Corozal Bay Wildlife Sanctuary

Sustainable Fishery Plan

Sarteneja Alliance for Conservation and Development

2020 – 2024

Sarteneja Alliance for
Conservation and Development

Planning for a Sustainable Fisheries

Acronyms

CBAC	Corozal Bay Advisory Committee
CBWS	Corozal Bay Wildlife Sanctuary
FAO	United Nations Food and Agriculture Organization
MCCAP	Marine Conservation and Climate Adaptation Project
NBCC	Northern Belize Coastal Complex
NBIO	National Biodiversity Office
NPAS Act	National Protected Areas System
SACD	Sarteneja Alliance for Conservation and Development
SBTPTA	Sarteneja Beach Trap Pesca Tours Association
SULFA	Sarteneja United Local Fishermen Association

Introduction

Situated in the north east of Belize, Corozal Bay Wildlife Sanctuary was established in 1998 as part of Belize's National Protected Areas System, to provide protection for the large population of Antillean manatee (*Trichechus manatus*) utilizing the waters. This national protected area encompasses approximately 178,000 acres (72,000 hectares) of the Belize portion of the largest estuarine system flowing onto the Mesoamerican Reef, and protects much of the northern shelf lagoon behind Ambergris Caye. The Wildlife Sanctuary, the second largest marine protected area in Belize, have long been recognized for their importance for the Antillean manatee (*Trichechus manatus manatus*), a sub-species of the West Indian manatee, highlighted as an area with one of the highest populations of this species within Belize, important as a calving and sheltered nursery area (O'Shea, 1989; Auil, 1998). It was established as a non-extractive Wildlife Sanctuary for its focus on this specific species, despite the local, small-scale, traditional artisanal fishing activities conducted by all CBWS stakeholder communities for commercial and home purposes. The designation, however, was never conceived to exclude rights-based fishing, and the non-extractive regulations have therefore never been enforced, with CBWS supporting more than thirty-three local fishers and their families (an estimated 187 people from coastal communities of Corozal District), and a further seven sport fishers. There is a national recognition of the need to recognize these local fishers and their rights-based traditional fishing activities, with legislative changes in the revision of the national Protected Areas System Act in 2015 to provide a framework for sustainable resource management in the relevant Wildlife Sanctuaries.

In Belize, there exists the challenge of ensuring successful community management of traditional fisheries resources in protected areas. Corozal Bay, Crooked Tree, Aguacaliente, and Gales Point Wildlife Sanctuaries all have fishers dependent on extraction of the local fisheries resources, and all face pressures from incursions by non-local fishers. Unsustainable resource use has depleted fish stock in all these locations, and in some, local extinctions have occurred (the small tooth sawfish (*Pristis pectinata*), for example, has disappeared from the coastal waters and lagoons), while other species are reaching critical levels (e.g. the critically endangered goliath grouper (*Epinephelus itajara*)).

Defining the Questions

Are current fishing practices impacting the commercial fish stocks of Corozal Bay Wildlife Sanctuary?

How can traditional fishers of Corozal Bay Wildlife Sanctuary maintain their livelihoods through effective fishery management?

What management activities can SACD implement toward the goal of a sustainable fishery for Corozal Bay Wildlife Sanctuary?

Corozal Bay is no exception. The community-based Sarteneja Alliance for Conservation and Development, the co-management agency for Corozal Bay, is working with the local fishermen to develop guidelines for the community management of the small-scale fishery in the Wildlife Sanctuary, towards the goal of long term sustainable use of the resources for the benefit of both current and future generations. Maintaining a healthy fish population and local fishery is highlighted as a priority objective within the Corozal Bay Wildlife

Sanctuary management plan and aligns with the National Protected Areas Policy for community use and benefit from natural resources. This Sustainable Fishery Plan provides a management framework for the long-term sustainability of the traditional rights-based fisheries in CBWS, with recommendations for the transition from a non-extractive protected area (Wildlife Sanctuary) to a protected area that provides for traditional extractive use (Wildlife Sanctuary (2). The plan has been developed through the following steps, and with the input of local fishermen and includes site specific regulations such as special permitting system, gear restrictions, zonation.

- Review of relevant literature, including the Corozal Bay Wildlife Sanctuary Management Plan (2020-2024), the CBWS Planning for a Sustainable Fishery Plan (2012), national policies and relevant literature on community management of sustainable fisheries and integration into planning.

- Meetings with the Sarteneja Alliance for Conservation and Development and interviews with local fishermen to characterize the current local fishery (Annexes 1, 2 and 3)- defining:

    - Fishing methods
    - Target species
    - Fishing effort
    - Spatial and temporal patterns of fishing activity,
    - Market and market value of produce

- Description of catch trends based on available data, to provide:

    - a biological reference point and baseline for future monitoring
    - catch per unit effort data
    - data to feed into planning for a sustainable fishery
    - identify existing data gaps and develop strategies for addressing these gaps

- Development of a monitoring framework for the continued, long-term monitoring of the fishery, for a rights based management approach that is inclusive of all fishing types (commercial, recreational, subsistence and sport).

- Validation of sustainable use regulations for the fishery of CBWS (Annex 4), aligned with area re-designation and re-alignment, The Fisheries Act, NPAS Act, Fisheries Policy and CBWS management plan.

- Identifying a strategy/approach for active stakeholder participation in implementation of the plan (e.g.: formation of a licensing vetting committee, advisory committee).

The outputs are designed to be understood at community level, to assist SACD, the National Biodiversity Office (the government authority in charge of biodiversity and protected areas), the Fisheries Department

(as the national authority for fisheries management), and local fishermen to make management decisions to increase the viability of the small scale fishery.

Part I: The Traditional Fishery of Corozal Bay Wildlife Sanctuary

"…Management of protected areas shall respect, preserve and maintain the traditional knowledge, innovations and practices of indigenous peoples and local communities provided that these do not conflict with the ecological integrity of the protected area and the various conventions and multi-lateral environmental agreements signed by the Government of Belize."

Belize National Protected Areas Policy and System Plan, 2005

1.1 SCOPE OF PLANNING AREA

The scope of this initiative covers the entire area of Corozal Bay Wildlife Sanctuary, established in 1998 under the National Park Systems Act, as part of Belize's National Protected Areas System, and as part of a transboundary protected area for the protection of the Antillean manatee, twinned with the Santuario del Manati in Mexico, as part of Belize /Mexico bilateral agreements. This national protected area encompasses approximately 178,000 acres (72,000 hectares) of the Belize portion of the estuary system, and much of the northern shelf lagoon behind Ambergris Caye.

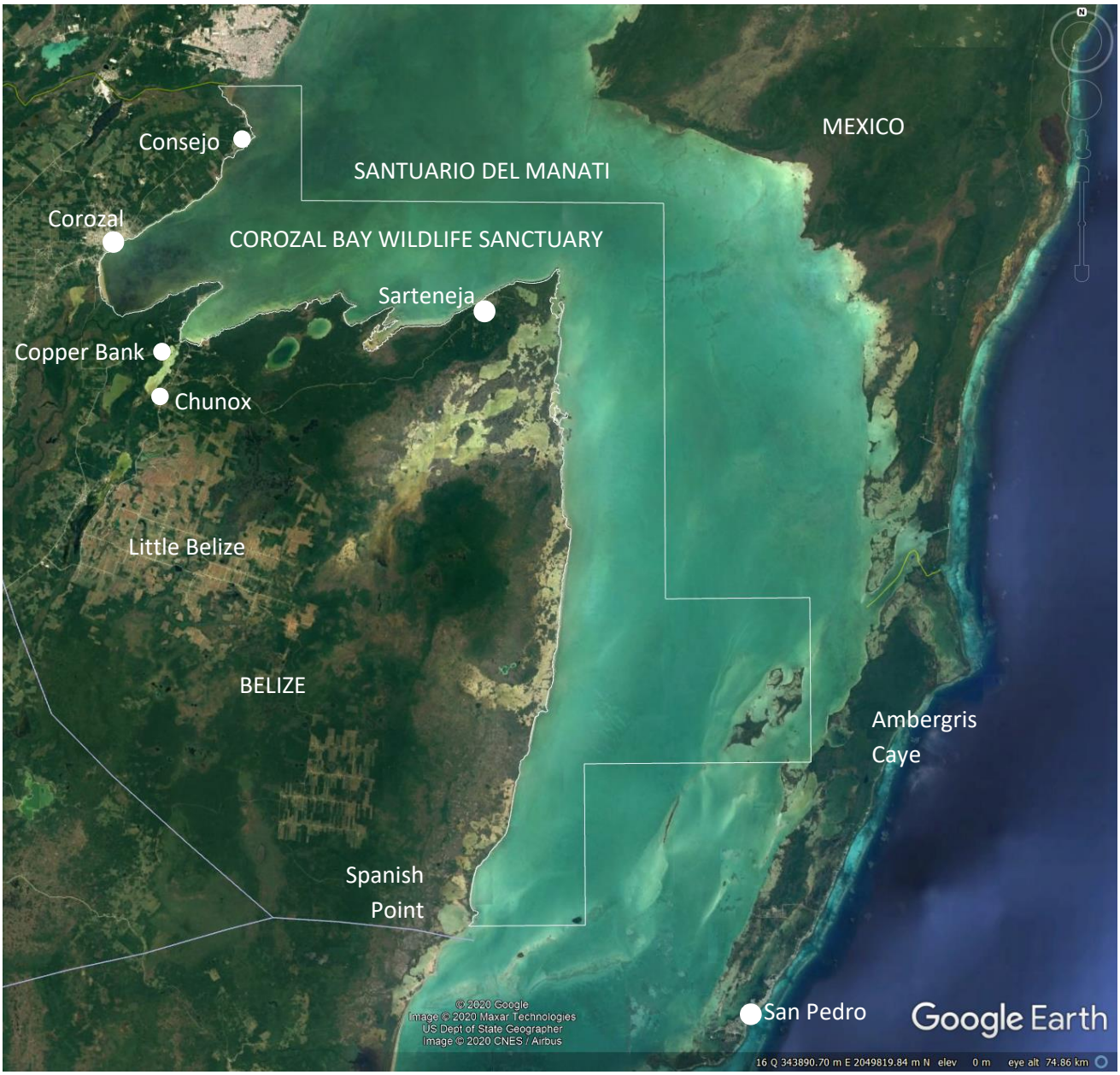
The boundaries of Corozal Bay Wildlife Sanctuary are defined by Statutory Instrument 48 of 1998 (Map 1). The protected area is defined by the high water mark rather than the 66' used in a number of other protected areas in Belize, and does not include cayes within the Wildlife Sanctuary, which has implication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

SITE INFORMATION

Size: 178,000 acres (72,000 ha)
Statutory Instrument: SI 48 of 1998
IUCN Category: IV
Management Authority: Forest Department
Co-management Partner: Sarteneja Alliance for Conservation and Development (SACD)
Contact E-mail: sacdsarteneja@gmail.com

Location: Corozal Bay Wildlife Sanctuary lies in the north of Belize, along the boundary with Mexico, and encompasses Corozal Bay. It is accessed primarily through Corozal, Sarteneja and San Pedro

Uses: Non-extractive – tourism, education and research. Some traditional fishing also continues within the area.
Management Plan: 2020 - 2025
Facilities (2020): SACD Office (Sarteneja)
Visitation (2020): No data
On-site Staff (2020): An Executive Director supported by the Natural Resource Manager, Education Officer, Development and Marketing Officers, 1 Head Ranger, 3 Rangers, and an Office Assistant



MAP 1: LOCATION OF COROZAL BAY WILDLIFE SANCTUARY

Under Belize law, Wildlife Sanctuaries, administered under the National Biodiversity Office, are non-extractive, with any fishing considered illegal unless by ministerial consent. In cases such as Corozal Bay, fishing has been a continuous traditional activity, and the fishery is an essential resource for the community. Traditional user rights by stakeholder communities was, however, recognized under the National Protected Areas Policy and System Plan (NPAPSP, 2005), which sought to harmonize the Belize protected areas system with international criteria to...

> *"…Allow for the full range of management options under international designations including those allowing managed extractive use (in whole or in zones) and other approaches aimed at harmonious integration of human activity and conservation at landscape level"*

The Wildlife Sanctuary designation is not intended to cause a shift in tradition but seeks to maintain the culture of the buffer communities, within the framework of maintaining the biodiversity and ecosystem values for which the area was first established (Forest Department, 2010).

The National Protected Areas Policy and System Plan (NPAPSP, 2005) also takes into account that:

> *"…Management of protected areas shall respect, preserve and maintain the traditional knowledge, innovations and practices of indigenous peoples and local communities provided that these do not conflict with the ecological integrity of the protected area and the various conventions and multi-lateral environmental agreements signed by the Government of Belize."*

The Sarteneja Alliance for Conservation and Development, as the co-management partner, is implementing its second management plan for the Wildlife Sanctuary, including strategies that support the strengthening of the current fishery to increase sustainability. This Sustainable Fisheries Plan provides a framework for building sustainability of the fisheries resources of the Corozal Bay Wildlife Sanctuary, within the Northern Belize Coastal Complex, and in line with SACD's management goal.

Conservation Seascape

Corozal Bay Wildlife Sanctuary (CBWS) lies within the Northern Belize Coastal Complex (NBCC), a river-to-reef seascape of connected marine protected areas in northern Belize. The Northern Belize Coastal Complex is, itself, part of a larger, transboundary seascape - it is contiguous with the Sanctuario del Manati and Parque Nacional Arrecifes de Xcalak, in Mexico. Water flows from the Rio Hondo, New River and the coastal lagoons into the Wildlife Sanctuary, and on to the Mesoamerican Reef at Bacalar Chico, Hol Chan and Caye Caulker Marine Reserves.

Under NBCC planning for the seascape, one of the strategic actions is that

> *2. By 2020, rights-based fishing regimes will be in place and implemented effectively in 100% of marine protected areas in the Northern Belize Coastal Complex, with populations of commercial and recreational species increased by 10% or more above the 2015 / 2016 stock assessment baselines*
>
> 2.2 Develop and implement a rights-based sustainable fishery plan in Corozal Bay Wildlife Sanctuary, with the participation of traditional fishers of the area

Corozal Bay Wildlife Sanctuary is recognized as is one of fourteen regional priority areas of the Mesoamerican Barrier Reef System, based on the importance of the estuarine system (part of one of the largest estuarine system flowing into the Caribbean Sea in the Mesoamerican ecoregion), manatee habitat, and extensive mangrove systems (Kramer and Kramer, 2002; Lopez-Galvez, 2007; Arrivillaga et. al., 2008). The sheltered waters of Corozal Bay have been highlighted as regionally important for mating and calving Antillean manatees (Auil, 2004; Morales-Vela et al. 2000),

The shallow bay also provides a protected nursery habitat for a variety of fish and invertebrates species including a number of locally important commercial and subsistence fish species, including chiwa/ mojarra, snappers and jacks, – supporting a local, traditional fishing industry. It is a pupping area for bull sharks - the only confirmed bull shark nursery in Belize (Graham, 2010), and the presence of snook (robalo), tarpon (sabalo) and permit supports a growing sport fishing industry.

KEY FEATURES OF COROZAL BAY WILDLIFE SANCTUARY

- Part of the largest, transboundary estuary flowing onto the Mesoamerican Reef
- Important mating and calving area for the Antillean manatee
- Regionally important nursery area for bull sharks
- Critical for filtering water before it reaches the Belize reef
- Mangrove cayes support important nesting colonies for waterbirds, including the reddish egret, roseate spoonbill
- One of the few places in the world to have a stromatolite reef – an increasingly rare cyanobacterial formation
- Potential remnant population of smalltooth sawfish

THREATENED SPECIES OF COROZAL BAY WILDLIFE SANCTUARY

CRITICALLY ENDANGERED

Hawksbill Turtle	***Eretmochelys imbricata***
Goliath Grouper	***Epinephelus itajara***
Smalltooth Sawfish*	***Prisitis pectinata***

ENDANGERED:

Green Turtle	***Chelonia mydas***
Antillean Manatee	***Trichechus manatus***

VULNERABLE:

Mutton snapper	***Lutjanus analis***
Cubera snapper	***Lutjanus cyanopterus***
Hogfish	***Lachnolaimus maximus***
Scalloped Hammerhead	***Sphyrna lewini***

IUCN Red List (2019)

Ecoregional Prioritization

The Wildlife Sanctuary has been categorised as a High Priority area with "a moderate capacity to adjust and recover from future disturbances" (Kramer & Kramer, 2002), though it is recognized that some intervention is necessary to maintain ecosystem integrity and functionality. Corozal Bay was also highlighted as a priority site under the recent Ecoregional Assessment of the Mesoamerican Reef (Arrivillaga et. al., 2008), based on the importance of the estuarine system, manatee habitat, and extensive mangrove systems (particularly on the East Coast). CBWS provides protection to at least nine highly threatened species (Critically Endangered, Endangered and Vulnerable) including the critically endangered goliath grouper (IUCN, 2019).

Although the critically endangered sawfish once also present, it is presumed to have been fished to local extinction (Gall, 2006, pers. com.), though up to 2017, several reports from local fishermen suggested that a remnant population may still have existed in the shallow coastal lagoons that flow into the Wildlife Sanctuary.

1.2 SARTENEJA ALLIANCE FOR CONSERVATION AND DEVELOPMENT

The Sarteneja Alliance for Conservation and Development (SACD) is the co-management partner for Corozal Bay Wildlife Sanctuary, together with the National Biodiversity Office, and has been operating since 2007. It is a community-focused non-governmental organization registered on 18th September 2008, and dedicated to improving the quality of life of the stakeholder communities of Corozal Bay Wildlife Sanctuary through conservation, protected areas management and promoting the sustainable use of the natural resources, with the goal of:

"Promoting conservation actions that benefit biodiversity and people"

SACD

Vision Statement

"A healthy, biodiverse Corozal Bay Wildlife Sanctuary in the larger northern seascape that supports and nurtures communities and sustainable livelihoods.

Mission Statement

"SACD, as a community-oriented NGO, is dedicated to ensuring effective management and good stewardship of Corozal Bay Wildlife Sanctuary in the larger seascape in partnership with all stakeholders."

The Sarteneja Alliance for Conservation and Development, as the co-management partner, is implementing its second management plan for the Wildlife Sanctuary, focused on achieving the organizational goal of:

Promoting conservation actions that benefit biodiversity and people

…with a series of five management objectives:

1. To ensure the effective conservation and sustainable use of natural resources of Corozal Bay Wildlife Sanctuary

2. To contribute towards the health and effective management of the larger Northern Belize Coastal Complex seascape

3. To ensure adequate knowledge for biodiversity and human resource use management

4. To increase community engagement, awareness and participation in the conservation of the natural resources of Corozal Bay Wildlife Sanctuary

5. To ensure public use is conducted in an environmentally aware and sensitive manner

The CBWS Planning for a Sustainable Fishery Plan (2012) provided the Sarteneja Alliance for Conservation and Development and the local fishermen with the first steps towards achieving a sustainable fishery, focusing on the most intensive users – the beach trap fishermen. This Plan builds on the planning process started in 2011, providing more comprehensive, updated information on the traditional fishery and a framework for community rights-based fishery management.

1.3 IMPORTANCE OF THE LOCAL FISHERY

Fishing in Corozal Bay Wildlife Sanctuary has been identified as a traditional resource-use activity, practiced from generation to generation, generating an income for families, and providing an important protein source in the five key stakeholder communities (Sarteneja, Chunox, Copper Bank, Corozal and Consejo) (Table 1). The Wildlife Sanctuary has been used by local fishermen since ancient Maya times, with the majority of local fishermen using beach traps, or cast nets, or more recently (in the last 60 years) gill nets. Sport fishers from San Pedro have also been identified as users of CBWS.

Located in the north east corner of Belize on the shore of the Wildlife Sanctuary, Sarteneja is recognized as the largest fishing community in Belize, with an economy that is fishing-dependent. With a population estimated at 2,500, Sarteneja is considered the primary stakeholder community of Corozal Bay Wildlife Sanctuary (CBWS). However, the majority of the fishermen utilize the marine resources associated with the reef system (primarily lobster and conch), and do not fish commercially within the Wildlife Sanctuary. CBWS supports an estimated thirty-three commercial, twenty-one subsistence and seven sport fishers[1], using a combination of beach traps, gill nets, crab traps, hand lines and / or cast nets. Sarteneja is

[1] Numbers of fishers have been defined during consultations, but will not be finalized until the permitting system and management committees are in place.

identified as having the most families dependent on the fish resources of CBWS with approximately twenty-four commercial fishers and seven subsistence fishers dependent on regular access to the fish resources for sale and household consumption (fisher consultations, 2020). The fish catch is marketed locally or in near-by towns - principally Orange Walk and Corozal, with a limited market for in San Pedro.

Five types of Sarteneja fisherman were identified as using the Wildlife Sanctuary, some for commercial purposes, others for home use. Each has a specific set of equipment, dependent on the type of fishing and distance travelled to reach the fishing area, and target a specific suite of species.

The consistent primary commercial users of CBWS in Sarteneja are the 14 to 15 beach trap fishers and between 6 and 9 gill net fishers. Both sectors also fish using cast nets to supplement their catch. Fishing with a cast net is considered a traditional recreational activity carried out by the majority of men, and at one time accompanied by their wives, generally in the shallow waters in front of the community, with the catch providing additional food for the family. Community consultations in other communities show a much lower dependence on the fish resources, with ten commercial fishers from Chunox, Copper Bank, Corozal and Consejo combined (fisher consultations, 2020), and between six and seven sport fishers from San Pedro (most originally from Sarteneja). These communities have improved access to other income sources with fishing as a supplemental income when necessary.

Community	Location (UTM)	Population (approx.)	Comments
Sarteneja	E16 378750 N20 29500	2,500	Largest fishing community, concentrating on lobster, conch and finfish throughout Belize waters. Approximately 24 fishers are dependent on fishing in Corozal Bay, with 13 to 14 using beach traps, and 9 to 10 with gill nets / cast nets. Fishing for the table suing a cast net is considered not only subsistence, but also recreational.
Chunox	E16 356500 N20 23500	1,400	Traditionally a sugar cane farming community that has shifted to reef fishing in the last fifteen years. 1 commercial fisher (gill net) and at least 4 subsistence fishers (gill nets, cast nets and hand lines) are dependent on CBWS.
Copper Bank	E16 356700 N20 26020	525	Some reef fishing, but many families rely on work in Corozal, the district commercial centre, or in the Economic Free Zone. 4 subsistence fishers use cast nets and hand lines.
Corozal	E16 353643 N 20 33873	9,100	District town with major services (banks, post office, Government offices etc.). 3 commercial fishers and at least 3 subsistence fishers dependent on Corozal Bay.
Consejo	E16 362344 N20 40688	<1,000	Border community, with an estimated 5 part-time fishers using Corozal Bay. Large expatriate component, including a yacht club that uses the Bay for boating activities and recreational / sport fishing.

San Pedro	E16 398200 N18 1981250	4,499	Tourism destination, embarkation point for many visitors to the reef. Sport fishing industry utilizes parts of Corozal Bay Wildlife Sanctuary.
Chetumal	E16 363347 N20 46291	238,520	Mexican coastal town with some illegal transboundary fishing incursions into the Wildlife Sanctuary (including use of crab traps). Holds several sport fishing tournaments a year.

TABLE 1: COMMUNITIES OF COROZAL BAY WILDLIFE SANCTUARY

Whilst unsustainable fishing is the direct threat to the fish stocks, the state of the fishery is also dependent on the health of the estuary as a whole and the management effectiveness. A number of reports provide information on the state of the protected area (including water quality, coastal vegetation, seagrass), with outputs summarized in the CBWS Management Plan 2020 – 2024.

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

1.4 THE BASICS FOR A SUSTAINABLE FISHERY

For fishing to be termed "sustainable", it must meet the following criteria:

- Be caught from a well-managed fishery with scientifically based quota's
- Be caught using responsible fishing methods
- Be species that are not regarded as threatened

...and can be variously described as:

- ...using resources in such a manner that they will continue to be available to future generations.
- ...fishing conducted over the long-term at an acceptable level of biological and economic productivity without leading to declines that close options for future generations.

Sustainable management can only be achieved if based on scientific information from CPUE monitoring and stock assessments, and through provision for zoned no take areas to allow protection of spawning and nursery grounds. This plan provides the foundation for the development of effective sustainable management of the small scale fishery of Corozal Bay Wildlife Sanctuary, in collaboration with the traditional fishers of the area.

Fish are considered renewable resources, with the expectation that they reproduce at a faster rate than they die, whether this death is through fishing or natural causes. Ensuring that fishing is sustainable is based on two basic concepts:

- If there are too few large (old) fish, the stock is over-fished and fishing pressure should be reduced
- If there are very many large (old) fish, the stock is under-fished and more fish can be taken

FAO, 1998

The fish caught should therefore be of neither too young (pre-reproduction) nor too old. A fish that is just large enough to be included in the catch is known as a '*recruit*', and all fish of that size and age are considered to represent a single '*cohort*' – a group of fish born at the same time, of the same age.
To complete a stock assessment for the fishery to better understand how sustainability can be achieved, it is necessary to have information on:

- The input: the fishing effort in terms of the amount of time spent fishing
- The output: the catch
- The processes that describe and link the input and output - the biological processes and fishing operations, represented by mathematical models

As it is not possible to sample the entire commercial fish population of the Wildlife Sanctuary, catch sampling for the Sarteneja beach traps has been used, with results extrapolated across the fishing sector. The beach traps provide an excellent opportunity for sampling catch, giving data on the number of species caught, seasonality, relative contribution of species to the catch, recruit size, and maximum, mean and mode length. SACD has catch data available for the beach trap season (April to November) for 2011, 2015, 2016, and 2018. However, it is important to recognise that the data has some limitations, with bias, as it:

- excludes all fish smaller than recruits (these are returned to the water as the catch is sorted and are not included in the assessment)
- is not sampling a static fish stock, but one that migrates into and out of the area, and is therefore affected by more than just the management regime of the area
- is focused primarily on fish species that move up and down the coastline
- much of the life history information available to assist with stock assessments (e.g. age-length and length-weight conversions, mortality) is based on data collected elsewhere in the region, rather than site specific to Corozal Bay Wildlife Sanctuary
- Differences in sampling effort and gear type limit the comparison between yearly data sets

Even with these limitations, the data does provide an insight into the fishery, identifying catch trends and informing management strategies that can be implemented to improve long term catch security. Data collection needs to be continued over at least the next four years, and be extended to the other fishing methods (gill nets, cast nets, crab traps) to provide an understanding of population dynamics of the commercial species being extracted, the snapshot has provided an initial insight into the fishery, and informed management strategies that can be implemented to improve long term catch security.

"States should apply the precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment. The absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures"

FAO, 1995

1.5 CONDITIONS REQUIRED FOR A COMMUNITY-MANAGED SUSTAINABLE FISHERY

A number of conditions are required for a small-scale sustainable fishery initiative to succeed within the Wildlife Sanctuary. These include:

- the identification and engagement of key stakeholders
- active participation from the local fishermen themselves
- agreements with the relevant agencies for strategy development and management

1.5.1 Relevant Legislative Framework

Fishing is deeply rooted in the culture and social fabric of Belize, reflected in the national policies. Belize has made considerable progress in developing strong and robust legislative frameworks to address the management of its natural resources, but where fishing exists in a protected area administered under the Forest Department / NBIO, there is often considerable overlap of mandates under different enabling laws, compounded by designations that do not always correspond to the most effective or realistic management regime. Two key government departments within the Ministry of Fisheries, Forestry, the Environment and Sustainable Development have the direct mandate to manage fishing activities within CBWS. Whilst access to the protected area is regulated by the NPAS Act (2015), under the jurisdiction of the Forest Department, access to the fish resources is regulated under the Fisheries Resource Act (2020), under the jurisdiction of the Fisheries Department. Management of the fish resources in Corozal Bay Wildlife Sanctuary has to take into account the policies guiding management of the protected area, as a Wildlife Sanctuary (transitioning to a Wildlife Sanctuary (2)), and the national policies guiding the management of the Belize fishery. Any sustainable fishery initiative needs to be managed within this framework, developing collaborative partnerships with the relevant Government agencies:

- the Forest Department / National Biodiversity Office (NBIO) with the mandate for management of Wildlife Sanctuaries within Belize (management of non-extractive protected areas is currently transitioning to the newly formed National Biodiversity Office),
- the Fisheries Department, with the mandate to manage fisheries resources within Belize.

All three departments (the forest and Fisheries Departments and the National Biodiversity Office) lie under the umbrella of the Ministry of Agriculture, Forestry, Fisheries, Environment and Sustainable Development. It is essential for SACD to engage these Departments and complementary agencies to streamline collaborative partnerships and to ensure the co-management agreements with the pertinent agencies are clear and effective.

Efforts to align Belize's protected areas with international categories under the International Union of Conservation of Nature and Natural Resources (IUCN), have been proposed which would allow for a broader array of management options with consideration of extractive use aimed at harmonious integration of human activity and conservation at the wider level and preserving and maintaining traditional knowledge and practices of indigenous peoples and local communities (NPAPSP, 2005).

National Protected Areas Policy and System Plan

Corozal Bay Wildlife Sanctuary (CBWS) was established by Statutory Instrument 48 of 1998 under the National Park Systems Act Chapter 215 revised edition 2003, as part of Belize's National Protected Areas System. It was established as a Wildlife Sanctuary defined under the National Protected Areas Act as:

> "*any area reserved as a nature reserve under this Act for the protection of nationally significant species, groups of species, biotic communities or physical features of the environment requiring specific human manipulation for their perpetuation*".

Section 37 1d of the National Protected Areas System (NPAS) Act is explicit in saying that "*no person shall hunt, shoot, kill or take any wild animal, or take or destroy any egg of any bird or reptile or any nest of any bird, in any Wildlife Sanctuary*"; however, section 39-1-i and k also mentions that the Chief Forest Officer can authorize fishing by any means whatsoever. In addition, section 42-3 states that "*the Minister may at his discretion, and subject to such conditions as he may think desirable attached thereto, issue permits for fishing in any area declared to be a national park, wildlife sanctuary or natural monument where such activity will not destroy or seriously detract from those values that were the principal reason for establishment of the protected area*". Moreover, section 51-1 gives the power to the Minister to make regulations pertaining to the protected area; in which section 52-1-f and k authorizes the Minister to make regulations pertaining to access to fishing within any protected area. Without the authorization from the Chief Forest Officer or Minister, any person engaged in extractive activity within a Wildlife Sanctuary commits an offence. Fines for offences can be up to twenty thousand ($20,000), imprisonment for two years or both, depending on the severity of the infraction. Furthermore, section 40-2 makes provisions for revocation of any license or permit and forfeiting of gear, equipment and conveyance used in committing the offense.

In Corozal Bay Wildlife Sanctuary, fishing has been a continuous "traditional" activity with the fishery considered an essential resource for the community; nevertheless, formal ministerial consent to legalize these activities has not gathered momentum. This conflict is recognized in the NPAS Act, with the creation of a new protected area category – Wildlife Sanctuary (2) – that provides the framework for traditional natural resource extraction, with the recommendation that CBWS be transitioned to this category. The Wildlife Sanctuary 2 designation:

> *"To protect nationally significant species, biotic communities or physical features, and allow for traditional sustainable extraction of natural resource"*

The NPAS Act clearly provides the enabling environment and mechanism to allow for fishing activity within the Wildlife Sanctuary. This, however, does not automatically override the Fisheries Department mandate as the competent authority to provide management of fisheries resources in all the fisheries waters of Belize.

The Sarteneja Alliance for Conservation and Development (SACD) is recognized as the non-governmental co-management partner for site-level management of Corozal Bay Wildlife Sanctuary under a co-management agreement, and as such, has the responsibility of ensuring effective enforcement of both protected area and fisheries legislation within the protected area, in collaboration with the Forest Department / NBIO and the Fisheries Department.

National Fisheries Policy and Action Plan

The main policy directly of interest to this plan is the National Fisheries Policy and Action Plan (Fisheries Department, 2020).

Policy Statement 9: Fisheries Governance in Support of Sector Development and Diversification is not Possible Without Assertive and Effective Private Sector and Civil Society Participation.

Anticipated Outcome 9.1.1: Fisheries diversification and expansion with assertive Private Sector leadership with Civil Society playing the critical role of co-managers, scientific resource, and fisheries management partners.

STRATEGIC ACTION

9.1.1.3 Institute the policies and structures necessary to better position Civil Society as an active and necessary player and partner for scientific research, advocacy and sustainable fisheries management.

9.1.1.4 Institute the policies and structures necessary to ensure fishers have a legitimate and genuine say in fisheries development and management issues.

The revised Fisheries Resources Act (2020) enacted February 14, 2020 under SI 20 of 2020 is the legislation established specifically for the management of fisheries resources in Belize. The act now incorporates and aligns to modern concepts in fisheries management such as the ecosystems approach, the precautionary approach, code of conduct for responsible fisheries and others. The Fisheries Resources Act (2020) creates the enabling environment for the creation of inland freshwater reserves, makes it a mandatory process to develop and implement fisheries management plans through a consultative process; and makes provisions for the creation of a fisheries council. It also defines the process for entering into co-management for marine protected areas; opens the possibility for stricter penalties including suspension and revocation of licenses by the Fisheries Administrator, among many other useful pieces of legislation conducive for enhanced Fisheries Management. The existing regulations still currently apply but are in the final stage of a revision

process - these regulations, once finalized, will provide the detail of what can and cannot be done within the fisheries waters of Belize.

The development of the regulations are based on the following:

- Assessment of morphometrics as a basis for size and weight regulation,
- Future management regimes that consider gear design, gear registration and tagging, and gear efficiency.
- Future management regimes that address allowable number of fishing gear per fisher.
- Catch quotas should be set to meet ecological objectives as well as economic and political ones, and should not be relied on solely to meet fishery objectives,
- Catch quotas should be used with a suite of other data-informed harvest control rules, such as closed seasons, gear restrictions, access rights, no-take-zones, all of which should also be based on scientific foundations and reviewed regularly in accordance with the Adaptive Management Framework.
- Climate-ready fisheries management and marine and coastal ecosystems management is essential for Belize, and as such, fisheries management approaches need to assertively address the impacts of Climate Change.

Several national legal requirements are currently in place to regulate fishing activity within Belize, and being enforced by SACD officers within CBWS.

GEAR RESTRICTIONS

NETS AND LONG LINES

- No gill net, or series of joined gill nets, can exceed 300m in length
- Gill, seine and stop nets, and long lines cannot block a river, creek or stream. No net or long line can stretch more than a quarter of the distance across that river, creek or stream and must not exceed 200m in total length
- No gill net, seine net, stop net, or long line can be set in a lagoon, that is more than one-tenth of the distance across the lagoon, and cannot exceed 200m in total length
- No nets or beach traps can be set within half a mile of any city, town, or village

WITHIN A MARINE RESERVE

Whilst CBWS is not a marine reserve, it is a marine protected area, and the fisheries legislation is being adopted

- Valid licences are required for commercial fishing, sport fishing and recreational fishing
- Fishing activities conducted can only be those permitted in accordance to the specific zone regulations.

- The use of beach traps and fish traps is prohibited in Conservation and Preservation Zones
- A license is required for the use of beach traps and fish traps in the General Use Zone.
- Fishing in a Conservation Zone is prohibited without a license
- Fishing, snorkelling and diving are prohibited in a Preservation Zone
- Spearfishing is prohibited in Marine Reserves
- Use of long lines, seine nets and gill nets is not permitted within Marine Reserves
- It will be assumed that anyone with a speargun, polespear, Hawaiian sling, spearfishing mask or powered speargun or sling is attempting to engage in spearfishing

1.5.2 Identification of Stakeholders

Traditional Fishers

Traditional use is defined as “Cultural use that originates in the past and is transmitted through from one generation to the next for at least three generations, and continues in the present in a way that respects the past use practices" (Walker, draft).

A **Traditional fisher** is defined as "a fisher originating and resident in a CBWS stakeholder community with a culture of at least three generations of traditional fishing, and with inherited user rights, that depends on the Wildlife Sanctuary for subsistence and/or commercial purposes. The fisher possesses traditional knowledge acquired in a generational manner and has a direct stake in the health of local fish populations”.

Fishery management committees will be established for the two key commercial sectors – beach trap and gill net fishers, to ensure transparent allocation of traditional fishery permits for fishing in Corozal Bay Wildlife Sanctuary, following the model provided by the rights-based managed access committees. Membership will include the Forest Department/NBIO, Fisheries Department, SACD, and for the gill net fishers, at least 3 fishers (one from each community). Clear criteria should be established for granting access and rejecting applicants, as well as a system for appeal and conflict resolution.

A database of traditional fishers and trap / gear ID will be established in collaboration with the traditional fishermen and the fishery management committee. To facilitate enforcement, all traditional fishers of CBWS will be issued with site level ID cards recognizing them as traditional fishermen with permission to fish within the Wildlife Sanctuary. All traps and gill nets will be tagged, linked to the details of the fisher.

In recognition of the importance and contribution of fish to food security and culture in the CBWS stakeholder communities, anyone originating from and resident in one of the five stakeholder communities can fish with a cast net for home consumption, following the recommended bag limit and registration process.

Traditional fishers from all the communities are represented on the Corozal Bay Advisory Committee (CBAC), and have been active participants in the sustainable fishery planning process, including the consultations for the establishment of management zones. Each has a specific set of equipment, dependent on the type of fishing and distance travelled to reach the fishing area, and target a specific suite of species.

Types of Fishermen	
Commercial	▪ Beach Trap
	▪ Gill Net
	▪ Cast Net
	▪ Crab Trap
	▪ Sport Fishing
Non-Commercial	▪ Cast Net
	▪ Hand line

TABLE 2: TYPES OF CBWS FISHERMEN

In Sarteneja, fishers organized into two groups – the Sarteneja Beach Trap Pesca Tour Association (Pesca Tours / SBTPTA), with 15-20 members (fishers / fisher wives and family members who are tour guides), and Sarteneja United Local Fishermen Association (SULFA), representing the gill net fishers, with 24-28 members. Fishers in the other communities are not organized.

The consistent primary commercial users of CBWS in Sarteneja are the 14 to 15 beach trap fishers and between 6 and 9 gill net fishers. Both sectors also fish using cast nets to supplement their catch. Fishing with a cast net is considered a traditional recreational activity carried out by the majority of men, and at one time accompanied by their wives, generally in the shallow waters in front of the community, with the catch providing additional food for the family. Community consultations in other communities show a much lower dependence on the fish resources.

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

Other Stakeholders

A number of public and private sector stakeholders have been identified as important to the success of any effort to develop a sustainable fishery in Corozal Bay Wildlife Sanctuary. These have been assessed as to the role each plays, and how they may impact development of the sustainable fishery - either positively or negatively. Engagement of these different sectors will be critical for successful management of fish resources in the future.

Community understanding of and participation in the establishment of the framework for the sustainable fishery initiative is essential - in the establishment of zones, sampling and monitoring strategies, and understanding of the medium-term benefits. This will assist in encouraging greater support of and compliance with the site-specific regulations for Corozal Bay Wildlife Sanctuary.

Engagement of the National Biodiversity Office and Fisheries Department as active partners in the initiative is important as a first step, with development of the framework for continued traditional

fishing within the Wildlife Sanctuary, and support for permitting and enforcement of regulations. Collaboration with the Fisheries Department for technical input into the process is also important, with the wealth of experience available that can contribute towards sound fishery design.

At the community level, SACD has established the Corozal Bay Advisory Committee to provide a mechanism for stakeholder input and two-way flow of information on issues impacting the Wildlife Sanctuary. The CBAC is keep informed of all key initiatives, and plays a key role in ensuring stakeholders input and participation in the planning and implementation of management is both active and meaningful.

The village councils and of the different stakeholder communities and Corozal Town Councils are active members of the CBAC, and supportive of the establishment of the fishery framework and regulations. However, as the council members are elected, this support may change following elections, so engagement and information needs to be ongoing to maintain support, with the recognition that incoming councils will probably need to be re-engaged.

PERSON /ORGANIZATION	**ROLE AND POTENTIAL IMPACT**
National Biodiversity Office (NBIO)	▪ Have mandate for management of Corozal Bay Wildlife Sanctuary ▪ Support SACD as the co-management partner for Corozal Bay Wildlife Sanctuary ▪ Provide training for Special Constables and in Forest Department legislation, and provide back-up support for enforcement ▪ Support the transitions from Wildlife Sanctuary to Wildlife Sanctuary (2), to provide the regulatory framework for rights based management ▪ Successful implementation will provide NBIO with a model for use in other similar situations ▪ Successful implementation will provide NBIO with a working example of the benefits communities can derive from protected areas through conservation management
Fisheries Department	▪ Have mandate for management of fish stocks in Belize ▪ Provide back-up support for prosecution of offences committed under the Fisheries Act ▪ Have technical expertise and experience in management and monitoring of fish stocks that can strengthen project design and implementation ▪ Monitoring of the fishery in Wildlife Sanctuary will fill a data gap on northern coastal fish populations ▪ Successful implementation will provide Fisheries Department with a model for use in other similar situations ▪

Person /Organization	Role and Potential Impact
Sarteneja Alliance for Conservation and Development	▪ Lead organization for implementation of the Sustainable Fishery Plan, with the goal of increasing fish stocks within the Wildlife Sanctuary for the benefit of the traditional fishers ▪ Responsible for engaging the fishing sector – NBIO and Fisheries Departments as collaborative partners in establishment and management of the sustainable fishery ▪ Responsible for collaboration with the NBIO Office to ensure a smooth transition to Wildlife Sanctuary (2) ▪ Responsible for leading the zoning consultation process and establishing the zones in the Wildlife Sanctuary ▪ Responsible for enforcement of regulations outlined in the Sustainable Fishery Plan, in collaboration with the NBIO Office and Fisheries Departments. ▪ Responsible for development of baseline and monitoring of fish catch, in collaboration with fishermen
Traditional Fishers of CBWS	▪ Rely on the Wildlife Sanctuary for subsistence and income ▪ Have one of the greatest impacts on the resources if unregulated and non-compliant ▪ Collaborative role with SACD in management of fish stocks within the Wildlife Sanctuary ▪ Participants in fish capture monitoring ▪ Will benefit from increased fish resources ▪ Will have greater control of resources, and more motivation in maintaining them ▪ Enforcement of regulations to prevent illegal incursions from non-local fishermen, reducing competition for resources ▪ Enforcement of regulations will increase available fish stocks
Sarteneja Beach Trap Pesca Tour Association (Pesca Tours / SBTPTA)	▪ A community group from Sarteneja formed to represent the interests of the beach trap fishers of Sarteneja village. ▪ Established to champion the designing of site-level regulations for beach traps to ensure the continued traditional use of the Corozal Bay fishery resources in a sustainable manner. ▪ registered on December 15, 2017 with 15 members who are considered to be the traditional beach trap owners and users of the CBWS.
The Sarteneja United Local Fishermen Association (SULFA)	▪ Fisher association representing local gill net fishers ▪ a community-based organization of Sarteneja with the mission is to act as stewards for the traditional fishery of Corozal Bay Wildlife Sanctuary (CBWS). ▪ registered on September 7, 2015, with 24 members

Person /Organization	Role and Potential Impact
Sport Fishing Guides	▪ Rely on sport fish species of the Wildlife Sanctuary as an important tourism resource, providing income and employment ▪ Need representation on any fishing committee or group established to assist with management of the fisheries resources ▪ Improved engagement and dissemination of information for improved compliance with CBWS catch and release regulations ▪ Potential participants in fish capture monitoring for sport fish species
Recreational Fishers of CBWS ▪ Local community members using cast nets / hand lines	▪ Need system for allocation of zone-specific CBWS user permits in recognition of traditional rights ▪ Need system for allocation of recreational fishing permits following the establishment of a national framework ▪ Improved engagement and dissemination of information for improved compliance with CBWS regulations (e.g. bag limits, zones)
Recreational Fishers of CBWS ▪ Non- traditional users (immigrants, people originally from non-CBWS communities)	▪ Need system for allocation of zone-specific CBWS user permits in recognition of traditional rights ▪ Improved engagement and dissemination of information for improved compliance with CBWS regulations (e.g. bag limits, protected species, fishing gear) ▪ Need system for allocation of recreational fishing permits following the establishment of a national framework
Non-local Fishermen	▪ Transboundary (primarily Mexico) and non-community visitors (e.g. Neuland) ▪ Have no incentive to follow the Belize Fisheries legislation or CBWS regulations ▪ Active enforcement against illegal incursions ▪ No justification for rights-based access to fish resources of the Wildlife Sanctuary

TABLE 3: STAKEHOLDERS OF THE CBWS FISHERY

1.5.3 Engagement of Fishermen

Engaging fishermen is as a long term process, though a number of mechanisms can be used to facilitate this process:

MECHANISM	CURRENT INITIATIVES UNDER SACD (2020)
▪ Regular meetings to keep the fishers informed	▪ Boat to boat outreach mechanism implemented by a specialized outreach officer. ▪ Regular meetings (every three months) with fishers, with additional meetings to be scheduled upon need.
▪ More structured meetings that do not clash with fishing schedules – can be held outside if preferred and should be relatively informal	▪ Starting 2018, a better relationship was built with trap fishers through the Pesca Tour initiative, leading to improved leadership and communication with this sector, including regular meetings.
▪ Meetings should start promptly, , and finish on time	▪Meetings should be short and succinct, and start and finish on time.
▪ Any visual aids used during meetings should be heavily image focused	▪Meetings are based on discussion, with minutes recorded. ▪Capacity building has been provided for interpretation of simple graphs to help fishers understand monitoring outputs
▪ Meetings should focus on the fishermen's needs	▪Fishers are aware of current legislations as a result of ongoing surveillance and enforcement outreach activities since 2015 ▪The representatives of the different fishing sectors inform the CBAC of issues and provide feedback to their sector
▪ There should be active and rapid follow-up on ideas put forward during meetings to show results	▪The specialized outreach officer will also follow up with the fishers to ensure feedback has been received and understood. ▪SACD is responsive to fisher needs, and is supporting the beach trap fishers through fisher tourism initiatives ▪As part of the area specific tour guide course for CBWS, the potential for starting fisher research on sport fish species was discussed and gained strong interest. Funds should be secured to implement this project.
▪ Informal training can be used to build capacity for articulating ideas for those fishermen interested in playing a more active role in fishery management	▪ There is a strong interest in tourism in CBWS among fishers. And in trainings related to sport fishing (fly fishing). ▪ A project focused on catch sampling with the participation of fishers has been identified as a good mechanisms to increase fishers participation, tied to incentives
▪ Establishment of management committees for the two key fisher components (trap and net fishers), with clear definitions of the role of the committee, and criteria for representation (election by fishers)	▪ CBAC provides a mechanism for community input - a task force/ subcommittee within CBAC can be formed by SACD, Forest Department/NBIO, Fisheries Department and fisher representatives to deal with issues related to fishing. ▪ Discussions focus on the establishment of two committees to meet on permitting - a beach trap fisher committee of 3 representatives, and a gill net committee with one representative from each of the communities with gill net fishers, role of the committee, and criteria for representation (election by fishers)

MECHANISM	CURRENT INITIATIVES UNDER SACD (2020)
▪ Meetings should be facilitated so that fishers direct the outcomes, through asking leading questions, and listening to the answers. Fishermen should also participate fully in the fishery management process, in partnership with SACD providing assistance and guidance	▪ The CBAC provides a structured mechanism for input and discussion ▪ The two sub committees will be small, chaired by SACD as a non-voting member, and with a structured agenda to achieve meeting decisions
▪ Ensure fishers benefit in outputs – eg. through stipends for participation as volunteer rangers, training, access to resources, income diversification opportunities etc.	▪ The monitoring framework will include identified mechanisms to provide incentives for fishers willing participate in the data collection beyond the completion of the required log book. ▪ SACD is supporting the Pesca Tours initiative, and is open to supporting other income diversification options identified by traditional fishers

TABLE 4: PROPOSED ENGAGEMENT MECHANISMS FOR IMPROVED COLLABORATION WITH FISHERS

1.5.4 Site Level Regulations

Traditional Fishers

Traditional use is defined as “Cultural use that originates in the past and is transmitted through from one generation to the next for at least three generations, and continues in the present in a way that respects the past use practices" (Walker, draft).

A **Traditional fisher** is defined as "a fisher originating or resident in a CBWS stakeholder community with a culture of at least three generations of traditional fishing, and with inherited user rights, that depends on the Wildlife Sanctuary for subsistence and/or commercial purposes. The fisher possesses traditional knowledge acquired in a generational manner and has a direct stake in the health of local fish populations”.

Fishery management committees will be established for the two key commercial sectors – beach trap and gill net fishers, to ensure transparent allocation of traditional fishery permits for fishing in Corozal Bay Wildlife Sanctuary, following the model provided by the rights-based managed access committees. Membership will include the Forest Department/NBIO, Fisheries Department, SACD, and at least 3 fishers. Clear criteria should be established for granting access and rejecting applicants, as well as a system for appeal and conflict resolution.

A database of traditional fishers and trap / gear ID will be established in collaboration with the traditional fishermen and the fishery management committee. To facilitate enforcement, all traditional fishers of CBWS will be issued with site level ID cards recognizing them as traditional fishermen with permission to fish within the Wildlife Sanctuary. All traps and gill nets will be tagged, linked to the details of the fisher.

In recognition of the importance and contribution of fish to food security and culture in the CBWS stakeholder communities, anyone originating from and resident in one of the five stakeholder communities can fish with a cast net for home consumption, following the recommended bag limit and registration process.

All fishers should be in possession of a valid fisherfolk license for Fishing Area 1, and a permit recognizing them as a traditional fisher of Corozal Bay Wildlife Sanctuary. All should be confirmed as traditional fishers by the CBWS fishery management committees. As part of the management process, SACD has been working with the local fishermen to develop and agree on a series of site-specific regulations for Corozal Bay Wildlife Sanctuary. All traditional commercial fishers should be in possession of a fisher license for Fisheries Area 1 and a site specific traditional fisher license for CBWS. All recreational / sport fishers should be in possession of a sport fishing license, and pay a user fee for access to the protected area.

All national fishery regulations are relevant, including gear restrictions, seasons and size restrictions, bag limits, fishing near communities, creeks and rivers. If there are changes in the national regulations, these will be reflected in the site level regulations. All boats must meet Port Authority registration and safety standards.

GEAR RESTRICTIONS

- The following fishing gear and techniques cannot be used in Corozal Bay Wildlife Sanctuary
  - Spear guns (powered or otherwise), polespear, Hawaiian sling, spearfishing
  - Fishing with scuba tanks
  - Fishing with explosives or chemicals
  - Trawling

COMMERCIAL FISHERS

Beach Traps

- Beach trap use is traditional for Sarteneja, with families dependent on the income
- A list of recognized trap owners and baseline mapping and marking of traditional fish traps has been completed and agreed upon by fishermen and SACD (2019).

  - all beach traps are to be mapped and registered with SACD, and are restricted to traditional beach trap locations, as identified in the individual permits
  - all recognized traditional beach trap fishers will be issued with a permit for use of beach traps within CBWS, issued by the Forest Department/NBIO
  - a special ID will be given to the beach trap owners to hire an assistant to engage in the commercial activity, in the presence of the traditional fisher – they would still need the relevant site specific permit, but would not inherit traditional rights
  - the number of traps is capped at the current level of 20 (SACD, 2020), and is restricted to the current number owned per fisher (at a maximum of two per fisher)
  - fish traps cannot be sold or rented, but only be passed from father to son or other immediate family member (son, daughter, son-in-law, daughter-in-law)
  - if a trap isn't used for two consecutive years, a fisher will lose their traditional rights unless the fisher informs management and presents evidence of valid cause (e.g. ill health) for temporary closure. The fisher will have the option to lend /rent the trap to another trap fisher during that period, if agreed by all parties, as long as this does not exceed the two-trap limit
  - traps can only be opened between March 1st and December 15th, and must be closed and removed from the water by December 15th
  - traps must conform to site-level minimum mesh size regulations, and should not have any type of net as part of the beach trap construction

- all fish caught must be legal (e.g. species, size) under the fisheries legislation / regulations
- beach traps may not be closer than 0.5 miles to the village, following the fisheries regulations. Where traditional beach traps now fall within the 0.5 miles, SACD will identify new locations in collaboration with fisher and fisher committee, FD / NBIO and BfD

Gill Nets

- A limited number of fishing families use gillnets within Corozal Bay Wildlife Sanctuary as their primary source of income
- Use is primarily on the east coast, and should be permitted to continue in recognition of the access rights of the traditional gill net users, with a site level permitting process in place, and following national regulations,

    - all gill nets will be registered with the Fisheries Department and be compliant with national regulations (including length, mesh size and number of gill nets)
    - all fishermen will be required to obtain an access permit from the Forest Department/NBIO for use within CBWS, recognizing them as traditional gill net users
    - gill nets may only be used in general use areas/zones of CBWS
    - fishermen must ensure that they do not leave nets unattended – any unattended net will be removed
    - the total number of gill nets in CBWS will be restricted to the legitimate traditional gill net fishers, to be verified by the vetting committee
    - a 'no new user' policy for gill netting within Corozal Bay Wildlife Sanctuary.
    - fish species caught must be legal under the fisheries legislation
    - Discuss seasons

Crab Traps

- Only one fisher uses crab traps within Corozal Bay Wildlife Sanctuary as their primary source of income, targeting the blue swimming crab ('jaiba')

    - all crab traps will be registered with the Fisheries Department and be compliant with national regulations
    - all crab trap fishers will be required to obtain an access permit from the Forest Department/NBIO for use within CBWS, recognizing them as traditional users
    - crab traps may only be used in specified locations within the general use areas/zones of CBWS,
    - the number of crab traps is capped at 60 for CBWS
    - crab traps cannot be sold or rented, but only be passed from father to son or other immediate family member (son, daughter, son-in-law, daughter-in-law)

- crab traps can only be set for the trap season (March 1st to June 30th)

Cast Nets (Commercial)

- Commercial fishers will also fish using a cast net to supplement the catch
  - a local access permit for cast net use will be issued by the Forest Department / NBIO, for use in general use zones, with registration and tagging of individual cast nets
  - all cast nets must have a mesh size of 3 inches or more are to be used in CBWS

NON COMMERCIAL FISHERS

Cast Nets

- Community use of cast or throw nets in CBWS has a long tradition, is very localised, is considered to have little impact on fish populations, and is an important supplemental food source for some families.
- anyone originating from and resident in CBWS stakeholder communities should have the option for using cast nets in front of their communities or other general use areas, for non-commercial use

  - a local access permit for cast net use will be issued by the Forest Department / NBIO, in general use zones, with registration and tagging of individual cast nets
  - all cast nets must have a mesh size of 3 inches or more are to be used in CBWS
  - Cast net users will be restricted by a bag limit as stipulated by the national legislation - recommended to be limited at this point in time to 20 individual fish per fisher
  - fish catch is not to be used for commercial purposes (not to be sold)

Recreational and Sport Fishing

- all recreational / sport fishers must be in possession of a sport fishing license from CZMAI
- all recreational and sport fishers will be required to pay a user fee to the site manager for user access to CBWS
- all recreational / sport fishing must be catch and release for sport fishing species as defined by Fisheries Department
- all recreational / sport fishers are required to follow the national bag limits for non-sport fishing species, with no sale of catch
- all sport fishing tour guides need to be in possession of a valid tour guide license and compliant with tour guide regulations under the Belize Tourism Board
- NOTE: once the Fisheries regulations have been finalized, all recreational fishers will need to be in possession of a recreational fishing license, once the regulations have been finalized

1.5.5 Proposed Zones

The following recommendations were made for the realignment of boundaries of Corozal Bay Wildlife Sanctuary based on the:

- reason for establishment of the protected area (transboundary protection of the Antillean manatee,
- wish to ensure a continued, sustainable, traditional fishery in the CBWS and
- national recommendations for the protected area's role in strengthening of Belize's National Protected Areas System through:
    - Increasing coverage of under-represented ecosystems within the National Protected Areas System
        - River
        - Mangrove and Marine Salt Marsh Ecosystems
    - Increasing species-specific protection for:
        - West Indian (Antillean) Manatee
        - Goliath Grouper
        - Bird Nesting Colonies
- improving fisheries management and fish nursery functionality (both commercial and sport fish species)
- building climate change resilience and improving ecosystem services in the Northern Belize Coastal Complex seascape
- baseline data developed by SACD over the last five years, and community input towards developing a sustainable fishery in the Wildlife Sanctuary, with the emphasis on long term viability of conservation targets, both of the Wildlife Sanctuary itself, and in the larger river to reef Northern Belize Coastal Complex seascape.
- identification and mapping of priority management areas formed the foundation for the information-based zoning recommendations (Maps 8 and 9)

A draft management zone plan has been developed for Corozal Bay Wildlife Sanctuary during 2017 - 2018 as part of the MCCAP project (Map 10). The initiative involved significant consultation with resource users, with the development of a series of five conservation zones and one special management zone to better manage the Wildlife Sanctuary and improve sustainability of the local fishery and viability of the CBWS conservation targets.

Conservation Zones:

Zone 1 encompasses the stromatolite area, with regulations that protect the integrity of the structures. It also encompasses a key transboundary area of conflict, to improve ease of management in an area with continued transboundary incursions.

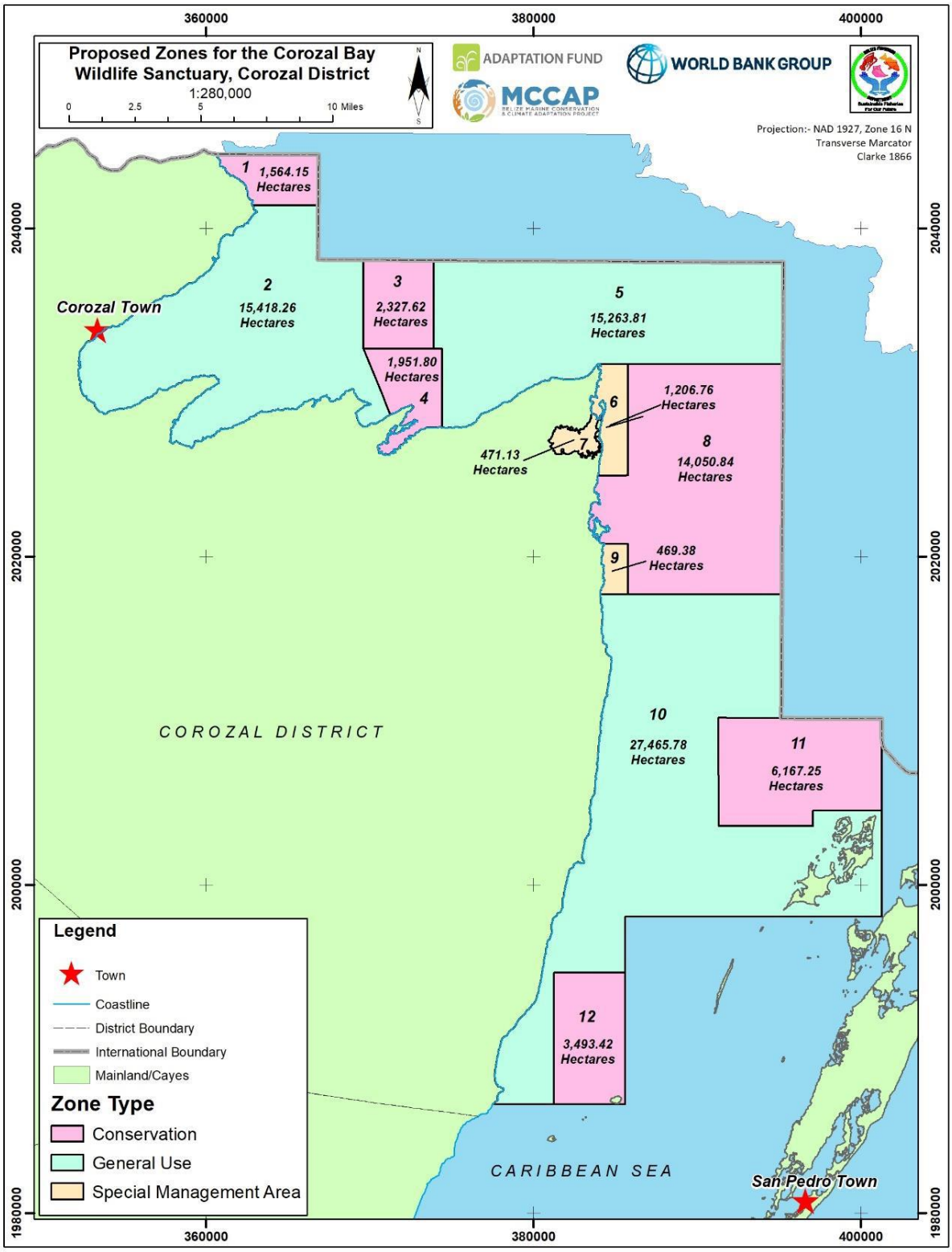


FIGURE 1: MAP OF PROPOSED ZONING FOR CBWS (MCCAP, 2017)

Zones 3 and 4 provide strict protection for the mangroves and bird nesting colony of the Cayo Falso area, as well as extending north to include one of the key manatee holes in the Wildlife Sanctuary.

Zones 4 and 8 are both designated as conservation zones, protecting shallow coastal ecosystems.

Zones 3, 11 and 12 focus on protection of deeper, off-shore areas of the Wildlife Sanctuary, providing representation for these areas within the designated non-extractive zones.

All other zones are designated for General Use, with regulated fishing managed under the CBWS Sustainable Fishery Plan and Managed Access framework, with integration into the Wildtracks Sanctuary (2) framework.

1.5.6 Enforcement

The Fisheries Regulations are part of Belize's laws. In Corozal Bay Wildlife Sanctuary, enforcement may be by one of the following:

- Fisheries Officers from the Fisheries Department
- Sarteneja Alliance for Conservation and Development on behalf of the Fisheries Department
- Fisheries Officers of NBCC partners (Bacalar Chico Marine Reserve and Hol Chan Marine Reserve
- Belize Coast Guard, on behalf of the Fisheries Department

The benefit of a well-designed fisheries management system is that participants have the incentive to comply with regulations, as they will personally or collectively benefit. Managers should be able to focus their efforts on enforcing illegal fishing from non-license holders and illegal transboundary fishermen.

First Phase: Communication

Effective communication, education and outreach are essential tools that will be critical during the transition period to implementation of the new regulations, so that a stricter enforcement can begin once the transition period is over. The recommended transition period is between two (2) to six (6) months. Education of fishermen should be a first step in successful enforcement, in particular to ensure they understand their rights and responsibilities. This will be through the development of a community engagement plan, outlining who the main stakeholders are and the best approach to socialize the new regulations of the protected area. Dissemination of information can be through several mechanisms:

- Rangers conducting patrols should be well trained to provide correct and up to date information to the users,
- CBAC members and local fishing associations should also be kept well informed and up to date, and provided with materials that will assist them in providing correct and current information to their sectors,

- Education officers should engage a cross section of stakeholder in the buffer communities to provide regular updates about the protected area.

Second Phase: Transition Period

A **three-strike rule** should be implemented once enforcement is initiated, during the transition period. This valuable tool was particularly useful during the pilot phase of the managed access program employed by the Belize Fisheries Department. A key element to its success was that the three-strike idea came from the fishers during the consultation process, and its implementation included the integration of the recommendations of the area-based committees, garnering considerable support (Adriel Castañeda per. com.). It has also been suggested by the CBWS fishers during consultations at the start of the sustainable fishery development planning. The implementation of the **three-strike rule policy** is a viable option for enforcement within CBWS, and a practical way of addressing the issues of illegal actions within the Wildlife Sanctuary. It will be strengthened by the integration of the CBWS Fisheries Management Committees and CBAC to provide community input into management decisions on applying the three strike rule in individual circumstances. This system is especially important considering the non-transferable tenure granted to fishers who have used the area since its establishment.

The three-strike rule is as follows:

First infraction – A written warning is issued to the fisher (depending on the severity of the infraction)

Second infraction – Consecutive infractions, whether processed in court or not, shall result in the fisher's CBWS fishing access license being suspended for a period not exceeding one (1) year.

Third infraction – A repeat offender, who has received written warnings and has already been charged and/or has had his CBWS fishing access license suspended, will be deemed as a non-compliant fisher and will have his license revoked.

Third Phase: Regular Enforcement

Following the transition period of Phase Two, enforcement will follow the policies and procedures of the Fisheries Department and the SACD Surveillance and Enforcement Plan.

Part II: A Snapshot…the Corozal Bay Wildlife Sanctuary Fishery

2.1 CURRENT STATUS

CBWS is highly biodiverse and provides many ecosystem services to stakeholder communities, including fish as a culturally important protein source. The mangroves and shallow lagoons provide nursery habitat for a number of important commercial, local and sport fish species (industry) including snapper (pargo), snook (robalo), striped mojarra (chiwa), mojarra and tarpon (sabalo). Regionally, the estuary is a key pupping area for bull and bonnethead sharks, and was once home to the smalltooth sawfish, though this is now considered nationally extinct.

However, with a trend of a declining fish stocks and increasing anthropogenic pressures on the Wildlife Sanctuary, it is becoming ever more critical to ensure resource use is sustainable if local fishermen are to be able to continue supporting themselves and their families, and at least maintain, if not increase, their standard of living. In planning for a sustainable fishery for the Wildlife Sanctuary, all local fisher sectors have been included in the consultations, with recognition of the need to secure rights to the fish resources and promote ownership and management of the resources by the fishermen, with support from SACD as the protected area co-management organization, and under the authority of the relevant authorities (Forest Department / NBIO and Fisheries Department).

Despite the importance of fishing for the local communities as a traditional, multi-generational activity, the legal designation of 'Wildlife Sanctuary' does not currently allow for extractive use. CBWS was originally established to provide protection for manatees, and designated as a non-extractive area, without recognition of the impacts to traditional fishing rights. Traditional fishing activities have continued regardless and local, small-scale, artisanal fishing activities are conducted by all stakeholder communities – beach traps, gill nets and cast nets are all used in the Wildlife Sanctuary for commercial and home purposes, and sport fishing is increasingly gaining in popularity.

This Sustainable Fishery Plan captures all fishing sectors in the Bay, and uses baseline data from the beach trap fishery to provide catch trends and guide management. Together with the traditional fishers, SACD is working with the National Biodiversity Office to re-designate the Wildlife Sanctuary as a Wildlife Sanctuary (2), to ensure there is a legal framework to support the fishery, and has defined site specific regulations that would allow continued access to the resources, towards ensuring sustainable use for long term benefit of the traditional users and stakeholder communities.

It is important to base any fisheries management strategy development on the best scientific information available. A number of mechanisms were used to characterise the beach trap fishery, including the fishing effort per beach trap fishermen, with random sampling of the catch over the catch season, providing estimates of the status of the stock over multiple years. This data has been used to inform strategy development towards long term sustainable management. The outputs also provide biological and economic reference points, to be used as baselines for adaptive management of the fishery resources over time.

> *"When considering the adoption of conservation and management measures, the best scientific evidence available should be taken into account in order to evaluate the current state of the fishery resources and the possible impact of the proposed measures on the resources"*
>
> **FAO, 1995**

2.2 STATUS OF FISH STOCKS

Conservation planning is a key part of management planning, with commercial fish species identified as a conservation target for management action. An assessment was made of the status and viability of the fish stocks, as well as the threats to the protected area based on biodiversity monitoring outputs and community input (Table 2). The viability of the Commercial Fish population was considered to be **FAIR** (*requiring urgent human intervention to restore numbers to viable levels*), based on the reductions seen over the, with the goal to increase this status to **GOOD** by the end of the 5-year management period, with the objectives of '*maintaining and improving the viability of the commercial species of Corozal Bay Wildlife Sanctuary*'. This is to be achieved through the establishment of a sustainable fishery framework, in partnership with the local traditional fishers.

Commercial Fish Species – Current Viability Rating		
Current Rating	**Goal**	**Justification for Rating, Goal and Indicator**
FAIR	**GOOD**	***Justification:*** Importance of traditional fisheries resource to Corozal Bay communities. Reduced fish populations due to unsustainable fishing practices and transboundary incursions.
		Goal: Improved fisheries resource within Corozal Bay Wildlife Sanctuary, with engagement of local traditional fishers and establishment of a sustainable fishery framework
		Indicator: Average biomass per species of catch per year per beach trap Average total length per species per year per beach trap

TABLE 5: CURRENT VIABILITY OF COMMERCIAL FISH POPULATIONS (CBWS MANAGEMENT PLAN, 2020-2024)

Species Assemblages: Native Commercial Marine Species			
Current Status	**NBCC Status**	**Goal**	***Objectives:*** ▪ *To maintain and improve the viability of the commercial species of Corozal Bay Wildlife Sanctuary*
FAIR	**FAIR**	**GOOD**	

Justification	**Species / ecosystems nested in this target**
Commercial finfish species support a local traditional fishing industry on which families in each of the coastal stakeholder communities depend. The role of many of the target finfish species as top predators is also essential in the maintenance of the estuary ecosystem. Most commercially important marine species have complicated life cycles that rely on the health and connectivity of the entire marine ecosystem – utilizing not just the seagrass beds and the mangroves, but also the reef and, for some, deep oceanic waters during their lives. The estuarine system of CBWS is important for the maintenance of local, culturally preferred finfish species – particularly the mojarra and snapper. Many of these reproduce in the estuary and rely on the inundated mangroves of the shallow coastal lagoons in their juvenile stage. Sport fish species – permit, tarpon, bonefish, jack, barracuda and (to a lesser extent) snook – are all fished in the Wildlife Sanctuary, and support a small sport fishing industry. This is primarily (but not entirely) catch and release.	Goliath Grouper (*Epinephelus itajara*) Striped mojarra (*Eugerres plumieri*) Yellowfin mojarra (*Gerres cinereus*) Grey snapper (*Lutjanus griseus*) Mutton snapper (*Lutjanus analis*) Lane snapper (*Lutjanus synagris*) Great barracuda (*Sphyraena barracuda*) Striped Mullet (*Mugil cephalus*) Crevalle Jack (*Caranx hippos*) Horse-eye jack (*Caranax latus*) Cero (*Scomberomonis regalis*) Snook (*Centropomus undecimalis*) Blue-striped grunt (*Haemulon sciurus*) Blue swimming crab Permit (*Trachinotus falcatus*) Tarpon (*Megalops atlanticus*) Bonefish (*Albula vulpes*) Snook (*Centropomus undecimalis*)

2.2.1 Perceived Trends

Many commercial fish species have decreased in CBWS over the last thirty years (community consultations), including the goliath grouper… and the smalltooth sawfish has disappeared. Community and fisher consultations in 2003, 2008 and 2020 indicate that very few interviewees perceived the status of fish stocks within the Wildlife Sanctuary as Very Good in any of the three survey years, with the majority of respondents reporting stocks as Good in 2003 and 2020, but Fair in 2008 (Figure 3).

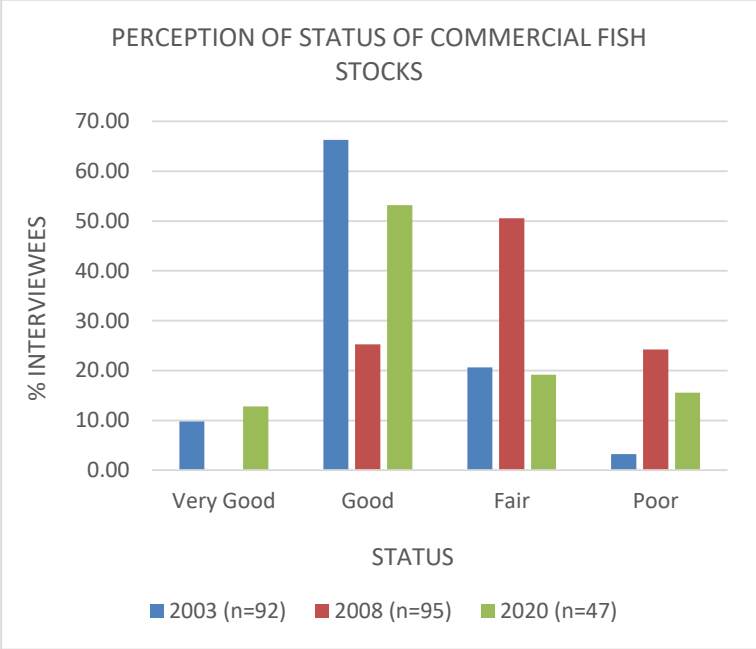


FIGURE 2: PERCEIVED STATUS OF COMMERCIAL FISH POPULATIONS OF CBWS (SACD, 2003, 2008, 2020)

Very Good: Does not need human intervention
Good: Populations reduced, but should recover with limited human intervention
Fair: Populations will decline if there is no human intervention
Poor: Populations are in danger of disappearing from the area, even with human intervention

Fisher consultations as part of this planning process in June and July of 2020 indicate that fishers perceive the current status of fish stocks within Corozal Bay Wildlife Sanctuary to be 'Good (Populations reduced, but should recover with limited human intervention)' (53%). The data also demonstrated that 48% of fishers consider fish stocks to have decreased, with 43% indicating that they think fish stocks have remained stable over the last 10-20 years.

In 2009, the majority of respondents believed that the primary reason for the decline in fishing resources was unsustainable fishing, principally through the use of gill nets (Figure 4). Also cited was the extraction of juveniles / undersized individuals, and transboundary incursions from Mexico.

2.2.2 Key Pressures and Threats

The conservation planning process also identified the threats to fish population viability, and to the estuarine system as a whole (Table 5). Unsustainable fishing is the highest ranked threat for the system - it occurs throughout the area, is happening now, and therefore is considered urgent, and is reported to be having a substantial effect on the local fish populations. Whilst the majority of target fishery species

are not considered in threat of immediate local extinction, unsustainable fishing pressure and illegal, transboundary fishing incursions has reduced goliath grouper to a currently non-viable population, and the smalltooth sawfish (*Pristis pectinata*), once present in large numbers, has been extirpated from the system.

Threats Across Targets	Coastal Ecosystems	Coral Reefs	Seagrass	Commercial Marine Species	Marine Mammals	Physio-chemical Environment	Ancient Formations	Overall Threat Rank
Climate Change	Very High	High	Low	High	Low	Medium	Very High	Very High
Coastal /Caye Development	Very High	High	Medium	Medium	Low	Medium	Very High	Very High
Land-based Pollution		High	Low		Low	High	Very High	High
Unsustainable /Illegal Fishing Pressure		High	Medium	High	Low			High
Oil drilling, Exploration and Spills	Low	High	Low		Low	High	Low	High
Lionfish		High		Medium				Medium
Improper disposal of waste (cruise ships, leachate, anti-fouling paint)		Medium				Low	Medium	Medium
Poor Tourism Practices		Low			Low		Medium	Low
Poor Boating Practices		Low	Low		Low			Low
Illegal Activities in Littoral Forest	Low							Low
Overall Threat Status for Targets	Very High	Very High	Medium	High	Low	High	Very High	Very High

TABLE 5: THREAT ASSESSMENT FOR CBWS, CBWS MANAGEMENT PLAN 2020 – 2024

The most recent assessment of threats to the protected area was completed in 2019, as part of a national management effectiveness assessment. The four highest threats were identified as:

1. Coastal Development
2. Water pollution
3. Unsustainable fishing practices
4. Transboundary illegal fishing incursions

Identified as one of the highest impacts when SACD took on the co-management role, transboundary incursions into the protected area have been significantly reduced, with other threats coming to the forefront. The scope of unsustainable fishing activities in CBWS has declined from widespread to localized over the last five years, with the impact declining from moderate to mild (Table 6).

UNSUSTAINABLE FISHING PRACTICES			
Recent History: ☐ ***Has*** ☐ **Has not** **been a pressure in the last 5 years**			
In the past 5 years this activity has:	**Extent**	**Impact / Severity**	**Permanence**
☐ Increased sharply ☐ Increased slightly ☐ *Remained constant* ☐ Decreased slightly ☐ Decreased sharply	☐ Throughout (> 50%) ☐ *Widespread (25-50%)* ☐ Scattered (5-25%) ☐ Localized (< 5%)	☐ Severe (target eliminated) ☐ High (target seriously degraded) ☐ *Moderate (moderately degraded)* ☐ Mild (slight impact)	☐ Permanent (> 100 years) ☐ Long term (20-100 years) ☐ *Medium term (5-20 years)* ☐ Short term (< 5 years)
Current Status		**Future Status**	
Extent	**Impact**	**Urgency**	**The probability of the threat occurring is:**
☐ Throughout (> 50%) ☐ Widespread (26-50%) ☐ Scattered (5-25%) ☐ *Localized (< 5%)*	☐ Severe (target eliminated) ☐ High (target seriously degraded) ☐ Moderate (measurable impact) ☐ *Mild (slight impact)*	☐ *Threat is occurring this year* ☐ Threat may occur in the next 1 – 3 years ☐ Threat may occur between 3 and 10 years ☐ Won't happen in < 10 years	☐ Very High ☐ High ☐ Medium ☐ Low ☐ Very Low

***TABLE 6: ASSESSMENT OF THE THREAT OF UNSUSTAINABLE FISHING PRACTICES IN CBWS (CBWS NAS-MEE 2019*)**

Fisher consultations demonstrate that the prioritized threats identified by fishers are consistent with those identified under the protected area assessment, with. Fishers identify 'mangrove clearance/unsustainable development', 'water pollution/agriculture runoff/sewage treatment', 'unsustainable fishing (fishing of juveniles, irresponsible use of gear), as the highest threats to the fishery, and also include 'climate change (changes in storms, salinity, and rain patterns).Climate change was not included in the NPAS assessment, which only targeted anthropogenic threats (Table 6.).

When asked for possible solutions, the 29 fishers who responded suggested:

- improved use and promotion of sustainable/responsible fishing practices (following fisheries regulations, increasing awareness of sustainable/responsible fishing, reporting of illegal fishing practices, proper use of gear/s, release of undersized and by-catch species) (45% of fishers)
- increased protection of mangrove habitats and coastal lagoons (key nursery areas) (21% of fishers)
- establishing zonation and increasing patrols (17% of fishers)
- regulation of access and number of fishers (14% of fishers)
- addressing water pollution through improved water management in stakeholder communities (including Corozal and Chetumal) (10% of fishers)

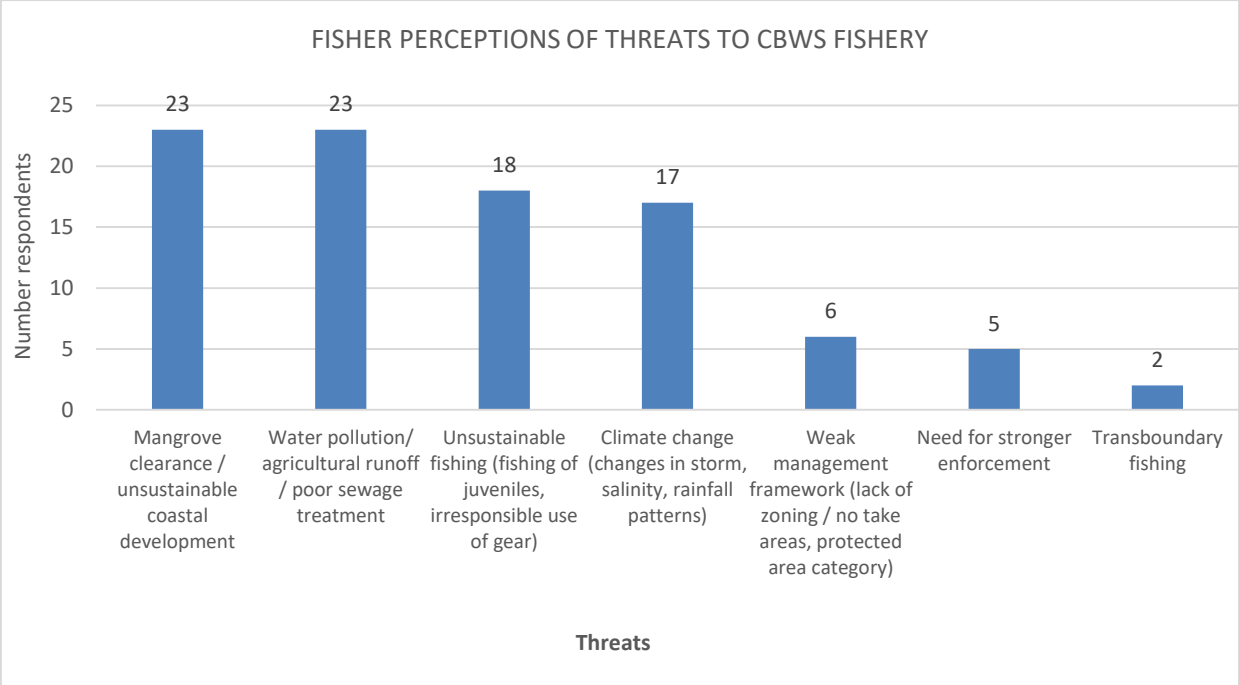


FIGURE 3. FISHER PERCEPTION OF THREATS FOR FISH POPULATIONS IN CBWS (N=40 FISHERS).

'Mangrove clearance/unsustainable development' and 'water pollution/ agriculture runoff/sewage treatment' ranked as the highest threat for the system (Figure 6) – with respondents highlighting the importance of improved water management in the CBWS coastal communities and in Chetumal, and increased protection and awareness of mangrove habitats and their role in the health of fish populations. Mangrove clearance was not only associated with coastal development, but also in the context of fishing, with some fishers entering the coastal lagoons and targeting fish living in the shelter of the mangrove roots of cayes ('mogotes') by surrounding these with nets and cutting the roots to be able to catch all fish. This practice was said to be done by both traditional and non-traditional fishers of CBWS.

Water pollution has been assessed by SACD, with primary sources being associated with the New River (including agriculture runoff from the sugar cane industry and runoff from Orange Walk), and the limited effectiveness of sewage treatment from Chetumal and Corozal, were main threats of concern. Unsustainable fishing, the threat that ranked highest in the community consultation in 2009, ranked as the third highest threat in 2020. The fishermen suggested that some fishers, both local and non-local (Mennonites, Chinese, and non-traditional fishers from stakeholder communities), used unsustainable and/or illegal practices in the lagoons and creeks, as well as in the Wildlife Sanctuary itself during the weekends or nights to avoid the patrols (e.g. using Chinese fishing nets, etc.), some accessing the bay through roads on private land. Releasing undersized commercial fish and by-catch species was highlighted as important and as a part of being a responsible fisher in CBWS.

Climate change was considered of concern by the fishers – northern Belize has been identified as at high risk from the impacts of climate change with increasing temperatures, reduced rainfall, an increase in extreme weather events (drought and unflooding) and unpredictable weather patterns (Table 7). With the increase in droughts and subsequent high salinity, which they associated with a decrease in the number of stone bass ('chiwas') over the last two years (2018 and 2019).

PREDICTED CLIMATE CHANGE IMPACTS ON COMMERCIAL FISH SPECIES	
Sea level rise	Snapper / grouper / chiwa / mojarra and other finfish: Shift in range / habitat loss of both adult and juvenile lobster – linked to inundation of mangrove, shift in seagrass distribution,
Sea surface temperature rise	Reduced capacity for holding oxygen - Increased potential for fish kills in high temperature peaks. May affect physiological processes, and disease may become more prevalent. Possible impacts from new invasive species and algal blooms. Changes in currents and larval dispersal
Increased frequency and intensity of storms	Seagrass and mangrove destruction, increased sedimentation, affecting larval and juvenile habitat Possible impacts on larval dispersal / survival (potential for wider dispersal of larvae)
Ocean acidification	Potential impacts on larval viability and adult growth rates Unknown how fish respond to changes in pH balance Potential decrease in egg viability Potential decrease in viability of eggs and juveniles
Decreased Precipitation	Possible changes in salinity impacting larval dispersal. Lobster migration patterns and times will change. More frequent, higher salinity pulses before equalization with main seawater body. There is a hypothesis that increased algal bloom may be attributed to reduced precipitation
Increased Air Temperature	Potential impacts on mangroves as a nursery habitat

TABLE 7: PREDICTED CLIMATE CHANGE IMPACTS ON COMMERCIAL FISH SPECIES

Transboundary fishing, identified as one of the major threats when SACD first took on the co-management role for CBWS, has decreased significantly, with fishers recognizing the impact of SACD's surveillance and enforcement programme. 'Insufficient enforcement' was generally interpreted in the context of fisher activity in the coastal lagoons (outside the SACD's enforcement mandate), with the illegal placement of gill nets and the destruction of red mangrove roots around cayes.

Strengthening of the management framework was also identified by fishers as important for strengthened management of the fishery - specifically the transition to the designation as a Wildlife Sanctuary (2) and establishment of zones to provide a more effective framework for enforcement.

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

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

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

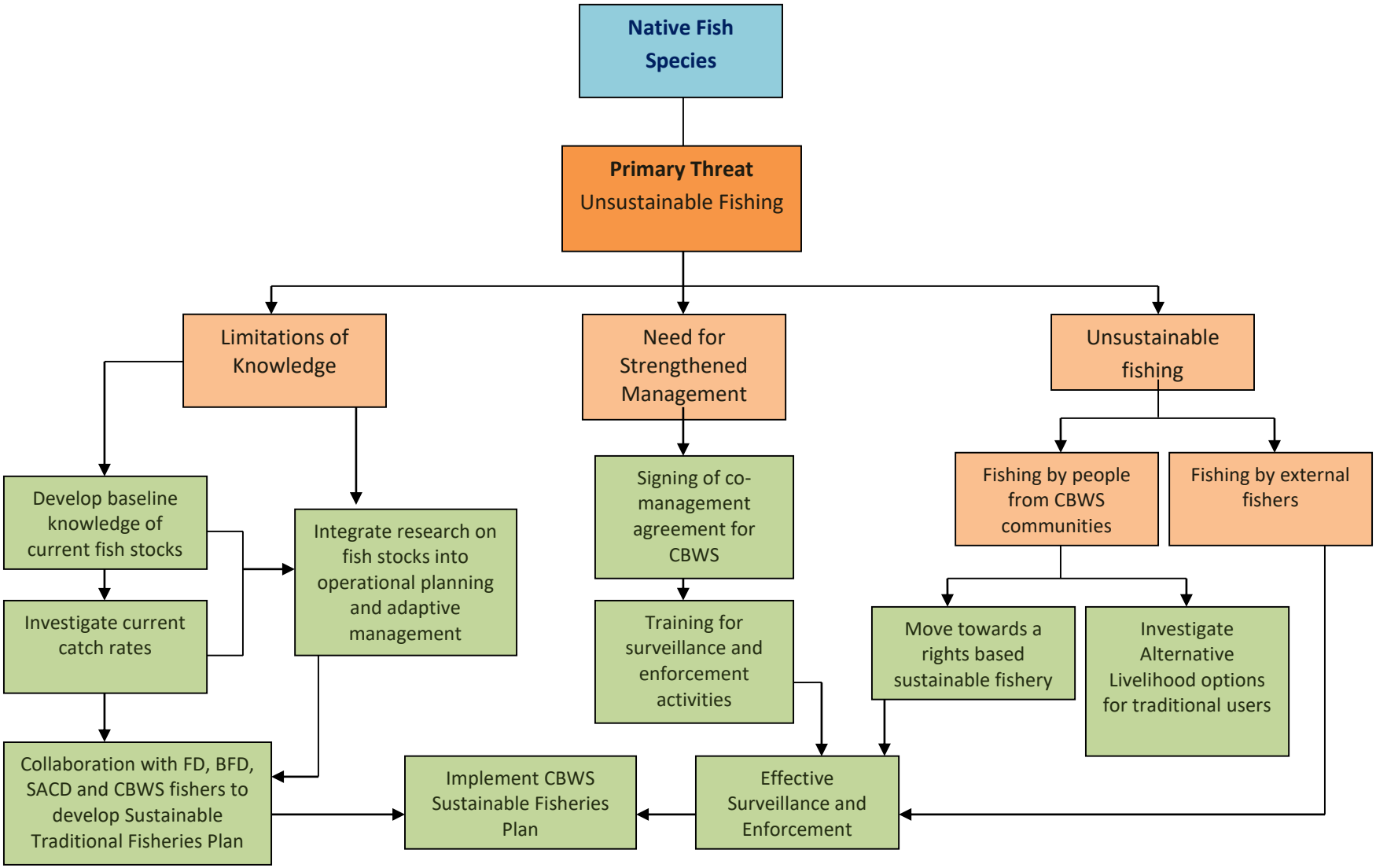


FIGURE 4: SITUATION ANALYSIS FOR COMMERCIAL FISH SPECIES OF COROZAL BAY WILDLIFE SANCTUARY

2.3 PROFILE OF FISHING ACTIVITY IN COROZAL BAY

Fish trap data, socio-economic surveys of the CBWS stakeholder communities and community consultations with fishermen, have provided extensive information on targeted fish species and fishing activities within Corozal Bay Wildlife Sanctuary.

An estimated 33 to 35 fishermen are considered to be dependent or largely dependent on the small scale fishery of Corozal Bay Wildlife Sanctuary (Table 3). The majority of these (50% +) are from Sarteneja, with the highest dependency, whilst those from Corozal and Consejo have greater opportunities for employment in other areas.

Five communities are considered stakeholders of CBWS – Sarteneja, Chunox, Copper Bank, Corozal and Consejo. Some sport fishers from San Pedro have also been identified as users of CBWS. An minimum estimated of 33 fishers are considered to be dependent or largely dependent on the small scale fishery of Corozal Bay Wildlife Sanctuary (Table 7). The majority are from Sarteneja.

COMMUNITY	TYPE OF FISHER	NUMBER
Sarteneja	Trap fishers	14-15
Sarteneja	Gill net fishers	6-9
Sarteneja	Subsistence/recreational fishers	7
Sarteneja/San Pedro*	Sport fishers (originally from Sarteneja – working the sport fishing season in San Pedro)	6-7
Chunox	Gill net fishers	2
Chunox	Subsistence/recreational fishers	4-5
Copper Bank	Subsistence/recreational fishers	5
Consejo	Gill net fishers	3
Corozal	Gill net fishers	3
Corozal	Subsistence/recreational fishers	4-5
Corozal	Trap fisher (Deer Caye)	1
San Pedro*	Sport fishers	1

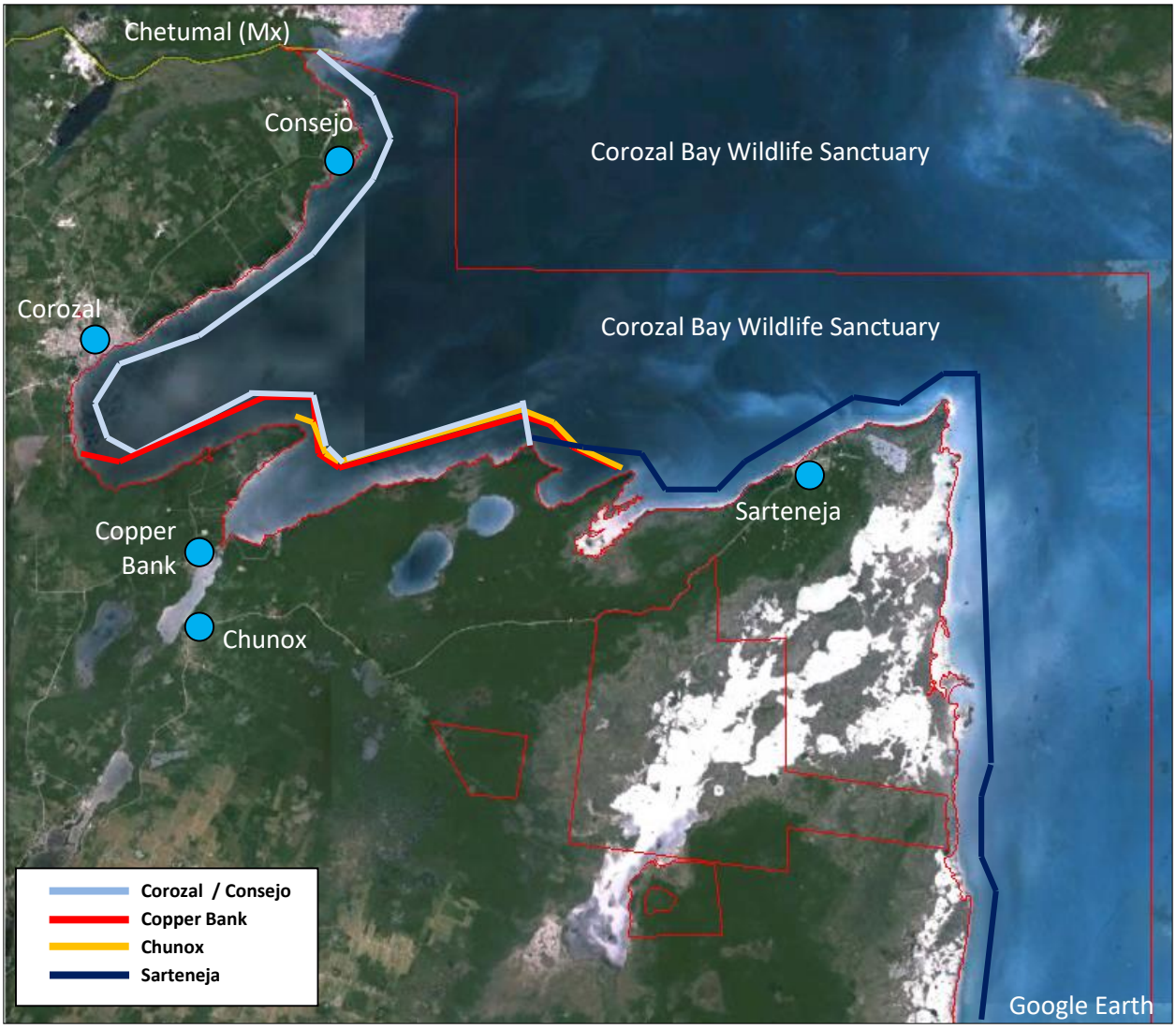
TABLE 7: TYPE OF FISHERS PER COMMUNITY (FISHER CONSULTATIONS, 2020).

*sport fishing guides from the Pescador Lodge use CBWS as part of their activities or upon request from a client.

Fishers were identified with the assistance of SACD, fishers and/or key informants. In total, 75 fishers were identified (both active and non-active) and 48 were interviewed in person. The remaining fishers were called, where possible, and informed about the process. The fishers were grouped by community, type (commercial, subsistence/recreational and sport fishing), and methods/gears used to provide a snapshot of the current fishery in CBWS.

2.3.1 Fishing Areas

Mapping exercises in the stakeholder communities demonstrate that there is a loose division of the fishing area per community that has changed little since 2009, with Sarteneja using the largest percentage of the Wildlife Sanctuary (Map 4). Fishing activities are almost exclusively within 300m of the shore, focused on catching species that move up and down the coastline, using a variety of fishing methods and equipment.



MAP 2: FISHING AREAS PER COMMUNITY (SACD COMMUNITY CONSULTATIONS, SARTENEJA, CHUNOX, COPPER BANK AND COROZAL, 2009 – 2011)

The area of highest overlap is Warree Bight, a sheltered bay accessed by Sarteneja, Chunox and Copper Bank fishermen. Sport fishers use the west of the bay, around Spanish Point, entering the coastal lagoons. Some occasionally venture all the way to Rocky Point and around Deer Caye.

2.3.2 Target Species

Fourteen species are regularly fished from Corozal Bay Wildlife Sanctuary for commercial or home-use purposes (Table 8), with four of these considered key targets for fishery management.

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

TABLE 8: SPECIES FISHED REGULARLY FROM COROZAL BAY WILDLIFE SANCTUARY (FISH TRAP DATA, 2011).

A profile of the demand for different species of fish by Sarteneja for both home and for commercial purposes was assessed through a survey of 150 households (SACD, 2009), providing information on species considered culturally important to the diet of the community (Table 5).

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

TABLE 9: PREFERRED TARGET SPECIES (SARTENEJA SOCIO-ECONOMIC SURVEY, 2009)

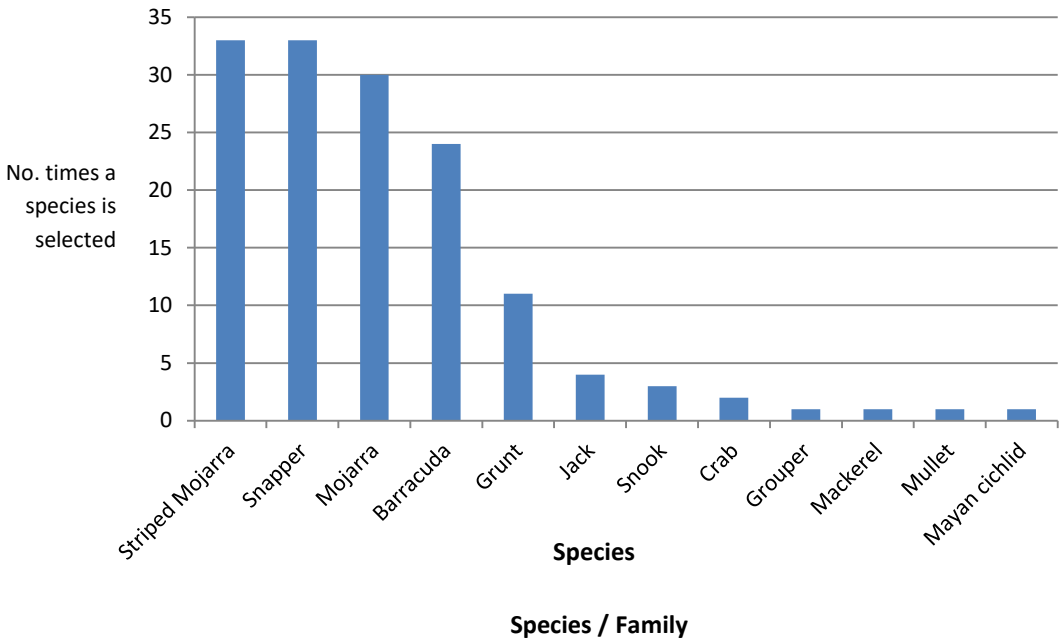


FIGURE 4: PREFERRED FISH SPECIES IN COROZAL BAY WILDLIFE SANCTUARY STAKEHOLDER COMMUNITIES (SACD, 2009).

There is a clear cultural preference for striped mojarra ('chiwa' or 'stone bass' - *Eugerres plumieri*), as well as the closely related yellowfin mojarra ('mojarra' - *Gerres cinereus*) (Figure 6). These preferences were confirmed during the consultation with the local fishers in 2020. There is a clear preference among fishers for striped mojarra ('chiwa' – 71% of fishers), as well as the closely related yellowfin mojarra (47%). Snapper, particularly grey (or mangrove) snapper ('pargo') and barracuda were also among the preferred species, favoured by 45% of the respondents, followed by snook ('robalo' – *Centropomus undecimalis),* favoured by 34% of the respondents.

Family	**% respondents (n=38)**	**Species**	
Stone Bass (Gerridae)	71%	Striped Mojarra	*Eugerres plumieri*
	47%	Yellowfin Mojarra	*Gerres cinereus*
Snapper (Lutjanidae)	45%	Grey Snapper	*Lutjanus griseus*
		Lane Snapper	*Lutjanus synagris*
		Mutton Snapper	*Lutjanus analis*
Barracuda (Sphyraenidae)	45%	Great Barracuda	*Sphyraena barracuda*
Snook (Centropomidae)	34%	Common Snook	*Centropomus undecimalis*
Jack (Carangidae)	5%	Horse-eye Jack	*Caranax latus*
		Crevalle Jack	*Caranax hippos*

TABLE 10: PREFERRED FISH SPECIES TARGETED BY FISHERMEN IN COROZAL BAY WILDLIFE SANCTUARY (SACD, 2020)

Community consultations with fishermen suggest that not all these species are available throughout the year... some enter the estuarine system in large numbers only seasonally, to spawn (Figure 7), generally running during the first north wind of the north front season and at the start of the first tropical storm.

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

FIGURE 5: SPECIES SEASONALITY WITHIN COROZAL BAY WILDLIFE SANCTUARY (SACD / LOCAL FISHERMEN, 2009).

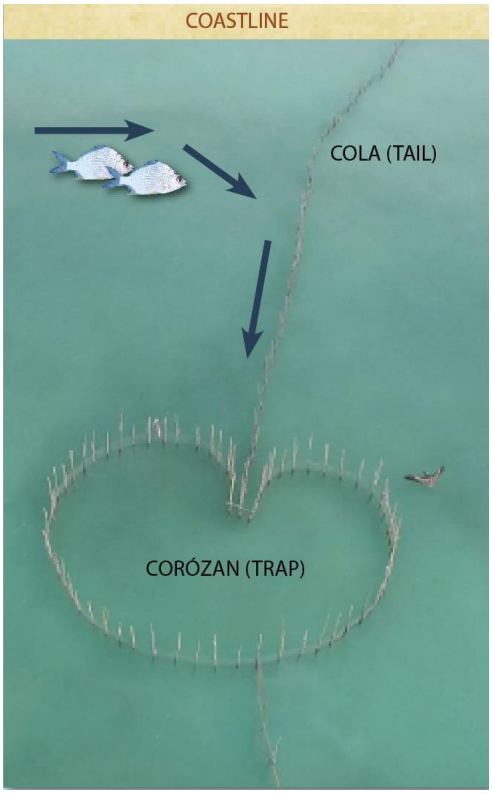
Assessments of the beach trap catch data collected in 2011, 2015, and 2016 demonstrate that the preferred species – striped mojarra, yellowfin mojarra, grey snapper and great barracuda - are also those that have the greatest representation in the catch.

2.3.3 CBWS Fishing sectors

The fishery in CBWS is composed of different fishing sectors, with most commercial fishermen using beach traps and/or gill nets. Fisher consultations (2020) also identified 2 commercial cast net fishers in Sarteneja.

Beach Trap Fishermen

The local fishers of Sarteneja use traditional beach traps, each set at a specific location on the coast that is handed down from generation to generation. Each trap is designed with a 'cola' (or tail) that extends from the beach into the sea for 250 to 300 feet, directly out from the coastline, leading to a heart shaped 'corazón', a holding pen approximately 150 feet perimeter. The corazón and cola are constructed of galvanised 1.5 inch chicken mesh supported on wooden stakes that are placed 2 feet apart, forming a fence.



The fish swim along the coastline until meeting the fence-like cola. They turn away from the coast to swim along the cola, ending up passing through the narrow entrance to the corazón. The shape of the corazón encourages the fish to stay inside the trap. Sarteneja fishers own the majority (fourteen of the fifteen) of the beach traps beach traps, which are located near the community. The exception is a beach trap established on Deer Caye by a fisher from Corozal. This is considered a traditional fishing method for the area, with traps being passed from father to son or other immediate family member.

At the start of 2020, 19 traps were registered with SACD, belonging to 15 Sarteneja fishers, and set in permanent locations along the coastline east and west from Sarteneja. An additional fisher has established a beach trap at Deer Caye (Map 5, Table 9). Fishing is seasonal, with traps opened in March and removed at the end of November / start of December, when the strong north winds start. The take is very discriminatory, with fish netted live and sorted at point of capture. By-catch (non-commercial species / undersized) is thrown back alive.

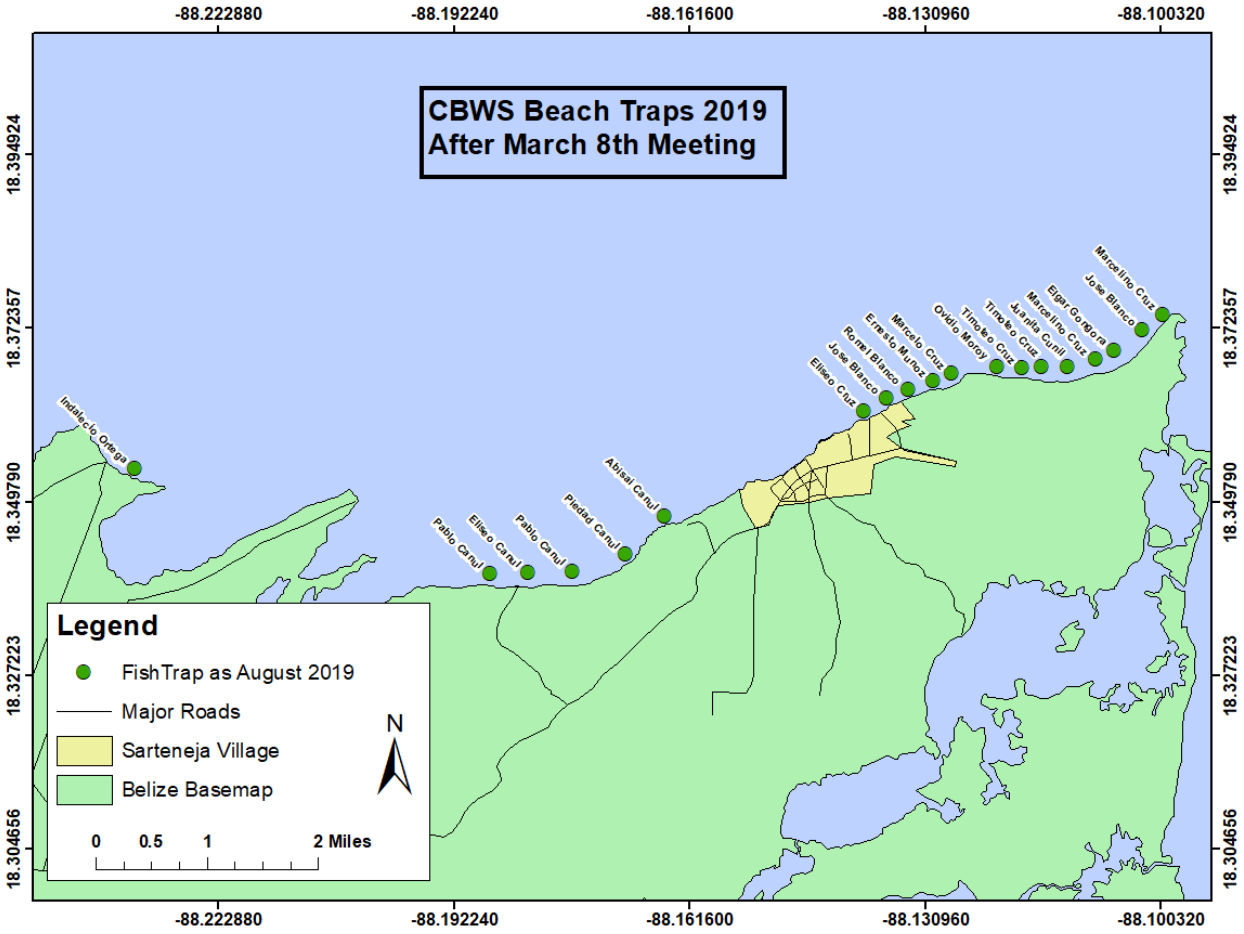


FIGURE 6. CBWS BEACH TRAPS 2019

Currently, 10 of the 16 beach trap fisher own one trap, with 3 owing two traps, and one owning three. Most fishers also possess gill nets and cast nets, and supplement their income using these within CBWS (Table 11). Beach traps are accessed by skiff or canoe, depending on distance from Sarteneja.

FISHER ID	TYPE	SIZE (FT)	HP	NO. OF TRAPS	OTHER GEARS	NO. OF GILL NETS (A. MESH SIZE, B. LENGTH, C. WIDTH)	STATUS
Fisher 1	Skiff	23	15	1			Active
Fisher 2	Skiff	18	40	1	Gill net, cast net	4 (a. 4'', 4'', 6'', 6'', b. 60 m, c. 7', 7', 12', 12')	Active
Fisher 3	Skiff (2)			1			Active
Fisher 4	Canoe	8		1	Gill net, cast net	2 (a. 4'', b. 100 m, c. 8')	Active
Fisher 5				1	Gill net		Active
Fisher 6	Skiff	16	15	1	Cast net		Not active
Fisher 15				1			Active
Fisher 9	Skiff	23	40	1	Gill net, cast net	2 (a. 4", b. 75 m, c. 10')	Active
Fisher 10				1			Active
Fisher 11				1	Gill net, cast net	3 (a. 3", 4", b. 100 m, c. 7')	Active
Fisher 13				1	Gill net, cast net	2 (a. 4", 100 m)	Active
Fisher 8	Skiff	23	90	2	Gill net, cast net, sport fishing	3 (a. 3", 4", 6", b. 100 m, c. 3')	Not active
Fisher 12	Skiff (2)	25	85	2			Active
Fisher 14	Skiff	16	15	2	Gill net, cast net		Active (1 trap)
Fisher 7	Skiff (3)	25	75	3	Gill net, cast net	3 (a. 3'', 5'', 4'', b. 100 m, c. 8')	Active
Fisher 16 *				1			Active

**Fisher 16 is from Corozal, with an established beach trap at Deer Caye*

TABLE 11. BEACH TRAP FISHERS AND GEAR

Commercial gill net / cast net

There are commercial gill net fishers in Sarteneja, Chunox, Consejo and Corozal, using different areas of CBWS for their activity. 4 teams of between 2 to 3 people from Sarteneja use gill nets on the East Coast, behind Deer Caye / Cayo Negro or on the north coast, depending on the time of year and water conditions (Table 10). Fishers from Chunox fish from Lorrie Bight up to Punta Col. Gill net fishers from Consejo and Corozal use the area from Consejo to the end of Lorrie Bight, mainly fishing around their own community.

Fishers leave nets overnight, setting them around dusk (5-6 pm) and retrieving them again around dawn (5-6 am), around 10-12 hours/night. They work with the phases of the moon, preferring dark nights for their activity. The fishers stay in the vicinity of their nets, checking them every one to two hours to ensure that the catch stays fresh and does not attract crocodiles, crabs and predator fish. This method is combined with cast net to catch fish for consumption ('vianda') or to add to the overall catch of the fishing trip. They also use the cast nets in coastal lagoons and creeks, where gill nets are not permitted.

They have the permitted number of 3 gill nets, with measures (mesh size, length and width) varying within the permitted sizes/dimensions (Table 12). The mesh sizes range from 3'' to 7'', depending on the target species. Smaller mesh size (3'' or called 'chiweras') is used for stone bass and/or mojarras. Larger mesh size (7'' or known as 'robaleras') is used to catch snook and other larger fish. They classify the selectiveness of their nets according to mesh size and target species. According to one fisher, the minimum allowed mesh size of 3'' catches as a minimum 0.5-1 lbs fish or a table sized pargo (over 10 cm in total length). The length of most nets is the permitted 100 m or below, with width varying 6 and 12 feet and an average mean width of 9 feet.

Additionally, a few commercial gill net fishers were identified in Chunox (2), Consejo (3), Corozal (3).

FISHER ID	COMMUNITY	TYPE	SIZE	HP	NO. NETS	MESH SIZE (")	LENGTH (M)	WIDTH (FEET)	OTHER GEARS
Fisher 1	Sarteneja	Skiff	25	60	3	3.5, 6, 6	100	8	Cast net
Fisher 2	Sarteneja	-			3	3, 4, 4	40	12	Cast net
Fisher 3	Sarteneja	Skiff	15	8	3	4	100	6	Cast net
Fisher 4	Sarteneja	Skiff	25	75	3	3, 5, 7, 7	100	6	Cast net
Fisher 5	Sarteneja	Canoe	11	-	3	3, 3, 3	100	5	Cast net
Fisher 6	Sarteneja	Skiff	25	75	3	3.5, 5, 6	100	6	Cast net
Fisher 7	Sarteneja	Skiff	25	40	3	3	40	12	Cast net
Fisher 8	Sarteneja	Skiff (2)	25, 25	40, 60	3	4.5	100	9	Cast net
Fisher 9	Sarteneja	-							Cast net
Fisher 10	Chunox	Canoe	12	4	1	4	400	4	Cast net, hand line

Fisher 11	Chunox	Canoe	12	5	1	4	400	7	Cast net, hand line
Fisher 12	Consejo	Skiff	23	60	3	4	100		Crab traps (60 units)
Fisher 13	Consejo	Skiff	25	85	4	5	100		Cast net
Fisher 14	Consejo	-							
Fisher 15	Corozal	Skiff	21	60	3	4			Cast net
Fisher 16	Corozal	Skiff	25	60	3	5			Cast net
Fisher 17	Corozal	-							

TABLE 12. GILL NET FISHERS AND GEAR

Seasonal gill nets

A number of Sarteneja fishermen, whilst not fishing in CBWS as their primary source of income, use gill nets commercially during peak fish movement times in front of Sarteneja or on the East Coast (primarily October / November), with the first north fronts. Many of these are beach trap fishers, fishing out of trap season.

Cast Net Fishing

Cast nets or throw nets are used by many fishermen in the shallow waters in front of stakeholder communities, especially when the lobster season is closed, for relaxation and to catch fish for the table. Cast nets are normally used in the early morning or evening, for better lighting, and to avoid the heat of the day. There are seldom more than four or five fishermen active at any one time, and the catch is small (generally aorund 20 lbs). Approximately 21 people from the stakeholder communities use cast nets on a regular basis (once every two weeks or more) throughout the year in front of Sarteneja, at Warree Bight and Rocky Point, in the creeks. Species targeted are striped and yellowfin mojarra (chiwa and mojarra), great barracuda and 'ishpinta' (Mayan cichlid). These subsistence fishers also sometimes use a hand line and/or rod and reel, especially for barracuda.

Sport Fishing

Sport fishing in CBWS is catch and release fishing, with a narrow range of target species, primarily focused on tarpon, permit, bonefish, snook, and barracuda, driven by market demand from the sport fishing industry. The fisher consultations (2020) demonstrated that most sport fishing guides in CBWS come from the stakeholder community of Sarteneja, and only work from San Pedro during the sport fishing season from November to June. The sport fishing guides cater to specialized fishing lodges, whose clientele are mainly foreign. The boats are adapted for fly fishing and can carry two to three fishers aboard, with one person fishing at a time. They engage in fly fishing, spinning, and bottom fishing. In Belize, sport fishers are trying to achieve a grand slam – catching and landing a tarpon, permit and bone fish in one day. Another species of great importance to visitors of CBWS is snook (*Centropomus undecimalis*). Other target species are jacks, great barracuda, and snappers.

The sport fishing guides working out of San Pedro fish in the flats behind Ambergris Caye, around the cayes on the border of CBWS (e.g.: Blackadore Caye) and/or different parts of CBWS, mainly along the south west coast of the bay, often in coastal lagoons and creeks. They come specifically to CBWS for specialized clients or when there is little fish in the vicinity of San Pedro. They fish in the protected area between 6 and 7 hours. According to interviewed guides, they come to CBWS for the abundance of target species - especially large size tarpon (approx. 40 lbs) and snook - safety (no piracy) and less boats on the water. As this is a catch and release activity, fish are also considered to be less accustomed to sport fishing in CBWS and easier to catch. Different types of fishing are conducted, including fly fishing, spinning rod, and bottom fishing (snapper). They sometimes also capture fish for harvest and consumption, particularly snapper. Snook is also occasionally kept, often at request of the client, to take back to their lodge.

FISHER ID	COMPANY	TYPE	SIZE	HP	FREQUENCY OF USE	AREA USED
Fisher 1		Skiff	23	90		Southern area of CBWS
Fisher 2	(independent/freelance, still in training phase)	Skiff	23	90	Once/week	Southern area of CBWS
Fisher 3	Reel Belize	Skiff	23	60	Twice a year	Southern area of CBWS
Fisher 4	Blue Bonefish, Barefoot Fisherman, Green Horizon	NA			6 days/week	All of CBWS
Fisher 5	Green Horizon	NA			Once to twice/week	Southern area of CBWS (coast and lagoons around

						Spanish Point)
Fisher 6	El Pescador	Skiff	23	100	Once to three times/week	Southern area of CBWS and Rocky Point
Fisher 7	Green Horizon	NA			5 days/week	All of CBWS
Fisher 8	Green Horizon, Blue Bonefish Lodge	Skiff (3)	24, 24, 24	50, 50, 50	4-5 days/ week	All of CBWS
Fisher 9	Green Horizon	NA				
Fisher 10	Pescador Lodge	-				

TABLE 12. GILL NET FISHERS AND GEAR

2.3.4 Target species of the different fishing sectors

The main target species of the different fishing sectors demonstrate that there is an overlap in use of species (Table 13).

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

TABLE 13: SPECIES CATCH PER FISHERMAN TYPE

3.4 Temporal Patterns of Fishing in Corozal Bay Wildlife Sanctuary

An assessment was also completed on the temporal nature of fishing in the Wildlife Sanctuary, per fishing sector (Table 12)

Type of fishermen	When do they fish?	Season
Commercial beach trap	Set out at 4.30 / 5:30 am each morning to check and empty the traps, and will be finished by 7.00 am, bringing the catch to Sarteneja for sorting and, in some cases, sale at point of landing.	Traps are erected between March 1st to November 30th*, and then dismantled. Checked every day / every two days (when fish are in low numbers). Trap fishermen don't fish for rest of the year
Commercial gill net	Trips are for two or three days. Nets are set in the evening around 6/7pm and checked during the night. Pulled in, in the morning, with fishermen using cast nets in creeks and coastal lagoons during the day.	Nets are set regularly during nortes, at the start of tropical storm season, and with the moon. At other times, they are set, on average, once a month.
Seasonal gill nets	As above	First north front systems, first tropical storm – when snapper start running. Set for a week / two weeks at a time. Set them at evening, often in front of the village
Sport fishing	Generally start fishing in the early morning - 6:00am...and fish for either a half or whole day, targeting specific sport species	Sometimes use south part of CBWS, even though some use all of the protected area. Fish bone fish, permit, tarpon, and snook.
Cast net	Morning and late evening	Recreation, traditional. Not day by day. Increases during the closed season.

TABLE 14. TEMPORAL PATTERNS OF FISHING IN COROZAL BAY WILDLIFE SANCTUARY

*Modified to March 15th to December 15th as part of the fisher consultations (2020)

4.4 Catch Value

The fishers use different markets to sell and distribute their products. Fishers sell in their village (often at the point of landing), in nearby communities and in the nearest towns – Orange Walk and Corozal. Fillets are sold to markets, restaurants and middlemen in the main towns (Orange Walk and Corozal) and there is also a lucrative market for this product in the tourism hub of San Pedro, especially for snook and snapper and jack species. Snook fillets e.g.: can be sold for up to 10.00-16.00 BZD/lbs to restaurants in San Pedro.*

Retail Value of Direct Sale of Commercial Species		
Species	**Value per pound (Bz$)**	
	Local*	**Orange Walk / Corozal**
Chiwa	$2.00-3.00	$3.50
Mojarra	$2.00-3.00	$3.50
Snapper	$2.50-3.00	$5.00
Barracuda	$2.50-3.50	$4.00

TABLE 15: RETAIL VALUE OF DIRECT SALE OF PRIMARY COMMERCIAL SPECIES (CONSULTATIONS WITH FISHERMEN, 2020)

****local prices vary with seasonal abundance***

Fish are sold locally, unless there is a seasonal abundance, making it financially cost effective to travel to town to sell the catch. In this case, fish is often also salted, to increase its durability. The local sale price ranges from $2.00 to $3.00 per lb, dependent on species (Table 15), whilst the value in Orange Walk / Corozal is $3.50 minimum ('chiwa' and 'mojarra'), though this includes preparation of the fish and transport costs to the point of sale. There is currently no organised cooperation between non-related local fishermen in sharing costs towards marketing to increase catch value.

*This market has been affected and is presently non-existent due to the loss of tourism caused by the pandemic.

Species	Lbs (total sample)	Value per lb (Bz$)	Average annual fishery value (Bz$)	Potential gross income per month per trap (Bz$)
Local Market: Sarteneja				
Total catch (all species)	29,093.74	$2.00	58,187.48	5,289.77
Striped Mojarra	7,273.43	$2.00	14,546.00	1,322.36
Yellowfin Mojarra	4,655.00	$2.00	9,310.00	846.36
Grey Snapper	6982.50	$2.50	17,456.25	1,586.93
Great Barracuda	4,655.00	$2.50	11,637.5	1,057.95
Out-sale: Orange Walk / Corozal				
Total catch (all species)	29,093.74	$3.50	101,828.09	9,257.09
Striped Mojarra	7,273.43	$3.50	25,457.00	2,314.27
Yellowfin Mojarra	4,655.00	$3.50	16,292.50	1,481.14
Grey Snapper	6,982.50	$5.00	34,912.50	3,173.86
Great Barracuda	4,655.00	$4.00	18,620.00	1,692.73

TABLE 16: EXTRAPOLATED VALUE OF CATCH FOR 2016 (BASED ON 11 TRAPS BEING OPERATIONAL)

The annual value of the beach trap fishery was conservatively estimated at Bz$58,187.48 through extrapolation, with a potential gross income per month per trap of 5,289.77, based on 11 operational traps (Table 16). Based on catch data provided as part of the fisher consultations and assuming 19 operational traps between March 1st and November 30th, an average of 7 trap days per week (39 weeks and 1 day/274 days), given a CPUE of 70 lbs/day, is the total catch biomass per fisher estimated at 16,660 lbs/year and the total catch biomass of the fishery at 45,220 lbs/year.

Identified gaps in information include:

- Site specific length-age and length-weight data
- A complete season of trap sampling at least once a week from April to November to provide the full season of data
- Four years of consecutive data – a time series of catch data - to provide information for developing a maximum sustainable yield
- Assessment of spatial catch associated with the locations of the different fish traps
- Assessment of other fishing sectors – the gill net fishers, sport fishers and cast net catch
- Weather data collection for identification of trigger points for fish movements
- Data on water parameters (particularly salinity) for identification of trigger points for fish movements
- A study on the importance of subsistence fishing in the community
- market analysis to provide information for strategies to increase the value of the catch
- Assessment of role of women in the catch, preparation and sale of fish
- Identification of important fish nursery areas and spawning grounds
- Better understanding of key species life histories and migration patterns, providing basic information towards identifying the separate stock units

Part III: Planning for an Effective Sustainable Fishery

5.0 Moving Forwards towards Co-Management and Sustainability

Co-management of a small-scale fishery such as that of Corozal Bay Wildlife Sanctuary is not a new concept. Globally, community based management of natural resources is considered one of the best options for achieving sustainable natural resource management and economic benefit – goals sought by the National Protected Areas Policy and System Plan (NPAPSP, 2005).

Corozal Bay Wildlife Sanctuary is ideally situated for developing sustainable community management of these resources, with the participation of the traditional fishermen in both planning and implementation, providing a model for other protected areas with traditional use. For effective planning, implementation and monitoring, it is necessary to develop a baseline of current fish catch and fishing effort in order to identify the criteria for achieving sustainability. A fully participatory process for the development of the Sustainable Fishery Plan was implemented, with input from all fishing sectors using CBWS, and open communication during the planning process.

A snapshot of fisheries information has been collated based on catch effort and landing data as part of this assessment to provide baseline data and sampling recommendations for fisheries catch monitoring, in order to measure the performance of the fishery over time, and develop strategies to promote sustainability. The Sarteneja Alliance for Conservation and Development is presently formalizing partnerships with the local fishermen towards community management of the fisheries resources, and has developed a framework for traditional rights based management.

This Sustainable Fishery Plan for the small-scale local fishery of Corozal Bay Wildlife Sanctuary was developed with full ownership by SACD and the fishermen who use those resources, laying the foundation for a successful implementation.

Step 1: Develop the Vetting Committees

- Two vetting committees should be established, chaired by SACD, and consisting of at least three representatives from each of the main commercial fishing sectors of Corozal Bay Wildlife Sanctuary (beach traps and gill nets), and with representation from fishermen of each of the other stakeholder communities

- The committees should meet at least twice a year to discuss access issues, management, and regulations (whether permanent or temporary) for implementation by SACD that could

improve the sustainability of the fishery – either through changes in fishing gear, limits or seasons for target species, or other mechanisms, with group commitment to adhering to the regulations.

- Zoning will establish conservation areas, which should be assessed for efficiency through adequate monitoring protocols (effectiveness of no take zones)
- High priority areas and times for surveillance and enforcement activities against fishing incursions should be identified and implemented by SACD, with the encouragement of local participation in enforcement activities
- The management group should also investigate mechanisms for reducing dependency on fishing through the creation of alternative livelihood opportunities for fishers
- At the end of the first year, the regulations should be reviewed and amended where necessary, and updated within a Sustainable Fishery Plan
- Site-specific regulations should be updated based on the development of relevant national regulations

Step 2: Beyond a Snapshot

- Whilst initial data has provided an insight into the fishery, there are many identified gaps that still need to be filled. Data collection on beach trap catch should continue on an ongoing basis to provide the information required to guide management
- By-catch of small fish should be included in subsequent assessments to provide more information on population structure (though needs to address the concerns of the fishers about increased mortality of juveniles if kept out of water for longer for data collection)
- Information on the other fishery sectors – the gill net fishers and cast net fishers, and on fishers from other communities – also needs to be collected

Step 3: Measure success of the Sustainable Fishery Plan for Corozal Bay Wildlife Sanctuary

- The results of data collection need to be incorporated into the Sustainable Fishery Plan for Corozal Bay Wildlife Sanctuary, with finalized zones and regulations, and be produced in full collaboration with fisher groups, relevant government bodies and SACD
- Funding should be located through SACD to implement the first two years of the Sustainable Fishery Plan to measure its success following review mechanisms

- The review mechanism should be followed to measure success of the Plan on an annual basis for an initial period of five years. This can be through a simple review matrix, as is included for the assessment of implementation of this plan.

5.1 Implementing the Sustainable Fishery Plan

The following table provides a two-year implementation plan for the Sustainable Fishery Plan and a sustainable fishery for Corozal Bay Wildlife Sanctuary, building on the outputs of this report, and integrating full community participation from the local fishermen (Table 17).

Table 17: 2-Year Plan for Implementation of the Sustainable Fishery						
Management Actions		**Current Status**	**Desired Status**	**Year**	**Responsible Parties**	**Limitations/Requirements**
1	Establish two (2) vetting committees for the main commercial fishing sectors in CBWS (beach traps and gill nets)	SACD has laid the foundation for establishing these committees in this plan	Two (2) active vetting committees are established to determine access and management of CBWS fish resources, meeting at least twice a year, as per guidelines presented in this document	1st	SACD	Chaired by SACD and with representation from different sector fishermen from all communities. Technical input to be sought from NBIO/Forest and Fisheries Dept.
2	Identify and recognize traditional users for CBWS	Traditional users have been identified and engaged in the development of this plan	Recognition by NBIO / Forest Dept / Fisheries Dept and GoB of traditional use for local community members, with training towards greater sustainable use	1st	SACD	Through discussion with NBIO/ Forest and Fisheries Depts., and initiation of a permitting process for identified traditional fishers
3	Integrate local fishermen of other stakeholder communities into the implementation and evaluation process	Fishermen of other communities have been identified, consulted, and integrated into the implementation for a sustainable fishery	Fishermen are fully engaged in the implementation of a sustainable fishery and are represented on the vetting committee	1st – 2nd	SACD	
4	Develop permitting system for local fishermen	A framework for the recognition and permitting of local fishermen has been developed	Local fishermen carry a permit for fishing within CBWS	1st	SACD Local fishermen	
5	Develop registration system for nets and traps	Traps have been identified and mapped. A framework for the registration for nets and traps has been developed	A system is place for registration of fishing equipment owned by fishermen of CBWS and is being implemented	1st	SACD Local fishermen	

6	Site-specific regulations are in place and are being regularly evaluated	Site-specific regulations have been developed in participation with the local fishing groups	Site-specific regulations are in place and are being evaluated on a yearly basis	1st-2nd	SACD NBIO/Forest Dept. Fisheries Dept. Local fishermen	Requires assistance from Belize Fisheries Department and/or consultant to develop baseline , guidelines and monitoring programme
2-Year Plan for Development of a Sustainable Fishery						
Management Actions		**Present Status**	**Desired Status**	**Year**	**Responsible Parties**	**Limitations/Requirements**
7	Monitor fishing activity	At present there is no formalized monitoring of level of fishing activity	Monitoring is ongoing and data is feeding into management, with findings being shared with the fishers on a yearly basis	1st – 2nd	SACD Traditional fishermen	Establishment of protocol – will be needed for formal recognition of traditional fishing rights
8	Identify critical areas and times of peak fishing pressure to increase efficiency of patrol effort	Only limited information on fishing activity within CBWS, though knowledge is available, and is guiding surveillance activities	Accurate mapping of fishing activity within CBWS, using community knowledge of the area Patrolling driven by knowledge of when and where patrolling needs to be carried out	1st	SACD Traditional fishermen	Broad cooperation with identified local traditional fishermen will assist this process. Assistance from Wildtracks for mapping of fishing activity
9	Promote greater participation in surveillance and enforcement by traditional fishermen	Fishers are reporting fishing incursions and/or unsustainable fishing practices to SACD	Traditional fishermen actively protect their resources and assist SACD with surveillance activities	1st-2nd	SACD Local fishermen	Traditional fishermen need to take ownership of their resources, and contribute towards management –
10	Liaise with NBIO/Forest and Fisheries Dept. for assistance with enforcement activities	SACD rangers are trained as Fisheries Officers, and joint patrols are being conducted on a regular with SEMARNAT, Hol Chan and Bacalar Chico	SACD in constant communication with NBIO / Forest and Belize Fisheries Departments	1st – 2nd	SACD	Support from the Forest and Fisheries Depts. will assist community acceptance and recognition of need for enforcement

11	Demarcate nursery areas and spawning grounds for zoning and protection	Zoning has been proposed and the areas have been validated with the fishers	Zoning (spatial / temporal) of CBWS is in place for the protection of nursery areas and spawning grounds	2nd	SACD Fisheries Dept. Local fishermen	Critical nursery areas and spawning grounds need to be monitored
12	Conduct four full seasons of catch monitoring for the beach trap fishery	A partial survey of the beach trap fishery of 2011, 2015, 2016 and 2018 has been completed	Four full seasons of catch monitoring for the beach trap fishery	1st – 2nd	SACD Local fishermen	Funding delays prevented the start of trap monitoring until June, and other issues prevented monitoring in Sept. / Oct.
2-Year Plan for Development of a Sustainable Fishery						
Management Actions		**Present Status**	**Desired Status**	**Year**	**Responsible Parties**	**Limitations/Requirements**
13	Conduct assessment of gill net fishery	No assessment has been conducted of gill net catches	A baseline assessment has been completed on the gill net fishery and monitoring is on-going	1st – 2nd	SACD Local fishermen	Logistical problems, as catch isn't always landed in Sarteneja
14	Conduct assessment of impact of cast net fishing in stakeholder communities	A baseline for cast net fishing has been developed through this plan	Information is available on the impacts of cast net fishing in front of Sarteneja and other stakeholder communities	1st – 2nd	SACD Local fishermen	
15	Conduct assessment of importance of subsistence fishing in stakeholder communities	A baseline assessment has been conducted on the importance of subsistence fishing in Sarteneja as part of this plan	Information ensures that mechanisms are in place to ensure families dependent on subsistence resource extraction are not affected by CBWS regulations	1st – 2nd	SACD Local fishermen	
16	Implementation of mechanisms identified under the Sustainable Fishery Plan	The Sustainable Fishery Plan has been developed with clear measurable indicators	SACD and the local fishermen are implementing the Sustainable Fishery Plan effectively	2nd	SACD Local fishermen	Needs to be approved by the NBIO / Forest and Fisheries Departments
17	Conduct a Market Survey to inform a Marketing Plan for identifying mechanisms for increased value for fish product	Only initial market data has been collected	A full market survey has been conducted with the fishermen, with data feeding into the development of a marketing plan	2nd	SACD Local fishermen	Potential markets on San Pedro, investigation of value added products, investigation of benefits of cooperative marketing

18	Develop a Marketing Plan, integrating information from the market survey	Fishermen are marketing independently, and not necessarily for maximum gain	Fishermen are able to increase their income through better marketing of their product	2nd	SACD Local fishermen	Would need a consultant to assist with this activity
2-Year Plan for Development of a Sustainable Fishery						
Management Actions		**Present Status**	**Desired Status**	**Year**	**Responsible Parties**	**Limitations/Requirements**
20	Characterize the role of women in the fishery	There is no information on the role of women in the fishery	Information is available on the role of women in the fishery, and integrated into the Sustainable Fishery Plan	1st	SACD	
21	Engagement of the women involved in the local fishery	There is engagement of the women involved in the Sarteneja trap fishery in Pesca Tours	Women involved in the local fishery are engaged through different mechanisms (e.g.: income diversification, etc.)	2nd	SACD	
22	Implementation of mechanisms identified under the Sustainable Fishery Plan	The Sustainable Fishery Plan has been developed, including implementation mechanisms	The Sustainable Fishery Plan is being implemented, including the proposed mechanisms	2nd	SACD Local fishermen	
23	Identification and implementation of income diversification mechanisms linked to reduced fishing pressure	Some fishermen are willing to integrate sustainable fishing practices into their fishing as their income base has diversified (Pesca Tours)	Fishermen are using sustainable fishing practices as part of income diversification opportunities	1st - 2nd	SACD Local fishermen	
24	Monitor climate conditions affecting fish stocks	SACD has a weather station and is collecting weather data to identify trigger points for fish movements	SACD has a solid fish stock monitoring programme in place, linked to the data provided by the weather station	1st – 2nd	SACD	
25	Monitor water parameters affecting fish stocks	Characterization of the water parameters of CBWS has been carried out since 2012 and SACD has	SACD has identified trigger points for fish movement is developing models to guide management	1st – 2nd	SACD	Collaboration with ECOSUR for modeling the changes in CBWS and the larger estuarine system in relationship to fish movement

		information on annual water parameter changes				

5.2 Timeline

The following Implementation Plan covers the activities required to develop the baseline data and Sustainable Fishery Plan over a one year period (Table 18).

Table 18: Development of a Sustainable Fisheries: Timeline

Management Actions		1st Year				2nd Year			
		1	2	3	4	1	2	3	4
1	Establish two vetting committee for the fishery resources of the Wildlife Sanctuary								
2	Resolve traditional resource use issue								
3	Integrate local fishermen of other stakeholder communities into the planning process								
4	Develop permitting system for local fishermen								
5	Develop registration system for nets and traps								
6	Develop a baseline and guidelines for sustainable traditional fishing within Corozal Bay Wildlife Sanctuary								
7	Monitor fishing activity								
8	Identify critical areas and times of peak fishing pressure to increase efficiency of patrol effort								
9	Promote greater participation in surveillance and enforcement by traditional fishermen								
10	Liaise with Forest and Fisheries Dept. for assistance with enforcement activities								
11	Demarcate nursery areas and spawning grounds for zoning and protection								
12	Conduct two full seasons of catch monitoring for the beach trap fishery								
13	Conduct assessment of gill net fishery								
14	Conduct assessment of impact of cast net fishing in at least two communities								

Development of a Sustainable Fisheries: Timeline									
Management Actions		1st Year				2nd Year			
		1	2	3	4	1	2	3	4
15	Conduct assessment of importance of subsistence fishing in stakeholder communities								
16	Implementation of the Sustainable Fishery Plan								
17	Implementation of mechanisms identified under the Sustainable Fishery Plan								
18	Conduct a Market Survey to inform a Marketing Plan for identifying mechanisms for increased value for fish product								
19	Develop a Marketing Plan, integrating information from the market survey								
20	Implement mechanisms identified under the Marketing Plan								
21	Characterize the role of women in the fishery								
22	Engagement of the women involved in the local fishery								
23	Identification and implementation of income diversification mechanisms linked to reduced fishing pressure								
24	Monitor climate conditions affecting fish stocks								
25	Monitor water parameters affecting fish stocks								

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Annex I

	Nombre	Village	Type	Primary method/gear	Completed survey	Phone number
1	Abisai Canul	Sarteneja	Commercial	Trap	Yes	669-8267
2	Darcy Natividad Raymundo / Juanita Reynoso Raymundo	Sarteneja	Commercial	Trap	Yes	
3	Eliseo Cruz	Sarteneja	Commercial	Trap	Yes	665-0306
4	Ernesto Munoz	Sarteneja	Commercial	Trap	Yes	669-5413
5	Iran Blanco	Sarteneja	Commercial	Trap	Yes	
6	Johan Alexander Ortega	Sarteneja	Commercial	Trap	Yes	623-7116
7	Marcelino Cruz	Sarteneja	Commercial	Trap	Yes	666-1216
8	Marcelo Cruz	Sarteneja	Commercial	Trap	Yes	602-8639
9	Ovidio Moroy	Sarteneja	Commercial	Trap	Yes	666-0560
10	Pablo Canul	Sarteneja	Commercial	Trap	Yes	652-3440
11	Romel Blanco	Sarteneja	Commercial	Trap	Yes	652-4574
12	Timoteo Cruz	Sarteneja	Commercial	Trap	Yes	601-2723
13	Eduardo Ortega	Sarteneja	Commercial	Gill net	Yes	652-9942
14	Eulalio Carrillo	Sarteneja	Commercial	Gill net	Yes	667-3775
15	Felis Torres	Sarteneja	Commercial	Gill net	Yes	
16	Indalesio Ortega	Sarteneja	Commercial	Gill net	Yes	651-2618
17	Jesus Carrillo	Sarteneja	Commercial	Gill net	Yes	663-1521
19	Nelsin Ortega	Sarteneja	Commercial	Gill net	Yes	652-1521
20	Richard Grant	Sarteneja	Commercial	Gill net	Yes	
21	Serviliano Allen	Sarteneja	Commercial	Gill net	Yes	
22	Marciso Torres	Sarteneja	Commercial	Gill net	Yes	661-2208
23	Anastasio Misael Rivero	Sarteneja	Recreational / Subsistence	Cast net	Yes	661-0675
24	Benito Juan Munoz	Sarteneja	Recreational / Subsistence	Cast net	Yes	651-4586

25	Darnel Cruz	Sarteneja	Recreational / Subsistence	Cast net	Yes	662-4862
26	Hector Lopez	Sarteneja	Recreational / Subsistence	Cast net	Yes	661-0517
27	Isaac Perez	Sarteneja	Recreational / Subsistence	Cast net	Yes	652-2708
28	Juan Guerrero	Sarteneja	Recreational / Subsistence	Cast net	Yes	636-1123
29	Rodrigo Lopez	Sarteneja	Recreational / Subsistence	Cast net	Yes	668-6766
30	Dayan Isamin Ortega	Sarteneja	Sport fisher	Fly fishing	Yes	654-4425
31	Eduardo Ortega (Jr.)	Sarteneja	Sport fisher	Fly fishing	Yes	634-1479
32	Indalesio Alexander Ortega	Sarteneja	Sport fisher	Fly fishing	Yes	620-8585
33	Nathaniel Verde	Sarteneja	Sport fisher	Fly fishing	No	652-1365
34	Naison Abdel Graham	Sarteneja	Sport fisher	Fly fishing	No	632-8264
35	Neftali Verde	Sarteneja	Sport fisher	Fly fishing	No	672-3474
36	Bartolo Tun	Chunox	Commercial	Gill net, hand line	Yes	652-7915
37	Bladimir Casanova	Chunox	Recreational / Subsistence		No	
38	Erick Casanova	Chunox	Recreational / Subsistence	Gill net, cast net and hand line	Yes	663-7830
39	Faustino Tun	Chunox	Recreational / Subsistence		No	
40	Vidal Santoya	Chunox	Recreational / Subsistence		No	624-5176
41	Rupert Casanova	Chunox	Recreational / Subsistence	Cast net, hand line	Yes	650-6467
42	Edilberto Oliveira	Copper Bank	Recreational / Subsistence	Cast net, hand line	Yes	602-9340
43	Elogio Oliveira	Copper Bank	Recreational / Subsistence	Cast net, hand line	No	602-9341
44	Raul Oliveira	Copper Bank	Recreational / Subsistence	Cast net, hand line	No	602-9340

45	Jorge Awayo	Copper Bank	Recreational / Subsistence	Cast net, hand line	Yes	633-1470
46	Dani Awayo	Copper Bank	Recreational / Subsistence	Cast net, hand line	No	
47	Carlos Arana	Consejo	Commercial	Gill net, cast net	No	620-1567
48	Ricardo Rivero	Consejo	Commercial	Gill net, crab traps	Yes	602-8866
49	Shamir Rivero	Consejo	Commercial	Gill net	No	608-1500
50	Conrad Riveroll	Corozal	Recreational / Subsistence	Cast net, hand line	Yes	
51	Edwin Henderson	Corozal	Recreational / Subsistence		No	602-2720
52	Derrick Riverol	Corozal	Recreational / Subsistence		No	608-5725
53	Gilberto Monima	Corozal	Recreational / Subsistence	Cast net	Yes	663-3242
54	Jose Exequiel Majil	Corozal	Commercial	Gill net	Yes	621-3239
55	Joseph Aragon	Corozal	Commercial	Gill net	Yes	663-5666
56	Mario Marin	Corozal	Commercial	Gill net	No	
57	Orion Moreno	Corozal	Commercial		No	
58	Ismaeli Moreno	Corozal	Commercial		No	

Annex 2

FISHER SURVEY – SUBSISTENCE AND COMMERCIAL FISHERS

1. **Name:** _____
2. **Village:** _____
3. **Phone number:** _____
4. **Do you hold a valid fisher license?** YES / NO
5. **If yes, for which zones is your license valid?**_____
6. **If no license, what is your date of birth**? _____
7. **If no license, what is your level of education?**
    a. Primary (infant 1 to standard 6) - completed incomplete
    b. Secondary (high school -1st form to 4th form) - completed incomplete
    c. Tertiary (4th form to undergraduate) - completed incomplete
8. **How many people eat and sleep in your household?**_____
9. **Do you belong to any fishing association?** YES / NO
10. **If yes, specify:**_____
11. **Do you own a boat?** YES / NO
12. **If yes, what type of boat do you own?**
    a. Canoe
    b. Skiff
    c. Sailing boat
    d. Other: _____
13. **If yes, what size:**_____**ft**
14. **If yes, what is the HP?** _____
15. **How many people participate in your crew?**_____
16. **From that crew, describe how many are the following:**
    a. Assistant/s:_____
    b. Equal beneficiary:_____ (license holder)
    c. Other:_____
17. **What kind of fishing do you do in CBWS?**
    a. Subsistence fishing (home consumption)
    b. Commercial fishing (selling of catch)
    c. Sport fishing (tourism)
18. **How long have you been fishing in Corozal Bay?**
    a. $x \leq 1$ year (is it less than one year?)

b. 1 year < $\mathcal{X}$ ≤ 5 years (is it less than 5 years?)
c. 5 years < $\mathcal{X}$ ≤ 10 years (is it less than 10 years?)
d. 10 years < $\mathcal{X}$ ≤ 15 years (is it less than 15 years?)
e. 15 years < $\mathcal{X}$ ≤ 20 years (is it less than 20 years?)
f. 20 years < $\mathcal{X}$

19. **Do you consider yourself a traditional user of Corozal Bay?** YES / NO

20. **If yes, what makes you a "traditional" user? OR What is a "traditional fisher" from CBWS to you?**

_____
_____
_____

21. **Will someone from your family inherit your fishing place in CBWS? YES / NO**

22. **If commercial, do you have other occupations? (skip for subsistence)**

a. Fishing at the reef
b. Masonry
c. Farming
d. Tourism
e. Other – specify: _____

23. **If commercial, how much percentage of your income comes from fishing in CBWS?**

a. $\mathcal{X}$ = 0% (is it none?)
b. 1% < $\mathcal{X}$ ≤ 25% (is it less than 25%?)
c. 26% < $\mathcal{X}$ ≤ 50% (is it less than 50%?)
d. 51% < $\mathcal{X}$ ≤ 75% (is it less than 75%?)
e. 76% < $\mathcal{X}$ ≤ 100%

24. **If commercial, what is your yearly income from fishing in CBWS?**_____

25. **Which fishing method/s do you use in CBWS?** (mark all that apply)

a. Beach trap
b. Gill net
c. Ramas
d. Crab traps
e. Other: _____

26. **What is your most used method?** _____

27. **Please complete this table based on a usual fishing trip in CBWS.**

Gear/ method	No. of gears used	Season (months)	Fish Species (main)	Price/lbs	Area (map)

***Categories: beach trap, gill net, crab trap, cast net, hand line, specify if other)**

28. How regularly do you fish in CBWS? (for each gear)

a. Daily b. 6 days/week
c. 5 days/week d. 4 days/week
e. 3 days/week f. 2 days/week
g. Once/week h. <Once/week
i. Other – specify: _____

29. How many hours do you fish during an average fishing trip? _____

30. Where do you land your catch?_____

31. If commercial, where do you sell your catch?

- **a.** In the community (locally)
- **b.** In other communities - specify where:_____ (district)
- **c.** To an individual
- **d.** To a restaurant
- **e.** At a market – specify where:_____
- **f.** Other – specify where:_____

32. If commercial, how much of your catch do you sell?

1. All
2. More than half
3. Less than half
4. None of the above – specify: _____

33. What is your daily production? MIN /MAX (possible monthly, just specify)

34. How much of your catch is usually by-catch?

a. = 0% (is it none?)
b. 1% < χ ≤ 10% (is it less than 10%)
c. 11% < χ ≤ 20% (is it less than 20%)
d. 21% < χ ≤ 30% (is it less than 30%)
e. 31% < χ ≤ 40% (is it less than 40%)
f. 41% < χ ≤ 50% (is it less than 50%)
g. 51% < χ ≤ 60% (is it less than 60%)
h. 61% < χ ≤ 70% (is it less than 70%)

i. $71\% < \mathcal{X} \leq 80\%$ (is it less than 80%)
j. $81\% < \mathcal{X} \leq 90\%$ (is it less than 90%)
k. $91\% < \mathcal{X} \leq 100\%$

35. What are the main species that make up your by-catch?

_____

36. What do you do with the majority of by-catch?

a. Dispose (throwback to the sea)
b. Use as bait
c. Release alive
d. Other:_____

37. What is your annual production?

1. $\mathcal{X} \leq$ 50 pounds,
2. $50 < \mathcal{X} \leq$ 150 pounds,
3. $150 < \mathcal{X} \leq 250$ pounds,
4. $250 < \mathcal{X} \leq 350$ pounds,
5. $350 < \mathcal{X} \leq$ 450 pounds,
6. $450 < \mathcal{X} \leq$ 550 pounds,
7. more than 550 pounds

38. What are your 3 preferred/target species?

_____

39. What do you think is the status of fish populations in Corozal Bay?

1. Very Good (does not need human intervention)
2. Good (Populations reduced, but should recover with limited human intervention)
3. Fair (Populations will decline if there is no human intervention)
4. Poor (Populations are in danger of disappearing from the area, even with human Intervention)

40. How do you perceive the trend of the fish population?

1. Increase (more fish than 10-20 years ago)
2. Stable (same as 10-20 years ago)
3. Decrease (less fish than 10-20 years ago)

41. What do you think are the major 3 threats to fish populations in the bay?

1. Mangrove Clearance/unsustainable coastal development
2. Water Pollution/Agriculture runoff/Seawage treatment
3. Transboundary Fishing
4. Unsustainable Fishing (fishing of juveniles, irresponsible use of gears)
5. Insufficient enforcement
6. Climate change (changes in storms, salinity, rain patterns)
7. Type of management (lack of zoning/no take areas, type of protected area status, insufficient enforcement)

42. **What do you think would improve fish populations in the bay?**

_____

_____

43. **What alternative fishing practices do you see can be viable for CBWS?** _____
44. **What type of mechanism do you recommend for controlling fishing access to CBWS?**
    1. CBAC
    2. Vetting committee per type of fishing (trap, gill net, subsistence, sport fishing)
    3. Vetting committee for the protected area (all fishers)
    4. Other – specify: _____
45. **If subsistence, what do you think should be a reasonable bag limit? _____**
46. **Please mark fishing areas in map (if not completed already).**
47. **When do you find the following?**

Chiwa:
Pequena:
Grande:
Corrida:
Hueva:
Sitios de cria:

Mojarra:
Pequena:
Grande:
Corrida:
Hueva:
Sitios de cria:

Pargo:
Pequena:
Grande:
Corrida:
Hueva:
Sitios de cria:

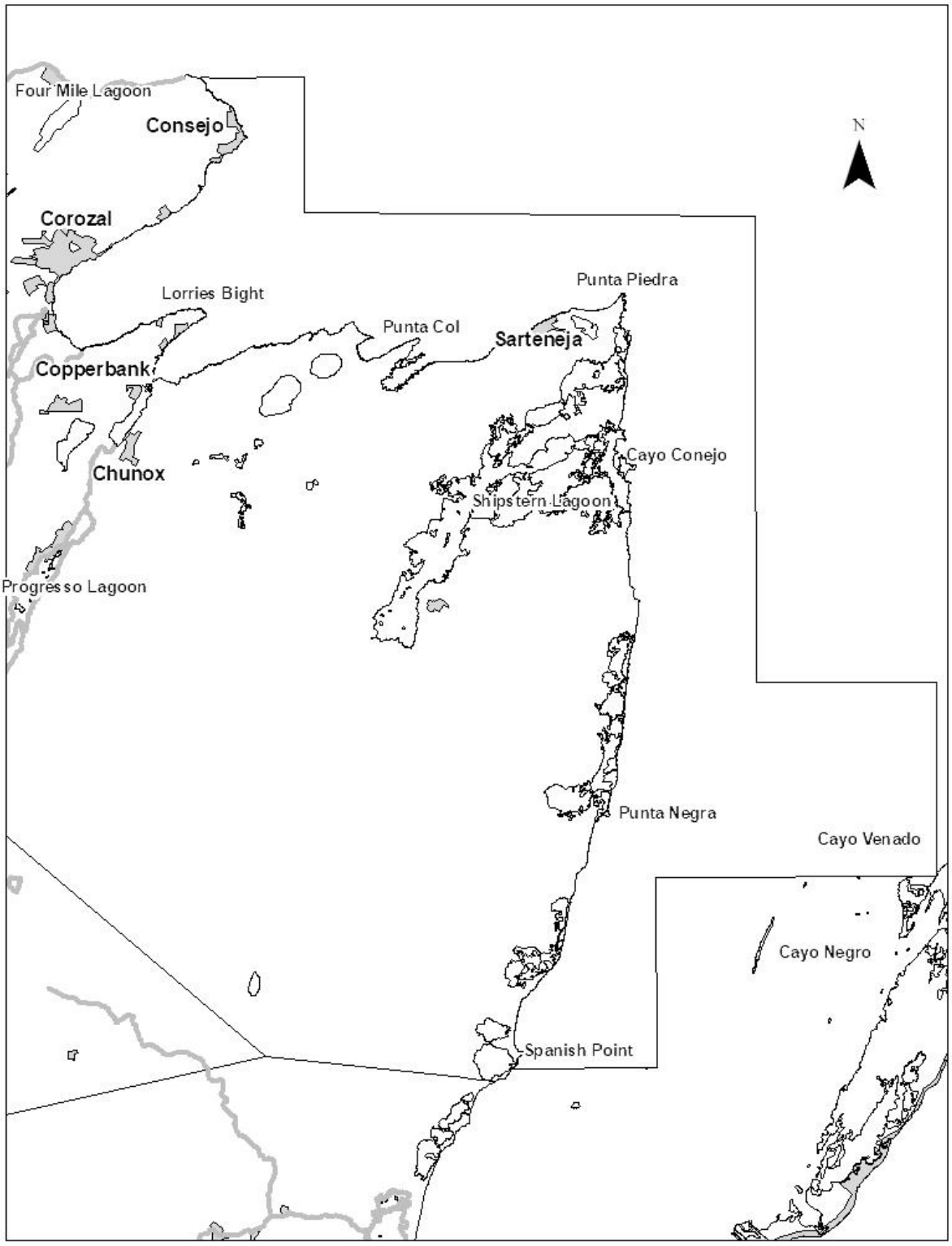
Picuda:
Pequena:
Grande:
Corrida:
Hueva:
Sitios de cria:

Especies extranas:

On gears:
Gill net:
Mesh size
Length
Width

With a line
Hook size
Weights (type and weight)
Leaders?
Rod? Hand?

Other traps (dimensions)


Four Mile Lagoon
Consejo
N
Corozal
Punta Piedra
Lorries Bight
Punta Col
Sarteneja
Copperbank
Cayo Conejo
Chunox
Shipstern Lagoon
Progresso Lagoon
Punta Negra
Cayo Venado
Cayo Negro
Spanish Point

Annex 3

FISHER SURVEY – SPORT FISHERS

28. **Name:** _____
29. **Village:** _____
30. **Phone number:** _____
31. **What is your date of birth**? _____
32. **What is your level of education?**
    a. Primary (infant 1 to standard 6) - completed incomplete
    b. Secondary (high school -1st form to 4th form) - completed incomplete
    c. Tertiary (4th form to undergraduate) - completed incomplete
33. **How many people eat and sleep in your household?**_____
34. **Do you belong to any fishing association?** YES / NO
35. **If yes, specify:**_____
36. **Do you work for a company?** YES / NO
37. **If yes, specify:**_____
38. **Do you own a boat?** YES / NO
39. **What type of boat do use in CBWS?**
    a. Canoe
    b. Skiff
    c. Sailing boat
    d. Other:_____
40. **If yes, what size:**_____**ft**
41. **If yes, what is the HP?** _____
42. **How many people do you usually take out fishing to CBWS?**_____
43. **Who are your clients?**
    a. Locals (_____%)
    b. Foreign visitors (_____%)
    c. Other:_____
44. **How long have you been fishing in Corozal Bay?**
    a. $\mathcal{X} \leq 1$ year (is it less than one year?)
    b. 1 year < $\mathcal{X} \leq 5$ years (is it less than 5 years?)
    c. 5 years < $\mathcal{X} \leq 10$ years (is it less than 10 years?)
    d. 10 years < $\mathcal{X} \leq 15$ years (is it less than 15 years?)
    e. 15 years < $\mathcal{X} \leq 20$ years (is it less than 20 years?)

f. 20 years < $\mathcal{X}$

45. **Do you consider yourself a traditional user of Corozal Bay?** YES / NO

46. **If yes, what makes you a "traditional" user? OR What is a "traditional fisher" from CBWS to you?**

_____

_____

_____

47. **Does anyone in your family fish in Corozal Bay?** YES / NO

48. **How long has your family been fishing in Corozal Bay?**

a. $\mathcal{X} \leq 1$ year (is it less than one year?)
b. 1 year < $\mathcal{X} \leq 5$ years (is it less than 5 years?)
c. 5 years < $\mathcal{X} \leq 10$ years (is it less than 10 years?)
d. 10 years < $\mathcal{X} \leq 15$ years (is it less than 15 years?)
e. 15 years < $\mathcal{X} \leq 20$ years (is it less than 20 years?)
f. 20 years < $\mathcal{X}$

49. **If sport fishing, do you have other occupations?**

f. Fishing at the reef
g. Fishing in CBWS
h. Farming
i. Tourism
j. Other – specify: _____

50. **How much percentage of your income comes from sport fishing?**

a. $\mathcal{X} = 0\%$ (is it none?)
b. $1\% < \mathcal{X} \leq 25\%$ (is it less than 25%?)
c. $26\% < \mathcal{X} \leq 50\%$ (is it less than 50%?)
d. $51\% < \mathcal{X} \leq 75\%$ (is it less than 75%?)
e. $76\% < \mathcal{X} \leq 100\%$

51. **Which fishing method/s do you use in CBWS?**

_____

52. **What species do you target in CBWS?**_____

53. **Do you also engage in subsistence fishing for consumption in CBWS? YES / NO (during sport fishing trip and/or separately) If yes, describe:**_____

54. **Please complete this table in regard to a usual fishing trip to CBWS.**

Gear/ method	No. of gears used	Season (months)	Fish	Quantity (lbs) (day)	Price	Areas (map)

***Categories: beach trap, gill net, cast net, hand line, specify if other)**

28. How regularly do you fish in CBWS? (for each gear)

a. Daily b. 6 days/week
c. 5 days/week d. 4 days/week
e. 3 days/week f. 2 days/week
g. Once/week h. <Once/week
i. Other – specify: _____

48. How many hours do you fish during an average fishing trip to CBWS? _____

49. Do you usually just come to CBWS to fish or do you come as part of a combined trip?

_____

50. What do you think are the attractions of CBWS related to sport fishing?

_____

51. What do you think is the status of fish populations in Corozal Bay?

- **a.** Very Good (does not need human intervention)
- **b.** Good (Populations reduced, but should recover with limited human intervention)
- **c.** Fair (Populations will decline if there is no human intervention)
- **d.** Poor (Populations are in danger of disappearing from the area, even with human Intervention)

52. How do you perceive the trend of the fish population?

- **a.** Increase (more fish than 10-20 years ago)
- **b.** Stable (same as 10-20 years ago)
- **c.** Decrease (less fish than 10-20 years ago)

53. What do you think are the major 3 threats to fish populations in the bay?

- **a.** Mangrove Clearance/unsustainable coastal development
- **b.** Water Pollution/Agriculture runoff/Seawage treatment
- **c.** Transboundary Fishing
- **d.** Unsustainable Fishing (fishing of juveniles, irresponsible use of gears)
- **e.** Insufficient enforcement
- **f.** Climate change (changes in storms, salinity, rain patterns)

g. Type of management (lack of zoning/no take areas, type of protected area status, insufficient enforcement)

54. **What do you think would improve fish populations in the bay?**
_____
_____

55. **Do you think CBWS has the potential to provide an income? If yes, how (viable activity)?** _____

56. What type of mechanism do you recommend for controlling fishing access to CBWS?

- **a.** CBAC
- **b.** Vetting committee per type of fishing (trap, gill net, subsistence, sport fishing)
- **c.** Vetting committee for the protected area (all fishers)
- **d.** Other:_____

57. Please mark fishing areas in map (if not completed already).

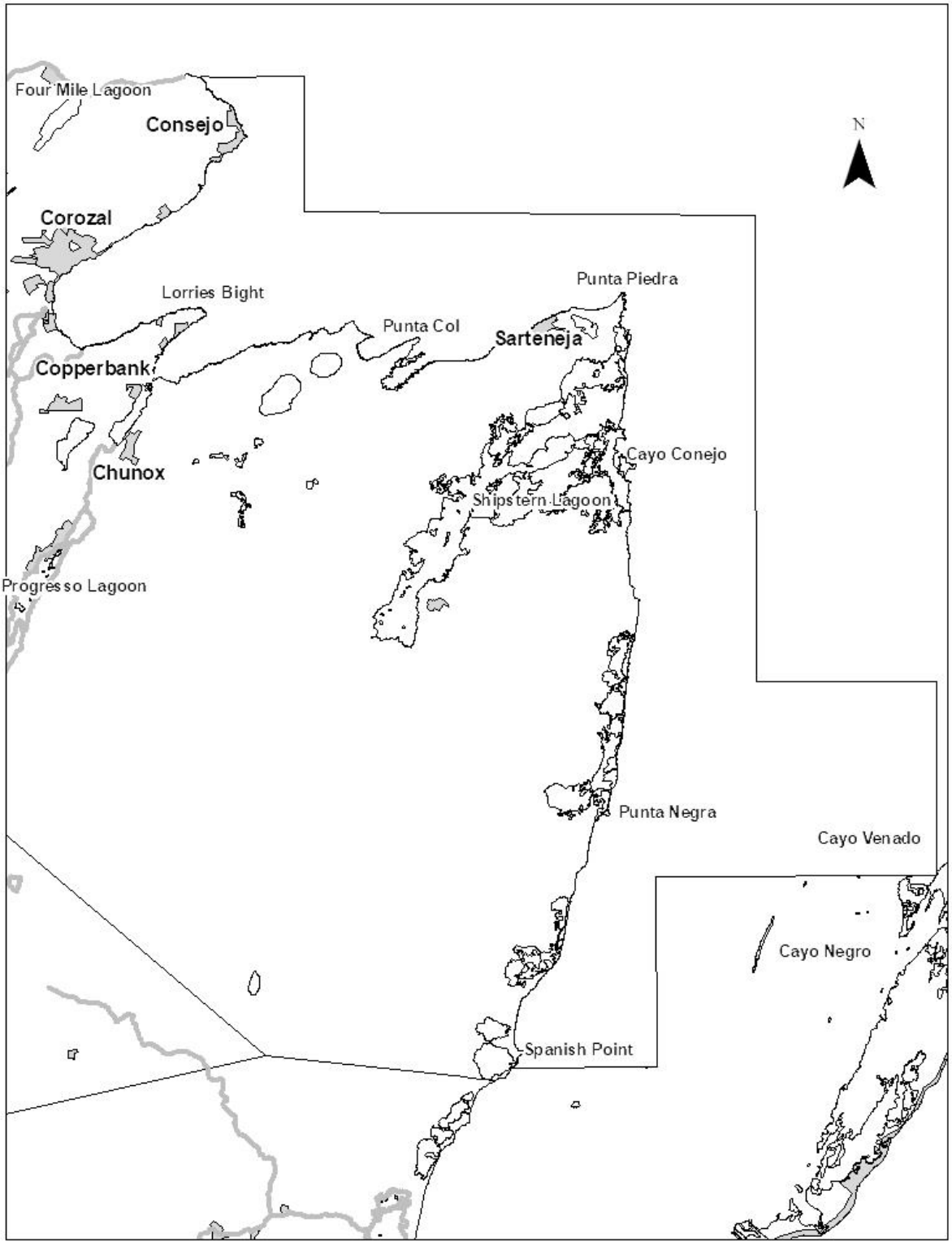
58. Notes:_____
_____

Tarpon:
Pequena
Grande
Corrida
Hueva
Sitios de cria

Permit:
Pequena:
Grande:
Corrida:
Hueva:
Sitios de cria:

Bone fish:
Pequena
Grande
Corrida
Hueva
Sitios de cria

Snook:
Pequena
Grande
Corrida
Hueva
Sitios de cria


Four Mile Lagoon
Consejo
N
Corozal
Punta Piedra
Lorries Bight
Punta Col
Sarteneja
Copperbank
Cayo Conejo
Chunox
Shipstern Lagoon
Progresso Lagoon
Punta Negra
Cayo Venado
Cayo Negro
Spanish Point

Annex 4

Register

28/07/2020

Event name: SFP presentation & validation

Name	Age	Gender	Community
~~Marcellino Cruz~~			
Abisai Canul			Sarteneja
Ivan Cruz	25	male	Sarteneja
Ernesto Muñoz	43	Male	Sarteneja
[illegible]	53	m	Sarteneja
Timoteo m Cruz	54	male	Sarteneja
Eliseo Cruz S.	67	male	Sarteneja
[illegible] Blanco	57	mel	Sarteneja
Claudia Matzdorf	35	female	Sarteneja
Natividad Raymundo	32	male	Sarteneja
Leonir Santoya	31	male	Sarteneja
Ceci Verde	37	male	Sarteneja

Register

28/07/2020

Event name: SFP presentation & validation

Name	Age	Gender	Community
Claudia Matzdorff	35	female	Sarteneja
Pablo Canul			
Narcisa [illegible]			
Nelson Ortega			
Edward Ortega			
Timoteo m Cruz	54		
Joel Verde	37	Male	Sarteneja
Leonor Santoya	31	male	Sarteneja

Register

29/07/20

Event name: SFP presentation & validation

Name	Age	Gender	Community
Joseph Aragon	62	M	Corozal Town
Raul Olivera.	21	m	copperbank
Jorge Amayo.			Copper Bank
Vidal Santoya	66	M	[illegible]
Eldina Jun			Chunox
Ovidio MOROY	33	[illegible]	SatehneJa