Caye Caulker Marine Reserve Management Plan

2021-2026

MINISTRY OF TOURISM & DIASPORA RELATIONS

STP SUSTAINABLE TOURISM PROGRAM II

BELIZE FISHERIES DEPARTMENT Sustainable Fisheries For Our Future

Prepared by: praxi5 Advisory Group Ltd.

March 2021

Management Plan for CCMR

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Protected Area Data Sheet		
Date	6 February 2021	
Name of Protected Area	Caye Caulker Marine Reserve	
Location of Protected Area	Belize District	
Date of establishment	1998	
Size of Protected Area	Total Area: 9,670 acres, of which: Preservation Zone: 1,442 acres Conservation Zone: 2,029 acres General Use Zone: 6,199 acres	
Statutory Instrument(s)	Declared under Statutory Instrument No. 35 of 1998; Amended by Statutory Instrument No. 115 of 2008.	
Land Tenure	National Land (submerged)	
Management Authority	Fisheries Department	
Affiliations/ Partnerships with other organizations	Government of Belize	
Number of Staff	Permanent: 5	Temporary: 0
Annual Budget (BZ$) for management of protected area	See Section 5.8 (Indicative Financing)	
Designation	Marine Reserve: • IUCN Category VI (WDPA ID 301908)	
Reasons for Designation	To conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. Most of the area is in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.	
Brief Details of Past Funding	Government allocations supplemented by mix of donor agency funding via domestic sources (e.g., PACT).	
Brief Details of Present Funding	As above	
Brief Details of Future Funding	Increased Government allocations with self-generated income prioritized, supplemented by donor/charitable support.	
List the primary protected area objectives:		
1. Protect and manage functional samples of important ecological systems (including coral reef and seagrass) to ensure their protection and management.		
2. Preserve the value of the area for its intrinsic value and for its socio-ecological and socio-economic potential (including fisheries and tourism), including export of adult marine life in addition to other important marine genetic resources and resource-based activities.		
3. Develop sustainable and ecologically balanced recreational and tourism activities that enhance the economic and social benefits of the area.		
4. Provide natural areas for the promotion of education and research.		

List the top two or three most important threats to the protected area:
1. Illegal fishing
2. Land-based pollution
3. Sargassum
List the top three or four critical management activities:
Integrate general adaptation strategies into the Caye Caulker Marine Reserve management activities to aim to reduce anthropogenic threats which may exacerbate the impacts of climate change.
Maintain effective surveillance and enforcement within and around Caye Caulker Marine Reserve in order to deter and prevent illegal activities within Marine Protected Area boundaries.
Strengthen the research and monitoring program for the Caye Caulker Marine Reserve in order to support science-based decision-making for adaptive management of the marine reserve.
Ensure greater stakeholder and community participation in the management activities of the Caye Caulker Marine Reserve.

Names of assessors and people consulted: Osmany Salas, Valentino Shal, Jan Meerman, and Kevin Geban in consultation with senior Fisheries Department staff, Caye Caulker Marine Reserve staff, and stakeholder and community representatives.

Contact details: Adriel Castañeda, Coordinator, Ecosystems-based Management Unit, Fisheries Department, Belize City, Belize.

Executing Agency: Ministry of Tourism and Diaspora Relations through its Sustainable Tourism Program II, Belize City, Belize.

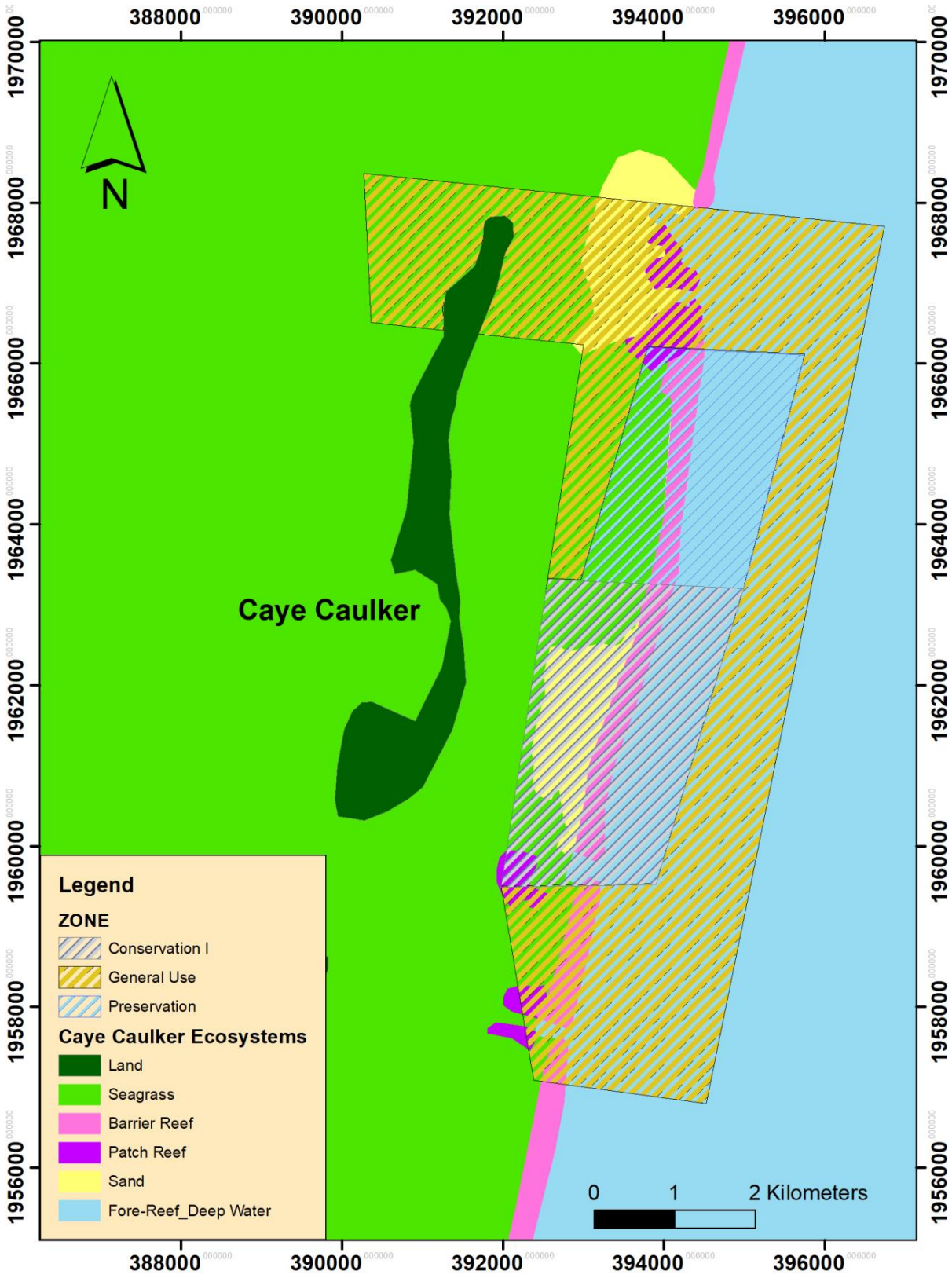

Figure 1: Caye Caulker Marine Reserve

Acknowledgements

Special appreciation goes to the staff members of the Caye Caulker Marine Reserve and, in particular, the Reserve Manager, Ali Cansino, for going beyond the call of duty to support our work throughout the management planning process. Thank you also to Adriel Castañeda, Ecosystems-based Management Unit Coordinator, and Alicia Eck-Nunez, Marine Reserve Operations Manager, at the Fisheries Department for providing us with information that was needed for the management plan, as well as for sharing his extensive knowledge pertaining to the management operations of CCMR.

Special mention goes to CCMR Biologist, Melissa Farias, and the CCMR Rangers, David Linarez and Bradford Smith, for actively participating during the planning workshops. Sofie Pipe, Frontier Country representative, was also very helpful during the planning workshops.

We extend our appreciation to the various CCMR stakeholders, in particular fishermen and tour guide representatives, representatives of the local BTIA Chapter and Swallow Caye Wildlife Sanctuary, and the Siwa Ban Foundation, who contributed their valuable time to share ideas, views, concerns and aspirations pertaining to the management of the CCMR. Your dynamic participation at the various meetings was invaluable to the planning effort, and resulted in the updating of the CCMR management plan for the next five years and beyond.

And last but certainly not least, we extend our gratitude to the STPII Project housed at the Ministry of Tourism and Diaspora Relations for its financial and editorial support. Safira Vasquez provided invaluable guidance and support throughout the planning process. Thank you.

praxi5 Advisory Group Ltd.

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Acronyms and Abbreviations

BAS	Belize Audubon Society
BBRRS	Belize Barrier Reef Reserve System
BTB	Belize Tourism Board
BTIA	Belize Tourism Industry Association
C	Celsius
CAP	Conservation Action Planning
Cat	Category
CC	Climate Change
CCFR	Caye Caulker Forest Reserve
CCMR	Caye Caulker Marine Reserve
CO_2	Carbon dioxide
CZMAI	Coastal Zone Management Authority and Institute
DO	Dissolved Oxygen
DOE	Department of the Environment
EMU	Ecosystem Management Unit
F	Fahrenheit
FAO	Food and Agriculture Organization
FOSC	Friends of Swallow Caye
GOB	Government of Belize
HQ	Headquarters
IT	Information technology
IUCN	International Union for Conservation of Nature
MBRS	Mesoamerican Barrier Reef Systems Project
METT	Management Effectiveness Tracking Tool
MTDR	Ministry of Tourism and Diaspora Relations
n	Number
NBCC	Northern Belize Coastal Complex
NGO	Non-governmental organization
No. In.	Number of individuals noted
PA	Protected Area
REA	Rapid Ecological Assessment

RZ	Replenishment Zone
SACD	Sarteneja Alliance for Conservation and Development
SCTLD	Stony Coral Tissue Loss Disease
SEA	Southern Environmental Association
SI	Statutory Instrument
SMART	Spatial Monitoring and Reporting Tool
Spp.	Species pluralis (Latin for multiple species)
STPII	Sustainable Tourism Project II
TASA	Turneffe Atoll Sustainability Association
TIDE	Toledo Institute for Development and Environment
TS	Tropical storm
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNK	Unknown
USA	United Stated of America
WCS	Wildlife Conservation Society
WRISCS	Watershed Reef Interconnectivity Scientific Study
WWF	World Wide Fund for Nature

Executive Summary

The Caye Caulker Marine Reserve (CCMR) was declared under Statutory Instrument No. 35 of 1998, first gazetted on April 25, 1998, and amended by Statutory Instrument No. 115 of 2008. The marine reserve covers 3,913 hectares (9,670 acres) and is managed by the Fisheries Department. The reserve was designated to conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. Most of the area is in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

This management plan provides the strategic framework for site management over the five-year period from 2021-2026. The management plan is a guiding document, setting out the main directions for the Caye Caulker Marine Reserve management over the planning period while providing a framework for broader management activities. The plan was prepared with input from key stakeholders of the marine reserve through meetings with a planning committee comprising representatives of the Fisheries Department, Caye Caulker community members, individuals from the fisheries and tourism sectors, reserve management staff and researchers.

Six conservation targets, each representing or capturing the array of ecological systems, communities and species of the CCMR, were identified for the CCMR: Commercial species, coral reef system, charismatic species, shark and rays, seagrass communities, and mangroves. The threat which ranked as the highest priority of active threats to these conservation targets was determined to be *illegal fishing, land-based pollution, and Sargassum*. As such, general adaptation strategies were identified for integration into the CCMR management Programmes.

The overall management purpose of the CCMR is “the protection of the key coral reef, sea grass and mangrove ecosystems, within the multi-zoned marine reserve”, to be achieved through the following core goals:

1. Protect and manage functional samples of important ecological systems (including coral reef and seagrass) to ensure their protection and management.
2. Preserve the value of the area for its intrinsic value and for its socio-ecological and socio-economic potential (including fisheries and tourism), including export of adult marine life in addition to other important marine genetic resources and resource-based activities.
3. Develop sustainable and ecologically balanced recreational and tourism activities that enhance the economic and social benefits of the area.
4. Provide natural areas for the promotion of education and research.

The management goal of the CCMR is aligned with the vision for the Northern Belize Coastal Complex:

A model of functional, river to reef ecosystems supported by dynamic, co-ordinated, trans-boundary, multi-stakeholder partnerships, for the effective stewardship of the environment, all biodiversity, and the socio-economic benefits for present and future generations (Wildtracks, 2016).

The five Management Programmes for CCMR are: 1) Surveillance and Enforcement Programme, 2) Research and Monitoring Programme, 3) Community Engagement Programme, 4) Tourism and Recreation Management Programme, and 5) Administration and Infrastructure Programme.

Specific strategic objectives under these programmes include:

- Maintain effective surveillance and enforcement within and around CCMR in order to deter and prevent illegal activities within MPA boundaries;
- Maintain an active, well-equipped staff and stakeholder surveillance presence within CCMR in order to ensure that MPA rules and regulations are being followed;
- Strengthen the research and monitoring programme for the CCMR in order to support science-based decision-making for adaptive management of the marine reserve;
- Develop rapid and post assessment mechanisms in order to engage staff and stakeholders in assessing and monitoring impacts on the resources of CCMR;
- Maintain database of research and monitoring information in order to enhance the level of coordination between researchers (such as Frontier), help identify gaps in information, and provide a platform from which the results can be easily and effectively communicated to a wider audience;
- Create greater public awareness of the value of and benefits derived from the CCMR;
- Ensure greater participation in the management activities of the CCMR;
- Facilitate learning through experiential education for the youth;
- Develop a Visitor Management Plan to mitigate negative impacts and enhance visitor experience, and implement the actions of the plan so as to minimize and mitigate user visitor impacts on the resources of CCMR and enhance the visitor experience benefiting all stakeholders[1];
- Maintain infrastructure and equipment at acceptable standards in order to ensure visitor safety and visitor satisfaction while ensuring the proper monitoring of visitor use; and
- Develop and maintain the CCMR tourism product;

[1] This management plan assumes a recovery of the tourism industry after the Covid-19 pandemic.

- Manage and enhance the human resources of CCMR in order to optimize employee performance in service of the Fisheries Department's resources management objectives;
- Develop a resource mobilization strategy for CCMR and implement thereafter in order to diversify the reserve's funding base and ensure the continuity and sustainability of its management programmes;
- Strengthen the equipment procurement system for CCMR in order to ensure adequate administration infrastructure and planning; and
- Conduct annual review of management activities in order to ensure compliance with the management plan and make adjustments as necessary (adaptive management).

Each of the fifteen strategic objective includes a set of management actions associated with the respective management purpose and goal. The logic is that the management actions are implemented to achieve the strategic objectives which in turn accomplish the management goal of CCMR.

An implementation plan sets out the management actions ("what will be done?"), and includes rationale ("why is it being done?"), information on responsibility ("who will do it?"), and timeline ("by when?"). The timeline lists the activities by quarters for the next five years. The implementation plan and timeline, taken together, serve as a monitoring tool to assist CCMR managers to keep on track with implementation of the management plan and to make adjustments, as may be necessary, in case target dates are not met.

On-site CCMR management is under the Reserve Manager, who is supported by two rangers, a marine biologist and a caretaker. These personnel are responsible for the on-site, day-to-day management of the reserve, and will be responsible for the implementation of the management plan through effective use of funds, staff and equipment, and supported by centralized activities such as community engagement and research.

1. Introduction

1.1. Background and Context

The Caye Caulker Marine Reserve (CCMR) was established in 1998 as a marine reserve (S.I. No. 35 of 1998) to conserve a portion of Belize's important Barrier Reef system and associated marine environment threatened by increased visitation, boat traffic, coral destruction and diseases, habitat degradation, unsustainable fishing practices, illegal and over fishing, invasive species, land-based pollution, and climate change[2]. The marine reserve covers 3,913 hectares (9,670 acres) and is managed by the Fisheries Department.

The management regime is based on protection and conservation of particular species or habitats, and management reflects this priority therefore corresponding to an IUCN Category VI Protected Area with Sustainable Use of Natural Resources[3]. As such, CCMR management should include regular, active interventions to address the requirements of particular species or to maintain habitats. The area is also an important component of the Belize Barrier Reef Reserve System and forms part of the greater Mesoamerican Barrier Reef System that extends from the northern tip of Mexico's Yucatan Peninsula to the south of Belize.

1.2. Purpose and Scope of Plan

The primary purpose of the management plan is to set out the strategic framework for site management over the five-year period from 2021-2026. The previous plans included an integrated management plan completed by the Fisheries Department in 1996 for the then proposed protected area, an updated version initiated by a Peace Corps Volunteer in 2002, and a five-year integrated management plan for Caye Caulker Marine and Forest Reserves in 2004. The management plan framework used for this planning cycle follows the Guidelines for Developing a Management Plan – Level Two (for conservation and non-governmental organizations) prepared by Wildtracks in 2005 for the National Protected Areas Policy and System Plan. Table 1 compares the new management plan with the previous management plan (2004) being updated.

[2] See Section 2.2.
[3] Source: IUCN

Table 1: Comparisons between Management Plans

Description	Caye Caulker Marine Reserve Management Plan (2021 – 2026)	Caye Caulker Forest and Marine Reserve Integrated Management Plan (2004 – 2009)
Life Cycle	5 years	5 years
Main Objective(s)	1. Protect and manage functional samples of important ecological systems (including coral reef and seagrass) to ensure their protection and management.	1. Preserve and maintain in optimal working condition, representative samples of the ecological systems (including coral reef, littoral forest, caye mangroves, and seagrass) in its natural state on and around Caye Caulker for all people, for all time.
	2. Preserve the value of the area for its intrinsic value and for its socio-ecological and socio-economic potential (including fisheries and tourism).	2. Preserve the value of the area for fisheries and tourism, including export of larval and adult marine and terrestrial life in addition to other important marine and terrestrial genetic resources and resource-based activities.
	3. Develop sustainable and ecologically balanced recreational and tourism activities that enhance the economic and social benefits of the area.	3. Develop sustainable and ecologically balanced recreational and tourism services that enhance the economic and social benefits of the area.
	4. Provide natural areas for the promotion of education and research.	4. Provide natural areas for the promotion of education and research.
Management Activities	Broad	Broad
Management by Zone	Yes	Yes
Climate change adaptation strategies	Yes	No
Cultural and Socio-economic values	• Community and Stakeholder Use • Archaeological Sites – unexplored and unmapped underwater cave system	• Tourism • Commercial Fishing • Education

	• Recreation and Tourism Use • Education Use	
Finance/ Budget Allocation	Government allocations with self-generated income prioritized, supplemented by donor/charitable support.	Self-generated income prioritized, supplemented by donor/charitable support.

The management plan is a guiding document, setting out the main directions for the Caye Caulker Marine Reserve management over the planning period while providing a framework for broader management activities as well as more specific management activities such as research and monitoring. Since the development of the last management plan, many changes have taken place, including the adoption of the Guidelines for Developing a Management Plan for the marine protected areas system of Belize, zoning regulations, and the incorporation of climate change adaptation strategies into management actions.

The management plan thus includes the protected area's current status such as location, regional and national context; general information on the physical and biological environment of the management area; the cultural and socio-economic values of the management area, including community and stakeholder use; an analysis of conservation targets and threats, including threats from climate change; management planning and strategies such as zones and limits of acceptable change; an outline of the management programmes and objectives; management actions; and how the marine reserve will be financed over the management period. The five management programmes, in particular, although listed separately, support each other and are designed to strengthen the overall management of the protected area.

The management plan was prepared with input from the key stakeholders of the marine reserve through meetings with a planning committee comprising representatives of the Fisheries Department, Caye Caulker community members, individuals from the fisheries and tourism sectors, reserve management staff and researchers. Monitoring and review of management plan implementation will involve managerial efficiency in implementing planned activities, overall effectiveness of the management regime, and success of the conservation strategies.

2. Current Status

2.1. Location

Caye Caulker Marine Reserve, encompassing fore reef, back reef, patch reef, seagrass beds and sand flats is an important marine protected area within the Belize Barrier Reef System. The marine reserve lies at the southern end of the Northern Belize Coastal Complex (Figure 2). CCMR encompasses approximately 3,913 hectares (9,670 acres) and is 11.1 kilometres (6.90 miles) in length, forming the shape of number seven. The top portion of the reserve crosses the northern tip of the island of Caye Caulker, specifically the Caye Caulker Forest Reserve, and extends into lagoon waters on the west of the island (Figure 3). Caye Caulker itself is located in the Northern Shelf Lagoon off the coast of Belize's mainland, and approximately 33.8 km (21 mi) north-northeast of Belize City. The island also lies roughly parallel to the Belize Barrier Reef and the windward shore is roughly one mile west of the reef crest. The northern tip of Caye Caulker is roughly five miles south of the southern tip of Ambergris Caye while its southern point is situated about two miles from the northernmost point of the island of Caye Chapel.

Access to the reserve is currently by sea, with boats originating mainly from Caye Caulker, Belize City, San Pedro and Sarteneja. The village of Caye Caulker, with a resident population of approximately 2,600[4] and the primary stakeholder community of the marine reserve, is located on the southern portion of the island. There is also a small but growing population of property owners and developers on the northern portion of the island (north of the "Split"). Other stakeholder communities that impact the reserve through either fishing or tourism activities include Belize City, San Pedro, Sarteneja, Chunox and Copper Bank. The headquarters and staff quarters for the marine reserve staff is located within the Forest Reserve on the west side of the northern tip of the island. The reserve shares an office with the Hol Chan Marine Reserve's sub-office in Caye Caulker Village near the water taxi terminals.

2.2. Regional Context

The Caye Caulker Marine Reserve encompasses fore reef, back reef, patch reef, seagrass beds and sand flats and is an important marine protected area within the Belize Barrier Reef Reserve System that forms part of the greater Mesoamerican Barrier Reef System. The Mesoamerican Barrier Reef System is the largest reef system in the Americas and second largest contiguous barrier reef in the world, only after the Great Barrier Reef in Australia. It runs for nearly 1,000 km (700 miles) from the northern tip of Mexico's Yucatan Peninsula to the south of Belize (UNESCO, 2019). This system contains seagrass beds, lagoons, coastal wetlands and mangrove forests that provide food and vital habitat for myriads of corals and fish species, including many species of outstanding universal value and conservation concern such as the Antillean (Caribbean) Manatee (*Trichechus manatus*) which is a sub-species of the West-Indian Manatee, Nassau Grouper (*Epinephalus striatus*), the Goliath Grouper (*Epinephelus itajara*), Hawksbill Sea Turtle (*Eretmochelys imbricata*), Green Sea Turtle (*Chelonia mydas*) and Loggerhead Sea Turtle (*Caretta caretta*).

[4] According to the 2010 census, which is conducted in Belize every 10 years, the population is 1,800. Due to the COVID-19 pandemic, the census scheduled for 2020 was postponed. According to the Caye Caulker Village Council Chairperson, the village population without tourists and tourism-related workers is currently 2,600.

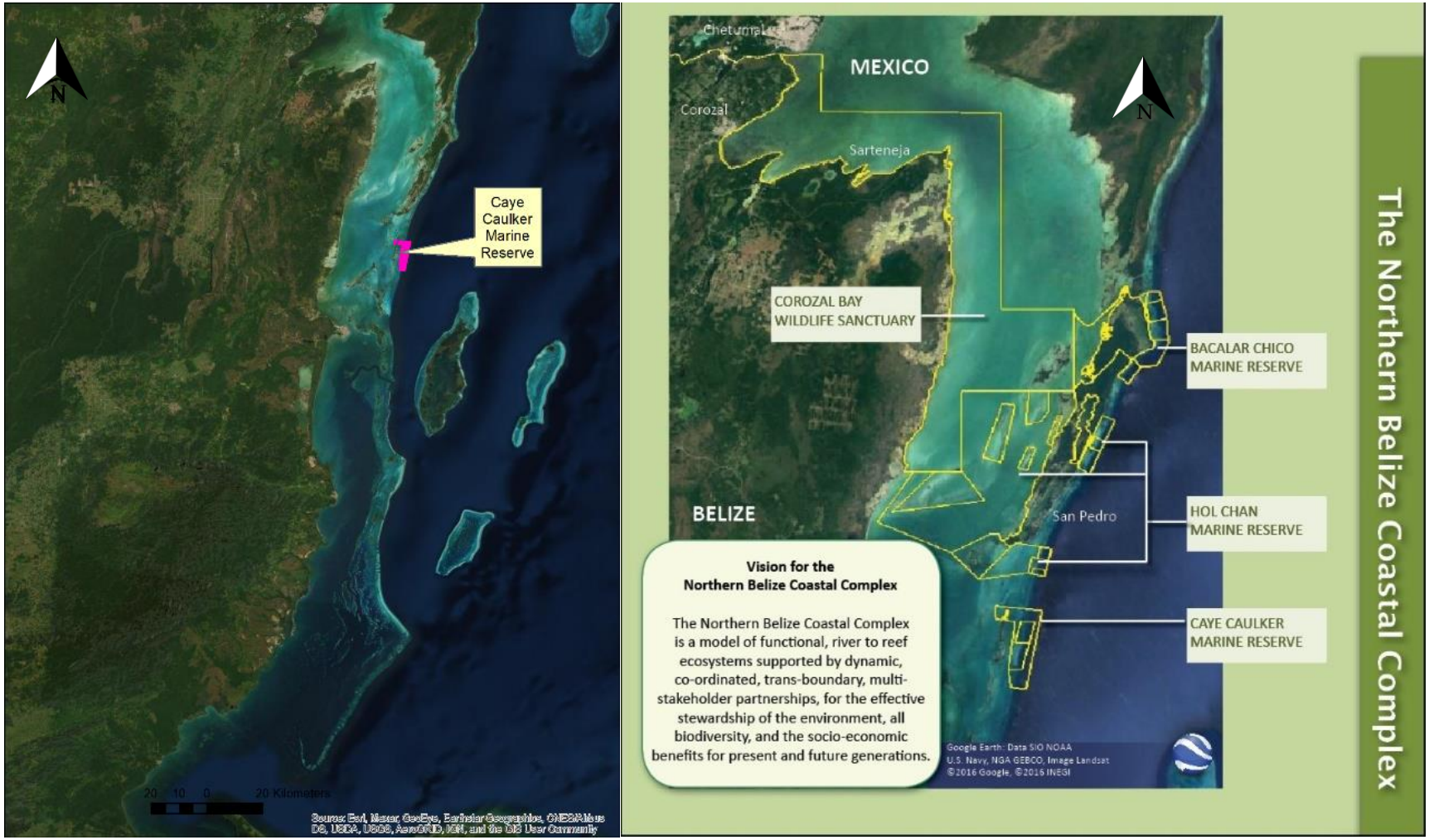


Figure 2: Northern Belize Coastal Complex and Location of CCMR[5]

[5] Source: Marine Protected Areas Atlas of Belize

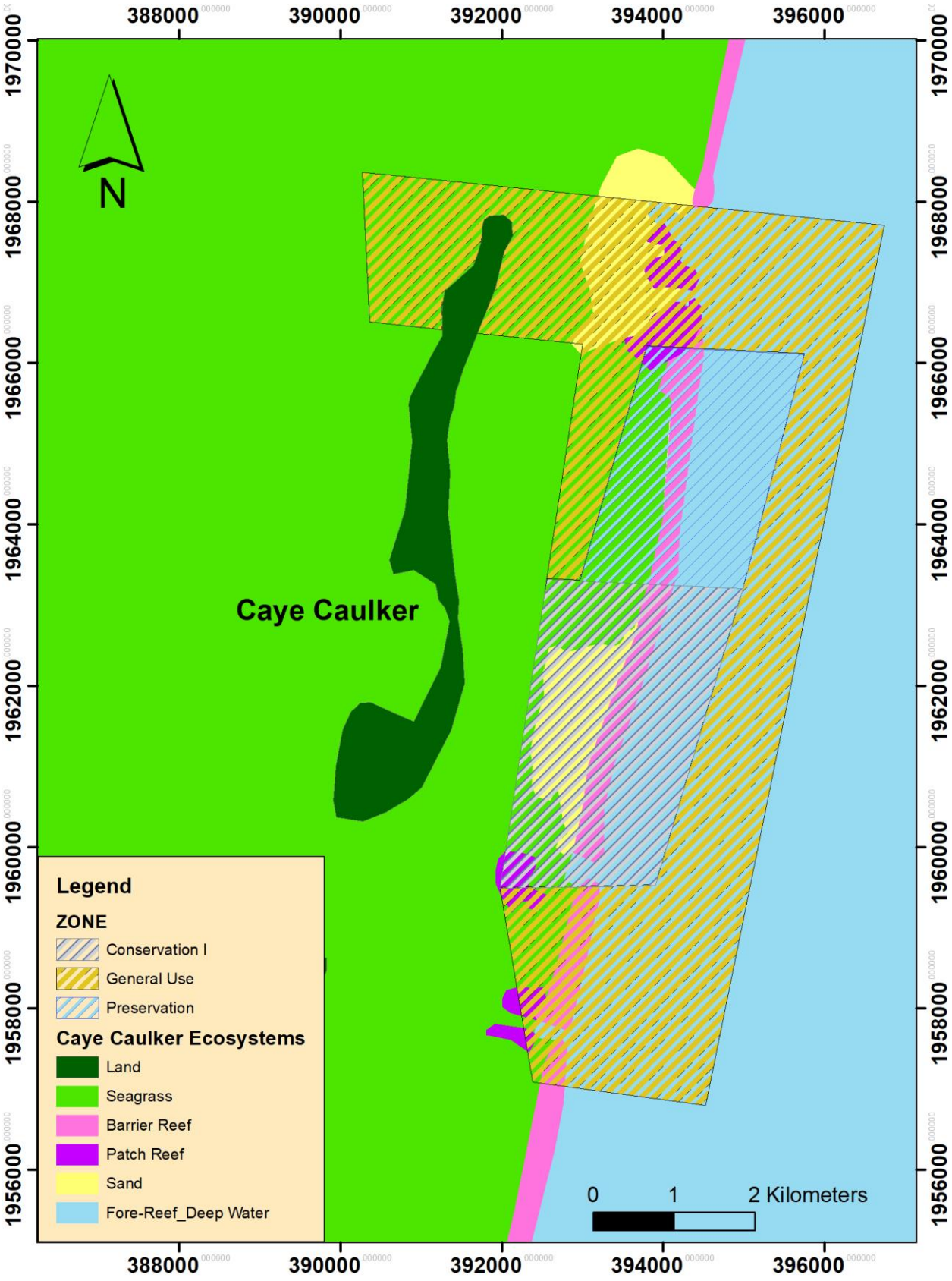


Figure 3: Caye Caulker Marine Reserve Boundaries

The Mesoamerican Barrier Reef System also helps to protect Belize's coastline from storms and hurricanes, and is depended upon by Belizeans for their traditional ways of life, livelihoods and food security. However, nutrient enrichment from untreated grey/black water disposal, illegal fishing, coastal development and climate change all threaten this important reef system (Wildtracks, 2016)

The Caye Caulker Marine Reserve is therefore a very important area for protection of the Mesoamerican Barrier Reef System, and is also a move towards fulfilling Belize's international commitments to conserve biological diversity 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 2).

Caye Caulker Marine Reserve was recommended for nomination to the Belize Barrier Reef World Heritage Site due to it containing areas of beauty and aesthetic importance, having representative examples of significant on-going ecological and biological processes, and containing important and significant natural habitats for in-situ conservation of biological diversity. The Belize Barrier Reef Reserve System, inscribed as a UNESCO World Heritage Site in 1996, is currently comprised of seven protected areas (Table 3).

Table 2: International Conventions and Agreements of Relevance to CCMR[6]

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.
Alliance for the Sustainable Development of Central America (1994)	Regional alliance supporting sustainable development initiatives.
Central American Commission for Environment and Development (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.
International Convention for the Protection and Conservation of Sea Turtles for the Western Hemisphere (December 21st, 1997)	To protect and conserve sea turtle species of the Western Hemisphere.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	CITES has been established to ensure that the international trade in specimens of wild animals and plants does not threaten their survival.
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. Includes the following protocols:

[6] Adapted from Wildtracks/WCS 2019 Glover's Reef Marine Reserve 2019-2023 Management Plan.

	• Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region (adopted in 1983 and entered into force on 11 October 1986. Ratified by Belize in 1999). • Protocol Concerning Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean Region (adopted on 18 January 1990 and entered into force on 18 June 2000. Ratified by Belize in 2008). • Protocol Concerning Pollution from Land-Based Sources and Activities (LBS) (adopted on 6 October 1999 and entered into force on 13 August 2010. Ratified by Belize in 2008).
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.
The UN Convention on the Law of the Sea (1982)	Establishes a comprehensive framework for issues related to the sea and directly interacts with the Convention on Biodiversity in relation to the Marine Environment.

Table 3: The Seven UNESCO World Heritage Sites in Belize[7]

SITE	IUCN CATEGORY
Bacalar Chico National Park and Marine Reserve	II (National Park) and VI (Protected area with sustainable use of natural resources)
Laughing Bird Caye National Park	II (National Park)
Half Moon Caye Natural Monument	II (Natural Monument or Feature)
Blue Hole Natural Monument	III (Natural Monument or Feature)
Glover's Reef Marine Reserve	VI (Protected area with sustainable use of natural resources)
South Water Caye Marine Reserve	VI (Protected area with sustainable use of natural resources)
Sapodilla Cayes Marine Reserve	VI (Protected area with sustainable use of natural resources)

[7] Source: Adapted from UNESCO and Wildtracks/WCS 2007 Glover's Reef Marine Reserve 2008-2013 Management Plan.

2.3. National Context

2.3.1. Legal and Policy Framework

The Caye Caulker Marine Reserve was declared under Statutory Instrument No. 35 of 1998, first gazetted on April 25, 1998, and amended by Statutory Instrument No. 115 of 2008 (Appendix 3). The Fisheries Resources Act (No. 7 of 2020) strengthens the process of declaration and management of Marine Reserves and extends to creation of Fisheries Priority Areas and inland water reserves. This new Act also widens the justification for creation or removal of a reserve, if necessary. Other important provisions of the Fisheries Resources Act is that it requires a management plan to be developed for any fishery, as well as an increase in fines for infractions specific to Marine Reserves.

Several other laws exist in Belize that are relevant to protection of the marine reserve and sustainable use of its natural resources:

- Belize Tourism Board (Tour Guide) Regulations, part of the Belize Tourism Board Act Revised Edition 2011, addresses academic qualifications and the duty and functions of licensed tour guides. These Regulations support the Fisheries Resources Act, and in addition, compel tour guides to take all necessary steps to safeguard the environmental integrity of Belize.
- The Wildlife Protection Act (Revised Edition, 2011) prohibits hunting or molestation of the American Crocodile (*Crocodylus acutus*), Antillean (Caribbean) Manatee (*Trichechus manatus manatus*), Common Bottlenose Dolphin (*Tursiops truncatus*) and other organisms found within the marine reserve.
- Forests (Protection of Mangroves) Regulations of 2018 require a permit to cut mangroves.[8]
- Mines and Minerals Act (Revised Edition 2011) requires that protection of the natural resources be considered before mining operations are carried out.
- Petroleum Act (Revised Edition 2011) requires that environment and pollution control be put in place before petroleum operations are carried out.
- Coastal Zone Management Act (Revised Edition 2011) which establishes the Coastal Zone Management Authority and Institute to promote the utilization and conservation of Belize's marine resources, and to monitor the implementation of a Coastal Zone Management Plan that includes guidelines for development activities in the coastal zone, and monitoring of biological species, communities and habitats.
- The Environmental Protection Act (Revised Edition, 2011) and the Environmental Impact Assessment Regulations of 2000 (amended in 2007) call for constraints in emissions, effluents and waste materials introduced into the marine waters. The Environmental Impact

[8] These regulations replaced the regulations in force at the time of signing and came into effect on June 23, 2018 (GOB Press Office).

Assessment Regulations require assessment of any project, programme or activity which may significantly affect the environment.

The Belize Barrier Reef Reserve System (BBRRS), comprising seven interconnected marine protected areas (highlighted in tan color in Table 4) situated along the length of the barrier reef, was declared a UNESCO World Heritage Site in 1996. The BBRRS is the largest reef complex in the Atlantic-Caribbean region, representing the second largest reef system in the world, and its seven marine protected areas comprise 12% of the entire Reef Complex (UNESCO, 2020).

Table 4: Marine Protected Areas in Belize[9]

Protected Area	Management/Co-Management	IUCN Category	SI	Area (Acres)
Bacalar Chico Marine Reserve	Fisheries Department	VI	88 of 1996	15,529
Blue Hole Natural Monument	Forest Department/BAS	III	96 of 1996	1,023
Caye Caulker Marine Reserve	Fisheries Department	VI	35 of 1998	9,670.2
Corozal Bay Wildlife Sanctuary	Forest Department/SACD	IV	48 of 1998	180,508.5
Gladden Spit and Silk Cayes Marine Reserve	Fisheries Department/SEA	VI	95 of 2003	25,978.3
Glover's Reef Marine Reserve	Fisheries Department	VI	70 of 1996	86,653
Half Moon Caye Natural Monument	Forest Department/ BAS	III	30 of 1982	9,771
Hol Chan Marine Reserve	Fisheries Department	VI	57 of 1987	3,813
Laughing Bird Caye National Park	Forest Department/SEA	II	94 of 1996	10,119
Port Honduras Marine Reserve	Fisheries Department/TIDE	VI	9 of 2000	100,000
Sapodilla Cayes Marine Reserve	Fisheries Department	VI	107 of 2020	321,623.5
South Water Caye Marine Reserve	Fisheries Department	VI	118 of 1996	117,875
Swallow Caye Wildlife Sanctuary	Forest Department/FOSC	IV	102 of 2002	8,972
Turneffe Atoll Marine Reserve	Fisheries Department/TASA	VI	2012	325,412
Total				**1,216,947.5**

As an IUCN Category VI protected area, the Caye Caulker Marine Reserve is regulated through several zones that allow for preservation, conservation and general use (Figure 4). The Conservation Zone is for non-extractive recreational use, primarily snorkeling and diving, with no

[9] Marine Protected Areas of the BBRRS highlighted (Modified from Glover's Reef Marine Reserve 2008-2013 Management Plan). Note that these areas may change with the expansion of replenishment zones.

commercial or sport fishing allowed. The Preservation Zone does not allow any activities (fishing or recreational), nor does it allow entrance to motor boats, except in emergencies. However, the General Use Zone permits fishing by traditional users under a licensing system. Catch and release sport fishing is also permitted. Tables 5 to 7 list the coordinates for each of these zones.

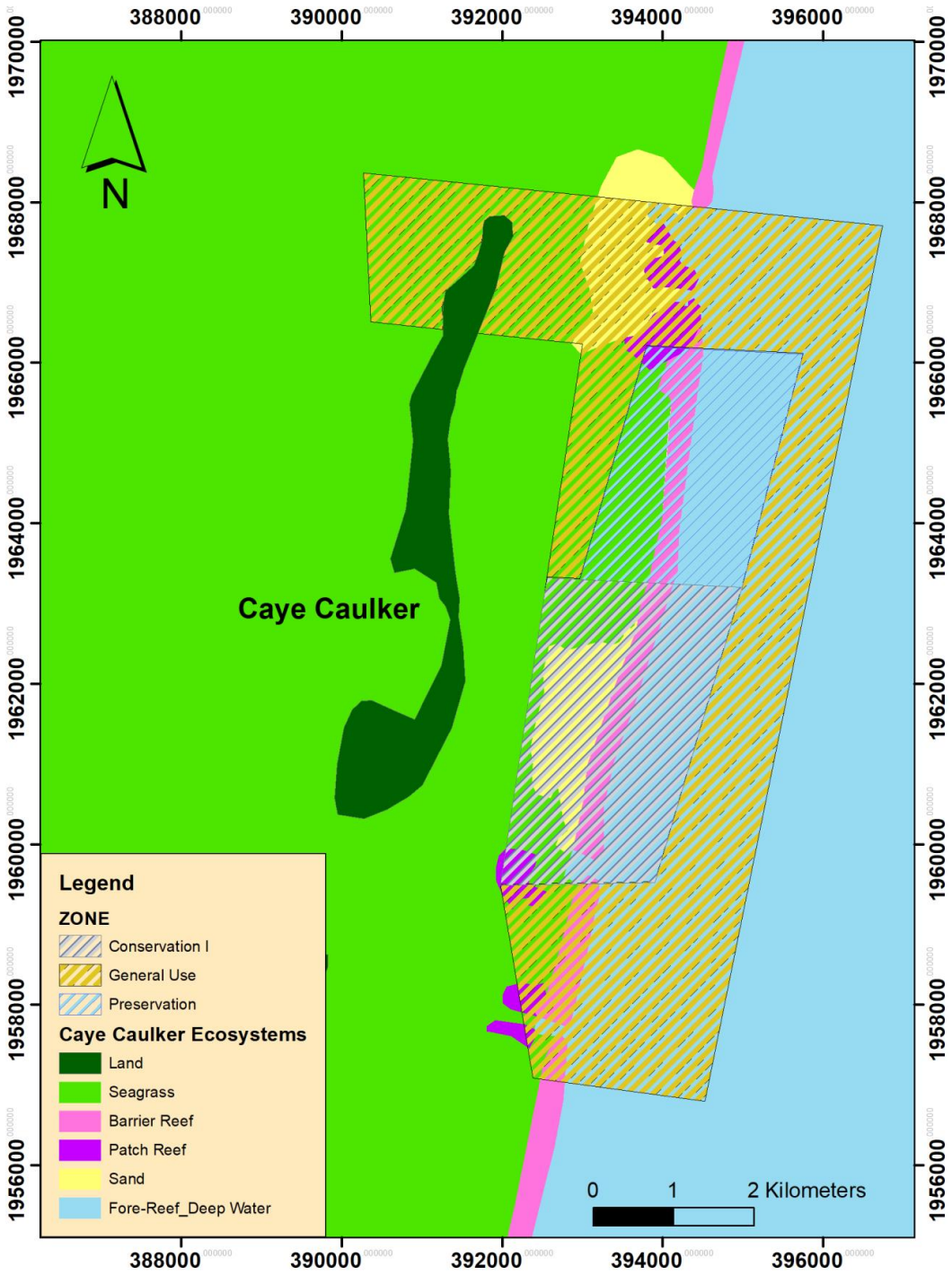


Figure 4: Caye Caulker Marine Reserve Management Zones

Table 5: CCMR General Use Zone Coordinates[10]

Eastings	Northings	Label
390144	1969769	CCMR01
396899	1968763	CCMR02
394458	1956570	CCMR03
392320	1956864	CCMR04
391913	1959275	CCMR05
392935	1966001	CCMR06
391550	1966147	CCMR07
391192	1966183	CCMR08
390299	1966280	CCMR09

Table 6: CCMR Conservation Zone Coordinates[11]

Eastings	Northings	Label
392495	1963105	CCMRCZ01
394924	1962986	CCMRCZ02
393835	1959304	CCMRCZ03
391912	1959274	CCMRCZ04

Table 7: CCMR Preservation Zone Coordinates[12]

Eastings	Northings	Label
394076	1966059	CCMRPZ01
395681	1965890	CCMRPZ02
394924	1962986	CCMRPZ03
392904	1963085	CCMRPZ04
393405	1964964	CCMRPZ05
393946	1964883	CCMRPZ06

2.3.2. Land Tenure

Within the Marine Reserve, the seabed or land extending seaward from the high-water mark is National Land owned by the Government of Belize under the authority of the National Lands Act (Revised Edition, 2011). Under the National Lands Rules, a 66-feet wide reserve measured from high water mark along all water frontages is kept for Government or public purposes.

[10] Datum: NAD1927 Zone16N
[11] Datum: NAD1927 Zone16N
[12] Datum: NAD1927 Zone16N

2.3.3. Evaluation of Protected Area

Local and National Importance

Caye Caulker Marine Reserve is economically important both locally and nationally as a source for tourism activities, as well as a source of Caribbean Spiny Lobster (*Panulirus argus*), Queen Conch (*Strombus gigas*), Stone Crab (*Menippe mercenaria*), and finfish for the local Caye Caulker fisherfolk and other fisherfolk from communities such as Belize City, San Pedro and north-eastern Belize (Sarteneja, Copper Bank an Chunox). CCMR lies within Fishing Area 1, a Managed Access Area administered as part of Belize's Managed Access Strategy.[13]

Tourism activities and the use of fisheries resources in the marine reserve are regulated through zonation, with the General Use Zone permitting fishing by traditional users through a special license system. Catch and release sport fishing is also permitted in this zone and catch and release tours can only remove fish for subsistence uses. The Conservation Zone allows for some non-extractive recreational activities and the Preservation Zone prohibits fishing or other water activities. Tourism activities in the marine reserve include SCUBA, snorkelling, sport fishing, water sports and other activities and services. Many tour guides and fishermen also engage in recreational and finfish fishery.

International Importance

Caye Caulker Marine Reserve is an important marine protected area within the Belize Barrier Reef Reserve System that forms part of the greater Mesoamerican Barrier Reef System. The reserve itself contains important seagrasses and coral reefs that provide food and vital habitat for numerous corals and fish species, including many species of international conservation concern such as the Antillean (Caribbean) Manatee (*Trichechus manatus manatus*), Nassau Grouper (*Epinephelus striatus*), Goliath Grouper (*Epinephelus itajara*), Queen Conch (*Strombus gigas*), Staghorn (*Acropora cervicornis*) and Elkhorn (*Acropora palmata*) corals, and the Hawksbill (*Eretmochelys imbricata*), Green (*Chelonia mydas*) and Loggerhead (*Caretta caretta*) Sea Turtles.

The reef at the north point of the marine reserve is a favourite area for the Antillean (Caribbean) Manatee. Although Belize is thought to have the highest concentration of this subspecies in the world, the population for the country is still considered low and declining. The Antillean (Caribbean) Manatee is listed as endangered, threatened primarily by being hit and injured by boats. The Nassau Grouper is a critically endangered species, and all the spawning aggregation sites in Belize have experienced declines in fish abundance over the past two decades. The main threats to this species include over-fishing and loss of quality coral reef habitat. Like the Nassau Grouper, the Goliath Grouper is also considered critically endangered, threatened globally by mainly overfishing and habitat destruction. The Queen Conch is threatened by illegal harvesting. Both the Staghorn and Elkhorn corals are considered threatened through their range, threatened by diseases, land-based sources of pollution, and climate change. All three sea turtle species are

[13] The Managed Access Strategy is based on the current patterns of fishing, reflecting customary resource use patterns, and establishes user rights for Belizean fisherfolk. Managed Access aims to strengthen management through a national system of secure tenure for fishermen to fish in designated fishing areas. (Source: Marine Protected Areas Atlas of Belize)

considered endangered, threatened by poaching and over-exploitation, habitat destruction, accidental capture in fishing gear and climate change (WWF, 2020).

Caye Caulker Marine Reserve was recommended for nomination to the Belize Barrier Reef World Heritage Site of Belize due to it containing areas of beauty and aesthetic importance, having representative examples of significant on-going ecological and biological processes, and containing important and significant natural habitats for in-situ conservation of biological diversity.

Environmental Services of CCMR

Apart from the specific values of the protected area, the coral reef and seagrass ecosystems present in the marine reserve also provide various ecosystem services (Table 8).

Table 8: Ecosystem Services of Caye Caulker Marine Reserve

Ecosystem Services	Seagrasses	Coral Reefs
Regulation	Improve water quality by decreasing the strength of water movement, and trapping and settling suspended particles Reduce erosion of Caye Caulker's coastline	Protect Caye Caulker and Belize's coastline and the barrier reef by dissipating energy from storm surges and waves Reduces beach erosion on Caye Caulker and Belize's coastline Supplies coral sand which is a major component in the formation of beaches and cayes
Recruitment	Support reef fish productivity and biodiversity of coral reef ecosystems.	Ensure viable populations of food species for subsistence and commercial fishing
Support	Provide nursery habitat for many commercial and non-commercial species in their different life stages	Cycle essential nutrients provided by the various fish species Provide nursery habitat for many commercial and non-commercial species in their different life stages Contain immense biodiversity and rival tropical rainforests as the most diverse and productive ecosystem on Earth

2.3.4. Socio-Economic Context

Belize has a rich diversity of peoples, languages and cultures and has the distinction of being the only English-speaking country in Central America. The total land area is almost 22,860 km^2 (8,867 mi^2) with the population estimated to be around 419,199 inhabitants (Table 9). Belize is also

home to approximately 80% of the Mesoamerican Barrier Reef System, the second largest contiguous barrier reef in the world, with more than 100 small cayes located offshore.

Table 9: National Profile[14]

Population and Social Indicators	
Land Area (sq. km.)	22,860
Population, July 2020	419,199
GDP per capita, (current US$), 2018	5,025
Life expectancy at birth (years), 2017	70.6
Human development index (rank), 2017	106
Under-five mortality rate (per thousand), 2017	14
Unemployment rate (percent), September 2020	13.7
Poverty (percent of total population), 2009	42
Consumer prices (average) (Annual percentage changes)	1.1

Belize's small open economy is supported primarily by natural resources with major sectors being agriculture (citrus, sugar, bananas, fisheries), light manufacturing and tourism (tertiary/services sector). The petroleum sector enjoyed a robust but short growth between 2006 and 2011, since oil was discovered in commercial quantities in 2005. Since the start of petroleum extraction in 2006 the value of exports rose from $77.0 million to $203.2 million in 2008. Oil production however has now declined. 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 major sectors of the Belizean economy and the principal source of foreign exchange. Since the early days of tourism in the mid-1970, Belize has enjoyed exponential growth in the industry in both the overnight and cruise tourism arrivals. At least half a million overnight and over one million cruise visitors came to Belize in 2019. It is estimated that more than 25% of the employed labour force is related to or driven by this sector. Cruise tourism has also become an important feature of the overall industry. 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 (Figure 5).

[14] Sources: UNDP Human Development Report; World Development Indicators, World Bank; 2009 Poverty Country Assessment; and International Monetary Fund (2020).

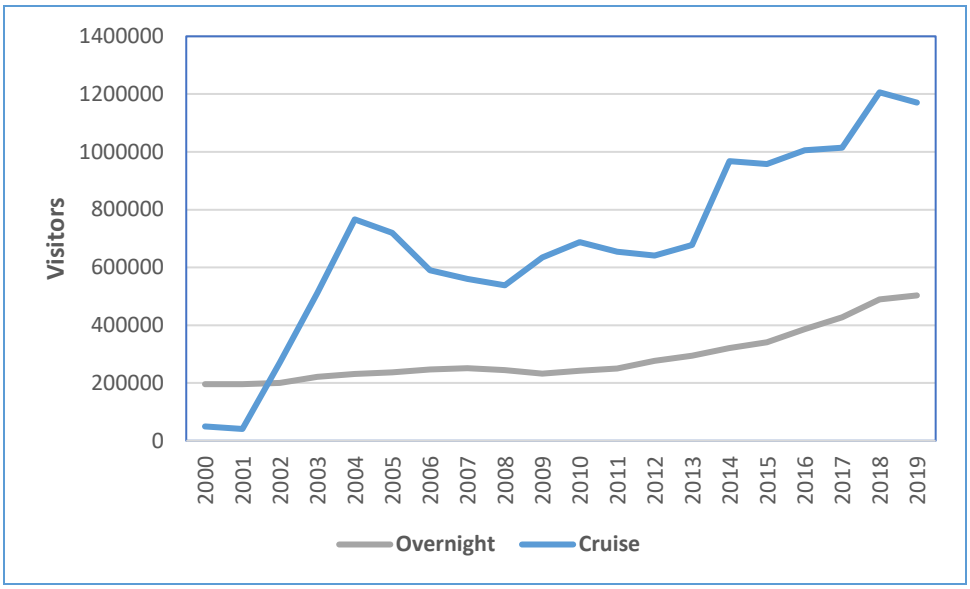


Figure 5: National Tourism Growth from 2000 - 2019[15]

The Ministry of Tourism and Diaspora Relations is pursuing the strategies to promote national tourism development and is looking to promote the development of responsible tourism in Caye Caulker. The Ministry sees these protected areas as natural assets for the development of nature and adventure tourism. To achieve this there is focus on improve tourism infrastructure and services on the island. Promoting sound management of the Caye Caulker Marine Reserve is part of the overall Sustainable Tourism Project II initiative.

The village of Caye Caulker lies mainly in the southern portion of the island of Caye Caulker and is the closest established community to the Caye Caulker Marine Reserve. A number of other communities that are recognized as stakeholders in the marine reserve include Belize City, San Pedro, as well as the norther communities of Sarteneja, Copper Bank and Chunox. Caye Caulker Village itself is a mixture of ethnicities, including Mestizo, Creole, Garinagu, Maya Yucatec, Maya Mopan, Q'eqchi Maya, Chinese, Salvadoran, Guatemalan, Honduran, North American and European.

Over the years Caye Caulker has been transitioning from a traditional fishing village to a tourism-and-fishing destination, attracting many of these ethnic groups to the promise of new economic opportunities. While the commercial fishing for lobster, conch, stone crab, and finfish remain an integral part of village life, tourism is now a leading direct and indirect income earner on the island. Today, most, if not all, commercial activities and services are in some way connected to the tourism sector. Guests are offered SCUBA, snorkelling, sport fishing, nature tours, water sports and other activities and services. Some local Caye Caulker fishermen, as well as fishers from Sarteneja, sometime engage in free-diving on the fore reef and back reef for mixed species, including lobster, conch, octopus, crab and finfish. Tour guides and fishermen also engage in recreational and finfish fishery.

[15] Source: Central Bank of Belize, BTB

Tourism in Caye Caulker started in the mid-60s with visitors coming over for the weekend. There has been a steady increase in the number of overnight visitors to the island of Caye Caulker ever since. A major boom in overnight visitors is seen starting from 2007 and has steadily grown to about 150,000 visitors today (Figure 6). In addition to this, there has also been a steady increase in the number of cruise ship visitors to the island as well.

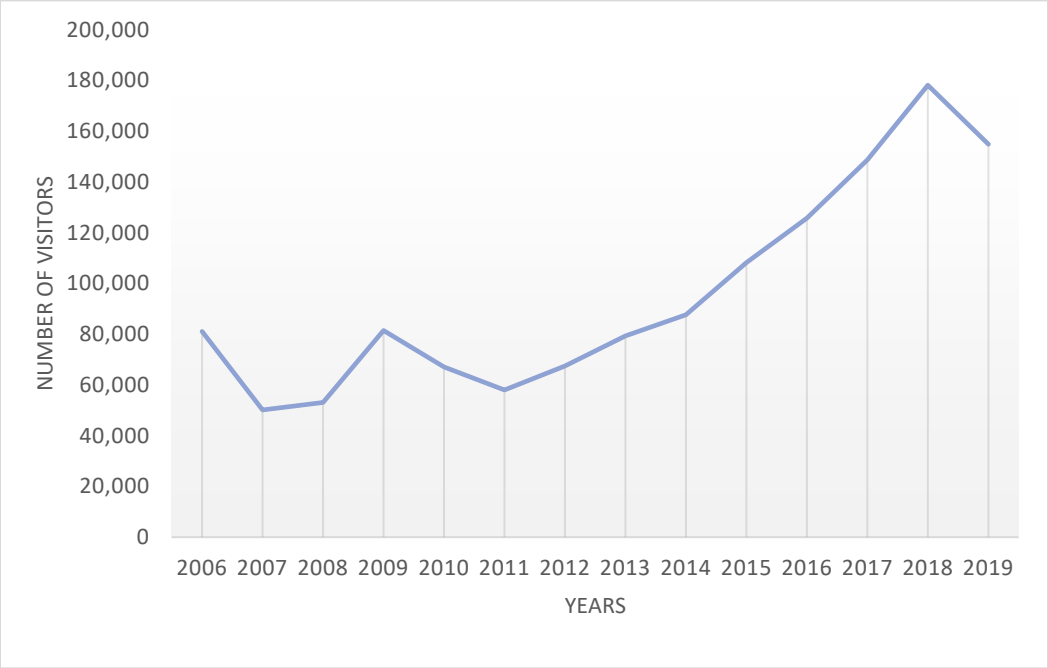


Figure 6: Total Visitors to Caye Caulker[16]

There has been a steady increase of visitation to the marine reserve by foreign and local visitors alike. About 37,526 persons visited the marine reserve in 2018 alone (Figure 7). Meanwhile, about quarter of the visitors to the reserve now are cruise ship visitors. There has been approximately a 184% in increase in visitation by cruise ship visitors between 2014 and 2018.

[16] BTB, 2019

Figure 7: Total Visitors to CCMR

2.3.5. CCMR Stakeholders

There are several stakeholders who have an interest in the CCMR (Table 10). This is based on the ecological services and benefits they obtain or their role in protecting and managing the resources of the reserve. There is a very strong inter-relationship between the stakeholders and the reserve given its biological, social and economic value to the tourism industry. The key stakeholders of the reserve have been identified and classified according to organizational interests and characteristics.

- **Government of Belize**

There are a number of government ministries and agencies that have a direct interest in the CCMR and this makes the Government of Belize a significant stakeholder of the protected area. The Fisheries Department is responsible for the management of the marine reserve while the Forest Department is responsible for the forest reserve that abuts the marine reserve. The CCMR base is located at the northern point of the forest reserve. Other important government ministries and agencies with an interest in the CCMR include the Department of the Environment (DOE), the Ministry of Tourism and Diaspora Relations (MTDR) and the Belize Tourism Board (BTB), the Police Department, the Belize Coast Guard, the Mining Unit, and the Coastal Zone Management Authority and Institute.

The DOE is responsible for ensuring that all development in the vicinity of the reserve are done according to environmental laws and regulations. Development can have direct and indirect impacts on the CCMR considering its proximity to the island of Caye Caulker. The Mining Unit is mandated to issue permits and no mining should occur without this permit. The DOE enforces environmental requirements. The MTDR and the BTB also have a strong interest in maintaining the natural features of the CCMR as part of the tourism product of the Caye Caulker destination. The reserve therefore has significant value for the tourism industry and the MTDR is currently investing in the enhancement of the management capacity of the reserve. The Police Department

and the Belize Coast Guard provide law enforcement support to the Fisheries Department within the reserve. The CZMAI is responsible for the sustainable use and planned development of Belize's coastal resources. This includes all islands and marine reserves.

- **Tourism and Business Interests**

The CCMR is part of the tourism product of Caye Caulker. The major private sector stakeholders in the CCMR are the tourism operators. This includes hotels, resorts, tour operators, tour guides, utilities and restaurants. There are also secondary stakeholders who are part of the island tourism value chain including land and water taxis, air services, laundromats, grocery stores, fruit and vegetable retailers among many others. There is a thriving tourism industry on Caye Caulker and the CCMR is both a service and a beneficiary of the visitation.

Tour operators and tour guides are the primary beneficiaries who most directly engage with visitors. Tour operators and tour guides take visitors on tour to the reserve daily. The main site they take their guests to visit is the Shark/Ray Alley[17]. There are other areas of the reserve that are used for tourism purposes for snorkelling, diving and fly fishing.

- **Commercial Fishers**

While fishers in Caye Caulker have been reducing in numbers, those who continue to practice fishing harvest important commercial species namely conch and lobster during their respective open season. The fishers make use of the general use zone of the reserve and harvest fisheries products every year. The Northern Fishermen's Cooperative maintains a receiving station on Caye Caulker. Although much of the product harvested comes from the marine reserve, several products come from outside the reserve, including products fished within the Turneffe Atoll Marine Reserve.

- **Educational Institutions**

There are several educational institutions, both local and international, which access the CCMR for educational, and scientific research purposes. These include local primary schools and foreign universities.

- **Local Communities**

The main communities that are direct beneficiaries of the goods and services of the CCMR are Caye Caulker and San Pedro, Ambergris Caye. The residents of Caye Caulker and to a lesser extent, San Pedro, benefit economically, and socially from the marine reserve. The history of the reserves shows that it was established mainly because of the interest and clamour of the residents of Caye Caulker who wanted to protect an invaluable community resource.

[17] CCMR's Shark/Ray Alley is not to be confused with the one at the Hol Chan Reserve.

Table 10: Stakeholder Analysis for Caye Caulker Marine Reserve

Stakeholder	Influence or Impact of Reserve on Stakeholder		Influence or Impact of Stakeholder on Reserve	
Community Stakeholder Caye Caulker & San Pedro	Management of reef for tourism and as a fisheries source area	+	Active cooperation and collaboration of tourism and fisheries stakeholders towards effective protected areas management	+
	Providing residents with economic opportunities in tourism, with increased economic benefits	+	Reduced impact of reef tourism activities and fisheries through compliance with management regulations and awareness	+
	Reserve as resource for education and awareness for schools and residents	+	Illegal fishing within the marine reserve	-
	Protection of reef resources and commercial fish species in perpetuity for future generations	+	Anchor and boat damage to coral and seagrass	-
	Maintenance of traditional fishing areas[18]	-		
	Environmental services – coastal protection and climate regulation	+		
Commercial Fishermen	Protection of fin fish, lobster and conch resources within the marine reserve ensuring continued viability of fishery	+	Support for effective management of protected area	+
	Maintenance of traditional fishing areas[19]	-	Illegal harvesting of fishery products within the marine reserve	-
	Opportunity for alternative livelihood as tour guides	+	Anchor damage to reef	-
Tour Guides (including tour boat captains)	Reserve is a major destination for snorkeling, diving and associated tourism	+	Support the conservation goals of the marine reserve	+
	Benefit from the management of tourism access to shark/ray alley as a tourism feature activity	+	Provide interpretation for visitors, facilitating overall visitor appreciation	+
	Employment and income from reef-based tourism activities	+	Assist with visitor management within the protected area through in-depth briefings	+
	Promotion of community awareness about importance and benefits of reserve	+	If poorly trained, can result in poor visitor management and increased impact on corals and associated fauna, anchor damage etc.	-
			Impact behavior of fish through feeding	-
			Anchor damage to coral and seagrass	-
			Illegal harvesting of fishery products within the marine reserve	-
			Anecdotal evidence points to some tour guides allowing tourists to engage in illegal practices such as touching corals	-

[18] Traditional fishing areas and rights are in place. Approximately 85% of the reserve is general use zone which is fishable.

[19] Traditional fishers in Caye Caulker have shades and traps on the western side of the island. They were pioneers in the parcel system used for setting traps and shades.

Stakeholder	Influence or Impact of Reserve on Stakeholder		Influence or Impact of Stakeholder on Reserve	
Local / National Tour Operators	Benefit from reserve as a major destination for diving and snorkeling-associated tourism	+	Provide marketing at a national and international levels, and bring visitors to the reserve	+
	Obtain income from using reserve as a tourism destination	+	Support the conservation goals of the reserve	+
	Benefit from the management of tourism access to Shark/Ray Alley[20] as a tourism feature activity	+	Contribute to the financial sustainability mechanism for management of the protected area through increase visitation	+
			Increase the potential for exceeding the carrying capacity of the reserve	-
BTIA/BHA	Benefit from having the reserve as a key feature of the Caye Caulker destination	+	Provide marketing at national and international level of the reserve	+
	Members benefit economically from the reserve both directly and indirectly	+	Support the conservation goals of the marine reserve; e.g., via fundraising	+
			Promote the protection of the reserve among the general public	+
General Public	Maintenance of commercial fisheries stocks (fish, lobster and conch stocks) via biodiversity protection	+	Lack of support may increase chances of de-reservation or degradation	-
	Environmental services – coastal protection and climate regulation	+	Unsustainable activities and land base pollution can negatively affect the reserve	-
	Cultural and aesthetic appreciation	+		
	Increased awareness through education	+		
Visitors: Tourists	Enjoy the reserve as a tourism destination for leisure	+	Entrance fee contributes to sustainable management of reserve	+
	Benefit from education and awareness opportunities	+	Provide marketing nationally and internationally for the reserve by word of mouth and social media sharing	+
	Improve personal well-being		Presence deters illegal fishing inside reserve	+
	Better appreciation of natural environments		Damage to reef and feeding of wildlife	-
Government of Belize	Provides fisheries management for fisheries industry	+	Political support through the national protected areas system plan and relevant legislation	+
	Provides surveillance and law enforcement for the reserve	+	Political support for long-term conservation, e.g., via passage of new fisheries legislation and replenishment zones expansion	+
	The reserves assist in fulfilling government's commitment to the conservation of natural resources, and international conventions and agreements	+	Low budget allocations to support day to day management of protected area	-
	Revenue generation and acquiring	+	Uncertainty of future commitment	-

[20] CCMR's Shark/Ray Alley is not to be confused with the one at the Hol Chan Reserve.

Stakeholder	Influence or Impact of Reserve on Stakeholder		Influence or Impact of Stakeholder on Reserve	
	significant foreign exchange through tourism expenditure and fisheries exports		especially in regard to financing of management activities	
	Provides employment opportunities in stakeholder communities	+		
	Collects taxes from business and entities in the tourism and fisheries sector related to the reserve	+		

2.4. Physical Environment of Management Area

2.4.1. Climate

Rainfall

Caye Caulker is located in northern Belize which has a subtropical climate with an annual rainfall of about 1500 mm (60 inches). The months in which the heaviest rainfall occurs, except during hurricanes, are November-December (northers) and June-July (tropical storms)[21]. For reference, Figure 8 shows the general distribution of rainfall across the country.

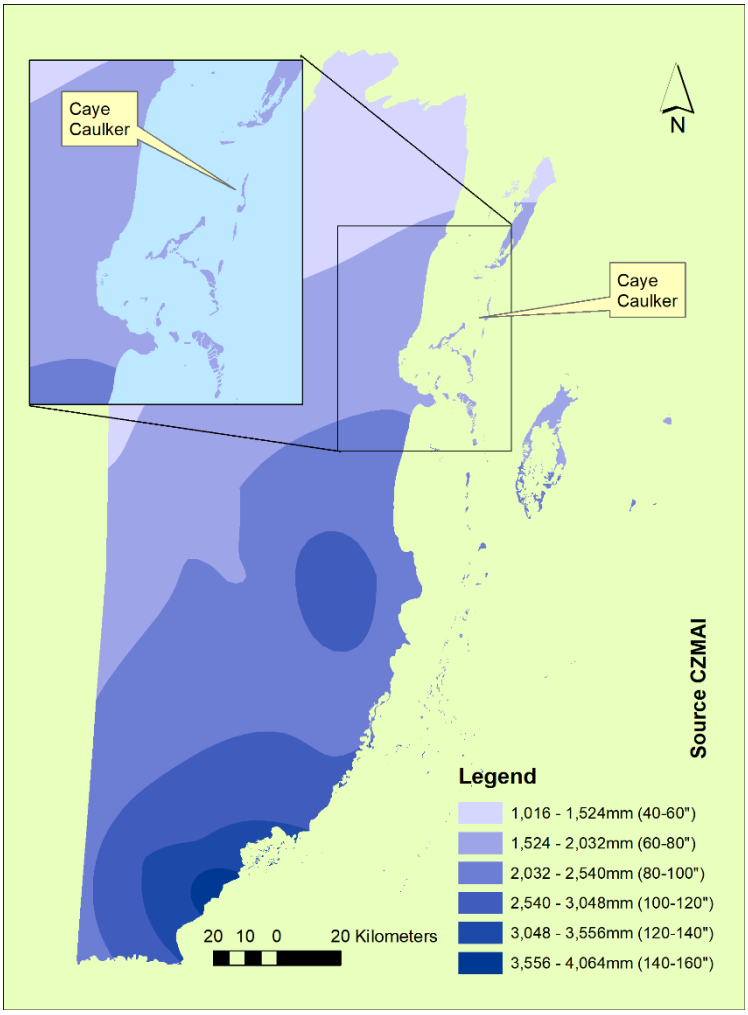


Figure 8: Rainfall distribution across Belize[22]

Temperature

The temperature for Caye Caulker averages 28° C (82° F) and average temperatures range from approximately 21° C in January to 24.8° in June. The average maximum temperature range is approximately 27° C in January to 32° C in May. Cold fronts normally begin in late October and finish by March, with the heaviest concentration in November to early December. The dry season typically begins in February to March and ends in May or June. Tropical waves generally

[21] Source: National Meteorological Service.
[22] Source: CZMAI.

commence in May or June, with a peak likelihood of tropical weather formation in the two-month period ranging from the middle of September to the middle of November.[23]

Tropical Storms and Extreme Weather Events

The primary systems that produce annual rainfall in Belize are Tropical waves, Tropical Storms and Hurricanes. Hurricanes typically move westward through the Caribbean over warn Tropical waters from June to November, gathering strength until they hit land. Their effects are felt particularly strong on the islands. Peak activity for Tropical waves occurs during June and July, and these systems could be active or inactive. On the other hand, Tropical storms and Hurricanes usually peak during September and October and could vary in number and strength from year to year (Figure 9).[24]

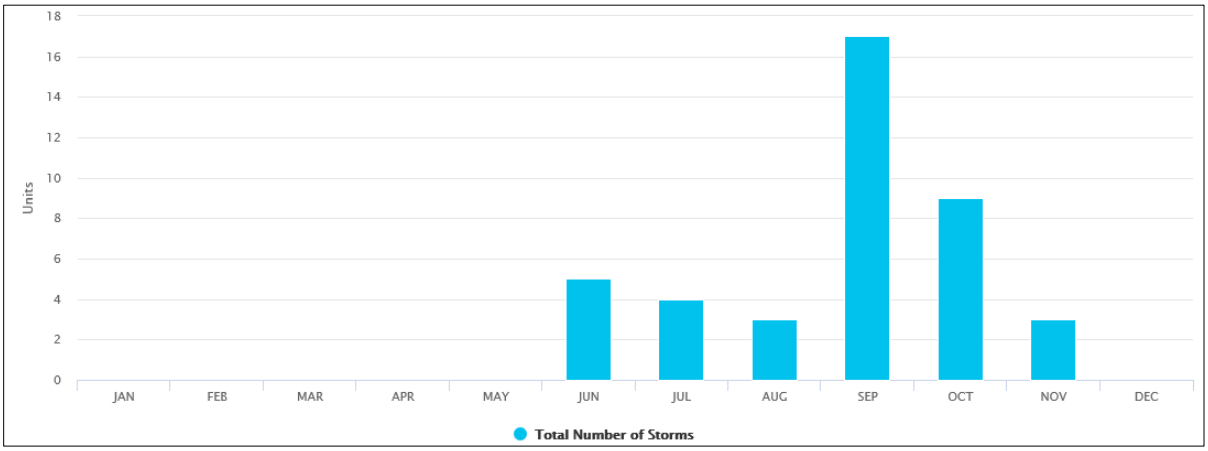


Figure 9: Frequency of Tropical Storms and Hurricanes in Belize

The most extreme weather events affecting Caye Caulker are hurricanes. Almost all historic hurricanes affecting Caye Caulker have formed within mid-September to mid-November. Table 11 lists hurricanes affecting Belize (and either affected and/or felt in Caye Caulker) over the past 50 years. Hurricanes usually occur in Belize at the rate of one every three or so years. Figure 10 shows the intensity of Hurricane Richard in 2010 and Hurricane Earl in 2016.

[23] Source: Ibid.

[24] National Meteorological Service, 2019

Table 11: Hurricanes that affected Belize and Caye Caulker over the past 65 years[25,26]

Year	Storm	Maximum Wind Speed Eyewall (kt)	Category	Effect on Caye Caulker
1955	Janet	165	5	Near over-wash; minimal wind damage to vegetation
1960	Abby	65	1	Negligible
1961	Anna	70	1	Negligible
	Hattie	140	5	Complete over-wash; structural damage to homes; downed trees
1969	Francelia	85	2	Minimal damage
1974	Carmen	120	4	Minimal damage, some sea rise.
1974	Fifi	90	2	Some sea level rise, TS-force wind
1978	Greta	95	2	Minimal wind effect
1988	Gilbert	175	5	Minimal wind effect; some sea level rise
1998	Mitch	180	5	Minimal wind effect (TS level); full over-wash event
2000	Keith	135	4	Full strength wind effects; full over-wash
2001	Iris	145	5	Strong TS winds; some sea level rise.
2007	Dean	165	5	Winds and rain
2010	Richard	92	2	Strong winds
2012	Ernesto	85	2	Wind and rain
2016	Earl	85	2	Strong winds and rain
2020	Nana	75	1	Passed south of Caye Caulker, minimal damage, little rain.

[25] Modified from Caye Caulker Forest and Marine Reserve Integrated Management Plan, 2004-2009
[26] National Meteorological Service, 2020

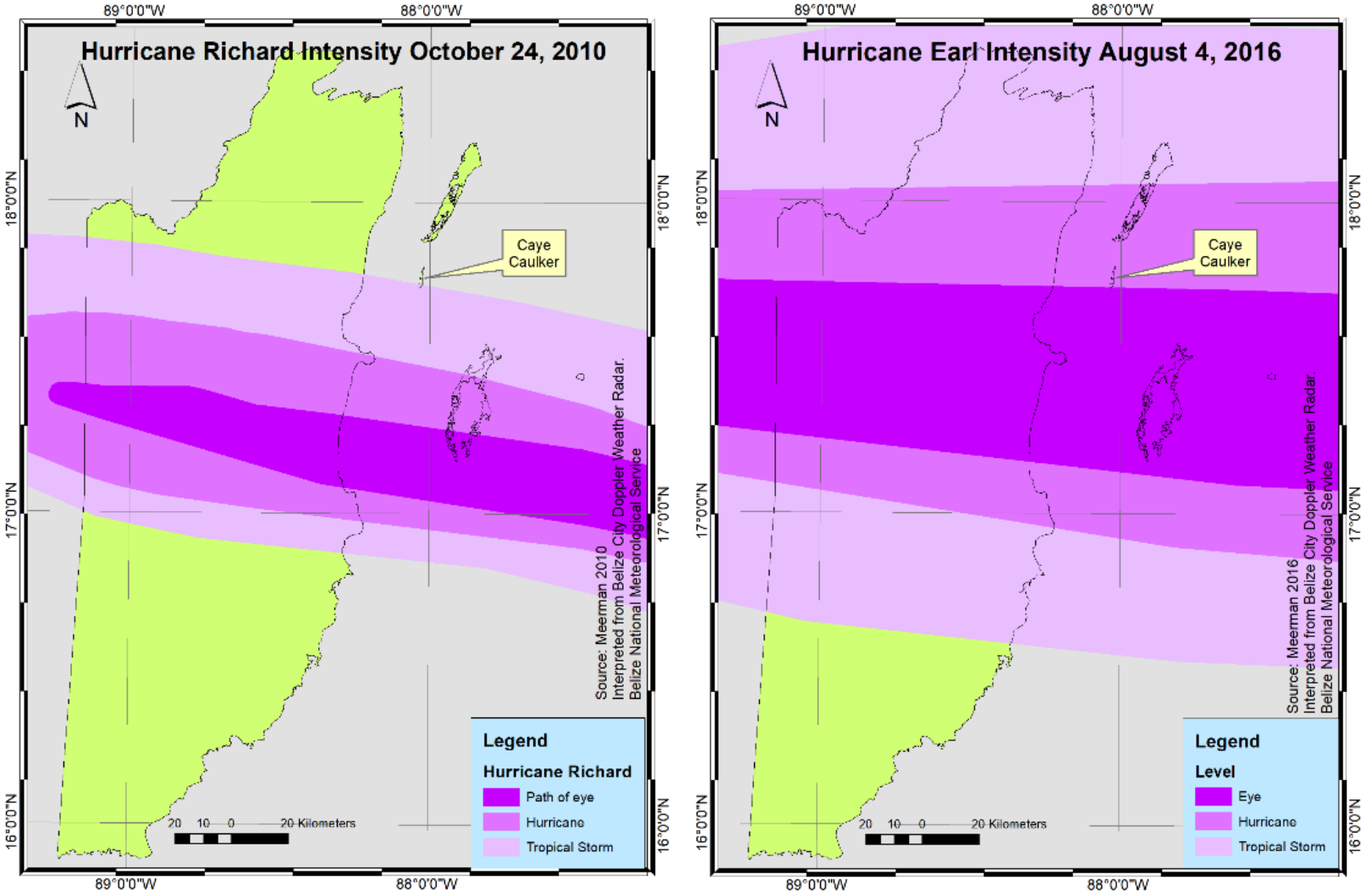


Figure 10: Path of Hurricane Richard in 2010 and Earl in 2016[27]

[27] Source: Weather Underground

2.4.2. Geology

Early reef growth commenced when five roughly parallel, north-northeast-trending fault escarpments were raised, dating from the close of the Cretaceous period, about 67 million years ago. Three of these support coral growth. The first – and least-developed – of these scarps forms the backbone of the Belize Barrier Reef system from just south of Cozumel, Mexico, to about the level of Gales Point, central Belize. Average ridge-top width is 1-5 km (Perkins, 1983). Caye Caulker lies along this first fault escarpment. The seaward ridge top lies in the vicinity of the reef crest, while the leeward edge is more or less under the line of cayes – including Caye Caulker – paralleling the Belize Barrier Reef.

The most recent earthquake to affect Caye Caulker was a 7.1 magnitude one that occurred off the coast of Honduras on May 28, 2009 (San Pedro Sun, 2009), that created a number of underwater sinkholes or craters in the vicinity of the Split (News 5, 2009). No negative impact to the Reserve was observed[28].

Recent seabed sediments are composed of carbonates generated by the reef and other marine sources, including coral and shell fragments, sponge and soft coral spicules and bits of coralline algae such as Halimeda (Hanson & von Twistern, 1996; Chamberlain, 1995; Perkins, 1983).

Soils

Caye Caulker is a mangrove/sand caye composed of limestone bedrock overlain by calcium carbonate sand (Stoddart et al, 1982).

2.4.3. Bathymetry

Caye Caulker is surrounded by the Northern Shelf Lagoon of the Belize Barrier Reef lagoon, an extension of the Caribbean Sea. Average depth in the Northern Shelf Lagoon is 2-4 m (Perkins, 1983). Turbidity currents are considered to be the most common depositional form for sediments in the Caribbean; this mechanism is responsible for the flat topography of the Yucatan, Columbian and Southern Venezuelan Basins (Fairbridge et al, 1966-in Hanson & von Twistern, 1996).

2.4.4. Tides and Water Movement

Tidal action within the Belize Barrier Reef lagoon is classified as semidiurnal mixed tides, with generally four peaks in any given tidal day as follows: a high-high, a high-low, a low-high and a low-low tide (Hanson & von Twistern, 1996; National Meteorological Service). Generally tidal variation is 0.3-0.5m, raising to 0.8m during spring tides or associated with storm action. Higher tides result from extreme weather events.

The prevailing water movement entering the Caribbean is the wind-driven Guiana Current, flowing from southeast to northwest; this becomes the Caribbean Current, flowing through the Lesser Antilles with the majority reaching the Yucatan Strait (Hanson & von Twistern, 1996). The current breaks at Rocky Point, northern Belize, to form a small gyre that drives the sea off Belize

[28] Cansino, Ali. Manager, CCMR, as per personal communication, April 22, 2020.

to flow from north to south (Perkins, 1983). While the prevailing current flow moves from north to south, powerful westerly winds during cold fronts or other storm events may generate temporary strong currents that may carry materials such as sediments as far as the Belize Barrier Reef. According to Hanson and von Twistern (1996), these currents vary seasonally.

Tides also affect currents. Narrow cuts such as the Caye Caulker Split funnel can have fast currents. Channels in the reef will also reflect tidal currents depending upon their dimensions. Hol Chan Channel also shows strong current speeds during peak tides, while the larger channels off Caye Caulker exhibit slower speeds.

2.4.5. Water Parameters

Since January 2019, the Fisheries Department collects water samples in and around the CCMR on a monthly basis. There are 10 water sampling locations around Caye Caulker of which half are within the CCMR (Figure 11). The parameters[29] are tested in situ using YSI water quality sampling and monitoring meters.

[29] Physical characteristics of water look at the temperature, colour, taste, and odour of the water sample. Chemical properties of water involve parameters such as pH and dissolved oxygen.

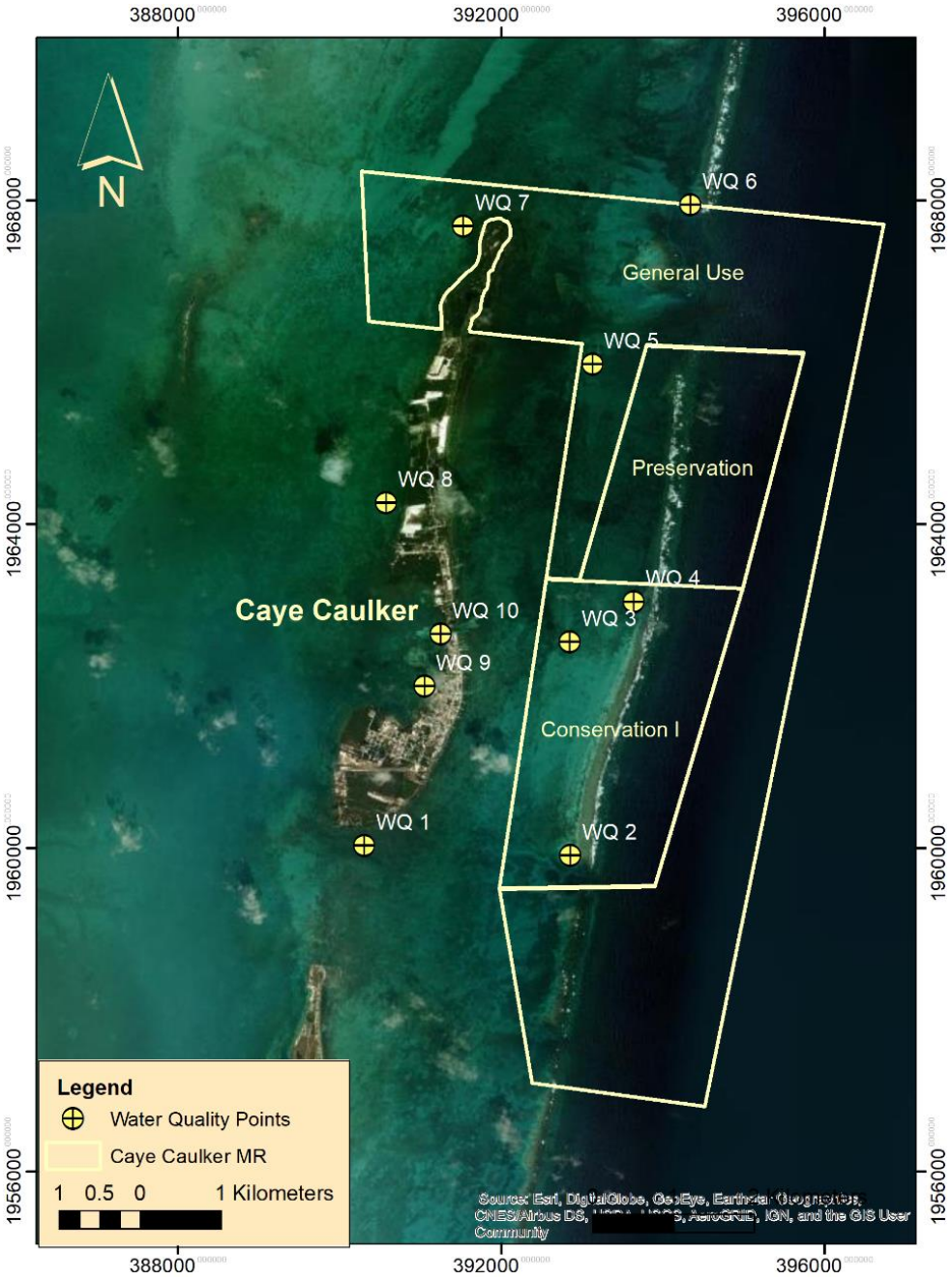


Figure 11: Fisheries Department water quality sampling points

Parameters tested are: Dissolved Oxygen, Conductivity, Salinity, pH, and Temperature. Nutrients such Nitrogen (N) and Phosphorus (P) are not tested. In contrast to freshwater systems where phosphorus is often the limiting nutrient, nitrogen is more commonly the key limiting nutrient of marine waters; thus, nitrogen levels have greater importance to understanding eutrophication problems in saltwater (Smith 1984). The absenced of the N and P in the water quality measurements should be seen as a shortcoming as it could have shed some light on the influence of land based sources of pollution.

Table 12 shows the average water quality data collected in and around the CCMR in 2019. These parameters are considered normal for sea water of this temperature.[30] [31] The parameters are further discussed below.

Table 12: Average water quality data collected in and around the CCMR in 2019[32]

Parameter	Mean values
DO (mg/L)	5.1
Conductivity (µS/m)	58,256
Salinity (ppt)	36.5
pH	8.5
Temp (° C)	28.1

Disolved Oxygen

Environmentally, the measuring of Dissolved Oxygen (DO) is of interest. Dissolved oxygen refers to the level of free, non-compound oxygen present in water or other liquids. It is an important parameter in assessing water quality because of its influence on the organisms living within a body of water. DO levels are strongly influenced by temperature, salinity and pressure (Table 13). Normal, healthy surface levels of DO for waters around Caye Caulker can be expected to be in the range of 6-7 mg/l. The measured values around Caye Caulker varied from 2-8 mg/l.

Table 13: Relationship of DO levels in sea water at different temperatures and pressures[33]

Solubility of Oxygen in Sea Water - ***Salinity ~ 35***										
Pressure abs	*mm Hg*	760			1520			3040		
	psi	14.7			29.3			58.7		
	bar	1			2			4		
	kPa	101.1			202.2			404.3		
Temperature		Solubility								
°C	*°F*	*µMol*	*mg/l*	*ml/l*	*µMol*	*mg/l*	*ml/l*	*µMol*	*mg/l*	*ml/l*
0	32	349	11.2	7.8	699	22.4	15.7	1399	44.8	31.3
5	41	308	9.9	7	616	19.7	14.1	1233	39	28
10	50	275	8.8	6.4	550	17.6	12.8	1099	35.2	25.6
15	59	248	7.9	5.9	495	15.9	11.7	991	31.7	23.4
20	68	225	7.2	5.4	450	14.4	10.8	901	28.8	21.7
25	77	206	6.6	5	413	13.2	10.1	826	26.4	20.2
30	86	190	6.1	4.7	381	12.2	9.5	761	24.4	18.9
35	95	176	5.6	4.5	353	11.3	8.9	706	22.6	17.9
40	104	165	5.3	4.2	329	10.5	8.5	658	21.1	16.9
45	113	154	4.9	4	308	9.9	8	616	19.7	16.1
50	122	146	4.6	3.8	292	9.4	7.7	585	18.7	15.4

[30] https://www.engineeringtoolbox.com/oxygen-solubility-water-d_841.html

[31] Sweetman, B.M., Foley, J.R. & Steinberg, M.K. A baseline analysis of coastal water quality of the port Honduras marine reserve, Belize: a critical habitat for sport fisheries. *Environ Biol Fish* **102,** 429–442 (2019). https://doi.org/10.1007/s10641-018-0811-6

[32] Based on 2019 data provided by Fisheries Department, analyzed by Michael F. Somerville (2020).

[33] Engineering ToolBox, 2005

Microbes such as bacteria and fungi also require dissolved oxygen. These organisms use DO to decompose organic material at the bottom of a body of water. Microbial decomposition is an important contributor to nutrient recycling. However, if there is an excess of decaying organic material (from dying algae and other organisms), in a body of water with infrequent or no turnover (also known as stratification), the oxygen at lower water levels will get used up quicker by these microbes (Fondriest, 2013).

Conductivity

Conductivity of water is a measure of its ability to conduct electricity. The SI unit of conductivity is Siemens per meter (S/m). In many cases, conductivity is linked directly to the total dissolved solids (TDS). High quality deionized water has a conductivity of about 0.5 µS/cm at 25 °C, typical drinking water is in the range of 200 - 800 µS/cm, while sea water is about 50 mS/cm (or 50,000 µS/cm). Temperature directly influences conductivity, and is also directly linked to salinity. Long term changes in conductivity are therefore difficult to interpret and may indicate changes in temperature, salinity and overall dissolved solids originating from a pollutant source.

Salinity

Salinity levels of seawater may be directly influenced by freshwater input such as from rainfall or nearby rivers. Salinity therefore can change per season. As the specific gravity of saline/fresh water differs, depth of the measurements are important.

pH[34]

Seawater is slightly basic (meaning pH > 7), and the pH for sea water is can range between 7.5 and 8.5 depending on the local conditions. A measurement of 8.5 is therefore to be considered "normal" or even "good'. The pH is important considering the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide (CO2) from the atmosphere. The main cause of ocean acidification is the burning of fossil fuels. and ocean acidification involves a shift towards pH-neutral conditions rather than a transition to acidic conditions (pH < 7). The issue of ocean acidification is the decreased production of the shells of shellfish and other aquatic life with calcium carbonate shells. The calcium carbonate shells can not reproduce under high saturated acidotic waters. Increasing acidity is thought to have a range of potentially harmful consequences for marine organisms such as depressing metabolic rates and immune responses in some organisms and causing coral bleaching.

Temperature

The effects of temperature change (rise) on marine ecosystems and then particulary coral reefs are well documented [35] [36]. Corals can tolerate a narrow range of environmental conditions and live near the upper limit of their thermal tolerance. Therefore, corals are very sensitive to changes in sea temperature. Abnormally high ocean temperatures (e.g., sea temperatures 1–2°C greater

[34] From https://en.wikipedia.org/wiki/Ocean_acidification
[35] https://www.nature.com/articles/s41598-019-45188-x
[36] https://reefresilience.org/climate-and-ocean-change/warming-seas/

than average summer maxima) can cause coral bleaching, and can result in coral mortality, declines in coral cover and shifts in the population of other reef-dwelling organisms.

The measured average of 28ºC should be considered a current baseline, already elevated compared to previous conditions.

Conclusions
From the water sampling efforts the Dissolved Oxygen measurements are the most important as its results may be co-related to land and marine based environmental changes. While addressing such changes may not be directly within the mandate of the CCMR management, data gathered may still be important tools in outreach activities.

The lack of measurements of phosphorous and particularly nitrogen needs to be addressed given that such measurements could shed some light on land based sources of pollution.

The measurements of salinity, temperature, pH and conductivity are of long term interest which will pay off after many decades of monitoring. Neither of the latter parameters are something that can be addressed by management of CCMR.

2.5. Biodiversity of Management Area

2.5.1. Ecosystems

The Caye Caulker Marine Reserve covers a number of marine ecosystems namely:

- Seagrass beds;
- Sand flats; and
- Coral Reefs which can be subdivided into: a) Barrier Reef (Fore Reef, Reef Crest, and Back Reef), and b) Patch Reef.

A marine habitat map was prepared by the CZMAI in 2003, which provided detailed information on the benthic composition of the Belize Barrier Reef System. Since then, coral bleaching and various diseases have wrought havoc among the composition of the coral reef, and the detailed information included in the mapping effort is now outdated.[37] A more generalized version of the same 2003 effort is probably still valid (Figure 12).

[37] Due to several cycles of coral bleaching since 2003, this map can no longer be considered up to date.

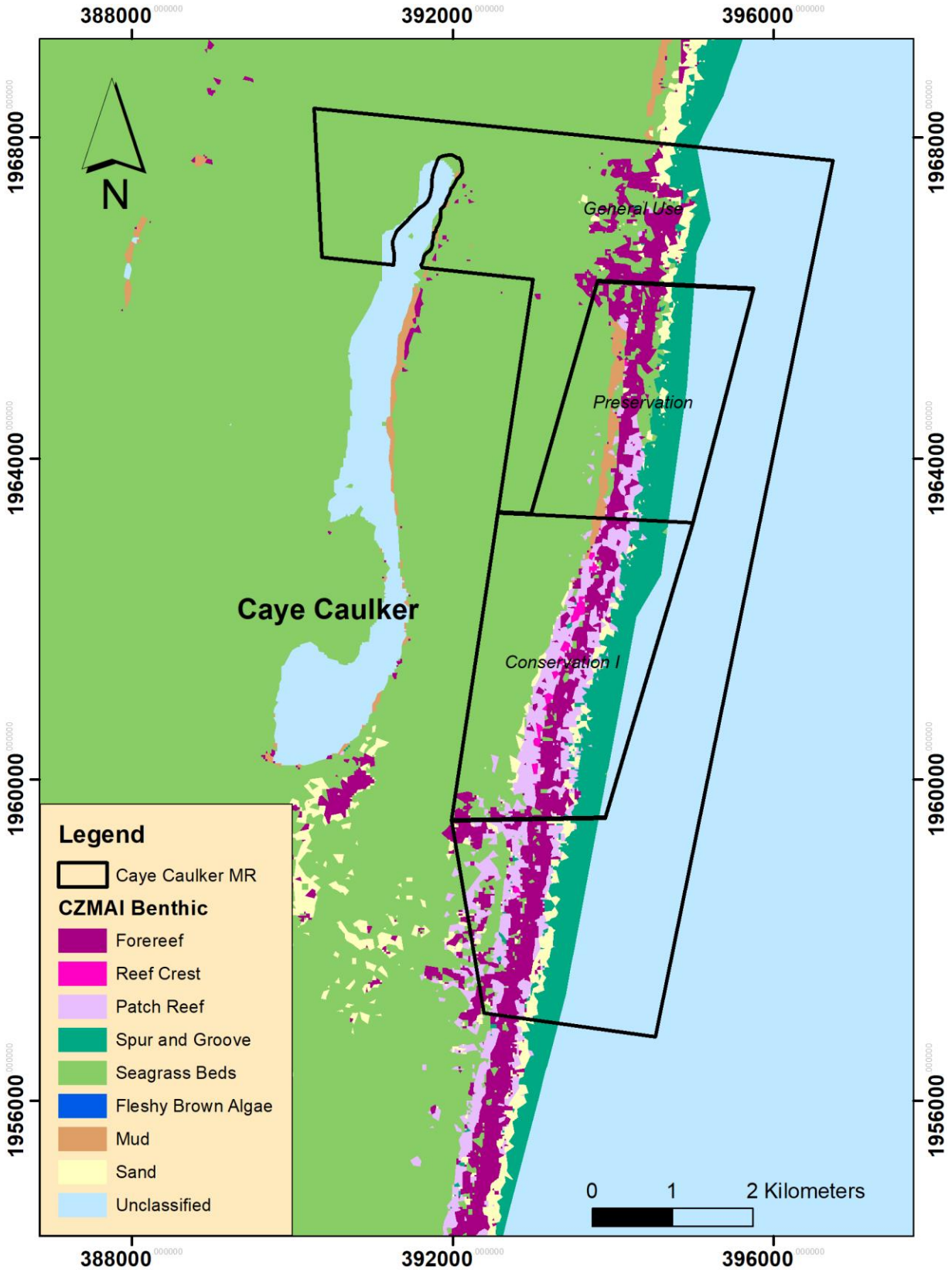


Figure 12. CZMAI Marine Habitats

Seagrass Beds

Three species of seagrass are found within the marine reserve, including the fine, flat shoal grass *Halodule wrighti*, the Manatee grass *(Syringodium filiforme)* and the broad-bladed Turtle grass (*Thalassia testudinum*). In addition, Three-finger leaf algae (*Halimeda incrassate*) and Saucer blade algae (*Avrainvilea asarifolia*) can be interspersed within the seagrass beds. Coverage of seagrass may be sparse, moderate and dense (Mumby, 1997), and the dense and moderate seagrass are the most productive of these habitats (McField et al., 1996; Kikuchi & Perez, 1977). Seagrasses form a dense rhizomal mat that holds bottom sediments, reducing erosion in times of strong current (McField et al., 1996; Zieman, 1982; Kikuchi & Peres, 1977). Their leaves accumulate sediments, helping to filter the water before it reaches fragile reef corals (McField et al., 1996).

Threats to Seagrass Ecosystem

The principal threats to seagrass ecosystems include pollution from a variety of sources, including sedimentation from excessive and inappropriate dredging (and mineral extraction), canal building and land clearance, agrochemicals, oil/fuel spills, excessive nutrient input into the ecosystem, and solid waste, including leachate from solid waste (Sibley, 2009; Dodge, 1995; LaPointe, 1992; McField et al., 1996; Klumpp & Von Westernhagen, 1995). Increasingly, climate change as a threat to seagrass beds is being recognized with changes in productivity and spatial shifts being reported (Brodie & DeRamon N'Yeart, 2018).

Proper waste management is an ongoing issue on Caye Caulker. While the village now has a solid waste transfer station, and residents are encouraged to utilize it and are charged a minimal waste disposal fee, some residents still practice illegal dumping along roadsides. Furthermore, several residents have a poorly designed septic tank and liquid wastes such as raw sewage and untreated grey water continue to leach or overflow into mangrove habitats, particularly on the Westside of Caye Caulker. Dredging contributes to sediment overflow that increases the turbidity and particulate content of surrounding waters, resulting in reduced productivity (McField et al., 1996) and compromised fishing grounds. Dredging and high water levels also re-suspend pollutants previously deposited (Duarte et al., 1997; Terrados et al., 1998).

Pesticides used in the Caye Caulker community could potentially be reaching the island's marine ecosystems. Fuel barges bound for Caye Caulker and San Pedro that routinely pass through or near the north-western lagoon areas of the marine reserve could also potentially expose the shallow marine habitats to fuel spills. Additionally, excessive nutrients may result in increased epiphyte cover over seagrass blades (McField et al., 1996). Nutrients may also result in increase of plankton in the water column, causing greater turbidity (McField et al., 1996; LaPointe, 1992). It is the authors' assumption that because of the fragility of the CCMR ecosystems, any input of chemicals from fuel or pesticides could potentially harm these ecosystems.

Sand Flats

Sand flats are dispersed throughout the seagrass beds and in the back-reef. Compared to seagrass beds and coral reefs, these are relatively species poor areas and have received little attention. Nevertheless, there are a number of species that utilize this ecosystem including the

Queen Conch (*S. gigas*), Sand Dollars (*Clypeasteroida spp.),* Peacock Flounders (*Bothus mancus*), Yellow Goatfish (*Mulloidichthys martinicus*), Yellow-head Jawfish (*Opistognathus aurifrons*), Southern Stingray (*Dasyatis americana*), and others.

Coral Reefs

Coral reefs of the marine reserve are extensive, with the barrier forming a wall 11.1 km (6.90 mi) long and about 1,609 m (1 mi) offshore the island of Caye Caulker. Significant patch reefs are associated with all channels within the reserve, and lesser patch reefs are found sporadically throughout the lagoons. The reef barrier has three major breaks, including North and South Caye Caulker and Caye Chapel Channels (Figure 13).

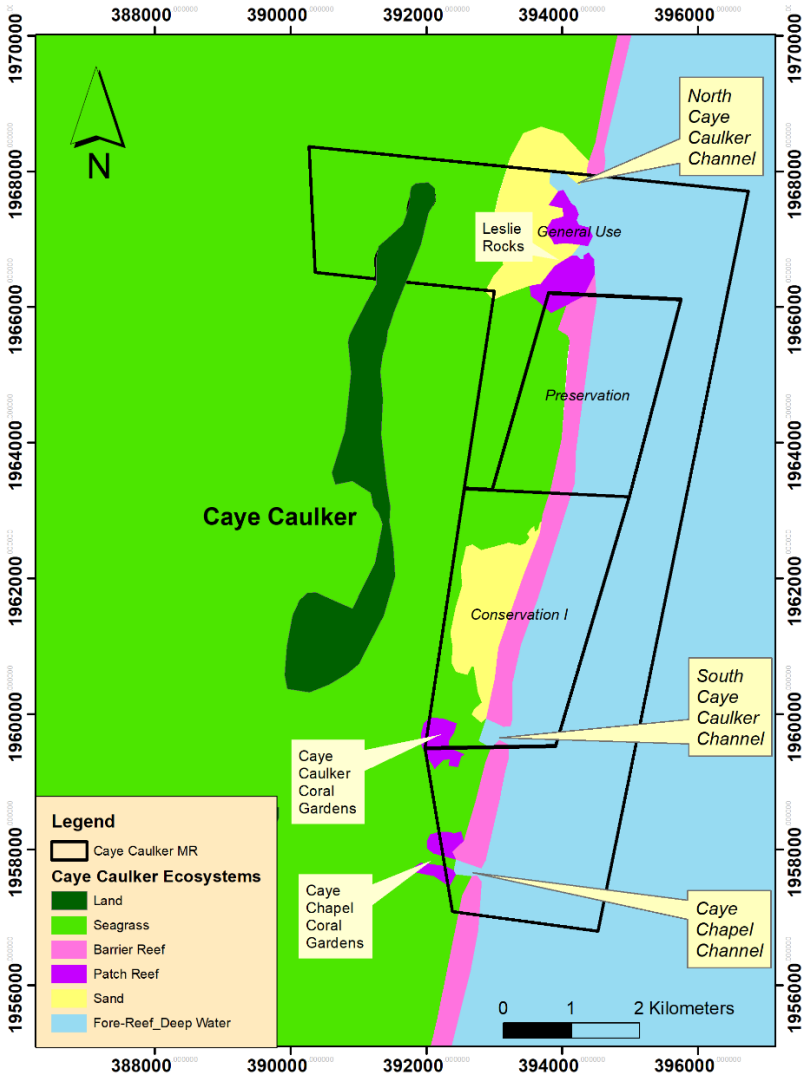


Figure 13: Channels and Major patch reefs present in the CCMR

Fore Reef

The fore-reef immediately seaward of the reef crest supports abundant *A. palmata* recruits and young colonies; Blade fire coral (*Millepora complanate)*, and young Symmetrical Brain Corals (*Pseudodiploria strigose*). Following past hurricane damage, regeneration resulted in a growing

reef built upon relict *A. palmata* skeletons encrusted by crustose coralline algae containing coral dominated by *A. palmata*, the brain corals *P. strigose* and *Pseudodiploria clivosa*, the early successional species *Porites astreoides* and the reef-building fire coral *M. complanata*. As the fore-reef slopes off to deeper water, the fish fauna has more pelagic influences.

Reef Crest

The reef crest was once dominated by large areas of *Acropora palmata* and *A. cervicornis*, but after years of coral bleaching and diseases, dating as far back as 1984, those species have declined substantially. Patchy regeneration remains, including a sizeable expanse of the hybrid *A. prolifera*. In comparison to the original dominant species, the remaining stands are vastly different[38].

Another distinctive species on the reef crest are *Montastraea annularis* and *Montastraea faveolata*, while *Millepora complanata* is an abundant robust reef-building stinging coral. Like elsewhere much of the coral reef is now Algal-dominated.

Back Reef

Considerable fleshy macroalgae dominated by *Dictyota* spp. and plentiful *Halimeda* spp. adorn the sporadic colonies west of the crest formation. Within approximately 100-200 meters from the mini-reef, mixed seagrass appears surrounding a sunken barge on the bottom in 5-6 m (15-18') of water. This artificial reef has lain in place approximately 25 years and features large shoals of juvenile fish such as French Grunt (*Haemulon flavolineatum*) and Tomtate (*H. aurolineatum*) in the presence of growing coral colonies and sea fans. Finally, moving west past reef structures and the sunken barge, patchy to dense-cover seagrass extends in flat to gently rolling featuring sand having mixed grain size, with embedded finer silt. Soils of the areas were described in McRae (2004). On the bottom larger CaCO3 grains arise from disarticulated joints of *Halimeda monile*, *H. incrassata* and other calcareous algae species.

Patch Reef

Patch Reefs are isolated "patches" of reef behind the actual barrier reef and a succession of patch reefs can be found sporadically distributed in the lagoon waters that overlap in the adjacent coastal waters. In Caye Caulker, patch reefs are often referred to as "Coral Gardens" (Figure 12).

Patch reefs occur in this area due to the displacement of coral fragments during periods of intense wave action (Young and Bilgre 2002). Encrusting coral such as *Porites asteroids* and *Diploria* spp often grow around dead coral fragments, building patch reefs. The corals *Agaricia agaricites* and *Siderastrea sidereal* also appear consistently on patch reefs in the back reef.

The hotspots for abundance and biodiversity have been observed to be concentrated around patch reefs, with a similar species assemblage to that found of the north coast of Caye Caulker (Herrera, 2017) This includes Schoolmaster snapper (*Lutjanus apodus*), Dog snapper (*Lutjanus jocu*), Mutton snapper (*Lutjanus analis*), White grunt (*Haemulon garnoti*), Caesar grunt

[38] Aronson & Precht. 2001.

(*Haemulon carbonarium*) and the Smallmouth grunt (*Haemulon chrysargyeum*). A total of 95 different fish species have been recorded off the coast of Caye Caulker and areas of Northern Belize similar to Caye Caulker (McRae, 2009).

A study on the marine reserve's patch reefs by the University of Wisconsin (Superior) revealed 31 species of *Scleractinia spp.* corals with an average species richness of 12.2 species per site (Burkett et al., 2002). But these figures are probably no longer valid.

Threats to Coral Reef Ecosystems

Anthropogenic greenhouse gas emissions have caused an increase in global surface temperature of approximately 1°C since pre-industrial times. This has led to unprecedented mass coral bleaching events which – combined with growing local pressures – have made coral reefs one of the most threatened ecosystems on Earth.

When conditions such as the temperature change, corals expel the symbiotic algae living in their tissues, responsible for their colour. A spike of 1–2°C in ocean temperatures sustained over several weeks can lead to bleaching, turning corals white. If corals are bleached for prolonged periods, they eventually die. Coral bleaching events often lead to the death of large amounts of corals.

Reefs around the world have suffered from mass bleaching events for many consecutive years. The bleaching, in many cases killed around 50% of its corals in just a few years. Corals cannot survive the frequency of current bleaching events from global temperature rise. If temperatures continue to rise, bleaching events will increase in intensity and frequency. Scientists estimate that even those events that occur twice per decade can threaten corals' survival. The first global scientific assessment of climate change impacts on World Heritage coral reefs, published in 2017 by UNESCO, predicts that the coral reefs in all 29 reef-containing World Heritage sites would cease to exist as functioning coral reef ecosystems by the end of this century if humans continue to emit greenhouse gases under a business-as-usual scenario[39].

More localised, direct threats to the coral reef ecosystems within the marine reserve include trampling by uncontrolled visitation, boat groundings, or breakage by commercial divers going after fish and lobsters or salvage operations (McField et al., 1996). Indirect threats include sedimentation (Gibson & Carter, 2003; McField et al., 1996, Cortes & Risk, 1985), nutrient loading (Burkett, 2003; LaPointe, 1992; McField et al., 1996; CZMP, 1998; Goreau, 1991), chemical/oil pollution (Dodge et al., 1995); biocide residues and solid waste (McField et al., 1996). Overfishing also threatens coral reef ecosystems (Roberts, 1996). Table 14 outlines the recent natural impacts to corals from 1983 to 2020, while Table 15 shows anthropogenic threats to coral reefs and their possible effects.

The southern portion of the marine reserve extends to offshore northern Caye Chapel, exposing corals in patch reef and barrier back reef areas to biocide pollution. Some chemicals absorb to

[39] https://www.iucn.org/resources/issues-briefs/coral-reefs-and-climate-change

soil particles and may be carried far in sediment by currents (McField et al., 1996). Dredging in the area not only raises sediment, but re-suspends contaminants embedded within sediments (McField, 1996). This can drift considerable distance down-current from its source (Cortes & Risk, 1985). Excessive nutrient load could reduce survival of coral recruits (Hoegh-Guldberg et al., 1996; Ward & Harrison, 1996).

Table 14: Recent natural impacts to Montastraea-dominated patch and back reef habitats[40] [41]

Timeframe	Impact and Explanation in Belize and Caye Caulker
Since 1983-4	Massive die-off of algae-grazing *Diadema antillarum* urchins, resulting in increased algae overgrowth of coral throughout the Caribbean—encroaching turf algae evident at Caye Caulker (Lessios, 1988). Some recovery.
1990s	Die-off of *Acropora* corals due to a variety of disease, such as White Band and White Pox, the latter recently linked to a human enteric bacterial; much die-off at Caye Caulker prior to Hurricanes Mitch and Keith (Patterson et al., 2002; Aronson & Precht, 2001; McField, 2001). Some patchy recovery since hurricane, especially along Barrier (REA, 2003).
1998-9	Massive worldwide bleaching event 1998 (McField, 2001) causing increased coral mortality. A lesser amount has been noted on some Caye Caulker reefs during the REA (2003).
1998, 2000, 2001	Hurricanes resulting in widespread breakage, overturning, sedimentation and flaying of delicate tissues by suspended sand grains in turbulent water (CZMAI, 2000; McField, 2001). Recovery in some areas (REA, 2003).
2019	The Stony Coral Tissue Loss Disease (SCTLD) was being monitored in Belize since it was first detected in June 2019 within the Bacalar Chico Marine Reserve (BCMR). In October 2019, findings from a team that conducted a rapid evaluation in the BCMR and Hol Chan Marine Reserve to assess spread of the SCTLD indicated that the disease did not spread beyond the Basil Jones Area.
2020	A rapid assessment confirmed the presence of the SCTLD within the CCMR and surrounding areas (See Appendix 7).

[40] Adapted from Caye Caulker Forest and Marine Reserve Integrated Management Plan, 2004-2009
[41] Cansino, email message to Somerville, April 22, 2020.

Table 15: Anthropogenic threats to reef corals in the area of CCMR[42]

Impact	Result	Source
Direct Damage		
Boat Groundings	Coral breakage	Careless boat handling
Anchors Thrown Into Coral	Coral Breakage	Careless anchor placement
Uncontrolled Visitor Damage (tourism, commercial fishermen)	Trampling; Breakage; Collection of Souvenirs; Spearfishing; raising sand/ sediment from bottom onto coral.	Lack of tour guide control over visitor behaviour; lack of knowledge and/or concern on part of reef users.
Indirect Damage		
Excess nutrient input	Cloudy Water (sub-lethal stress); Algae turf overgrowth of coral and seagrass (if enough, death results); reduced survival of recently settled colonies.	Sewerage effluent; contaminated groundwater (septic overflow); fertilizers; decomposing food waste; food processing, excessive/ Inappropriate coastal & caye development.
Excess sediment	Cloudy water; introduction of disease; suffocation of coral.	Dredging within 2 miles of reef corals; Inadequate/ inappropriate dredge/fill; mangrove deforestation; Poorly-designed roads; excessive/inappropriate coastal & caye development.
Overfishing	Algal overgrowth of healthy living coral; breakage from fishermen; loss of reproductive potential of large individuals; reduction of biodiversity.	Removal of algae-grazing species such as large parrotfishes; upsetting the natural balance by removal of the largest predators
Introduction of chemicals, including oil and fuel, into marine environment	Suppression of natural immunity to disease; hormonal interference; death by poisoning.	Fuel spills; industrial effluent; excessive pesticide use; use of persistent pesticides; hypersaline brine from desalination plants.
Solid waste, including leachate (seepage of waste materials into ground or seawater)	Entry of toxic chemicals into sea or groundwater (see above); drifting trash in sea, including entanglement with reef corals; ingestion of waste by marine life, including turtles, often resulting in death.	Improper waste disposal (ie, dump sites into groundwater or permeable soil, permitting leaching; throwing trash into the sea).
Elevated sea temperatures, acidification, Now considered to be the main threat, more important that the above mentioned, particularly since mitigations of the impact is outside the capacities of any local management plan.	Coral bleaching, elevated disease levels	Global climate change brought about by excessive pollutants in the atmosphere.

[42] Adapted from Caye Caulker Forest and Marine Reserve Integrated Management Plan, 2004-2009

2.5.2. Flora

In the marine reserve, the primary floral species are the planktonic and benthic algae found in the reef habitats. The University of Wisconsin (Superior) study noted 28 species of macroalgae, most common of which were *Dictyota spp.*, *Porolithon pachydermum*, *Laurencia obtusa*, *Galaxaura spp.*, *Amphiroa rigida* and *Halimeda spp.* (Burkett et al., 2002). Table 16 lists the most common macroalgae noted in the CCMR during a rapid ecological assessment (REA) conducted in 2003. Percent cover of algae overall in patch reefs was noted at 72% and attributed to damage from past hurricanes (Burkett et al., 2002). Data recorded over the past decade indicate that algae cover increased while coral cover consequently decreased (Table 17). The most essential microalgae are *Zooxanthellae* within living reef corals. To date, no studies have been conducted on phytoplankton in the marine reserve.

Table 16: Most common algae species noted on various reef habitats in CCMR (REA, 2003)

Species	Group	Habitat
Halimeda opuntia	Calcareous green	Back-reef; patch
Porolithon pachydermum	Calcareous red	Back-reef; patch; crest
Turbinaria turbinata	Brown	Reef flat
Dictyota spp	Brown	All reef types
Halimeda discoidea	Calcareous Green	Back-reef; patch
Dictyota bartrayresi	Brown	Reef crest; back-reef
Amphiroa spp	Calcareous red	All reef types
Ventricaria ventricosa	Green	Back-reef
Sargassum polyceratium	Brown	Reef crest
Neomeris annulata	Green	Reef crest

Table 17: Algae and coral cover during the past decade[43]

Year	Algae Cover (%)	Coral Cover (%)
2011	43	27
2017	44	22
2018	35.74	18.53

A number of algal species are also found in lagoon habitats. The most commonly known algae include a variety of Chlorophyta, including *Halimeda spp.*; *Penecillus capitatus*; *Udotea flabellum* and a variety of *Caulerpa spp.* (REA, 2003). Patches of bare ground between seagrass areas may have fine filamentous algae growing in places. A list of known flora occurring in the marine reserve is shown in Appendix 1.

[43] Cansino, email message to Somerville, April 22, 2020. There was a data gap in 2018 as not all sites were surveyed.

2.5.3. Marine Fauna

The coral reef ecosystems of the marine reserve contain myriads of species from the major animal phylums, and occupy the benthic, infaunal and pelagic niches. Tables 18, 19 and 20 show the common species observed during the 2003 REA conducted in the reserve. A total of 19 sponge species were noted by Burkett, et al. (2002). The same study noted that invertebrates other than hard and soft corals, sponges, and hydrozoan corals comprised less than 1% of total bottom cover.

Table 18: Most frequently-encountered non-coral reef invertebrates[44]

Phylum	No. Species	Most Commonly Encountered Species
Porifera	6	*Calyspongia* spp.
Cnidaria	3	*Palythoa caribaea*
Annelida	3	*Spirobranchia gigantean*
Mollusca	7	*Strombus gigas; Xanus angulatus*
Arthropoda	7	*Panulirus argus*
Echinodermata	8	*Diadema antillarum; Echinometra viridis; E. lucunter*

A total of at least 24 hexacoral, 10 octocoral, 2 zoanthid and 2 hydrozoan coral species were noted during the 2003 REA. Sheet corals (*Agaricia spp.*) on the fore reef visits were identified only at the genus level. The most common of the group were regenerating or remnant Seafans (*Gorgonia ventolina*); young Branching and Crenulated Fire Coral (*Millepora alcicornis* and *Millepora complanata*); Columnar Boulder Coral (*Montastraea annularis*); young colonies of *Acropora palmata* (Elkhorn Coral) and small colonies of *Acropora cervicornis* and *Porites asteroides*.

Table 19: Most frequently noted living Hexacoral and Octocoral species[45]

Species	Habitat	Group
Gorgonia ventolina	Back reef; patch	*Octocorallia*
Millepora alcicornis	Back reef; patch; crest	*Hydrozoa*
Montastraea annularis	Back reef; patch; fore reef	*Hexacorallia*
Acropora palmata	Back reef; crest; patch	*Hexacorallia*
Millepora complanata	Crest; back reef	*Hydrozoa*
Porites asteroides	Back reef; patch; crest	*Hexacorallia*

Fish were the most frequently observed vertebrate species during the 2003 REA, and a total of 94 species in 32 families were noted in patch and barrier reef habitats. The most common fish species were Striped Parrotfish (*Scarus iseri*) in patch reefs (n=115), Sergeant Majors (*Abudefduf saxatilis)* in the back-reef area (n=333) and on the outer crest (n=151), and Creole Wrasse

[44] Noted during the 2003 REA (adapted from Caye Caulker Forest and Marine Reserve Integrated Management Plan, 2004-2009)

[45] Observed during the 2003 REA (adapted from Caye Caulker Forest and Marine Reserve Integrated Management Plan, 2004-2009).

(*Clepticus parrae*) in the fore reef (n=335). The most well-represented families were *Serranidae* (15 species), *Pomacentridae* and *Labridae* with 9 species each, and *Haemulidae* with 8 species. Of the total fish species recorded in 2018, 67.6% were herbivorous and 21.9% were listed as commercially important without reference.

Table 20: Most frequently-encountered reef fish[46]

Species	Common name	Reef type noted	No. in.
Thalassoma bifasciatum	Bluehead Wrasse	Common everywhere	≥ 940
Abedefduf saxatilis	Sergeant Major	All, especially back reef and crest	≥ 692
Scarus croicensis	Striped Parrotfish	Principally back reef, patch reefs	≥ 609
Clepticus parrai	Creole Wrasse	Principally forereef	≥ 381
Acanthurus coeruleus	Blue Tang	Common everywhere (An additional 340 mixed Blue Tangs- Doctor fish were reported)	≥ 320
Haemulon flavolineatum	French Grunt	Mostly back reef and fore reef	196
Stegastes planifrons	3-Spot Damselfish	Mostly back and patch reefs	179
Microspathodon chysurus	Yellowtail Damselfish	Most back reef	173
Caranx ruber	Barjack	All habitats, but most on fore reef	≥ 171
Stegastes fuscus	Dusky Damselfish	Most back reef	≥ 170

In addition to fish, several marine reptiles and mammals are known to inhabit the marine reserve, including the Hawksbill (*E. imbricata*), Loggerhead (*C. caretta*) and Green (*C. mydas*) sea turtles, Saltwater Crocodile (*Crocodylus acutus)*, Bottlenose Dolphin (*Tursiops truncatus*), Antillean (Caribbean) Manatee (*T. manatus manatus*). Lugworms (*Arenicola cristata*) and molluscs such as the West-Indian Fighting Conch (*Strombus pugilis*), West-Indian Chank (*Xanus angulatus*) and Milk Conch (*Strombus costatus*) inhabit the bare substrate, and Luminescent Threadworms occupy surface waters over seagrass (Gaston & Hall, 2000). Table 21 shows the most common invertebrates observed in lagoon and seagrass habitats during a 2003 REA. A list of known fauna occurring in the marine reserve is shown in Appendix 1 and Appendix 2 (Birds).

[46] Noted during the 2003 REA (adapted from Caye Caulker Forest and Marine Reserve Integrated Management Plan, 2004-2009).

Table 21: Most common invertebrate fauna in lagoon and seagrass habitat[47]

Species	Common name	Habitat type
Manicina aureolata	Rose Coral	Seagrass; Seagrass/algae
Arenicola cristata	Lugworm	Seagrass; Seagrass/algae; Bare sand
Leodia sexiesperforata	6-Hole Sand Dollar	Seagrass; Seagrass/algae
Xanus angulatus	West-Indian Chank	Seagrass; Seagrass/algae; Bare sand
Oreaster reticulate	Cushion Seastar	Seagrass/algae
Strombus gigas	Queen Conch	Seagrass; Seagrass/algae
Spheciospongia vesparium	Loggerhead Sponge	Seagrass; Seagrass/algae
Petrochirus diogenes	Conch Hermit Crab	Seagrass; Seagrass/algae

2.5.4. Birds

Birds are the best recorded biodiversity section of Caye Caulker. Since the launch of eBird (https://ebird.org) in 2002, the popularity of this Citizen Science Platform has expanded and Belize quickly grew out to be biggest contributor of Bird data worldwide on a per capita basis (Figure 14). However, birding has typically focused on the terrestrial habitats. The platform allows the creation of "hotspots"; places favoured for birding. While Caye Caulker has a number of listed hotspots, only the one called "Caye Caulker – Forest Reserve (north end), is of relevance for the CCMR. Technically, it deals with the Forest Reserve, which is not part of this management plan, but given its location and the migratory aspect of birds, the hotspot is likely to capture the "marine" bird species that utilize the CCMR.

The species list for the CCFR hotspot currently (July 2020) stands at 79 species, of which 30 could be considered "marine" or at least "shore". Given the widely spaced visits (10 visits in 5 years) this is not a frequently sampled location and the actual species utilizing the area is likely to be greater than this number.

[47] Noted during the 2003 REA (adapted from Caye Caulker Forest and Marine Reserve Integrated Management Plan, 2004-2009)

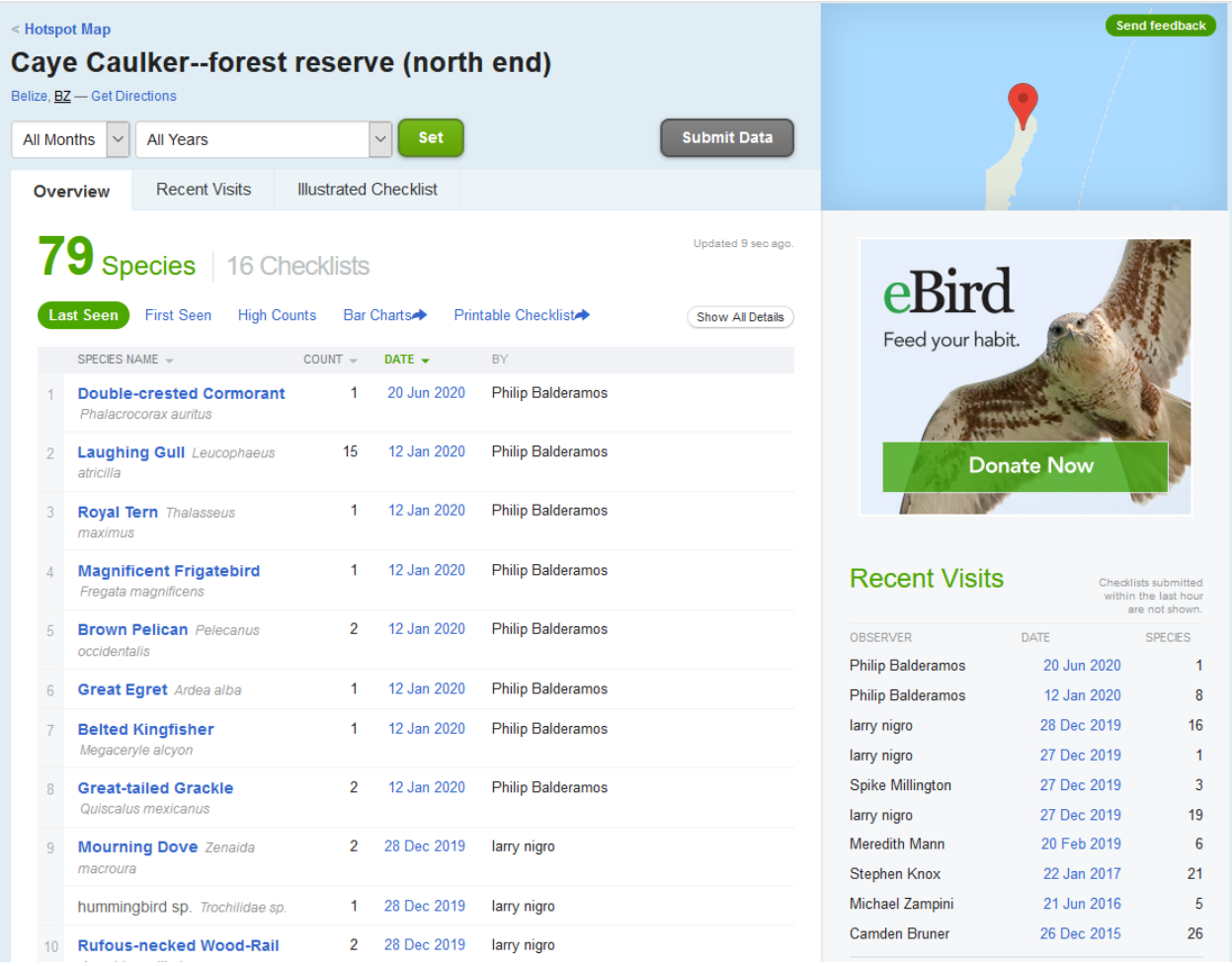


Figure 14: eBird Hotspot records for the Caye Caulker Forest Reserve [48]

Commercially Harvested Species

The coral reef and seagrass ecosystems of the Caye Caulker Marine Reserve harbours many economically important species, including the Spiny Lobster (*P. argus*), Queen Conch (*S. Gigas*), Goliath Grouper (E. itajara), Nassau Grouper (*E. striatus*), and a variety of snapper (*Lutjanidae spp.*), Grunt (*Haemulidae spp.*, *Pomadasyidae spp.*), and Parrotfish (*Scaridae spp.*). The Spiny Lobster is highly dependent upon seagrass habitats for 2.5-4 years of its life (Zieman, 1982). Seagrass also provides critical habitat for juveniles of a wide variety of fish species which are fished commercially in reef habitat.

The Spiny Lobster is primarily fished using traps set in seagrass beds but is also caught in reef habitats by diving fishermen using a hook stick to extract lobsters from beneath coral heads. The Queen Conch is fished primarily from seagrass beds and secondarily from the reef. Reef fish are speared by commercial fishermen and trolled or drop-fished by sport-fishing guides.

[48] Accessed on July 31, 2020.

The Spiny Lobster, Queen Conch and other fish species bring in much needed foreign exchange to Belize annually. According to a 2019 FAO Belize Country Brief, from 2008-2016 lobster production averaged 700 tonnes per year, and production of conch was stable around 3,000 tonnes until 2013. Both lobster and conch fisheries are currently considered stable in Belize, and in 2014, the Fisheries Department developed a Spiny Lobster Management Plan and a Queen Conch Management Plan. The sustainability of both fisheries has been largely due to implementation of sound regulations, monitoring and enforcement, including closed seasons, minimum size limits, gear restrictions and no-take areas.

Rare, Threatened, Vulnerable and Endangered Species

A number of rare, threatened and endangered species inhabit the marine reserve, including the Goliath Grouper (*E. itajara*), Nassau Grouper (*E. striatus*), Hawksbill (*E. imbricata*), Green (*C. mydas*) and Loggerhead (*C. caretta*) sea turtles, Antillean (Caribbean) Manatee (*T. manatus manatus)*, Queen Conch (*S. gigas*), and Staghorn (*A. cervicornis*) and Elkhorn corals (*A. palmata*).

In 2019, the IUCN listed the Nassau Grouper as critically endangered. According to scientists, this species is now at risk of extinction, and worldwide surveys carried out since 1980 indicate that its population throughout its range has declined by more than 80%. In Belize, especially over the past 10 years, the Nassau Grouper has been protected through size limits, closed seasons and no-take areas, but main threats to this species continue to be overfishing and loss of coral reefs – their primary habitat. The Nassau Grouper is protected in Belize under SI No. 49 of 2009 of the Fisheries (Nassau Grouper and Species Protection) Regulations 2009.

According to a 2017 study by Valdiva *et al*., predatory fishes like the Goliath Grouper are scarce across Caribbean coral reefs due to decades of overfishing. This species, like the Nassau Grouper, is also listed as critically endangered by the IUCN. The Goliath Grouper's population has decreased significantly throughout their range in the Gulf of Mexico, Caribbean and Atlantic, and in Belize, this species is not currently afforded protected status.

All three of the sea turtles occurring in the marine reserve are endangered, listed on CITES Appendix 1, and protected in Belize under Regulation 10 of Statutory Instrument No. 66 of 2002, under the Fisheries Resources Act No. 7 of 2020. The Queen Conch and Spiny Lobster are protected in Belize under Regulation 6 and 3, respectively, of the Fisheries Regulations, Chapter 210 of the Subsidiary Laws of Belize Revised Edition, 2003.

2.5.5. Past and Present Research

CCMR staff has an ongoing monitoring programme that follows that of the Fisheries Department, and engages the research group, Frontier Belize, with some monitoring and research. Table 22 shows past research projects conducted at Caye Caulker focused on biological, environmental and social aspects.

Table 22: Formal research/monitoring in the area of Caye Caulker[49]

Date	Researcher	Topic
2019-current	Fisheries Department	Water Quality (in situ analysis of five parameters: Dissolved Oxygen, Conductivity, Salinity, pH, and Temperature)
2019-current	Fisheries Department	Conch Surveys
2019-current	Fisheries Department	Lobster Surveys
2019-current	Fisheries Department	Fisher surveys (catch)
2018-2020	Fisheries Department assisted by Frontier	Overall Biodiversity monitoring, benthic data, coral cover.
2017	Emrich, K., M. Martinez-Colon & H.A. Alegria. (University of South Florida)	Research into impact of untreated sewage on coral reefs of Caye Caulker: "Is untreated sewage impacting coral reefs of Caye Caulker, Belize?"[50]
2015	University of Florida	Impact of sewerage on Caye Caulker Coral Reefs
2014	Emrich, Kristen Lynn, USFSP Master's Theses	Assessing the Impact of Untreated Sewage on the Coral Reef System off the Coast of Caye Caulker, Belize: Applying the Foram Index"[51]
Fall 2003	Siwa Ban	Lobster fishing and the Caye Caulker Marine Reserve. Animal encounters: An assessment of tour guide practices at Shark/Ray Alley-Caye Caulker
Fall 2001	Siwa Ban	Comparison of reef management in 3 reserves.
2001	University of Wisconsin (Superior)	Baseline information on patch reefs of Caye Caulker: coral cover, condition, species composition, algal cover and species, sponges and octocorals
Spring 2001	Siwa Ban	Study of heavy metals in Caye Caulker groundwater. The future of development on Caye Caulker
1999	Siwa Ban	Coral recovery at Caye Caulker after Hurricane Mitch
1999	WRISCS	Mapping of seafloor between Caye Chapel and southern San Pedro (single action: actual project focus on three southern estuaries)
1994	Siwa Ban	Investigation of coral bleaching east of Caye Caulker
1993	Bruce & Carolyn Miller	Investigation of the birds at the site of CCFR (REA)
1993	Jan Meerman	Insects and Reptiles as part of a Siwa Ban REA
Early 1990s	Smithsonian	Investigation of submerged cave fauna
Early 1970s	David Greenfield	Identification of smaller fishes such as gobies and blennies of Belize.

[49] Adapted from Caye Caulker Forest and Marine Reserve Integrated Management Plan, 2004-2009 (and updated).

[50] https://www.researchgate.net/publication/314396046_Is_untreated_sewage_impacting_coral_reefs_of_Caye_Caulker_Belize

[51] https://digital.stpetersburg.usf.edu/cgi/viewcontent.cgi?article=1124&context=masterstheses

Water Quality Monitoring

Water quality monitoring by the Fisheries Department has taken place at 10 locations since January 2019 (see Figure 11 above). See Section 2.4.5 (Water Parameters) for more details. Relatively recent research has looked at *Foraminifera* as indicators for water pollution caused by sewerage leaking into the marine habitat. The results showed that the impact on the Foraminiferal flora was distinct at locations near shore, there were no discernable impacts on the actual reef, indicating that sewage pollution has not affected the barrier reef as yet (Emrich et al., 2017).

Conch Surveys

Fisheries Department Conch Survey Data (Figure 15) from May 2019 in the preservation and conservation zones of the CCMR indicate a predominance of the larger sizes in these zones and a virtual absence of juveniles. It is not known whether these data indicate that the CCMR is not a nursery area.

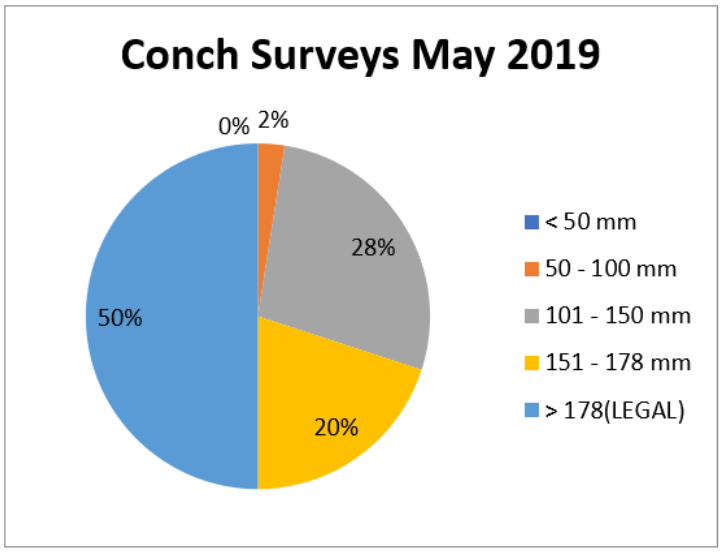


Figure 15: Conch Surveys (May 2019)

Lobster Surveys

Lobster Survey Data from the Fisheries Department from May 2019 in the three zones indicate a prevalence of the larger size classes with the immatures only recorded in small numbers (Figure 16). Numbers were highest in the preservations zone.

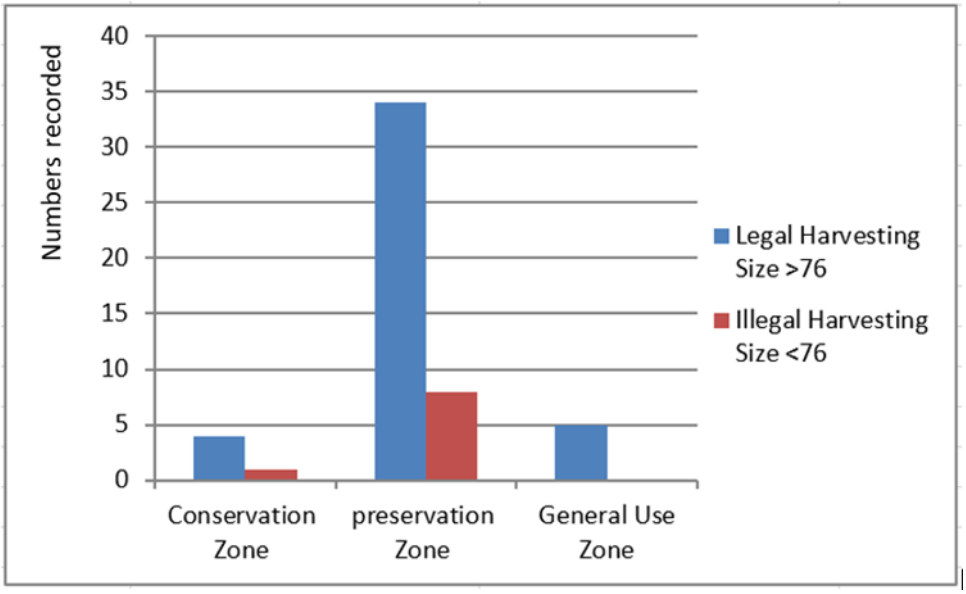


Figure 16: CCMR Lobster Survey Data (May 2019)

Lobster morphometric data are being collected during fisherman inspections and analyzed by the Capture Fisheries Unit of the Fisheries Department.

SMART monitoring

The SMART monitoring tool has been used at the CCMR; some issues have been encountered but staff have been using the tool since 2018 when the tool was rolled nationally to all sites.[52] The SMART tool is particularly useful for the monitoring of management activities, especially the recording of incursions and other (illegal) activities. In addition, the SMART tool can also be used for recording and monitoring species. However, the recording of biodiversity data is typically an activity that is difficult to combine with patrolling. Biodiversity modules in SMART are only sparingly used in Belize, but recently (after the consultation phase for this management plan), a new component was added to record the sightings of charismatic species such as turtles or manatees.

Frontier

Frontier is a Volunteer Operation from the UK, providing opportunities for interested students and young people in general to have experience in natural locations. In Belize they have been operating on Caye Caulker since 2018. Using its volunteer crew, Frontier does routine data collection and has a data repository including: Benthic data, Coral cover, and overall biodiversity.

Conclusions

Overall, there is a dearth of analysis of the data collected by the various entities and that data, in many cases, lack validation. But the data collected by these entities, specifically by Frontier, claim

[52] Fisheries Department has a policy for the use of SMART on enforcement activities (personal communication, Adriel Castañeda, 4 November 2020 and 31 January 2021).

to show rapid changes in all parameters recorded and these changes appear to be accelerating. Data like this are likely to hold important management implications.

The data collection that has taken place appears to be quite extensive and covering numerous parameters. The challenge will lie in the overall data management and analysis for management purposes.

Cruise ships (pre-Covid) can bring up to 300 visitors to the park in a single visit. However, additional research needs include a study in carrying capacity for the management of tourism flows.

2.6. Cultural and Socio-Economic Values of Management Area

2.6.1. Community and Stakeholder Use

The village of Caye Caulker has traditionally been a fishing community, with the fisheries industry once the leading income generator on the island. Over the years, however, this industry has given way to tourism the largest foreign exchange earner (pre-Covid) for Belize. While the commercial fishing for lobster, conch, stone crab and finfish maintains the community's livelihoods, it is declining and seasonal. Today, most commercial activities and services are in some way connected to tourism.

In 2018, the island had 44 registered tour operators and 145 registered tour guides (BTB Tourism Indicators, 2020). Tour guides and operators are members of the Caye Caulker Tour Guide Association and many possess both fishing and tour guide licenses. Hence, apart from conducting tours, many also engage in extractive commercial fishing activities, including harvesting of lobsters using traps. Local fishermen, including those from Sarteneja sometimes practice dive fishing for mixed species. Tour guides from San Pedro also utilize the marine reserve for tourism activities.

Today, tourism activities on the island include SCUBA diving, snorkelling, sport fishing, nature tours, and water sports and other activities and services. Many tour guides and fishermen also engage in hook and line fishery and bait fishery.

Diving

Diving is a major tourism activity, and the island provides several options for tourists to get certified. Several dive shops offer both PADI and NAUI certification classes. Diving trips to the marine reserve are typically to a variety of sites, including the Caye Caulker South Channel and areas on the fore reef that include some canyons, spur and groove, and the wall.

Snorkelling

Snorkelling is a favoured tourist activity, since it involves snorkelling the reef and swimming with nurse sharks and stingrays within the marine reserve. Most tour guides, including dive shops would conduct snorkelling trips. Favoured snorkel sites within the CCMR include the following:

Swash, Sponge Avenue, Sunset Avenue, Shark and Ray Alley, South Channel, Raggedy Anne, Leenas, and Pyramind (Figure 17).[53]

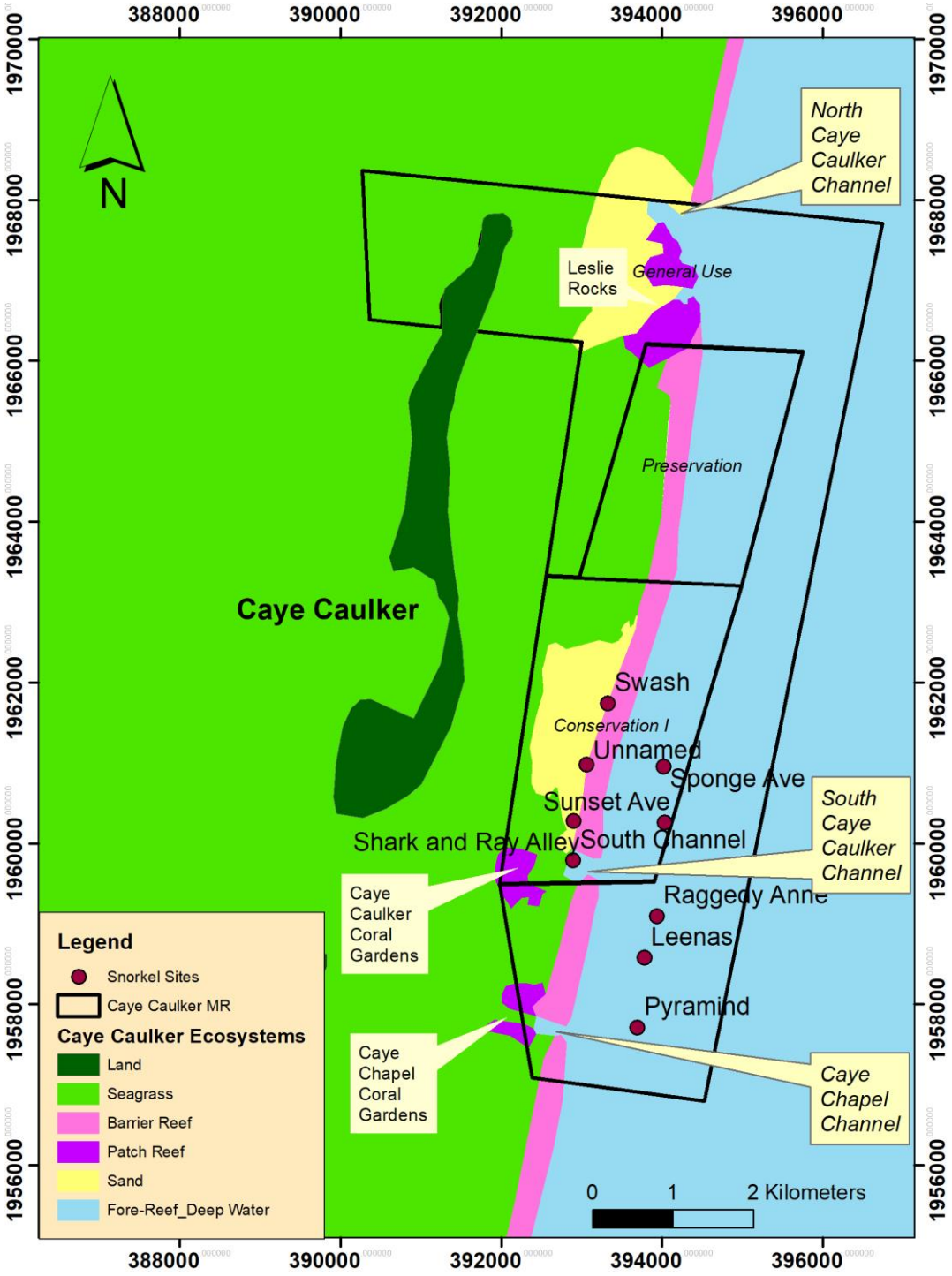


Figure 17: CCMR Favored Snorkel Sites

[53] Cansino, Ali. Manager, CCMR, email message to Michael F. Somerville, April 22, 2020

Sport fishing

Sport fishing is a growing attraction on the island and includes fly fishing for bonefish (*Albula vulpes*) along the outer perimeter of the marine reserve since no bonefish flats occur within the protected area. Sport fishermen would often troll for Barracuda (*Sphyraena barracuda*), Kingfish (*Scomberomorus cavalla*), and other fast-moving species.

COMMERCIAL FISHING

Spiny Lobster and Stone Crab Fishery

Many fishermen catch lobster in traps and shades made of palmetto strips. Traps and shades are set partially within the marine reserve and back reef areas. Many of the local fishermen, including from San Pedro are also using shades in their waters to attract lobsters that have a natural tendency to aggregate and hide on seagrass bottoms within or adjacent to lobster trap territories. The shades are then accessed by diving, and the lobsters caught with a hooked stick. A small stone crab fishery also exists, and these are fished from the waters in similar ways as lobster.

Use of Diving as a Main Fishing Method

Many fishermen use a variety of hands-on, direct methods to fish the reef. Conchs are usually caught by hand from the sea bottom in reef and seagrass areas, while lobster and fish are caught by spearfishing or with hooked sticks. The fishermen primarily originate from the Caye Caulker community and Sarteneja.

Dive fishing for mixed species usually takes place in the reef areas in the marine reserve, patch reefs to the leeward, as well as Mitchell Rocks and various coral gardens. On other occasions, the fishermen fish the southern areas of the marine reserve, or the shallow to moderate depth fore reef areas in front of the island for larger fish, including grouper (*Epinephalus spp.)*, snapper (*Lutjanus spp.)*, grunt (*Haemulon spp.*), jack (*Carangidae*), barracuda (*Sphyraena barracuda*), hogfish (*Lachnolaimus maximus)*, queen triggerfish (*Balistes vetula)*, and parrotfish (*Scaridae spp.*).

Finfish Fishery

Many tour guides would catch fish while on drop fishing or trolling trips in the northernmost portion of reef in the marine reserve and would sell their catch to the Cooperatives or local restaurants. Drop-fishing trips in the coral areas mainly harvest snapper and grunt, while fish caught during trolling trips are mainly barracudas and mackerel. Outside the reef trolling may yield kingfish (*Scomberomorus cavalla*), wahoo (*Acanthocybium solandri*), jacks (*Carangidae*), and large gamefish such as Marlins (*Makaira spp*), Sailfish (*Istiophorus platypterus*) and Dolphinfish (*Coryphaena hippurus*).

Additionally, some diving fishermen may troll as they move from one fishing spot to another or go into the deeper blue waters outside the reef to catch barracudas, mackerels, jacks, and Cobia (*Rachycentron canadum*). Each year, a Frenchie's Offshore Open catch and release tournament is hosted in Caye Caulker by the Belize Game Fish Association, and an additional tournament since 2016 is organized by the Barrier Reef Sport's Bar in collaboration with Oceana Belize, that focuses on reducing the invasive Lionfish populations.

Bait fishing is usually conducted using a cast net in the shallow nearshore seagrass areas, often near mangroves. Preferred species include the Red-ear Herring (*Harengula humeralis*) and the Scaled Sardine (*H. jaguana*); these are used primarily as bait to catch larger species.

2.6.2. Archaeological Sites

The island of Caye Caulker lies above a mostly unexplored and unmapped underwater cave system. Although first explored in 1981[54] and subsequent exploration dives conducted by professional cave divers, presently there are no plans for guided tours or other public access to the enormous cave complex.

2.6.3. Recreation and Tourism Use

Caye Caulker was traditionally a fishing village, where commercial lobster fishing and traditional harvest of conch and fish was the mainstay. It was not until the 1960s when tourism became an alternative income source from backpackers visiting Caye Caulker while travelling Belize and Yucatan Peninsula. Guests to the island often would share boats with anglers when visiting the reef, and local families would provide meals.

Today, tourism at Caye Caulker has overtaken the traditional fisheries industry as the largest earner of foreign exchange for the island, and today tourism is woven into all the commercial activities and services on the island and its associated marine environment. Presently, tourism activities on the island include SCUBA, snorkelling, sport fishing, nature tours, water sports and many others. Given the importance of tourism as a main economic driver for the village, a tourism development plan was developed for the years 2016-2020. Caye Caulker's vision for its tourism product reads "A high-quality marine tourism destination with healthy ecosystems, friendly people, and a low-key island charm sustainably harnessed by a progressive, thriving and prosperous community"[55]. It was identified from the plan that the main product demand of visitors to the island was marine activities with the majority engaging in swimming and beach activities, some 94%. Many, however, also engage in reef activities that include visits to the reserve. 83% cited diving and snorkelling as the main activity and some 53% cited visiting Sharks/Manta Ray reserve as a primary activity. One can easily assume that respondents to diving and snorkelling could have also been referring to visits to the marine reserve (the full survey results are in Table 23 below).

[54] https://www.islandexpeditions.com/belize-vacations-blog/caye-caulkers-cave-possibly-largest-world
[55] Source: Caye Caulker Tourism Development Plan, November 2015.

Table 23: Top activities by visitors to Caye Caulker 2015[56]

Caye Caulker visitors top activities	
Swim, sunbathe, relax on beach	94%
Enjoy cuisine & local products	88%
Diving, snorkeling	83%
Visit barrier reef/Blue Hole	58%
Visits to islands & cayes	55%
Watersports sailing, kayak, paddle board	55%
Shark/Manta Ray reserve	52%
Discover local history, culture	45%
Turneffe Atoll Marine Reserve	20%
Sport fishing	17%
Cultural events, shows, festivals	16%
Note: not mutually exclusive	
Source: Exit survey of May 2015	

After San Pedro (Ambergris Caye), Caye Caulker is the most visited destination in Belize. Ambergris Caye in 2019 registered 185,068 visitors which was down 9% from 2018 while Caye Caulker registered 154,863 visitors in 2019, down 13.1% from 2018, which coincidentally is the largest percentage loss amongst all destinations. Figure 18 below displays the most visited destinations in Belize.

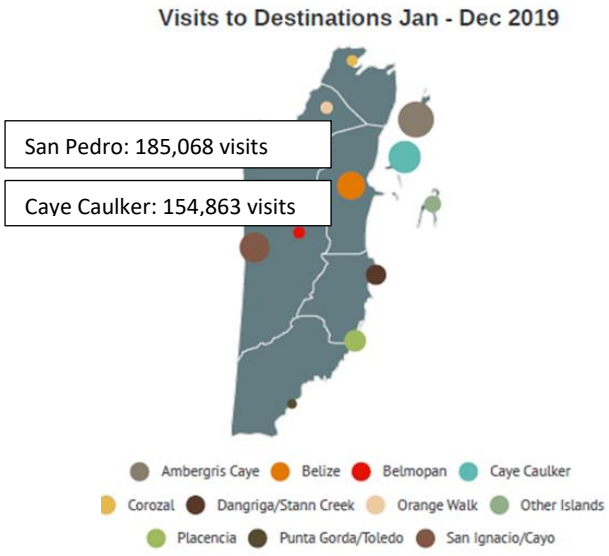


Figure 18: Destinations Visited (BTB)

[56] BTB Exit Survey (May 2015)

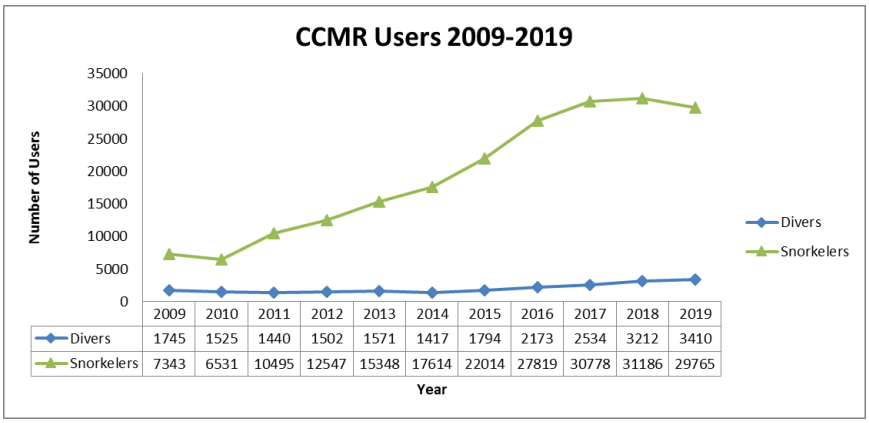
Caye Caulker's leading tourist attractions are its marine resources which include the Caye Caulker Marine Reserve as described above. To meet this demand, tourism development in Caye Caulker is inevitable and the village has seen tremendous growth in its tourism supply over the years. In 2019, Belize registered a total hotel stock of 953 with 8,853 rooms. Caye Caulker had 14% of Belize's hotel stock with 134 hotels. The village had 10.6% of the total room stock with 939 rooms, reflecting that the village concentrates on smaller properties as opposed to some of its domestic competitive destinations. As compared to 2018, Caye Caulker has seen growth in both its hotel and room stock, registering 127 hotels and 909 rooms in that year. Although there has been an increase in hotel room stock, Caye Caulker, unfortunately, registered the most significant drop in occupancy 2019, a reduction of 5.7% from 2018 and a registered occupancy of 38.7%. This is still above the national occupancy rate of 35.8% which also experienced a national reduction of 2.2% from 2018. The natural correlation of this decrease is the decrease in 2019 visitors to the destination and anecdotal evidence also points to the "shared economy" such as Airbnb.

One of the main attractions visited in Caye Caulker is the CCMR, one of the most visited marine attractions in Belize. There's no data indicating the level of satisfaction of visitors to the CCMR, but visitor satisfaction overall indicates that after accommodation and food and beverage services, marine experiences recorded the third highest level of guest satisfaction at 66% (good rating). In 2019, the reserve hosted over 38,000 visitors, most of them international visitors. Table 24 highlights the composition of visitors in 2019. The revenues generated is estimated to be BZ$167,600, a reflection of the lower visitation numbers in Caye Caulker in 2019. Most visitors originated in Caye Caulker and most over 80% engage in snorkelling activities. Since 2009, snorkelling has been the main activity at the reserve (see Figure 19 and 20).

Table 24: Visitors to CCMR, 2019[57]

Total Visitation	**38,026**		**Cruise ship**	**39.9%**
Total Paying Visitors	**33,175**		**Caye Caulker**	**60.0%**
Belizeans	**2,908**		**San Pedro**	**0.1%**
Total Guides	**6,834**			

[57] BTB (2019)



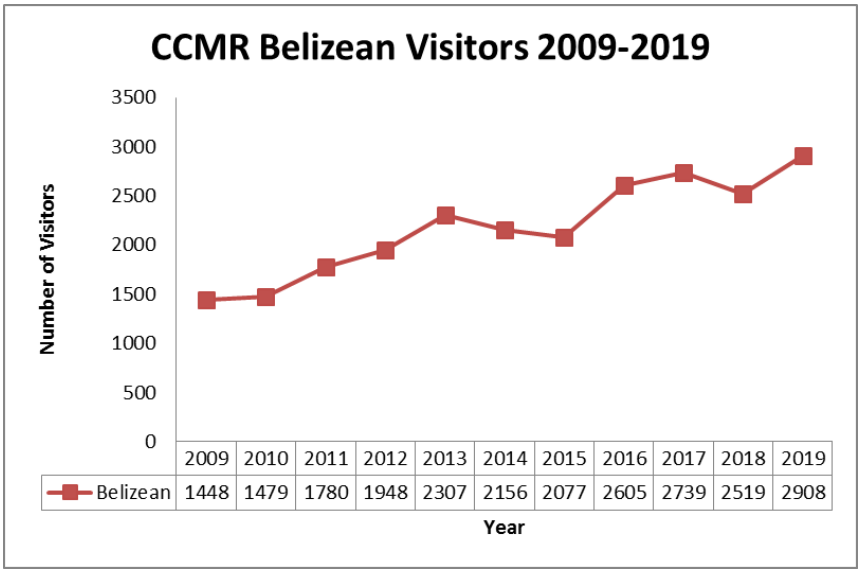


Figure 19: CCMR Users, 2009-2019

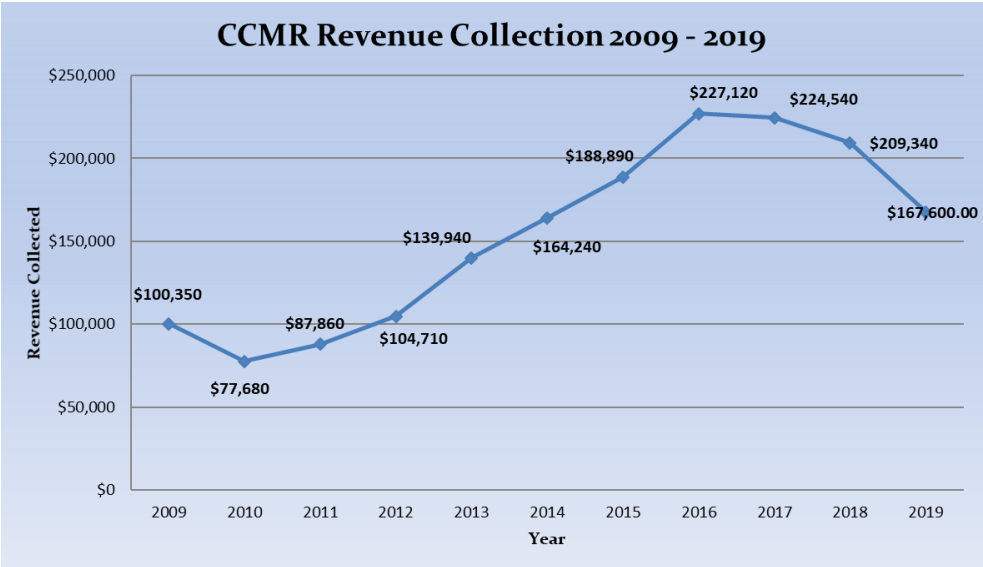


Figure 20: Total Revenues collected at CCMR, 2009-2019

To provide service to these visitors, key tourism suppliers are tour operators and tour guides. Nationally, there are 233 tour operators and 2,191 tour guides registered as of the writing of this plan. There were only 21 registered tour operators and 76 tour guides in Caye Caulker around the time of the last management plan (2006). The number of tour operators and tour guides has since then increased to 34 and 89, respectively in 2020 (Belize Tourism Board, Unpublished Statistics, 2006-2020). In 2019, the increase was significant over 2006 with 145 registered tour guides and 89 tour operators. The reduction in 2020 can possibly be traced to the Covid-19 pandemic with individuals not renewing their licenses. The main activities that these operators and guides rely on are marine activities and the number of these providers represent the popularity of Caye Caulker.

Residents of Caye Caulker, however, are aware of the impacts on the natural resources and environment by fishing and tourism development and are embracing the need for the conservation and sustainable use of these resources.

An increase in tourism development on the island and the heavy use of the area's marine environment for tours for visitors, including from cruise ships, increase the demand for recreational sites and place greater threats on the island and its associated natural ecosystems. For example, sedimentation from excessive and inappropriate dredging and mineral extraction, land clearance, oil/fuel spills and solid waste and leachate could destroy fragile seagrass ecosystems that are vital to the survival of many marine species.

Similarly, trampling by uncontrolled visitation, boat groundings, or breakage by commercial divers going after fish and lobsters, sedimentation, nutrient loading, chemical/oil pollution, biocide residues, solid waste, and overfishing also threatens the vital coral reef ecosystems.

COVID-19

Obviously from the data and evidence above, Caye Caulker, and by extension the CCMR, has been experiencing tremendous tourism activities. All that, however, came to a halt in 2020 as the Covid-19 pandemic impacted the globe. The Covid-19 pandemic placed an immediate halt to travel and leisure within Belize. This is arguably the hardest hit sector of this pandemic. Travel and leisure came to a screeching halt, which prompted an economic downturn due to unemployment and no foreign income.

One of the first economic responses by the Government of Belize (GOB) was to provide unemployment assistance to those in the tourism sector. The initial target of the programme were those directly employed in tourism, but then the "cries" came from the indirectly employed (along with some long time unemployed), and the programme ended up with some 81,000 applicants. The pandemic clearly demonstrated the sensitivity of the tourism product and how it can have substantial adverse effects on an economy. But it is not only a pandemic that can cause such a ripple effect. Our primary tourism market is the USA. Similar results can happen if the US government, say, places a travel ban on Belize, or if there is a terrorist event that can halt travel.

The economic shocks have been worsening during the months of the pandemic and Belize made the decision to re-open the airport for tourist travel on October 1, 2020. Many tourism enterprises are at risk of closing their doors according to the BTIA and tourism stakeholders are now calling on the government to assist with soft loans to support operational expenditures. But the government itself is hard pressed for revenue, so it leaned on the Development Finance Corporation to lend support with a tourism loans programme with an interest rate of 6%. Given an easing of some restrictions in the country, tourism policymakers are promoting the concept of "domestic tourism", but domestic tourism is not sufficient to sustain the industry until tourism "bounces" back. The disposal income is simply not there, and this is a symbol of the country's small market size. It is probably arguable as well that the domestic tourist will not be major visitors to marine reserves such as the CCMR.

For now, GOB will do its best to continue "pumping" money into the domestic economy, and this will come at a considerable cost. Some estimates point to the economy contracting by some 20% and public debt ballooning to 120% of GDP. Given that Caye Caulker was Belize's second most visited destination, it was heavily impacted by the pandemic. Recovery will be slow, but the island will be able to use this recovery period to improve its tourism product using plans like this one.

2.6.4. Other Economic Use

Currently, no other economic use has been identified for the marine reserve.

2.6.5. Education Use

Through its Education and Awareness Programme, the marine reserve's biologist and manager collaborate with the staff of the Hol Chan Marine Reserve in activities that promote responsible tour-guiding and reef awareness. The CCMR staff also participates in a yearly Lobsterfest booth display conducted by the Fisheries Department. The staff has also been active in community meetings and often holds consultations with stakeholders. Occasionally, Belizean student groups, including from the University of Belize, would visit the CCMR. Educational groups from abroad have not visited the reserve in the last five years. Additionally, CCMR staff teaches relevant lessons to students of the island's Ocean Academy High School in line with the Fisheries Department's policies.

3. Analysis of Conservation Targets and Threats

Conservation action 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 results of this section are based on the conservation action planning workshops conducted as part of the CCMR management planning process.

3.1. Conservation Targets

3.1.1. 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 six conservation targets, each representing or capturing the array of ecological systems, communities and species of the CCMR (Table 25).

Table 25: Conservation Targets for CCMR

Conservation Target	Justification for Target	Species, Communities or Ecological Systems represented by Conservation Target
1. Commercial species	Economically important – livelihoods, food supply, servicing the tourism industry; Environmentally important – food for the shark & rays, etc.	Finfish, Queen Conch, lobster
2. Coral reef system	Habitat; coastline protection; economic value for tourism, fishers, islanders, leisure & recreation	Coral Reef communities and all associated reef species (reef fish, grazers, gorgonians, sponges etc.)
3. Charismatic Species	Species of tourism interest -- economically important; Ecological importance (e.g., nutrient recycling)	Manatees, permits, bonefish, dolphins, sea turtles, crocodiles, Sea Turtles
4. Shark & rays	Mostly impacted by the tourism sector (e.g., snorkelers)	Elasmobranchs
5. Seagrass communities	Shoreline stabilization, habitat, water quality – filtration system, carbon sequestration	Seagrass beds, juvenile fish and invertebrate species, manatees and turtles
6. Mangroves	Although Fisheries Department is not legally mandated to manage these, it is an important CCMR nursery habitat which requires the assistance of the Forest Department	Mangroves

3.1.2. Assessment of Conservation Target Viability

The Viability Assessment, as conducted under the Conservation Action Planning (CAP) process, provides:

- A means for determining changes in the status of each focal conservation target over time, allowing the Fisheries Department 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 viability rating (Table 26).

Table 26: Conservation Target 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 27.

Table 27: Viability Assessment of Conservation Targets[58]

Assessing the Health of the Conservation Target				
Indicator	**Current Status**			
	Poor	**Fair**	**Good**	**Very Good**
CHARISMATIC SPECIES[59] [60]				
a) Abundance of sea turtles per annum				
b) Abundance of manatees per annum				

[58] This viability assessment is based on the CAP process that was conducted as part of the management planning process. Changes can be made when there is actual data coming forward.
[59] Species selected to raise support for biodiversity conservation within their habitat.
[60] The Fisheries Department assigned a Good rating to "abundance of sea turtles, manatees, permits, bonefish and dolphins" based on direct observation from their monitoring program. However, the current status ratings from the workshop stated these to have a Fair rating.

Assessing the Health of the Conservation Target				
Indicator	**Current Status**			
	Poor	**Fair**	**Good**	**Very Good**
c) Abundance of permits per annum				
d) Abundance of bonefish per annum				
e) Abundance of dolphins per annum				
f) Abundance of American Saltwater Crocodiles per annum				
COMMERCIAL SPECIES				
a) Water quality				
b) Commercial fish biomass[61]				
c) Conch density[62]				
d) Lobster density				
CORAL REEF COMMUNITIES				
a) Current Integrated Reef Health Index of resilient site				
b) Water quality				
c) % average live coral cover[63]				
d) % recent coral mortality				
e) Level of coral recruitment				
f) Commercial fish biomass				
g) Reef fish biomass				
h) % macroalgal cover[64]				
SEAGRASS COMMUNITIES				
a) Extent of seagrass				

[61] Rating is "Fair" according to CAP planning workshop data, but adjusted to "Good" based on MBRS data.
[62] Rating is "Fair" according to CAP planning workshop data, but adjusted to "Good" based on 2020 national conch status assessments (unpublished) which estimated combined total density to be 500 conch/ha (Legal size: 190 conch/ha).
[63] Rating is "Poor" according to workshop data, but Fisheries Department assessments conducted by staff in 2018 determined a coral cover of 18.53%. Also refer to https://www.healthyreefs.org/cms/report-cards/.
[64] 43.7% per average MP data (excluding 2018 due to data gap).

Assessing the Health of the Conservation Target				
Indicator	**Current Status**			
	Poor	**Fair**	**Good**	**Very Good**
b) % seagrass cover				
c) Water quality				
d) Coverage of seagrass not impacted				
e) Seagrass density				
SHARKS AND RAYS				
a) Density and size class of Sharks[65]				
b) Density and size class of Rays				
MANGROVES				
a) **Coastal mangrove health**				

[65] Dr. Chapman (Draft) notes that the shark population nationally is "Good".

3.2. Threats to Biodiversity

The threats affecting the conservation targets as identified by the CAP process are presented in Table 28:

Table 28: Threats to Conservation Targets of CCMR

Conservation Target	Threats
Charismatic Species	▪ Illegal fishing/harvesting ▪ Sport fishing (keep) ▪ Inappropriate behavior by tourists (harassment, feeding, chasing) ▪ Boat traffic (collision) ▪ Plastic ingestion
Commercial Species	▪ Poaching (harvesting in Replenishment Zone) ▪ Illegal fishing (under-sized, out of season, etc.) ▪ Habitat destruction – coral breakage (not major but still an issue) ▪ Unsustainable fishing practices (e.g., overfishing) ▪ Invasive species (e.g., lionfish) ▪ Land-based pollution – e.g., sewage runoff, grey water disposal ▪ Climate change impacts ▪ Sargassum
Coral reef system	▪ Climate change -- ocean acidification, fluctuation in sea surface temperatures ▪ Habitat destruction – e.g., coral breakage (not major but still an issue) ▪ Pollution (land-based) ▪ Diseases (e.g., SCTLD) ▪ Invasive species (changes the reef fish assemblage) ▪ Overfishing (changes the reef fish assemblage)
Seagrass communities	▪ Pollution (land-based) – nutrient loading rapidly increases the epiphyte cover on the blades of grass which reduces the photosynthesis rate, etc. ▪ Habitat degradation (dredging) ▪ Sargassum
Sharks and Rays	▪ Inappropriate behavior (feeding, touching, harassment by tourists)
Mangroves	▪ Habitat degradation (Removal from developments, dredging and filling) ▪ Storms & Hurricanes

Rating Critical Threats

Threats were then prioritized using three criteria to direct resources toward mitigation of the most critical threats. The threats were assessed by Area, Severity and Urgency, using the criteria shown in Table 29.

Table 29: Critical Threats Rating (Area, Severity, Urgency)

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

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

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

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

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

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

Table 30 presents the rated threats to conservation targets of CCMR.

Table 30: Threats to Conservation Targets of CCMR

Threat	Area	Severity	Urgency	A*S*U
Proposed Conservation Target: Commercial species				
Poaching (harvesting in RZ)	3	2	3	**18**
Illegal fishing (under-sized, out of season, etc.)	4	2	3	**24**
Habitat destruction – coral breakage	2	2	3	**12**
Unsustainable fishing practices (e.g., high fishing effort/pressure)	2	2	3	**12**
Invasive species (e.g., lionfish)	4	2	2	**16**

Land-based pollution – e.g., sewage runoff, grey water disposal, PAV1 Virus[66]	2	1	1	**2**
Climate change -- ocean acidification, fluctuation in sea surface temperatures[67]	2	1	1	**2**
Sargassum	3	1	3	**9**
Proposed Conservation Target: Coral reef system				
Climate change -- ocean acidification, fluctuation in sea surface temperatures[68]	3	1	3	**9**
Habitat destruction – e.g., coral breakage	2	2	3	**12**
Pollution (land-based)	4	2	3	**24**
Diseases (e.g., SCTLD, white band disease, dark spot disease, black band disease)[69]	3	1	3	**9**
Invasive species (changes the reef fish assemblage)	1	1	3	**3**
Overfishing (changes in the reef fish assemblage)	1	1	3	**3**
Illegal fishing (harvesting of grazers)	1	1	3	**3**
Proposed Conservation Target: Seagrass				
Pollution (land-based) – nutrient loading rapidly increases the epiphyte cover on the blades of seagrass which reduces the photosynthesis rate, etc.	4	1	3	**12**

[66] This rating is recommended by the Fisheries Department based on direct observation from their monitoring program. However, the threats ratings from the CAP planning workshop stated these to be 4 for Area, 2 for Severity, and 3 for Urgency.
[67] This rating is recommended by the Fisheries Department. However, the threats ratings from the CAP planning workshop stated these to be 4 for Area, 3 for Severity, and 3 for Urgency.
[68] This rating is recommended by the Fisheries Department. However, the threats ratings from the CAP planning workshop stated these to be 3 for Area, 3 for Severity, and 3 for Urgency.
[69] This rating is recommended by the Fisheries Department. However, the threats ratings from the CAP planning workshop stated these to be 3 for Area, 2 for Severity, and 3 for Urgency.

Habitat degradation (dredging)	1	1	3	**3**
Sargassum	4	2	3	**24**
Proposed Conservation Target: Charismatic Species				
Illegal fishing/harvesting (turtles/permits)	2	1	3	**6**
Sport fishing	1	1	3	**3**
Inappropriate behavior by tourists (harassment, feeding, chasing)	2	2	3	**12**
Boat traffic (collision)	2	1	3	**6**
Plastic ingestion[70]	1	0	1	**0**
Proposed Conservation Target: Sharks & Rays				
Inappropriate behavior (feeding, touching, harassment by tourists)	1	2	3	**6**
Human consumption (shark)	2	1	3	**6**
Proposed Conservation Target: Mangroves				
Habitat degradation (Dredging and filling)	3	2	3	**18**
Storms & Hurricanes[71]	4	1	2	**16**

3.3. Prioritizing Threats

Once the threat assessment was completed, the threats were prioritized, to effectively focus financial and human resources. This occurred through a standard prioritization process, with the threat scores being transferred from the threat assessment. The threat with the highest total threat score is ranked as the highest threat (Table 31). The threats which ranked as the highest priority of active threats were ***illegal fishing (commercial species), land-based pollution (coral reef system), and Sargassum (seagrass communities)***.

[70] This rating is recommended by the Fisheries Department based on their observation that this has not been documented as a major issue. However, the threats ratings from the CAP planning workshop stated these to be 4 for Area, 2 for Severity, and 3 for Urgency.

[71] This rating is recommended by the Fisheries Department. However, the threats ratings from the CAP planning workshop stated these to be 4 for Area, 2 for Severity, and 2 for Urgency.

Table 31: Results of Threat Assessment[72]

Threat	SCORE
Illegal fishing (commercial species)	**24**
Land-based pollution (coral reef system)	**24**
Sargassum (seagrass communities)	**24**
Poaching (harvesting in Replenishment Zone) (commercial species)	18
Invasive species (commercial species)	16
Inappropriate behavior by tourists (charismatic species)	12
Habitat destruction (commercial species)	12
Habitat destruction (coral reef system)	12
Unsustainable fishing practices (commercial species)	12
Land-based pollution (seagrass communities)	12
Climate change (coral reef system)	9
Sargassum (commercial species)	9
Diseases (coral reef system)	9
Illegal fishing/harvesting (charismatic species)	6
Human consumption (shark & rays)	6
Boat traffic (collision) (charismatic species)	6
Inappropriate behavior (sharks & rays)	6
Invasive species (coral reef system)	3
Overfishing (coral reef system)	3
Illegal fishing (coral reef system)	3
Habitat degradation (dredging) (seagrass communities)	3
Sport fishing (charismatic species)	3
Climate change (commercial species)	2
Land-based pollution (commercial species)	2
Plastic ingestion (charismatic species)	0

[72] While Mangroves are important nursery areas and their removal may impact the CCMR, it is not included here at the recommendation of the Fisheries Department since the marine reserve does not cover mangrove stands.

4. Planning for Climate Change

Belize is considered to be highly vulnerable to the impacts of 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 (CC) Analysis Workshop was held with stakeholders to look at how climate change can impact the CCMR. The results of the CC Analysis reflect potential impacts and related management strategies for CCMR.

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 32.

Table 32: Predicted Climate Change Elements for Belize

Climate Change Impacts	Current Status	25-50 years	100 years
Sea level rise	In 2014, global sea level was 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 0.3 cm per year. While this does not sound like much, sea level rose by 19 cm since Stoddart did his assessment of the Belize cayes. The Silk Cayes are at risk of disappearing soon, with their 2017 sizes reduced between 60%-79% compared to their sizes in 1960/61.	Predicted increase of between 0.38 m to 0.47 m	Predicted increase of between 0.47 m and 0.91 m over next 100 years
Sea surface temperature rise	Water temperature has increased by 0.75˚C between 1906 and 2005		Predicted regional increase of temperature by up to 5˚C by 2080, with the greatest warming being experienced in the north-west Caribbean (including Belize) (WWF,
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 years
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)

4.1. Priority Climate Change Adaptation Focal Targets

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

- Conservation Targets identified during Conservation Action Planning Workshop
- Ecosystem Services provided by the Protected Area (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?

4.2. Results of the Climate Change Analysis Workshop

4.2.1. 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 CCMR, three of these were selected as priority conservation targets that would be most affected by climate change: Coral Reef System, Seagrass Communities, and Mangroves. Although CCMR is not legally mandated to manage Mangroves, it is an important nursery habitat along with seagrass ecosystems and thus included as a CCMR conservation target.

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 (Table 33).

The Potential Climate Change impacts on each of the priority conservation targets (Table 34) are described in Table 35.

Table 33: Climate Change Analysis Prioritization Ratings

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 34: Priority conservation targets[73]

Predicted Climate Change Elements		Conservation Targets					
		Commercial Species[74]	**Coral Reef System[75]**	**Charismatic Species[76]**	**Sharks & Rays**	**Seagrass Communities[77]**	**Mangroves**
1	**Increased Air Temperature**	1	1	1	1	1	2
2	**Decreased Precipitation**	2	1	1	1	2	2
3	**Increased Intensity of Storms**	2	3	2	2	1	3
4	**Sea Level Rise**	1	3	1	1	2	2
5	**Sea Temperature Rise**	3	4	3	3	3	1
6	**Ocean acidification (corals)**	3	4	3	3	4	3
	Average Score	2.0	**2.7**	1.8	1.8	**2.2**	**2.2**

[73] Selected based on predicted Climate Change elements
[74] E.g., Finfish, Angel fish and grazers, Queen Conch, lobster
[75] Including associated reef species (reef fish, gorgonians, sponges etc.)
[76] Manatees, permits, bonefish, dolphins, sea turtles, crocodiles, Sea Turtles
[77] Seagrass beds, juvenile fish and invertebrate species, manatees and turtles

Table 35: Potential Climate Change impacts on priority conservation targets

CC Impacts	Coral Reef System	Seagrass Communities	Mangroves
Sea level rise	▪ Increased sedimentation – coral smothering ▪ Change in diversity	▪ Alterations on growth rate ▪ Alteration in distribution	▪ Drowning of mangrove/ plant death ▪ Reduction in productivity
Sea temperature rise	▪ Algae expelled (bleaching) ▪ Stops photosynthesis	▪ Reduced photosynthetic capacity ▪ Death	▪ Photosynthesis ceases ▪ Limits biochemical reactions
Increased intensity of storms	▪ Disease outbreak ▪ Unbalance of species ▪ Breakage ▪ Increased sedimentation from shore erosion– coral smothering	▪ Significant loss in seagrass coverage ▪ Decline of health	▪ Reduced absorption of carbon ▪ Decline of health
Ocean acidification	▪ Decreases in coral calcification rates ▪ Decreased growth rates and structural strength ▪ Affects the shells of reef organisms such as mollusks and lobster	▪ 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	
Increased air temperature	▪ Coral bleaching	▪ Reduced photosynthetic capacity	▪ Pollination ▪ Impacts the germination of the propagules
Decreased precipitation	▪ Lower reproduction rates ▪ Coral diseases ▪ Death in coral species that aren't able to adapt	▪ Density decline	▪ Limits sediment supply ▪ Distribution and growth rates ▪ Decreased seedling survival

4.2.2. Key Ecosystem Services

The group considered various ecosystem services provided by the PAs. Through expert advice and group consensus, three CCMR ecosystem services were considered to be at greatest risk from climate change. These are:

- **Climate Regulation**
- **Species Recruitment**
- **Habitat Support**

Table 36 summarizes the predicted climate change impacts to these ecosystem services.

Table 36: Predicted climate change impacts to CCMR ecosystem services

Ecosystem Service				
Ecosystem	**Climate Regulation**	**Species Recruitment**	**Habitat Support**	**Climate Change Impact**
Mangroves	Improves water quality by decreasing the strength of water movement, and trapping and settling suspended particles	Ensures viable populations of food species for subsistence and commercial fishing	Provide nursery habitat for many commercial and non-commercial species in their different life stages	Higher sea water levels will affect the distribution of mangroves, most likely leading to a reduction in coverage and thereby reducing the services they provide
	CO_2 absorption			
	Erosion reduction			
Seagrass Communities	Improve water quality by decreasing the strength of water movement, and trapping and settling suspended particles	Ensures viable populations of food species for subsistence and commercial fishing	Provide nursery habitat for many commercial and non-commercial species in their different life stages	Calciferous algae will be affected by acidification of the sea and as such beach replenishment will be negatively affected
	Reduce erosion of Caye Caulker's coastline			Sea level rise will lead to a shift in areas suitable for seagrass (it will disappear from deeper locations) resulting in an overall reduction of coverage within the CCMR
	CO_2 absorption			
Coral Reef System	Protect Caye Caulker and Belize's coastline by dissipating energy from storm surges and waves	Ensures viable populations of food species for subsistence and commercial fishing	Cycle essential nutrients provided by the various fish species	Coral species are affected by higher water temperature and will be increasingly affected over time. While some species may take the place of others, and some may develop resistance over time, the changes may be too rapid for it to occur at any meaningful scale.
	Reduces beach erosion on Caye Caulker, Belize's coastline		Provide nursery habitat for many commercial and non-commercial species in their different life stages	Coral species will also be affected by acidification of the sea and will be increasingly affected over time
			Contains immense biodiversity rivalling tropical rainforests as the most diverse and productive ecosystem on Earth	Sea level rise will lead to a shift in areas suitable for (any surviving) corals (it will disappear from deeper locations) resulting in an overall reduction of coverage within the CCMR
				Deterioration of Corals and possibly seagrasses due to climate change will negatively affect general biodiversity including commercial species

4.2.3. Priority Stakeholder Communities

Caye Caulker Village was selected as the priority stakeholder community in the CCMR stakeholder analysis. Three vulnerability factors were considered:

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; and
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.

Caye Caulker Village was considered to have a high exposure and sensitivity to climate change and low adaptive capacity.

4.2.4. Key Socio-Economic Activities

The stakeholder analysis of CCMR showed that the main socio-economic activities 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.

4.2.5. Developing Adaptation Strategies

General adaptation strategies were identified for integration into the CCMR management Programmes (Table 37). The strategies aim to reduce anthropogenic threats which may exacerbate the impacts of climate change.

Table 37: General Adaptation Strategies for Climate Change Impact

Climate Change Impact Themes	Strategies
Overall impacts of climate change	▪ Buffer the current conservation targets against impacts from climate change by preserving as much of each target as possible.
Reduction in fish catch	▪ Increase/improve enforcement of regulations
Degradation of tourism destination	▪ Implement carrying capacity measures ▪ Increase monitoring of tourism development activities
Degradation of underwater habitat	▪ Install mooring buoys around sensitive areas ▪ Expansion of coral restoration activities ▪ Monitor impact of tourism activities

5. Management Planning

5.1. Management and Organizational Background

Caye Caulker Marine Reserve is managed by the Fisheries Department. The Department has the mandate to sustainably manage and develop Belize's fisheries sector, under the Fisheries Resources Act (No. 7 of 2020).

The Fisheries Department is headed by the Fisheries Administrator and assisted by several technical staff to carry out its functions. The Department's responsibilities is programmed into four units responsible for conservation and sustainable use of fishery resources, registration and licenses, fisheries research, education, liaison with fishing cooperatives, management of marine reserves, fisheries law enforcement, export and research permits (Belize Fisheries Department, 2013).

Figure 21: CCMR Headquarters

The Ecosystems-based Management Unit is one of the four units under the oversight of the Fisheries Administrator and includes the Protected Area Management programme[78]. Under this mandate, the Fisheries Department is able to establish and manage the marine reserves in Belize (including CCMR), under the Protected Area Management (Marine Reserve) programme of the Ecosystems Management Unit (EMU), which is specifically in charge of the management of the Marine Reserves, under the EMU Coordinator. The Department has established a staffed CCMR Base of Operations (Figure 21) on the northern point of the Caye Caulker Forest Reserve for site-level management of the area.

At CCMR, on-site management is under the Reserve Manager, who is supported by two rangers, a marine biologist and a caretaker. These personnel are responsible for the on-site, day-to-day management of the reserve, and will be responsible for the implementation of the management plan through effective use of funds, staff and equipment, and supported by centralized activities such as community engagement and research. The Reserve Manager is required to submit annual operational or work plans, monthly progress reports, and comprehensive annual reports to the Marine Reserves Operations Manager.

[78] The other Units are the Policy and Planning Unit, the Capture Fisheries Unit, and Administration.

An Advisory Committee for CCMR has not been in place for many years. Such a committee would assist Fisheries Department and CCMR with management recommendations.

Based on the regulatory framework, it is proposed that an Advisory Committee be established composed of representatives from key stakeholders, such as the Fisheries Department, Coastal Zone Management Authority and Institute, Tour Guide Association, Belize Tourism Industry Association, Fishermen's Associations and Cooperatives, Village Council representative, Frontier representative, Representative of Private Landowners, and Representative of Tourism Operators.

This committee would have the following Terms of Reference:

- Ensure regular revision and review of management plan;
- Comment on and recommend legislation and regulations (e.g. regarding extension of geographic boundaries of reserve and zoning);
- Provide advice on all applications for permits within the general boundaries of the reserve;
- Report on activities impacting the reserve and liaise with government enforcement agencies;
- Assist in the development of sustainable financing mechanisms for the reserve;
- Advise on and, where appropriate, assist with administrative matters, publicity, community engagement, and interpretive programmes; and
- Review and advise on research proposals and research permit applications related to the reserve.

The first draft management plan was prepared for CCMR in 2004 (McRae, 2004). This current revision (praxi5 Advisory Group, 2020) is to ensure the management plan complies with the updated objectives of the National Protected Area System Plan and National Management Planning frameworks as well as recent enacted laws and policies.

5.2. Review of Management Effectiveness and Success

A management effectiveness self-assessment was conducted for the CCMR in December 2019. The results of the self-assessment indicate that overall management effectiveness is fair with a score of 52%, despite notable weaknesses in security of budget, seascape planning, education outreach, and monitoring and evaluation. This management effectiveness score is lower than the result of an independent management effectiveness assessment conducted in November 2019 which gave a score of 62.58% (Wildtracks, 2019).

The method used for the self-assessment is adopted from procedures set out by the World Bank and is a rapid assessment that utilizes a scorecard questionnaire that includes the six elements of management (context, planning, inputs, process, outputs and outcomes). The method provides

a mechanism to identify needs, constraints and priority actions, and for monitoring progress towards more effective management of protected areas over time.

A review of the management success of implementation of the Programme set out in the 2004-2009 integrated management plan shows that while all of the objectives have been met with some overall level of progress, many of the strategic actions were only partially implemented or undertaken.

5.3. Management Goal and Objectives

The Caye Caulker Marine Reserve was established under the Fisheries Act (Revised Edition 2011) which states that the purpose of a Marine Reserve is to:

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

The overall management purpose of the CCMR is "the protection of the key coral reef, sea grass and mangrove ecosystems, within the multi-zoned marine reserve", to be achieved through the following core management goals:

1. Protect and manage functional samples of important ecological systems (including coral reef and seagrass) to ensure their protection and management.
2. Preserve the value of the area for its intrinsic value and for its socio-ecological and socio-economic potential (including fisheries and tourism), including export of adult marine life in addition to other important marine genetic resources and resource-based activities.
3. Develop sustainable and ecologically balanced recreational and tourism activities that enhance the economic and social benefits of the area.
4. Provide natural areas for the promotion of education and research.

The management purpose and goals of the CCMR are aligned with the vision for the Northern Belize Coastal Complex:

> *A model of functional, river to reef ecosystems supported by dynamic, co-ordinated, trans-boundary, multi-stakeholder partnerships, for the effective stewardship of the environment, all biodiversity, and the socio-economic benefits for present and future generations (Wildtracks, 2016).*

5.4. Management Strategies

5.4.1. Management Zones

Boundaries

The CCMR encompasses a total area of over 9,670 acres (3,913 hectares), with boundary demarcation by marker buoys. The marine reserve was declared through Statutory Instrument (SI) No. 35 of 1998, which was replaced by SI. No. 115 of 2008. The rules and

regulations were gazetted on December 6, 2008, via SI No. 127 of 2008.

Zones

The Marine Reserve currently has three zones, defined by SI No. 127 of 2008 (Figure 22; Appendix 3):

- General Use Zone – 6,199 acres;
- Conservation Zone – 2,029 acres; and
- Preservation Zone (Replenishment Zone) – 1,442 acres.

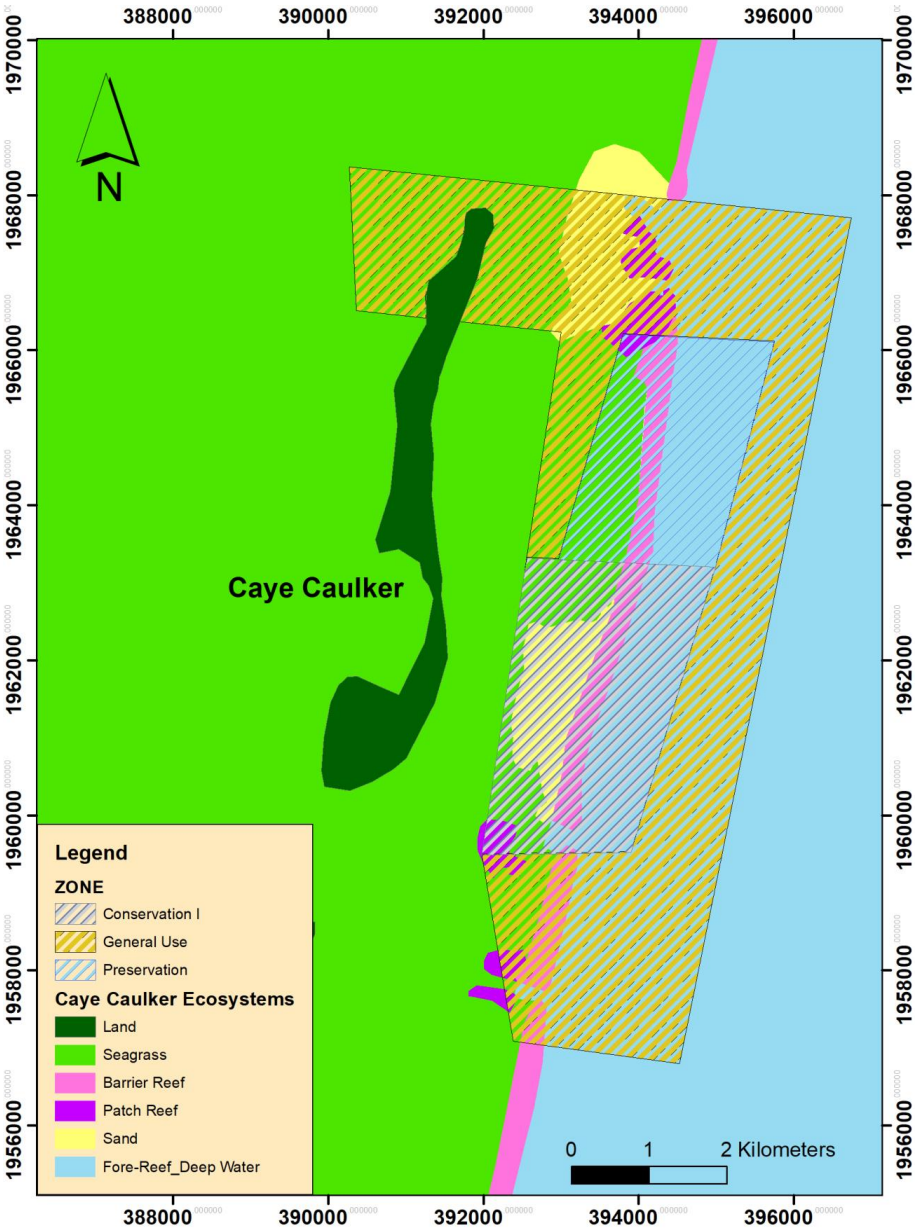


Figure 22: CCMR Management Zones

General Use Zone

1. No person is permitted to use long lines, spear guns or gill nets in the Reserve unless authorized by the Fisheries Administrator.
2. No person shall, within the General Use Zone, cast or drag any anchor in any manner which may damage or cause damage to corals.
3. Commercial fishing is allowed in this zone only with valid fisherfolk license; traps and/or shades must be placed 100m away from corals.
4. Residents of Caye Caulker who have special license to fish may fish solely for subsistence purposes.
5. Sport fishing is allowed under license from the Fisheries Department and in accordance with the following:
   - Spear fishing is not permitted.
   - Catch and release tours can only remove fish for subsistence purposes.

Conservation Zone

1. No fishing or collection of marine items (living or non-living) of any type.
2. There shall only be non-extractive recreational activities in the Conservation Zone.
3. Boats must use appropriate moorings if available; no throwing of anchor on coral reef formations.
4. No feeding of marine life.
5. No person shall engage in water skiing or jet skiing.

Preservation Zone (Replenishment Zone)

1. No fishing, sport fishing, diving, or any other water activities shall be permitted at the Preservation Zone.
2. No person shall operate a motorboat within the Preservation Zone except in case of emergencies, or where written permission has first been obtained from the Fisheries Administrator.

Recommendations:

- The existing zones should be reviewed and, if necessary, revised;
- High resilience reef areas, source populations and key larval dispersal routes should be identified within and around CCMR, and integrated into the decision-making process related to zone revision or CCMR expansion;
- The assessments required should be as participatory as possible, to engage stakeholders, increase their awareness of climate change, and develop support for any zone changes of CCMR extension.

Rules and regulations for each management zone in CCCMR are guided by the Fisheries (Caye Caulker Marine Reserve) Regulations – see Appendix 3.

5.4.2. Limits of Acceptable Change/Carrying Capacity

In order to better protect the CCMR from human activities, the acceptable kinds of resource, social conditions and managerial conditions must be understood. Management actions that can be tracked and traced can then be prescribed to protect or achieve those conditions and allow for stability over time.

Limits of acceptable change, then, are basically the amount of change within the protected area that is considered acceptable as a result of human use. Any amount of human activity will have an impact on the protected area and therefore management should be based on constant monitoring of the site as well as the objectives established for it. It is advisable that within the limits of acceptable change framework, a visitor limit can be established.

For the CCMR, visitor use capacity and guidelines need to be established. A visitor capacity study for the CCMR should be developed via a separate study as new or more information becomes available in the post-Covid times.

Exceeding or not meeting limits of acceptable change for any component of the site may not necessarily indicate that there has been a change in the protected area's ecosystem components, processes, benefits and services. However, when a limit of acceptable change is not met or has been exceeded this may require investigation to determine whether there has indeed been a change in the CCMR's ecological character.

5.4.3. Management Constraints and Limitations

Management constraints for the CCMR mostly come down to lack of sufficient staff and equipment. The Marine Reserve may be small but it envelops a densely populated island. Moreover, the economic base of the islanders depends on two pillars that are partly overlapping but often conflicting: Tourism and Fishing. The clash between the two economic pillars is best demonstrated through the constant sabotaging of buoys that mark the corners of the management zones. Clearly the resources (mostly conch and lobster) within the management zones are important enough for a small group of resource users to go through the considerable effort to move or sabotage the marker buoys. Consequently:

- Staff, financial resources and equipment are not adequate to sufficiently patrol the reserve (particularly at night) to prevent such sabotage; and
- Management of the CCMR has clearly not succeeded in getting support from the resource users on the island resulting in unabated pressure on the resources within the reserve.

While the CCMR is managed by the Fisheries Department and as such is not directly dependent on entrance fees for its management, the current COVID-19 crisis has effectively halted all income from tourism. While the outcome of this crisis is not clear, it will be safe to assume that tourism-based income will remain completely absent for the immediate and at best only slowly recover over the coming decade. The **principal** management constraint for the current management plan period will therefore be:

- A severely reduced or even absent tourism-based income stream potentially resulting in: a) Reduced management, b) Economic hardship on the island; and c) Increasing pressure on the marine resources within the CCMR.

While data is being collected on a number of parameters in and around the CCMR, the data collection remains mostly that. There is little analysis by CCMR managers and even less translation of the outcomes of such analysis into management actions. For all intents and purposes, management remains *ad hoc* and reactive.

There have been attempts to introduce the SMART monitoring tool which is designed to streamline the move from data collection to data management. SMART is dependent on expensive equipment and a certain "IT-Level" expertise of the administrative staff. The successful implementation of SMART therefore depends on a steady budget for frequent replacement of equipment and the constant training of staff.

It should be noted that some of the most important threats to the CCMR such as climate change, marine acidification and tourism pressure are completely out of the control of CCMR management.

5.5. Management Programmes and Objectives

Management programmes are a means of grouping management objectives within related areas – for example, grouping objectives related to natural resource management, or to tourism and recreation management (public use). The strength of the combined programmes is greater than the sum of the individual programmes, as each supports the others over space and time, with areas of overlap that strengthen the overall management of the protected area. It is recognized that several strategies need to be included to strengthen communication and collaboration between programme areas, inter-program collaboration mechanisms for greater adaptive management effectiveness.

Six general management programmes are identified under the National Protected Area Management Plan Framework (NPAMPF), which are recognized by the Updated National Protected Areas System Plan (GOB, 2015). This has been adapted to reflect the five Management Programmes for CCMR:

- **Surveillance and Enforcement Programme**
- **Research and Monitoring Programme**
- **Community Engagement Programme**
- **Tourism and Recreation Management Programme**
- **Administration and Infrastructure Programme**

5.5.1. Surveillance and Enforcement Programme

The **Surveillance and Enforcement Programme** at CCMR is focused on supporting and upholding the Marine Reserve legislation, and to ensure fishing and tourism rules and regulations are

enforced. This falls under the remit of the Reserve Manager and is supported by the Belize Fisheries Department. CCMR's Rangers are also active in the adjacent seascape, with patrols guided by mapping of enforcement hotpots, and focusing on enforcing the Fisheries Legislation.

Surveillance and enforcement efforts are also conducted at enforcement hotpots within the wider Northern Belize Coastal Complex (NBCC), in collaboration with Fisheries Department and the Belize Coast Guard, focused on enforcing the Fisheries Legislation.

Specific strategic objectives under this programme include:

- Maintain effective surveillance and enforcement within and around CCMR in order to deter and prevent illegal activities within MPA boundaries; and
- Maintain an active, well-equipped staff and stakeholder surveillance presence within CCMR in order to ensure that MPA rules and regulations are being followed.

5.5.2. Research and Monitoring Programme

Research and monitoring are essential activities to ensure informed, effective management, and to assess the effectiveness of the CCMR in achieving its objectives. The Research and Monitoring Programme comes under the responsibility of the Reserve Biologist.

Several areas have been identified as priorities for research and monitoring activities through the development of conservation planning actions, or in response to specific research or monitoring requirements.

Major strategic objectives under this programme include:

1. Strengthen the research and monitoring programme for the CCMR in order to support science-based decision-making for adaptive management of the marine reserve.
2. Develop rapid and post assessment mechanisms in order to engage staff and stakeholders in assessing and monitoring impacts on the resources of CCMR.
3. Maintain database of research and monitoring information in order to enhance the level of coordination between researchers (such as Frontier), help identify gaps in information, and provide a platform from which the results can be easily and effectively communicated to a wider audience.

Too often there is a focus on collecting of data and not on data management and analysis. For any monitoring activity that is undertaken, there needs to be a clear understanding of the human resources needed to manage and analyze the collected data.

As a first step there is a need to review all existing monitoring programmes and re-assess suitability of protocols, contribution to the objectives of the reserve, data management and data analysis.

5.5.3. Community Engagement Programme

The threats affecting the conservation targets of the CCMR are mainly land-based and human-induced. These include issues such as: poaching (harvesting in Replenishment Zone), illegal fishing, unsustainable fishing practices, land-based pollution (effluents), inappropriate behaviour by tourists, boat traffic (collision), plastic pollution, among others. At their core, these are behaviour issues and limited consideration of the impacts to the biodiversity of the CCMR over the long terms. The limited staff with management and monitoring responsibilities of the CCMR further compounds the problem. This means that staff are overstretch and limited time can be dedicated to community and stakeholder engagement.

Engagement in this context means the active involvement and participation of community members and stakeholders in the management of the CCMR. In community-focused conservation, broad community representation, stakeholder participation, and the building of social capital are recognized as fundamental to conservation goals given that social and ecological dimensions are entwined. Best management practices in human dimensions of conservation include the integration of culture and traditions, effective public and stakeholder engagement, maintenance of livelihoods and wellbeing, promotion of economic sustainability, conflict management and resolution, transparency and matching in institutions, legitimate and appropriate governance, and social justice and empowerment. Stakeholder engagement and involvement is the basis of a participatory process and is fundamental to acceptance of management actions and by definition the process is not participatory if stakeholders are not involved.

The future of protected areas depends on the respect and actions taken by the next generation of decision-makers. Not only do youth under the age of 30 represent 60% of Belize's national population, but they also represent tomorrow's conservationists, scientists, political and community leaders. Therefore, stakeholder engagement in conservation must become more inclusive and embracing of youth as core to present and future conservation goals. Not only can engaging youth in conservation practices lead to a lifelong affinity and care for marine environments, youth are also uniquely positioned to integrate new technologies into digital and experiential conservation efforts. Moreover, youth have been found to be particularly receptive, expressing greater levels of concern relative to other age groups.

The CCMR Community Engagement Programme will therefore have the following major strategic objectives:

1. Create greater public awareness of the value of and benefits derived from the CCMR;
2. Ensure greater participation in the management activities of the CCMR; and
3. Facilitate learning through experiential education for the youth.

Actual levels of engagement are likely to vary at different times throughout the life cycle of the management plan (5 years) depending on the possible and actual contributions of stakeholders at different times. Most stakeholders are likely to be involved at discrete times throughout the

implementation of the plan rather than all the time. Involvement of all stakeholders all the time for every aspect of the CCMR Management Programmes, would be costly in terms of time and resources, for both the CCMR and the stakeholders.

The methods used for engagement will depend on objectives, the required level of engagement, the timing of when engagement activities are intended to take place, and the expected role of the stakeholder(s). All engagement methods have particular strengths and weaknesses; the key is to choose the right one(s) for the particular purpose and context. Methods should also be selected to meet the needs, capacity and expectations of the relevant stakeholders. More than one method is often desirable, and several methods can be combined to achieve an objective.

A combination of methods will be used to engage stakeholders on an active and regular basis. The feedback from consultations carried out at different levels and time during the management plan implementation will inform the future design of management activities, improve implementation efficiency, and ensure that the plan meets its establish goal. See Appendix 4 to see the main activities of the programme.

5.5.4. Tourism and Recreation Management Programme

The Tourism and Recreation Management Programme covers a number of different responsibilities, overseen largely by the Reserve Manager, through implementation of a visitor management plan and enforcement of visitor regulations, with input from the CCMR staff (for monitoring visitor impacts and developing carrying capacity guidelines).

The Tourism and Recreation Management Programme focuses on three strategic objectives:

- Develop a Visitor Management Plan to mitigate negative impacts and enhance visitor experience, and implement the actions of the plan so as to minimize and mitigate user visitor impacts on the resources of CCMR and enhance the visitor experience benefiting all stakeholders;
- Maintain infrastructure and equipment at acceptable standards in order to ensure visitor safety and visitor satisfaction while ensuring the proper monitoring of visitor use; and
- Develop and maintain the CCMR tourism product.

Under current legislation, visitor management and safety is, to some extent, the responsibility of the tour guides and tour operators. The Reserve Staff also need to monitor visitor activities to ensure compliance with the rules and regulations of the marine reserve. For visitor management to be strengthened, there is a need for certified guides and dive instructors, as well as boat captains, to explain the rules of the CCMR to snorkelers and divers within the Reserve, and ensure that all visiting divers are adequately qualified.

It is recognized that assessments for achieving lower visitation impacts need to be ongoing, and that there needs to be greater education of visitors, tour operators, and tour guides as to Best Practices for tourism use of the marine resources for sustainability.

Physical management of the natural resources, particularly those highlighted as conservation targets, is the responsibility of all CCMR staff. The integration of information collected to ensure adaptive management is essential. CCMR staff implementing management activities targeted at maintaining and improving the viability of conservation targets need to have a clear understanding of the reasons behind these activities, with these activities being guided by the Research and Monitoring Programme, in close collaboration with the Reserve Manager.

The Tourism and Recreation Management Programme also covers activities such as the maintenance of present infrastructure and equipment, and planning for future infrastructure and equipment needs.

Visitor facilities also include mooring buoys, placed at key mooring and dive sites, as well as other important sites (Figure 23), which should be serviced monthly, throughout the year.

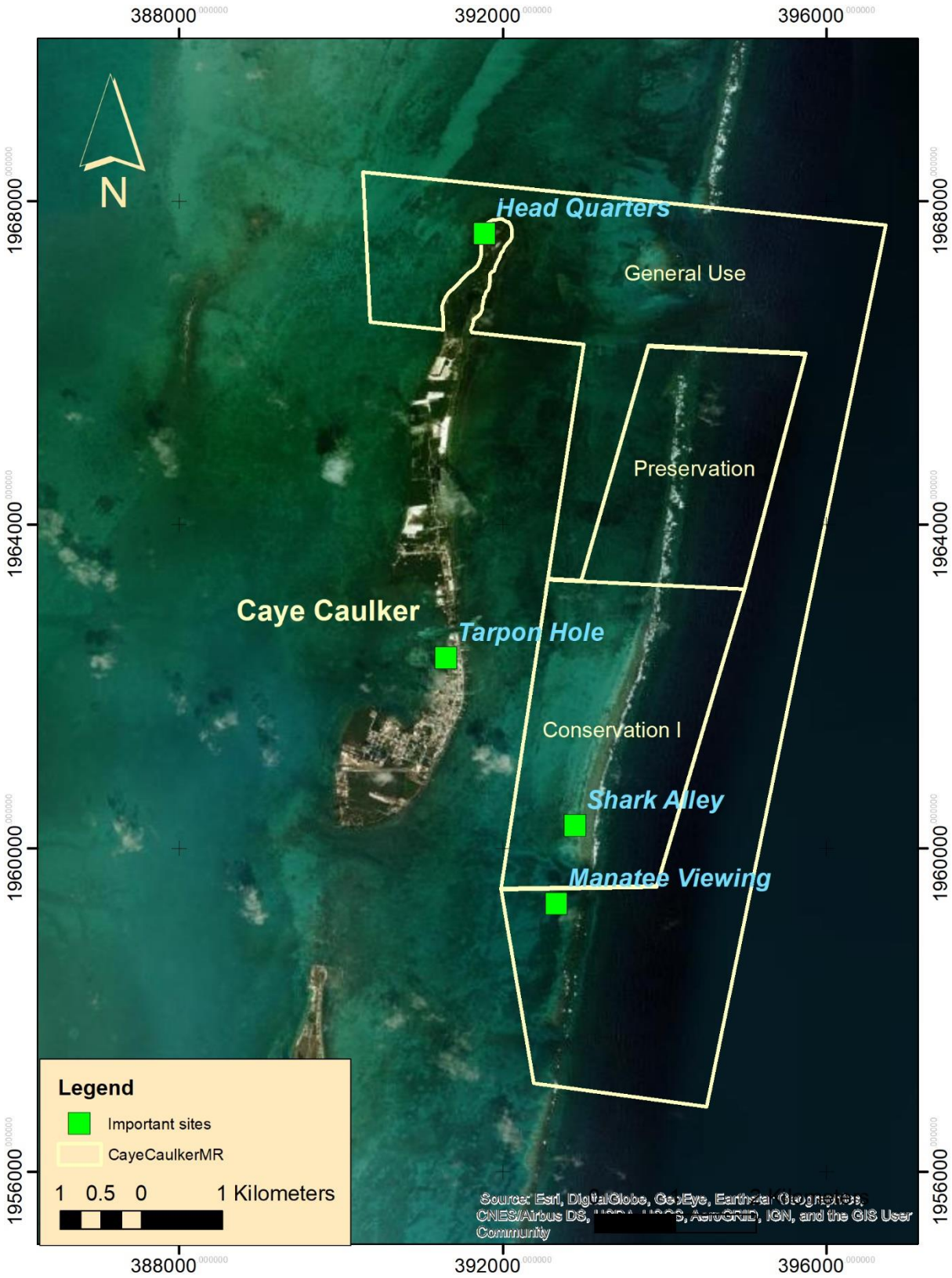


Figure 23: CCMR important sites

MINISTRY OF TOURISM & DIASPORA RELATIONS STP

5.5.5. Administration and Infrastructure Programme

The Administration Programme is centralized at the Reserve headquarters located at the northern point of the Caye Caulker Forest Reserve. CCMR also shares an office with Hol Chan Marine Reserve at Caye Caulker Village.

Activities fall under four major strategic objectives:

- Manage and enhance the human resources of CCMR in order to optimize employee performance in service of the Fisheries Department's resources management objectives;
- Develop a resource mobilization strategy for CCMR and implement thereafter in order to diversify the reserve's funding base and ensure the continuity and sustainability of its management programmes;
- Strengthen the equipment procurement system for CCMR in order to ensure adequate administration infrastructure and planning; and
- Conduct annual review of management activities in order to ensure compliance with the management plan and make adjustments as necessary (adaptive management).

5.6. Management Actions

Table 38: CCMR Management Actions

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
A. Surveillance and Enforcement Programme							
Objective #1: Maintain effective surveillance and enforcement within and around CCMR							
Rationale: To deter and prevent illegal activities within CCMR boundaries.							
1. Ensure improved demarcation of CCMR boundaries to enable visual recognition of boundaries at all points.	Reserve Manager, Rangers						
2. Increase night patrols within CCMR.	Reserve Manager, Rangers						
3. Install mooring buoys where necessary for reducing boat impacts on reef.	Reserve Manager, Rangers						
4. Increase surveillance and enforcement collaboration with Hol Chan Marine Reserve for fisheries infractions in NBCC hotspot areas.	Reserve Manager, Rangers						
5. Support and uphold Fisheries regulations relevant to maintenance of commercial species within the CCMR and NBCC.	Reserve Manager, Rangers						
6. Continue to collaborate with Police Department and Coast Guard for surveillance and enforcement within the CCMR.	Reserve Manager						
Objective #2: Maintain an active, well-equipped staff and stakeholder surveillance presence within CCMR							
Rationale: To ensure that MPA rules and regulations are being followed.							

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
1. Ensure adequate surveillance and enforcement staff on site at CCMR at all times.	Reserve Manager						
2. Engage and train local fishermen and tour guides in fisheries legislation and regulations to increase enforcement presence.	Reserve Manager						
3. Maintain patrol log books for CCMR.	Rangers						
4. Produce monthly and quarterly reports, and submit to Fisheries Department HQ.	CCMR staff						
5. Ensure patrols are fully equipped and rangers trained for effective surveillance and enforcement (including night patrols and reliable radios installed on boats).	Reserve Manager						
6. Ensure ranger station at Caye Caulker Forest Reserve (northern point) is equipped for effective enforcement activities.	Reserve Manager						
B. Research and Monitoring Programme							
Objective #3: Strengthen the research and monitoring programme for the CCMR.							
Rationale: To support science-based decision-making for adaptive management of the marine reserve.							
1. Ensure the Research and Monitoring Programme is equipped and staffed (including a Marine Biologist/Data Manager) for effective program management and strategy implementation	Reserve Manager						

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
2. Re-evaluate the Research and Monitoring Programme to ensure that the objectives and activities will inform the management needs of the CCMR.	Reserve Manager, Biologist and Marine Reserves Science Manager						
3. Ensure that the Research and Monitoring Programme includes the conservation targets: Coral Reef System, Seagrass Communities and Mangroves.	Reserve Manager, MR Science Manager						
4. Re-design the monitoring program to ensure that the sampling design is robust and allows for resource management decisions to be made.	Reserve Manager, Biologist/ Science Manager						
5. Re-evaluate Water Quality Monitoring Programme focussing on location, quality control, and data analysis. Expand with parameters such as nitrates (NO3), nitrites (NO2), ammonia (NH3) and faecal coliform.	Reserve Manager, Biologist/Data Manager/ MR Science Manager						
6. Design a database system to ensure that the data can be easily retrieved or analyzed; and provide training to the research and monitoring staff in database management.	Reserve Manager, Biologist/Data Manager/ MR Science Manager						
7. Train the staff in conducting basic analysis of monitoring data.	Reserve Manager, Biologist/Data Manager, Rangers; MR Science Manager						

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
8. Continue to train the staff, particularly new staff and volunteers, in monitoring protocols to maintain data quality standards.	Reserve Managers, Biologist, Rangers						
9. Strengthen communication and collaboration with current and future (national and international) research partners.	Reserve Manager						
10. Update ecosystem mapping for the Marine Reserve.	MR Science Manager						
Objective #4: Develop rapid and post assessment mechanisms.							
Rationale: To engage staff and stakeholders in assessing and monitoring impacts on the resources of CCMR.							
1. Conduct assessments on the impact of continued dredging within/near CCMR for development in northern Caye Caulker.	Reserve Manager, Biologist, MR Science Manager						
2. Implement an improved protocol to monitor in-water nutrient levels and relative algal growth on a regular basis to monitor anthropogenic impacts within CCMR.	Reserve Manager, Biologist, MR Science Manager						
3. Train tour guides and other stakeholders to participate in monitoring activities.	Reserve Manager, Biologist, MR Science Manager						
C. Community Engagement Programme							
Objective #5: Create greater public awareness of the value of and benefits derived from the CCMR.							
Rationale: So that there is greater support for CCMR from the community, resource users, and the general public.							

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
1. Establish and implement an Annual Community Forum to report on activities and plans for the New Year.	Reserve Manager						
2. Prepare and disseminate a bi-annual electronic Newsletter via social media platforms.	Fisheries Department Main Office						
3. Establish a Visitor Centre for the CCMR on Caye Caulker.	Reserve Manager						
4. Install informative signs of rules and regulations of the reserve.	Reserve Manager						
5. Prepare and disseminate an Annual Fact Sheet to highlight program activities.	Education & Outreach Officer						
6. Conduct educational presentations on various topics at local schools.	Education & Outreach Officer/ Manager/ Biologist						
Objective #6: Ensure greater participation in the management activities of the CCMR.							
Rationale: So that there is greater support for CCMR from resource users.							
1. Provide training sessions to fishers on various but relevant topics on the management of CCMR.	Education & Outreach Officer; MR Science Manager, Rangers						
2. Provide training sessions to tourism and business entities on various but relevant topics on the management of CCMR.	Education & Outreach Officer; Rangers						

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
3. Establish a CCMR Community Advisory Committee made up of various stakeholders to advise on the implementation of the management plan.	Reserve Manager						
4. Participate in Reef Week activities in collaboration with fishers and tourism stakeholders.	Education & Outreach Officer, MR Science Manager						
5. Carry out boat2boat outreach with fishers on a regular basis.	Education & Outreach Officer; Rangers						
Objective #7: Facilitate learning through experiential education for the youth.							
Rationale: To generate greater support for CCMR from the youth and the general public.							
1. Carry out an annual shoreline clean-up campaign with the youth of the village.	Education & Outreach Officer						
2. Implement an annual Reef Summer Camp for students of the village.	Education & Outreach Officer						
3. Carry out School Presentations.	Education & Outreach Officer						
4. Implement an annual marine art competition for local schools in San Pedro and Caye Caulker.	Staff in coordination with the Education & Outreach Officer (Fisheries Department)						

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
5. Establish a citizen science monitoring program specifically tailored for youth participation.	Reserve Biologist; Education & Outreach Officer						
D. Tourism and Recreation Management Programme							
Objective #8: Develop and implement a Visitor Management Plan.							
Rationale: To mitigate negative impacts and enhance visitor experience.							
1. Develop a Visitor Management Plan, including a carrying capacity study and visitor surveys, and implement key recommendations..	Consultant(s); Reserve Manager						
2. Regulation of visitors by visitor types, e.g., via pricing mechanisms.	Consultant						
3. Develop and enforce a more stringent Visitor Code of Conduct.	Consultant						
4. Develop a system of accreditation for Operators at the site.	Consultant						
5. Inform the owners/Captains of bareboat charters (live-aboards) about the regulations and guidelines to operate within CCMR.	CCMR Staff						
6. Enforce recreational policies and regulations e.g., divers/snorkelers: licensed guide ratio (in collaboration with the BTB).	Fisheries Officers and Tourism Police Unit						
7. Exclude jet-ski and water-ski use within the reserve.	CCMR Staff						

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
8. Develop conflict resolution mechanisms and in-house skills for dealing with public use conflicts.	Consultant						
9. Strengthen visitor management, and enforcement of visitor rules and regulations; resulting from Visitor Management Plan.	Reserve Manager						
10. Conduct sensitization programme of the carrying capacity study with users of the CCMR.	Reserve Manager						
11. Conduct an assessment of visitor entrance and user fee structure to maximize revenue.	Consultant						
Objective #9: Maintain infrastructure at acceptable standards.							
Rationale: To ensure visitor safety and proper monitoring of visitor use.							
1. Ensure all rangers are equipped with first aid kits and trained in first aid and CPR, and dealing with marine-based first aid.	Reserve Manager						
2. Prepare an emergency/evacuation plan.	Consultant						
3. Improve designated mooring sites and boat access channels to reduce mechanical impacts on corals by boats.	Reserve Manager						
4. Install sufficient and adequate mooring buoys for visitation requirements.	Reserve Manager						
5. Install warning signs regarding boat access to areas of seagrass beds in shallow areas that have been scarred due to high boat activity.	Reserve Manager, Rangers						
6. Institute mooring buoy use regulations at dive sites.	Reserve Manager, Rangers						

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
7. Implement rule that fishing gear must be kept stowed and secured at all times during transit through, or stopping and anchoring at CCMR (which is already signed into law).	Reserve Manager						
8. Develop and implement a maintenance plan for all infrastructure at the CCMR.	Consultant						
Objective #10: Develop the CCMR tourism product.							
Rationale: To strengthen the competitiveness and sustainable development of CCMR as a tourism destination.							
1. Partner with the BTB to ensure completion of Marine Tour Guide specialization and require only certified marine guides to operate within CCMR	Reserve Manager and Ministry of Tourism/ BTB						
2. Develop a specialized tour guide training component for CCMR guides.	Reserve Manager						
3. Install appropriate buoy markers and signage to complement activities in Objective 9.	Reserve Manager						
4. Create laminated guides highlighting life-forms found within CCMR (to be sold by CCMR management).	CCMR Staff						
5. Develop a volunteer/internship program targeting students from national and international educational institutions with specific skills.	CCMR Administrative Staff						
6. Explore the feasibility to expand CCMR replenishment zones.	Fisheries Administrator						
Objective #11: Market the CCMR tourism product.							
Rationale: To promote CCMR, make it stand out from other destinations, attract visitors, and generate brand awareness.							

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
1. Install signage around Caye Caulker and San Pedro promoting the CCMR.	Reserve Manager						
2. Enhance CCMR's visibility on streamlined website and social media platforms of the Fisheries Department.	Consultant						
3. Set up system for quarterly consultations with Tour Operators and tour guides.	Advisory Committee						
4. Develop an outreach plan to educate schools/institutions about CCMR.	CCMR Staff						
5. Create a promotional video that can be aired on the internet, visitor centres, electronic media, etc.	Ministry of Tourism/ BTB, and Fisheries Dept.						
E. Administration and Infrastructure Programme							
Objective #12: Manage and enhance the human resources of CCMR.							
Rationale: To optimize employee performance in service of the CCMR's conservation objectives.							
1. Explore collaborative management partnership/ arrangement with a suitably qualified NGO.	Fisheries Administrator						
2. Ensure all current and new employees are familiar with organizational policies and procedures of the Fisheries Department.	Reserve Manager						
3. Recruit an additional two Rangers to improve managerial effectiveness (via projects).	Fisheries Administrator						
4. Develop a robust Volunteer Program.	Consultant						

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
5. Ensure staff and volunteers have sufficient administrative training for effective general management, fundamental accounting, budget and proposal/work plan preparation and implementation.	Reserve Manager						
6. Conduct bi-annual evaluation of staff performance and identify human resource skills gaps.	Marine Reserves Operations Manager						
7. Implement training program for all on-site and operational staff members (operation and maintenance of reserve equipment, patrols, monitoring, conflict resolution, first aid, etc.).	Marine Reserves Operations Manager						
8. Ensure all staff working in CCMR have adequate insurance for their roles.	CEO, Ministry of Fisheries						
Objective #13: Strengthen the equipment procurement system for CCMR.							
Rationale: To ensure adequate administration infrastructure and planning.							
1. Develop and implement a five-year infrastructure development and equipment procurement and maintenance plan.	Marine Reserves Operations Manager/EMU Coordinator						
2. Install a permanently staffed sub-station in Caye Caulker Village.	Marine Reserves Operations Manager						
3. Procure an additional fully-rigged boat and engine.	EMU Coordinator						
4. Procure and install (at strategic locations) durable reef moorings, marker buoys and demarcation buoys.	Marine Reserves Manager						

Management Actions	Responsibility	Year					
		2021	2022	2023	2024	2025	→
5. Ensure staff are equipped for health and safety – with extensive first aid kit, life-jackets, fire extinguishers (boat and Ranger Station), and flares at a minimum.	Marine Reserves Operations Manager and Reserve Manager						
6. Ensure ranger equipment (boats, engines, radio equipment, compressor) are adequately maintained.	Reserve Manager						
Objective #14: Conduct annual review of management activities.							
Rationale: To ensure compliance with the management plan and make adjustments as necessary (adaptive management).							
1. Prepare annual work plan and budget in November of each year	Reserve Manager						
2. Conduct management effectiveness self-assessments[79] on a bi-annual basis, for submission to the Fisheries Administrator	Reserve Manager						
3. Conduct "Measures of Success" monitoring on a bi-annual basis	Consultant						
4. Review annual work plans	CCMR staff						
5. Review management plan after 5 years	Consultant						

[79] METT tool is used to conduct assessments.

5.7. Monitoring and Evaluation

Monitoring and evaluation will operate at three levels:

- Managerial efficiency in implementing planned activities – i.e., are planned activities under each programme actually carried out?
- Overall effectiveness of the management regime as organized under the management plan – do these activities add up to a better managed site?
- Success of conservation strategies in containing or reducing levels of threat acting on conservation targets – are the strategies properly targeted, with management improvement leading to improvement in conservation status?

5.7.1. Evaluating managerial efficiency

The following coordination and monitoring process will serve as the mechanism for tracking progress of the Management Plan's implementation and ensuring compliance with assigned responsibilities within the Management Plan. The process includes the following steps:

- The Marine Reserve Operations Manager of the Fisheries Department shall collect monthly updated management objective summary/status reports (see Appendix 5) from the Reserve Manager, who compiles such reports based on input from CCMR personnel, volunteers (including Local Advisory Committee members), and consultants.
- The Reserve Manager, in consultation with the Marine Reserve Operations Manager, ensures that all objectives have been accounted for.
- Monitoring of management plan implementation shall be included as a recurrent agenda item for CCMR staff meetings and Fisheries Department MPA meetings; reporting of the results of such meetings can be done via the Marine Reserve Operations Manager quarterly reports to the Ecosystems Management Unit Coordinator.
- The Marine Reserve Operations Manager, based on consultation and in coordination with the Reserve Manager, makes note of unfinished objectives (shortfalls), needs for readjustments of outcomes and target dates (reforecasts), meetings to be called, etc., on a bi-monthly basis. This is recorded using the Objectives, Responsibilities and Targets (ORT) form (see Appendix 6). Reporting can be done via the Marine Protected Areas Coordinator's quarterly reports to the Ecosystems Management Unit Coordinator.

5.7.2. Assessing managerial effectiveness

The management plan is only a guiding document, setting out a framework for the different actions. Actual implementation is affected by a range of factors that cannot be foreseen up to five years ahead, notably funding availability and the need in practice to modify detailed actions to the terms of financing agreements while maintaining the overall policy thrust.

The principal working documents at this level are the annual plans covering the budget for the organization and for individual programmes. These are then supported by periodic reports, submitted to the Fisheries Department and usually also required by the funding agency

concerned. The cross-check is the key monitoring mechanism for management efficiency, allowing timely remedial action as and when necessary.

Two primary means of assessing overall managerial effectiveness have been used for this plan – the Management Effectiveness Tracking Tool (METT) Self-Assessment Framework and the Review of Management Success Tool. These exercises should be repeated at the end of the first and third years of the lifetime of the plan, and again in the fifth in preparation for the subsequent plan.

The first assessment gives the opportunity for early revision/overhaul of programmes where necessary and the second is essentially a mid-term review, allowing re-orientation as required. The third assessment represents the final assessment of management performance over the planning period.

5.7.3. Monitoring management effectiveness

The METT Self-Assessment Framework reports progress on management effectiveness via a simple and rapid site assessment system.

The assessment focuses on six elements: context (assessment of importance, threats, and policy environment), planning (assessment of CCMR design and planning), inputs (assessment of resources needed to carry out management), processes (assessment of the way in which management is conducted), outputs (assessment of the implementation of management programmes and actions; delivery of products and services); and outcomes (assessment of the outcomes and the extent to which they achieved objectives).

The METT Self-Assessment therefore provides an overview of progress in improving the effectiveness of management in the CCMR, and helps to identify trends and patterns in the management of the CCMR over time.[80]

A more comprehensive management effectiveness evaluation was conducted for CCMR in 2017 and 2019. This management plan will use the average of the 2019 MEE and 2020 METT scores as the baseline management effectiveness evaluation score, in order to include the feedback from the CCMR core planning team (Table 39).

Table 39: MEE Scores (2019 and 2020)

2019 MEE Score[81]	2020 METT Self-Assessment Score	Average MEE Score
62.58%	51.5%	57.04%

[80] The result of the METT Self-Assessment was used for the purposes of the CCMR Management Plan.
[81] Wildtracks, 2019

Ideally, the goal is to lift CCMR's average MEE score from 57.04%[82] to over 70% by the end of the management plan implementation period.

A METT Self-Assessment, guided by an Independent Facilitator, should be conducted at the end of the first and third years of the lifetime of the plan, and again in the fifth in preparation for the subsequent plan. See Appendix 7 for the METT Self-Assessment Framework.

5.7.4. Reviewing management success

The Evaluation of Management Success (using the tool at Appendix 8) reviews the management actions set out in this Management Plan and assesses the degree to which the management actions have been implemented, to what effect, and what gaps remain. The methodology is set out for the National Protected Area System Plan (2019) and is used to guide management actions for the upcoming period.

A review of the management actions set out in the 2004-2009 management plan indicated that 57.7% (117.7 points out of 204 possible points – under a C Rating) of that plan was implemented.[83] The goal is to lift CCMR's management success scores to at least a B rating or above for planned programmes (Improved Rating - Not completely met but situation improved) or over 70% by the end of the management plan implementation period.

5.8. Indicative Financing

The budget figures presented here are only indicative, and reflect budgetary needs over the duration of this management plan (Table 40). Where budget figures are based on annual needs, this figure has been multiplied by the number of years (see Section 5.6 – Management Actions) to reflect the relevant time period.

Furthermore, where a budgetary figure is shown as "-----", this suggests that salaries outlay covers the cost of the activity.

Where the costs of projects or consultancies are not yet known, these are indicated as "Project Funding" meaning that the costs are to be determined.

To understand the projected budgetary outlays for the respective annual time periods, refer to Section 5.6 (Management Actions).

It must be noted also that the indicative budget is specified as "non-staff" or "investments". The non-staff budget refers to operations, training, materials and equipment, travel and per diem, and contracting and consulting fees. The investment budget denotes budgetary requirements for capital investments in infrastructure, vehicles, major equipment, and the like.

[82] This score was assigned via a METT Self-Assessment conducted via the management planning process.
[83] This rating is based on the results of a stakeholder workshop conducted as part of the CCMR management planning process.

Please refer to Section 5.8.1 for the summary of the non-staff and investments indicative budget (Table 41).

Finally, the staff budget is shown separately (Section 5.8.2), and is based on the Administrative Structure presented in Section 5.1 (Table 42).

Table 40: CCMR Indicative Budget (General)

Management Actions	Indicative Budget
A. Surveillance and Enforcement Programme	
Objective #1: Maintain effective surveillance and enforcement within and around CCMR	
7. Ensure improved demarcation of CCMR boundaries to enable visual recognition of boundaries at all points.	$13,200 (bi-annual X 3 = $39,600)
8. Increase night patrols within CCMR.	----- (see Staff Salaries)
9. Install mooring buoys where necessary for reducing boat impacts on reef (including maintenance).	$18,400 (bi-annual X 3 = $55,200)
10. Increase surveillance and enforcement collaboration with Hol Chan Marine Reserve for fisheries infractions in NBCC hotspot areas.	----- (see Staff Salaries)
11. Support and uphold Fisheries regulations relevant to maintenance of commercial species within the CCMR and NBCC.	----- (see Staff Salaries)
12. Continue to collaborate with Police Department and Coast Guard for surveillance and enforcement within the CCMR.	----- (see Staff Salaries)
Objective #2: Maintain an active, well-equipped staff and stakeholder surveillance presence within CCMR	
7. Ensure adequate surveillance and enforcement staff on site at CCMR at all times.	----- (see Staff Salaries)
8. Engage and train local fishermen and tour guides in fisheries legislation and regulations to increase enforcement presence.	$1,000 (annual X 5 = $5,000)
9. Maintain patrol log books for CCMR.	----- (see Staff Salaries)
10. Produce monthly and quarterly reports, and submit to Fisheries Department HQ.	----- (see Staff Salaries)
11. Ensure patrols are fully equipped and rangers trained for effective surveillance and enforcement (including night patrols and reliable radios installed on boats).	----- (see Staff Salaries)

Management Actions	Indicative Budget
12. Ensure ranger station at Caye Caulker Forest Reserve (northern point) is equipped for effective enforcement activities.	$150,000 (equipment investment)
B. Research and Monitoring Programme	
Objective #3: Strengthen the research and monitoring programme for the CCMR.	
11. Ensure the Research and Monitoring Programme is equipped and staffed (including a Marine Biologist/Data Manager) for effective program management and strategy implementation	$7,200 (equipment investment)
12. Re-evaluate the Research and Monitoring Programme to ensure that the objectives and activities will inform the management needs of the CCMR.	----- (see Staff Salaries)
13. Ensure that the Research and Monitoring Programme includes the conservation targets: Coral Reef System, Seagrass Communities and Mangroves.	----- (see Staff Salaries)
14. Re-design the monitoring program to ensure that the sampling design is robust and allows for resource management decisions to be made.	----- (see Staff Salaries)
15. Re-evaluate Water Quality Monitoring Programme focusing on location, quality control, and data analysis. Expand with parameters such as phosphates, nitrates (NO3), nitrites (NO2), ammonia (NH3), biological oxygen demand (BODs), and faecal coliform.	$15,000 (non-staff)
16. Design a database system to ensure that the data can be easily retrieved or analyzed; and provide training to the research and monitoring staff in database management.	----- (see Staff Salaries)
17. Train the staff in conducting basic analysis of monitoring data.	----- (see Staff Salaries)
18. Develop a training programme: to train the staff, particularly new staff and volunteers, in monitoring protocols to maintain data quality standards.	----- (see Staff Salaries)
19. Strengthen communication and collaboration with current and future (national and international) research partners.	----- (see Staff Salaries)
20. Update ecosystem mapping for the Marine Reserve.	----- (see Staff Salaries)
Objective #4: Develop rapid and post assessment mechanisms.	
4. Conduct assessments on the impact of continued dredging within/near CCMR for development in northern Caye Caulker.	----- (see Staff Salaries)

Management Actions	Indicative Budget
5. Implement an improved protocol to monitor in-water nutrient levels and relative algal growth on a regular basis to monitor anthropogenic impacts within CCMR.	----- (see Staff Salaries)
6. Train tour guides and other stakeholders to participate in monitoring activities.	$5,000 (training X 3 = $15,000)
C. Community Engagement Programme	
Objective #5: Create greater public awareness of the value of and benefits derived from the CCMR.	
7. Establish and implement an Annual Community Forum to report on activities and plans for the New Year.	Project Funding ----- (see Staff Salaries)
8. Prepare and disseminate a bi-annual electronic Newsletter via social media platforms.	$5,000 (bi-annual X 2 = $10,000)
9. Establish a Visitor Centre for the CCMR on Caye Caulker.	Project Funding
10. Install informative signs of rules and regulations of the reserve.	Project Funding ----- (see Staff Salaries)
11. Prepare and disseminate an Annual Fact Sheet to highlight program activities.	$1,000 (annual X 5 = $5,000)
12. Conduct educational presentations on various topics at local schools.	----- (see Staff Salaries)
Objective #6: Ensure greater participation in the management activities of the CCMR.	
6. Provide training sessions to fishers on various but relevant topics on the management of CCMR.	----- (see Staff Salaries)
7. Provide training sessions to tourism and business entities on various but relevant topics on the management of CCMR.	----- (see Staff Salaries)
8. Establish a CCMR Community Advisory Committee made up of various stakeholders to advise on the implementation of the management plan.	----- (see Staff Salaries)
9. Participate in Reef Week activities in collaboration with fishers and tourism stakeholders.	----- (see Staff Salaries)
10. Carry out boat2boat outreach with fishers on a regular basis.	----- (see Staff Salaries)
Objective #7: Facilitate learning through experiential education for the youth.	

Management Actions	Indicative Budget
6. Carry out an annual shoreline clean-up campaign with the youth of the village.	----- (see Staff Salaries)
7. Implement an annual Reef Summer Camp for students of the village.	Project Funding ----- (see Staff Salaries)
8. Carry out School Presentations.	----- (see Staff Salaries)
9. Implement an annual marine art competition for local schools in San Pedro and Caye Caulker.	Project Funding ----- (see Staff Salaries)
10. Establish a citizen science monitoring program specifically tailored for youth participation.	Project Funding ----- (see Staff Salaries)
D. Tourism and Recreation Management Programme	
<u>Objective #8</u>: Develop and implement a Visitor Management Plan.	
12. Develop a Visitor Management Plan, including a carrying capacity study and visitor surveys, and implement key recommendations.	$75,000 (non-staff)
13. Regulation of visitors by visitor types, e.g., via pricing mechanisms.	
14. Develop and enforce a more stringent Visitor Code of Conduct.	
15. Develop a system of accreditation for Operators at the site.	
16. Inform the owners/Captains of bareboat charters (live-aboards) about the regulations and guidelines to operate within CCMR.	----- (see Staff Salaries)
17. Enforce recreational policies and regulations e.g., divers/snorkelers: licensed guide ratio (in collaboration with the BTB).	----- (see Staff Salaries)
18. Exclude jet-ski and water-ski use within the reserve.	----- (see Staff Salaries)
19. Develop conflict resolution mechanisms and in-house skills for dealing with public use conflicts.	$10,000 (non-staff)
20. Strengthen visitor management, and enforcement of visitor rules and regulations, resulting from Visitor Management Plan.	----- (see Staff Salaries)
21. Conduct sensitization programme of the carrying capacity study with users of the CCMR.	----- (see Staff Salaries)
22. Conduct an assessment of visitor entrance and user fee structure to maximize revenue.	----- (see Staff Salaries)

Management Actions	Indicative Budget
<u>Objective #9</u>: Maintain infrastructure at acceptable standards.	
9. Ensure all rangers are trained in first aid, especially marine-based first aid and CPR and equipped with first aid kits.	Project Funding ----- (see Staff Salaries)
10. Prepare an emergency/evacuation plan.	----- (see Staff Salaries)
11. Improve and maintain designated mooring sites and boat access channels to reduce mechanical impacts on corals by boats.	----- (see Staff Salaries)
12. Install the necessary and adequate mooring buoys for visitation requirements.	See Objective 1 Action #3 above
13. Install warning signs regarding boat access to areas of seagrass beds in shallow areas that have been scarred due to high boat activity.	Project Funding ----- Combine with Objective 5 Action #4.
14. Institute mooring buoy use regulations at dive sites.	See Objective 1 Action #3 above
15. Implement rule that fishing gear must be kept stowed and secured at all times during transit through, or stopping and anchoring at CCMR (which is already signed into law).	----- (see Staff Salaries)
16. Develop and implement a maintenance plan for all infrastructure at the CCMR.	----- (see Staff Salaries)
<u>Objective #10</u>: Develop the CCMR tourism product.	
7. Partner with the BTB to ensure completion of Marine Tour Guide specialization and require only certified marine guides to operate within CCMR	----- (see Staff Salaries)
8. Develop a specialized tour guide training component for CCMR guides.	Project Funding ----- (see Staff Salaries)
9. Install appropriate buoy markers and signage to complement activities in Objective 9.	-----
10. Create laminated guides highlighting life-forms found within CCMR (to be sold by CCMR management).	Project Funding ----- (see Staff Salaries)
11. Develop a volunteer/internship program targeting students from national and international educational institutions with specific skills.	----- (see Staff Salaries)
12. Explore the feasibility to expand CCMR replenishment zones.	----- (see Staff Salaries)

Management Actions	Indicative Budget
<u>Objective #11</u>: Market the CCMR tourism product.	
6. Install signage around Caye Caulker and San Pedro promoting the CCMR.	----- (see Staff Salaries)
7. Enhance CCMR's visibility on streamlined website and social media platforms of the Fisheries Department.	----- (see Staff Salaries)
8. Set up system for quarterly consultations with Tour Operators and tour guides.	----- (see Staff Salaries)
9. Develop an outreach plan to educate schools/institutions about CCMR.	Project Funding ----- (see Staff Salaries)
10. Create a promotional video that can be aired on the internet, visitor centres, electronic media, etc.	$10,000 (non-staff)
E. Administration and Infrastructure Programme	
<u>Objective #12</u>: Manage and enhance the human resources of CCMR.	
9. Explore collaborative management partnership/ arrangement with a suitably qualified NGO.	----- (see Staff Salaries)
10. Ensure all current and new employees are familiar with organizational policies and procedures of the Fisheries Department.	----- (see Staff Salaries)
11. Recruit an additional two Rangers to improve managerial effectiveness (via projects).	Project Funding
12. Develop a robust Volunteer Program.	----- (see Staff Salaries)
13. Ensure staff and volunteers have administrative training for effective general management, fundamental accounting, budget and proposal/work plan preparation and implementation.	----- (see Staff Salaries)
14. Conduct bi-annual evaluation of staff performance and identify human resource skills gaps.	----- (see Staff Salaries)
15. Implement training program for all on-site and operational staff members (operation and maintenance of reserve equipment, patrols, monitoring, conflict resolution, first aid, etc.).	----- (see Staff Salaries)
16. Ensure all staff working in CCMR have adequate insurance for their roles.	----- (see Staff Salaries)
<u>Objective #13</u>: Strengthen the equipment procurement system for CCMR.	

Management Actions	Indicative Budget
7. Develop and implement a five-year infrastructure development and equipment procurement and maintenance plan.	$10,000 (non-staff) ----- (see Staff Salaries)
8. Install a permanently staffed sub-station in Caye Caulker Village.	Project Funding
9. Procure an additional fully-rigged boat and engine.	$132,000 (equipment investment)
10. Procure and install (at strategic locations) durable reef moorings, marker buoys and demarcation buoys.	-----
11. Ensure staff are equipped for health and safety – with extensive first aid kit, life-jackets, fire extinguishers (boat and Ranger Station), and flares at a minimum.	5,000 (equipment investment)
12. Ensure ranger equipment (boats, engines, radio equipment, compressor) are adequately maintained.	----- (see Staff Salaries)
Objective #14: Conduct annual review of management activities.	
6. Prepare annual work plan and budget in November of each year	----- (see Staff Salaries)
7. Conduct management effectiveness self-assessments on a bi-annual basis (using the METT tool), for submission to the Fisheries Administrator	$4,000 (non-staff) X 2 = $8,000
8. Conduct "Measures of Success" monitoring on a bi-annual basis	Combined with Objective 14 Action #2 above
9. Review annual work plans	----- (see Staff Salaries)
10. Review management plan after five years	$25,000 (non-staff – at end of Year 5)

5.8.1. Indicative Budget – Non-Staff and Investments (Summary)

Table 41: CCMR Indicative Budget (Non-Staff and Investiments)

Management Actions	Indicative Budget
A. Surveillance and Enforcement Programme	
Objective #1: Maintain effective surveillance and enforcement within and around CCMR	$94,800 (equipment investment)
Objective #2: Maintain an active, well-equipped staff and stakeholder surveillance presence within CCMR	$5,000 (training) +

Management Actions	Indicative Budget
	$150,000 (equipment investment)
B. Research and Monitoring Programme	
Objective #3: Strengthen the research and monitoring programme for the CCMR.	$15,000 (non-staff) + $7,200 (equipment investment)
Objective #4: Develop rapid and post assessment mechanisms	$15,000 (training)
C. Community Engagement Programme	
Objective #5: Create greater public awareness of the value of and benefits derived from the CCMR.	$15,000 (investment) + Project Funding
Objective #6: Ensure greater participation in the management activities of the CCMR.	-----
Objective #7: Facilitate learning through experiential education for the youth.	Project Funding
D. Tourism and Recreation Management Programme	
Objective #8: Develop and implement a Visitor Management Plan.	$75,000 (non-staff)
Objective #9: Maintain infrastructure at acceptable standards.	Project Funding
Objective #10: Develop the CCMR tourism product.	Project Funding
Objective #11: Market the CCMR tourism product.	$10,000 (non-staff) + Project Funding
E. Administration and Infrastructure Programme	
Objective #12: Manage and enhance the human resources of CCMR.	Project Funding
Objective #13: Strengthen the equipment procurement system for CCMR.	$10,000 (non-staff) +

Management Actions	Indicative Budget
	$137,000 (equipment investment)
Objective #14: Conduct annual review of management activities.	$33,000 (non-staff)

5.8.2. Indicative Budget – CCMR Staff Salaries

Table 42: CCMR Indicative Budget (Staff Salaries)

Staff Post	Indicative Annual Budget (Gross Salaries)
Reserve Manager (13 years on staff)	$34,101.12
Biologist (2 years on staff)	$20,917.13
Ranger (3 years on staff)	$12,281.28
Ranger (20 years on staff)	$19,708.32
+ Ranger – Year 2	$12,000.00
+ Ranger – Year 4	$12,000.00
Caretaker (6 years on staff)	*$14,160.00*
GRAND TOTAL	**$125,167.85**

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Appendices

Appendix 1 – Known Species Occurring at the CCMR[84]

ORGANISM	Habitat Observed	Lifestage	Residence	List
FUNGI				
Pycnoporus cinnabarinus (Orange-Bracket Fungi)	E3, 4, 5, 10			B
PLANTS				
Phycophyta—Algae				
Division Cyanophyta				
Phormidium corallyticum (Black Band Disease-primary component)*	B2, B4		-	A*
Division Phaeophyta				
Padina gymnospora (Petticoat Algae)	B2, B4		-	A*
Padina sanctae-crucis (" ")	B2, B4			A*
Dictyota spp				A*
Dictyota mertensii				
Dictyota divaricata	C1, B2		-	A*
Dictyota bartrayresi	C1, B2, 4			A*

[84] Key: Habitat of protected area: F1=Fore reef groove/spur; F2=Gorgonian plain; F3=Fore reef crest; C1=Reef crest; B1=Back reef flat; B2=Back reef coral; B3=Back reef Gateway (coral near breaks in the reef); B4=Patch reef behind Barrier; A1=Algae/rubble Zone; L1=Lagoon bare substrate; L2=Lagoon sparse algae bottom; L3=Lagoon –moderate to dense algae bottom; L4=Lagoon-algae/seagrass; L5=Lagoon-sparse seagrass mixed or monoculture (*Halodule, Syringodium)*; L6=Lagoon-moderate-dense seagrass mixed (*Syringodium, Thalassia);* L7=Lagoon-moderate-dense small patches (*Thalassia)*; L8=Lagoon-moderate-dense large patches or expanse (*Thalassia);* L9=On other substrates in seagrass beds; L10-Infauna; L11=intertidal mud/seagrass; M1=Mangrove roots 20 cm to > 1m depth (*Rhizophora mangle)*; M2=Mangrove roots 20 cm to surface (*Rhizophora mangle)*; M3=Lagoons within caye; M4=Other subtidal shoreline habitat; M5=Sealevel mangrove roots/stems-20cm above and below waterline; M6=intertidal mud; E1=Emergent mangroves (>20 cm above water line-*Rhizophora mangle*); E2= Emergent mangroves other species; E3=Emergent mixed vegetation (other mangroves, associates, littoral forest growing together); E4=Emergent littoral thicket (1-3m); E5=Emergent littoral forest/coconut woodland (>3m); E6=Saltmarsh (dominated by *Salicornia* or *Batis);* E7= Strand vegetation; E8= Developed areas; E9=Wrack line; E10=Other low emergent vegetation; E11=Epiphyte; E12=bare sand; W1=water column over fore reef; W2=Water column over back reef or crest; W3=Water column over seagrass/other lagoon bottom; W4=air over sea. Lifestage: No mark=all stages; A=Adult; I=Immature; L=Larval forms/eggs. Residence: No mark=Resident; SR=Seasonal resident; T=Transient; I=Introduced species; H=Historic resident but no recent records. List: A=Observed within Caye Caulker Marine/Forest Reserves by scientists—NOTE: * following the letter —A‖ indicates organism was noted during the between 26 Aug and 25 Dec, 2003 during the REA; B=Observed by scientists at Caye Caulker area in general, therefore likely to occur in CCMR/FR at some place and time; C=Organisms reported Caye Caulker area by nonscientists; D=Organisms observed in areas of Northern Belize similar to Caye Caulker, therefore may be expected to be found at Caye Caulker. (*With several bacteria species, the causative agent of Black Band Disease in reef corals).

Division Phaeophyta	Habitat	Lifestage	Residence	List
Dictyota linearis	B2, 4			A*
Dictyota ciliolata	B4			A*
Sargassum spp	B2	-		A
Sargassum polyceratium	C1			A*
Turbinaria turbinata	B2, 4	-		A*
Division Rhodophyta				
Coelothrix irregularis	B2			A*
Laurencia intricata	L5	-		A*
Laurencia poitei	C, B4			A*
Echeuma ----------	L7-8----------	all	----------	D
Jania adherens	B2			A*
Amphiroa fragilísima	B2,4			A*
Amphiroa rigida	B2			A*
Amphiroa tríbulus	B4			A*
Porolithon pachydermum --	C1, B2,4	-		A*
Galaxaura subverticillata	B4			A*
Wrangelia argus	B4			A*
Division Chlorophyta				
Acetabularia calyculus	M			A*
Avrainvillea longicaulis	L			A*
Cladophora prolifera	B2			A*
Ulva sp	L	-		B
Ventricaria ventricosa--------	L9, B2----------	-	----------	----------A*
Dictyosphaera cavernosa (Green Bubble Weed)	B2, L5	-		A*
Halimeda discoidea	B3, 4	-		A*
Halimeda incrassata	L5, B4	-		A*
Halimeda monile	L5	-		A*
Halimeda opuntia	B2, 4	-		A*
*Caulerpa sertularioloides (*Feather Algae)	M2	-		A*
*Caulerpa racemosa (*Grape Algae)	C, M2			A*
Caulerpa cupressoides	B2			A*
Caulerpa paspaloides	L5	-		A*
Caulerpa prolifera	L6			A*
Cladocephalus luteofuscus	B4			A*
Cladophora prolifera	L			A*
Penecillus capitatus	L4, 5	-		A*
Penecillus pyriformis	L5	-		A*
Rhipocephalus phoenix	L1			A
Acetabularia calyculus	M2			A*
Batophora oerstedi	L5	-		B
Udotea flabellum	L5	-		A*
Neomeris annulata	C1, B2			A*

Vascular Plants	Habitat	Lifestage	Residence	List
Division Coniferophyta-Conifers				
Casaurina equisetifolia	E8	-	I	B
Division Anthophyta-Flowering plants				
Zosteraceae—Seagrasses				
Halodule wrighti (Shoalgrass)	L4, 5	-		A*
Syringodium filiforme (Manateegrass)	L5-9	-		A*
Hydrocharitaceae—Seagrasses				
Thalassia testudinum (Turtlegrass)	L5-9	-		A*
Graminae—Grasses				
Cenchrus tribuloides (Sandspur, Burbur)	E7	-		B
Distichlis spicata (Seashore Saltgrass)	E7			B
Sporobolis virginicus (Seashore Dropseed)	E7			B
Eragrostis dominguensis (Love Grass)	E7			B
Eustachys petraea	E7			B
Cyperaceae				
Cladium jamaicense (Pinchehuevos)	E10			B
Cyperus ligularis (Caribbean Sedge)	E10, E7			A*
Cyperus sp	E10, E7			B
Fimbristylus spathacea	E10, E7			B
Palmae—Palms				
Cocos nucifera (Coconut Palm)	E4, 5		I	A*
Thrinax radiata (Chit, Fan Palm)	E5			A*
Liliaceae—Lilies				
Crinum latifolium (Milk & Honey Lily)	E8	-		B
Hymenocallis (Spiderlily)	E8	-		B
Tillandsia sp. 1 (Bromeliad)	E11			B
Tillandsia sp. 2 (Bromeliad)	E11			B
Orchidaceae				
Brassavola nodosa (Dama de Noche Orchid)	E7,8, 11			B
Schomburgia tibicinis (Cowhorn Orchid)	E11			B
Moraceae				
Ficus sp (Fig)	E5			B
Polygonaceae				
Coccoloba uvifera (Seagrape)	E5			A*
Bataceae				
Batis maritima (Saltwort)	E6			A
Chenopodiaceae				
Salicornia perennis (Glasswort)	E6			A
Amaranthaceae				
Philoxerus vermicularis	E	-		B

Division Anthophyta- Portulacaceae-	Habitat	Lifestage	Residence	List
Portulaca oleracea (Iceplant; Purslane)	E7			B
Azoaceae				
Sesuvium portulacastrum (Seaside Purslane)	E7			B
Rosaceae				
Chrysobalanus icaco (Cocoplum)	E4,5			B
Fabaceae				
Canavalia maritima (Seaside Bean)	E7			B
Crotalaria verrucosa (Cascabel)	E7			B
Pithecellobium keyense (Blackbead)	E4, 5			A*
Sophora tomentosa (Necklace-Pod)	E4,5, 8			B
Vigna luteola (Beach Pea)				B
Surianaceae				
Suriana maritima (Bay Cedar)	E3,4, 5			A*
Burseraceae				
Bursera simaruba (Gumbolimbo)	E5			B
Euphorbia blodgetti	E7			B
Chamaesyce buxifolia				B
Malvaceae				
Hibiscus tiliaceus (Caye Mallow)	E4			B
Sida acuta (Broomweed)				B
Turneraceae				
Turnera ulmifolia (Ramgoat Dashalong)				B
Rhizophoraceae				
Rhizophora mangle (Red Mangrove)	M1-3, E1	-		A*
Combretaceae				
Bucida spinosa		-		B
Conocarpus erectus (Buttonwood)	E2,3,5			A*
Laguncularia racemosa (White Mangrove)	E2, E3	-		A*
Terminalia catappa (Tropical Almond)	E3,5,8		I	B
Apocynaceae				
Catharanthus roseus (Madagascar Periwinkle)	E8		I	B
Convolvulaceae				
Ipomoea macrantha (Moonflower)	E7	-		B
Ipomoea pes-caprae (Seaside Morningglory)	E7			B
Ipomoea stolonifera (Beach Morningglory)	E7			B
Ipomoea sp (Epiphytic Morningglory)	E11			B
Merremia dissecta (Noyo)	E7			B

Division Anthophyta- Boraginaceae-	Habitat	Lifestage	Residence	List
Cordia sebastena (Island Ziricote)	E4, 5			A*
Mallotonia gnaphalodes (Seaside Lavender)	E4, 7			B
Verbenaceae				
Avicennia germinans (Black Mangrove)	E2, E3	-		A*
Lantana involucrata				B
L. sp. (Cimarron)	E4			B
Lippia nodoflora (Lippia)	E2,7			B
Stachytarpheta jamaicense (Vervaine)	E4			B
Solanaceae				
Solanum blodgetti (Nightshade)	E4			B
Rubiaceae				
*Erithalis fruticosa (*Seaside Cherries)	E4, 5			A*
Ernodea littoralis (Beach Creeper)	E4			A*
Hamelia patens (Ixcanan, Firecracker)	E4, 5, 8			B
Spermacoce (Borreria) sauveolens				B
Compositaceae				
Ageratum littorale (Ageratum)	E7			B
Borrichia arborescens (Seaside Oxeye)	E7			B
Wedelia trilobata (Seaside Marigold)	E7			B
ANIMALS				
Phylum Porifera				
Spheciospongia vesparium (Loggerhead Sponge)	L5			A*
Chondrilla nucula (Chicken Liver Sponge)	L3-L9			B
Cliona spp. (Boring Sponges)	B2, 3			B
*Amphimedon compressa (*Red Finger Sponge)	L4-L8			A*
Ulosa ruetzleri (Orange Lumpy Encrusting Sponge)	B4			A*
Calyspongia vaginalis (Tube Sponge)	B4			A*
Phylum Cnidaria				
Class Anthozoa				
Octocorallia				
Briareum asbestinum (Corky Seafinger)	B2,3,4, F2			A*
Pseudopterogorgia bipinnata (Bipinnate Feather-coral)	B2, 4			A*

Phylum Cnidaria—Octocorallia	Habitat	Lifestage	Residence	List
Pseudopterogorgia spp (Sea Plumes)	B4			A*
*Gorgonia ventalina (*Common Seafan)	B2, 3, 4, F2			A*
Eunicea mammosa (Knobby Candelabrum)	B4			A*
Muricea sp	B4			A*
Erythropodium caribaeorum (Encrusting Gorgonian)	B4			A*
Pseudoplexaurella sp. (Searods)	B2			A*
Hexacorallia				
Acropora cervicornis (Staghorn Coral)	B2, 4			A*
Acropora prolifera (Fused Staghorn Coral)	B2			A*
Acropora palmata (Elkhorn Coral)	B1, 2, 3, 4; C			A*
Porites porites (Finger Coral)	L5, B2			A*
Porites branneri (Blue Finger Coral)	B2, 4			A*
*Dendrogyra cylindricus (*Pillar Coral)	B2, 4			A*
Montastraea annularis (Knobby Boulder Coral)	B2, 3, 4, C			A*
Montastraea faveolata (Mountainous Boulder Coral)	B4			A*
Montastraea franksi (Boulder Star Coral)	B2, 4			A*
Montastraea cavernosa (Great Boulder Coral)	B2			A*
Dichocoenia stokesii (Elliptical Star Coral)	B2			A
Favia fragum (Golfball Coral)	B2, 4			A*
Porites asteroides (Mustard Hill Coral)	B2, 3, 4, C			A*
Siderastraea siderea (Massive Starlet Coral)	B2			A*
Siderastraea radians (Lesser Starlet Coral)	B2			A*
Diploria strigosa (Smooth Brain Coral)	B1, 2, 3, 4, C			A*
Diploria clivosa (Knobby Brain Coral)	B2, 3, 4, C			A*
Diploria labrynthiformis (Grooved Brain Coral)	B2, 4			A*
Meandrina meandrites (Maze or Butterprint Coral)	B4			A*

Class Anthozoa-(Hexacorallia)-----Habitat	Lifestage	Residence	List
Manicina aureolata (Rose Coral)	L5		A*
Colpophyllia natans (Boulder Brain Coral)	B2		A
Agaricia agaricites (Lettuce Coral)	B2, 4		A*
Agaricia humilis (Low Lettuce Coral)	B2, 4		A*
Agaricia tenuifolia (Thin-leaf Lettuce Coral)	B2, 3		A*
Agaricia [Sheet Coral]	F1		A*
Agaricia fragilis (Saucer Coral)	B2, 4		A*
Mycetophyllia (Cactus Coral)	B2, 4		A*
Antipatharia			
Antipathes spp (Black Corals)	F1		D
Actinaria			
Condylactis gigantea (Giant Caribbean Anemone)	B2, 4, L9		A*
Stichodactyla helianthus (Carpet or Sun Anemone)	B2		A
Bartholomaea annularis (Ringed Anemone)	B2, A		A*
Lebrunia danae (Branching Anemone)	B2		A
Calliactis tricolor (Tricolour Anemone)	B4		B
Zoanthus pulchellus (Green Zoanthid)	B4		A*
Palythoa caribaeorum (Encrusting Zoanthid)	B4		A
Class Scyphozoa			
Aurelia aurita (Moon Jelly)	W1,2		A
Carybdea spp (Sea Wasps)	W3		B
Linuche unguiculata (Thimble Jellyfish)	W2, 3		B
Cassiopeia xamachana (Mangrove Upside-Down Jellyfish)	L		B
Chrysaura quinquecirrha (Sea Nettle)	W2		
Class Hydrozoa			
Millepora alcicornis (Branching Fire Coral)	B2, 3, 4, C		A*
Millepora complanata (Crenelated Fire Coral)	B4, F3		A*
[Unk. Stinging hydroids]	L9		B

Class Scyphozoa-(Siphonophora)-Habitat	Lifestage	Residence	List
Physalia physalia (Portuguese Man o' War)	W2, 3		B
Porpita porpita (Blue Button)	W2, 3		B
Phylum Ctenophora			
Beroe spp(Comb Jelly)	W2		B
Phylum Platyhelminthes			
Class Turbellaria			
Pseudoceros crozieri (Lined Flatworm)	L9		D
Pseudoceros sp (Black Flatworm)	L9		D
Phylum Nemertinea			
[unk Purple Nemertine]	L9		D
Phylum Annelida			
Class Polychaeta			
Family Sabellidae			
Sabellastarte magnifica (Magnificent Featherduster)	B2		A
Bispira brunnea (Social Featherduster Worms)	B2		A*
Anamobea orstedii (Split-crown Featherduster)	B2		A*
Family Serpulidae			
Pomatostegus stellatus (Red Horseshoe Worm)	B2, C		A*
Spirobranchia gigantea (ChristmasTree Worm)	B2, 4		A*
Spirobranchia sp (Horned Christmas Tree Worm)	B2		A*
Family Amphinomidae			
Hermodyce carunculata (Green or Bearded Fireworm)	B2		A
Family Arenicolidae			
Arenicola cristata (Southern Lugworm)	L4-L9		A*
Family Terrebellidae			
Eupolymnia crassicornis (Spaghetti Worm)	B2		A*
Family Scyllidae			
Odontosyllis enopla (Luminescent Threadworm)	W3		B

Phylum Mollusca	Habitat	Lifestage	Residence	List
Class Bivalvia				
Tellina persica (Puerto Rican Tellin)	L10			B
Arca zebra (Turkey Wing)	L10			B
Brachidontes sp (Dwarf Mussel)	L10			B
Isognamon alatus (Mangrove Oyster)	M2			D
Dendostraea frons (Frons Oyster)	B2			A
Lima scabra (Rough File Shell)	B2			A
Atrina seminuda (Spiny Pen Shell)	L10			A
Phacoides pectinatus (Thick or Tiger Lucine)	L10			A
Anodontia alba (Butter Lucine)	L10			B
Americardia sp (Strawberry Cockle)	L10			B
Laevicardium laevigatum (Egg Cockle)	L10			B
*Pteria colymbus (*Hammer Oyster)	L9			A*
Tellina radiata (Sunrise Tellin)	L			B
Class Gastropoda				
Family Cymatiidae				
Charonia variegata (Triton)	L4-9			B
*Cymatium caribbeum (*Doghead Triton)	L			B
Cymatium femorale (Angular Triton)	L			B
Family Cassidae				
Cassis tuberosa (King Helmet)	L			D
Cassis madagascarensis (Queen or Emperor Helmet)	L			D
Cassis flammea (Flame Helmet)	L			D
Cypraecassis testiculus (Reticulated Cowrie-Hemet)	L, C			A*
Family Strombidae				
Strombus gigas (Queen Conch)	L4-9; B2			A*
Strombus costatus (Milk Conch)	L, B2			A*
Strombus raninus (Hawkwing Conch)	L1			A*
Strombus gallus Roostertail Conch)	C			A*
Strombus pugilis (West-Indian Fighting Conch)	L1, 2			A*
Family Fasciolariidae				
Fasciolaria tulipa (True Tulip)	L, B2			D
Xana americana (West-Indian Chank)	L1			A*

Class Gastropoda-Family Cypraeidae---Habitat	Lifestage	Residence	List
*Cypraea zebra (*Measled Cowrie)	L		D
Cypraea cervus (Atlantic Deer Cowrie)	M2		D
Family Tonnidae			
Tonna maculosa (Partridge Tun)	L10		B
Tonna galea (Giant Tun)	L		D
Family Muricidae			
Murex pomum (Apple Murex)	L4-9		D
Murex recurvirostris) (Rose Murex)	L4-9		D
Family Ovulidae			
Cyphoma gibbosum (Flamingo Tongue)	B2, 4		A*
Family Naticidae			
Polinices lacteus (Milk Moonshell)	L		B
*Natica canrena (*Colourful Atlantic Natica)	L		B
Family Columbellidae			
*Columbella mercatoria (*Common Dove Shell)	L		B
Family Xancidae			
Vasum muricatum (Caribbean Vase)	B2, 4		A*
Family Marginellidae			
Prunum apicinum (Common Atlantic Marginella)	L		B
Family Conidae			
Conus spurius (West-Indian Alphabet Cone)	L		B
Conus verrucosus (Warty Cone)	L		B
Family Trochidae			
Tegula fasciata (Smooth Turban)	L4-9		B
Tegula lividomaculata (West-Indian Tegula)	L4-9		B
Turbo canaliculatus (Channeled Turban)	L4-9		B
Calliostoma javanicum (Chocolate-lined Top Shell)	L4-9		D
Astraea phoebia (Long-spined Starshell)	L4-9		B
Astraea tecta (Imbricated Star-(=*Lithopoma)* Shell)	B2, 4		D
A. caelata (Carved Starshell)	B4, L4-9		A*
Family Neritidae			
Neritina virginea (Virgin Nerite)	L1, M2		B
Nerita tesselata (Checkered Nerite)	L		B

Class Gastropoda- Family Littorinidae ---	Habitat	Lifestage	Residence	List
Littorina angulifera (Mangrove Periwinkle)	M5, E1			B
Tectarius muricatus (Beaded Periwinkle)	L4-9			B
Family Cerithiidae				
Cerithium littoratum (Stocky Cerith)	L5-9			B
Family Bullidae				
Bulla striata (Striated Bubble)	L10			B
Opisthobranchia				
Aplysia dactylomela (Spotted Sea Hare)	L5-9			B
Tridachia crispata (Lettuce Slug)	M2			B
Class Cephalopoda				
Sepioteuthis sepioides (Caribbean Reef Squid)	B2			A
[Octopus]	L			B
Phylum Arthropoda				
Class Insecta				
Order Lepidoptera				
Automerus rubescens	E			B
Ascia monuste (Cabbage Butterfly)	E	A	T	B
Agraulis vanillae	E			B
Euptoieta hegesia	E			B
Danaus gilippus	E			B
D. plexippus	E			B
Phocides pigmalion	E			B
Papilio sp (Swallowtail Butterfly)	E	A	T	B
Order Coleoptera				
[Longhorn Beetle]				B
[Brown Beetle]				
[Fireflies]				
Order Hymenoptera				
[Killer Bees]				
[Digger Bees]				
Order Odonata				
Erithrodiplax berenice	all		PR	B
Anisoptera	?		?	B
Order Diptera				
[Mosquitos]				
[Sandflies]				
[Doctorflies]				
Class Arachnida				
[Mangrove Orb Weaver]	E1			B

Arachnida	---------Habitat	Lifestage	Residence	List
[Grey Jumping Spider]	E1			B
Gasteracanthus aculeatus)				
*(*Spinning Burr)	E1			B
Class Crustacea				
Entomostraca				
Subclass Cirripedia				
Lepas spp (Pelagic Barnacle)	W1-3			B
*[*Sessile barnacles]	M2			B
Malacostraca				
Subclass Peracarida				
Mysidacea				
Mysidium spp Ref. Mysids	B2			A*
Isopoda				
Anilocra laticaudata				
(Parasitic Isopod)	B2			A
Ligia spp (Sea Roach)	E10			B
[Stinging Isopod]	W3			A*
Amphipoda				
Orchestia, Talorchestia spp				
(Beach Hoppers)	E9			B
Subclass Eucarida				
Decapoda-Natantia				
Caridea				
Alphaeus armatus (Red				
Snapping Shrimp)	B2			A
Synapheus sp (#42 Snapping				
Shrimp)	L-; B2			D
[Yellow Snapping Shrimp]	L			D
Stenopus hispidus (Banded Coral				
Shrimp)	L, B2			A
Stenopus scutellatus (Golden				
Coral Shrimp)	L, B2			D
Stenopus sp. (Slender Coral				
Shrimp*)	L			D
Lysmata wurdemanni (Veined				
Shrimp)	L, B			D
Thor amboinsis (Spotted				
Anemone Shrimp)	B2			A
Tozeuma sp (Ocellated Grass				
Shrimp)	L			D
Periclemenes pedersoni				
(Pederson's Cleaning Shrimp)	L, B2			A
Periclemenes yucatanicus				
(Spotted Cleaning Shrimp)	L, B			A

Decapoda---Reptantia---------Habitat	Lifestage	Residence	List
Gnathophyllum americanum (Banded Bumblebee Shrimp)	L		D
Panulirus argus (Caribbean Spiny Lobster)	L, B		A*
Panulirus guttatus (Spotted Spiny Lobster)	L, B2		A
Scyllarides acquinoctialis (Spanish Lobster)	B2		A
Brachyura			
Dromidia antillensis (Lesser Sponge Crab)	L		D
Dromia erythropus (Round Sponge Crab)	L		D
Uca spp (Fiddler Crab)	E1,2,6		B
Sesarma sp (Marsh Crab)	E1,2,3,6,7,9		B
Gecarcinus sp (Land Crab)	E1,2,3		B
Ucides cordatus (Mangrove Crab)	E1		B
Ocypode quadrata (Ghost Crab)	E12		B
*Cardisoma guanhumi (*Great Land Crab)	E		B
Calappa flammea (Flaming Shamefaced Crab)	L		B
Percnon gibbesi (Nimble Spray Crab)	C, B2, 4		A*
Grapsus grapsus (Sally Lightfoot)	E1, 8 (piers)		B
Stenorhynchus seticornis Arrow Crab	L, B2, 4		A*
Pitho aculeatus (Grey Pitho)	L		A*
Microphrys bicornutus (Spotted Decorator)	L		B
Mithrax sculptus (Green Spider Crab)	L, B2		B
M. spinosissimus (Spiny Spider Crab)	L		D
M. cinctimanus (Banded Spider Crab)	B		A
M. forceps (Rock Mithrax)	L		D
M. spp (Spider Crabs)	L, B		D
Dissodactylus primitivus (Heart Urchin Pea Crab)	L		A*

Decapoda---Brachyura---------Habitat	Lifestage	Residence	List
Portunus sebae (Eyed Swimming Crab (Rati)	L		B
P. spp. (Swimming Crabs)	L		B,D
Callinectes spp. (Blue Crabs)	L		D
Carpilus corallinus (Red Coral Crab)	B		A
Panopeus spp (Mud Crabs)	L		B
Menippe mercenaria (Stone Crab)	L		D
Anomura			
Petrolisthes galathinus (Lined Porcelain Crab)	L		D
P. politos (Smooth Porcelain Crab)	L		D
Dardanus venosus (Star-Eyed Hermit Crab)	L		B
Clibinarius tricolor (Tricolour Hermit Crab)	L, M6		B
Coenobita clypeatus (Soldier)	E		A
Petrochirus diogenes (Conch Hermit Crab)	L1, A		A*
Paguristes punticeps (White-Specked (Blueyed) Hermit)	L		B
Hoplocarida			
Squilla spp, *Gonodactylus* sp	L		B,D
Phylum Echinodermata			
Class Asteroidea			
Oreaster reticulata (Cushion Sea Star)	F1; L		A*
Class Ophiuroidea			
Ophiothrix sp (Sponge Brittle Star)	B2,4		A*
Ophionereis reticulata (Reticulated Brittle Star)	L		D
Astrophyton muricatum (Basket Star)	L, B, F		B
Class Echinoidea			
Diadema antillarum (Long-spined Black Sea Urchin)	B		A*
Echinometra lucunter (Rock-Boring Urchin)	B		A*
E. viridis (Reef Urchin)	B		A*
Tripneustes ventricosa (Sea Egg)	B, L		A*

Echindermata---Echinoidea-------Habitat	Lifestage	Residence	List
Eucidaris tribuloides (Slate-pencil Urchin)	B		A*
Lytechinus variegatus (Variable Urchin)	L		D
Meoma ventricosa (Biscuit Urchin)	L		A*
Plagiobrissus grandis (Great Biscuit Urchin)	L		B
Leodia sexiesperforata (6-holed Keyhole Urchin)	L		A*
Class Holothuria			
Holothuria mexicana (Donkey Dung Sea Cucumber)	B		A*
Euapta lappa (Beaded Sea Cucumber)	B		D
Holothuria thomasi (Tigertail or Vacuum-cleaner Sea Cucumber)	B2		A
Phylum Chordata			
Subphylum Urochordata			
Class Ascidiacea			
Ecteinascidia turbinata (Mangrove Tunicate)	M1,4		B
Subphylum Vertebrata			
Class Chondricthyes			
Ginglymostoma cirratum (Nurse Shark)	M2, L, B2,4		A*
Carcharhinis limbatus (Blacktip Shark)	L, B2,3,4		A
Rhinobatus lentigenosus (Guitarfish)	L		A*
Dasyatis americana (Southern Stingray)	L, B2		A*
Aetobatis narinari (Spotted Eagle Ray)	L, B2,4		A*
Narcine brasiliensis (Lesser Electric Ray)	L		B
Urolophus jamaicensis (Yellow Stingray)	L, B2		A
Rhincodon typus (Whaleshark)	W1	T	C
Class Osteichthyes			
Family Elopidae			
Megalops atlanticus (Tarpon)	M1, B2, C, W1		A
Family Albulidae			
Albula vulpes (Bonefish)	L		B

Osteichthyes---Synodontidae -Habitat	Lifestage Residence	List
Synodus intermedius	B2, 4	A
Family Muraenidae		
Gymnothorax funebris (Green Moray)	B2,4	A*
G. moringa (Spotted Moray)	B2	A
Muraena miliaris (Goldentail Moray)	B2	A
Family Ophichthidae		
Myrichthys acuminatus (Sharptail Eel)	L	B
Family Clupeidae		
Harengula humeralis (Redear Herring)	W3	B
H. jaguana (Scaled Sardine)	W3	A
Family Atherinidae (Silversides)	W3	A
Family Exocoetidae		
Cypselurus heterurus (Atlantic Flyingfish)	W1	D
Family Hemirhamphidae		
Hemirhamphus brasiliensis (Ballyhoo)	W2	A*
Family Belonidae		
Tylosurus crocodilus (Houndfish)	W2	A*
Strongylura sp (Needlefish)	W3	
Family Aulostomidae		
Aulostomus maculatus (Trumpetfish)	B2,4	A*
Family Fistulariidae		
Fistularia tabacaria (Cornetfish)	L	B
Family Syngnathidae		
Hippocampus erectus (Lined Seahorse)	L, B2	A
Family Holocentridae		
Holocentrus rufus (Squirrelfish)	B2,3,4, F,C	A*
H. adscionalis (Longjaw Squirrelfish)	B2, C, F	A*
H. vexillarius (Dusky Squirrelfish)	F	A*
H. marianus (Longspine Squirrelfish)	F	A*
Myripristis jacobus (Blackbar Soldierfish)	L	D
Family Serranidae		
Epinephalus striatus (Nassau Grouper)	B2	A
E. morio (Red Grouper)	L	D

Osteichthyes---Serranidae -Habitat	Lifestage	Residence	List
E. itijarra (Goliath Grouper)	B3		A
E. guttatus (Red Hind)	B2		A*
E. adscensionalis (Rock Hind)	F		A*
E. fulvus (Coney)	B2, F		A*
E. cruentatus (Graysby)	B3, 4		A*
Mycteroperca bonaci (Black Grouper)	B2, 3, C, F		A*
M. venenosa (Yellowfin Grouper)	F		A*
M. tigris (Tiger Grouper)	B2, B4, F		A*
Hypoplectrus puella (Barred Hamlet)	B2		A
H. nigricans (Black Hamlet)	B2, 4		A*
H. indigo (Indigo Hamlet)	B3, F		A*
H. unicolor (Butter Hamlet)	L		D
Serranus tigrinus (Harlequin Bass)	A, F		A*
Rypticus saponaceus (Greater Soapfish)	B2		D
R. bistrispinis (Freckled Soapfish)	L		D
Family Grammatidae			
Gramma loreto (Fairy Basslet)	B2, F		A*
G. melacara (Blackcap Basslet)	F		A*
Family Apogonidae			
Apogon maculatus (Flamefish)	B4, L		D
Apogon sp (Cardinalfishes)	L		D
Astrapogon stellatus (Conchfish)	(in Queen Conch)		B
Family Priacanthidae			
Priacanthus cruentatus (Glasseye Snapper)	B4		A*
P. arenatus (Bigeye)	B		A
Family Echineidae			
Echineis spp (Sharksuckers)	L, B		A
Family Inermidae			
Malacanthus plumieri (Sand Tilefish)	A, B2		A
Family Carangidae			
Caranx ruber (Barjack)	B2, 3, 4, C, F		A*
C. bartholomei (Yellow Jack)	B3,4		A*
C. hippos (Crevalle Jack)	B3	T	A
Trachinotus goodei (Palometa)	B3	T	D
T. falcatus (Permit)	B3, 4	T	D
Family Lutjanidae			
Lutjanus apodus (Schoolmaster)	B2, 4, C, F, M1		A*
L. griseus (Grey Snapper)	B4, M1		A*
L. analis (Mutton Snapper)	B2, 4, L7-8		A*
L. mahogani (Mahogany Snapper)	B2, 3, 4, F		

Osteichthyes---Lutjanidae ----Habitat	Lifestage	Residence	List
L. jocu (Dog Snapper)	B3, 4, F		A*
Ocyuris chrysurus (Yellowtail Snapper)	B2, 3, 4, C, F		A*
Family Haemulidae			
Haemulon flavolineatum (French Grunt)	B2, 3, 4, C, F		A*
*H. sciurus (*Bluestriped Grunt)	B2, 4, C, F, L, M1		A*
H. chrysargyreum (Smallmouth Grunt)	B2, 3		A*
H. plumieri (White Grunt)	B2, 3, 4, C, F, L, M1		A*
H. carbonarium (Caesar Grunt)	B2, 4, F		A*
*H. bonariense (*Black Grunt)	B4, F		A*
H. album (Margate)	B4		A*
Anisotremus virginicus (Porkfish)	B2, 3, 4, F, L		A*
Family Lobotidae			
Lobotes surinamensis (Tripletail)	L		B
Family Gerreidae			
Gerres cinereus (Yellowfin Mojarra)	A, B2, L		A*
Eucinostomus sp. (small Mojarras)	L1, M1		B
Family Sparidae			
Calamus spp (Porgies)	B4, F		A*
Family Kyphosidae			
Kyphosus sectatrix (Bermuda Chub)	B2, 3, 4, L9, M1		A*
Family Sciaenidae			
Equetus punctatus (Spotted Drum)	B4, F		A*
E. acuminatus (Highhat)	L		D
Family Mullidae			
Mulloidichthys martinicus (Yellow Goatfish)	B3, 4		A*
M. maculatus (Spotted Goatfish)	B2, 4, F		A*
Family Pempheridae			
Pempheris schomburgki (Glassy Sweepers)	C		A
Family Chaetodontidae			
Chaetodon ocellatus (Spotfin Butterflyfish)	B2, 4, C, F		A*
C. striatus (Banded Butterflyfish)	B4, F		A*
C. capistratus (Foureye Butterflyfish)	B2, 3, 4, F, L, M1		A*
Family Ephippidae			
Chaetodipterus faber (Spadefish)	B3, 4		B
Family Pomacanthidae			
*Holacanthus tricolor (*Rock Beauty)	F		A*
H. ciliaris (Queen Angelfish)	B2, 3, 4, F, L9		A*

Osteichthyes--Pomacanthidae---Habitat	Lifestage	Residence	List
Pomacanthus paru (French Angelfish)	B4, L9		A*
P. arcuatus (Grey Angelfish)	B2, 3, 4, F, L9, M1		A*
Family Pomacentridae			
Microspathodon chrysurus Yellowtail Damselfish)	B2, 3, 4, L9, F		A*
Stegastes partitus (Bicolor Damselfish)	B2, 4, L9, F		A*
S. dorsopunicans (Dusky Damselfish)	B2, 3, 4, C, L9, M1		A*
S. diencaeus (Longfin Damsel)	B2, 3, 4, C, L9		A*
S. leucostictus (Beaugregory)	A, B2, 3, 4, C, F, L9, M1, 2		A*
S. planifrons (3-Spot Damselfish)	B2, 3, 4, L9, F		A*
Chromis insulatus (Sunshinefish)	F		A*
C. cyanea (Blue Chromis)	B2, 4, F		A*
C. multilineatus (Brown Chromis)	B2, 3, F		D
Abedefduf saxatilis (Sergeant Major)	A, B2, 3, 4, C, F, L9, M1, 2		A*
Family Labridae			
Halichoeres radiatus (Puddingfish)	B2, 3, 4, C, F, L9		A*
H. maculipinna (Clown Wrasse)	B2, 3, 4, C		A*
H. garnoti (Yellowhead Wrasse)	B2, 3, 4, F, L9		A*
H. poeyi (Blackear Wrasse)	B2, 4, C, L		A*
H. bivittatus (Slippery Dick)	A, B2, 3, 4, C, F, L1-7		A*
Bodianus rufus (Spanish Hogfish)	B2, 3, 4, C, F, L		A*
Lachnolaimus maximus (Hogfish)	B2, 4, F		A*
Clepticus parrai (Creole Wrasse)	B2, 3, F		A*
Thalassoma bifasciatum (Bluehead Wrasse)	B2, 3, 4, C, F, L9		A*
Hemipteronotus splendens (Green Razorfish)	L5		A*
Family Scaridae			
Scarus vetula (Queen Parrotfish)	B2, 3, 4, F, L9		A*
S. croicensis (Striped Parrotfish)	B2, 3, 4, C, F, L9		A*
S. taeniopterus (Princess Parrotfish)	F		A*
S. coeruleus (Blue Parrotfish)	B2	I	A
S. coelestinus (Midnight Parrotfish)	B2, 3		A
S. guacamaia (Rainbow Parrotfish)	B2, 3		A
Sparisoma chrysopterum (Redtail Parrotfish)	A, B2, 3, 4, C, F, L		A*
S. viride (Stoplight Parrotfish)	B2, 3, 4, C, F, L9		A*
S. rubripinne (Yellowtail (Redfin) Parrotfish)	B2, 3, 4, C, F, L		A*
S. aurofrenatum (Redband Parrotfish)	B2, 3, 4, C, F, L9		A*

Osteichthyes--Sphyraenidae---	Habitat	Lifestage	Residence	List
Sphyraena barracuda (Great Barracuda)	B2, 3, 4, C, F, L9, M1			A*
Family Mugilidae				
Mugil sp (Mullet)	L			B
Family Gobiesocidae				
Acyrtops beryllina (Emerald Clingfish)	L			D
Family Opistognathidae				
Opistognathus sp (Jawfishes)	A, B2			A
Family Gobiidae				
Gobiosoma oceanops (Neon Goby)	B2			A
Coryphopterus sp (Goby)	A, B2			A
Family Labrisomidae				
Malacoctenus sp (Blenny)	L			D
Family Blenniidae				
Ophioblennius atlanticus (Redlip Blenny)	B4, L			A*
Family Batrachoididae				
Sanopus sp (Toadfish)	L, F			A
Family Antennariidae				
Antennarius ocellatus (Ocellated Frogfish)	L			D
Family Ogcocephalidae				
Ogcocephalus nasutus (Shortnose Batfish)	L, M1			B
Family Scombridae				
Scomberomorus cavalla (Kingfish)	B3, F			A
S. sp (Mackerel)	B4			A*
Family Dactylopteridae				
Dactylopterus volitans (Flying Gurnard)	A, B2			A
Family Scorpaenidae				
Scorpaena grandicornis (Plumed Scorpionfish)	L			D
S. plumieri (Spotted Scorpionfish)	A, B2			A
Scorpaenodes caribbaeus (Reef Scorpionfish)	L	I		D
Family Soleidae				
Trinectes inscriptus (Scrawled Sole)	L1			B

Osteichthyes—Bothidae ---Habitat	Lifestage	Residence	List
Bothus lunatus (Peacock Flounder)	A, B2		A
B. ocellatus (Eyed Flounder)	B2		A
Family Balistidae			
Balistes vetula (Queen Triggerfish)	B2, 4, C, F		A*
B. capriscus (Grey Triggerfish)	L		D
Melichthys niger (Black Durgon)	F		A*
Canthidermis sufflamen (Ocean Triggerfish)	B2, C		A
Family Monacanthidae			
Aluterus scriptus (Scrawled Filefish)	B2, L		A
Cantherhines macroceros (White-spotted Fliefish)	B4		A*
C. pullus (Orange-spotted Filefish)	B4		D
Monacanthus sp (small Filefishes)	L		D
Family Acanthuridae			
Acanthurus coeruleus (Blue Tang)	B2, 3, 4, C, F, L2, 4		A*
A. bahianus (Ocean Surgeon)	B2, 4, C, F, L9		A*
A. chirurgus (Doctorfish)	B2, 3, 4, C, F, L2, 3, 8		A*
Family Ostraciidae			
Lactophrys polygonia (Honeycomb Cowfish)	B2		D
L. quadricornis (Scrawled Cowfish)	L		B
L. triqueter (Smooth Trunkfish)	B2, 4		A*
L. bicaudalis (Spotted Trunkfish)	B2		A
L. trigonus (Trunkfish)	B4, L		A*
Family Tetraodontidae			
Sphoeroides splengleri (Bandtail Puffer)	L		B
S. testudineus (Checkered Puffer)	L, M1,2		B
Canthigaster rostrata (Sharpnose Puffer)	B2		A

Osteichthyes—Diodontidae ---	Habitat	Lifestage	Residence	List
Chilomycterus antennatus (Bridled Burrfish)	B3			A
Diodon holacanthus (Balloonfish)	A			A
D. hystrix (Porcupinefish)	B2			A
Class Amphibia				
[Accidental occurrences only]				
Class Testudinea				
Eretmochelys imbricata (Hawksbill Turtle)	B2, 4			A*
Caretta caretta (Loggerhead Turtle)	L, B2			B
Chelonia mydas (Green Turtle)	L, B, F			A
Class Crocodilia				
Crocodilus acutus (American or Saltwater Crocodile)	E1, M1, 3, 5			A
Class Lepidosauromorpha				
Aristrelliger georgensis (Gecko)	E5			A
Phyllodactylus tuberculosis (Gecko)	E5			A
Sphaerodactylus glaucus (Dwarf Gecko)	E		?	A
(Asian House Gecko)	E8		I	B
Ctenosaura similis (Spiny-tailed Iguana or Wishwilly)	E			A
Anolis saigre (Brown Anole)	E1, 2, 3, 4, 5, 6, 7, 8, 10,12			A*
A. limifrons (Forest Gecko)	E5			A
Cnemidophorus sp. (Garden Lizard or Whiptail)	E4, 5, 8, 10			B
Boa constrictor (Boa Constrictor)	E1, 2, 3, 4, 5, 10			B
Drymarchon corais (Blacktail Indigo)	E4, 5		H	B
Class Aves				
Family Procellariidae				
Puffinus lherminieri (Audubon's Shearwater)	W4		V	B
Family Sulidae				
Sula leucogaster (Brown Booby)	W4		V	B
S. sula (Red-footed Booby)	W4		V	B
Family Pelecanidae				
Pelecanus occidentalis (Brown Pelican)	W4			A*

Aves— Phalacrocoracidae---Habitat	Lifestage	Residence	List
Phalacrocorax auritus (Double-Crested Cormorant)	W4		A*
Family Fregatidae			
Fregata magnificens (Magnificent Frigatebird)	W4		A*
Family Ardeidae			
*Ardea herodius (*Great Blue Heron)	L11		A*
A. alba (Great Egret)	L11, M3		A*
Egretta thula (Snowy Egret)	M3		B
E. caerulea (Little Blue Heron)	L11, M3		B
E. tricolor (Tricolour Heron)	L11, M3		B
E. rufescens (Reddish Egret)	L11		B
Bubulcus ibis (Cattle Egret)	E, L11, M3		A
Butorides virescens (Green Heron)	L11, M3		B
Nyctanassa violacea (Yellow Crowned Night-heron)	L11, M3		B
Cochlearius cochlearius (Boat-billed Heron)	L11, M3	V	B
Family Threskiornidae			
Eudocimus albus (White Ibis)	L11, M3		B
Ajaia ajaja (Roseate Spoonbill)	L11, M3	O	B
Family Anatidae			
Anas discors (Blue-winged Teal)	M3	V	B
Family Accipitridae			
Pandion haliaetus (Osprey)	W4		A*
Elanoides forficatus (Swallow-Tailed Kite)	E13	T, V	B
Buteogallus anthracinus (Common Black Hawk)	E13		A*
Buteo brachyurus (Short-tailed Hawk)	E13	V	B
Family Falconidae			
Falco sparverius (American Kestrel)	E4, 10	SR	B
F. columbarius (Merlin)	E	T	B
F. peregrinus (Peregrine Falcon)	E	T	B
Family Rallidae			
Rallus longirostris (Clapper Rail)	E1, 2		B
Aramides axillaris (Rufous-necked Woodrail)	E1, 2, 3, 4, 5		B
Porzana carolina (Sora)	E1	T	B
Family Charadriidae			
Pluvialis squatarola (Black-Bellied Plover)	E7, L11	SR	B
Charadrius alexandrinus (Snowy Plover)	E7	V	B

Aves—Charadriidae ----------Habitat	Lifestage	Residence	List
Charadrius wilsonia (Wilson's Plover)	E7	O	B
Charadrius semipalmatus (Semipalmated Plover)	E7	SR	B
Charadrius vociferus (Killdeer)	E7, 8	SR	B
Family Recurvirostridae			
Himantopus mexicanus (Black-Necked Stilt)	M3	SR	B
Family Scolopacidae			
Tringa melanoleuca (Greater Yellowlegs)	M3	O-T	B
T. flavipes (Lesser Yellowlegs)	M3	O-T	B
T. solitaria (Solitary Sandpiper)	M3	O	B
Catoptrophorus semipalmatus (Willet)	E7	SR	B
Actitis macularia (Spotted Sandpiper)	E7, M3	SR	B
Numenius phaeopus (Whimbrel)	E7, M3	SR	A*
Numenius americanus (Long-Billed Curlew)	E7	O-T	B
Limosa fedoa (Marbled Godwit)	E7	SR	B
Arenaria interpres (Ruddy Turnstone)	E7, 9, M3	SR	B
Calidris alba (Sanderling)	E7	V	B
C. pusilla (Semipalmated Sandpiper)	E7	T	B
C. mauri (Western Sandpiper)	E7, M3	T	B
C. minutilla (Least Sandpiper)	E7, M3	T	B
C. fuscicollis (White-rumped Sandpiper)	E7	V	B
Limnodromus griseus (Short-billed Dowitcher)	E7	SR	B
L. scolopaceus (Long-billed Dowitcher)	E7	V	B
Gallinago gallinago (Common Snipe)	M3, E8	V	B
Laridae			
Larus atricillus (Laughing Gull)	W4		B
L. argentatus (Herring Gull)	W4	V	B
Sterna nilotica (Gull-billed Tern)	W4	V	B
S. maxima (Royal Tern)	W4		B
S. sandvicensis (Sandwich Tern)	W4	SR	B
S. hirundo (Common Tern)	W4	O	B
S. antillarum (Least Tern)	W4	O	B

Aves—Columbidae ----------	Habitat	Lifestage	Residence	List
Columba livia (Rock Dove)	E8		I	B
C. leucocephala (White-crowned Pigeon)	E1, 2, 3, 5		SR	B
Zenaida asiatica (White-winged Dove)	E8, 10			B
Z. macroura (Mourning Dove)	E8		V	B
Columbina passerina (Common Ground Dove)	E1, 2, 3, 4, 5, 8, 10			B
Leptotila jamaicensis (Caribbean Dove)	E1, 2,10		O	B
Family Psittacidae				
Aratinga nana (Aztec Parakeet)	E3, 4, 5, 10, 13		OSR	B
Family Cuculidae				
Coccyzus americanus (Yellow-Billed Cuckoo)	E5, 8, 10		T	B
C. minor (Mangrove Cuckoo)	E1, 5, 10			B
Crotophaga ani (Smooth-billed Ani)	E8, 10		O	B
C. sulcirostris (Groove-billed Ani)	E4, 8, 10		SR	B
Family Caprimulgidae				
Chordeiles acutipennis (Lesser Nighthawk)	E4, 5, 10		T	B
C. minor (Common Nighthawk)	E		V	B
Family Apodidae				
*Chaetura pelagica (*Chimney Swift)	E13		T	B
Family Trochilidae				
Anthracothorax prevostii (Green Breasted Mango)	E1, 2, 3, 4, 5, 8,10			B
Chlorostilbon caniveti (Canivet's Fork-tailed Emerald)	E10		O	B
Amazilia rutila (Cinnamon Hummingbird)	E3, 4, 5, 8, 10			B
Archilochus colubris (Ruby-throated Hummingbird)	E6, 8, 10		T	B
Family Trogonidae				
Trogon melanocephalus (Black-Headed Trogon)	E5, 10		O	B
Family Alcedinidae				
Ceryle alcyon (Belted Kingfisher)	E1, 2, 3, 8		SR	A*
Chloroceryle aenea (Pygmy Kingfisher)	E		T	B
Family Picidae				
Melanerpes pygmaeus (Yucatan or Red-vented Woodpecker)	E1, 2, 3, 5, 10			B
M. aurifrons (Golden-fronted Woodpecker)	E1, 2, 3, 5, 8, 10			B

Aves—Picidae ----------Habitat	Lifestage	Residence	List
Sphyrapicus varius (Yellow-bellied Sapsucker)	E1, 2, 3, 5, 8, 10		A*
Family Tyrannidae			
Elaenia martinica (Caribbean Elaenia)	E1, 2, 3, 5		B
E. flavogaster (Yellow-bellied Elaenia)	E8	O	B
Contopus virens (Eastern Wood-Pewee)	E1, 2, 3, 4, 5, 8, 10	T	B
Empidonax spp. (Flycatchers –small Transient)	E1, 2, 3, 4, 5, 8, 10	T	B
Pyrocephalus rubinus (Vermillion Flycatcher)	E8	V	B
Myiarchus tuberculifer (Dusky-Capped Flycatcher)	M1, 2, 3	?	B
Myiarchus crinitus (Great-crested Flycatcher)	E5, 10	T	B
M. tyrannulus (Brown-crested Flycatcher)	E4, 5, 10	SR	B
Pitangus sulphuratus (Kiskadee)	M1, 2, 3, 4, 5, 10	SR	B
Tyrannus melancholicus (Tropical Kingbird)	E1, 2, 3, 4, 5, 8, 10		B
T. couchi (Couch's Kingbird)	E8, 10	O	B
T. tyrannus (Eastern Kingbird)	E1, 2, 3, 5, 10	T	B
T. dominicensis (Grey Kingbird)	E1, 2, 3, 5, 10	T	B
T. forficatus (Scissortail Flycatcher)	E8	T	B
Family Vireonidae			
Vireo griseus (White-eyed Vireo)	E8, 10	T	B
V. flavifrons (Yellow-throated Vireo)	E5	O	B
V. philadelphicus (Philadelphia Vireo)	E8, 10	O	B
V. olivaceus (Red-eyed Vireo)	E4, 5	T	B
V. magíster (Yucatán Vireo)	E1, 2, 3, 4, 5, 10		A*
Family Hirundinidae			
Progne subis (Purple Martin)	E8, 10, 13	SR	B
Tachycineta bicolor (Tree Swallow)	E13	T	B
T. albilinea (Mangrove Swallow)	E7, 8, W4	O	B
Stelgidopteryx serripennis (Northern Rough-winged Swallow)	E13	O	B
Petrochelidon pyrrhonota (Cliff Swallow)	E13	T	B
P. fulva (Cave Swallow)	E13	V	B
Hirundo rustica (Barn Swallow)	E8, 10	T	B
Family Turdidae			
Catharus fuscicens (Veery)	E3, 4, 5, 8, 10	T	B
C. ustulatus (Swainson's Thrush)	E1, 2, 3, 4, 5, 7, 8, 9, 10	T	B
Hylocichla mustelina (Wood Thrush)	E1, 2, 3, 4, 5, 8, 10	T	B

Aves—Mimidae ----------Habitat	Lifestage	Residence	List
Dumatella carolinensis (Grey Catbird)	E3, 4, 5, 8, 10	SR	B
Melanoptila glabirostris (Black Catbird)	E4, 5, 10		A*
Mimus gilvus (Tropical Mockingbird)	E2, 3, 4, 5, 8, 10		B
Family Bombycillidae			
Bombycilla cedrorum (Cedar Waxwing)	E5, 10	T, SR	B
Family Parulidae			
Vermivora chrysoptera (Golden-Winged Warbler)	E8, 10	O-T	B
V. peregrina (Tennessee Warbler)	E4, 5, 8, 10	SR	B
V. ruficapilla (Nashville Warbler)	E8	T	B
V. virginiae (Virginia's Warbler)	E8, 10	T	B
Parula americana (Northern Parula)	E4, 5	SR	B
Dendroica petechia (Yellow Warbler)	E1, 2, 3, 4, 5, 8, 10	SR	B
D. petechia erythacoides (Mangrove {Yellow} Warbler)	E1, 2, 3, 4, 5, 8, 10		A*
D. pensylvanica (Chestnut-sided Warbler)	E8, 10	T	B
D. magnolia (Magnolia Warbler)	E8, 10	SR	B
D. tigrina (Cape May Warbler)	E8, 10	SR, T	B
D. caerulescens (Black-throated Blue Warbler)	E1, 2, 3, 4, 5, 8, 10	T	A*
D. coronata (Yellow-rumped Warbler)	E1, 2, 3, 4, 5, 6, 7, 8, 10	SR	B
D. virens (Black-throated Green Warbler)	E2, 3, 4	T	B
D. fusca (Blackburnian Warbler)	E1, 2, 10	T	B
D. dominica (Yellow-throated Warbler)	E3, 5, 8, 10	SR	A*
D. discolor (Prairie Warbler)	E4, 5, 7	SR	B
D. palmarum (Palm Warbler)	E1, 2, 3, 4, 6, 7, 8, 9, 10, 12	SR	B
D. castanea (Bay-breasted Warbler)	E4, 5, 8, 10, 12	T	B
D. striata (Blackpoll Warbler)	E8, 10	T	B
D. cerulea (Cerulean Warbler)	E8	T	B
Mniotilta varia (Black-and-white Warbler)	E1, 2, 3, 5, 8, 10	O	B
Setophaga ruticilla (American Redstart)	E1, 2, 3, 4, 5, 8, 10	SR	A*
Protonotaria citrea (Prothonotary Warbler)	E1, 2, 3, 8, 10	T	B
Helmitheros vermivora (Worm-Eating Warbler)	E3, 4, 5	O	B
Limnothlypis swainsoni (Swainson's Warbler)	E5	?	B

Aves—Parulidae ----------	Habitat	Lifestage	Residence	List
Seiurus aurocapillus (Ovenbird)	E1, 2, 3, 4, 5, 8, 10		T	A*
S. novaboracensis (Northern Waterthrush)	E1, 2, 3, 6, 8, 9		SR	B
S. motacilla (Louisiana Waterthrush)	E1, 2, 6		T	B
S. sp. (unk. Waterthrush)	E1			A*
Oporornis formosa (Kentucky Warbler)	E1, 2		V	B
O. philadelphia (Mourning Warbler)	E1, 7, 9		T	B
Geothlypas trichas (Common Yellowthroat)	E3, 4, 10		SR	B
G. poliocephala (Grey-crowned Yellowthroat)	E8		V	B
Wilsonia citrina (Hooded Warbler)	E1, 2, 3, 8, 10		T	B
Wilsonia pusilla (Wilson's Warbler)	E3, 10		T	B
*W. canadensis (*Canada Warbler)	E7		T	B
Icteria virens (Yellow-breasted Chat)	E8		T	B
Family Coeribidae				
Coereba flaveola (Bananaquit)	E3, 4, 5, 8, 10			A*
Family Thraupidae				
Piranga rubra (Summer Tanager)	E1, 2, 3, 5, 8, 10		T	B
P. olivacea (Scarlet Tanager)	E5, 8, 10		T	B
*Thraupis episcopus (*Blue-grey Tanager)	E5, 8		V	B
Euphonia affinis (Scrub Euphonia)	E5		V	B
Family Emberizidae				
Sporophila torqueola (White-Collared Seedeater)	E3, 4, 8, 10			B
Spizella passerina (Chipping Sparrow)	E4, 10		T	B
Chondestes grammacus (Lark Sparrow)	E		V	B
Family Cardinalidae				
Pheucticus ludovicianus (Rose-breasted Grosbeak)	E8, 10		T	B
Guiaraca caerulea (Blue Grosbeak)	E10		T	B
Passerina cyanea (Indigo Bunting)	E10		SR	B
Spiza americana (Dickcissel)	E4, 7, 9,10		T	B
Family Icteridae				
Dolychonyx orizivous (Bobolink)	E10		T	B
*Quiscalus mexicanus (*Great-tailed Grackle)	E8, 10			A*
Molothris aeneus (Bronzed Cowbird)	E8		V	B
*Icterus spurius (*Orchard Oriole)	E4, 5, 8, 10		T	B
*I. cucullatus (*Hooded Oriole)	E4, 5, 8, 10			B

Aves—Icteridae ----------Habitat	Lifestage	Residence	List
I. galbula (Baltimore Oriole)	E4, 5, 8, 10	T	B
Class Mammalia			
Order Rodentia			
Rattus rattus (Roof or Brown Rat)	E	I	B
Order Chiroptera			
[unk. Bats]	E5, 8, 10		B
Order Carnivora			
Felis catus (Housecat)	E	I	B
Order Sirenia			
Trichechus manatus (West-Indian Manatee)	B2, 3, L		A
Order Cetacea			
Tursiops truncatus (Bottlenosed Dolphin)	L		A

Appendix 2 – Birds

eBird Field Checklist
Caye Caulker Forest Reserve (north end)
ebird.org/hotspot/L4057847
79 species (+4 other taxa) - Year-round, All Years[85]

Pigeons and Doves
Rock Pigeon *Columba livia*
White-crowned Pigeon *Patagioenas leucocephala*
Eurasian Collared-Dove *Streptopelia decaocto*
White-winged Dove *Zenaida asiatica*
Mourning Dove *Zenaida macroura*

Cuckoos
Mangrove Cuckoo *Coccyzus minor*

Swifts
Chimney Swift *Chaetura pelagica*

Hummingbirds
Cinnamon Hummingbird *Amazilia rutila*
hummingbird sp. *Trochilidae sp.*

Rails, Gallinules, and Allies
Rufous-necked Wood-Rail *Aramides axillaris*

Shorebirds
Black-bellied Plover *Pluvialis squatarola*
Semipalmated Plover *Charadrius semipalmatus*
Whimbrel *Numenius phaeopus*
Ruddy Turnstone *Arenaria interpres*
Sanderling *Calidris alba*
Least Sandpiper *Calidris minutilla*
Short-billed Dowitcher *Limnodromus griseus*
Spotted Sandpiper *Actitis macularius*
Willet *Tringa semipalmata*

Gulls, Terns, and Skimmers
Laughing Gull *Leucophaeus atricilla*
Least Tern *Sternula antillarum*
Royal Tern *Thalasseus maximus*
Sandwich Tern *Thalasseus sandvicensis*

[85] This checklist is generated with data from eBird (ebird.org), a global database of bird sightings in Belize.

Frigatebirds, Boobies, and Gannets
Magnificent Frigatebird *Fregata magnificens*
Brown Booby *Sula leucogaster*
Red-footed Booby *Sula sula*

Cormorants and Anhingas
Anhinga *Anhinga anhinga*
Double-crested Cormorant *Phalacrocorax auritus*
cormorant sp. *Phalacrocoracidae sp.*

Pelicans
Brown Pelican *Pelecanus occidentalis*

Herons, Ibis, and Allies
Great Blue Heron *Ardea herodias*
Great Egret *Ardea alba*
Snowy Egret *Egretta thula*
Little Blue Heron *Egretta caerulea*
Tricolored Heron *Egretta tricolor*
Cattle Egret *Bubulcus ibis*
Green Heron *Butorides virescens*
Yellow-crowned Night-Heron *Nyctanassa violacea*
White Ibis *Eudocimus albus*
Roseate Spoonbill *Platalea ajaja*

Vultures, Hawks, and Allies
Osprey *Pandion haliaetus*
Common Black Hawk *Buteogallus anthracinus*

Kingfishers
Belted Kingfisher *Megaceryle alcyon*

Woodpeckers
Golden-fronted Woodpecker *Melanerpes aurifrons*
woodpecker sp. *Picidae sp.*

Falcons and Caracaras
Peregrine Falcon *Falco peregrinus*

Tyrant Flycatchers: Pewees, Kingbirds, and Allies
Eastern Wood-Pewee *Contopus virens*
Great Kiskadee *Pitangus sulphuratus*
Tropical Kingbird *Tyrannus melancholicus*

Eastern Kingbird *Tyrannus tyrannus*

Vireos
Yellow-throated Vireo *Vireo flavifrons*
Red-eyed Vireo *Vireo olivaceus*
Yucatan Vireo *Vireo magister*

Martins and Swallows
Purple Martin *Progne subis*
Mangrove Swallow *Tachycineta albilinea*
Barn Swallow *Hirundo rustica*
Cliff Swallow *Petrochelidon pyrrhonota*

Catbirds, Mockingbirds, and Thrashers
Black Catbird *Melanoptila glabrirostris*
Gray Catbird *Dumetella carolinensis*
Tropical Mockingbird *Mimus gilvus*

Blackbirds
Bobolink *Dolichonyx oryzivorus*
Orchard Oriole *Icterus spurius*
Hooded Oriole *Icterus cucullatus*
Baltimore Oriole *Icterus galbula*
Bronzed Cowbird *Molothrus aeneus*
Great-tailed Grackle *Quiscalus mexicanus*

Wood-Warblers
Worm-eating Warbler *Helmitheros vermivorum*
Northern Waterthrush *Parkesia noveboracensis*
Black-and-white Warbler *Mniotilta varia*
Prothonotary Warbler *Protonotaria citrea*
Nashville Warbler *Leiothlypis ruficapilla*
American Redstart *Setophaga ruticilla*
Magnolia Warbler *Setophaga magnolia*
Yellow Warbler *Setophaga petechia*
Chestnut-sided Warbler *Setophaga pensylvanica*
Black-throated Blue Warbler *Setophaga caerulescens*
Palm Warbler *Setophaga palmarum*
Yellow-rumped Warbler *Setophaga coronata*
Yellow-throated Warbler *Setophaga dominica*
Prairie Warbler *Setophaga discolor*

warbler sp. (Parulidae sp.) *Parulidae sp.*

Cardinals, Grosbeaks, and Allies
Summer Tanager *Piranga rubra*

Tanagers and Allies
Bananaquit *Coereba flaveola*

Appendix 3 – Caye Caulker Marine Reserve Regulations

CAYE CAULKER MARINE RESERVE

REGULATIONS 2008

ARRANGEMENT OF REGULATIONS

14. Condition of licenses.

15. Duty to report accidents or damage to property.

16. Non-liability of Government.

17. Application of Fisheries Regulations.

18. Opening days of Reserve.

19. Admission fees.

20. Prohibition of certain acts.

21. Fisheries Administrator may designate certain areas.

22. Rendering fish catch information to rangers.

23. Officers to uphold Regulations.

24. Offences and penalties.

25. Negative Resolution.

BELIZE:

STATUTORY INSTRUMENT

No. 127 of 2008

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REGULATIONS made by the Minister of Agriculture and Fisheries in exercise of the powers conferred upon him by section 13 of the Fisheries Act, Chapter 210 of the Substantive Laws of Belize, Revised Edition 2000-2003; and all other powers thereunto him enabling.

(Gazetted 6th December, 2008.)

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PART I

Preliminary

1. These Regulations may be cited as the

FISHERIES (CAYE CAULKER MARINE RESERVE) REGULATIONS, 2008.

2. In these Regulations, unless the context otherwise requires

"Advisory Committee" means the Committee established under Regulation 3;

"Fisheries Officer" means any fisheries officer, assistant fisheries officer, biologist or ranger employed by the Reserve;

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

"recreational fishing" means fishing for enjoyment and with the intention of eating the fish caught but not for the purpose of selling the fish caught;

"Reserve" means the Caye Caulker Marine Reserve declared under the Fisheries (Caye Caulker Marine Reserve) Order, 1998;

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

"Schedule" means the Schedule to these Regulations;

"sport fishing" means catch and release fishing;

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

PART II

Establishment of an Advisory Committee

3. (1) The Fisheries Administrator shall establish an Advisory Committee for the purpose of assisting in the management of the Reserve.

(2) The Committee members shall be appointed by the post they hold in their organization.

(3) The Committee shall consist of one representative each from the following organizations

(a) Fisheries Department;
(b) Forest Department;
(c) Coastal Zone Management Authority and Institute;
(d) Caye Caulker BTIA;
(e) Caye Caulker Village Council;
(f) Siwa Ban Foundation;
(g) Caye Caulker Tour Guide Association;
(h) FAMRACC;
(i) Northern Fishermen Association;
(j) Sarteneja Fisherman.

PART III

Establishment of Zones and Rules for Zones

4. (1) For the purposes of these Regulations and for the control of the Reserve, there shall be established within the Reserve, the following three zones

(a) the General Use Zone;
(b) the Conservation Zone; and
(c) the Preservation Zone.

(2) The descriptions of the Zones set out above shall be as set out in the Schedule to the Fisheries (Caye Caulker Marine Reserve) Order, 1998.

5. (1) The General Use Zone is restricted to fishing by licensed fishermen who currently use this Zone and a fishermen who is desirous of fishing in this Zone shall apply for a license to fish in accordance with these Regulations.

(2) Residents of Caye Caulker who have special licenses to fish may fish solely for subsistence purposes, and such fishing shall be determined by the terms and conditions of each resident's license.

(3) No person is permitted to use long lines, spear-guns or gill nets in the Reserve unless authorized by the Fisheries Administrator.

(4) Sport Fishing is allowed in the General Use Zone only in accordance with the following

(a) spear fishing is not permitted;

(b) catch and release fishing tours can only remove fish for subsistence purposes during the tour.

(5) No person shall, within the General Use Zone, cast or drag any anchor in any manner which may damage or cause damage to coral.

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

(2) No person shall engage in commercial, sport or subsistence fishing within the Conservation Zone.

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

(4) Every diver in the Conservation Zone shall adhere to the following rules

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

(b) charter dives shall first obtain a license in accordance with these Regulations, before operating in the Conservation Zone and all dive boats shall fly the "divers down flag" when they have divers in the water;

(c) only certified scuba divers, or divers undergoing a training course conducted by a recognized instructor, are allowed to use scuba equipment in the Reserve;

(d) dive guides are required to explain the rules of the Reserve to a diver within the Reserve;

(e) every boat owner desirous of operating a boat in this Zone, shall first register his boat with the Fisheries Administrator in accordance with these Regulations;

(f) every operator of a motor boat shall observe the low wake zone boat way when approaching snorkelers or divers;

(g) for Scuba tours, a maximum of eight divers per licensed dive master is permitted;

(h) for snorkel tours, a maximum of eight snorkelers per licensed tour guide is permitted;

(i) no person shall harass or in any way tamper with any fauna within the Conservation Zone.

(5) For the purpose of this Regulation, "divers down flag" means a flag with a white diagonal stripe upon a red or blue background.

(6) No person shall engage in water-skiing within the Conservation Zone.

7. (1) Subject to sub-regulation (2) below, no fishing, sport fishing, diving or any other water activity shall be permitted within the Preservation Zone.

(2) No person shall operate a motor boat within the Preservation Zone except in cases of emergency, or where written permission has first been obtained from the Fisheries Administrator.

PART IV

Commercial Fishing, Research, and Registration of Dive Boats

8. (1) A person desirous of fishing within the Reserve shall apply to the Fisheries Administrator, in the form prescribed as Form I in the Schedule, for a commercial fishing license.

(2) The Fisheries Administrator may, within fourteen (14) days of the receipt of an application under this Regulation, grant a fishing license in the form prescribed as Form II in the Schedule.

(3) Upon the expiry of a fishing license granted under these Regulations, the license holder may apply to the Fisheries Administrator, in the form prescribed as Form I in the Schedule, for a renewal of that license.

(4) A fee of twenty-five dollars (BZ $25.00) is payable upon the receipt of a fishing license or for the renewal of that license.

9. (1) A person desirous of conducting research within the Reserve shall apply to the Fisheries Administrator, in the form prescribed as Form III in the Schedule, for a license to conduct such research.

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

(3) The Fisheries Administrator may attach conditions to a research license issued under these Regulations.

(4) A fee of five hundred dollars (BZ $500.00) is payable by an applicant upon the receipt of a research license or for the renewal of that license.

(5) The Fisheries Administrator may waive or vary, at his discretion, the fee payable for a research license.

10. (1) A boat operator desirous of conducting SCUBA diving and snorkeling within the Reserve shall apply to the Fisheries Administrator for registration in the form prescribed as Form IV in the Schedule.

(2) A fee of ten dollars (BZ $10.00) is payable by an applicant upon registration of a boat pursuant to sub-regulation (1) above.

(3) Boat registration pursuant to this Regulation expires on the 31st day of December next, after the date of issue.

PART V

General

11. Every license issued pursuant to these Regulations shall not be transferable.

12. Every license issued under these Regulations, unless otherwise stated, is valid until December 31st of any year and may be renewed for a like period upon payment of the fees prescribed in these Regulations.

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

14. In issuing a license under these Regulations, the Fisheries Administrator may attach conditions to such licenses, as the case may be, having due regard to the nature of the license and the need to protect the environment and natural resources.

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

16. The Government is not liable for any personal injury or damage to property occurring within the Reserve.

17. Notwithstanding the provisions of these Regulations, the Fisheries Regulations, as amended, shall apply within the Reserve.

18. The Reserve Office shall be open daily to the public between the hours of 8:00 a.m. to 5:00p.m.

19. (1) The fees payable by foreign visitors for all water recreational activities, excluding sports and recreational fishing, are ten dollars (BZ $10.00) per person per day or thirty dollars (BZ $30.00) per person per week.

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

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

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

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

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

21. (1) The Fisheries Administrator may designate areas for certain activities.

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

22. Every commercial, recreational, subsistence, and sport fisherman shall render to the Reserve Rangers upon request, the weight of fish caught within the Reserve.

23. Every person employed by the Reserve for the purpose of management of the Reserve, is a Fisheries Officer charged with upholding the Reserve Regulations as well as the Fisheries Regulations.

24. (1) A person who contravenes any of the provisions of these Regulations commits an offence and is liable on summary conviction to a fine not exceeding five hundred dollars or to imprisonment for a term not exceeding six months, or to both fine and imprisonment.

(2) A person who damages any coral shall pay an administrative fine not exceeding fifty thousand dollars.

25. These Regulations are subject to negative resolution of the National Assembly.

MADE by the Minister of Agriculture and Fisheries this 17th day of November, 2008.

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(RENE MONTERO)

Minister of Agriculture and Fisheries

Appendix 4 – Community Engagement Programme Activities

Community/Stakeholders	Engagement Methods	Level of Engagement	Timeframe
Local communities	Annual Community Forum	Inform	Annually
	Community Advisory Group	Collaborate	Every quarter
	Bi-annual Newsletter	Inform	Biannually
	Visitor Center	Inform	During Year 3
	Reef Week	Collaborate	Annually
Government	Annual Community Forum	Inform	Annually
	Community Advisory Group	Collaborate	Every quarter
	Bi-annual Newsletter	Inform	Biannually
	Annual Report	Collaborate	Annual
Tourism and Business Entities	Training sessions	Involve	Start of season
	Bi-annual Newsletter	Consult	Biannually
	Annual Report	Involve	Annually
	Annual Community Forum	Collaborate	Annually
	Reef Week	Collaborate	Annually
Commercial Fishers	Training sessions	Involve	Start of season
	Boat2Boat outreach	Consult	Biannually
	Bi-annual Newsletter	Inform	Biannually
	Community Advisory Group	Collaborate	Every quarter
	Annual Community Forum	Inform	Annually
	Annual Report	Inform	Annually
	Reef Week	Collaborate	Annually
Education Institutions	School Presentations	Inform	Twice per quarter
	Art competition	Consult	Annually
	Shoreline Cleanup	Involve	Annually
	Citizen Monitoring	Collaborate	Once every quarter
	Reef Kids Summer Camp	Involve	Annually
	Annual Report	Inform	Annually

Appendix 5 – Monthly Status Report Form

Monthly Status Report
Caye Caulker Marine Reserve
Fisheries Department
Ministry of The Blue Economy & Civil Aviation

Form: FD-CCMR 0001

Management Objectives/Actions	Responsibility	Target Date	Completed? (Yes, No, Ongoing)	Comments

Submitted by:

Name	Signature	Position	Date

Approved by:

Name	Signature	Position	Date

Appendix 6 – Objective, Responsibilities and Targets (ORT) Report Form

ORT Report Form
Caye Caulker Marine Reserve
Fisheries Department
Ministry of The Blue Economy & Civil Aviation

Form: FD-CCMR 0002

Unfinished Management Actions	Adjustment Required	Responsibility	Proposed Target Date	Adjusted Target Date

Submitted by:

Name	Signature	Position	Date

Approved by:

Name	Signature	Position	Date

Appendix 7 – METT Self-Assessment Tool[86]

METT Self-Assessment Tool Form
Caye Caulker Marine Reserve
Fisheries Department
Ministry of The Blue Economy & Civil Aviation

Form: FD-CCMR 0003

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
1. Legal status Does the protected area have legal status (or in the case of private reserves is covered by a covenant or similar)? *Context*	The protected area is not gazetted/covenanted	0			
	There is agreement that the protected area should be gazetted/covenanted but the process has not yet begun	1			
	The protected area is in the process of being gazetted/covenanted but the process is still incomplete (includes sites designated under international conventions, such as Ramsar, or local/traditional law such as community conserved areas, which do not yet have national legal status or covenant)	2			
	The protected area has been formally gazetted/covenanted	3			
2. Protected area regulations Are appropriate regulations in	There are no regulations for controlling land use and activities in the protected area	0			
	Some regulations for controlling land use and activities in the protected area exist but these are major weaknesses	1			

[86] This Self-Assessment Tool is designed to be utilized by CCMR staff without the need for an independent consultant.

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
place to control land use and activities (e.g. hunting)? *Planning*	Regulations for controlling land use and activities in the protected area exist but there are some weaknesses or gaps	2			
	Regulations for controlling inappropriate land use and activities in the protected area exist and provide an excellent basis for management	3			
3. Law enforcement Can staff (i.e. those with responsibility for managing the site) enforce protected area rules well enough? Input	The staff have no effective capacity/resources to enforce protected area legislation and regulations	0			
	There are major deficiencies in staff capacity/resources to enforce protected area legislation and regulations (e.g. lack of skills, no patrol budget, lack of institutional support)	1			
	The staff have acceptable capacity/resources to enforce protected area legislation and regulations but some deficiencies remain	2			
	The staff have excellent capacity/resources to enforce protected area legislation and regulations	3			
4. Protected area objectives Is management undertaken	No firm objectives have been agreed for the protected area	0			
	The protected area has agreed objectives, but is not managed according to these objectives	1			
	The protected area has agreed objectives, but is only partially managed according to these objectives	2			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
according to agreed objectives? Planning	The protected area has agreed objectives and is managed to meet these objectives	3			
5. Protected area design Is the protected area the right size and shape to protect species, habitats, ecological processes and water catchments of key conservation concern? Planning	Inadequacies in protected area design mean achieving the major objectives of the protected area is very difficult	0			
	Inadequacies in protected area design mean that achievement of major objectives is difficult, but some mitigating actions are being taken (e.g. agreements with adjacent land owners for wildlife corridors or introduction of appropriate catchment management)	1			
	Protected area design is not significantly constraining achievement of objectives, but could be improved (e.g. with respect to larger scale ecological processes)	2			
	Protected area design helps achievement of objectives; it is appropriate for species and habitat conservation; and maintains ecological processes such as surface and groundwater flows at a catchment scale, natural disturbance patterns, etc.	3			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
6. Protected area boundary demarcation Is the boundary known and demarcated? Process	The boundary of the protected area is not known by the management authority or local residents/neighbouring land users	0			
	The boundary of the protected area is known by the management authority but is not known by local residents/neighbouring land users	1			
	The boundary of the protected area is known by both the management authority and local residents/neighbouring land users but is not appropriately demarcated	2			
	The boundary of the protected area is known by the management authority and local residents/neighbouring land users and is appropriately demarcated	3			
7. Management plan Is there a management plan and is it being implemented? Planning	There is no management plan for the protected area	0			
	A management plan is being prepared or has been prepared but is not being implemented	1			
	A management plan exists but it is only being partially implemented because of funding constraints or other problems	2			
	A management plan exists and is being implemented	3			
Additional points: *Planning*					

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
7a. Planning process	The planning process allows adequate opportunity for key stakeholders to influence the management plan	+1			
7b. Planning process	There is an established schedule and process for periodic review and updating of the management plan	+1			
7c. Planning process	The results of monitoring, research and evaluation are routinely incorporated into planning	+1			
8. Regular work plan Is there a regular work plan and is it being implemented? Planning/Outputs	No regular work plan exists	0			
	A regular work plan exists but few of the activities are implemented	1			
	A regular work plan exists, and many activities are implemented	2			
	A regular work plan exists, and all activities are implemented	3			
9. Resource inventory	There is little or no information available on the critical habitats, species and cultural values of the protected area	0			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
Do you have enough information to manage the area? Input	Information on the critical habitats, species, ecological processes and cultural values of the protected area is not sufficient to support planning and decision making	1			
	Information on the critical habitats, species, ecological processes and cultural values of the protected area is sufficient for most key areas of planning and decision making	2			
	Information on the critical habitats, species, ecological processes and cultural values of the protected area is sufficient to support all areas of planning and decision making	3			
10. Protection systems Are systems in place to control access/resource use in the protected area? *Process/Outcome*	Protection systems (patrols, permits etc) do not exist or are not effective in controlling access/resource use	0			
	Protection systems are only partially effective in controlling access/resource use	1			
	Protection systems are moderately effective in controlling access/resource use	2			
	Protection systems are largely or wholly effective in controlling access/ resource use	3			
11. Research Is there a programme of	There is no survey or research work taking place in the protected area	0			
	There is a small amount of survey and research work but it is not directed towards the needs of protected area management	1			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
management-orientated survey and research work? Process	There is considerable survey and research work but it is not directed towards the needs of protected area management	2			
	There is a comprehensive, integrated programme of survey and research work, which is relevant to management needs	3			
12. Resource management Is active resource management being undertaken?	Active resource management is not being undertaken	0			
	Very few of the requirements for active management of critical habitats, species, ecological processes and cultural values are being implemented	1			
	Many of the requirements for active management of critical habitats, species, ecological processes and, cultural values are being implemented but some key issues are not being addressed	2			
Process	Requirements for active management of critical habitats, species, ecological processes and, cultural values are being substantially or fully implemented	3			
13. Staff numbers	There are no staff	0			
	Staff numbers are inadequate for critical management activities	1			
Are there enough people employed	Staff numbers are below optimum level for critical management activities	2			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
to manage the protected area? Inputs	Staff numbers are adequate for the management needs of the protected area	3			
14. Staff training Are staff adequately trained to fulfil management objectives? Inputs/Process	Staff lack the skills needed for protected area management	0			
	Staff training and skills are low relative to the needs of the protected area	1			
	Staff training and skills are adequate, but could be further improved to fully achieve the objectives of management	2			
	Staff training and skills are aligned with the management needs of the protected area	3			
15. Current budget Is the current budget sufficient?	There is no budget for management of the protected area	0			
	The available budget is inadequate for basic management needs and presents a serious constraint to the capacity to manage	1			
	The available budget is acceptable but could be further improved to fully achieve effective management	2			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
Inputs	The available budget is sufficient and meets the full management needs of the protected area	3			
16. Security of budget Is the budget secure? Inputs	There is no secure budget for the protected area and management is wholly reliant on outside or highly variable funding	0			
	There is very little secure budget and the protected area could not function adequately without outside funding	1			
	There is a reasonably secure core budget for regular operation of the protected area but many innovations and initiatives are reliant on outside funding	2			
	There is a secure budget for the protected area and its management needs	3			
17. Management of budget Is the budget managed to meet critical management needs?	Budget management is very poor and significantly undermines effectiveness (e.g. late release of budget in financial year)	0			
	Budget management is poor and constrains effectiveness	1			
	Budget management is adequate but could be improved	2			
	Budget management is excellent and meets management needs	3			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
Process					
18. Equipment Is equipment sufficient for management needs? *Input*	There are little or no equipment and facilities for management needs	0			
	There are some equipment and facilities, but these are inadequate for most management needs	1			
	There are equipment and facilities, but still some gaps that constrain management	2			
	There are adequate equipment and facilities	3			
19. Maintenance of equipment Is equipment adequately maintained? *Process*	There is little or no maintenance of equipment and facilities	0			
	There is some *ad hoc* maintenance of equipment and facilities	1			
	There is basic maintenance of equipment and facilities	2			
	Equipment and facilities are well maintained	3			
20. Education and awareness Is there a planned education programme linked	There is no education and awareness programme	0			
	There is a limited and *ad hoc* education and awareness programme	1			
	There is an education and awareness programme but it only partly meets needs and could be improved	2			
	There is an appropriate and fully implemented education and awareness programme	3			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
to the objectives and needs? Process					
21. Planning for land and water use Does land and water use planning recognise the protected area and aid the achievement of objectives? *Planning*	Adjacent land and water use planning does not take into account the needs of the protected area and activities/policies are detrimental to the survival of the area	0			
	Adjacent land and water use planning does not take into account the long term needs of the protected area, but activities are not detrimental the area	1			
	Adjacent land and water use planning partially takes into account the long term needs of the protected area	2			
	Adjacent land and water use planning fully takes into account the long term needs of the protected area	3			
Additional points: Land and water planning					
21a: Land and water planning for habitat conservation	Planning and management in the catchment or landscape containing the protected area incorporates provision for adequate environmental conditions (e.g. volume, quality and timing of water flow, air pollution levels, etc.) to sustain relevant habitats.	+1			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
21b: Land and water planning for connectivity	Management of corridors linking the protected area provides for wildlife passage to key habitats outside the protected area (e.g. to allow migratory fish to travel between freshwater spawning sites and the sea, or to allow animal migration).	+1			
21c: Land and water planning for ecosystem services & species conservation	Planning addresses ecosystem-specific needs and/or the needs of particular species of concern at an ecosystem scale (e.g., volume, quality and timing of freshwater flow to sustain particular species, fire management to maintain savannah habitats, etc.)	+1			
22. State and commercial neighbours Is there co-operation with adjacent land and water users? *Process*	There is no contact between managers and neighbouring official or corporate land and water users	0			
	There is contact between managers and neighbouring official or corporate land and water users but little or no cooperation	1			
	There is contact between managers and neighbouring official or corporate land and water users, but only some co-operation	2			
	There is regular contact between managers and neighbouring official or corporate land and water users, and substantial co-operation on management	3			
23. Traditional people	Traditional peoples have no input into decisions relating to the management of the protected area	0			
	Traditional peoples have some input into discussions relating to management but no direct role in management	1			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
Do traditional peoples resident or regularly using the protected area have input to management decisions? Process	Traditional peoples directly contribute to some relevant decisions relating to management, but their involvement could be improved	2			
	Traditional peoples directly participate in all relevant decisions relating to management, e.g. co-management	3			
24. Local communities Do local communities resident or near the protected area have input to management decisions? Process	Local communities have no input into decisions relating to the management of the protected area	0			
	Local communities have some input into discussions relating to management but no direct role in management	1			
	Local communities directly contribute to some relevant decisions relating to management, but their involvement could be improved	2			
	Local communities directly participate in all relevant decisions relating to management, e.g., co-management	3			
Additional points Local communities/indigenous people					
24 a. Impact on communities	There is open communication and trust between local and/or indigenous people, stakeholders and protected area managers	+1			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
24b. Impact on communities	Programmes to enhance community welfare, while conserving protected area resources, are being implemented	+1			
24c. Impact on communities	Local and/or indigenous people actively support the protected area	+1			
25. Economic benefit Is the protected area providing economic benefits to local communities, e.g. income, employment, payment for environmental services? Outcomes	The protected area does not deliver any economic benefits to local communities	0			
	Potential economic benefits are recognised and plans to realise these are being developed	1			
	There is some flow of economic benefits to local communities	2			
	There is a major flow of economic benefits to local communities from activities associated with the protected area	3			
26. Monitoring and evaluation Are management activities	There is no monitoring and evaluation in the protected area	0			
	There is some *ad hoc* monitoring and evaluation, but no overall strategy and/or no regular collection of results	1			
	There is an agreed and implemented monitoring and evaluation system but results do not feed back into management	2			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
monitored against performance? Planning/Process	A good monitoring and evaluation system exists, is well implemented and used in adaptive management	3			
27. Visitor facilities Are visitor facilities adequate? Outputs	There are no visitor facilities and services despite an identified need	0			
	Visitor facilities and services are inappropriate for current levels of visitation	1			
	Visitor facilities and services are adequate for current levels of visitation but could be improved	2			
	Visitor facilities and services are excellent for current levels of visitation	3			
28. Commercial tourism operators Do commercial tour operators contribute to	There is little or no contact between managers and tourism operators using the protected area	0			
	There is contact between managers and tourism operators, but this is largely confined to administrative or regulatory matters	1			
	There is limited co-operation between managers and tourism operators to enhance visitor experiences and maintain protected area values	2			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
protected area management? Process	There is good co-operation between managers and tourism operators to enhance visitor experiences, and maintain protected area values	3			
29. Fees If fees (i.e. entry fees or fines) are applied, do they help protected area management? Inputs/Process	Although fees are theoretically applied, they are not collected	0			
	Fees are collected, but make no contribution to the protected area or its environs	1			
	Fees are collected, and make some contribution to the protected area and its environs	2			
	Fees are collected and make a substantial contribution to the protected area and its environs	3			
30. CONDITION OF VALUES What is the condition of the important values of the protected area as compared	Many important biodiversity, ecological or cultural values are being severely degraded	0			
	Some biodiversity, ecological or cultural values are being severely degraded	1			
	Some biodiversity, ecological and cultural values are being partially degraded, but the most important values have not been significantly impacted	2			

Issue	Criteria	Score: Tick only one box per question		Comments/Explanation	Next steps
to when it was first designated? *Outcomes*	Biodiversity, ecological and cultural values are predominantly intact	3			
Additional Points: Condition of values					
30a: Condition of values	The assessment of the condition of values is based on research and/or monitoring	+1			
30b: Condition of values	Specific management programmes are being implemented to address threats to biodiversity, ecological and cultural values	+1			
30c: Condition of values	Activities to maintain key biodiversity, ecological and cultural values are a routine part of park management	+1			
TOTAL SCORE					

Appendix 8 – Management Success Review Tool

Management Success Review Tool Form
Caye Caulker Marine Reserve
Fisheries Department
Ministry of The Blue Economy & Civil Aviation

Form: FD-CCMR 0004

The review takes the management actions set out in the 2021-2026 management plan and assesses the degree to which they have been implemented, and to what effect. This methodology is set out for the National Protected Area System Plan (Wildtracks 2005) and is used to guide management actions for the upcoming period.

Ratings are awarded as follows:

Scale	Rating	Criteria
A	Succeeded	Successfully met
B	Improved	Not completely met but situation improved
C	No change	No change in status
D	Worse	Not met, situation worsened

+ and **–** are assigned where it is judged that actions are more or less effective within a given rating.

Management Action	Score	Notes	Action
Programme:			