Final Technical Report on the Assessment of the Priority Protected Areas and Suitable Mechanisms and Avenues for Income Generation

CONSULTANCY TO UNDERTAKE SOCIO-ECONOMIC AND ENVIRONMENTAL ASSESSMENTS OF PRIORITY PROTECTED AREAS AND DEVELOP STRATEGIES AND GUIDELINES FOR INVESTING IN PROTECTED AREAS AND THEIR BUFFER AREAS.
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Consultancy to Undertake Socio-economic and Environmental Assessments of Priority Protected Areas in Belize and develop Strategies and Guidelines for Investing in Protected Areas and their Buffer Areas.

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FINAL TECHNICAL REPORT ON THE ASSESSMENT OF THE PRIORITY PROTECTED AREAS AND MECHANISMS AND AVENUES FOR INCOME GENERATION

Under the

CONSULTANCY TO UNDERTAKE SOCIO-ECONOMIC AND ENVIRONMENTAL ASSESSMENTS OF PRIORITY PROTECTED AREAS AND DEVELOP STRATEGIES AND GUIDELINES FOR INVESTING IN PROTECTED AREAS AND THEIR BUFFER AREAS.

Submitted By: Allan Herrera M.Sc.

May 2012
# CONTENTS

<table>
<thead>
<tr>
<th>LIST OF TABLES</th>
<th>vii</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF FIGURES</td>
<td>viii</td>
</tr>
</tbody>
</table>

## 1 Introduction
1.1 Objectives of the Study 1
1.2 This Task - Task A-6: Assessment and Analysis 2

## 2 Methodology
2.1 Descriptive Component - Analysis of the Characteristics of the System 4
2.2 Evaluative Component 7
2.3 Identification of Suitable Mechanisms for Income Generation 8

## 3 Assessment of the Nine Priority PAs
3.1 What is Carrying Capacity? 10
3.2 The preferred Carrying Capacity Framework for Belize’s Priority Protected Areas 11
3.3 The Descriptive Factors 13
3.4 Broad Economic Context Analysis of Priority PAs 14
   3.4.1 Potential Risks / Costs to Protected Areas and Biodiversity 15
   3.4.2 Protected Areas and Border Communities, Direct Benefits 16
   3.4.3 The Socioeconomic Need to Expand Carrying Capacities 24
3.5 Broad Socio-Demographic Analysis of the Priority PAs 25
3.6 Environmental, Social and Economic Assessment of the nine PAs 32
   3.6.1 Hol Chan Marine Reserve 33
   3.6.2 Caye Caulker Marine Reserve 40
   3.6.3 Blue Hole & Half Moon Caye Natural Monument 49
   3.6.4 Gladden Spit and Silk Cayes Marine Reserve 59
   3.6.5 Sapodilla Cayes Marine Reserve 70
   3.6.6 Nohoch Cheen Archaeological Reserve 78
   3.6.7 Chiquibul National Park 84
   3.6.8 Mountain Pine Ridge Forest Reserve 93
   3.6.9 Cockscomb Basin Wildlife Sanctuary 98

## 4 Evaluation and Analysis of the Nine Priority PAs
4.1 Methods Used for the Determination of Carrying Capacity 104
4.2 Factors that Influence the Determination of Carrying Capacity 105
4.3 Important Considerations for the Nine Priority PAs 106
4.4  Analysis of the Marine Priority Protected Areas
4.5  Analysis of the Terrestrial Priority PAs
4.6  Insights on Carrying Capacity within Individual Priority PAs
4.7  Recommendations on the way Forward

5  Recommendations for Income Generation  
5.1  Identifying a Protected Area’s Goods and Services
5.2  Income Generation Categories for PAs
      5.2.1  Income from public and International Organizations
      5.2.2  Income from private sources (Commercial and Neighbors)
      5.2.3  Perverse Incentives as Impediments to Income Generation
5.3  Recommendations for Income generation in the Nine Priority PAs
      5.3.1  General Insights and Observations
      5.3.2  Recommendations for the Nine Priority PAs
5.4  Linkages to the Sustainable Finance Strategy

Appendix 1 - Workshop Program
Appendix 2 - IUCN Categories for PAs
Appendix 3 – PA Scorecard
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Exports of Marine Products.</td>
<td>17</td>
</tr>
<tr>
<td>3.2</td>
<td>Number of Hotels, Rooms, Beds and Tourist Arrivals: 1991 – 2011.</td>
<td>17</td>
</tr>
<tr>
<td>3.3</td>
<td>Hotel Statistics 2004 (select areas).</td>
<td>18</td>
</tr>
<tr>
<td>3.4</td>
<td>Hotel Statistics for December 2007.</td>
<td>18</td>
</tr>
<tr>
<td>3.5</td>
<td>Hotel Statistics for October 2011.</td>
<td>19</td>
</tr>
<tr>
<td>3.6</td>
<td>Labor Force Status.</td>
<td>20</td>
</tr>
<tr>
<td>3.7</td>
<td>Population Age Structure for Selected Buffer Communities – 2010.</td>
<td>26</td>
</tr>
<tr>
<td>3.8</td>
<td>Selected Social &amp; Economic Indicators – Buffer Communities.</td>
<td>28</td>
</tr>
<tr>
<td>3.9</td>
<td>Specific practices to be allowed and disallowed within the Site.</td>
<td>82</td>
</tr>
<tr>
<td>5.1</td>
<td>IUCN PA Management Objectives and Types of Actual and Prospective Customers.</td>
<td>135</td>
</tr>
<tr>
<td>5.2</td>
<td>Total Economic Values of Protected Areas.</td>
<td>138</td>
</tr>
<tr>
<td>5.3</td>
<td>Feasibility of Implementing Selected Income Generating Mechanisms</td>
<td>145</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td><strong>Figure 3.1</strong></td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Priority Protected Areas visited during study.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Figure 5.1</strong></td>
<td>142</td>
<td></td>
</tr>
<tr>
<td>Schematic of system to evaluate potential income sources.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ACRONYMS

BAS  Belize Audubon Society
BDF  Belize Defense Force
CBD  Convention on Biological Diversity
CBO  Community Based Organization
CBWS  Cockscomb Basin Wildlife Sanctuary
CCMR  Caye Caulker Marine Reserve
CDB  Caribbean Development Bank
CNP  Chiquibul National Park
CZMAI  Coastal Zone Management Authority and Institute
FAMRACC  Forest and Marine Reserve Association of Caye Caulker
FAO  Food and Agriculture Organization
FCD  Friends for Conservation and Development
FD  Forest Department
GDP  Gross Domestic Product
GoB  Government of Belize
GSSCMR  Gladden Spit and Silk Cayes Marine Reserve
HCMR  Hol Chan Marine Reserve
HMCBHNM  Half Moon Caye and Blue Hole Natural Monument
IUCN  International Union for the Conservation of Nature
LAC  Limits of Acceptable Change
LFS  Labor Force Survey
MMM  Maya Mountain Massif
MPA  Marine Protected Area
MPRFR  Mountain Pine Ridge Forest Reserve
NGO  Non-government Organization
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NICH</td>
<td>National Institute of Culture and History</td>
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<tr>
<td>NCAR</td>
<td>Nohoch Che’en Archaeological Reserve</td>
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<td>NPAS</td>
<td>National Protected Areas Secretariat</td>
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<td>NPASP</td>
<td>National Protected Areas Systems Plan</td>
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<td>PA</td>
<td>Protected Areas</td>
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<td>PACT</td>
<td>Protected Areas Conservation Trust</td>
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<td>PMU</td>
<td>Project Management Unit</td>
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<tr>
<td>PNLF</td>
<td>Persons not in the Labor Force</td>
</tr>
<tr>
<td>SBRC</td>
<td>Southern Belize Reef Complex</td>
</tr>
<tr>
<td>SCMR</td>
<td>Sapodilla Cayes Marine Reserve</td>
</tr>
<tr>
<td>SEA</td>
<td>Southern Environmental Association</td>
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<tr>
<td>SIB</td>
<td>Statistical Institute of Belize</td>
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<td>TNC</td>
<td>The Nature Conservancy</td>
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<td>UNDP</td>
<td>United Nations Development Program</td>
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<td>UNESCO</td>
<td>United Nations Education Scientific and Cultural Organization</td>
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<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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<td>VPNM</td>
<td>Victoria Peak Natural Monument</td>
</tr>
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<td>VIM</td>
<td>Visitor Impact Management</td>
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<td>WCPA</td>
<td>World Commission on Protected Areas</td>
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<td>WWF</td>
<td>World Wildlife Fund</td>
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</tbody>
</table>
Executive Summary

Belize has an extensive system of marine and terrestrial protected areas organically built up over many years and managed by a diverse array of actors including public institutions, NGOs and private owners. The protected areas system makes a substantial contribution to the national economy especially in the areas of tourism, forestry and fisheries and in providing a slew of vital environmental services. To that end it is essential that care is taken to prevent the PAs from visitor overexploitation while ensuring that the PAs are marketed to produce income for their own management and upkeep.

A. Carrying Capacity

The traditional carrying capacity approach emphasizes setting visitor numbers based on mathematical relationships to variables of concern. Over time, the original carrying capacity concept has evolved into a number of alternative decision-making frameworks whereas a strict carrying capacity approach prioritizes science over public values and interests.

At this point in time it appears that the main threats to the ecological functioning and biodiversity of the nine priority PAs is not from visitation but from chronic underfunding to carry out the protection mandate including monitoring and the continued propagation of illegal activities including unsustainable extraction. In addition, limited visitation to many protected areas has nothing to do with ecological considerations and more to do with limited welfare facilities, poor development of attractions, inaccessibility and security concerns.

In regards to the Belize priority PAs the following are evident:

a. No single framework for determining carrying capacity will address the needs of the 9 priority PAs,

b. Impacts cannot be avoided but they can be mitigated and managed based on established objectives and understanding of the variables,

c. No clear relationship between amount of use and impact for PAs since many variables come into play and are relevant in determining this relationship,

d. Complex combination of variables that must be considered renders a numeric value for carrying capacity ineffective and undesirable,

e. A prior understanding of conditions on the ground and a baseline is needed before contemplating establishing a carrying capacity benchmark,
Use reduction and other heavy-handed visitor restrictions will be perceived by the stakeholders as a potential threat to generating tourism income, a high priority for a developing country like Belize. The following is recommended:

1. The NPAS should lobby for standardization of management plans with clear objectives and indicators for determining carrying capacity,

2. Very little monitoring is taking place in the priority PAs hence it is impossible to know the state and condition of the resources upon which a carrying capacity study should be based. There is a pressing need for good quality monitoring in the priority PAs,

3. The concept of a “number” or “range of numbers” for carrying capacity should be abandoned in favor of Alternative Decision Making Frameworks even though they are associated with time constraints, substantial costs, and extensive financial and personnel resource requirements.

4. PAs should establish a set of conditions or values reflecting environmental, physical and social aspects of the site,

5. There is a need for the establishment of standards and the standardization of indicators for protected areas across their various management categories and zones.

6. Instead of setting a number of visitors for dive sites site managers should work to get stakeholders buy in to strong management practices.

7. At some of the MPAs it might be advisable to disperse tourist to other sites since externalities appear only when the system reaches certain levels of thresholds. This suggests the need for land use/special planning.

8. Most of the priority PAs do not have a carrying capacity issue – they need increase visitation for revenue generation. It is recommended that a set of guidelines including the development of indicators be formulated to guide them in their incipient tourism enterprise.

**B. Mechanisms/Avenues for Income Generation**

In the new paradigm shift a PA must be able to provide biodiversity services, while being able to use a business approach which is profit centered and entrepreneurial to maximize its financial capacity to achieve conservation aims. This is because PAs supply goods and services in a generally competitive marketplace; hence like all businesses they face a complex array of customers who may wish to spend their limited funds elsewhere.
To diversify funding sources, protected areas managers need to have quality information about the protected area’s goods and services and the values which stakeholders, investors and other potential supporters or customers place on them. Through a process of valuation a PA manager can understand which values are being captured and which are not.

When considering options for income generation Belizean protected areas managers will need to take account of the following factors:

- The management category for the area. Some IUCN categories allow a broader range of use than others giving greater scope for revenue generation and rent capture.
- The quality of management of the protected area.
- The intrinsic capacity of the protected area to attract and entice investments and revenue.

Any option chosen for income generation in the individual priority PAs should ideally meet the following criteria:

- Capitalize on the existing strengths of the PA,
- Relatively easy, simple and straightforward to implement,
- Benefits buffer zone communities and contributes to the national economy,
- Must not compromise the biodiversity conservation objectives of the PAs,
- Must take into account the true value of the resources.

Options for income generation must take into account the current economic and political situation in the country especially as it relates to increasing fees taxes and levies. There is almost universal opposition to increases in fees, taxes and levies across all sectors of Belizean society. In addition, cultural perceptions support the view that the environmental services offered by protected areas should be available for free.

Some potential income generating schemes will require large investments and technical expertise which indicates the need to collaborate with the private sector. Many PAs have limited financial technical and scientific resources and would be at a disadvantage in terms of moving into new untested, uncharted enterprises.

Nevertheless there are many potential income generation avenues available to PA managers and the capacity exists within the PA system as a whole and the larger stakeholder community and international agencies to capitalize on these opportunities. Cross subsidization and collaboration in the general interest of conservation is indicated.
1 Introduction

The Global Environment Facility via the United Nations Development Programme is providing financing for the consolidation of the National Protected Areas System under the project entitled “Strengthening National Capacities for the Operationalization, Consolidation, and Sustainability of Belize’s Protected Areas System”. The project is being implemented by the National Protected Areas Secretariat, in concert with the Fisheries and Forest Departments. The primary aim of the project is to ensure that sound legal, financial, and institutional capacities are developed to ensure the sustainability of the existing protected areas.

As a result of the project, Belize is expected to have modernized and diversified financing mechanisms to increase the sustainability of its protected areas system. To accomplish this, various business and financial mechanisms will be used to increase protected areas revenue. However, it is necessary to undertake socio-economic and environmental assessment of selected protected areas as a precursor to the development of the various mechanisms. It will also be necessary to increase investments in protected areas and their buffer zones in a responsible and sustainable manner through the development of sector strategies and guidelines for the main productive sectors.

The objectives of this consultancy will be achieved within the framework of the Project “Strengthening National Capacities for the Operationalization, Consolidation, and Sustainability of Belize’s Protected Areas System” – ‘PIMS4207’ according to the Project Document 00074617 and the Standard Basic Agreement (SBAA) between the Government of Belize and the United Nations Development Programme (hereinafter referred to as UNDP).

1.1 Objectives of the Study

To support the aim of achieving financial sustainability within the country’s protected areas system a Sustainable Financing Strategy is being developed by the National Protected Areas Secretariat (NPAS); however there is a need to inform the project on the extent to which elements of the Strategy can be applied within the Belize Protected Areas System. In Component A of this study, nine (9) priority protected areas have been chosen for socio-economic and environmental assessment. The information obtained will help in the formulation of appropriate financing mechanisms for the nine priority protected areas (PAs).
In addition to this, there is the need to explore the use of economic policies and instruments to influence development behavior and achieve conservation objectives. This indicates the need to encourage investment within protected areas as part of a strategy to achieve financial sustainability while ensuring the protection of the supporting resource base. The development of sector strategies and guidelines for investing in protected areas, including their buffer zones will provide guidance for investors who want to invest in protected areas while enabling sector planners to appraise proposals for development in an informed manner. The development of these strategies and guidelines forms Component B of this consultancy.

The objectives of the components are as follows:

I. Component A:

The objectives of this component are to:

a. Undertake an assessment of nine priority protected areas in Belize to determine such factors as carrying capacity, limits of acceptable change, benefits to buffer communities and management policies on these in the target protected areas

b. Provide recommendations on the most suitable mechanisms/avenues for income generation in the identified protected areas and the extent to which these ought to be developed.

II. Component B:

The objectives of this component are to:

a. Develop strategies and guidelines for investing in protected areas and their buffer by key productive sectors (tourism, forestry, agriculture and fisheries, water resource users, energy generation, and oil and mineral extraction). These guidelines should embrace the concept of biodiversity offsets to ensure that there is no net loss of biodiversity in the PA system as a result of developmental activities.

b. Inform the National Environmental Impact Assessment processes on the importance of considering these guidelines in processes related to approval of development projects.

1.2 This Task - Task A-6: Assessment and Analysis

Within the terms of reference for this study the consulting team is being tasked to undertake the assessment of nine (9) priority protected areas. These protected areas are to be assessed to
determine factors such as carrying capacity, limits of acceptable change, benefits to buffer communities and management policies. The priority protected areas are:

1. Blue Hole and Half Moon Caye Natural Monument,
2. Caye Caulker Marine Reserve
3. Chiquibul National Park
4. Cockscomb Basin Wildlife Sanctuary
5. Gladden Spit Marine Reserve
6. Hol Chan Marine Reserve
7. Mountain Pine Ridge Forest Reserve
8. Nohoch Cheen Archaeological Reserve
9. Sapodilla Cayes Marine Reserve

Based on the result of the assessment of the nine priority protected areas the consultancy team is required to make recommendations on the most suitable mechanisms/avenues for income generation in the nine priority protected areas and the extent to which these potential income generation schemes could be sustainably developed.

The specifications for the study require the consultants to undertake consultations with the various stakeholders using a participatory and inclusive approach and provide training to the PA managers (See Appendix 1).
2 Methodology

There are various approaches used to determine carrying capacity for protected areas, however and method chosen will depend on the management objectives of the site. It is now generally accepted that any of the methods will have the following two components.

A. **Descriptive part:** This describes how the system works, including physical, ecological, social, political and economic aspects of development. Within this context of particular importance is the identification of:
   a. Constraints - limiting factors that cannot be easily managed (inflexible)
   b. Bottlenecks - limiting factors of the system which can be manipulated
   c. Impacts - elements of the system affected by the intensity and type of use

B. **Evaluative part:** Describes how an area should be managed and the level of acceptable impacts. This part of the process starts with the identification (if it does not already exist) of the desirable condition/preferable type of development and involves value judgment as to the acceptability of different levels of impact. In particular it needs to deal with:
   a. Goals/ objectives
   b. Evaluative criteria (This will specify acceptable levels of change)

The implementation of carrying capacity must be assisted, guided and monitored, with a coherent set of indicators.

2.1 Descriptive Component - Analysis of the Characteristics of the System

The team visited each of the nine priority protected areas to gather information on the descriptive components. In addition, a thorough study was made of the available literature including management plans, action plans, annual reports, research papers, zonation plans, ecosystems maps and maps of biological corridors. In this study we used three different combinations of descriptive components:

- Physical-ecological components - natural and man-made including infrastructure. The following issues was raised and discussed with participants:
  o Acceptable level of congestion or density in key areas/spatial units.
o Maximum acceptable loss of natural resources without significant degradation of ecosystem functions or biodiversity or loss of species.

o Acceptable level of air, water and noise pollution on the basis of tolerance or the assimilative capacity of local ecosystems.

o Intensity of use of transport infrastructure, facilities and services.

o Use of utility facilities and services such as water supply, electric power, waste management of sewage and solid waste collection, treatment and disposal.

o Adequate availability of community facilities and services such as those related to public health and safety, housing and community services.

- Socio-demographic components - population and social structure and dynamics. Levels of capacity for the components will be discussed including:

  o Number of visitors and activity types which can be absorbed without affecting the sense of identity, lifestyle and social patterns and activities of host communities,

  o Level and type of activity which does not significantly alter local culture in terms of arts, crafts, belief systems, ceremonies, customs and traditions,

  o Level of visitation/use in an area without unacceptable decline of experience of visitors

- Political-economic - including institutional and organizational

  o Level of specialization,

  o Loss of labor from other sectors leading to loss of self sufficiency,

  o Distribution of revenue from enterprises at local level.

I) The Ecological/Physical Components

Data was collected for the general analysis of the ecological and physical characteristics of the area. Data collection and analysis included defining the boundaries of the system (the spatial extent of the area on the basis of homogeneous or functional characteristics such as biological corridors or ecosystems).

Special consideration was given to key features and processes such as hydrology, coastal dynamics (in case of coastal areas and islands), vegetation patterns and cover, wildlife
species distribution, natural and cultural landscape, urban and tourist development patterns, land use patterns and dynamics, transport network, water supply and sewage disposal, wastewater treatment facilities, energy production, presence of a variety of services, necessary to support tourism where these existed.

II) The Social/Demographic Components

We analyzed the general demographic and social characteristics of the area including analysis of population growth and density, age structure, participation in the labor force, education etc. We also analyzed cultural patterns and social relations including the use of resources and the relationship between communities and visitors especially in terms of conflicts and perceived threats.

III) The Political/Economic Components

For this component we analyzed the general political and economic characteristics of the area such as the following:

   i) The state/structure of the economy - employment/unemployment, presence of traditional activities like agriculture and fishing, seasonality of activities, average income.

   ii) Political, decision making process major actors and community participation.

   iii) Organizational aspects and mechanisms in place including scientific, technical and management capabilities to manage problems.

   iv) Regulatory/institutional context including goals and policies for tourism, development and environment, land use plans, regulations and standards in force related to overall sensitivity of the area and public, private investments for the area. We also looked at relationship within the broader system (political-economic linkages) where these existed.

In considering carrying capacity the three components (physical-ecological, socio-demographic, and political-economic) are assigned different weights (or importance) in different protected areas. This stem from three things:

1. The type (characteristics/particularities) of the site. These provide the basic structure and can be evidenced in terms of local resources, the vulnerability of local natural ecosystems, population size, economic structure, culture and local heritage. The size,
structure and dynamism of the local society, culture and economy can be significant factors which influence the local ability to cope with pressures and impacts from development.

2. The type(s) of activities/use present. In this context it is important to consider differences in terms of expectations, attitudes and behavior as these condition the pressures and impacts on a place.

3. The development/environment interface. The development/environment interface is a composite of the previous two factors mainly in the form of spatial patterns, the level of organizational and technological systems employed, the management regime, etc. The development/environment interface is expressed in terms of constraints evolving either from the impacts on the environment or from the degradation of the environment.

For the nine (9) priority protected area we conducted a literature review and carried out structured interviews with protected areas managers and management body representatives using a questionnaire. We also toured each individual protected area and visited the buffer zone communities and interviewed community members.

2.2 Evaluative Component

Analysis of Carrying Capacity

Based on the information gathered during the descriptive phase we looked at alternative options and courses of action which combine two (2) types of components:

- Constant components: constraints (remain unchangeable in the various options).
- Flexible components: bottlenecks (changeable given the various courses of action).

We established a system for:

- **Formulation of goals and objectives**: Goals are important in planning for development by giving broad directions and clarifying that some aims should have more priority than others.

- **Elaboration of alternative course of actions**: Taking into account future trends and prospects for tourism development etc.

When dealing with flexible parameters (bottlenecks) for the preferable option, total carrying capacity does not necessarily have to take the form of unique numerical value, resulting from a “calculation” of the various carrying capacities for each component.
After we selected the desired option the next step was to identify the final key factors and therefore the thresholds and indicators to be considered bearing in mind that it may be possible that only one proves to be the real key factor.

In selecting the total carrying capacity for each system we needed to:

a. Elaborate carrying capacity policy measures,
b. Select a final list of indicators for the constraints and bottlenecks identified and,

Establish definitions for thresholds and standards.

A schematic diagram of our proposed approach is given below:

2.3 Identification of Suitable Mechanisms for Income Generation

The next task was to identify suitable mechanisms for income generation in the nine (9) priority protected areas. The important thing to consider at this stage is that the income generation scheme must be subservient to the carrying capacity of the site which should not be exceeded and which should be continuously evaluated based on accepted empirical indicators and standards.

For the various options a scoring system was developed bearing in mind that there are a large number of different types of impacts to be considered and many cannot be measured or have not been measured or is inconsistently measured. We also had to compare impacts across
impact types using measurements where possible. There are many complexities when measuring impacts such as the often perceived observation that a negative impact on one species can be beneficial to another.

It was necessary to use value judgment in cases where there is no empirical evidence to support a decision or where the scientific evidence is lacking or conflicting. Income generation options for individual protected areas gaining the highest scores were selected and the degree to which they will be developed was evaluated based on the carrying capacity which was in turn based on the impacts as evidenced by the indicators.

Our system for identifying the preferred option has the following salient features:

1) be easy, quick, inexpensive and cost-effective to implement;
2) be able to successfully assess impacts;
3) consider multiple underlying causes of impacts;
4) facilitate selection of a variety of management actions;
5) produce defensible decisions;
6) separate technical information from value judgments;
7) encourage public involvement, shared learning, and consensus building; and
8) incorporate local resource uses and resource management issues.
9) capitalize on existing infrastructure, skills and resources.
3 Assessment of the Nine Priority PAs

3.1 What is Carrying Capacity?

The initial focus of carrying capacity was on the physical and environmental impacts to the protected area. This approach was later revisited, on the basis that in addition to physical impacts, the quality of the visitor’s experience was also affected as measured by over-crowding, conflicts, noise, and other related variables, thus suggesting an ‘environmental’ and a ‘social’ component to carrying capacity.

Park management objectives must define and articulate the ‘desired’ future environmental status of the park and the visitor experience it can provide, to be continuously measured against an established baseline which captures a variety of impact types. Results of this continuous monitoring will provide the basis for adjusting carrying capacity as may be needed. Carrying capacity, therefore, includes ‘descriptive components’ which include management parameters like the type and extent of use-related impacts, and ‘evaluative components’ which includes value judgments about the acceptability of different levels of impacts (Farrell and Marion, 2002).

Specifically, management objectives are monitored via a series of factors, indicators and standards which allow quantitative measurement and minimize subjectivity. Stankey and McCool (1990) defined factors, indicators and standards as follows:

**Factors** are “broad categories of issues or concerns” (such as trail conditions), from which one or more indicators can be identified that reflect the overall condition of the factor.

**Indicators** are specific variables” (such as soil compaction) “that singly, or in combination, are taken as indicative of the conditions of the overall opportunity class” or “factor.”

**Standards** are measurable aspects of indicators” that “provide a base against which a particular condition can be judged as acceptable or not”

It is crucial that ‘acceptable experience’ is measured according to carefully defined factors, indicators and standards. Farrell and Marion (2002) later refined the definition of carrying capacity as the amount of visitor-related use an area can support while offering a sustained quality of recreation, based on ecological, social, physical and managerial attributes and conditions. It must be borne in mind, however, that the concept of carrying capacity carries a
series of assumptions that are rarely ever achieved in the real world (McCool and Lime, 2001), emphasizing the need for carrying capacity determination to be management-driven.

The descriptions and comparisons of possible frameworks clearly indicate that the relationship between amounts of use a protected area receives and resulting impact is neither clear nor linear. A number of variables are relevant in this relationship and include visitor behavior, management objectives and practices, protected area conditions, season of use, visitor expectations, visitor education and awareness, type of visitor, timing of visit, visitor interactions, cognitive processes, etc. This complex combination of processes makes establishing a singular numerical capacity not only extremely difficult, but also suggests any singular number for carrying capacity may be highly ineffective. Additionally, the spatial displacement of effects are common and establishing a carrying capacity for one area does not help because problems may be displaced to another area, requiring additional technical, management, and institutional capacity to address them.

3.2 The preferred Carrying Capacity Framework for Belize’s Priority Protected Areas

As part of this study, an assessment was made of a suitable carrying capacity framework for Belize’s protected areas system. From the assessment it is clear that to manage user access, social and environmental impacts, and quality of the visitor experience in Belize’s protected areas, the following guiding considerations and principles must be embraced:

- It is impossible not to have negative effects as a consequence of visitation or other economic activity in a protected area;
- To define carrying capacity in terms that are essentially numeric is not only unrealistic, but inappropriate;
- All economic activities within a protected area represent a set of tradeoffs;
- Impacts cannot be avoided, but they can be managed based on established objectives or an understanding of the biophysical or social conditions desired; and
- For management to be effective and beneficial to both protected areas and society, management intervention should:
  - Be scientifically and socially informed
  - Allow for the use of a combination of scientific and value judgments
  - Allow broad public participation
In recommending a framework for the management of Belize’s protected areas, and being guided by the above considerations and principles, it is clear that no one framework will address the needs of the nine priority areas identified under the National Protected Areas System Plan. It is also clear that for all frameworks reviewed, there is the underlying assumption that management objectives and targets exist for each protected area, based on a predetermined understanding of environmental and social conditions on the ground.

A prior understanding of these conditions on the ground will constitute the baseline against which any selected framework will be applied, and thus require that corresponding management objectives and targets of protected areas are consistent with this baseline. All frameworks require an existence of competent management capacity to conduct the research, monitoring and evaluation necessary to determine the effectiveness of the framework being applied and thus the effectiveness of management of the protected area. While this required capacity may or may not be resident within the institutional framework of the protected area, some of this capacity can be actively outsourced through technical support from expert groups or academic institutions.

The frameworks that best seem to fit the considerations listed above are the Limits of Acceptable Change (LAC) and the Visitor Impact Management (VIM). The first ensures the early definition of acceptable or “desired” status of change (management targets) for each major visitation type based on scientifically and socially informed research, with the corresponding standards and indicators for measurement. The latter ensures that the causes of the impacts are also addressed and minimized in the management interventions, while allowing for judgmental considerations to complement the science being considered in the LAC.

The nine priority protected areas identified in the NPAS, especially the terrestrial areas, provide a wide diversity of visitation opportunities and types, and thus require a framework that provides flexibility and allow for adaptive management based on robust and informed decision-making with broad public participation. A combination of the LAC and the VIM meets these requirements. It is important to also mention that, as part of a broad management framework
for Belize’s priority protected areas, a periodic evaluation of management compliance and effectiveness is desirable, for example, every three to five years.

For this specific purpose, it is recommended that due consideration be given to the application of the MASTEC method, which is suitable for measuring compliance with the indicators and standards of both the LAC and the VIM and will help to clarify what corrective management interventions may be most effective to bring the protected area into compliance with the established standards and indicators.

### 3.3 The Descriptive Factors

The descriptive aspect in determining carrying capacity is used to describe how the system works. It includes description of the physical, ecological, social, political and economic aspects of the site and its buffer areas. Within this context of particular importance is the identification of:

- **Constraints** - limiting factors that cannot be easily managed (inflexible)
- **Bottlenecks** - limiting factors of the system which can be manipulated
- **Impacts** - elements of the system affected by the intensity and type of use

During this assessment we visited all nine (9) priority protected areas and collected information on the different components for measuring carrying capacity viz:

**A. Physical-ecological**

i) Analyze general ecological and physical characteristics of the area. Define boundaries of the system on the basis of homogeneous or functional characteristics.

ii) Special consideration was given to key features and processes such as hydrology, coastal dynamics (in case of coastal areas and islands), vegetation patterns and cover, wildlife species distribution, natural and cultural landscape, urban (and tourist) development patterns, land use patterns and dynamics, transport network, water supply and sewage disposal, wastewater treatment facilities, energy production, presence of a variety of services, necessary to support tourism (i.e. health facilities), etc.

iii) Definition of relationships with the adjacent/ neighboring areas on the basis of strong linkages with the system under study, i.e. due to existing infrastructure or key ecological processes
B. **Socio-demographic**

   i) Analysis of general demographic and social characteristics of the area e.g. population growth and density, age structure, etc.

   ii) Analysis of cultural patterns and social relations. This will include the use of resources and the relationship between communities and visitors especially in terms of conflicts and perceived threats.

   iii) Definition of the relationship with the broader system (cultural and social conditions in wider region) which may influence the system under study.

C. **Political-economic** - Analysis of general political and economic characteristics of the area data collection for analysis will include

   i) The state/structure of the economy - employment/unemployment, presence of traditional activities like agriculture and fishing, seasonality of activities, average income.

   ii) Political, decision making process major actors and community participation.

   iii) Organizational aspects - Mechanisms in place. Scientific, technical and management capabilities to manage problems.

   iv) Regulatory/ institutional context - Goals and policies for tourism, development and environment, land use plans, regulations and standards in force related to overall sensitivity of the area.

   v) Public, private investments for the area. We will look at relationship with the broader system (political-economic linkages).

### 3.4 **Broad Economic Context Analysis of Priority PAs**

The protected areas (PAs) of Belize are part of the economic foundation and sustainable livelihoods of all Belizeans and need to be understood as a cross cutting issue with far ranging impacts. Hence the need to present an in depth look at the present situation of which they form an integral part. The PAs need to be viable and sustainable if the nation is to meet its economic goals and objectives over the long term.
3.4.1 Potential Risks / Costs to Protected Areas and Biodiversity

Belize has a well-known wealth of biological diversity in our protected areas. In addition the nation, while having a relatively small human population, is blessed with a rich cultural heritage arising out of the variety of races and cultures that call Belize home. This special combination has made Belize a popular tourist destination, and the tourism industry makes up a significant part of the nation’s economy, providing jobs and foreign exchange earnings.

The rich biodiversity and abundant natural resources comprised of both marine and land-based beauty and abundant flora and fauna make Belize a special destination that goes beyond the traditional offering of sea-based recreation. Land-based tourism with forests, rivers, caves and wildlife are an important attraction in their own right.

It is beyond question that Belize’s biodiversity is the source of much of its wealth. However, a question does arise as to how the natural resources and biodiversity should be developed or protected from negative development and how the protected areas should be managed so that they yield long-term benefits to the nation and its people.

As a small, developing nation with a fairly rapid population growth rate there are increasing demands for the use of these resources, whether it be for the tourism industry, agriculture, forestry or for newer activities such as petroleum exploration. At the same time, public awareness of the value of these resources and of the potential impacts of development activities, such as caused by oil spills from offshore oil production, are at an all-time high. This is of course aided by widespread access to the international news media and the more recent British Petroleum oil spill in the Gulf of Mexico off the coast of Louisiana.

While the potential for adverse impacts of offshore oil exploration in Belize’s pristine waters is an ongoing issue for national discussion as part of our democratic process, the remaining potential impacts on biodiversity caused by more commonplace activities seem to have been largely overlooked. The wealth of biodiversity is more likely to be impacted upon on a more routine basis by agricultural runoffs of pesticides, fertilizers and other chemical inputs.

The land, rivers and subsequently the sea and precious barrier reef can also be impacted upon by effluents produced by normal urban activities such as sewage and the use of household chemicals. While Belize does not have major industrial activities that create huge discharges of industrial contaminants the tendency in developing nations as well as in the more developed world is to use the sewage system for disposal of liquid industrial waste.

Impacts of the more commonplace agricultural and urban runoffs can lead to the contamination of drinking water and harm to the human population as well as to the species
that either drink water from potentially contaminated rivers or are dependent on the rivers and sea for life. These would include fish and other creatures such as manatees that live there as well as aquatic life such as corals that comprise our barrier reef.

Considering the importance of tourism to Belize, any degrading of our biodiversity would lead to an immediate impact in the value of the natural resources which are important for their diversity and beauty. More important could be the possible effect on the Belizean population. The impacts are not always evenly spread across a nation’s population. The heaviest impact falls on the rural poor and urban poor. These persons may either live near to or use the natural resources close to a protected area for their direct livelihood, such as for agriculture or for drinking water. It is known that a nation’s economic productivity is directly tied to the health of its population.

In brief, while it is important to protect the nation’s rich biodiversity for its own sake and the beauty of the natural resources and flora and fauna, there must also be the recognition that this is a major part of the tourism attraction. The other part of our national tourism product is of course the special culture, which has arisen over the centuries in Belize. The physical health and economic well being of our population are fundamental reasons to protect our biodiversity as we live in harmony with nature and require its sustainable use over the long run.

3.4.2 Protected Areas and Border Communities, Direct Benefits

The direct economic benefits provided by the protected areas needs to be estimated through the use of known indicators in order to have a sound economic basis for interpretation. There is some data for the larger communities namely San Pedro, Caye Caulker and Placencia. Data for the smaller communities such as Maya Center and Red Bank, etc. is not available. The lack of data is an indication that economic benefits in a financially measurable manner are not directly accruing to the smaller population centers around the protected areas. Measures therefore need to be addressed directly to these

Other measurable benefits are more national in scope and not readily attributable to a specific protected area.

**Fishing**

**Table 3.1** shows that the direct economic benefits from traditional i.e. non-farmed fish products amounts to BZ$28.0 million and BZ$28.8 million in 2010 and in 2011 respectively. This benefit accrues in a direct manner to the fishing communities, the fishing cooperatives, the urban centers where the expenditures for basic and other human necessities occur and finally
to the wider nation which benefits from the foreign exchange that helps to keep our national currency stable and helps in a very direct way in paying for our major imports and financing our foreign debt. On the other hand attributing that benefit to specific marine protected area and border community is not directly quantifiable and is therefore attributable to all the marine protected areas and mangroves which serve as breeding grounds for the marine resources.

**Table 3.1**: Exports of Marine Products.

<table>
<thead>
<tr>
<th>Category</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Millions BZ$</td>
<td>Million BZ$</td>
</tr>
<tr>
<td>Marine Products</td>
<td>54.3</td>
<td>48.9</td>
</tr>
<tr>
<td>Farmed Shrimp</td>
<td>26.3</td>
<td>20.1</td>
</tr>
<tr>
<td>Traditional Fishing, Conch and Lobster</td>
<td>28.0</td>
<td>28.8</td>
</tr>
</tbody>
</table>


**Tourism**

Tourism is more quantifiable as reliable data is kept by the Belize Tourist Board and by the Statistical Institute of Belize, however the data applies mainly to the larger communities and the nation at large. This belies the fact that the success of tourism is heavily dependent on the inland and marine protected areas and their natural attractions.

**Table 3.2**: Number of Hotels, Rooms, Beds and Tourist Arrivals: 1991 – 2011.

<table>
<thead>
<tr>
<th>Belize Country Totals</th>
<th>Hotels</th>
<th>Rooms</th>
<th>Beds</th>
<th>Tourist Arrivals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>248</td>
<td>2,784</td>
<td>4,742</td>
<td>86,656</td>
</tr>
<tr>
<td>2000</td>
<td>391</td>
<td>4,106</td>
<td>7,045</td>
<td>195,766</td>
</tr>
<tr>
<td>2004</td>
<td>510</td>
<td>5,139</td>
<td>8,722</td>
<td>230,832</td>
</tr>
<tr>
<td>2011</td>
<td>706</td>
<td>7,067</td>
<td>12,117</td>
<td>977,807</td>
</tr>
</tbody>
</table>

Source: SIB Abstract of Statistics 2009
### Table 3.3: Hotel Statistics 2004 (select areas).

<table>
<thead>
<tr>
<th>District</th>
<th>No. of Hotels</th>
<th>No. of Rooms</th>
<th>No. of Beds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cayo District</td>
<td>79</td>
<td>759</td>
<td>1,481</td>
</tr>
<tr>
<td>Stann Creek District</td>
<td>54</td>
<td>423</td>
<td>755</td>
</tr>
<tr>
<td>Toledo District</td>
<td>28</td>
<td>232</td>
<td>388</td>
</tr>
<tr>
<td>San Pedro</td>
<td>81</td>
<td>1228</td>
<td>2,079</td>
</tr>
<tr>
<td>Caye Caulker</td>
<td>62</td>
<td>509</td>
<td>840</td>
</tr>
<tr>
<td>Placencia</td>
<td>67</td>
<td>446</td>
<td>744</td>
</tr>
<tr>
<td><strong>Belize Country Total</strong></td>
<td><strong>510</strong></td>
<td><strong>5,139</strong></td>
<td><strong>8,722</strong></td>
</tr>
</tbody>
</table>


### Table 3.4: Hotel Statistics for December 2007.

<table>
<thead>
<tr>
<th>No</th>
<th>Area Description</th>
<th>No Of Hotels</th>
<th>No of Rooms</th>
<th>No of Beds</th>
<th>Total Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Belize City</td>
<td>35</td>
<td>724</td>
<td>1030</td>
<td>492</td>
</tr>
<tr>
<td>2</td>
<td>Belize Rural</td>
<td>24</td>
<td>242</td>
<td>439</td>
<td>136</td>
</tr>
<tr>
<td>3</td>
<td>Caye Caulker</td>
<td>73</td>
<td>580</td>
<td>921</td>
<td>169</td>
</tr>
<tr>
<td>4</td>
<td>Cayo</td>
<td>97</td>
<td>942</td>
<td>1726</td>
<td>876</td>
</tr>
<tr>
<td>5</td>
<td>Corozal</td>
<td>29</td>
<td>283</td>
<td>394</td>
<td>138</td>
</tr>
<tr>
<td>6</td>
<td>Offshore North</td>
<td>9</td>
<td>105</td>
<td>201</td>
<td>150</td>
</tr>
<tr>
<td>7</td>
<td>Offshore South</td>
<td>26</td>
<td>195</td>
<td>395</td>
<td>137</td>
</tr>
<tr>
<td>8</td>
<td>Orange Walk</td>
<td>20</td>
<td>237</td>
<td>432</td>
<td>137</td>
</tr>
<tr>
<td>9</td>
<td>Placencia</td>
<td>88</td>
<td>689</td>
<td>1058</td>
<td>553</td>
</tr>
<tr>
<td>10</td>
<td>San Pedro</td>
<td>99</td>
<td>1443</td>
<td>2410</td>
<td>1144</td>
</tr>
<tr>
<td>11</td>
<td>Stann Creek</td>
<td>56</td>
<td>495</td>
<td>952</td>
<td>544</td>
</tr>
<tr>
<td>12</td>
<td>Toledo</td>
<td>35</td>
<td>265</td>
<td>544</td>
<td>392</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>591</strong></td>
<td><strong>6200</strong></td>
<td><strong>10502</strong></td>
<td><strong>4868</strong></td>
</tr>
</tbody>
</table>
Table 3.5: Hotel Statistics for October 2011.

<table>
<thead>
<tr>
<th>No</th>
<th>Area Description</th>
<th>No Of Hotels</th>
<th>No of Rooms</th>
<th>No of Beds</th>
<th>Total Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Belize City</td>
<td>30</td>
<td>683</td>
<td>1023</td>
<td>468</td>
</tr>
<tr>
<td>2</td>
<td>Belize Rural</td>
<td>22</td>
<td>254</td>
<td>431</td>
<td>126</td>
</tr>
<tr>
<td>3</td>
<td>Caye Caulker</td>
<td>86</td>
<td>636</td>
<td>1042</td>
<td>200</td>
</tr>
<tr>
<td>4</td>
<td>Cayo</td>
<td>107</td>
<td>1069</td>
<td>1916</td>
<td>859</td>
</tr>
<tr>
<td>5</td>
<td>Corozal</td>
<td>37</td>
<td>350</td>
<td>536</td>
<td>155</td>
</tr>
<tr>
<td>6</td>
<td>Offshore North</td>
<td>12</td>
<td>146</td>
<td>225</td>
<td>171</td>
</tr>
<tr>
<td>7</td>
<td>Offshore South</td>
<td>28</td>
<td>236</td>
<td>440</td>
<td>223</td>
</tr>
<tr>
<td>8</td>
<td>Orange Walk</td>
<td>21</td>
<td>261</td>
<td>469</td>
<td>139</td>
</tr>
<tr>
<td>9</td>
<td>Placencia</td>
<td>115</td>
<td>736</td>
<td>1151</td>
<td>634</td>
</tr>
<tr>
<td>10</td>
<td>San Pedro</td>
<td>151</td>
<td>1855</td>
<td>3363</td>
<td>1134</td>
</tr>
<tr>
<td>11</td>
<td>Stann Creek</td>
<td>58</td>
<td>527</td>
<td>885</td>
<td>383</td>
</tr>
<tr>
<td>12</td>
<td>Toledo</td>
<td>39</td>
<td>314</td>
<td>636</td>
<td>368</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>706</td>
<td>7067</td>
<td>12117</td>
<td>4860</td>
</tr>
</tbody>
</table>

### Table 3.6: Labor Force Status.

<table>
<thead>
<tr>
<th>District</th>
<th>Labor Force Status</th>
<th>Total</th>
<th>Unemployed as a % of Employed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Employed</td>
<td>Missing Age</td>
<td>PNLF</td>
</tr>
<tr>
<td>Corozal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chunox</td>
<td>397</td>
<td>-</td>
<td>331</td>
</tr>
<tr>
<td>Copper Bank</td>
<td>149</td>
<td>-</td>
<td>101</td>
</tr>
<tr>
<td>Sarteneja</td>
<td>489</td>
<td>-</td>
<td>475</td>
</tr>
<tr>
<td><strong>District Total</strong></td>
<td>13,429</td>
<td>3</td>
<td>10,172</td>
</tr>
<tr>
<td>Belize</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Pedro, A.C.</td>
<td>5,221</td>
<td>-</td>
<td>2,169</td>
</tr>
<tr>
<td>Caye Caulker</td>
<td>688</td>
<td>-</td>
<td>356</td>
</tr>
<tr>
<td><strong>District Total</strong></td>
<td>36,364</td>
<td>3</td>
<td>20,233</td>
</tr>
<tr>
<td>Cayo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frank's Eddy</td>
<td>51</td>
<td>-</td>
<td>106</td>
</tr>
<tr>
<td>San Antonio</td>
<td>585</td>
<td>-</td>
<td>441</td>
</tr>
<tr>
<td><strong>District Total</strong></td>
<td>22,777</td>
<td>1</td>
<td>17,468</td>
</tr>
<tr>
<td>Stann</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Georgetown</td>
<td>97</td>
<td>-</td>
<td>137</td>
</tr>
<tr>
<td>Creek</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maya Centre</td>
<td>110</td>
<td>-</td>
<td>124</td>
</tr>
<tr>
<td>Maya Mopan</td>
<td>151</td>
<td>-</td>
<td>203</td>
</tr>
<tr>
<td>Placencia</td>
<td>860</td>
<td>-</td>
<td>340</td>
</tr>
<tr>
<td>Red Bank</td>
<td>291</td>
<td>-</td>
<td>328</td>
</tr>
<tr>
<td>Municipality</td>
<td>Total Population</td>
<td>Population in Marine Reserve</td>
<td>Total Marine Reserve Area (ha)</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>San Roman</td>
<td>11,448</td>
<td>275</td>
<td>417</td>
</tr>
<tr>
<td>Santa Cruz</td>
<td>276</td>
<td>-</td>
<td>141</td>
</tr>
<tr>
<td>Santa Rosa</td>
<td>98</td>
<td>-</td>
<td>208</td>
</tr>
<tr>
<td><strong>District Total</strong></td>
<td><strong>11,448</strong></td>
<td><strong>1</strong></td>
<td><strong>7,811</strong></td>
</tr>
</tbody>
</table>

Source: SIB 2010 Census Data.
The tables above show that the nation on a whole has benefited in a very direct manner since 1991 from economic activity directly related to tourism. The direct impact includes construction of hotels, employment and the related expenditures on these economic activities.

The data also shows how the border communities of San Pedro, Caye Caulker and Placencia as well as the Cayo, Stann Creek and Toledo Districts have been positively impacted as otherwise the unemployment rates would be even higher.

Noteworthy is that these three stated buffer communities are major population centers with other economic activities such as fishing, commerce, and construction. The small communities such as Maya Center and Frank’s Eddy and the others that directly border protected areas are not major population or economic centers. The direct implication of this is that while they border protected areas they do not have the capacity to directly absorb the traditional tourism benefits from hotels and related economic activity. The case can be made then that there is no single category of border communities.

### 3.4.2.1 Two Broad Categories of Border Communities

Analysis of the available data indicates that there are two broad categories of border communities. The first of these is comprised of major economic centers that capture and retain economic benefit from tourism as well as possible direct fishing benefits. The second category is comprised of the small and economically isolated communities such as Maya Center and Frank’s Eddy among all the remainder of the border communities.

An exception would be Sarteneja which is a large village yet suffers from high levels of unemployment. There may be reasons as to why Sarteneja is a statistical outlier or unique case in not benefiting much from the PAs. A part of this can be explained by distance, large population and sharing only in the fishing resource and not participating much if at all in the tourism aspects of the PA system. This also makes the point that the tourism benefit is the major direct economic benefit of the PA system.

Any intervention and direct support measures must therefore be directed at these marginalized border communities that comprise the second category of protected areas. Their identified benefits may consist mostly of traditional uses such as spiritual, medicinal, thatch and related housing materials, access to fire wood, traditional fishing and hunting within the protected areas. Ways of addressing their perceived needs and clear lack of economic benefit may center more on some forms of limited and controlled access to these traditional uses.
A recommendation is that where employment occurs within a protected area these communities need to be clearly targeted. A second recommendation is that since major and clearly identified benefits accrue to the nation at large from the protected areas and natural resources of Belize, these border communities should be targeted for special social and development assistance in areas such as health, education and basic community infrastructure. This would boost their medium and long term ability to be able to actively and meaningfully participate in the economic bounty that is around yet passes through their communities without leaving much direct benefit due to a lack of an absorptive capacity. The relatively small population of these category two border communities indicates that the socioeconomic and any negative PA perception (lack of benefits) situation is possible to address without major national resource implications.

3.4.2.2 Employment Directly and Indirectly Related to Protected Areas

The data generated from the 2010 Census shows an unemployment rate near 23% at a national level. There was an explanation given by the Statistical Institute of Belize that the Census was an exercise that was spread over several months as opposed to a Labor Force Survey (LFS) that is more time specific. Using the LFS taken during April of 2008 and 2009 the unemployment rates are 8.2% and 13.1% respectively. This is consistent with unemployment rates during a time of global recession.

A comparison with Tables 3.4 and 3.5 for hotel employment shows a different result for the Hotel Industry. Note that overall employment figures for the entire tourism industry were not available as that would also include restaurants, dive shops, tour businesses, gift shops, and other related enterprises. Nonetheless the hotel industry data provides a good indicator for the tourism industry as a whole. Table 3.4 for 2007 which is just before the global recession set in shows total employment in the Hotel Industry of 4,868 persons.

Table 3.4 for 2011, which is still a time of great economic uncertainty in the world as a definite economic recovery has yet to set in, shows total employment in the Hotel Industry of 4860 persons. This varies markedly from the unemployment figures for the nation as a whole. The rest of the nation as has been shown in the economic baseline depends on agriculture, construction, commerce and related service industries for much of the employment generated. The entire nation has a high unemployment rate whichever measurement instrument is used i.e. Census vs. Labor Force Survey.
With a high proportion of the nation under protected area status and the dependence of the tourism industry on land and sea based natural resources it is significant to note that employment related directly or indirectly to these sites is stable.

3.4.3 The Socioeconomic Need to Expand Carrying Capacities

Some conclusions for possible future policy initiatives can be inferred from this benefit. One is that employment from the PAs at a national and category one border community are stable and likely to benefit from continued sustainable management and balanced and progressive development of the sites. A second is that unemployment in the rest of the nation can have a negative impact on the PAs if former residents and newer immigrants drift to the category two border communities in search of a subsistence level existence due to loss or lack of formal employment.

It may appear counter intuitive to develop the social and economic infrastructure in the PAs and category two border communities if this is likely to encourage population drift to these marginalized communities. This would be a short sighted view as the above economic baseline shows that abundant benefits accrue to the nation at large and to the category one border communities. Improving active management and promoting increase visitation to the protected areas in a balanced and regulated manner would show positive results in stimulating broader economic activity and employment at a national level. This would ease any perceived population drift to category two border communities while addressing the basic human and employment needs of the regular residents of these communities.

A socioeconomic recommendation for policy initiative consideration related to this reality is that visitation to protected areas under active management need to be increased. From a social and economic viewpoint and to prevent deterioration of the resources in the PAs due to impoverished residents and “unemployed economic migrants” resorting to illegal activities such as hunting, fishing, logging, land clearing, etc. to sustain their own daily human existence.

A related economic recommendation is that the PAs under consideration require active management and the resources to effectively implement increase visitation. This will necessitate increasing the financial resources available to the PA system. Related to this is also a need to look more closely at the investment requirements for the PAs both from a long term conservation aspect i.e. opening new attractions, international quality visitors centers where appropriate, “hardening” of much visited sites, etc. and from the economic perspective of attracting and positively impacting the visitation levels required to benefit Belize, the category one and category two border communities.
It is understood that any increase in carrying capacity needs to be carried out in an environmentally sensitive manner and necessary safeguards put in. This in and of itself requires additional financial resources to allow for effective PA management on the ground. The social and economic benefits are clear, taking a narrow view will lead to more rapid degradation and political pressures to allow other potentially unmanageable uses of the PAs due to human pressure.

3.5 Broad Socio-Demographic Analysis of the Priority PAs

The socio-demographic analysis of the nine priority protected areas focuses on, inter alia, an analysis of general demographic and social characteristics of the area, population growth and density, age structure etc. It also focuses on an analysis of cultural patterns and social relations, including use of resources and the relationships between communities and visitors especially in terms of conflicts and perceived threats. Finally it gives a definition of the relationship with the broader system (cultural and social conditions in the wider region) which may influence the system under study.

The research methodology relied substantially on data gleaned from the recently concluded Census 2010 conducted by the Statistical Institute of Belize supplemented by extensive field research in selected buffer communities associated with the PA either via geographic proximity or through shared resource use. The census provided a range of social data on the specific communities including population, age structure, education, labor force data and living conditions. The field research sought to provide perspectives from a random sample of community leaders on their knowledge of the protected area, who they think are the major beneficiaries of the nearby protected area, and who benefits the least from the protected area. Information was also gleaned from these community leaders on who should provide new sources of revenues for any required investments in protected areas.

Table 3:7 below shows the current population of the selected buffer communities, broken down by age cohorts. The selected buffer communities are Maya Centre as the main buffer for the Cockscomb Basin Wildlife Sanctuary, Frank’s Eddy Village as the buffer community for Nohoch Cheen Archaeological Reserve, Placencia as the buffer for Gladden Spit/Silk Caye Marine Reserve and San Pedro Town and Caye Caulker as the main buffer communities for Hol Chan Marine Reserve, Caye Caulker Marine Reserve, Blue Hole and Half Moon Caye Natural Monument. The other selected protected areas under analysis, namely Chiquibul National Park, the Mountain Pine Ridge Forest Reserve and the Sapodilla Cayes Marine Reserve were deemed by their respective park managers not to have any identifiable buffer community.
Table 3.7: Population Age Structure for Selected Buffer Communities – 2010.

<table>
<thead>
<tr>
<th>Age</th>
<th>Maya Centre</th>
<th>Placencia</th>
<th>Frank’s Eddy</th>
<th>Caye Caulker</th>
<th>San Pedro</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>42</td>
<td>156</td>
<td>54</td>
<td>208</td>
<td>1240</td>
</tr>
<tr>
<td>5 - 9</td>
<td>47</td>
<td>124</td>
<td>69</td>
<td>204</td>
<td>1241</td>
</tr>
<tr>
<td>10 – 14</td>
<td>45</td>
<td>163</td>
<td>57</td>
<td>164</td>
<td>1048</td>
</tr>
<tr>
<td>15 – 19</td>
<td>44</td>
<td>149</td>
<td>35</td>
<td>144</td>
<td>1129</td>
</tr>
<tr>
<td>20 – 24</td>
<td>46</td>
<td>199</td>
<td>28</td>
<td>199</td>
<td>1405</td>
</tr>
<tr>
<td>25 - 29</td>
<td>26</td>
<td>194</td>
<td>33</td>
<td>168</td>
<td>1340</td>
</tr>
<tr>
<td>30 – 35</td>
<td>43</td>
<td>165</td>
<td>14</td>
<td>134</td>
<td>1107</td>
</tr>
<tr>
<td>36 – 40</td>
<td>26</td>
<td>138</td>
<td>20</td>
<td>135</td>
<td>960</td>
</tr>
<tr>
<td>41 – 45</td>
<td>17</td>
<td>105</td>
<td>15</td>
<td>107</td>
<td>660</td>
</tr>
<tr>
<td>46 – 49</td>
<td>13</td>
<td>88</td>
<td>15</td>
<td>89</td>
<td>565</td>
</tr>
<tr>
<td>50 – 54</td>
<td>10</td>
<td>66</td>
<td>12</td>
<td>58</td>
<td>380</td>
</tr>
<tr>
<td>55 – 59</td>
<td>12</td>
<td>75</td>
<td>10</td>
<td>45</td>
<td>261</td>
</tr>
<tr>
<td>60 - 64</td>
<td>7</td>
<td>49</td>
<td>10</td>
<td>46</td>
<td>189</td>
</tr>
<tr>
<td>65 +</td>
<td>9</td>
<td>78</td>
<td>6</td>
<td>66</td>
<td>254</td>
</tr>
<tr>
<td>Not Stated</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total (2010)</td>
<td>387</td>
<td>1,749</td>
<td>378</td>
<td>1,767</td>
<td>11,779</td>
</tr>
<tr>
<td>Gender (M/F) %</td>
<td>51.3% &amp; 48.7%</td>
<td>53.6% &amp; 46.4%</td>
<td>52.7% &amp; 47.3%</td>
<td>49.6% &amp; 50.4%</td>
<td>51.3% &amp; 48.7%</td>
</tr>
<tr>
<td>Total (2000)</td>
<td>293</td>
<td>458</td>
<td>199</td>
<td>630</td>
<td>4499</td>
</tr>
</tbody>
</table>

Source: SIB Census 2010 & Census 2000

As noted in Table 3.7 above, while population has grown in all the selected buffer communities over the intercensal years, the growth has been most phenomenal in Placencia where over the ten year period the population grew by some 280%. This was by far the single largest percentage growth, though growth was also very large in Caye Caulker at 180% and in San Pedro, which grew by 169%. Growth was comparatively smaller in Frank’s Eddy at 89%, then Maya Centre at 32%.

It is noteworthy that in all these municipalities, population growth rate over the decade exceeded the national average since population for the country as a whole grew by marginally in excess of 30%. That population grew by substantially greater percentages than the national average in these select communities, where it is acknowledged that some aspect of tourism is the mainstay of their economic life, is indicative of the increasing importance of this sector, certainly to these communities. This provides a most logical explanation of the demographic shift as persons seeking employment relocate to these communities.
This socio-demographic analysis will now focus in substantially more detail on the specific protected area and its respective main buffer community.

The select social and demographic analysis above posits that the buffer communities adjacent to the protected areas being studied benefit from the existence of the said protected area. This can be corroborated from Table 3.8 which compares select indicators at the national country level with these same indicators at the micro level for the buffer communities.

The most recent census report cites Belize as having a labor force participation rate of marginally over 65%. This means that more than 6 out of every ten members of the population who are over the working age of 14 years are participating in the country’s labor force, either by having a job (employed) or actively seeking a job (unemployed). Belize’s labor force typically excludes students, homemakers, person’s severely disabled, retired persons and persons who explicitly state that they do not want to work.

These categories of persons who are excluded are officially regarded as Persons Not in the Labor Force (PNLF). A high labor force participation rate means that the majority of the population is available for work and this also implies a low dependency ratio. This national average was exceeded in the buffer communities of Placencia, San Pedro and Caye Caulker. This implies that in these municipalities, proportionally more persons are available for work and employment prospects are better than average.

This is likely a result of tourism, since tourism forms the backbone of the economy in those communities and this is indicative of a main benefit that these buffer communities derive from the nearby protected area. The labor force participation rate is lower than average in Maya Centre and in Frank’s Eddy. This perhaps is a main explanatory reason why some villagers in the former community indicate that they see little benefit in the protected area status of the nearby Cockscomb basin Wildlife Sanctuary.

Another important social indicator is the level of unemployment. Nationally the rate of 23% is exceeded only in Frank’s Eddy, whereas all the other buffers have unemployment rates that are substantially below the national average with the rate being lowest in Placencia at 13.7%. That unemployment is low in these select buffer communities, corroborate the narrative being established that tourism continues to contribute well to the economy of these buffer communities.
**Table 3.8: Selected Social & Economic Indicators – Buffer Communities.**

<table>
<thead>
<tr>
<th>Protected Area &amp; main Buffer Community</th>
<th>Labour Force Participation Rate (%)</th>
<th>Unemployment (%)</th>
<th>Private Sector Employment (%)</th>
<th>Employed Pop as % of Pop over 14 yrs &amp; PNLF</th>
<th>% Graduates (Primary &amp; above)</th>
<th>Use of flush toilet (%)</th>
<th>Home Ownership (%)</th>
<th>Land Ownership (%)</th>
<th>Public Water Source (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cockscomb Basin Wildlife Sanctuary – Maya Centre</td>
<td>52%</td>
<td>18.5%</td>
<td>89.1%</td>
<td>42.5%</td>
<td>45.6%</td>
<td>20.1%</td>
<td>69.8%</td>
<td>28.3%</td>
<td>72.02%</td>
</tr>
<tr>
<td>Gladden Spit &amp; Silk Cayes Marine Reserve – Placencia</td>
<td>72.4%</td>
<td>13.7%</td>
<td>94.8%</td>
<td>64.3%</td>
<td>85.1%</td>
<td>97.7%</td>
<td>36.9%</td>
<td>92%</td>
<td>98.4%</td>
</tr>
<tr>
<td>Nohoch Cheen Park Reserve – Frank’s Eddy Village</td>
<td>50%</td>
<td>48.5%</td>
<td>100%</td>
<td>24.2%</td>
<td>28.9%</td>
<td>19.8%</td>
<td>56.3%</td>
<td>43.5%</td>
<td>0.79%</td>
</tr>
<tr>
<td>Hol Chan Marine Reserve – San Pedro Town &amp; Caye Caulker Village</td>
<td>74.2% (SP) &amp; 70.6% (CC)</td>
<td>16.5% (SP) &amp; 19.4% (CC)</td>
<td>83.2% (SP) &amp; 83.5% (CC)</td>
<td>62% (SP) &amp; 56.9% (CC)</td>
<td>74.9% (SP) &amp; 70.8% (CC)</td>
<td>97.51% (SP) &amp; 97.48% (CC)</td>
<td>28.5% (SP) &amp; 46.5% (CC)</td>
<td>88.1% (SP) &amp; 78.4% (CC)</td>
<td>90.1% (SP) &amp; 81.2% (CC)</td>
</tr>
<tr>
<td>Blue Hole /Half Moon Caye Natural Monument - San Pedro Town &amp; Caye Caulker Village</td>
<td>74.2% (SP) &amp; 70.6% (CC)</td>
<td>16.5% (SP) &amp; 19.4% (CC)</td>
<td>83.2% (SP) &amp; 83.5% (CC)</td>
<td>62% (SP) &amp; 56.9% (CC)</td>
<td>74.9% (SP) &amp; 70.8% (CC)</td>
<td>97.51% (SP) &amp; 97.48% (CC)</td>
<td>28.5% (SP) &amp; 46.5% (CC)</td>
<td>88.1% (SP) &amp; 78.4% (CC)</td>
<td>90.1% (SP) &amp; 81.2% (CC)</td>
</tr>
<tr>
<td>Caye Caulker Marine Reserve - San Pedro Town &amp; Caye Caulker</td>
<td>74.2% (SP) &amp; 70.6% (CC)</td>
<td>16.5% (SP) &amp; 19.4% (CC)</td>
<td>83.2% (SP) &amp; 83.5% (CC)</td>
<td>62% (SP) &amp; 56.9% (CC)</td>
<td>74.9% (SP) &amp; 70.8% (CC)</td>
<td>97.51% (SP) &amp; 97.48% (CC)</td>
<td>28.5% (SP) &amp; 46.5% (CC)</td>
<td>88.1% (SP) &amp; 78.4% (CC)</td>
<td>90.1% (SP) &amp; 81.2% (CC)</td>
</tr>
<tr>
<td>Mountain Pine Ridge Forest Reserve – No Buffer Community</td>
<td>74.2% (SP) &amp; 70.6% (CC)</td>
<td>16.5% (SP) &amp; 19.4% (CC)</td>
<td>83.2% (SP) &amp; 83.5% (CC)</td>
<td>62% (SP) &amp; 56.9% (CC)</td>
<td>74.9% (SP) &amp; 70.8% (CC)</td>
<td>97.51% (SP) &amp; 97.48% (CC)</td>
<td>28.5% (SP) &amp; 46.5% (CC)</td>
<td>88.1% (SP) &amp; 78.4% (CC)</td>
<td>90.1% (SP) &amp; 81.2% (CC)</td>
</tr>
</tbody>
</table>
### Chiquibul National Park - No Buffer Community

### Sapodilla Cayes Marine Reserve – No Buffer Community

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BELIZE</strong></td>
<td>65.7%</td>
<td>23.1%</td>
<td>81.8%</td>
<td>50.6%</td>
<td>51.6%</td>
<td>64.6%</td>
</tr>
</tbody>
</table>

Source: SIB Census 2010 and Author’s calculations
Other related social indicators support this narrative. The Statistical Institute of Belize reports that 15% of Belize’s employed population is employed by the Government of Belize (SIB, Census 2010). Nationally, employment by work categories excluding Government, quasi-government institutions and international organizations is marginally less than 82%. SIB regards these other work categories or private sector employment broadly as Own Business with Paid Help, Own Business Without Paid Help, and Other Private or NGO employee.

This means that 82 out of every 100 employed persons countrywide are employed with the private or non-government sector. It is within these work categories that all tourism related employment falls. As noted by the table, employment by work categories in all the specified buffer communities was above the national average. In Frank’s Eddy, it was highest at 100%, meaning that all the employed persons in this buffer community were employed either in their own business, as owners or employees or were employed in the private sector. No one working at Frank’s Eddy is in the employ of the Government of Belize, a quasi-Government institution or an international organization. This indicates that the entire employed population in this village is working with the private sector or working for themselves.

Information gleaned from other labor force indicators also show buffer communities benefiting from the existence of protected areas. SIB reports that the country’s employed population are marginally in excess of 100,000. This amount is over 50% of the working age population – defined as being over 14 years old. Only in the buffer communities of Maya Centre and Frank’s Eddy was this percentage lower than the national average. This implies either a lower level of employment in both communities, or a higher proportion of persons not in the labor force (PNLF) in those communities. In either instance, there is a higher and average level of employment dependency, implying the few working persons are supporting many persons who are not.

Countrywide nearly 52% of Belizeans have an educational level that is either at the primary level and higher. In all the selected buffers except Maya Centre and Frank’s Eddy, the rate is substantially higher than the national average. In Maya Centre, while it is accepted that the rate is some 6 percentage points lower than the national average, it is to be noted that this village is majority populated by Mayas, a distinct ethnic group that up to comparatively recently made little efforts to encourage high levels of formal education among its female population. Given the new paradigm shift in this ethnic group, it is to be expected that educational levels in the village is likely to increase considerably as secondary schools in Dangriga and Georgetown, which are relatively accessible, will facilitate this process.
Whereas only 65% of Belizeans use a flush toilet, the corresponding percentages are near universal in Placencia, San Pedro and Caye Caulker. And once again, Maya Centre and Frank’s Eddy are lacking in this indicator. In both communities, one in every five households has indoor plumbing.

Home ownership is perhaps the sole indicator where nearly all the buffer communities fare worse than the national average. The single exception is Maya Centre where nearly 7 in every ten families own their homes. A likely explanatory reason here is that the present location of the village of Maya Centre is relatively new, having only been established at its current site subsequent to the establishment of the Jaguar Preserve. Relocation of the people from the reserve most likely meant that homes had to be built for them. In the other buffer communities though, the lower than national average home ownership increased costs of home ownership occasioned by the tourism industry pricing properties beyond the reach of the traditional residents.

Maya Centre also has the lowest percentage land ownership. This is perhaps explained by land tenure systems among the majority Maya in the village who often utilize a communal land system. In the other buffer communities, there is a high degree of land ownership, except in Franks Eddy.

A final social indicator that is the focus of this analysis would be percentage of households that have a public source of water piped into their dwelling or into their yards. Countrywide the national average is over 68%, indicating that 68 out of every one hundred households utilize a public water system instead of using wells, public standpipe or using water from rivers or streams. Any increases in this percentage indicate improved social conditions. In areas where the local averages exceed the national, this is an indication of social conditions regarding water availability being better than average. The table indicates that in all the selected buffer communities, with the sole exception of Frank’s Eddy, the percentage of households with water piped either into their homes or their yards substantially exceed the national average, indicating better than average social conditions for this specific indicator.

This social analysis focused on at least nine different indicators, and it established that for eight of those nine indicators, social conditions at the community level at the select buffers are better than overall national averages. This establishes more than a prima facie evidence that these better than average social conditions are largely due to tourism, given the importance of that sector in the economic livelihood of the selected buffer communities. That provides a powerful rationale for the local population to support tourism and notably the nearby protected area.
That some social conditions in some buffer communities are below the national average is acknowledged and this remains of primary concern, since that reality enhances the likelihood of threats to the protected area. These threats necessarily reduce carrying capacity. In the communities therefore, notably Maya Centre and Frank’s Eddy, where, in general, social conditions are below nationwide averages, public policy initiatives ought to be directed at achieving positive change. The change ought to involve direct social investments in these communities and it is to be reiterated that a most likely result of such initiatives will be the enhancement of the carrying capacity of the nearby protected area.

3.6 Environmental, Social and Economic Assessment of the nine PAs

Figure 3.1 shows the protected areas visited and reported upon during this study. The narrative which follows describes each of the priority PAs along the following themes

- environmental/physical,
- social/demographic and
- political/economic
Priority Protected Areas

Figure 3.1: Priority Protected Areas visited during study.

3.6.1 Hol Chan Marine Reserve

(i) Physical-ecological

Hol Chan Marine Reserve (hereafter Hol Chan or HCMR) is located about four (4) Km south of San Pedro, Ambergris Caye. It is probably the best known marine reserve in the country and the most frequently visited. Hol Chan benefits from its proximity to San Pedro and Caye Caulker, two of Belize’s premier tourism destination; however there are frequent excursions to
the site from the mainland and other offshore destinations. Visitors come to see healthy populations of marine life in their natural setting including such important keystone species as Hawksbill Turtles, West Indian Manatee and Goliath Groupers.

The Fisheries Department is the government agency with management authority over the site. The Department is guided in its management interventions by a Board of Trustees which was appointed in 1994 seven years after the site was first declared. The Board of Trustees works as a semi-autonomous body with responsibility for staffing, financing and most day to day management activities.

Under the IUCN Classification system for protected areas Hol Chan falls within Category II (A habitat management area managed mainly for conservation through management interventions).

The reserve has an area of 5,517ha of which Zone A comprises the coral reef (259ha), Zone B comprises the sea grass beds (2,176ha), Zone C covers the mangrove ecosystem (2,564ha) and Zone D is Shark Ray Alley one of the premier tourist attractions within the reserve. All zones are multiple use extractive zones except for Zone A and the "Exclusive Recreational Area" within Zone D. In the extractive zones recreational and commercial fishing is allowed under special license approved by the Fisheries Administrator. Spear fishing and netting are prohibited within this area. The Site is managed from an office/visitor centre located in San Pedro, Ambergris Caye.

According to the staff there are no immediate plans to expand the reserve, however the Ambergris Caye Marine Reserve Complex is being planned which will create a new marine reserve between the Corozal Bay Wildlife Sanctuary (CBWS) and HCMR thus creating a network of Marine Protected Areas (MPAs) that will serve as a biological corridor between Bacalar Chico, CBWS and HCMR. There is also talk of extending the reserve 3 miles in front of San Pedro to protect predator fish species and habitats and to increase the number of available recreational sites for visitors. According to the HCMR manager, the legislation for the Mexico Rocks Marine Reserve should be enacted in 2012.

Main habitats are mangrove swamps, shallow lagoon, sea grass beds, patch reefs, back and fore reefs. Within this area is also found the Boca Ciega Sink Hole and its associated cave system plus the Hol Chan Channel which is a natural break in the reef that allows navigation into and out of the reef lagoon area. In 2008 the Cangrejo Shoals were included in Zone C of the marine reserve. This includes the large island of Cangrejo and all the channels and shoal adjoining Boca Chica and South Ambergris Caye. This represents a large expanse of mangrove wetlands and
muddy shoals that are important for the catch and release fishery of tarpon, permit and bonefish.

Although not the best example of reef structure within the Belize Reef system, Hol Chan has good representation of fore reef, reef crest, back reef, and lagoon shoals. These structures help to support viable representative populations of fish, which in turn supports the tourism industry which is the major employer in the area.

Coral population is generally healthy at the main recreational sites, however sedimentation from uninitiated divers and swimmers not using life vest is an identified problem causing damage to corals. For the most part, site monitoring shows slight deterioration in the quality of some of the marine resources however; it appears the population of commercial species of fish is healthy with good representation through the various size classes. Site management attributes this to their protection work within the reserve.

Studies done at the Hol Chan cut showed a high number of fin marks on living corals. Other studies have shown significant mortality from coral bleaching with the worst cases arising from the bleaching event in 1998. In the post recession period it can be expected that visitor numbers will recover to the pre-recession levels. In order to minimize the environmental impact to the coral reef environment, visitor use at the reserve needs to be carefully regulated and measures taken for the recovery of damaged resources.

Apart from the Hol Chan Channel and Shark Ray Alley, diving also occur at 6 other locations along the 3 mile stretch of fore-reef. These sites include: Pillar coral Dive Site; Eagle Ray Canyon; a site in front of the Hol Chan Channel; Sandbore Dive Site; Amigos wreck; and another site between the Sandbore and Amigos wreck.

**Monitoring**

Biological monitoring is an ongoing activity within the reserve however monitoring at the main recreational site is limited due to heavy use. As a result Hol Chan staff are not monitoring for sea grass and corals at these sites, however from the available evidence they believe them to be generally healthy. Monitoring within the reserve is done on conch, lobster, coral, fin fish, sea grass and turtles. Coral surveys have also focused on diseases such as the Black Band disease and the coral-bleaching phenomenon however the main focus is on benthic cover and overall reef health.

No water testing is being carried out at present, however the need for such testing is recognized and there are plans afoot to do so in the future. Biological monitoring conducted in the past showed that Hol Chan had higher population density and larger specimen of conch
lobster and fin fishes than surrounding areas and comparable habitats outside the Reserve. These results have helped to support the view that the protection work afforded species in the HCMR is helping to maintain their numbers and to support healthy breeding populations to reseed other depleted areas.

Monitoring efforts in all marine habitat of the reserve have been very basic. Long-term comparisons to assess the success of the management interventions are now being made and published in Reserve’s annual reports. The monitoring methods used at the site are standardized and consistent with those adopted by the Coral Reef Monitoring Working Group for use throughout the country.

Data methods are standardized and consistent to allow for comparisons across time scales, but also other causative factors need to be eliminated from the data to truly understand the success of the reserve. Collecting simple data on currents, turbidity, salinity, and surface and sub-surface water temperatures could easily assess fluctuations in environmental variables.

Species of International Conservation Concern at Hol Chan MR.

<table>
<thead>
<tr>
<th>Species</th>
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<th>Endangered</th>
<th>Vulnerable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coral</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staghorn Coral (<em>Acropora cervicornis</em>)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elkhorn Coral (<em>Acropora palmata</em>)</td>
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<td></td>
</tr>
<tr>
<td>Star Coral (<em>Montastraea annularis</em>)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Star Coral (<em>Montastraea faveolata</em>)</td>
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<td></td>
</tr>
<tr>
<td><strong>Fish/Turtle</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hawksbill Turtle (<em>Eretmochelys imbricata</em>)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Loggerhead Turtle (<em>Caretta caretta</em>)</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
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<td></td>
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</tr>
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<td>Nassau Grouper (<em>Epinephelus striatus</em>)</td>
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<td>Rainbow Parrotfish (<em>Scarus guacamaia</em>)</td>
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<tr>
<td>Queen Triggerfish (<em>Balistes vetula</em>)</td>
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<td>Hogfish (<em>Lachnolaimus maximus</em>)</td>
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<td>Cubera Snapper (<em>Lutjanus cyanopterus</em>)</td>
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</tr>
<tr>
<td>Mutton Snapper (<em>Lutjanus analis</em>)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>West Indian Manatee (<em>Trichechus manatus</em>)</td>
<td></td>
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</table>
Rangers complain about the tour guides feeding the marine life at the Hol Chan Channel to increase visitor appreciation. This is not allowed at the channel but allowed at Shark Ray Alley. The HCMR conducts "Visitor's Impact Analysis Surveys" to look at visitor’s behavior at recreational sites. Visitation is only allowed at the recreational site which represents about 10% of the reef area in the Reserve.

The rangers of the HCMR patrol the sites on a continuous basis sometimes in the company of the tourism police who opportunistically share the HCMR vessels.

(ii) Socio-demographic

The main buffer communities for the Hol Chan Marine Reserve are San Pedro Town and Caye Caulker. This PA was established in the late 1980s and most respondents in the buffers have heard of its existence and are supportive of its management objectives. Many see their livelihoods as closely intertwined with the success of the reserve.

Over 72% of respondents believe that the country of Belize benefits the most from the existence of this reserve. Only 11% believe that the tourist operators benefit the most and perhaps not surprisingly only 5.6% believe that the communities benefit the most from this PA.

<table>
<thead>
<tr>
<th>Benefits Most</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Belize</td>
<td>13</td>
<td>72.2</td>
<td>72.2</td>
<td>72.2</td>
</tr>
<tr>
<td>Tourist Operators</td>
<td>2</td>
<td>11.1</td>
<td>11.1</td>
<td>83.3</td>
</tr>
<tr>
<td>Communities</td>
<td>1</td>
<td>5.6</td>
<td>5.6</td>
<td>88.9</td>
</tr>
<tr>
<td>Other</td>
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<td>11.1</td>
<td>11.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

When asked who they think benefits the least from this reserve, nearly 78 % think that the communities, specifically San Pedro and Caye Caulker benefit the least from this protected area (see table below). Substantially smaller percentages believe that the country as a whole and visitors benefit the least from Hol Chan.
### Benefits least

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid visitors</td>
<td>1</td>
<td>5.6</td>
<td>5.6</td>
<td>5.6</td>
</tr>
<tr>
<td>Belize</td>
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<td>5.6</td>
<td>5.6</td>
<td>11.1</td>
</tr>
<tr>
<td>Communities</td>
<td>14</td>
<td>77.8</td>
<td>77.8</td>
<td>88.9</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>11.1</td>
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</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Some important social issues identified within the Hol Chan MR and the buffer zone area are:

- Some guides do not obey the rules and regulations even though they are aware of them. The HCMR regularly holds training with tour guides to teach them of the management objectives for the reserve and about the rules for operating in the area,

- According to the staff there is generally good respect and support for the reserve among fisher folk and most tour guides who take visitors to the sites,

- There are occasional issues of overcrowding when there are not enough moorings sites for all those intending to use the site at a particular time. The management of the reserve tries to control use of these sites (and hence overcrowding) by having a limited number of moorings. This in turn influences the carrying capacity of the site at any given time and can influence total annual visitor numbers generally.

- There is a general lack of community participation in the management of the reserve. It is believed participation waned when the Board of Trustees replaced the Advisory Committee.

- Divers are required to have a trained dive guide on every dive. On diving expeditions guides are required to explain the rules and regulations of the reserve, in the hope that this will reduce the risk of damage to corals and fish life. The relatively few number of dives sites in relation to the large numbers of divers, has sometimes led to overcrowding, user conflicts between operators, and concerns about environmental degradation.
• In the past conflicts occurred between commercial fishermen in Zone D who sometimes have difficulty determining the boundaries of the Exclusive Recreational Zone from the General Use Zone, however this boundary has now been marked.

• Resource-use conflicts at Hol Chan Channel and Shark Ray Alley sometimes lead to clashes among the various user groups. This concentration of visitors in two small areas has already led to some degradation of the reef and seagrass habitat.

Based on the current number of visitors, the staff does not think that the carrying capacity of the site has been exceeded. At the present time the main concern is visitor safety and congestion. It is quite common during certain hours of the day for the popular sites to become congested. The staff thinks that scheduling visits during the day would help to relieve this congestion however they realize this would be a difficult proposition to enforce given the seasonality of the tourism trade and the importance of HCMR to the national and local economy.

Rangers carry out daily checks to ensure that tour guides have tickets for all visitors on their boat. According to the rangers, the main problems are the sailboats. At the present time there are 3 moorings available for these boats, however the general impression is that the rangers would like to see sailboat use around the Hol Chan channel decreased.

There are 13 moorings boat moorings inside the Channel and 4 outside. Once these spots are filled tour guides either have to await their turn or go to alternative sites such as shark Ray alley or other satellite sites. There are several of these alternative sites available. Buoys are used to demarcate some areas within the reserve specifically the no take conservation zone and the fisheries zone. The ratio of snorkelers to divers has traditionally been 3 to 1 although the legal limit is 8 to 1.

(iii) Political-economic

The main revenue source for the Hol Chan MR is the fee charged to visitors who dive and snorkel and for the registration of vessels that use the reserve. In the early days substantial funding came from external sources, however the collection of user fees has displaced this and the present funding situation appears to be tenable and sustainable going forward. The regulations which required the HCMR to pay the Protected Areas Conservation Trust (PACT) 20% of the revenues it collects has now been amended and this payment is no longer made.

At the present time the financial resources of the reserve are enough to cover its operating budget. A shortage of funds could compromise the ability of staff to carry out their protection
mandate. It is not clear how the reserve meets the cost of additional expenditures such as equipment, training and infrastructure.

Belizeans are not charged for entrance to the recreational sites. Children and the elderly are also exempted from payment.

At this point in time the following economic arrangements hold at the reserve.

- HCMR charge each foreign visitor Bz$20.00 per visit,
- At its peak in 2008 there were 66,908 visitors to the site including Belizeans and non-paying volunteer groups. This number has decreased since then but is now holding steady,
- Tour guides buy tickets for tours they intend to take out. Tickets are checked by HCMR staff at the various sites.
- The presence of HCMR makes a significant contribution to the economy of San Pedro and Caye Caulker including employment from guiding and hospitality.

Economic studies carried out in the past show that tourists visiting San Pedro are willing to pay more money to enter the reserve than was currently being charged (Schmidt, 1990, Bonilla et. al., 2000). Given the quality of the visitor experiences this seems to be a reasonable conclusion.

### 3.6.2 Caye Caulker Marine Reserve

An integrated management plan was prepared for Caye Caulker Forest and Marine reserve spanning the period 2004 to 2009, however this plan is now out of date.

(i) **Physical-ecological**

The Caye Caulker Marine Reserve (CCMR) is located south of Hol Chan Marine Reserve and has an area of 3,913ha of which the preservation zone occupies 584ha, while the conservation zone occupies 821ha and the general use zone occupies 2,509ha. The Fisheries Department has the statutory responsibility for management of the reserve. The Forest Department have signed a co-management agreement with the Forest and Marine Reserve Association of Caye Caulker (FAMRACC) for the management of the adjacent Caye Caulker Forest Reserve.

The Fisheries Department have retained responsibility for day to day management of the site including protection, education, research and visitation with some assistance from FAMRACC.
The management prerogatives of the site indicate that it would fall under IUCN Category VI which can be defined as follows:

“An area containing predominantly unmodified natural systems managed to ensure long term protection and maintenance of biological diversity while providing at the same time a sustainable flow of natural products and services to meet community needs (Managed Resource Protected Area)”

The primary objective in declaring the marine and forest reserve was to protect a chain of interlinked ecosystem including the littoral forest, the mangrove forest, the lagoon, reef crest and fore reef along a continuum. Since its declaration the marine reserve has played a pivotal role as a tourism resource attracting visitors to Caye Caulker and in protecting the fishing and diving resource that so many local stakeholders depend upon. The main marine habitats are sandy beaches, lagoon marshlands, shallow lagoon, sea grass beds, the fore reef and the back reef.

**Lagoon Ecosystems**

The lagoon ecosystems within the CCMR range in complexity from bare sand, through mixed algae succession to mixed small seagrass (*Halodule wrighti*, *Syringodium filiforme*), on to Turtlegrass (*Thalassia testudinum*). The seagrass vary in the intensity of their coverage ranging from sparse (30% coverage) to dense (70% coverage). Of importance to the ecosystem is that seagrass protects the habitats by forming a dense rhizomal mat that holds bottom sediments, reducing erosion in times of strong current. In addition, their leaves accumulate sediments, helping to filter the water before it reaches fragile reef corals.

Lagoonal substrates at the site support a considerable full or part-time infauna, such as Lugworms (*Arenicola cristata*); a variety of mollusks, West-Indian Chank (*Xanus angulatus*) and Milk Conch (*Strombus costatus*). Seagrass is an important habitat for a number of commercially important species including the Spiny Lobster which bring in considerable revenue to the local fishing industry. Local fisherman set traps in sea grass beds or dive and use hook sticks to haul them from under coral heads.

The Queen Conch (*Strombus gigas*) is another species taken predominantly from seagrass beds and secondarily from the reef. In addition, sea grass in the lagoonal area is a critical habitat for juveniles of a wide variety of fish species including members of the grunt (Pomadasysidae), Snapper (Lutjanidae), and Parrotfish (Scaridae) family which are fished commercially in reef habitat. Other important species are Yellowtail (*Ocyurus chrysuris*), Lane (*Lutjanus synagris*), and especially Mutton Snappers (*L. analis*).
Coral Reef Ecosystems

The reef within the CCMR is extensive, with the Barrier forming an 11.1-km-long wall slightly over a mile offshore the island with three major breaks—North and South Caye Caulker and Caye Chapel Channels. The channels have significant patch reefs with lesser patch reefs found scattered throughout the lagoon area.

The reef within the CCMR and throughout the Belize Barrier Reef System has been damaged over the last decade and a half by coral bleaching and a series of hurricanes and storm events (CZMA/I, 2000). The reef has recovered over time and is in a succession phase although some species of corals appear to be more affected than others. The general consensus within the scientific community is that coral bleaching appears to be a recurrent event triggered by changes in water temperature which itself is being brought about by incipient climate change.

A study by the University of Wisconsin on Caye Caulker’s patch reefs revealed 31 species of Scleractinian corals with an average species richness of 12.2 species per site in Caye Caulker’s patch reefs (Burkett et al, 2002). On average, density of coral was 584 colonies/25 m², with coral cover averaging 14.64%. Dominant species by coverage were Montastraea annularis, Porites astroides, and Montastraea faveolata (88.4%), while M. annularis, P. astroides, Porites porites, Agaricia agaricites, and Acropora cervicornis were dominant by density (90.1%). The University of Wisconsin study found that, of all coral species, M. annularis was by far the most important species, with 97.6% of density and coverage (Mcray, E., 2004).

The most common of the groups that are regenerating are remnant Seafans (Gorgonia ventolina); young Branching and Crenulated Fire Coral (Millepora alcicornis, M. complanata); Columnar Boulder Coral (Montastraea annularis); Acropora palmata (Elkhorn Coral) as well as small colonies of A. cervicornis and Porites astroides.
A Rapid ecological assessment carried out in 2003 found ninety-four (94) species of fish in 32 families in patch and barrier reef habitats with the most abundant species being Striped Parrotfish in patch reefs, Sergeant Majors in the backreef area and on the outer crest, and Creole Wrasse in the fore reef.
Several marine reptiles and mammals are known from the area including Hawksbill (Eretmochelys imbricata), Loggerhead (Caretta caretta) and Green Sea Turtle (Chelonia mydas), Bottlenose Dolphin (Tursiops truncatus) and West-Indian Manatee (Trichechus manatus).

Before the establishment of the CCMR some species such as Goliath Grouper (Epinephalus itijarra), Nassau Grouper (E. striatus) and a variety of snapper (Lutjanidae) and Grunts (Haemulidae) were in decline, however the staff now claim that populations have rebounded with good representation through all size classes.

The reserve provides sanctuary to several critically endangered species including Hawksbill (Eretmochelys imbricata), Green (Chelonia mydas), and Loggerhead Turtles (Caretta caretta) and manatees (Trichechus manatus).

**Monitoring**

The Fisheries Department staff in Caye Caulker is carrying out an ongoing monitoring program to track the health of the ecosystems. Monitoring is carried out for conch, lobster, corals, patch reef, sea grass, mangrove, coral bleaching, commercial fish species and fish diversity, Monitoring program is conducted at various time and frequency within the year. According to the CCMR biologist the ecosystems are essentially stable; however there is a proliferation of algae on the corals. This is attributed to decline in herbivorous fish population. To counter this phenomenon the Fisheries Department has now banned catch of herbivorous species.

Surveillance is carried out throughout daylight hours for illegal activities; however the staff believes that some illegal activities occur at nights. In recreational areas, CCMR staff complains about divers who stir up sediments and cruise ship passengers with no experience of snorkeling who stand on corals while snorkeling. There is also the pervasive problem of tour guides feeding fish for the benefit of their quest thereby creating dependency on humans and inability to cope naturally.
(ii) **Socio-demographic**

Though Caye Caulker is the natural buffer community for this reserve, occasional users also come from San Pedro Town. In both of these communities, there is near unanimity that the area should continue to be protected.

As noted below, over 72 % of respondents believe that Belize as a country benefits the most from the existence of this protected area. A smaller percentage (11%) believe that tourist operators benefit most while an even smaller percentage (5.6%) believe that the buffer communities benefit the most from this PA.
Benefits most

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Belize</td>
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<td>72.2</td>
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<tr>
<td>Tourist Operators</td>
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<td>11.1</td>
<td>11.1</td>
<td>83.3</td>
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<td>Communities</td>
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</tr>
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<td>Total</td>
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<td></td>
</tr>
</tbody>
</table>

The respondents were also asked whom they believe benefit the least from this PA. The responses highlight the perspectives of the residents that the communities benefit least from this particular protected area as nearly 78% of respondents offered this perspective.

Benefits least

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
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</tbody>
</table>

Perhaps a reason for this view is that the reserve itself is hardly visited by Belizeans as the cost of travel would be prohibitive for most people. The residents were also asked if new sources of revenues were required to manage the operations of the reserve, where should these new sources of revenue come from. As noted below, the single largest percentage (39%) believes that the resources of the park should be exploited to provide the required revenues. Some 28 percent believe that visitors should be the source of the enhanced revenues, while 22 percent opined that new fees ought to be instituted.
Fishing in the general use area of the reserve is restricted to traditional users and regulated through a licensing/permit system. Most people in the buffer zone communities of San Pedro and Caye Caulker support the protected area and abide by its rules and regulations. However according to the staff there is a problem of poaching and other illegal activity from transient fishermen who pass through and opportunistically take from the reserve. The no-extraction zone does not allow fishing, however fishing is allowed in the extraction zone for traditional users but only under controlled extraction methods approved by the Fisheries Department.

Accommodation for visitors is not provided by the reserve management. Most visitors who recreate in the reserve find accommodation in San Pedro, Caye Caulker and Belize City where ample accommodations are available. Tourism and tourism related services are by far the biggest employer in Caye Caulker with a noticeable movement away from fishing although many people still fish in the tourism off season.

The staff of the CCMR schedules meetings with the stakeholders but claims that turnout in most cases has been disappointing hence a need to revitalise the stakeholder community.

The following were noted during the site visit:

- There is annual training of tour guides in proper use of marine resources, in best tour guiding practices and reserve management policies and guidelines,

- Most guides cooperate with the management of the reserve and even help in policing by reporting illegal practices,

- Usually up to 30-40 persons per tour boat and 3 to 4 large boats anchored in choice location at a time with smaller boats present as well,

- Tour guides help to alleviate overcrowding by queuing and diverting to other locations within the reserve,
Most visitors are happy with the quality of marine resources at the site and some have indicated a willingness to pay more considering the quality of the resource,

Tour outfits and guides complain about not having enough mooring buoys. On site Fisheries Department (FD) staff attributes lack of mooring buoys to time, expense and difficulty in obtaining them rather than an intentional strategy to control site use. Fisheries Department would like to install more buoys in the future.

Fisheries Department does not think the reserve has exceeded its carrying capacity and is happy to host current levels of visitation. Staff believe there is elasticity in the number of visitors the site can accommodate,

Caye Caulker residents increasingly moving away from fishing into tourism.

(iii) Political-economic

The following are salient economic conditions prevailing at the site

CCMR charge each visitor BZ$10.00 per visit. There are no complains about current fee structure from guides or visitors.

There were about 11,000 visitors to the site in 2010. Fisheries Department is happy with this number and thinks the sites can comfortably accommodate at this level with minimal ecological effects and the results of the monitoring program seems to support this,

About $110,000 collected from tourism receipts,

Cost of managing reserve is greater than total collected receipts. Site management is subsidized from the public purse.

Seniors, children, the clergy and volunteers do not pay visitation fees as long as they can prove their age or profession.

3.6.3 Blue Hole & Half Moon Caye Natural Monument

(i) Physical-ecological

Both sites are managed jointly under a co-management agreement between the Belize Audubon Society (BAS) and the Forest Department (FD). Under the agreement, the FD has passed day to day management responsibilities of the two sites to the BAS. In effect the BAS
responsibilities include site protection, visitor management, research, publicity and education. The Forest Department retains legislative responsibility as the government entity under whose ultimate responsibility both sites fall.

The Blue Hole Natural Monument (hereafter Blue Hole) and the Half Moon Caye Natural Monument (hereafter Half Moon Caye) are separate entities however they are often considered together (hereafter the HMCBHNM) because they are located in the same general area, are both classed as natural monuments, are marketed together as a single package to tourism operators and both are managed by the same entity as a more or less single unit.

Both Half Moon Caye and Blue Hole are considered protected areas recognized by United Nations Education Scientific and Cultural Organisation (UNESCO) as falling within the Belize Barrier Reef Reserve System – Belize’s World Heritage Site which has been recognized by UNESCO. Apart from tourism and some fishing, both sites have limited anthropogenic influences owing to the fact that they lie on the farthest atoll from mainland Belize.

Together Half Moon Caye and the Blue Hole provide protection for up to twenty species rated as critically endangered, endangered or vulnerable including a number of keystone species. Under their designation both sites are managed for non-extractive uses with the goal of protecting and preserving the environment, while allowing revenue earning and educational pursuits such as tourism and research.

Under the Belizean classification system for protected areas both sites are classified as Natural Monuments, however under the IUCN system the Blue Hole would fall under Category III “An area containing one or more specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance” and Half Moon Caye under Category II “A natural area of land and/or sea designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations; (b) exclude exploitation or occupation inimical to the purposes of the area; and (c) provide foundation for spiritual, scientific, educational, recreational, and visitor opportunities all of which must be environmentally and culturally compatible”. Both sites have a management plan spanning the period 2008 to 2013.

**Blue Hole Natural Monument**

The Blue Hole lies near the centre of the Lighthouse Reef Atoll and was declared a Natural Monument in 1996 and given an area of 414 ha. Its principal attraction is the impressive submarine sink hole formed when a part of the limestone formation collapsed. The resultant
cave formation extends down to a depth of 124m and is 320m in diameter at its widest point near the upper rim. Since the collapse, the sinkhole has been colonized by a spectacular array of marine life for which the cavern is best known.

Coral reef formation is limited to the upper portion of the sinkhole near the rim where 16 coral species are known to exist. As a general rule, benthic life is limited to the upper 50m of the sinkhole with the main limiting factor being the high levels of sedimentation below this point. Seagrass beds can be found near the rim and in the numerous patch reefs near the site, with the healthiest stands found in the areas with the lowest boat traffic. The two species of seagrass found are Thalassia testudinum and Syringodium filiforme.

Habitats including sea grass beds, coral reefs and patch reefs appear to be healthy. There is also good diversity of marine life including fin fishes. Of particular importance is that the population of commercial fish species seems to be robust across all size classes testifying to the success of the management program.

The site is of international renown and often considered the crown jewel of Belize’s protected areas with star revenue generating potential. It attracts visitors and divers from around the world who come to the submerged caves and spectacular stalactite formations. It is one of the few places left on earth where visitors can still view relatively healthy populations of sharks, groupers and turtles.

The site itself has no infrastructure other than mooring buoys however visitors mostly come from Belize City, Caye Caulker and San Pedro and use the facilities on the nearby island of Half Moon Caye as a rest stop and staging area. Tourism facilities are being developed or have been developed on two of the five cayes in the Lighthouse Reef Atoll namely Northern Caye and Long Caye.

**Half Moon Caye Natural Monument**

Half Moon Caye lies near the southeastern end of the Lighthouse Reef Atoll and consist of both marine and terrestrial components. The site contains good representation of the surrounding marine ecosystems including an impressive reef wall drop off, seagrass beds, littoral forest, impressive shallow patch reefs and white sandy beaches. All these attributes help to make it a favoured tourism and dive destination.

**Reef** - The offshore waters support healthy stands of sea grass with Turtle grass (*Thalassia testudinum*) being the dominant specie but with good representation of Manatee grass (*Syringodium filiforme*). Numerous researchers have reported that Lighthouse Reef including
the two marine protected areas have some of the best coral assemblage within the Belize Barrier Reef System (McField 2001, Graham et. al., 2004). The 2004 Rapid Marine assessment (RMA) documented 48 species of scleractinian coral comprising 24 genera within the Blue Hole and Half Moon Caye protected areas; however the amount of cover varied considerably both within and between sites. Interestingly there was also a decline in coral cover on the fore reef from 43.6% in a 1997 study to 30.74% in 2004.

The RMA found that there was a healthy live coral population on the forereef with up to 36 species of scleractinian coral and live coral cover ranging from 12% to 43% with low levels of bleaching or diseases noted. Most abundant corals on the fore reef are the Montastraea annularis with a relative abundance of 39.73%, Agaricia agaricina (15.73%), Colpophyllia natans (8.73%) and Porites porites (6.34%). Acropora cervicornis (2% relative coral composition) was the only specie noted to be in decline. Macroalgae and turf algae together covered 37% of the area.

The reef crest has similarly been noted to be in good condition with dominant species able to withstand the high wave energy, strong currents and exposure dominating in this location. Behind the reef crest in the lagoon area there are numerous patch reefs but here coral diversity decreases (Graham et. al., 2004). The REA identified 23 species of hard coral in this area. Algal growth was noted to be high in this area dominating the patch reef at 79% cover and with a large turf algae composition.

About 138 species of reef fish have been documented within the two protected areas belonging to 42 families and 76 genera. Although this is less than half of the reef fish identified over the entire reef it stills indicate outstanding biodiversity supported by good habitats, under controlled exploitation and intact food chains. The three spawning aggregation sites (Sandbore Caye, HMC Elbow and South Point Elbow) attract up to 20 commercial species of fish many of them vital to the commercial fishing industry since they often represent the total annual production of spawn for the individual species.

**Flora** - The eastern half of the island has been disturbed and in earlier times transformed into a coconut plantation which has been kept into present time for visitor appreciation. This coconut stand appears to be inching into the hardwood forest and colonizing parts of the littoral forest. The western half still has natural littoral forest cover, a vegetation type which is under intense development pressure elsewhere and considered one of the most threatened forest ecosystems in Belize. It is grossly under represented within the current national protected areas system.
The littoral forest is home to what is now considered the only viable colony of White Phased Red Footed Boobies in the Western Caribbean as well as Magnificent Frigatebirds. In addition, the south east facing beach on Half Moon Caye is considered an important nesting area for Hawksbill Turtle (*Eretmochelys imbricata*) a critically endangered species which nest on the island as well as Green Turtle (*Chelonia Midas*) and Loggerhead turtles (*Carretta caretta*) both of which are endangered.

Tree species include *Cordia sebestena, Bursera simaruba, Sideroxylon americanum,* which are used by red-footed booby and magnificent frigate bird to form nesting colonies. Other common species include *Pithecellobium keyense, Pouteria campechiana,* and *Ficus citrifolia.* This forest and the associated ecosystems support in one form or another 128 species of birds and is especially important for migrants which use them as stopover points for feeding and cover.

The littoral forest has suffered significantly from recent storm events. After the storms the BAS had to mount major cleaning up operations. The ecosystem appears to be bouncing back surprisingly quickly with little evidence of the storm observable. It is now given an overall grade of good with some areas being fair while others are considered very good. Low herbaceous beach vegetation grows in a narrow band between the littoral forest and the sea.

**Birds**—The bird fauna of Half Moon Caye is composed of a few resident species – the red-footed booby (*Sula sula*), magnificent frigate bird (*Fregata magnificens*), white-crowned parrot (*Columba leucocephala*), cinnamon hummingbird (*Amazilia rutila*), osprey (*Pandion haliaetus*) and great tailed grackle (*Quiscalis mexicanus*). The black catbird, the golden fronted woodpecker and tropical mockingbird, have been recorded from the adjacent Long Caye, but have not been reported in recent years as resident on Half Moon Caye.

In consideration of this it would not be unreasonable to expect these species to re-establish a presence on Half Moon Caye given the right conditions as they had done in the past. The resident population is supplemented by a seasonal influx of migratory species using the caye as a refuelling point after being blown off course on their route southwards from North America to Central or South America to over winter. The species inventory now stands at 128 species residents and migrants.
Species of International Conservation Concern.

Blue Hole NM = ✓  Half Moon Caye NM = ✓

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<th>Species</th>
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(ii) Socio-demographic

Though users of the fishing grounds surrounding this reserve come mainly from the communities of Chunox, Copper Bank and Sarteneja in northern Belize, the diving tours, which are substantially more lucrative, originate almost exclusively from San Pedro and Caye Caulker. It is these latter communities that are regarded as buffer communities for this PA.

Census results show that both San Pedro and Caye Caulker continue to grow rapidly. In year 2000, San Pedro had a population of marginally less than 5000 persons, while Caye Caulker had
630. By 2010, San Pedro’s population had more than doubled to 11,778, with 73% being Mestizo, 8% Creoles and a smaller 5% being Caucasian/White. The remaining 14% is divided among Belize’s other ethnic groups. By 2010, Caye Caulker’s population had nearly tripled to 1,767 (SIB Census 2010). The ethnic breakdown is 66% Mestizo, with smaller percentages of Creole, Maya and Caucasians. While many factors including internal migration from the mainland may have accounted for the substantial population increase in both islands over the intercensal years, the shift in their macroeconomic structure to tourism is likely a major draw and contributory factor.

The age structure of San Pedro’s population indicates that some 3,529 residents are below the working age of 14 years and an additional 254 are above 65 years old. This indicates an age dependency ratio of 32% on the island. San Pedro’s labor force is some 6,252 persons, with 5,221 being employed and the remaining 1,031 unemployed. Thus the employment dependency ratio calculates to 72.4%.

For neighboring Caye Caulker, there are 576 persons under 14 years and 66 persons over 65. Given a population of 1,766 the age dependency ratio is 36.4%. The labor force on this smaller island is comprised of 686 employed persons and 166 unemployed. The employment dependency ratio is 94%.

San Pedro’s unemployment rate of 16% is some 7 percentage points below the national average of 23%. Given this lower than average unemployment, largely possible from its tourism and service related economy, social conditions for the majority on the island are such that of its 3,774 households, some 98 percent use a flush toilet. The corresponding percentage in Caye Caulker is marginally lower at 97%.

Other social indicators in these buffer communities are also above average. Over 45% of the island’s population has completed an educational level above secondary school and that percentage includes the 3% of its population that has a university education. For Caye Caulker, the corresponding numbers are 49% having a secondary education and higher, including 4% who have a university education.

There is a high level of awareness of the Blue Hole and Half Moon National Monument on both San Pedro and Caye Caulker. Focusing specifically on this PA, a random sample of respondents revealed that 42% said that the country of Belize benefits the most from the existence of this PA. Equal percentages of 16% said that visitors, tourist operators and the communities benefit the most from this PA.
When asked whom they believe benefits the least from this specific protected area, 47 percent of respondents opined that the community benefited the least, while an additional 42 percent said that the visitors benefited the least. Note Figure below.

Perhaps one reason accounting for the fact that a large percentage of respondents believe that the communities derived little benefit from this PA is because comparatively few community
members visit this protected area due to distance and transportation costs. BAS has been seeking to increase local visitations by allowing Belizeans to camp for free.

Like its sister site the Blue Hole, Half Moon Caye is a magnet for tourist and recreational divers who come out on day trips to enjoy the spectacular scenery and world class underwater attractions. The physical infrastructure on the site includes a ranger station, researcher’s building, gift shop and visitor centre, bathrooms with showers and a kitchen. Camping area with basic facilities are also available. The Belize Port Authority has a functioning lighthouse on the island.

Since assuming management responsibilities of the monuments the BAS has carried out numerous projects to improve the amenities at the site to better accommodate visitors as well as to put the management and protection work on a more solid footing. At the present time the BAS has 8 staff posted to HMC on a rotational basis. The staff are involved in a variety of work, however the core task are in protection, education, monitoring and research and tourism.

Over time the organization has built the infrastructure to house the staff and to provide adequate facilities for day visitors. Island expedition (a tour adventure company) also uses the site on a seasonal basis. The group provides their own accommodation on agreement with the BAS which share some of their facilities and who will come into ownership of the facilities when the agreement expires. At the present time Island Expedition have 12 elevated tents on the eastern facing beach south of the main visitor facilities which are able to hold a maximum of 12 persons. They have also built a pavilion and kitchen which they share with BAS.

Other infrastructure and amenity improvement are:

- Rudimentary rain water system based on roof runoff and collection in plastic tanks. These have limited capacity and are vulnerable to damage from hurricanes, seasonal availability, and health and safety considerations.

- Some water is extracted from the fresh water lens but available supply saline and used for washing and cleaning and other non-consumptive uses.

- Rudimentary solar system consisting of a single solar panel – very limited capacity used to power radios and some lights only. Anticipate augmenting the system soon through grant funding which has been approved. Apart from this a small generator is used to power tools and for the use of Island Expedition Camp.
Site uses composting toilets with seven units install and more planned for the Miller building. These toilets appear to function well and could accommodate additional users.

Garbage is periodically taken out to the mainland on boats, additional users would probably strain this system and raise cost. Cost of transportation to and from the mainland is a major cost consideration.

Existing quarters could accommodate more people, however more people would mean the need to use more of the resources of the island and increase supply from the mainland driving up cost and creating a bottleneck.

The marine resources of the Lighthouse Reef attract a large number of fisher folks and provide direct employment for over 3,000 people (McConney et. al., 2003). The majority of the Lighthouse Reef fishermen hail from the three northern mestizo communities of Copper Bank, Sarteneja and Chunox, with a small number of fishermen from Belize City. Fishermen harvest mainly Spiny Lobster (Panulirus argus) and Queen Conch (Strombus gigas), whose populations are in a state of decline in Belizean waters generally due to over harvesting. The following are observable at the site:

Main users of the area around the monuments are fisher folks from Chunox and Copper Bank with some from Sarteneja,

Many diving tours originate from Caye Caulker and San Pedro. Both of these communities are big supporters of the protected areas,

Most visitors come to dive, snorkel see the Blue hole, walk the trails and see the nesting sites of the Red Footed Boobies and the Magnificent Frigatebirds,

Very few Belizeans can afford to visit the site on account of high transport cost, even though BAS has been allowing Belizeans to camp for free.

Up to 90% of the lobster and conch catch is exported while the remainder is consumed locally. Most of the finfish is consumed locally. Due to limited opportunities many young men from these communities go into fishing straight after leaving primary school (FAO, 2005).

The Lighthouse Reef Atoll and particularly Half Moon Caye and the Blue Hole Natural Monuments attract a large number of visitors who come primarily to dive in its world class diving sites. Visitors to the sites arrive on day trips by charter dive boats primarily from San Pedro, Caye Caulker, Belize City or Turneffe Caye. Two of the four Cayes within Lighthouse Atoll (Northern Caye and Long Caye) have tourism developments.
(iii) Political-economic

Based on information from previous studies the BAS raised the visitation rates for visitors up to US$40.00 partly as a revenue enhancing measure and partly to curb demands for visitation to the site. The result of this is that only those willing to pay this rate now travel to the site. At the present time the reserve receives from 11,000 to 13,000 visitors per annum and it appears this number is relatively stable. The BAS believes that the carrying capacity of the site is around this level of use. Almost all visitors are of foreign origin and travel to the monuments for day trip to dive at 3 sites along the reef, visit the blue hole and see the nesting sites on Half Moon Caye.

The BAS is for the meantime happy with this level of visitation however there is a chance that demand for visitation will increase as the international economy recovers.

The following economic conditions are operative within these sites:

- Site is very expensive to run - cost about .5 million per annum,
- Very expensive to resupply PAs which has caused BAS to use other carriers to transport their personnel where feasible, however BAS still make trips once a fortnight using chartered boat,
- Visitors charged total of $40US for visit to Blue Hole and Half Moon Caye,
- BAS has raised entry fee to increase revenue and to cut down on the number of users based on the “willingness to pay principle”.

3.6.4 Gladden Spit and Silk Cayes Marine Reserve

(i) Physical-ecological

The Gladden Spit and Silk Cayes Marine Reserve (hereafter Gladden Spit or GSSCMR) is located roughly 26km east of Placencia in the Stann Creek District and has an area of 10,523ha which is divided into a conservation zone (153ha), a general use zone (10,370ha) and the Gladden Spit spawning aggregation site (518ha). Under this zonation system both extractive and non-extractive activities take place; however even in the extractive zone regulations apply to control over exploitation. The site was declared a marine reserve in May 2000.

The present management objectives of the reserve would place it under IUCN Category IV which denotes a habitat species management area and is defined as follows “An area of land
and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species”.

The primary reason for the designation of the area as a Marine Reserve is to protect the spawning aggregation site which attracts whale sharks (*Rhincodon typus*). The site is now considered the most important spawning aggregation site in Belize (Heyman et. al., 2002). Many species of commercially important fish spawn in the Gladden Spit area and these in turn attract the spectacular Whale Shark which predictably makes their appearance each year between March and June to feed on the spawn.
Other important features include the Barrier Reef which is well developed in this area and the beauty of the small cayes with their potential for tourism. Within the marine reserve are 3 small idyllic islands called Northern, Middle and South Silk Cayes which are popular for their sand beaches and shallow clear waters. The reserve is now recognized as a site of key conservation value by such eminent natural resource management organizations as The Nature Conservancy (TNC), World Wildlife Fund (WWF) and Conservation International.

The Fisheries Department has statutory management authority over the site and had entered into a Co-management Agreement with Friends of Nature which subsequently changed its name to Southern Environmental Association (SEA) on amalgamation with another southern conservation organisation. The SEA is responsible for day to day management of the site which includes protection, monitoring, research, education and tourism.

The location in which the GSSCMR falls is recognized as an eco-regional priority for conservation planning mainly because of its role in maintaining regional commercial fish stocks through its role in protecting critical spawning aggregation. The Gladden Spit spawning site is now famous for the diversity of important species which congregate in the area and spawn. These include over twenty species of reef fish and near shore pelagics including jacks, grouper and snapper.

The most important habitats are the sand beaches of the Silk Cayes, shallow clear waters, vibrant coral reefs and prolific sea grass beds. The main current uses of the reserve are for research, education, tourism, fisheries and the protection of flora and marine fauna. Owing to the quality of attractions, it is reasonable to assume that tourism will continue to be important at the site.

The protected waters of the reserve provide nursery and feeding habitats for at least twenty four species of international concern, recognized under the IUCN Redlist as Critically Endangered, Endangered or Vulnerable, including at least twenty five species of international concern, recognized under the IUCN Redlist as Critically Endangered, Endangered or Vulnerable.

Terrestrial plant life has been transformed through the agency of man and hurricanes, with the Northern Silk Caye deforested while Middle and South Silk Cayes have had their natural vegetation removed and replaced by coconut orchard to increase visitor appreciation.

**Corals** - have been negatively impacted from recurrent hurricanes and coral bleaching which it is believed has resulted from global warming with live coral cover averaging 18.1% on the fore reef and 8.3% on the back reef.
The 2007-2008 assessments of live coral cover across 96 sites in Belize found that GSSCMR live coral cover averaged 11% (McField, et al., 2008 (ed. Wilkinson et al., 2008)), which was lower than the national average of 16.6%. However a more recent study in 2010 estimates the average live coral cover at 13.6%, ranging from 18.1% on the outer barrier reef (at a depth of 10m), and 8.3% on the shallow back reef. The study also found 18.7% macro-algal cover at the same monitoring sites. The GSSCMR is known to host ten species of coral considered critically endangered, endangered or vulnerable on the global scale. It also protects a number of high quality coral reefs including some large stands of endangered Elkhorn (Acropora palmata) and Staghorn (Acropora cervicornis) corals.

**Seagrass** – Within the reserve two species of seagrass have been identified with Turtle Grass (Thalassia testudinum) being dominant and sparse strands of Manatee Grass (Syringodium filiforme) dispersed. Also dispersed throughout the seagrass beds are algae such as Halimeda spp., which is considered an important ecosystem component. Seagrass habitats play an important role in nutrient cycling, filtration and sediment stabilization and provide an important habitat for many marine species but especially such important commercial species as conch and lobster. The seagrass beds of the GSSCMR are considered to be in robust condition and experiencing minor impacts at this point in time.

Sea grass stands which serve as a nursery and habitat for many important commercial species appear to be in robust health. The islands provide valuable nesting sites for endangered sea turtles. Quiet encouragingly Snapper and Grouper populations appear to be stable or even on the rise.

**Fish** – Over 260 species of fish have been identified within the GSSCMR with three species considered critically endangered or endangered globally. These species include the Goliath Grouper (Epinephelus itajara), the Nassau Grouper (Epinephelus striatus), and the Great and Scalloped Hammerheads (Sphyrna mokarran and S. lewini).

Probably the most famous fish that navigate the waters within the reserve is the Whale Shark (Rhincodon typus) which congregates during the ten days of the full moon in May, June and July to feed on spawn at the aggregation site. The highly predictable presence of the Whale Shark has in turn spawned a vibrant and lucrative tourism trade for people in the buffer communities such as Placencia. The SEA has tried to minimize impacts to these iconic animals by regulating the number of tours and number of visitors allowed at the site at any given time.

Recently there has been an increase in the number of fish observed within the GSSCMR. This is widely attributed to better enforcement of the regulations on the part of the SEA. Despite this,
the number of fish visiting the spawning sites has not increased although they are believed to be stable.

Regulations introduced by the SEA and the Fisheries Department to protect the reserve’s resources include the granting of special licenses to traditional fishermen, careful enforcement of fisheries laws and the prohibition of night fishing. Due to these regulations the vast majority of fish targeted by local fishermen are mutton snapper and not the Cubera and Dog Snapper which are the major attraction for Whale Sharks.

The reserve helps to conserve such keystone and critically endangered and endangered species as the Hawksbill Turtle (*Eretmochelys imbricata*), Goliath Grouper (*Epinephelus itajara*), Green and Loggerhead Turtles (*Chelonia mydas* and *Caretta caretta*). It also protects viable populations of such important commercial species as the Queen Conch (*Strombus gigas*) and Spiny Lobster (*Panulirus argus*) and has a good population and variety of ray and shark species.

**Reptiles and Mammals** – It is believed that Loggerhead and Green Turtles frequent the waters of the GSSCMR, and Green Turtles are known to nest on the cayes of the reserve.

Several species of dolphins are believed to use the waters within and adjacent to the reserve. These include the Atlantic Bottlenose Dolphin (*Tursiops truncates*), the Atlantic Spotted Dolphin (*Stenella plagiodon*), the deeper-water Rough-toothed Dolphin (*Steno bredanensis*) and Fraser’s Dolphin (*Lagenodelphis hosei*). Antillean (or West Indian) Manatees (*Trichechus manatus*) have been reported from the Silk Cayes area and are believe to enter the reserve to graze on the sea grass beds.

**Monitoring**

Monitoring of target fish abundance is ongoing in the area since 2003. A monitoring manual is now available to ensure standardized monitoring techniques across the three protected areas managed by the SEA. Lobster and Conch stock assessments are included and the data shared with the Belize Fisheries Department.

The SEA does not have a research facility within the GSSCMR although there is ongoing research being undertaken by other collaborating organizations. This research is mostly focused on the spawning aggregation site, the whale sharks, currents, physical oceanography, and connectivity.
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<td>Whale Shark (<em>Rhincodon typus</em>)</td>
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<td>West Indian Manatee (<em>Trichechus manatus</em>)</td>
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<td>Marbled Grouper (<em>Dermatolepis inermis</em>)</td>
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<td>White Grouper (<em>Epinephelus niveatus</em>)</td>
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<tr>
<td>Snowy Grouper (<em>Epinephelus flavolimbatus</em>)</td>
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</table>
(ii) Socio-demographic

Although communities as far north as Sarteneja in the Corozal District utilize this reserve, the most important buffer communities are Independence, Monkey River, Hopkins, Seine Bight and Placencia.

Placencia which lies some 36km due west of the reserve is the nearest community to the GSSCMR. It is by far the single most important community in terms of resource use and associated benefits. Placencia has a population of some 1,749 residents, with the largest ethnic groups being Creoles at 42% and Mestizos at 25%. Some 443 residents are younger than 14 years old and an additional 78 are over 65 years. Thus the age dependency ratio of the village is 30%.

The village has a labor force of some 997 persons, with 860 being employed and the remaining 137 being unemployed. The employment dependency ratio calculates to marginally in excess of 60 percent. Over 28% of the village’s population has attained an educational level that is higher than secondary schooling, and this percentage includes nearly 5% with a university education.

Thirty seven percent of the households in the village are paying rent, while the remaining households are freehold properties owned by the occupants. Over 98% of residents have a source of potable water that is either piped directly into their yards or piped into their homes. A similarly high percentage of households use a flush toilet that is linked to a septic tank.

<table>
<thead>
<tr>
<th>Who benefits most from a Protected Area?</th>
</tr>
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<tbody>
<tr>
<td>Frequency</td>
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<td>-----------</td>
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<tr>
<td>Valid Visitors</td>
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<tr>
<td>Belize</td>
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<tr>
<td>Tourist Operators</td>
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<tr>
<td>Communities</td>
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<tr>
<td>Other</td>
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<tr>
<td>Total</td>
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</tbody>
</table>
The benefits of tourism in Placencia are easy to discern. There is a general consensus in the village that the protected area status of Gladden Spit and the Silk Cayes ought to continue. Thirty five percent of respondents are of the opinion that Belize benefits most from protected areas, while an additional 20% are of the view that visitors benefit most from this protected area. Equal percentages of 15% opine that tourist operators and communities benefit from this protected area.

Villagers were also asked if new sources of revenues are needed for investment in protected areas, from where these new revenues should be sourced. As noted from the graph above, the single largest bloc of respondents – 35% indicated that new fees ought to be instituted for the Protected Area. Correspondingly smaller percentages opined that international donors and visitors, respectively, ought to be the source of the required revenue inflows.
There is no permanent settlement within the reserve, however some Belizean fishermen have traditionally fished and camped within the area and are considered to have traditional rights to the fishing grounds. The traditional fishing sector provides employment for over 2,750 fishers (Ministry of Agriculture and Fisheries, 2010). Fishermen who work the grounds around the GSSCMR hail mainly from the mainland communities of Hopkins, Sittee River, Riversdale, Seine Bight, Placencia, Independence and Monkey River, and the northern coastal communities of Sarteneja, Copper Bank and Chunox.

Most fishermen from the south utilize the site during the spawning aggregation while the fishermen from the north and particularly Sarteneja tend to be visible all year round. Northern fishermen mostly engage in free diving and hand line fishing with the main focus being on conch and lobster. Many of the fishermen who fish these waters are young (15-35yrs) and would otherwise face bleak employment prospects on the mainland given their limited educational attainment and skills level. There is evidence that Guatemalan and Honduran fishermen also enter the waters within the reserve and fish illegally at night.
The many attractions of the GSSCMR attract heavy day-tourism use during the spawning season when the whale sharks are present, however many visitors also engage in snorkeling and Kayak tours. A number of sail charters also use the area for overnight stops.

Modest accommodations are available for these day visitors on South Silk Caye. The facilities include two bathroom stalls, four picnic tables and a barbecue grill with a second barbecue grill located on Middle Silk Caye. The Port Authority has installed 2 mooring buoys near South Silk Caye for use by both day and overnight tour boats. Additional mooring buoys are available in the whale shark zone for boats conducting day trips to the spawning aggregation site.

Placencia is the main departure point for tourist bound for the GSSCMR. This community has grown into a major tourism destination and has seen its economy transformed within the last decade from one based on fishing to a service economy with tourism at its core. Tour guides are required to use best practice when taking tours on the reef. The SEA has implemented controls over visitation to the whale shark congregation areas through a series of regulations agreed to by the tour operators, and there are stiff penalties imposed for those who fail to abide by the rules.

The SEA is trying to increase stakeholder support for the reserve through efforts aimed at educating stakeholders and giving them a voice in the management of the reserve. The organization supports initiatives aimed at promoting alternative livelihoods to decrease pressure for the marine resources within the reserve. Education programs are aimed primarily at developing greater understanding among stakeholders of all ages about the importance of marine conservation and marine protected area management.

Although the small cayes within the reserve boundaries are uninhabited many of the cayes surrounding the reserve have been and continue to be used as fishermen’s camps. Fishing is permitted at the spawning site for traditional fishermen, but is strictly regulated, with special licenses granted for fishing Mutton snapper from April-June and absolutely no night fishing allowed. Local fishermen still harvest conch, lobster and fin-fish within the GSSCMR’s general use zone.

- SEA regards the buffer communities for GSSCMR as Placencia, Independence, Sarteneja, Hopkins (seasonal) and Monkey River (seasonal).
- Buffer communities benefit via direct resource use or through employment.
- No visitation allowed on Northern Silk Caye. It is a habitat for birds and has a large hawks nest.
Middle Silk Caye is the only island with a permanent beach, but hardly frequented by tourists.

Southern Silk Caye is smallest of the cayes and has the most visitors. A single bathroom is on this caye and uses sea water to flush. The beach on Southern Silk Caye washes away frequently.

Similar to Sapodilla Cayes, garbage from Honduras occasionally washes on Southern Silk Caye, though not with the same frequency.

All garbage is shipped out to the mainland for disposal.

Carrying capacity on Silk cayes is estimated by the rangers to be from 75 to 100 persons per island.

For Gladden Spit, carrying capacity determined via consultation between SEA and tour operators/stakeholders. Maximum 6 Boats per day. Maximum 12 persons per boat and maximum 90 minutes per boat. Visits start around full moon for months of April and May. Hence only about 10 to 12 days of visitation for each of these two months.

(iii) Political-economic

Gladden Spit and Silk Cayes Marine Reserve has an estimated yearly use value of approximately Bz$2.50 million per year to the tourism industry, and provides over Bz$136,000 (US$68,000) in ticket revenue (Bravo, 2010). Whale shark tourism is a major draw for many visitors to Placencia, and other parts of southern Belize, with over 8,500 guests visiting in 2009. GSSCMR is also of economic importance as a lobster, conch and fin-fish resource for traditional fishermen from mainland fishing communities - particularly Sarteneja, Hopkins, Placencia and Monkey River.

- Entrance fees is $20 per person per day and for whale shark visitation $30 per person per day,
- On a good day revenue from visitation can reach up to BZ$2000.00.,
- Fishing licenses $25.00,
- SEA’s operating costs for this reserve is estimated at over $110,000 annually.

Whale sharkting provides the most important revenue source for the reserve, however it should be pointed out that the reserve only provides a small percentage of revenues needed to fund SEA’s operations with the rest coming from public sources and international funding.
There may be scope for increases in the above fees as the visitors are generally environmentally aware and higher income tourists. Potential new income generating activities include shark ray location nearby – similar to shark ray alley – where different marine species congregate. It was thought that cruise tourism would have been a financial bonanza for this reserve however the Placencia community is against this venture. The rangers report substantial amount of visits from Guatemalans and Hondurans.

3.6.5 Sapodilla Cayes Marine Reserve

(i) Physical-ecological

The Sapodilla Cayes Marine Reserve (SCMR) is the most southerly of the marine protected areas in Belize lying near the southernmost tip of the Belize Barrier Reef about 75km east of Punta Gorda Town. The reserve has an area of 15,619ha and is part of the Belize Barrier Reef World Heritage Site. The reserve has several management zones including a preservation zone (222ha), a conservation zone (264ha), a general use zone (1,988ha) and three (3) spawning aggregation sites.

The management objectives of the site indicate it falls under IUCN Category IV (Habitat/Species Management Area) defined as “An area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species”.

Sapodilla Caye is one of the four marine reserves that form the Southern Belize Reef Complex (SBRC), which stretches southwards from the northern boundary of South Water Caye Marine Reserve to the northern boundary of Port Honduras Marine Reserve, and south-eastwards from the coastline of Belize to the Sapodilla Cayes and the outer reef.

Important cayes in the range include Hunting, Nicholas, Lime, Franks, Northeast, Ragged, Seals, Tom Owens and other smaller outlier cayes. All cayes are composed of sand or boulder and most are privately owned. Because it is located so close to the international frontier with Guatemala and Honduras this reserve receives a lot of visitors from those countries – both legal and illegal.

The Fisheries Department is the designated management authority for the reserve and has an active presence in the reserve, however they have entered into a co-management agreement with the Toledo Association for Sustainable Tourism and Empowerment (TASTE) which subsequently amalgamated with Friends of Nature to form the Southern Environmental Association (SEA) with headquarters in Placencia Village, Stann Creek District.
The SEA as the successor organization now assumes all co-management obligations of TASTE and is responsible for day to day management, protection work, monitoring and research and tourism related activities in conjunction with the Fisheries Department. A management plan for the reserve was produced in 2011 and should guide management interventions until 2016.

Besides SEA several entities have a toehold in the reserve and have established infrastructure on Hunting Caye to support their operations. This includes the University of Belize which owns land on Hunting Caye and maintains a research facility, the Belize Coast Guard which monitors the territorial seas of Belize and is active in the southern region and the Fisheries Department which maintains a strong physical presence in the reserve and shares accommodations with the Immigration Department. The Belize Port Authority maintains a lighthouse on Hunting Caye. SEA has a ranger station and some tourism infrastructure to accommodate visitors to the island.

Main uses of the reserve are fishing (extractive and non-extractive), Research/education, Tourism/recreation. Tourism and recreational visitation is on the increase and the site is visited by small cruise ships.

Some of the Cayes within the Sapodilla Range are considered among the most beautiful in the country and the coral diversity is the highest within the entire Belize Barrier Reef Complex. As a result, the islands of the Sapodilla Cayes Marine Reserve have high ecological and touristic value as well as significant potential for education and research. Some of this potential is currently being developed and the site may yet become an important tourism, educational and research center within Belize.

The Cayes are considered important nesting sites for Hawksbill turtles, whose nesting populations are now stable, although far below their historic highs. There are spawning aggregation sites near Rise and Fall Bank, Seal Caye and Nicholas Caye. The most abundant species observed in the spawning aggregation were Nassau Grouper, Yellowtail Snapper and Cubera Snapper with at least 8 other species observed.

In recent years the spawning aggregation sites have shown decreasing numbers of fish. It is not clear why the decrease is taking place despite the protected areas status of the site; however it appears that fishing might be taking place even during the closed (spawning) season.

**Ecosystems** - The Marine Reserve contains assemblages of regionally important ecosystems of remarkable biodiversity and great scientific value. Main ecosystems are the forereef, reef crest, lagoon and patch reefs with sea grass beds, however there are several channels that penetrate the reef and connect the inner reef from the forereef and promote water exchange between
the two habitats. Most of the Marine Reserve consists of submerged sand in shallow water. The reef drop-off have created conditions suitable for the establishment of three nationally and regionally important spawning aggregation sites including Nicholas Caye, Rise and Fall Bank, Seal Caye and the Elbow.

**Habitats**

**Reef** – The sheltered waters of the back reef contains some of the best assemblages of corals and sponges within the entire Belize Reef system. Corals of incredible structure and diversity are found in this area. This area also contains sea grass beds and patch reefs some of incredible diversity, with high live coral cover, making them popular attractions for snorkelers.

Live coral cover which is often taken as a snapshot of a reef’s health is lower than at other neighboring sites 9.9% vs 16.6% although numbers vary depending on the time and entity carrying out the surveys. This number is low when compared to national and international averages, and when historical accounts of live coral cover is taken into account. It should be noted however that some locations within the marine reserve had exceptionally high live coral cover of up to 46%. Algal cover within the back reef ranged from 14 to 34.1% but here again the numbers differed widely.

The SCMR is home to nine species of coral considered critically endangered, endangered or vulnerable on the global scale with at least 21 coral species regularly recorded on the back reef. The majority of the coral is composed of massive reef building corals *Agaricia tenuifolia* and *Montastraea annularis* make up the majority of corals encountered at each site however there is great diversity in the composition of corals between the sites.

**Seagrass** – Seagrass found within the shallow backreef lagoon is predominantly turtle grass (*Thalassia testudinum*), interspersed with sparse strands of manatee grass (*Syringodium filiforme*). Seagrass meadows in general support a high diversity of critical habitats in shallow marine ecosystems, and play a role in nutrient cycling, filtration and sediment stabilization. Seagrass beds also play a critical role as a nursery area for commercially important conch and reef fish species. At the SCMR these habitats are considered to be in good condition although there are some threats associated with visitor use. The seagrass beds of the SCMR have some of the best conch nurseries in the country and the highest density of juvenile conch.

**Terrestrial Ecosystems** – The islands within the SCMR still contain good stands of littoral forest which is endangered and disappearing rapidly elsewhere in the country. These forests play a vital role in protecting the soil and in providing habitat for animals. Along with the herbaceous
beach communities, they provide a valuable habitat for birds and seas turtles some of which are critically endangered.

In all a total of 33 species of naturally occurring plant species have been identified on the cayes, however this forest tends to be dynamic and changing over time in the face of natural disturbances and human influences. The littoral forest has been impacted by humans who have introduced new species or removed the natural forest to promote development and make the area more aesthetically appealing. As a result some species are in decline or in danger of being wiped out.

**Fish and Wildlife**

**Fish** – Fish populations within the SCMR is less than would be expected. The numbers of Herbivorous grazers such as parrot fish have been significantly reduced. Sharks populations are in decline because of over exploitation, however up to seven species have been recorded in the waters of the SCMR and adjacent areas.

Lobster has traditionally been a major fishery resource within the Sapodilla Range, however the numbers today have declined dramatically especially when compared to other managed reserves. There is a surprisingly high population of juvenile conchs within the reserve (densities of up to 3000 individuals per hectare) however there is also a disproportionately small amount of conchs in the larger size classes.

Fin fish can still be taken legally by a small number of traditional fishermen using spear and hand lines, however their numbers are declining while the number of Honduran and Guatemalan fishermen appear to be increasing. Species taken include groupers (*Epinephelus* spp. and *Mycteroperca* spp.), snappers (*Lutjanus* spp. and *Ocyurus* spp.) and hogfish. Species observed aggregating at the Nicholas site include; black grouper (*Mycteroperca bonaci*), red hind (*Epinephelus guttatus*), tiger grouper (*Mycteroperca tigris*), yellowfin grouper (*Myceteroperca venenosa*) and various other reef fish.

**Birds** – Like most of the offshore islands of Belize the Sapodilla Cayes provides crucial habitat and stopover for a diverse range of migratory birds and the predators which depend on them. The sandy cayes also serve as nesting ground for a number of bird species. Lime and Ragged Caye as well as the Sandbore in the SCMR serve as important rookery sites for terns. After suffering from the impact of human encroachment onto the islands when several species ceased to nest on the islands present indication are that at least some of the species are coming back.
### Species of International Conservation Concern.

<table>
<thead>
<tr>
<th>Species</th>
<th>Critically Endangered</th>
<th>Endangered</th>
<th>Vulnerable</th>
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<tbody>
<tr>
<td><strong>Coral</strong></td>
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<tr>
<td>Staghorn Coral ((Acropora cervicornis))</td>
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<tr>
<td>Elkhorn Coral ((Acropora palmata))</td>
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<tr>
<td>Fire Coral ((Millepora striata))</td>
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<tr>
<td>Star Coral ((Montastraea annularis))</td>
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<tr>
<td>Star Coral ((Montastraea faveolata))</td>
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<td>Lamarck's Sheet Coral ((Agaricia lamarcki))</td>
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<td>Pillar Coral ((Dendrogyra cylindrus))</td>
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<tr>
<td>Elliptical Star Coral ((Dichocoenia stokesii))</td>
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<tr>
<td>Montastraea coral ((Montastraea franksi))</td>
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<td>Rough Cactus Coral ((Mycetophyllia ferox))</td>
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<td><strong>Fish/Turtle</strong></td>
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<td>Hawksbill Turtle ((Eretmochelys imbricata))</td>
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<td>Loggerhead Turtle ((Caretta caretta))</td>
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<td>Nassau Grouper ((Epinephelus striatus))</td>
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<td>Great Hammerhead ((Sphyrna mokarran))</td>
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<td>Scalloped Hammerhead ((Sphyrna lewini))</td>
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<td>Rainbow Parrotfish ((Scarus guacamaia))</td>
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<td>Queen Triggerfish ((Balistes vetula))</td>
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<td>Hogfish ((Lachnolaimus maximus))</td>
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<td>Cubera Snapper ((Lutjanus cyanopterus))</td>
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<td>White-lined Toadfish ((Sanopus greenfieldorum))</td>
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<td>Snowy Grouper ((Epinephelus niveatus))</td>
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**Reptiles and Mammals** - Three species of sea turtle are known from the SCMR namely the critically endangered Hawksbill \((Eretmochelys imbricata)\), the endangered Green Turtle \((Chelonia mydas)\), and Loggerhead \((Caretta caretta)\). Both the Loggerhead and Green Turtle are believed to still nest within the reserve.
For a number of years rangers and biologists have been monitoring turtle nesting populations at the Sapodilla Cayes Marine Reserve. This has included recording the number of nests and where possible calculating nesting success. The SEA has been monitoring for turtle nests within the reserve and the results for 2010 show that nesting is taking place on Lime Caye, Nicholas Caye and Hunting Caye with at least 20 nesting taking place. Earlier monitoring had shown a 68-81% success rate for turtle nesting sites on the cayes. It is believed that turtle nests within the marine reserve have been raided in the past by poachers originating from Guatemala and Honduras, however the situation has improved with the advent of onsite protection.

Other reptiles found on the islands include the Brown Anolis (Anolis sagrei), St. George’s Island Gecko (Aristelliger georgeensis), the Green Iguana (Iguana iguana), the Boa (Boa constrictor) and the American Crocodile (Crocodylus acutus).

Manatee sightings have been reported within the waters of the SCMR but these have not been reliably confirmed. Dolphins which have been observed in the waters to the north of the reserve are also believed to use the waters of the SCMR but this also has not been confirmed.

(ii) Socio-demographic

The Sapodilla Caye Marine Reserve (SCMR) comprises some six cayes at the southeastern most part of the country of Belize. All these cayes are privately owned except Hunting Caye, which is the single largest caye and which is also the location of the government departments that oversee the reserve. These government agencies are Coast Guard, Port Authority, Fisheries Dept., Immigration Dept. and the University of Belize. In total some 15 persons are employed among these agencies as well as two lighthouse keepers working under the Port Authority.

Presently the SEA’s staff has accommodations on Hunting Caye which host the personnel of the Fisheries Department. A portion of Hunting Caye is also privately owned.

Located some 36 miles due east of Punta Gorda Town, there is no immediate buffer community near this marine reserve. Though Punta Gorda town is not regarded as a buffer for this PA, this town is the nearest population centre to the reserve. There are no scheduled trips to the reserve due to high costs. There is a perception in Punta Gorda that Belizeans are being denied the use of the resources of the PA, while simultaneously these resources are being exhausted by the Guatemalans and Hondurans.

The islands have traditionally been used in an unregulated way by Honduran and Guatemalan fishermen and tour operators. At the present time visitation onto the reserve from neighboring countries is documented and regulated by an immigration officer. At certain times of the year
(e.g. Christmas and Easter) the Marine Reserve receives an influx of visitors mostly from Guatemala but also from Honduras. At least some of these visits are arranged by tour companies operating from those countries although some people who arrive at the site come in their own vessels. Hunting Caye serves as a getaway for the economic elite in Guatemala and Honduras, who visit the island and either come on shore to enjoy the beach or remain in their pleasure boats docked nearby.

Some of the tour companies from Guatemala and Honduras offer three-day camping excursions to the Sapodilla Cayes although this only takes place on some of the islands. A Guatemalan company, Teacher Caribbean Tours, also bring tourists from that republic to the SCMR. An entrance fee of US $10 per person per day is charged. As a result of these excursions, there are close links with the Guatemalan communities of Livingston and Puerto Barrios and the Honduran communities of Punta Manabique, Omoa and Puerto Cortes. Most of these visitors engage in fishing, snorkeling and diving.

The Sapodilla Cayes has been used for some time now by small cruise ships which continue to make regular scheduled visits. The Seabourne Cruise Line began making regular trips to the islands in 2006 and continues to make six trips annually for day excursions.

The location of the islands – some 36 miles from Punta Gorda town and its attendant transportation cost serves as a limitation to the number of local visitors and as a result very few Belizeans visit the islands, however those who do normally participate in sport fishing, snorkeling and diving. Some Belizean live aboard charter boats from Placencia also visit the site. All visitors that enter the reserve must register and pay visitation fees at the office on Hunting Caye. The travel distance ranges from one to two hours and even more depending on the size of the boat and weather conditions. None of the hotels in Punta Gorda offer scheduled tours to the SCMR, though a tour company in that municipality, Garbutt’s Marine, as well as a tour company in Placencia, Trade Winds, do offer occasional tours to the reserve.

Tourism and the business of catering to tourist is now an established enterprise on the islands and a basic infrastructure has been built to facilitate this. The infrastructure includes:

- bioremediation toilets and shower facilities,
- palapas
- kitchen and bar
- eco-friendly shower facilities,
- pier, and
- Raised picnic area with BBQ grills,
Local fishermen from Monkey River, Punta Negra and Punta Gorda have traditionally used the area now occupied by the reserve as their fishing ground, however the use of this area by these fishermen has decreased considerably over the last five years partly as a result of the cost of reaching the site, the lack of available space for camp sites and partly because of the ongoing protection work which now restricts their activities. In addition to this, the marine resources within the southern region are significantly depleted discouraging native Belizean fishermen.

Where local fishermen have vacated the field the space has been eagerly filled by trans-border fishermen who fish, hunt and dive illegally within the southern waters of Belize. Recently a lively trade has developed in Guatemala for Sea Cucumber and up until recently these were being intensively harvested in Belizean waters.

The location of the cayes – specifically Hunting Caye- facing the huge rivers of Honduras and Guatemala where tons of garbage are deposited and subsequently washed into the sea means that a substantial amount of garbage washes up on the north and eastern portions of the reserve. For about three months of every year, about twenty large plastic bags of garbage, mainly plastics, are collected every day. Disposal of such large accumulated quantities of garbage has become problematic. Ideally they should be brought to the mainland and properly disposed but this is hardly ever done. They are simply burnt on the island.

The PA Manager of SCMR believes the carrying capacity of the reserve to be 50 visitors. His estimate was based on the number of people that can be accommodated by the bathroom facilities on Hunting Caye. This estimate though must be regarded as being substantially conservative. This is because several visitors visit the SCMR and remain on their boats without stepping foot on any island. In addition if the facilities are beefed up the islands and the recreational sites are large enough to accommodate far more people.

A major factor influencing the determination of carrying capacity is the ability to supply sufficient potable water for visitors and residents. At the present time water is supplied from wells and pumped into large vats. The tour company with facilities on Hunting Caye has six vats each with a capacity of 2,500 liters. These vats provide water for bathing and flushing of the toilets. Waste from the toilets enters a septic tank and overflows into the bushes which act as a soak away. The impact of this practice on the ground water is at present unknown but leaves room for concern.
(iii) Political-economic

The non-Belizean visitors to the island pay a fee of US $10.00 per day. Since these visitors are likely to have above average incomes, perhaps there is scope for increases in this fee. If their demand for visits to the SCMR is inelastic, any fee increase will result in increased revenues to GOB.

The Immigration Department also earns revenues at Hunting Caye. This would be the late fee payable by foreigners who arrive on visits on weekends and after working hours.

The facility owned by the University of Belize on Hunting Caye is aimed at “facilitating research and sustainable use and management of the Belize Barrier Reef.” UB could seek to expand its fledgling research efforts and possibly generate more income. The University has a nine room guest house on Hunting Caye and also makes Noni juice from the Noni plant which grows abundantly on Hunting Caye.

3.6.6 Nohoch Cheen Archaeological Reserve

(i) Physical-ecological

Nohoch Cheen Archaeological Reserve (NCAR) is a small site that has recently assumed prominence among Belizean protected areas because of its importance to the fledgling cruise tourism industry and as a site of outstanding geological, historical and cultural value. The NCAR has unique subterranean river, caves, archaeological relics, cultural expressions, vegetation and wildlife which are all popular attraction for visitors.

The total area of the NCAR is 453.71 acres (183.6ha) distributed among four parcels. Three (3) of these parcels are very small and together make up only 3.71 acres (1.5Ha). The NCAR is located 5.4 miles (8.64km) south of the Western Highway at the end of the Frank’s Eddy Road that links the site to the Western Highway. The road which was formerly paved is now in a state of disrepair and is best classified as a secondary all weather road.

The NCAR is located in the Boundary Fault Karst Region of Belize. The subsurface area of the site consists of seven caves representing less than 1% of the total area of the reserve. The Caves Branch River originates in the Mountain Pine Ridge, with a non-carbonate catchment area of 64 km$^2$ and transport water and sediment from the highlands through the karst.

A gate at the northern entrance to the park regulates access into the tourism and recreational grounds. A ticket booth and spacious parking lot for buses, vans, and other smaller vehicles are located next to the entrance gate.
The NCAR is managed by the Archaeology Department which comes under the umbrella of the National Institute of Culture and History (NICH). To ensure that NCAR continue to provide abundant opportunities for education, research and sustainable development the NICH seeks to protect, restore, and manage the resources within their broader ecosystem and cultural context.

It is the purpose and goal of the National Institute of Culture and History to preserve and protect the diverse and significant features of the NCAR while allowing for the continued recreational use of the cave, with the understanding that for this to occur, the natural processes that created the cave must continue to function unimpeded by anthropogenic interference.

Cave-tubing through the caves is by far the most popular attraction at the site. To access the caves visitors take a 40 minute hike along a trail that leads from the park entrance and parking lot, across the Caves Branch River and through forested trails, to the entrance of the cave system. At the present time only two (2) of the seven caves are used for cave-tubing.

Visitors use the inner tube of vehicle tires for flotation and are always accompanied by a licensed tour guide who is trained in caving and safety. Visitors are required to have headlights and to use helmets for safety. In the caves stalagmites, stalactites and evidence of Mayan occupation are clearly visible. Visitors float past the exit and continue down the river back to the initial crossing point, and walk back to the parking lot.

The site is important because of the quality of the attractions, the presence of visitor facilities and its accessibility to large population centers. It is especially important for the cruise ship industry whose passengers have only a short amount of time to spend onshore and who need an attraction that is close by and exciting. The site also offers educational and research tours however these are not nearly as popular with visitors. The park may be closed for cave tubing activities for certain periods during the rainy season due to increased cave tubing risks associated with high river levels.

Archaeological and Cultural Resources

The ancient Mayas used the areas around the Caves Branch area and the NCAR extensively as can be inferred from evidence in the caves. It is believed that the Mayas starting used the caves for at least 400 years beginning in the early classic period. Among the evidence that supports this is the abundance of ceramics that provide evidence of the use of the caves in the Caves Branch Valley. The site contains red-orange slipped dish or bowl which was popular
during that period in the Maya Lowlands. These bowls were popular at Caves Branch and came in diameters ranging from 32-38 cm, 28-30 cm, 21 cm, to as small as 9 cm.

Other archaeological evidence suggests ritual offerings by the Maya in caves using stone, bone, shell, wood, incense, and maize. Still other evidence suggests ceremonial offerings including piles of broken pottery, and items of flint, obsidian, bone (both animal and human). A cache of 26 burial sites was discovered in the Caves Branch area and a recent additional site found with nine individuals. Some Mayan artwork has also been discovered in the caves.

Vegetation
Forest covers the vast majority of the surface area of the NCAR. The limestone and clay soil in has a determining influence on the type of vegetation found in the area. The vegetation is predominantly Lowland Broadleaf Forest, which is characteristic of the Sibun River Watershed and typical of Central Belize. The forested part of the NCAR is by far the larger portion of the reserve and contains a large diversity of plants.

Some typical species found in the NCAR includes the following: Craboo (Byrsonima crassifolia); Chicle (Manilkara zapota); Ramon or Bread-nut (Brosimum alicastrum); West Indian Mahogany (Swietenia macrophylla); Cedar (Cedrela odorata); Boatan Palm (Sabal mauritiformis); Logwood (Hematoxylum campechianum); Fiddlewood (Vitex guameri); Gumbolimbo (Bursera simaruba), Copal (Protium sp.); Cockspur (Acacia cornigera); Give and Take Palm (Cryosophila stauracantha); Yemeri (Vochysia hondurensis); Santa Maria (Calophyllum brasiliense); Wild Grape (Coccoloba belizensis); Black Cabbage Bark (Lonchocarpus castilloi); Cohune Palm (Orbigyna cohune); MyLady (Aspidosperma cruentum); and Glassy Wood (Guettarda combsii).

Fauna
The NCAR has a diversity of habitats which supports a rich array of faunal species, however research into the flora and fauna of the area is sketchy and still in its infancy. The bird fauna represents in excess of 210 species, however this is more an indication of the limited observations and not a true indication of species diversity which must be much higher.

Key resident and migrant species typical of the area include: Vermilion Flycatcher (Pyrocephalus rubinus), Great Kiskadee (Pitangus sulphuratus), American Kestrel (Falco sparverius), Thrush-like Schiffornis (Schiffornis turdina), White-whiskered Puffbird (Malacoptila panamensis), Squirrel Cuckoo (Piaya cayana), Lineated Woodpecker (Dryocopus lineatus), Black-Headed Trogon (Trogon melanocephalus), Indigo Bunting (Passerina cyanea), Rose Breasted Grosbeak (Pheucticus ludovicianus), White Crowned Parrot (Pionus senilis), the Laughing Falcon
(Herpetotheres cachinnans), the Collared Aracari (Pteroglossus torquatus), the Keel-Billed Toucan (Ramphastos sulfuratus), plus 4 species of orioles, 9 species of tanagers, 20 species of flycatchers, and many more.

Mammals common to NCAR includes bats of the genera Carolia and Glossophaga, observed specifically within the Caves Branch area. Others include the Gray Four-eyed Opossum (Philander opossum), the Nine-banded Armadillo (Dasypus novemcinctus), Antsbear (Tamandua mexicana), Mexican Black Howler Monkey (Alouatta pigra), Gray Fox, (Urocyon cinereoargenteus), Margay (Leopardus wiedi), Striped Hog-nosed Skunk (Conepatus semistriatatus), Kinkajou (Potos flavus), Coati (Nasua narica), Raccoon (Procyon lotor), Baird’s Tapir (Tapirus bairdii); White-lipped Peccary (Tayassu pecari), White-tailed Deer (Odocoileus virginianus); and Deppe’s Squirrel (Sciurus deppei).

The Green Iguana (Iguana iguana) and the Scaly Iguana (Ctenosaura similis) may also be observed in the area. Snakes expected to be found in this area include the Eyelash Viper, (Bothriechis schlegelii), Tropical Rattlesnake (Crotalus simus), Tropical Kingsnake (Lampropeltis tiangulum), Green Vine Snake (Oxybelis fulgidus), Central American Coral Snake (Micrurus nigrocinctus), Fer de Lance (Bothrops asper), and the Jumping Viper (Atropoides nummifer), among others.

The exotic Tilapia (Oreochromis niloticus) has been observed as a common freshwater species in the Caves Branch River, along with other native species such as the Bay Snook (Petenia splendida), Mus Mus (Parachromis friedrichstahlii), and the Blue Catfish (Ictalurus furcatus).

(ii) Socio-demographic

Though the villages of St Matthews and Frank’s Eddy may be regarded as the buffer communities for this reserve, the latter village is substantially more dependent upon the park for its economic livelihood.

Frank’s Eddy has a population of 386 persons, the overwhelming majority of whom are Mestizo/Hispanic. Some 180 villagers are younger than the working age of 14 years. Coupled with the 6 villagers who are older than 65 years, the age dependency ratio in the village is 48%.

However, given the age structure of the village and the large percentage of persons who are not in the labor force, the employment dependency ratio is over 500%. This implies that many persons depend upon the village’s relatively small employed population of only 51 persons. The unemployment rate in the village is greater than 50%.
Unlike the other buffer communities, where substantial numbers of persons have gone to at least secondary education, this is not the case in Frank’s Eddy where, a quarter of the villagers have no formal education, and an additional 17 percent only completed primary education. Frank’s Eddy is also below average in other social indicators, namely percentage of households with flush toilets and land ownership.

It would appear then that whereas all the other buffer communities studied seem to benefit from the existence of a nearby protected area, the same cannot be said of Frank’s Eddy since its social indicators generally seem to be below average.

**Visitation to the Site**

The NCAR is one of the most popular destinations for visitation of any protected area in Belize. In 2007 the NICH records show that paid visitation to the NCAR averaged 100,474 visitors per annum however these numbers have fallen since then commensurate with the observed reduction in overnight tourism and cruise ship passengers to Belize as a general consequence of the global economic turndown. This trend showed in 2010 when only 70,672 paid visitors entered the reserve. There are indications that tourism arrivals including cruise tourism which are the major clienteles of the reserve were increasing in 2011, however figures for that year are not currently available.

**Table 3.9:** Specific practices to be allowed and disallowed within the Site.

<table>
<thead>
<tr>
<th>The following uses may be permitted within the NCAR.</th>
<th>The following activities shall <strong>not</strong> be permitted within the NCAR.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Hiking and Jogging on forested trails</td>
<td>I. Extractive actions and practices of any kind</td>
</tr>
<tr>
<td>I. Camping in designated above-ground areas</td>
<td>II. ATV vehicles</td>
</tr>
<tr>
<td>II. Rappelling in designated areas</td>
<td>III. Motor powered boats</td>
</tr>
<tr>
<td>III. River Kayaking in surface river</td>
<td>IV. Motor-powered vehicles, except in the parking lot</td>
</tr>
<tr>
<td>IV. Bird Watching on forested trails and designated bird-walks</td>
<td>V. Mining of any kind</td>
</tr>
<tr>
<td>V. Cave tubing in designated areas</td>
<td>VI. No concrete walkways</td>
</tr>
<tr>
<td>VI. Scientific research</td>
<td>VII. Publicity signs for marketing/promotional purposes by private ventures</td>
</tr>
<tr>
<td>VII. Educational visits and field trips</td>
<td>VIII. Installation of overhead wiring for electricity, telephone or cable television</td>
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<tr>
<td></td>
<td>IX. Any endeavour deemed by NICH to be incompatible with the management objectives of the NCAR</td>
</tr>
</tbody>
</table>
Visitation in the reserve follows an observable seasonal trend with intensive activity during seven (7) months of the year followed by a low period of five (5) months. During peak season the site receives up to 3000 visitors per day with the vast majority of visitors being cruise ship passengers. The following table summarizes activities which visitors may or may not engage in while at the site:

**Sustainable Visitation levels**

Carrying capacity at the site can be defined as the amount of people who can visit a cave at any given time and have a quality experience while ensuring the environmental, physical and cultural protection of the cave.

During the high visitation period there is a constant movement of people into and out of the site. According to the draft management plan during a typical 8 hour day in the high season up to 3000 visitors were observed to be visiting the reserve. This would translate into an average of 375 visitors an hour crossing the river and floating through the caves per hour. The site requires all visitors to be accompanied by a “trained” tour guide hence all these tours are under the guidance and observance of these guides. Assuming the required ratio of eight tourists per tour guide is followed, this visitation rate requires a total of 47 guides per hour.

According to site management, during the low season visits average around 80 to 100 persons per day (Armstrong pers. com). It was suggested by the management that the carrying capacity of the site is around 5000 persons per day. Management bases this figure on the number of passengers traveling a typical cruise ship visiting Belize.

There is concern that this constant movement of people on the forested trails, river crossing and through the caves is an intensive activity that can result in overcrowding and other impacts especially when compared with other similar destinations in developed countries where best practice methods are routinely applied. Such high levels and density of use is inconsistent with the wilderness feel, sanctity and preservation of the fragile cave environment.

Of note is that physical damages though visibly obvious in some cases, have not been properly documented to constitute a baseline for proper monitoring. Similarly, deterioration of the archaeological and cultural values of the NCAR can be easily inferred, but have not been evaluated and reported.

It has been suggested that a cap be placed on the number of visitors visiting the caves per day based on existing and proposed infrastructures and the amount of people the caves can actually handle. The following guidelines have been established:
1. maximum of 6 visitors per guide,
2. maximum of three (3) tours per guide per day (8:00 a.m. to 5:00 p.m.)
3. maximum of 300 visitors per hour consistently throughout an 8 hour day

(iii) Political-economic

Virtually all the revenue accruing to the NICH from this site comes from visitor entrance fees which at the time of the visit were set at US$10.00 per head. Almost everyone who visits the park do so to engage in cave tubing which is the main attraction. These rates suggest that the park can generate revenues of up to BZ$2,000,000 per annum for the NICH.

Revenues generated at the park include fees for rental equipment, tour guide services, sale of souvenirs, food etc but all these fees/revenues are garnered by private sector interests and not the NICH.

As part of its income generating activities, the National Institute of Culture and History shall apply all such fees as may be necessary to provide the resources needed to properly maintain, restore and manage the NCAR.

NICH reserves the right to provide all such services from within the park deem to be compatible with the NCAR for income generating purposes. These services may be provided directly or through concessions. For the time being, Entrance Fees to the park for both locals and foreigners shall be USD$10.00.

3.6.7 Chiquibul National Park

(i) Physical-ecological

The Chiquibul National Park (CNP) is the largest protected area in Belize lying at the heart of the Maya Mountain Massif and bordering ten other conservation managed areas. The Chiquibul has great political and environmental importance since it abuts the Belize-Guatemala border and is contiguous to the Chiquibul-Montañas Mayas Biosphere Reserve, located in the Department of Petén, Guatemala.

The area was first designated as the Chiquibul Forest Reserve in 1956 for watershed protection and sustainable production of timber, later a large area was excised from the reserve and became the Chiquibul National Park with the central area remaining within the Forest Reserve. Like all other National Parks the CNP is managed primarily for the protection and preservation of natural and scenic values of national significance.
The CNP covers an area of 106,838ha and under the IUCN system for the classification of protected area would fall under Category II which is defined as follows:

“[a] natural area of land and/or sea designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations; (b) exclude exploitation or occupation inimical to the purposes of the area; and (c) provide foundation for spiritual, scientific, educational, recreational, and visitor opportunities all of which must be environmentally and culturally compatible.”

The importance of the area is on account of the multitude of ecosystems, its role in the protection of numerous species of international conservation concern, its role as a watershed feeding some of the country’s most important rivers and the rich geological formations which contain the largest known cave network in the Americas.

There is a single road that allows access into the CNP which passes from the Western Highway through the Mountain Pine Ridge and over the Macal River at the Guacamallo Bridge and into the Caracol Archaeological site which is a protected area excised from the CNP. Because of the importance of Caracol as a tourist destination the road has been improved to allow all weather access. Other secondary roads and trails exist within the park, however the most extensive network of trails penetrate the park from Guatemala and facilitates illegal entry and extraction of natural resources.

The Forest Department is the statutory management authority for the CNP but they have transferred day to day management responsibility to the Friends for Conservation and Development (FCD) a Cayo District based conservation NGO with whom they have a co-management agreement. The current management plan for the park covers the period 2008 to 2013.

Current management philosophy regards the park as a distinct management unit but part of a larger ecological landscape and greater management area integral with the larger Maya Mountains Massif (MMM) and the Chiquibul-Montañas Mayas Biosphere Reserve in Guatemala.

The Greater Chiquibul/Maya Mountains Region, spans both sides of the Belize-Guatemala border and forms a contiguous forest cover offering biological connectivity (corridors) between the two countries although the Guatemalan portion is becoming increasingly fragmented. The area also forms the headwaters of the Belize River watershed the largest and most important watershed in Belize which also includes the Chiquibul, Mopan and Macal sub-water sheds.
These watersheds provide multiple environmental services to stakeholders countrywide and throughout the region. These include water for human consumption and agriculture, renewable energy generation, recreation, trade and commerce and food among other services.

Under the current management regime the allowed uses of the parks resources should be non-extractive allowing such un-intrusive activities as education tourism and research. In practice the reality is different from the perception as the park is currently receiving tremendous pressure for its resources from Guatemalans who covet its wildlife, archaeological heritage, timber and exotic plants and rich fertile lands.
**Flora and fauna**

The Chiquibul has 17 known ecosystems and protects at least 20 species of conservation concern ranging from critically endangered to vulnerable. Rare and endangered species, include Jaguar (*Panthera onca*), Ocelot (*Felis pardalis*), Margay (*Felis wiedii*), Scarlet macaw (*Ara macao*) and Baird's Tapir (*Tapirus bairdii*). The area contains the healthiest breeding population of Scarlet Macaws in the country.

The area is considered prime habitat for the endangered Baird’s Tapir which is believed to have a robust population in the area. The Chiquibul is also a stronghold for other important species including Currasow, Crested Guan, Ocellated Turkey, White-lipped Peccary, Paca and Red Brocket Deer.
In the areas frequented by the Xateros (which is now presumed to be most of the Chiquibul forest and beyond) there has been widespread poaching of wildlife with the greatest impact nearer to the Guatemalan border. As a result, the population of such popular game species as Currasow, Crested Guan, Ocellated Turkey, White-lipped Peccary, Collared Peccary, Paca, Red Brocket Deer and White-tailed Deer are in decline and severely impoverished in some areas.

Although the extraction of Xate is the main objective of the Guatemalans they will opportunistically take anything of value including cultural resources, wildlife for the pet trade, and other forest products. Nearer to the Guatemalan border the problem is magnified with illegal settlements, timber harvesting and extensive land clearing for agriculture. The FCD is engaged in a constant battle to stem the tide, however there are important bilateral and trans-boundary considerations existing within a sensitive geopolitical climate which complicates attempts at effectively addressing the situation.

Other Resources

Mining for gold has been an ongoing activity within the Ceibo Chico area of the CNP for many years and continues to increase in size driven by the current high price of gold on international markets. The enterprise is being driven by Boiton Minerals/Erin Ventures Inc. (under Belizean Gold Corporation). The mining concession area covers four contiguous blocks covering an area of 34km², and a mining license which now covers 160.25 ha. Another company called Orion also has a concession to operate within the CNP and the Chiquibul Forest Reserve (CFR).

It should be noted that under its designation, mining can be permitted but under strict guidelines. The FCD has undertaken several expeditions to monitor the mining activity and has developed guidelines for mining that awaits government approval. At the present time, mining for precious metals is in its incipient stage in Belize and there are scant regulations and experiences to guide the industry. There is no evidence that the responsible statutory bodies including the Geology and Petroleum Department, Department of the Environment and the Forest Department are exercising due vigilance in oversight.

A report produced for the FCD in 2011 also mentions the issuance of non-exclusive prospecting permits to individuals entitling them to work within the boundaries of the CNP (Arevallo, 2011). Evidence produced from the report indicates that the mining operation being conducted by Boiton’s Minerals Ltd is well resourced with modern equipment including heavy earth moving machinery. This increases the capacity for mineral exploitation; however it also increases the potential for environmental damage.
From the recent field visit the FCD identified several actual and potential impacts from the mining activity including scarification of the natural landscape leading to potential conflicts with other landscape uses such as recreation and biodiversity conservation. At the present time some reconstitution of the natural landscape is taking place but this is poorly regulated and guided. Other potential negative impacts include soil piles, waste dumps, haul roads, sedimentation of the water system, abandoned mining equipment and structures and improper disposal of garbage.

The report identifies management shortcomings such as inadequate facilities for the servicing of equipment, poor fuel storage practices and fuel and oil leaks from equipment as a potential danger for pollution to groundwater and streams. In addition water used in the process was being added back to the streams full of sediments without treatment. The streams themselves were blocked by spoils generated from the mining operation.

**Monitoring and Research**

Monitoring has been an ongoing activity within the Chiquibul Forest since 1995 to document the biodiversity of the area including the diversity and the structure of the forest and to contribute practical knowledge to the country’s sustainable development and the conservation of resources through evaluating human and natural impacts on the forest.

Research has covered several areas including the following:

- Harpy Eagle Release Program (Belize Zoo and Peregrine Fund),
- the Darwin Initiative for Sustainable Conservation of Xaté (Natural History Museum, Belize Botanical Gardens and New York Botanical Gardens),
- Jaguar Population Survey (WCS),
- Scarlet Macaw Artificial Nest Program (BECOL and FCD),
- Genetic Studies of Spiders and Reptiles by (Memphis Zoo and Natural History Museum),
- Birds and butterflies (Malory and Brokaw 1995),
- Cave system within the Chiquibul.

Currently there is a need for monitoring of water quality within the mining operations, as well as the impact of the gold mining operations on the biodiversity of the Chiquibul. Since the Chiquibul is such a large area and mostly inaccessible it is hard to fully assess the extent and impact of the illegal activities being perpetuated on the protected area by Guatemalan
Nationals, however an understanding of this impact and its implications is critical for effective management.

Species of International Conservation Concern.

<table>
<thead>
<tr>
<th>Species</th>
<th>Critically Endangered</th>
<th>Endangered</th>
<th>Vulnerable</th>
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<tbody>
<tr>
<td><strong>Flora</strong></td>
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<tr>
<td>Spanish Cedar (<em>Cedrela odorata</em>)</td>
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<tr>
<td>Mountain Pimento (<em>Schippia concolor</em>)</td>
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<td>✓</td>
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<tr>
<td>Mahogany (<em>Swietenia macrophylla</em>)</td>
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<td>✓</td>
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<tr>
<td>Cycad (<em>Ceratozamia robusta</em>)</td>
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<tr>
<td>Gaussia Palm (<em>Gaussia maya</em>)</td>
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<tr>
<td>Fiddlewood (<em>Vitex Guameri</em>)</td>
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<tr>
<td>Zanthoxylum sp. (<em>Zanthoxylum procerum</em>)</td>
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<tr>
<td>Quinnia spp. (<em>Quiina schippii</em>)</td>
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<tr>
<td><strong>Fauna</strong></td>
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<tr>
<td>Yucatan Black Howler (<em>Alouatta pigra</em>)</td>
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<tr>
<td>Geoffroy’s Spider Monkey (<em>Ateles geoffroyi</em>)</td>
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<tr>
<td>Sabrinus Rain Frog (<em>Craugastor sabrinus</em>)</td>
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<tr>
<td>Sanderson’s Rain Frog (<em>Craugastor sandersoni</em>)</td>
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<tr>
<td>Bairds Tapir (<em>Tapirus bairdii</em>)</td>
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<tr>
<td>Cerulean Warbler (<em>Dendroica cerulea</em>)</td>
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<tr>
<td>Keel-Billed Motmot (<em>Electron carinatum</em>)</td>
<td>✓</td>
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<tr>
<td>Leprus Chirping Rain Frog (<em>Eleutherodactylus leprus</em>)</td>
<td>✓</td>
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<tr>
<td>Thomas’s Sac-winged Bat (<em>Balantiopteryx io</em>)</td>
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<tr>
<td>Van Gelder’s Bat (<em>Bauerus dubiaquercus</em>)</td>
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<tr>
<td>Great Curassow (<em>Crax rubra</em>)</td>
<td>✓</td>
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<tr>
<td>Morelets Tree Frog (<em>Agalychnis moreletii</em>)</td>
<td>✓</td>
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</table>

(ii) Socio-demographic

**Stakeholders** - This protected area forms part of Belize’s western border with Guatemala. A peculiarity of this PA is that it has no Belizean buffer communities since it is solidly buffered by other Belizean protected areas.
On the Guatemalan side there are approximately sixty-five (65) Guatemalan communities spread along a 45 km stretch of the Belize-Guatemala border, however the FCD only recognize eleven (11) namely: Monte de Los Olivos, San Jose Las Flores, El Carrizal, Naranjo, Nueva Armenia, Las Brizas de Chiquibul, Centro Maya, San Marcos, Sacul Arriba, Las Flores de Chiquibul and El Rondón. These communities serve as a springboard for incursions into Belize for illegal extraction. When the FCD took over management of the park in 2007 more than 1000 Xateros were operating in the area, however it is believed that this number has since fallen to about 200 individuals. Unfortunately since then there has been a diversification of illegal activities hence the total number of people involved in illegal activities may be far more than this.

These communities depend on small scale agriculture and gathering from nature’s table for their subsistence, however grinding poverty, scarcity of land and opportunities has driven them to farm on the Belizean side and within the CNP. Indications are that by 2011 up to 4,931 ha have been cleared within the CNP and the Caracol Archaeological Reserve.

The seeming inability of Belize’s security forces to demonstrate a significant deterrence indicates the magnitude and sensitivity of the problem and the potential for conflict. The CNP management plan identifies five (5) categories of stakeholders. These are:

1. community and resource users,
2. institutional stakeholders,
3. recreation and tourism users,
4. education stakeholders and
5. private enterprises.

This grouping includes communities and organizations in the east-central Petén region of Guatemala, the Comisión Nacional de Áreas Protegidas (CONAP) and agencies involved in the management of the Reserva de la Biósfera Montañas Mayas/Chiquibul, as well as communities along the Belize-Guatemala border.

The FCD has an outreach and advocacy program that targets select communities bordering adjacent protected areas for educational programs about the CNP and the Maya Mountain Massif management area. The focus of the educational program is on the services to communities provided by protected areas and the importance of the Chiquibul Forest. The communities include Arenal, Benque Viejo del Carmen, San Ignacio, San José Succotz, Siete Millas, Cristo Rey and San Antonio. Across in Guatemala, FCD also have an environmental educator whose role is to promote a water conservation ethic and the importance of the forest.
as well as strengthen confidence among Guatemalan counterparts. Eight (8) communities in Guatemala are targeted along these lines.

The Belize Defense Force and the British Army Training and Support Unit have developed designated zones within the CNP for military training purposes. Troops engage in live military drills including the discharge of weapons and the use of explosives which can cause noise pollution, damage to vegetation and soil rutting leading to erosion.

**Tourism** – Apart from researchers who are based in Las Cuevas, there is minimal visitation into the CNP although there is substantial visitation into the adjacent Caracol Archaeological Reserve. Security threats, access issues and lack of development of potential attractions retard the growth of this industry even though there are many potential attractions within the park. These include the spectacular Chiquibul Caves regarded as the largest cave of its type in Central America, the Natural Arch, spectacular sinkholes and the highest mountain in the country.

The CNP also boast spectacular wildlife including the big cats, Scarlet Macaws, Tapirs and some of the best birding in Belize, however as previously noted these are now under threat.

For tourism to grow in the CNP the security threat to visitors must be addressed. In the past visitors have been held up and detained for ransom. In addition the basic amenities have to be improved and the sites made more accessible and presentable to the public.

**Other Uses** - Within the Chiquibul area legitimate licensees have concessions for mining, timber extraction and the harvesting of Xate on a sustainable basis. A logging outfit called Bull Ridge Company (a subsidiary of Pine Lumber Company) has a long-term forest license for the entire CFR. The company is engaged in selective logging.

Under the Xate concession the following species was being exploited by the now dormant Gosen Product Co Ltd.:

- Chamaedorea tepejilote,
- Chamaedorea elegans,
- Chamaedorea oblongata and,
- Chamaedorea ernesti-augustii
(iii) Political-economic

None of the survey participants supported extractive use of the natural resources of the park, but were keen on advocating for non-extractive use that would increase visitor appreciation including trails, birding, medicinal plants, caving, mountain climbing, archaeological sites, etc.

Security and trans-boundary poaching were the biggest management challenge, putting at risk important potential income-generating activities. This leaves primary sources of funding coming primarily from donors. To entice visitors and generate income from entrance fees is very much dependent on the security issues being addressed. It is important to note however that tourism will be an effective vehicle to promote the importance of the reserve despite the challenges. In recognizance of this, the FCD has formed a tour company named “Eco-Quest Expeditions” to promote visitation into the park.

3.6.8 Mountain Pine Ridge Forest Reserve

(i) Physical-ecological

The Mountain Pine Ridge Forest Reserve (MPRFR) is situated in the Cayo District, Western Belize and occupies an area of approximately 106,352 acres (43,039ha). The reserve is mostly surrounded by and buffered by other statutory protected areas including the Vaca Forest Reserve, the Chiquibul Forest Reserve and National Park, and the Sibun Forest Reserve. The reserve is also partly buffered by Noj Kaax Me’en Eligio Panti National Park.

The remaining boundary area although occupied by private lands are in reality defacto protected areas since the owners pursue a policy of natural resource protection on their lands. The Macal River which is one of the main tributaries of the Belize River forms much of the boundary between the Mountain Pine Ridge Forest Reserve and the Vaca and Chiquibul Forest Reserves.

Mountain Pine Ridge Forest Reserve is managed by the Forest Department, however several logging companies have long term licenses to log designated zones within the MPRFR. At the present time such timber extraction agreements exist with Pine Lumber Company (PLC) which has a long term (40 year) concession covering 25,086.6 acres (10,152.2ha) of the reserve.

The reserve was one of the first protected areas to be declared in Belize. At the time of the declaration the purpose was to safeguard the valuable resource of pine timber for the use of present and future generation. Since then the MPRFR has had a long history of management for timber production; however nowadays it is also being recognized for other roles including
the protection of scenic, natural and cultural resources. These resources support the development of tourism which has recently figured very prominently as a major use of the area. The reserves attractions include idyllic rivers, waterfalls and caves. Other important uses include watershed protection for potable water supply and hydroelectric production, flora and fauna protection and military training grounds.

The landscape consists for the most part of uplifted granite hills with a small region of limestone karst in the west which supports broadleaf forests. Elevation ranges from around 122m to 1006m above sea level. Vegetation is dominated by pine forests and savannas, with localized areas of broadleaf forest, including in some of the river valley systems. Grasslands and small wetland areas complete the natural landscape.

In recent years the region has been significantly affected by an infestation of the pine bark beetle, which has devastated the pine forests. It is estimated that the outbreak affected up to
90% of the pine stocks, reduced the timber stocks by 70% and turned the area into a virtual wasteland. This has had an impact on both timber extraction and tourism. The area is still recovering from this impact and full recovery is still many years off hence the practice of traditional forestry will take many years to recover in the MPRFR.

Following the devastation a combination of encouraged natural generation and planting was implemented to regenerate the pine stocks. At the present time the pine forest are regenerating even if slowly and unevenly.

**Forest Ecosystems**

The reserve is ecologically important in that it plays host to a variety of ecosystem types. It also forms a significant portion of the Maya Mountain block, highlighted as one of few large tracts of natural forest ecosystem left in Central America and providing critical biological corridor connectivity.

Fifteen land use/ecosystem types have been identified within the Forest Reserve. These are:

- Agriculture
- Deciduous broad-leaved lowland riparian shrubland in hills
- Deciduous broad-leaved lowland shrubland, well-drained, over poor soils
- Deciduous mixed submontane shrubland over poor soils
- Fire-induced lowland fern thicket
- Fire-induced submontane fern thicket
- River
- Tropical evergreen seasonal broad-leaved lowland hill forest on steep karstic terrain
- Tropical evergreen seasonal broad-leaved lowland hill forest, on rolling karstic terrain
- Tropical evergreen seasonal broad-leaved lowland hill forest: Simaruba - Terminalia variant
- Tropical evergreen seasonal broad-leaved submontane forest on steep karstic hills
- Tropical evergreen seasonal mixed lowland hill forest
- Tropical evergreen seasonal mixed submontane forest
- Tropical evergreen seasonal needle-leaved lowland hill forest
- Tropical evergreen seasonal needle-leaved submontane forest

Fire is vital to the natural survival of the pines, as it is only when the understory of grass and hardwood species is burnt that the pines can regenerate. However if the fires are too frequent or intense they can have a negative effect on the pine forest and the structure of the forest.
Pine forest is the dominant vegetation type in about 99,565.7 acres of the MPRFR and the remaining acreage (9840.3) is under hardwood cover. The logging companies extract pine logs belonging to two species - *Pinus caribaea* and *P. patula*, of which the former is the dominant species covering approximately 86% of the pine forest and 14% by the latter. After the beetle infestation it became clear that only a small area of pine forest to the east of the reserve was still marginally profitable to log.

The pine savannahs have scattered broadleaf stands dominated by oak and palmetto, however riparian hardwood stands dominate along streams throughout the reserve and along the river corridors on limestone and karstic soils. The riparian forest is considered the most sensitive habitat within the MPRFR with the widest diversity of species. It is currently the only ecosystem still left relatively intact after the beetle infestations and concomitant fires. These
forest ecosystems help to maintain overall forest health by serving as a natural fire break and forming a barrier to Pine Bark Beetle infestation.

**Fauna**

Several important species exist within the Mountain Pine ridge that are very restricted in their range or are known entirely from that area. These include the endemic frog species *Rana juliani* and the *Eleutherodactylus sandersonii*.

The Macal River that passes along the southern and western boundary of the reserve is home to the endemic fish species *Poecilia teresae*. Also along the Macal, at its confluence with the Rio On can be found the only known troop of Black Howler Monkeys known to exist in the reserve.

The area known as Rubber Camp had until recently harbored healthy populations of Morelets Crocodiles, Scarlet Macaws and Baird’s Tapir. The rare Orange Breasted Falcons are known to nest near Thousand Foot Falls as is the Keel Billed Motmot which is also known from the north and northeast of the reserve.

**(ii) Socio-demographic**

Though the road entrance to this reserve passes through the villages of Georgeville, Cristo Rey and San Antonio, none of these three villages are regarded by the managers of this PA to be buffer communities. To the north of the reserve are the villages of El Progresso, San Antonio, Big Eddy, Macaw Bank and Negroman, primarily agriculture-based communities. The town of San Ignacio, an important tourism centre, lies a little further north on the banks of the Macal River.

There are no formal settlements within this reserve; however Douglas Da Silva, the administrative headquarters of the Forest Department Western Division can be considered a population center. It is situated within the reserve, and has been the center of operations for the construction of the Chalillo Dam when a transient and temporary work crew inhabited the site. There are also a number of tourism establishments existing within the reserve.

The local tourism industry, concession loggers, enclave farmers and landowners, local communities, researchers, the military, NGOs and quasi-governmental organizations are all considered stakeholders of the MPRFR.

A Visitor Use Master Plan (VUMP) was prepared for the reserve in 2004 and was supposed to have guided the development of the site as a major recreational tourism hub going forward.
There is little evidence that the plan has ever been ratified or any of its components adopted and applied within the reserve.

Annual visitation to the MPRFR is estimated at between 20,000 to 30,000 per annum of which roughly a third are Belizeans. In this respect the MPRFR is unique among Belizean protected areas in that it attracts a sizeable proportion of Belizean visitors. The existing facilities and available activities are insufficient to sustain current use and inadequate for increased visitation into the reserve.

Physical presence in the park in terms of rangers/guards was limited to the guard at the main entrance; otherwise there were no ‘boots on the ground’, except for the BDF post. During the meeting with the Chief Forest Officer (CFO), it was suggested that the only ‘direct beneficiaries’ of the MPRFR were the people having logging concessions and the four or five key resorts in the area. From time to time these resorts take guests into the park for nature based activities.

(iii) Political-economic

The reserve fulfills an important role in the protection of biodiversity and water resources, as well as providing opportunities for revenue generation from tourism and recreational use (though there is no entrance fee charged).

The Forest Reserve is important as a source of tourism revenue for San Ignacio and the nearby communities, with sites such as the Rio On pools attract significant visitation levels. In addition to this, a number of tourist lodges operate in and around the reserve.

The sale of pine timber, seeds and other forest products are an important source of income, although the devastation by the Pine Bark Beetle has had a significant effect on this. As a prime watershed for the Macal and Belize Rivers, the MPRFR also plays the dual role of providing potable water for downstream users as well as helping to provide a reliable source of water for the nearby hydroelectric facilities which now sustainably provide most of Belize’s energy requirements.

3.6.9 Cockscomb Basin Wildlife Sanctuary

(i) Physical-ecological

Cockscomb Basin Wildlife Sanctuary (CBWS) also known locally as the “Jaguar Reserve”, the is one of the best known terrestrial protected areas within the national protected areas system with a multitude and diversity of ecosystems, important watersheds and drainage systems and numerous attractions. The CBWS is located on the east facing slope of the Maya Mountains
and to the east and southeast face onto the communities of the Stann Creek lowlands and Toledo. To the southwest, west and north the CBWS is buffered by other protected areas.

The sanctuary has an area of 49,477ha and is managed by the Belize Audubon Society under a co-management agreement with the Forest Department. Under its current designation, the site corresponds to a IUCN Category IV which by definition is “an area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species”. The last management plan ran up to 2011 and is in need of updating. Current land uses include tourism, education and research.

Access into the sanctuary is along a dirt road that leads from the southern Highway passing through the village of Maya Center and traveling in a direction due west to the field station which houses the administrative headquarters, visitor facilities, staff and visitor accommodations, museum/interpretative center and other buildings. From the field station roads and trails radiate out to the main visitor attractions. Another lesser and more challenging road leads into the sanctuary from Maya Mopan.

The CBWS has 21 known ecosystems of which some are of limited distribution in Belize or are poorly represented within the existing system of protected areas. The diversity of ecosystem can be partly attributed to variations in elevation which ranges from 50 to 1000m. Victoria Peak, the second highest mountain in the country is located adjacent to the CBWS within its namesake the Victoria Peak Natural Monument (VPNM) and are managed and marketed along with the other attractions of the CBWS. The VPNM and the CBWS are often considered together as a management unit since both are managed by the BAS although their designations indicate different management objectives.

The CBWS protects two major watersheds, namely the South Stann Creek and parts of Monkey River watersheds and contains four distinct drainage systems which are the Cockscomb East Basin, the Cockscomb West Basin, Trio Branch and Richardson Creek. These systems drain the area and feed into rivers which are vitally important in supporting the citrus and banana industry.

The CBWS is best known for the protection of the areas wildlife including the iconic Jaguar, however there are several other notable species including the Scarlet Macaw, Yucatan Black Howler Monkey, Spider Monkey, Baird’s Tapir and the White Lipped Peccary all of which need large range of undisturbed forest to survive. It is estimated that the CBWS has 58% of the mammals, 56% of the bird, 42% of terrestrial reptiles and 69% of the amphibian species that have been recorded in Belize.
Apart from protecting rare and endangered flora and fauna the CBWS also occupies an important position as a connecting link within the national and regional biological corridors system. Protection at the landscape and systems level favors the protection of species which require large habitats and extensive ranges to survive and reproduce.

There are four (4) known archaeological sites within the lowland area of the sanctuary with a further three identified within the Trio area.

The CBWS is an important tourist destination, drawing in visitors who come to climb the Victoria Peak, walk the extensive system of nature trails, experience the wildlife, waterfalls, rivers and scenery.

Since assuming management responsibilities, the BAS has invested considerable resources in developing the tourism and research infrastructure. These include a visitor center and gift shop, kitchen and dining facilities, conference center, visitor welfare facilities including dormitory, cabanas and camp grounds. There are continuous efforts to further upgrade the facilities. Other infrastructure improvements support the management programs including a ranger station and headquarters building.

Species of International Conservation Concern.

<table>
<thead>
<tr>
<th>Species</th>
<th>Critically Endangered</th>
<th>Endangered</th>
<th>Vulnerable</th>
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</thead>
<tbody>
<tr>
<td><strong>Flora</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Spanish Cedar <em>(Cedrela odorata)</em></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Mountain Pimento <em>(Acropora pimento)</em></td>
<td></td>
<td>√</td>
<td></td>
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<tr>
<td>Mahogany <em>(Swietenia macrophylla)</em></td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Cycad <em>(Zamia prasina)</em></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td><strong>Fauna</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yucatan Black Howler <em>(Alouatta pigra)</em></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Geoffroy's Spider Monkey <em>(Ateles geoffroyi)</em></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Sabrinus Rain Frog <em>(Craugastor sabrinus)</em></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Sanderson’s Rain Frog <em>(Craugastor sandersoni)</em></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Bairds Tapir <em>(Tapirus bairdii)</em></td>
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<td>√</td>
</tr>
<tr>
<td>Cerulean Warbler <em>(Dendroica cerulea)</em></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Keel-Billed Motmot <em>(Electron carinatum)</em></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Leprus Chirping <em>(Eleutherodactylus leprus)</em></td>
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</tbody>
</table>
(ii) Socio-demographic

Though there are several nearby Mestizo/Hispanic villages that utilize the resources and share the benefits of this protected area, the Mayan village of Maya Centre located at the entrance to the reserve can be regarded as the primary buffer community.

Maya Centre Village is located along the Southern Highway some twenty miles south of Dangriga and is at the entrance to the Cockscomb Basin Wildlife Sanctuary. The population of the village is 386 (SIB Census 2010), and is comprised of Mopan and Kekchi Mayas and Central American immigrants.

The village was founded when the original settlers were forced to relocate from their original home within the Cockscomb Basin around the time the area was accorded protected areas status. The villagers had to seek new means of livelihood as they could no longer engage in their traditional agricultural practices of Milpa farming and hunting. Tourism seemed to be a viable option as the men could serve as tour guides for visitors to the sanctuary, while the women could engage in producing arts and crafts for sale.

A detailed breakdown of the village’s population of 386, reveal that 127 are younger than 14 years old while an additional 124 are persons are not in the labor force (PNLF). Thus the age dependency ratio calculates to marginally over 65%.

The labor force in the village is 135 persons with 110 being employed and the remaining 25 unemployed. The employment dependency ratio is some 228%. Eighteen of the eighty seven households or over a quarter of families live in homes with a flush toilet linked to a septic tank. Only a mere 4 of these 87 households are paying rent, with the majority of the others either living rent free or owning their homes as freehold property. Over 72 percent of villagers have potable water piped in their yards or their dwelling.

Some 117 villagers are formally enrolled in school. Secondary school is easily accessible to the students since there are school buses to the secondary schools in Dangriga and to Georgetown Technical High. A breakdown of the highest educational levels in the village reveal that 88 villagers completed primary education, 18 completed secondary education, 5 completed post-secondary education and 1 has completed university.

Notwithstanding the above social indicators, there is a perception in the village that the CBWS has not benefited the community. Villagers were asked who they think benefits least from the existence of the protected area and as noted from the table below, nearly 73 percent opined that the communities benefited least from the PA. Conversely, nearly 64 % of the respondents were of the view that Belize as a country benefited the most from the protected area.
For the most part, opinion on carrying capacity by management staff was limited, with no hard numbers on optimum visitation numbers provided. One person interviewed during the field visits suggested 75-100 persons per day, but could not articulate a justification or explanation for the suggested number.

<table>
<thead>
<tr>
<th>Benefits least</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid visitors</td>
<td>1</td>
<td>9.1</td>
<td>9.1</td>
<td>9.1</td>
</tr>
<tr>
<td>Tourist Operators</td>
<td>1</td>
<td>9.1</td>
<td>9.1</td>
<td>18.2</td>
</tr>
<tr>
<td>Communities</td>
<td>8</td>
<td>72.7</td>
<td>72.7</td>
<td>90.9</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>9.1</td>
<td>9.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

The Women’s Group and the tour guides operating out of Maya Center in particular were supportive of the CBWS. Anecdotal evidence suggests villagers from Maya Centre support the park, as long as the park continues to generate benefits to the community. The Women’s Group emphasized the need for more direct support to the community, especially to the school and overall educational support to the village.

The tour guides complained about the ‘seasonal benefit’ the park provides. This is in reference to the fact that they are only able to take tourist out during the high season. This suggests that they would like park management to advocate for a more diversified non-extractive uses of the park to provide year round opportunities and benefits.

Villagers of Red Bank all support Cockscomb and derive tour guiding benefits and provide tourist lodging and meals as a business benefit that owes its existence to the park, however villagers of San Roman did not see any benefits for themselves by the existence of the park and claim that benefits were primarily for the people of Maya Center.

**Stakeholders**

The BAS recognizes a host of public and private stakeholders whose activities could impact the CBWS. For those communities adjacent to the PA, the BAS has divided the buffer communities into three (3) distinct groups dependent on their relationship with the CBWS. These groups and representative communities are:
- Type 1 Communities – are communities that feel they benefit directly from the protected area. The BAS identifies an example of this type of community as the village of Maya Centre,

- Type II Communities – are those communities who believe they can benefit from the protected area and are willing to work towards this but at the present time are exerting a predominant negative influence on the protected area and do not currently see any direct benefits for themselves. The BAS identified Maya Mopan as falling into this category.

- Type III Communities – These are communities that exert a predominantly negative influence on the PA and are yet to develop a constructive working relationship with the BAS. These include the communities of Red Bank, San Roman, Santa Rosa, San Pablo and Kendal.

The list was included in the last management plan, however during our study we found that there was widespread support for the BAS in some of the communities listed as Type III, suggesting a new awareness among at least some of the communities of the importance of the CBWS and its potential benefits. Residents of Red Bank were even talking about setting up their own Scarlet Macaw Bird Sanctuary. This suggests that there is changing attitudes and mobility in the rankings as the advocacy and outreach programs bear fruits.

There are several large agriculture holdings (agro-industries) within the buffer zone region which occupy large areas of land and offer employment to community members. These enterprises are causing land use changes as land is converted from forest to agriculture. This is fragmenting biological corridor connections to the east. These companies also use large amounts of chemicals which have potential to cause pollution to waterways and affect wildlife and plant populations.

(iii) Political-economic

Lack of funding is the primary factor limiting management intervention at the site. Site managers see best prospect for additional funding needed to cover management costs coming from donors and increased visitor fees. Management staff interviewed did not support extraction of natural resources, as a viable additional source of funding for the park.
4 Evaluation and Analysis of the Nine Priority PAs

Carrying capacity is defined as the amount of visitor-related use an area can support while offering a sustained quality of recreation, based on ecological, social, physical and managerial attributes and conditions. The focus is on determining the level of use beyond which impacts exceed acceptable levels specified by evaluative standards. The traditional carrying capacity approach emphasizes setting visitor numbers based on mathematical relationships to variables of concern. Over time, the original carrying capacity concept has evolved into a number of alternative decision-making frameworks.

4.1 Methods Used for the Determination of Carrying Capacity

The Limits of Acceptable Change method establishes limits of change for key biophysical and socio-psychological processes. It focuses on the impacts of use rather than how much use an area can tolerate. The Limits of Acceptable Change method requires a manager to identify where, and to what extent, changes in key biophysical and social processes are appropriate and acceptable, and to select a management action that is most likely to achieve conformance between observed conditions and established standards.

The Visitor Impact Management method identifies key indicators and standards for evaluating visitor impacts, compares those indicators to existing field conditions, and determines appropriate management actions for alleviating unacceptable impacts. Impacts are defined in terms of natural, cultural and historical resources and visitor experiences. Indicators used in the Visitor Impact Management method are equivalent to the attributes of management actions used in the carrying capacity modeling system.

The MASTEC method implements the integrated Limits of Acceptable Change/Visitor Impact Method in a multiple attribute decision making framework. The method uses multiple attribute decision theory to identify the best management action for bringing an ecosystem into compliance with carrying capacities.

It is widely accepted that adaptive management is the only logical approach under the circumstances of uncertainty and the continued accumulation of knowledge which so often accompanies protected areas management. Such frameworks do not discard the concept of
carrying capacity, but rather shift emphasis from fixed resource capabilities and amount of use to achieving desired conditions by recognizing that standards are value laden.

Alternative decision-making frameworks use a management by objectives approach and are iterative, continuous processes that specify prescriptive management objectives that define desired resource and social conditions and select appropriate indicators and standards that reflect those objectives.

4.2 Factors that Influence the Determination of Carrying Capacity

The setting of carrying capacity limits on any protected area is always a contentious one often pitting the PA managers on one side and the tourism/commercial sector on the other. Setting limits on visitors while also satisfying tourism stakeholders can be a challenge wherever there is an active private tourism sector to oppose them. Where tourism is already well-established, the suggestion of a carrying capacity is often interpreted by the private sector as a potential limit on business.

A strict carrying capacity approach prioritizes science over public values and interests. Because of this many protected areas do not set carrying capacity limits at all while others determine carrying capacity by examining in hindsight the impact of visitors on PAs. This means that managers simply observe a level of use above which degradation occurred and set that level as the carrying capacity.

Degrees of carrying capacity:
1. very low, high vulnerable ecosystem (high internal as well as external liability),
2. low, vulnerable ecosystem (high external liability, internal stability),
3. relatively stress tolerant ecosystem, both internal and external stability, vulnerable only through rough mechanical disturbances,
4. stress tolerant ecosystem,
5. high stress tolerant invasive (expansive) ecosystem.

To complicate matters further, many problems of recreational use are a function not so much of numbers of people, but their behavior hence a more appropriate question is what resource and social conditions are acceptable, and how can those conditions be attained. This is especially true of the Belize cruise tourism industry where PA managers often cite uninitiated divers and snorkelers as the prime reason for coral damage and not necessarily overuse of the site.
4.3 Important Considerations for the Nine Priority PAs

To estimate or evaluate carrying capacity in any of the nine (9) priority PAs is extremely difficult and any arbitrary attempt at an approximation is bound to antagonize stakeholders. In the first instance there are various frameworks in use for measuring carrying capacity all with inherent strengths and weaknesses; hence there is no wrong way or right way to measure carrying capacity. In addition the choice of indicators is bound to be a contentious one since they will determine whether the carrying capacity has already been reached. How to quantify the impact on the indicators, their sensitivity and resilience to change from anthropogenic influences will figure prominently in the arguments.

At this point in time it appears that the main threats to the ecological functioning and biodiversity of the nine priority PAs is not from visitation but from the continued propagation of illegal activities including uncontrolled extraction and chronic underfunding to carry out the protection mandate including monitoring. In addition, current limited visitation to many protected areas has nothing to do with ecological considerations and more to do with limited welfare facilities, poor development of attractions, inaccessibility and security concerns. In regards to the priority PAs the following are evident:

f. No single framework for determining carrying capacity will address all the needs of the 9 priority PAs,

g. Impacts cannot be avoided but they can be mitigated and managed based on establish objectives and understanding of the variables,

h. No clear relationship between amount of use and impact for PAs since many variables come into play and are relevant in determining this relationship,

i. Complex combination of variables that must be considered renders a numeric value for carrying capacity ineffective and undesirable,

j. A prior understanding of conditions on the ground and a baseline is needed before contemplating establishing a carrying capacity benchmark,

There is a pressing need to develop a comprehensive approach to this issue with all the various stakeholders with a view of agreeing a suitable methodological approach and the development of appropriate standards. Such an approach will invariably introduce the concept of carrying capacity into management planning with the development of solid objectives and indicators throughout. A basic scorecard for MPAs has been produced by the World Bank to assess the condition of the MPAs (see Appendix 3); however other scorecards and management
effectiveness guidelines are readily available on the web. The scorecard can help resource strapped MPAs to carry out an assessment with minimal additional field level research. Scorecards are also available for terrestrial protected areas.

In such a scenario all PAs would be required to carry out monitoring and collection of baseline data which would feed into the assessment and analysis of the system. This would then produce credible, reliable data that management could use with confidence to decide the carrying capacity of the site. In particular the following would have to be carried out:

- prepare an inventory of ecosystems of the protected area and grade them according their sensibility or resistance to anthropogenic impacts,
- describe all types of primary and secondary anthropogenic impacts in the area taking into account cumulative effects (synergism),
- long-term monitoring of impacts to determine differences in space and time,
- select a list of the most convenient indicators of sustainability and monitoring using these indicators,
- implement appropriate management interventions when standards are violated. This would necessitate the use of a multiple-attribute evaluation method to identify the best management action for achieving compliance with the standards.

To support these critical functions a secure system of funding will be necessary. This will need to come from the national budget, internally generated or from external sources.

### 4.4 Analysis of the Marine Priority Protected Areas

Tourism visitation is the economic engine for marine PA management with most PA having the narrow focus view that more visitors means more money without due consideration to issues such as visitor capacity and resource protection. Consequently there are few mechanisms in place to control the number of visitors hence the potential for crowding and resource damage exist.

Tourism in marine protected areas creates pressures on the natural and cultural environment, affecting the quality of the resources, social structures, cultural patterns, economic activities and land uses in local communities. Such pressures can create problems for the long term sustainability of the tourism industry and the functioning of ecosystems and the welfare of communities. Because of this, the issue of tourism development is increasingly being
incorporated into local strategies for sustainable development hence determining the capacity of local systems to sustain tourism becomes a central issue.

Carrying capacity studies conducted at various diving sites in the Caribbean found that reefs could sustainably support roughly 5000-6000 dives per dive site per year, but greater levels of use caused a rapid rise in diver damage as measured in broken coral. However an MPA with multiple dive sites could as a general rule sustain many times that figure as a whole, as long as no site exceeded the 5000-6000 dive limit (Barr, 2004).

Circumstances that could influence this number include reef health, number of suitable moorings per site, level of diver experience, and enforcement of regulations, among other factors. Despite this research and a similar World Bank study which closely supported its premise very few MPAs in the Caribbean had set formal carrying capacity limits at all, whether for diving or other visitor activities.

One of the reasons for this is political: it can be difficult for resource managers to limit the number of tourists allowed when local businesses depend on those tourists and, understandably, want to maximize their revenue. This is the case for most Belizean marine MPAs. Inversely, many less visited MPAs may not yet be experiencing negative impacts from tourism hence establishing a carrying capacity number is pure conjecture.

I. Hol Chan Marine Reserve

The management plan for this PA is in the process of being updated, however at the present time it is unclear what would be the future management goals or objectives. The goals and objectives below are from the previous management plan.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Objectives</th>
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</table>
| Goal 1: To maintain a sample coral reef ecosystem in its natural state. | a) To restore the earlier beauty of the Hol Chan area  
                               | b) To preserve areas of critical habitat for several endangered species such as the reef and turtle grass beds for turtles and the mangrove areas for manatees.  
                               | c) To regulate the use of the area by tourists and fishermen to prevent its overexploitation. |
| Goal 2: To provide recreation and tourism services and preserve the value of the area for fisheries. | a) To provide an undisturbed area for tourism and recreation, but in a controlled and well-informed manner.  
                               | b) To promote uses compatible with conservation and sustainable development objectives, primarily through zoning.  
                               | c) To provide protected habitats for commercially important species i.e. The coral reef for reef fish and lobster, the turtle grass beds for lobster and conch, and the mangrove areas for nurseries of many different finfish species and invertebrates. |
d) To enhance the social and economic benefits of the area.

**Goal 3:** To provide an area for education and research.

- **a)** To foster general interest in and knowledge of the coastal environment through education and interpretative programs.
- **b)** To encourage scientific research in all sections of the reserve.

**Goal 4:** To conserve genetic resources.

- **a)** To provide an undisturbed area that will result in increased recruitment to the fisheries of the adjacent areas.
- **b)** To conserve an ecosystem i.e., mangroves, turtle grass beds and coral reef, which is representative of the reef complex and which functions as an ecological entity.

**Threats**

The following threats were identified from observations made during the field visits, interviews with managers and a review of management reports and related documents.

1. There is heavy demand on the part of the tourism industry to use the marine reserve for recreational purposes including sightseeing, adventure sports, fishing, diving and snorkelling. There is no agreed carrying capacity for visitation to the site and since the site is so important to the local economy there is the danger that the system can become overstressed with economic imperatives overriding environmental considerations.

2. San Pedro is a growing urban centre with numerous resorts resulting in high boat traffic through the area. It is not known what affect this is having on wildlife and the reef in general; however such heavy use is bound to create concern over pollution and damage to coral formations.

3. Heavy demand for the favoured dive sites has the potential to create conflicts especially during the high season where only a limited number of mooring buoys are available.

4. The reefs near San Pedro have already been exposed to heavy use and show signs of stress caused by over collecting, over fishing, and damage by anchors. With increased development, greater stress on the reefs and their life processes is anticipated, including the effects of dredge and fill operations which lead to increased sediment load in the water column and reduced light, both of which are highly detrimental to corals and sea grasses.

5. Increased sewage output will result from an increasing population. This can lead to depressed oxygen levels and altered nutrient cycles, which in turn disrupt the ecological balance of coral reefs. Trans-boundary waste from Chetumal may be contaminating the
entire Bay of Chetumal including Hol Chan. Although some monitoring is taking place for nutrient levels it is not comprehensive enough.

Constraints and bottlenecks

1. Apart from the Hol Chan Channel and Shark Ray Alley the other potential recreational sites are not adequately developed or subscribed to leading to overcrowding at the two sites. There is a need to diversify the sites.

2. Demarcation of some of the zones is incomplete hence resource users do not have a clear idea of where they are in relation to some of the zones.

3. Community participation in the management of the reserve has been less than ideal. There is a need to get the communities engaged in the running of the PA and to buy in to management objectives.

4. Although revenues are enough to cover operating expenses, it is not enough to cover expenditure on infrastructure and scientific monitoring including the purchase of equipment, hence there is scant resources for replacement of equipment or infrastructure.

5. Although some monitoring is taking place it is incomplete to give a true picture of the state of the resources within the HCMR and in particular to guide management interventions and to decide on tourism related issues.

II. Caye Caulker Marine Reserve

The management plan for this PA spanned the period 2004 to 2009 and needs to be updated.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Objectives</th>
</tr>
</thead>
</table>
| Goal 1: To preserve and maintain in optimal working condition, representative samples of the ecological systems in its natural state on and around Caye Caulker for all people, for all time. | a) To preserve, maintain, and, where deemed necessary and possible, work toward restoration of structure and function of the outstanding living ecosystems of the area; b) To protect and preserve the integrity and natural production of the physical and biological resources in all zones included in both Protected Areas, all ecosystems and habitats through a mixture of sustainable usage and conservation; c) To safeguard critical habitat areas for endangered, threatened and rare species of flora and fauna; d) To assure that the quality of air and water resources entering the protected area from outside its boundaries remains suitable for the sustained existence of the ecosystems, flora and fauna existing within the protected areas; and to assure that actions resulting in impact are prevented or detected promptly, removed and penalized in an effective manner; e) To manage the area on a scientific basis; and in such a way that the management
system remains sufficiently flexible to incorporate strategies based on new scientific information.

**Goal 2:** To provide natural areas for the promotion of education and research.

- a) To encourage the use of the area as a scientific study centre for discerning and demonstrating optimal management of protected areas, including application of such techniques;
- b) To encourage the use of the areas as a base for pure and applied research on ecosystems, flora and fauna of the Protected Areas;
- c) To foster interest in and knowledge of the coastal and marine environment through educational and interpretive programs for schools and other educational establishments, visitors from around Belize and abroad, and the local community;
- d) To encourage and promote the use of the area as a study centre for local and international students.

**Goal 3:** To preserve the value of the area for fisheries and tourism, including export of larval and adult marine and terrestrial life in addition to other important marine and terrestrial genetic resources and resource-based activities.

- a) To afford protection to all habitats supporting species of importance for commercial fisheries and tourism—endangered, threatened, charismatic and interdependent;
- b) To provide undisturbed areas that will ensure increased fisheries production based on larval recruitment from up current sources as well as habitat and refuge for important species to grow and thrive;
- c) To ensure larval export supply for down current habitats;
- d) To provide areas for large showy species to live and grow unmolested, providing attraction for high-grade tourism;
- e) To provide undisturbed or minimally disturbed habitat bolstered by infrastructure that affords low-impact visitation while providing quality habitat for permanent and seasonal resident, migrant and transient species;
- f) To provide non-destructive, non-polluting habitat enhancement in appropriate areas for attraction of fish and other marine life.

**Goal 4:** To develop sustainable and ecologically balanced recreational and tourism services that enhance the economic and social benefits of the area.

- a) To provide well-managed zones for tourism and recreation which do not disturb or impact the Preservation Zone, or significantly reduce the quality of any other zone in both Reserves;
- b) To promote uses compatible with conservation and sustainable development objectives, primarily through education, in addition to surveillance and enforcement of the zoning scheme, including monitoring of high impact development activities on nearby cayes.
- c) To assist the local community in providing ecologically balanced recreational and tourism services, including contribution to training of tour guides and fishermen.

**Threats**

The following threats were identified from observations made during the field visits, interviews with managers and a review of management reports and related documents:

1. Onshore developments which result in runoff of pollution and sediments; however the full effects of these anthropogenic influences on the reef cannot be quantified. These could potentially be organic effluents in particular from fertilizer runoff, sewerage, solid waste and waste from businesses. Additional pollution could potentially come from
dredging to fill low lying areas resulting in sedimentation. Coral reefs have been shown to be sensitive to even very low concentrations of nutrients and sediments.

2. Although some monitoring is taking place not enough of it is directed towards potential pollution from inland and onshore sources. Neighbouring Caye Chapel is known for its use of chemicals on their golf courses but it is not known to what effect this activity is impacting the reserve if at all.

3. High visitation rates overstretch the guide’s capacity to supervise the visitors resulting in damage to corals and unnecessary disturbance to wildlife. This is coupled with damage from boats to corals from groundings or from improperly placed anchors.

4. Inappropriate conduct with respect to wildlife encounters, especially at Shark/Ray Alley. These include grabbing, hauling, even lifting sharks out of the water by guides; and standing, walking, grabbing, hauling and feeding by tourists.

5. Lack of proper delineation for the various management zones as the demarcation buoys available are not sufficient.

6. There are persistent cases of illegal fishing using prohibited methods including spearfishing and hooksticking, although in general, cooperation of stakeholders with the management objectives of the site is good.

7. Fuel barges bound for Caye Caulker and San Pedro routinely pass through or near the northwestern lagoon areas of CCMR, exposing shallow marine habitats to potential fuel spills.

8. Anthropogenic threats include trampling by uncontrolled visitation; boat groundings; breakage by commercial divers going after fish, lobsters or salvage operations.

9. Over fishing

10. Rising sea temperatures as a result of global warming.

**Constraints and bottlenecks**

1. Unknown amount of pollution entering the CCMR current monitoring methods are not adequate to detect this. As the population of Caye Caulker continues to increase along its current rapid trajectory this phenomenon is expected to worsen

2. The management zones have not been adequately marked by buoys making it quite convenient for mal-intentioned resource users to enter under the pretext of not knowing the boundaries,

3. A single boat carries out patrols and supervises visitors; however this is in no way adequate in high season when large numbers of novice, unsupervised snorkelers and divers descend on the sites.
4. There are not enough buoys for all the charter boats hence some are known to cast anchor damaging the sea bed.
5. Over visitation in some areas while other potential sites are undersubscribed.
6. Non-payment of prescribed fees by users of the PA.
7. Lack of meaningful targeted community and/or stakeholder education programs.
8. Lack of motivation by townspeople to attend meetings even though there is generally could support for the reserve.

III. Half Moon Caye and Blue Hole Natural Monument

These sites have a current management plan that spans the period 2008 -2013. The goals and objectives are given below.

<table>
<thead>
<tr>
<th>Site</th>
<th>Goal</th>
<th>Objectives</th>
</tr>
</thead>
</table>
| Half Moon Caye Natural Monument | **Goal:** To protect and preserve natural resources and nationally significant natural features of special interest or unique characteristics to provide opportunities for interpretation, education, research and public appreciation for the benefit of current and future generations, within a functional conservation area. | a) To protect and maintain geology, marine and terrestrial ecosystems and associated biodiversity within two functional conservation areas, as integral parts of the National Protected Areas System Plan  
b) To provide recreational and educational opportunities for Belizean and international visitors in a manner that is compatible with the natural environment  
c) To protect and maintain natural resources and spawning aggregation sites important for the maintenance of traditional commercial fisheries on the Lighthouse Reef Atoll  
d) To promote and facilitate active research and biodiversity monitoring activities towards provision of information for adaptive management  
e) To further develop mechanisms to ensure long term financial sustainability |
| Blue Hole Natural Monument    | **Goal:** To protect and preserve natural resources and nationally significant natural features of special interest or unique characteristics to provide opportunities for interpretation, education, research and public appreciation for the benefit of current and future generations, within a functional conservation area. | a) To protect and maintain geology, marine and terrestrial ecosystems and associated biodiversity within two functional conservation areas, as integral parts of the National Protected Areas System Plan  
b) To provide recreational and educational opportunities for Belizean and international visitors in a manner that is compatible with the natural environment  
c) To protect and maintain natural resources and spawning aggregation sites important for the maintenance of traditional commercial fisheries on the Lighthouse Reef Atoll  
d) To promote and facilitate active research and biodiversity monitoring activities towards provision of information for adaptive management  
e) To further develop mechanisms to ensure long term financial sustainability |
The HMCBHNM is fortunate to have had a site-level self-assessment to measure management effectiveness. This assessment provides a snapshot of the state of the PAs in mid-2009, with site-level recommendations for use by protected area managers for adaptive management (Walker and Walker, 2009).

The assessment used seven (7) national indicator categories based on 64 indicators. The national Indicators were adopted for use under the National Protected Areas Policy and System Plan and evaluated through the Monitoring Package for Assessing Management Effectiveness of Protected Areas. The indicator categories are:

**Indicator Categories**

1. Resource Information
2. Resource Administration, Management and Protection
3. Participation, Education and Socio-Economic Benefit
4. Management Planning
5. Governance
6. Human Resources
7. Financial and Capital Management

Although not completely applicable some of the indicators could be used to determine carrying capacity or limits of acceptable change for these sites, however additional indicators would be needed for physical and ecological components.

**Threats**

The ecosystems within the two monuments appear to be reasonably healthy and to have benefited from the protection work, however policing the site requires constant vigilance and considerable resources in terms of manpower and equipment. The BAS appears to be working closely with the Tourism Police and the Belize Coast Guard to control the threat. At the present time Tourism Officers are stationed on Half Moon Caye and use BAS facilities. During the visit, our boat encountered a group of poachers diving within the protected zone. These men were arrested and their catch and equipment confiscated. Normal procedure is for the BAS to take them before the courts where they will be charged.

Long distance from the Belize mainland and its distant location from neighbouring countries have helped to keep human impacts on these sites relatively small. In addition the site has a dedicated well resourced staff with a resident site manager. Notwithstanding this the following threats were noted:
1. Fisherfolks from the aforementioned communities over fish the waters around the monuments for commercial species and also stage sporadic and illegal incursions into the protected area for this activity.

2. High visitation results in high boat traffic which has an as yet un-quantified impact on the local ecosystem but is believed to at least negatively impact the growth of sea grass beds.

3. At favoured dive sites there have been incidences of large vessels not using the anchors but instead using anchors which resulted in anchor drag and damage to the sea floor. In other instances boats beyond the capacity of the moorings provided drag the moorings and cause their anchor to damage the sea floor.

Constraints and bottlenecks

1. Hurricanes have seriously affected the ecosystem of these protected areas however experience have shown that with time such ecosystems will rebound and have actually evolved with such storms. Damage to infrastructure from these storms is expensive to fix and can compromise management effectiveness.

2. Protection of the resources within the protected areas is a major challenge, the low fines for those caught is offset by the temptation to make a big haul within the no extraction zone. Many miscreants are repeat offenders.

3. Lack of cooperation with management objectives of the PA on the part of some members of the northern communities even with extensive public outreach on the part of the BAS.

4. Although the site is a great revenue earner it is also very expensive to manage. There is a need to increase and diversify income to fund management activities.

5. Only small portions of the Lighthouse Reef Atoll (Blue Hole and Half Moon Caye portion) are actually protected.

6. There is a seasonal high visitation rate to both sites with attendant demand for services and amenities.

IV. Gladden Spit and Silk Cayes Marine Reserve

The management plan is current and runs from 2011 to 2016. The following are the goals and objectives of the PA.
Goal | Objectives
--- | ---
**Goal:** “The protection of the key reef ecosystems, the idyllic Silk Cayes, the spawning aggregation and Whale Sharks of Gladden Spit, within the multi-zoned marine reserve”, a) Effectively manage the natural resources of Gladden Spit and Silk Cayes Marine Reserve, with the participation of all stakeholders.  
b) Ensure adaptive management decisions are informed by research and monitoring outputs.  
c) Effectively manage the commercial marine resources for sustainability, and for the benefit of traditional users of the Marine Reserve.  
d) Effectively manage recreational opportunities for environmental sustainability, visitor appreciation and socio-economic benefit to local stakeholders.  
e) Effectively manage the spawning aggregations for sustainability of commercial fish stocks and individual species.  
f) Provide opportunities for interpretation, education and increased awareness of the Marine Reserve, its environmental services.

The GSSCMR is fortunate to have had a site-level self-assessment to measure management effectiveness. This assessment provides a snapshot of the state of the Marine Reserve in mid-2009, with site-level recommendations for use by protected area managers for adaptive management (Walker and Walker, 2009).

The assessment used seven (7) national indicator categories based on 64 indicators. The national Indicators were adopted for use under the National Protected Areas Policy and System Plan and evaluated through the Monitoring Package for Assessing Management Effectiveness of Protected Areas. The indicator categories are:

**Indicator Categories**

1. Resource Information  
2. Resource Administration, Management and Protection  
3. Participation, Education and Socio-Economic Benefit  
4. Management Planning  
5. Governance  
6. Human Resources  
7. Financial and Capital Management  

Although not completely applicable some of the indicators could be used to determine carrying capacity or limits of acceptable change however additional indicators would be needed for physical and ecological components.
Threats

The following threats could compromise the management and future viability of the site:

1. Over fishing for commercial species.

2. Illegal encroachment into the reserve by foreign registered boats is an identified management challenge although local fishermen are also to blame. Foreign and local vessels enter the reserve because of the bountiful supply of commercial fish species which have proliferated thanks to the protection program. Fortunately the stepped up patrols and other protection work has increased both the detection rate for these illegal vessels and the successful prosecution of the offences.

3. Although the spawning aggregation site is one of the few places in Belize reporting stable and even increasing numbers of a variety of important commercial fish species there are incipient threats which could reverse the gains if not nipped in the bud.

4. Sedimentation and agrochemical contamination from mainland watersheds have been highlighted as perhaps one of the greatest impacts on the Belize reef, after climate change. Considering that GSSCMR lies near the mouth of five watersheds - South Stann Creek, Santa Maria Creek, Mango Creek, Sennis Creek and Monkey River which drain some of the principal citrus and banana growing areas of central Belize there is room for concern given the reputation of these industries for using harmful chemicals.

5. There is an increase supply of sediments onto the reef as rivers wash increasing amount of topsoil with embedded chemicals into the sea from the ever expanding agricultural frontier although this phenomenon is more pronounced in the south.

6. Heavy tourism impact on the Whale Shark zone during peak season resulting in reduced Whale Shark visitation and changing patterns of spawning aggregation,

7. Overfishing and unsustainable fishing practices including undersize, restricted and out of season catch,

8. Poor boat handling resulting in damage to the reef and seas grass beds,

9. Illegal fishing practices using spears and gill nets,

10. Uninitiated visitors resulting in impacts to corals,

11. Climate change resulting in reduced coral cover and loss of biodiversity,

12. Aquaculture on the mainland releasing nutrient rich effluents into rivers.
Constraints and bottlenecks

1. Although protection work within this reserve appears to be going well and bearing fruits there are an identified need to bring the GSSCMR into closer integration with the Southern Belize Reef Complex (SBRC). This would help to promote conservation efforts at a landscape level and promote a unified vision, with the SBRC goals and objectives for system level management being incorporated into the management planning process.

2. The number of turtles nesting has decreased as well as the number of migrant birds seen on the islands.

3. Whale Sharks visitation which is one of the biggest tourist draw to the area is on the decline and high visitation and human interaction appears to be one of the culprits, however reducing visitation is bound to produce stakeholder derision.

4. Unregulated and excessive number of tourist into sensitive sites at certain times of the year which can create unnatural stress on the ecosystem.

5. There is indication of damage to corals from visitor activities and coral bleaching is a cyclical phenomenon against which the corals appear to be holding their own even if bleaching events are getting more frequent.

V. Sapodilla Cayes Marine Reserve

The management goal and objectives of this PA is given below.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Objectives</th>
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| **Goal**: To conserve and protect biodiversity of the Sapodilla Cayes Marine Reserve for the sustainable use of present and future generations | a. To develop sustainable fisheries in the SCMR through effective surveillance and enforcement of zoning, and prevention of trans-boundary fishing incursions  
b. To identify and protect resilient reefs, with effective, ongoing monitoring of biodiversity to inform management decisions  
c. To ensure sustainable tourism use of the Sapodilla Cayes Marine Reserve though developing and implementing a ‘limits of acceptable change’ programme, with established carrying capacities  
d. To address uses and activities outside Sapodilla Cayes Marine Reserve that threaten conservation and protection of biodiversity within the marine protected area, through trans-boundary collaboration  
e. To ensure stakeholders are informed and supportive through regional education and outreach strategies  
f. To ensure proper administration and implementation of the Sapodilla Cayes Marine Reserve, with full stakeholder input into decision making |
The SCMR is fortunate to have had a site-level self-assessment to measure management effectiveness. This assessment provides a snapshot of the state of the PAs in mid-2009, with site-level recommendations for use by protected area managers for adaptive management (Walker and Walker, 2009).

The assessment used seven (7) national indicator categories based on 64 indicators. The national Indicators were adopted for use under the National Protected Areas Policy and System Plan and evaluated through the Monitoring Package for Assessing Management Effectiveness of Protected Areas. The indicator categories are:

**Indicator Categories**
1. Resource Information
2. Resource Administration, Management and Protection
3. Participation, Education and Socio-Economic Benefit
4. Management Planning
5. Governance
6. Human Resources
7. Financial and Capital Management

Although not completely applicable some of the indicators could be used to determine carrying capacity or limits of acceptable change for these sites, however additional indicators would be needed for physical and ecological components.

**Threats**

The biggest threat is the demand for the fisheries resources in the area which attract not only local fisherfolk but also fishermen who cross the international frontier and who hail from Guatemala and Honduras. As a result fishing stocks are being severely depleted. There is a need to strengthen the protection of terrestrial ecosystems of the cayes, and cease land sales within the World Heritage Site of which the SCMR is a part. Lands already under private ownership needs to be brought under a regulated system in which there are guidelines to control their development.

Other threats include pollution from land based pollution sources, the accumulation of water borne waste from passing ships and neighboring countries, manatee hunting and disturbance to the reef and seagrass beds.

The reserve provides nursery and feeding habitats for at least twenty five species of international concern, recognized under the IUCN Redlist as Critically Endangered, Endangered
or Vulnerable. These include five species of coral, three species of turtle, fifteen species of fish and the vulnerable West Indian manatee. In addition a number of the cayes have historically provided nesting sites for hawksbill, green and loggerhead turtles, important to the survival of these species within the region. Alteration of habitats, uncontrolled exploitation and pollution is threatening these ecosystems.

Other threats include:
1. Clearance of mangroves and other natural vegetation,
2. Invasion of alien species,
3. Beach erosion,
4. Turtle nesting sites are endangered by human encroachments.
5. Climate change which could result in loss of coral and fish diversity.
6. Intensive fishing pressure including the taking of under size, restricted and out of season species.
7. Illegal fishing methods including the use of spear and gill nets.
8. Poor practices by charter boats and private recreational vessels.
9. Poor boat handling practices resulting in anchor damage, damage to corals and sea grass beds.
10. Removal of littoral forest for development and destruction of beach vegetation.
11. Impacts from agricultural runoff entering rivers and flowing out to sea resulting in pollution from nutrient enrichment and turbidity.
12. Reduced viability of turtle nesting sites.
13. Reduced viability of bird nesting sites.

**Constraints and bottlenecks**

1. International dispute over sovereignty and confusion about international boundaries,
2. Need for more monitoring and research to better understand the ecosystems including their present condition, capacities for and resilience to change,
3. Incipient phenomena of Climate Change and its attendant disruption of ecosystems including coral bleaching and loss of reef biodiversity,
4. Impacts from hurricanes which results in damage to corals and alteration of terrestrial habitats. Such impacts can reverse years of careful stewardship.
5. Need for better communication between Programmes manifested through limited sharing of information and collaboration.
6. Wider stakeholder recognition of SEA as an organization is still relatively low.
7. Need to improve the dissemination of research, monitoring and management results to local community stakeholders.

4.5 Analysis of the Terrestrial Priority PAs

I. Nohoch Cheen Archaeological Reserve

A management plan for the PA was prepared in 2011 but is still in draft form. The proposed management goal is as follows:

**Management Goal:** To ensure that the natural and cultural resources and associated values of the NCAR are protected, restored, maintained in good condition, and managed within their broader ecosystem and cultural context. It is the purpose and goal of the National Institute of Culture and History to preserve and protect the diverse and significant features of the NCAR while allowing for the continued recreational use of the cave, with the understanding that for this to occur, the natural processes that created the cave must continue to function unimpeded by anthropogenic interference.

**Threats**

The following threats were identified from observations made during the field visits, interviews with managers and a review of management reports and related documents.

1. The primary threat to the park is from overuse due to excessively high visitation numbers which can produce significant impacts on the environmental cultural and physical resources at the site. Management is cognizant of this and is prepared to take measures to address the problem however the reserve needs an adequate evaluation of its baseline resources and a monitoring program to gauge significance of impacts.

2. There is evidence to suggest that the caves of the NCAR have been looted and a considerable amount of archaeological relics removed. Continuous looting is an ever present threat.

3. The above ground areas of the NCAR are subject to a variety of illegal uses and its integrity has thus been compromised and the park is at risk of continuous deterioration.

4. People from the buffer communities of the park are known to conduct illegal hunting for small mammals and reptiles, and fish with nets within the Caves Branch River of the NCAR. The Bayleaf Palm, the Cohune Palm, Palmetto, and Bamboo are also extracted illegally from the park.
5. Substantial areas of the forested areas are subject to wildfires and physical damage from hurricanes.

**Constraints and bottlenecks**

1. Limited capacity of managers to control tourism numbers due to nature of the cruise tourism industry.
2. Limited understanding of the underlying biological processes.
3. Need to get stakeholder (especially buffer zone communities) buy in to management objectives of the park.

**II. Chiquibul National Park**

The current management plan spans the period 2008 to 2013.

**Management Goal:** The Chiquibul National Park functions as a core area of protection of biological diversity within the Chiquibul forest and is recognized within the Greater Chiquibul/Maya Mountains Region for its intrinsic natural and cultural values, whilst contributing to national development, regional security and cooperation, and enhancing and maintaining its ecological integrity.

**Threats**

The Chiquibul Forest which includes the CNP is facing a number of threats some of them severe enough to threaten the viability of the park and its central role in protecting biodiversity and cultural and natural landscapes.

The park is under a sustained onslaught from Guatemalan Nationals who not only unsustainably collect the ornamental Xate palms for sale abroad but who are also believed to be heavily involved in looting archaeological sites, poaching Macaw Parrots for the pet trade and decimating the areas game species. Nearer to the Guatemalan border the situation is even worst with farmers clearing and colonizing the forest, extracting timber and destroying fragile habitats.

Other threats include damming of rivers for energy generation and unregulated mining among others. The main threats to the Chiquibul and its buffer protected areas are summarized below:
1. **Illegal Hunting** – This wanton practice has impoverished select game species and even some species not traditionally taken for meat such as Tapirs and Spider monkeys. This is destroying select food chains and trophic structures especially as it relates to predators which rely on these species for survival.

2. **Illegal harvesting of ornamental palms** – This unsustainable practice on the part of Guatemalan Xateros is totally unregulated and threaten to decimate the preferred species (*Chaemadorea ernestii-augustii*) while providing a staging ground for other illegal activities such as collection of Macaws for the pet trade and illegal hunting.

3. **Expansion of the Agricultural frontier and land use change in adjacency areas** – On the Belizean side agriculture is expanding into the buffer protected areas as land is illegally excised with no recourse to legal review. On the Guatemalan side settlers are crossing over into the Chiquibul Forest and slash and burning large areas destroying habitats wildlife and ecosystems and opening up the area to further exploitation and wildfires. The FCD and the security forces are trying their best to control this activity and even reverse the damage caused, however the hurdles are immense and complicated by bilateral protocols along a contentious border.

4. **Logging** – Both legal and illegal logging is taking place within the area. Legal logging (although with minimal controls) is taking place in the Chiquibul Forest Reserve under license from the Belize Forest Department. Within the concession area logging is selective with high grading of primary species such as Mahogany and Cedar which results in their selective removal without replanting.

   Illegal logging is taking place across the international frontier within the Chiquibul Forest by Guatemalan loggers. The practice is totally unregulated and unsanctioned and is in all likelihood highly destructive to both timber species and the larger ecosystem. An assessment looking at impacts is currently underway.

5. **Impacts from dams** – Dams recently constructed along the boundaries of the Mountain Pine Ridge Forest Reserve and the Chiquibul have inundated large areas of riparian forest, resulting in changed forest cover and species composition and changed the annual dynamics of the flood plains. Commensurate changes have included alteration of aquatic systems and annual hydrological cycles. Damage to aquatic and riparian species has not been properly documented.

6. **Mining and mineral exploration** – Mining is an ongoing enterprise within the Chiquibul forest. Regulations and controls where they exist do not appear to be adequately enforced. Destructive side effects include sedimentation of streams, pollution into
water bodies from machinery, scarification of the landscape and disruption to ecosystems.

7. **Looting of cultural artefacts** – The Chiquibul is rich in Mayan Archaeological Sites, spiritual sites and cultural remains. Some of the best sites in Belize are located in this region, however given the remoteness of the area and the presence of marauding Guatemalan Nationals (who have systematically covered most of the park) this priceless treasure is now at risk. An unknown but likely devastating amount of looting is probably taking place within the area.

**Constraints and bottlenecks**

The following are environmental, social and economic constraints and bottlenecks within the CNP:

1. While some biodiversity information exist for the park it is not easily accessible and needs to be compiled,
2. Very little research is available to inform management intervention, however there is a Biodiversity Research Inventory and Monitoring Framework in place which is being used. The FCD has a research team in place.
3. Inventory data has been collected on the extent of illegal logging, milpa cultivation, Xate harvesting and Macaw poaching, however given the pressures on the resources this data must be updated periodically.
4. Few and inadequate facilities to accommodate visitors at the park nor is there any concerted marketing strategy to attract and bring visitors into the park.
5. Boundary lines are not properly demarcated giving a ready excuse for those who enter the park illegally. In addition the international frontier has boundary issues that are beyond the capacity of park management to handle.
6. There is a need to bring stakeholders and agencies in line with the management objectives of the park.
7. Limited direct benefit for stakeholders in adjacency areas.
8. Limited funding has compromise the ability of management to respond to some of the most pressing threats facing the park.
9. Funding is very much reliant on donors making the park susceptible to changes in donor funding priorities.
10. Management planning is needed to regulate future visitation into the park. There are plans to prepare a Tourism Management Plan for the Chiquibul Forest and a Tourism
Management Plan for the Chiquibul Cave System, however none of this has yet come into fruition.

III. Mountain Pine Ridge Forest Reserve

The original purpose of the reserve was the protection of economically valuable sources of pine timber, and this is still a significant factor in management policies. The reserve also fulfills an important role in the protection of biodiversity and water resources, as well as providing opportunities for revenue generation from tourism and recreational use. The MPRFR does not have a current management plan however a new management vision was articulated in the Visitor Use Management Plan with the following goals and objectives.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal 1: To sustainably manage the physical features and natural attractions in the Mountain Pine Ridge Forest Reserve for the benefit of all residents and visitors.</td>
<td>a) To create a model for the management of protected areas in Belize with a tourism emphasis, b) To promote and facilitate environmental and natural resource education, c) To generate income for the sustainable management of the MPRFR d) To improve the MPRFR visitor experience</td>
</tr>
<tr>
<td>Goal 2: To contribute to the growth of the economy via employment creation and income generation</td>
<td></td>
</tr>
</tbody>
</table>

Threats

Significant current threats identified in the Forest Reserve are considered to be:

1. Seasonal fires which threaten large areas including newly regenerating pine seedlings and saplings,
2. Recurrent infestation from Pine Bark Beetle,
3. Possibility of dereservation on the prerogative of the minister,
4. Illegal incursion for wildlife, building materials and plants,
5. Damage to ecosystem caused by the construction of the dams and modification of the natural hydrological regime,
6. Encroaching development into buffer zone region.

Constraints and bottlenecks

1. The reserve lacks a management plan hence no coherent management framework,
2. Poorly maintain roads discouraging visitation,
3. Need to improve baseline collection of data on the physical, environmental, cultural and social context of the reserve,
4. Environmental monitoring program is deficient and needs strengthening,
5. The current surveillance and enforcement program is deficient,
6. Not enough funding to cover essential management activities,
7. Stakeholder participation in management of reserve is minimal not enough stakeholder support,
8. Visitor management and visitor monitoring capacity deficient and needs upgrading,
9. Poor dissemination of information on the reserve, need to improve the delivery of environmental education and the dissemination of information.
10. The destruction wrought on the forest by the Southern Pine Bark Beetle (*Dendroctonus frontalis*) from which the forest will take many years to recover.

**IV. Cockscomb Basin Wildlife Sanctuary**

The existing current management plan spanned the period 2006 to 2011 and is currently out of date. The BAS has plans to update the document.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Objectives</th>
</tr>
</thead>
</table>
| **Goal:** To maintain biodiversity, cultural resources and watershed areas within a functional conservation area, as an integral part of the National Protected Areas System | a) To maintain biodiversity, ecosystems, cultural resources and watershed areas within a functional conservation area, as an integral part of the National Protected Areas System  
 b) To provide an enabling environment for economic opportunities for local communities and society, towards sustainability  
 c) To engender greater public support, public awareness and participation to increase acceptance and security  
 d) To develop Cockscomb Basin Wildlife Sanctuary as a nationally and internationally known research site  
 e) To strive towards a greater level of sustainability through expansion and further development of tourism, compatible with biodiversity |

**Threats**

The BAS has identified a number of threats that if not addressed could compromise the integrity of the CBWS. The ring of buffer communities to the east has traditionally used the area for hunting and fishing and to extract building materials etc. With the designation of the site as wildlife sanctuary this practice is no longer allowed bringing management objectives into conflict with traditional use.

Jaguars which find safe refuge within the CBWS often cross over into private lands and predate on livestock causing violent reaction from landowners. This is becoming an increasingly
important issue as the agriculture frontier moves ever closer to the boundary of the CBWS. This expansion of land clearing for agriculture is also threatening to break biological connectivity to the coastal plain to the east.

In addition, there is some looting of archaeological sites and some buffer communities have yet to buy into the objectives of the CBWS being lukewarm to its existence at best. To counter these threats the BAS is concentrating resources on better patrols and the successful prosecution of cases within the courts. The staff carries out short and deep (long) patrols, however the BAS Annual Report 2010, mentions increase in illegal hunting, fishing and the incipient growth of illegal Xate harvesting. The following are identified as some of the main threats to the park:

1. Hunting and fishing – mostly carried out for food and purse.
2. Tourism - especially impacts to elfin forest in the Victoria Peak area.
3. Killing of Jaguars – these are attributable to Jaguars crossing into communities and preying on livestock.
5. Residential, agricultural and community development in adjacent areas.
6. Logging – mainly legacy effects but still reports of some illegal activity.
7. Wildfires – The Cabbage Haul ecosystems are prone to damage from wildfires.
8. Illegal milpas - mostly geared at marijuana cultivation.
10. Mining – none taking place but under present legal framework mining could be allowed.
11. Dereservation – the minister still has the authority to dereserve all or part of the PA.
12. Failure to renew the Comanagement agreement with
13. Hurricanes – these have had dramatic effects in the past and will likely strike again.

**Constraints and bottlenecks**

1. Some stakeholders have not bought into the BAS management objective for the site,
2. Loss of biological connectivity with the approach of the agricultural frontier nearer to the site boundary.
3. Fires are prevalent within some of the forest ecosystems of the sanctuary although there is evidence to show that many of the species and the ecosystem has evolved with fire and may even be fire dependent.
4. Despite its many great attractions and hospitality related infrastructure visitation is still relatively low.
5. Cost of running the site far exceeds revenue from gate receipts, suggesting vulnerability to public and external donors.

4.6 Insights on Carrying Capacity within Individual Priority PAs

In regards to carrying capacity/limits of acceptable change within the individual priority PAs the following observations can be made.

I. Hol Chan Marine Reserve – Of the nine (9) priority PAs this is the one most often cited as having a carrying capacity issues yet the site offers at best a mixed picture which is far from convincing:
   a. At certain times in the year (tourist season) the two main sites are heavily subscribed however this only for about 3-4 months and only at certain times of the day,
   b. Many other potential dive and snorkeling sites are under subscribed, hence the problem is more one of concentration and the need for dispersion,
   c. Even in the two most heavily subscribed sites of Hol Chan Channel and Shark Ray Alley nothing from the monitoring is definitively showing overuse, however a strong case can be made for irresponsible use on the part of visitors,
   d. The staff appears to be highly motivated and dedicated, however without proper physical and biological indicators it will be hard for them to determine what constitutes over use at the sites.

Since the staff cannot change the tourist season or dictate to tour guides and visitors when to visit the popular dive sites, perhaps the way forward until appropriate indicators are developed is to charge higher rates for the most popular sites and keep the rates for the less subscribed sites at a lower rate. More marketing and promotion could also be made for the less subscribed sites. This could apply for at least the tourism high season.

II. Caye Caulker Marine Reserve – This reserve gets only about one sixth the numbers of visitors of Hol Chan Marine Reserve yet carrying capacity issues often surface in discussions of the site.
a. The main recreational site is often crowded during the peak tourist season, however at other times use is very light,
b. Other satellite sites with good potential for diving and snorkeling are undersubscribed,
c. The staff does not believe the popular recreational site is overused and nothing from the monitoring indicates otherwise, however a case can be made for misuse and carelessness on the part of visitors especially from the cruise ships.
d. The general impression is that the sites within this reserve are world class and could contribute to the national economy and conservation in general by generating more revenue through increased visitation.

III. **Half Moon Caye and Blue Hole Natural Monuments** – The BAS has already carried out carrying capacity studies for these sites using the LAC method. At the present time distance from tourism centers, traveling cost and the entrance fee combine to control visitation numbers to these sites. This is despite the fact that they are unmatched for physical beauty, pristine habitats and the health of the ecosystems. These sites are very expensive to manage, however this cost is covered by tourism receipts. Measures taken to control visitation include:

a. Raising the fee to US$40.00
b. Restricting number of mooring Buoys

Within the sites the only area which may have a carrying capacity issue is the Blue Hole which covers only a small area; otherwise all the other visited sites appear to be in good health based on the results of the ongoing monitoring program. Damage to ecosystem here as elsewhere appears mainly due to irresponsible use on the part of boats and uninitiated divers and snorkelers.

Of particular note is that the BAS is happy for the time being with the current visitation level, use of the facilities and the income being generated. The question remains as to whether PAs such as these with star earning potential should maximize revenue as a way of subsidizing other PAs within the system with lesser earning potential.

IV. **Gladden Spit and Silk Cayes Marine Reserve** - The SEA recently carried out a carrying capacity study for this site. From our observations the following conclusions can be drawn in terms of carrying capacity:

a. The Whale Shark aggregation site appears to be heavily subscribed for 2 to 3 months of the year. The current observation is that less of these animals are
showing up in the spawning aggregation area, however the evidence cannot
prove conclusively whether the decrease in sighting is caused by high visitation
numbers or whether less fish are spawning (hence less feedstock for the sharks)
due to over fishing.

b. Visitation to the site is already regulated by SEA by controlling the numbers of
boats that can enter the aggregation area,

c. Other attractions within the reserve seems to be currently undersubscribed,

d. The SEA would like to increase visitation into the site on a responsible basis as a
revenue enhancement measure.

e. On the basis of the limited monitoring that is being carried out it appears that
the habitats are in good shape, what appears to be less wholesome is the
population of commercial species. The problem therefore appears to be one of
excessive fishing and not the number of visitors.

V. **Sapodilla Cayes Marine Reserve** – This marine reserve appears to have relatively sound
habitats but low populations of commercial species at least within the more mature size
classes. This however can be attributed to unsustainable use on the part of fishermen
and illegal poaching.

The ecosystems on the islands are also somewhat degraded but here again the problem
is with the large number of government and institutional stakeholders who have set up
shop on the islands and not tourism pressure. From the evidence gathered this reserve
does not have a tourism capacity issue but might be approaching a bottleneck in terms
of facilities available to accommodate tourism and the infrastructure and amenities
available to support the other stakeholders.

VI. **Nohoch Cheen Archaeological Reserve** – This is one of the few mainland PAs that have
high visitation numbers and may have a carrying capacity issue. The following
observations can be made:

a. There are periods of very high visitation corresponding to the period of peak
cruise tourism. During other times of the year the site is undersubscribed with
spare capacity,

b. Recent guidelines introduced will help to regulate visitation and reduce stress on
the environment and cultural relics. This includes control over the size of
groups, required qualifications for guides and restriction on the number of
people passing through the caves at a given time. Guides will also be required not to handle more than a certain amount of groups per day,

c. The site has a small area hence the footprint of large visitation numbers is greater,

d. The need to do a comprehensive assessment of this site is urgent, however again the absence of indicators and clear objectives for site management will be an impediment.

VII. **Chiquibul National Park** – Visitation to this park is extremely low despite the many attractions. Impediments to increase visitation include security concerns, lack of access, lack of facilities, lack of marketing and poorly presented attractions. At the present time this site does not have a carrying capacity issue and is not liable to for some time to come. Physical damage to the landscape and the impoverished state of aspects of the ecosystem has more to do with irresponsible use of resources e.g. mining and illegal extraction of flora and fauna.

VIII. **Mountain Pine Ridge Forest Reserve** – This site was recently physically and ecologically devastated by the Pine Bark Beetle devastation and the attendant fires which were used to clear debris and promote regeneration. Since then it has lost much of its popularity with both foreign and local visitors.

In the present context this site does not have a carrying capacity issue and indeed there is considerable room for expansion in visitation numbers and pressing financial reasons to do so. This will only happen in tandem with the proper development of visitor facilities, improvement to roads and other infrastructure and development and improvement in the presentation of attractions.

IX. **Cockscomb Basin Wildlife Sanctuary** – This PA is well endowed with good attractions for tourism development. The Victoria Peak Natural Monument is the only area where visitor carrying capacity may present a management issue, however impacts has less to do with numbers and more to do with the sensitivity of the ecosystems and the behavior of the visitors.

Further increases in visitation numbers are contingent on the development of tourism in the coastal communities of Placencia, Hopkins and Seine Bight where most of its visitors spend their vacation. Facilities within the sanctuary are well developed and continuously improving. The site has considerable elasticity to accommodate increase
visitation numbers and this is expected as tourism in the southern region matures and come into its own.

### 4.7 Recommendations on the way Forward

The determination of carrying capacity is a complex and time consuming undertaking requiring dedication and considerable resources of time and expertise. At the present time only a few of the protected areas have the necessary baseline information needed to input into such a framework. In addition most of the management plans are outdated or are being revised. In the absence of a “live” management planning document it is impossible to determine what the objectives of the protected area is or should be.

Use reduction and other heavy-handed visitor restrictions will be perceived by the stakeholders as a potential threat to generating tourism income, a high priority for a developing country like Belize. To that end carrying capacity limits are difficult to defend and often are exceeded due to pressure for economic gain from visitation. For a variety of biophysical and social impacts the amount of use is only one factor contributing to impact; the type of use, time of use, group size and behavior, management actions, developer practices and environmental characteristics may be more important.

The following is recommended:

1. The NPAS should lobby for standardization of management plans with clear objectives and indicators for determining carrying capacity,

2. Very little monitoring is taking place in the priority PAs hence it is impossible to know the state and condition of the resources upon which a carrying capacity study should be based. There is a pressing need for good quality monitoring in the priority PAs,

3. The concept of a “number” or “range of numbers” for carrying capacity should be abandoned in favor of Alternative Decision Making Frameworks even though they are associated with time constraints, substantial costs, and extensive financial and personnel resource requirements.

4. PAs should establish a set of conditions or values reflecting environmental, physical and social aspects of the site,

5. There is a need for the establishment of standards and the standardization of indicators for protected areas across their various management categories and zones. In the present context any notion of carrying capacity for PAs is both confusing and divisive.
6. Instead of setting a number of visitors for dive sites site managers should work to get stakeholders buy in to strong management practices. This will prevent environmental deterioration while allowing maximum revenue generation.

7. At some of the MPAs it might be advisable to disperse tourist to other sites since externalities appear only when the system reaches certain levels or thresholds. This suggests the need for land use/spatial planning.

8. Most of the priority PAs **do not** have a carrying capacity issue – they need increase visitation for revenue generation. It is recommended that a set of guidelines including the development of indicators be formulated to guide them in their incipient tourism enterprise.
5 Recommendations for Income Generation

Protected areas financing in Belize has always presented a mixed picture but what emerges is a system facing chronic underfunding and insufficient investments. In times of fiscal austerity and tightening government budgets the problem is exacerbated with the result that funding is falling well short of what is required to maintain the system.

The basic premise is that the government has limited resources to spend on services for its citizens and must make difficult decisions about how and where to spend these resources. The implications of this are that protected areas must compete with other worthwhile development priorities such as health, education and welfare services. The budget allocated to PAs cover little more than salaries and the occasional infrastructure improvement with meager amounts left over for biodiversity conservation.

Though a protected area is in the business of providing biodiversity services, it can use a business approach which is profit centered and entrepreneurial to maximize its financial capacity to achieve conservation aims. Since protected areas supply goods and services in a generally competitive marketplace they are, in an economic sense, businesses facing a complex array of customers who may wish to spend their limited funds elsewhere.

To diversify funding sources, protected area managers need to have quality information about the protected area’s goods and services and the values which stakeholders, investors and other potential supporters or customers place on them. There also needs to be an understanding of which values are being captured and which are not through a process called valuation. In particular there is a need to identify the following:

- those who are not contributing to the protected area but derive benefits from it (potential sources of revenue),
- those who are excluded from deriving benefits from the protected area but are being asked to ‘pay’ for the protected area, such as taxpayers.

When considering options for income generation Belizean protected areas managers will need to take account of the following factors:

- PA management category - Under some IUCN category a broader range of use is allowed giving greater opportunity for revenue generation and to capture rent (see Appendix 2).
For example a Category V or VI protected area has the potential to accommodate a wide range of uses in different zones as compared to a Category I which only allows low impact use such as research (see Table 5.1 below).

- **Management Effectiveness** - To capitalize on the values within a protected area requires the capacity to manage that area to maintain these values.
- **Intrinsic Values** - The protected area needs to attract and entice investments and revenue. This suggests that the attributes of some protected areas might be very easy to sell while others might have less appeal even though they have important conservation and biodiversity roles to play. Cross subsidization within the system will obviously be a necessity.

**Table 5.1:** IUCN PA Management Objectives and Types of Actual and Prospective Customers.

<table>
<thead>
<tr>
<th>Management objectives</th>
<th>IUCN protected area management category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ia</td>
</tr>
<tr>
<td>Scientific research</td>
<td>1</td>
</tr>
<tr>
<td>Wilderness protection</td>
<td>2</td>
</tr>
<tr>
<td>Preservation of species and genetic diversity</td>
<td>1</td>
</tr>
<tr>
<td>Maintenance of environmental services</td>
<td>2</td>
</tr>
<tr>
<td>Protection of specific natural and cultural features</td>
<td>–</td>
</tr>
<tr>
<td>Tourism and recreation</td>
<td>–</td>
</tr>
<tr>
<td>Education</td>
<td>–</td>
</tr>
<tr>
<td>Sustainable use of resources from natural ecosystems</td>
<td>3</td>
</tr>
<tr>
<td>Maintenance of cultural and traditional attributes</td>
<td>–</td>
</tr>
</tbody>
</table>

Key:
1 Primary objective; 2 Secondary objective; 3 Potentially applicable objective; – Not applicable

Ia Strict Nature Reserve; Ib Wilderness Area; II National Park; III Natural Monument; IV Habitat/Species Management Area; V Protected Landscape/Seascape; VI Managed Resource Protected Area
Source: IUCN, 1994
• Legal Framework – The existing legal framework can work against income generation in PAs. For example the co-management agreements which run on a five year cycle before renewal or cancellation does not give enough security of tenure for some PAs to attract investors.

Protected areas managers can think of the population as a direct threat to the protected area (in terms of wanting to exploit the PA for goods and services) or as potential customers. In most cases, the population is responding to perverse incentives which actually encourage them to work against the objectives of the protected area. A range of misplaced economic factors including macroeconomic and sectoral policies, social and economic conditions allow these activities.

To counter this, PA managers can employ positive measures and inducements which can help to achieve the desired outcome of biodiversity conservation while allowing a commercial relationship. Positive incentives can be put in place so that commercial operations can be structured to generate revenues for the protected area which will in turn support the overall goal of biodiversity conservation.

In other cases services are provided to an entire community, region or country such as clean drinking water from a watershed maintained in good condition by a protected area. These indirect benefits could be enjoyed by a range of users and therefore these groups have a stake in conserving the protected area. It is the job of the PA manager to capitalize on the interest of these beneficiaries in the management of these resources by encouraging and enabling them to support the protected area. For example fiscal measures can be used to collect revenues from these downstream and indirect customers.

Other benefits could include an even larger numbers of stakeholders up to the global level. These could include biodiversity conservation, carbon sequestration, habitat for endangered species and migratory species, replenishing fish stock for traditional and commercial fisheries, mitigation of natural disasters and impacts related to climate change etc.

5.1 Identifying a Protected Area’s Goods and Services

Identifying a protected area’s goods and services, determining who values those goods and services, and measuring these values is not always a straightforward process since there is a wide array of potential services and hence a diverse group of potential customers. In addition, many of these goods and services are not traded on commercial markets and therefore have no evident market value. These services need to be measured and expressed in monetary terms so that they can be weighed on the same scale as commercially traded components.
The concept of Total Economic Value (TEV) is now a well-established and useful framework for identifying the various values associated with protected areas. The TEV of a protected area consists of its use values and non-use values. A protected area’s use values are in turn made up of its direct use values, indirect use values, and option values. Non-use values include bequest values and existence values. Table 5.2 illustrates the relationships between these values with explanations given below:

- **direct use values** - of a protected area are values derived from the direct use of the protected area for activities such as recreation, tourism, natural resource harvesting, hunting, gene pool services, education and research. These activities can be commercial or non-commercial.

- **indirect use values** - are values derived from the indirect uses of the protected area. Indirect uses are largely comprised of the protected area’s ecological functions such as watershed protection, breeding habitat for migratory species, climatic stabilisation and carbon sequestration.

- **option values** - of a protected area are values derived from the option of using the protected area sometime in the future. These future uses may be either direct or indirect and may include the future value of information derived from the protected area.

- **Non-use values** - are values which humans hold for a protected area which are in no way linked to the use of the protected area. Two common examples of non-use values are bequest values and existence values. **Bequest values** relate to the benefit of knowing that others benefit or will benefit from the protected area. **Existence values** reflect the benefit of knowing that the protected area exists even though one is unlikely to visit it or use it in any other way.

Once the potential uses and benefits of protected areas and the relevant beneficiaries have been identified the PA manager need to determine how beneficiaries will pay for the goods and services they derive from the protected area. The important thing is that PA managers should explore all public and private options for financial resources hence they need to service both their public and private customers, and receive a fair return through appropriate financing mechanisms. PA customers can be roughly classified into four groups:

1. neighbours as customers;
2. commercial customers;
3. bioregional customers; and
4. global customers.
Table 5.2: Total Economic Values of Protected Areas.

<table>
<thead>
<tr>
<th>Use values</th>
<th>Non-use values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct use value</td>
<td>Indirect use value</td>
</tr>
<tr>
<td>Recreation</td>
<td>Ecosystem services</td>
</tr>
<tr>
<td>Sustainable</td>
<td>Climate stabilisation</td>
</tr>
<tr>
<td>Sustainable</td>
<td>Future information</td>
</tr>
<tr>
<td>harvesting</td>
<td>Use and non-use values for legacy</td>
</tr>
<tr>
<td>Wildlife harvesting</td>
<td>Flood control</td>
</tr>
<tr>
<td>Fuel-wood</td>
<td>Ground-water recharge</td>
</tr>
<tr>
<td>Grazing</td>
<td>Carbon sequestration</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Habitat</td>
</tr>
<tr>
<td>Gene harvesting</td>
<td>Nutrient retention</td>
</tr>
<tr>
<td>Education</td>
<td>Natural disaster prevention</td>
</tr>
<tr>
<td>Research</td>
<td>Watershed protection Natural services</td>
</tr>
</tbody>
</table>
5.2 Income Generation Categories for PAs

The successful management of the nine (9) priority protected areas depends on ensuring that sufficient finance/income is available, that stakeholder groups are provided with sufficient incentives to support conservation, and that the underlying economic threats to their integrity and status are overcome.

There are 11 potential sources of income which PA managers can use to generate revenue for their PA. These are:

- government allocations;
- taxes, levies, surcharges and subsidies;
- user fees;
- cause-related marketing;
- debt-for-nature swaps;
- joint implementation projects and carbon offsets;
- grants from multilateral/bilateral sources, and from foundations;
- loans from the private and public sectors; and
- public and private donations.

Each of these has its strengths and weaknesses. Internal and external factors determine which mechanism is appropriate.

5.2.1 Income from public and International Organizations

Even with funding and support from the private sector through income generation schemes it is critical that governments retain and honor their obligations at the national level toward the establishment and sound management of an adequate and representative system of protected areas. It is manifestly important for government and international organizations and institutions to provide such funds, as they represent a societal payment for the public benefits of protected areas.

Government allocation for protected areas management should continue to be the foundation of their financing, as protected areas provide many public goods and services at a local, regional, national and global level. This is especially important where the PA has little obvious
commercial value but is important to protect biodiversity, watersheds and genetic resources. In addition there needs to be a system of cross-subsidization to support such PAs.

At the national level, this funding can be tied to the provision of indirect use benefits, such as watershed protection, while at the global level it could be tied to existence benefits, such as conserving critical habitats for endangered biodiversity. This should be complemented by a sound legal and planning framework and an aggressive campaign of public education and institutional lobbying on the part of PA managers. The following summarizes and rationalizes funding sources:

- The purely public goods provided by protected areas require public funding e.g. government allocation, overseas development assistance or foundation grants,
- The private good aspects of protected areas, on the other hand, can be commercialised and funded from private sources e.g. tourism, licensing, bioprospecting etc,
- Combination of public and private financing may be needed for common pool goods.

In Belize this can be translated to mean that the PA revenue policy should allow for tax dollars to pay for the cost of establishing and protecting PAs and the public goods they provide while those who use and enjoy them should pay for the additional personal or commercial benefits that they receive. In cases where both a public good and personal benefit are derived, financing could be through a combination of taxes (public) and fees (private). Ideally the PA should be able to generate enough income to cover its operating expenses plus retain a surplus to invest in conservation and community development projects.

To realize maximum benefit from government and foreign assistance (even in the face of changing funding priorities) Belizean PA managers will need to be vigilant in the following areas:

1. Ensure that governments live up to the core PA and biodiversity funding commitments they have already made,
2. Steer development and poverty reduction funds towards PA objectives by being more explicit about the contribution of PAs to socio-economic development for example via the provision of ecosystem services such as clean water supply, disaster mitigation and soil protection.
3. Lobby the political establishment to overcome the continuing low awareness among decision-makers of the role of PAs in achieving sustainable development.
4. Raise the priority of biodiversity conservation within the sustainable development agenda, with an explicit focus on how PAs can help achieve local, national and global development goals.
5. Conduct economic valuation studies of PA costs and benefits. When economic benefits of PAs are well articulated a case can be made for maintaining or even increasing funding.

This suggests an arrangement in which traditional funding sources are strengthened while additional funding sources are accessed and has the benefit of diversifying a protected area’s income sources thus helping it to become more viable.

5.2.2 Income from private sources (Commercial and Neighbors)

Income from private sources is where the greatest latitude and potential exist for the nine (9) priority protected areas. Most of these sites are fortunate in that they have good potential for revenue generation notwithstanding the fact that some of them come under strict IUCN equivalent management categories which restrict certain types of activities.

In addition to this, PA managers need to be aware of and respect the prevailing political, social and legal circumstances in which the PA is embedded. For example in Belize public opinion supports certain types of extractive activities in PAs while other commercial activities are frowned upon. Belizean PA managers must bear in mind the following when investigating potential income generation schemes:

i. the protected area’s goals and objectives are clearly articulated and defined;
ii. the existing customer base is known;
iii. the demands on the resources are identified and quantified;
iv. potential new customers and relative levels of use versus contribution are known (see Figure 5.1);
v. mechanisms to capture income from customers are identified;
vi. the feasibility of the proposed mechanisms and the plan to achieve the desired outcome are known.

In a recent study it was found that fraudulent leakage from Belizean PAs was estimated to be 30% (Haas, 2011). In addition the authors found that unmanaged or benign leakage exists and affect PAs in the following ways:

a. an estimated 60% of the PAs do not have an entrance fee program and,
b. Some PAs’ entrance stations are not manned for certain days resulting in leakage that could amount into the hundreds of thousands per annum,

Against this should be balanced the cost of fee collection which consumed considerable amounts of staff time and money (Haas, 2011).
Figure 5.1: Schematic of system to evaluate potential income sources.

It is important to understand that the chosen option for income generation if not properly evaluated and assessed may result in the following negative consequences:

1) impacts may compromise protected area resource protection mandates;
2) Impacts can occur rapidly at low levels of use;
3) some impacts are cumulative, increasingly degrading resources over time; and;
4) impacts may lead to other undesirable consequences such as diminished visitation, economic benefits or resource protection incentives.

5.2.3 Perverse Incentives as Impediments to Income Generation

The issue of perverse incentives must be taken into account when discussing income generation for Belize’s PAs. These incentives serve as a disincentive for PA managers to increase income and generate revenue.

Probably the most glaring example of this is the collection of fees for government managed PAs. Fees collected ends up in the governments consolidated funds and not spent directly on the PA. As a result of this, managers of these PAs have little incentive to be innovative and increase collection of fees or to look for alternative sources of income generation. Indeed their
Incentive is not to collect fees since they do not benefit directly from it but rather it adds to their administrative burden and consumes staff time.

In the same vein the co-management agreements run for only five years before they are renewed, although there are moves afoot to increase this to seven years. Co-management partners work under the uncertainty of not knowing whether their management tenure will be renewed. Without longer term tenure it is hard to attract private investments and the PA managers might be reluctant to invest a lot of time and resources in a PA which may be taken away from them.

5.3 Recommendations for Income generation in the Nine Priority PAs

Many options are available for income generation in the individual priority PAs however any option chosen must ideally meet the following criteria:

- Should capitalize on the existing strengths of the PA including staff expertise and capacity, available infrastructure and the specific attractions of the site,
- Be relatively easy, simple and straightforward to implement,
- Benefits buffer zone communities and contributes to the national economy,
- Must not compromise the management objectives of the PAs including biodiversity conservation and indeed should promote these objectives,
- Must take into account the true value of the resources.

5.3.1 General Insights and Observations

In the future there must be a paradigm shift in the management philosophy of PAs from one based on a top down exclusionary approach (fences and fines mentality) to one that is more inclusive and actively engages and includes the broader stakeholder community in PA management. There is a need to integrate PAs into the economic and social context locally regionally and nationally. In other words a linkage must be forged between conservation and development and the two must become mutually complementary and reinforcing to each other.

Although many options for income generation may appear promising it is important to take into account the current economic and political situation in the country especially as it relates to increasing fees taxes and levies. There is almost universal opposition to increases in fees, taxes and levies across all sectors of Belizean society. In the same vein raising access fees to enter protected areas have raised the ire of tour operators and hotels who complain about tight margins and loss of clients.
The very tight margins under which the public and private sectors operate mean there is only a small leeway to raise revenue using these methods. There is also the general cultural perception that the environmental services offered by protected areas should be available for free.

In other instances the institutional cost to protected areas of instituting fees, sale of souvenirs etc may not be offset by income earned while it diverts staff from their core conservation duties. Most importantly the designation of certain sites precludes certain income generation activities even though there may be good potential for income generation in those proscribed sectors.

In addition to this, contracting private sector entities as business partners, though feasible in many cases will require increase management vigilance and oversight on the part of the PA entity and hence additional cost which must be factored in. Many potential income generating scheme such as renewable energy require massive outlays of cash, and technical expertise both of which may not be available to PA managers. To reduce risk, collaboration with the private sector is essential.

Some PAs have more potential to generate income than others simply because of their resource base, location and the fact that their designation allows a wider variety of uses. Indications from the field visits indicate that MPAs are already capturing a significant amount of rent from the use of their resources, while considerable latitude exist for terrestrial PAs to generate additional income, especially the forest reserve which allows multiple use.

There is a raft of new and innovative income and financing schemes being applied worldwide for PAs e.g. bio-prospecting, biodiversity enterprise funds etc, however a review of the literature shows that many are not living up to their original promise and most are achieving below expectation. For these schemes to work requires that certain critical elements be present in the PAs and only few will meet those standards.

Finally many PAs have limited financial technical and scientific resources and would be at a disadvantage in terms of moving into new untested, uncharted enterprises. Nevertheless the capacity exists within the PA system as a whole and the larger stakeholder community and international agencies. Cross subsidization and collaboration in the general interest of conservation is indicated.

Table 5.3 shows selected income generating mechanisms across the PA system based on an income feasibility assessment. For any individual PA this would have to be further evaluated against the management category.
### Table 5.3: Feasibility of Implementing Selected Income Generating Mechanisms.

<table>
<thead>
<tr>
<th>Source</th>
<th>Legal</th>
<th>Political</th>
<th>Complexity</th>
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<td><strong>Self Generated Sources</strong></td>
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<td>Tourism fees (visitors, hotels, tour operators)</td>
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</table>
5.3.2 Recommendations for the Nine Priority PAs

Recommendations made for income generation in the nine (9) priority PAs are not exhaustive. There will always be innovative mechanisms that will be open to individual PA managers in select niche markets on an opportunistic basis (e.g. Conservation of a particular wildlife species or at risk habitat). PA managers should capitalize on these opportunities where they exist, however they are highly unpredictable and are not considered secure long term funding.

Additionally some of the recommendations made may be unpalatable to some PA managers, however the purpose of the exercise is to look objectively at possible income sources. The recommendations should therefore not be regarded as prescriptive.

The following income generation avenues/measures are recommended for the nine (9) PAs based on a rapid feasibility assessment.

1. **Hol Chan Marine Reserve & Caye Caulker Marine Reserve**— These PAs have star revenue generation potential and appears to be doing reasonably well even in the middle of a recession. It appears management for both sites are happy for the time being with both the level of use of the sites and the income being generated. However given the quality of the attractions there are options for increased revenue generation going forward. These include:

   a. **Raising the entrance fees** – It appears that visitors are quite willing to pay the prescribed fee of US$10 and US$5 for the HCMR and CCMR respectively to enjoy the reserve but given the quality of the attractions and the proximity to San Pedro and Caye Caulker there is latitude to increase this once the economy improves. This might have the dual benefit of helping to reduce demand and overcrowding at the sites. Many studies have shown that visitors are willing to pay more if the additional money spent will be used to promote the cause of conservation.

   b. **Licenses or Permits** – It is possible to capture more of the rent at the site by requiring charter boat owners, fishermen, sailboats etc to have special permits or licenses that would need to be renewed annually. The site appears to require this now but the fees seem to be very small compared to what is being offered. This can be used to control and limit access especially for sailboats against which the staff had numerous complaints.

   c. **Royalties and Sales Revenue** - Third parties selling souvenirs that use the name, logo or other proprietary materials associated with the site can provide another
source of income as long as the legal entity and symbols/products are properly registered.

d. **Carbon Sequestration** – Coral Reefs store abundant carbon. It is possible for HCMR and CCMR along with a consortium of Belizean Marine PAs to investigate the feasibility of this funding source in the future if a market develops for this,

e. **Corporate funding** – It is feasible to approach hotel chains, energy companies etc who have established funds for biodiversity conservation to donate towards the sites,

f. **Personal donations** – The many satisfied visitors who visit these sites every year should be regarded as fans and supporters of the PAs. This support can be used to generate revenues through workplace donations, personal donations etc. This can be important in protecting some of the flagship species including turtles.

g. **Resource extraction fees** – Both reserves have an abundance of resources that can be used by artisanal craftsmen who manufacture crafts for sale.

h. **Commercial leases, concessions or franchises** – Commercial leases, concessions or franchises can take a variety of forms in both PAs and can be used to enlist outside support for the management of PA facilities. This may involve delegating broad PA management responsibility to a private company or to manage specific PA facilities or provide particular services on a professional commercial or cost-recovery basis.

i. **Trophy fishing** – Trophy fishing is a popular sport worldwide that attracts a well resourced clientele who are prepared to pay more for an exceptional catch. The PAs could sell licenses to groups for this type of fishing providing the fish are released unharmed.

j. **Catch and release fishing** – Both PAs have a good supply of fish including well known game species. Catch and release fishing could bring in much needed revenue for both PAs, while promoting the local tourism industry and providing jobs to stakeholders.

2. **Blue Hole Natural Monument & Half Moon Caye Natural Monument** – These sites also have star revenue generating potential and it appears the BAS is happy for the time being with both the level of use and the income being generated. The designation of these sites, distance from the mainland and cost of doing business will restrict the type of activities however the following are possible:
a. **Raising the entrance fees** – BAS has recently raised the entrance fee to US$40 to increase revenue and reduce the number of people at the site. Charter boat owners and tourist complain that the fee is very high, however the site is world class and it may be possible for BAS to still increase the fee using a differential system in which US$40 would give access to some of the sites while those willing to pay more would have a high graded visit with access to more locations.

b. **Commercial leases Concession and franchises** – Presently the only fee that is captured is from tourism visitation into the reserve. The potential exist for the BAS to generate additional income from sales of souvenirs and consumables such as food and snacks or to contract this service out to a private entity on a concessionary basis. At the present time the site suffers from limited potable water resources and power which could sap such a venture.

c. **Corporate funding** – corporate entities, hotel chains, energy companies etc who have established funds for biodiversity conservation could be asked to donate towards the site,

d. **Personal donations** – The many satisfied visitors who visit the BHHMCNM should be regarded as potential long term friends and supporters of the PAs. This support can be used to generate revenues through workplace donations, personal donations etc. This can be important in protecting some of the flagship species including the Boobies, sharks, turtles and the Blue Hole itself.

e. **Education and research** – The BAS has established facilities that could be used to host university groups and researchers as a revenue generating measure. Some monitoring and research already occurs at the sites.

f. **Renewable energy** – Half Moon Caye appears to have good potential for wind and solar development however any system would have to be small as there is no potential to sell surplus energy to the grid. Generating indigenous power on site would promote other enterprises on the island which would in turn generate additional income for BAS besides the sale of power. There would also be the option of selling power to Island Expedition which has a tented facility on the island.

   i. **Wind**- Half Moon Caye has an excellent wind resource at least at certain times of the year when the wind blows continuously day and night,
however a wind mast and monitoring over a 1 year period would be required to determine the true potential of the resource.

ii. **Solar** – A small solar installation already exist on the island and there is a plan to augment this system. Combining solar and wind would produce a reliable hybrid system.

g. **Recreation** - Despite its many spectacular attractions no effort is being made to market the site to Belizean campers and day visitors. There is a large and growing market for camping especially in the Easter and summer months. This could be combined with courses in swimming, snorkelling and scuba diving.

h. **Sale of forest products** – At the present time there is an abundance of coconuts on the island some of which is taken out for sale as whole nuts. A concession could be granted to a private entity to process these coconuts into edible oils and other products on a sustainable basis.

3. **Gladden Spit and Silk Cayes Marine Reserve** – Although this PAs has spectacular attractions, its revenue generating potential has not been fully harnessed and hence incomes are not near the level of the other marine sites. The GSSCMR require increases in income to continue to maintain their PA management obligations and improve the environmental and visitor services while securing their management objectives into the future.

a. **Increase visitation** – The evidence of the field survey, literature review and consultation with management and stakeholders does not indicate that the carrying capacity for this site has been reached, although there are certain zones that might be reaching that level including the spawning zones at certain times of the year. Diversion into other recreational sites is recommended.

b. **Entrance fees** – Considering the quality of the attractions especially for the experience with the Whale Sharks the entrance fee is too low and there is latitude to increase it. Visitors to GSMR are mostly the affluent and educated who would be in a position to pay more for a unique experience. SEA should commission a study to determine visitors’ willingness to pay as raising the fee would also have the double benefit of reducing visitor numbers and hence impacts.
c. **Admission fee** – Management could charge a separate admissions fee for those visitors wanting to enter the fish spawning areas where the whale sharks are known to congregate.

d. **User fees** – The islands could allow camping and other recreational pursuits and charge an appropriate fee for use of the facilities. This would necessitate additional controls but the revenues generated may be worth the effort.

e. **Cause related marketing** – SEA could sell the intangible item of Whale Shark conservation by asking for donations. Buyers would benefit from knowing they are contributing to the conservation of important species.

f. **Research and education** – SEA could bring research groups and students to the site both to increase knowledge of the ecosystems and as a revenue generating measure.

g. **Corporate funding** – It is possible to approach corporate entities, hotel chains, energy companies etc who have established funds for biodiversity conservation to donate towards the site.

h. **Personal donations** – The many satisfied visitors who visit the site could be tapped into as a pool of goodwill to generate revenues through workplace donations, personal donations etc. This can be important in protecting perhaps the most important flagship species of them all - the Whale Shark.

i. **Trophy fishing** – Trophy fishing is a popular sport worldwide that attracts a well resourced clientele who are prepared to pay more for an exceptional catch. The SEA could sell licenses to groups for this type of fishing providing the fish are released unharmed.

j. **Catch and release fishing** – This PA has a good supply of fish including well known game species. Catch and release fishing in certain zones could bring in much needed revenue for the PA.

4. **Sapodilla Caye Marine Reserve** – This is another site with great attractions and hence revenue generating potential but with a multitude of management challenges not least of which is poaching and other illegal activities across international boundaries. Unfortunately the SCMR does not yet see very high sustained visitation rates being away from major population and tourism centres; however it benefits from having numerous agencies and organizations with a firm foothold within the PA. This site badly needs to
increase and diversify its income going forward, especially from tourism. Suggested income generating measures include:

a. **Increase visitation** – The evidence of the field survey, literature review and consultation with management and stakeholders does not indicate that the carrying capacity for this site has been reached, although at this point in time welfare facilities may pose a bottleneck.

b. **User fees** – The management currently allow camping and other recreational pursuits and there appears to be a market from neighbouring countries for this, however the facilities would have to be both improved and increased with clear regulations drawn up to manage this activity. With larger numbers and better facilities, SEA could charge an appropriate fee for use of the facilities.

c. **Research and education** – The site is currently used by the University of Belize (UB) for research and education. SEA in collaboration with UB could bring international research groups and students to the site both to increase knowledge of the ecosystems and as a revenue generating measure.

d. **Corporate funding** – corporate entities, hotel chains, energy companies etc who have established funds for biodiversity conservation could be approached to donate towards the site,

e. **licenses or permits** – There is a lively trade across the border in Guatemala for Sea Cucumbers a lot of which is harvested within the SCMR and adjacent waters. SEA could sell licenses to mine this resource under a sustainable harvesting regime.

f. **Increase visitation** – There is some potential to increase visitation to the site. SEA could promote and market the attractions of the site to tour guides and hoteliers in Placencia and in neighbouring Honduras and Guatemala. Increase frequency of visitation by small cruise lines should be encouraged.

g. **Renewable energy** – The cayes of the Sapodilla range appears to have good potential for wind and solar development. However distance from the grid would indicate the need for a small system able to meet the needs of the SEA and for sale to the other stakeholders on the island who now must rely on expensive power from portable generators. A sufficiently robust hybrid system could induce investors to invest in the area and provide additional income.
5. **Nohoch Cheen Archaeological Reserve** - By all accounts this small protected area draws in a disproportionately large amount of visitors, however only the entrance fee is collected by the NICH which is the public body responsible for the site. The other revenue coming to the site accrues to the concessionaire who charges for services provided including guiding, rafting, food, souvenirs, etc.

The recommendation is to for the NICH to capture a bigger part of the revenues coming to the site. In common with all the other PAs, very little is being done to attract Belizeans to the site. Since there is a five (5) month slow season corresponding to the summer break the management should advertise and encourage more Belizeans to visit and recreate. This is a viable option considering that up to 100,000 Belizeans live within a 50 mile radius of the site – well within travelling distance.

6. **Chiquibul National Park** – The CNP has a range of attractions and natural resources that could be used to generate income for the site, however in the present climate given the unfavourable security situation mainstream tourism should not be considered one of them. The following are recommended as potential income generating measures for the park:

   a. **Payment for environmental services** – This is probably one of the best prospects for revenue generation given that the park protects some of the country’s most important watersheds that provide potable water for up to 40% of the country’s population. In a recent meeting with Belize Water Services Ltd. (BWS) the vital role of the protected areas in protecting the country’s watershed was recognized.

   The BWS acknowledged that without this protection it would become much more expensive to treat water. The Friends for Conservation and Development (FCD) should lobby strongly to enact legislation that would recognize this role and compensate the protected area for this important and currently subsidized service.

   b. **Carbon Sequestration** – This is another very promising area for potential revenue generation. The forest of the CNP locks in large amounts of carbon and can sequester more if properly managed especially in the areas (illegally) deforested along the border. The FCD has already submitted a proposal to the Forest Department and Archaeology Department for the CNP to be considered a “Carbon Conservation Area”.
c. **Licenses or Permits** – The government has made an attempt to bring the illegal harvesting of Xate leaves under a sustainable harvesting regime using a permit/licensing system. However, this activity is poorly regulated and in addition, Guatemalan Xateros continue to wreak havoc in the park. The recommendation is for the activity to be brought under the FCD who will have responsibility for oversight as well as use of any fees collected. At the moment, the current concession holder has lost interest in pursuing Xate harvesting.

d. **Research and education** – The Las Cuevas site in the Chiquibul forest has long been used for education and research in tropical forestry management. It could continue to play this role while also taking other diverse roles in archaeology and cave research. The FCD has submitted a proposal to manage the facility.

e. **Bioprospecting** – This is a long shot but worth looking into as a potential revenue source.

f. **Oil and mineral exploitation** – Companies mining for minerals already operate within the Chiquibul, however, the pollution they cause and the disruption to natural ecosystems present a negative externality that must be borne by the park. These companies should be charged a fee under the “polluter pays principle” which should accrue to the FCD along with compensation to remediate any damage caused to the local ecosystems as well as other fees to operate within the park. The most feasible option is for mining companies to sign a bond in which they would be obliged to pay for any damages or cost incurred to the management of the park as a result of their activity.

g. **Adventure Tourism** – Although the present security situation would rule out mainstream tourism given the quality of the attractions there may be a niche for adventure tourism within the park especially in caving, rafting, rock climbing and jungle expeditions. This could be developed with minimal infrastructure and investments. Eco-Quest Expeditions the business arm of the FCD intends to pursue this type of tourism.

h. **Corporate Social Responsibility (CSR)** – Given the fact that international mining companies have an interest in the Chiquibul the potential exist for transfer of funds from these entities to the park as part of their budget earmarked for Corporate Social Responsibility. This would also open the door for the FCD and...
the mining companies to negotiate and draw up guidelines for socially and environmentally responsible mining. The FCD realises that this is a promising avenue to income generation.

i. **Renewable Energy** – The Chiquibul has an excellent renewable energy resource including wind, solar, biomass and hydro, however the designation category may preclude investments in areas such as biomass. In addition the national power grid may not be available in many areas with good wind and hydro potential.

   i. **Wind** – The Chiquibul has some of the best wind resource in the country with several locations where power density values exceed 400Wm\(^{-2}\), considered in the industry to be the average wind speed conducive to large scale commercialized development.

   ii. **Hydropower** – The Chalillo Dam and much of the impoundment area falls between the MPRFR and the Chiquibul. There is still considerable untapped potential for smaller hydro schemes away from the main rivers, however access to the grid would be an issue for consideration, notwithstanding this at least some of the sites could offer good connection.

j. **Sale of Commodities** – The Chiquibul produces an abundance of forest products some of which are being tapped illegally with no benefit to the park, however there exist the potential to extract products such as honey, chicle and thatch on a sustainable basis in collaboration with private sector partners.

k. **Fishing and water sport** – The impoundment of water behind the Chalillo dam has produced a large man made fresh water lake ideal for water sports (boating and skiing) and fishing. This resource is currently underutilized and needs to be brought under a sustainable management regime.

l. **Tourism** – With the creation of the fresh water lake within the Chiquibul and the many other attractions within the park the time is ripe to create small low impact tourism enterprises. This could bring a valuable source of income to the FCD if private investors can be found. At the moment the FCD is investigating the potential of such a venture.

m. **Voluntary Carbon Markets** – In this arrangement companies (national, international and multinational) voluntarily pledge funds for reforestation to offset their own emissions as a sort of Corporate Social Responsibility measure.
Since large areas of the CNP have been illegally deforested there is good prospect for obtaining funding via this avenue.

n. **Marketable Permit System** – The CNP can use a marketable permit system for the gold mining operation and any other similar enterprise which produce environmental pollution. In such a case an initial rights to use or to pollute can be allocated based on an acceptable level of resource use or pollution. Anything produced in excess of this would incur a cost to the polluter who would then have to buy pollution credits.

o. **Biodiversity Offsets** – The construction of the dams have devastated large areas of riparian forest in the CNP. The FCD should lobby for the energy companies to compensate for loss of biodiversity and ecosystems by offsetting the effects of their activity through funding positive intervention elsewhere in the park.

7. **Mountain Pine Ridge Forest Reserve (MPRFR)** – In the past the MPRFR was a popular tourism destination in its own right and a stalwart contributor to the nations stock of timber and sawn wood. This potential has been reduced somewhat with the devastation of the bark beetle, however the ecosystems are recovering and the site should soon recover some of its former glory. A Visitor Use Management Plan (VUMP) already exists for the site but it has never been implemented. Potential income generating schemes include:

a. **Payment for environmental services** – This is probably one of the best prospects for revenue generation given that the reserve protects a large part of the upper Macal River watershed which is used for power generation and to provide potable drinking water. Downstream users (e.g. utility companies) who benefit from this resource are not paying for the service that the MPRFR provides. There is a need to enact legislation that would recognize this role and compensate the protected area for this important and currently subsidized service. This legislation would need to be passed in concert with other PAs which also provide such services.

b. **Research and education** – The Douglas de Silva Forest Station has long been a centre for forest management in Belize. The site has some facilities in place and could once again become a regional centre for education and research in forest management.
c. **Increase visitation** – The beautiful mountain vistas of the MPRFR have been a favourite with visitors. The management needs to resurrect the VUMP and position the site as an important tourism destination in its own right with an eye on capturing the increased revenue that will be coming into the site.

d. **Entrance fees** – At the present time people entering the MPRFR to recreate do not pay an entrance fee. The reserve could charge a modest fee for this service and as compensation for use of its roads and facilities for people passing through to visit Caracol. The FCD has put forward a proposal for an entrance fee to be charged within the MPRFR to be shared between the CNP, Caracol Archaeological Reserve and MPRFR.

e. **Carbon Sequestration** – This is another very promising area for potential revenue generation. The ravaged forest of the MPRFR will sequester huge amounts of carbon as they recover provided there is good management presence on the ground to encourage regrowth and to fight fires and further beetle infestation. Funding could be under the Clean Development Mechanism or REDD+.

f. **Renewable Energy** – The MPRFR has an excellent renewable energy resource including wind, solar, biomass and hydro. In addition the designation category of the PA is conducive for investments in any of these areas. In addition the national power grid passes through the PA making it easy to sell generated energy.

  i. **Wind** – The MPRFR has some of the best wind resource in the country with several locations where power density values exceed 400Wm$^{-2}$. This is the average wind speed generally considered suitable for commercialized large scale operations. In all the area with suitable wind speeds covers ~ 125km$^2$ with good access to the grid making such a venture highly feasible.

  ii. **Hydropower** – the MPRFR already figures large in hydropower generation (Chalillo, Mollejon and Vaca) with considerable untapped potential on a smaller but nonetheless quite commercially viable scale. This would include small microhydro (up to 100kw) and medium size facilities (up to 1Mw). Again access to the grid would be an issue for consideration, however at least some of the sites would offer good connection.
iii. **Biomass** – Waste from the logging operations plus salvaging and thinning operations could be profitably collected and burn for electricity generation. Energy from biomass is gaining in popularity worldwide as fuel prices and energy cost continue to rise. In this scenario a private sector investor could set up a plant and use a resource which is presently wasted (and present a fire hazard) for power generation, thereby generating revenues not only for itself but also the MPRFR (through royalties) and local communities (through employment).

g. **Product Certification** – The MPRFR has long had a sustainable program for timber extraction based on area management system and annual allowable cut. Although timber production has declined recently with the Pine Bark Beetle infestation the foundation exists for the MPRFR to raise their game and get certification under the Smartwood or Woodmark certification scheme. This would apply to the existing forest area and to new areas as trees are recruited into merchantable size classes. Certification would enable wood (and wood products) to be exported under preferential prices from forest certified as sustainably managed.

h. **Trophy Hunting** – In earlier times trophy hunting was allowed in the MPRFR as an income generation measure. Although unpalatable to some, trophy hunting for big game species and wildcats has the potential to generate much needed revenue. Such an enterprise would also benefit buffer communities who could be employed as guides, cooks, porters etc.

i. **Sale of plants** - The MPRFR used to grow seedlings to replenish its own timber stocks and for sale to private interest. This enterprise could be resuscitated as an income generation scheme, especially given the abundance of land, seed trees and water in the reserve.

j. **Grazing rights** – Unlike most terrestrial PAs the MPRFR has extensive areas of grassland that could be leased out for grazing to private investors. This was a practice employed in the past and could be used again as long as it does not compromise biodiversity values. Apart from generating fees for the reserve such an enterprise would produce substantial employment for local stakeholders.

k. **Fishing and water sport** – The impoundment of water behind the Chalillo dam has produced a large man made fresh water lake ideal for water sports and
fishing. This resource is currently underutilized and needs to be brought under a management regime that will promote stocking with native species of fish.

l. **Tourism** – Several tourism resorts are already located in the MPRFR, however there remains potential for additional resorts, especially along the Chalillo upstream water impoundment area. This could bring a valuable source of income to the MPRFR if private investors can be found.

m. **Recreation** – The MPRFR has traditionally allowed camping and other outdoor recreational pursuits, however this needs to be systematically packaged and marketed to attract Belizeans and foreigners who want to embrace nature.

n. **Charcoal** – The MPRFR has substantial reserves of quality wood stock for charcoal production. Again such a venture would be best placed in the hands of a private entrepreneur under a sustainable harvesting regime drawn up by management with the MPRFR collecting fees as royalties.

o. **Communications** – The MPRFR could encourage the installation of communication facilities (e.g. transmission towers) within the reserve and charge a fee for the service.

p. **Biodiversity Offsets** – The construction of the dams have devastated large areas of riparian forest in the MPRFR. The FD should lobby for the energy companies to compensate for loss of biodiversity and ecosystems by offsetting the effects of their activity through funding positive intervention elsewhere in the reserve.

8. **Cockscomb Basin Wildlife Sanctuary** – Under the BAS, this PA has developed credible facilities and infrastructure that will allow it to capitalize on a range of potential income generating schemes in the future notwithstanding the strict category of its designation. Potential income streams include:

a. **Increase visitation** – As a pristine area dedicated to the protection of Jaguars and with the Victoria Peak in easy access this site has potential to draw visitors. Much of the infrastructure and facilities are already in place. More effort needs to be placed in marketing the attractions of the sanctuary and in working with tour groups and hotels to increase visitation.

b. **Research and education** – The facilities are available and amenable to education and research including for large student groups. The BAS should pursue
marketing the site to colleges and universities along the lines of the “Save the Rainforest” student program.

c. **Corporate funding** – It is possible to approach corporate entities, hotel chains, energy companies etc who have established funds for biodiversity conservation to donate towards the site. As one of the few Jaguar reserves in the world the site has great selling powers for corporate donors.

d. **Personal donations** – The many satisfied visitors who visit the site could be tapped into as a pool of goodwill to generate revenues through workplace donations, personal donations etc. This can be important in protecting perhaps the most important terrestrial flagship specie in the Americas – the Jaguar.

e. **Renewable Energy** – The CBWS has a number of renewable energy resources that could be exploited for production of renewable energy. These include:

   i. **Wind Energy** – There is a good wind resource at higher elevations that could be commercially exploited, however distance from the grid would make it very expensive to sell this energy, although smaller scale wind turbines could be used to power the site and sell to concessionaires operating out of the area.

   ii. **Hydropower** – There is some capacity to generate hydropower from the many streams flowing from the upland areas with minimal environmental impacts. None of these schemes would have large capacity but given the cost of power in Belize, they should be quite lucrative to operate and should pay for themselves within 2 to 3 years. Again the main restraint would be distance from the grid, however there is clearly a chance for collaboration with private sector investors and local communities in such an enterprise.

f. **Payment for Environmental Services** – Watersheds protected by the CBWS provide reliable clean potable water to downstream users in the banana and citrus belt who benefit from this service at no cost to themselves, receiving it as a positive externality. The CBWS could negotiate with these industries to levy a cess on their banana and citrus exports to pay for this service.

g. **Tourism Concessions** – There is some tourism into the CBWS and the Victoria Peak Natural Monument but the full potential of the site is yet to be realised. Leasing concessions within the PA to private sector entity could result in a
refined tourism product under professional management. This could generate much needed revenues for the BAS, relieve staff for core protection duties and help community stakeholders by increasing sales and receipts for goods and services.

h. **Extraction of commodities** – Tropical forest produce many commodities which find ready markets abroad especially when sold under the “green” eco label. This could include honey, chicle and xate to name a few. There is a large demand for thatch in offshore tourism resorts. This commodity has now become quite scarce on public lands and has been shown to respond well to sustainable harvesting. The BAS could negotiate with private sector entities to harvest these products under an approved management regime.

i. **Recreation** – The CBWS like most Belizean PAs have completely overlooked the spending power of the Belizean population. Each year Belizeans spend millions abroad on vacation. There is an increase demand for camping, hiking, canoeing and adventure sports. Cockscomb could develop and market the facilities to support these pursuits with minimal investments. The result would be more public support for PAs and additional income.

### 5.4 Linkages to the Sustainable Finance Strategy

The Sustainable Finance Strategy made a number of recommendations on improving revenue generation within Belizean PAs. On the basis of the information collected during this study most elements of the strategy could be applied within the Belizean PA system however the following must be taken into account:

1. **Raising entrance fees** – According to the authors the entrance fees for Belizean PAs are below par for the region and fail to capture the quality and uniqueness of what is being offered. There may be some latitude to raise fees especially in places like Hol Chan MR and Caye Caulker MR, however this must be approached with caution since many tour guides interviewed complained about the high fees and attribute it to reduce demand for tours on the part of tourist. A strong public relations campaign and proper consultation with stakeholders is indicated. Our general recommendation here is to concentrate less on raising entrance fees and more on capturing revenue through the provision of services e.g. gift shops, adventure tours etc.
2. **Payment for Environmental Services** – The Sustainable Finance Strategy (Drumm, 2011) recommended the institution of a watershed protection fee on the same lines as those being implemented in Costa Rica. The utility companies are the most obvious beneficiary of watershed protection and their financial resources would suggest ability to contribute to the PAs that manage the watersheds. Again there is potential for income generation here however a word of caution is warranted.

Recent attempts at raising water and electricity rates have raised the ire of the public and have had to be watered down or withdrawn. Although the utility companies appreciate the contribution of protected areas to water quality and flow control they are silent on making contributions to the system given their financial position.

3. **Global Carbon Markets** – The “Report” mentioned potential to generate revenues for PAs from international carbon markets, however with the global financial crisis the carbon markets have suffered. In addition there is little scope for Belize’s participation within the Clean Development Mechanism (CDM) since the CDM only finances afforestation and reforestation projects none of which would apply to our protected areas.

Likewise progress has been slow on another UNFCCC initiative called reducing emissions from deforestation and degradation (REDD+). Some financing is available under that scheme but full details of implementation are still to be worked out.
Bibliography


Haas, G., R. Aukerman, 2011. *Increasing the Efficiency in the Collection, Administration and Investment of Protected Areas Fees in Belize.*

Launchpad Consulting, 2005: *Sustainable Financing Mechanisms Belize’s Protected Areas System (Result 5):* Prepared For National Protected Areas System Plan Project.


Appendix 1- Workshop Program

Training Workshop

NPAS Consultancy

Training Workshop on Carrying Capacity Frameworks for Protected Areas

10th February, 2012

Cedar Cabins Lodge, Frank’s Eddy Village, Cayo District

8:00 Registration and Settle In

8:30 Welcome Remarks

(Ansel Dubon, Director of NPAS Project)

8:40 Introduction of Project and Objectives of Workshop

(Allan Herrera, Consultancy Team Leader, Nextera)

8:50 Origin and Concept of Protected Areas Management

(Allan Herrera, Consultancy Team Leader, Nextera)

10:00 COFFEE BREAK

10:15 Working Group Session: Carrying Capacity as a Management framework & Tool – Comparison of methods and protected area-specific variables

(Allan Herrera, Consultancy Team Leader, Nextera)

12:00 LUNCH

1:00 Variables and Indicators Relevant for Determining Carrying Capacity of Protected Areas

(Noel Jacobs, Team Member, Institutional Development Consultants)

2:00 Working Group: Recommendations for a Carrying Capacity for Belize’s Protected Areas

(Noel Jacobs, Team Member, Institutional Development Consultants)

3:00 COFFEE BREAK
3:15  Continuation: **Working Group**: Recommendations for a Carrying Capacity for Belize’s Protected Areas  
*(Noel Jacobs, Team Member, Institutional Development Consultants)*

4:00  Limitations for the Implementation of a Carrying Capacity Framework in Belize  
*(Noel Jacobs, Team Member, Institutional Development Consultants)*

5:00  Recap of the Day’s Session  
*(Allan Herrera, Consultancy Team Leader, Nextera)*

5:30  Closing Remarks  
*(Ansel Dubon, Director of NPAS Project)*
<table>
<thead>
<tr>
<th>NO.</th>
<th>NAME</th>
<th>ORGANIZATION</th>
<th>ADDRESS</th>
<th>TEL. (501)</th>
<th>E–MAIL</th>
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<tbody>
<tr>
<td>1</td>
<td>Ansel Dubon</td>
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<td>10</td>
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<tr>
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</tr>
</tbody>
</table>
Appendix 2 - IUCN Categories for PAs

Category I
Ia: An area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species available primarily for research and/or environmental monitoring.
Ib: A wilderness area is a large area of unmodified or slightly modified land and/or sea retaining its natural character and influence without permanent or significant habitation which is protected and managed so as to preserve its natural condition. (Strict Nature Reserve/Wilderness Area)

Category II
A natural area of land and/or sea designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations; (b) exclude exploitation or occupation inimical to the purposes of the area; and (c) provide foundation for spiritual, scientific, educational, recreational, and visitor opportunities all of which must be environmentally and culturally compatible. (National Park)

Category III
An area containing one or more specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance. (Natural Monument)

Category IV
An area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species. (Habitat/Species Management Area)

Category V
An area with coast and sea, as appropriate, where the interaction of people and nature over time has produced an area with significant aesthetic, ecological and/or cultural value and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area. (Protected Landscape/Seascape)

Category VI
An area containing predominantly unmodified natural systems managed to ensure long term protection and maintenance of biological diversity while providing at the same time a sustainable flow of natural products and services to meet community needs. (Managed Resource Protected Area)

Source: IUCN
Appendix 3 – PA Scorecard

Protected Areas Management Effectiveness Information Module

**WWF - WorldBank MPA Score Card**

1.1 **Organisation**

WWF-World Bank

1.2 **Primary methodology reference**

Staub F and Hatziolos, ME (2004a) ‘Calificador para Evaluar el Progreso en Alcanzar las Metas de la Efectividad de Manejo de las Áreas Marinas Protegidas.’ Banco Mundial.


1.3 **Brief description of methodology**

This is a simple scorecard system designed for marine protected areas. It consists of a data sheet to gather general information about the protected area, and an assessment sheet with a total of 68 questions. It covers all elements of the IUCN-WCPA Framework.

This type of assessment requires little or no additional data collection and focuses on the context of the MPA along with the appropriateness of planning, inputs and processes of management. It relies largely on available date through literature searches and informed opinions of site managers and/or independent assessors, takes a short period of time and costs little. Issues are broadly covered, but depth of analysis is generally low (Staub and Hatziolos 2004b).

1.4 **Purposes**

./ To improve management (adaptive management)
./ For accountability / audit

1.5 **Objectives and application**

‘The purpose of the Score Card is to help marine protected area managers and local stakeholders determine their progress along the management continuum. It is a short, straightforward self-assessment tool to help managers identify where they are succeeding and where they need to address gaps. Because it is intended to be completed by the MPA staff and other stakeholders, it can be a useful team building exercise (Staub and Hatziolos 2004b).

‘The MPA Score Card has many uses as an orientation tool to help managers of new protected areas scope out issues to be addressed in establishing an effective MPA, or as a Tracking Tool to provide managers with a sense of “where they are” along the management continuum. It also serves as a user-friendly reporting tool on MPA status based on
information largely already collected without any additional field level research’ (Staub and Hatziolos 2004b).

1.6 Origins
This is a marine adaptation of the World Bank/WWF Management Effectiveness Tracking Tool (METT) and from other tools (Hockings et al. 2000; Staub and Hatziolos 2004b; Wells and Mangubhai 2004).

**Protected Areas Management Effectiveness Information Module**

**Methodology Description**

1.7 How the methodology is implemented
‘The Score Card should be completed by marine protected area staff and, ideally, local stakeholders to validate the scoring. It is designed to be completed within a relatively short period, such as during a staff meeting or other routine meeting, by referencing available reports or datasets’ (Staub and Hatziolos 2004b).

1.8 Elements and indicators
The questionnaire consists of a data sheet and an assessment form with a total of 68 questions as follows. There is also space for comments and respondents are encouraged to add their comments.

The indicators are arranged according to the IUCN-WCPA elements).

**Indicators in Marine Tracking tool scorecard methodology**

<table>
<thead>
<tr>
<th>Context</th>
<th>1</th>
<th>Legal status – Does the marine protected area have legal status?</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>Marine protected area regulations – Are unsustainable human activities (e.g. poaching) controlled?</td>
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<tr>
<td></td>
<td>3</td>
<td>Law enforcement – Can staff sufficiently enforce marine protected area rules?</td>
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<td></td>
<td>3a</td>
<td>There are additional sources of control (e.g., volunteers, national services, local communities)</td>
</tr>
<tr>
<td></td>
<td>3b</td>
<td>Infractions are regularly prosecuted and fines levied</td>
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<td></td>
<td>4</td>
<td>Marine protected area boundary demarcation – Are the boundaries known and demarcated?</td>
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<tr>
<td></td>
<td>5</td>
<td>Integration of the MPA in a larger coastal management plan – Is the MPA part of a larger coastal management plan?</td>
</tr>
<tr>
<td></td>
<td>5a</td>
<td>a. The MPA is part of a network of MPAs which collectively sustain larger marine ecosystem functions</td>
</tr>
<tr>
<td></td>
<td>5b</td>
<td>b. The MPA is part of a network of MPAs which collectively represent the range of bio-geographic variation in a marine eco-region</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Resource inventory – Is there enough information to manage the area?</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Stakeholder awareness and concern – Are stakeholders aware and concerned about marine resource conditions and threats?</td>
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<tr>
<td>Planning</td>
<td>8</td>
<td>Marine protected area objectives – Have objectives been agreed?</td>
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<tr>
<td></td>
<td>9</td>
<td>Management plan – Is there a management plan and is it being implemented?</td>
</tr>
<tr>
<td></td>
<td>9a</td>
<td>There is also a long term master plan (at least 5 years)</td>
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<tr>
<td>9b</td>
<td>The planning process allows adequate opportunity for key stakeholders to influence the management plan</td>
<td></td>
</tr>
<tr>
<td>9c</td>
<td>Stakeholder participation includes representation from the various ethnic, religious and user groups as well as representation from both genders</td>
<td></td>
</tr>
<tr>
<td>9d</td>
<td>The socioeconomic impacts of decisions are considered in the planning process</td>
<td></td>
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<tr>
<td>9e</td>
<td>The local culture, including traditional practices, social systems, cultural features, historic sites and monuments, is considered in the planning process</td>
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<tr>
<td>9f</td>
<td>There is an established schedule and process for periodic review and updating of the management plan</td>
<td></td>
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<tr>
<td>9g</td>
<td>The results of monitoring, research and evaluation are routinely incorporated into planning</td>
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<tr>
<td>9h</td>
<td>Management plan is tied to the development and enforcement of regulations</td>
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<tr>
<td>10</td>
<td>Research – Is there a program of management-oriented survey and research work?</td>
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<tr>
<td>10a</td>
<td>a. Carrying capacity studies have been conducted to determine sustainable use levels</td>
<td></td>
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<tr>
<td>11</td>
<td>Staff numbers – Are there enough people employed to manage the protected area?</td>
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<tr>
<td>11a</td>
<td>There is additional support from volunteer programs, local communities, etc</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Current budget – Is the current budget sufficient?</td>
<td></td>
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<tr>
<td>12a</td>
<td>There is a secure budget for the marine protected area and its management needs on a multi-year basis.</td>
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<tr>
<td>12b</td>
<td>The budget is not entirely dependent on government funding; instead, funding also comes from NGO contributions, taxes, fees, etc.</td>
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<tr>
<td>13</td>
<td>Education and awareness program – Is there a planned education program?</td>
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<td>14</td>
<td>Communication between stakeholders and managers – Is there communication between stakeholders and managers?</td>
<td></td>
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<tr>
<td>14a</td>
<td>There is some communication with other MPA managers (and for example exchanges of good practices</td>
<td></td>
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<td>15</td>
<td>Stakeholder involvement and participation – Do stakeholders have meaningful input to management decisions?</td>
<td></td>
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<tr>
<td>15a</td>
<td>There are clear financial contributions / agreements between MPA and tourism operators to recover MPA resources rents for local benefits</td>
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<tr>
<td>16</td>
<td>Indigenous people – Do indigenous and traditional peoples resident or regularly using the MPA have input to management</td>
<td></td>
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<tr>
<td>17</td>
<td>Staff training – Is there enough training for staff?</td>
<td></td>
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<tr>
<td>18</td>
<td>Equipment – Is the site adequately equipped?</td>
<td></td>
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<tr>
<td>19a</td>
<td>Monitoring and evaluation – Are biophysical, socioeconomic and governance indicators monitored and evaluated?</td>
<td></td>
</tr>
<tr>
<td>19b</td>
<td>The MPA participates as a site in national or international environmental monitoring programs such CARICOMP, CPACC, GCRMN, AGGRA or similar. (Provide the name of the program(s))</td>
<td></td>
</tr>
<tr>
<td>20a</td>
<td>There is an Emergency Response Capability in place to mitigate impacts from non-threats</td>
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<tr>
<td>20b</td>
<td>Legal status has improved (refers to question 1. Legal status)+2</td>
<td></td>
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<tr>
<td>20c</td>
<td>Regulations have improved (refers to question 2. MPA Regulations)+2</td>
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<tr>
<td>20d</td>
<td>Law enforcement has improved (refers to question 3.</td>
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<tr>
<td>20e</td>
<td>Boundary demarcation has improved (refers to question 4.</td>
<td></td>
</tr>
<tr>
<td>20f</td>
<td>The MPA has been integrated into ICM (refers to question 5. Integration of the MPA)+2</td>
<td></td>
</tr>
<tr>
<td>20g</td>
<td>The resource inventory has improved (refers to question 6.</td>
<td></td>
</tr>
<tr>
<td>20h</td>
<td>Stakeholder awareness and concern has improved(refers to question 7.)+2</td>
<td></td>
</tr>
<tr>
<td>21a</td>
<td>Signs – signs are now available, or new one have been installed</td>
<td></td>
</tr>
<tr>
<td>21b</td>
<td>Moorings – moorings are now available, or new one have been installed</td>
<td></td>
</tr>
</tbody>
</table>
1.9 Scoring and analysis

For most questions, there is a choice of four responses (rating 0 to 3), where zero is equivalent to no progress or very little/poor situation and three is an ideal situation. Scores are added for each of the six elements of evaluation and a final total score can also be calculated. If some questions are not scored (e.g., not relevant), the maximum score should be changed to an adjusted score (maximum possible score minus points for question that are not applicable).

The final score is calculated as a percentage of the score obtained divided by the adjusted maximum score.