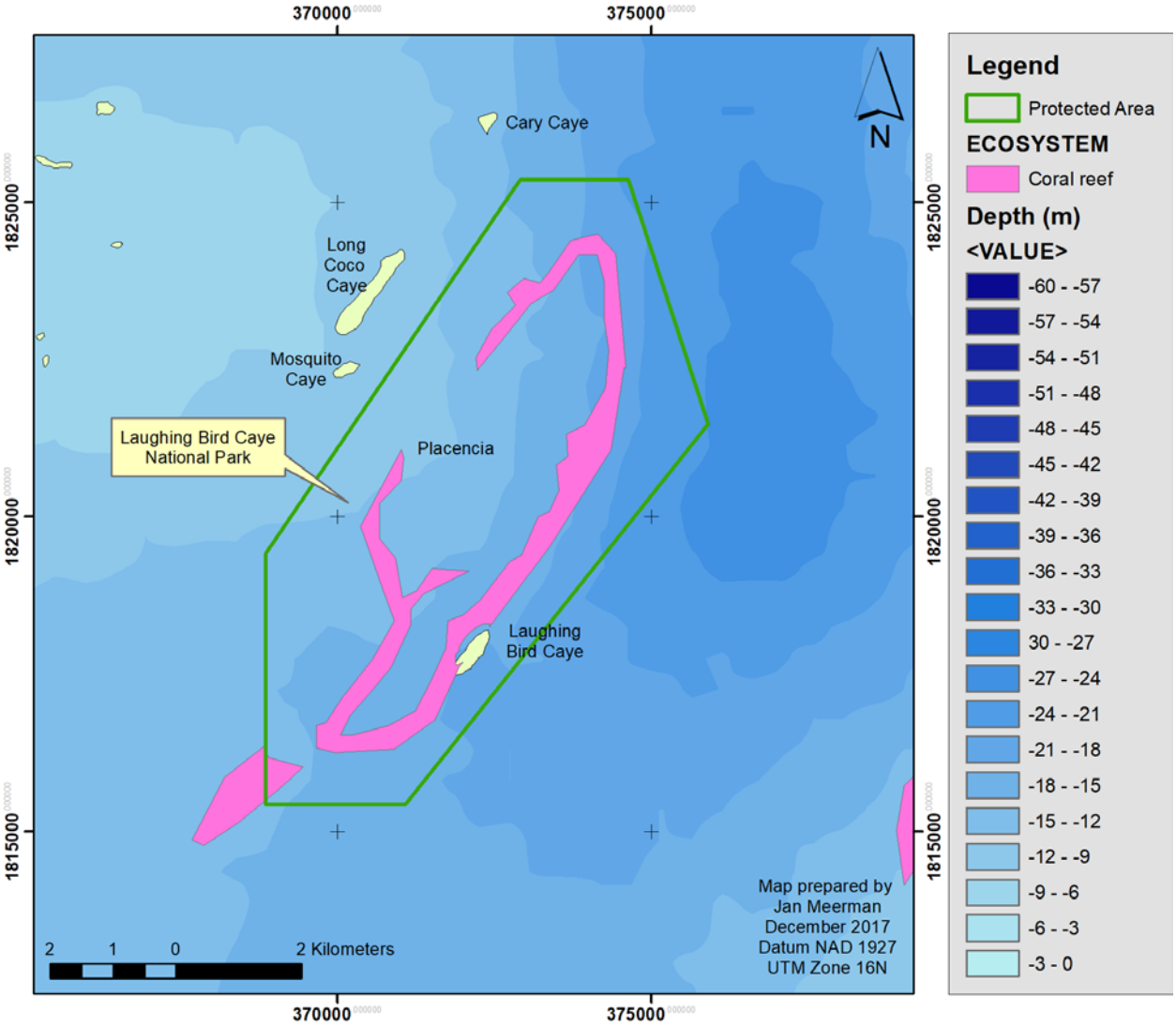

Figure 6: Laughing Bird Caye National Park: Bathymetry

Laughing Bird faro, lying in the relatively deeper waters of the southern province lagoon, rises out of depths of 144.4 feet (44 m) - the Victoria Channel to the east; the Inner Channel (the main commercial shipping route) to the west, reaching depths of 98.4 feet (30 m) (WRISCS Project, 2000/British Royal Admiralty Charts), both lying outside the protected area boundary. The faro can be divided into three distinct areas: the rim, inner flank, and outer flank. The rim of the faro is a nearly continuous ring of relatively narrow reef which encloses a densely pinnacled lagoon with a floor that is 80 feet (24 m) deep in some places, with spires sticking up 50 to 60 feet (15 – 18 m). The windward side of the faro rim is within 10 feet (3 m) of the surface in most places, with Laughing Bird Caye itself occupying 1.4 acres (0.57 ha) of the southeast surface of the rim (Wantland and Pusey, 1971).

The inner lagoon is completely enclosed and reaches a maximum depth of 16.4 feet (5 m). Patch reefs and mounds, diverse in size and structure, crisscross the inner lagoon across a floor that is nearly flat, with a fine mud substrate, atop carbonate sand, above dense limestone.

Laughing Bird Caye sits on an elongated sand ridge, and is the southernmost of the islands in the central lagoon – and the only one associated with the Laughing Bird Faro (Figure 6). The caye is not static in either size or shape, the sand beach changing with the currents and seasons. In 1962, it was estimated to have an area of approximately 3.4 ha (Stoddart, 1963). In 2017, the island was estimated to have an area of 1.8 ha (Meerman, 2017), almost half of the 1962 size (Figure 7).

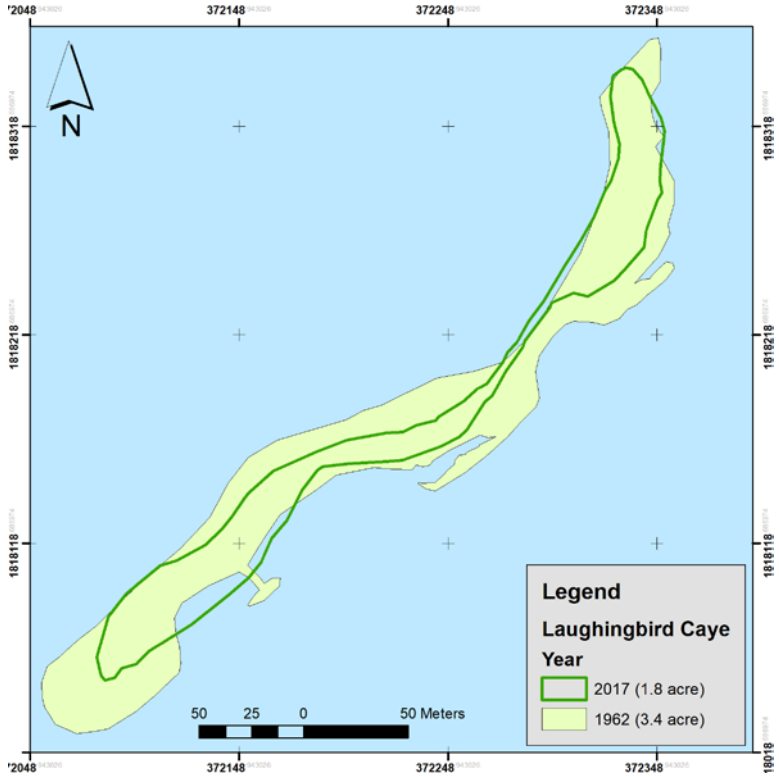

Figure 7: Changes in the size of Laughing Bird Caye between 1962 and 2017.

Laughing Bird Caye National Park lies within a fault area affected by occasional earth tremors and earthquakes. In 2009, a 7.3 magnitude earthquake occurred off the coast of Roatan, resulting in damage to the coral rim of the Laughing Bird area, primarily on the west and south-facing slopes of the faro. A reported 30% of the reef surveyed during a post-earthquake assessment of the area (both within the National Park and to the immediate south) was completely lost, with a further 25% showing moderate damage - cracking and overturned corals (Shank *et al.*, 2010).

2.4.4. Tides and Water Movement

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

On a regional scale, the main oceanic current, the warm-water Caribbean Current, forms the main surface circulation in the Caribbean Sea, flowing westwards from the Lesser Antilles towards southern Belize, then northwards offshore, beyond the atolls, eventually through the Yucatan Channel, with an average flow rate of between 15 to 17 inches (38 to 43 cm) per second. This creates a counter current in the Gulf of Honduras area, including much of the coastal waters of Belize, which flows south/southwest-wards past the Belize coastline and Barrier Reef (Heyman *et al.*, 2000; Stoddart, 1962), in the shelf lagoon and offshore basins (Purdy *et al.*, 1975).

Tides in the central region of the Belize reef system are considered to be microtidal, and average an estimated 11.8 inches (30 cm) throughout the coastal shelf (Stoddart, 1962; Caribbean Coral Ecosystems Program, 2005). The currents generated by these tides as they pass through reef cuts and at river mouths are thought to play a significant role in the spatial dispersion of sediment, nutrients, and larvae along the shallow reef flats and back reef (Heyman & Kjerfve, 2001).

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

2.4.5. Water Parameters

SEA has been conducting monthly water quality testing in the LBCNP since 2013 in an effort to collect baseline data which would be used to determine if there are any changes in the oceanic conditions. Effectively, SEA is thus building up a

baseline data set for sea-water quality in the area. Unfortunately, the data do not automatically lend themselves for taking management decisions.

The Smithsonian Institute Field Station has been monitoring basic water parameters within South Water Caye Marine Reserve since 1994/1995 in the central reef region.

Water Temperature

Measurements in 2015–2016 showed that mean monthly water temperatures ranged between 23.2 – 33.6 °C at a depth of 13 m at the Carrie Bow Cay Field Station (CCRE, 2017). Belize's reefs, including those at Laughing Bird Caye National Park, were impacted by the third global coral bleaching event in 2015/2016. The coral bleaching event was not as severe as the 1995 and 1998 events and no coral mortality was recorded at surveyed sites.

Sedimentation/Turbidity

Sedimentation and agrochemical contamination from mainland watersheds have been highlighted as perhaps one of the greatest impacts on the Belize reef, after climate change. Laughing Bird Caye National Park lies east of five watersheds - South Stann Creek, Santa Maria Creek, Mango Creek, Sennis Creek and Monkey River (Figure 8), which drain some of the principal citrus and banana growing areas of central Belize (Figure 9). Following storm events, the increased sediment load of these rivers is also accompanied by an increased pesticide load, as rain washes agrochemicals from the watersheds into the rivers, and from there into the sea. Generally occurring in September/October, these events impact water turbidity and quality within the National Park, as seen following the passage of Hurricane Mitch in October 1998.

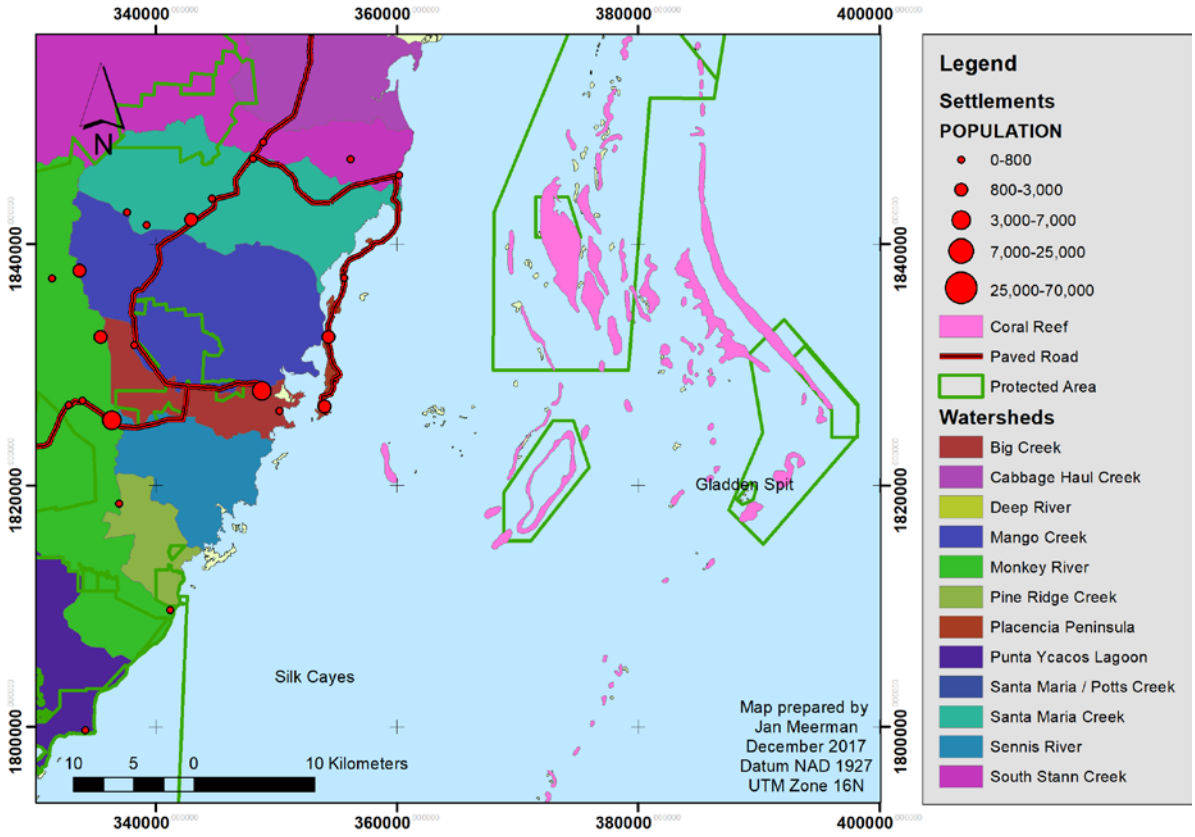

Figure 8: Laughing Bird Caye National Park: Watersheds

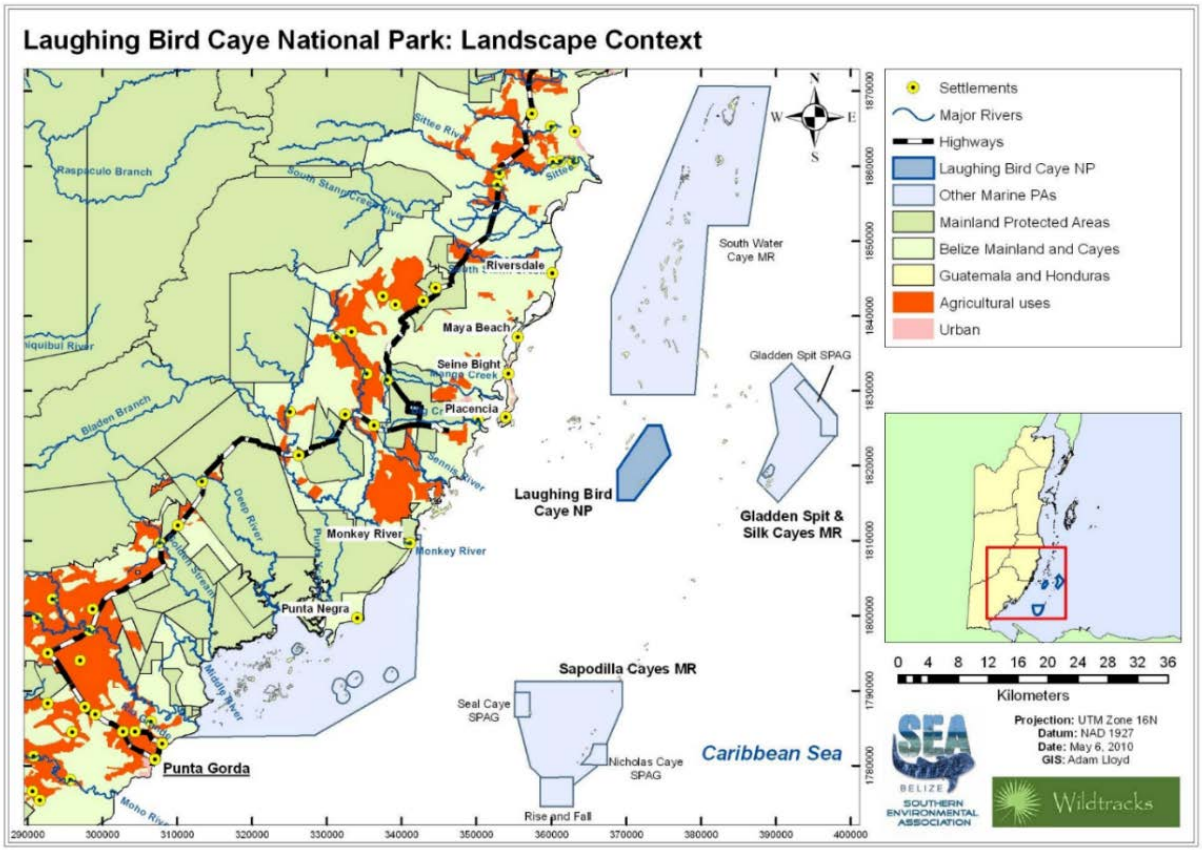

Figure 9: Laughing Bird Caye National Park: Landscape Context

Sediment core analysis of two sites within the Belize reef system (Turneffe Atoll and Sapodilla Cayes), indicate that sediment and agrochemical runoff onto the reef has increased relatively steadily over time, consistent with historical and current land use trends. Sediment supply to the reef is greater in the south, in the Sapodilla reef area with greater urgency for action to reduce runoff impacts (Figure 10, WRI, 2006; Carilli *et al.* 2009), though the Laughing Bird faro is also affected.

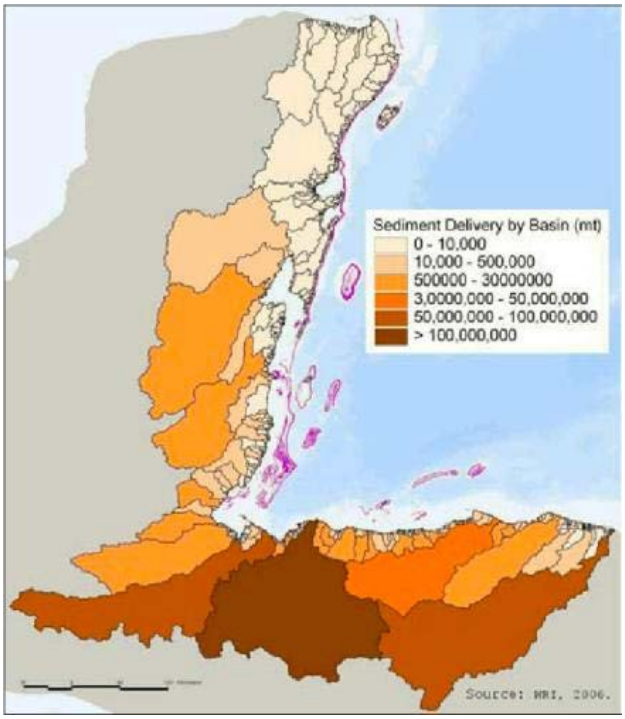

Figure 10: Sediment delivery by watersheds. After Burks and Sugg/WRI, 2006

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

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

Seawifs ocean colour images also shows that a large pulse of river water extends from the Guatemalan and Honduran rivers, stretching all the way to Laughing Bird Caye National Park, and even out as far as Glover's Reef Atoll, during these storm events (Figure 11; Soto *et al.* 2009; WRI/ICRAN, 2006; Andrefouet *et al.*, 2002). Connectivity was tracked using the proxy of weekly mean chlorophyll-a concentrations, derived from satellite imagery over a nine-year period. These

studies indicated that Honduran river plumes, particularly that of the Ulu´a River, reached the southern part of the Belize Reef 61% of the time. This provides further support for WRI studies on the origins of impacting watershed run-off on the Mesoamerican Reef (WRI, 2006).

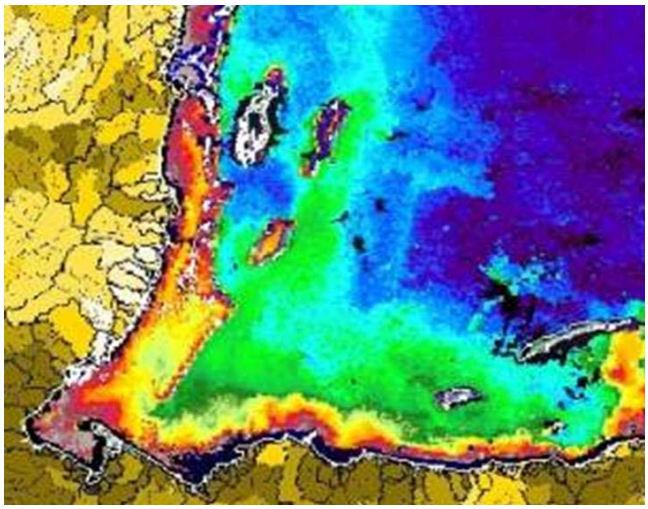

Figure 11: SeaWifs Chlorophyll a.
After Shank *et al.*, 2010/ Soto *et al.*, 2009

Salinity

Salinity varies dependent on the time of year, with lower salinity during the wet season. The salinity of normal seawater is 35.9 parts per thousand (ppt), with variation from 30.4‰ to 37.7‰ at the Carrie Bow Caye site (CCRE, 2017). This range of salinities persists throughout the Belize continental shelf, including the Laughing Bird Caye area (Rath, 1996).

pH

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

2.5. Biodiversity of Management Area

2.5.1. Ecosystems

There is an array of ecosystems within the National Park that have evolved in response to the degree of exposure and impact of wave action, current direction and intensity, light intensity and light spectra, and are defined by their species composition, formation and substrate characteristics. National ecosystem mapping gives a broad overview of the ecosystems to be found in the Laughing Bird Caye National Park (Figure 12; Meerman, 2017), with the National Park encompassing four broad ecosystems: 1) Reef, 2) Seagrass, 3) Sparse algae/sand, and 4) Herbaceous Beach Community/Littoral Forest.

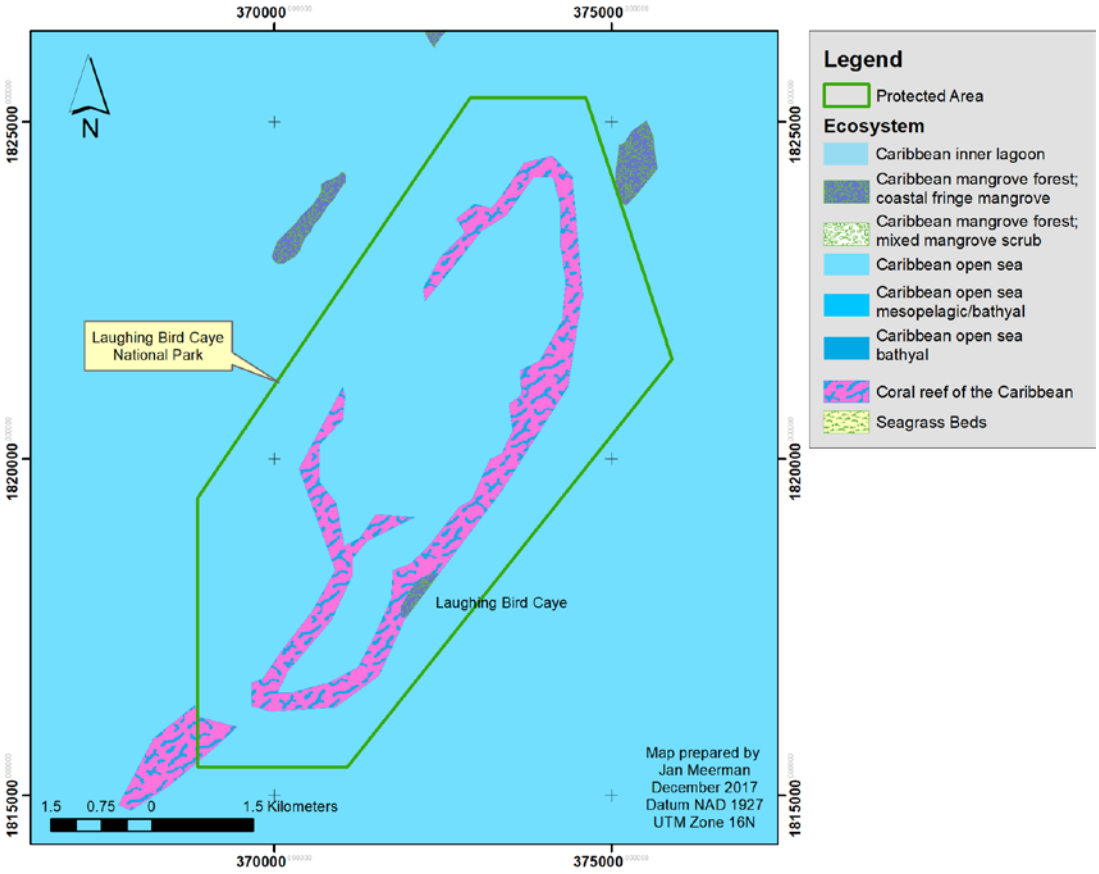

Figure 12: Broad Ecosystems of Laughing Bird Caye National Park

The marine components are further organized into five categories (Meerman *et al.*, 2004) and seventeen sub-categories (Table 9; Figure 13) Mumby and Harborne, 1999). The marine ecosystems of Laughing Bird Caye National Park fall into three main categories: seagrass, coral reefs and sparse algae (Caribbean inner lagoon).

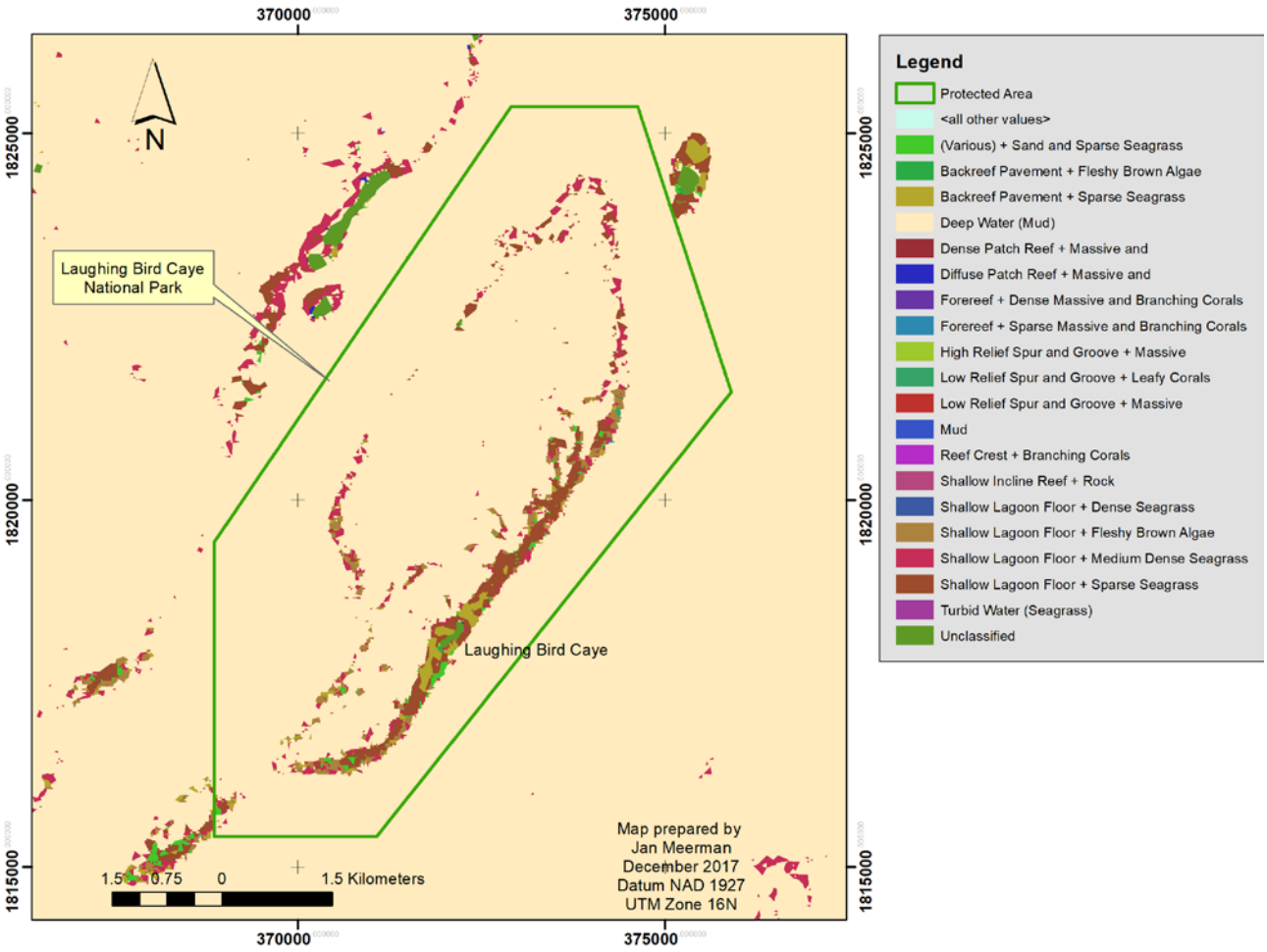

Figure 13: Ecosystems (detailed) of LBCNP (Meerman 2004) and (Mumby and Harborne (1999)

Table 9: Ecosystems of Laughing Bird Caye National Park

Ecosystems of Laughing Bird Caye National Park				
	Meerman (2004)		**Mumby and Harborne (1999)**	
Terrestrial	Herbaceous Beach Community	Herbaceous Beach Community /Littoral Forest		
	Reef	Patch Reef	Patch Reef	Dense patch reef
				Diffuse patch reef
		Shallow Coral reef	Other Reef	Reef crest
				Low relief spur and groove
Epipelagic	Seagrass	Seagrass beds	Shallow Lagoon Floor – Seagrass dominated	Sparse seagrass
				Medium density seagrass
				Dense seagrass
				Seagrass with distinct coral patches
	Caribbean inner lagoon /Sparse Algae	Fleshy brown Algae / Gorgonians	Algal dominated	Fleshy brown Algae and sparse Gorgonians
		Sparse Algae / sand		Green algae
				Lobophora
				Euchmea and *Amphiroa*
				Bedrock / rubble and
				Bedrock / rubble and sparse gorgonians
			Bare substratum dominated	Rubble and sparse algae
				Sand with sparse algae
				Mud / bedrock

2.5.2. Flora of Laughing Bird Caye

The terrestrial vegetation of Laughing Bird Caye is constantly changing over time, as current and past storm events change the shape, height and substrate of the caye. Comparing historical data (Stoddart, 1963) with measurements taken during fieldwork in 2017, Laughing bird Caye went from 3.4 acre in 1962 to 1.8 acre in 2017 (Figure 14). These changes, though dramatic, may be natural, but there appears to be a strong observed link between replacement of the original littoral forest/vegetation to make way for coconut plantations (Stoddart, 1964) while stating "indications are that the dominants of natural littoral thicket are well adapted to resist storm action".

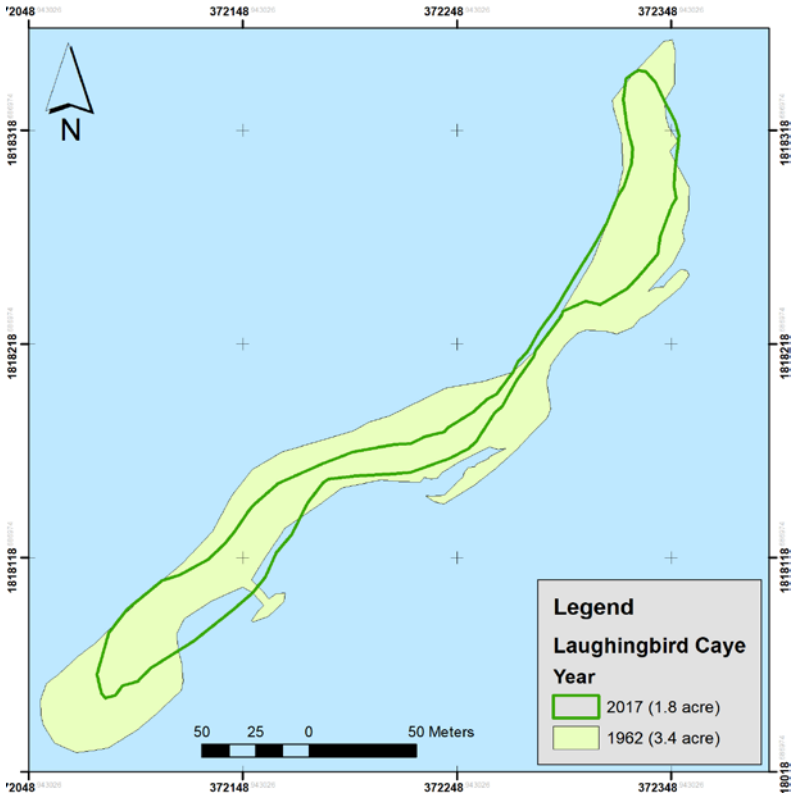

Figure 14: Changes in the size of Laughing Bird Caye between 1962 and 2017

Another factor in the altering of Belize's cayes is sea-level rise. Global sea level has been rising over the past century, and the rate has increased in recent decades. In 2014, global sea level was 2.6 inches (6.6 cm) above the 1993 average—the highest annual average in the satellite record (1993-2014). Sea level currently rises at a rate of about one-eighth of an inch (0.3 cm) per year (NOAA, 2017). While this does not sound like much, sea level rose by 2.4 inches (6 cm) during the 19th century and 7.5 inches (19 cm) in the 20th century (Jevrejeva, 2008). The level of sea-level rise varies per location on earth, and there are no good data for Belize, but in the 55 years between the Stoddart mission and today, it is conceivable that the sea-level rose at least 3.9 inches (10 cm), which is more than enough to explain the observed erosion of Laughing Bird Caye.

A damage assessment of Laughing Bird Caye following Hurricane Iris in 2001, noted complete defoliation and uprooting of the mangroves, and the emergence of a channel approximately 16.4 feet (5 m) in width that completely intersected the island. The vegetation on the southern half of the caye – primarily coconuts,

was completely removed by the storm (Bood, 2001). A more recent storm – Hurricane Richard, in 2010 – resulted in the reformation of the caye as a single sand caye (SEA, 2010). Historical records show that the Laughing Bird Caye was previously covered by a 'coconut woodland' with scattered coastal mangroves, with only a few plant species recorded (Stoddart, 1963). Following its designation as a National Park, the caye has been zoned to allow regeneration of the northern end to natural vegetation, promoting a natural vegetation, with some littoral forest components, whilst the southern portion is maintained for visitor use.

The flora can be considered as occurring within two ecosystems (within the UNESCO classification system): mixed mangrove scrub and littoral forest / herbaceous beach community (Meerman, 2005). The very limited extent of the natural vegetation cover on the island dictates that there is no clear boundary between the two vegetation types, but in general the mixed mangrove scrub species occur on lower ground, while the components of littoral forest/herbaceous beach community are found on higher, drier sandy soils. Whilst it is likely that Laughing Bird Caye historically supported a rather more typical littoral forest prior to clearance and planting of coconuts, the tree species are only now making a modest comeback with the establishment of White Mangrove thicket on the northern tip of the island.

Native caye plant species, are very resilient to storms, and re-establish relatively quickly, but species turnover can be rapid as well. A survey in 2010 for the benefit of the 2011-2016 management plan identified fifteen plant species on the caye, up from the 8 listed for 1982, including all three mangrove species – red (*Rhizophora mangle*), black (*Avicennia germinans*) and white (*Laguncularia racemosa*) - as well as buttonwood (*Conocarpus erectus*) the mangrove associate. These, along with the introduced coconuts, formed the basis for the higher vegetation structure to the north end of Laughing Bird Caye (Figure 15). Fieldwork for the current management plan in October 2017, resulted in a species list of 13 species including three not previously noted species, but with the apparent loss of Red Mangrove and Buttonwood (Table 10).

Figure 15: Northern Tip of Laughing Bird Caye with *Laguncularia racemosa* thicket (J. Meerman, 2017)

An original vegetation cover is important for nesting birds such as brown pelicans and osprey. Thus, in line with the designation of the National Park and the remit to conserve biodiversity, and in the interests of stabilizing the island against potential complete loss during one or more tropical storm events, it is critical that un-impeded regeneration of natural vegetation be encouraged on as much of the island as possible: the larger the area of bare white sand and coconut trees, the greater the risk to the island itself.

Table 10: List of plants found on Laughing Bird Caye National Park

Species	**1982** **Stoddart *et al.*, 1982**	**2010** **Wildtracks (2011)**	**2017** **Field work consultant team 3 Oct, 2017**
Avicennia germinans	x	x	x
Batis maritima			x
Chamaesyce mesembrianthemifolia		x	x
Chamaesyce blodgettii		x	
Chamaesyce sp.	x		
Casuarina equistifolia		x	
Coccoloba uvifera	x	x	x
Cocos nucifera	x	x	x
Conocarpus erectus		x	
Cyperus planifolius			x
Cyperus plystachos		x	
Hymenocallis littoralis	x	x	x
Ipomoea macrantha			x
Ipomoea sp.	x	x	
Iresine diffusa			x
Laguncularia racemosa		x	x
Rhizophora mangle	x	x	
Sesuvium portulacastrum	x	x	x
Surania maritima		x	x
Tournefortia gnaphaloides		x	
Ximenia americana			x
Total number of plant species recorded	**8**	**15**	**13**

Active rehabilitation/restoration of the littoral forest should be seriously considered, with a focus on increasing the taller woody shrub / tree species cover. Seagrape is still present and could be propagated for transplanting; *Thrinax* palms, *Coccoloba, Bursera* and *Pouteria* spp. seeds / seedlings could be re-introduced to the island from the nearest source, as it can be presumed that these species would have been predominant on the island prior to the establishment of the coconut trees. The majority of the southern portion of the caye is maintained as sand, with shading provided by coconuts, for visitation. On this southern portion of the caye, there is more limited scope for regeneration, with greater visitor access, though the area is considered a buffer between the heavy visitor use area and the natural vegetation to the north. Management recommendations are for the increased use of native flora within the visitor access area - over time it would be possible to replace a number of

the coconuts with *Thrinax* palms, seagrape and *Bursera* – retaining visitor appeal, stabilizing the island against storm damage, and strengthening its biodiversity conservation functionality.

Seagrass

The inner rim of the faro of the Laughing Bird faro is shallow, and supports varying densities of turtle grass (*Thalassia testudinum*), interspersed with sparse strands of manatee grass (*Syringodium filiforme*), particularly on the north east, north and north west walls. Small pioneer seagrass such as *Halodule* spp. and *Halophila baillonii* are widely distributed in the area and may also occur in limited patches within the National Park. Algae such as *Halimeda* spp., also considered important components of this ecosystem, are distributed throughout the seagrass beds (SEA data).

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

Laughing Bird Caye is a seagrass monitoring site following the seagrassnet.org protocols. Little is known about that apart from that seagrass data used to be collected and entered into the www.seagrassnet.org database. Apparently, no analysis of entered data has ever been conducted.

Seaweed

Algae of the genera Euchema and Gracelaria are being farmed in areas surrounding Laughing Bird Caye. This in an attempt to provide alternative – marine based – sources of income for local fishermen.

2.5.3. Fauna of Laughing Bird Caye National Park

Laughing Bird Caye National Park encompasses both terrestrial and marine fauna. Whilst not quite littoral forest, the littoral forest component on the northern end of the caye offers habitat for a number of species – particularly birds – that would otherwise not be found within the protected area, and an

important stopping point for migratory birds. Hawksbill turtles and ground nesting birds use the sandy beaches of the caye as crucial nesting grounds. Laughing Bird faro itself is considered to be a good example of faro formation in the Caribbean, and is recognized for supporting marine diversity, with a wide range of fish, coral and other species.

The protected waters of Laughing Bird Caye National Park are assumed to serve as an important source for conch. The conch open season is from 1 October to 30 June of the following year. Recent monitoring data from SEA indicate higher encounter rates for the Queen conch inside the no take zones as compared to outside. Other species such as lobster and finfish also flourish within the park boundaries, providing a source area for the fisheries industry. The lobsters can be split into two species; the Spotted Lobster (*Panulirus guttatus*) and the more common Spiny Lobster (*Panulirus argus*). Based on recent monitoring data, both are less abundant within the LBCNP than should be expected based on the conservation status of the area. Overall the monitoring frequency is insufficient to extract any seasonal fluctuations and fluctuations based on closed versus open fishing season.

Fish

More than 230 fish species are included in the current species list (Appendix 2) including the invasive Lionfish. Of this list, three are considered to be Critically Endangered or Endangered at global scale, including the critically endangered goliath grouper (*Epinephelus itajara*), the endangered and further decreasing Nassau grouper (*Epinephelus striatus*) and the scalloped hammerhead (*Sphyrna lewini*) (Table 11). All three of these species have been, and continue to be, impacted by commercial fisheries. Nassau grouper has declined within Belize by more than 80% since the late 1970s, primarily due to fishing pressure at spawning aggregation sites where it is most vulnerable (Paz and Grimshaw, 2001). Nassau grouper surveys at the Gladden Spit Spawning Aggregation Site during the 2016/2017 season recorded a maximum of 6 Nassau grouper individuals.

Table 11: Fish Species of International Concern of LBCNP (IUCN, 2017)

Critically Endangered	
Goliath Grouper	*Epinephelus itajara*
Endangered	
Nassau Grouper	*Epinephelus striatus*
Whale Shark	*Rhincodon typus*
Splendid toadfish	*Sanopus splendidus*
Scalloped Hammerhead	*Sphyrna lewini*

Near threatened	
Queen Triggerfish	*Balistes vetula*
Mutton Snapper	*Lutjanus analis*
Rainbow Parrotfish	*Scarus guacamaia*
Vulnerable	
Hogfish	*Lachnolaimus maximus*
Cubera Snapper	*Lutjanus cyanopterus*
Yellowmouth Grouper	*Mycteroperca interstitialis*
Whitelined toadfish	*Sanopus greenfieldorum*

In 2001, it was predicted that under the existing management conditions, Nassau grouper (once the second most commonly caught fish in Belize) would disappear from Belize waters by the year 2013 (Paz and Grimshaw, 2001). In light of these concerns amendments made to the regulations now impose size limits and make it illegal to take Nassau grouper during the peak spawning months of December to March, though it can still be fished outside of this time. The regional outlook is similarly bleak - it is thought that one-third of all known Nassau grouper spawning aggregation sites in the Caribbean region have disappeared. Herbivorous fish populations – such as the parrotfish (Scaridae) and surgeonfish (Acanthuridae) - are considered important for the maintenance of the health of the reef, being the dominant grazers of the ecosystem, keeping algal growth under control. The reefs of Laughing Bird faro have a relatively moderate population of medium parrotfish, with a maximum density of 29g/m^2 and an average of 12g/m^2 (Shank *et al.* 2010) – densities of 25.5g/m have been shown to effectively reduce algal cover in the Bahamas (Mumby *et al.*, 2006).

Monitoring carried out by SEA does distinguish between "herbivores" and "commercial" species. Overall, based on the limited data available, the number of either group of species does not appear to differ from within the closed and the unprotected areas although the irregularity of the data sampling does not really allow for proper analysis and interpretation of potential seasonal movements.

The endangered scalloped hammerhead (*Sphyrna lewini*) is also still fished in Belize, despite its global status. However, the endangered whale shark (*Rhincodon typus*) is protected under the Fisheries Act, with no fishing, or even touching, permitted. This species is an important tourism resource, especially within the spawning aggregation area of the adjacent Gladden Spit and Silk Cayes Marine Reserve, and has been reported passing through the deeper waters of the outer reef rim of the Laughing Bird Caye faro. A further ten shark species

have also been confirmed as present within the National Park (SEA data; R. Graham, 2011 Management Plan).

Commercial fish species data is being collected by SEA, but there is no data analysis and the recorded data is not in a format that allows for easy analysis.

Mammals

Four species of dolphin have been reported from within the adjacent South Water Caye Marine Reserve. Atlantic bottlenose dolphin (*Tursiops truncatus*) and the Atlantic spotted dolphin (*Stenella plagiodon*) are commonly seen inside the Belize Barrier Reef (CCC, 1993). The deeper-water rough-toothed dolphin (*Steno bredanensis*) has also been reported, as has Fraser's Dolphin (*Lagenodelphis hosei*). There is an unconfirmed report of a sighting of a group of eight common dolphins (*Delphinus delphis*) in July of 1997 between Laughing Bird Caye and Point Placencia along the mainland coast (Ramos *et al.*, 2016)

Antillean (or West Indian) manatees (*Trichechus manatus*) have been reported from the Laughing Bird Caye area, on the outside of the faro, and as far west as the inside of the barrier reef in the Gladden Spit area. The Belize coast is home to the largest population of Antillean manatee in the Caribbean (Morales-Vela *et al.*, 2000), with a population estimated at between 800 and 1,000 individuals (Auil in 2011 Management Plan). Historically, the manatee has been hunted for meat, with bone middens discovered on archaeological sites, and in the 17th century, it was taken to provide food for seafarers and explorers (Self-Sullivan and LaCommare, 2004). Today, the Antillean manatee is considered threatened throughout its range, and is listed as 'Vulnerable' and decreasing (IUCN, 2017), but is fully protected under the Wildlife Protection Act.

Birds

Laughing Bird Caye was named for the presence of a large nesting colony of Laughing Gulls (*Leucophaeus atricilla*) once present on the caye. Reported impacts by Hurricane Fifi in 1974, coupled with the continuous disturbance and harvesting of eggs by fishermen, and increased tourism visitation, drove the colony away and since then, the signature species of the island has not returned as a breeding bird. Pelicans and osprey, however, have started to occupy the White Mangrove thicket on the north side of the island for nesting. In October 2017, more than two dozen occupied Brown Pelican nests were noted in the White Mangrove trees (Figure 17). For this reason, and to encourage the possible return of the Laughing Gulls, the Northern Tip of the Island should remain off limits to visitation.

Figure 16: Brown Pelican Nests in White Mangroves on the northern tip of Laughing Bird Caye (Photo: Jan Meerman, 2017)

No long-term monitoring of bird species has been conducted for Laughing Bird Caye National Park, but the recent popularity of the citizen science effort eBird (http://www.ebird.org), the number of bird species recorded from Laughing Bird Caye is increasing rapidly and currently stands at 37 species (Appendix 3). This number is made up by a small number of local seabirds plus a larger number of migratory birds that use Laughing Bird Caye and similar islands as stepping stones on their migratory routes. With increased recording, the number of migratory species recorded from Laughing Bird Caye is certainly to rise as visiting birders continue to lodge data.

Although neither the Brown Pelican nor the Osprey are species of immediate conservation concern, they have a strong symbolic and tourism value and therefore need to be protected. The potential return of the Laughing Gull, even if not of international conservation concern should be strived for simply because it is the signatory species for the island.

Reptiles

The only terrestrial reptile on Laughing Bird Caye is the Anole (*Norops sagrei*). But the conservation priorities for the herpetofauna of Laughing Bird Caye National Park relate to the three species of sea turtle known to use the area: the critically endangered **Hawksbill** (*Eretmochelys imbricata*), the endangered **Green Turtles** (*Chelonia mydas*), and the vulnerable **Loggerhead** (*Caretta caretta*). As elsewhere, sea turtle numbers have plummeted in recent decades, having been exposed to enormous exploitation for over 250 years in Belize and adjacent countries. As relatively recently as 1925, their numbers were considered inexhaustible in Belize (Smith *et al.*, 1992) – a far cry from the current situation with only the hawksbill still nesting within the National Park, and in only very small numbers (an average of 5 nests each season (SEA) see Figure 18).

Whilst now afforded full legal protection from harvesting in Belize, turtle populations remain highly threatened by loss or degradation of nesting habitat - the same high, sandy beaches used for millennia by turtles are now being converted into beach properties, with all the impacts associated with human habitation on mainland beaches and inhabited cayes outside of the protected area, increasing the critical importance of maintaining those characteristic of Laughing Bird Caye that increase nesting success, and balancing this with tourism activities in the area. The Hawksbill turtle tends to be more confined to shallow waters than loggerhead and green turtles, where it feeds primarily upon sponges and marine invertebrates. It has a protracted nesting season of 6 months or more – peaking in June and July, with the period between nesting seasons generally being 2-4 years, sometimes longer. Nesting occurs at night, generally at high tide, with a clutch size of 50-200 eggs. Nests tend to be concealed in beach vegetation quite high on the beach and, except for a faint asymmetrical crawl leading to and from the sea, there is seldom any obvious evidence of the visiting female.

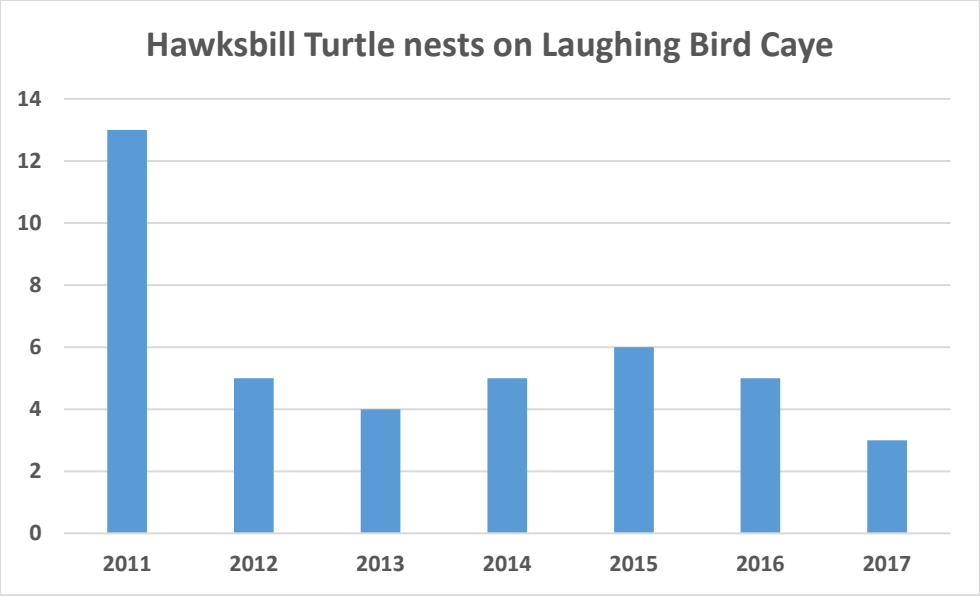

Figure 17: Hawksbill Turtle nesting numbers on Laughing Bird Caye: Source: SEA monitoring data

Loggerhead and green turtles still frequent the waters of Laughing Bird Caye National Park, though are not reported as nesting on the caye in any of the recent monitoring events carried out by SEA. SEA conducts annual monitoring of Sea Turtle Nests on Laughing Bird Caye and in the wider area, but data is not collected in a uniform way and exact location and species identification are not always established.

Corals

The 2011 management plan provides in-depth details on the coral cover situation in within the LBCNP. The entire marine protected area lies within the Epipelagic (sunlit) Zone, with depths ranging from 0 to 147.6 feet (0 to 45 m), and includes the shallow waters of the inner faro lagoon and Laughing Bird Caye, as well as a portion of the deeper waters of the surrounding channels – the Victoria Channel to the east and Inner Channel to the west. A large limestone structure, the Laughing Bird faro consists of narrow, steep outer rim walls that enclose a lagoon with depths ranging from 9.8 to 114.8 feet (3 to 35 m), and spires or banks projecting up from the lagoon floor for 49.2 to 59.1 feet (15 to 18 m). The morphometric complexity at Laughing Bird faro leads to a remarkable diversity of habitats and marine life (Rath, 1996).

The eastern ridge of the faro, adjacent to Laughing Bird Caye, is comprised of a shallow seaward facing crest of *Millepora complanata* and other corals that grow on top of rubble from dead branching *Acropora palmata.* The reef formations along the faro crest are considered patch reefs, forming a modified version of the

reef crest of the barrier reef itself. Below this, on the eastward facing slope as it falls into the Victoria Channel, lies a band of the *Montastraea - Acropora palmata* community similar to that found on the main barrier platform. As the water gets deeper and drops towards the lower slopes of the channel, coral becomes sparser, giving way to gorgonians. Within the faro lagoon lie numerous patch reefs and banks, some rising from deeper waters. These areas often consist of a mixture of coral (predominantly *Montastraea annularis*), seagrass (*Thalassia testudinum*) and gorgonians. To the west, the rim rises less steeply out of the lagoon to then fall away at a gentler slope to the west into the Inner Channel, with scattered dense stands of *Acropora cervicornis* and *Porites porites*.

The reef formations that surround Laughing Bird Caye itself are an important tourist attraction, containing a mixture of coral, established on the dead colonies of *A. palmata,* along with larger colonies of *Montastraea annularis*. These reefs are also home to a high diversity of fish species, with a current species list of 234 species, spanning 59 families. The sandy flats and patch reefs surrounding the caye are also home to abundant numbers of conch and lobster and it is not unusual to spot tiger sharks and hawksbill turtles cruising near the caye. In addition to the many coral and fish species, Laughing Bird faro is also well known for its diversity of sponges.

Laughing Bird Caye National Park hosts nine species of coral considered critically endangered, endangered or vulnerable on the global scale (IUCN, 2017) (Table 12). Coral diversity at the National Park was assessed in 2006, with 17 coral species encountered between 0 to 65.6 feet (0-20 m) of depth, representing the major contributors to live coral cover within the National Park (Figure 17). Of the species surveyed, the patch reef had the highest diversity, with thirteen of the fourteen species recorded, and was the only site with *Diploria clivosa.* One species, *Stephanocoenia intersepta,* was only recorded outside the marine protected area.

Table 12: Coral Species of International Concern – Laughing Bird Caye National Park. (Source: IUCN, October 2017)

Laughing Bird Caye National Park Coral Species of International Concern	
Critically Endangered	
Staghorn Coral	*Acropora cervicornis*
Elkhorn Coral	*Acropora palmata*
Endangered	
Boulder Star Coral	*Montastraea annularis*
Star Coral	*Montastraea faveolata*
Vulnerable	
Lamarck's Sheet Coral	*Agaricia lamarcki*
Pillar Coral	*Dendrogyra cylindrus*
Elliptical Star	*Coral Dichocoenia stokesii*
Montastraea coral	*Montastraea franksi*
Rough Cactus Coral	*Mycetophyllia ferox*

Based on this data, the two most abundant species within Laughing Bird Caye National Park are the endangered *Montastraea annularis* (an average of 15.5% contribution to total coral cover) and *Montastraea cavernosa* (an average of 11.0%). *Montastraea annularis* is the dominant patch reef species (contributing 28.3% to total coral cover at the survey site), with the vulnerable *Montastraea franksi* as the second most dominant species (13.2%). The Reef Flat 1 site has a number of co-dominant species (*Porites asteroids* and the endangered *Montastraea faveolata* (both 14.6%), and *Montastraea franksi* and *Millepora complanata* (both 12.2%). The Reef Flat 2 site is dominated by *Montastraea annularis* (contributing 29.3% to total coral cover), with *Colpophyllia natans* (12.2%) as the second most dominant species.

Percentage live coral cover for the Laughing Bird faro in 2006 ranged from 11.7% at the Reef Flat 1 site, to 18.8% at the Patch Reef site, averaging 15.3% (AGRRA/SEA, 2009). A 2009 study under Marine Managed Areas Science (MMAS) estimated average cover at the lower figure of 12.4% – with no significant difference between coral cover inside and outside the National Park (Shank *et al.*, 2010). Research carried out by SEA reports on a continued downward trend, demonstrating a decrease in average live coral cover to 7% (SEA data, 2010). In all cases, the percent live coral cover is very low compared with the 1986 figure of 85% for the Channel Caye faro, situated a few miles to the north, or the estimate of 60% live coral cover from LBCNP in the late 1970s (SEA, 2008). SEA continues to monitor coral bleaching and thereby live coral cover, for the year 2016, SEA reported a bleaching level of 11% for LBCNP.

Locally there appears to be a threat to corals around Laughing Bird Caye

originating from the heavy tourism visitation, with repeated outbreaks of fleshy macro-algae attributed to high nutrient levels caused by inappropriate sanitary facilities on the island (Guardian, 2017). Unfortunately, there are no water quality data to support or contradict this. See the section on "Past and Present Research" for a discussion on this. The Healthy Reefs Initiative has provided regional-level data, developing a reef health report card as recent as 2015. Based on the data in its online database, the situation of all coral monitoring sites within the Laughing Bird Caye National Park is "Critical", indicating a continued further decline in coral quality and presenting an alarming trend (Figure 19).

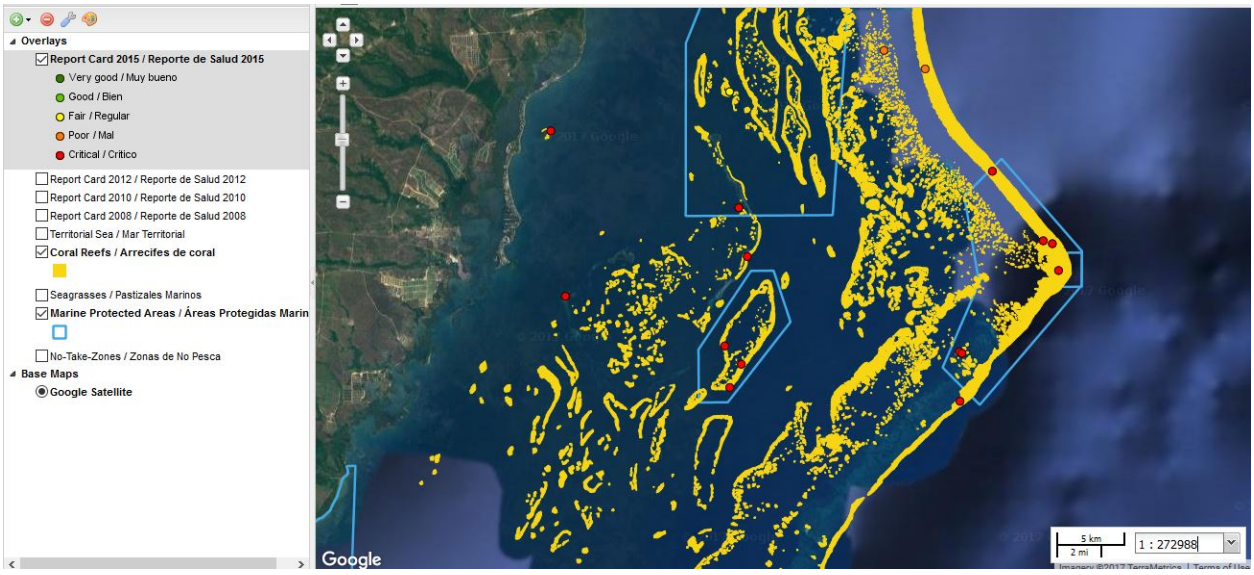

Figure 18: Status of coral reefs in the project area (2015)[1]

2.5.4. Past and Present Research

With the unique structures of the faros of the Southern Belize reef, the general area has attracted research interest on the geological context over many years. The 2011 management plan reported on work by Wantland and Pusey (1971) and Purdy (1974), James and Ginsberg produced a summary of the geological studies of the Southern Belize Reef in 1979, in the 'Seaward margin of Belize barrier and atoll reefs (International Association of Sedimentologists). This work was further interpreted by Choi and Holmes and Choi and Ginsburg in 1982, later re-summarized in Gischler and Hudson (2003), and most recently by Gischler, Ginsberg, Herrle and Prasad in 2010, providing a wealth of information on the geological history of fault lines, barrier reef and faro formation. This depth of knowledge was not matched by research on the biodiversity of the area in the years before its designation as a National Park. A survey of the caye itself and

[1] Derived from the Healthy Reefs database (October 2017).

its vegetation was conducted in the early 1960s (Stoddard, 1963), and a number of reef-based studies were completed in the 1990s that might have the potential to provide valuable comparative baselines for demonstrating the wide-scale ecological shift in the coral species of the faro over recent years. Coral Caye Conservation (CCC) completed eight transects of the faro wall in 1991, and produced a fish species list for the area (FoLBC/TIDE, 2000). A fish survey was also conducted in 1996 under the Fisheries Department (Azueta, 1996). Conservation, Education, Diving, Awareness and Marine Research (CEDAM) International also surveyed the faro in 1999, establishing a transect across the faro, approximately 0.5 miles (0.8 km) south of Laughing Bird Caye, and recording coral growth (FoLBC/TIDE, 2000). However, it would appear that the results of both the CCC and CEDAM surveys are no longer accessible (2011 Management Plan, 2010; SEA, 2010), negating the use of these transects as baselines for comparative surveys. In 2001, WWF launched the Meso-American Reef Program, which assessed coral health over the entire Mesoamerican reef system, including Laughing Bird Caye, during the impacts of the 2001 coral bleaching episode (McField, 2001). This was followed a month later by Hurricane Iris, and an assessment of damage to fore reef, back reef and patch reefs of the faro (Bood, 2001). Surveys of reef condition were also conducted using the AGGRA methodology in 2006, providing a baseline for the Healthy Reefs programme. Using data from these surveys as a baseline, a more robust monitoring programme for coral reefs has been developed, implemented first by Friends of Nature, and more recently by the Southern Environmental Association.

Every year, SEA conducts commercial species survey quarterly, with its focus of monitoring for this survey on the Queen Conch, lobster and finfish at LBCNP. This survey is conducted by means of doing a 30-minute timed swim for each site in accordance with Dr. Charles Acosta's Long -term Atoll Monitoring Program, otherwise known as LAMP. There is a total of 12 sites in LBCNP. There are 5 "control" sites (outside the park) and 7 sites located within the park. Normally, this survey is conducted by a team of four persons; three divers and one boat captain. The depth of each site varies from 11.8 to 30.8 feet (3.6 m to 9.4 m) with the survey conducted during daylight hours only.

Laughing Bird Caye National Park is the most important site for the "Fragments of Hope" Coral restoration efforts in Belize. Marine Biologist Lisa Carne has been leading the restoration initiative in Belize for ten years, growing corals in nurseries and slowly restoring the reefs of Laughing Bird Caye National Park (Figure 20). The restoration project focus on the culture of *Acropora palmata, A. cervicornis*, and the hybrid coral, *A. prolifera,* although ten other coral species including, *Dendrogyra cylindrus, Agaricia (Undaria) tenuifolia, Colpophyllia natans, Orbicella annularis, O. faveolata, O. franski, Diploria strigosa,*

Pseudodiploria clivosa, Porites furcata and Montastraea cavernosa are also growing in the nurseries.

Since 2009, Fragments of Hope has been successful in raising and transplanting corals in Belize and has documented survivorship on some of their transplanted corals in Laughing Bird Caye. In an effort to replenish corals reefs which are more resilient to climate change, the restoration project has focused on identifying and propagating corals which are most resistant to bleaching and disease. However, this has not happened without some setbacks, as they have documented white band disease, rapid tissue loss, predation from snails, fireworms and fish as well as damage from boat anchors and invasive sponges.

A true testament to success of Fragments of Hope is the annual coral spawn which they have been able to document since 2012. In 2012, Fragments of Hope documented four different *A. cervicornis* genotypes with gamete formation, less than two years after they were out planted (Bowden-Kerby and Carne, 2012; Carne and Kaufman, 2015; Carne and Baums, 2016).

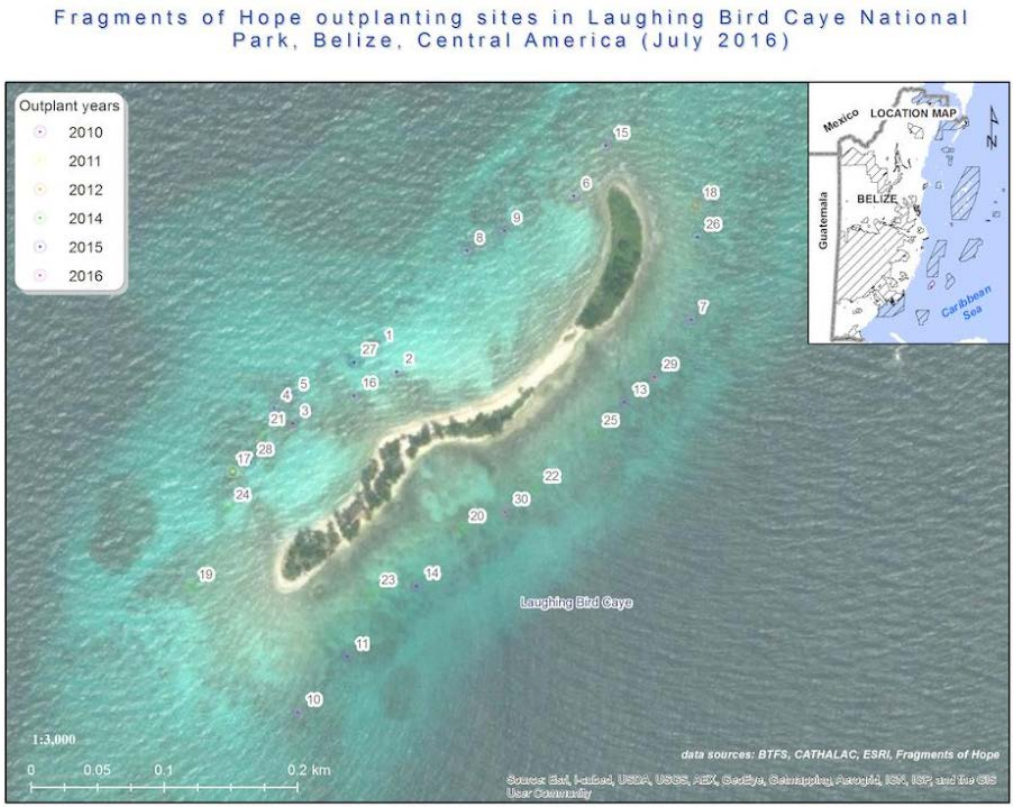

Figure 19: Out planting sites around Laughing Bird Caye (Carne & Kaufman 2015)

SEA has been conducting monthly water quality testing in the LBCNP since 2013 in an effort to collect baseline data which would be used to determine if there are any changes in the oceanic conditions. Furthermore, it can be used to make management decisions for these protected areas for continued marine resource/ecosystem sustainability.

Testing is conducted for a mixture of both physical and chemical parameters as follows:

- pH
- Dissolved Oxygen (DO) in % and mg/l
- Temperature (degrees Celsius)
- Conductivity (SPC us/cm)
- Sea Level Atmospheric Pressure (inHg)
- Turbidity (meters)
- Nitrate (mg/l)
- Phosphate (mg/l)
- Salinity (ppt)

Majority of these parameters are tested using the YSI ProPlus Quattro water monitoring probe at varying depths; surface, 0.5 m, 1 m, 2 m, 5 m, 10 m, 15 m and 20 m (if depth allowed) for which a 500 ml sample is collected at each site. The testing for the chemical parameters for nitrate (Cadmium Reduction/UV VIS Spectro), phosphate (PhosVer/ Orthophosphate/UV VIS Spectro) and salinity (Mercuric Nitrate Titration) is done at the Belize Aquaculture Limited Water Quality Laboratory.

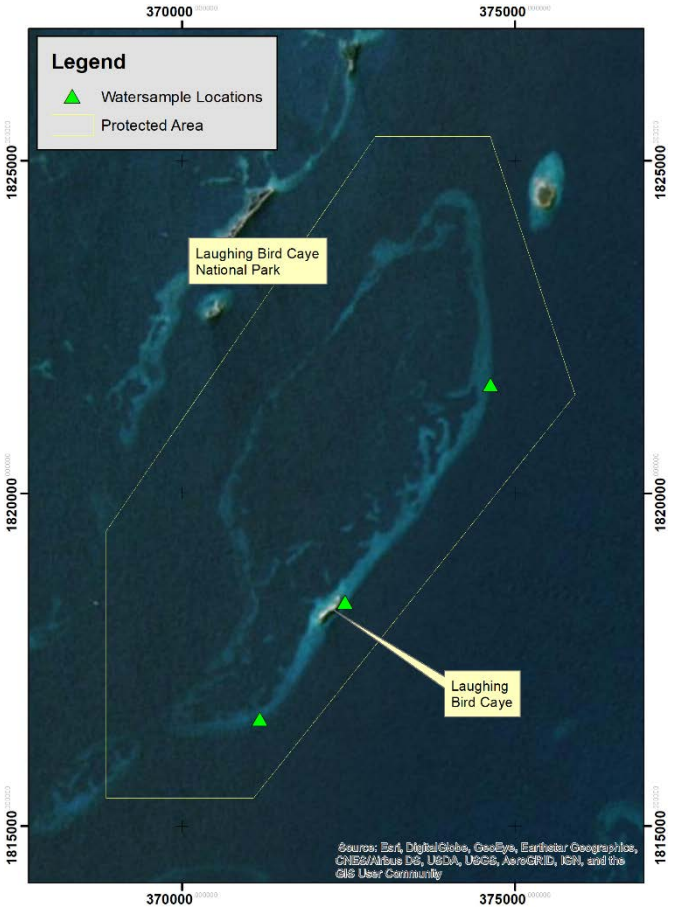

Figure 20: Laughing Bird Caye National Park Water Quality Monitoring Sites

Effectively, SEA is thus building up a baseline data set for sea-water quality in the area. Unfortunately, the data do not automatically lend themselves for making management decisions. Based on the location of the water monitoring sampling sites (Figure 20), it would be necessary to have an additional number of sampling sites immediately next to Laughing Bird Caye combined with a higher sampling frequency. In this way it might be possible to identify whether visitation (and resulting bath-room use) have a measurable effect on the water quality and thereby being able to possibly link algae outbreaks to any increases in nutrient input.

2.6. Cultural and Stakeholder Use of LBCNP

2.6.1. Community and Stakeholder Use

The Laughing Bird Caye based on its designation as a national park is essentially a no-take area and as such extractive use by community members and stakeholders is prohibited. Nonetheless, the Laughing Bird Caye area has historically been an important fishing location for both conch and lobster for fishers from nearby Placencia and as far north as Sarteneja. At that time, the caye itself served as a camping site during regular fishing trips. It also served as camping areas for family recreational visits, and culturally important trips for the Garinagu, such as the *Adugahatía*, an integral part of the Dugu ceremony. The *Adugahatía* entails the gathering of specific marine products to fulfil traditional ancestral spirits' requests for the traditional Dugu ceremony. During community consultations on the establishment of the protected area, some participants raised concerns about how restrictions on camping at the caye may affect the ceremony. Access to Buttonwood Caye is now provided by SEA as an alternative, for this purpose.

Community consultations held in 2010 suggest that Seine Bight and Hopkins did not historically use the Laughing Bird Caye area for fishing, as it was considered too far and too expensive to reach (Clarke (MMAS draft, 2009)). Following the establishment of the National Park, a number of Sarteneja fishers shifted their area of focus to the reef adjacent to the boundaries, whilst others moved to different areas. The establishment of the protected area had only a relatively small impact on fishers who were able to adjust their livelihood activities.

From the 1980s onwards, until the declaration of the caye as a National Park, both tour operators and fishermen continued to use the area. Once the caye and the surrounding waters were legally declared, in 1991, however, fishing was no longer permitted within the boundaries. From 1991 onwards, tourism has been the primary stakeholder use of the area, with a limited amount of research including coral propagation.

2.6.2. Recreation and Tourism Use

Laughing Bird Caye has been considered a local tourism destination even before its designation as a protected area. The area continues to be a destination for tourism operators especially in the Placencia area. Tour operators and tour guides from within the region continue to frequently use the area to take their guests for snorkeling and diving activities. Local tourism business such as hotels and restaurants are by extension stakeholders and beneficiaries of the LBCNP as key players in the local tourism industry.

SEA data shows that visitation peaked in 2007, with about 10,526 visitors

using the caye and surrounding waters (Figure 21). Since then, however, visitation appears to be on a decreasing trend reaching a low in 2015 of about 5,167 visitors. Since then the trend has been tending upwards however whether this will reach the 10,000 high mark again is yet to be seen.

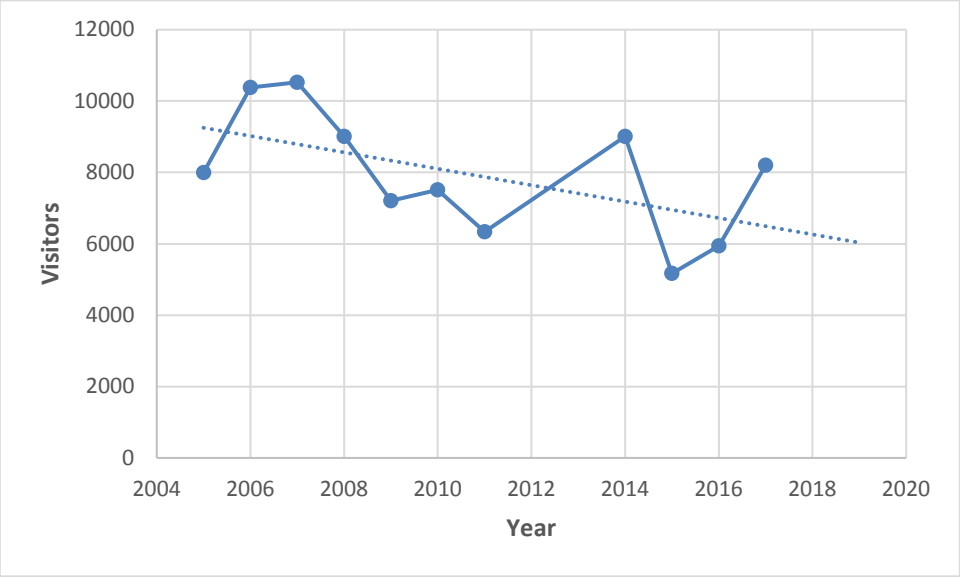

Figure 21: LBCNP Visitation 2005 to 2017
Source: SEA. Data for 2012 and 2013 unavailable

Visitation to LBCNP varies across the year with increases starting around November and generally peaking between March and April (Figure 22). The lowest visitation occurs during September.

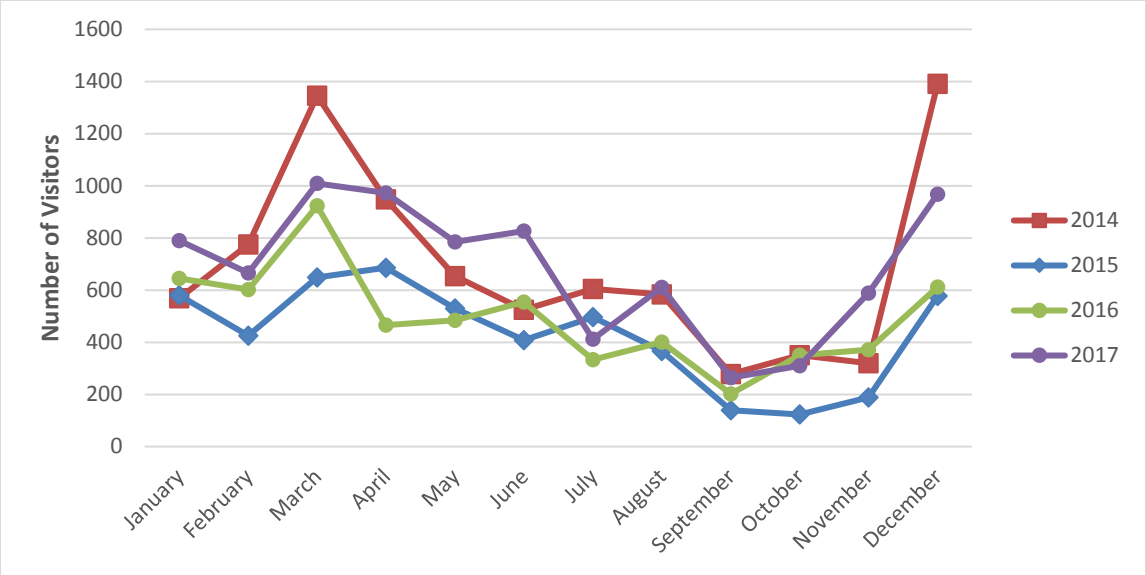

Figure 22: LBCNP Visitation 2014 to 2017
Source: SEA. Some data for 2015 is incomplete.

The majority of visitors are snorkelers and divers, participating in guided day tours to the national park, with a small number of kayaking groups and live aboard bareboat charters.

2.6.3. Educational Use

SEA uses the LBCNP to reach out to its stakeholders, and is therefore the focus of its Education and Outreach Programme. Easy access makes it the ideal location for hosting school trips. This activity, which has been ongoing throughout the history of the National Park in developing greater understanding among stakeholders of all ages about the importance of marine conservation and marine protected area management. SEA continues to work with local schools in the Placencia area to provide students with field trips to experience the reef environment and discuss management issues. Aside from local students, foreign schools also bring international students for educational activities at the LBCNP. These activities have provided SEA with a firm foundation and model for use of Laughing Bird Caye National Park as an educational resource, strengthening stakeholder support for management of the protected area.

3. 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. The methodology used in the Conservation Action Planning process was developed by The Nature Conservancy (TNC, 2007).

3.1. Identification of Conservation Targets

Conservation targets are species, species assemblages or ecosystems that have been selected as representing the biodiversity of a protected area – such that strategic actions, taken to ensure their continued viability and reduce the pressures impacting them, will adequately address the needs of the system as a whole. 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 (Table 13).

Table 13: Conservation Targets for Laughing Bird Caye National Park

Conservation Target	Justification for Target	Species, Communities or Ecological Systems represented by Conservation Target
Turtle nesting	Sea turtles are threatened with the hawksbill being listed as critically endangered. Actions can be implemented to reduce the pressures.	Hawksbill, loggerhead and green turtles, beaches
Bird colonies - Laughing Gulls	Signature species of Laughing Bird Caye. There is currently nesting at southern LBC (~4 nests).	Laughing Gulls
Natural beach vegetation	Prevent erosion; habitat for brown pelicans and ospreys which have strong symbolic values and tourism values, last remaining colonies of these bird species	Mangroves, habitat for brown pelicans and ospreys
Coral reef communities	Impacted by global warming; bleaching; basis of the commercial fishery (reef species); coral out-planting	Coral Reef communities and all associated reef species (reef fish, gorgonians, sponges, etc.)
Seagrass communities	Feeding and nursery habitat for juvenile fish and invertebrate	Seagrass beds, juvenile fish and invertebrate

Conservation Target	Justification for Target	Species, Communities or Ecological Systems represented by Conservation Target
	species; filters sediment from water. Currently unaware of the status due to absence of monitoring; ecological importance; over 90% considered intact 5 years ago	species, manatees and turtles

3.2. Assessment of Conservation Target Viability

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

- A means for determining changes in the status of each focal conservation target over time, allowing SEA to measure 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.

The results of the Viability Assessment are included in Table 14.

Table 14: Viability Assessment of Conservation Targets

Assessing the Health of the Conservation Target				
	Current Status			
Indicator	**Poor**	**Fair**	**Good**	**Very Good**
TURTLE NESTING				
a) Number of turtle nests			Good	
b) Number of successful hatches			Good	
c) Abundance of hawksbill and green turtles per annum per hectare		Fair		
BIRD COLONIES – Laughing Gull, Brown Pelican and Ospreys				
a) Number of birds nesting				
b) Number of nests		Fair		
NATURAL BEACH VEGETATION				
a) Total area of littoral forest	Poor			
b) % littoral forest in natural condition	Poor			
c) Presence of invasive species – e.g. coconut			Good	
CORAL REEF COMMUNITIES				
a) Current IRHI of resilient site		Fair	Good	
b) Water quality		Fair		
c) % average live coral cover		Fair		
d) % recent coral mortality		TBC		
e) Level of coral recruitment		TBC		
f) Commercial fish biomass		TBC		
g) Parrot fish biomass		TBC		
h) % macroalgal cover		TBC		
i) % survey sites/coral bleaching per annum		TBC		
SEAGRASS COMMUNITIES				
a) Extent of seagrass				Very Good

Assessing the Health of the Conservation Target				
	Current Status			
Indicator	**Poor**	**Fair**	**Good**	**Very Good**
b) % seagrass cover				Very Good
c) Water quality		TBC		
d) Coverage of seagrass not impacted				Very Good
e) Seagrass density		Fair		
*TBC – To be confirmed				

3.3. Threats to Biodiversity

Laughing Bird Caye National Park is often cited as an example of an effective protected area, with rules, regulations and guidelines in place for visitor use, along with effective enforcement. Despite this, the National Park is facing impacts outside the control of the site-level and national management bodies.

A threat assessment was conducted in 2017 for the conservation planning process, with input from a wide range of stakeholders – including protected area site management staff, researchers, tour guides and fishermen with local and technical knowledge of the area.

3.3.1. Identified Threats

The threats affecting the conservation targets as identified by the CAP participants included:

- Erosion of sandy beaches
- Erosion of natural beach vegetation
- Human impacts related to tourism/recreational use
- Coral bleaching
- Pollution
- Boat impacts (anchor damage)
- Sedimentation to coral and seagrass communities

Outputs from the threat assessment are presented in Table 15. Threats to the conservation targets included:

Table 15: Threats to Conservation Targets of LBCNP

Conservation Target	Threats
Turtle Nesting	▪ Erosion of sandy beaches (loss of vegetation coverage) ▪ Human impact on nesting beaches

	(interference with nests)
Bird Colonies – Laughing Gulls	▪ Removal of vegetation (to improve aesthetics of site for tourism purposes) ▪ Human impact (trampling)
Natural Beach Vegetation (erosion)	▪ Erosion (removal of vegetation, wave action) ▪ Removal of vegetation (to improve aesthetics of site for tourism purposes)
Coral Reef Communities	▪ Human impact (tourist activities i.e. diving snorkeling) ▪ Coral bleaching ▪ Boat impacts (anchor damage) ▪ Pollution – contamination of waters due to inappropriate sewage and grey water treatment. ▪ Sedimentation and nutrient rich waters
Seagrass Communities	▪ Boat impacts (anchor damage) ▪ Sedimentation and nutrient rich waters

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 needed to mitigate the threat

Rating Critical Threats

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

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

Proportion of Area Affected		(adapted
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
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
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

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 16). The threat with the highest total threat score is ranked as the highest threat.

Table 16: Threats to Conservation Targets of LBCNP

Direct Threat Indirect Threat	Area A	Severity S	Urgency U	Total A x S x U
TURTLE NESTING				
▪ Erosion o Removal of Vegetation	4	1	3	**12**
▪ Human impact (interference with nests) o Improper visitor control	1	0	3	**3**
BIRD COLONIES – LAUGHING GULLS				
▪ Removal of vegetation o Clearing of vegetation to improve site aesthetics for tourists	4	3	3	**36**
▪ Human impact/visitation (trampling) o Improper visitor controls	4	2	3	**24**
NATURAL BEACH VEGETATION				
▪ Erosion o Wave action o Removal of vegetation	4	2	3	**24**
▪ Removal of vegetation o Clearing of vegetation to improve site aesthetics for tourists	4	2	3	**24**
CORAL REEF COMMUNITIES				
▪ Human impacts/tourism (diving, snorkeling, swimming) o Improper visitor control o Carrying capacity issues	3	2	3	**18**
▪ Bleaching o Climate Change	4	3	3	**36**
▪ Boat impacts (anchor damage) o Improperly monitored Charter Boats	2	2	3	**12**
▪ Sewage/Wastewater o Inappropriate technology o Facilities on LBC not adequate for number of visitors o No adequate mooring facilities on the coast	3	2	3	**18**
▪ Sedimentation (and nutrient rich waters)	4	3	3	**36**
SEAGRASS COMMUNITIES				
▪ Boat impacts (anchor damage, urgent)	2	2	3	**12**
▪ Sedimentation (and nutrient rich waters)	1	1	1	**1**

As shown in Table 17, this places ***Removal of vegetation (bird colonies), Sedimentation (coral reef),*** and ***bleaching (coral reef)*** as the highest priority of active threats, with the potential to reduce the viability of all conservation

targets of Laughing Bird Caye National Park. The threats of **Human impact/visitation to Bird Colonies**, **erosion of natural beach vegetation** and **removal of natural beach vegetation** were also ranked as high priority.

Table 17: Results of Threat Assessment

Threat	Score
Removal of vegetation (Bird Colonies)	36
Sedimentation (Coral Reef)	36
Bleaching (Coral Reef)	36
Human impact/visitation (trampling) (Bird Colonies)	24
Erosion (Natural Beach Vegetation)	24
Removal of Vegetation (Natural Beach Vegetation)	24
Human impacts/tourism (diving, snorkeling, swimming) (coral reef)	18
Wastewater/sewage (coral reef)	18
Erosion (Turtle nests)	12
Boat impacts (anchor damage) (Coral Reef)	12
Boat impacts (anchor damage) (Seagrass)	12
Interference with turtle nests (Turtle nests)	3
Sedimentation (Seagrass)	1

3.4. Planning for Climate Change

Belize is considered to be highly vulnerable to Climate Change related impacts such as sea level rise, sea surface temperature rise, increased intensity of storms and ocean acidification. Protected Areas play a critical role in the maintenance of ecosystem services and will become even more important as climate change impacts increase in the future. When developing management plans it is important to understand and integrate climate change adaptation into protected areas planning. The management strategies identified should help to ensure that the protected area continues to mitigate the predicted impacts of climate change. The methodology for identifying the Climate Change related management strategies is based on the ***Guidelines for Integrating Climate Change Adaptation Strategies into Management Plans*** (Wildtracks, 2012) which is an addendum to Management Plan Framework developed under the National Protected Areas Policy and System Plan (NPAPSP, 2005).

A Climate Change Analysis Workshop was held with stakeholders to look at how climate change can impact the LBCNP. The management plan for the Gladden Spit and Silk Cayes Marine Reserve, also co-managed by SEA, is currently being updated and given the close proximity of the two PAs and the similar CC impacts

they would face, they were considered as one unit for the Climate Change Analysis exercise. The results of the CC Analysis reflect potential impacts and related management strategies for both LBCNP and GSSCMR.

Situation Analysis

To achieve conservation, the impacts of climate change must be mitigated. This can be achieved through an understanding of the changes that will come about at the national and site level as a result of these forces, and identifying conditions that may lead to solutions. The potential climate change impacts for Belize are described in Table 18 (Walker, 2010).

Table 18: Predicted Climate Change Elements for Belize

Adapted from SEA and Walker, 2010

Climate Change Impacts	Current Status	25-50 years	100 yrs
Sea level rise	Increased global average sea level rise rate of 1.8mm per year from 1961 – 2003. Current average increase in sea level rise in the Mesoamerican region is estimated at 2mm per year	Predicted increase of between 0.38m to 0.47m	Predicted increase of between 0.47m and 0.91m over next 100 years
Sea surface temperature rise	Water temperature has increased by 0.75˚C between 1906 and 2005		Predicted regional increase of temperature by up to 5˚C by 2080, with the greatest warming being experienced in the north-west Caribbean (incl Belize)
Increased frequency of Storms	Increased storms from 1999 onwards, with annual fluctuations. More storms during El Nina, fewer El Nino. Stronger storms >Cat 4 / 5		
Ocean acidification (corals, lobster/ conch)	Atmospheric CO_2 concentration has increased from 280 parts per million (ppm) in 1880 to nearly 380 ppm in 2005; – 30% of all atmospheric CO_2 resulting from burning of fossil fuels has been taken up by the ocean (IPCC 2007).	Predicted 30% decrease in pH Predicted decrease in calcification rate by 20 – 50% by 2050	Decrease of 0.5 unit pH for 100 years (UNDP, 2009)
Decreased Precipitation	Mean annual rainfall over Belize has decreased at an average rate of 3.1mm per month per decade since 1960 (UNDP)	Predicted ecological shifts up the altitudinal gradient of the Maya Mountains Massif may remove the cloud forest, and the catchment functionality important for maintaining rivers in dry season in the south of Belize, and providing nutrients to the reef environment.	Predicted decrease in precipitation of 9% by 2099 (IPCC, 2007), with significant fluctuations, attributed to El Niño

Climate Change Impacts	Current Status	25-50 years	100 yrs
Air Temperature	Mean annual temperature has increased in Belize by 0.45°C since 1960, an average rate of 0.10°C per decade. Average number of 'hot' days per year in Belize (days exceeding 10% of current average temperature) has increased by 18.3% between 1960 and 2003 (NCSP/UNDP).		Predicted mean annual temperature increase is 3.5° by 2099 (UNDP, 2009)

3.4.1. Priority Climate Change Adaptation Focal Targets

A series of Focal Targets on which to base Climate Change Adaptation planning was identified to ensure that the financial and human resource investments for adaptation strategies are prioritized for maximum effectiveness. The four Focal Targets included:

- Conservation Targets identified during Conservation Action Planning Workshop
- Ecosystem Services provided by the PAs
- Socio-economic Activities dependent on the natural resources of the PA
- Stakeholder Communities (Community Resource Users) of the PA

The key questions asked to determine the Priority Focal Targets were:

- Which of the Conservation Targets identified during Conservation Planning would be most affected by climate change?
- What key ecosystem services provided by the protected area will be significantly impacted by climate change?
- Which community resource users would be most affected by climate change impacts on the protected area?
- How vulnerable / resilient are those communities?
- What socio-economic activities dependent on the natural resources of the protected area will be most affected by climate change?

Results of the Climate Change Analysis Workshop

Priority Conservation Targets

Which of the Conservation Targets identified during Conservation Planning would be most affected by climate change?

Of the conservation targets identified during the conservation planning sessions for LBCNP (Table 19), four of these were selected as priority conservation targets that would be most affected by climate change.

Table 19: Conservation Targets identified for Laughing Bird Caye National Park

Laughing Bird Caye National Park
Turtle nesting
Bird colonies - Brown Pelican/Laughing Gulls
Coral reef communities
Seagrass communities
Natural beach vegetation

These were selected through a prioritization process based on a rating (on a scale of 1 to 4) of the impacts of the relevant predicted climate change elements for Belize (Tables 20 and 21). They include:

- Turtle nesting
- Natural beach vegetation
- Coral Reef Communities
- Seagrass Communities

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 20: Priority conservation targets selected based on predicted climate change elements

Predicted Climate Change Elements		Conservation Targets			
		Natural Beach Vegetation	Coral Reef	Seagrass	Turtle Nesting
1	Sea Level Rise	Very High	High	High	Very High
2	Sea Temperature Rise	High	Very High	Very High	Very High
3	Increased Intensity of Storms	High	High	High	Very High
4	Ocean Acidification	High	Very High	Very High	Very High
5	Decreased Precipitation	High	Low	Low	Medium
6	Increased Air Temperature	High	Low	Low	High
	Average Score	3.2	2.7	2.7	3.5
		Selected	Selected	Selected	Selected

Table 21: Potential Climate Change Impacts on Priority Conservation Targets

Climate Change Impacts	Natural Beach Vegetation	Coral Reef Communities
Sea level rise	▪ Inundation, habitat loss, distribution shift ▪ Where inland migration cannot occur (i.e. low-lying cayes), mangroves may disappear ▪ Damage to coral reefs may adversely impact mangrove systems that depend on the reefs to provide shelter from wave action	▪ Should be able to keep up with sea level rise, barring other impacts (bleaching/mortality and erosion). ▪ Decrease in light availability may lead to a loss of deeper corals, shift in distribution ▪ Increased sedimentation and reduced light availability due to shore erosion
Sea surface temperature rise	▪ Loss of reef may reduce protection from erosion and storm events	▪ Increased coral bleaching ▪ Increased prevalence of coral disease ▪ Reduced biodiversity due to a shift towards more tolerant, opportunistic species
Increased frequency of Storms	▪ Destruction, inundation, changes in sediment dynamics ▪ Large storm impacts result in mass mortality	▪ Increased damage of corals ▪ Increased sedimentation ▪ Reduced ability of colonies to re-establish after storm events
Ocean acidification	▪ Increase in growth	▪ Decreases in coral calcification rates ▪ Decreased growth rates and structural strength
Decreased Precipitation	▪ Decreased precipitation results in a decrease in mangrove productivity, growth, and seedling survival, and may change species composition favoring more salt tolerant species	
Air Temperature	▪ May alter timing of flowering and fruiting ▪ Increased temperatures could lead to decline in leaf forming rate ▪ Thermal stress affecting. mangrove root structures and establishment of mangrove seedlings	

Table 21 (contd.). Potential Climate Change Impacts on Priority Conservation Targets

Climate Change Impacts	Turtle Nesting	Seagrass Communities	Commercial Species
Sea level rise	▪ Inundation of nesting beaches	▪ Will reduce light availability ▪ Changes in currents may cause erosion and increased turbidity of water column ▪ Shifts in distribution of seagrass beds	▪ Shift in range / habitat loss of both adult and juvenile fish and lobster ▪ Shift in seagrass distribution ▪ Changes in coral reef ▪ Potential changes in water currents affecting viability of spawning aggregation sites
Sea surface temperature rise	▪ Extended nesting season, with earlier onset of nesting	▪ Shifts in distributions of seagrass beds ▪ Changes in growth rates	▪ Habitat loss (impacts on reef) ▪ Reproduction in seagrass is temperature driven, so may be affected ▪ Possible impacts from new invasive species and algal blooms ▪ Disease may become more prevalent
Increased frequency of Storms	▪ Inundation of nests from higher groundwater ▪ Habitat destruction	▪ Massive sediment movements can uproot or bury seagrass ▪ Increase annual turbidity may reduce light availability for deeper water seagrasses	▪ Habitat destruction - seagrass and mangroves ▪ Sedimentation ▪ Possible impacts on larval dispersion / survival
Ocean acidification (corals, lobster/ conch)		▪ Possible direct positive effect on photosynthesis and growth ▪ Higher CO_2 levels may increase the production and biomass of epiphytic algae on seagrass leaves leading to shading	▪ Habitat loss (impacts on reef). ▪ Impacts on larval viability and adult growth rates ▪ Possible increase in seagrass productivity
Decreased Precipitation	▪ Possible changes in humidity, altering hatch succes		▪ Possible changes in salinity impacting larval dispersal

Climate Change Impacts	Turtle Nesting	Seagrass Communities	Commercial Species
Air Temperature	▪ Warming of beaches, resulting in changes in reproductive patterns, increased egg mortality, shorter hatching time, reducing survival potential		▪ Potential impact on mangroves as a nursery habitat

Key Ecosystem Services

What key ecosystem services provided by the protected area will be significantly impacted by climate change?

The group initially listed seven ecosystem services provided by the PAs. These included: coastal protection, climate regulation, recreation, nursery habitat, food production, waste assimilation and research and education. Through group consensus, three of the seven ecosystem services were considered to be at greatest risk from climate change. These included:

- **Coastal Protection**
- **Climate Regulation**
- **Nursery Habitat**

Priority Stakeholder Communities

Which community resource users would be most affected by climate change impacts on the protected area?

The initial list of seven stakeholder communities was selected from those identified in the LBCNP and GSSCMR stakeholder analysis. The communities were evaluated based on 3 vulnerability factors:

1. **Exposure**: The extent to which a community comes into contact with climate events or specific climate impacts
2. **Sensitivity**: The degree to which a community is negatively affected by changes in climate
3. **Adaptive Capacity**: The potential or capability of a community to adjust to impacts of changing climate, and to minimize, cope with and recover from the consequences of changes

Three priority stakeholder communities were chosen:

- Placencia Village
- Monkey River Village
- Sarteneja Village

How vulnerable / resilient are those communities?

All communities were considered to have a high exposure and sensitivity to Climate Change and low adaptive capacity.

Key Socio-Economic Activities

What socio-economic activities dependent on the natural resources of the protected area will be most affected by climate change?

The stakeholder analysis of LBCNP and GSSCMR showed that the main socio-economic activities of the PAs are tourism and fishing.

Potential climate change impacts on the tourism sector include loss of beaches, coastal infrastructure and property due to sea level rise and loss of coral reefs due to temperature induced bleaching events and ocean acidification.

Potential impacts on the fisheries sector include loss of key habitats such as coral reefs, mangroves and sea grasses. Rising sea levels could lead to partial or complete disappearance of these habitats through inundation and increased sea surface water temperature and increased ocean acidification may cause severe bleaching events and loss of coral reefs.

Developing Adaptation Strategies

General adaptation strategies were identified for integration into the LBCNP management program. The strategies aim to reduce anthropogenic threats which may exacerbate the impacts of climate change.

Climate Change Impact Themes	Strategies
Reduction in fish catch	▪ Prohibit fishing in SPAG areas ▪ Increase/improve enforcement of regulations
Degradation in tourism destination	▪ Implement hard adventure carrying capacity measures
Reduction of terrestrial habitat	▪ Increase vegetation coverage by prohibiting access to certain areas ▪ Reforestation ▪ Implement sea level rise vulnerability studies to inform management decisions
Reduction of underwater habitat	▪ Install mooring buoys around sensitive areas ▪ Implement no-wake zones ▪ Expansion of coral restoration activities ▪ Increase monitoring of tourism development activities around the MPAs ▪ Monitor impact of tourism activities in MPAs

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APPENDICES

Appendix 1: Legislation – Laughing Bird Caye National Park

CHAPTER 215

NATIONAL PARK RESERVATION

(LAUGHING BIRD CAYE) ORDER

ARRANGEMENT OF PARAGRAPHS

SCHEDULE

CAP. 215

94 of 1996.
Ch. 181A.

NATIONAL PARK RESERVATION (LAUGHING BIRD CAYE) ORDER

(Section 3)

[20th July, 1996.]

1. This Order may be cited as the

Short title.

NATIONAL PARK RESERVATION (LAUGHING BIRD CAYE) ORDER.

2. The area specified in the Schedule to this Order is hereby declared to be a National Park.

Declaration of National Park.

3. A map of the said area may be seen at the office of the Chief Forest Officer, Ministry of Natural Resources, Belmopan.

MADE by the Minister of Natural Resources this 8th day of July, 1996.

Map of National Park.

(HON. EDUARDO JUAN)
Minister of Natural Resources

SCHEDULE
[Paragraph 2]

LAUGHING BIRD CAYE NATIONAL PARK

ALL THAT portion of the Caribbean Sea comprising approximately 10,119 acres in the Stann Creek District, situate within and surrounding the Laughing Bird Caye Faro and being part thereof and being described as follows:

Commencing at a Point 'A' Northeast of Laughing Bird Caye having the scaled U.T.M. coordinates of 375 904 East and 1821 478 North;

thence in a Northwesterly direction to a Point 'B' North-Northwest of Laughing Bird Caye having the scaled U.T.M. coordinates of 374 630 East and 1825 363 North;

thence in a general Westerly direction to a Point 'C' North of Laughing Bird Caye having the scaled U.T.M. coordinates of 372 904 East and 1825 363 North;

thence in a Southwesterly direction to a point 'D' West-Northwest of Laughing Bird Caye and having the scaled U.T.M. coordinates of 368 860 East and 1819 430 North;

thence in a general Southerly direction to a Point 'E' Southwest of Laughing Bird Caye and having the scaled U.T.M. coordinates of 368 860 East and 1815 416 North;

thence in an Easterly direction to a Point 'F' having the scaled U.T.M. coordinates of 371 073 East and 1815 416 North;

thence in a Northeasterly direction to the point of commencement.

Appendix 2: Laughing Bird Caye National Park: Fish Species

Laughing Bird Caye National Park: Fish Species			
Family	Species	Common name	IUCN
Acanthuridae	*Acanthurus bahianus*	Ocean surgeonfish	
	Acanthurus chirurgicus	Doctorfish	
	Acanthurus coerulus	Blue tang	
Albulidae	*Albula vlupes*	Bonefish	
Apogonidae	*Apogon bintatus*	Barred Cardinalfish	
	Apogon lachneri	Whitestar cardinalfish	
	Apogon maculatus	Flamefish	
	Apogon townsendi	Twospot cardinalfish	
	Apogon robinsi	Roughlip Cardinalfish	
	Apogon stellatus	Conchfish	
Aulostomidae	*Aulostomus maculatus*	Trumpetfish	
Balistidae	*Aluterus schoepfi*	Orange filefish	
	Balistes vetula	Queen triggerfish	VU
	Cantherdermis sufflamen	Ocean triggerfish	
	Cantherhines macrocerus	Whitespotted filefish	
	Cantherhines pullus	Orangespotted filefish	
	Melichthys niger	Black durgon	
	Monocanthus tuckeri	Slender filefish	
	Xanthichthys ringens	Sargassum triggerfish	
Batrachoides	*Batrachoides gilberti*	Large eye toadfish	
	Sanopus barbatus	Bearded toadfish	
	Sanopus greenfieldorum	Whitelined toadfish	VU
	Sanopus splendidus	Splendid toadfish	VU
Belonidae	*Ablennes hiannes*	Flat needlefish	
	Strongylura notata	Redfin needlefish	
	Tylosurus crocodilus	Houndfish	

Laughing Bird Caye National Park: Fish Species			
Family	Species	Common name	IUCN
Bothidae	*Bothus lunatus*	Peacock flounder	
Carangidae	*Caranx batholomaei*	Yellow jack	
	Caranx crysos	Blue runner	
	Caranx hippos	Crevalle jack	
	Caranx latus	Horse-eye jack	
	Caranx ruber	Bar jack	
	Decapterus macarellus	Mackerel scad	
	Elagatis bipinnulata	Rainbow runner	
	Trachinotus falcatus	Permit	
	Trachinotus goodei	Palometa	
Carcharhinidae	*Carcharhinus leucas*	Bull shark	
	Carcharhinus perezi	Caribbean Reef Shark	
	Carcharhinus falciformis	Silky shark	
	Negaprion brevirostris	Lemon shark	
Centropomidae	*Centropomus undecimalis*	Common snook	
Chaenopsidae	*Emblemariopsis dianae*	Orangeflag blenny	
Chaetodontidae	*Chaetodon aculeatus*	Longsnout butterflyfish	
	Chaetodon capistratus	Foureye butterflyfish	
	Chaetodon ocellatus	Spotfin butterflyfish	
	Chaetodon sedentarius	Reef butterflyfish	
	Chaetodon striatus	Banded butterflyfish	
Cirrhitidae	*Amblycirrhitus pinos*	Red-spotted hawkfish	
Clinidae	*Acanthemblemaria spinosa*	Spinyhead blenny	
	Chaenopsis ocellata	Bluethroat pike blenny	
	Emblemaria pandionts	Sailfin blenny	
	Lucayablennius zingaro	Arrow blenny	

Laughing Bird Caye National Park: Fish Species			
Family	Species	Common name	IUCN
	Malacoctenus boehlkei	Diamond blenny	
	Malacoctenus macropus	Rosy blenny	
	Malacoctenus triangulatus	Saddled blenny	
	Ophioblennius atlanticus	Redlip blenny	
Congridae	*Heteroconger halis*	Garden eel	
Dasyatidae	*Dasyatis americana*	Southern stingray	
	Dasyatis gutatta	Longnose stingray	
	Himantura schmardae	Chupare stingray	
Diodontidae	*Diodon holocanthus*	Balloonfish	
	Diodon hystrix	Porcupinefish	
Echeneidae	*Echeneis neucratoides**	Whitefin sharksucker	
Elopidae	*Megalops atlanticus*	Tarpon	
Ephippidae	*Chaetodipterus faber*	Atlantic spadefish	
Exocoetidae	*Hirundichthys speculiger*	Mirrorwing flyingfish	
Gerreidae	*Eucinostomus lefroyi*	Mottled mojarra	
	Gerres cinereus	Yellowfin mojarra	
Ginglymostomidae	*Ginglymostoma cirratum*	Nurse shark	
Gobiidae	*Ctenogobius saepapellans*	Dash goby	
	Coryphopterus dicrus	Colon goby	
	Coryphopterus eidolon	Pallid goby	
	Coryphopterus galucofraenum	Bridled goby	
	Coryphopterus lipernes	Peppermint goby	
	Gnatholepsis thompsoni	Goldspot goby	
Gobiidae	*Gobionellus saepepallens*	Dash goby	
	Gobiosom evelynae	Sharknose goby	
	Gobiosoma genie	Cleaning goby	

Laughing Bird Caye National Park: Fish Species			
Family	Species	Common name	IUCN
	Cleaning goby	Tellowline goby	
	Yellowline goby	Barsnout goby	
	Barsnout goby	Broadstripe goby	
	Lophogobius cyprinoides	Crested goby	
Gramistinidae	*Gramma loreto*	Fairy basslet	
	Gramma melacara	Blackcap basslet	
	Liopropoma rubre	Peppermint basslet	
Haemulidae	*Anisotremus surinamensis*	Black margate	
	Anisotremus virginicus	Porkfish	
	Haemulon album	White margate	
	Haemulon aurolineatum	Tomtate	
	Haemulon carbonarium	Caesar grunt	
	Haemulon chrysargyreum	Smallmouth grunt	
	Haemulon flavolineatum	French grunt	
	Haemulon macrostomum	Spanish grunt	
	Haemulon melanurum	Cottonwick	
	Haemulon parra	Sailor's choice	
	Haemulon plumieri	White grunt	
	Haemulon sciurus	Bluestriped grunt	
	Haemulon striatum	Striped grunt	
Hemiramphidae	*Hemiramphus brasiliensis*	Ballyhoo	
Holocentridae	*Holocentrus adscensionis*	Squirrelfish	
	Holocentrus rufus	Longspine squirrelfish	
	Sargocentron coruscum	Reef squirrelfish	
	Sargocentron vexillarium	Dusky squirrelfish	
	Neoniphon marianus	Longjaw squirrelfish	

Laughing Bird Caye National Park: Fish Species			
Family	Species	Common name	IUCN
	Priacanthus arenatus	Bigeye	
Inermiidae	*Emmelichthyops atlanticus*	Bonnetmouth	
	Inermia vittata	Boga	
Kyphosidae	*Kyphosus sectatrix*	Bermuda chub	
Labridae	*Bodianus pulchellus*	Spotfin hogfish	
	Bodianus rufus	Spanish hogfish	
	Clepticus parrae	Creole wrasse	
	Doratonatus megalepis	Dwarf wrasse	
	Halichoeres bivittatus	Slippery dick	
	Halichoeres cyanocephalus	Yellowcheek wrasse	
Labridae	*Halichoeres garnoti*	Yellowhead wrasse	
	Halichoeres maculipinna	Clown wrasse	
	Halichoeres radiatus	Puddingwife	
	Hemipteronotus novacula	Pearly razorfish	
	Lachnolaimus maximus	Hogfish	
	Thalassoma bifasciatum	Bluehead wrasse	
	Xyrichtys martinicensis	Rosy razorfish	VU
	Xyrichtys spendens	Green razorfish	
Labridomidae	*Malacoctenus triangulatus*	Saddled blenny	
Lutjanidae	*Lutjanus analis*	Mutton snapper	
	Lutjanus apodus	Schoolmaster	
	Lutjanus cyanopterus	Cubera snapper	VU
	Lutjanus griseus	Grey Snapper	
	Lutjanus jocu	Dog snapper	VU
	Lutjanus mahogani	Mahogany snapper	
	Lutjanus synagris	Lane Snapper	

Laughing Bird Caye National Park: Fish Species			
Family	Species	Common name	IUCN
	Ocyurus chrysurus	Yellowtail snapper	
Malacanthidae	*Malacanthus plumieri*	Sand tilefish	
Mobulidae	*Manta birostris*	Atlantic manta	
	Mobula hypostoma	Devil ray	
Monacanthidae	*Cantherhines macrocerus*	Whitespotted filefish	
	Aluterus scriptus	Scrawled filefish	
Muglidae	*Mugil curema*	White mullet	
Mullidae	*Mulloidiochthys martinicus*	Yellow goatfish	
	Pseudopeneus maculatus	Spotted goatfish	
Muraenidae	*Enchelycore carychroa*	Chestnut moray	
	Gymnothorax funebris	Green moray	
	Gymnothorax miliaris	Goldentail moray	
	Gymnothorax moringa	Spotted moray	
	Gymnothorax vicinus	Purplemouth moray	
Myliobatidae	*Aetobatus narinari*	Spotted eagle ray	
Ophicthidae	*Myrichthys breviceps*	Sharptail eel	
Opisthognatidae	*Opistognathus aurifrons*	Yellowhead jawfish	
	Opistognathus macrognathus	Banded jawfish	
	Opistognathus whitehurstii	Dusky jawfish	
Ostraciidae	*Acanthostracion polygonia*	Honeycomb cowfish	
	Acanthostracion quadricornis	Scrawled cowfish	
	Lactophrys bicaudalis	Spotted trunkfish	
	Lactophrys trigonus	Buffalo trunkfish	
Ostraciidae	*Lactophrys triqueter*	Smooth trunkfish	
Pempheridae	*Pempheris schomburgki*	Glassy sweeper	
Pomacanthidae	*Holacanthus ciliaris*	Queen angelfish	

Laughing Bird Caye National Park: Fish Species			
Family	Species	Common name	IUCN
	Holacanthus tricolor	Rock beauty	
	Pomacanthus arcuatus	Grey angelfish	
	Pomacanthus paru	French angelfish	
	Holacanthus ciliaris	Queen angelfish	
Pomacentridae	*Abudefduf saxatilis*	Sergeant major	
	Abudefduf taurus	Night sergeant	
	Chromis cyanea	Blue chromis	
	Chromis insolata	Sunshinefish	
	Chromis multilineata	Brown chromis	
	Microspathodon chrysurus	Yellowtail damselfish	
	Stegastes diencaeus	Longfin damselfish	
	Stegastes adustus	Dusky damselfish	
	Stegastes leucostictus	Beaugregory	
	Stegastes partitus	Bicolor damselfish	
	Stegastes planifrons	Threespot damselfish	
	Stegastes variabilis	Cocoa damselfish	
Priacanthidae	*Priacanthus arenatus*	Bigeye	
	Priacanthus cruentatus	Glasseye snapper	
Rhincodontidae	*Rhincodon typus*	Whale shark	
Scaridae	*Scarus coelestinus*	Midnight parrotfish	
	Scarus coeruleus	Blue parrotfish	
	Scarus guacamaia	Rainbow parrotfish	
	Scarus iserti	Striped parrotfish	
	Scarus taeniopterus	Princess parrotfish	VU
	Scarus vetula	Queen parrotfish	
	Sparisoma atomarium	Greenblotch parrotfish	

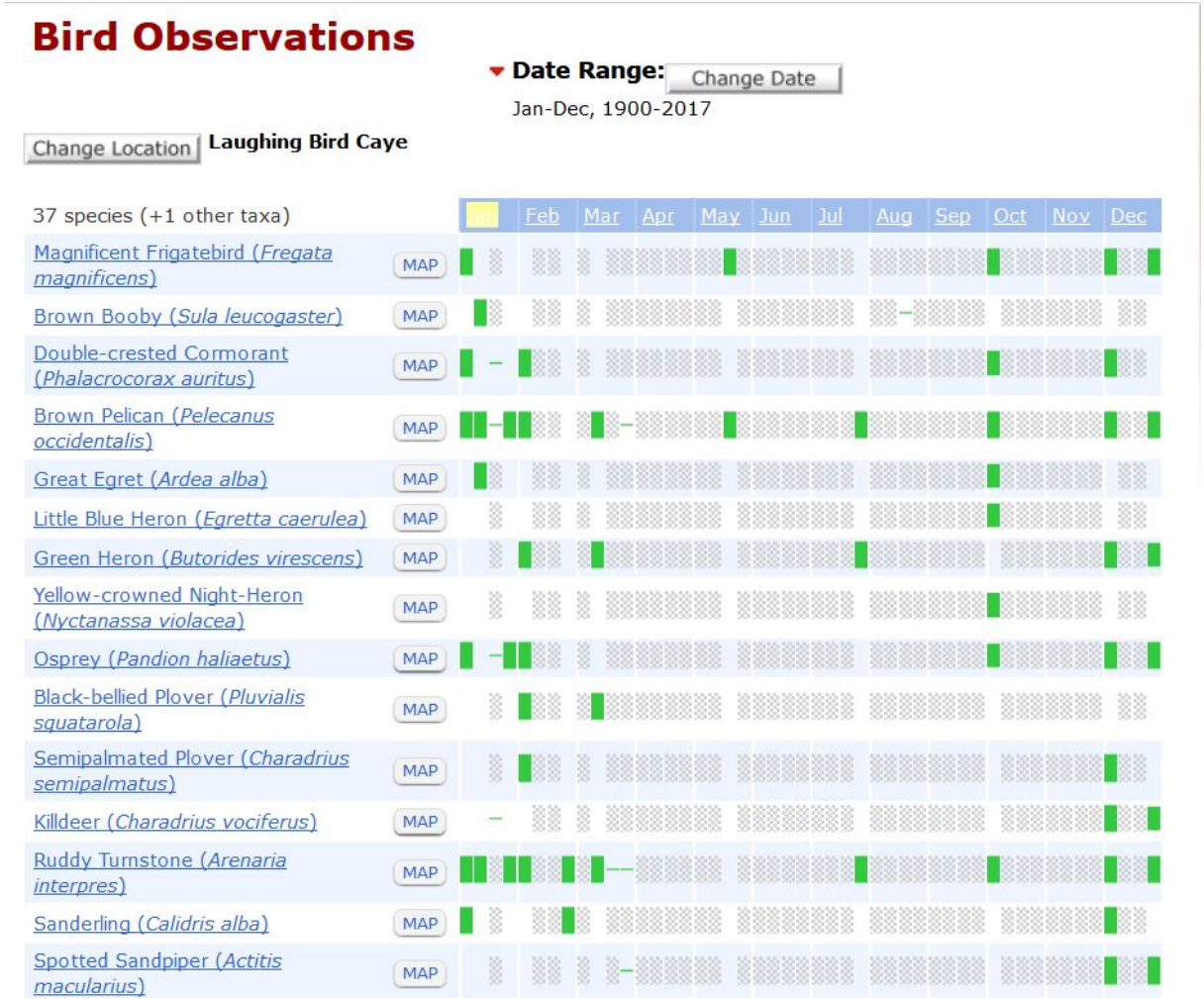
Laughing Bird Caye National Park: Fish Species			
Family	Species	Common name	IUCN
	Sparisoma aurofrenatum	Redband parrotfish	
	Sparisoma chrysopterum	Redtail parrotfish	
	Sparisoma rubripinne	Yellowtail parrotfish	
	Sparisoma viride	Stoplight parrotfish	
	Cryptotomus roseus	Bluelip parrotfish	
Sciaenidae	*Equetus punctatus*	Spotted drum	
	Equetus umbrosus	Cubbyu	
Scombridae	*Scomberomorus regala*	Cero	
Scorpaenidae	*Scorpaena plumieri*	Spotted scorpionfish	
	Pterois volitans	Red Lionfish	INV
Serranidae	*Alphestes afer*	Mutton hamlet	
	Cephalopholis fulvus	Coney	
	Cephalopholis s cruentatus	Graysby	
	Epinephelus adscensionis	Rock hind	
	Epinephelus guttatus	Red hind	
	Epinephelus itajara	Goliath grouper	
	Epinephelus morio	Red grouper	
	Epinephelus striatus	Nassau grouper	CR
	Hypoplectrus aberrans	Yellowbelly hamlet	
	Hypoplectrus chlorurus	Yellowtail hamlet	EN
	Hypoplectrus gemma	Blue hamlet	
	Hypoplectrus gummingatta	Golden hamlet	
	Hypoplectrus indigo	Indigo hamlet	
	Hypoplectrus nigricans	Black hamlet	
	Hypoplectrus puella	Barred hamlet	
	Mycteroperca bonaci	Black grouper	

Laughing Bird Caye National Park: Fish Species			
Family	Species	Common name	IUCN
	Mycteroperca interstitialis	Yellowmouth grouper	
	Mycteroperca rubra	Comb grouper	CR
	Mycteroperca tigris	Tiger grouper	
	Mycteroperca venenosa	Yellowfin grouper	
	Paranthias furcifer	Creole-fish	
	Rypticus saponaceus	Greater soapfish	
	Serranus baldwini	Lantern bass	
	Serranus flaviventris	Twinspot bass	
	Serranus tabacarius	Tobaccofish	
	Serranus tigrinus	Harlequin bass	
	Serranus tortugarium	Chalk bass	
Sparidae	*Calamus bajonado*	Jolthead porgy	
	Calamus calamus	Saucereye porgy	
Sphyraenidae	*Sphyraena barracuda*	Barracuda	
	Sphyraena picudilla	Southern sennet	
Sphyrnidae	*Sphyrna lewini*	Scalloped hammerhead	
	Sphyrna tiburo	Bonnethead	
Synodontidae	*Synodus intermedius*	Sand diver	VU
	Synodus saurus	Bluestriped lizardfish	
Tetraodontidae	*Canthigaster rostrata*	Sharpnose puffer	
	Chilomycterius antennatus	Bridled burrfish	
Tetraodontidae	*Chilomycterius antillarum*	Web burrfish	
	Diodon holocanthus	Balloonfish	
	Diodon hystrix	Porcupinefish	
	Sphoeroides spengleri	Bandtail puffer	
	Sphoeroides testudineus	Checkered pufferfish	

Laughing Bird Caye National Park: Fish Species			
Family	Species	Common name	IUCN
Urolophidae	*Urolophus jamaicensis*	Yellow stingray	

Based on 2010 management plan using AGGRA data, SEA / MBRS / LAMP data - Annelise Hagan, Christina Garcia and Reylando Castro and Linda Garcia, 2010.

Appendix 3: Bird species recorded from Laughing Bird Caye (eBird.org – downloaded October 17, 2017).



Bird Observations

Date Range: Change Date

Jan-Dec, 1900-2017

Change Location **Laughing Bird Caye**

37 species (+1 other taxa)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Magnificent Frigatebird (*Fregata magnificens*)	MAP												
Brown Booby (*Sula leucogaster*)	MAP												
Double-crested Cormorant (*Phalacrocorax auritus*)	MAP												
Brown Pelican (*Pelecanus occidentalis*)	MAP												
Great Egret (*Ardea alba*)	MAP												
Little Blue Heron (*Egretta caerulea*)	MAP												
Green Heron (*Butorides virescens*)	MAP												
Yellow-crowned Night-Heron (*Nyctanassa violacea*)	MAP												
Osprey (*Pandion haliaetus*)	MAP												
Black-bellied Plover (*Pluvialis squatarola*)	MAP												
Semipalmated Plover (*Charadrius semipalmatus*)	MAP												
Killdeer (*Charadrius vociferus*)	MAP												
Ruddy Turnstone (*Arenaria interpres*)	MAP												
Sanderling (*Calidris alba*)	MAP												
Spotted Sandpiper (*Actitis macularius*)	MAP												


Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Laughing Gull (Leucophaeus atricilla) MAP
Roseate Tern (Sterna dougallii) MAP
Royal Tern (Thalasseus maximus) MAP
Sandwich Tern (Thalasseus sandvicensis) MAP
White-crowned Pigeon (Patagioenas leucocephala) MAP
White-winged Dove (Zenaida asiatica) MAP
Belted Kingfisher (Megaceryle alcyon) MAP
Merlin (Falco columbarius) MAP
Eastern Wood-Pewee (Contopus virens) MAP
Tropical Kingbird (Tyrannus melancholicus) MAP
Scissor-tailed Flycatcher (Tyrannus forficatus) MAP
Purple Martin (Progne subis) MAP
Barn Swallow (Hirundo rustica) MAP
Northern Waterthrush (Parkesia noveboracensis) MAP
Black-and-white Warbler (Mniotilta varia) MAP
Common Yellowthroat (Geothlypis trichas) MAP
American Redstart (Setophaga ruticilla) MAP
Northern Parula (Setophaga americana) MAP
Yellow Warbler (Setophaga petechia) MAP
Yellow-throated Warbler (Setophaga dominica) MAP
warbler sp. (Parulidae sp.) (Parulidae sp.) MAP
Baltimore Oriole (Icterus galbula) MAP
Great-tailed Grackle (Quiscalus mexicanus) MAP
KEY: = insufficient data | = rare to widespread
Download Histogram Data