

SACD

Corozal Bay Wildlife Sanctuary

Planning for a Sustainable Fishery



*Sarteneja Alliance for
Conservation and Development*



SACD

Sarteneja Alliance for Conservation and Development

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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, principally to provide protection for the large population of West Indian manatee (*Trichechus manatus*) utilizing the waters. This national protected area encompasses approximately 178,000 acres (72,000 hectares) of the Belize portion of the large estuarine system, and much of the northern shelf lagoon behind Ambergris Caye. The Wildlife Sanctuary, the largest marine protected area in Belize, was established as a non-extractive designation, despite the local, small-scale, artisanal fishing activities conducted by all stakeholder communities – beach traps, gill nets and cast nets are all used within the Bay for commercial and home purposes, and are supporting more than thirty local fishermen and their families.

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 are all cases in point where sectors of the population are dependent on extraction of the local fisheries resources. Inappropriate resource use has depleted fish stock in all these locations, and in some, local extinctions have occurred (the small tooth sawfish (*Pristis pectinata*)), while other species are reaching critical levels (eg. the critically endangered goliath grouper (*Epinephelus itajara*)).

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. 50% of primary fishermen (those economically dependent on the fish resources) originate from Sarteneja fishing community, and have been participating in the planning process and baseline development. Local fishermen from other stakeholder communities have also been participating, and are addressed within

the plan, though their numbers are far fewer than those of Sarteneja, and their reliance on the resources is lower, with their greater accessibility to alternative employment options.

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 plan provides 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.

Defining the Questions

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

How can traditional, artisanal fishermen 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?

The report is based on the completion of the following steps:

- Review of management plan and relevant literature on community management of sustainable fisheries and integration into planning
- Meetings with the Sarteneja Alliance for Conservation and Development and local fishermen to introduce the planning process and characterize the current local fishery - to define:
 - Fishing methods
 - Target species
 - Fishing effort
 - Spatial and temporal patterns of fishing activity,
 - Market and market value of produce
- Individual interviews with local fishermen and focal group meetings for both current and historical perspectives
- Data collection focusing on Sarteneja beach traps, with analysis of catch data for the 2011 season, 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

The outputs are designed to be understood at community level, to assist SACD and local fishermen to make management decisions to increase the viability of the small scale fishery and develop answers to the initial questions.

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 Initiative

The scope of this initiative covers the entire area of Corozal Bay Wildlife Sanctuary, established in 1998 (under the National Park Systems Act of 1981), as part of Belize’s National Protected Areas System, and as part of a transboundary protected area, twinned with the Chetumal Bay Wildlife Sanctuary of Mexico, following 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 (Maps 1 and 2). 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 as protective nurseries for many fish species.

Corozal Bay and adjacent waters have long been recognized for their importance for the Antillean manatee (*Trichechus manatus manatus*), a sub-species of the West

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: Draft (2010)

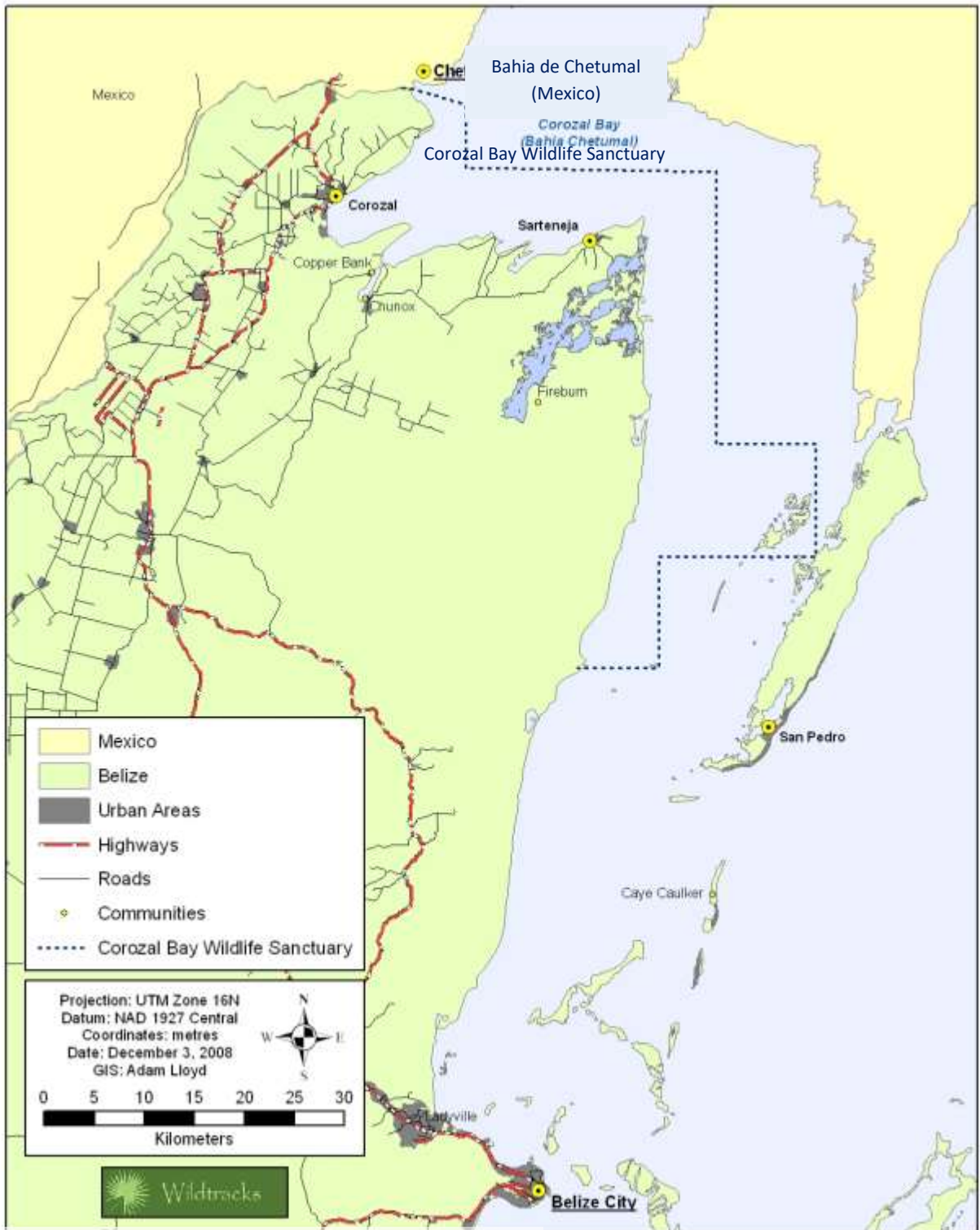
Biodiversity Information: Extensive research work by Ecosur (Chetumal) on the adjacent Santuario del Manati. Biodiversity overview of Corozal Bay by Wildtracks for SACD (2009)

Facilities (2012): SACD Office (Sarteneja)

Visitation (2012): No data

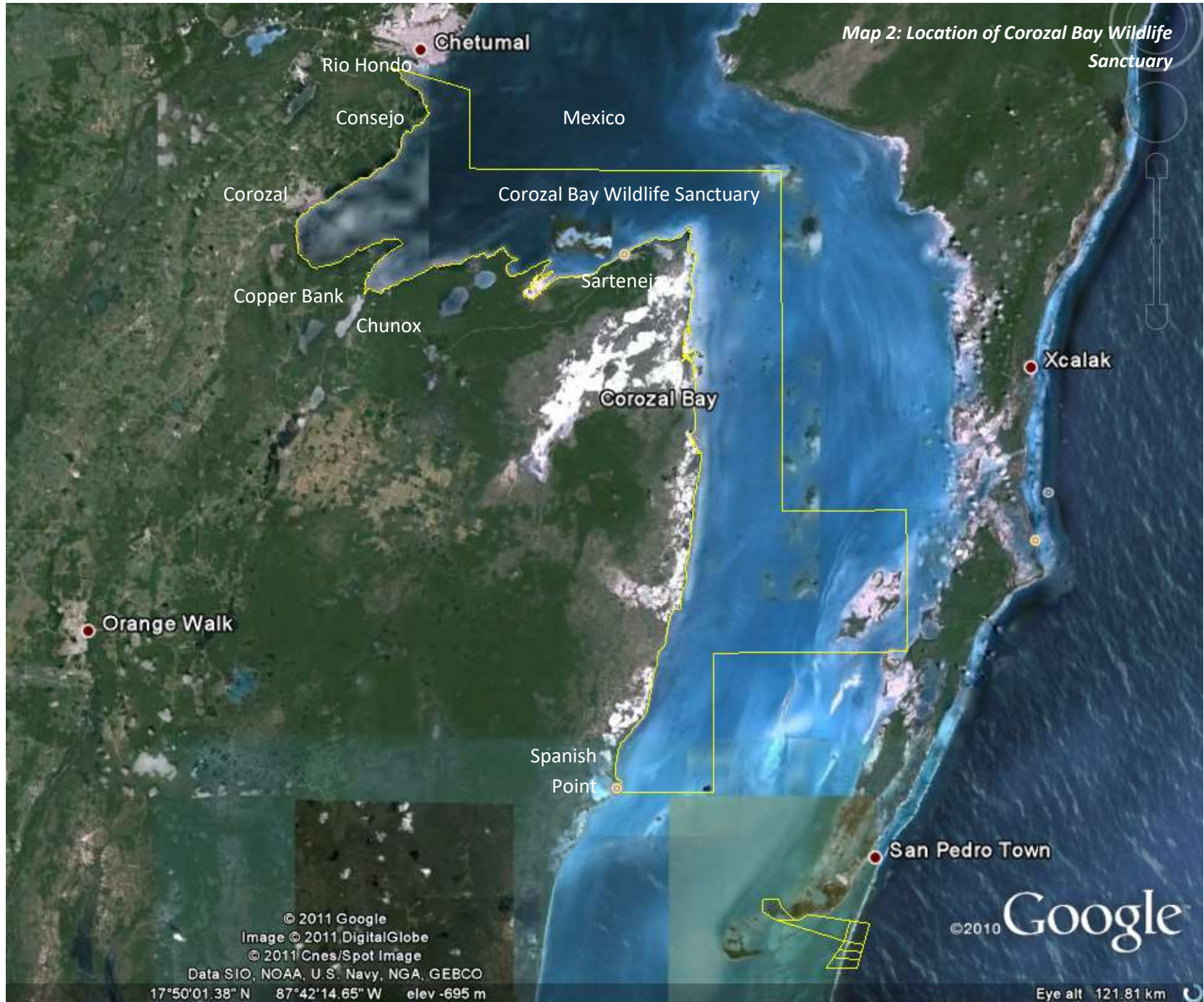
On-site Staff (2012): An Executive Director supported by 1 Head Ranger, 2 Rangers, an Education Officer and Office Assistant

Indian manatee, being highlighted as an area



Map 1: Location of Corozal Bay Wildlife Sanctuary

Map 2: Location of Corozal Bay Wildlife Sanctuary



with one of the highest populations of this species within Belize, and an important calving area (O’Shea, 1989; Auil, 1998). As such, it was declared as the Corozal Bay Wildlife Sanctuary by the Government of Belize in 1998 (SI 48 of 1998), as part of a transboundary initiative with Mexico. Under Belize law, Wildlife Sanctuaries, administered under the Forest Department, 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, though there has been no move to seek ministerial consent to legalize the activities. Traditional use by stakeholder communities is, however, recognized under the National Protected Areas Policy and System Plan (NPAPSP, 2005), which seeks 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 NPAPSP 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, has drafted a management plan for the Wildlife Sanctuary, focused on achieving a series of goals (Figure 1).

**SACD Management Goals for
Corozal Bay Wildlife Sanctuary**

1. Ensure the conservation and sustainable use of the natural resources of Corozal Bay Wildlife Sanctuary.
2. Increase community engagement, awareness and participation in the protection and conservation of the natural resources of Corozal Bay Wildlife Sanctuary.
3. Support all members of the Alliance in activities towards promotion of conservation and environmentally sustainable development for stakeholder communities of Corozal Bay Wildlife Sanctuary
4. Advocate for the proper management and sustainable use of natural resources and address environmental and development issues in and around Corozal Bay Wildlife Sanctuary
5. Ensure the long term sustainability of Corozal Bay Wildlife Sanctuary

Figure 1: Management Goals of the Corozal Bay Wildlife Sanctuary (SACD)

Within these goals is the recognition of the need to...

“ensure...sustainable use of the natural resources” and “...advocate for the proper management and sustainable use of natural resources,”

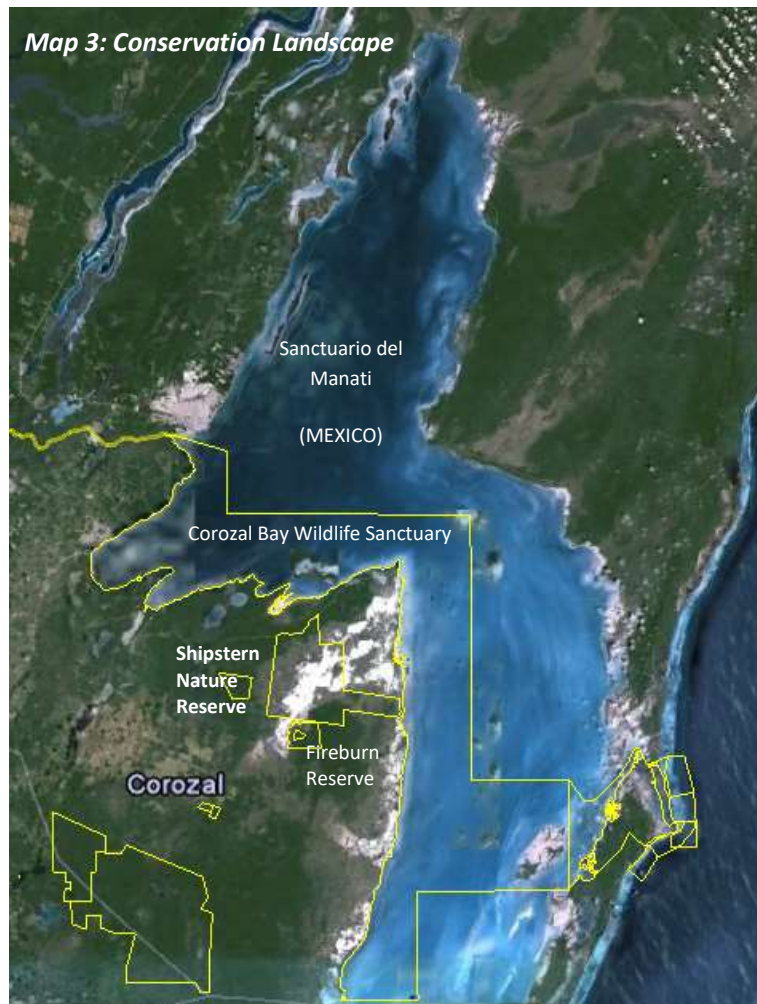
...for stakeholder benefit. This Sustainable Fisheries Baseline provides a route forward for building sustainability of the fisheries resources of the Corozal Bay Wildlife Sanctuary, within the National Protected Areas System framework, and in line with SACD’s management goal.

Local Conservation Landscape

Within the local conservation landscape, Corozal Bay Wildlife Sanctuary fits within a larger matrix of conservation areas that includes the Sanctuario del Manati, in Mexico, and a continuum to the Barrier Reef through Bacalar Chico Marine Reserve and National Park in Belize (Map 3). This provides the only protected connectivity between the estuarine environment and the reef drop off in Belize’s marine protected areas system. This connectivity is critical for the maintenance of the fish stocks utilized by the fishermen, with several commercially important fish species moving into the estuarine system to spawn.

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. The area has also been identified as an important transboundary drainage system, shared by Mexico and Belize, and one of the principle areas with transboundary issues (GEF, 2001). 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).



1.2 Sarteneja Alliance for Conservation and Development

The Sarteneja Alliance for Conservation and Development (SACD) has been operating since 2007, and was registered on 18th September, 2008. It is a community-based Non Governmental Organization, dedicated

Vision Statement

“SACD is the leading conservation organization in the Corozal District, ensuring the protection and sustainable use of the Corozal Bay Wildlife Sanctuary, based on good stewardship and equitable distribution of opportunities for all stakeholders.”

Mission Statement

“SACD is an Alliance dedicated to improving the quality of life of its stakeholder communities through conservation, protected areas management and the sustainable use of the natural resources.”

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:

“bringing people together to promote conservation and development”...

The Alliance provides a mechanism for effective communication, collaboration and networking between local individuals, associations and organizations in Sarteneja, and has a structured Executive Board composed of representatives from the active organizations in Sarteneja, and from the local fishing, education, tourism/business and conservation sectors, forming an Alliance of community organizations.

SACD Primary Objectives:

- 1) Ensure the conservation and sustainable use of the natural resources of the Corozal Bay Wildlife Sanctuary.
- 2) Increase community awareness and involvement in the protection and conservation of the natural resources of the Corozal Bay Wildlife Sanctuary.
- 3) Support all members of the Alliance in activities towards promotion of conservation and environmentally sustainable development for Sarteneja and other stakeholder communities of Corozal Bay Wildlife Sanctuary.
- 4) Advocate for the proper management and sustainable use of natural resources in and around Sarteneja, and the marine environment generally, and address environmental and development issues affecting Corozal Bay Wildlife Sanctuary and Sarteneja
- 5) Develop and implement a sustainable funding mechanism for the Sarteneja Alliance for Conservation and Development.

SACD is an active promoter of conservation in Sarteneja, through a number of specific program areas, and is recognized as the co-management partner for Corozal Bay Wildlife Sanctuary by the mandated management body – the Belize Forest Department.

In 2010, SACD implemented a project funded under the US Fish and Wildlife Service (Wildlife without Borders) programme, focused on the development of a for sustainable fisheries baseline for Corozal Bay Wildlife Sanctuary, to provide a foundation for future implementation of sustainable fishery mechanisms, with the integration of community participation into these activities – a core principle of the organization.

SACD Management Objectives for Corozal Bay Wildlife Sanctuary

- Ensure the conservation and sustainable use of the natural resources of the Corozal Bay Wildlife Sanctuary.
- Increase community engagement, awareness and participation in the protection and conservation of the natural resources of the Corozal Bay Wildlife Sanctuary.

1.3 Importance of the Local Fishery

Five communities are considered stakeholders of Corozal Bay Wildlife Sanctuary (Table 1). 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 (primarily lobster and conch) throughout the reef system of Belize, and do not fish commercially within the Wildlife Sanctuary. Approximately fifteen families in Sarteneja are dependent on the fish resources of the area, using either beach traps or gill nets, and marketing locally or in near-by towns - principally Orange Walk and Corozal. There is also a limited market for a number of fish species in San Pedro.

Chunox and Copper Bank each also identify four to five fishermen dependent on the fisheries resources of the Wildlife Sanctuary (Community meetings, Chunox and Copper Bank, 2010), and Corozal and Consejo Shores have around 10 part time fishermen who use the Bay to supplement other income sources (Community meetings, Corozal, 2010). This Plan therefore focuses on the Sarteneja fishery, and, in particular, the beach trap fishery.



Whilst these are direct threats to the fish stocks, the health of the fishery is also dependent on the ecosystem health of the estuary system as a whole. A more formal assessment was conducted during the management planning process for Corozal Bay Wildlife Sanctuary, covering all seven of the identified conservation targets of the protected area.

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. A limited number of local fishermen (12 – 15) are dependent on fishing in Corozal Bay, using beach traps and gill nets
Chunox	E16 356500 N20 23500	1,400	Located on Laguna Seca, part of the Progreso Lagoon system. Increasing number of reef fishermen, focused primarily on Lighthouse Reef Atoll. A limited number of local fishermen (4 – 5 in both communities) using Corozal Bay, primarily using gill nets and throw nets.
Copper Bank	E16 356700 N20 26020	525	
Corozal	E16 353643 N 20 33873	9,100	District town with major services (banks, post office, Government offices etc.). A limited number (2 to 3) of fishermen dependent on Corozal Bay. Recreational fishing by youths in the mornings.
Consejo	E16 362344 N20 40688	<1,000	Border community, with some (7) fishermen dependent on Corozal Bay. Large expatriate component, including a yacht club that uses the Bay for boating activities.
San Pedro	E16 0398200 N18 1981250	4,499	Tourism destination, embarkation point for many visitors to reef. Fly fishing industry utilizes Corozal Bay Wildlife Sanctuary.
Chetumal	E16 363347 N20 46291	238,520	Mexican coastal town with significant water quality impacts on the estuarine system.

Table 1: Communities of Corozal Bay Wildlife Sanctuary

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

2.0 Current Status

With a trend of a declining fish stock and increasing anthropogenic pressures on the Corozal Bay 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 types of local fishermen 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 management organization. The focal point for this plan has been the beach trap fishermen. Whilst only one of five different fishing sectors identified as using the protected area, these fishermen are also recognized as having the greatest impact. Much of the stock assessment focus has been on the trap fishery, but participation in management decisions has also included the gill net fishermen, with input into site level rules and regulations for incorporation into the draft management plan, and for implementation by SACD.

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, to provide estimates of the state of the stock. 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.

“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

2.1 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 closures to allow protection of spawning and nursery grounds. This plan seeks to provide the foundation for the development of effective sustainable management of the small scale fishery of Corozal Bay Wildlife Sanctuary, in collaboration with the local fishermen.

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 is used, with results extrapolated across the fishing sector. The beach traps provide an excellent opportunity for sampling catch in the Wildlife Sanctuary, giving data on the number of species caught, seasonality, relative contribution of species to the catch, recruit size, and maximum, mean and mode length. 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)
- 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 (eg. age-length and length-weight conversions, mortality) is based on data collected in Florida, rather than site specific to Corozal Bay Wildlife Sanctuary

Recognizing these weaknesses in the data, and that data collection needs to be continued over at least the next four years 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

2.2 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

2.2.1 Identification and Engagement of Stakeholders

A number of 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 any efforts towards a sustainable fishery (either positively or negatively). Engagement of these different sectors – both public and private – will be critical for successful management of fish resources in the future.

Community understanding of, and involvement in, any sustainable fishery initiative will be essential in the development of sampling and monitoring strategies, and understanding of the medium-term benefits will assist in encouraging greater support of general management strategies for the Corozal Bay Wildlife Sanctuary.

The Village Councils of the different stakeholder communities need to be engaged as partners, with their support for regulations developed to build sustainability of fish resources. Engagement of the Forest Department as an active partner in the initiative is important as a first step, with development of the agreements for continuation of traditional fishing within the Wildlife Sanctuary. Engagement of the Fisheries Department towards collaboration and technical input is also important, with the wealth of experience available that can contribute towards sound project design.

Person /Organization	Role and Potential Impact
<p><i>Sarteneja Alliance for Conservation and Development</i></p>	<ul style="list-style-type: none"> ▪ 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 communities ▪ Responsible for engagement of other stakeholders – fishermen, sport fishermen, Forest and Fisheries Departments ▪ Responsible for enforcement of regulations outlined in the Sustainable Fishery Plan (in collaboration with Forest and Fisheries Departments) ▪ Responsible for development of baseline and monitoring of fish catch, in collaboration with fishermen <hr/> <p><i>Impacts: Positive</i></p> <ul style="list-style-type: none"> ▪ Long term sustainability of the Wildlife Sanctuary fish stocks ▪ The sustainable fishery will act as a focus for supporting and engaging the local fishermen <p><i>Impacts: Negative</i></p> <ul style="list-style-type: none"> ▪ May result in conflict with some fishermen

Person /Organization	Role and Potential Impact
<i>Local Fishermen</i>	<ul style="list-style-type: none"> ▪ Rely on the Wildlife Sanctuary fishery for their income ▪ Have one of the greatest impacts on the resources ▪ Need to take on collaborating role with SACD in management of fish stocks within the Wildlife Sanctuary ▪ Participants in fish capture monitoring <hr/> <p><i>Impacts: Positive</i></p> <ul style="list-style-type: none"> ▪ Will benefit from increased fish resources ▪ Will have greater control of resources, and more motivation in maintaining them ▪ Will benefit from greater organization as a stakeholder group ▪ Enforcement of regulations to prevent Mexican, Honduran and other non-local fishermen from fishing within the Wildlife Sanctuary, reducing competition for resources ▪ Enforcement of regulations regarding not permitting netting over mouth of creeks and rivers will increase available fish stocks <p><i>Impacts: Negative</i></p> <ul style="list-style-type: none"> ▪ Fishing regulations will be enforced within the Wildlife Sanctuary
<i>Sport Fishing Guides</i>	<ul style="list-style-type: none"> ▪ Rely on sport fish species of the Wildlife Sanctuary as an important tourism resource, providing income and employment within the community ▪ Need to be represented on any fishing committee or group established to assist with management of the fisheries resources ▪ Need to be engaged – with mechanism for reporting fishing-related issues within the Wildlife Sanctuary ▪ Potential participants in fish capture monitoring (focus is currently on beach trap fishermen)
<i>Non-local Fishermen</i>	<ul style="list-style-type: none"> ▪ Reportedly primarily from Mexico, but also from Honduras and Guatemala ▪ Have no incentive to follow Belize Fisheries legislation ▪ Will not have permits for fishing within the Wildlife Sanctuary, with active enforcement against illegal incursions ▪ No basis for access to fish resources of the Wildlife Sanctuary, with related loss of income

<i>Person /Organization</i>	<i>Role and Potential Impact</i>
<i>Forest Department</i>	<ul style="list-style-type: none"> ▪ Have mandate for management of Corozal Bay Wildlife Sanctuary ▪ Have identified 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 ▪ Have ability to grant or refuse permission for development of a sustainable fishery within the Wildlife Sanctuary ▪ Successful implementation will provide Forest Department with a model for use in other similar situations ▪ Successful implementation will provide Forest Department with a working example of the benefits communities can derive from protected areas through conservation management
<i>Fisheries Department</i>	<ul style="list-style-type: none"> ▪ Have mandate for management of fish stocks in Belize ▪ Have potential for back-up support for enforcement against 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 provide data on northern coastal fish populations ▪ Successful implementation will provide Fisheries Department with a model for use in other similar situations

Engaging local Fishermen

Fishermen, whether commercial or traditional, and whether from Sarteneja, from other stakeholder communities, other coastal communities in Belize, or from elsewhere in the World, are considered a particularly difficult sector to engage. This is partly as a result of the characteristics that led to them selecting fishing as an occupation. The traditional fishing lifestyle – self-employed, relatively little structure, outdoors – is very different from the organizational structure that seeks to meet indoors at set times to conceptualize and discuss ideas. Many fishermen also have limited education and literacy skills, and are uncomfortable speaking in public.

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

Mechanism	Current Initiatives under SACD (2011 / 2012)
<ul style="list-style-type: none"> ▪ Regular meetings should be held by SACD to keep the fishermen informed 	<ul style="list-style-type: none"> ▪ SACD and local fishermen have agreed to meet once every two weeks to ensure ongoing, clear communication, from mid-2012 onwards
<ul style="list-style-type: none"> ▪ More structured meetings should not clash with fishing schedules – these meetings, too, can be held outside if preferred and should be relatively informal 	<ul style="list-style-type: none"> ▪ Meetings are scheduled following discussion with fishermen as to the best day / time
<ul style="list-style-type: none"> ▪ Meetings should be reliable and prompt, regardless of turn-out, and finish on time 	<ul style="list-style-type: none"> ▪ Meetings are normally delayed to allow full participation, but do finish on time
<ul style="list-style-type: none"> ▪ Any visual aids used during meetings should be heavily image focused 	<ul style="list-style-type: none"> ▪ Meetings are based on discussion
<ul style="list-style-type: none"> ▪ Meetings should focus on the fishermen’s needs 	<ul style="list-style-type: none"> ▪ The first meeting included discussion on the need for collaboration and good, non-antagonistic communication between SACD rangers and fishermen when encountering each other on the water ▪ Discussion also covered the recent new legislation protecting bonefish, and the course to follow if bonefish are netted as by catch, as a point of interest for the fishermen
<ul style="list-style-type: none"> ▪ There should be active and rapid follow-up on ideas put forward during meetings to show results 	<ul style="list-style-type: none"> ▪ The bonefish issue was discussed with Fisheries Department officers and follow-up information provided to the fishermen
<ul style="list-style-type: none"> ▪ Informal training can be used to build capacity for articulating ideas for those fishermen interested in playing a more active role in fishery management 	<ul style="list-style-type: none"> ▪ SACD has integrated fisherman participation into Green Laws training by the Forest Department
<ul style="list-style-type: none"> ▪ The formation of a management group for the Sustainable Fishery needs to come out of initial meetings as a requirement voiced by the fishermen, who should also participate in defining the structure and role of the management group (number / type of participants) 	<ul style="list-style-type: none"> ▪ An informal committee was developed earlier in the process, but needs to be re-vitalised
<ul style="list-style-type: none"> ▪ Meetings should be facilitated so that fishermen direct the outcomes, through asking leading questions, and listening to the answers. Fishermen should also lead the fishery management process as much as possible, with SACD providing assistance and guidance 	<ul style="list-style-type: none"> ▪ Meetings focus on how fishermen see SACD assisting them in maintaining the fishery, with SACD providing a forum where the fishermen have formulated the rules and regulations for the Wildlife Sanctuary. In partnership with SACD. Capacity building is still required for the fishermen to take on more of the management decisions regarding the fishery

Mechanism	Current Initiatives under SACD (2011 / 2012)
<ul style="list-style-type: none"> ▪ Suggest a start-up project for the management group – something small with achievable outcomes (eg. lamination and distribution of zone map for posting in community; distribution of copies of map to fishermen; erection of Fishermen’s notice board (with map). 	<ul style="list-style-type: none"> ▪ Fishermen have drawn up the rules and regulations for the different fishing sectors of the Wildlife Sanctuary, and nine are participating in an alternative livelihoods project (household chicken units), in both project design and implementation
<ul style="list-style-type: none"> ▪ Not all fishermen can be engaged at the start of the process – work with those willing and interested in more effective management of fish resources, then reach out during the baseline development process 	<ul style="list-style-type: none"> ▪ The majority of fishermen are participating in the process, attending meetings and making input. The remaining fishermen are invited, but have not made a decision on participation as yet
<ul style="list-style-type: none"> ▪ Ensure fishermen benefit in outputs – eg. through stipends for participation as volunteer rangers, training, access to resources, alternative livelihood opportunities etc. 	<ul style="list-style-type: none"> ▪ Stipends have been provided to those fishermen participating in fish trap surveys, and nine are participating in an alternative livelihoods project (household chicken units), to assist in reducing dependency on fishing

2.2.2 Relevant Legislative Framework

Within Belize there is a strong legislative framework supporting natural resource management. Any sustainable fishery initiative needs to be managed within this framework, developing collaborative partnerships with the relevant Government agencies

- the Forest Department with the mandate for management of Wildlife Sanctuaries within Belize, and
- the Fisheries Department, with the mandate to manage fisheries resources within Belize.

Both departments lie under the umbrella of the new Ministry of Forestry, Fisheries and Sustainable Development.

Forest Department Legislation

Under the National Parks System Act, the Wildlife Sanctuary category is non-extractive. It is therefore currently (theoretically) not permissible for anyone to fish within the Wildlife Sanctuary. However, the National Protected Areas Policy and System Plan recognizes the need to permit certain traditional uses of natural resources by local communities. An ongoing rationalization process (2012) seeks to align the requirement for traditional community use with the legislation, but only with planning in place for sustainability.

Fisheries Department Legislation

The Fisheries Act provides a framework for fishing activities within the marine environment, and is currently being revised to cover any aquatic environment. A number of legal requirements are in place throughout Belize to regulate fishing, all of which are being enforced, where feasible, within the Corozal Bay Wildlife Sanctuary.

- all fishermen need to be in possession of a valid fisherman's license
- all boats and boat captains need to be in possession of the relevant valid licenses
- no fisherman can use poison or explosives in fishing
- all nets should have a minimum mesh size of 3" (preferably 4"), and be set following the Fisheries Department restrictions, which prohibit setting of nets in the following localities:
 - at river and creek mouths
 - within a mile of any community
 - in a channel
 - in spawning areas
- no fishermen would target species covered under the sport fishing legislation

Sarteneja Alliance for Conservation and Development

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, and as such, is building its capacity to ensure effective surveillance and enforcement. It is recommended that a tri-partite Memorandum of Agreement be developed between the Forest Department, Fisheries Department, and the Sarteneja Alliance for Conservation and Development to formally recognise the traditional access rights of all identified local fishermen of the stakeholder communities, and in support of the development of a community-managed fishery, following the development of a mutually approved sustainable fishery plan. This should stipulate that community managed fishing will follow the regulations under the Fisheries Act:

Until a formal local fisherman's group has been established, it is recommended that a Memorandum of Agreement should also be developed between the Sarteneja Alliance for Conservation and Development and each of the local fishermen, for implementation of the sustainable fishery plan.

Once this structure has been established

- A formalized agreement between trap fishermen, Forest Department, Fisheries Department and SACD, to protect the traditional access rights of the fish trap fishermen

Site Level Regulations

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 (Figure 2). These are based on the following:

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 (2012)

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, with a site level permitting process in place

Cast Nets

- Community use of cast or throw nets in CBWS has a long tradition, is very localised, considered to have little impact on fish populations, and is an important supplemental food source for some families.
- SACD will need to take on responsibility of assessing cast net impact, and demonstrating that cast nets have a very low impact on the fish populations

Fishermen have also agreed to assist SACD with monitoring activities, particularly in the following areas:

- reporting illegal fishing activities within CBWS
- reporting any dead manatees or threats to manatees within CBWS, as soon as possible
- reporting lionfish caught in traps or nets
- assisting with catch monitoring activities

Proposed Site-level Regulations for Fishermen of Corozal Bay Wildlife Sanctuary

Beach Trap Fishery

- all traps are to be mapped and registered with SACD
- capping the number of traps at the current level
- a 'no sale' and 'no new trap' policy within Corozal Bay Wildlife Sanctuary.
- fish traps can only be passed from father to son
- fishermen lose their traditional rights if a trap isn't used for two consecutive years
- traps can only be opened between April 15th and must be closed by November 15th
- trap walls must be removed by November 15th, to avoid accidental capture of manatees
- fish species caught must be legal under the fisheries legislation

Gill Nets

- all gill nets are to be registered with SACD
- gillnet fishermen will be issued with ID cards identifying them as traditional fishermen with permission to fish within the Wildlife Sanctuary
- fishermen will ensure that they do not leave nets unattended, particularly in areas known to have manatees
- non-CBWS fishermen, with no traditional use history of the area, will not be permitted to fish in CBWS
- no new net-fishermen (fishermen planning to use net fishing as their main form of income in the future) will be licensed for Corozal Bay Wildlife Sanctuary

Cast Nets

- all residents of Corozal Bay communities should have the option for using cast nets in front of their communities for non-commercial use

Sport Fishing

- all sport fishing should be catch and release

Figure 2: Fishing Regulations for Corozal Bay Wildlife Sanctuary

2.3 Current Status of Fish Stocks

Conservation planning is a key part of management planning, and was conducted for Corozal Bay Wildlife Sanctuary, following the national Management Planning framework (Level One). Under this framework, an assessment was made of the status and viability of the fish stocks, as well as the threats to the protected area based on 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 years in the fish populations, with the goal to increase this status to **GOOD** by the end of the 5-year management period.

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 maintenance of sustainable fishery
		Indicator: Average biomass per species of catch per year per beach trap Average total length per species per year per beach trap

Table 2: Current Viability of Commercial Fish Populations (CBWS Management Plan, draft)

2.3.1 Trends

Community consultations suggest that fish stocks within the Wildlife Sanctuary are considered to have fallen significantly since the arrival of gill nets between twenty and thirty years ago. Many commercial fish species populations have decreased over the last fifteen years, including the goliath grouper and the smalltooth sawfish. Current trends continue to point to a decrease, as indicated by local fishermen from Sarteneja, Chunox and Copper Bank during community consultations, household surveys, and workshops (Figure 3).

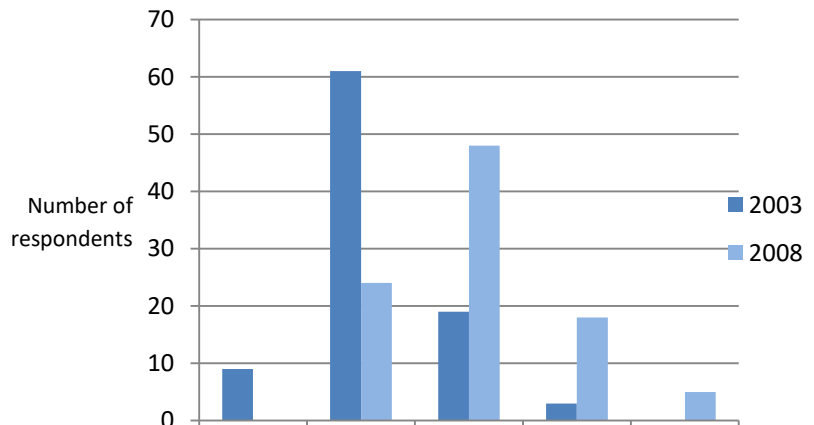


Figure 3: Perceived Status of Resource (Commercial Fish Populations of CBWS) (SACD, 2008)

The majority of respondents believe that over-fishing, largely caused by gill nets, is the main reason for the decline in fishing resources (Figure 4). Also cited was the overfishing of juveniles / undersized individuals, and illegal fishing from foreign incursions.

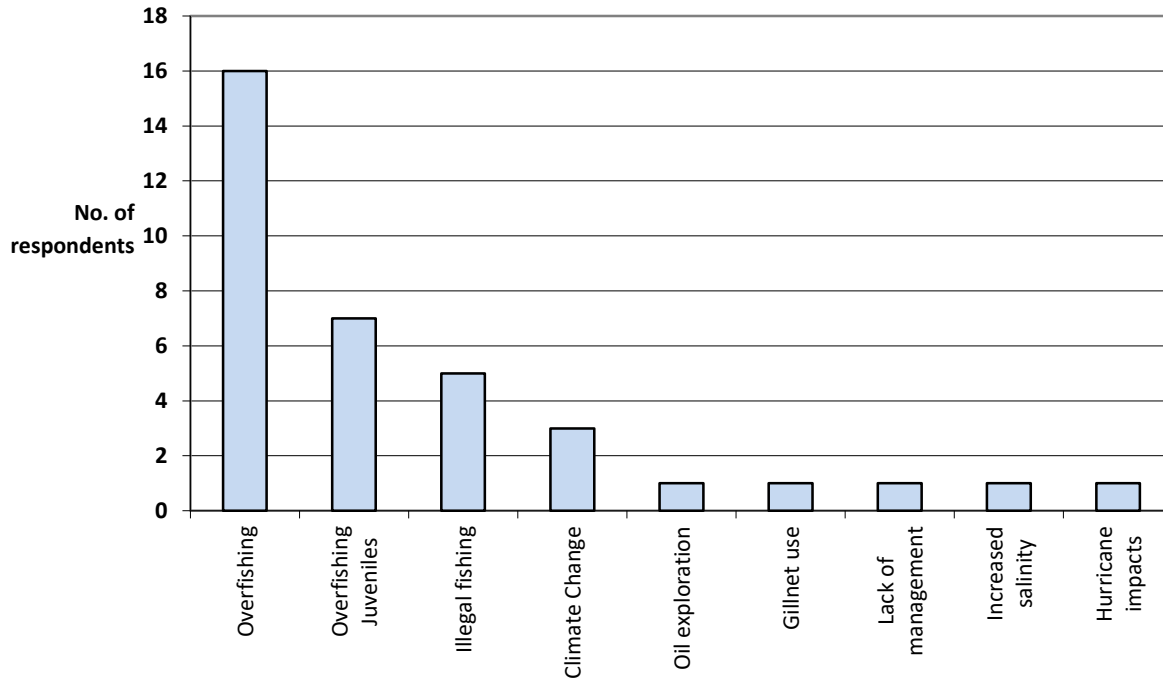


Figure 4: Reasons Cited by Community Respondents for Decline in Fish Stocks (SACD Socio-economic Survey data, 2009)

When asked to provide possible solutions, respondents suggested the following:

- 19% suggested increased patrols within Corozal Bay Wildlife Sanctuary
- 15% suggested increasing enforcement of laws within Corozal Bay Wildlife Sanctuary
- 17% suggested stricter laws for fisheries management in Belize
- 12% suggested increasing community involvement and participation in management
- 10% raising the level of education to reduce the number of young people needing to go into fishing

2.3.2 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 ...). 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, past fishing has reduced goliath grouper to a currently non-viable population, and small tooth sawfish (*Pristis pectinata*), once present in large numbers, has been extirpated from the system, as a result of unsustainable fishing practices and illegal, transboundary fishing incursions.

Ten impacts were identified during the assessment, of which the four most critical were considered to be:

- **Mangrove Clearance**
- **Water Pollution**
- **Transboundary Fishing**
- **Unsustainable Fishing**

Each impact was assessed using a modified RAPPAM assessment methodology (WWF, 2003), both as a pressure and as a threat¹ on the system, based on the extent, impact and permanence of the activity.

The highest pressures are considered to come from coastal mangrove clearance, with increased pressure for waterfront properties (Figure 5). Pollution from poor sewage treatment in Chetumal is also a cause for concern, as is agricultural runoff originating from farming areas along the New River, Rio Hondo and Progreso watersheds, all of which include Mennonite farmlands, with heavy use of agro-chemicals, extensive cattle farms, and, adjacent to the Rio Hondo, inundated rice fields. Transboundary fishing has been highlighted as both a pressure and threat, and is considered to be having a greater impact on the fish populations than local fishing. It is recognized that without further financial and human resources to increase surveillance and enforcement activities, fishing levels are not going to decrease.

Corozal Bay Wildlife Sanctuary: Key Pressures and Threats

- Inappropriate caye development
- Inappropriate land use/ industrial development
- Inappropriate fishing practices:
 - Gill nets
 - Non catch and release sport fishing
 - Unsustainable fishing
- Agricultural runoff
- Mangrove clearance
- Sedimentation
- Oil exploration and drilling
- Sewage pollution
- Insufficient enforcement
- Transboundary impacts – fishing agricultural runoff and tourism (sport fishing)

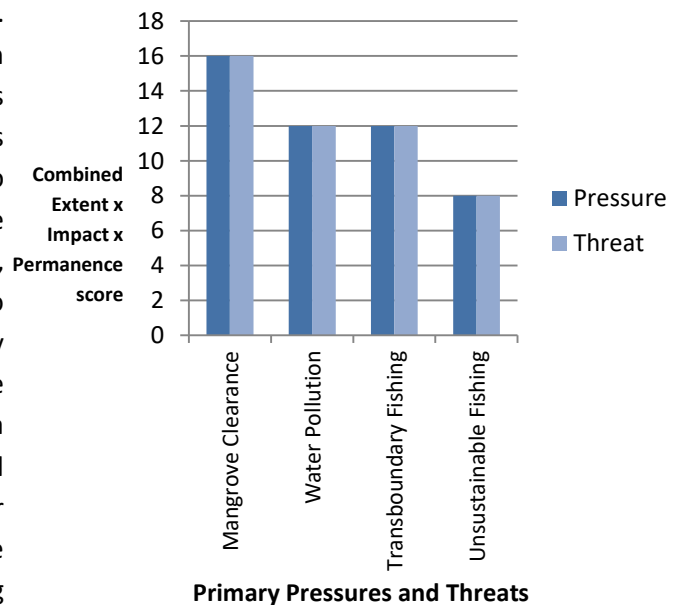


Figure 5: Primary Pressures and threats for Corozal Bay Wildlife Sanctuary

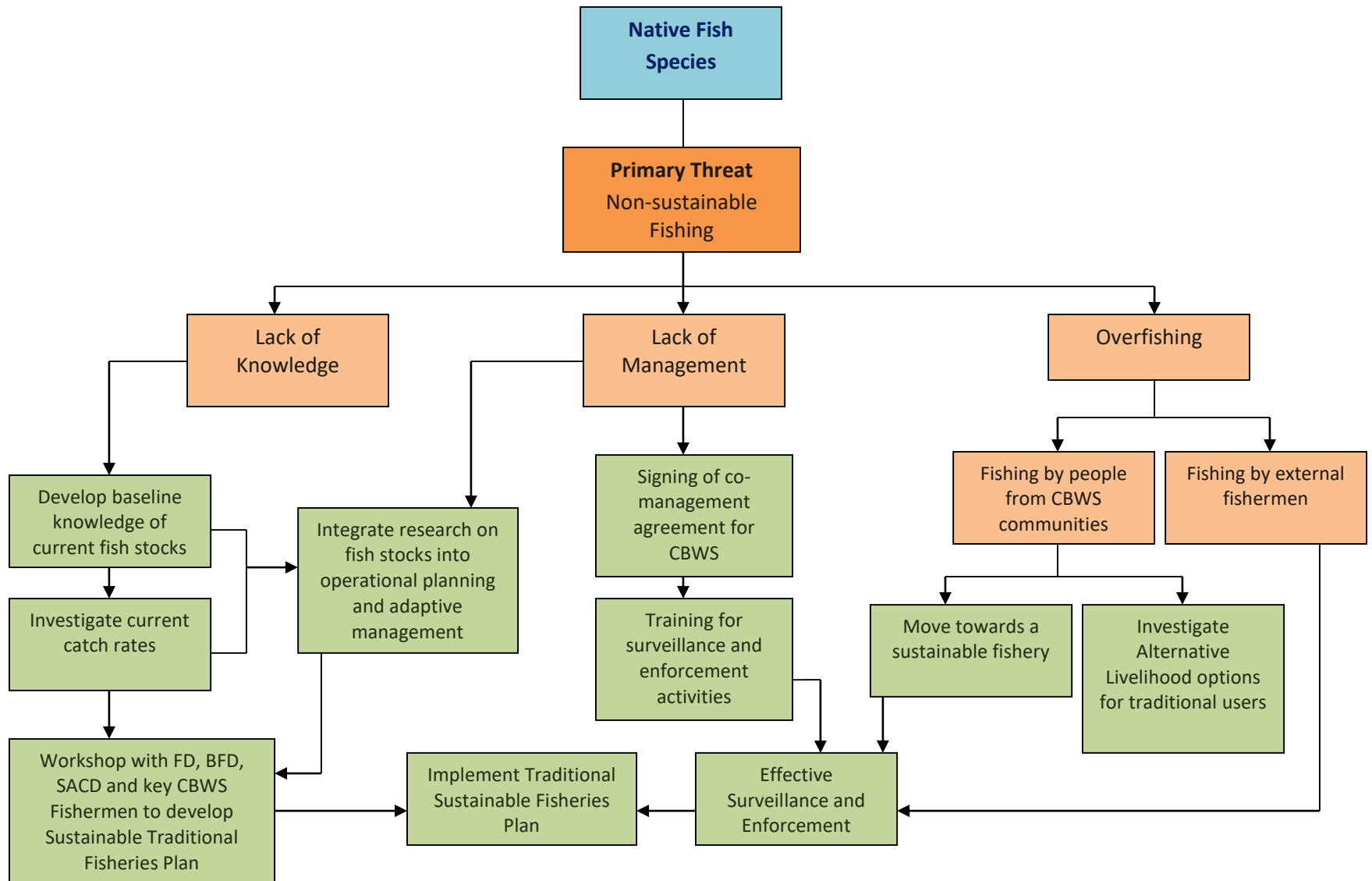
¹ Pressures are considered as past direct and indirect negative impacts on the biodiversity, whilst threats are the future potential negative impacts (Ervin, 2003).

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 6: Situation Analysis for Commercial Fish Species of Corozal Bay Wildlife Sanctuary



3.0 Profile of Fishing Activity in Corozal Bay

Fish trap data, a socio-economic survey of Sarteneja (the focal community of this plan) and community consultations with fishermen of Sarteneja and the other stakeholder communities, 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.

Community	Estimated number of fishermen*	Fishing Methods	Relative Dependency
Sarteneja	15	Beach traps, gill nets, cast nets	High
Chunox	4 - 5	Gill nets, cast nets	High
Copper Bank	4 - 5	Gill nets, cast nets	Medium
Consejo	7	Gill nets, cast nets	Low
Corozal	3	Gill nets, cast nets	Low

* Traditional fishermen considered dependent on fishing in Corozal Bay Wildlife Sanctuary for the majority of their income

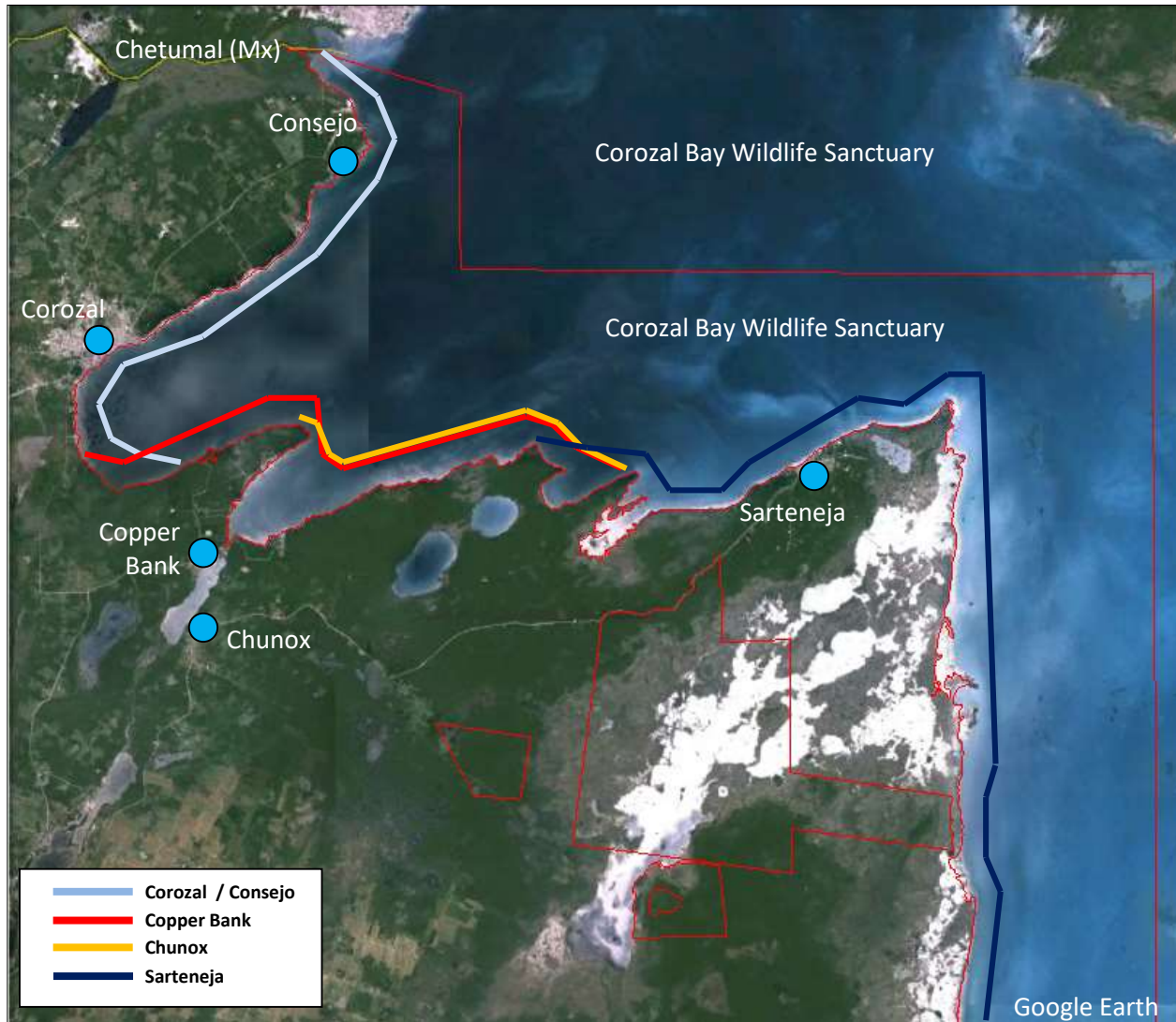
Table 3: Origin of Fishermen of Corozal Bay Wildlife Sanctuary



Sanctuary over generations

3.1 Fishing Areas

Mapping exercises in the stakeholder communities demonstrate that there is a loose division of the fishing area per community, 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 4: 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.

3.2 Target Species

Fourteen species are regularly fished from Corozal Bay Wildlife Sanctuary for commercial or home-use purposes (Table 4), with four of these considered key targets for fishery management.

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

Table 4: 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	<i>Eugerres plumieri</i>
		Yellowfin Mojarra	<i>Gerres cinereus</i>
Snapper (Lutjanidae)	23	Grey Snapper	<i>Lutjanus griseus</i>
		Lane Snapper	<i>Lutjanus synagris</i>
		Mutton Snapper	<i>Lutjanus analis</i>
Barracuda (Sphyraenidae)	15	Great Barracuda	<i>Sphyraena barracuda</i>
Jack (Carangidae)	4	Horse-eye Jack	<i>Caranax latus</i>
		Crevalle Jack	<i>Caranax hippos</i>

Table 5: Preferred Target Species (Sarteneja Socio-economic Survey, 2009)

Two fish families were highlighted as preferred species within the community, and therefore targeted by local fishermen. 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*), this family being favoured by 55% of respondents. The Lutjanidae – the snapper, particularly the grey (or mangrove) snapper ('pargo' - *Lutjanus griseus*) is favoured by 23% of respondents) (Figure 6).

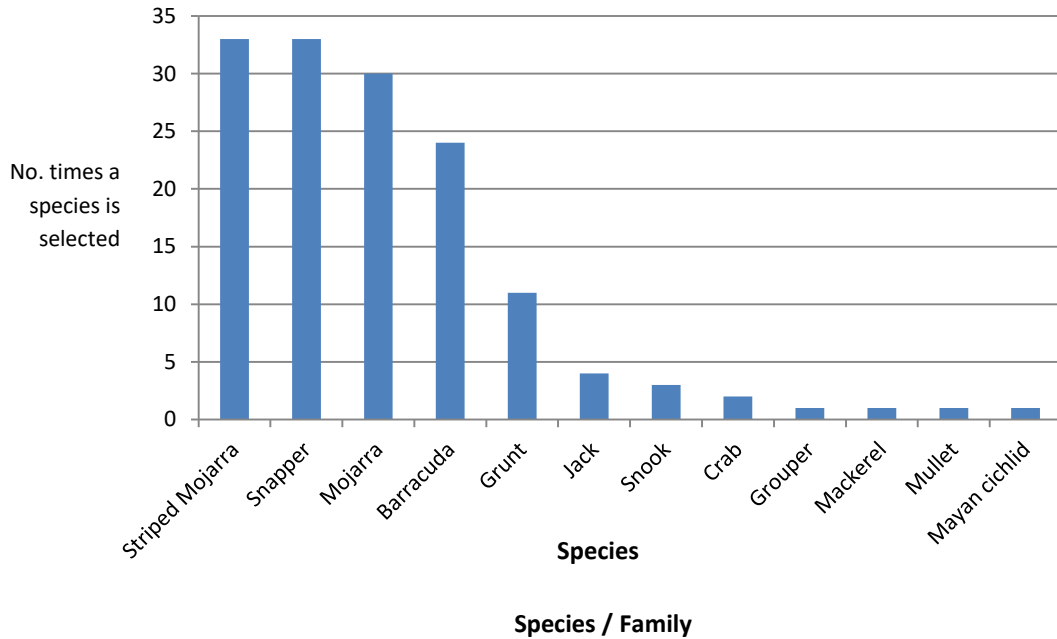


Figure 6: Preferred fish species targeted by fishermen in Corozal Bay Wildlife Sanctuary (SACD, 2009)

Whilst these results are specifically for Sarteneja, community participants in management planning workshops in Chunox, Copper Bank and Corozal (March - June, 2009) also agreed with these preferences.



Grey snapper ('pargo') *Lutjanus griseus*



Yellowfin Mojarra ('mojarra')
Gerres cinereus



Striped Mojarra ('chiwa')
Eugerres plumieri

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 - <i>Eugerres plumieri</i> (Chiwa)												
Striped Mullet - <i>Mugil cephalus</i> (Lisa)												
Crevalle Jack - <i>Caranx hippos</i> (Jurel)												
Mackerel - <i>Scomberomonis regalis</i> (Cero)												
Yellowfin mojarra - <i>Gerres cinereus</i> (Mojarra)												
Grey snapper - <i>Lutjanus griseus</i> (Pargo)												
Lane Snapper – <i>Lutjanus synagris</i> (Pargo)												
Mutton Snapper - <i>Lutjanus analis</i> (Pargo)												
White Mullet – <i>Mugil curema</i> (Mullet)												
Snook - <i>Centropomus undecimalis</i> (Robalo)												
Blue-striped grunt - <i>Haemulon sciurus</i> (Chac chi)												

Figure 7: Species seasonality within Corozal Bay Wildlife Sanctuary (SACD / local fishermen, 2009)

An assessment of the beach trap catch data collected in 2011 demonstrates that the preferred species are also those that have the greatest representation in the catch.

3.3 Types of Fishermen

Five types of Sarteneja fisherman were identified as using the Wildlife Sanctuary, some for commercial purposes, others for home use (Table 8)

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	<ul style="list-style-type: none"> ▪ Beach Trap ▪ Gill Net ▪ Seasonal Gill Net ▪ Sport Fishing
Non-Commercial	<ul style="list-style-type: none"> ▪ Cast Net

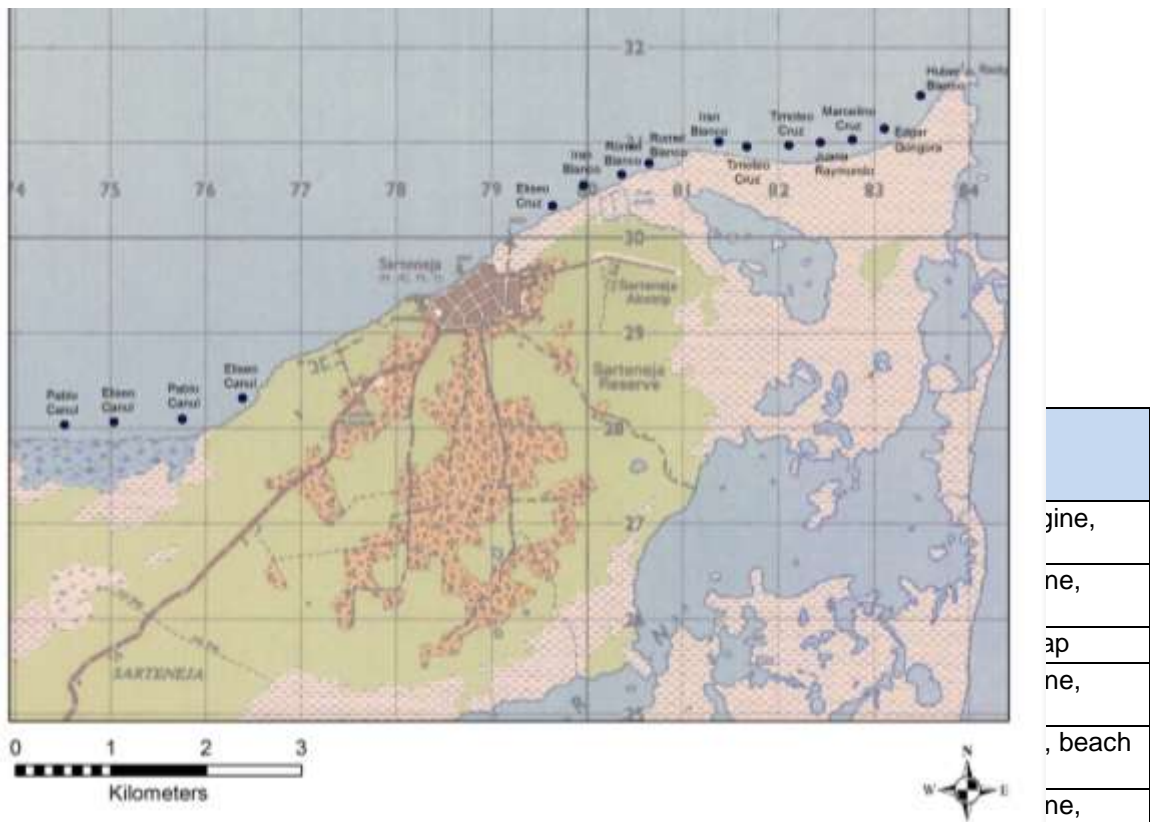
Table 8: Types of Fishermen in Sarteneja

The consistent primary commercial users of CBWS in Sarteneja are the 15 or so commercial fishermen who use traditional beach traps or gill nets, along with their assistants. Fishing with a cast net is considered a traditional recreational activity by the majority of men, 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 gill net fishing and, in the past, opportunistic manatee poaching. Honduran and Guatemalan fishermen are also known to frequent the southern end of the Wildlife Sanctuary.

3.3.1 Beach Trap Fishermen

Sarteneja is the only community of CBWS to have beach traps, consist of a line of wooden sticks spaced 2 ft apart extending 250-300ft from shore, leads into a circle 25-30ft in diameter, and target species that move parallel to the shore. This is considered a traditional fishing method for the area, with traps being passed from father to son. 10 trap fishermen man 15 traps, set in permanent locations along the coastline east and west from Sarteneja (Map 5, Table 9). Fishing is seasonal, with traps opened in mid-April and removed in mid-November. 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.



Map 5: Location and ownership of beach traps

Fisherman	Traps	Equipment
Fisherman 8	2	23 ft skiff, 40 HP engine, beach trap

Table 9: Beach trap fishermen equipment

3.3.2 Commercial gill net / cast net

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). Nets are set in the evening and pulled in early morning. These nets are not discriminatory, and kill by-catch and undersized fish as well as those targeted. Cast nets are then used during the day – sometimes within the coastal lagoons and creeks.



Team	Number of Team Members	Equipment
Fisherman 1	2	Gill net, 60/75HP engine, 25 ft skiff
Fisherman 2	3	Gill net, 60/75 HP engine, 25 ft skiff
Fisherman 3	2	Gill net, 40 HP engine, 12 ft skiff
Fisherman 4	3	Sink net, 30 HP engine 20 ft sailboat, 8 HP 9 ft skiff

Table 10: Gill net fishermen

Four teams of gill net fishermen use Corozal Bay Wildlife Sanctuary

3.3.3 Seasonal gill nets

A number of Sartenejans, 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. These nets are not discriminatory, and kill by-catch and undersized fish as well as those targeted. Species targeted are jack, snook, and snapper.

3.3.4 Cast Net Fishing

Cast nets (or throw nets - 8-12ft circular nylon nets with a mesh size of 1.5 inches and about 20 small lead weights around the outer edge) are used by many fishermen in the shallow waters in front of Sarteneja 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 between 10 and 20 fish). Approximately 10 people from Sarteneja 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, both for recreation and for the table. Species targeted are striped and yellowfin mojarra (chiwa and mojarra) and the sailfin catfish (vaca).

3.3.5 Sport Fishing

Sport fishing in the Wildlife Sanctuary is primarily catch and release, but guides will sometimes keep a fish for the tourist / family to eat. Four sport fishing guides fish from Sarteneja, in addition to an unknown number from Corozal and San Pedro, using specific areas of the Wildlife Sanctuary, such as the Punta Caul sink hole for tarpon, and the Spanish Point and Deer Caye areas for bonefish. Sport fishermen are far more selective, with a narrower range of target species, primarily focused on tarpon, permit, bonefish, snook, and barracuda, driven by market demand from the sport fishing industry.

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 and permit 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 11: Species catch per fisherman type

Illegal Fishing Incursions

There are also incursions from commercial fishermen from Mexico, Honduras and Guatemala, on a more intensive and less selective scale than the local fishing practices, and considered a greater threat to the viability and sustainability of the fishing industry within the Wildlife Sanctuary. As recommendations are focused on enforcement activities against use of the Wildlife Sanctuary by this sector, they are not included within the assessment activities, other than as a threat.

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 April 15th to November 15 th , 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. San Pedro guides come all the way to Punta Caul cenote. Also fish bone fish / Spanish Point and Deer Caye. Morning / during day
Cast net	Morning and late evening	Recreation, traditional. Not day by day. Increases during the closed season.

Table 12: Temporal Patterns of Fishing in Corozal Bay Wildlife Sanctuary

4.0 Current Estimation of Catch – a Snapshot

4.1 Data Collection

4.1.1 Catch Data

The beach trap fishery of Sarteneja has been the focus for community sampling of current fish catch and fishing effort, and is recognised as the most realistic mechanism for sampling fish catch with the human and financial resources available. Sampling was conducted by SACD, Wildtracks, Blue Ventures, with active participation from the local trap fishermen, using the following methodology:

1. Sampling is at point of extraction, with two recorders accompanying the fishermen to the traps in the early morning (generally leaving Sarteneja between 4:30 and 5:30am)

2. The date, name of recorders, weather conditions, and fisherman / trap location are recorded

3. As fishermen empty their nets, the catch is divided by species, and by-catch is listed as it is returned to the sea

4. All commercial fish within the catch are measured using a fish measuring board (Tail Length in cm, to the nearest 0.5cm), with species and total length (TL) recorded per individual fish on the data sheet (Figure 8)

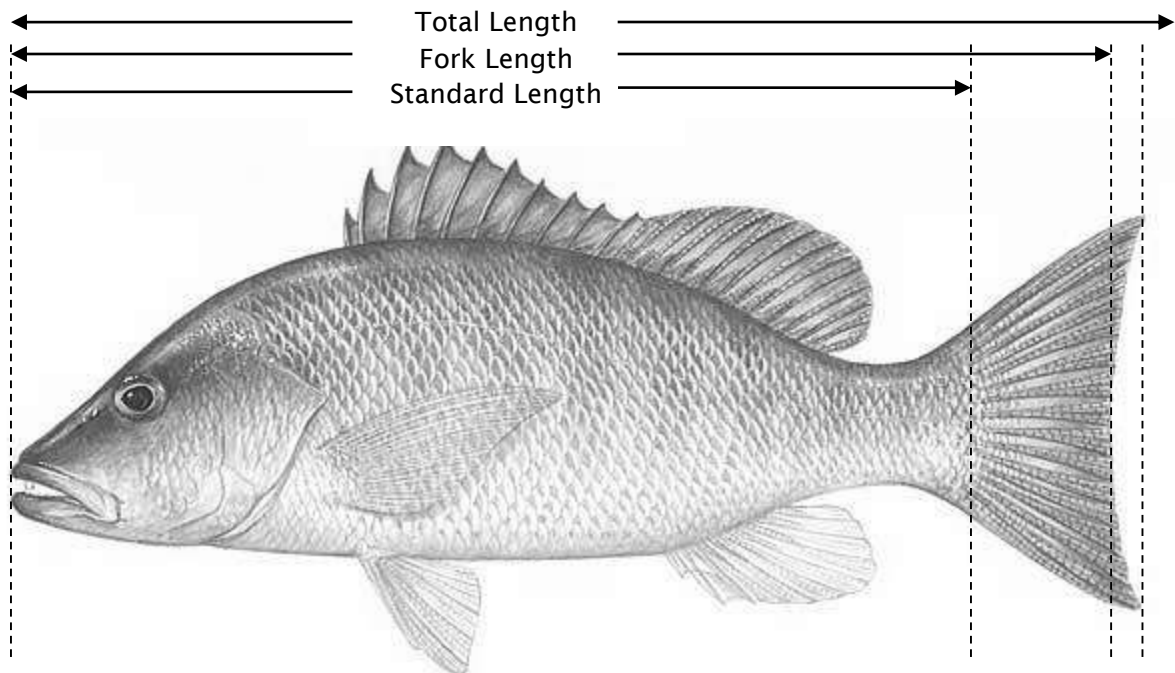


Figure 8: Total length is recommended for length / frequency sampling

5. Length-weight conversions are used to calculate the estimated weight per species (Table 13). Fish weight is calculated using the power function: $W = aL^b$, where W is the weight (grams), L is the length (cm), and a and b are parameters estimated by linear regression of logarithmically transformed length-weight data

Fish Biomass Conversion Functions per Species			
Scientific name	Common name	a	b
<i>Chaetodipterus faber</i> ²	Atlantic Spadefish	0.0314	3.0700
<i>Haemulon sciurus</i> ¹	Bluestriped Grunt	0.0194	2.9996
<i>Caranx hippos</i> ²³	Crevalle Jack	0.0156	2.9400
<i>Caranx latus</i> ²	Horse Eye Jack	0.0156	2.9400
<i>Lutjanus analis</i> ¹	Mutton Snapper	0.0295	2.8146
<i>Lutjanus griseus</i> ¹	Gray Snapper	0.0232	2.8809
<i>Lutjanus synagris</i> ¹	Lane Snapper	0.0295	2.8146
<i>Eugerres plumieri</i> ²	Striped mojarra	0.0071	3.1900
<i>Gerres cinereus</i> ²	Yellowfin Mojarra	0.0142	2.9400
<i>Mugil cephalus</i> ²⁴	Striped Mullet	0.0132	2.8900
<i>Mugil curema</i> ²	White Mullet	0.0132	2.8900
<i>Sphyræna barracuda</i>	Great Barracuda	0.0050	3.0825

¹Marks and Klomp (REEF and AGGRA); ²De la Hoz et al (2009)

³Model is horse eye jack

⁴Model is white mullet

Table 13: Fish Biomass Conversion Functions per Species (J. Chapman / Blue Ventures

6. Data is stored electronically, in an excel sheet, with each trap data stored as a separate sheet, then compiled for analysis (Figures 9 and 10).

Figure 9: Microsoft Excel data entry sheet

	A	B	C	D	F
	Common name	Local name	Genus	Species	Tip of tail
2	Great Barracuda	Barracuda / Picuda	Sphyræna	barracuda	52.4
3	Striped mojarra	Chiwa	Eugerres	plumieri	23.2
4	Striped mojarra	Chiwa	Eugerres	plumieri	23.9
5	Striped mojarra	Chiwa	Eugerres	plumieri	24.2
6	Striped mojarra	Chiwa	Eugerres	plumieri	22.2
7	Striped mojarra	Chiwa	Eugerres	plumieri	22.9
8	Crevalle jack	Jurel	Caranx	hippos	65.1
9	Atlantic spadefish	La Vleja	Chaetodipterus	faber	18.3
10	Grey snapper	Pargo	Lutjanus	griseus	28.1
11	Grey snapper	Pargo	Lutjanus	griseus	30
12	Grey snapper	Pargo	Lutjanus	griseus	30.1
13	Grey snapper	Pargo	Lutjanus	griseus	31.2
14	Grey snapper	Pargo	Lutjanus	griseus	31.9
15	Grey snapper	Pargo	Lutjanus	griseus	29.7
16	Grey snapper	Pargo	Lutjanus	griseus	27.8

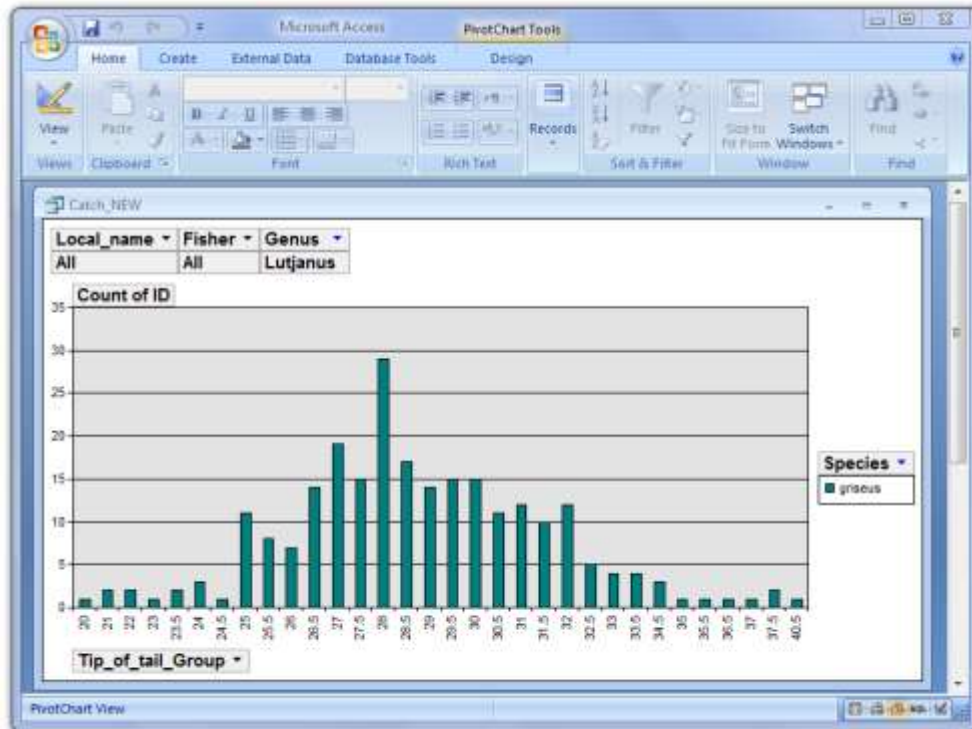


Figure 10: Analysis using Microsoft Access

4.1.2 Data on Fishing Effort

Data on fishing effort - **the number of days each fisherman is fishing during each month** – is derived from interviews and meetings with the fishermen and provided an estimation of fishing effort over the fish trap season for the beach trap fishery and the probability that any one beach trap fisherman will be emptying his trap on any one day.

- the beach trap fishery only operates during the trap season – all traps are installed at, or after, the start of the trap season, and dismantled before or at the end
- the trap season runs from April 15th to November 15th (31 weeks / 155 days)
- not all traps open and close at the same time, primarily depending on the seasonality of north winds (a strong north wind can cause significant damage to trap infrastructure if the trap is still in place at the start of the north front season)
- of the 15 beach trap locations, an estimated 10 traps were operational at any one time during trap season
- for each trap, fishermen extracted fish on average of 5 days per week. The traps were generally checked every morning of the week, exceptions being in very bad weather, very low catch conditions, or in cases of illness, when a day may be skipped.

4.2 Outputs

Six of the 9 beach trap fishermen participated in the survey, covering a total of 9 of the 15 traps (65%) between June and November, with sampling of catch at point of extraction by the sampling team (SACD, Wildtracks and Blue Ventures). 32 catch samples were conducted (Table 14), with each trap being sampled between 1 and 9 times during the trapping season. Unfortunately external conditions resulted in sampling gaps occurring in April and May, and again in September and October, when sampling was not feasible.

Month	Number of surveys conducted
April	-
May	-
June	2
July	10
August	4
September	-
October	-
November	16
Total	32

Table 14: Temporal spread of surveys

All catches were mixed, with 1,343 individual fish over a range of 15 commercial species. The most abundant species was the striped mojarra ('chiwa' – *Eugerres plumieri*), with a total of 549 individuals sampled (representing 40.9% of the total catch), followed by the grey snapper ('pargo' – *Lutjanus griseus*) with 248 (18.5%), the yellowfin mojarra ('mojarra' – *Gerres cinereus*) with 200 individuals (14.9%), and great barracuda ('picuda' – *Symphaena* with 177 (13.2%) (Figure 11). The remaining species were represented by less than 100 individuals each. Blue swimming crabs (*Callinectes sapidus*) are also frequently caught in the traps and sold commercially.

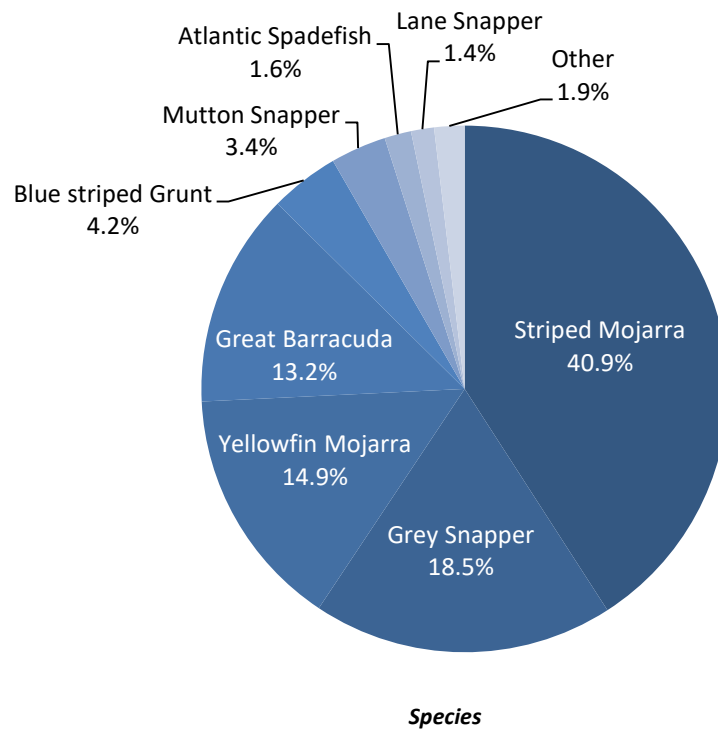


Figure 11: Percentage catch per species (SACD beach trap data, 2011)

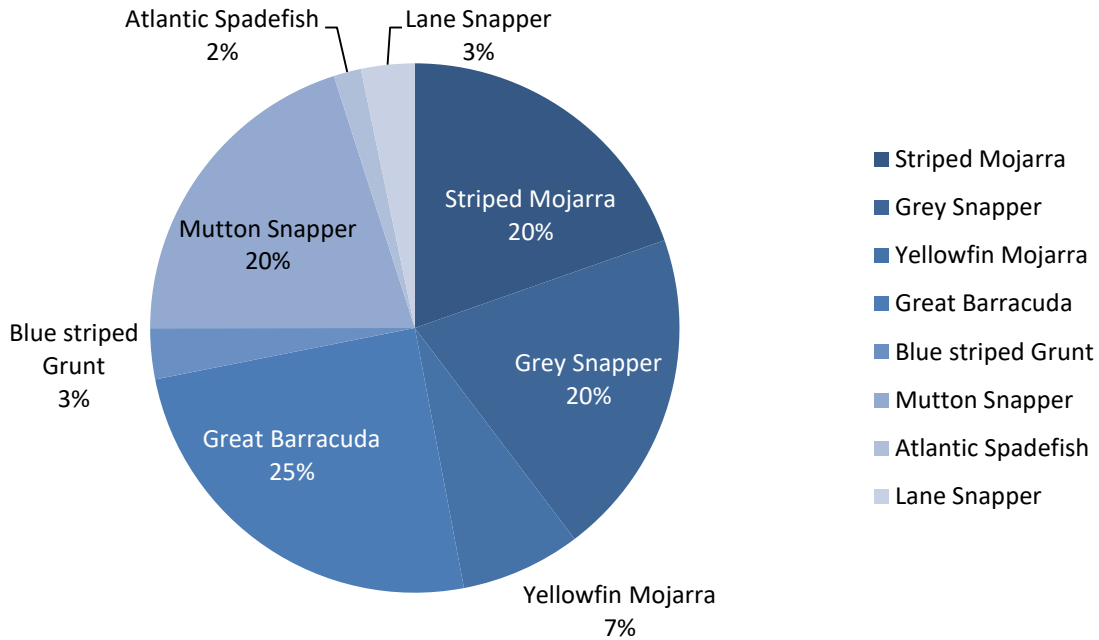


Figure 12: Percentage catch biomass per species (SACD beach trap data, 2011)

The by-catch consisted of ten species. Three of these are sport fish species (permit, bonefish and palometa), two are stingrays (southern stingray and longnose stingray), and the lookdown, catfish, chequered puffer, burrfish, redfin needlefish and yellow tail jack, as well as undersized commercial fish - all by-catch was returned live to the water, where possible. There were incidental mortalities caused by a small number of fish being caught in the chicken wire wall of the trap (generally barracuda), or becoming prey to brown pelicans or magnificent frigatebirds as they were being thrown back into the water.



The lookdown (Selene vomer), part of the beach trap by-catch, though occasionally taken for home use

Species		Total Number	Total Biomass (g)	% of catch mature (L ₅₀)	Mean Length	Mode Length
Striped Mojarra	<i>Eugerres plumieri</i>	549	93,530.0	88.5%	23.3	23.0
Yellowfin Mojarra	<i>Gerres cinereus</i>	200	35,037.7	99.0%	24.1	22.5
Grey Snapper	<i>Lutjanus griseus</i>	248	95,686.1	88.7%	28.9	27.6
Mutton Snapper	<i>Lutjanus analis</i>	46	15,600.2	0.0%	26.9	28.0
Lane Snapper	<i>Lutjanus synagris</i>	19	8,662.0	94.7%	30.2	31.4
Great Barracuda	<i>Sphyaena barracuda</i>	177	118,545.8	2.26%	45.2	43.0
Blue-striped Grunt	<i>Haemulon sciurus</i>	57	14,8772.6	100.0%	23.6	23.0
Atlantic Spadefish	<i>Chaetodipterus faber</i>	22	7,973.6	-	20.7	20.0
Striped Mullet	<i>Mugil cephalus</i>	7	2,682.9	42.9%	34.7	33.0
White Mullet	<i>Mugil curema</i>	7	1,713.5	100.0%	29.5	25.0
Crevalle Jack	<i>Caranx hippos</i>	4	8,006.3	0.0%	53.8	51.0
Horse Eye Jack	<i>Caranx latus</i>	3	740.0	100.0%	26.4	23.0

4.2.1 Catch per Species

Percentage catch per species can be estimated from the total catch, as can species length frequency and seasonality of catch. Mojarra (striped mojarra (*Eugerres plumieri*) and yellowfin mojarra (*Gerres cinereus*)) and snapper (grey snapper (*Luthanus griseus*)) made up the majority of the catch, with catch analysis being focused primarily on species of these families.



Mixed mojarra catch

Striped Mojarra ('Chiwa' - *Eugerres plumieri*)

The locally preferred striped mojarra or 'chiwa' (*Eugerres plumieri*) is also the most frequently caught species, with 549 individuals, representing 40.9% of the sampled catch. Striped mojarra catch ranged from 15cm to 32.2cm in length, with a mean total length of 23.3cm and mode of 22cm (Figure 12). The total sampled catch is estimated at 93.6kg for 32 trap events, 23.7% of the total catch biomass, and an average of 2.9kg per trap. All fish under 15.0cm are returned live to the water at point of capture, during the catch sorting process, as part of the traditional fishing practice.



Striped Mojarra (*Eugerres plumier*)

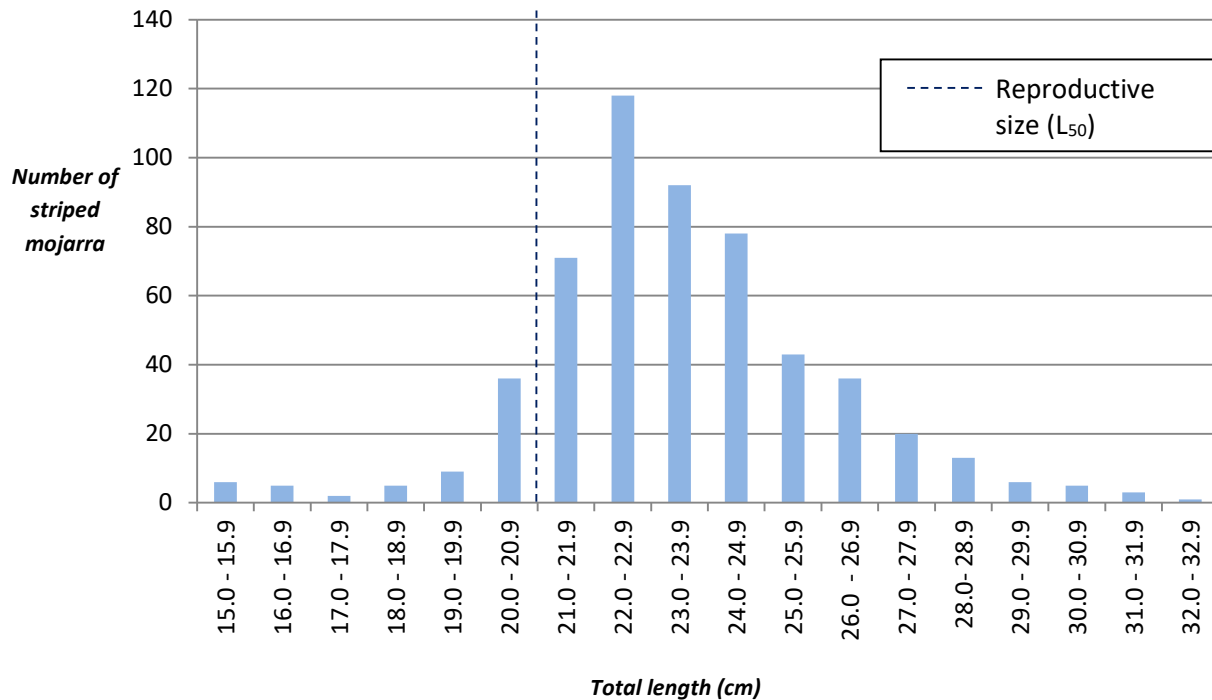


Figure 12: Size range of striped mojarra (*Eugerres plumieri*) sampled from beach traps, total catch data, 2011

This species matures at a total length of between 18.0 cm and 22.0 cm (7.0 to 8.5 inches). Based therefore on an estimated average maturity at 20.0cm total length, the majority of individuals in the catch (88.5%) are reported to be in the range where at least 50% of the population is thought to be sexually mature (L_{50}).

Striped mojarra are present throughout the beach trap season (Figure 13), but has a very seasonal abundance, peaking in July, with 47.9% of the sampled catch being caught in one trap event (Trap 3) on 8/7/2011. July brings the first major rains of the wet season, reducing the salinity of the estuarine system.

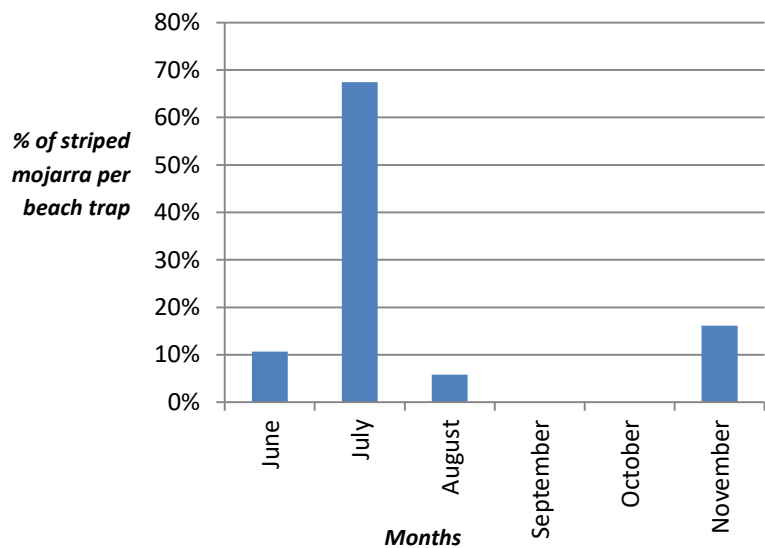


Figure 13: Striped mojarra ('chiwa' – *Eugerres plumieri*) - Seasonality of catch. (n=56.2)

NB: No data for September or October

Yellowfin Mojarra ('mojarra' – *Gerres cinereus*)

The yellowfin mojarra (*Gerres cinereus*), the second preference as a food fish in Sarteneja,² represents 14.9% of the total sampled catch. Yellowfin mojarra ranged from 19.0cm to 44.9cm in total length, with a mean size of 24.1cm and mode of 22.0cm (Figure 14). The total sampled catch is estimated at 35.0kg for 32 trap events, an average of 1.1kg per trap. All fish under 19.0cm are returned live to the Bay as by-catch, as part of the traditional fishing practices. Total length at maturity is estimated at between 17.0 cm and 20.0 cm³ (approximately 7.0 to 8.0 inches). Based on an averaged length at maturity of 19.0cm, 99.0% of individuals in the catch are reported to be in the range where at least 50% of the population is thought to be sexually mature (L_{50}).



Yellowfin mojarra (*Gerres cinereus*)

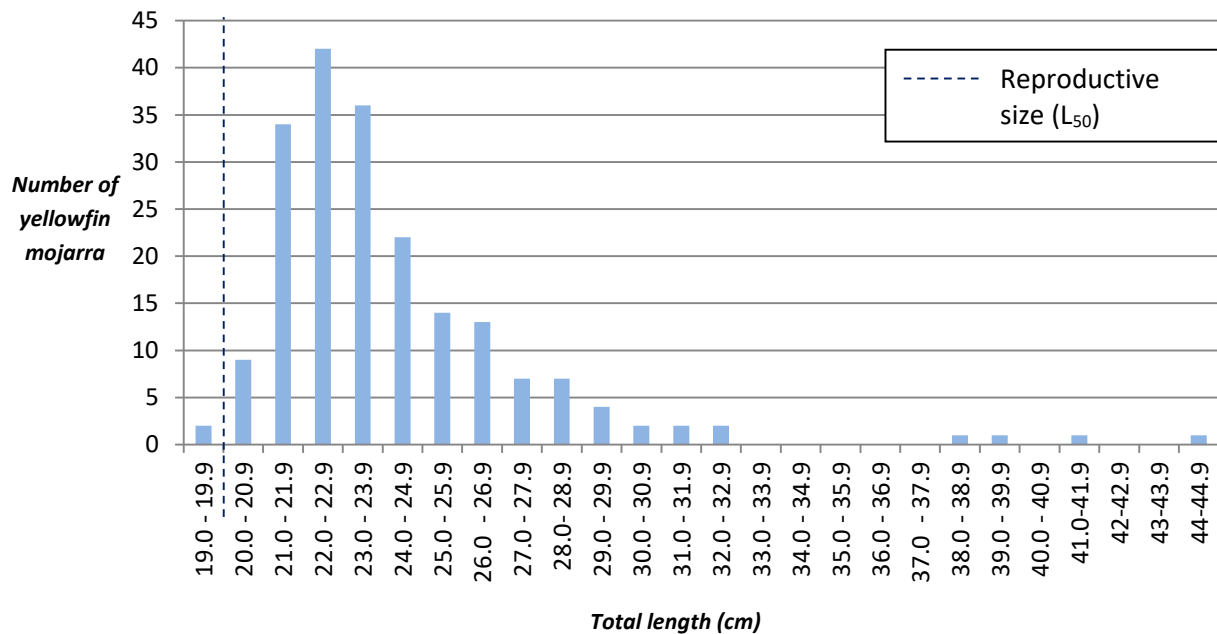


Figure 14: Size range of yellowfin mojarra (*Gerres cinereus*) sampled from beach traps, total CBWS catch data, 2011.

² SACD socio economic survey data, 2008

³ Fishbase

The yellowfin mojarra, like the striped mojarra is present throughout the beach trap season (Figure 15), but is very seasonal in abundance, peaking in July with the advent of the first major rains of the wet season.

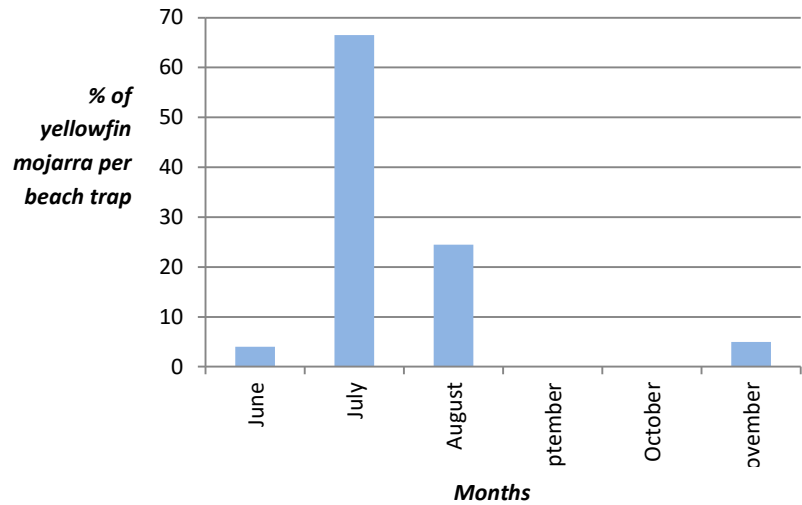


Figure 15: Yellowfin mojarra - Seasonality of catch
NB: No data for April, September or October (n=200)

Grey Snapper ('Pargo' – *Lutjanus griseus*)

Three species of snapper were represented within the catch, with the majority (248 individuals, - 79.0% of the snapper catch) being grey snapper (*Lutjanus griseus*). 15.0% of the snapper catch was mutton snapper (*Lutjanus synagris*), with the remaining 6.0% being lane snapper (*Lutjanus analis*) (Figure 16). Lane and mutton snapper were not caught in the same catches – mutton snapper were the most seasonal, all individuals being caught in November, whilst lane snapper occurred in catches from June to August.

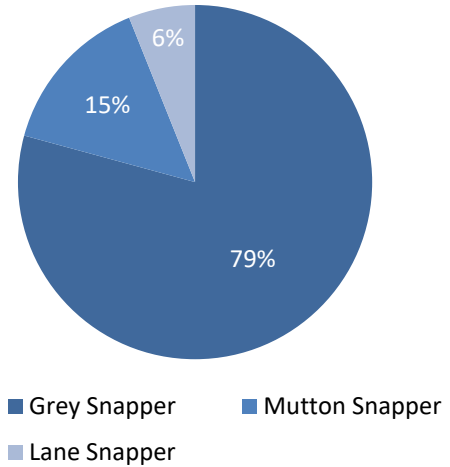


Figure 16: Relative abundance of snapper species in catch samples (n=248)

The Grey snapper catch ranged from 20.0cm to 40.3cm in total length, with a mean size of 29.0cm and mode of 28.0cm (Figure 17). The total sampled catch is estimated at 95.7kg for 32 trap events, an average of 3.0kg per trap. This species matures at a size of 18.0 – 33.0 cm (7.0 – 13.0 inches; Allen, 1985). Based on a length at maturity of 25.0cm, the majority of individuals in the catch (88.7%) are reported to be in the range where at least 50% of the population is thought to be sexually mature (L₅₀).

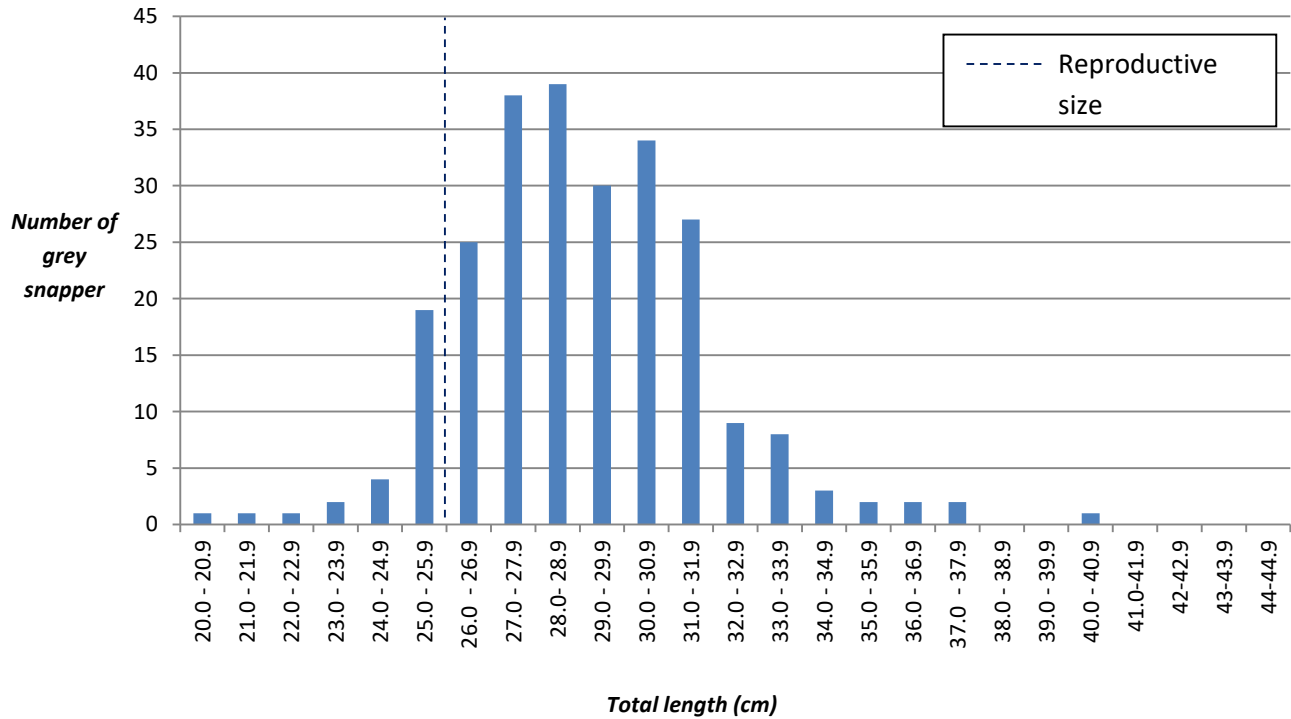


Figure 17: Size range of grey snapper (*Lutjanus griseus*) sampled from beach traps, total CBWS catch data, 2011

Whilst present throughout the beach trap season, grey snapper are more abundant in the catch towards the start of the season, with the average number of fish caught per trap event gradually reducing through the year (Figure 18).

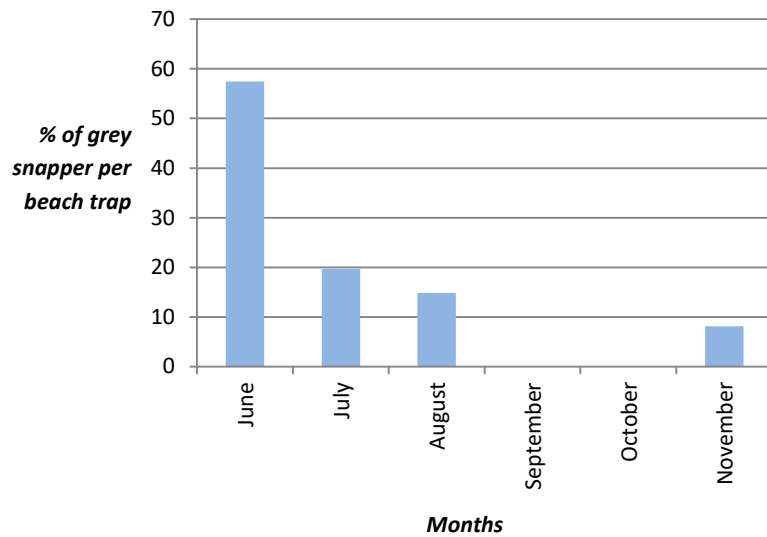


Figure 18: Grey snapper (*Lutjanus griseus*) – seasonality of catch

4.3 Estimate of Catch

The data from catch samples and fishing effort can be used to develop a picture of the overall small-scale fishery. The total catch for the beach trap fishery can be defined as:

“all species harvested from Corozal Bay Wildlife Sanctuary by the beach traps over a given time period, by the beach trap fishermen”

...and can be estimated from ‘catch per unit effort’ data – the number/weight of all targeted fish caught by one beach trap sample (the ‘unit effort’) multiplied by the estimated effort (number of days of trap activity over the beach trap fishery).

- Assuming 10 operational traps for the weeks between April 15th and November 15th, and an average of 5 trap days per week (31 weeks / 155 days)
- 32 trap events sampled for 2011, from 9 traps (Table 15)
- the total catch biomass from 32 trap events is estimated at 404.0kg (891 lbs)
- this gives an average catch per unit effort for a beach trap of 12.6kg (27.8 lbs)
- the total estimated average catch for the beach trap fishery over one day is therefore estimated at 126 kg (278 lbs), based on an estimated 10 operational traps on any one day during the trap season
- the total estimated catch for the beach trap over the year (155 days (31 weeks x 5 days)) is therefore 19,530 kg (43,056 lbs)
- this gives an estimated annual average catch biomass of 1,956 kg (4,316 lbs) per trap, based on 10 operational traps

Trap Number	Number of times sampled
Trap 1	1
Trap 2	1
Trap 3	9
Trap 4	1
Trap 5	1
Trap 6	9
Trap 7	2
Trap 8	2
Trap 9	6
Total	32

Table 15: Trap Samples

4.3.1 Breakdown per species

Striped Mojarra

- using the conversion parameters $a = 0.0071$ and $b = 3.1900$, the total biomass of striped mojarra sampled over the 32 trap events was estimated at 93.5 kg (206 lbs)
- based on this, the average catch for striped mojarra per beach trap event was estimated at 2.92 kg (6.4 lb)
- the average annual catch per beach trap would therefore be approximately 450 kg (998 lb) based on the trap being operational an average of 5 trap days per week between the weeks of April 15th and November 15th (31 weeks / 155 days)

- this gives an annual total catch for the beach trap fishery for striped mojarra estimated at 4,530 kg (9,967 lb), based on an average of 10 operational traps for the weeks between April 15th and November 15th, and an average of 5 trap days per week (31 weeks / 155 days)

Yellowfin Mojarra

- using the conversion parameters $a = 0.0142$ and $b = 2.9400$, the total biomass of yellowfin mojarra sampled over the 32 trap events was estimated at 35 kg (77 lbs)
- based on this, the average catch for striped mojarra per beach trap event was estimated at 1.1 kg (2.4 lb)
- the average annual catch per beach trap would therefore be 170 kg (373 lb) based on the trap being operational an average of 5 trap days per week between the weeks of April 15th and November 15th (31 weeks / 155 days)
- this gives an annual total catch for the beach trap fishery for yellowfin mojarra estimated at 1,700 kg (3,733 lb), based on an average of 10 operational traps for the weeks between April 15th and November 15th, and an average of 5 trap days per week (31 weeks / 155 days)

Grey Snapper

- using the conversion parameters $a = 0.0232$ and $b = 2.8809$, the total biomass of grey snapper sampled over the 32 trap events was estimated at 95.7 kg (210 lbs)
- based on this, the average catch for grey snapper per beach trap event was estimated at 3 kg (6.6 lb)
- the average annual catch per beach trap would therefore be 463 kg (1,021 lb) based on the trap being operational an average of 5 trap days per week between the weeks of April 15th and November 15th (31 weeks / 155 days)
- this gives an annual total catch for the beach trap fishery for grey snapper estimated at 4,634 kg (10,216 lb), based on an average of 10 operational traps for the weeks between April 15th and November 15th, and an average of 5 trap days per week (31 weeks / 155 days)

4.4 Catch Value

Fish are marketed either whole in Sarteneja (often at point of landing) or as fillet in the nearest towns - Orange Walk or Corozal. In either case, fish are sold directly to the consumers. Fish are generally sold in Sarteneja unless there is a seasonal abundance, as occurs with both the mojarra and snapper, making it financially cost effective to travel to town to sell the catch. The local sale price ranges from \$2.00 to \$3.00 per lb, dependent on species (Table 16), whilst the value in Orange Walk / Corozal is Bz\$3.50 minimum, 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 outside of Sarteneja to increase catch value.

Retail Value of Direct Sale of Commercial Species		
Species	Value per pound (Bz\$)	
	Local	Orange Walk / Corozal
Mojarra	\$2.00	\$3.50
Snapper	\$3.00	\$4.50*
Barracuda	\$2.00	-

Table 16: Retail Value of Direct Sale of Primary Commercial Species (Consultations with beach trap fishermen, 2011)

***\$5 for fillet**

Species	Lbs (total sample)	Value per lb (Bz\$)	Value Bz\$ (total sample)	Average annual fishery value (Bz\$)	Potential gross income per month per trap (Bz\$)
<i>Total catch (all species)</i>	891	\$2.00	1,782.00	86,315.63	1,233.00
Striped Mojarra	206	\$2.00	412.00	19,956.25	285.10
Yellowfin Mojarra	77.1	\$2.00	154.00	7,459.38	106.56
Grey Snapper	210	\$3.00	630.00	30,515.63	435.94
Out-sale: Orange Walk / Corozal					
<i>Total catch (all species)</i>	891	\$3.00	2,673.00	129,473.44	1,850.00
Striped Mojarra	206	\$3.50	721.00	34,923.44	498.91
Yellowfin Mojarra	77	\$3.50	269.50	13,053.91	186.50
Grey Snapper	210	\$4.50	945.00	45,773.44	654.00

Table 17: Extrapolated Value of catch (based on 10 traps being operational)

The annual value of the fishery was conservatively estimated at Bz\$86,300 through extrapolation, with a potential gross income per month per trap of Bz\$1,230, based on 10 of the 15 traps being operational.

IMPORTANT NOTE: Whilst these figures provide an indication of the fishery they are based on only limited data, and on a number of very broad assumptions. It should be recognized that the small sample size and the problems encountered in sampling in September and October does not capture some of the seasonality of the fish catch, nor has the spatial variation of catch associated with the location of the each trap been investigated, so should be considered only a first estimate until knowledge gaps can be filled during the full stock assessment to be conducted under the sustainable fishery planning.

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
- A 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).

Sarteneja, as the primary community utilizing the fish resources of 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 community management organizations. 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 snapshot of fisheries information has been collated based on catch effort, boat activity 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 has taken the first steps towards formalizing a partnership with the local fishermen towards community management of the fisheries resources, and is facilitating the formation of a management committee for the fishery.

This document provides guidance for SACD to engage fishermen in the development of a Sustainable Fishery Plan for the small-scale local fishery of Corozal Bay Wildlife Sanctuary, with full ownership and implementation by SACD and the fishermen who use those resources.

Step 1: Develop a Management Committee

- A management committee should be established, chaired by SACD, and consisting of representatives from each of the fishing sectors of Corozal Bay Wildlife Sanctuary, and with representation from fishermen of each of the other stakeholder communities
- The committee should meet once every quarter to discuss management issues, and additional 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

- High priority areas requiring zoning for protection should be identified and integrated into SACD management activities
- High priority areas and times for surveillance and enforcement activities against fishing incursions should be identified by the management group and implemented by SACD, with the encouragement of local participation in enforcement activities
- During the quarterly meetings, the management group should also discuss mechanisms to reduce waste – for example, collaborating with the pig-rearing project to provide food supplement from the fish waste
- The management group should also investigate mechanisms for reducing by-catch through adaptation of fishing gear, fishing times or management of catch
- At the end of the first year, the regulations should be reviewed and amended by the management group where necessary, and presented within a Sustainable Fishery Plan

Step 2: Beyond a Snapshot

- Whilst this assessment has provided the initial data required to give 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: Development of a Sustainable Fishery Plan for Corozal Bay Wildlife Sanctuary

- A fully participatory process for the development of the Sustainable Fishery Plan should be implemented, with input from all fishing sectors using CBWS, and open communication during the planning process

- The results of data collection need to be incorporated into a Sustainable Fishery Plan for Corozal Bay Wildlife Sanctuary, with finalized zones and regulations, and produced in full collaboration with the management group, the Village Council and technical advisors
- The Sustainable Fishery Plan should be presented to the Forest and Fishery Departments for approval
- Funding should be located through SACD to implement the first two years of the Sustainable Fishery Plan
- A review mechanism should be integrated into the Sustainable Fishery Plan 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 Developing a Sustainable Fishery Plan

The following table provides a two-year implementation plan for the development of a 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 18).

Table 18: 2-Year Plan for Development of a Sustainable Fishery

Management Actions		Current Status	Desired Status	Year	Responsible Parties	Limitations/Requirements
1	Establish a community management committee for the fishery resources of the Wildlife Sanctuary	SACD working towards engagement of fishermen	An active management committee is established for management of CBWS fish resources, meeting at least once a quarter, as per guidelines presented in this document	1 st	SACD	Needs to include SACD and representation from different sector fishermen from all communities. Village councils? Technical input to be sought from Forest and Fisheries Dept.
2	Resolve traditional resource use issue	Local fishermen are extracting fish from CBWS in contravention to the current Forest Department legislation	Recognition by Forest Dept / Fisheries Dept and GoB of traditional use for local community members, with training towards greater sustainable use	1 st	SACD	Through discussion with Forest and Fisheries Depts., and initiation of a permitting process for identified traditional fishers
3	Integrate local fishermen of other stakeholder communities into the planning process	Fishermen of other communities have been identified and consulted, but have not yet been integrated into planning for a sustainable fishery	Fishermen of other communities have been integrated into planning for a sustainable fishery and are represented on the management committee	1 st – 2 nd	SACD	
4	Develop permitting system for local fishermen	No formal recognition or permitting of local fishermen is in place	Local fishermen carry a permit for fishing within CBWS	1 st	SACD Local fishermen	
5	Develop registration system for nets and traps	No system is in place for registration of nets. Traps have been identified and mapped	A system is in place for registration of fishing equipment owned by fishermen of CBWS and allowed to be used in the mpa	1 st	SACD Local fishermen	
6	Develop a baseline and guidelines for sustainable traditional fishing within Corozal Bay Wildlife Sanctuary	Only preliminary baseline or guidelines exist, and are not based on scientific information	Baseline and guidelines for sustainable fishing have been developed based on sound scientific research	1 st -2 nd	SACD 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. A fishing impact monitoring programme with output of findings presented in annual report	1 st – 2 nd	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	1 st	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	Whilst discussion has started, very few fishermen are fully engaged in the protection of CBWS	Traditional fishermen actively protect their resources and assist SACD with surveillance activities	1 st -2 nd	SACD Local fishermen	Traditional fishermen need to take ownership of their resources, and contribute towards management – engagement through participatory focal workshops towards development of a Sustainable Fisheries plan
10	Liaise with Forest and Fisheries Dept. for assistance with enforcement activities	Training of rangers as Fisheries Officers, but no mechanism set up for assistance from Hol Chan or Bacalar Chico if needed	SACD in constant communication with Forest and Belize Fisheries Departments	1 st – 2 nd	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	No zoning currently in place	Zoning (spatial / temporal) of CBWS for protection of nursery areas and spawning grounds	2 nd	SACD Fisheries Dept. Local fishermen	Critical nursery areas and spawning grounds need to be identified
12	Conduct four full seasons of catch monitoring for the beach trap fishery	A partial survey of the beach trap fishery of 2011 has been completed	Four full seasons of catch monitoring for the beach trap fishery	1 st – 2 nd	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	1 st – 2 nd	SACD Local fishermen	Logistical problems, as catch isn't always landed in Sarteneja
14	Conduct assessment of impact of cast net fishing in Sarteneja	No assessment has been conducted on the impacts of cast net fishing in Sarteneja	Information is available on the impacts of cast net fishing in front of Sarteneja	1 st – 2 nd	SACD Local fishermen	
15	Conduct assessment of importance of subsistence fishing in Sarteneja	No assessment has been conducted on the importance of subsistence fishing in Sarteneja	Information ensures that mechanisms are in place to ensure families dependent on subsistence resource extraction are not affected by CBWS regulations	1 st – 2 nd	SACD Local fishermen	
16	Develop a Sustainable Fishery Plan	SACD has conducted a rapid assessment – a first snapshot of the beach trap fishery	An effective Sustainable Fishery Plan has been developed based on good scientific information and with full participation from the fishermen	1 st – 2 nd	SACD Local fishermen	Needs to be approved by the Forest and Fisheries Departments
17	Implementation of mechanisms identified under the Sustainable Fishery Plan	The Sustainable Fishery Plan is still to be developed	SACD and the local fishermen are implementing an effective Sustainable Fishery Plan	2 nd	SACD Local fishermen	Needs to be approved by the Forest and Fisheries Departments
18	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	2 nd	SACD Local fishermen	Potential markets on San Pedro, investigation of value added products, investigation of benefits of cooperative marketing
19	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	2 nd	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	1 st	SACD	
21	Engagement of the women involved in the local fishery	There is no information on the role of women in the fishery	Women understand the need for the Sustainable Fishery Plan, are fully supportive and play a role in its implementation	2 nd	SACD	
22	Implementation of mechanisms identified under the Sustainable Fishery Plan	There is no current effort to engage the women of the local fishing families	Women are engaged and participators	2 nd	SACD Local fishermen	
23	Identification and implementation of income diversification mechanisms linked to reduced fishing pressure	Fishermen are too dependent on the state of the fish resources and need to diversify their income base if they are going to reduce their fishing impact	Fishermen are willing to integrate sustainable fishing practices into their fishing as their income base has diversified	1 st - 2 nd	SACD Local fishermen	
24	Monitor climate conditions affecting fish stocks	No weather data is being collected	SACD has a weather station and is collecting weather data to identify trigger points for fish movements	1 st - 2 nd	SACD	SACD needs a weather station
25	Monitor water parameters affecting fish stocks	Characterisation of the water parameters of CBWS has started (2012) and is ongoing	SACD has information on annual water parameter changes, and has identified trigger points for fish movements	1 st - 2 nd	SACD	Collaboration with ECOSUR for modeling the changes in CBWS and the larger estuarine system





Development of a Sustainable Fisheries: Timeline									
Management Actions		1 st Year				2 nd Year			
		1	2	3	4	1	2	3	4
15	Conduct assessment of importance of subsistence fishing in Sarteneja								
16	Develop a 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								

5.3 Measuring Success

It is important to ensure that not only is the implementation monitored, but also the outputs. This can be through a simple review matrix that tracks implementation performance (Table 20), combined with indicators (Table 21).

A review mechanism, with measurable indicators, should also be integrated into the Sustainable Fishery Plan to measure success of the Plan on an annual basis for an initial period of five years.

Table 20: Development of a Sustainable Fisheries: Tracking Implementation											
Management Actions		Current Status	1 st Year				2 nd Year				Desired Status
			1	2	3	4	1	2	3	4	
1	Establish a community management committee for the fishery resources of the Wildlife Sanctuary	SACD working towards engagement of fishermen									An active management committee is established for management of CBWS fish resources, meeting at least once a quarter, as per guidelines presented in this document
2	Resolve traditional resource use issue	Local fishermen are extracting fish from CBWS in contravention to the current Forest Department legislation									Recognition by Forest Dept / Fisheries Dept and GoB of traditional use for local community members, with training towards greater sustainable use
3	Integrate local fishermen of other stakeholder communities into the planning process	Fishermen of other communities have been identified and consulted, but have not yet been integrated into planning for a sustainable fishery									Fishermen of other communities have been integrated into planning for a sustainable fishery and are represented on the management committee
4	Develop permitting system for local fishermen	No formal recognition or permitting of local fishermen is in place									Local fishermen carry a permit for fishing within CBWS
5	Develop registration system for nets and traps	No system is in place for registration of nets. Traps have been identified and mapped									A system is in place for registration of fishing equipment owned by fishermen of CBWS and allowed to be used in the mpa

 Not started	 Behind Schedule	 On schedule	 Completed
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Development of a Sustainable Fisheries: Tracking Implementation												
Management Actions		Current Status	1 st Year				2 nd Year				Desired Status	
			1	2	1	2	1	2	1	2		
6	Develop a baseline and guidelines for sustainable traditional fishing within Corozal Bay Wildlife Sanctuary	Only preliminary baseline or guidelines exist, and are not based on scientific information										Baseline and guidelines for sustainable fishing have been developed based on sound scientific research
7	Monitor fishing activity	At present there is no formalized monitoring of level of fishing activity										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										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	Whilst discussion has started, very few fishermen are fully engaged in the protection of CBWS										Traditional fishermen need to take ownership of their resources, and contribute towards management – engagement through participatory focal workshops towards development of a Sustainable Fisheries plan
10	Liaise with Forest and Fisheries Dept. for assistance with enforcement activities	Training of rangers as Fisheries Officers, but no mechanism set up for assistance from Hol Chan or Bacalar Chico if needed										Support from the Forest and Fisheries Depts. will assist community acceptance and recognition of need for enforcement

Development of a Sustainable Fisheries: Tracking Implementation											
Management Actions		Current Status	1 st Year				2 nd Year				Desired Status
			1	2	1	2	1	2	1	2	
11	Demarcate nursery areas and spawning grounds for zoning and protection	No zoning currently in place									Critical nursery areas and spawning grounds need to be identified
12	Conduct two full seasons of catch monitoring for the beach trap fishery	A partial survey of the beach trap fishery of 2011 has been completed									Funding delays prevented the start of trap monitoring until June, and other issues prevented monitoring in Sept. / Oct.
13	Conduct assessment of gill net fishery	Conduct assessment of gill net fishery									A baseline assessment has been completed on the gill net fishery
14	Conduct assessment of impact of cast net fishing in Sarteneja	Conduct assessment of impact of cast net fishing in Sarteneja									Information is available on the impacts of cast net fishing in front of Sarteneja
15	Conduct assessment of importance of subsistence fishing in Sarteneja	Conduct assessment of importance of subsistence fishing in Sarteneja									Information ensures that mechanisms are in place to ensure families dependent on subsistence resource extraction are not affected by CBWS regulations
16	Develop a Sustainable Fishery Plan	Develop a Sustainable Fishery Plan									An effective Sustainable Fishery Plan has been developed based on good scientific information and with full participation from the fishermen
17	Implementation of mechanisms identified under the Sustainable Fishery Plan	Implementation of mechanisms identified under the Sustainable Fishery Plan									SACD and the local fishermen are implementing an effective Sustainable Fishery Plan

Development of a Sustainable Fisheries: Tracking Implementation											
Management Actions		Current Status	1 st Year				2 nd Year				Desired Status
			1	2	3	4	1	2	3	4	
18	Conduct a Market Survey to inform a Marketing Plan for identifying mechanisms for increased value for fish product	Conduct a Market Survey to inform a Marketing Plan for identifying mechanisms for increased value for fish product									A full market survey has been conducted with the fishermen, with data feeding into the development of a marketing plan
19	Develop a Marketing Plan, integrating information from the market survey	Develop a Marketing Plan, integrating information from the market survey									Fishermen are able to increase their income through better marketing
20	Implement mechanisms identified under the Marketing Plan	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
21	Characterize the role of women in the fishery	There is no information on the role of women in the fishery									Women understand the need for sustainable fishing and are fully supportive and play a role in its implementation
22	Engagement of the women involved in the local fishery	There is no current effort to engage the women of the local fishing families									Women are engaged and participatory
23	Identification and implementation of income diversification mechanisms linked to reduced fishing pressure	Fishermen are too dependent on the state of the fish resources and need to diversify their income base									Fishermen are willing to integrate sustainable fishing practices into their fishing as their income base has diversified
24	Monitor climate conditions affecting fish stocks	No weather data is being collected									SACD has a weather station and is collecting weather data to identify trigger points for fish movements
25	Monitor water parameters affecting fish stocks	Characterization of the water parameters of CBWS has started (2012) and is ongoing									SACD has information on a water parameter changes, and has identified trigger points for fish movements

Table 21: Development of a Sustainable Fisheries: Indicators

Management Actions		Current Status	Desired Status	Indicators
1	Establish a community management committee for the fishery resources of the Wildlife Sanctuary	SACD working towards engagement of fishermen	An active management committee is established for management of CBWS fish resources, meeting at least once a quarter, as per guidelines presented in this document	<ul style="list-style-type: none"> ▪ Management committee with established structure (Chairman, Secretary etc.) ▪ Minutes from quarterly meetings
2	Resolve traditional resource use issue	Local fishermen are extracting fish from CBWS in contravention to the current Forest Department legislation	Recognition by Forest Dept / Fisheries Dept and GoB of traditional use for local community members, with training towards greater sustainable use	<ul style="list-style-type: none"> ▪ Letter of Agreement between SACD and Ministry of Forestry, Fisheries and Sustainable Development recognizing traditional use of CBWS by local fishermen ▪ At least 2 training activities building capacity in local fishermen towards greater sustainability of the fishery
3	Integrate local fishermen of other stakeholder communities into the planning process	Fishermen of other communities have been identified and consulted, but have not yet been integrated into planning for a sustainable fishery	Fishermen of other communities have been integrated into planning for a sustainable fishery and are represented on the management committee	<ul style="list-style-type: none"> ▪ At least one local fishermen from each of Copper Bank, Chunox, Corozal, Consejo and San Pedro sit on the management committee
4	Develop permitting system for local fishermen	No formal recognition or permitting of local fishermen is in place	Local fishermen carry a permit for fishing within CBWS	<ul style="list-style-type: none"> ▪ List of recognized local fishermen ▪ A permit / ID is developed, with input from Forest and Fisheries Department for fishermen recognized as CBWS traditional fishermen ▪ All local fishermen have a permit
5	Develop registration system for nets and traps	No system is in place for registration of nets. Traps have been identified and mapped	A system is place for registration of fishing equipment owned by fishermen of CBWS and allowed to be used in the mpa	<ul style="list-style-type: none"> ▪ List of recognized local fishermen and gear ▪ Gear registration mechanism has been developed ▪ All local fishermen have registered their nets and traps

Development of a Sustainable Fisheries: Indicators				
Management Actions		Current Status	Desired Status	Indicators
6	Develop a baseline for sustainable traditional fishing within CBWS	Only a preliminary baseline exist, with limited scientific information	A baseline for sustainable fishing has been developed based on scientific research	<ul style="list-style-type: none"> ▪ Data from 2012 trap season (May – November) ▪ Baseline report
7	Monitor fishing activity	At present there is no formalized monitoring of level of fishing activity	Establishment of protocol – will be needed for formal recognition of traditional fishing rights	<ul style="list-style-type: none"> ▪ Patrol reports include boat sightings, number of crew, origin of boat and activity for all patrols ▪ Boat activity summary is prepared for each quarter
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	Broad cooperation with identified local traditional fishermen will assist this process. Assistance from Wildtracks for mapping of fishing activity	<ul style="list-style-type: none"> ▪ Critical fishing areas have been mapped ▪ Timeframe of peak fishing activities have been documented
9	Promote greater participation in surveillance and enforcement by traditional fishermen	Whilst discussion has started, very few fishermen are fully engaged in the protection of CBWS	Traditional fishermen need to take ownership of their resources, and contribute towards management – engagement through participatory focal workshops towards development of a Sustainable Fisheries plan	<ul style="list-style-type: none"> ▪ At least 10 local fishermen have participated in at least 2 focal workshops ▪ At least five reports have been submitted by local fishermen regarding illegal activities within CBWS ▪ At least five reports have been followed up by SACD rangers
10	Liaise with Forest and Fisheries Dept. for assistance with enforcement activities	Training of rangers as Fisheries Officers, but no mechanism set up for assistance from Hol Chan or Bacalar Chico if needed	Support from the Forest and Fisheries Depts. will assist community acceptance and recognition of need for enforcement	<ul style="list-style-type: none"> ▪ An annual meeting with Forest and Fishery personnel to discuss collaboration for enforcement ▪ When enforcement assistance has been requested by SACD, Forest and Fishery Depts. have responded at least 75% of the time
11	Demarcate nursery areas for zoning and protection	No zoning currently in place	Critical nursery areas need to be identified	<ul style="list-style-type: none"> ▪ Data has been collected to identify critical fish nursery areas ▪ Mapping of critical fish nursery areas ▪ Signs marking nursery zones at at least 75% of critical nursery sites

Development of a Sustainable Fisheries: Indicators				
Management Actions		Current Status	Desired Status	Indicators
12	Conduct two full seasons of catch monitoring for the beach trap fishery	A partial survey of the beach trap fishery of 2011 has been completed	Funding delays prevented the start of trap monitoring until June, and other issues prevented monitoring in Sept. / Oct.	<ul style="list-style-type: none"> ▪ A sampling protocol has been written ▪ A full data set exists for two beach trap seasons (April to November) ▪ Data has been analysed and integrated into the Sustainable Fishery Plan ▪ Data is summarized in the Annual Reports
13	Conduct assessment of gill net fishery	Conduct assessment of gill net fishery	A baseline assessment has been completed on the gill net fishery	<ul style="list-style-type: none"> ▪ A sampling protocol has been written ▪ A data set exists for two years ▪ Data has been analysed and integrated into the Sustainable Fishery Plan ▪ Data is summarized in the Annual Reports
14	Conduct assessment of impact of cast net fishing in Sarteneja	Conduct assessment of impact of cast net fishing in Sarteneja	Information is available on the impacts of cast net fishing in front of Sarteneja	<ul style="list-style-type: none"> ▪ A sampling protocol has been written ▪ A data set exists for two years ▪ Data has been analysed and integrated into the Sustainable Fishery Plan ▪ Data is summarized in the Annual Reports
15	Conduct assessment of importance of subsistence fishing in Sarteneja	Conduct assessment of importance of subsistence fishing in Sarteneja	Information ensures that mechanisms are in place to ensure families dependent on subsistence resource extraction are not affected by CBWS regulations	<ul style="list-style-type: none"> ▪ Data has been collected ▪ Report on importance of subsistence fishing to Sarteneja
16	Develop a Sustainable Fishery Plan	Develop a Sustainable Fishery Plan	An effective Sustainable Fishery Plan has been developed based on good scientific information and with full participation from the fishermen	<ul style="list-style-type: none"> ▪ A sustainable fishery plan for the small-scale fishery of Corozal Bay Wildlife Sanctuary ▪ At least four meetings with participation from fishermen during the planning process
17	Implementation of mechanisms identified under the Sustainable Fishery Plan	Implementation of mechanisms identified under the Sustainable Fishery Plan	SACD and the local fishermen are implementing an effective Sustainable Fishery Plan	<ul style="list-style-type: none"> ▪ Agreement on at least 5 mechanisms for implementation during the second year ▪ Implementation of at least 5 mechanisms during the second year

Development of a Sustainable Fisheries: Indicators				
Management Actions		Current Status	Desired Status	Indicators
18	Conduct a Market Survey to inform a Marketing Plan for identifying mechanisms for increased value for fish product	Conduct a Market Survey to inform a Marketing Plan for identifying mechanisms for increased value for fish product	A full market survey has been conducted with the fishermen, with data feeding into the development of a marketing plan	<ul style="list-style-type: none"> ▪ Market survey report ▪ At least 2 mechanism have been identified for increasing value of the fish product ▪ At least 2 mechanism have been integrated into the Marketing Plan
19	Develop a Marketing Plan, integrating information from the market survey	Develop a Marketing Plan, integrating information from the market survey	Fishermen are able to increase their income through better marketing	<ul style="list-style-type: none"> ▪ Marketing Plan
20	Implement mechanisms identified under the Marketing Plan	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	<ul style="list-style-type: none"> ▪ At least 1 mechanism has been / is being implemented
21	Characterize the role of women in the fishery	There is no information on the role of women in the fishery, though 2 women regularly attend meetings	Women understand the need for sustainable fishing and are fully supportive and play a role in its implementation	<ul style="list-style-type: none"> ▪ Report on the role of women in the fishery
22	Engagement of the women involved in the local fishery	There is no current effort to engage the women of the local fishing families, though 2 women regularly attend meetings	Women are engaged and participatory	<ul style="list-style-type: none"> ▪ At least 1 woman is on the management committee ▪ At least 2 women are engaged and participatory in the sustainable fishery management process
23	Identification and implementation of income diversification mechanisms linked to reduced fishing pressure	Fishermen are too dependent on the state of the fish resources and need to diversify their income base. SACD has started chicken farming as one alternative	Fishermen are willing to integrate sustainable fishing practices into their fishing as their income base has diversified	<ul style="list-style-type: none"> ▪ Identification of at least 3 income diversification mechanisms by local fishermen ▪ Planning / Implementation of at least 2 income diversification mechanisms ▪ At least 50% of local fishermen in Sarteneja have a secondary source of income
24	Monitor climate conditions affecting fish stocks	No weather data is being collected	SACD has a weather station and is collecting weather data to identify trigger points for fish movements	<ul style="list-style-type: none"> ▪ SACD has installed a weather station ▪ SACD has 1 year of weather data ▪ A summary of weather data is included in the Annual Report

Development of a Sustainable Fisheries: Indicators				
Management Actions		Current Status	Desired Status	Indicators
25	Monitor water parameters affecting fish stocks	Characterisation of the water parameters of CBWS has started (2012) and is ongoing	SACD has information on water parameter changes, and has identified trigger points for fish movements	<ul style="list-style-type: none"> ▪ SACD has salinity data for 2 years ▪ SACD has temperature data for 2 years ▪ Data is analysed and summarized in the Annual Report

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