Ministry of Natural Resources and the Environment

BELIZE ENVIRONMENT OUTLOOK

GEO Belize 2010

LAND AND SURVEYS DEPARTMENT
M.N.R.E - BELIZE

University of Belize
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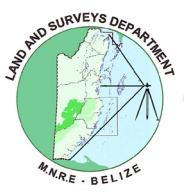
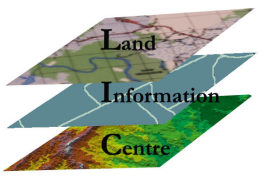
UNEP

Belize Environment Outlook

GEO Belize
2010





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We regret any errors or omissions that may have unwittingly made.

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We are very grateful to: The Forest Department, Department of the Environment, Geology and Petroleum Department, The National Meteorological Service, The Statistical Institute of Belize, Ministry of Health, Ministry of Agriculture, Caribbean Community Climate Change Centre, Fisheries Department, Coastal Zone Management Authority and Institute, Belize Water Service Limited, Belize Audubon Society, Belize Tourism Board, The Nature Conservancy, Association of Protected Areas Management Organization, Belize Natural Energy, Wildlife Conservation Society, Healthy Reefs, Programme for Belize, The Belize Sugar Industry, PANTHERA, CATHALAC, World Resource Institute, World Wildlife Fund and many other institutions that collaborated with us in one form or the other.

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FOREWORD

Belize is blessed with “wealth untold” of natural wonders that provide our country with economic, social and environmental benefits. The Ministry of Natural Resources and the Environment through its legislative mandate is empowered to oversee the sustainable management and use of the natural resources in Belize. In this context, the Ministry has the ultimate responsibility for the assurance of the adequate use of the country’s natural wealth, ensuring its sustainable use and ensuring an equitable distribution and access to the benefits of this natural patrimony.

The Government of Belize make available to the general population, national and international organizations and the Belizean populace in particular, the first ever Belize Environment Outlook (GEO Belize) report 2010. This important and useful tool is the result of a tripartite collaboration among the Ministry of Natural Resources and the Environment, the University of Belize and the United Nations Environment Programme – to who I express my sincerest appreciation.

This report was developed using UNEP’s GEO methodology which is strongly geared towards integrated environmental analysis. Through this process it is hoped that critical environmental issues will be mainstreamed in the political agenda and national development plans in such a way that science is linked with policy decision making. Thus, this is an important tool that will strengthen future policy initiatives in areas such as forestry, biodiversity, coastal resources management, waste management, water resources management and climate change to name a few. It is also foreseen that this report will be of importance to researchers, scientists, planner and students.

As per the requirements of the GEO process, this report was developed through a series of consultations with stakeholders. I take this opportunity to thank all those individuals and organizations that actively participated in this process and made this report a reality.

Finally, I am proud to announce by virtue of the powers granted to me to endorse this first Belize GEO Report and commit to the nation of Belize and its people that we will continue to produce this type of report in the future. This represents the recognition of the commitments and high standards of work we place as a people and Government on the collaborative efforts at the local, regional and the international levels towards achieving our sustainable development goals and of our planet.

Yours in Development,

Hon. Gaspar Vega
Deputy Prime Minister and
Minister of Natural Resources and the Environment

GEO BELIZE 2010 Presentation

The United Nations Environment Programme (UNEP), through its Regional Office for Latin America and the Caribbean, is pleased to present the first GEO Belize report, as a result of a joint effort with the Government of Belize, through the Ministry of Natural Resources and the Environment and its Land and Surveys Department, and the University of Belize.

This report uses UNEP's methodology for Integrated Environmental Assessment (IEA), known as GEO methodology that promotes a participatory and multidisciplinary approach to include the views and inputs of experts and practitioners, in identifying the most relevant environmental challenges and options for action. Indeed, the GEO Belize report was developed through the participation of experts from the academia, NGO´s and inputs from Ministries and their technical bodies whose contributions have converged into a shared view of the main environmental challenges faced by the country.

Through this process, an up to date environmental panorama is presented, which does not only describe the environmental state and trends but also analyzes the root causes of such situations and their impacts, looking at the effectiveness of policy actions already in place, and suggesting specific areas for consideration of decision and policy- makers.

The GEO Belize report highlights that important natural resources of the country and the services they provide, are seriously threatened by unsustainable use. This situation undermines the main basis of the Belizean economy and the wealth of its people. The findings of the report call, among others, for actions in the systematic collection of data and indicators, to support informed decisions and for strengthening the governmental agencies responsible for enforcing existing environmental laws and face today's environmental challenges. While the report recognizes that forest loss and degradation, as well as coral reef decline, are issues of concern - not only for the intrinsic values of these ecosystems but also for the economic activities that they support - it also proposes targeted options for action to strengthen the already extensive system of national protected areas.

The technical and scientific solid base, guaranteed by the specialists and expert partners participating in the process, makes the report a useful tool to promote targeted actions towards sustainable development. Finally, UNEP is pleased to contribute, through its support to the preparation of this report, to promote the improvements to human well-being the Belizean society is looking for.

Mrs. Margarita Astrálaga
UNEP Regional Director
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Executive Summary

Belize is a Caribbean country located in Central America that has a small area and a relatively small population size compared to its neighboring countries and other countries around the world. But despite its small size, the country is rich in biodiversity and natural resources, in particular, boasting the longest barrier reef in the Western Hemisphere. However, similar to the situation in the majority of developing nations, Belize's natural resources and environment, including its world re-known barrier reef, are under growing pressure as the country seeks to develop in order to be competitive in the global economy. The purpose of this report was to examine the state of the country's environment by documenting the existing pressures on the country's environment and the responses that have been taken with respect to these pressure either contributing to their exacerbation or their mitigation. The report reflects the Government of Belize's mandate and commitment to report on and take stock of the state of the environment in order to inform future decision–making for the sustainable management of the country's natural resources.

The first chapter takes a close look at the drivers of environmental change or the factors underlying various environmental pressures. It discusses demographic factors and highlights the fact that with a young population expected to double in the next decade, an increase in pressures to the environment particularly with respect to resource extraction and land-use is expected. The demographic section also highlights urban centers such as Belize City and Ambergris Caye as hotspots for environmental issues, particularly those concerning waste disposal and management. Furthermore, it also discusses the social situation of the country focusing on overall human development, poverty, employment and health as these and the relationship of these to the environment. The country's high poverty rate, in particular, is expected to continue negatively impacting the environment. As long as the poverty rates for the country remain high, the majority of the Belizeans will continue to focus on how to obtain their basic needs on a daily basis rather than planning ahead for a sustainable future in which the country's forests and seas continue to provide for the younger generations. The country's economic base is also discussed in the chapter, including major industries such as tourism and agriculture, which directly rely on use of the country's natural resources. A shift to better environmental practices in both of these industries as well as others is necessary in order to sustain their productivity for the long-term. The chapter ends with a discussion of education, particularly environmental education, as the pillar of change in the attitudes and behavior of people towards the environment.

Although the second chapter only focuses on a detailed discussion of the already mentioned drivers of environmental change, it is noted that underlying many of these drivers of environmental change are two other very important aspects of Belizean society. The first of these is the country's external debt and the pro-development decisions with little environmental consideration that are made in an effort to earn foreign exchange to service this debt.

The second chapter of the report examines the state of the country's environment by discussing seven environmental issues highlighted as the most important for the country by a wide group of stakeholders. These include forest loss and degradation, coastal degradation, coral reef decline, overfishing, climate change, poor waste management and loss in the quality of the country's water resources. All of the above issues are examined in terms of their importance to the Belizean economy, the direct pressures and threats that contribute to them and the positive and negative responses directly affecting them.

In terms of forest loss and degradation, the country is continuing to experience a high degree of both due to forest conversion for agriculture and legal and illegal extraction of forest resources. Although the country has made some very positive steps to mitigate this, for example, through the issuance of long-term logging licenses that are more sustainable in nature, these only cover a very small portion of the country's forested areas and monitoring and enforcement to ensure compliance is weak. There is also still no visible solution to the problem of controlling illegal incursions into Belize's forests for agriculture and resource extraction by non-Belizeans.

In the marine area, coastal degradation continues unabated, especially in hotspots such as Placencia and the country's offshore islands. This is mostly as a result of unsustainable development projects meant to provide infrastructure for the tourism industry. Although the Coastal Zone Management Authority and Institute has now been re-activated, there is still a need to implement the national coastal zone management

plan that has be formulated for the country. In the meantime, unsustainable coastal development pressures, inland factors such as the transport of contaminants from the agriculture industry and sediments via rivers, as well as climate change impacts are all contributing to a decline in the health of the country's coral reefs. Coral cover in Belize's reefs is now below the Caribbean average and recent data shows that more than half of the country's reefs are in poor to fair condition, with a small percentage in good condition but none in very good condition. The report highlights the possibility of recovery through protection and enforcement in no-take zones but for this, a concerted management effort is needed across the country's coastal-marine area. Related to the decline in the health of coral reefs is the issue of overfishing. As is the case worldwide, the country's marine areas are being overfished with certain fish such as shark experiencing large decline. An increased incidence in the fishing of non-traditional species is also noted in the report as well as the passing of recent legislation banning the fishing of grazers such as parrotfish and the use of certain fishing methods. The success of the legislation, however, rests on future enforcement. Illegal fishing is identified as a major pressure exacerbating the overfishing issue.

With respect to all of the above environmental issues, the report highlights that, despite the country's record of having 22.8 percent of the national territory under protection, there is still a lot of commitment needed from the Central Government in terms of support to the agencies, such as the Forest Department and Department of the Environment. These agencies are directly responsible for regulatory work to ensure improvement in the management of the countries natural resources and environmental issues discussed in the report yet they are all understaffed and in many instances lack the necessary capacity to appropriately enforce the country's environmental laws. Another large gap hindering the improvement of the environmental issues discussed in the report is the lack of an institutionalized national environmental monitoring program. Most of the data gathered to inform on the state of the environment for this report has been gathered from individual private organizations and researchers. A national environmental monitoring program would allow for the consistent and accurate gathering of data on specific indicators related to the environmental factors discussed in the report to allow for consistent and easy periodic reporting by the Ministry of Natural Resources and the Environment on the state of the environment.

The third chapter of the report focuses on an overview of responses that are related to the environmental issues discussed in chapter 2 and which are of a cross-sectoral nature. In particular, this chapter looks at several of the main international conventions and agreements that Belize is a signatory to and tracks the country's progress in the implementation of these agreements. The agreements discussed include the United Nations Convention on Combating Desertification (UNCCD), the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Convention on Biological Diversity (UNCBD), the International Convention for the Prevention of Pollution for Ships known as MARPOL and the Convention on the International Trade of Endangered Species of Wild Fauna and Flora (CITES), among others. It is noted that in many instances the country still lacks the capacity to implement these international conventions and agreements and that better coordination among the various focal points and implementation activities for these conventions is needed. The chapter also addresses one key local response that is relevant to all environmental issues addressed in the report: the Environmental Protection Act (EPA) and its Subsidiary Act & Amendments. Although there have been many improvements in the EPA over the past few years, the lack of personnel and capacity at the Department of Environment remains a challenge for enforcement of this key piece of legislation.

The report concludes with a chapter that outlines several options for action focusing on four key areas, namely: good governance, institutional strengthening, capacity-building, and education and public awareness. Each major action recommended is further subdivided into more concrete and targeted actions or recommendations, which can be pursued by the Government of Belize, as well as non-governmental agencies, in order to ameliorate and improve the environmental issues that the country is facing today. Key recommendations include the development of sustained communication linkages amongst Ministries responsible for the management and use of the country's natural resources, further revision of the EIA regulations, implementation of the Coastal Zone Management Plan, reform of the Protected Areas Conservation Trust as the national funding agency for protected areas management, capacity-building within regulatory agencies responsible for the management and oversight of the country's resources, developing environmental indicators and coordinating data collection of these in order to strengthen the country's capacity to report on the state on Belize's environment and encouraging public participation in decisions being made for the country that affect or impact the environment.

CHAPTER 1
SOCIOECONOMIC CONTEXT

Belize
Environment
Outlook

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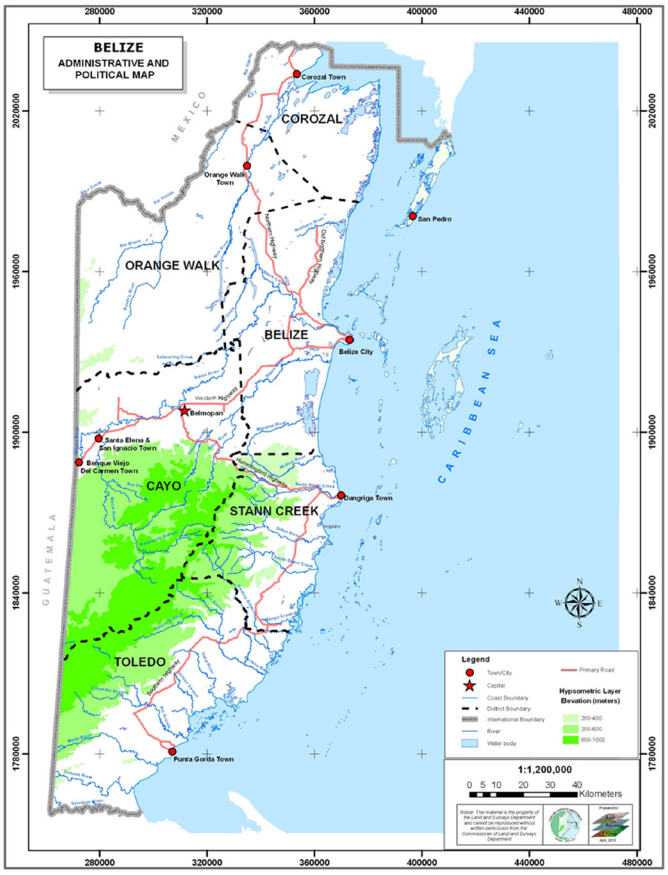
CHAPTER 1
Socio-economic Context

1.1 Introduction

The country of Belize, formerly known as British Honduras, is a relatively new nation, independent only since 1981. It is located in Central America but has strong historical ties to the Caribbean, particularly what was once the British Caribbean. Located below the Yucatán Peninsula, it is bounded on the north by Mexico, on the west and south by Guatemala and on the East by the Caribbean Sea. Despite its relatively small size of 22,966 km2 the country boasts a wealth of natural resources. Unique among them is an extensive barrier reef along its approximately 386 km of coast, which comprises the single largest portion of the Mesoamerican Barrier Reef, a system that extends for approximately 1000 km across several countries and is the largest reef system in the Western hemisphere (Burke and Sugg, 2006). Also included are a rich flora and fauna of at least 1,014 native species of vertebrates and 3,411 native species of plants, approximately 69.0 percent of forested land area, 18 major river catchments (Central Statistical Office (CSO), 2004a). The country also has over 100 protected areas that cover 34.9 percent of the country's total land area and 10.6 percent of the country's total sea area (Land Information Center (LIC), 2009). In total, protected areas cover 22.8 percent of the country's national territory (LIC, 2009). The recent discovery of oil in commercial quantities has also added non-renewable sources of energy to Belize's vast list of resources. In addition to this wealth of physical and biological resources the country is populated by a diversity of people from more than six different ethnic groups, each with unique customs, and languages.

Map 1: Administrative and Political Map



As in every society, people in Belize ultimately depend on the country's environment and natural resources for survival. As Belize continues to develop there will be a continued use and therefore a decrease of this resource base, along with changes in its quality. Belize's greatest challenge then is achieving sustainability, a condition first posed as relevant in Stockholm in 1972 (United Nations Environment Programme (UNEP), 2003), but which continues to be a challenge worldwide as reflected in the United Nations (UN) Millennium Development Goals (MDGs) signed to by all nations of the world. If Belize is to minimize the changes in the quantity and quality of its natural resource base as it continues to develop, it is important that the country generate policies that are not only environmentally friendly but which also address social inequity, and which are enforced. Ultimately, the amount of change in the quantity and quality of the natural resources will be determined by social, political and

economic conditions. It is within this context that this chapter focuses on an overview of the socio-economic issues that are the major driving forces for the environmental problems that the country is facing today. These driving forces contribute to the direct pressures that cause environmental change. The four primary socio-economic areas addressed in this chapter include demography, social situation, economy and education, particularly environmental education. Governance, which includes the manner in which policies and legislation are made, their enforcement or lack thereof, and the participation and input of civil society into the formulation and enforcement of such policies and legislation, is a fifth major socio-economic aspect that is an important driving force influencing the environmental problems of the country. However, this aspect is addressed in a more detailed discussion of specific policies influencing particular environmental problems in Chapter 2, which describes the state of the environment and in Chapter 3, which focuses on policies that target multiple environmental issues at a national, regional and global scale.

In terms of demography, the last census in 2000 indicated that the population of the country was 240,204 (Statistical Institute of Belize (SIB), 2009). Mid-year estimates show that the 2000 population increased by 29 percent to 322,100 in 2008 (SIB, 2009), that is, at an average annual growth rate of 3.2 percent since 2000. Urban areas in Belize were home to a slight majority of the country's entire population in 2008. However, it is important to note that Belize City alone was home to the majority of the urban population of the country or 20 percent of the total national population.

A major aspect of the social well-being of a country is the degree of poverty in its population. Poverty estimates, based on a report by Costello and the National Human Development Advisory Committee (NHDAC) (2005) that used 2002 figures, indicated that 33.5 percent of the population, comprising 24.5 percent of the country's households, was poor. Approximately 11 percent of the population was reported as indigent, that is, unable to meet food costs. Rural areas in the country were found to have a percentage of poor in their population that was almost twice as high as the percentage of the urban population considered poor. Toledo was by far the poorest district in the country with 79.0 percent of its population classified as poor and 56.1 percent as indigent (Costello and the NHDAC, 2005).

In terms of health, data on indicators such as infant mortality rate and under-five mortality rate show that while these decreased from 2006-2007, the 2007 figures are still higher than they were in 2004. The total fertility rate for the country has also been declining for a couple of years now, but the 2007 rate for Belize was higher than the Central American and Caribbean average. As the Belizean population continues to increase based on this total fertility rate, the intensified use of natural resources can be expected. Along with poverty, this intensified use of natural resources can impact Belizeans in the form of diseases associated with poverty and poor environmental conditions. The Ministry of Health collects data on the number of cases and incidence for diseases such as cholera, malaria and dengue which have a direct environmental link; cases of cholera have not been reported since 1999 and although malaria and dengue had a very high number of cases in 2005, the number of cases for both has since been declining. In contrast, acute respiratory infections have been increasing but the country lacks the type of data that shows how much of these cases might be linked to environmental conditions. The reported cases of food-borne illnesses have also been increasing and these are of concern because of their association with contaminated food and water due to poor hygiene and environmental conditions.

Economically, the country appears to be experiencing growth in certain sectors, particularly, tourism and a decline in others such as sugar and bananas (SIB, 2008). The 2007 Gross Domestic Product (GDP) at constant market prices was reported as 2.5 billion $BZ, (SIB, 2008) an increase from the previous year. However, the GDP per capita was 7,900.00 $BZ, an increase from 2004 and inflation continues to rise. In 2007, 8.5 percent of the total labor force was unemployed, particularly women (SIB, 2008). Tertiary industries, which include the service industry, accounted for 15.2 percent of the 2005 GDP (CSO, 2006) and it was estimated that in 2007, 91.5 percent of the labor force was employed in the service industry (SIB, 2008). Except for tourism, key sectors of the economy including sugar, citrus, bananas, forestry and wood, fishing and fish processing and tourism all experienced a decline or relatively small increase in their contribution to GDP from the previous year. Tourism increased its contribution to GDP by 16.8 percent from 2004 – 2006 (CSO, 2006).

In terms of environmental education, the greatest advancements have been at the tertiary level. All junior colleges in the country, except one, and both Universities, currently offer degree programs in fields directly related to the environment. At the primary school level, environmental education is currently being integrated into the curriculum at all levels but rural schools in particular are still behind in the subject (Hoare et al., 2007). According to the assessments by Hoare et al. (2007), pre-schools and particularly high schools appear to be the farthest behind when it comes to environmental education. Increased coordination in environmental education initiatives by the non-formal sector, which includes Non Governmental Organizations (NGOs), government agencies and churches, is also still needed in order to increase knowledge and appreciation of environmental issues within the general public to a level that promotes a proactive approach to protecting the environment.

1.2 Demography

At the beginning of the 20th century there were less than two billion people worldwide (Wright, 2005). The world population exceeded the six billion mark in 1999 and continues to grow at a rate of nearly 77 million people per year (Wright, 2005). Most of this increase is occurring in densely populated developing countries where the basic needs of people are still not being met. As populations increase, demand for goods and services increase. Ultimately, production of these goods and services depend directly or indirectly on a country's natural wealth. Although patterns of increased consumption, which accompany greater demand for goods and services, may or may not lead to economic growth depending on a country's social, political and economic situation, they always lead to an increase in pollution and waste generation. Although its population has been ranked among the smallest in the Caribbean and Latin America, the country of Belize is no exception when it comes to the increased pattern of consumption observed as its population continues to grow. Various demographic aspects, including population growth, indirectly drive some of the environmental problems that the country is currently facing. These problems include inadequate solid and liquid waste management and disposal, intensified agriculture and unsustainable farm practices, coastal development for housing that involves mangrove clearing, and water pollution. This section looks at the various demographic aspects of the country that are likely to impact the environment.

1.2.1 Population Growth

Census data exists for the country from 1946-2000 (Table 1) and mid-year population estimates from 2001-2008 (Table 2 and Figure 1). Some of the census data are not fully comparable due to the use of different census methodologies for some of the older data. However, based on just the overall census figures up to 2000 and the mid-year population estimates up to 2008, it is clear that the population of Belize continues to increase as shown in Table 1, Table 2 and Figure 1. In 1946, the population of Belize was 59,220 (Table 1 and Figure 1). Thirty-four years later in 1980, the year preceding the country's independence, the population had already more than doubled to 145,353 (Table 1 and Figure 1). In the last census in 2000, population had increased to 240,204 (Table 1). Mid-year estimates from 2000-2008 also show continued growth (Table 2 and Figure 1). Based on these estimates the 2008 population was 322,100 (SIB, 2009), representing a 29 percent increase in population since 2000 and an average annual population growth rate of 3.2 percent. This population growth rate was higher than the 1.3 percent average annual growth rate in 2005 for Latin America and the Caribbean (World Bank, 2007). An increasing population coupled with a high growth rate will inevitably lead to an increase in the environmental pressures that the country is facing today.

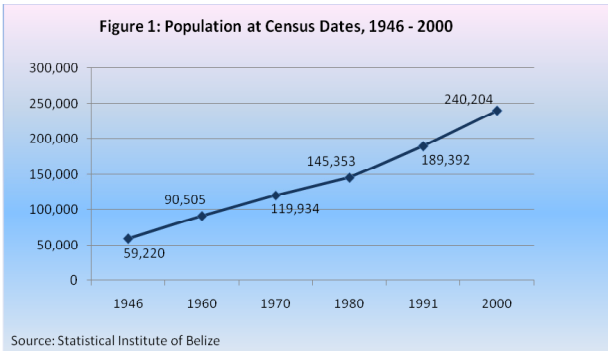


Table 1: Population at Census Dates 1946-2000.

District and Subdivisions	1946	1960	1970	1980	1991	2000
Country Total	59,220	90,505	119,934	145,353	189,392	240,204
Urban	33,073	48,768	65,025	76,277	90,005	114,541
Rural	26,147	41,737	54,909	69,076	99,387	125,663
Corozal Dist.	6,773	9,730	15,551	22,902	28,464	32,708
Corozal Town	2,190	3,171	4,724	6,899	7,062	7,888
Corozal Rural	4,583	6,559	10,827	16,003	21,402	24,820
Orange Walk Dist.	5,520	10,306	17,041	22,870	30,681	38,890
Orange Walk Town	1,395	2,157	5,698	8,439	11,014	13,483
Orange Walk Rural	4,125	8,149	11,343	14,431	19,667	25,407
Belize Dist.	26,781	40,084	49,355	50,801	57,030	68,197
Belize City	21,886	32,867	39,050	39,771	44,087	49,050
San Pedro	*	*	*	1,125	1,849	4,499
Belize Rural/Urban	4,895	7,217	10,305	9,905	11,094	14,648
Cayo Dist.	7,370	11,764	15,975	22,837	37,693	52,564
Belmopan	*	*	274	2,935	3,558	8,130
Benque Viejo	1,264	1,607	1,921	2,435	3,580	5,088
San Ignacio/Santa Elena	1,548	1,890	4,336	5,616	8,962	13,260
Cayo Rural/Urban	4,558	8,267	9,444	11,851	21,593	26,086
Stann Creek Dist.	6,373	10,906	13,023	14,181	18,085	24,548
Dangriga	3,414	5,287	6,939	6,661	6,435	8,814
Stann Creek Rural	2,959	5,619	6,084	7,520	11,650	15,734
Toledo Dist.	6,403	7,715	8,989	11,762	17,439	23,297
Punta Gorda	1,376	1,789	2,083	2,396	3,458	4,329
Toledo Rural	5,027	5,926	6,906	9,366	13,981	18,968

* Were not established at that period.

Source: Statistical Institute of Belize

Table 1 details the population numbers for all districts and subdivisions for each census from 1946–2000. In the 2000 census, a population of 68,197 was reported for the Belize District and 52,564 for the Cayo District. Together these two districts accounted for 50 percent of the population of the entire country in 2000. Estimates available for population by district show that the Belize District continues to have the largest population in the country, followed by the Cayo District (Table 2 and Figure 2). In 2008, the population in Belize City comprised 67 percent of the population in the Belize District and 20 percent of the population of the entire country. Belize City, the old capital city, still remains the most important trading center in the country, providing more employment and investment opportunities. These opportunities include those brought by the introduction of cruise ship tourism in 1998, since Belize City is the port of entry for cruise ship passengers. As in the Belize District, the large population in the Cayo District is also probably due in large part to employment opportunities available in the tourism industry. Cayo remains one of the main tourist destinations in the country. Table 1 also shows that Belmopan, the capital of the nation, located in the Cayo District has doubled its population since 2001. Increased job and education opportunities in this city have probably contributed to this growth but a closer look at Belmo-

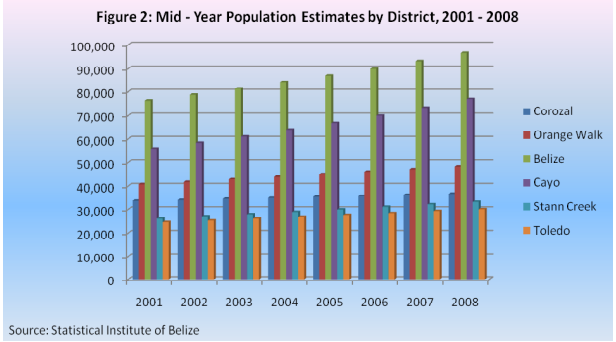


Table 2: Mid-year Population Estimates 2001-2008.

District and Subdivisions	2001	2002	2003	2004	2005	2006	2007	2008
Country Total	257,310	265,200	273,700	282,600	291,800	301,300	311,500	322,100
Urban	125,830	130,500	135,600	141,000	146,600	152,500	159,000	165,700
Rural	131,480	134,700	138,100	141,600	145,200	148,800	152,500	156,400
Corozal Dist.	33,750	34,100	34,600	35,000	35,500	35,800	36,300	36,800
Corozal Town	8,215	8,300	8,500	8,600	8,800	8,900	9,100	9,300
Corozal Rural	25,535	25,800	26,100	26,400	26,700	26,900	27,200	27,500
Orange Walk Dist.	40,725	41,700	42,800	43,800	44,900	46,000	47,100	48,300
Orange Walk Town	14,085	14,400	14,700	15,000	15,300	15,700	16,000	16,300
Orange Walk Rural	26,640	27,300	28,100	28,800	29,600	30,300	31,100	32,000
Belize Dist.	76,370	78,800	81,400	84,200	87,000	90,000	93,200	96,600
Belize City	55,380	56,700	58,000	59,400	60,800	62,200	63,700	65,200
San Pedro	5,495	6,100	6,800	7,600	8,400	9,300	10,400	11,600
Belize Rural/Urban	15,495	16,000	16,600	17,200	17,800	18,500	19,100	96,600
Cayo Dist.	55,950	58,400	61,000	63,900	66,800	70,000	73,400	77,000
Belmopan	14,125	14,800	15,400	16,100	16,800	17,500	18,300	18,100
Benque Viejo	5,535	5,900	6,300	6,700	7,200	7,700	8,200	8,700
San Ignacio/Santa Elena	9,115	10,000	11,100	12,300	13,500	14,900	16,400	19,100
Cayo Rural/Urban	27,175	27,700	28,200	28,800	29,300	29,900	30,500	77,000
Stann Creek Dist.	26,000	27,000	27,900	28,900	30,000	31,100	32,200	33,300
Dangriga	9,345	9,700	10,000	10,400	10,800	11,200	11,600	12,000
Stann Creek Rural	16,655	17,300	17,900	18,500	19,200	19,900	20,600	21,300
Toledo Dist.	24,515	25,200	26,000	26,800	27,600	28,400	29,300	30,100
Punta Gorda	4,535	4,600	4,800	4,900	5,000	5,100	5300	5,400
Toledo Rural	19,980	20,600	21,200	21,900	22,600	23,300	24000	24,700

Source: Statistical Institute of Belize

pan is taken in section1.2.2 part from looking at overall population numbers, another important population factor to take into consideration in terms of potential impacts to the environment is population density. This change is also due to the inclusion of areas such as San Martin and Salvapan as part of the Belmopan population. Population density is the ratio of total population to a given area. This means that population density measures the concentration of a population in reference to space (CSO, 2004a). Table 3 summarizes population density by district per square kilometer. The estimated population density for 2008 for the country is 14.0 persons per square kilometer. In this same year, the districts with the two highest population densities are the Belize and Corozal Districts with densities of 22.4 and 19.8 persons per square kilometer, respectively (Table 3). Since population density for all districts has been rising, the increase of 15 percent in the country's density from 2003–2008, means that crowding in Belize City continues to increase. If not accompanied by the appropriate social conditions, including access to clean water, sanitation and health services, increasing population density conditions are ideal for exerting negative pressure on an already vulnerable environment. The lack of appropriate treatment for sewage and the increased vulnerability to hurricanes due to further alteration of mangrove habitats are of particular concern in the Belize City area as its population density continues to increase.

Table 3: Population Density based on 2003-2007 Mid Year Population Estimates.

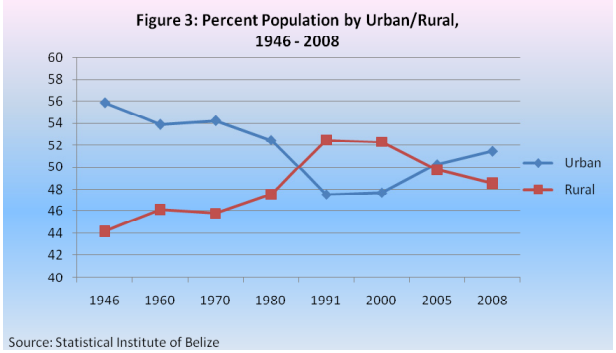
District	Area	Density Per Square Kilometers				
	in sq. km	2003	2004	2005	2006	2007
Country	22,966	30.9	31.9	32.9	34	35.1
Corozal	1,860	48.2	48.7	49.4	49.9	50.6
Orange Walk	4,636	23.9	24.5	25.1	25.7	26.3
Belize	4,307	48.9	50.6	52.3	54.1	56
Cayo	5,196	30.4	31.9	33.3	34.9	36.6
Stann Creek	2,554	28.3	29.3	30.4	31.5	32.6
Toledo	4,413	15.3	15.7	16.2	16.7	17.2

Source: Statistical Institute of Belize, 2009

Urban vs. Rural Population

In most developing nations, populations in urban areas are higher than in rural areas for several reasons. One major reason for this migration to urban areas is due to poverty. Wright (2005) observes that ''faced with the poverty and hardship of the countryside, many hundreds of millions of people in developing nations continue to migrate to cities in search of employment and a better life.'' Countries in the region with higher urban to rural area populations include El Salvador, Jamaica and St. Vincent and the Grenadines (United Nations Development Programme (UNDP), 2005). Population growth in Belize followed a similar trend with population higher in urban than in rural areas until 1980 (Table 1). The most dramatic shift in the growth and distribution of the urban vs. rural population was observed from 1980 – 1991, when the rural area population in Belize increased by 44.0 percent, exceeding the urban population, which only grew 18.0 percent (Table 1 and Figure 3). This trend continued until 2004 and was finally reversed in 2005 as the urban population once more became larger than the rural population (Table 2 and Figure 3). The urban population continues to exceed the rural population since 2005 (Table 2 and Figure 3).

The increase in rural settlements in Belize in the 1980's was caused by the influx of Central American immigrants escaping political and economic crises in El Salvador, Guatemala, Honduras and Nicaragua. A field survey conducted in 1993 by the United Nations High Commission for Refugees (UNHCR) estimated that there were a total of 28,500 refugees/immigrants living in Belize at the time (The National Committee for Families and Children and UNICEF Belize, 1995). This number represented 14.3 percent of the total population for that year. This survey also indicated that 85 percent of the rural villages received some of these immigrants. Facing low standards of living in their home country, immigrants usually settle in rural areas of the country where farmland and living conditions are less expensive and where ''many of them have subsistence farming as their sole means of livelihood'' (The National Committee for Families and Children and UNICEF Belize, 1995). Moreover, ''UNHCR reports that generally the living conditions of Central American immigrants vary and are dependent not on their legal status, but rather on their access to land or employment, and the economic conditions of the communities in which they reside'' (The National Committee for Families and Children and UNICEF Belize, 1995). Immigrants migrate to rural areas and settle by squatting or by purchasing cheap land areas for farming purposes. The influx of immigrants to rural areas in Belize led to an increase in the rural population but has consequently contributed to a dominant increase in the Mestizo population in the country (see section 1.2.4).



Once the 1980 -1991 change in the growth and distribution of urban vs. rural population of the country occurred, which resulted in a larger rural population, the next fourteen years served to close the gap in the growth and distribution of urban vs. rural population. From 1991-2000, the rural population increased by 26.4 percent while the urban population increased by 27.2 per-

cent. At the end of this period, the rural population was still larger than the urban population by 4.6 percent. This 4.6 percent increase in rural population observed in 2000 was reduced to 2.2 percent in 2001, 1.6 percent in 2002, 1.0 percent in 2003 and 0.1 percent in 2004 based on population estimates (Table 2). In 2005, the urban population exceeded the rural population and according to mid-year population estimates (Table 2), urban population was greater than the rural population by 0.5 percent in 2005, 1.2 percent in 2006, 2.1 percent in 2007 and 2.9 percent in 2008. Urbanization appears to once more be on the rise as in the pre-independence period and before.

However, the difference in urban vs. rural population figures in 2008 is only a difference of approximately of 9,000 people. This means that the country needs to be equally concerned about addressing environmental pressures brought about by high population numbers in the urban as well as rural areas. While adequate sanitation services and increased vulnerability to natural disasters are major concerns in the urban environment, rural population expansion, especially if not planned adequately, exerts pressure on rivers and creeks used for domestic purposes and exacerbates land conversion for agriculture. The latter can lead to a suite of environmental problems ranging from loss of soil and water quality to erosion and pollution.

A close look at the percentage growth in the inter-censal population by urban center, from 1960 to 2000 (Table 4), reveals that towns, such as Orange Walk Town and Santa Ignacio/Santa Elena, experienced more than a doubling of their population in the 1960-1970 inter-censal period. This same population growth pattern is seen for San Pedro Town and the city of Belmopan in the more recent inter-censal period of 1991-2000. Careful Analysis of population growth estimates in urban centers (Table 2) shows that these same two urban centers continue to experience the greatest population increase since the 2000 census. In 2008, both of these urban centers had more than twice their 2000 census population (Table 1 & 2); San Pedro Town had approximately 2.6 times its 2000 population and Belmopan had approximately 2.2 times its 2000 population.

The increase in San Pedro is likely due to increased employment opportunities available in its thriving tourism industry (CSO, 2004a). Ambergris Caye is reported as the tourist destination with the largest number of hotel beds and the largest number of people employed in hotels when compared with other tourist destinations (BTB, 2009).

It has already been suggested that high population growth in Belmopan may be due in part to the increased job and education opportunities in this city. These opportunities have resulted from the move of government offices and the main campus of the University of Belize to the city, and the continued establishment and move to Belmopan by several businesses and organizations. In addition, Belmopan has better access to healthcare, safe drinking water, solid waste collection services, and increased housing, which makes the city appealing to people migrating from other parts of the country. A final important factor that may be a contributor to a high population growth rate in Belmopan is high fertility rates in the Central American immigrant and indigenous communities surrounding the city, namely, Las Flores, Salvapan, San Martin and Maya Mopan. However, more data is needed to assess this option.

Table 4: Percentage Growth in Inter-Censal Population by Urban Center, 1960 - 2000

Urban Center	1960-1970	1970-1980	1980-1991	1991-2000
Corozal Town	49%	46%	2%	12%
Orange Walk Town	164%	48%	30%	22%
Belize City	19%	2%	11%	11%
San Pedro Town	*	*	64%	143%
San Ignacio/ Sta. Elena	129%	30%	60%	48%
Benque Viejo Town	20%	27%	47%	42%
Belmopan	*	971%	21%	128%
Dangriga Town	31%	-4%	-3%	37%
Punta Gorda	16%	15%	44%	25%

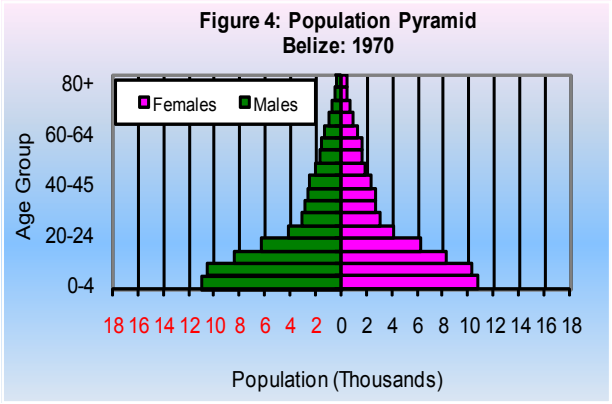
* No census data was available for this area previous to the period shown

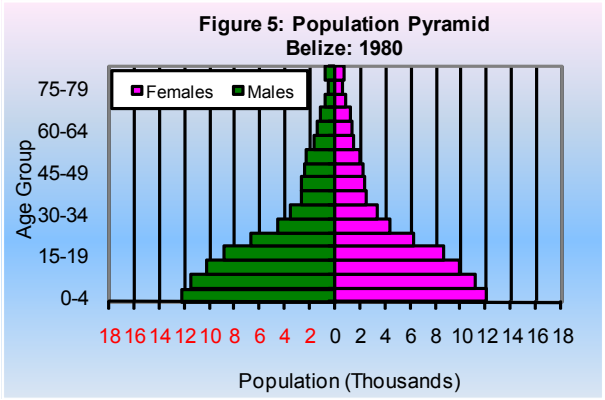
Source: Statistical Institute of Belize, 2009

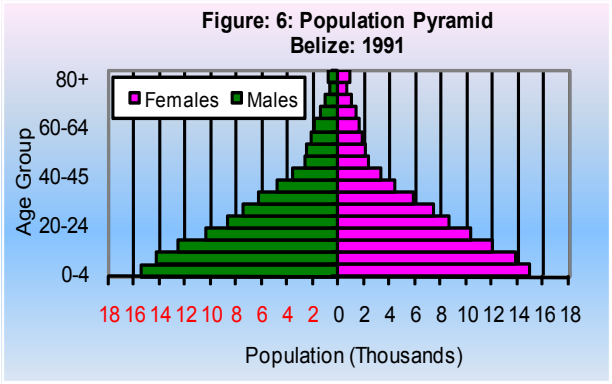
1.2.3 Population Structure

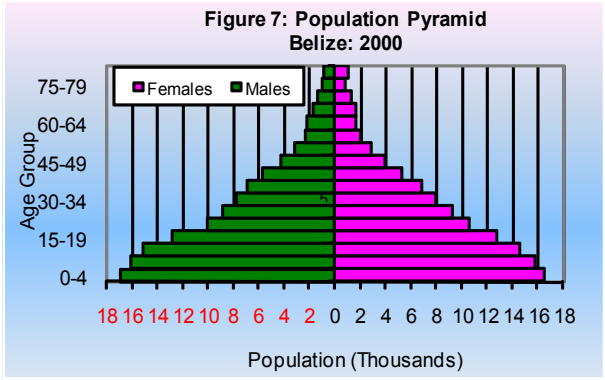
A population profile is a bar graph showing numbers of males and females for successive ages in the population at a given date (Wright, 2005). Immigration and emigration rates are not subtracted when doing population profiles, instead each bar in the profile starts out as a generation of babies at a given point in the past, and that generation is only diminished by deaths as ages (Wright, 2005). For governments, population profiles are planning tools. As noted by Wright (2005): ''more than a view of the past, a population profile provides governments and businesses with a means of realistic planning for future demand for various goods and services, ranging from elementary schools to retirement homes.''

tween the ages of 15 – 49 years during that year. This is the age bracket considered to be child-bearing age. For that same year, 41 percent of the population was between the ages of 0-14, representing the pool of people that can become of child-bearing age. In 2000, only 10 percent of the population was between the ages of 50-85+. These percentages are what give the population profile (Figure 7) for that year its shape. This shape translates into a pattern of continued population increase as 90 percent of the members in the population are entering their reproductive ages, a phenomenon called population momentum (Wright, 2005). In order to determine how to decrease the environmental pressures brought on by an increasing population, it would be worthwhile to focus interventions and programmes for environmental protection in parts of the country that are undergoing population momentum.









Source: Statistical Institute of Belize

Figures 4-7 summarize Belize's population profiles for the years 1970, 1980, 1991 and 2000. All four figures have a pyramid shape with a wide base, indicating a large young population. In taking a look at each consecutive figure, it can be seen that from 1970-2000 the base of each profile gets increasingly wider. Information from the 2000 Housing and Population Census showed that 49 percent of the population consisted of people be-

1.2.4 Ethnic Composition of Population

One of the defining features of Belize as a country is that despite its small size and population, as compared to other countries in the region, it is home to several ethnic groups. Each of these ethnic groups has its particular cultural practices and in many instances, languages.

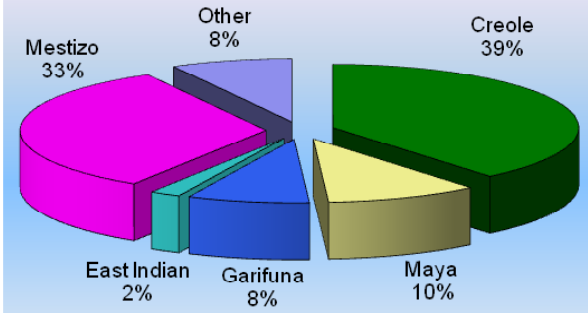
The cultural practices of each group are often rooted in their history. The Maya were the first inhabitants of the country. The second group that arrived was comprised of British pirates and the buccaneers. African slaves were then imported by the British to work on the fast growing Logwood and later Mahogany industries. The Creole emerged from the biological and cultural mixing of the Europeans and the Africans. The Garifuna arrived in Belize in 1802 after being forcefully removed from the Caribbean Island of St. Vincent by the British. The largest number of immigrants to Belize was comprised of the Yucatec Maya and Mestizo (descendants of Maya mixed with Spanish) fleeing from the Guerra de las Castas (Caste War) in the Yucatan area in the 1840s (BTB, 2001). In 1857-58, native Indian soldiers (called Sepoys) revolted against British rule in India resulting in about 1,000 Sepoy families being transported to Belize. East Indians would later be brought to Belize again, mostly from Jamaica, as indentured laborers for the sugar estates in Toledo in the 1880's (National Library Service of Belize, 2007). In 1865, the British imported 474 Chinese. Another group of immigrants to Belize was the American Confederates who arrived in 1868. Mopan and Ke'kchi Mayas migrated to Belize between 1883 and 1885 from Guatemala. In the 20th century, more migration occurred. Mennonites migrated from Mexico and Canada between 1957 and 1959 (BTB, 2001).

Over time, the population of the ethnic groups mentioned above has changed. More recently, this has been primarily due to the influx of Central American immigrants in the 1980's as noted in section 1.2.3. The major shift in the composition of the population by ethnic group has been observed mainly in the change in the percentage of the total population comprised by the two historically dominant ethnic groups in the country, the Creole and the Mestizo. Figures 8-10 summarize the country's population based on ethnicity in 1980, 1991 and 2000.

As observed in these figures, the Creole population, comprising 39 percent of the total population in 1980 and being the dominant ethnicity at this time (Figure 8), declined to 30 percent of the total population in 1991 (Figure 9) and 25 percent in 2000 (Figure 10). In contrast, the Mestizo, an ethnic group that comprised 33.0 percent of the total population in 1980, increased in numbers to represent 44 percent of the country's population in 1991 and 48 percent in 2000. The significant changes in the percentage of the population comprised by these two dominant ethnic groups have a number of socio-economic implications. These involve areas such as education, labor force and land-use.

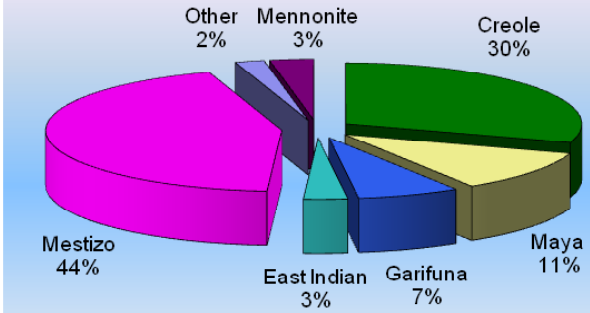
The changes in ethnic composition due to immigration will bring many challenges for Belize but also many opportunities. A challenge that is already being faced by the country involves finding a way to integrate a non-English speaking population into the currently English-based education system. This will test the flexibility of the established system, but is in itself something that can be regarded as an opportunity for Belize to truly evolve into the only country in Central America fluent in two of

Figure 8: Population by Ethnicity, 1980



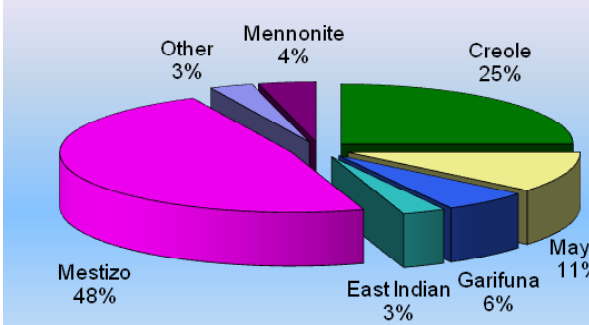
Source: Statistical Institute of Belize

Figure 9: Population by Ethnicity, 1991



Source: Statistical Institute of Belize

Figure 10: Population by Ethnicity, 2000



Source: Statistical Institute of Belize

the world's most widely spoken languages, English and Spanish. In terms of the impact of a large recent immigrant population on the environment, research will have to be done comparing the effect on the environment of the agricultural and land-use practices of recent immigrants, including the Mennonites and Central American immigrants vs. those of people from various ethnic groups who settled in Belize before the 19th century. The general perception is that these more recent immigrant groups use forests in a non-sustainable manner and practice intensive agriculture that can harm the environment. Among the agricultural practices perceived to be part of these immigrant groups are the liberal use of fertilizers that can pollute water sources and clear-cutting and farming on slopes, which can lead to severe erosion and increased vulnerability to natural disasters such as landslides. However, specific research is needed investigating resource use and agricultural practices in these more recent immigrant groups as compared to the traditional practices of the native Maya and earlier immigrant groups as there is a lack of this type of data in the country.

Thus far nothing has been said regarding emigration of Belizeans to North America and its effect on the shift in composition of the two major ethnic groups. However, it is worth taking into consideration that probably a large proportion of Belizean migrants are probably from amongst the Creole population in Belize City. While the implications of emigration on the environment are indirect, emigration has important implications for other socioeconomic aspects of life in Belize that divert attention from addressing environmental protection as a priority for the country. Therefore, consistent, accurate and current data on both immigration and emigration by region and ethnicity are needed for the country.

1.3 Social Situation

Although a high degree of social well-being in terms of health, education and income does not necessarily go hand-in-hand with a desire by people to protect their environment and use their natural resources in a sustainable manner, there is no doubt that the inverse has negative effects on the environment. Often, a country's natural resources are the only resources to which poor people have access. Moreover, when people's basic necessities have not been satisfied and meeting those basic needs is the primary issue on their mind, it is highly unlikely that they will pay attention or be participants in efforts to mitigate the environmental impacts from the unsustainable use of the country's resource base. This is especially likely to be the case in a country like Belize, where resources such as forests and water seem abundant. Therefore, the social situation of a country can have a major influence on environmental issues. This section takes a closer look at a few important aspects of the social situation of Belize including overall human development, poverty, employment, and health, all of which are important or related to environmental issues. Economy and education are covered in separate sections.

1.3.1 Human Development

One measure of progress towards human development is the United Nations' Human Development Index (HDI). The HDI is a composite index that covers three aspects of human welfare: income, education and health. For developing countries such as Belize, it measures deprivations in these three basic dimensions: "living a long and healthy life (measured by life expectancy), being educated (measured by adult literacy rate and enrolment at the primary, secondary and tertiary school level) and having a decent standard of living (measured purchasing power parity, PPP, income" (UNDP, 2006). All countries are classified into three clusters of achievement: High Human Development, Medium Human Development and Low Human Development. Belize is considered to be under Medium Human Development with a reported HDI of 0.751 in 2004 (UNDP, 2006). Based on UNDP (2006b) figures, Belize improved its HDI value from 1980 to 2000 when it achieved an HDI of 0.780 (the highest value recorded for the country). Since then its HDI has been declining.

There are several characteristics of human development that the HDI does not take into account. Therefore the index is not "a comprehensive measure of human development" (UNDP, 2006). "Inequality and respect for human rights and political freedoms" are two of the most important aspects that the HDI does not cover (UNDP, 2006). Both of these aspects are of particular importance in Belize since studies have shown that there is an uneven distribution of wealth in the country. The most recent estimates of poverty in Belize indicate that for every poor person in an urban area of the country, there are approximately two in the rural areas (Costello and the NHDAC, 2005). Toledo is also classified as the poorest district in the country by a very wide margin. Poverty figures are discussed in more detail in the section below.

1.3.2 Poverty

The poorest people in the world are those who depend most on the natural resource base of their countries. Because of this, "questions of human development and the alleviation of poverty cannot be separated from issues of environmental management" (Wright, 2005). Chronic or long-lived poverty and resource degradation, especially land degradation, go hand in hand (Wright, 2005). Resource degradation is exacerbated by the fact that those subjected to its consequences, in particular, environmental degradation, are the very poor who cannot afford to deal with these consequences. For example, it is the poor who lack adequate housing to withstand the increased incidences in hurricanes attributed to global climate change or lack the means necessary to get access to healthcare as might be required from an increase in water-borne diseases brought on by the pollution of water resources. Wright (2005) identifies poverty as a major pathway for environmental vulnerability.

In 2003, 225 million people (greater than 40.0 percent of the total population) in the Latin American and Caribbean region were living in poverty (UNEP, 2003). Approximately 19.0 percent of the population of this same area was considered extremely poor (UNEP, 2003). This region also showed the largest income inequality, where the poorest 40.0 percent of the population received approximately only 15.0 percent of the income (UNEP, 2003). In general this trend is on the rise in the region (UNEP, 2003).

In terms of poverty rates for Belize, according to the last Country Poverty Assessment (CPA) released in 2005 but based on 2002 data, 33.5 percent of the country's population was classified as poor; "poor" is defined as those who cannot meet basic food and non-food costs (Costello and the NHDAC, 2005). The same assessment classified 10.8 percent of the country's population as indigent or not able to meet food costs. The highest incidence of poverty, 39.0 percent was reported amongst children. Additionally, 24.5 percent of households in the country were reported as poor while only 7.5 percent were classified as indigent. In terms of urban vs. rural poverty, the 2002 CPA reported 44.2 percent of the rural population as poor compared to only 23.7 percent of the urban population (Costello and the NHDAC, 2005).

In general, the total percentage of the Belizean population that is poor has only increased slightly, by 0.5 percent, from the 1995/1996 to the 2002 CPA. However, there has been a decrease of 3.4 percent in the indigent population since the 1995/1996 CPA (Costello and the NHDAC, 2005). Despite these figures, the reality is that poverty is not equally distributed in the country and that from the 1995/1996 to the 2002 CPA, poverty estimates have actually increased in all districts except for the Cayo District, which has experienced a decrease (Costello and the NHDAC, 2005). The largest increase in poverty since the 1995/1996 CPA has been in the Toledo District, which according to the 2002 CPA has 79.0 percent of its population classified as poor and 56.1 percent as indigent (Costello and the NHDAC, 2005). These estimates by far supersede the poverty estimates for all other districts as seen when comparing the Toledo District estimates to those of the Orange Walk District, the district with the second highest incidence of poverty (34.9 percent poor population and 7.1 percent indigent population) (Costello and the NHDAC, 2005).

Costello and the NHDAC (2005) postulate that part of Toledo's poverty situation is related to its role as an entry point for immigrants, who move away from this District as soon as they find better employment opportunities, for example in the Cayo District and especially in Belmopan. Once these immigrants have left, a new set of immigrants enters the country from the Toledo District and the cycle of poverty continues. It has also been argued in public forums, including the local newspapers, that people in Toledo, especially those belonging to the Maya culture, do not consider themselves poor and that the manner in which "poverty" is measured needs to be adjusted. In contrast to the trend in Toledo poverty figures, Costello and the NHDAC (2005) suggest that the decrease in poverty in the Cayo District is related to this district being a major tourist destination, to its high employment rate in the hotel industry and high tour guide growth rate as compared to the national average. A decrease in poverty in the Cayo District has also been attributed to a booming Belmopan. The decline in poverty in the Cayo District from a 41.0 percent poor population in 1995/1996 to 27.4 percent in 2002 and from 20.0 percent indigent population to 4.8 percent in the same period, is indeed striking.

In contrast to the marked changes in poverty levels in the Toledo and Cayo Districts, the Belize District showed very little change from a 24.5 percent poor population in 1995/1996 to a 24.8 percent in 2002 (Costello and the

NHDAC, 2005). In this same period of time, the country also experienced improvements in sanitary facilities, electricity and concrete outer walls. However, problems remain in other dimensions of poverty, including a decrease in the proportion of people who own or hire-purchase their home, or the fact that less than half of homes have access to piped or purified drinking water among other things (Costello and NHDAC, 2005).

The poverty situation in the country, particularly in the Toledo District, has important implications for the environment. Apart from being the poorest district, Toledo is also one of the most forested and one in which activities such as tourism have impacted the marine resources, including the condition of the reef, to a lesser extent than in the Northern part of the country. A high poverty rate means that the forest and marine resource base is in danger of being impacted more in this area especially since chronic poverty increases the reliance on natural resources. Unfortunately there are many other factors that are specific to Toledo that together with poverty will only exacerbate the environmental degradation that can result from the unsustainable use of the resource base. These include a large population of reproductive age as well as the district's close proximity to neighboring countries. In terms of a fast growing and poor population, the district seems to already be suffering from a high rate of unplanned population expansion and forest conversion for agriculture. In terms of the close proximity to neighboring countries, the district already suffers from illegal extraction of forest and marine resources from non-nationals and is likely to suffer more than other districts from environmental hazards generated outside of Belize. For example, watersheds in Honduras are responsible for the majority of sediment and nitrogen and phosphorous being discharged into the Mesoamerican Reef, a good portion of which sits in the southern coast of Belize (Burke and Sugg, 2006). More studies are needed on what other substances are being transported into Toledo through adjacent watersheds. However, poverty will likely compound the impact of any harmful discharge.

1.3.3 Employment

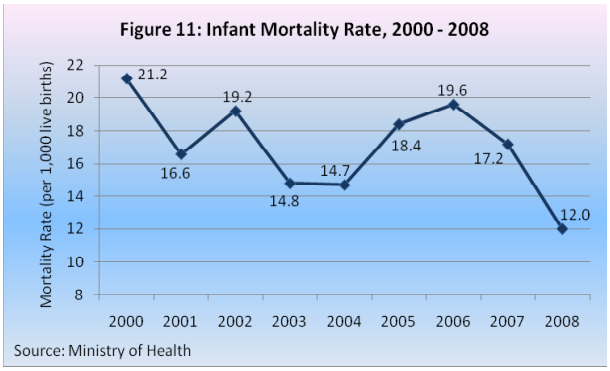
In Latin America and the Caribbean, the lack of economic growth and its reduced impact on the labor market are associated with slow poverty reduction (UNEP, 2003). From 1990 to 1997 the majority of new jobs in the region were in the informal sector. Furthermore, apart from Panama and Chile, the number of jobs in the informal sector grew and unemployment increased (UNEP, 2003). In 1999, the unemployment rate in the region peaked at 8.8 percent after a decade (UNEP, 2005). In Belize, the 1999 unemployment rate of 12.8 percent was higher than this Latin America and Caribbean region average (CSO, 2005).

In 2007, the Statistical Institute of Belize conducted a labor force survey (SIB, 2008). The results indicated that Belize's labor force stood at 122,400. This same survey indicated that the average household size was 4.2 and that 1.4 persons per household were employed (SIB, 2009). The national unemployment rate stood at 12.1 percent or 14,800 persons (SIB, 2009). The National Committee for Families and Children and UNICEF Belize (1995) reports that migration and "a lack of skill-training opportunities in the country, leaves Belize with an acute shortage of professional and technical workers in both public and private sectors" (The National Committee for Families and Children and UNICEF Belize, 1995). A shortage in skilled labor leaves the country with an unskilled labor force. Like poverty, unemployment and an abundance of unskilled laborers place more pressure on the environment as the poor, the unemployed and the unskilled must seek ways to support themselves through the use of the country's natural resource base.

1.3.4 Health Indicators

1.3.4.1 Child Health Indicators

Infant mortality rate (IMR) is defined as the "quotient between the number of deaths in children under 1 year of age in a given year and the number of live births in that year, for a given country, territory, or geographic area, expressed per 1,000 live births, as reported from the national health authority" (Ministry of Health). Overall, infant mortality in Belize has decreased substantially by approximately two orders of magnitude since 1970 when it was 51:1000 live births (live birth) (The National Committee for Families and Children and UNICEF Belize, 1995). A summary of the main health indicators, including IMR and under-five mortality rate for Belize, for the years 2005 to 2008, is presented in Table 5. These figures were obtained from the Ministry of Health (MoH). In 2008, the MoH reported an IMR of 12.0:1000 live births (Figure 11) and an under-five mortality rate of 17.0:1000 live births (Table 5). Infant mortality rate averaged 16.8



during the 2005-2008 period, while the under-five mortality rate averaged 21.5. Both indicators had an increase from 2005 to 2006, followed by a decrease from 2006 to 2008. However, it is worth noting that the 2005-2007 figures for both indicators are an increase from the 2004 figures of 14.7:1000 live births for IMR and 19.0:1000 live births for the under-five mortality rate. At least for IMR, the 2004 rates were the lowest during the 2000-2007 period as shown in Figure 11, however in 2008 a new low record of 12.0:1000 live births was registered. It can be seen that the trend in IMRs over the nine-year period illustrated in Figure 11 is still not one of consistent decline.

Table 5: Main Health Indicators for Belize 2005-2007.

Indicator	2005	2006	2007
Infant Mortality Rate (per 1,000 live births)	18.4	19.6	17.2
Neonatal Mortality Rate (per 1,000 live births)	10.9	10	9.7
Post-neonatal Mortality Rate (per 1,000 live births)	20.2	8.1	7.5
Under-five Mortality Rate (per 1,000 live births)	23.5	24.8	20.5
Maternal Mortality Rate (per 100,000 live births)	134.1	41.8	85.3
Crude Death Rate (per 1,000 population)	4.7	4.6	4.5
Crude Birth Rate (per 1,000 population)	25.6	23.3	22.6
Percentage of Low-Birth-Weight Babies	6.9	14.2	6.9
Stillbirth Rate	11.3	13.9	10.9
Total Fertility Rate	3.6	3	2.9
Percentage of all Births in Public Hospital	76.8	77	86.9
Incidence of Malaria (per 1,000 population)	5.3	2.8	2.7
Incidence of Tuberculosis (per 100,000 population)	36.3	30.2	20.2

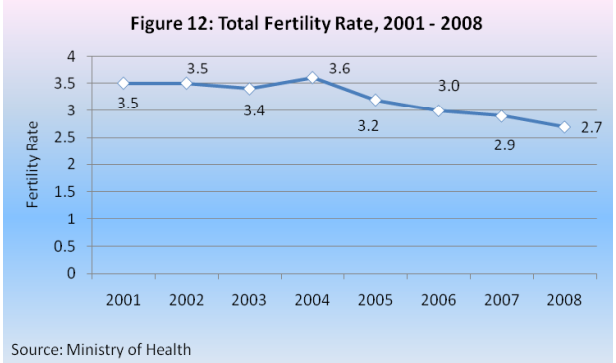
Source: The Epidemiology Unit, Ministry of Health

In terms of major diseases that can affect children and their development, Belize achieved Universal Child Immunization in 1990. Vaccination coverage includes DPT (Diphteria, Pertussis (Whooping Cough) and Tetanus), BCG (Tuberculosis), Polio, Measles, Mumps and Rubella. Most children are fully immunized before their first birthday. Villages throughout the country have permanent clinics or mobile clinics supported by health workers visit villages providing information, mobilizing mothers for clinic visits and administering vaccines. The Ministry of Health reports that in 2008, 98.1 percent of one-year olds countrywide were fully immunized against tuberculosis (Bacille Calmette-Guérin, BCG), 95.7 percent against measles, mumps and rubella, 94.1 against polio, and 93.9 against diphtheria, pertussis and tetanus.

According to the Ministry of Health, the five leading causes of deaths in children under one year in 2007, from highest to lowest, were: (i) hypoxia, birth asphyxia and other respiratory conditions, (ii) congenital anomalies, (iii) other conditions originating in the perinatal period, (iv) septicemia and (v) intestinal infectious diseases (MOH, 2007). The five leading causes of death in children, one to four years old, in 2007 and also in decreasing order, were: congenital anomalies, acute respiratory infections, accident caused by fire and flame and nutritional deficiencies and anemia. Accidental drowning and submersion, HIV/AIDS and diseases of the nervous system other than meningitis are reported as the remaining three leading causes of death in one to four year-old children in the country (MOH, 2007).

1.3.4.2 Adult Health Indicators

The total fertility rate is the average number of children each woman in a particular country has over her lifetime, expressed as a yearly rate based on fertility occurring during a particular year (Wright, 2005). Childbearing age is normally between the ages of 15 - 49



(Population Reference Bureau, 2006). In 2008, the total fertility rate for Belize was 2.7 (Table 5). Figure 12 shows that from 2001 – 2003, total fertility rate declined. It increased in 2004 and decreased since then until 2008 (Figure 12). The total fertility rate in Belize has always been higher than the regional averages for Central America and the Caribbean, which were 2.7 and 2.6 respectively in 2005 (Ministry of Health, 2008). Belize had a higher total fertility rate than all the countries in Central America except Guatemala and Honduras. In the Caribbean, only Haiti had a higher total fertility rate than Belize (Population Reference Bureau, 2006). Based on Figure 12, a continued decline in the total fertility rate is expected for Belize. However, the reality of developing countries like Belize is that although fertility rates are generally declining, they are still above Replacement Level Fertility. Replacement level fertility is when "fertility rate just replaces a couple, theoretically 2.0, but adjusted slightly higher because of mortality and failure to reproduce" (Wright, 2005). Although decreasing fertility rate in Belize cannot halt population growth it can still have a significant effect in controlling the rate of population growth and hence the increased pressure on the country's environment and natural resources.

The overall life expectancy in Belize in 2000 was 69.8 years, 66.7 for males and 73.5 for females (MoH, 2005). The crude death rate per 1,000 in the population averaged 4.6 during 2005-2007 (Table 5). According to the MoH (2005), the ten leading causes of mortality in 2004 were hypertensive disease, diabetes mellitus, HIV/AIDS, acute respiratory infections, diseases of pulmonary circulation and other forms of heart disease, transport accidents, ischaemic heart diseases, cerebrovascular diseases, other chronic pulmonary diseases, diseases due to external agents and residual, and homicide & injury purposefully inflicted on other person. In terms of important and preventable diseases that afflict the country, both incidence and death from hypertension are becoming more prevalent. A similar trend can be seen for diabetes and also HIV/AIDS, the third leading cause of death in 2004 (MOH, 2005).

1.3.4.3 Diseases and the Environment

Diseases that have an important link to environmental conditions include malaria, dengue, tuberculosis, gastroenteritis, food borne illnesses and some forms of acute respiratory infection. It is important to note that since outbreaks in 1998 and 1999 when 29 and 12 cholera cases were reported respectively, the country has not had another case reported to date (MoH, 2009). Malaria and dengue, mosquito-borne diseases, which especially afflict poverty-stricken areas with limited access to disposal of garbage items that can serve as mosquito breeding receptacles, both showed an increase in reported cases in 2005. Malaria cases increased from 1,066 in 2004 to 1,549 cases in 2005 and decreased to 884 cases in 2006 and 845 cases in 2007 (MoH, 2007). The incidence of malaria for 2005 was also the highest incidence recorded in the past five years (MOH, 2005). However, overall, the incidence of malaria per thousand in the population continues to decrease, from 5.3 in 2005 to 2.7 in 2007 (Table 5).

Of great concern is the outbreak of dengue, which the country and the region in general have been experiencing. In 2003 only 18 cases of dengue were reported for the entire country. This figure rose to 42 in 2004 (MoH, 2005). However, in 2005 the cases grew exponentially to 652 (MoH, 2005). In 2007 this figure decreased to 137 (SIB, 2008 and MoH 2007). Tuberculosis, another disease that afflicts poverty stricken areas and people living in crowded conditions, had less cases reported in 2004 (91 cases) compared to the 127 cases reported in 2000 (MoH, 2005). Overall, the incidence of this disease has also been declining (Table 5).

Cases of gastroenteritis, which result from drinking contaminated water or eating contaminated foods, have dramatically increased since 2001, when the MoH reported 703 cases (MoH, 2005). In 2005, the Ministry reported 3,737 cases (MoH, 2005), a greater than five-fold increase in four years. A total of 3,304 cases were reported in 2007 representing a decrease since 2005 (SIB, 2008). Food borne illness, a potential indicator of unsanitary conditions has also been rising. For example, the MoH reports 77 cases of hepatitis for the country in 2007 compared to 53 in 2004 and 29 in 2003.

Acute respiratory infection cases, which may also be affected by environmental conditions, have also been rising; 9,186 cases were reported by the MoH in 2006 compared to 7,332 in 2005, 2,190 in 2004 and 923 in 2000. There is no data as to what may be causing so many acute respiratory infections but in the developed world some cases are linked to air pollution. More data is needed on potential environmental links with a high incidence of acute respiratory infections.

Finally, apart from the above diseases with an environmental link and for which data is available, there are other medical conditions, whose incidence has been signaled as indicators of environmental degradation. One of these is the incidence of rashes from swimming in the rivers. Although there is very little data available on this, there is sufficient anecdotal data, especially from people in the San Ignacio and Santa Elena areas who report an increased incidence of rashes from bathing in the Macal River, to warrant a study of this situation. In conclusion, in general it appears that preventable diseases related to lifestyle changes are on the rise while there is a both a decline (cholera, tuberculosis, malaria) and an increase (dengue, gastroenteritis, food borne illness, acute respiratory infections) in diseases related to environmental conditions.

1.4 Economy

Poverty rates, employment and the general quality of life are directly related to the economic activity of the country. When it comes to the environment, unregulated economic activity can result in degradation. However, if this economic activity is regulated it can provide the means and resources needed to deal with socio-economic problems that exacerbate degradation and direct environmental problems. This allows for development to proceed in a sustainable manner. According to Wright (2005), "a strong relationship exists between the level of development of a nation and the effectiveness of its environmental public policies". Patterns that emerge out of this relationship include: environmental problems that decline once economic activity provides the resources to make effective technologies available, for example technologies for sanitation or water treatment; problems that increase and then decline once their effects are recognized and policies are developed and implemented to address them; and finally, problems that increase without any apparent end due to increased economic activity, for example solid waste problems (Wright, 2005).

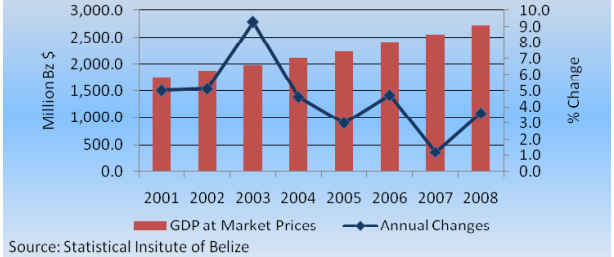
In most developing nations economic activities have not improved human and environmental health. In fact, the last section shows that in Belize there appears to be an increase in the country's infant mortality rate, a higher incidence of diseases associated with environmental factors including malaria, dengue, gastroenteritis and hepatitis, and an increase in poverty in most of the country with the exception of the Cayo District.

The basis of the Belizean economy lies in its natural resources. Primary industries such as fishing, forestry and mining rely on the extraction of these resources while tertiary industries, such as tourism, rely on their indirect use, particularly as attractions. Therefore, it is imperative that economic activities in Belize be regulated so that these resources are not completely exhausted and remain for posterity - in other words, development needs to be sustainable.

1.4.1 Economic Growth

Belize has an open and simple structured economy that is comprised of a variety of sectors but that is increasingly relying on the service industry. Other important contributing industries include agriculture and forestry, in particular the growing of crops and horticulture, and manufacturing, in particular the manufacturing of food and clothing products. The GDP in Belize has been showing a steady growth as shown in Figure 13. In 2008, the GDP for Belize (constant prices) was 2,377.7 billion Bz $ (Figure 13). However, the annual changes of GDP growth have fluctuated over the years. In 2003, annual GDP change (growth as in this case) reached 9.3% but a low change was observed in 2007. A 3.6% annual change was recorded for the year 2008 (Figure 13). The GDP per capita which was 7,359.84 $BZ in 2005 also decreased from the previous year (SIB 2009).

Figure 13: Gross Domestic Product at (Current Prices) and Annual Percent Change (Constant Prices), 2001 - 2008



Source: Statistical Insitute of Belize

1.4.2 Structure of the economy

The manner in which economic activity impacts the environment is directed by the patterns of this activity, for example, the sectors that contribute the most to the GDP. Patterns of economic activity direct patterns of consumption and the manner in which waste and pollutants are generated (CSO, 2004a). Within the agricultural sector, the growing of crops and horticulture are the predominant industries. Traditional agriculture practiced in Belize for some of the main crops such as sugar, citrus and bananas bring about significant land conversion and utilization of chemicals harmful to the environment and especially water sources. In addition, livestock farming, which is rapidly expanding throughout the country, plays a significant role in the agriculture sector but involves environmentally harmful practices. Land conversion to pasture and agricultural lands are the worst forms of land degradation when compared to practices such as agroforestry systems, plantations and selective logging (Montagnini and Jordan, 2006). In particular, pasture lands cause a loss of soil fertility and diversity, and the resulting soil compaction from cattle leads to erosion and makes recovery of forest on these lands very difficult.

Figure 14 and Table 6 show the percent contribution to GDP by sector from 2001-2007. Both show that in 2007, tertiary industries, which provide services, made the most significant contribution to GDP (61.7 percent), while primary industries such as Agriculture and Forestry have contributed the least to GDP (9.1 percent) (SIB, 2008). These figures represent an increase in the contribution to GDP by the tertiary industries and a decrease in contribution by the primary industries since 2004. Figure 14 and Table 6 also show that the increasing contribution to GDP by tertiary industries and decreasing contribution by primary industries has been the overall trend from 2001-2007. These patterns can be attributed to a large ex-

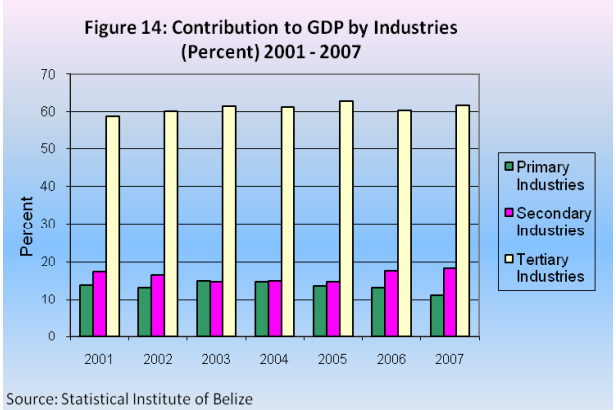


Table 6: Percent Contribution to GDP by Sector, 2001-2007 (Current prices)

Industry	2001	2002	2003	2004	2005	2006	2007
Primary Industries	13.7	13.2	14.8	14.7	13.6	13.1	11.1
Agriculture and Forestry	9.7	9.3	9.4	9.8	9.5	9.5	9.1
Fishing	3.4	3.4	5	4.4	3.8	3.1	1.5
Mining and quarrying	0.5	0.5	0.5	0.5	0.4	0.4	0.4
Secondary Industries	17.2	16.5	14.6	14.8	14.6	17.4	18.1
Manufacturing	8.9	8.3	7.8	7.8	7.8	10.3	11.4
Electricity and Water Supply	3.5	3.4	3	3.1	3.1	3.5	3.4
Construction	4.8	4.8	3.8	3.9	3.7	3.6	3.4
Tertiary Industries	58.8	60.2	61.4	61.3	62.9	60.4	61.7
Wholesale and Retail Trade, Repairs	16.6	16.2	15.4	14.4	14.7	14.2	14.6
Hotels and Restaurants	3.8	3.7	4.2	4.6	4.6	4.4	4.6
Transport, and Communication	9.5	10.7	10.4	10.7	11.1	10.4	11.2
Financial Intermediation	6.4	7.2	8.3	8.2	8.1	7.5	7.5
Real Estate, Renting and Business Services	6.4	6.7	6.5	6.7	7.2	7.5	7.3
Community, Social and Personal Services	6	5.8	6.1	6.5	6.7	6.5	6.5
General Government Services	10.0	10.1	10.4	10.2	10.3	6.9	10.0
Less: Financial Services Indirectly Measured	3.2	4.0	4.6	4.5	4.6	4.2	4.4
All industries at Basic Prices	86.4	85.9	86.2	86.3	86.5	86.6	86.5
Taxes Less Subsidies on Products	13.6	14.1	13.8	13.7	13.5	13.4	13.5
GDP at Market Prices	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Statistical Institute of Belize, 2009

tent on the rapid growth of the service industry, particularly tourism, during this period.

Within the primary industries, agriculture and forestry have contributed the most to annual GDP (9.1 percent) (Table 6). However, the figures from the CSO (SIB, 2006; Land and Surveys Department, 2006) reflect that within the agriculture and forestry sector the majority of the contribution is from the growing of crops and horticulture and livestock farming rather than from forestry and logging (SIB, 2005). It is important to note that contributions from the forestry and logging sector reflect only contributions obtained from royalties collected by the forest department for permits, fines and the selling of logs. The contribution of the forestry sector in the form of protected areas open to visitation to tourists is only reflected in the contribution to GDP by the service industry. In addition, the environmental services, which forests provide, such as clean and abundant water are also completely unaccounted for within the contribution to GDP figures from the forestry and logging sector. This type of contribution is only partially reflected in the secondary industries such as water and electricity supply.

Within the secondary industries, manufacturing was the sector that contributed the most to GDP in 2007 (11.4 percent) (Table 6) and according to the CSO/SIB data (Land and Surveys Department, 2006), the largest contribution to this sector was from the manufacturing of food and beverage products. Within the tertiary industries, wholesale and retail trade and repairs contributed the most to GDP (14.6 percent) in 2007, followed by transport and communication (11.2 percent) and general government services (10.0 percent) (Table 6).

Figure 15 and Table 7 show the percent annual changes in GDP by sector for 2001 to 2007. In 2005, tertiary industries underwent the largest rates of change

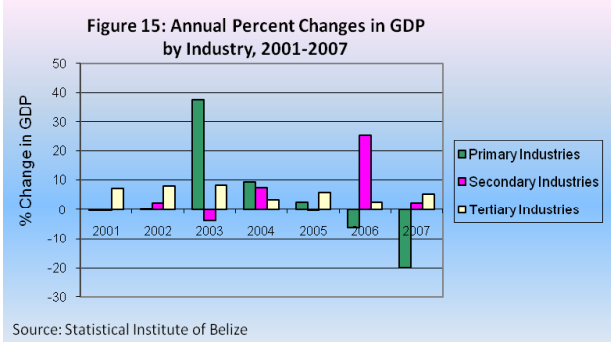


Table 7: Annual Percent Changes in GDP Contribution by Sector, 2003-2007 (Constant prices)

Industry	2003	2004	2005	2006	2007
Primary Industries	**37.6**	**9.4**	**2.7**	**-6.2**	**-19.8**
Agriculture and Forestry	15.5	11.9	-0.9	0.8	-1.4
Fishing	110.3	5.5	9.8	-15.5	-57
Mining and Quarrying	0.5	4.9	-5.7	3.5	14.8
Secondary Industries	**-3.7**	**7.4**	**-0.4**	**25.3**	**2.3**
Manufacturing	-0.5	12.3	0.9	30.5	3.8
Electricity and Water Supply	8.4	-1.5	-0.5	41.4	2.4
Construction	-17.9	4.6	-3.6	-2	-3
Tertiary Industries	**5.4**	**3.3**	**5.7**	**2.5**	**5.4**
Wholesale and Retail Trade, Repairs	1.4	0	5.4	1.3	1.6
Hotels and Restaurants	14.5	7.8	4.5	-0.8	5.2
Transport, and Communication	8.6	5	8.8	3.5	13.1
Financial Intermediation	31.5	5.4	5.6	8.3	7.8
Real Estate, Renting and Business Services	1.1	5.6	10.1	8.2	1.8
Community, Social and Personal Services	5	3.9	4.9	3.2	3.4
General Government Services	6.3	1.3	1.4	-5.1	4.7
Less: Financial Services Indirectly Measured	32.6	4.1	9.8	9.6	11.5
All Industries at Basic Prices	**9.4**	**5.2**	**3.8**	**4.1**	**-0.3**
Taxes Less Subsidies on Products	8.6	1.4	-1.9	8.2	10.9
GDP at Market Prices	**9.3**	**4.6**	**3**	**4.7**	**1.2**

Source: Statistical Institute of Belize

in terms of their annual contribution to GDP; these industries increased their contribution to GDP by 5.4 percent (Table 7). In 2007 all the tertiary industries underwent an increase in their contribution to GDP but the greatest change was in transport and communication (13.1 percent) and real estate, renting and business services (1.8 percent) (Table 7). In contrast, primary industries showed a negative annual change in their contribution to GDP during this year (-19.8 percent) and this was mainly due to a decrease in contribution by fishing (-57.0 percent) and agriculture and forestry (-1.4 percent). Mining and quarrying was the only primary industry that had a positive annual change in its contribution to GDP in 2007 of14.8 percent. In 2007, secondary industries also saw an overall positive annual change in GDP contribution (2.3) (Table 7).

The annual percent change in GDP contribution observed in the various industries and their specific sectors has important implications for the environment. A positive change in the livestock farming and forestry and logging sectors as reported by the CSO for 2005 (Land and Surveys Department, 2006) may signify an increase in land conversion and degradation as more areas are turned into pasture and also declining quality of forests as these are logged. A decrease in the real estate, renting and business services industry (Table 7) and hotels and restaurants industries may be coming with an environmental trade-off: coastal degradation, deforestation and heavy impact on fragile ecosystems like the reef, as tourism continues to increase. Table 8 summarizes the annual percent change in contribution to the GDP by key sectors from 2003-2007 and shows that especially livestock farming and mining and quarrying but also hotels and restaurants and forestry and logging, have had a recent positive change in 2007. All of these industries can have profound impacts on the environment but the following sections take a more detailed look at agriculture and tourism, two sectors whose management and manner of development have profound implications for the environment.

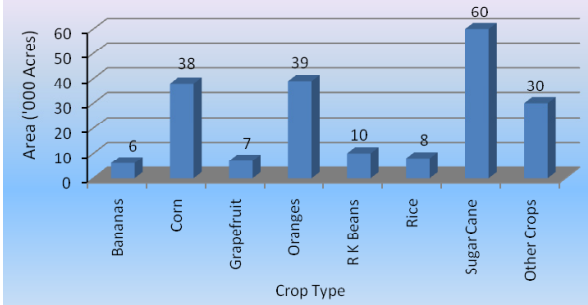
1.4.2.1 Agriculture

The Agriculture sector is a very important sector in the economy of Belize. Agriculture activities produce a diverse range of both beneficial and harmful impacts that affect the environmental quality. Farming for example, can lead to soil deterioration, poor and contaminated water and air quality and loss of biodiversity and habitats. Despite the adverse effects agriculture activities can contribute to environmental benefits such as acting as a sink for greenhouse gases.

In addition, agriculture expansion should be well -planned in order to avoid undue environmental degradation, contamination and depletion. A key to reduce environmental damage is sustainable agricultural practice.

In 2008, 198,000 acres or 3.45 percent of Belize's total land area was being used for major agricultural and other crops (Ministry of Agriculture, 2009). The major agricultural crops include bananas, corn, citrus (grapefruit and oranges), red kidney beans, rice and sugar cane. Figure 16 shows the total acreage utilized for each of these major crops in 2008 in thousands of acres. Accord-

Figure 16: Area Under Main Crops ('000 Acres) 2008



Source: Ministry of Agriculture

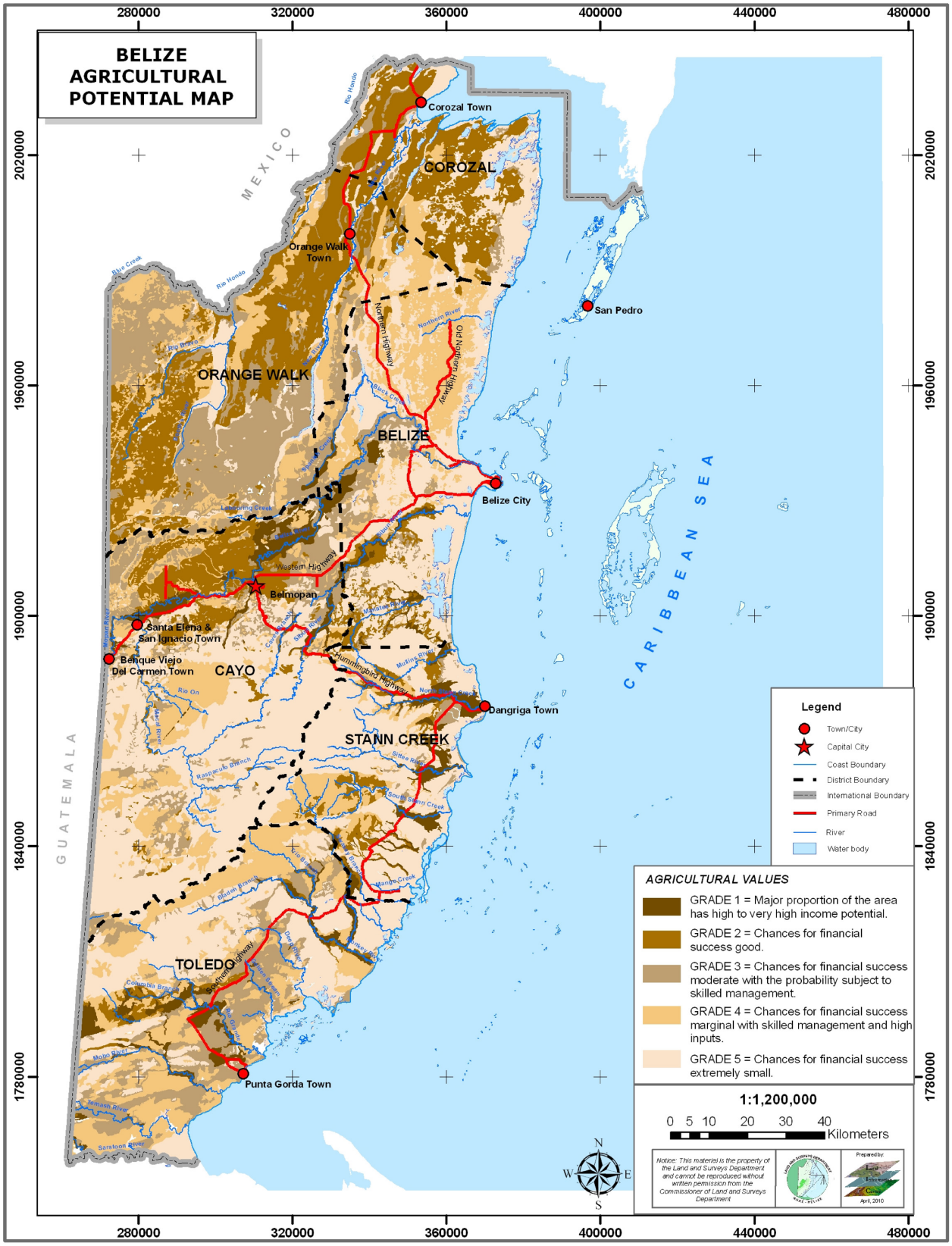
Table 8: Annual Changes in Contribution to GDP by Sector 2003-2007 (%)

Sector	2003	2004	2005	2006r	2007p (%)
Agriculture and Forestry	15.5	11.9	-0.9	-0.8	-1.4
Growing of crops; horticulture	20.3	12.6	-1.9	3.1	-3.2
Livestock Farming	3.8	10	0.4	-17.7	7.2
Forestry and Logging	-5.2	8.1	11.1	0.5	1.1
Fishing	110.3	5.5	9.8	-15.5	-57
Mining and quarrying	0.5	4.9	-5.7	3.5	14.8
Hotels and Restaurants	14.5	7.8	4.5	-0.8	5.2

Source: Statistical Institute of Belize

ing to this figure, sugar cane accounts for the majority of acreage (60,000 acres; 30.2 percent of total) under major agricultural production followed by citrus (46,000 acres; 23.1 percent of total) and corn (38,000 acres; 19.1 percent of total) (Ministry of Agriculture, 2009).

Map 2: Agricultural Potential Map



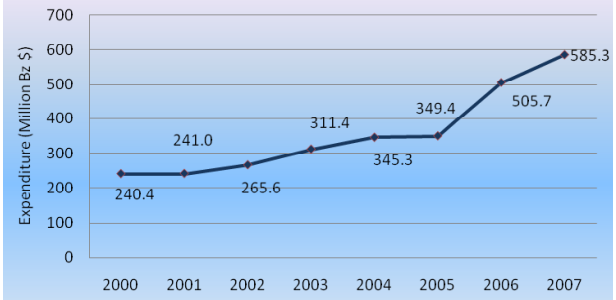
1.4.2.2 Tourism

1.4.2.2.1 Tourism Revenue and Employment

The country of Belize has been largely promoted and is internationally known as an eco-tourism destination. Since the mid 1970s, Belizean tourism development has been occurring and expanding in the coastal-marine environment and particularly in the Belize District, Ambergris Caye and Caye Caulker, and the southern offshore cayes of the Stann Creek and Toledo Districts. The tourism industry itself has largely been seen as being beneficial to the country (BTB, 2008) and based on the address of the Prime Minister, as well as the Minister of Tourism at the 10th Annual Industry Presentation, the Government of Belize (GOB) intends to put in place the enabling environment for the expansion of the industry. A high priority is being placed on infrastructure development to support tourism (GoB web site, 2008). Statistics from the BTB indicate that the tourism sector is the single largest contributor to GDP at 15-16 percent and provides 1 in every 4 jobs in the country. It also contributes 25 percent of foreign exchange earnings.

The hotel and restaurant sector's industry contribution to the country's GDP in 2007 was estimated to be 4.6 percent (SIB 2009, Table 6). In fact, employment in the hotel sector in Belize has grown by 48 percent during the period 2000 (3,134) to 2008 (6,471); this growth can be attributed to growth in the Belize District, including Caye Caulker and San Pedro Town and Placencia. However, the hotel and restaurant sector's contribution to GDP does not reflect the industry's total contribution. Based on the estimated total tourism expenditure for 2007 by the BTB (2006) and the country's 2007 GDP at constant prices (CSO, 2006a), the tourism's contribution to GDP in 2007 was approximately 16.3 percent. Figure 17 shows a general increase in tourism expenditure from 2000-2007.

Figure 17: Tourism Expenditure (mn Bz $), 2000 - 2007



Source: Belize Tourism Board

There are many indicators that reflect the growth in the tourism industry. In 2008, the country had 222 tour operators, representing a 72% increase from 2000 when 129 operators were reported (Table 9). However, it is important to note that tour operators around the country are unevenly distributed. Of a total of 222 tour operators in the country in 2008, only 11 were in Toledo (Table 9).

Tourism growth is also reflected in the increase in the number of hotels around the country (Table 10). Table 10 shows the number of hotels by area and by district up to the year 2008. Hotels are also not evenly distributed across the districts and Orange Walk had the lowest number of hotels in 2008 (Table 10).

Table 9: Number of Tour Operators, 2000 - 2008

Area	2000	2001	2002	2003	2004	2005	2006	2007	2008p
Belize District	30	28	41	43	54	49	55	58	55
Ambergris Caye	17	22	27	34	30	35	31	30	46
Caye caulker	10	11	15	23	21	21	21	20	23
Cayo	34	31	38	44	43	46	30	36	42
Corozal	1	2	1	2	2	0	2	1	1
Orange Walk	0	0	2	1	1	1	1	0	1
Stann Creek	11	11	19	20	19	21	20	22	19
Placencia	22	21	24	28	28	29	28	28	24
Toledo	4	4	4	5	6	7	9	10	11
Total	129	130	171	200	204	209	197	205	222

Source: Belize Tourism Board

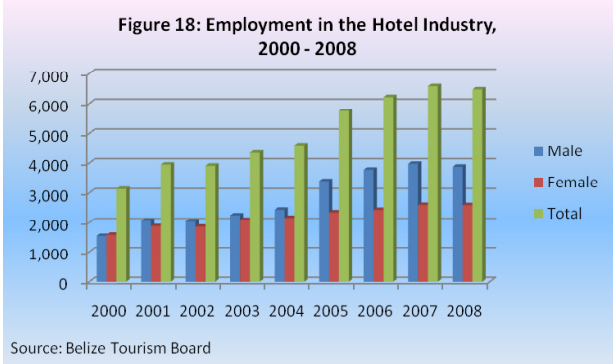
Table 10: Number of Hotels by Area, 2001 - 2008

Area	2001	2002	2003	2004	2005	2006	2007p	2008p
Ambergris Caye	63	68	74	81	92	98	99	105
Cayo	68	70	73	79	87	89	97	94
Placencia	57	54	63	67	81	81	88	94
Belize District	61	57	59	59	60	54	59	64
Caye Caulker	37	50	54	62	67	70	73	72
Stann Creek	41	50	53	54	55	55	56	58
Other Islands	28	31	30	37	36	36	35	37
Toledo	36	24	27	28	33	29	35	34
Corozal	16	20	21	25	29	31	29	33
Orange Walk	11	13	12	18	17	18	20	20
Total	418	437	466	510	557	561	591	611

"p" Provisional figures.

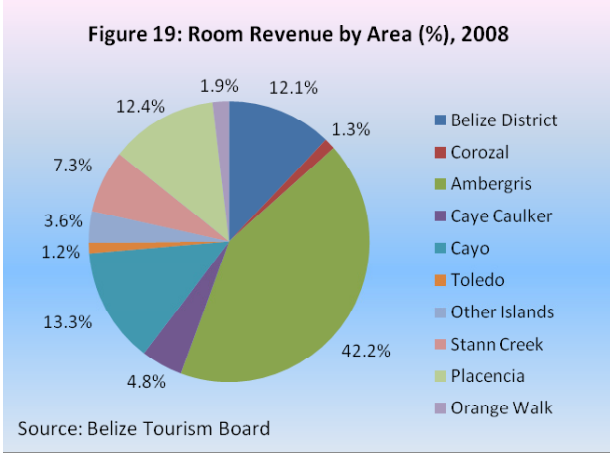
Source: Belize Tourism Board

In addition, to the increasing trend in the contribution of tourism expenditure to GDP over the last ten years, the industry has also continued to provide an increasing number of jobs in this time period. Figure 18 summarizes employment in the hotel industry by sex from 2000 - 2008. Since 2000 there have been more men than women employed in the sector. In 2008, 60 percent of people employed in the hotel industry were male compared to 40 percent female. Although employment in the hotel industry has been steadily rising, employment opportunities in the industry are unevenly distributed. Ambergris Caye, a single tourist destination, had the largest number of people employed in the hotel industry in 2008. This number accounted for 28 percent of the total number of people employed in the industry (BTB, 2008). Placencia, another single tourist destination, had 6.6 percent of the total number of people employed in the industry in 2008. Together these two destinations accounted for approximately a third of the total number of people employed in the hotel industry. District wise, Cayo and Belize had the largest number of people employed in the industry for the same period. It can be noted that employment in the hotel industry decreased by 1.7 % in 2008.

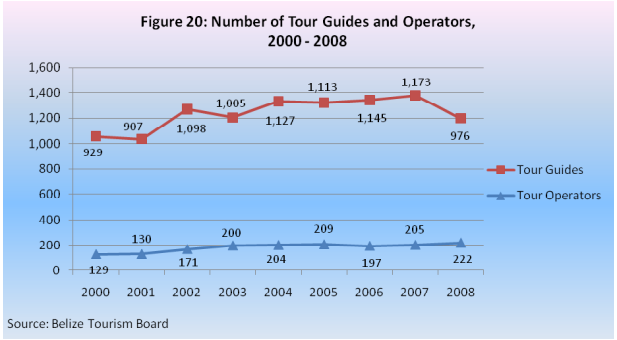


The uneven distribution of the benefits that tourism affords the country is even more pronounced when looking at the percentages of room revenue generated by area (Figure 19). In 2008, Ambergris Caye was the destination that received the largest percentage of room revenue (42.2 percent) (Figure 19). Cayo District and Placencia were the other two destinations with the highest percentage of room revenue for 2008, 13.3 % and 12.4% respectively. Together Ambergris Caye and Placencia also employed approximately a third of the total number of employees in the hotel industry in 2008, derived approximately two-thirds of the room revenue in the same year. District-wise, Belize and Cayo generated the most room revenue in 2008, 13 and 12 percent respectively. All other districts and destinations generated well below 10 percent each of the total room revenue.

In addition to an increase in employment in the hotel



industry, particularly in selected areas such as Ambergris Caye and Placencia, the tourism industry has also been instrumental in providing an increasing number of jobs to tour guides and/or tour operators. The tour guide training program offered by the Tourism Training Unit (TTU) of the BTB is one of the big successes of the industry and has been used as a model in other Caribbean nations (BTB, 2004). Figure 20 shows the total number of tour guides and tour operators from 2000 – 2008. The number of tour guides has fluctuated from year to year since 1998, but overall there is an increasing trend in the number of tour guides from 2000 to 2004. In 2008, a decline of 16.8% was registered in the number of tour guides as compared to 2007. The number of tour operators has also been increasing albeit more slowly than the number of tour guides. In 2008 there were 222 tour operators compared to 129 in 2000.

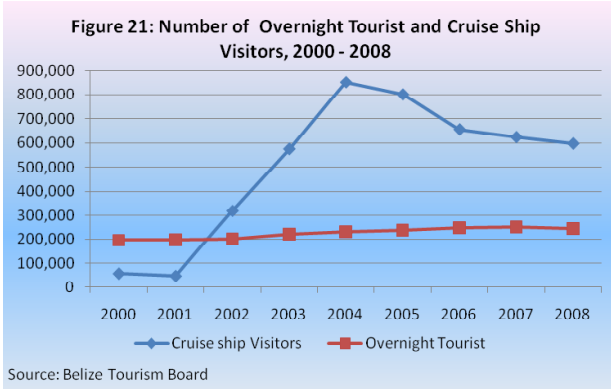


Based on the figures on tourism expenditure, employment rates and room revenues discussed above, there is little doubt today that the country will continue to develop its tourism industry. A bigger challenge for Belize will be how to ensure that more places off the beaten path benefit from tourism dollars.

1.4.2.2.2 Challenges of the Tourism Industry

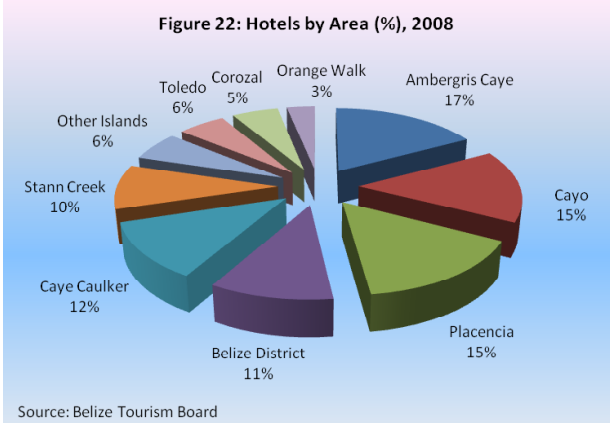
An issue that has sparked debate around the country has to do with the shift in the type of tourism that the country is primarily hosting, from overnight or stay-over tourism to cruise or "mass tourism" and the emphasis being placed on cruise tourism as the "main engine for growth in the tourism sector and the national economy" (BTB, 2004). A recent report on the terrestrial impacts of cruise tourism in Belize suggests that the choice Belize has to make concerns which type of tourism it should promote: cruise tourism or "mass tourism" vs. overnight "experiential" tourism including ecotourism (CESD, 2006). This choice needs to be a conscious one and that is because "mass tourism" has a bigger negative impact on the environment per dollar spent in the country per tourist (CESD, 2006).

Overnight tourism steadily grew from 2000-2008 (Figure 21). In contrast, cruise ship tourism grew at a much faster rate than overnight tourism from 2001 until 2004; the country more than doubled the amount of its cruise ship visitors from 319,690 in 2002 to 851,436 in 2004 (Figure 21).

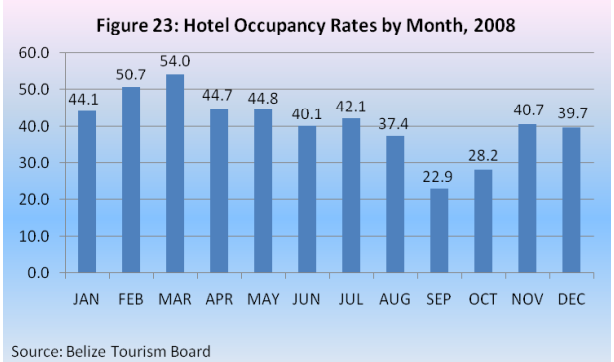


It then experienced a 6 percent decrease in cruise ship visitors from 2004-2005, an 18 percent decrease from 2005-2006 and a 4.3 percent decrease in from 2007-2008 (Figure 21). The most dramatic shift in overnight vs. cruise visitors occurred in 2002 when the 38 percent (199,521 visitors) of overnight visitors were far outnumbered by the 62 percent (319,690 visitors) of cruise ship visitors who entered the country that year (BTB, 2009). The limited growth of the cruise ship industry prior to this period is attributed to high head taxes and limited infrastructure (SIB, 2006), both of which have changed to allow this boom in the cruise ship industry. However, the decline in the cruise ship industry experienced since 2004 will probably continue with the current global recession.

One limitation in cruise tourism development that has been mentioned by stakeholders is that the country lacks capacity in large hotels, which could be marketed for package deals to relatively large groups. Indeed, in 2008, almost 40% of all hotels were located in the Belize District (with San Pedro accounting for 17%), (Figure 22). In addition to a lack of large hotels, a major challenge faced by the already existing hotels in Belize is the low occupancy rates. In 2006, the occupancy rate was 42.9 percent (BTB, 2006). This was almost the same as in 2004 and has been cited as lower than the average for other Caribbean destinations (BTB, 2004). Figure 23

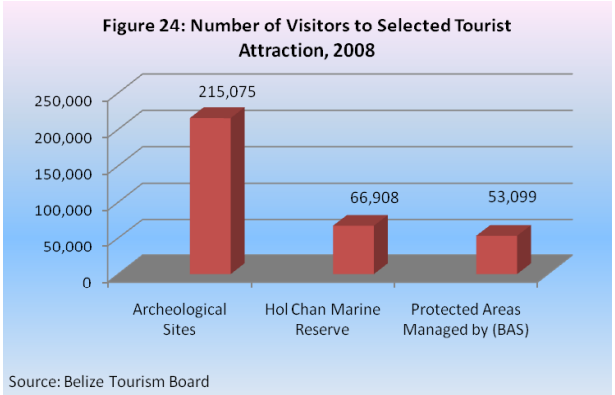


shows the monthly occupancy rate in 2008. February and March had the highest occupancy rates while September and October had the lowest. The preliminary figures on occupancy rate for 2008 show 41.1 percent.



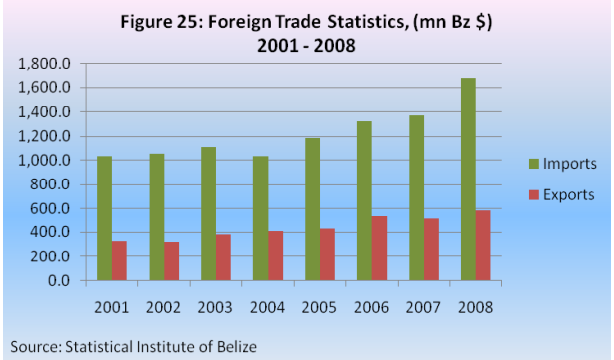
Apart from challenges faced by the hotel industry, another possible reason why the overnight sector has not boomed as much as the cruise sector is the fact that despite the work of the Tourism Training Unit of the BTB and other efforts in training, the country has much work to do in the service industry (BTB, 2004). A visitor who will spend more than a day at a destination is looking for quality service. The 2003 Visitor Expenditure and Motivation Survey (VEMS) (BTB, 2006) showed that three quarters of visitors to the country that year were visiting Belize for the first time. This figure was up by 6 percent since 2000 (BTB, 2006). Although more than 75 percent of the tourists surveyed said they would recommend Belize to a friend or return to Belize, the 2000 and 2003 VEMS data show that most of the visitors to the country are not returning (BTB, 2006). Value for money rating of services showed that less than half of visitors (47.5 percent) rated a good value for money. That the "embracing and enforcement" of standards, which could lead to the tourism industry selling a "market-ready" product, has not occurred (BTB, 2004) is not helping the industry although BTB has recently launched a new initiative to produce a marketing brand for the country.

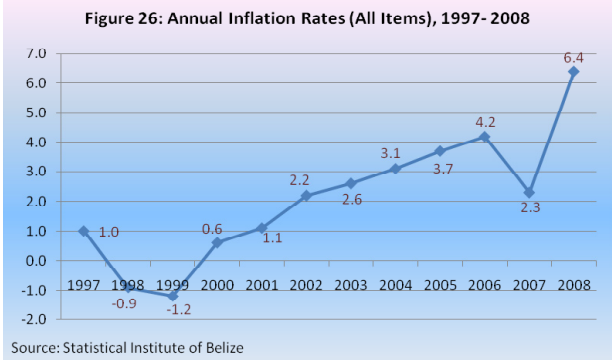
Other reasons that may have contributed to preventing a boom in the overnight sector include the lack of a clearly defined strategy for information dissemination once the tourist is in country and the lack of proper signage or roads leading to tourist destinations (BTB, 2004). Projects like the Tourism Development Project funded by the IDB have improved roads and infrastructure especially those related to visitation of archaeological sites (BTB, 2004). This can perhaps partially account for the pattern in visitation to different categories of sites, especially comparing inland sites. Figure 24 summarizes the total number of visitors to Mayan Archaeological sites compared to the Hol Chan Marine Reserve and several protected areas under management of the Belize Audubon Society. Many visitors to Belize express that they visit the country because of its natural beauty and protected areas (CESD, 2006). Therefore, funding is needed to upgrade access roads and facilities at all Protected Areas similarly to what has been done at archaeological sites in the country through the Tourism Development Project. The tourism industry needs to be engaged in actively supporting and contributing to the country's natural areas and fragile ecosystems and in mitigating efforts to counter environmental degradation for the industry to be sustainable.



1.4.3 Foreign Trade

External Trade shows the relation of an economy with other economies in the world in terms of goods imported and exported (SIB, 2010). The total numbers of major foreign trade aggregates from 2001-2008 are shown in Figure 25. According to this figure, the country's gross imports clearly surpass the country's domestic exports. Mineral fuels and lubricants, machinery and transport equipment, the commercial free zone, export





processing zones and manufactured goods made up more than 75 percent of the country's gross imports in 2008 (SIB, 2009). In this same year, the five major domestic exports by value and in order of greatest to lowest value were petroleum, orange concentrate, sugar, marine products and bananas. In 2008 the country's major source of imports was the United States followed by the rest of the World and Central America. In 2000, the U.S. supplied Belize with 50.0 percent of its gross imports, 42.5 percent in 2003 and 34 percent in 2008. In contrast, Belize has been increasingly relying on its Central American neighbors for its imports. In 2008, the country obtained 31.1 percent of its gross imports from Central America and Mexico compared to 24.5 percent in 2003. In contrast the amount of imports from CARICOM nations has decreased from 2.7 percent in 2000 to 1.6 percent in 2008. Therefore, although there is the perception that "Belize is geographically closer to its Central American neighbors, but its cultural, political and economic ties are strong with the Caribbean nations" (The National Committee for Families and Children and UNICEF Belize, 1995), this is not reflected in the economy of the country.

Having stronger economic ties with geographic neighbors can have many benefits for Belize in terms of sustainable development and protection of the environment. Many of the pressures being directly exerted on Belize's environment such as illegal extraction of forest and fisheries resources, watershed protection and immigration, transcend Belize's borders. Negotiating solutions and finding common ground to these problems can more easily be resolved with neighbors who are also economic partners.

1.4.4 Inflation

According to the SIB, 2009, the inflation rate can be defined as "the percentage change in the price level from the previous period". Figure 26 below shows the trend in inflation rates based on the consumer price indices for 1997-2008. At 6.4 percent in 2008, the inflation rate was the highest it had ever been in the country in the years shown on the graph. Although the inflation rate has shown an increase since 2000 a decline of 2.3 % was recorded in 2007. This deceleration was mainly due to the Transportation and Communication index holding steady and slower growth in the Rent, Water, Fuel and Power index. These movements are primarily attributed to the slower growth in fuel prices. High inflation rates put a major stress on the population especially if salaries have not increased to reflect this inflation. Especially for the country's poor, high inflation rates make buying food and taking care of their basic needs even more unaffordable and unattainable. Since poverty is directly linked to the use of the natural resource base and environmental impact, an increase in inflation rates also place stresses on the environment.

1.5 Education and Environmental Education

The level of education of a nation is usually indicative of development as measured by indices such as the Human Development Index employed by the United Nations. Moreover, since poverty is associated with a higher degree of use of natural resources, an increased level of education within a country can be a positive force in the adequate management of the environment. It is imperative that Belize continues to educate its population if the country is to look forward to a sustainable future. A powerful process through which this can be done is environmental education.

As per the Conference on Environmental Education held in Tbilisi in 1977, environmental education can be defined as a "process aimed at developing a world

population that is aware of, and concerned about the total environment and its associated problems and which has the knowledge, attitudes, skills and motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones" (BAS, 2006; Hoare et al., 2007). The goals of environmental education are that it should be a lifelong, practical, holistic and interconnected process, which is in harmony with social and economic goals and given equal priority to these (Hoare et al., 2007). However, the most important goal of environmental education and perhaps its biggest challenge is that it should be for everyone.

Environmental education challenges faced by Belize include lack of access to reliable information about the environment, limited community interest, human resources and funding, lack of continuity of programs, lack of capacity and especially capacity for measurement and evaluation of impacts, and a lack of national and international partnerships and networks for environmental education (Hoare et al., 2007). These challenges seem insurmountable when coupled with the challenges education in the country in general is facing today. Included among these are a lack of trained teachers, a lack of resources, particularly in rural areas, and a decline in both the adult and youth literacy rate. In 1990, the adult and youth literacy rates were 89.1 and 96 percent respectively and 76.9 and 84.2 percent respectively in 2003 (UNDP, 2005). The latest Human Development Report (UNDP, 2006) indicates an adult literacy rate of 75.1 in 2004. This value is lower than the 2003 figure.

This section looks at some of the highlights of education and particularly, environmental education in Belize, the extent of which or lack thereof is a major driving force in some of the environmental problems the country is facing today.

1.5.1 Preschool Education

Six (6) percent of the total school students or 5,801 were enrolled in pre-schools across the country in the academic year 2007/2008. Approximately 49.5 percent of the children enrolled in preschool were male and the remaining 50.5 percent were female. In the last six years the number of preschools has increased by 53 percent from 91 in 1990/1999 to 171 in 2007/2008. In 2007/2008, 46.1 percent of these were located in urban areas and the available data show that in this year, preschool enrollment for all six districts was the highest in urban areas (SIB, 2009). The highest and lowest preschool enrollment figures for 2007/2008 were for the Belize and Toledo districts respectively. Forty one and a half percent (41.5 percent) of the children enrolled in preschool countrywide were in the Belize District while only 8.1 percent were in the Toledo District. In general there is a correspondence between the level of preschool enrollment per district and the size of the population of the district. However, it is worth noting that although the enumerated population at census date in 2000 shows that the Stann Creek and the Toledo Districts are very similar in terms of their population numbers, Stann Creek has almost twice as many children enrolled in preschool (SIB, 2009).

There is a lack of studies showing the level, strategy and results of environmental education at the pre-school level. However, an environmental assessment by Hoare at al. (2007) showed that in general, pre-school students have a good understanding of environmental education. One of the major problems for environmental education at the pre-school level appears to be the lack of materials and resources relevant to the Belizean context (Hoare et al., 2007).

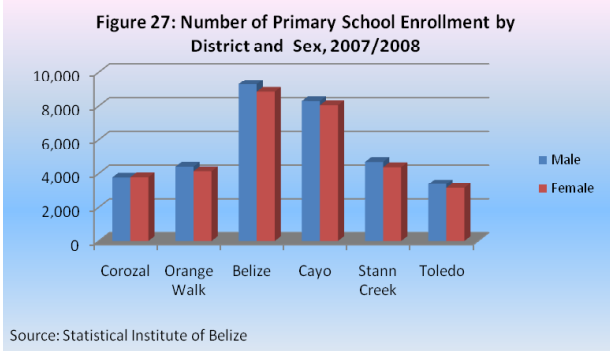
If the country is indeed to move towards sustainable development it will be imperative that environmental themes and issues be strategically incorporated into the entire preschool curriculum. The earlier children start gaining an understanding and appreciation for their surroundings, and participating in hands-on activities that encourage environmental responsibility, the greater the chance that the country will be able to sustainably manage its resources in the near future. Currently preschool enrollment in the Belize district accounts for more than 40 percent of enrollment in preschools and most of the enrollment in preschools countrywide was in rural areas. This means that opportunities for pre-school education in general need to be broadened across all districts and especially across rural areas so that any integration of environmental themes in the preschool curriculum can have an effect countrywide.

1.5.2 Primary School Education

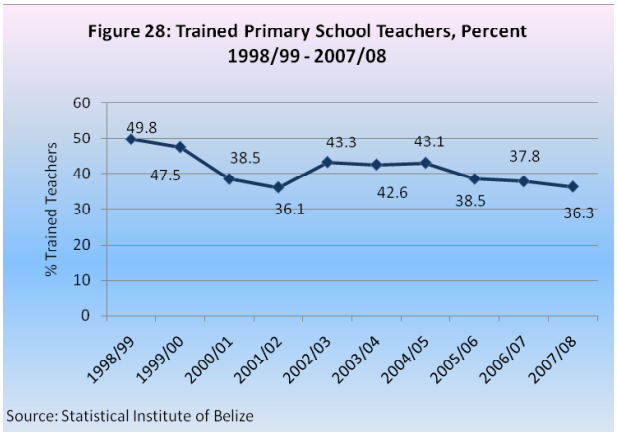
In 2007/2008 there were 292 schools countrywide with a total of 3,134 teachers (SIB, 2009). Only 18.0 percent of all primary schools were under government management while most of the remaining 82.0 percent

were under some type of church management, predominantly Roman Catholic. Seventy two percent of all primary schools were located in rural areas. The Belize and Cayo Districts had the largest number of schools and 50.0 percent of teachers. However, unlike the figures for preschool that showed Toledo had the least number of schools, this district had the third largest number of primary schools (50) in the country in 2007/2008 (SIB, 2009).

Gross enrollment figures for primary school in 2007/2008 indicate that 66,007 children were enrolled in primary school countrywide, 51.0 percent of them males and the remaining 49.0 percent females (Figure 27). However, net enrollment figures show that 16 percent of enrolled children did not attend primary school in this year. In every district the number of males enrolled was slightly higher than the number of females. The two highest enrollment rates correspond to the two largest districts population wise (as per the 2000 census), the Belize and Cayo districts respectively. The Toledo District showed the lowest level of enrollment although this district has the third largest number of primary schools in the country.



At the primary school level environmental themes and issues are currently being incorporated into science and social studies classes and also in occasional field trips. Two of the main challenges for environmental education at the primary level include the lack of adequate teacher training in environmental education, which has in turn led to coverage of environmental education topics on a per teacher basis. There is also a lack of quality teaching material relevant to Belize. The lack of trained teachers in environmental education is likely to remain a challenge since 2007/2008 figures from the SIB (2009), indicate that only 35.2 percent of teachers were trained teachers at various levels. Figure 28 shows that in general there has been a decrease in the percent of trained teachers in the past seven years according to the SIB.



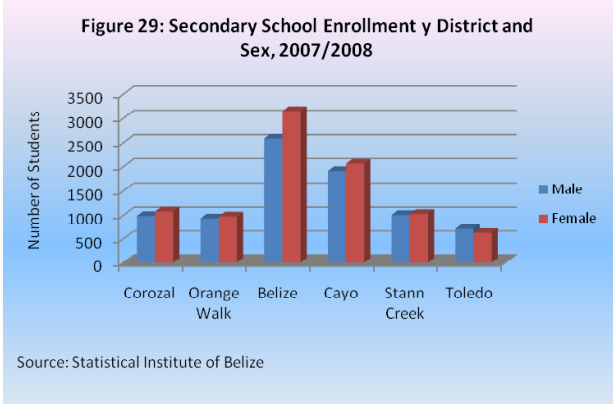
An environmental education assessment in primary schools conducted by Hoare et al. (2007) concluded that city schools are outperforming town schools when it comes to environmental education. Assessments are needed to evaluate the performance of rural schools in environmental education. However, since more than half of trained teachers are located in urban areas (SIB, 2009), it might be expected that rural schools would perform even less well than town schools. The assessment by Hoare et al. (2007) also found that knowledge of the environment at the primary school level is only on certain topics. There were some topics addressed in the assessment, such as the importance of sea grasses, for which students know very little. Since transition rates keep decreasing as children go from primary to secondary school and then secondary to tertiary school it is imperative that more resources are invested in primary school education, particularly teacher training.

1.4.3 Secondary Education

There were 49 secondary schools in the country in 2007/2008. Fifty nine (59) percent of them were located in urban areas compared to 41.0 percent in rural areas. Thirty seven percent (37) of the all secondary schools were located in the district of Belize. Toledo had the lowest percentage of secondary schools in the country, 6.0 percent, comprised by only two secondary schools. Of the total number of secondary schools 31.0 percent were government schools, 51.0 percent were government aided, and the remaining 18.0 percent were under private management (SIB, 2009).

Gross enrollment in secondary schools for 2007/2008 was 17,107 with 48.0 percent male students and 52.0 percent female students. Net enrollment figures for sec-

ondary school show a 40.0 percent decrease from gross enrollment and a net enrollment rate of only 53.5 percent of the secondary school age population. Less than half of children of secondary school age go to high school. Figure 29 shows the 2007/2008 secondary school enrollment by district and sex. All northern districts had a higher enrollment of females compared to males.



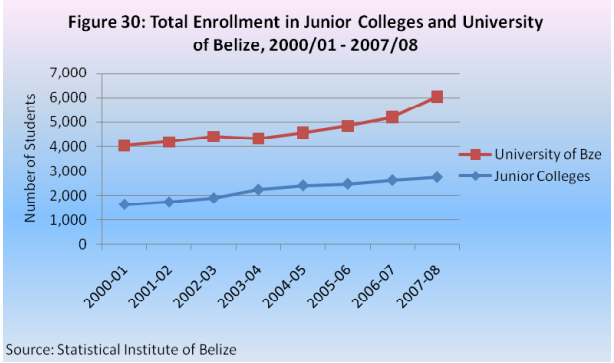
In contrast, Cayo and the southern districts had higher male enrollment, particularly Toledo, where 53.1 percent of the enrollment was male. In 2007/2008 the secondary school completion rate for the country was 59.8 percent. The completion rate for females was 54.7 percent vs. 64.8 percent for males. Data for the past seven years show a similar trend and a more or less constant total secondary school completion rate (SIB, 2008).

In terms of environmental education at the secondary school level, students cover a limited number of relevant topics and issues in the first two years in the required integrated science classes. After the second year, only science students continue to cover some environmental topics as part of their Biology classes (Hoare et al., 2007). The high school curricula simply do not incorporate many environmental themes and if covered these are often through the personal initiative and interest of individual teachers (Hoare et al., 2007). Challenges that environmental education faces at this level also include a lack of resources and teacher training, and a lack of hands-on experience for students. Organizations such as the Belize Audubon Society (BAS) and the Belize Zoo and Tropical Education Center (TEC) have been leaders in continuously offering programs in environmental education for both teachers and students. More recently, the Hugh Parkey Foundation, in collaboration with the Ministry of Education, is offering field experience to high school teachers and students countrywide. However, there is no structured training program for teachers in environmental topics (Hoare et al., 2007) as might be one day offered or mandated for all teachers by the Ministry of Education.

An assessment of students in their final year of high school showed that they are not performing at the level they should in environmental education. For example 35 percent or less of students assessed knew that vehicles are a source of pollution of carbon monoxide poisoning (Hoare et al., 2007). In contrast, the assessment found out that most students assessed were aware of what the PACT acronym stands for, probably due to the visibility of the organization through the media. Encouragingly, the assessment also showed that most students knew the Ministry of Natural Resources and the Environment (MNRE) as the government agency responsible for the environment (Hoare et al., 2007). This opens the door for the MNRE to act as a powerful driving force in environmental education by partnering with the Ministry of Education. Hoare et al. (2007) concluded that city and town schools performed equally poorly in environmental education assessment, which means that whatever environmental messages children are getting at the primary school level are not necessarily being internalized. In order for this to occur environmental education has to be integrated and sustained throughout all levels of education and also through learning at home and the non-academic sector. More studies are needed across the board to find out what factors contribute the most, at school and home, to the formation of environmentally conscious and proactive students.

1.4.4 Tertiary Education

In 2007/2008 a total of 6,029 students were enrolled at Junior Colleges around the country and at the University of Belize, the national university. Forty five percent of the all enrolled students were spread out amongst the various junior colleges while 55.0 percent were at the University of Belize. Figure 30 shows the total enroll-



ment for junior colleges and the University of Belize from 2000/2001, the year of the University's inception, to 2007/2008. Enrollment at junior colleges around the country appears to be increasing at a steeper rate than enrollment at the University.

In 2007, of eight tertiary level institutions in country, only two have little or no incorporation of environmental education topics in their programs (Hoare et al., 2007). These are Wesley Junior College and Corozal Junior College, which only incorporates some environmental information into their Biology program (Hoare et al., 2007). The remaining six tertiary education institutions have majors or degree programs directly relating to environmental stewardship and often also incorporate environmental themes or issues in additional relevant programs such as Biology, Agriculture and Tourism and Hospitality. Muffles Junior College offers an Environmental Science major; St. John's Junior College and Sacred Heart Junior College offer Associate degrees in Environmental Science; Stann Creek Ecumenical Junior College offers an Associate Degree in Environmental Science and in addition requires students in all other programs to take at least one of six modules from the Environmental Science program (Hoare et al., 2007).

Both Universities in the country offer degrees in an environmental field. The University of Belize, the national University and the one with the widest reach through its Belize City, Punta Gorda and Central Farm campuses, has the only Natural Resources Management (NRM) degree program in the country. Its Associate degree in NRM program started in 1996 and currently this program is offered at the Belmopan and Punta Gorda campuses. Approximately 64 students were enrolled in this program in 2006. A Bachelor in NRM program is offered at the Belmopan campus. The University of Belize requires that the majority of students enrolled at the University take Environmental Conservation and Development (NRMP 101). The Bachelor in NRM (BNRM) Program at UB started in 2005 and resulted from stakeholder consultation. While the Associate degree in NRM program is one of the programs at UB with the highest enrollment rate, in the past four years, the BNRM program has accepted between 15 and 20 students per year. Many of the students enrolled come from organizations active in conservation and Protected Areas management including the Fisheries and Forest Department, the Department of Environment (DoE), the Belize Agricultural and Health Authority (BAHA) and PACT. The program was funded by PACT and the OAK foundation soon after its inception to facilitate the hiring of qualified personnel and in order to make practical field activities and field research by students feasible. All students enrolled in the BNRM program are part of an Education Outreach Program that takes students to primary school classrooms in Belmopan. Final year BNRM students must complete a semester of sequential field or field-based courses as well as an independent research thesis project or an internship. With the recent inception of the Environmental Research Institute (ERI) at UB, students now have the opportunity to complete their thesis projects and internships within larger research projects being implemented by the ERI. Furthermore, in 2011, students in the BNRM as well as other programs relevant to natural resources management will be able to enroll in a Master in Biodiversity Conservation and Sustainable Development program offered by UB in partnership with the University of the West Indies – Trinidad and Tobago, University of Guyana and Anton de Kom University in Suriname.

Galen University, a private tertiary institution in Belize, currently offers a Bachelor Degree in Environmental Science and a Master in Business Administration (MBA) with a specialization in Sustainable Development. At Galen all students at the undergraduate level must enroll in a sustainable development course.

Many of the programs in the environmental field, including the University of Belize's BNRM Program and St. John's Junior College Environmental Science Program, have come about as a modification and a formalization into a program of several classes long offered by these institutions. This is encouraging in that environmental education at the tertiary level is no longer ad hoc but rather programmatic. This means that the country recognizes the need and market for qualified people who will be responsible managers and active stewards of the environment. With such programs formalized, what is now needed in Belize is a focus on strengthening environmental education at the more basic levels. This will ensure that students enrolling in tertiary level programs that are environmental in focus are not only doing so to corner the job market, but also as a result of a strong environmental ethic and love for Belize's cultural, physical and biological resources.

1.4.5 Non-Formal and Informal Environmental Education

The non-formal sector for environmental education is comprised of agencies and organizations that are not formally involved in day to day teaching as in the primary, secondary and tertiary schools. These include government agencies, non-governmental organizations and community-based organizations. Most organizations, especially NGOs, involved in conservation and management of natural resources have environmental education components to many of their projects. However, few have actually institutionalized these. Two examples of NGOs, which have made environmental education a major and long-term part of their institution, are BAS and the Belize Zoo.

The BAS has had environmental education as a priority since its inception in 1969 (BAS, 2006). Both members and staff of BAS have worked to teach young people about plants and animals of Belize and environmental issues by giving presentations to schools, organizing environmental carnivals and with their nature school programs in which both teachers and students get the opportunity to experience a Protected Area managed by BAS. The Society has been such a major player in environmental education that it has participated in teacher training and worked on curriculum development with the Ministry of Education. In 2006, BAS was a member of the Curriculum Development Committee in the Ministry of Education (BAS, 2006). In addition, BAS has always sought to educate not only students but also the public at large. This has been through radio programs, information videos and through the Belize Audubon Newsletter, known as the BAS Bulletin prior to 1987. Over the past 37 years the Society has produced many other environmental education publications and collaborated with many other organizations in spearheading environmental education initiatives. The Belize Zoo and Tropical Education Center is a younger organization than BAS but also has environmental education as a priority. The zoo was founded in 1983 and in 1986 it founded its education department. This department runs outreach and education programs that take both teachers and students directly to the outdoors. The zoo estimates that 10,000 students and 600 teachers countrywide visit the zoo annually (Belize Zoo, 2007).

More recently PACT has developed an Environmental Education Strategy Plan, 2007-2012, through BAS, UB and stakeholders, as a framework to address some of the challenges of environmental education in Belize and recognizing that environmental education involves everyone, not just students. The idea behind the strategy plan is that this would eventually lead to a national strategy in environmental education (Hoare et al., 2007). This would include the building of quality programs, capacity building especially amongst teachers and the mainstreaming of environmental education principles (Hoare et al., 2007). Through a national strategy PACT aims to equip all citizens to not just be aware but to adopt the attitudes and values that would allow them to act and work towards an environmentally sustainable future. The PACT Environmental Education Strategy Plan has seven strategic objectives. The objectives involve developing a national environmental education strategy, building awareness, knowledge, skills and values for positive environmental action and behavior in the public at large, building capacity among educators, achieving better coordination and networking of environmental activities countrywide, developing quality environmental information and educational resource materials relevant to Belize and accessible to Belizeans, promoting environmental education partnerships among the private sector, natural resources management agencies and managers and communities, and promoting the integration of environmental education principles into mainstream education at all levels (Hoare et al., 2007).

CHAPTER 2
INTEGRATED ENVIRONMENTAL ANALYSIS

Belize
Environment
Outlook

GEO Belize
2010

CHAPTER 2
Integrated Environmental Analysis

1 Introduction

In Chapter 1 of this report, the socioeconomic driving forces leading to direct pressures on Belize's natural resources and environment are discussed. This chapter analyzes the state of the country's environment in light of these pressures by discussing the most pressing environmental problems that Belize is facing today. These are forest loss and degradation, coral reef decline, coastal degradation, over fishing, a loss in the quality of water resources, climate change, threat to water resources and waste management. The chapter also discusses the importance of the resources that these environmental problems are affecting, the impacts expected on Belize's environment and its people if these problems persist, and the responses, negative or positive that these problems have elicited from multiple actors, including the state and non-governmental organizations (NGOs).

Although each of these environmental problems is highlighted separately in the chapter, readers will note that a separation of these eight problems, the pressures exacerbating them and particularly their impacts are in fact deeply linked and intertwined. An increase in forest loss and degradation, for example, ultimately leads to increased erosion, and increased agricultural run-off and sedimentation; run-off and sediments in turn may travel to the country's coral reefs through the various watersheds connecting the mainland to the coasts. Ultimately, the coral reefs may be negatively impacted and so are the country's tourism and fishing industries that depend on them. Who stands to lose the most from further environmental degradation or gain the most from the appropriate stewardship of the environment? Ultimately, it is the Belizean people as they see their health, their safety and livelihoods all being negatively or positively affected depending on the choices and demands they make and demands they place on the government for the sound management of the country's natural resources.

2.2 Forest Loss and Degradation

2.2.1 Importance of Forests

Tropical forests, such as those found in Belize, are among the most diverse and productive ecosystems on earth (Montagnini and Jordan, 2005). They provide a wide range of economic and social benefits, and environmental services to human societies through their productivity and diversity. Economically, they contribute to formal and well-established industries such as timber and tourism, particularly ecotourism, and also to younger industries based on trade of non-timber forest products. Forests also contribute to the informal economy of countries through the provision of many products including fuel wood, game meat and other non-timber forest products that are extracted and consumed by locals. Montagnini and Jordan (2005) report that global production and manufacture of industrial wood products accounted for 2 percent of the world's GDP through a contribution of approximately US$400 billion in the early 1990s. The primary consumers of this industrial wood are industrialized countries, but much of it comes from developing nations.

Broadleaf Forest

Table 11: Contribution to GDP by the Primary Sector (percent), 1970 – 2007, Current Prices

Industry	1970	1980	1990	2000	2005	2006	2007
Primary Industries	23.7	30.0	22.4	15.2	13.7	13.0	11.1
Agriculture	17.8	25.1	17.4	10.5	8.9	9.0	8.6
Forestry & Logging	2.5	2.7	2.3	0.5	0.6	0.5	0.5
Fishing	3.1	2.0	2.1	3.7	3.8	3.1	1.5
Mining &quarrying	0.3	0.3	0.6	0.5	0.4	0.4	0.4
Secondary Industries	16.1	23.6	26.0	18.0	14.6	17.4	18.1
Tertiary Industries	60.2	50.1	56.4	56.4	62.4	60.4	61.7
Less: Financial services indirectly measured	-	3.7	4.8	2.1	4.2	4.2	4.4
All Industries at basic Prices				87.5	86.5	86.6	86.5
Taxes less subsidies on products				12.5	13.5	13.4	13.5
GDP at market prices	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Statistical Institute of Belize

In Belize, the forestry and logging industry was historically the "mainstay of the economy". However, today, agriculture in the form of crop production, horticulture and livestock farming is the most important revenue generator among the primary industries.

As shown in Table 11, during the 1970s up to the 1990s contribution by the forestry and logging sector to Gross Domestic Product ranged from 2.7% to 2.3% but has remained constant at about 0.5% since 2000.

It is important to note that land use assessments for the country indicate that only 14.0 percent of the land area of Belize has potential for sustainable high yield timber production; at least on national lands the commercial size timber resources are almost exhausted (Belize FD and FAO, 2004). Approximately 69 percent of land in the country with the potential for sustainable high yield agriculture is located within protected areas and private lands. This highlights the importance of sound management of Belize's forested protected areas and engagement of private landowners to create private protected areas for the sustainability of the forestry and logging industry.

Apart from the timber industry, another well-established sector in many countries to which forests contribute economically is tourism, in particular ecotourism. Ecotourism is nature-based travel that according to Conservation International (2007) "conserves the environment and improves the welfare of local people". It is an example of an industry that can help to foster the economic development of natural areas, especially protected areas, while protecting their ecological integrity, making them viable from a national development standpoint (Montagnini and Jordan, 2005). In Belize, the tourism industry has become the fastest growing and most important industry for the country in terms of its contribution to GDP. The BTB (2008) reports that in 2006, tourism expenditure accounted for 16.8 percent of the country's GDP. In the last five years for which data is available, 2002-2006, tourism expenditure has consistently been increasing annually and has increased overall from BZ$265.6 million in 2002 to BZ$398.8 million in 2006 (BTB, 2008). An exact figure for the portion of this tourism revenue that comes from ecotourism is not available, but in 2007 a total of 289,986 visits by tourists were reported for three of the forested protected areas co-managed by the Belize Audubon Society (BAS), the Mountain Pine Ridge Forest Reserve, and 12 archaeological sites in the country (BTB, 2008).

Apart from generating revenues through tourism visitation and production industries such as the timber industry, protected areas contribute to Belize's economy in many other ways including employment of protected area managers, park wardens and other staff and generation of foreign exchange through large grants and donations. Box 1 helps to illustrate this by taking a closer look at the BAS, Belize's largest and oldest NGO, which is currently managing nine of the country's protected areas, through co-management agreements with the Forest Department and Fisheries Department.

Box 1: Belize Audubon Society and its contributions to Belize through Protected Areas Management

By: Anna D. Hoare, Executive Director, Belize Audubon Society

Belize Audubon Society (BAS) is a non-governmental non-profit membership organization dedicated to the sustainable management of Belize's natural resources through leadership and strategic partnerships with stakeholders in order to create a balance between people and the environment. BAS oversees and manages nine protected areas which occupy approximately 192,000 acres of Belize in terrestrial, aquatic, and marine environments on behalf of the people and government of Belize. The seven terrestrial protected areas which BAS manages include: Cockscomb Basin Wildlife Sanctuary, renowned as the first Jaguar Preserve in the world, Crooked Tree Wildlife Sanctuary, a Ramsar Site, St. Herman's Blue Hole National Park, Guanacaste National Park, Tapir Mountain Nature Reserve, Actun Tunichil Muknal Natural Monument, and Victoria Peak Natural Monument. BAS also manages two marine protected areas that are part of the Belize Barrier Reef World Heritage Site system. These are Half Moon Caye and Blue Hole Natural Monuments.

As the leading environmental conservation organization in Belize, BAS plays several critical roles as a national leader in environmental policy-making, environmental advocacy and education in addition to community development. BAS, for example, took active part in the development of the National Protected Areas System Act in 1981 and the National Protected Areas System Policy and Plan in 2005. The advocacy programs play a key role in the creating a strong conservation ethic in Belizeans. The organization also provides education for the Belizean public as well as thousands of international tourists on environmental issues, preservation, and sustainability. The environmental education programs are stepping stones for many schools to learning about Belize's land and the impact humans have on it. Audubon provides international internships through colleges abroad to provide program support for BAS.

Another component in BAS's effort for protected areas management is its commitment with stakeholder communities that live in the vicinity of the protected areas. BAS provides these communities with community development initiatives, alternative livelihoods, community empowerment and voice as well as environmental education and advocacy. The Society focuses primarily on the development of alternative livelihoods through capacity building, participatory management of resources, skills development and demonstration projects.

BAS recognizes the importance of networking and so is internationally affiliated as a member with the World Conservation Union (IUCN), BirldLife International as a partner, and holds accredited NGO status with the United Nations Convention which participates in combating desertification. Other local affiliations include membership with the Association of Protected Areas Management Organizations (APAMO), Bladen Management Consortium, and the Women's Issues Network (WIN-Belize).

BAS is an active player in the Belizean economy through foreign exchange generation from tourism visitation (Table 1) to the protected areas it manages, large grants and donations it receives for conservation and management work within protected areas, other income generating activities and providing employment to over 45 staff. The trained and professional staff include: an Executive Director, Education Manager, Advocacy Manager, Publicity Coordinator, Community Liaison Officer and protected area teams headed by the Protected Areas Program Managers, and has been steadily increasing since 2000 (Table 12).

Table 12: Number of Visitors to Protected Areas Managed by BAS, 2000-2007.

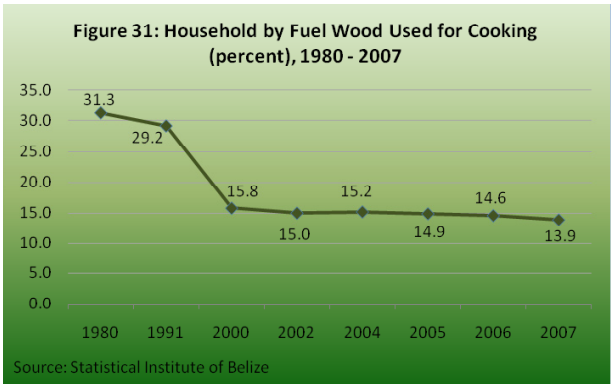
Sites	YEAR							
	2000	2001	2002	2003	2004	2005	2006	2007
Half Moon Caye Natural Monument	7768	12317	10207	7141	9000	5000	7740	9450
Guanacaste National Park	1691	1184	2445	2288	1800	1000	1400	1459
Crooked Tree Wildlife Sanctuary	1619	947	1541	1299	2000	2000	1801	1510
Cockscomb Basin Wildlife Sanctuary	3383	5189	6343	10132	9000	9000	3675	1090
Actun Tunichil Muknal*	-	-	-	-	2000	2000	5550	9871
Saint Herman's Blue Hole National Park	5195	10080	8485	7880	10000	11000	8130	9156
Total	19656	29717	29021	28740	33,000	30,000	28,296	32536

* Actun Tunichil Muknal (ATM) was not established until 2004

Source: Belize Audubon Society

Forests also contribute to the economy of countries like Belize through less established industries and informal trade. Most of these informal industries revolve around the extraction of forest products such as fuel wood or of non-timber forest products (NTFPs) that in Belize include: game meat, medicinal plants, edible plants or plant parts, orchids and other ornamentals, craft materials for making items such as baskets, palm leaves for thatching roofs, seeds such as those of the palmetto (*Acoelorrhaphe wrightii*) exported to the United States for extraction of a chemical compound believed to have medicinal value, and xaté leaves that are exported abroad to be sold in the floral industry. In most cases the monetary value derived from the extraction and trade of these products has not been quantified and this remains an issue for the management of the extraction of such products. Fuel wood or "wood consumed for energy production purposes" at various scales from domestic to industrial including wood that has been converted to charcoal provides one such example (Bull and Northway, 2008).

Although it is known that the majority of fuel wood is produced and consumed in developing countries (Montagnini and Jordan, 2005) and although consumption of fuel wood in commonwealth countries accounts for a third of global consumption (Bull and Northway, 2008), there is very little reliable data on the exact volumes extracted from forests in Belize and the amounts sold annually. Bull and Northway (2008) report a figure of 126,000 m3 for Belize in 2004, but state that the figure may be only an indication and unreliable. In some rural communities and some rapidly expanding newer immigrant communities in Belize such as the ones surrounding Belmopan, for example, fuel wood is still a primary or sole source of energy for many households. According to the Population and Housing Census and the Labor Force Survey (SIB, 2008), in 2007, the primary cooking fuel for 13.9 percent of households in the country was fuel wood (Figure 31). Fuel wood was also found to be the primary cooking fuel for 47 percent of households in the Toledo District (Table 13). Furthermore, 26 percent of the energy consumed in Belize is reported as derived from biomass in the forms of fuel wood and bagasse (BAS, 2008). Both of these are derived locally. Although Belize's dependency on fuel wood for cooking has been decreasing since 1980 (Figure 31), in commonwealth countries, deriving energy from fuel wood is expected to continue growing as an industry since biomass such as fuel wood is perceived as a fairly clean and renewable energy source (Bull and Northway, 2008).



In contrast to the poorly documented value of the fuel wood industry much better documentation of the value of the resource exists in the case of some NTFPs such as xaté. Xaté refers to leaves of palms in the genus *Chae-*

Table 13: Percent of Households by Main Type of Fuel Used for Cooking, 2007

	Corozal	Orange Walk	Belize	Cayo	Stann Creek	Toledo
Gas (Butane)	81.4	79.9	88.8	86.0	86.8	49.2
Wood	17.3	18.9	4.5	12.3	9.6	47.0
Kerosene Oil	0.3	0.6	1.3	0.3	0.5	0.5
Electricity	0.3	-	1.1	0.3	0.9	-
Other	-	0.3	0.1	-	0.5	-
None	0.6	0.3	4.1	0.8	1.8	-
DK/NS	-	-	0.1	0.3	-	3.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Labour Force Survey 2007, SIB

maedorea harvested for export abroad for use in the floral industry. Xaté exports for the Maya Biosphere Reserve in the Petén area in Guatemala were estimated to be worth more than US$4 million in 2000 and the "palm foliage" market has been estimated to exceed US$30 million (Bridgewater et al., 2006). In Belize, Bridgewater et al. (2006) carried out an assessment of the extent and value of the resource in the Chiquibul Forest Reserve and also the Greater Maya Mountains and estimated that the current standing export value of xaté at US$1.8 million and US$5 million respectively for these two areas. Although the harvesting of xaté and the establishment of a sustainable xaté industry is ridden with problems that transcend Belize's borders, as will be discussed later in this section, the valuation of the resource allows for a clearer picture of the economic value that can be derived from products that in the past have been extracted as part of less formal industries. Table 14 shows the amount of xaté produced and the revenue collected from it through legal harvesting in Belize.

Table 14: Xate Production and Revenue Collected, 2006 - 2008/09

	2006	2007	2008/09
Production	2,820,080	5,755,664	1,759,984
Revenue	$56,401.60	$94,536.62	$34,993.94

Source: Forest Department, MNRE, 2009

Some of the least valued, but perhaps the most important benefits of forests are in the form of the environmental services they provide. These include: the regulation of climate at the local level, through their influence on ambient temperatures, relative humidity and the hydrologic cycle, and at global levels, through their action as carbon sinks that help to ameliorate global warming, water and air purification, soil conservation and the housing of biodiversity and its genetic pool (Montagnini and Jordan, 2005). In Belize, contributions to GDP based on the forestry and logging industry for example are based solely on direct income generated from royalties collected for extracted forest resources, mostly logging, and the cost of licenses granted. However, up to date, the contribution of environmental services that forests provide has never been reflected in the contribution to GDP. Water resources, which derive from forest watersheds, for example, are being used by companies to supply potable water to many parts of the country and to generate electricity, but the value of forests for maintaining healthy watersheds that can provide this resource are not reflected in the forest sector's contribution to GDP. Although it is often not recognized, these environmental services in effect provide an important economic resource base without which the development of a country is unsustainable as per a definition of sustainable development that incorporates the safeguarding of resources for future generations.

The recognition of the value of these environmental services has to a large extent been hampered by the lack of a clear definition for many of these services (Bull and Northway, 2008), which are not as tangible as goods derived from industries. Among other challenges to the development of markets for environmental services are: defining what are sustainable levels for these services, including the costs of measuring and monitoring such services in their management; finding buyers for these services; ensuring the equitable distribution of the income generated from these services, and developing appropriate systems of taxation and property rights for these services. Despite these challenges countries must continue to seek market-based initiatives when it comes to environmental services because "non-market or regulatory mechanisms to protect environmental services and products" have to a large extent not been successful (Bull and Northway, 2008). In Belize seeking market based initiatives for environmental services is especially critical

since they may be a lot more viable than activities such as timber production.

One of the environmental services that is considered more tangible and around which many market - based initiatives have been developed is the ability of forests to act as carbon sinks; that is, the ability of forests to sequester carbon, thereby reducing greenhouse gas emissions, particularly carbon dioxide, and contributing to global warming and climate change mitigation. Presently there are several initiatives all over the world aimed at valuating and tapping the economic potential of the carbon sequestration ability of forests. In particular, many of these activities or projects are being carried out under the UNFCCC Activities Implemented Jointly by the Parties (AIJ) (UNFCCC, 2008).

An example of these AIJ projects and the only carbon sequestration project in Belize to date is the Rio Bravo Carbon Sequestration Pilot Project, which started in 1995. This project was based in northwest Belize adjacent to and within the Rio Bravo Conservation and Management Area (RBCMA) managed by Programme for Belize (PfB) and was developed by PfB in partnership with The Nature Conservancy (TNC) and various foreign utility companies willing to fund the project as a way to offset their greenhouse gas emissions. The main goals of the project were to acquire forested land and to develop a sustainable forestry program in order to achieve carbon sequestration and greenhouse gas benefits from the growing forest. Approximately 13,313 ha of land were purchased under the project. The sustainable forestry management project, which incorporated activities in forest preservation, sustainable timber harvesting, reduced impact logging (RIL), silviculture, fire management, tourism, NTFP harvesting and research, was carried out in approximately 40,761 ha including the purchased land and a portion of the RBCMA. Certification of the timber harvesting regime and forest management practices from the Forest Stewardship Council (FSC) was achieved under this project. Implementation of this 40 year project required approximately US$2.5 million. Today, PfB is once more looking at pioneering a new initiative for the sale of carbon credits, but this time through clean development mechanisms for example the voluntary carbon market. The new initiative is in the form of a Reduction of Emissions from Deforestation and Degradation (REDD) project which focuses on being able to sell carbon credits based on preserving existing carbon stocks or that is, preventing deforestation.

Apart from the productive capacity of forests, which allows them to contribute to a country's economy, whether through formal or informal industries or through the provision of environmental services, forests also provide many social benefits. The cultural and aesthetic values of forests are examples of these and are often difficult to quantify because they are not tangible. Belize for example is a country rich in ethnic diversity and it is well known that the traditional way of life of people belonging to several ethnicities in Belize in particular the Maya, the Garifuna, the Mestizo and the Creole include the extraction of forest products such as medicinal or edible plants not only because of their commercial value but because the use of these is part of their cultural traditions. Certain cultures also have high regard for forests and certain forests animals and plants because these are intimately tied to their spiritual beliefs. In terms of the aesthetic value of forests perhaps the best example in Belize is the country's vibrant tourism industry. The majority of the tourists that come to Belize come to experience the natural beauty of the country including the landscapes such as those presented by the Maya Mountains, a glimpse of the wildlife inhabiting the country's forests and the natural formations, caves and archaeological sites set amidst the country's forested protected areas.

2.2.2 State of Forest Loss and Degradation

The Food and Agriculture Organization (FAO) defines forests as "land spanning more than 0.5 ha with trees higher than 5 m and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ" and other wooded land as "land not classified as forest, spanning more than 0.5 ha; with trees higher than 5 m and a canopy cover of 5-10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and shrubs above ten percent" (Commonwealth Forestry Association, 2008). Both of these definitions exclude land being used mostly for agriculture or urban land uses.

The forests of Belize are comprised of forests on national lands, which as defined by the Forest Department comprise lands that are not private or otherwise designated or allocated, private lands, and protected areas including forest reserves, national parks, nature reserves and

private protected areas. The Ministry of Natural Resources and the Environment (MNRE) is the responsible body for the administration and use of the country's natural resources including forests on national lands and protected areas. Within this Ministry, the Forest Department is responsible for overseeing the use and protection of forests including granting of licenses and permits, collection of royalties for forest resources, monitoring, and to a large extent the design and implementation of management plans. The Forest Department is responsible for the management of approximately half of the country's protected areas. The Lands Department under the MNRE is another body whose activities and responsibilities involve the use and administration of forests mainly because they are the responsible body for land allocation and distribution.

More recently, the Commonwealth Forestry Association (2008) provides estimates for extent of forest in Belize for 2005 of 1,653,000 ha covering 72.5 percent of the country's land area and resulting in 5.8 ha of forest per capita. Although these figures rank Belize as 25th in terms of amount of forest among the 54 commonwealth countries, in terms of percent of the country's land area under forest cover and forest area per capita, it ranks as 4th and 6th respectively (Commonwealth Forestry Association, 2008). It is not surprising that Belize ranks high for these types of data for two reasons. The first is the country's small population relative to other Central American and Caribbean countries, and also the fact that it is considered one of the countries in the region with the highest level of territory, particularly terrestrial territory, under protection.

According to the LIC, over 100 protected areas have been declared under various designation, including the following categories: Archaeological Sites, Bird Sanctuaries, Forest Reserves, Marine Reserves, National Parks, Natural Monuments, Nature Reserves, Wildlife Sanctuaries, Private Protected Areas, Spawning Aggregation Sites and Public Reserves (Table 15 and see Appendix 1 & 2 for a full listing and acreage). Belize has approximately 22.8 percent of its total national territory under protection; 10.7 percent of its total sea area, and 34.9 percent of its land area (Appendix 1). The majority of the terrestrial area under protection is forested. However, it is important to note that almost half of the 35 percent of terrestrial area under protection or 17.2 percent is mostly for resource use and extraction (Appendix 1). This means that activities such as logging can take place within this area making it accessible and hence vulnerable to other pressures such as illegal extraction of forest products and fire. In fact, assessment of the status of Belize's forests and the extent of their loss and degradation can only be done by looking at the pressures being exerted on them.

Table 15: Number of Protected Areas of Belize by Category, 2009

Category	Total
Forest Reserves	19
National Parks	17
Nature Reserve	3
Wildlife Sanctuaries	7
Natural Monument	5
Archaeological Reserves	14
Private Reserves	8
Marine Reserves	8
Spawning Sites(1)	13
Public Reserves	5
Mangrove Reserve	1
Bird Sanctuaries	7

(1) Includes two Nassau Grouper and some may be part of a Marine Reserve

Source: Land Information Center, MNRE

According to the Forest Department Strategic Plan 2005-2010, the Forest Department has experienced significant changes in the last 20 years including: "the depletion of timber stock, thereby reducing the Department's revenue generating capacity and contribution to the national economy, the major damage caused by the bark beetle infestation in the country's pine forests, the constant pressure by the growing population and their local political representatives to go further into the forests for agriculture and other domestic purposes, the cross border incursions into the forests by neighboring farmers extracting forest products as new economic opportunities are discovered, and the rapid economic growth of the tourism industry that continuously requires newer attractions for the increasing number of visitors to the countries of Belize" (MNRLGE, 2005). In many respects, the changes mentioned above accurately reflect the pressures being experienced by the forestry sector in Belize and the socioeconomic and political forces driving such pressures.

One important driving force on the forest sector is the steadily increasing population growth of the country coupled with a culture of non-sustainable forest use.

Population growth has led to deforestation due to urban and agricultural expansion and illegal extraction of forest resources, as people seek to generate better livelihoods. As a result, forests continue to disappear or decrease in their quality, that is, degrade. Another major driving force on the forest sector is the economic situation of the country including government austerity measures coupled with the government's need to promote the development of new industries. Government austerity measures have been largely responsible for significant reductions in the financing for departments such as Forest Department, which is tasked with the management of the country's forests. At the same time, as the timber industry continues to decline, the need for the development of industries, which will generate additional revenue for the country, has contributed to the rapid growth of the tourism industry especially. These economic forces have led to pressures on the forestry sector that include financial constraints faced by an understaffed and under - funded Forest Department and a demand for increased use of the forest, in particular, forest protected areas for visitation by tourists. The result of such financial constraints is a Forest Department lacking the appropriate capacity: to adequately manage its protected areas so that they may become financially sustainable through tourism ventures; and to respond to relevant management issues, for example, the 2000-2003 bark beetle outbreak in the Mountain Pine Ridge, which caused significant forest loss, and to control illegal logging or other illegal forest extraction operations.

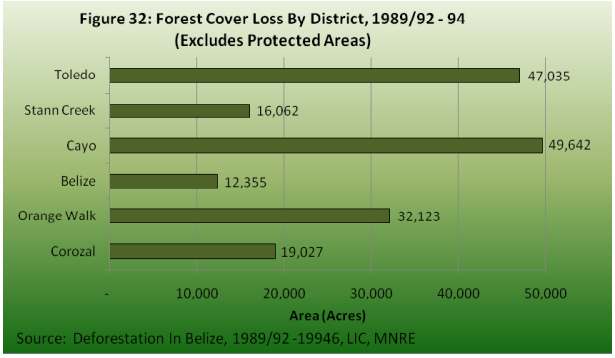
Another major driving force on the forest sector in Belize is one external to the country. This driving force is the socioeconomic and political situation of neighboring countries. Both immigration and trans-boundary incursions are direct activities accompanying this force as people from neighboring countries seek to better their livelihoods. Immigration from neighboring countries brings with it an increase in the demand for land for housing and farming as well as the introduction or reinforcement of unsustainable agricultural practices. Trans-boundary incursions, while temporary, can also have a severe impact on the forest because of the unsustainable harvesting of multiple forest species. The fact that Belize cannot physically patrol its borders adequately, because the country simply lacks the manpower and resources needed to do so, exacerbates the negative effects of the unsustainable harvesting of forest products including wildlife, timber and NTFPs, such as xate (Chamaedorea spp.), thereby reducing the quality of the forest.

Pine Forest Loss: Bark Beetle Outbreak

The most significant direct pressures on forests caused by the above mentioned driving forces include deforestation and extraction of timber and NTFPs, particularly illegal extraction. These are discussed further below.

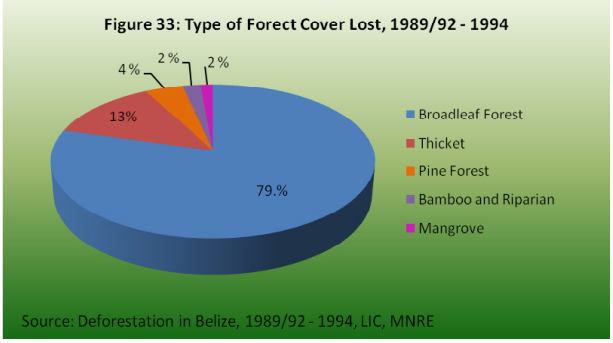
2.2.2.1 Forest Loss

Forest loss or deforestation leads to environmental degradation. It is a major cause of soil erosion, loss of soil productivity and destruction of wildlife habitats and biological diversity, among other devastating effects.



The estimated rate of forest cover loss for Belize for the years 1980 to 1987 was 22,239 acres per year (World Resource Institute 1987, cited in Ledec 1992) and for the years 1981 to 1990 it was 12,355 acres per year (FAO, 1994). The accuracy of the rates is unknown. The estimated rate for 1989/92 to 1994 was 61,727 acres per year (Table 16) of which 16,510 acres was lost from protected areas and managed areas. The districts that had the most extensive forest cover losses were Cayo, Toledo and Orange Walk (Figure 32). Broadleaf Forest, which comprised 79 percent of Belize's forested area (approximately 153,000 acres), was the most common forest type that was lost during the period 1989/92 to 1994 (Figure 33).

Forest cover in Belize has also been lost as a result of forest fires. In the MPRFR approximately 13,000 acres of



forest was under wild fire in 1998 and 1999. The Forest Department recently developed a national fire management strategy in collaboration with the Nature Conservancy and other partners that addresses wildfire issues.

2.2.2.2 Extraction of timber and NTFPs from forests

Table 16: Rates of Forest Cover Loss on Mainland Belize, 1989/92 to 1994

Period	Approximate Location in Belize	Loss (Acres)	Annual Rate (Acres/year)
1989 - 94	South	60,527	12,105
1990 - 94	Central	66,302	16,575
1992 - 94	North	66,097	33,047
Total		192,926	61,727

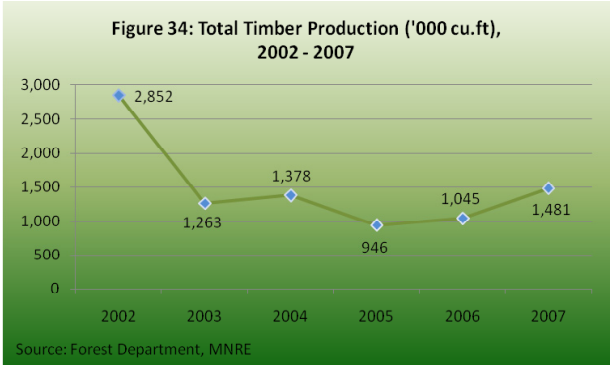
Source: Deforestation in Belize 1989/92 - 1994/96

The effects of timber and NTFP extraction range from the tangible to the more intangible. Extraction can reduce populations of certain timber and non-timber species including wild animals to numbers that can make these populations non-viable, causing biodiversity loss in an area and increasing their extinction potential. In Belize practices such as selective logging, for example, have been known to reduce populations of commercially favored timber species such as mahogany in certain areas.

The more intangible effects of timber extraction on the other hand, range from changes in forest microhabitats and reduction of seedling populations due to the skidding and soil compaction that may result from logging operations, to the perhaps much larger issue of creating access for the illegal extraction of forest products through the opening of roads. In Belize one of the biggest challenges to implementing sound practices in the legal extraction of forest products is the lack of scientific information regarding extraction practices. One example of this in Belize comes from the extraction of NTFPs such as "popta" seeds, which come from the pimento palm, *Acoelorrhaphe wrightii*. Currently, there is one company in Belize buying these seeds for export because of markets abroad for their medicinal value. The palms from which the seeds are harvested are found in the savanna forests of the country. Although the Forest Department currently issues a license for the harvesting of these seeds they have very little scientific information on which to base the conditions of the harvesting permit issued and to create regulations that will safeguard the sustainability of the industry.

Despite these challenges, legal extraction of timber and NTFPs have a much greater chance of being controlled through various measures including the issuance of permits stipulating the terms and manner of extraction, enforcement of policies, laws and penalties meant to curb the environmental impact of extraction by agencies such as the Forest Department, and adoption of best practices and certification systems especially in the logging industry. Some of these measures being put into practice in Belize are discussed under the "Responses" for this section but it remains important that the Forest Department monitor these activities to ensure sustainability of the timber resource, which remains important to the country's economy.

Table 17 and Chart 34 show the statistics for timber extraction in Belize for the years 2002-2007. According to this information, Belize produced 2,852,112 cubic feet of timber products in 2002. This decreased to 1,480934 cubic feet in 2007, representing a 57 percent decrease in total production. The primary reason for this was the drastic decrease in the production of pine, which accounted for 50.5 percent of total production in 2002, but which



fell to 19.7 percent of total production in 2007. The drop in the production of pine was due to the infestation with the bark beetle (*Dendroctalis frontalis*), which devastated the Mountain Pine Ridge Forest Reserve, an important source of pine timber. It should also be noted that Mahogany, Pine, Santa Maria and Yemeri are the four hardwoods with the highest production rates. The production of these hardwoods, (Table 17) represented 65.2 percent of total production in 2002. This figure decreased to 55.8 percent of total production in 2007.

In contrast to the legal extraction of timber and NTFPs, illegal extraction, poses a much greater challenge to the long-term integrity of forests. Belizeans as well as non-Belizeans illegally extract forest products throughout the country. Remote areas such as border areas are extremely vulnerable because there is not sufficient enforcement of environmental laws in these areas due to a tremendous amount of resources and political will that it requires. An example of such an area is the Chiquibul Maya Mountain (CMM) forest block comprised of several protected areas including the Chiquibul National Park (CNP), the Chiquibul Forest Reserve (CFR) and the Caracol Archaeological Reserve (CAR). These areas occupy a total of 437,366.232 acres (LIC, 2009). The CNP shares a 45 km border with Guatemala and 65 Guatemalan com-

Table 17: Timber Production (cu. Ft.) by Major Species, 2002 - 2007

Species	2002	2003	2004	2005	2006	2007
Banak	4,280	3,025	5,196	5,125	5,815	5,694
Barba Jolote	10,706	2,985	11,725	5,580	11,925	8,141
Bastard Rosewood	-	-	1,667	3,922	3,064	5,810
Billy Webb	5,778	1,724	7,741	6,352	12,964	35,102
Bitterwood	35,372	15,858	12,088	13,845	16,033	33,596
Black Cabbage Bark	37,368	27,217	51,292	64,693	42,832	36,809
Black Poisonwood	-	-	5,534	3,694	3,638	9,385
Bullett Tree	22,743	28,185	25,514	28,386	18,817	32,149
Cedar	23,214	17,548	20,528	8,083	2,428	5,755
Cotton	4,246	2,612	1,058	1,550	855	11,346
Fig	-	-	38,835	57,460	25,696	10,048
Ironwood	1,817	79	347	431	1,135	1,383
Mahogany	145,359	169,455	184,832	74,117	88,807	119,957
Male Bullhoof	25,823	70	17,652	…	74	…
Monkey Apple	0	487	309	143	1,302	711
Mylady	39,031	51,392	65,699	47,179	29,503	46,753
Nargusta	25,358	31,823	55,822	53,989	77,441	93,975
Pine	1,440,754	602,899	407,842	103,150	158,572	291,753
Prickly Yellow	7,287	-	5,420	7,544	11,085	15,758
Quam Wood	9,367	14,804	6,680	9,406	15,628	23,143
Santa Maria	117,181	146,257	174,303	208,455	176,101	241,539
Sapodilla	19,452	20,476	37,058	25,712	24,519	44,166
Sillion	-	-	1,152	4,091	12,380	6,479
Tambran	1,475	3,802	5,606	12,721	38,242	28,126
White Breadnut	153	773	6,627	3,789	5,446	180
Yemeri	155,508	44,187	129,288	119,726	119,576	173,298
Subtotal	**2,132,272**	**1,185,656**	**1,279,814**	**869,141**	**903,877**	**1,281,059**
Other Timber	719,840	76,913	98,619	76,841	141,490	199,875
Grand Total	**2,852,112**	**1,262,569**	**1,378,433**	**945,981**	**1,045,367**	**1,480,934**

Source: Forest Department, MNRE

munities are located near this border, which makes it particularly vulnerable to incursions by Guatemalans. As early as 1987, satellite imagery showed 280 acres in the CNP that had been cleared by Guatemalans for agricultural use. By 1994, this cleared area had increased six-fold to 1,710 acres and to approximately 7,725 by 2007 (FCD, 2007). Today, illegal incursions by Guatemalans have been documented throughout the CMM forest block (Table 18) and the Forest Department (Marcelo Windsor, pers. comm.) reports cattle ranches, milpas and homes belonging to Guatemalans as far as 4.5 km into Belize or 3.5 km past the 1 km adjacency zone at the Belize-Guatemala border, in the CMM area.

A recent "dramatic increase" in Guatemalan incursions of four main types, namely: xatero, hunting, military and farming has been reported along the border and in the CNP by FCD (2007). As explained in section 2.1 xaté refers to leaves of certain species of *Chaemaedorea* palms harvested for export to the United States and Europe where they are used in the floral industry. Xateros are people who illegally harvest these leaves and they have been moving further into Belize as the xaté near the border grows scarce. Apart from extracting xaté, xateros also hunt animals and extract other forest products in order to subsist in the forest and possibly also for sale in bordering Guatemalan towns. According to FCD (2007) there is a connection between xaté harvesting, hunting and looting of archaeological sites within the forest. Table 19 shows the amounts and value of xaté confiscated from 2005-2007.

Table 18: Estimated Forest Area Cleared up to 2007 From Illegal Incursions and for Agriculture in Protected Areas near the Maya Mountains

Protected Area	Area (acres)	Area (ha)
Chiquibul National Park	7,725	3,126
Caracol Archaeological Reserve	3,303	1,337
Columbia River Forest Reserve	2,485	1,006

(Source: FCD, 2007)

The Xate plant, Chamaedorea species

In addition to xatero incursions, Guatemalan hunters from bordering communities are also entering the forest to obtain game meat being sold commercially within these communities. More than 1,000 acres of freshly cultivated area have also been reported in the CNP and incursions into Belize by Guatemalan armed forces have also been observed (FCD, 2007). Unlike legal extraction, which can be regulated illegal extraction and particularly illegal extraction by non-Belizean nationals continues to escalate. In fact, in September of this year, Wicks and Miller (2008) from the Ya'axché Conservation Trust (YCT), a local non-governmental agency and protected areas management organization, report in the Amandala, a local newspaper, the first incident in which illegal loggers and xateros from Guatemala opened gunfire on a Belizean multi-agency patrol team. This incident occurred in the Columbia River Forest Reserve and the patrol team that came under attack included Belize Defence Force soldiers, YCT and Bladen Nature Reserve rangers.

Table 19: Volume and Value of Xate Confiscated, 2005 - 2007

Year	Quantity	Value (Bz$)	# of persons Involved
2005	42,872	$857.44	14
2006	2,300	$46.00	10
2007	2,830	$56.60	4

Source: Forest Department, MNRE

2.2.3 Impacts

The impacts of deforestation and legal and illegal extraction of timber and NTFPs extend to Belizean forests and the biodiversity that resides in them as well as the people who are beneficiaries of the goods and services provided to them by these forests. In Belize as in most of the world, the deforestation is a result of land conversion for agriculture. This land conversion then leads to a loss of forest cover and also biodiversity. Farmers and companies that cultivate deforested land initially experience economic returns from cultivated products. However, in the long run, erosion and soil degradation occur if the land being cultivated is given no time to recover and regain nutrients or is located in unsuitable areas such as hillsides and mountains. Degraded soils require more

intensive farming with the use of increased amount of fertilizers, pesticides and other chemicals. Eventually, as soils become more degraded farmers have to move on to freshly deforested land. This vicious cycle of deforestation resulting in soil degradation and eventually leading to more deforestation is particularly true for tropical areas such as Belize. It is well documented that once the forest cover is removed from highly productive tropical forests, rapid leaching of nutrients and erosion results in infertile soils and low productivity. Soil degradation can also reach more extreme levels and ultimately result in desertification. This is particularly the case when forests are converted to cattle pastures, the most intense form of land use and the one from which it is hardest to recover soil function. Cattle ranching has been an important agriculture activity and its practice is presently increasing in Belize as more forests are converted for this purpose it is important that Belizeans realize that despite high economic returns for a few, there is a steep environmental price to pay.

Like cattle ranching, deforestation of riparian areas also has significant impacts. Normally these areas act as biodiversity homes and corridors, maintain the conformation of the river, act as natural filters for sediments and sediments and act as protective buffers to the impacts of extreme events such as flooding. However, once riparian areas are removed they result in erosion and alteration of the flow of sediments and water through rivers. Riparian deforestation along the Swasey, Bladen and Trio Rivers has been implicated in the severe coastal erosion being experienced in the Monkey River Village (GUARD Institute, 2007). This demonstrates that deforestation on land eventually has impacts on the coast. The extreme flooding events caused by Tropical Storm Arthur in June, 2008 that affected thousands of Belizeans is a warning call signaling the importance of riparian areas. Damage from this storm was manifested in human fatalities as well as the loss of houses and major infrastructure, such as the Kendall Bridge, causing the disruption of travel and commerce between the north and south of the country. All of this damage has severe economic implications for the country of Belize. After Tropical Storm Arthur it is clear that Belizeans no longer only have hurricane wind and water damage to worry about but also increased flooding events and eventually landslides if the deforestation on hills such as those of the Hummingbird Highway continues to increase.

Legal and illegal extraction of timber and NTFPs has also affected and continues to affect Belizean forests by degrading these. In terms of biodiversity, practices such as selective logging have contributed to declining populations of commercial hardwood species such as mahogany, *Swietenia macrophylla*, and rosewood *Dalbergia,Stevensoni*. It is actually quite common these days to see furniture made from young mahogany being sold commercially. Animal populations are also being impacted. Many people working in the Chiquibul Maya Mountains area, for example, note that these forests are experiencing what is popularly known as the "empty forest" syndrome. An "empty forest" is an area that still has vegetation cover but in which wildlife no longer resides. As previously noted there is evidence of illegal hunting of game species in areas such as the Chiquibul. Box 2 also illustrates how forest loss and degradation can affect biodiversity, in particular jaguars, a charismatic species that in and of itself is a major attraction to the country.

Forest loss and degradation as well as the pressures causing these are also contributing to the increased frequency of fire. Box 3 presents data on forest fires in Belize from 2003-2007, with a clear increasing trend. During the study period, fires have been detected in approximately 33 percent of all of the country's protected areas and fires detected in these areas account for 20 percent of overall fires on average over the study. Forest reserves are particularly vulnerable to fires, and some of them experience burning on a yearly basis. The causes of fire and increased fire incidence in forests include: agricultural fires whether set on purpose or escaped; illegal activities within protected areas, and natural fires such as those caused by lightning. In this sense fire and increased fire incidence is at once a direct impact of forest conversion to agricultural lands, forest loss and degradation.

Box 2: Status of Jaguars in Belize

By: Bart Harmsen, Wildlife Conservation Society

Abundance and distribution

The Jaguar; *PANTHERA ONCA*

Jaguar populations in Belize can be considered healthy compared to neighboring countries. The low human population level in combination with high levels of natural vegetation cover creates a situation that is ideal for a connected jaguar population. Anecdotal evidence shows that jaguars are seen right outside of major urban areas like Dangriga and Punta Gorda. Scientific research on density of jaguars at specific locations, estimates jaguar abundance at the highest levels recorded in Central America (10 jaguars/100km2).

However, these high densities have been recorded in areas with high levels of protection and located in more ideal habitat than generally found within Belize. All of these studied areas are located in flat lowland forests while large tracts of Belize's protected areas consist of rugged steep mountainous habitat. Jaguars are considered not to do well in rugged terrain, preferring the lowland areas. Nothing is known of jaguar densities within these rugged areas but they could potentially be very low, which would reduce the potential total Belizean population levels considerably.

Jaguar densities have been recorded in less ideal areas, like the Mountain Pine Ridge at the much lower levels of 4 jaguars/100km2. Areas with high levels of human hunting can also reduce jaguar populations considerably. The relatively flat areas of the Chiquibul Forest Reserve used to hold a healthy jaguar population of 8 jaguars/100km2 but this has been reduced over the years by excessive hunting of prey species to levels of 4 jaguars/100km2. If these levels of hunting are not checked, jaguar population levels will continue to decrease.

Human activity is greatest in the areas most ideal for jaguars, the lowland areas. Pressure from hunting is highest in these areas as well suppressing jaguar numbers. This means that we have to put a caution on the initial premise of a really healthy jaguar population in Belize. We know densities can be high in ideal conditions but we do not know the exact distribution throughout the country.

Threats and pressures

The main driving force behind the direct threats and pressures on jaguar populations is population growth and the general development that accompanies it. Jaguars can survive in areas with farmland with small pockets of forest around it but they can only survive in such conditions when there is still natural prey available and cover to remain hidden from human disturbance. Jaguars become locally extinct if development in an area reaches a certain threshold and most natural cover is removed or only a minimum level of natural prey is left. These local extinctions mean that the presently continuous jaguar population in Belize gets fragmented into unconnected pockets that have a much higher chance of extinction by themselves due to stochastic events, for example, hurricanes and disease. The main threat of severing connectivity is between the Southern Maya Mountain block and the Northern Selva Maya block. Development will take place along the main highways in Belize and the two blocks are interrupted by the western highway and the hummingbird highway. At the moment jaguars still cross these highways but increased traffic and urbanization will stop this present connectivity with predicted levels of development.

Another main threat is over-hunting of prey species. Development deeper into previous jaguar areas will inevitably increase levels of hunting throughout their range. Many game species are high priced meat species in Belize and considered delicacies. The previously considered impenetrable Maya Mountains, with minimum local hunting, are currently overrun by Guatemalan xateros. These xateros used to enter Belize's forests primarily to harvest the leaves of xate palms but now hunt and harvest other forest products apart from xate and including game species. All edges of other natural areas are frequently hunted by Belizean hunters and recent immigrants. Jaguars and humans both prefer the larger species, peccary and deer. Jaguars can survive on armadillo as part of their staple diet. These small animals seem to be relatively resilient to over-hunting (although more research needs to be done on this). It is however possible that a jaguar can survive on armadillo to sustain itself but cannot sustain a breeding female. A breeding female might need larger species to sustain herself and her offspring since she is simply unable to hunt the number of armadillo necessary to sustain multiple individuals. Lowering levels of the larger game species could seriously suppress breeding and cause local extinctions.

The high overlap of taste in meat between jaguars and humans shows itself in conflict between jaguars and livestock farmers. Jaguars prey on a wild array of domestic animals from chickens and dogs to pigs and cattle. Jaguars will especially resort to these domestic species if their natural prey species are seriously depleted. Depletion of natural prey happens in areas with high levels of human development and this goes hand in hand with increases in domestic animals in the area. The jaguar switches from natural prey to domestic prey. The conflict, although causing considerable economic losses on livestock owners, usually ends with the jaguar getting killed. This situation further lowers potential persistence of jaguar populations in fragmented areas where jaguars might otherwise live at lower densities.

Future of jaguars in Belize

If the threats and processes described above remain unchecked and increase in the manner they have over the years, it can be projected that jaguars will eventually go extinct in the region and Belize. Belize will be the last country where they will go extinct due to much lower level of threats compared to its neighboring countries but it will nevertheless happen. Development and progress can and should not be stopped in Belize but the conservation community should focus and pinpoint the main jaguar strongholds that require protection. These strongholds should form a connected network of areas that not only connect all Belizean jaguars as one population but connect to jaguar populations in neighboring Mexico and Guatemala. The designation of jaguar stronghold areas should be guided by scientific knowledge of jaguar numbers and the potential for connectivity to other areas. The conservation community should also be willing to give up areas for development in favor of a long-term strategy of safeguarding a continuous jaguar population.

Although all larger predators are considered keystone species, meaning they keep prey populations in check by balancing their numbers, the roll of Neotropical carnivores like jaguars is much less important as keystone species. The relatively low densities of prey species, compared to African or North American ungulate populations, are more controlled by natural cycles of limitations of food and disease than predator control. Jaguars are however a symbol of wilderness, an indicator of a healthy ecosystem. They need large tracks of land and enough prey to sustain themselves. If a top predator, like the jaguar, can survive in such a landscape than it means that there is a healthy natural environment. Examples of impoverished natural environments are unfortunately rife in the world. Europe and the Eastern United States lack such large predators due to extermination and impoverished natural habitat. Belize attracts tourists from these areas who want to experience true wilderness since they have lost this at home. All inland tourist organizations indicate a jaguar as a symbol on their brochures. Tourists know they got a low chance of seeing jaguars but they are more than happy to walk around in an area where they know the big cat still prowls. Extinction of these carnivores will have considerable ramifications on the growing inland tourist industry.

Current conservation measures

Belize can boast a high conservation commitment, having a large percentage of its land locked up in some level of protection. Several organizations within the country and outside of the country are committed to the continued survival of jaguars in Belize. The Forest Department of Belize oversees all protected area management and is officially responsible for jaguars in Belize. Several Non Governmental Organizations help manage these areas, with the Belize Audubon Society managing the only protected area strictly set aside for jaguars, the Cockscomb Basin Wildlife Sanctuary. Many organizations study jaguars within Belize with the Wildlife Conservation Society and the Panthera Foundation are spearheading many initiatives within Belize. Virginia Tech University is similarly committed to long term research within the country. These efforts are vital to allow accurate pinpointing of the jaguar strongholds and create a future plan for jaguar survival in the long-term. Connectivity of areas is vital and the potential loss of connectivity along the western highway is currently investigated and a dialogue is started with the government concerning zoning of economic development. The Forest Department has recently got on board a fulltime Conflict Jaguar Coordinator to alleviate conflict for livestock owners trying to use none lethal methods of preventing losses to jaguars. Friends for Conservation and Development is trying with help from the Forest Department and the Belize Defence Force to roll back the incursions by Guatemalans and further efforts are being discussed to control and regulate overall hunting within Belize. Many organizations doing equally good work remain unmentioned in this document but it is the combined and continued effort of all the stakeholders that will ensure that Belizean jaguars stand a good chance of making it into the next century.

Box 3: Fire Trends for Belize (2003-07): Data from Satelite-Based Monitoring

By: Emil A. Cherrington

Water Center for the Humid Tropics of Latin America & the Caribbean (CATHALAC),

Mesoamerica is crucial to efforts at global biodiversity conservation; while the isthmus represents less than a percent of the globe's landmass, by stark contrast, 7% of the world's terrestrial species are found there (Barry 2003). Nevertheless, the region's globally significant biological diversity is vulnerable to climatic events. Year after year, hurricanes, tropical storms, floods, fires and drought ravage the region.

Recognizing that satellite-based technologies can play a significant role in the monitoring of environmental phenomena and response to natural disasters, Central America's governments requested the development of the Regional Visualization & Monitoring System (SERVIR). SERVIR is implemented by NASA, the Water Center for the Humid Tropics of Latin America & the Caribbean (CATHALAC), the Central American Commission for the Environment & Development (CCAD), the U.S. Agency for International Development (USAID), the World Bank, and other partners. SERVIR constitutes a platform for the observation, forecasting and modeling of environmental processes in Mesoamerica and provides information freely to the region's decision-makers and scientists via the Internet (see www.servir.net).

Particularly important to regional environmental monitoring efforts is the influence of fire, which constitutes an especially significant threat to Mesoamerica's biodiversity. In the context of fire monitoring, SERVIR makes much use of the Rapid Response System developed for the Moderate Resolution Imaging Spectroradiometer (MODIS), and the University of Maryland's associated Fire Information for Management System (FIRMS). Flying approximately 705km above the earth on NASA's Terra and Aqua satellite platforms, MODIS can detect fires and other thermal anomalies such as gas flares and volcanic eruptions (Lillesand et al 2004, UMD 2007). MODIS takes snapshots of Mesoamerica about four times daily, allowing for detection of fires occurring at set intervals, when these fires are not obscured by cloud cover or by thick smoke (UMD 2007). This paper is a brief review of the past five years' worth of satellite-based data on fires in the Central American nation of Belize.

Data Pre-Processing

Fire data from MODIS were obtained for Belize through the University of Maryland's Fire Information for Resource Management System (FIRMS). Prior to analysis, however, careful filtering of the data was necessary. While MODIS-Terra has effectively been collecting data since 2000, it was preferable to restrict the study period to the period in which the dual platform Aqua / Terra system was operational. The period of January 1, 2003 through to December 31, 2007 was thus selected. Additionally, the current data archive is a mix of data derived from two differing processing algorithms; these sets of data are referred to as MODIS Collections 4 and 5 (UMD 2007). To negate the likely errors of commission resultant from Collection 4, and to ensure a suitable degree of compatibility between data derived from the two algorithms, only data with high estimated confidence values (at or exceeding 70%) have been selected for this analysis.

Through spatial analysis in powerful geographic information systems (GIS) applications, fire detections can be combined with other data to trace detections, for instance, to which types of vegetative cover were burning. Whether such detections were occurring within national parks and other protected areas can also be assessed. Important caveats to recall are that (i) fires detected by MODIS on any given day are mere subsets of the total fires occurring, representing only 'snapshots' of fires occurring throughout the day, and (ii) clouds or thick smoke occlude fire detections (UMD 2007).

[1] For this reason, many times these are referred to "hotspots" in place of "fires" although the University of Maryland's standard term is "active fire detections."

Results

In the five years between 2003 and 2007, the MODIS sensors have detected over 2,000 fires across Belize (NASA / UMD 2008). For the sake of differentiating the various land cover / vegetation types upon which such fires occur, these are broken out by land cover type in Table 2.3.5 below. The data indicate that over time, the incidence of forest fires is increasing, even as the overall incidence of detected fires is fluctuating. The year 2003 seems to have had the worst fire season, with an estimated 850 fires detected, compared to 2007, which had an estimated 473 fires. The data indicate, in fact, that 2007 had the most forest fires (44.2% of all fire detections), though overall, fires on agricultural lands – likely due to land clearing – represents over a third of total fires detected between 2003 and 2007. While not representing substantial losses of biomass, fires in scrublands and savannas also represent on average a quarter of all detected fires. Some wetland clearings have also been detected, although these represent a very small proportion of detected fires. The MODIS sensor has even detected a number of fires in human settlements.

Table 20: Detected Fires by Land Cover Type [2]

Year	Land Cover Types										Total
	Agricultural		Forest		Scrubland		Wetlands		Settlements		
	N	%	n	%	n	%	n	%	n	%	
2003	361	42.5	254	29.9	204	24.0	28	3.3	3	0.4	850
2004	81	42.6	49	25.8	47	24.7	12	6.3	1	0.5	190
2005	133	31.1	148	34.6	131	30.6	15	3.5	1	0.2	428
2006	47	33.8	53	38.1	35	25.2	3	2.2	1	0.7	139
2007	123	26.0	209	44.2	132	27.9	8	1.7	1	0.2	473

Table 21 illustrates that fire incidence varies geographically in any given year, although in any given year – with the exception of 2007 – the number of fires occurring annually in the Orange Walk district represent the majority of fires occurring (between 25% and 34%, excluding 2007). Fires in Cayo, however, represented a quarter of all fires in the five year period. In any given year, the fires in the Orange Walk, Cayo, Toledo and Belize districts represent some 80% of all fires, with the Corozal and Stann Creek districts and the offshore cayes accounting for less than 20% of fires nationally. The fires in Orange Walk were largely agricultural fires (e.g. burning of agricultural fields) while those in the Cayo district likely represented the clearing of land for agricultural development. From late April to late May 2007, massive fires likewise burned tens of thousands of acres of forest the Mountain Pine Ridge in the Cayo district (CATHALAC/ NASA 2007).

Nevertheless, the fires detected have not been confined to activities occurring on the mainland. In early 2004, in particular, a small but nonetheless alarming number of fires were detected on the Turneffe Atoll. Anecdotal information later suggested that the fires on Turneffe were caused by clearing of mangroves on the Atoll. This therefore illustrates the ability of the technology to serve as an 'eye in the sky' detecting phenomena that might otherwise go unnoticed.

[2] All the fire data presented in the tables were extracted from the MODIS Collection 4 / 5 data obtained from the University of Maryland / FIRMS. Data were filtered in a GIS environment, as described above.

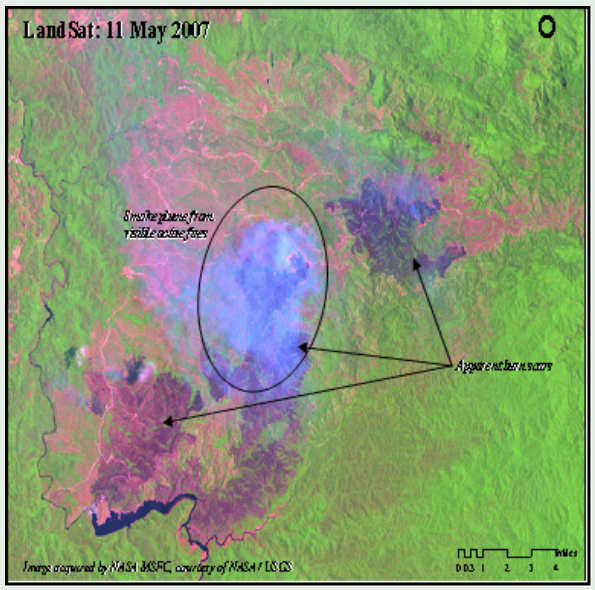
Table 21: Detected Fires by District

Year	Region														Total
	Corozal		Orange Walk		Belize		Cayo		Stann Creek		Toledo		Cayes		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
2003	44	5.2	217	25.5	143	16.8	182	21.4	59	6.9	204	24.0	1	0.1	850
2004	21	11.1	61	32.1	30	15.8	25	13.2	14	7.4	34	17.9	5	2.6	190
2005	24	5.6	115	26.9	67	15.7	110	25.7	36	8.4	76	17.8	0	0.0	428
2006	4	2.9	48	34.5	6	4.3	22	15.8	18	12.9	41	29.5	0	0.0	139
2007	18	3.8	72	15.2	47	9.9	208	44.0	38	8.0	89	18.8	0	0.0	473

In fact, a distinct pattern can be seen with regard to the temporal distribution of fires. The majority of fires occur between March and May of any given year, pertaining to the height and close of the dry season in Belize – both when conditions are most dry and wildfires are likely to break out, and when farmers are likely to be preparing their fields for the onset of the rain. Nevertheless, it bears noting too that a number of fires have been detected outside of the dry season per se, perhaps pointing to the incidence of specific development-related activities.

Table 22: Distribution of Detected Fires by Months

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2003	0	2	201	251	377	15	0	0	3	0	0	1	850
2004	1	4	20	72	44	7	6	35	2	0	0	1	192
2005	3	21	112	198	76	15	4	1	0	0	0	0	430
2006	0	2	12	53	70	1	0	2	0	0	0	0	140
2007	1	5	26	109	308	14	4	2	2	0	1	1	473



In addition to noting types of vegetation affected by fires and the geographic areas in which such fires occur, other trends that can be examined from the MODIS fire data are the threats to protected areas (particularly terrestrial protected areas). The April-May 2007 fires noted previously affected significant portions of the Mountain Pine Ridge Forest Reserve, as illustrated in Figure 2.2.6 below.

Extent of the Mountain Pine Ridge Fires[3] (source: CATHALAC/ NASA 2007)

Looking at the data holistically – as presented in Table 7 – it is, however, noted that overall fires detected in protected areas account, on average, for about a fifth of all fires. MODIS cannot, nevertheless, point out whether those fires are anthropogenic or natural in nature. The year 2005, with its intense drought, saw almost a third of detected fires occurring in protected areas, while 2007 saw almost two fifths of all fires occurring within the bounds of protected areas.

[3] According to the satellite data, the Mountain Pine Ridge fires lasted from April 28 through May 25, 2007 (UMD 2008). Figure 2.2.6 therefore shows the extent of the fires approximately mid-way through the event's duration, and shows the fires actively burning on the morning of May 11, 2007, as well as the smoke produced by the fire. According to the assessment conducted by CATHALAC and NASA (2007) for the Belize Forest Department, some 33,000 acres of the Mountain Pine Ridge Forest Reserve possibly burned.

Conclusion

In summary, the MODIS-based fire detection data indicate that in recent years, the incidence of fires in Belize has varied from year to year, with over 2,000 fires detected in the past five years. Nevertheless, for a country the size of Belize and with significant forest resources and associated biodiversity, the high proportion of forest fires and fires within specially protected zones should be of concern. Fires have been detected in recent years in nearly a third of Belize's protected areas, and this should be a cause of concern for land managers.

It is nonetheless promising that there exist platforms for the remote monitoring of forest fires and other types of environmental disasters. These include the collaborations between FIRMS, the MODIS Rapid Response System and SERVIR. Belize's Ministry of Natural Resources and the Environment is an important stakeholder in the implementation of SERVIR. In its role as a regional resource, SERVIR was able to provide support to that Ministry in the damage assessment of the huge fires which occurred in Belize's Mountain Pine Ridge area in May 2007.

It is therefore hoped that institutions in Belize will further take advantage of the simple and user-friendly satellite-based tools that are now available for monitoring of the environment – tools which were unavailable only a few years ago prior to the establishment of the Regional Visualization & Monitoring System, SERVIR. These tools provide the perspective of an 'eye in the sky' on the environment that would otherwise be unavailable.

2.2.4 Responses

At the institutional level, the Forest Department is the institutional body charged with the management of the country's forests, specifically forests on national lands and forest reserves. As a body it is authorized to issue and regulate licenses on these lands, it is also responsible for administering approximately half of all existing protected areas, and is the focal point for several international conventions including CITES, UNCBD and the RAMSAR convention on wetlands (Forest Department, 2006). The main legal instrument empowering the department is the 1927 Forests Act. The Forests Act is the major piece of legislation that establishes the Forest Department and its mandate, sets the ground rules for issuance of licenses and collection of royalties by the department, and allows the Minister of Natural Resources and the Environment, with technical advice from the Forest Department, to declare forest reserves.

The 1971 Forest Rules, which comprises subsidiary regulations to the Forest Act, were updated in 1990 and provide the main legal instrument supporting sustainable forest management. The Forest Rules provide guidance on what species can be harvested, the manner in which licenses are granted based on sustained or non-sustained yield and the issuance of public notices and a timeframe for public response before licenses are issued (Forestry Department, 2006). In 1995, the Forest Rules were amended specifically to address royalties collected for forest timber. Other subsidiary laws under the Forests Act include the Forest Reserves (Consolidation) Order, the Forest (Protection of Trees) Regulations, the Forest (Export Duty) Order, the Forest Licenses (Delegation of Powers) Order, the Forests (Protection of Mangroves) Regulations, the Application of Act to Private Land, the Powers of Forest Officers proclamation and the Forest Roads Regulations. Other major laws and regulations pertaining to forest management include the 1945 Private Forests (Conservation) Act and the 1962 Forest Fire Protection Act. The Wildlife Protection Act and the National Parks System Act are complementary pieces of legislation to the Forest Act and Rules as they deal with the wildlife species inhabiting Belizean forests and the designation of forested protected areas respectively.

The Forest Department often operates under informal policies since the country's Forest Policy dates back to 1954 and focuses primarily on the establishment, preservation and development of a Forest Estate and particularly ensuring the timber supply (Forest Department, 2006; Colonial Secretary's Office, 1954). The Forest Department realizes the need to formalize instruments such as the Forest Rules into policy and law and furthermore, recognizes the need to integrate existing frameworks such as the National Biodiversity Strategy into this policy and peg the "current spread of sustainable development values attached to forest management" in a forest policy for the country that is cross-sectoral (Forest Department, 2006). This policy will address issues such as poverty alleviation, community involvement, ecotourism and ecosystem goods and services, including NTFPs and environmental services making the policy relevant to the pressures and potential opportunities in the forest sector. Ultimately, legislation concerning the use, development, conservation and sustainable management of forests would have to be revised.

The Forest Department currently has funding to support the development of such a cross-sectoral forest policy through a National Forest Programme Facility grant (Percival Cho, pers. comm.). The Facility is hosted by the Food and Agriculture Organization (FAO) and has a steering committee of multiple stakeholders including stakeholders of the beneficiary countries and international partners and funding agencies. The grant that Forest Department has from the Facility allows the department to grant money to stakeholders to implement projects that will gather data that will directly inform a revision of the old Forest Policy. These projects can be in relevant areas such as extraction of NTFPs, community forestry including involvement of indigenous groups in forest management, plantations and agro-forestry, and riparian and mangrove forest management. One of the main goals of the Forest Department for the revision of the Forest Policy is that the revision be based on scientific data and wide consultation. A clear and updated forest policy based on the inputs of stakeholders would be the first step towards other actions that are also part of moving Belize towards the institutionalization of a National Forest Programme. These actions include amendments or changes in forest legislation, development and implementation of action plans and intersectoral plans, creation of partnerships, information sharing, institutional reforms and capacity building for forest management and the creation of the appropriate financial mechanisms.

Despite the lack of a formal updated forest policy,

the Forest Department currently uses informal policies and the National Biodiversity Strategy and Action Plan (NBSAP) as the policies to address forest conservation and management directly (Forestry Department, 2006). The National Biodiversity Strategy is a fairly comprehensive document that "provides a long term framework for Belize to conserve and sustainably use its biological resources" while the Action plan is "a guide for the implementation of actions necessary for achieving the objectives identified in the Biodiversity Strategy" (Jacobs and Castañeda, 1998a; Jacobs and Castañeda, 1998b). The strategy addresses the vast majority of threats to biodiversity including everything from deforestation to inappropriate legislation but one of its major points of emphasis is community participation and involvement so that communities are primary beneficiaries of conserving biodiversity, as a crucial factor to the implementation of the plan.

An example of an initiative in which the level of community involvement advocated by the NBSAP plays a primary role is the Toledo Healthy Forest initiative (THFI). The Toledo District, with 79% of its population considered poor and 56.1% of its population considered indigent, is the district with the highest rates of poverty by far (National Human Development Advisory Committee, 2005). Therefore, any initiative addressing resource use in the district must necessarily seek to address the poverty issue. Indeed, the vision of the THFI is to alleviate poverty and empower the people of Toledo through their active involvement in sustainable forest management. The THFI hopes to achieve the perpetuity of forests and forest resources in Toledo and serve as model of sustainable forest management and a community forest approach for the rest of the country. The initiative hopes to accomplish this by acting as "a coordinating mechanism that promotes an integrated, participatory, multi-sectoral and multidisciplinary approach to sustainable forest management" (Toledo Healthy Forests Initiative Steering Committee, 2006). The steering committee for the initiative is comprised of 12 members with each of four sectors, Government, Communities, NGO's and Industries equally represented. The use of advocacy to promote sustainable forest management and obtaining funding for the initiative are among the general aims of the committee. In addition, the committee hopes to achieve certain objectives in a number of more specific categories including forest licenses, in particular their monitoring and evaluation, forest sector development, partnership building, poverty alleviation and operations (THFI steering Committee, 2006). However, despite the strong initial support by the Forest Department and other stakeholders for this initiative, the recent court rulings granting customary land rights to the Maya people of the villages of Conejo and Santa Cruz has placed this initiative on hold, especially as there is currently a question of whether such a ruling would be extended to all the Maya of the Toledo District. The Forest Department has to now determine how the THFI initiative might need to be adjusted given the new legal context of who owns the forests in Toledo but the granting of customary land rights to the Maya of Toledo could actually present a good opportunity for much more active participation and ownership of forest management by local communities.

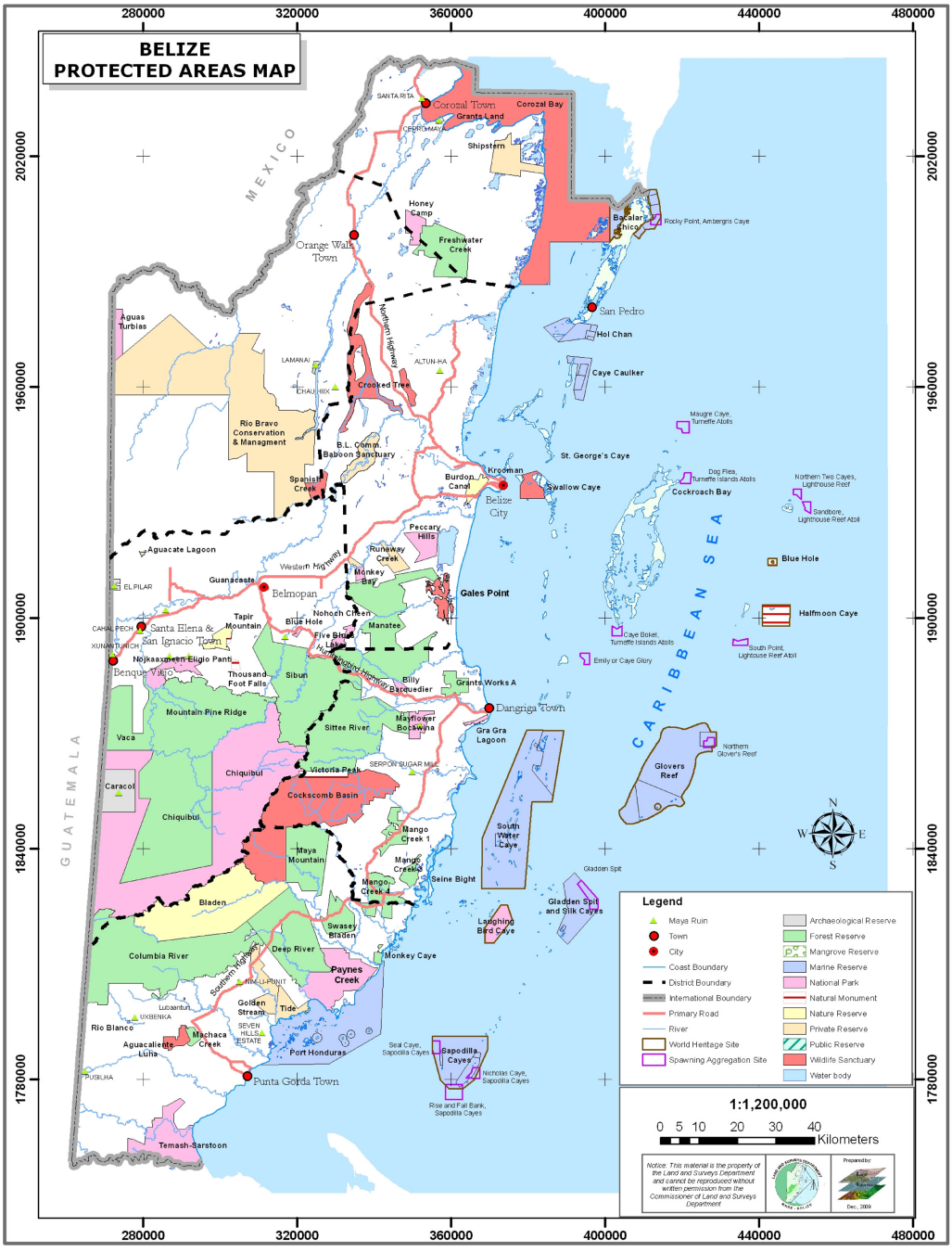
Another example of an initiative taken up by the Forest Department based on informal policy and aimed at better managing forest resources is the change in the conditions under which logging concessions are given. Since 2005 there has been a shift from granting short term logging licenses to granting long term 30-40 year licenses. Under these long-term licenses concessions are given for a sizable area which is subdivided into blocks. Each block is only harvested once every 30-40 years allowing for recovery of the forest. The long term licenses also require that logging prepare a management plan for their concession area and practice reduced impact logging (RIL) techniques to minimize the impact to forests and its biodiversity; both of these requirements are a standard part of sustainable forest management. Current RIL practices include doing an inventory of the trees in the blocks that will be logged, planning access roads, minimizing the skidding time of machines in order to reduce soil compaction and microhabitat alteration and directional felling of trees to minimize impact on other trees and seedlings. Currently, four companies, Bull Ridge, Pine Lumber, Wood Depot and Gomez Brothers hold long-term logging licenses for the Chiquibul Forest Reserve, the Mountain Pine Ridge, the Southern Coastal Plains and the Deep River Forest Reserve, respectively.

Another practice of sustainable forest management that some of logging companies in Belize have already put into action is certification of the timber they harvest. Certification for sustainable forest management is done by independent, third party certifiers who are accredited by the Forest Stewardship Council (FSC). Certification can be used as an incentive for logging companies to manage

forests sustainably as it allows them to transfer some of the costs of sound management to the consumer. At the same time, certification allows the consumer to make environmentally responsible choices when it comes to the timber products they purchase. Although the certification process itself is not a guarantee of sustainability it does provides independent evidence of good management that hopefully leads to sustainability (Montagnini and Jordan, 2005). That said, certification schemes are very expensive, as they require contracting an accredited certifier and a big investment up front and in countries such as Belize these issues are compounded by the lack of capacity for certification. Currently in Belize, Smartwood, an accredited certifier, certifies pine harvested by the Pine Lumber Company and hardwoods harvested from the Rio Bravo Conservation and Management Area (RBMCA), a private protected area managed by Programme for Belize (PfB). In the future, more logging companies are expected to move towards certification especially as the paradigm shift to sustainable forest management continues and the country builds upon initiatives such as the granting of long term logging licenses.

A major response to the protection of forests in Belize is the designation of protected areas as previously discussed in this section. The country has over 100 protected areas, representing 22.8 percent of its national land, and 35 percent of its land territory (Appendix 1 and 2). Figure 42 shows a map of these country's protected areas. These include 19 Forest Reserves, 17 National Parks, 3 Nature Reserves and 7 Wildlife Sanctuaries among others (Table 15, Map).

Map 3: Protected Areas Map of Belize, 2009



Box 4: The National Protected Areas Policy and System Plan

In October 2003, the Ministry of Natural Resources and Environment in collaboration with the Ministry of Fisheries and Agriculture and the Ministry of Tourism appointed a task force comprised of representatives from the Fisheries Department, the Forest Department, the Belize Tourism Board (BTB), the Protected Areas Conservation Trust (PACT) and the Association of Protected Area Management Organizations (APAMO) to develop a plan and policy for the establishment and management of Belize's protected areas system. Many local and foreign non-governmental institutions and organizations provided the financial and technical support that led to the formulation of this National Protected Areas Policy and System Plan (NPAPSP), which represents the consensus views of protected area and particularly, protected area management stakeholders. The NPAPSP was completed in November 2005; approximately two years after its formulation had been commissioned. The National Protected Areas Policy (NPAP) was approved by Cabinet in December 2005 while the National Protected Areas System Plan (NPASP) was approved by Cabinet and presented to the public in January of 2006 (NPAC, 2007).

The National Protected Areas Policy is "the key statement on the role and management of protected areas" in order to create a protected areas system that incorporates all sites under a framework that allows them to function cohesively and coherently and that allows Belize to meets its obligations to international agreements such as the Convention on Biological Diversity (CBD) to which the country is a signatory (MNRE, 2005; NPASP Operational Framework, 2006). According to the MNRE (2005), the policy's main goals are for the protected areas system to:

- "be comprehensive" through the inclusion of representative examples all ecosystems found in Belize but in particular those of economic or scenic value and those that provide important environmental services or critical habitats for species of biological or economic interest,
- "be integrated" with national and regional development plans and approaches promoting biological connectivity,
- be economically, socially and ecologically sustainable through the optimization, equitable distribution and awareness promotion of socio-economic benefits derived from the system "as far as these are compatible with maintaining biodiversity values and sustainable resource management",
- be managed in a transparent fashion through delivery of "measurable benefits" and through public participation including instances when protected areas are established, modified or de-reserved within the national network.

The role of the system plan is to implement the above policy for the national protected areas network through strategic actions that include: the formation of a National Protected Areas Commission (NPAC) that would enable coordinated action as the protected area system develops, revision of existing laws "to give legislative underpinning to the plan", provision of support services to protected areas managers in order to make the system more cost effective and make management more effective, filling in the gaps in the network in order to make its coverage comprehensive and simplification of the system through consolidation of "adjacent protected areas into single, multi-zoned management units". According to the plan (MNRE, 2005) these strategic actions would be accomplished under the four objectives below:

- "an enabling administrative structure is established for policy implementation",
- "the national protected area system is functional",
- "the national protected area system is comprehensive",
- "the national protected area system is consolidated and simplified".

It was not until November 2007, a year after the completion of the NPAPSP that the NPAC was officially commissioned by the Minister of Natural Resources and the Environment. This was primarily due to outcries that formation of the Commission was long overdue from non-governmental entities such as APAMO, which at the time were opposing the sale, and hence de-reservation by Government

of a portion of the Bacalar Chico National Park and Marine Reserve, one of the seven protected areas comprising Belize's only world heritage site. The NPAC is comprised of 14 voting representatives from both governmental and non-governmental agencies including the: Fisheries Department, Forest Department, BTB, Agriculture Department, Institute of Archaeology, PACT, University of Belize (UB), Belize Association of Private Protected Areas (BAPPA), Indigenous Peoples for Conservation Alliance (IPCA), National Federation of Community Based Co-Managers and APAMO. In addition there are three non-voting members in the Commission including a representative of the Lands Department, a representative of the Ministry of National Development and the MNRE Legal Counsel (Terms of Reference for NPAC, 2007).

The NPAC is a standing commission whose main purpose is to coordinate the implementation of the NPAPSP guided by the system plan and an operational framework that outlines the principal themes and areas of action for implementation and which was drafted through a consultancy "commissioned and funded by the Nature Conservancy" (TNC) (NPASP Operational Framework, 2006; NPAC, 2007). In addition the NPAC is responsible for advising "the Ministers responsible for protected areas in matters pertaining to the implementation of the NPASP", promoting "efforts to incorporate the NPAP in the plans, strategies and operations" of all relevant governmental and non-governmental entities, oversee the revision and consolidation of the relevant protected areas legislation, and identify funds for implementation of the NPASP among other duties (NPAC, 2007). Currently the Commission has been able to secure a grant from the Global Environmental Facility (GEF) under the Programme of Work on Protected Areas (PoWPA) to carry out a complete economic valuation of the Maya Mountain Massif (MMM) and to develop a financial sustainability plan for the protected area system and is seeking additional funds to implement other activities under the operational framework of the NPASP. The NPAC has also recently obtained a verbal commitment of support for the NPASP and its implementation, and the work of the NPAC from the Deputy Prime Minister and Minister of Natural Resources and the Environment. At this point in time it is crucial for the NPAC to solidify its position as the primary vehicle to maintain the Ministers responsible for protected areas informed on the implementation of the NPASP, the needs and benefits of protected areas and the impacts of decisions made at the national level on protected areas. It is important that as soon as possible this commission receive legal status in order that it can work with the Ministries responsible for protected areas in formulating a transparent process for the reservation, de-reservation or modification of protected areas within the protected areas system of the country. In addition, NPAC needs to truly start liaising with all protected area stakeholders on the implementation of the NPASP and mainstreaming the benefits of implementing the NPASP in order to garner support for its work which includes such activities as the consolidation of the protected areas management at the national level under a national parks service.

2.3 Coral Reef Decline

2.3.1 Importance of Coral Reefs

Coral reefs are among the most biologically diverse and productive ecosystems on earth. In the Mesoamerican Region they are also structurally diverse (McField and Kramer, 2007). The coral reef systems of Belize comprise what is perhaps the most significant portion of the Mesoamerican Reef (MAR) as they include the longest barrier reef in the Western Hemisphere, which extends 280 km along the coast of the country and covers an estimated 1,400 km^2, numerous lagoon patch reefs, fringing reefs, and three of the four off-shore atolls in the North Western Caribbean (McField and Bood, 2007).

Coral Reef

The most tangible manner in which coral reefs benefit humans is through the provision of livelihoods from fisheries and tourism activities. These include not only the extraction of fish for subsistence and nutrition but also employment in the export fishing industry and as tour guides and tour operators in the tourism industry. Burke and Maidens (2004) estimated net annual revenues of US$310 million from coral-reef associated fisheries and US$2.1 billion in 2000 from dive tourism in the Caribbean region. In our Central American region, Gorrez and McPherson (2006) estimated that the livelihood of more than one million people depends directly on a healthy MAR.

Table 23: Estimated Economic Contribution of Coral Reefs and Mangroves to the Belizean Economy

	Coral Reefs	Mangroves	Combined Contribution
Tourism	US$135-176 m	$60-78 m	$150-196 m
Fisheries	US$13-14 m	$3-4 m	$14-16 m
Shoreline Protection	US$120-180 m	$111-167 m	$231-347 m

Source: World Resources Institute, 2008

In Belize, both the fisheries and tourism industries are significant contributors to the national economy of the country and both are intimately tied to the health and proper functioning of coral reefs and their associated ecosystems such as mangrove forests. In 2006, excluding white farm shrimp, BZ$66.3 million of marine products were exported, accounting for 12.4 percent of the country's total exports in that year (SIB, 2008a). In 2008, the fishing industry accounted for 3 percent of the country's GDP and tourist expenditure totaled BZ$398.8 million, accounting for 16.4 percent of GDP (BTB, 2008; SIB, 2007). A recent study by the World Resources Institute (WRI), focusing specifically on the economic contribution of coral reefs and mangroves to Belize, estimated the contribution of coral reefs to the country's fisheries at US$13-14 million and to tourism at US$135-176 million (Cooper et al., 2008). Table 23 below summarizes these figures and the overall results of the WRI study in 2008 are summarized in Box 5: COASTAL CAPITAL: Belize - The Economic Contribution of Belize's Coral Reefs and Mangroves below.

An equally important ecosystem service for human well being that is provided by coral reefs is coastal and shoreline protection through the dissipation of wave and storm energy. In the Caribbean, Burke and Maidens (2004) estimated that reefs provide US$700 million to US$2.2 billion per year in shoreline protection services. Based on the percentage of Caribbean reefs located in Belize and extrapolating from Burke and Maidens (2004), McField and Bood (2007) estimated that the value of shoreline protection in Belize is between US$35 - $100 million per year. This value has been shown to be much higher, between US$120-180 million, in a recent study specific to Belize (Cooper et al., 2008 and see Table 23 and Box 5).

Other overlooked goods and services that coral reefs provide include the provision of building materials such as sand, and a wealth of biodiversity, which contribute to the healthy functioning of the reef, its capacity to supply a healthy fishery, its beauty and is also a potential source of pharmaceutical compounds. McField and Bood (2007) estimated that the total value of yearly goods and services provided by coral reefs in Belize is at least US$250 million. This figure has been corroborated by Cooper et al. (2008) who estimate the combined value of the economic contribution of coral reefs to Belize, through tourism, fisheries and avoided damages from shoreline protection, at US$268-370 million (see Table 23 and Box 5).

WORLD RESOURCES INSTITUTE

Box 5: COASTAL CAPITAL: Belize The Economic Contribution of Belize's Coral Reefs and Mangroves

WWF

By: Emily Cooper, Lauretta Burke and Nadia Bood
World Resources Institute and World Wildife Fund

From 2006 – 2008, the World Resources Institute (WRI) worked with the World Wildlife Fund (WWF) and many local partners to assess the economic contribution of coral reefs and mangroves to Belize. The country's coral reefs and mangrove-lined coasts provide critical protection against erosion and wave-induced damages from tropical storms; they have supported artisanal fishing communities for generations; and they stand at the center of a vibrant tourism industry, drawing snorkelers, divers and sport fishermen from all over the world. This study looked at only three out of the many culturally and economically valuable services provided by these ecosystems in Belize. Even within this narrowed scope, we find that the country's coastal resources are extremely valuable. Findings include:

Tourism: In 2007, reef- and mangrove-associated tourists spent an estimated US$150–$196 million on accommodation, reef recreation, and other expenses (equal to 12–15 percent of GDP). Additional indirect economic impacts, including locally manufactured materials that support the industry, contribute another US$26–$69 million per year.

Tourists spent between US$30–$37 million on sport fishing and diving alone. These high-value industries require the presence of healthy reefs. Belize's cruise industry, by comparison, contributes an estimated US$5.3–$6.4 million in reef- or mangrove-related taxes and revenues to the country per year. Hence, while the negative impacts of cruise tourism affect coastal and marine areas disproportionately, these areas reap very little economic benefit from the industry.

Fisheries: Fishing is an important cultural tradition, as well as a safety net and livelihood for many coastal Belizeans. Annual economic benefits from reef- and mangrove-dependent fisheries are estimated at between US$14–$16 million.

Shoreline: Reefs and mangroves also protect coastal properties from erosion and wave-induced damage.

Protection: Emergent reefs, such as the Belize Barrier reef, can mitigate over ¾ of wave energy. Belize's coral reefs provide an estimated US$120–$180 million in avoided damages per year. Coastal mangroves offer protection worth an additional US$111–$167 million per year.

The combined value of reef- and mangrove-related fisheries, tourism, and shoreline protection in Belize is estimated to be US$395–$559 million per year. Mangroves provide an estimated US$174–$249 of this total - some independently, and some through the important supporting roles they play for nearby coral reefs.

Belize's government, NGOs, and private sector are increasingly promoting the importance of coastal ecosystems. Nevertheless, the amount currently invested in protecting Belize's coral reefs and mangroves is very small when compared to the contribution of these resources to the national economy.

Marine Protected Areas:
Belize's Marine Protected Areas (MPAs) generate economic benefits well beyond the amount invested in their protection. MPAs recorded almost 115,000 visitors in 2007. Reef-related tourism at Glover's Reef Marine Reserve, one of several MPAs that we assessed individually, contributes an estimated US$3.9–$5.9 million per year to the economy. Commercial fishing inside the reserve contributes an additional US$1 to 1.5 million. Typical government spending per MPA, by comparison, is US$100,000. Without greater support for monitoring and enforcement, Belize's MPAs will not be able to provide this level of economic benefits into the future.

2.3.2 State of Belize's Coral Reef Systems

Historically, Belize's coral reefs have been subjected to several human-induced and natural pressures. Fishing and pollution are examples of threats to the reef that result from human activities while coral bleaching, coral diseases and hurricane storms are often natural phenomena. Today, with global climate change having been accepted as a reality (UNEP, 2007), the distinction between human-induced and natural pressures on coral reefs has become less certain. Currently, Belize's coral reef systems are experiencing pressures whose cumulative impacts will become increasingly difficult to assess as they are compounded by threats in the form of natural phenomena. These natural phenomena are potentially being exacerbated by human-induced global climate change. The state of Belize's coral reefs can only be examined in light of these variables.

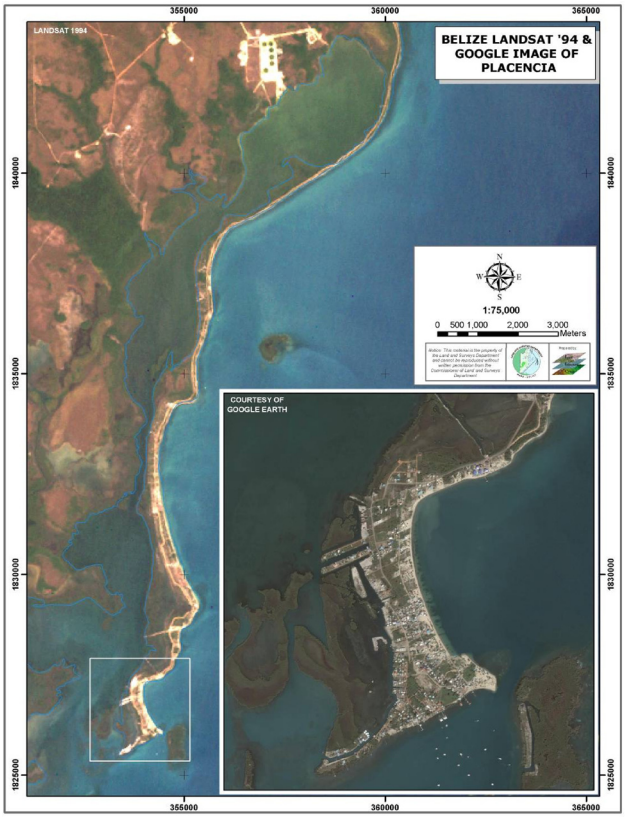
2.3.2.1 Overfishing

Over fishing has been identified as the predominant pressure on coral reef ecosystems in the Caribbean, threatening 60 percent of coral reefs in the area (Burke and Maidens, 2004). McField and Bood (2007) agree that over fishing is a significant pressure on coral reefs in Belize particularly since many of the reef fish species being removed until recently were ones which "fulfill critical roles in the ecosystem". Parrotfish, a well-known example of such fish species, are critical in controlling the growth of macro algae on the reef along with other grazers or herbivores. These macro algae might otherwise out compete with the corals causing coral reef decline. The state of the country's fisheries including the demise of top predators such as sharks (see section 2.5 below for more details on shark population decline), the severe decline in large fishes such as the various types of grouper, and the now persistent fishing of species traditionally not considered good for eating are discussed in section 2.5: "Fisheries Decline".

2.3.2.2 Unsustainable Coastal Development

Unsustainable coastal development is another major threat being experienced by the coral reef systems of Belize. Belize's coastline, particularly in sensitive ecological areas such as the Placencia Peninsula and many of the country's mangrove islands, are experiencing unprecedented infrastructure development. Figure 43 below shows a satellite image showing the development in the Placencia Peninsula. Beach erosion and sediment run-off into coral reefs from the loss of mangroves and other coastal vegetation are among the primary adverse impacts. As discussed in more detail in section 2.4: "Coastal Degradation" below, much of this infrastructure in sensitive areas has been fueled by the tourism industry and the budding of an industry meant to attract foreign retirees to Belize. Other direct pressures on the coral reefs of Belize induced by coastal development are in the form of marine dredging operations that destroy sea grass beds and wetlands which normally function to trap sediments, pollutants and sewage waste runoff from improper waste disposal into the sea.

Map 4: Satellite Image Showing Comparative Development in the Placencia Peninsula



Source: Landsat and Google Earth

2.3.2.3 Land-based threats

Although McField and Bood (2007) mention that the flow of the currents in Belize's coastline helps to maintain the sediments delivered to the coast away from the coral reefs, land use changes, and in particular deforestation of riparian vegetation, can result in erosion that produces

excess run-off and sedimentation into the coast. In addition to sedimentation from various land use practices, contamination with nutrients and pollutants, such as pesticides, from the agriculture and aquaculture industries also threatens coral reefs. Ultimately, sediments and nutrients slow down the growth of corals by increasing the cloudiness of the water and diminishing the light levels needed for coral growth. Burke and Maidens (2004) estimate that approximately a third of Belize's reefs are under high threat from sedimentation and inland pollution. This is particularly prevalent in the steeper south, which has the additional threat of trans-boundary pollution and sedimentation. This is also true for metropolitan Belize City.

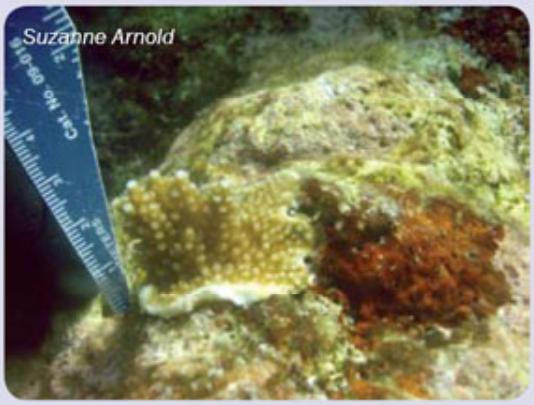
2.3.2.4 Natural pressures

In terms of natural pressures, Belize's reefs have been subjected to everything from hurricane disturbance, coral bleaching, loss of grazers, such as *Diadema urchins*, to disease. McField and Bood (2007) point out that the earliest expedition to Belize's reefs and the first descriptions of reef zonation and dominant species identification occurred after Hurricane Hattie of 1961. Since then, Belize's coral reefs have been subjected to nine major hurricanes, from Hattie to Dean in 2007. *Acropora* spp. coral disease also affected the reef in the late 1970's to mid-1980's. It was in the middle of this that a *Diadema* urchin die-off occurred and the effects of both this die-off and the coral disease have had continuing ecological effects on Belize's reefs, such as a decline in percent coral cover (McField and Bood, 2007). Five major coral bleaching events in 1995, 1998, 2005, 2008 and 2009 have followed the *Diadema* die-off and the *Acropora* coral disease making it difficult for the reefs to recover.

2.3.2.5 Coral Cover and Health in Belize's reefs

It is very difficult to assess to what extent anthropogenic pressures have contributed to the decline in the health of Belize's coral reefs compared to the above "natural" pressures". But there is data for Belize that shows a decline in the health of the reefs. Percent cover of live coral is one indicator of reef health for which data has been collected at multiple sites in Belize. The national average for coral cover, based on the 2006 WWF-TNC Rapid Reef Assessment of over 140 sites in Belize was below 12% (McField and Bood, 2007). This amount is considerably below the Caribbean average of approximately 25% based on data from the Atlantic and Gulf Rapid Reef Assessment Database 1999-2004 (www.agrra.org).

Coral Recruitment



Scientists study recruitment, a key determinant of future reef success, by counting small stony corals. This staghorn coral recruit was spotted near Carrie Bow Caye, Belize.

Source: Healthy Reefs for Healthy People

Additionally, specific data for patch reefs at Glover's Reef indicate that in 1971, percent coral cover at in this area was as much as 80 percent. This figure decreased to 20 percent in 1996 (McClanahan and Muthiga, 1998) and to as little as 13 percent in 1999 (McField and Bood, 2007). The latest data from the Wildlife Conservation Society for patch reefs at Glover's indicates a figure of 16 percent coral cover in 2009 (Muthiga and McClanahan, 2009) indicating that new regulations protecting reefs (see section 2.3.4 below for more detail on regulations) may be having a positive recovery effect, at least within protected areas.

However, percent coral cover is only one of several indicators of reef health. Therefore, in order to get a more

Coral Mortality

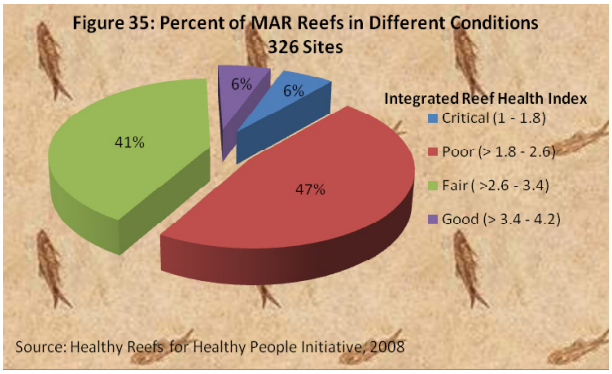
About 40% of this mountainous star coral colony is recently dead (white area) due to white plague disease.

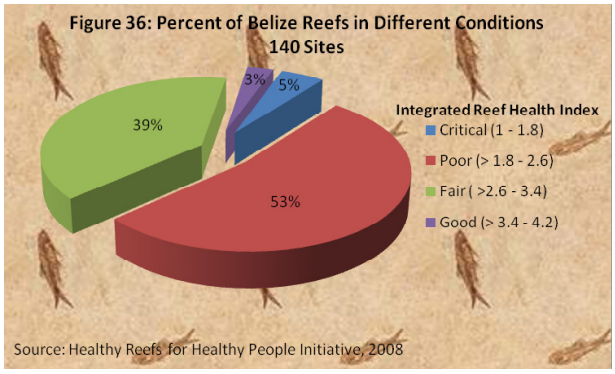
Source: Healthy Reefs for Healthy People

accurate picture the Healthy Reefs for Healthy People Initiative produced an Eco-health Report Card for the Mesoamerican Reef (MAR), based on an Integrated Reef Health Index that incorporated seven indicators of reef health. The Healthy Reefs for Healthy People Initiative assessment done to develop the Report Card compared over 330 reef sites throughout the region. The findings showed that over half (53%) of the region's reefs are in poor or critical condition, with only 6 percent in good condition and none ranked as very good (Figure 35). A large percent (41%) were in fair condition and could easily change for better or worse depending on management interventions. Based on the assessment done by the Healthy Reefs for Healthy People Initiative, the breakdown for the condition of Belize reefs is similar to that of the regional perspective (Figure 36) (Healthy Reefs Initiative, 2008).

2.3.2.6 Conclusion

The pressures on Belize's reefs will continue to increase as the warming of sea temperatures due to global climate change will only intensify "natural" stressors on the reef such as hurricanes, coral bleaching and sea water acidification. The effects of climate change on the reef, its role as an emerging environmental issue in Belize and WWF's initiative to promote adaptation to climate change are discussed in Box 6 across.





Box 6: Enabling Resilience of Social and Coastal Ecological Systems to Global Climate Change Through Adaptive Management in Belize

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In its Fourth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) concluded that the globally averaged surface temperatures increased 0.74 ± 2°C between 1906 and 2005. This trend is expected to persist, with a 1.8 to 4°C warming predicted for the current century. Warming will vary by region and be accompanied by significant changes in local precipitation, sea level rise and changes in the frequency and intensity of some extreme events. The IPCC estimates that approximately 20-30% of plant and animal species are likely to be at increasingly high risk of extinction as global mean temperatures exceed a warming of 2-3°C above pre-industrial levels. Climate change impacts will be felt most severely on fragile ecosystems and the world's poor. During this century, the resilience of many ecosystems (their ability to adapt naturally) is likely to be exceeded by an unprecedented combination of changes in climate and in other global change drivers (especially land use change and overexploitation). Yet these impacts will not be distributed or felt uniformly as those "with the least resources have the least capacity to adapt and are the most vulnerable." The poor are more vulnerable than the non-poor because of their high dependence on natural resources for their livelihood and well-being, and they have limited capacity to cope with variability and extremes.

Climate change will impact natural and human systems, altering the productivity, diversity and functions of many ecosystems and human livelihoods around the world. For poor natural resource-dependent communities, climate change will compound existing vulnerabilities. Settlement on marginal or unstable lands already heightens exposure to climate hazards and heavy dependence on ecosystem services can place a community's welfare at the mercy of environmental conditions. As the availability and quality of natural resources decline, so will the security of livelihoods dependent on such resources.

With climate-related impacts already being observed in the wider Caribbean region and the Central American region already considered a locale to experience increased vulnerability to extreme events (IPCC 2007 Report), there is an urgent need for adaptive response measures. Many natural systems, on all continents and in some oceans, are being affected by regional climate changes, particularly temperature increases. At the same time, there are currently very few studies establishing the effectiveness and costs of climate change adaptation options in ecosystems and although there are many studies that stress adverse impacts of climate change on biodiversity, few offer comprehensive appraisals of adaptation options to deal with declining biodiversity. Survival of ecological systems and processes, and the human social structures dependent on such, will depend greatly on whether they can adapt and continue to function under the new conditions.

As climate change affects biodiversity, it also affects people, with Belize being no exception. The Belizean nation, for example, relies greatly on its natural environment for national economies as well as local livelihood needs. The country's high biodiversity is recognized and draws interest from those that wish to protect it but makes it also highly attractive for large scale economic development ventures. Belize's natural environment already sustains a booming tourism, agricultural and industrial sector as well as sustains the livelihoods of numerous coastal and inland communities. Specifically, Belize's coral reefs and coastal areas support two main economic generators (tourism and fisheries) making it a prime target for economic development and making its conservation and effective management an ultimate priority.

The health and integrity of Belize's coastal ecosystems are under increasing threat due to varied anthropogenic activities that will undoubtedly be compounded in the face of climate change. Threats include declining or depleted fisheries stocks, habitat degradation or loss, declining water quality, among others. Whether be it directly or indirectly, the Belizean populace relies heavily on this nation's diverse coastal/marine resources. For instance, a significant portion of the population's livelihood and sustenance is intricately linked to reef systems. This has propelled population density escalation in coastal areas due to increased migration by individuals seeking financial opportunities and a better quality of life from growing business and employment opportunities in the tourism and fisheries sectors. This chain effect has resulted in an increased clearance of coastal mangrove buffers, encroachment into vulnerable low-lying areas, and other technically unsound development practices that are likely increasing coastal ecosystems' and human's vulnerability to natural disasters, including those associated with climate change.

It is forecasted that Belize's coastal resources and populace will be subjected to increasing threat from global climate change, with more frequent coral bleaching events and potentially more frequent and violent storms projected. The reefs have already been considerably impacted by the 1995 and 1998 mass bleaching events, which both coincided with elevated sea temperatures and calm seas (well known promoters of bleaching) and a number of storms events. Hurricanes are fueled by warm sea surface temperatures and have had devastating ecological, economic and human-health related impacts within the country. Under continued changing climatic conditions, it is projected that the frequency of intense storms will increase.

Climate change will indubitably compound impact to this already vulnerable nation. Increased frequency and intensity of mass bleaching incidences and storm events, sea level rise, and lowered ocean pH are some of the major impacts of climate change on dependent resources. All have contributing disastrous effects on vital biological communities, and human properties, livelihood and way of life. Coral reefs and associated habitats, for example, offer substantial socioeconomic benefits via fisheries and tourism economies. However, under continued impact from climate change, their ecological integrity, and the goods and services they provide, are likely to be compromised. The predicted increase in the frequency and severity of coral bleaching events (related to sea temperature increases associated with global climate change) within this region poses a major threat to these critical resources and the livelihoods, sociocultural and physical benefits dependent upon them. Hence, if the social and ecological systems within Belize are to cope under aforementioned impacts, wise use and interaction with resources are critical as well as measures to foster resilience (ability to withstand shocks and surprises and revitalize itself if suffer damage) within both natural ecosystems and society.

It has been suggested that building resilience into both human and ecological systems might be the best way to cope with unknowable risks or future surprises. To do this, however, Belize will need to better understand its response capacity to climate impacts and fully accept identified strategies that can allow for resilience building. Populations and local communities will need to enhance their response capacity to face future impacts that are likely to lie outside their experienced coping range. Furthermore, however challenging it may be at the local natural resource management and national agreements and actions scales, it would be wise to promote adaptive capacity in the context of sustainable development objectives. Explore response measures that are holistic; that consider both integrated conservation and development concepts. Adaptive management, herein referred, is a means of responding to expected or experienced impacts associated with changing climatic conditions to reduce their degree of effect or capitalize on new circumstances. Both 'adaptive management' and 'resilience building' are concepts strongly tied to the principle of sustainable response.

World Wildlife Fund-Central America's strategy to build resilience to climate change within Belize is focusing on elements such as social and ecological systems' vulnerability reduction, social networking, and capacity building within the process of how to build resilience in both social and ecological systems; including coastal

communities, coral reefs and mangroves. Efforts thus far are being focused on comprehensively assessing the status of reefs and identifying healthy and potentially resilient reef systems, working with partners to advocate for conservation and management of identified healthy/resilient reefs, and working with coastal communities to identify locally based strategies to promote resilience of reefs and mangroves, and adaptation of community to the impacts of climate change. At local levels, adaptation measures are being identified and implemented through a participatory effort with community members. Such measures include mangrove restoration and mangrove clearance avoidance campaigns (as a means for facilitating shoreline stabilization), updating of community planning documents to include climate change variables, among others. Pilot mangrove restoration initiatives along the Placencia Peninsula and Lagoon, for example, have been carried out (and currently still ongoing), with mangrove propagules (seedlings) planted in areas associated with anthropogenic nutrient loading for nutrient and sediment retention at shrimp farms, and restored (replanted) in developed commercial and residential areas where they had been previously removed (including along seawalls). We have also been actively raising public awareness of the need for mangrove habitats and enlisting support from local stakeholders to use mangrove friendly techniques for landscape building and restoring mangroves wherever possible. Additionally, we have collaborated with the World Resources Institute (WRI) to carry out a national economic valuation of Belize's reefs and mangroves based on benefits derived through fisheries, tourism and shoreline protection to lend support for the great need for conservation and sustainable use of these resources. This study found that Belize's reefs and mangroves are extremely valuable. The combined value of reef- and mangrove-related fisheries, tourism, and shoreline protection in Belize is estimated at US$395–$559 million per year. Mangroves provide an estimated US$174–$249 million of this total, some independently, and some through the important supporting role they play for nearby coral reefs. As these resources become increasingly threatened, it is critical to recognize the value they provide, and to incorporate these values into decision-making.

Climate change is a real threat to the nation of Belize. As such, it is critically important that we identify and implement coping mitigation and adaptation strategies. Current pressures from resource overexploitation and coastal development are already undermining coastal ecosystems' ability to withstand stresses to climate change. As such, we are trying to address the issue of adaptation to climate change alongside existing work on sustainable development. It is in the long-term economic interest of Belize for the Government to:

- **Invest in management, monitoring, and compliance.** The government has taken an important first step by reinstating the Coastal Zone Management Authority and Institute. Now, it needs to invest in CZMAI and other science-based efforts to expand monitoring activities and assess the state and use of coastal resources. Additional resources for tightening and enforcing fishing regulations are also badly needed.
- **Plan and implement development sensibly.** The government needs to enforce existing land-use and development regulations in the coastal zone. Minimizing the loss of mangroves along the shoreline will be increasingly important, as they provide critical habitat and protect the coast from storms. Longer-term tourism and development strategies should incorporate the ecosystem services provided by coral reefs and mangroves; for instance decisions on development permits, sewage and waste disposal regulations, and the balance between cruise and overnight tourism should all include consideration of potential impacts on the flow of benefits from coastal resources.
- **Increase support for Belize's valuable MPA system.** Belize's MPA system is among the best in the world, but it is suffering from uneven funding and management. To avoid a continuing decline in the health of coral reefs and fish populations in MPAs, Belize should increase overall investment, improve fee collection, monitoring and enforcement efforts, and establish a permanent source of funding to support the valuable MPA system. Strategic planning at the system level is also needed to address disparities and gaps in the current structure.

2.3.3 Responses

Responses to coral reef decline include both regional and national responses. Two of the most visible regional responses are the Mesoamerican Barrier Reef System (MBRS) Project, the first phase of which was just completed in 2007, and the ongoing Healthy Reefs for Healthy People Initiative. The most direct and powerful national response is the establishment and current management and monitoring of coral reefs in Belize's marine protected areas (MPAs) and the enactment of fisheries legislation to address specific impacts.

Currently there is a Coral Reef Monitoring Network comprised of both governmental and non-governmental stakeholders, in particular protected area co-management organizations, who collaborate on the collection and storage of coral reef monitoring data. The new Environmental Research Institute (ERI) at the University of Belize is now in the process of developing a coordination mechanism for the collection, storage, curation and analysis of this data at the national level as well as the development of a National Marine Biodiversity Monitoring Program in collaboration with stakeholders.

In addition to these responses, at the legislative level, the Environmental Protection Act was recently amended (August 2009) to penalize hitting of the reef, for example through strict fines. Additionally, the Hol Chan Marine Reserve in San Pedro Ambergris was expanded and zoning has been implemented for Caye Caulker Marine Reserve to include a no-take zone; new zoning legislation for the Southwater Caye Marine Reserve and the Sapodilla Cayes has doubled the no-take area at these locations. More recently, the Ministry of Agriculture and Fisheries, responsible for the management of the fishing industry and marine reserves through the Fisheries Department, has enacted legislation (Fisheries (Nassau Grouper & Species Protection) Regulations, 2009) to protect reef herbivores or grazers in the Scaridae and Acanthuridae families, which include parrot fish, surgeon fish and blue tangs (SI 49 of 2009). This legislation prohibits the fishing and possession of grazers, and mandates that fish landed as fish fillet have a skin patch.

Some of the above responses are discussed in detail in the following sections.

2.3.3.1 Mesoamerican Barrier Reef System (MBRS) Project

The Mesoamerican Barrier Reef System (MBRS) spans the countries of Mexico, Belize, Guatemala and Honduras. In June 1997, recognizing the MBRS as a resource to the people of their countries and its vulnerability to increasing threats to its health, the leaders of the four countries committed to protecting it. This commitment was made through the signing of a document known as the Tulum Declaration, which called for an action plan for the conservation and sustainable use of the MBRS. Funds were obtained from the Global Environment Facility (GEF), through the Central American Commission on Environment and Development (CCAD) to formulate and implement this action plan. The MBRS project was designed based on an action plan and was the first phase of a 15-year program for the conservation and sustainable use of the MBRS. The first phase of the project was officially launched in 2001 and ended in 2007.

The overall goal of the MBRS project was to enhance protection of the marine ecosystems comprising the MBRS, and to assist the participating countries "to strengthen and coordinate regional policies, regulations and institutional arrangements for the conservation and sustainable use" of the MBRS (MBRS, 2007). The project aimed to achieve these goals through various project components, each involving specific activities. Project components and activities focused on: marine protected areas, particularly on their planning, management and monitoring as well as institutional strengthening; sustainable use of the MBRS, particularly through the promotion of sustainable fisheries management and sustainable coastal and marine tourism; regional environmental monitoring and information system, particularly through the development and distribution of an electronic information system and the establishment of an MBRS synoptic monitoring program; and finally, public awareness and education, particularly through the development of an environmental education campaign and through formal and informal training.

The MBRS project indeed produced scientific data, a web-based data portal not operational – need to ask Noel and many technical reports addressing everything from coral reef ecology, marine pollution, management effectiveness of MPAs, environmental education in MPAs and training manuals for tour guides and various tourism activities.

In July of 2006, the governments of Mexico, Belize, Guatemala and Honduras once more reaffirmed their commitment to the protection of the MBRS. However, since the close of the first phase of the program in 2007, there has been little news as to whether and when a second phase of the MBRS project, which would also focus on watershed management issues and their impact on the MBRS, will be implemented.

2.3.3.2 Healthy Reefs for Healthy People Initiative

A second important regional response with direct relevance to monitoring, evaluating and helping to alleviate coral reef decline in Belize is the Healthy Reefs for Healthy People Initiative. The initiative is a collaboration of several international organizations and is spearheaded by the Smithsonian. The initiative was launched in 2003 and is based on the premise that the health of the reef is dependent on the well-being of people and vice-versa. The main goals of the Healthy Reefs Initiative are to "promote the adoption and application of Healthy Reefs indicators" by those who are interested in the health of the Mesoamerican Reef (MAR) ecosystem, "standardize the analysis of reliable scientific data to improve reef ecosystem management" and act as a forum for the exchange of information and networking among stakeholders (McField and Kramer, 2007).

The initiative has been working towards these goals through the development and dissemination of "A guide to indicators of reef health and social well-being in the Mesoamerican Reef Region". This publication provides a set of indicators and details on how to measure them in order to evaluate the status of coral reefs; it includes ecosystem structure and function indicators, drivers of change indicators and social well-being and governance indicators. Data is given for some of the indicators while the Initiative has on-going projects to measure the others in the MAR. More recently, the Initiative has developed an Eco-health Report Card for the MAR based on an Integrated Reef Health Index that indicates the condition of reefs in the MAR (see section 2.3.2.5 above for more details on the Eco-health Report Card).

2.3.3.3 National Responses: Belize's Marine Protected Areas (MPAs)

Approximately 22.8 percent of Belize's national territory is under some form of protection (Appendix 1). This protection applies to only 10.7 percent of the country's coastal-marine area (Appendix 1) in the form of 8 Marine Reserves, 13 Spawning Aggregation Sites (SPAGs), some of which are part of marine reserves, 1 National Park, 2 Natural Monuments and 2 Wildlife Sanctuaries (Table 24). According to Bood (2007), four of the current MPAs lack management presence. These are Corozal Bay Wildlife Sanctuary, and three spawning aggregations, namely Sandbore, South Point and Caye Glory. The remaining areas are under various types of management. Bacalar Chico Marine Reserve and National Park is managed by the Government of Belize, through the Fisheries and Forest Departments. Hol Chan Marine Reserve is under quasi-government management through the Fisheries Department and the Hol Chan Trust Fund. South Water Caye and Glover's Reef Marine Reserves are also managed by government through the Fisheries Department. The remaining MPAs are under co-management agreements between either the Fisheries or Forest Department and non-governmental agencies. Map 5 shows Belize's marine reserves and their respective management zones.

According to Bood (2007), estimated management costs for the actively managed MPAs are over BZ$3.4 million per year, while annual revenues generated in these areas are not enough to cover the costs of their management. Bood (2007) reports revenues for Hol Chan Marine Reserve at BZ $494,526 in 2003, BZ $661,558 in 2004 and BZ $897,326 in 2005. In 2008, Bacalar Chico Marine Reserve and National Park, Caye Caulker Marine and Forest Reserve, South Water Caye, Port Honduras, Sapodilla Cayes and Glover's Reef marine reserves generated BZ $560,000 in revenues. Main funding sources for the management of these MPAs include user fees, the Government of Belize, the Protected Areas Conservation Trust (PACT), the Oak Foundation, The Nature Conservancy (TNC), the World Wildlife Fund (WWF), the Global Environment Facility (GEF) through the United Nations Development Programme (UNDP), and the Wildlife Conservation Society (WCS).

Although it appears that these MPAs are not generating the necessary revenue for their management to be sustainable, they have great potential to generate more income. All MPAs, apart from the SPAGs and Corozal Bay Wildlife Sanctuary, charge entrance fees to foreign visitors that range from BZ$10 to $60. In contrast, only Laughing Bird Caye National Park and Half Moon Caye

Table 24: Declared Marine Protected Areas, 2009

Classification	Designation	S.I. Acreage	GIS Acreage	S.I. Number
Bacalar Chico	Marine Reserve	15,577	16,337	136
Caye Caulker	Marine Reserve	9,670	9,670	115
Glovers Reef	Marine Reserve	25,600	25,978	137
Gladden Spit/Silk Cayes	Marine Reserve	86,652	80,692	68
Hol Chan	Marine Reserve	13,336	13,666	114/116
Port Honduras	Marine Reserve	101,100	100,096	9
Sapodilla Cayes	Marine Reserve	38,594	38,594	50
Southwater Cayes	Marine Reserve	117,875	117,874	51
Caye Bokel, Turneffe Island Atoll	Spawning Site	1,376	1,379	161
Dog Flea Caye, Turneffe Island Atoll	Spawning Site	1,408	1,424	161
Emily or Caye Glory	Spawning Site	1,344	1,351	161
Gladden Spit	Spawning Site	3,590	3,677	161
Nicholas Caye, Sapodilla Cayes	Spawning Site	1,664	1,663	161
Northern Glover's Reef Atoll	Spawning Site	1,799	1,577	161
Rise and Fall Bank, Sapodilla Cayes	Spawning Site	4,250	4,252	161
Rocky Point, Ambergris Caye	Spawning Site	1,405	1,409	161
Sandbore, Lighthouse Reef Atoll	Spawning Site	1,280	1,105	161
Seal Caye, Sapodilla Cayes	Spawning Site	1,600	1,601	161
South Point, Lighthouse Reef Atoll	Spawning Site	1,344	1,307	161
Maugre Caye, Turneffe Atoll(1)	Spawning Site	1,918	1,919	49
Northern Two Cayes, Lighthouse Reef(1)	Spawning Site	927	928	49
Laughing Bird Caye NP	National Park	10,119	10,120	94
Corozal Bay WS	Wildlife Sanctuary	180,800	180,507	48
Halfmoon Caye NM	Natural Monument	9,700	9,771	30
Swallow Caye	Wildlife Sanctuary	5,985	8,980.810	102
Blue Hole NM	Natural Monument	1,023	1,023.000	96

Source: Land Information Centre, MNRE

Natural Monument have daily fees for locals in place. Bood (2007) showed that foreign visitors range from 1,000 people per year at Port Honduras Marine Reserve to more than 50,000 at Hol Chan Marine Reserve. On the other hand, 200 domestic visitors at Half Moon Caye and Blue Hole Natural Monuments to more than 4,000 at Hol Chan Marine Reserve are registered annually. Total domestic visitors for 8 MPAs were just over 10,000 while foreign visitors to 10 MPAs were over 110,000 per year (Bood, 2007).

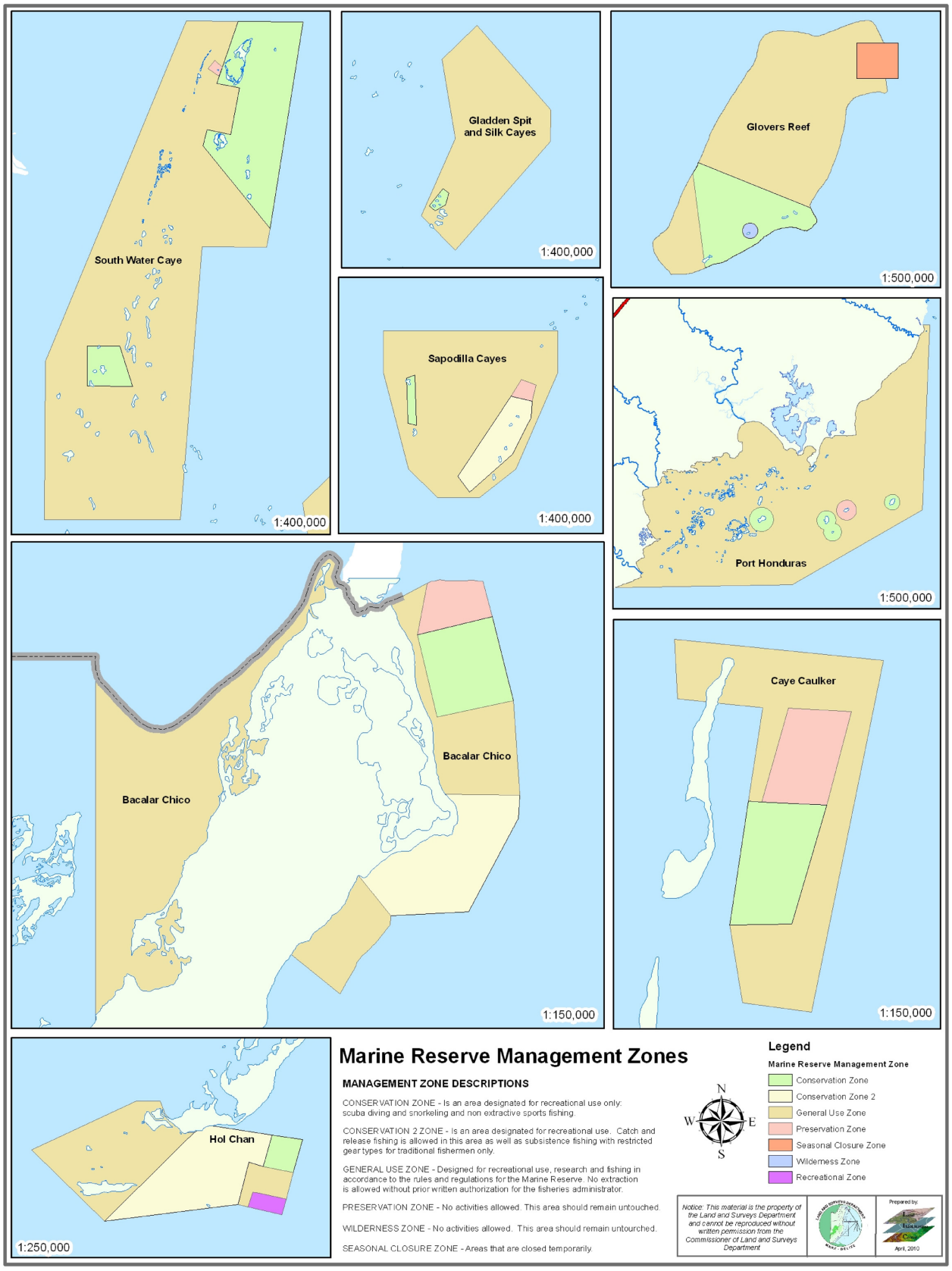
Apart from the provision of jobs and the generation of revenue through tourism and fishing, MPAs have great potential to help to maintain healthy coral reefs in the future. However, it is imperative that each MPA has management presence and a management plan in place that addresses the sustainability of the area. In addition, it is important that other areas of the marine realm, particularly in unique areas such as the atolls come under protection for a more effective protected area system.

2.4 Coastal Degradation

2.4.1 Importance of Coastal Ecosystems

The length of Belize's continental coastline is approximately 584 km (LIC). This does not include the coastline associated with the various cays and islands that also form a part of the country. Much of the coast and indeed the cays and islands are naturally lined by mangrove vegetation that provide critical habitat, in particular, to many species of birds, endangered animals such as the American crocodile and West Indian manatee, resident fish and young fish that eventually make it out to the reefs and open ocean.

Map 5: Marine Reserves and Management Zones, 2009



Coastal ecosystems include "coastal lands, areas where fresh water and salt water mix, and near shore marine areas" (MEA Conditions and Trends Working Group, 2005). Therefore they include ecosystems such as mangrove forests, littoral forests, estuaries, wetlands, sea grass beds and coral reefs. Although the "coast" encompasses areas beyond land areas influenced by the tide or areas where fresh and salt water mix, this section of the report will look at "coastal degradation" with an emphasis on these particular systems.

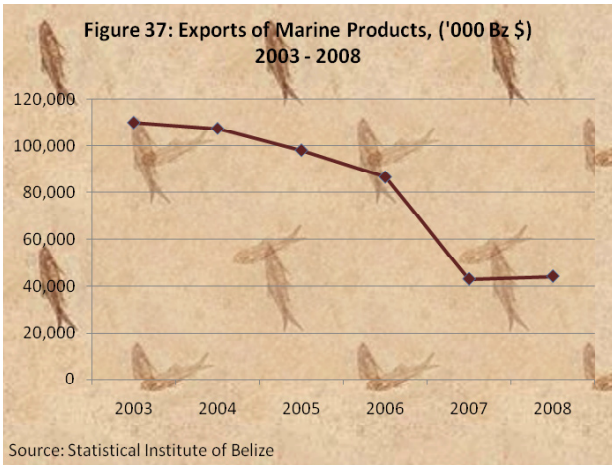
Mangroves

Coastal ecosystems are among the most important because of the goods and services they provide to humans. Mangrove forests are amongst the better known coastal ecosystems for the goods and services they provide. They significantly protect shores and shoreline properties against natural disasters such as hurricanes. They act as hatcheries and nurseries for fish species, many of which eventually make it to the coral reefs or Open Ocean, where they can be caught for food or export. The MEA Conditions and Trends Working Group (2005), estimates that annual coastal capture fisheries are worth a minimum of US$34 billion worldwide. In many areas of the world, mangroves also provide local people with fuel wood and food other than fish, especially since they act as a refuge for many plant and animal species. Through blockage of excess sediment and absorption of nutrients from wastes such as sewage, mangrove forests also act as natural filters for waters that eventually make it to the sea. Other coastal ecosystems such as coral reefs are especially vulnerable to polluted waters and depend on the filtered water that mangroves provide for their survival. Therefore, the very existence of areas with mangrove forests that have retained their ecosystem structure and function safeguards the goods and services that the reef ecosystem provides. Coastal ecosystems are inextricably interlinked and therefore, the management and protection of one cannot be done in isolation but rather must consider a degree of protection for all others.

Other coastal ecosystems such as estuarine and wetland areas also provide people with important goods and services. Since they have the ability to adapt to changes in sea level, wetlands are an important buffer against storm surge and also play a major role in flood control (CZMAI, 2004). Wetlands also provide unique habitats for many species of birds while estuaries provide a home for many species of fish. Along with mangroves, these ecosystems often provide the best home for threatened or endangered species in Belize such as the American Crocodile (*Crocodylus acutus*) and the West Indian Manatee (*Trichechus manatus*). In addition to providing humans with food and protection against natural disasters such as floods and hurricanes, the ability of these ecosystems to house biodiversity is really an add-on to the goods and services these systems provide people. Areas with such high biodiversity often serve as tourism hotspots for those wishing to view interesting, unique or rare plants and animals thereby contributing to local economies through employment and income generation. Coastal ecosystems also provide what is considered prime habitat for setting up shrimp and fish farms by the aquaculture industry and in this manner generate foreign exchange through the export of these "water-farmed" products.

Although it is difficult to estimate exact figures that reflect the total contribution of coastal ecosystems to the Belizean economy, there are some figures that show that this contribution must be quite significant. The fishing industry alone, which is dependent on all coastal ecosystems, was worth more than BZ$100 million annually from 2003-2006 (SIB, 2007a). In 2005 and 2006, this industry's contribution to the country's GDP was 6.79 and 5.40 percent respectively. However in 2008 the fishing GDP decreased to BZ$49.6 million at constant prices (SIB, 2009).

Marine products accounted for 16.04 and 8.30 percent of the income derived from all major domestic exports in 2006 and 2007 respectively (SIB 2007a). In 2006, white-farmed shrimp exported accounted for BZ$62.44 million or 72.59 percent of all the income derived from marine exports during this year. In 2007, these amounts declined to BZ$19.75 million and 46.84 percent of all the income derived from marine exports (SIB, 2007a). Apart from farmed-shrimp, other marine exports include farmed fish such as Tilapia and Cobia. The decline in marine exports as shown in Figure 37 was due to the close down of important shrimp companies mostly because of



the decrease in global market prices. The 2009 Aquaculture sector performance data from the Fisheries Department indicates that there are 10 shrimp farms comprising a total 25, 454 acres of land that are no longer operational.

Apart from the contributions of coastal ecosystems through the aquaculture industry, the economic contribution of mangrove ecosystems to fisheries have recently been estimated at US$3-4 million (Table 23). In addition, these mangrove ecosystems also contribute to the tourism industry as well as shoreline protection. These contributions are estimated at US$60-78 million for the tourism industry and US$111-167 million in the form of shoreline protection from hurricanes, floods and erosion (Table 23). Hence, it is very clear that Belize benefits significantly from coastal ecosystems.

2.4.2 State of Belize's Coasts and Coastal Ecosystems

Stakeholders of the present GEO Belize assessment identified unsustainable development associated with population expansion, tourism and the aquaculture industry, and unsustainable land-based or non-coastal practices that produce pollution and sedimentation, as the major threats affecting the portion of coastal ecosystems being discussed in this section. The effect of global climate change and its expected impacts on coastal ecosystems is further discussed at the end of this chapter in section 2.6.

Unfortunately, despite their importance to humans, these ecosystems are among the most vulnerable and threatened due to human activities. There are two major factors that influence the high level of destruction and degradation of coastal ecosystems. The first is the large number of people living or wanting to live near the coast all over the world. According to the MEA Conditions and Trends Working Group (2005), "nearly 40 percent of the people in the world live within 100 km of the coast" and "population densities on the coast are nearly three times that of inland areas". The Global Environment Outlook, GEO-4 (UNEP, 2007), estimates that approximately half of the population, in the Latin American and Caribbean region, live within 100 km of the coast. Belize is no exception, since its entire population resides approximately 68 miles or 109 km from the coast at the furthest. Five of Belize's nine urban centers are situated on the coast or completely surrounded by coastal areas as is the case of San Pedro Town, which is located on an island. In the last census for the country, carried out in the year 2000, these coastal urban areas alone comprised 31.04 percent of the total population of the country (CSO, 2004). Mid-year population estimates for 2007 by the SIB (2007b) indicate a similar figure (32.13 %).

The second major factor that makes coastal ecosystems so vulnerable and highly threatened is the fact that they are subject not only to the immediate pressures from the activities of the people living on it or near it but also by activities occurring all the way inland. Coastal systems are ultimately connected to land systems by rivers and streams and in Belize, "twenty main river catchment areas drain into the continental coast" of the country (CZMAI, 2004). This means that the impacts of upstream activities such as agriculture and the creation of dams are ultimately pressures on coastal ecosystems.

2.4.2.1 Unsustainable Development

Recently, many individuals and organizations including the Association of Protected Areas Management Organizations, which includes many of the more prominent conservation NGOs, such as BAS, Programme for Belize (PfB), Friends of Nature (FoN) and The Toledo Institute for Development and Environment (TIDE), have raised alarm at the rapid rate of what appears to be unsustainable development along Belize's coastline, in coastal wetlands and lagoons and particularly in the coastal mangrove ecosystems of the islands (Green Reef, 2008; APAMO, 2007a; Gonzalez, 2007; McField and Bood, 2007). The pace and manner at which this development is taking place points to it as the major and most immediate threat to Belize's coastal ecosystems.

Table 25: List of Environmental Impact Assessments (EIAs), 2006 – 2008

Year	Project/Development Type	District	Approved	Under Investigation
2006				
	Tourism Development and Marina	Stann Creek	×	
	Road Construction	Stann Creek	×	
	Tourism Development & Port Facility	Belize	×	
	Tourism Development	Belize	×	
	Energy	Cayo	×	
	Residential/Tourism	Belize	×	
	Oil Exploration (Seismic)	Orange Walk	×	
	Tourism/Marina	Belize	×	
	Tourism	Corozal	×	
	Oil Exploration (Exploration)	Cayo	×	
	Oil Exploration (Exploration)	Cayo	×	
2007				
	Marina/Condo	Corozal	Not Approved	
	Resort	Cayo	EIA not Accepted	
	Marina/Condo	Belize	×	
	Resort	Belize	×	
	Oil Exploration	Cayo	×	
	Oil Exploration	Toledo	×	
	Residential Subdivision	Stann Creek		×
	Marina/Condo	Stann Creek		×
	Cruise Terminal	Belize	×	
	Marina/Condo	Corozal	×	
	Resort	Stann Creek		×
2008				
	Free Zone	Cayo	×	
	Tourism Development	Belize	×	
	Granite Quarry	Cayo	×	
	Marina/Condo	Belize	×	
	Tourism Development	Belize	×	
	Resort	Stann Creek	×	

Source: Department of the Environment, MNRE

Among the primary reasons for coastal development is the provision of infrastructure for local populations in the forms of businesses, homes and roads but also infrastructure to attract tourism and increasingly retirees from the developed world. Two types of data illustrate the pressures on Belize's coasts from this type of infrastructure development. Data on Environmental Impact Assessments submitted to the Department of Environment and approved by the National Environmental Appraisal Committee (NEAC) is shown on Table 25. Data on mangrove alteration in terms of permits issued, area altered and royalties received from permits are shown on Table 26-28.

Table 25 illustrates the different types of development for which EIAs are being submitted. In 2006, 60 percent of submissions were directly related to tourism, all of these in districts that have a coastline (Belize District, Corozal District and Stann Creek District). In 2007, 73 percent of submissions were for tourism developments, of which more than 60 percent were for developments on the coast. In 2008, 67 percent of submissions corresponded to tourism projects, all of them in the Belize and Stann Creek Districts, which are coastal (refer to Table 25). Coastal development for tourism usually involves the clearing of mangroves.

Table 26: Mangrove Alteration Permits, 2000 - 2007

District	2000	2001	2002	2003	2004	2005	2006	2007
Belize	1	3	1	2	0	9	7	10
Corozal	0	0	0	0	0	0	1	1
Stann Creek	2	2	1	5	4	10	20	16
Toledo	0	0	1	0	0	0	0	1
Total	3	5	3	7	4	19	28	28

Source: Forest Department, MNRE

Table 27: Acreage of Mangrove Altered, 2000 - 2007

District	2000	2001	2002	2003	2004	2005	2006	2007
Belize	4.8	5.7	0.4	3	0	18.4	10.4	23.8
Corozal	0	0	0	0	0	0.0	4.0	0.0
Stann Creek	0.5	5.1	0.6	1.3	3	249.3	41.6	65.6
Toledo	0	0	0.2	0	0	0.0	0.0	15.0
Total	5.3	10.8	1.2	4.3	3	267.7	56.0	104.4

Source: Forest Department, MNRE

Table 28: Mangrove Royalty Value (Bz$), 2000 - 2007

District	2000	2001	2002	2003	2004	2005	2006	2007
Belize	300	400	25	400	0	2,400	1,800	…
Corozal	0	0	0	0	0	0	300	…
Stann Creek	100	350	300	650	500	2,300	3,350	…
Toledo	0	0	25	0	0	0	0	…
Total	400	750	350	1,050	500	4,700	5,450	…

Source: Forest Department, MNRE

Table 26 shows that the number of permits issued for mangrove alteration have been increasing since 2000 and that in 2008, the number of permits issued was more than nine times the number issued in 2000. The acreage of mangroves being altered has fluctuated from 1999 to 2007, mostly keeping within a range of 1.2-10.8 acres until 2005, when a record number of 267.7 acres were altered. This number decreased almost five-fold in 2006 and once again increased in 2007 to 104.4 acres (Table 27). Table 28 shows the royalties collected from mangrove alteration permits. These have been consistently increasing but in no-way compare to the economic value attributed to unaltered mangroves shown in Table 23. The number of permits issued, the amount of acres altered and royalties collected from the permits (Table 26-28) only reflect legal alteration of mangroves.

The Forest Department does not have data for how many acres of mangroves are cleared illegally in the country compared to the number of acres cleared through a permit every year. In addition, there is no data available on the total acreage of mangrove altered by utility companies, which are exempt from applying for an alteration permit "in or adjacent to a public or private easement or right of way". As per the FD, when it comes to mangrove alteration from permit holders, the majority of it is occurring in the southern part of the country in the Stann Creek and Toledo Districts.

A "Clearing of Mangrove on the Belizean Mainland" study produced by Emil Cherrington under the CZMAI/ICRAN-MAR project is perhaps more revealing of rates of mangrove clearance. Based on this study, 3,600 acres of mangrove were likely cleared from 1992 to 2004. This means that in the 12 years from 1992-2004, the average rate of mangrove clearance was 300 acres per year, almost 2.9 times higher than the 2007 rate shown by the mangrove alteration permit data (Table 27). Cherrington also estimated that 137,000 acres of mangrove remained on the mainland in 2004. The mangrove alteration permit data (Table 27) reveals that 428.1 acres of this remaining total has been legally altered from 2005-2007. However,

as mentioned previously the data in Table 27 does not account for all mangroves being altered legally nor illegally. In addition, the estimates from Cherrington and the mangrove permit data do not take into account alteration of mangroves on the islands off of the Belizean mainland. As revealed by concerns raised by APAMO (2007a) and Green Reef (2008), mangrove ecosystems of outstanding ecological value in islands such as those in the Pelican Cay Range, which are part of the South Water Cay Marine Reserve (SWCMR) and the Bird Cayes near Ambergris Caye are being altered and under severe threat from development. The fact that there is mangrove alteration in these islands, some of which form a part of the Protected Area network of the country, is very alarming and points out to the need for clear data that shows the actual extent of mangrove degradation.

2.4.2.2 Aquaculture

Aquaculture is another type of development that is impacting Belize's coasts, apart from infrastructure developments associated with tourism or housing developments. In Belize, the main form of aquaculture is mariculture or salt water culture of shrimp. The mariculture business is a threat to the coasts because these provide the prime habitat for setting up aquaculture ponds. Apart from the potential conversion of coastal habitat such as mangrove areas for mariculture, there are several other activities from the industry that can impact coastal systems and their waterways. These include the discharge of effluents from ponds or the disposal of parts of the shrimp, such as the heads, which are not exported. Wastes from effluents or from the decomposition of unused shrimp parts can then leach into coastal waterways polluting them. In the case of Cobia farms, because these fish are raised in cages inside the water, they can release a certain nutrient load into the water.

Wade (2005) reported 12 shrimp farms in 2002 and 14 in 2004. The total production area in 2002 was 6,675 acres and this figure increased to 6,888 acres in 2004 (Wade, 2005). More recently, data from the Fisheries Department on the aquaculture sector performance indicate that in 2009 there were a total of seven operational shrimp farms (Table 29). These farms cover a total land area of 33,940 acres, only 8 percent (2,788 acres) of which is considered production area (Table 29). Currently, there are also 10 non-operational shrimp farms in the country. Apart from the seven operational shrimp farms there is a single Tilapia farm and a single Cobia farm in the country (Table 29). Fresh Catch Belize Limited, the single Tilapia farm was opened in December of 2002 with ap-

Table 29: Aquaculture farms in Belize, 2009

Farm	Total Land (acres)	Species Farmed	Production Area (acres)	Production Area (Ha)	Production Units	Hatchery Capacity Million Pl's/ Month	Processing Plant (Lbs. heads-on/ day)
Paradise	3,100	Shrimp	750	304	38	20	25,000
Melinda Mariculture	5,000	Shrimp	100	40	20	-	-
Haney's	2,040	Shrimp	152	62	10	-	-
Belize Aquaculture	14,000	Shrimp	340	138	67	50	60,000
Royal Mayan	1,000	Shrimp	318	129	23	-	-
Texmar	1,800	Shrimp	128	52	40	-	-
Aqua Mar	3,000	Shrimp	1,000	405	76	80	45,000
Total Shrimp	**33,940**		**2,788**	**1,129**	**279**	**150.00**	**130,000.00**
Fresh Catch Belize Ltd.		Tilapia	300	121			
Marine Farms Belize Ltd.		Cobia			17	Construction 1 million fingerlings per year	
Total Aquaculture	**-**		**-**	**-**			**-**

Source: Fisheries Department, Ministry of Agriculture, Fisheries & Cooperative

proximately 62.3 acres under production but with a total of 150 acres under production envisioned as part of its first phase (Wade, 2005). In 2004 this company exported BZ$1.1 million in farmed fish (Wade, 2005).

Overall, the aquaculture industry in Belize has come a long way in terms of production and export earnings since 1997 when 2,711 thousand pounds of shrimp were produced (Table 30). By 2004 the 1997 production had grown tremendously to 24.3 million pounds earning BZ$84.5 million in foreign exchange (Table 30). Based on these figures of export earnings for the country and the earlier reported figures from the SIB (2007) for 2005 and 2006 (BZ$61.4 BZ$62.4 million respectively), it seems that 2003-2006 marked the most successful years of the industry in terms of record export earnings. However, the trend in export earnings since 2003 has been one of decline and from 2006 to 2008, the amount of farmed shrimp exported declined by approximately 66 percent and the foreign exchange generated from the export of these products declined by approximately 70 percent perhaps indicating a turning point in the industry and its potential at becoming more competitive. If the industry does become more competitive the fact that the 2004 acreage only represents 12.5 percent of the "overall area under the tenureship of shrimp farmers" (Wade, 2005), reveals that the development of the aquaculture industry in Belize could potentially still be in its infancy stage.

Table 30: Production and Exports of Farmed Shrimp, 1997 - 2007

Year	Total	Export	
	Production ('000 lbs)	Exports ('000 lbs)	Value ('000 Bz $)
1997	2,711	1,654	12,832
1998	3,732	3,076	23,820
1999	6,989	4,603	35,707
2000	8,002	4,904	49,134
2001	9,812	6,697	46,564
2002	9,579	6,183	51,408
2003	24,546	15,905	91,772
2004	24,343	17,068	84,450
2005	36,997	18,970	61,367
2006	**…**	**15,916**	**62,435**
2007	…	5,439	19,749

Source: SIB and Fisheries Department

2.4.2.3 Unsustainable Land-based or Non-coastal Practices

In addition to unsustainable coastal development, there are threats to Belize's coasts and coastal ecosystems that stem from practices not necessarily carried out near the coast. Pollution and sedimentation that travel down to the coast through rivers within Belize and in neighbor countries are the primary threats. The main sources of pollution are agricultural practices that employ agrochemicals and generate wastes. Unfortunately, very little monitoring is done for these chemicals, and there is no data showing the levels of chemicals reaching the coasts from inland farms in Belize or from farms in neighboring countries. In addition, although oil pollution has not been a significant concern until the development of the recent oil industry, this type of pollution could have devastating impacts on the coast and particularly the wildlife that lives in the coasts.

Similarly to pollution, sedimentation poses a significant threat to coastal ecosystems. Sedimentation becomes a threat to the coastal ecosystem when natural sediment flows are severely altered so that there is either a lack of the proper amounts of sediments arriving at the coast, such as can happen when rivers are dammed, or there is an overload of sediments arriving at the coast as can happen when riparian forests along rivers are removed. The MEA Conditions and Trends Working Group (2005) states that "worldwide human activities have increased sediment flows in rivers by about 20%", but about 30% of sediments do not reach oceans (any longer) because of water diversions and reservoirs". This results in a 10% net reduction of sediment delivery to the coasts. However, we have very little data showing whether this is the case in Belize.

Although there is very little data on the amount of sediments and pollutants arriving at the Belize coast from rivers and their watersheds, Burke and Sugg (2006) have shown that Honduras was the country contributing the largest amounts of erosion and nutrients, including nitrogen and phosphorus to the Mesoamerican Reef (MAR) drainage, a large portion of which is located in the coasts of Belize. In their evaluation of the accumulation of sediment, nitrogen, phosphorous and total suspended solids in more than 400 watersheds across the MAR region, Burke and Sugg (2006) found that the largest contributor of these was a river in Honduras. However, they indicated that the Belize River in Belize is also a large contributor (Burke and Sugg, 2006).

2.4.3 Impacts

The impacts of coastal degradation will ultimately be hardest on the people who live near coasts and enjoy the goods and services provided. Coasts provide nursery grounds for many fish species of commercial value, therefore increased coastal degradation, particularly from unsustainable coastal development, will affect fisheries stocks that many depend on for food and livelihoods. Exports based on coastal fisheries will also continue to decline with increased coastal degradation. Apart from the economic losses to the fishing industry, coastal degradation will also increase the potential from economic losses due to impacts from hurricanes. Coasts degraded from mangrove clearing will increase the vulnerability, particularly of those without the means to build adequate infrastructure that will withstand hurricane damage. Belize City and the Southern parts of the country will continue to be the most vulnerable to storm damages. Coastal degradation will also affect those with businesses and home near the coast as beach erosion continue to occur and as the impacts of rising sea level, due to global climate change, start to be felt. Therefore, although the poor are the most vulnerable to the impacts of coastal degradation, everyone will be affected.

In terms of ecosystems, the unique biodiversity of coasts will continue to suffer due to coastal degradation. Turtles nesting sites will be severely affected by coastal degradation and loss of littoral forests due to development. American crocodiles will continue losing habitat and therefore come in contact with people more often as they compete for the same beach resources. Bird populations that nest on mangrove islands could suffer population declines if coastal degradation continues unabated. Biodiversity loss, loss of ecosystem structure and function and increased vulnerability to storms will have their own cascading effect with regard to the tourism industry. Currently this is Belize's fastest growing and most important industry but with the degradation of coasts and their associated ecosystems, such as coral reefs, and increased vulnerability to storms, tourism in Belize will become less marketable and the country will have to seek new ways to attract tourists away from coastal areas into inland areas.

2.4.4 Responses

When it comes to the protection of critical coastal ecosystems in Belize there are several major pieces of general as well as specific policy and legislation that are relevant. The EIA and pollution regulations under the Environmental Protection Act are important, but because they have implications for areas extending beyond the coastal zone, they are discussed in more detail in Chapter 3: "Policy Responses". Other responses include the Forest Regulations under the Forest Act as well as the Mangrove Protection Act. The Department of Environment has also recently developed a National Plan of Action for Land-based sources of Pollution; implementation of this plan of action is important as the coastal region is integrated with land-activities and the plan seeks actions by government to reduce pollution inland in order to reduce impacts on the coast. Some of the above responses are discussed below in more detail.

2.4.4.1 Forest Regulations and Mangrove Protection Act

Legislation that is critical and more specific to the sound management of coastal resources includes the Forest Regulations of 1989 that are provided under the 1980 Forest Act. Under these regulations, the Forest Department is the agency responsible for the issuance of permits to allow the selective trimming of mangroves. Technically, alterations such as cutting and defoliation are not permitted and any type of dredging and filling can be done only with a license from the Department of Geology and Petroleum (CZMAI, 2004; McCalla, 1995). According to the Forest Regulations, dredging and filling should only be authorized in "exceptional circumstances" yet the majority of permits issued for mangrove trimming appear to involve filling if not also dredging. In addition, issuance of permits for mangroves should take into consideration the distance of the proposed project or development to coastal and reef areas that are of "outstanding ecological value" and also existing or proposed national or regional plans for coastal zone management. As per the regulations ,the Forest Department is supposed to publish permit applications in the local newspaper. According to McCalla (1995), despite the fact that the Forest Regulations meant to encourage public participation and the recognition that mangrove ecosystems provide important and valuable goods and services, they fail to encourage better collaboration among the Forest Department that issues the permits and other government departments and agencies involved in the use and management of the coastal zone. More recently, the FD has spearheaded an effort, which

has as its main goal the amendment of the Mangrove Protection Act of 1990. The FD convened a working group from amongst various governmental and no-governmental agencies to provide input for the proposed amendments. Main changes being proposed include increased mangrove alteration permit charges and increased violation fines for mangrove clearance. The amendments also include a monitoring compliance program and a schedule of priority areas (M. Windsor, pers. comm.)

2.4.4.2 The National Lands Act

A second important piece of legislation that deals specifically with the protection of coastal ecosystems is the National Lands Act of 1992. This Act establishes the management framework for lands that are not reserved or allocated (McCalla, 1995). Under this Act an "important condition is that where national land is leased and such land is outside a city, town or village and adjoins any running stream, river or open water, a 66 feet wide strip of land" along such water body should be left unaltered (McCalla, 1995). One aspect of this condition that has important implications for the protection of coastal ecosytems is that not only does the condition apply directly to vegetation along the coasts, but also to vegetation on the riverbanks or riparian vegetation. Mangroves or any other vegetation along the rivers are what ultimately regulates the level of erosion and the sediment loads that eventually are received at the coast. This 66 feet wide strip condition has been the subject of much discussion and debate and the reason for its existence seems to have more to do with not allowing ownership of "beachfront" property to anyone in order to allow others passage to and along the beach, rather than for purposes of protection of coastal ecosystems (CZMAI, 2001). The Coastal Zone Management Authority and Institute (CZMAI) (2001) expresses the general sentiment that the 66-feet wide condition is not respected even by those who are supposed to "know the law", for example, surveyors of land, while others are not aware of this condition in the law. Further, the National Lands Act does give the minister the discretion to authorize the exemption of this condition when land is leased. The matter is not a simple one and phenomena such as beach erosion and accretion "further complicate the issue" if they render the 66 feet setback unenforceable (CZMAI, 2001). However, one manner strengthening the 66-feet wide condition, as suggested by the (CZMAI, 2001) is to make it clear in the Act when it is acceptable not to employ the 66 feet setback as opposed to allowing a single individual with authority to decide.

2.4.4.3 The Coastal Zone Management Authority & Institute (CZMAI)

One of the responses that has had negative repercussions for coastal ecosystems countrywide is the failure to follow a coastal zone management plan. This has been one of the largest barriers to the sustainable management and development of the country's coasts and coastal ecosystems. Adoption and implementation of this plan falls within the purview of the CZMAI. The CZMAI was established as a statutory body within the public service through the 1999 Coastal Zone Management Act. Under this Act, the Institute was envisioned as the body that would carry out relevant research and monitoring of coastal ecosystems, in order to inform coastal zone management by the Authority. On the other hand, the Authority had the mandate to manage the coastal zone of the country by drawing from the technical expertise and findings at the Institute as well as from an advisory board comprised of various private and public sector stakeholder agencies (CZMAI, 2004). The CZMAI was one of the first institutions in Belize to operate by bringing together at the table agencies such as the Fisheries Department, the Forest Department, the Department of Agriculture, the Lands and Survey Department, the Geology and Petroleum Department among others, each of which shared a portion of statutory coastal functions and responsibilities in Belize. Although other government bodies had the responsibility of final decision-making in matters involving the development and use of the resources of the coastal zone, the Authority was the body responsible for advising the minister on these matters (CZMAI, 2004).

One of the main requirements of the CZMAI under the Act that established it was the development of a detailed coastal zone management plan that would "satisfy regional and local requirements" (CZMAI, 2004). The first phase of development of the plan was the formulation of a National Integrated Coastal Zone Management Strategy in 2000 through the review of available data, a public awareness campaign and wide consultation with stakeholders countrywide (CZMAI, 2004). Apart from fostering and enhancing collaboration among stakeholder agencies involved in the management of the coastal zone, the strategy really aimed to mainstream the value of the coastal zone not only in terms of its economic potential but also in terms of the "interdependence between all

natural resources and processes, and human interventions in the coastal area of Belize" (CZMAI, 2004). An equally important function of the strategy was to allow the CZMAI to become a model for the use of science as the basis for setting targets and standards for environmental management of Belize's coastal zone (CZMAI, 2004). The CZMAI strategy proposed to follow through on the above functions through the implementation of activities under its three strategic objectives, which were: Knowledge and Sustainable Coastal Resource Use, Supporting Planned Development and Building Alliances to Benefit Belizeans. Unfortunately, the strategy and further elaboration of the coastal zone management plan were never fully implemented; the majority of the technical staff had already left the CZMAI by late 2004, after failing to get the support of the higher levels of government to continue the work. Much of the early work of the CZMAI was funded through grants to the Government of Belize from the Global Environment Facility (GEF) and the United Nations Development Programme, and the European Union and when these grants ran out, the government was not willing to take on a larger share of the responsibility in ensuring that the CZMAI continue to function.

Many organizations and individuals involved in natural resource management and conservation talked about the need to revive and revitalize the CZMAI since its demise. Following the news in October, 2007 that the Government of Belize had plans to sell a portion of the Bacalar Chico National Park (BCNP), one of the seven areas comprising the Belize Barrier Reef World Heritage Site, the Association of Protected Areas Management Organizations (APAMO) was an important force in rallying some of the most important organizations to demand from the Government that it does not de-reserve any portion of the BCNP and marine reserve. As part of a press release, APAMO (2007a) stated that it was "prepared to work with the Government of Belize in promoting the proper management of the protected areas and the sustainable development of Belize's natural resources" and that the public and other stakeholder organizations could be assured that APAMO would "continue to collaborate" and "remain vigilant in order to ensure" the proper and sustainable management of the country's protected areas. Indeed APAMO did follow up by investigating and confirming that "substantial mangrove clearance, dredging and land filling" had occurred within the last year on at least three cayes in the Pelican Cay Range, which are part of the South Water Cay Marine Reserve (SWCMR). Like BCNP and marine reserve, the SWCMR is also one of the seven sites that form the Belize's only World Heritage Site. In a press release, APAMO (2007b) stated that they recognized the importance and necessity of development in Belize but that a balance was needed "between development and conservation of critical habitats and ecosystem service. In the same press release APAMO expressed concern at "the rate at which coastal development is now occurring" in Belize and highlighted the importance of finalizing, fully enacting and enforcing" the Coastal Development Plan for Belize (APAMO, 2007b). In essence this is a call by APAMO and the member organizations that comprise it for the Government to revitalize the CZMAI.

Finally, in 2008, the CZMAI was re-activated. Currently, the Authority is the more active component of the CZMAI, which is focusing on its role of policy formulation and implementation. However, the limited number of personnel and resources continues to be a challenge.

2.4.4.4 Other responses to coastal degradation

Apart from legislation there are a variety of other responses that have important implications for the sustainable use and development of Belize's coastal zone. One such response was the recent project that was undertaken by the World Resources Institute (WRI), with funding from the Oak Foundation, and in collaboration with various stakeholder agencies and institutions in Belize, to do an economic valuation of the coastal ecosystems of Belize. The objectives and results of this project are presented in Box 5: Coastal Capital. However, since the results of this project, which valued the combined contribution of coral reefs and mangroves, to the Belizean economy, at US$231-347, were made public, much has remained unchanged in terms of the pace of coastal development and degradation.

A second effort that also has important implications for the sustainable use and management of Belize's coastal resources is one spearheaded by the Worldwide Fund for Nature (WWF), Central America and US offices. Previously WWF had a series of regional consultations involving the leading producers, processors and of shrimp produced in the aquaculture industry as well as academics, and representatives from government agencies and NGO's in an effort to create a set of measurable, perfor-

mance based shrimp farming standards in the region. The effort was to identify criteria, in order to reduce the key environmental and social impacts related to shrimp farming, and indicators that can show whether reducing these impacts is being achieved.

2.5 Over fishing

2.5.1 Importance of Fisheries

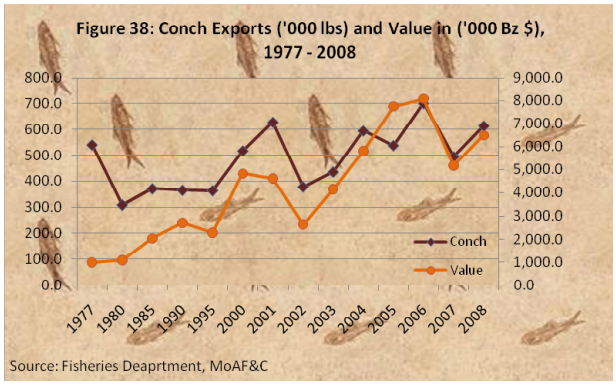
Fisheries stocks all over the world not only supply locals with an important food source but also generate income and livelihoods for fishermen. In addition, commercial fisheries have traditionally been important foreign exchange earners for many nations, particularly coastal ones such as Belize. According to the Millennium Ecosystem Assessment "coastal capture fisheries yields are estimated to be worth a minimum of US$34 billion annually" (Conditions and Trends Working Group, 2005). In 2008, exports in the fishing industry that generated foreign exchange for the country amounted to BZ$43.6 million of which farmed shrimp and fish represented 52.3 percent of the total export value (Table 31). Figures 38 and 39, which show the value of the conch and lobster industry, respectively, indicate that exports of both of these products generate millions of dollars annually for Belize. In addition, the fishing industry in Belize generates employment for thousands of people as illustrated by Table 32, which shows the types and numbers of licenses issued by the Fisheries Department. In 2008, over 2,267

Table 31: Quantity and Value of Marine Exports, 2008

Type	Quantity ('000 lbs)	Value ('000 Bz $)
Captured		
Conchs	614	6,494
Fish	13	19
Lobster	424	13,994
Shrimps	2	18
Aquarium Fish*	38	240
Sub-total	**1,054**	**20,764**
Farmed		
Shrimp	5,014	18,492
Fish	2,654	4,311
Total	**8,722**	**43,568**

* Quantity in numbers

Source: Fisheries Department and SIB



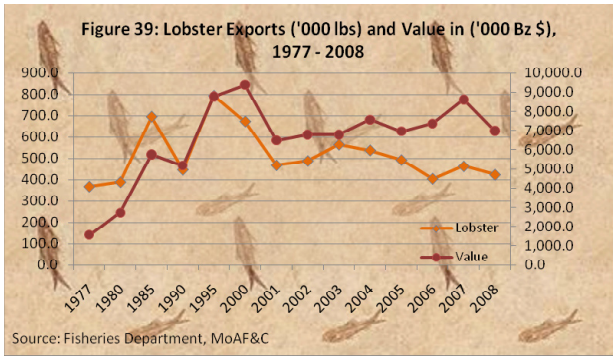


Table 32: Number of Licenses Issued by Type of Activity, 2000 - 2008

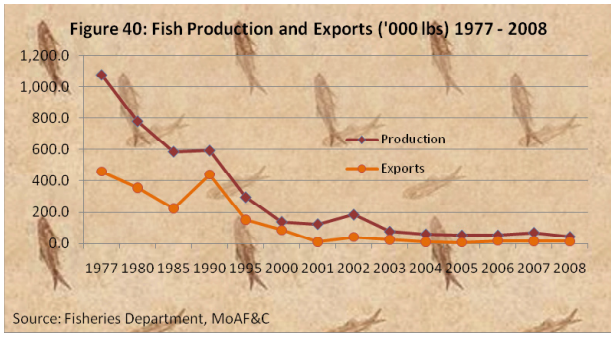
Type	2000	2001	2002	2003	2004	2005	2006	2007	2008
Black Coral License	15	18	36	26	40	39	42	35	30
Boat License	750	608	708	689	621	652	653	593	643
Shrimp Trawlers	10	6	9	3	3	2	2	2	2
Fishermen License	1,872	1,707	1,947	2,009	1,731	2,026	2,131	2,110	2,267
Research License	23	33	54	43	35	16	14	14	7
Aquarium License	4	3	3	3	3	5	7	5	2
Sea Food Export Permits	-	2,577	2,811	2,786	2,646	2,564	2,626	2,296	2,210
Fish Exporters	-	13	14	18	15	21	15	20	18
Aquaculture Operations[1]	-	9	10	7	4	5	3	3	0

[1] note that several are in operation but have not yet paid their license

Source: Fisheries Department

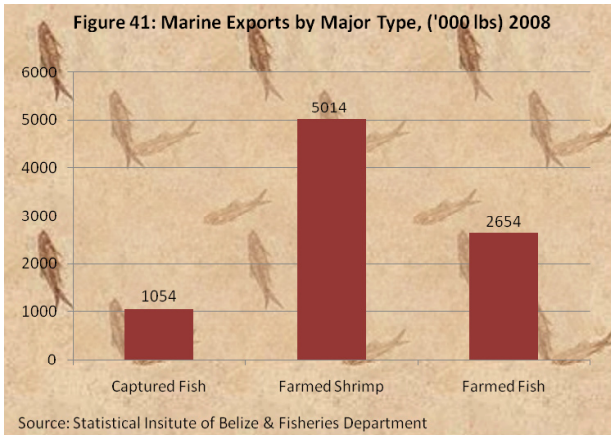
licenses were issued to fishermen and over 2,210 permits were issued to seafood exporters, who also employ others in their operations.

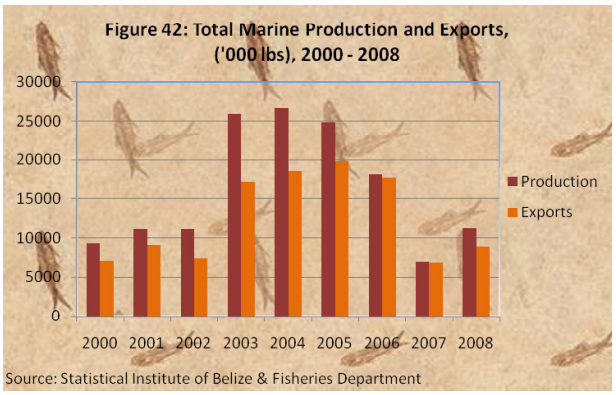
2.5.2 Pressures on and State of Fisheries Sector



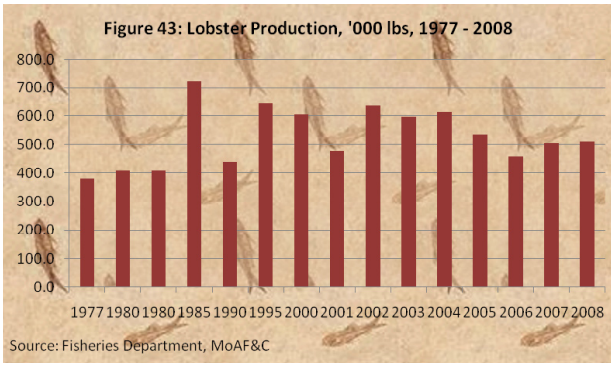
Fish stocks in the Caribbean are considered over-exploited (McField and Bood, 2007) and Belize is no exception. The largest pressure on Belize's fisheries stocks are from fishing, including illegal fishing. Belize is no exception to the rest of the world with large-scale declines that have been shown (UNEP, 2007b). Figure 40 shows the drastic decline in finfish production and export in Belize since the 1970's. Figure 41 shows that in 2008, the great majority of Belize's marine exports were accounted for by farmed shrimp and farmed fish rather than by captured fish. In 2007 and 2008, both total marine production and marine exports are much lower than they were from 2003-2005 (Figure 40).

The increase in the fishing industry for 2003 (Figure 42) was caused by a significant rise in the production of farmed shrimp. The decline between 2006 and 2008 (Figure 42) was caused by the closure of some key shrimp farm companies. The growth observed in 2008 can be mostly attributed to the increase in farmed fish production, namely Tilapia and Cobia (Figure 41). Of the





various open ocean fisheries stocks, finfish contribute the least to production and exports, while lobster and conch stocks are the largest contributors. When tracking lobster production over the past 32 years (1977 to 2008) (Figure 43) as expressed by McField and Bood (2007), in general lobster production in pounds "has remained fairly constant over the last two decades, indicating that populations may be able to maintain this level of production". In contrast to lobster, Figure 40 clearly shows that finfish production has been steeply declining over the last two decades. McField and Bood (2007) report a similar declining pattern for wild caught shrimp. Only two trawlers have been operating for the last couple of years.



Another indicator of higher pressure on Belize's fisheries stocks are reports that fish that used to be considered of lesser quality for consumption are now targeted for capture. Fish in this category included herbivorous fish such as parrotfish (McField and Bood, 2007). Such fish are critical regulators of coral reef ecosystems and coral cover build-up, as they graze on macro algae that compete with corals. These fish species are being caught due to a continued decline in large, preferred commercial fish species such as the groupers, and are usually filleted.

In terms of the large fish, the Nassau Grouper is on the IUCN Red List of Endangered Species and the Goliath Grouper is categorized as critically endangered by

the IUCN Red List. Nassau Grouper is particularly vulnerable to depletion as large numbers meet during predictable times in spawning aggregations. Similarly, Goliath Grouper is a species that is also vulnerable, mostly because this species must inhabit mangrove habitats as juveniles and is therefore especially sensitive to unsustainable coastal development (Graham, 2007). Graham (2007) reports that based on restaurant demand surveys there will continue to be increased pressure on Goliath Grouper, the third preferred species at restaurants after snapper (Lutjanus spp.) and snook (Centropomus undecimalis). McField and Bood (2007) highlight that the growing resident and tourist population will continue to place increased pressure on Belize's fisheries and that more opportunities for direct sales will be available making the enforcement of size regulations more difficult.

In addition to the disappearance of large species like groupers recent reports indicate that there is a great scarcity of apex predators such as sharks and rays (Graham, 2007; See Box 6). These species are also considered to have critical ecosystems roles and play an important role in regulating coral reef functioning. They are believed to be good indicators of fishing pressures and "in coral reef habitats, of high fish biomass and a functional ecosystem" (Graham, 2007). Surveys conducted by Graham (2007) reveal that these once abundant species are in decline. They are being hunted not only by Belizeans, but also by non-Belizeans. Graham (2007) estimates that there are approximately 30 transboundary fishermen from Livingston, Guatemala who fish in Belize, who possess Belizean fishing permits and who are increasingly hunting rays as shark populations decline in transboundary areas.

Box 7: Contemporary shark fishing in Belize: scraping the barrel of an impoverished marine ecosystem

Rachel Graham, Wildlife Conservation Society

Numerous populations of fish are in decline globally due to overfishing (Botsford et al. 1997; Pauly et al 1998; Myers and Worm 2003) and habitat loss (Valiela et al 2001; Gardner et al 2003) and sharks and rays are no exception (Baum and Myers 2004). As the food chain's top predators with K-selected life history traits of long life, slow growth, low fecundity and late maturity coupled with low population recovery rates, elasmobranchs may be potent indicators of fishing pressure (Stevens et al. 2000) and in coral reef habitats, of high fish biomass and a functional ecosystem (Newman et al. 2006, Stevenson et al. 2006). Elasmobranchs help to regulate prey Under increasing pressure from unsustainable fisheries driven by the demand for meat and fins, elasmobranchs (as sharks and rays are collectively known), have shown dramatic declines with extirpations of several coastal and pelagic species documented over relatively short time scales (Thorson 1982, Baum et al. 2003, Baum and Myers 2004). Recent studies in the western Atlantic indicate that the removal of larger shark species has led to cascading trophic effects such as an increase in mid level predators and the disappearance of prey species (Myers et al. 2007). The declines throughout their ranges have, in cases, led to localized extinctions that have earned several species such as the sawfish (Pristis pectinata and P. perotteti) the label "Critically Endangered," and the great and scalloped hammerheads (Sphyrna mokarran and S. lewini) the label "Endangered" by the World Conservation Union's Red List (IUCN 2006). Decreased elasmobranch catches globally led the United Nations Food and Agriculture Organisation (UNFAO) to request in 1998 that coastal states develop National Plans of Action for Sharks as a means to manage stocks of sharks and rays.

Existing studies on elasmobranchs in Belize in particular are scarce. Population or behavioral studies have focused on whale sharks (Rhincodon typus), an economically important but non-targeted species in Belize (Graham 2003, Graham 2004, Graham and Roberts 2007), and on population abundances and movement behavior of reef-associated sharks at Glover's Reef Atoll (Chapman et al. 2005, Pikitch et al. 2005), in Southern Belize and at Lighthouse Reef Atoll (Graham unpublished data). Although shark products were assessed cursorily as part of a larger assessment of fisheries (Thompson 1944; Heyman and Graham 2000), there have been no recent reviews of the state of shark fisheries in Belize. Yet, results from a broad shark fishery and field survey conducted in Belize in 2006 and 2007 (Graham 2007) suggest that sharks in Belize are scarce where they were once abundant and are highly vulnerable to both direct and indirect anthropogenic threats.

Ironically, shark meat is not regularly consumed in Belize and shark fisheries were never a large scale industry. Currently elasmobranchs are rarely targeted by Belizean fishers and are usually only caught as by catch in the finfish fisheries. A boom in shark captures fueled by external demand in the 70s and 80s led to the deployment of dedicated shark fishing boats working the territorial waters of Belize. Due to rapidly declining catches coupled with low prices for shark meat, the Belizean shark fishery closed in the early 1990s and by 1993, the cooperatives were no longer purchasing shark products. Fishers from Guatemala's Caribbean coastal communities increasingly fished Belizean waters to satisfy market and Lenten demand, in essence creating a shadow fishery to the legal and documented fisheries of Belize. Although shark fishing historically began in January and lasted until the onset of the Lenten season towards the end of March, continued declines in shark captures have doubled the length of the fishing season, which now runs from October to April. Fishers have also noted shifts in species distribution and abundance, as well as species marketed. This suggests that Belize is already witnessing the cascading effects from the loss of the top predatory species similar to that suggested in the Atlantic by Myers et al. (2007). Most dramatically of all, the two species of sawfish (Pristis spp.) that existed in Belize appear to be ecologically extinct, if not fully extinct.

Numerous obstacles exist to assessing the collective value of shark products in Belize as landings and fishers are not centralized and the fishery is practiced by a collection of permitted and non-permitted fishers. Meat is either sold locally in coastal cities in Guatemala or exported to Guatemala City. Fins

are sold primarily to Guatemalan middlemen, who then sell to Asian buyers. All landings from shark camps in Southern Belize are sold in Guatemala under the umbrella of export permits for salted fish (D. Castellanos, Fisher, and Customs, Punta Gorda, pers com.). Each export license is worth US$25/yr and several fishers export product under the umbrella of one license. Fishers self-report the value of their export to Customs when leaving the country and no revenue remains in country. A combination of shark fisher interviews, site visits to seasonal shark fishing camps, landings data capture and visits to fish markets was used to derive values. Fillet is sold wet salted for a mean price of US$1.3/lb and fins are sold dried for a mean price of US$50/lb[5]. Fishers informed us that meat prices have doubled in the past five years as the availability of shark fillet has declined. Concomitantly, over the same period, Guatemalan fishers have begun to capture and process rays to substitute for shark. Fishers have also indicated that fin prices have quadrupled following increased demand from Asian markets.

Coupled with study results on the number of shark fishing camps in Southern Belize, we used fisher numbers, catch effort and average capture rates, to derive an estimate for total amount and value of shark products removed seasonally from Southern Belize (as demarcated by Sittee River, the Sarstoon River or Southern Guatemalan border and east to the Barrier Reef). Using conversions of fin weights to whole shark weights noted by Vannuccini (1999) and using 2007 market prices in Guatemala provided by shark fishers, fillet and dried fins fetched an estimated total of US$1,984,842. These estimates are conservative as they represent average catch rates and do not include the sale of shark oil or teeth and jaws. Moreover, these figures do not include shark fishing occasionally undertaken between May and October nor the value of ecosystem services provided by sharks and rays such as maintaining the balance of smaller predatory species and hence the abundance of their prey populations.

By comparison, the Belize Tourism Board recorded 73,619 visitors to the Hol Chan and Shark Ray Alley marine reserves in 2005[6] whose visitation at entrance fee rates of US$10 per person would yield US$736,190 for 2006. Graham (2003, 2004) estimated visitor expenditures of US$1.35 million in five stakeholder communities from whale shark tourism conducted at Gladden Spit over a sex-week period in 2002. Although whale sharks are not fished, these combined figures suggest that considerable revenue can be expected from shark related tourism in Belize. These activities are sustainable, broadly distributed to businesses and communities in-country and offset the one-time revenue generated through shark fishing that primarily benefits neighboring Guatemala.

There is considerable financial incentive to continue the transboundary shark fishing despite declining catches, especially of larger shark species. Increased demand from Asia for fins and fishing pressure from Guatemala to supply the large population and the requirements of white meat for the Lenten season combined with the use of unsustainable fishing gears such as nets and long lines pose real challenges for conservation. However, the incentives for killing sharks are offset by the non-consumptive value sharks generate for tourism and services they provide to the ecosystem. Rebuilding shark populations in Belize will require a combination of elasmobranch-specific regulations developed under the umbrella of the National Plan of Action for Sharks such as limiting or placing a ban on the export of salted fish coupled with gear bans (long lines and nets) bolstered by firm commitment at the highest levels of Government.

[5] All prices are from 2007
[6] BTB 2006. Visitor levels per activity. http://www.belizetourism.org/belize-tourism/visitor-activities.html

2.5.3 Impacts

Employment, income and foreign exchange generation through capture fishing will continue to decline if an adequate fisheries management regime is not implemented. It is likely then that the role of aquaculture will continue to increase, perhaps eventually replacing capture fisheries. This, however, can add pressure to coastal ecosystems through land-use changes. It is also likely that as long as there are still viable fisheries stock people will continue to fish legally or illegally. Therefore, apart from the economic losses, the health of the coastal and reef ecosystems may be lost as fisheries stocks decline beyond recovery. If this were to happen, Belize will not only lose its wild fisheries stocks but also the other ecosystem services that the coasts and reefs provide.

2.5.4 Responses

The Fisheries Department is the government agency that has the mandate to enforce fisheries laws and regulations. Table 33 below shows the various enforcement actions taken by the Fisheries Department from 2000-2008. The department made 178 arrests in 2000; this number declined until 2002 but since then has been steadily increasing. In 2008, the department made 137 arrests. There have been less convictions than arrests but in general, convictions have followed a similar pattern to arrests. Although not as high as in 2000, convictions have been steadily increasing since 2002.

2.5.4.1 Fisheries Regulations

The fishing sector has probably been one of the most active in passing recent legislation in an effort to protect the industry. Fisheries regulations in Belize include size and weight limits and closed seasons for commercially exploited species, such as conch and lobster. Table 34 summarizes some of the fish regulations pertaining to specific species such as conch and lobster.

Table 33: Type of Enforcement Action taken by the Fisheries Department, 2000 - 2008

Type	2000	2001	2002	2003	2004	2005	2006	2007	2008
Arrests (no)	178	77	44	47	67	56	68	103	137
Convictions (no)	134	67	31	45	56	56	68	82	92
Boats Confiscated (no)	10	3	1	3	2	-	3	4	7
Conchs Confiscated (lbs)	1,874	1,874	2,270	6,175	2,655	2,787	-	562	959
Engines Confiscated (no)	13	3	1	3	2	-	3	4	7
Lobster Confiscated (lbs)	1,398	438	1,074	1,148	149	165	-	168	63
Total Fines Charged	**99,490**	**120,720**	**70,070**	**85,975**	**112,698**	**121,770**	**52,960**	**62,560**	**110,285**

Source: Fisheries Department, MoAF&C

Table 34: Fish Regulations Pertaining to the Protection of Specific Marine Species

Species	Closed Season	Size/Weight Limit	Legislation
Deer or antelope	July 1 – September 30 Males)/ last day of February (Females)		SI# 38/1980
Crawfish	February 15 - June 14	carapace length 3 inches tail weight should exceed 4 oz	SI # 168/1991
Conch	July 1 - September 30	7 inches shell length/m Meat weight should exceed 3 oz	SI # 143/1993
Green Turtle		All year (hunting not permitted)	
Loggerhead		All year (hunting not permitted)	
Hicatee	May 1 - May 31	Females > 43 cm < 38 cm cannot have 3 or more	SI # 55/1994
Hawksbill		All year (hunting not permitted)	
Shrimp	April 15 - August 14		SI # 139/1990
Nassau Grouper	December 1 – March 31st	Not less than 20 ins in total length or greater than 30 ins in total length	SI # 49/2009

Source: Fisheries Department, MoAF&C

Nassau grouper also benefit now from protection through a closed season, minimum size limit, whole fish landing and also the designation of certain spawning aggregation sites as protected areas. In addition to these elements, marine reserves in Belize usually include no-take zones that are supposed to be areas in which heavily exploited species can replenish (McField and Bood 2007).

In 2009, fisheries regulations were also enacted to totally protect critical herbivores in the Scaridae and Acanthuridae families. The grazers include parrotfish, which were usually caught, filleted and passed off as other fish. These species were heavily exploited due to scarcity of other more desirable species. The new 2009 regulations mandate that no person shall have in their possession any grazers and that all fish landed as fillet needs to have a 2 X 1 inch skin-patch so that the fish can be recognized.

Also in 2009, the Government passed a new sport fishing regulation that stipulates that "bonefish, tarpon and permit" are for catch and release only.

2.5.4.2 Other Responses

The Fisheries Department is in the process of legitimizing the Fishing Capacity, Sharks and Illegal, Unreported and Unregulated (IUU) Plans of Actions as required by the Food and Agriculture Organization (FAO) of the United Nations. The Fisheries Department has also embarked in the creation of a comprehensive national fisheries management plan. This plan will be strengthened with the upgrade and modernization of the substantive and subsidiary fisheries legislations.

Finally, after many years of neglect, the Government of Belize has increased the Fisheries budget in order for the necessary purchase of equipment and fuel for greater surveillance and enforcement. In order to maximize outputs the Fisheries Department is working as closely as possible with co-managers of its marine reserves.

2.6 Climate and the Environment

2.6.1 Climate Change

The energy that drives the earth/atmosphere system comes from the sun. Most of the incident energy is in the form of short-wave radiation. This radiation passes through the atmosphere virtually unimpeded except for most of the harmful ultraviolet radiation, which is absorbed in the upper atmosphere by ozone. The short-wave radiation is absorbed at the earth's surface, which becomes warmer, results in the earth radiating most of this energy as long-wave radiation back into the atmosphere. Certain gases such as Carbon Dioxide, Nitrous Oxide, and Methane in the atmosphere called greenhouse gases (GHG) absorb some of this energy. This leads to warming of the atmosphere. In the absence of these greenhouse gases, the earth/atmosphere system would be too cold to support life. The excess energy is radiated out to space and the earth/atmosphere system is maintained in radiative balance.

Over the last one hundred and fifty to two hundred years, the levels of greenhouse gases in the atmosphere have increased considerably, trapping more of the earth's long-wave radiation resulting in warmer global temperatures. Such increases have been scientifically measured at observing sites around the world.

The global concern over the anthropogenic contribution to Climate Change prompted over 150 countries to sign the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol to the Climate Change Convention. By signing the UNFCCC parties to the convention acknowledge "that change in the Earth's climate and its adverse effects are a common concern of humankind". Furthermore, Article 2 of the convention states that "The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Belize signed the UNFCCC in 1992. As part of their obligations upon signing the UNFCCC, countries that are party to the convention are required to submit periodic national communications which should include reports on GHG inventories that are conducted as part of the exercise to prepare the "Communication" to the conference of the parties. In fulfilling this commitment Belize has undertaken the inventory exercise, whose summary is used in the preparation of this section.

The inventory requires that information be accessed from several sectors. In 2000, the National Meteorological Services reviewed the emissions by sector (Table

35). The results indicate that the Land Use Change and Forestry (LUCF) sector has accounted for the highest percentage of GHG emissions since 1994. In 1994, the LUCF sector accounted for more than 72.7% of all emissions, while in 1997 this increased to 87.3% and a further increase in 2000 to 91.5% (Table 35). The energy sector was the second highest contributor, with emissions ranging from 21.8% of the totals in 1994, to 12.6% of totals in 1997 and decreasing to 8.4% in 2000. The decrease in the emissions from the energy sector during the years 1994 to 2000 were attributed in part due to the change of the default values for the GHG emissions that were used in the calculations but mostly due to introduction of Hydro power and purchase of electricity from Mexico; which influenced the results.

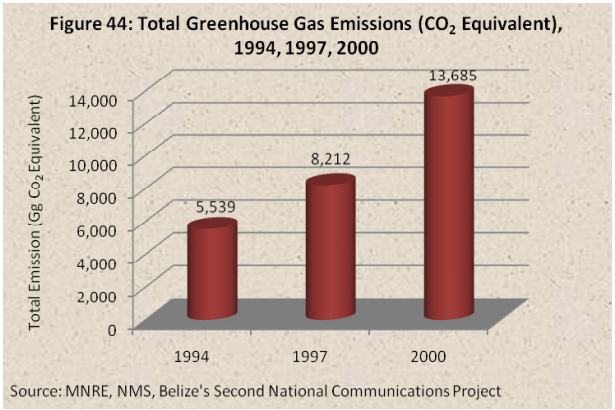
The waste sector was one of the lowest by percent, ranging from 3.7% in 1994 to less than 1% in the subsequent years. The agriculture and industrial sector processes both accounted for a little more than 1% of total emissions. Waste management is not measured and therefore may be underestimated (municipal waste and industry).

Table 35: Percent of GHG Emission by Sector, Gg, 1994, 1997, & 2000

Sector	1994r % of Total	1997 % of Total	2000 % of Total
Land-Use Change & Forestry	72.747	87.340	91.593
Energy	21.846	12.600	8.361
Waste	3.704	0.019	0.014
Agriculture	1.642	0.019	0.015
Industrial Processes & Solvents	0.061	0.022	0.016
Total	**100.000**	**100.000**	**100.000**

Source: MNRE, NMS, Belize's Second National Communications Project.

According to Belize's Second National Communication to UNFCCC, total GHG emissions for 1994, 1997 and 2000 were 2,827 Gg, 8,149 Gg and 13,238 Gg respectively. However, total emissions do not reflect the real impact of those gases on the atmosphere, i.e. some gases are more powerful than others. Nitrous Oxide has a GHG effect 320 times and Methane 24.5 time more powerful than Carbon Dioxide, CO2. In this context, GHG emissions in CO2 equivalent reached 5,539 Gg, 8,212 Gg and 13,685 Gg in 2294, 1997 and 2000 respectively (Figure 44).



By far the gas most responsible for the emissions is Carbon Dioxide. In the years 1997 and 2000, CO2 was the single gas responsible for all emissions averaging at 91%. In 1994, however, CO2 emissions accounted only for 47% (Table 36). Methane (CH4) and Nitrous Oxide (N2O) accounted for 8% and 2 % respectively in 2000 (Figure 45 & Table 36).

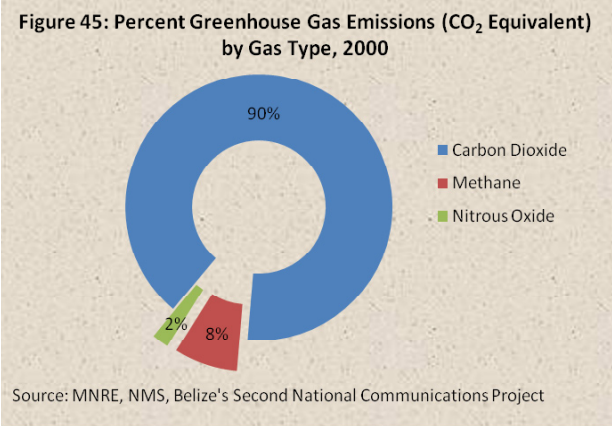


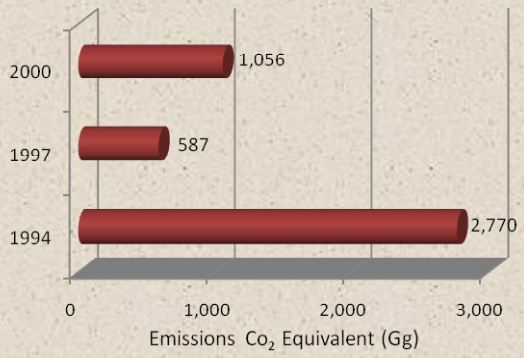
Table 36: Percent Greenhouse Gas Emissions (CO2 Equivalent) by Gas, 1994, 1997 & 2000

Greenhouse Gase	1994	1997	2000
Carbon Dioxide	47	92	90
Methane	50	7	8
Carbon Monoxide	…	…	…
Nitrogene Oxide	…	…	…
Non-Methane Volatile Organic Compound	…	…	…
Nitrous Oxide	3	1	2
Sulpher Dioxide			
Total	100	100	100

Source: MNRE, NMS, Belize's Second National Communications Project.

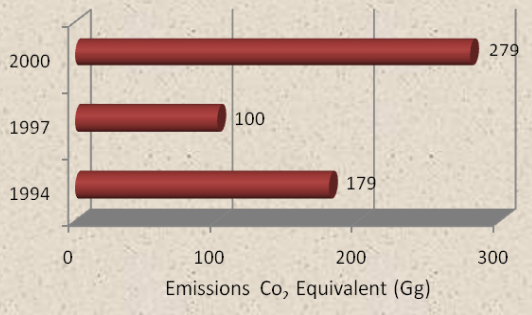
In terms of GHG emissions by other gases, the important GHGs are Sulpher Dioxide and Carbon Monoxide. Nonetheless, when emissions measured in CO2 equivalent the other important GHG become Methane and Nitrous Oxide. According to Figure 46, Methane emissions in CO2 equivalent was 2,770 Gg in 1994 decrease by almost fivefold in 1997 to 587 Gg but there was a twofold increase in 2000 to 1,056 Gg. The situation with Nitrous Oxide is quite different. In 1994 emission in CO2 equivalent was 179 Gg, decreased by almost 50% in 1997 standing at 100 Gg but the year 2000 marked an almost threefold increase standing at its highest level with 279 Gg.

Figure 46: Methane Emissions (Gg Co_2 Equivalent), 1994, 1997 and 2000



Source: MNRE, NMS, Belize's Second National Communications Project

Figure 47: Nitrous Oxide Emissions (Gg Co_2 Equivalent), 1994, 1997 and 2000



Source: MNRE, NMS, Belize's Second National Communications Project

2.6.2 Vulnerability to Climate Change

Climate Change is emerging as a serious threat to human health and well being, and it also threatens health directly because many diseases are sensitive to variations in climate. Changes in temperature, water availability and atmospheric conditions will affect most plants, animals and micro-organisms in some way or the other. Natural variability will lead to extreme heat waves, floods, droughts, severe storms, and other extreme events. Some of the most vulnerable infrastructure includes industrial plants and products; equipment for producing and distributing energy; roads, ports and other transportation facilities; residential and commercial properties; and coastal embankments. Most susceptible to extreme events are agro-industry; the production of hydroelectricity, biomass, and other forms of renewable resources; energy use; construction; some transportation activities; and infrastructure located in coastal zones.

The First (Initial) National Communication (INC) reported on Vulnerability Assessments conducted in the agriculture sector in 1995 under the US Country Studies Program, and the Second National Communications Project also conducted several vulnerability assessment reports. Future climate scenarios of 1 and 2° Celsius warmer temperatures accompanied by a ±20% change in precipitation were selected. The crop simulation model "Decision Support System for Agrotechnology Transfer" (DSSAT3) was used to simulate the yield of upland rice, beans and maize under these climates. The model projected a 14 to 19% reduction in yield for beans, a 10 to 14% reduction for rice, and a 17 to 22% reduction for maize. The temperature rise shortened the growing period of the crops, which lowered their yields. Changes in precipitation did not affect the growing season, but it did affect the yield, especially that of maize.

2.6.3 Responses

The Caribbean Community Climate Change Center (CCCC) with base in Belize was officially opened in August 2005 as agreed amongst member states of the Caribbean Community. The Centre has the objective to implement projects designed to prepare for and to reduce the harmful effects of climate change and sea level rise and seek ways in which the Community can benefit from any opportunities that may result from climate change. Additionally, the CCCCC is intended to position the Region to prepare itself for work arising from the United Nations Framework Convention on Climate Change (UNFCC). The Centre will serve the entire Caribbean region as a key node for information and initiatives regarding climate change by coordinating the region's response to managing and adapting to climate change.

The Government of Belize Policy for Adaptation to Climate Change, which is a comprehensive policy, for-

mulated through a consultative process shortly after the completion of the First National Communication, has remained a draft since the final steps to obtain government's endorsement have not been completed. It is planned that the process will be finalized after the second set of vulnerability assessments has been completed for the Second National Communication. The review of the draft will seek to address emergent issues that have been identified since the initial effort.

The Government of Belize Draft Policy for Adaptation to Climate Change encourages all agencies in Belize to explore and access the opportunities being developed by the climate change negotiation process such as capacity building, new sources of funding, and technology transfer. It also mandates the relevant government agencies to prepare adaptation policy options for their sectors.

The objectives of the Belize Draft Policy for Adaptation to Climate Change are to:

1. Explore and access the opportunities being developed through the climate change negotiation process to meet the development objectives of the nation.

2. Prepare all sectors of Belize to meet the challenges of global climate change.

3. Promote the development of economic incentives, which encourage investment in public and private sector adaptation measures.

4. Develop Belize's negotiating position on climate change at the regional and international levels to promote its economic and environmental interests.

5. Foster the development of appropriate institutional systems for planning and responding to global climate change.

The Draft Policy directs that the Chief Meteorologist, National Meteorological Service, is Belize's Focal Point on all matters related to climate change. The Government recognizes that there are many initiatives on climate change, which involve different sectors. The Chief Meteorologist is directed to remain abreast of these initiatives. Agencies involved in these initiatives are requested to provide reports to the Chief Meteorologist on these activities and on others of which they may be aware. Of special interest for this study is the statement on health. It is accepted that changes in air temperature and the water cycle could have serious effects on the nation's health. Disease vectors could become more prevalent and resilient to control measures leading to more outbreaks of diseases such as malaria, cholera and yellow fever. There could be more incidences of respiratory illnesses. Proposed directives for the Ministry of Health include:

- Undertake climate change vulnerability studies in the health sector.

- Prepare options to address the potential threats.

- Include a report on climate change related activities in the Ministry's Annual Report.

- Provide a report on its climate change activities to the National Climate Change Committee and the Chief Meteorologist.

The Belize Forest Department is the agency responsible for management and protection of forested areas. Approximately 14 % of the country is designated as forest reserves, with another 40 % of the terrestrial areas under some form of protection and conservation management. This agency is an essential partner to any implementation of Clean Development Mechanisms or their equivalent in the 'post-Kyoto' era. As the manager of national forests and protected areas this institution is a key stakeholder in the effort to reduce emissions from deforestation. Improved law enforcement to control illegal harvests will assist this objective, but better results will be achieved by the application of sustainable forest management practices across the country. To this end, the department will also have to engage the several non-government organizations involved in forest management.

After an enabling environment has been created with Belize's increasing demand for electrical energy, and continually increasing fossil fuel prices, it has become feasible and mutually favorable for the sugar factory and the electrical power produce to enter into partnership. The Belize Electricity Limited and Belize Sugar Industries have completed negotiations to enable the supply of electrical energy, under a co-generation scheme, to the power company throughout the year. This will be generated using the bagasse (waste) from the sugar factory. This will help to reduce the amount generated using fossil. At the time the negotiations were initiated, the mix of

energy production was described as 63 % purchased from Mexico, 17 % from Hydro in Belize, and 20 % from fossil fuels (Tillett, 2006). With the BSI Co-generation plan coming on line in 2009, the proportions of the energy mix would be change to 1 % fossil fuels, 44 % purchased from Mexico, and 22 % from BSI Co-generation at a guaranteed 13.5 megawatts throughout the year (Tillett, 2006). In 2006 the sugar industry catered to over 6000 farmers, and represented 46 % of the labor force in the agriculture sector. It also accounted for 7.8 percent of GDP at that time (Tillett, 2006).

Solar energy is another source being considered. One entire village in southern Belize has been energized utilizing solar panels. The abatement impact of this project is currently being evaluated under the SNC project.

2.7 Loss of Water Quality and Quantity

2.7.1 Importance of Water

Water is undoubtedly the most essential substance for life. It is essential for the survival of all biological organisms, including man, who must directly consume it. On a larger temporal and spatial scale water minimizes changes in climate. Therefore, the most important natural resource that a country possesses is an abundant and clean water supply.

The global supply of freshwater is unequally distributed and its per capita availability is declining worldwide (UNEP, 2007). A portion of the world's population already lives in water-stressed environments, but, if present trends continue, it is expected that 1.8 billion people will be facing water scarcity by 2025 (CSO, 2004; UNEP, 2000, 2008). As countries all over the world face increasing shortages in their clean water supplies due to increasing consumption, contamination and the effects of climate change, those countries with abundant clean water supplies will be at a significant advantage.

2.7.2 Pressures on and State of Water Resources in Belize

Belize had the highest per capita volume of freshwater available in Latin America in 1995 and the country possesses a more than adequate surface and groundwater supply. Boles et al. (2008) point out that the country is regionally recognized for its abundance of good quality freshwaters. While Belize is recognized as having one of the best qualities of water, this resource may be threatened if the pressures are not addressed.

In Belize the major driving force that is leading to the direct pressures impacting upon the country's water resources is impending and rapid development. As the population grows, there is a need to supply water to new residences in urban and rural settlements. However, the largest portion of the development occurring is a direct result of the country seeking economic growth through the expansion of industries such as agriculture and tourism (e.g. the Cayes). These three types of development bring with them an increased demand for water and particularly treated water as more of the water sources become contaminated. This is particularly the case in rapidly expanding areas such as Belmopan, where many housing projects lack proper disposal and sanitary systems. According to BEST (2008) the vulnerability of Belize's water resources may ultimately be determined less by an increase demand for water and more due to the loss of water quality due to pressures such as contamination and salt water intrusion.

In fact, the major direct pressures on the country's water resources that result from development as a driving force and which will lead to a loss of water quality and quantity include contamination and pollution from the use of agrochemicals and fertilizers and the discharge of liquid effluents.

Other pressures on Belize's environment such as deforestation compound pressures such as contamination. This is because the erosion resulting from deforestation can increase the amount of run-off from agrochemicals. Pollution from the oil industry is now also a concern. Other pressures include increased waste and illegal dumping of waste, the use of rivers for washing clothes, an increase in latrines, land filling and drainage of wetlands as illustrated by development in the Belize City area and Placencia, alteration of water courses (drainage), and climate change. Climate change is expected to result in an increase in natural disasters including floods and drought.

The pressures outlined above all result in reduced water quality and quantity, two greatly intertwined issues. Pollution cannot be offset without the appropriate water flow to "sustain the social, ecological and hydrological

Table 37: Water Consumption by Area (mn gals), 2000 - 2007

City/Town	2000	2001	2002	2003	2004	2005	2006	2007
Belize City	664.7	648.1	655.8	772.1	830.0	825.4	815.2	816.6
Belmopan City	117.7	120.1	116.6	137.0	163.2	165.8	174.7	195.0
Benque Viejo Town	38.2	41.0	40.2	45.7	50.6	36.6	46.8	50.2
Corozal Town	76.7	94.0	92.2	99.9	115.1	113.7	114.1	123.6
Dangriga Town	77.6	76.9	75.4	77.8	81.6	85.3	89.3	93.8
Orange Walk Town	106.6	110.6	112.4	115.2	126.1	129.0	130.0	141.5
Punta Gorda Town	35.4	49.8	49.5	37.1	43.8	47.1	50.6	56.4
San Ignacio Town	114.1	121.8	118.7	132.6	169.4	179.4	163.6	174.6
San Pedro Town	69.6	74.3	73.7	76.6	99.9	99.5	110.0	122.4
Consumption	**1,300.6**	**1,336.6**	**1,334.5**	**1,494.1**	**1,679.8**	**1,681.9**	**1,694.3**	**1,774.0**
Abstraction	**2,355.1**	**2,575.7**	**3,057.0**	**2,919.6**	**2,913.9**	**2,787.3**	**2,711.2**	**2,857.3**
% Loss	**44.8**	**48.1**	**56.3**	**48.8**	**42.4**	**39.6**	**37.5**	**37.9**

Source: Belize Water Services Limited

functions of watersheds and wetlands" (Krchnak, 2007). So what is the state of Belize's freshwater resources? The country has 16 major watersheds apart from numerous smaller coastal tidal creek watersheds, which are not always found in their entirety within Belize (Boles et al. 2008). The headwaters for most of the major watersheds in central and southern Belize have their origin in the Maya Mountains Massif, a region of the country which still remains forested but which is starting to experience increasing deforestation and poaching pressures as illegal incursions, particularly from people living along the Guatemalan border continue to increase. However, the intactness of the Maya Mountains has to a large extent helped to safeguard the quality and quantity of much of the water resources for the country so far.

The total water abstraction for the country's urban centers in 2007 was 2,857.2 million gallons (Table 37). Figure 48 shows that total water abstraction for urban centers shows a generally declining trend since 2002, except in 2007 when an increase was registered. This decline can be justified because the water company has been instrumental in controlling the amount of water loss per year to suffice water consumption demands (Table 37). The fast increase in water abstraction for 2002 was due to the major fact that the amount of water loss was 56.3% while consumption for that period was only 46.7%. The total water consumption for the country's urban centers for 2007 was approximately 1,774 million gallons; with a 37.9% loss from the total water abstracted (Table 37). Unlike the water abstraction trend observed above, Table 37 shows that water consumption in the urban centers in the country continue to increase. Belize City records the highest quantity of water consumption in Belize (Table

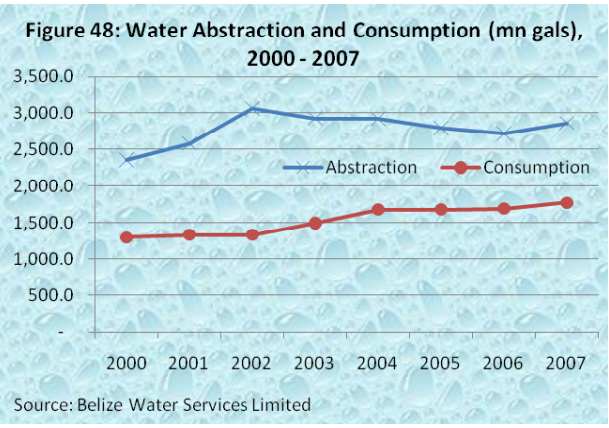


Table 38: Water Connections by Area, 2003 – 2007

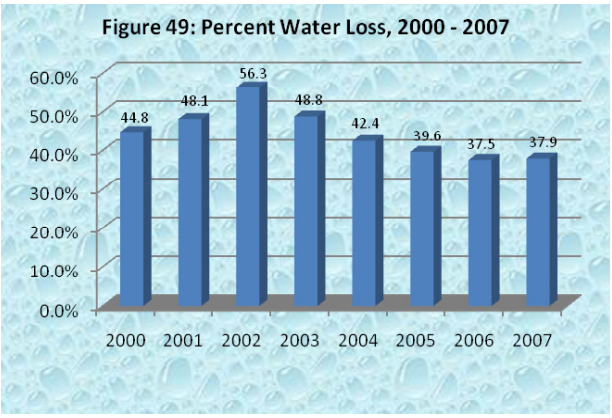
City/Town	2003	2004	2005	2006	2007
Belize City	16,364	16,388	16,323	17,614	18,072
Belmopan	3,797	4,089	4,114	4,336	4,548
Benque Viejo	1,628	1,663	1,686	1,602	1,579
Corozal	3,465	3,724	3,579	3,726	3,828
Dangriga	2,404	2,520	2,391	2,439	2,536
Orange Walk	3,777	3,619	3,646	3,827	3,965
Punta Gorda	1,374	1,429	1,454	1,505	1,758
San Ignacio	4,167	4,215	4,964	4,584	4,802
San Pedro	2,116	2,117	2,197	2,497	2,747
Total	**39,092**	**39,764**	**40,353**	**42,130**	**43,835**

Source: Belize Water Services Limited

37).

Increase water consumption is directly related to increased number of water customers. As expected the number of water costumers in the nation has been increasing (Table 38). As per Table 38, 41% of water customers are in Belize City – the biggest water consumer. Interestingly Benque Viejo Town was the only urban area to record a decrease, 2%, in the number of customers in 2007.

Whilst analysis of trends in volume of water usage is a measure that is used to monitor water balances, analysis of trends in per capita water consumption is an important measure for observing human behavior for example in water conservation measures. In contrast to trends observed in Table37 where there is a generally increasing trend in water consumption particularly influenced by increasing population, the daily per capita water consumption rate fluctuates from year to year. In 2002 the lowest daily per capita water consumption rate (23.7 gallons/person/day was recorded, the highest rate of 27.6 gallons/person/day in 2004 was observed but the rate remained at 26.0 gallons/person/day in 2007(Table 39).San Pedro Town, Belmopan and Belize City report the highest daily per capita water consumption rates with 32.2, 30.4 and 29.9 gallons per person per day in 2007 (Table 39). Whilst San Pedro Town reported the lowest volume of water consumption (Table 37), the picture is different in terms of daily per capita water consumption rate where it ranks the highest. A contrasting trend is observed for Belize City using the same analysis.



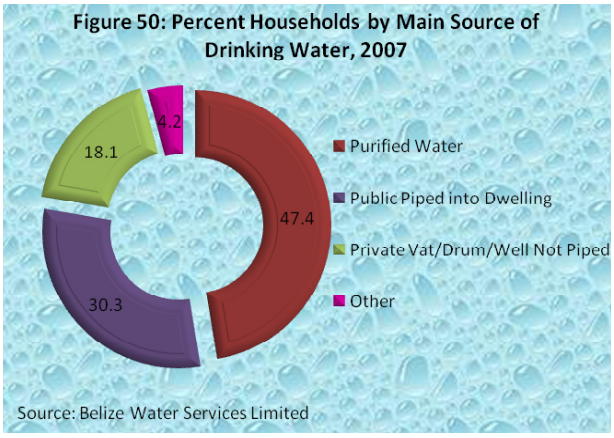
The CSO (2004) reports that according to BWSL, water losses, at least for 2003-2004 were mainly due to leakages, illegal connections and the under-registration of meters. It is likely that the same factors accounted for water loss thereafter. However, despite the steady increase in water consumption since 2000 (Figure 48), water losses have been decreasing since 2002 which marked the highest level water loss rate during the period with approximately 56.3% loss (Table 37, Figure 49). This increase in the water use efficiency may be partly due to a recent public awareness campaign launched by BWSL on water conservation and also escalating utility prices. There is much room for improvement in increasing the efficiency of use of the total water abstracted per year given that a 37.90% loss in all urban areas, as in 2007, is still very significant.

In 2000, a household's main source of drinking water was private vat/drum/well not piped into dwelling (27 percent of households) and public piped into dwelling (26 percent of households) (CSO 2004). However in 2004, purified water (32 percent) and public piped into dwelling (24 percent) were the main sources. The trend towards

Table 39: Daily Per capita Water Consumption (gals), 2001 – 2007

City/Town	2001	2002	2003	2004	2005	2006	2007	2007
Belize City	28.3	27.9	31.9	33.3	32.1	30.8	29.9	816.6
Belmopan	28.7	25.8	27.7	30.2	30.6	29.7	30.4	195.0
Benque Viejo	15.2	14.2	15.3	16.0	10.9	13.2	13.4	50.2
Corozal	17.7	17.1	18.1	20.6	19.9	19.7	20.9	123.6
Dangriga	22.5	21.3	21.3	21.5	21.6	21.8	22.1	93.8
Orange Walk	17.2	17.0	17.0	18.1	18.1	17.7	18.8	141.5
Punta Gorda	28.8	28.2	20.3	23.4	24.7	26.0	27.9	56.4
San Ignacio	21.9	20.5	22.0	26.9	27.4	24.0	24.6	174.6
San Pedro	37.0	33.1	30.8	36.0	32.5	32.4	32.2	122.4
Total	**24.7**	**23.7**	**25.6**	**27.6**	**26.8**	**25.9**	**26.0**	**1,774.0**

Source: Belize Water Services Limited



more households relying on purified water and piped water as their main source of drinking water is even more pronounced in 2007 as seen in Figure 50. In this year, the majority of households used purified water (47.4 percent) and piped water (30.3 percent) as their main sources of drinking water. These figures seem to indicate that access to potable water has been increasing countrywide but perhaps not as fast as access to purified water. The mobility of purified water, made accessible to stores nationwide, perhaps coupled with the perception that purified water is the best possible source of drinking water, has contributed to its dramatic rise as the major source of drinking water in the country.

2.7.3 Impacts

A decline in the quantity and quality of water in Belize can bring an entire slew of social and economic impacts. Degradation of water quality can result in a decline in human health due to an increase in water borne and water related diseases such as cholera, dysentery and typhoid fever. Contaminated water is in fact cited as "the greatest single environmental cause of sickness and death" (UNEP, 2007). Increased sickness also translates into economic losses for any country as governments are forced to spend money on the treatment and prevention of diseases. Moreover, as water quality declines there is a need for more intensified treatment of water, which ultimately translates into consumers paying more for such treatment services.

Declines in water quantity as well as phenomena such as droughts and floods, expected to intensify with global climate change, also have negative socio-economic impacts particularly on the agricultural sector. In Belize, the agriculture industry is one of the country's largest income earners and any decrease in productivity negatively affects the ability of the country to generate foreign exchange from agricultural exports as well as diminishes the food security of Belizeans.

In terms of the environment, the impacts of a decline in water quality and quantity are also significant, and in and of themselves have socio-economic ramifications. One example that helps to illustrate these impacts is the loss of aquatic life due to contamination and saltwater intrusion. This aquatic life can be in the form of freshwater fishes, an important source of protein and livelihoods for fishing communities. However, contamination of water is not limited to only freshwater. The aquatic life arising from Belize's coral reefs is also coming under intense pressure due to the effects of sedimentation and agricultural run-off (see Coral Reef Decline section in this chapter) because activities occurring in the mainland ultimately affect the coast as these two systems are connected through freshwater systems.

2.7.4 Responses

Cardona (2005) summarizes the current legislation dealing with Belize's Fresh water resources under the following four areas of focus: supply of water and sewerage services, water safety for human consumption and health, protection and conservation of water sources and water abstraction. The primary and most comprehensive piece of legislation in Belize dealing with several of these areas of focus is the 2001 Water Industry Act, CAP. 222. This Act provides for the supply and control of water and sewerage services in the entire country and the licensing of persons to provide these services to the public. As Cardona (2005) notes, the licensing component also includes exclusive licenses for the provision of water and sewerage services to the public. It was under this Act that the assets and liabilities of the former nationally-owned Water and Sewerage Authority (WASA) were transferred to the Belize Water Services Limited (BWSL), a private company. The Water Industry Act charges the licensee with the provision of a safe and reliable supply of water and sewerage services and also the upkeep, improvement and extension of these services. Under this Act the Public Utilities Commission (PUC), established under the Public Utilities Commission Act, CAP. 223, is the entity responsible for monitoring and regulating the activities and operations of the licensee.

Apart from the provision of services, the Water Industry Act also stipulates that gathering grounds should be retained as Forest Reserves, National Parks or declared to be controlled areas by the Minister responsible for Forests. The Act also provides for the regulation of the discharge of wastes that can negatively affect water resources and allows for the Minister to take into consideration the manner in which the law is applied for the protection of the flora and fauna of water and watercourses. In both instances the Act demonstrates its relevance to the protection of water resources. The country of Belize has yet to place an economic value on environmental services such as the generation and maintenance of clean water by intact ecosystems. This makes it hard to increase efficiencies in water use based on value.

In terms of water abstraction, the Act provides for the regulation of water abstraction and use in any area of Belize designated for such regulation in the public interest. Licenses for abstraction must be obtained in any controlled area, controlled use area or controlled class of uses area unless the water is to be used for domestic purposes.

The Village Councils Act, CAP. 88, is a second piece of legislation dealing with the first area of focus, the supply of water and sewerage services. The Village Water Boards established under this Act are the responsible entities for operating and maintaining adequate water supply and services. The agencies that oversee the provision of water services in the rural areas are the Ministry of Rural Development supported by the Social Investment Fund, and have responsibility to approve plans and designs. In urban areas the city and town councils are charged with the responsibility of setting up and controlling public lavatories, garbage collection and ensuring that public drains and canals are maintained as per the Belize City Council Act, CAP. 85, the Belmopan City Council Act, CAP. 86, and the Town Councils Act, CAP. 87.

The second area of focus for water resources legislation according to Cardona (2005) is water safety for human consumption and health. The primary legislation dealing with this area is the Public Health Act, CAP. 40. This Act charges the Director of Public Health with the inspection and monitoring of water and sewerage works under the control of any public or private entity responsible for ensuring the supply of water and sewerage works for human health purposes.

Table 40: Monitoring of Other Drinking Water Sources, 2006

Source	No. of Samples Tested	No. of Samples Found Contaminated with Fecal Coliform
Private Well	100	28
Creek	55	18
Rainwater Tank	9	3
Rivers	10	9
Other (ponds etc.)	8	5

Source: Public Health Bureau

The protection and conservation of water sources is the third area of focus for water resources legislation and apart from the Water Industry Act is mainly dealt with by the Coastal Zone Management Act, CAP. 329, the Environmental Protection Act, CAP. 328, the Forests Act, CAP. 213, the National Parks System Act, CAP. 215, and the Land Utilization Act, CAP. 188 (Cardona, 2005). Most of these Acts deal with water resources as part of a general mandate to ensure the sustainable use of the country's natural resources and protect the environment in general. The Environmental Protection Act (Effluent Limitations) Regulations, CAP. 328, is a set of regulations that does directly apply to water resources. It provides for the regulation of the discharge of sewage or industrial effluent into any inland or marine waters. The Environmental Impact Assessment Regulations, CAP. 328, also directly pertain to water resources. These Regulations mandate that an EIA must be conducted for activities that could negatively impact water resources. Finally, the land Utilization Act makes a provision for the demarcation of water catchment areas or watersheds and prohibition of vegetation clearing in those areas.

The final area of focus for existing water legislation in Belize is water abstraction (Cardona, 2005). Both the Petroleum Act, CAP. 225, and the Mines and Minerals Act, CAP. 226 regulate water abstraction for the purposes of petroleum operations and extraction of a substance of commercial value respectively.

As already mentioned, the Water Industry Act is the most comprehensive piece of legislation dealing with water resources in Belize. It is clear from this Act and from other existing legislation thus far presented, that the water legislation for the country lacks integration. Often different sets of legislation and their enforcement rest at

the hands of different entities not necessarily under the same Ministry. A draft 2006 Cabinet paper, aimed at obtaining approval for current drafts of a water policy and bill, summarizes the current system of water resources management as "incoherent, fragmented and not ensuring the planned allocation, sustainable development and adequate protection of water resources". Moreover it points out that there is confusion as to the ownership and use of water resources and conflicts in their allocation and protection.

Despite this present state, it is clear that the country has long recognized the need for integrated water resources management (IWRM) as seen by the establishment of a Pro Tempore Water Commission with a Secretariat at the National Hydrological Service and the development of a draft "Water Resources Management Policy, Planning and Organization and Water Resources Bill" in 1994. As Cardona (2005) points out, even the 2001 Water Industry Act reflects the principles of IWRM in some of its policy statements, seemingly pointing the way forward. Section 14 of the Water Industry Act states that the policy of the Government is "to see to the orderly and coordinated development and use of Belize's water resources, to conserve and protect such resources for the benefit of the future and present generations of Belizeans and provide the Belizean public with a safe, adequate and reliable supply of water with dependable public sewerage services". In addition, Section 14 also states that the Minister of Natural Resources "shall promote a national policy for water" so that water resources may be conserved, properly used and so that gathering grounds may be protected. Furthermore, Section 26 of the Act stipulates that licensees have a duty to carry out certain technical obligations, in consultation with the relevant government agencies, including the preparation of plans for more efficient management of the country's natural resources (Cardona, 2005).

At present a draft IWRM Policy, a draft Water Resources Management Act, and a draft Cabinet paper asking for approval of the draft policy, the draft Act, and establishment of a National Water Resources Commission (NWRC) have been developed. The policy includes thirteen components including the establishment and maintenance of a comprehensive information system on water resources, the vesting of water resources in the state, domestic use taking precedence in the event of scarcity, the preparation and updating of a National Water Resources Master Plan, access to potable water for all, approved means of disposal for all for prevention of contamination of water resources, improvement of the effectiveness and efficiency of water use, the preservation of resources at levels of quality, the prevention of pollution, the provision of an institutional framework for dealing with all aspects of water resources planning, management and development, the development of management and technical expertise, the development of financial arrangements, and cooperation with neighboring countries in accordance with international conventions and guidelines (Cardona, 2005).

The draft Water Resources Management Act would ensure the management of our water resources, and complement the Water Industry Act, if passed into legislation. The Act provides for the management, controlled allocation and sustainable use and protection of the country's water resources. It also provides for water quality control and the establishment of a National Water Resources Commission (NWRC).

2.8 Waste Management in Belize

2.8.1 Solid Waste Management

One of the biggest threats to Belize's water resources and the environment continues to be the threat of contamination from solid and liquid wastes. The country's lack of a comprehensive waste management system is consistently cited as one of the greatest environmental challenges and is a key topic brought up as a major issue at national meetings and consultations on environmental matters (BAS, 2008; Young, 2008).

In the solid waste sector, Belize continues to face overall managerial challenges. Despite improvements in the collection service as well as legislative improvements, the country is still faced with the lack of adequately designed final disposal facilities. That said, it should be noted that there is an increasing level of organization in addressing this issue. However, the facilities serving the rapidly expanding urban population are being stressed and the capacity of these systems to cope with increasing effluent loading is being reduced.

Through a loan from the Inter American Development Bank (IDB), the solid waste program will focus on the solid waste management needs of the Western Corridor (Belize City, San Ignacio and Santa Elena, San Pedro

and Caye Caulker), and will also strengthen the overall capacity of the central government to improve solid waste management. The total population served along the Western Corridor is 119,000 people, which accounts for 40% of the total population of Belize.

The infrastructure investments of the program include the closure of the open dump site in Mile 3 and the construction of a main waste transfer facility to help waste separation and recycling, the construction of a new regional waste disposal facility at Mile 24 and the long haul of wastes volumes for final disposal at the new site. Open dumpsites in San Pedro, Caye Caulker and San Ignacio will be close down and transfer facilities in those sites or in alternative sites will be built.

The institutional strengthening component will assure that capacity within Belize's Solid Waste Management Agency (SWMA) is in place to execute the project and carry out its mandate.

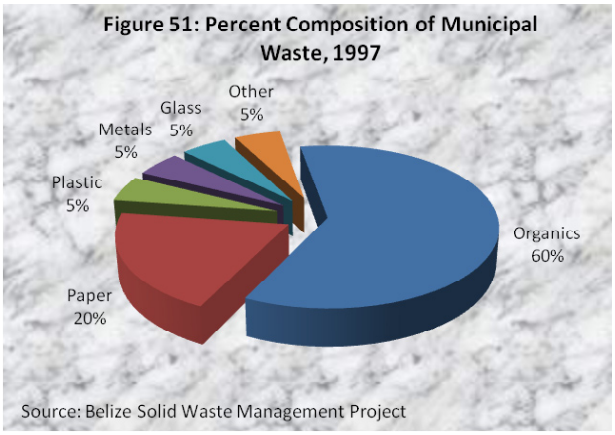
One consequence of the lack of a systematic solid waste management includes the open dumping of garbage, particularly in urban areas of the country. Open dumpsites are common, and are as a result of the lack of management systems for these wastes. Burning solid waste in open dumpsites or in people's backyards is another common practice. Open dumpsites provide the perfect place for flies, rodents and other potential disease carrying organisms to thrive and along with the toxic fumes released from the burning of plastics, rubber and any other forms of solid waste pose a major health hazard.

The country's most precious resource, clean water, including groundwater sources, is also heavily threatened by improper solid waste disposal. Many designated solid waste dumping grounds in the country, are located in environmentally sensitive areas such as wetlands and swamps that allow for leachate or contaminants from the waste to enter water bodies directly or easily. The illicit disposal of solid waste and garbage also takes place in other sensitive environments including riverbanks and waterways, along the seashore, and on small islands. In certain beach areas, such as the Placencia Peninsula and offshore cayes, the impact of solid waste is compounded by the tourism activities and by the large garbage loads that arrive across the sea from nearby countries or from the dumping of garbage in the open seas. This increases the threat to the country's marine environment, including the Barrier Reef, an extremely sensitive ecosystem. Include data on coastal waste collected by the scouts association, if possible.

Presently, there exists limited data on the impacts or level of contamination of Belize's environment as a result of the lack of waste management. Currently, there is no routine monitoring in place at designated dumpsites to determine the possible impacts such as from leachate or other by-products of waste decomposition from dumpsites.

Waste disposal has become a necessary function of modern society. Economic activity involves the production, consumption, and the ultimate disposal of materials consumed by individuals and industries. The composition of waste to be disposed provides useful input such as recycling and composting initiatives. Reuse and recycling are becoming important means of achieving a sustainable

Open Dump Sites in Southern Belize



development. It is very important to note that most (60 %) of the municipal waste generated in Belize is organic in nature (Figure 51), which means that if properly disposed of, it will effectively be taken care of by natural processes of decomposition.

Waste also contributes to the increase of atmospheric concentrations of GHGs. The bulk of the emissions from this sector consist of methane from the decomposition of organic waste from the landfill sites. If not properly managed, sanitary landfills could have the potential of releasing pollutants to water bodies and soil.

Based on the Belize Solid Waste Management Project (1999), in 1997 a total of 38,148 tons of waste was generated on the Urban Centers of the country. Further analysis revealed that the daily per capita waste generation rate stood at 2.1 pounds/person/day in 1997. In 2000 the Central Statistical Office estimated that the volume of waste generated by the municipalities reached 69,357 tons (Table 42) increasing the daily per capita waste generation rate at 3.4 pounds/person/day (Table 41). In less than

Table 41: Estimated Daily Per Capita Solid Waste Generation Rate, lbs/person/day, 2000 - 2008

Municipality	Daily Per Capita Waste Generation Rate								
	2000	2001	2002	2003	2004	2005	2006*	2007*	2008*
Corozal	3.2	3.5	3.8	4.1	4.4	4.8	5.2	5.6	6.0
Orange Walk	2.8	2.6	2.9	3.4	3.8	4.3	4.6	5.2	5.9
Belize City	4.2	4.5	4.8	5.1	5.4	5.8	6.2	6.6	7.0
San Ignacio	3.0	3.4	3.8	4.6	5.3	5.6	5.9	6.2	6.5
Benque	2.5	2.6	2.7	2.9	3.0	3.2	3.3	3.5	3.7
Belmopan	2.6	2.7	2.8	2.6	2.6	3.1	3.3	3.4	3.5
Dangriga	2.1	2.2	1.7	1.4	1.9	2.6	2.7	2.8	2.9
Punta Gorda	2.2	2.4	2.8	3.5	3.5	3.9	4.4	4.9	5.6
San Pedro	4.8	6.0	5.0	5.1	5.1	5.2	5.3	5.4	5.5
Total	**3.4**	**3.6**	**3.8**	**4.1**	**4.5**	**4.8**	**5.1**	**5.4**	**5.8**

(*) Estimates.

Source: Land Information Centre, MNRE.

Table 42: Estimated Solid Waste Generated by Municipality, 2000 - 2008

Municipality	Tons per annum								
	2000	2001	2002	2003	2004	2005	2006*	2007*	2008*
Corozal	4,680	5,151	5,669	6,240	6,868	7,559	8,320	9,157	10,078
Orange Walk	6,365	7,348	8,482	9,953	11,552	13,409	15,064	17,390	20,074
Belize City	37,070	40,439	44,115	48,125	52,499	57,271	62,477	68,155	74,350
San Ignacio	7,072	8,352	9,864	12,288	14,773	16,250	17,875	19,663	21,629
Benque	2,080	2,336	2,625	2,948	3,311	3,720	4,179	4,694	5,273
Belmopan	3,510	4,020	4,604	4,680	5,186	6,915	7,919	9,070	10,387
Dangriga	3,120	3,359	2,617	2,340	3,250	4,514	4,860	5,233	5,634
Punta Gorda	1,560	1,799	2,075	2,730	2,787	3,185	3,674	4,237	4,888
San Pedro	3,900	4,404	4,973	5,616	6,342	7,161	8,086	9,131	10,311
Total	**69,357**	**77,208**	**85,024**	**94,920**	**106,568**	**119,984**	**132,454**	**146,730**	**162,624**

(*) Waste estimates derived using per capita waste generation rate and population statistics

Source: Land Information Centre, MNRE.

ten years the per capita waste generation rate has almost increased twofold standing at an estimated 5.8 pounds per person per day in 2008 (Table 41). Belize City, San Ignacio and San Elena Towns, Corozal Town and Orange Walk Town have a daily per capita waste generation rate well above the national average.

Unpublished results from a recent survey in San Pedro indicate that the average current daily solid waste generation rate per person is above 7 pounds (A. Castañeda, pers. comm.). This is a very high solid waste generation rate and is likely due to the high number of hotels and tourists in this town and a higher rate of consumption of goods in disposable packages and bottles. In fact it is estimated that tourists produced between 6.8 and 7.6 pounds of solid waste per overnight stay from 2000-2005, resulting in the generation of between 2,258 and 3,447 tons of solid waste per year in this same period (LIC, 2006). However, the LIC (2006) estimates are based on the national daily per capita solid waste generation rate and if as expected the tourist industry results in a higher rate of consumption of prepackaged goods and bottled drinks then these are underestimates.

Using the estimated per capita waste generation rate of 2008, the major towns in the country produced an estimated total 162,624 tons of solid waste in 2008 (Table 42). This quantity represents an almost 2.5 times increase compared to 2000 when total waste generation in urban centers reached 69,357 tons. According to this estimates, Belize City generates approximately 46% of total waste generated by the urban areas in Belize. During this same period, San Ignacio/Santa Elena and Orange Walk Town produced the second and third highest annual amounts of solid waste, respectively.

The assumption that daily per capita waste generation rates in urban areas of Belize is similar to that of the rural areas gives a good perspective of the total volume of waste generated in the country. Using this principle it is observed that waste generation in Belize increased from 128,335 tons in 2000 to 292,658 tons in 2008 representing over a twofold increase (Table 43). As expected, Belize and Cayo Districts generate the highest volumes of waste (57%) throughout the country.

Households, particularly in urban areas, are consistently producing more garbage. This trend likely reflects the shift in our society to a more consumer-based culture that does not have as much necessity to re-use materials either because they can afford not to or because when buying goods they are confronted with an overwhelming amount of prepackaged and disposable items at a cheaper price. An obvious example today is the widespread use of disposable plastic and foam products equally available from the larger commercial businesses to street vendors. Table 44 summarizes the imports of certain potential waste products into the country from 2003 to 2007, including paper, plastic bottles, glass bottles, and batteries, new and used tires. There is a generally increasing trend in the imports of paper during the period 2003-2007 except in 2007 when there was a substantial decrease of over 50% from the 2006 figures (Table 44). Imports of plastic bottles continue to show an increasing trend but a remarkable increase was observed in 2005 when imports almost tripled compared to the 2004 figures (Table 44). Import of glass bottles also continue to show growth. Import of batteries increased 1.5 times from 28,754 in 2003 to 43,492 in 2007 but recorded a 35% decrease in 2007 compared to 2006. Import of new tires showed a 19% increase during the period 2003 to 2007. Interestingly the imports of used tires in the country recorded a 35% fall in 2007 compared to 2006.

Table 43: Estimated Solid Waste Generated by District, 2000 - 2008

District	Tons per annum								
	2000	2001	2002	2003	2004	2005	2006	2007	2008
Corozal	17,382	19,125	21,070	22,973	25,247	27,540	30,184	32,966	35,968
Orange Walk	18,345	17,061	20,017	23,854	26,884	31,183	34,811	39,920	46,316
Belize	51,353	57,159	61,594	67,508	71,596	83,666	88,821	97,207	106,488
Cayo	24,174	27,548	31,384	35,821	41,045	46,480	50,865	55,696	61,006
Stann Creek	8,685	9,346	7,284	6,529	9,031	12,539	13,495	14,526	15,634
Toledo	8,396	9,725	11,367	14,788	15,243	17,581	20,459	23,423	27,246
Total	128,335	139,963	152,717	171,472	189,046	218,989	238,635	263,738	292,658

Source: Land Information Centre, MNRE.

Table 44: Imports of Potential Waste Products, 2003 – 2007

Type	Units	2003	2004	2005	2006	2007
Paper	lbs	24,259	25,048	25,807	29,620	13,943
Plastic Bottles	lbs	822,026	915,248	2,300,029	2,830,416	3,211,887
Glass Bottles	no	2,323,152	2,699,200	3,696,141	3,075,759	4,173,809
Batteries	no	28,754	31,731	55,385	66,518	43,492
New Tyres	no	77,960	73,946	94,341	75,324	93,103
Used Tyres	no	29,750	33,952	29,672	41,467	27,116

Source: Statistical Institute of Belize (SIB)

Table 42 reflects the solid waste generated by and collected from households and businesses in urban areas. However, apart from this waste, many of our industries also produce their own solid waste. Available figures from the LIC (2006) show that the country's shrimp industry generated from 3,835 tons of waste in 2003 to 5,781 tons in 2005. In the shrimp industry approximately 35% of the total production is waste. Whilst the country's citrus processors produced 139,083 metric tons of solid waste per year in 2000 to 131,762 metric tons in 2007 in the form of peel from oranges and grapefruits (Table 45). Run-off from the solid waste generated by both the shrimp and citrus industries has been a cause for concern in the past to the Department of Environment. Run-off from composting citrus peels result in high levels of biological oxygen demand (BOD) during decomposition. When the effluent enters sensitive areas such as water bodies in the Stann Creek District, this can lower the dissolved oxygen (DO) in the water body choking biological organisms living in it. There is currently a plant in the Stann Creek District that is using citrus peels and dried pulp to make cattle feed.

Table 45: Solid Waste Generated by the Citrus Companies (metric tons), 2000 - 2007

Year	Rinds (Solid Waste)			
	Orange	Grapefruit	Total	Compost
2000	113,083	26,000	139,083	-
2001	100,980	23,830	124,810	-
2002	83,867	22,247	106,114	-
2003	70,315	32,011	102,326	-
2004	101,320	39,221	140,541	56,216
2005	122,681	17,189	139,870	55,132
2006	98,491	32,900	131,391	52,556
2007	104,889	26,872	131,761	52,704

Another industry that also creates solid waste is the sugar industry (Table 46). This industry generated a total of 407,065 to 370,551 tons of waste per year in crop year 2001/2002 to crop year 2007/08. However 69 to 82 percent of the total waste generated by the sugar industry during this period was used for energy production in a given crop year, 7 to 8 percent was incinerated and 10 to 13 percent was discarded (LIC, 2006).

2.8.2 Liquid Waste Management

Apart from solid waste, liquid wastes and sewage also pose a threat to the country's water resources. At the same time, individual efforts by the commercial and industrial sector to treat and manage liquid waste and effluents are

Table 46: Sugar Production & Baggase Generated by the Sugar Industry, tons 2001/02 – 2007/08

Crop Year	Sugar Production	Total Waste Generated	Waste used for energy production	Waste Incinerated	Waste Discarded	Filter Mud Produced
2001/02	113,184	407,065	281,606	72,717	52,742	66,006
2002/03	106,162	402,027	237,451	68,037	96,539	73,322
2003/04	116,576	382,705	238,747	70,485	73,473	74,490
2004/05	100,435	321,909	265,176	24,300	32,433	51,917
2005/06	111,394	417,219	321,564	-	95,655	65,361
2006/07	97,254	426,395	355,092	0	71,280	69,810
2007/08	78,220	370,551	335,280	0	35,271	64,154

Source: Land Information Centre, MNRE

slowly improving. The above-mentioned industries, in particular the sugar industry, produce a large quantity of liquid waste. In 2002-2007, the sugar industry produced 5,074,261 to 5,950,123 gallons of liquid waste per year. Although this waste is normally treated in oxidation ponds, fish kills in the New River, Orange Walk District, due to contamination from such liquid wastes has posed a problem in the past. The citrus industry also produces liquid waste and from 2003 - 2007 treated 41,800 to 89,468 gallons of liquid waste.

However, liquid wastes produced in the country also come from wastewaters from washing and bathing and sewage. The public and private human waste disposal facilities throughout Belize include systems such as individual sewage disposal systems (ISDS) such as pit latrines and septic tanks with cess-pools, activated sludge systems, aerobic systems and compost toilets. Animal waste facilities include anaerobic digesters (biogas) systems, of which a few are used throughout Belize.

Belize Water Services currently operates and maintains sewerage systems in three municipalities namely Belmopan, Belize City and San Pedro Town. None of the municipalities served by these sewerage systems enjoy 100% coverage. The systems came into operation in 1970, 1980 and 1996 respectively. In the three municipalities with sewer systems, 6,926 connections were reported in 2007 (Table 47). Belize City alone accounts for approximately 72% of all connections.

The existing sewerage system in each municipality consists of conventional gravity sewers in zones (Belmopan - 2, Belize - 15 and San Pedro - 6), complete with concrete manholes and submersible fiberglass reinforced plastic pumping stations. In each zone, sewage is collected by gravity at each a pumping station and pumped to a neighboring zone towards the treatment works. Pump operations in each station are automatic and controlled by float switches. In Belmopan the sewage stations are wet-dry well type and made of concrete.

In Belize City, treatment is provided by a two-cell facultative lagoon system (Table 49) and the treated effluent is discharged into the Caribbean Sea via canals cut through a mangrove wetland. The lagoon cells operate in series and are designed to provide 10 days hydraulic retention time in each. The system presently treats about 1,500,000 gallons of sewage per day.

In San Pedro Town, two facultative lagoons operating in series followed by one maturation pond with impermeable layers at their bottoms are used to treat the collected sewage in San Pedro Town. The treated effluent from the maturation pond is discharged to the surrounding mangrove wetland, via a dispersion pipe, for polishing before final disposal into the natural lagoon environ (the Caribbean Sea). The cells are each designed to provide a hydraulic retention time of 10 days. The sewerage system currently treats about 160,000 gallons of sewage per day.

In Belmopan, a primary treatment plant made up of a settling tank and four sludge drying beds together with 1½ miles of 18" diameter disposal pipe makes up the facility for treatment of sewage in Belmopan. The treated effluent (clarified waste water) empties into the Belize River via the disposal pipe and the sludge is deposited onto the drying beds and later made available for agricultural uses. It is estimated that the flow to sewage treatment plant is 200,000 gallons per day.

In some areas of Belize City disposal of sewage into open canals is still practiced (BAS, 2008). In while in Belmopan the central sewage disposal system is to a large extent non-functional and has surpassed its maximum treatment capacity. The BAS (2008) also reports that in high tourism areas such as San Pedro, small-scale treatment plants that use chemical treatment, biological treatment or irradiation to kill bacteria and other potentially

Table 47: Number of Units Connected to the Sewer System, 2002 - 2007

Location	2002	2003	2004	2005	2006	2007
Belize City	4,530	4,940	4,963	4,965	4,970	4,963
Belmopan City	1,650	1,650	1,653	1,655	1,657	1,657
San Pedro Town	282	295	301	304	306	306
Total	6,462	6,885	6,917	6,924	6,933	6,926

Source: Belize Water Services Limited (BWSL)

Table 48: Number of Ponds and Treatment Method

Location	Number of Ponds	Treatment Method	Ponds Functioning
Belize City	2	Facultative	Yes
Belmopan City	2	Sedimentation Tank	No
San Pedro Town	3	Facultative	Yes
Total	**7**		

Source: Belize Water Services Limited (BWSL)

Table 49: Households by Type of Toilet Facility, (percent) 2004 - 2007

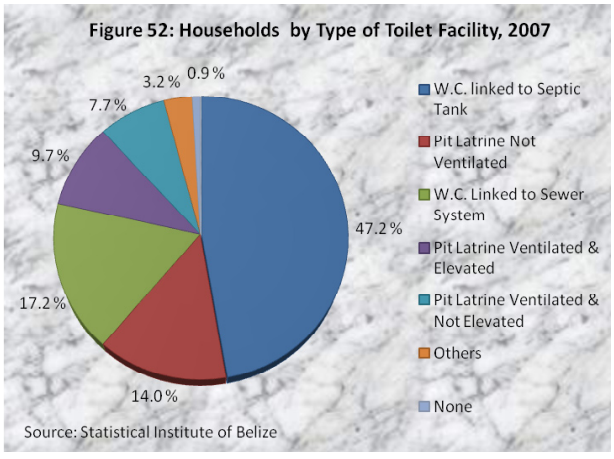
	2004	2005	2006	2007
W.C. linked to Septic Tank	42.7	44.4	47.1	47.2
Pit Latrine Not Ventilated	16.6	16.1	11.5	14.0
W.C. Linked to Sewer System	16.0	16.4	17.4	17.2
Pit Latrine Ventilated & Elevated	11.0	7.8	11.0	9.7
Pit Latrine Ventilated & Not Elevated	8.6	10.5	8.1	7.7
Others	2.6	3.7	2.7	3.2
None	1.9	1.1	2.2	0.9
Total	**100.0**	**100.0**	**100.0**	**100.0**

Source: Statistical Institute of Belize

harmful microorganisms are increasingly being used. San Pedro and Caye Caulker are in fact good examples of the contamination of ground water sources that can result from improper waste disposal. The island currently obtains its drinking water through a desalinization plant, a relatively expensive system to put in place. The waters in and around islands and other coastal areas are particularly vulnerable to effluents from septic tank systems and improper liquid waste and sewage disposal. Fish, coral reefs and people including tourists are susceptible to the impacts of contamination. Overall, improper waste disposal is not only a public health issue but a threat to the sustainable development of the country.

Belize City, San Pedro Ambergris Caye and Belmopan have a central sewage disposal system but individual sewage disposal systems (septic tanks and pit latrines) are more commonly used in other parts of the country, particularly in rural communities. Septic tanks, whether served or un served by cesspool, particularly in highly populated areas pose a serious threat to ground water sources and man-made and natural waterways such as rivers and streams since the effluent released from them is usually high in micro-organisms (BAS, 2008). In addition, it is important to note that there have been gradual changes in the improvement of the toilet facilities since the Population and Housing Census of 2000 (Figure 54). For example, in 2007, 47.2 percent of the population was using septic tanks as a means of sewage treatment and disposal as compared to 42.7 % in 2004 (Table 48).

Figure 52 shows that in 2007 most households (47.2 percent) around the country used flush toilets linked to septic tanks. Only 17.2 percent of households used flush toilets linked to a sewer system, roughly the amount of households using non-ventilated pit latrines is 14.0 percent. In general, 64.4 percent of households country-wide used flush toilets types while 31.4 percent used pit latrines of various types. The remaining 4.2 percent of households used other types of toilet facilities or had no access to them. While clean drinking water in the form of purified or piped water has become available to greater than 75 percent of the population, proper sanitation has not. This has important implications for contamination of water sources in the country.



2.8.3 Responses

Environmental sanitation is an essential factor contributing to the health, productivity and welfare of the people of Belize. It is identified in Belize's programme of social and economic development as set out in the National Poverty Elimination Strategy and Action Plan (NPESAP) an agenda for growth and prosperity, as a key element underlying health and human development. The Government's National Environmental Action Plan and Environmental Protection Act also place a high priority on environmental health and sanitation as well as the establishment and implementation of environmental health standards. The Ministry of Health is focused on policy advice, public health protection, planning, regulation, research, quality and standards, international and regional collaboration, and monitoring the overall performance of the health system. It is against this background, and in recognition of its importance to national development that greater emphasis must be placed on environmental sanitation in the allocation of national development resources.

These policies are continuously adjusted as a result of rapid urbanization, high urban population growth and increasing investment in the commercial and industrial sector over the last twenty years of economic development. This accelerated economic growth has had the consequences of increasing production of municipal liquid and solid waste and has resulted in growing public health and environmental challenges. Therefore, the need for expanded services that address environmental sanitation and public health related problems require a parallel increase in emphasis in order to the mitigate these problems. Liquid waste management has predominantly been a public sector investment. Lately, however, environmental policies established by various agencies has resulted in increased private sector interest in the adoption of and participation in waste management schemes, with overall net positive results. For example, both public and private sector investments have established secondary and tertiary sewage treatment technologies for the treatment of sewage and grey water from the operational activities. Those investments located in sensitive marine environments, and in proximity to other water bodies are now required to install a minimum of secondary treatment systems for their effluent. The monitoring of the disposal of these effluents is also required annually or bi annually for most commercial and industrial plants.

Several pieces of legislation have been enacted by Belize to address waste disposal issues. Among these are the Littering Offences (Violations Tickets) (Amendment) Regulations of 1996, the Pollution Control Regulations, 1996 under the Environmental Protection Act, the Derelict Vehicles Regulations of 1999 and the Solid Waste Management Authority Act of 1991 (BAS, 2008), Effluent Limitations Regulations, 1995 and its amendment of 2009. All of these laws have been applied with several degree of success, with challenges in the enforcement of these laws. Challenges to waste management include lack of adequate staffing of enforcement agencies, the lack of financial support from Central Government, high initial cost associated with technology transfer, inadequate human and institutional capacities, and weak foreign exchange capacity. The implementation of the Solid Waste Management Plan created under the Solid Waste Management Authority Act for example, has been delayed for many years. However, the new government has recently appointed a new board and has recently secured funds to support the institutional strengthening of Belize's Solid Waste Management Agency (SWMA), and for the implementation of the first phase of the solid waste plan, which includes for the design, installation and operation of a central sanitary land fill to serve the Western Corridor.

In 1997, a National Solid Waste Management Plan was developed under a technical assistance project funded by the Japanese Government (1998). The overarching goal of the plan was to properly dispose of garbage in the country under the management of the National Solid Waste Authority. A major effort outlined under the project was for the construction of one central sanitary landfill on the Western Highway. Other existing dumpsites would be converted into transfer stations to facilitate sorting and recycling efforts. Transport would then take appropriate garbage to the central facility. As part of its financial sustainable mechanisms, the solid waste management plan was partially successful in that an Environmental Tax was established in 2001. According to BAS (2008), this tax amounted to BZ$17 million in 2007 (Ministry of Finance). The idea of the tax was that it would provide part of the necessary funds for the management of solid waste in the country. However, full implementation of the solid waste plan, including the construction of the central landfill was delayed until 2009.

After several efforts, the Government has committed to the implementation of phase one of the solid waste plan, and has identified funds from the Inter-American Development Bank (IDB), for the design, construction and operation of the central sanitary facility on the Western Highway. Belize will receive a US$11,150,000 loan from the Inter American Development Bank (IDB) to improve solid waste management practices, reduce environmental pollution and enhance the image of Belize in the eco-tourism market through better management of its municipal dump sites (IDB, 2009).

Some consultations have been undertaken by DOE with the respective town councils as part of a revival of the solid waste management project and plan. Other ongoing efforts include an updating of the Environmental Impact Assessment of the proposed site of construction for the central sanitary landfill, a soil characterization at the site to determine how the clay substrate will react under certain acidic conditions created by waste, and a waste characterization effort along the Western Corridor, which includes all communities from San Pedro, Ambergris to Benque Viejo del Carmen and includes Caye Caulker and Belize City.

Preparations for implementation of the National Solid Waste Plan are now fully under way, with the Solid Waste Management Authority preparing documentation for the bidding and contracting process that will be required to design, construct and operate the Central Sanitary Landfill.

CHAPTER 3
POLICY RESPONSES

Belize
Environment
Outlook

GEO Belize
2010

CHAPTER 3
Policy Responses

For years Belize has actively participated in International Conventions and Agreements. Evidence of this can be found in the Compendium on Environmental Protection and Natural Resource Management Legislation in Belize, McCalla (1995). These international agreements bring to head a multitude of environmental concerns such as, climate change, desertification, biological diversity, pollution and hazardous waste among others. As one can see many of the issues are cross-sectoral and trans-boundary in nature so much so that international responses are the only way to adequately address them.

One cannot deny the importance of environmental law in the management of natural resources. Environmental legislation has two realms, the national and the international. Our interest is: how do international conventions and agreements play a role in the further development of local legislation and policies? The outcome should be the integration of the conventions into national legislation; this end product is the success of a convention. Understanding exactly how the integration occurs is critical. In order to understand the process one must be familiar with some "convention terminology".

The first step is the participation of a country in the development of a convention when one country must either agree or disagree with the concepts of the convention. Upon agreement the country becomes "Signatory". This means that a state agrees with the main ideas of a convention; however, they are not legally bonded in any way. It is at this point that a country "ratifies" the convention upon returning home where the relevant legislative bodies of the country assesses whether or not the convention can be incorporated into the country's legal system. In other words can a national strategy be put in place to implement the convention? The act of ratifying may take anywhere from a few months up to a few years. In the process of ratifying, a country may also make a statement of "Reservations and declaration" in which it excludes or modifies certain legal components of conventions or treaties, or puts in place certain provisions. This act depends on the nature of the convention and in most cases statements of reservations and declarations are made. However, a few conventions are package deals "all-or- nothing" like the United Nation Law of the Sea (1982). An alternative to the signing and later ratifying, a country may "Accede", whereby in a single act the country becomes a party to a convention. This is often referred to as "Accession". A final term one may run across in the discussion of conventions and their implementation is "Succession" which is the right of inheritance, assuring the perpetuity of a convention.

In the Global Environment Outlook of a country certain policy responses are so cross-sectoral that they are best addressed on their own rather than under any one single environmental issue. The issue then becomes how to select which policy responses to focus on. In light of the areas of concern addressed in previous chapters, the list was narrowed to the following conventions and legislation:

1. UNCBD - United Nations Convention on Biological Diversity
2. UNCCD - United Nations Convention on Combating Desertification
3. UNFCCC - United Nations Framework Convention on Climate Change
4. MARPOL - International Convention for the Prevention of Pollution for Ships 1973, Modified by Protocol 78 (MARPOL 73/78)
5. RAMSAR - Convention on Wetlands of International Importance Especially as Waterfowl Habitat
6. CITES - Convention on the International Trade of Endangered Species of Wild Fauna and Flora
7. Millennium Summit - Millennium Development Goals
8. Local Legislation: EPA - Environmental Protection Act; Its Subsidiary Act & Amendments

The Conventions

In 1992 a monumental convention on the environment was held. The convention was the UNCED, United Nations Conference on Environment and Development, a.k.a. the Rio Convention. The importance of the convention lay in the nature of the meeting; it was the first time the relationship between environmental protection and economic development was addressed. Rio was the birthplace of the term "sustainable development". The generally accepted definition of sustainability also comes from this very convention. The convention attempted to link many of the different facets of human life - social, cultural and economic with the environment. The resulting product was Agenda 21, a 600 page document outlining the action plan for the 21st century. Several conventions succeeded Rio in order to emphasis and clarify issues that arose in Rio in 1992.

3.1 UNCBD - United Nations Convention on Biological Diversity

Summary

The UNCBD was convened on June 5, 1992 as a global recognition of the importance of planet Earth's rich biological diversity, now commonly known as biodiversity. The convention agreed that each country has rights to their biological diversity, but at the same time there is a common concern among mankind as to the life of these resources. Mankind is depleting and destroying these resources that have intrinsic ecologic, social and economic value. Therefore, human needs must be addressed in regards to biodiversity as an asset for present and future generations. In light of the latter the convention addressed the need for commitment to sustainable development and management, including the uses of the biological diverse resources. The convention also recognized serious gaps in information, which are needed to properly understand all aspects of biological diversity.

The objectives of UNCBD, UN (1992a, Article 1) are "*the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding*".

Belize's obligations to UNCBD upon ratifying in December 1993 are to:

1. Establish general measures and conservation use by:

(a) Development of national strategies for the conservation and sustainable use of biological diversity; and

(b) Integration of the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies.

2. Identify and monitor components of biological diversity important for its conservation and sustainable use by having regard to the indicative list of categories set down in Annex I.

3. Practice ***In-situ*** *Conservation* by a variety of measures, a few of which are the establishment of protected areas; promotion of environmentally sound and sustainable development in areas adjacent to protected areas; and the rehabilitation and restoration of degraded ecosystems and promotion of the recovery of threatened species.

4. Practice ***Ex-situ Conservation*** by various means including (to name a few), the establishment and maintenance of facilities for ex-situ conservation of and research on plants, animals and micro-organisms; and the adoption of measures for the recovery and rehabilitation of threatened species and for their reintroduction into their natural habitats under appropriate conditions.

The Convention included Articles dealing with the Sustainable Use of Components of Biological Diversity, Incentive Measures, Promotion of Research and Training, and Public Education and Awareness, Impact Assessment and Minimizing Adverse Impacts, Access to Genetic Resources, Access to and Transfer of Technology, Exchange of Information, Technical and Scientific Cooperation and Handling of Biotechnology and Distribution of its Benefits.

Assessment of Convention

The need for Belize to sign a convention of this nature is inherent in that the marketing of the country's tourism destinations and export commodities hinges on its

rich biological diversity. Movement for the protection of these resources has been continuous at various levels and in late 1997 Belize began the preparation of its National Biodiversity Strategy and Action Plan with the assistance of the UNDP and the GEF.

Belize has advanced to the stage of developing a National Protected Areas System Plan, which delineates a network of protected areas based on substantial biological resources, current land uses and other data. The goal is to establish a biodiversity base-line and monitoring programme. However, it must be noted that adequate standards are being delineated for this monitoring, and there is an adequate public awareness campaign by GOB, NGO/CBOs and the private sector. In addition, the National Environmental Action Plan has as its immediate objective "the development and implementation of environmentally sustainable development policies by the Government and the improvement of inter-sectoral coordination of the various environmental players," (NEAP, 2005. pg. 3).

The NCSA (2005) summarizes how well Belize has performed in regards to it commitments to the UNCBD. And truthfully much work has been initiated but there is a constant complaint in regards to the poor coordination among regulating agencies involved in biodiversity management, plus gaps exist in the legislative framework. Further weaknesses are the lack of biodiversity evaluation and monitoring capabilities within country, with poor financing and a general lack of "man power" thus requiring great efforts in addressing these weaknesses. The need for proper monitoring and overall assessment of our resources is essential in that if we don't know the status of our resources, how can we plan adequately to sustainably manage them. With a lack of a national guidance such as a National Biodiversity Policy and Act, all bodies involved will continue to have poor coordination and simple do what they deem necessary to meet the deliverables to funding agencies. Tied to this very concept is that no one statutory body is in charge of enforcement work. The poorly staffed agencies addressing these issues are slow in achieving the CBD objectives and also this occurs with no urgency.

To conclude on a positive note there has been an attempt to consolidate a biodiversity database at the Forestry Department via the Clearing House Mechanism. But it must be noted that there is very little awareness of its existence even among government agencies, little input into it from envisioned collaborators and a lack of personnel at the Forest Department dedicated to updating it. Under the National Protected Areas System Plan it was envisioned that the Clearing House Mechanism would be eventually housed at the University of Belize. Two private initiatives (the Wildlife Conservation Society database and the Belize Environmental Resource Database) have developed biodiversity data of Belize during the last ten (10) years.

Another positive development is the recent establishment of a new department at the University of Belize, the Environmental Research Institute (ERI). The ERI's mission is to build local capacity for research and monitoring in order to provide scientific results that can be used for decision-making. Several of the activities that the Institute will be undertaking in 2010-2011 will help to further Belize's obligations to the UNCBD. These include the development of a National Natural Resources Management Research Agenda, a National Training Program, which is expected to include training in biodiversity inventory and monitoring, and a National Biodiversity Monitoring Program. This biodiversity monitoring program will be implemented in partnership with protected area managers and co-managers and will be coordinated by the ERI. The ERI is expected to house, curate and analyze the monitoring data gathered through the program in order to be able to consistently report on the status of Belize's biodiversity at the level of the protected areas system.

Recommendations

- Workshop to establish better routes of communication and designation of duties among active agencies and parties involved in biodiversity conservation;
- Public awareness campaign of the Clearing House Mechanism to increase awareness and contributions; and
- Continued work, assessment and revision of the National Protected Areas System Plan, National Biodiversity Strategy and Action Plan, National Biodiversity Policy and National Environmental Action Plan, among others.

Relevant Policy

National legislations for the establishment of protected areas are:

- The National Parks Systems Act, 1981
- The Forest Act
- The Fisheries Act
- The Crown Lands Ordinance
- The Ancient Monuments and Antiquities Act

In regards to the environment legislation, there are some 41 pieces of legislation related to biodiversity and ecosystem issues.

Related Convention/Protocols

Most conventions pertaining to species conservation, recovery, protection and rehabilitation have core fundamentals similar to UNCBD. These are: Convention for the Conservation of Biodiversity and Protection of Priority Areas in Central America, Central American Agreement on Biodiversity and the Central Alliance for Sustainable Development (ALIDES), The Western Hemisphere Convention, The Migratory Species Convention, CITES, and Ramsar Convention.

Commentary on Rio Conventions

The National Capacity Self Assessment Action Plan has a goal of 2010. Perhaps one of the most useful things to come out of the Action Plan is the revision of various key legislations as they pertain to the three Rio conventions. Legislation pertaining to the environment must be dynamic as the very resources they attempt to maintain. In many cases this process will fulfill the legislative gap mentioned although at this point the discussion is not done rather the focus will need to be on enforcement.

3.2 UNCCD - United Nations Convention on Combating Desertification

Summary

Desertification is one of these issues that had been addressed at the United Nations Conference on Environment and Development (UNCED) 1992. Little had been done in regards to this issue since, and in September 1994 the UNCCD was held. The convention emphasized the need to address both nature and human activity as they affect desertification and drought conditions in arid, semi-arid, and dry sub-humid areas. Unfortunately these areas are found primarily in least developed countries, with drought and desertification affecting food production, water supply, soil quality and overall poverty levels. (UN, 1994)

The overall objective of the Convention, as stated in UNCCD (1994) Article 2, is "*to combat desertification and to mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa, through effective action at all levels, supported by international cooperation and partnership arrangements, in the framework of an integrated approach which is consistent with Agenda 21, with a view to contributing to the achievement of sustainable development in affected areas*".

In Belize's accession of the convention in August 1998, as stated in Article 3, we agreed to:

a. Prevent and/ or reduce land degradation, whereby "land degradation" means reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range pasture, forests and woodlands resulting from land use or from a process, or combination of processes, including processes arising from human activities and habitation patterns, such as:

(i) soil erosion caused by wind and/or water;
(ii) deterioration of the physical, chemical and biological or economic properties of soil;
(iii) long-term loss of natural vegetation;

b. *Rehabilitate partially degraded land and*;

c. *Reclaim desertified land*

The ultimate goal of the convention is for countries to either individually or jointly develop long-term strategies that focus simultaneously, in affected areas, on improved productivity of land, and the rehabilitation, conservation and sustainable management of land and water resources, leading to improved living conditions, in particular at the community level. (UNCCD 1994, Article 2)

More specifically a National Action Programme is to be developed with one of the main purposes being to identify the factors that contribute to desertification and the practical measures necessary to combat desertification and mitigate the effects of drought. The idea is to

outline the contributing factors and the respective roles of all parties: government, local communities and land users. Specifications in the agreement (Article 10) state that The National Action Programme should include:

a. Measures to prepare for and mitigate the effects of drought;
b. Measures in priority fields as they relate to combating desertification; and
c. Mitigating the effects of drought in affected areas and to their populations such as: promotion of alternative livelihoods, programmes aimed at the eradication of poverty and at ensuring food security; demographic dynamics; sustainable management of natural resources; sustainable agricultural practices; and development and efficient use of various energy sources.

Appendix III specifically applies to Belize as it addresses the National Action Program for Latin America and the Caribbean in which it takes into consideration the particular conditions of the region.

Assessment of Convention

Prior to the signing of the UNCCD there existed little or no awareness on the issue of desertification. Changes in land quality and shortage of water had been noted and duly acknowledged but no action had been taken to address these issues. At the inaugural ceremony to launch the UNCCCD in Belize Honorable John Briceño, former Minister of Natural Resources and the Environment, is quoted as saying:

"When should we be alerted to this? It is never too early.

When should we start taking precautionary measures? It is never too early.

Sometimes desertification creeps up on a country without its being aware of what is happening."

This quote had more truth and resonance to it than perhaps anyone knew. In Belize the agricultural sector has been actively developing. However, this has been occurring with little to no guidance by any form of land use policy. No significant policy has utilized soil suitability in land development. Land use planning measures that have been implemented are nominal and more importantly have been used in isolation with no involvement of people with appropriate expertise. The absence of National Forest Management and Land Use policies has left Belize with very vulnerable resources that can easily be misused and mismanaged. Policies need to address appropriate human settlement in areas that are ecologically vulnerable or fragile.

To reiterate UNCCD's main objective, Belize is to: prevent desertification, rehabilitate lands that have experienced degradation and reclaim lands that have undergone desertification. In 2000, a Draft of Belize's First National Report on the Implementation of the United Nations Convention to Combat Desertification was completed. In the document one of the first assessments was the need for the development and implementation of the National Action Plan to Combat Desertification. The document reiterates that the most degradation of land resource is due to developmental activities in the different sectors; agriculture, forestry and mining of sediments. To date no such strategy has been formulated.

In order to more thoroughly understand Belize's limitation in committing to its obligations, in 2005, the first phase of the National Capacity Self Assessment (NCSA) was performed with the objective to assess Belize's performance or rather, the country's capacity to fulfill the obligations for UNCCD, UNFCCC and UNCBD. In regards to UNCCD one of the major comments is that currently there is no cohesiveness; no connectivity between the government agencies that have interests in addressing land degradation and eventually desertification. In addition there existed some serious information gaps, by which an attempt was made to try address in a National Awareness Seminar on Land Degradation.

Perhaps more directly speaking to these obligations, no areas have been delineated as degraded or in need of rehabilitation. Significant work needs to been done in the compiling of complete land-usage data bases. The Data from the 1999 Environmental and Social Technical Assistance Project's (ESTAP) Regional Development Plan for southern Belize stated the rate of deforestation at 98 square miles per year in 1996. The study went on to state that the land cleared between the mid 80s to mid-90s was originally virgin forests. Logging, and roads cleared for this activity, has been a significant force in the increase in deforestation. Logging has provided access to areas for further deforestation and degradation of lands. Far more current and useful data can be gotten from the Preliminary Survey of Land Degradation in Belize, in which Meerman and Cherrington detailed the causes, types and extent of land degradation in Belize.

Recommendations

- Compilation of a complete land-usage data base;
- Compilation of land resources suitability for different activities/ development; and
- Based on the latter, Strong National Land Use Policy

Relevant Policy

- Land Utilization Act (LUA)
- Belize Land Development Authority
- National Lands Act (NLA)
- Forest Act

Related Conventions

UNCED, UNFCCC and UNCBD

3.3 UNFCC—United Nations Frame work Convention on Climate Change

Summary

Similar to UNCBD, the UNFCCC is an agreement, which was outlined in UNCED, 1992. The UNFCCC is a treaty aimed at reducing emissions of greenhouse gases in order to combat global warming. It was developed with full awareness that human activities have been substantially increasing the atmospheric concentrations of greenhouse gases that will result in an additional warming of the Earth's surface and atmosphere. In the same light developing countries were made aware that developed countries have been and are releasing the largest quantity.

The ultimate objective of this Framework Convention is "the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner". (UNFCCC, 1992b; Article 2)

Keeping the above in mind and the development priorities of all parties, national and regional, in Article 4, countries are still committed to (as of January 1995 when the convention entered into force):

(a) A detailed and periodically up to date list of national inventories of anthropogenic emissions sources and removals by sinks of all greenhouse gases.
(b) Formulate, implement, publish and regularly update national and regional programmes containing measures to mitigate climate change;
(c) Work on technology, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases;
(d) Promote sustainable management, and promote and cooperate in the conservation and enhancement of sinks and reservoirs of greenhouse gases;
(e) Cooperate in preparing for adaptation to the impacts of climate change;
(f) Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods;
(g) Promote and cooperate in research, systematic observation and development of data archives related to the climate system;
(h) Promote and cooperate in exchange of relevant information related to the climate system and climate change, and to the economic and social consequences of various response strategies;
(i) Promote and cooperate in education, training and public awareness related to climate change and encourage the widest participation in this process, including that of non-governmental organizations; and
(j) Communicate to the Conference of the Parties (COP) information related to implementation.

Countries within the convention are separated into three groups:

Annex I - Industrialized countries

Annex II - Developed countries, which pay for costs of developing countries

Developing countries—Belize falls under this category and it thereby is under no immediate restrictions under the UNFCCC; however, they do have the obligations listed above.

As noted the convention did not require any control of greenhouse gases rather it requested monitoring these gases as well as detailed assessments of the countries' source and sinks of greenhouse gases.

Assessment of Convention

The focal point for the UNFCCC is the National Meteorological Service. Directly pertaining to Belize's obligations to the convention, a national assessment has been done on greenhouse gases source and sinks; however, it must be noted that there were deficiencies in the data. At the time of the study it was noted that there is a great need for contour mapping so as to adequately estimate the effects of sea level rise. Additionally, there is a need to develop the national capacity to store, analyze and compile relevant data. The assessment and compiled data was included in the First National Communication done in 2002 and the Second National Communication of 2007 to the COP of the UNFCCC. Although the two assessments have been done so far, no funding by the GOB has allotted for the development of a management plan for this inventory of sources and sinks.

In light of Belize's obligations to the UNFCCC, perhaps the most severe limitation has been a lack funds along with human and material resources, as well as, technical capacity. As a result proper adaptation options have not been formulated and therefore cannot be implemented. Inadequate funding has limited the national ability to perform many of the other requirements such as the promotion and carrying out of research. However, it has been noted that there is a low level of awareness of the country's vulnerability to climate change, especially with recent increase in frequency and intensity of hurricanes which have a direct threat to all citizens. Similarly, many of the potential threats such as the negative impacts to crops (drought, flooding, increase in atmospheric carbon dioxide concentration, etc) cannot be assessed for similar reasons which include lack of base-line data, new data collection, and primarily funding.

On a positive note Belize is host to the Caribbean Community Climate Change Centre (CCCCC). In addition, training has been on-going. NEMO has begun a gap analysis of where research needs to be done in regards to assessing our vulnerability. Additionally the Integrated Water Resources Act has been developed and is going through its readings in Cabinet.

Other reports of relevance that highlight impacts of climate change, specifically sea level rise are: The report on National Climate Change Adaptation and The National Assessment Report for Barbados +10.

The table below is an excerpt from the NCSA (2005) stating where work still needs to be done in order to fulfill our obligations with the UNFCCC.

Article	Requirements
4.1.(e)	The development of integrated coastal zone management plans have been initiated, and a draft Water Resources Act has been formulated, but similar efforts for agriculture, and for the protection and rehabilitation of areas affected by drought and floods have not been addressed.
4.1.(g)	No programme exist to detect climate trends or to study the socio-economic impacts of climate change or impacts of response measures.
6.a.(i)	Implementation of a national public education and outreach programme for climate change had not previously been initiated, but will shortly be addressed through collaboration with the MACC project.
7.6; 9.1; 10.1	Belize's participation in the COPs and sessions of the Subsidiary Bodies is limited by the donour allocations which usually funds one person only. GOB has not made any financial provisions in support of such participation.
12.4	Belize has been unable to propose projects for financing, including specific technologies, materials, equipment or practices that would be needed to implement such projects along with an estimate of incremental costs for mitigating climate change as well as an estimate of the consequent benefits.

Recommendations

- Sourcing of Funding for relevant research in assessing areas of vulnerability and base-line data;
- Development of public awareness campaign; and
- Capacity building within Meteorological Department to be able to fulfill some of the requirements in house.

Relevant Policy

Draft: National Policy Framework on Adaptation to Climate Change

Related Convention/Protocols

UNCED, UNCCD, Vienna Convention, Montreal Protocol, Kyoto Protocol, Barbados Conventions (SIDS)

3.4 MARPOL--International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78)

Summary

The MARPOL Convention is the main international convention covering the prevention of pollution of the marine environment by ships ranging from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and has been updated by amendments through the years.

MARPOL addresses the areas of pollution by oil, chemicals, and harmful substances in packaged form, sewage and garbage. The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental as well as those from routine operations. As it currently exists there are six technical Annexes:

Annex I Regulations for the Prevention of Pollution by Oil—this annex addresses oil discharge (that is quantities as well as monitoring equipment). On a larger scale it is also applied to the regulation of oil storage and thus ship construction, in order to prevent oil spills in cases of catastrophe.

Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk—details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk. It provides a clear restriction to not discharge any noxious substance in Territorial Waters.

Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form.

Annex IV Prevention of Pollution by Sewage from Ships—this annex contains requirements to control pollution of the sea by sewage.

Annex V Prevention of Pollution by Garbage from Ships- this deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of. The annex imposed a complete ban on the dumping into the sea of all forms of plastic. (entry into force 31 December 1988).

Annex VI Prevention of Air Pollution from Ships (entry into force 19 May 2005).

Assessment of Convention

In the MARPOL Convention Annexes I and II are mandatory to sign on to, thereafter all Annexes are voluntary. Belize signed its commitment to MARPOL on May 26, 1995. Belize signed on to all of the annexes.

Most important to us fulfilling our commitment to the MARPOL convention is the need for clear delineation of functions. Only in doing so can proper enforcement be achieved. The focal point is "supposed" to be the Belize Port Authority, however, the overseeing body is from the private sector and it is this entity that participates at the meeting and decides on the training session. Poor communication exists between the two bodies and how much is really being done in regard to Belize actively fulfilling its requirements is questionable. However, with the increase in marine vessels in Belizean waters, there is a great necessity to clarify these issues.

The subsidiary document for the Environmental Protection Act stipulates most of the standards in regard to the annexes of MARPOL. However, the enforcement of these regulations is minimal due to capacity issues, technical, financial and human.

Recommendations

- Make a government agency in-charge of the convention and its duties, however, maintain a good functioning relationship with relevant private sector bodies. In particular, the Environmental agencies need to be more involved; in this case it is recommended that the Department of Environment and the Port Authority work together closely in the implementation of the convention.
- Hold workshops to involve all stakeholders in the convention.
- In particular, as it pertains to conventions such as these, appropriate agencies need to be involved before signing on conventions

Relevant Policy

- Maritime Areas Act #1 of 1992
- Solid Waste Act
- Solid Waste Authority Act
- EPA, 1992
- Summary Jurisdiction offenses Act with special reference to Littering offences and violation Ticket Regulations
- Belize Port Authority Act cap.189
- Cruise Ship Policy
- Policy development in pipeline in reference to tourist related vessels-DOE
- Belize National Oil Spill Plan
- National programme of Action for Land Based sources of Marine Pollution

Related Convention/Protocols

The London Dumping Convention, LOME IV Convention, Basel Convention, OILPOL Convention 1954, SOLAS Convention 1974, SOLAS Protocols 1978, and Cartagena Convention.

CARTAGENA Convention - Convention for the Protection and Development of the Marine Environment of the Wider Caribbean, Cartagena de Indias, Colombia 1983

The focus of the Cartagena Convention is for greater control, prevention and overall reduction of marine pollution. It is meant to support many of the actions put forward by other conventions such as MARPOL.

Cartagena Convention has three areas of focus:

1. Protocol on the Cooperation to fight oil spills in the wider Caribbean 1983;
2. Protocol on Areas and Wildlife Especially Protected by the convention for the Protection and Development of the Marine Environment of the Wider Caribbean, Jamaica 1990; and
3. Protocol on sovereign Pollution from Land-based sources and Terrestrial activities in the Wider Caribbean Region, Aruba 1999.

Assessment of Convention

As relates to this convention, currently the DOE is using a draft emergency plan to deal with oil spills. The DOE is also working on the development of a national plan of action for land-based sources of pollution recognizing that what happens in the coastal region is integrated with land-activities. This national action plan seeks actions by the government to reduce impacts inland in order to reduce impacts on the coast.

3.5 RAMSAR Convention — The Convention on Wetlands of International Importance Especially as Waterfowl Habitat

Summary

The RAMSAR convention was signed under similar ideals as UNCBD. It is based on a global recognition of the importance of wetlands as critical habitats. We must mitigate for human encroachment on vitally important wetland; while at the same time keeping in focus the demands and needs of humans for sustainable usage of these areas, which are of both intrinsic and instrumental value.

The overriding objective of the convention is "for the conservation, management and wise use of migratory stocks of waterfowl" (Article 2). The idea is to provide recognition for vital wetlands that are of "international importance". The definition for wetlands as stated in the convention are "areas of marsh, fen, peat land, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters (Article 1.1).

The convention states that wetlands should be selected "on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology. In the first instance wetlands of international importance to waterfowl at any season should be included". (Article 2)

The convention emphasizes the importance of coordinated activities in regard to policy and regulation concerns. In addition, it establishes regular conferences to discuss all pertaining issues to conservation and management of RAMSAR sites.

Assessment of Convention

Belize has two Ramsar Sites: the Crooked Tree Wildlife Sanctuary co-managed by the Belize Audubon Society (BAS) and the Sarstoon-Temash co-managed by the Sarstoon Temash Institute for Indigenous Management (SATIIM).

Perhaps the only true down fall of Ramsar is that it is really just a listing service for vital wetlands as it has no true 'teeth' since it cannot legally obligate parties to ensure protection, nor enforce proper management of the List sites.

Related Convention/Protocols

CITES, UNCBD

3.6 CITES -- Convention on International Trade in Endangered Species of Wild Fauna and Flora

Summary

CITES was signed in Washington, D.C., on 3 March 1973 and entered into force in 1975. Since then, it was amended at Bonn, Germany on 22 June 1979. Contracting states came together under the premise that *"there are a great many beautiful creatures; however, they are being exploited by man"*. In return it was decided that we, as individuals and nations, must take action to preserve wild flora and fauna because of their aesthetic, scientific, cultural, recreational, economic and ecological value to use and for future generations.

The convention divides species to be protected into three Appendices I, II and III.

Appendix I	All species threatened with extinction, which are or may be affected by commercial trade.
Appendix II	All species that need to be protect because they are in eminent danger of becoming threatened or even extinct if continue to be exploited
Appendix III	All species a country identifies as being subject to regulation with the purpose of preventing or restricting exploitation.

The preceding articles of the convention proceed to detail the trade of specimens in regards to each appendix, as special circumstance should arise.

Stated in Article VIII is the fact that individual parties must take "appropriate measures to enforce the provisions of the present Convention and to prohibit trade in specimens in violation thereof. These shall include measures:

(a) to penalize trade in, or possession of, such specimens, or both; and
(b) to provide for the confiscation or return to the State of export of such "specimens."

Assessment of Convention

In Belize there is legislation in regard to CITES namely the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Act, 2006. However, as in many countries our greatest criticism is that enforcement needs strengthening. Forest Department does more close regulation on species such mahogany, BAHA & Forest Department cooperate on importation of seeds while the Fisheries Department monitors the export of conch.

Recommendations

- Workshop with enforcement agencies on CITES

Related Convention/Agreements

Washington Convention for the Regulation of Whaling, Lists of Convention exists that protect species. On a separate note various conventions exist that serve in adjunct to CITES. Since CITES does not protect habitats, it works well with conventions that do such as RAMSAR and The Migratory Species Convention

3.7 Millennium Summit 2000

Summary

In the year 2000, world leaders from around the globe congregated at the Millennium Summit in Johannesburg, South Africa. Here they came up with "a vision for the future – the culmination of a twenty-five year global agenda to address issues of development, human rights, environmental sustainability, peace and secure world". The vision is of *"a world with less poverty, hunger and disease, greater survival prospects for mothers and their infants, better educated children, equal opportunities for women, and a healthier environment; a world in which developed and developing countries work in partnership for the betterment of all"*. The result was the eight Millennium Development Goals (MDGs), which were designed to provide a framework for development for countries around the world.

The goals focus on eight major areas, they are:

1. Eradicate extreme poverty and hunger;
2. Achieve universal primary education;
3. Promote gender equality and empower women;
4. Reduce child mortality;
5. Improve maternal health;
6. Combat HIV/AIDS, malaria and other major diseases;
7. Ensure environmental sustainability; and
8. Develop a global partnership for development.

SUMMARY OF PROGRESS TOWARDS ACHIEVEMENT OF MDGS[7]			
GOALS	**Targets (relevant)**	**General Status**	**Main Challenges**
Goal 1: Eradicate extreme poverty and hunger [8]	Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day	Far Behind as it relates to halving the percentage of persons living below the poverty line[9] (This target is not relevant to Belize as the minimum wage is US $ 10 for an 8 hour day)	• Unstable economic environment • Chronic poverty among the indigenous population • Influx of immigrants from neighboring countries
	Halve, between 1990 and 2015, the proportion of people who suffer from hunger.	Far Behind as it relates to eradicating extreme poverty (i.e. those below the indigent line[10] as there are limited cases of hunger)	• Increasing poverty in urban areas • Identification of viable economic opportunities for vulnerable groups • Changing weather patterns affecting food production
Goal 2: Achieve universal primary education	Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.	Well Poised	• Ensuring that slippage does not occur • Improve the quality of education • Lower cost of education to poor families
Goal 3: Promote gender equality and empower women	Eliminate gender disparity in primary and secondary education preferably by 2005 and to all levels of education no later than 2015	Well Poised as it relates to education but lagging Behind in women's participation in employment and decision making	• Stem the gap that is threatening boys secondary and tertiary education • Ensure equal access to economic opportunities for women
Goal 4: Reduce child mortality	Reduce by two-thirds, between 1990 & 2015, the under-five mortality rate	Well Poised	• Maintain current trends • Ensure access to quality services in rural areas • Improve registration of infant deaths
Goal 5: Improve maternal health	Reduce the maternal mortality ratio by 75% between 1990 and 2015.	Reasonably Poised	• Improve level of participation in pre- and ante natal clinics • Build capacities at local level for birth attendants • Increase information and education on contraceptive use and family planning
Goal 6: Combat HIV/ AIDS, malaria and other diseases	Have halted by 2015, and begun to reverse, the spread of HIV/AIDS	Behind	• Combat stigma and discrimination • Change attitudes and behavior to reduce risk • Effectively target girls and ensure that they are protected • Empower PLWHA and change messages to those that give hope to PLWHA
	Have halted by 2015, and begun to reverse the incidence of malaria and other major diseases	Behind	• Improve surveillance • Stem increasing trend in major non-communicable diseases

GOALS	Targets (relevant)	General Status[11]	Main Challenges
Goal 7: Ensure environmental sustainability	Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	Behind	• Ensure that integration of principles translate into reversal of environmental resource losses • Enforcement • Achieve community buy-in
	Halve, by 2015, the proportion of people without sustainable access to safe drinking water	Well Poised	• Standardize data gathering protocols • Achieve 100% access to rural communities and pockets of poverty in urban centers
	By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers	Reasonably Poised	• Increase access to security of tenure my landless Mayans • Address the poverty hot spot on the Southside of Belize City • Improve quality and availability of sanitation facilities in poor communities
Goal 8: Develop a global partnership for development	Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term	Far Behind	• Reduce current level of debt • Restore credit worthiness • Maintain competitiveness of exports and diversify the range of export products
	Develop/implement strategies for decent and productive work for youth	Behind	• Review legislation and update • Improve quality of vocational education • Cultivate entrepreneurship culture among children and youth • Strategies and policies need to result in tangible outputs
	Provide access to affordable essential drugs[12]	Far Behind	• Reduce cost of essential drugs • Increase availability of essential drugs in rural areas
	Make available the benefits of new technologies, especially information and communications	Reasonably Poised	• Strengthen science and technology education • Increase access to rural areas

[7]This summary and report is based on analysis of data presented up to 2003 as agreed by the Social Indicators Committee of NHDAC

[8]The indicators chosen to track this goal refer to the halving of the percentage of the population

[9]The poverty line is defined as the minimum estimated cost of basic food and non-food items that an individual requires to meet its basic food needs. The figure ranges from US $ 2.51 to US $ 3.95 per individual per day depending on geographic location. If the expenditure is less than the poverty line then the individual is considered **poor**.

[10]The indigent line is defined as the minimum cost of food requirement necessary for healthy existence of an individual. The figure ranges from US $ 1.51 to US $ 2.15 per individual per day depending on geographic location. If the expenditure is less than the indigent line then the individual is considered **very poor**.

[11]Where the country has achieved the rate of progress (ie. 90 %) necessary to achieve the target of 2015 the summary table labels this as Well Poised. Reasonably Poised reflects a 70 to 89 % rate of progress. Behind refers to a 50 to 69 % rate of progress and Far Behind refers to less than 50 % rate of progress.

[12]The proportion of the population with access to affordable, essential drugs on a sustainable basis, according to WHO and the UN, is the percentage of the population that has access to a minimum of 20 most essential drugs. Access is defined as having drugs continuously available and affordable at public or private health facilities or drug outlets that are within one hour's walk of the population.

Assessment of Convention

In September of 2004 "The first Millennium Development Goals Report" for Belize was delivered, below is an excerpt from that text summarizing Belize's goals.

3.8 Local Legislation

In reviewing International Convention it was evident that one also had to take internal stock of legislations that exist within the country. As a result the following is an assessment of the National Environmental Protection Act.

3.8.1 Environmental Protection Act

Summary

The EPA entered into force September 1992. It was the first comprehensive environmental protection legislation. The main objective of the Act is the regulation of pollution, however; it includes sections on preservation, protection and improvement of the environment, as well as, the rational use of natural resources and the control of pollution from incidentals.

The Act is composed of numerous parts. The following highlights the main portions of the legislation:

Part II—Administration—It is within this section that the Department of Environment (DOE) is established and its (27) powers, duties and functions are delineated. More specifically it is here that the powers, duties and functions of the Officers of the Department of Environment are outlined.

Part III—Prevention and Control of Environmental Pollution-- "The Minister may, after consultation with the Department, make regulations to specify the permitted level for the emission, discharge or deposit of pollutants or the emission of noise into any area, segment or element of the environment within which the emission, discharge or deposit is prohibited or restricted."

The initial legislation left much to interpretation as such the 2003 amendments to the Act dealt with pollution and pollutants more extensively in Section III: Pollution Regulations outlines possible sources of pollution. It includes emission of contaminants into environment, air pollution, particulate emission from stationary sources, emission or organic compound from stationary sources, emissions of carbon dioxide from stationary sources, emissions from combustion engines, water pollution, marine crafts, pollution of land, noise abatement, and prohibition of manufacturing on ozone layer. To complement the comprehensive list of sources of marine pollution, there are detailed schedules which outline pollutants and the categories they fall into. The regulations highlight prevention, standards, and activities acceptable by law.

Part IV—Prohibition of Dumping, in which the term "dumping" means the deliberate disposal at sea from ships, aircraft, tankers, floating craft or other marine vessels, or other man-made structures, and includes disposal by incineration or other thermal degradation of any substance." The latter is a blanket statement prohibiting dumping of any garbage, refuse, toxic substances or hazardous wastes. Schedules follow outlining what exactly is considered Hazardous substances. In addition the legislation on Hazardous waste has been strengthened with the 2009 Hazardous Wastes Regulations.

Part V—Environmental Impact Assessment (EIA)—"Any person intending to undertake any project, programme or activity which may significantly affect the environment shall cause an environmental impact assessment to be carried out by a suitably qualified person, and shall submit the same to the Department for evaluation and recommendations." The EIA process is mandated in this legislation, however, Section I: Environmental Impact Assessment Regulation of the Subsidiary Laws of Belize, 2003 expands on the Environmental Impact Assessments Regulation clarifying the requirements for an EIA. The Amended action contains a detailed Schedule listing of the types of activities, programs and projects for which an EIA is needed; and a second schedule stating activities, programs and projects where it may be necessary. In many aspects, the revised Act details the criteria and process of carrying out an EIA where the original EPA was lacking. The Act lists the content needed, preparation, review and approval process. It also includes a list of roles the developer and DOE play in the EIA and the reporting mechanisms. Public Participation is also a new area of focus, citing its importance at various levels in the EIA development process. Finally there is the establishment of the National Environmental Assessment Committee (NEAC), which is a committee established to review all EIAs. It must be noted, however, that the NEAC does not reject EIAs rather "can resubmit, amend, or ask for more work or studies to be done on an EIA." The committee's

role and responsibilities are detailed in the revised Act. The composition of the committee is composed mainly of government agencies.

Part VI—Nutrients-- "nutrient" means any substance or combination of substances that, if added to any waters in sufficient quantities, provides nourishment that promotes the growth of aquatic vegetation in those waters to such densities as to-

(a) interfere with their use by human beings or by any animal, fish or plant that is useful to human beings; or

(b) degrade or alter or form part of a process of degradation or alteration of the quality of those waters to an extent that is detrimental to their use by human beings or by any animal, fish or plant that is useful to human beings;

Regulations-

(a) prescribing nutrients;

(b) prescribing the permissible concentration of any prescribed nutrient in any cleaning agent or water conditioner; and

(c) respecting the manner in which the concentration of any prescribed nutrient in a cleaning agent or water conditioner shall be determined.

The Revised Edition 2003 of the EPA, Section II: Environmental Protection (Effluent Limitations) Regulations outlines the regulations and standards of effluent discharge. Article 8 of the revised act states that "Notwithstanding any other provisions of these Regulations, no person shall without prior written permission of the Department carry out any work on any premises that may result in a new source of effluent discharge or cause a material change in the quantity or quality of the discharge from an existing source". There also should be no discharge of sludge onto the land. And anyone who does wish to discharge effluents must file a license to discharge effluents. A detailed list of effluents and their maximum acceptable standards can be found within various schedules at the end of this section.

Further Amendments of the Environmental Protection Act, Chapter 328, S.I. 24 of 2007

The new amendments make various clarification and corrections. A few worth mentioning are:

- It is now clearly stated that Environmental Compliance Plan, which is received as a result of an approved EIA, is a legally binding document that must be abide by.
- The infamous term "suitable qualified person" is clearer outlining the minimum academic qualification.
- Fees were adjusted
- The composition of NEAC has been altered; the number has increased from 11 to 13. Changes: new Chief Engineer, a person with Human Development or Social Services background, and a person from a tertiary level institution; a Trained person in Coastal zone management or natural resource management (always in committee but did not have voting rights….now given voting rights),. No longer: Chief Agriculture Officer, Chief Archaeology Officer and Chief Hydrologist. Additionally the committee was given the right to call in people with technical expertise when needed. With the changed membership from 11 to 13 the new quorum is 7 and no longer 6.
- Additionally the listing of certain projects changed from schedule one to two. Schedule 1 are projects that must have an EIA versus Schedule II in which they *may be required or only a limited level study* may have to be done.

Assessment of Legislation

- The Act of 1992 establishes the Department of the Environment, and within it articles substantiate various titles and positions. The major concern in reading the powers, functions and duties of the DOE is the amount of duties and functions them are required to perform. In total the EPA stipulates some 27 functions. Many of these functions are stated in such a way that the duties of DOE are overwhelming for the limited human and financial capacity that exists within the Department. To ensure that if DOE is to fulfill all their functions, it needs to be adequately funded. In addition recruitment and training of environmental officers and inspectors is necessary to achieve these goals of the legislation.
- Ministerial discretion is still prevalent through the legislation, more decentralization is necessary.
- There needs to be the establishment and funding of a National Water Quality Laboratory in country to test these effluents, pollution levels and overall water quality
- Guidelines for enforcement need to be established.

CHAPTER 4
OPTIONS FOR ACTION

Belize
Environment
Outlook

GEO Belize
2010

CHAPTER 4
Options for Action

Thus far this report has documented the major environmental problems that Belize is facing today and some of the pressures directly influencing the exacerbation of these. These are coastal degradation, in particular, mangrove loss due to the rapid and unsustainable coastal development for tourism; coral reef decline due to unsustainable development practices, pollution, climate change, overfishing and illegal extraction of marine resources; deforestation and forest degradation due to the illegal extraction of forest resources; and finally a decline in water quality, in particular, due to the inappropriate management of solid and liquid waste and pollution from the agriculture industry. The aim of this chapter is to highlight a number of achievable actions that go beyond the environmental successes that the country has achieved. Through their implementation, these actions and their accompanying targeted actions would have a large impact in abating these environmental problems and in ensuring a healthier environment for Belize. Ultimately, a healthy environment is intricately linked with the livelihoods, health and overall quality of life of the Belizean people. The actions suggested here can be categorized into three main areas: good governance, institutional strengthening, capacity building among Belizeans for the sustainable management of the country's natural resources, and education/public awareness.

4.1 Good Governance:

Action 1: Formulation of and adherence to a development plan for the country that is in tune with sustainable development as agreed to by all nations of the world, including Belize, in the Millennium Development Goals, and through a series of targeted actions.

The accomplishment of such an action immediately appears as a daunting prospect and in fact all the planning done by the previous CZMAI (1999-2004) to zone the coastal areas and its work to develop a coastal zone development plan, which was never made into law, is an example of how political will can impact progress towards the accomplishment of Action 1. Today, the CZMAI has been revived with the rehiring of a Chief Executive Officer and Director and is focusing on the implementation of policy. However, this body needs a lot more support to be effective. The Government of Belize is of course constrained by the lack of resources, in particular funds. Action 1 may continue to be a daunting prospect because coupled with this lack of resources is the reality that, in general, from the very top levels of decision-making for the country to the level of the average citizen, who must everyday earn a living to continue supporting him/herself and his/her family, the citizens of Belize have not yet internalized the very fundamental concept of sustainable development and the premise on which it is based. Sustainable development is development that allows the people of a country to enjoy the benefits of that country's natural resources and environment while at the same time safeguarding these for future generations. It is built on the premise that if resources are used wisely, especially those considered "renewable" these should "keep on giving" and that without these natural resources development cannot proceed. Sustainable development requires a long-term vision that goes beyond part politics and election terms. Based on the findings of this report it is clear that Belize's development, in particular because we are such a small nation, cannot proceed without the safeguarding of the very resources that must be used in order to ensure it.

Accomplishment of Action 1 really needs a shift in thinking at all levels of society but in particular so that the will and commitment of Belize's decision makers provides an impetus for sustainable development that will translate into good for the average citizen of Belize. Likewise, a recognition and vocalization by the average citizen of Belize, that he/she depends at all levels of his or her life (job security, security from disasters, health

and quality of life) on the health of the environment and the sound management of the country's natural resources, should provide the impetus for the country's decision makers to make this paradigm shift to sustainable and equitable development. If Action 1 is broken into several targeted actions and is accompanied especially by the goodwill of the government and the people it serves, the action no longer seems as daunting or impossible. The Coastal Zone Management Plan that has already been formulated for the country provides an excellent example to show that the groundwork for a large portion of Action 1 has been done and that the real need is its true implementation.

Targeted Actions:

1.1 Support for the development of direct and sustained communication linkages, through a regularly meeting inter-ministerial committee, between the Ministries responsible for the development of the nation and those responsible for the use and management of the country's natural resources. These Ministries would include, but are not limited to: the Ministry of Natural Resources and the Environment, the Ministry of Agriculture and Fisheries, the Ministry of Economic Development, the Ministry of Human Development and Social Transformation, the Ministry of Tourism and Ministry of Education. These meetings should incorporate updates and technical briefings from bodies such as the National Protected Areas Commission. The Ministry of Natural Resources and the Environment has already taken a first step in this action through its relatively new Policy Coordination and Planning Unit (PCPU). The unit has been working to legally establish the Natural Resources and Environmental Policy Subcommittee (NREPS). This subcommittee will essentially work as a clearinghouse for environmental policy in the country, therefore bringing more order and process to the legislative work of the Ministries directly responsible for the management of Belize's natural resources. Long-term support for the PCPU, in the form of institutionalization and constant mainstreaming of its work, is critical. This will allow it to survive beyond the support of the United Nations Development Programme (UNDP) and other donor agencies, and prevent its work from becoming excessively bureaucratic and ineffective.

1.2 Revision and strengthening of the environmental laws of the country by steering away from a colonial legacy in which ministerial discretion is the rule within each and everyone of Belize's laws. There needs to be a move towards laws in which change rests on much more than in a single individual's decision. This would necessitate that more public participation be written into the laws and can include structuring bodies such as the Department of the Environment, to be more autonomous. This may require a change of the constitution.

1.3 Formulation of and adherence to a national policy on land use in which the country is zoned according to the most appropriate land-use practices and access to resources. This policy needs to take into account the appropriate use and long term safeguarding of the country's most vital natural resources including water. In order to advance on this the country needs an updated land use and land cover map. The Ministry of Natural Resources and the Environment is currently advancing on this front through a Global Environmental Facility (GEF)-funded project, known as the sustainable land management program (SLM program), implemented by UNDP and executed through the Forest Department. The project is co-financed by other agencies including PACT and the Belize Electricity Company Limited (BECOL). One of the main outputs of this program is the development of a national sustainable land use policy as the SLM program's main goal is the maintenance of ecosystem function and integrity in landscapes in Belize through the sustainable use of the country's land resources. The support of all the key ministerial agencies and departments, especially the Lands Department, is critical, in order for this project to be successful, that is, for its results to be adapted and institutionalized. Furthermore, any progress and project results need to be constantly communicated to all relevant agencies and the implementation of the land-use policy needs to be mainstreamed into the national budget.

1.4 Full adherence to already existing policies such as the tourism policy, which espouses the values and benefits of promoting more overnight tourists and eco-tourists, who have been shown to contribute more income per visit to the country, and recommends a much more tempered cruise tourism industry.

In addition, the recommendations of two widely consulted recent initiatives including: "Protecting Belize's Natural Heritage: An Action Plan for Shared Stewardship of a Cruise Destination" produced in 2008 through a Conservation International Project in collaboration with the Ministry of Tourism and Civil Aviation, the BTB and the OAK Foundation and the "Assessment of Priority Tourism Policies: Recommendations and Action Plan for the inclusion of Biodiversity Conservation in Tourism Policies" produced in 2008 and spearheaded by APAMO, need to be adopted.

1.5 Public consultations for the revision and strengthening of particularly insidious laws that harm or have great potential to harm the environment by not allowing disclosure of information, and which encourage a lack of transparency in the manner that foreign investment contracts, in particular those pertinent to the environment, are drafted and implemented.

1.6 Development of Mechanisms for implementing a sound Environmental Impact Assessment (EIA) Process. These include:

1.6.1 Establish a certification process under DOE to sensitize the EIA consultants and developers as to their role and responsibility in the development process of and requirements for conducting an EIA. These roles and responsibilities would include ethical behavior and requirements would include compliance with a clear policy that mandates the composition of an EIA team to include an engineer, an ecologist (marine or terrestrial, depending on the type of project) and a social scientist. The guidelines and requirements produced from this process would be adhered to in the Terms of Reference for EIA's. Currently, there is a general consensus among stakeholders consulted for this report that the EIA process in Belize is not transparent and adhering to clear guidelines and requirements would help to add some transparency to the process.

1.6.2 Capacity building within the DOE and also the cultivation of alliances between the DoE and academic institutions that would allow the DoE to better evaluate what components a complete EIA should have addressed and whether these components, if included in the EIA, were based on valid scientific evidence. This process of evaluation would be carried out prior to the NEAC receiving the EIA for review and would add another level of transparency to the EIA process.

1.6.3 Revision of the EIA regulations to allow disclosure of the minutes of NEAC meetings. Full disclosure of the minutes of NEAC meetings does not necessarily need to be mandated by law. For example, the DOE made NEAC meeting minutes available upon request by the public until May 2007. However, revision of the regulations to allow disclosure would ensure that a confidentiality policy, as is currently in place, would not be implemented.

1.7 Now that the Government has agreed on standard product sharing agreements for all companies investing in oil exploration, the Petroleum Act should be reviewed to incorporate a fund for environmental mitigation for impacts from the Petroleum Industry. This should be a "designated" fund rather than a fund that gathers money, which simply goes into the country's Consolidated Revenue Fund.

1.8 Revision of the laws through regulations or statutory instruments such that the Environmental Tax currently being charged on imported goods goes to a designated fund specifically for the purpose of appropriate solid waste management and in particular the creation of sanitary landfills to service all areas of the country. Currently, the Government has acceded to using some of the Environmental Tax along with a loan from the IDB towards implementation of the Solid Waste Management Plan and Project. However, eventually the country needs to move towards sustainability of the solid waste management system and earmarking the Environmental Tax for this purpose only through the Solid Waste Management Authority.

1.9 Reactivation of the National Protected Areas Commission and implementation of the National Protected Areas System Plan (NPASP) through collaborations and partnerships with academic institutions and non-governmental agencies. A necessary step in this process is the passing of the National Protected Areas System Policy into

law. The National Protected Areas Commission (NPAC) can directly report to NREPS but should be fully empowered to develop and preside over the mechanisms for the reservation and de-reservation of National Protected Areas. These mechanisms need to be based on science and public consultation.

1.10 Full adherence to the Integrated Coastal Zone Management Strategy, a formally adopted policy framework and adoption and formalization of the coastal development guidelines that were prepared for the entire coastal zone (except Ambergris Caye). These guidelines need to be adhered to when reviewing and approving developments.

1.11 Reform of PACT as the national funding agency for protected areas management. In particular, innovative mechanisms that will enable the growth of PACT's resources should be developed and the manner in which PACT allocates funds for protected areas management needs to be revised to ensure that the basic needs of the protected area system are met. One example of this includes the earmarking of funds for the periodic development and updating of management plans as well as management effectiveness evaluations at the system level.

4.2 Institutional Strengthening:

Action 2: Strengthen the institutions responsible for the direct management of the country's natural resources.

The institutions directly responsible and involved in the direct management of the country's natural resources include the Forest Department (FD), the Fisheries Department, the DoE and the Coastal Zone Management Authority and Institute (CZMAI). The Hydrology and Meteorology Department as well as the Public Health Department are also major stakeholders in the protection of the countries water resources in particular. Throughout the course of formulating this report it has become clear that these institutions are under-funded, under-staffed and in many instances lack the capacity to perform the tasks expected of them for the sound management of the country's natural resources. An example of this is the Forest Department which is comprised of less than 40 staff members expected to handle everything from the management of protected areas to the issuing of a variety of licenses for extraction of forest products to monitoring and enforcement within and outside of protected areas. The Department of Environment is another example of an institution that lacks the resources to perform its duties with currently under 15 employees. Under the Environmental Protection Act, the DoE is assigned more responsibilities than the number of staff it employs today.

Targeted Actions:

2.1 In some instances, some of the above institutions, for example the FD, have carried out recent institutional assessments that have identified their strengths and weakness and have given them a vision for the future. This type of assessment needs to be carried out for each of these institutions. Often assessments have been carried out but are simply not being implemented due to lack of ownership, especially when it is a consultant that puts it together, or lack of resources. The necessary time and resources should be given to these institutions to work and implement an action plan that they can truly own.

2.2 Mechanisms for funding and partnerships that build capacity within these institutions should be sought with the guarantee to funding agencies and partners that ministerial discretion or any type of political interference will not affect the programs of these institutions.

2.3 At this time, funding for these agencies should be particularly targeted towards monitoring and enforcement, the weakest aspects of what these institutions are tasked with.

2.4 The CZMAI has been revived and now it needs revitalization not only as a coordinating body but especially empowering it to be regulatory through monitoring and enforcement. The regulatory function of the CZMAI is very crucial as it has to do with blanket coastal regulations that cover areas outside of protected areas, for coastal zone management such as planning guidelines and dredging activities and for user fees for the coastal zone. The Coastal Zone Development Plan should be implemented and the CZMAI, Fisheries and the Coast Guard need to be linked through active and sustained communication to avoid duplication of

efforts and help each other fulfill their roles and responsibilities. Within the CZMAI or through a partnership with them, a comprehensive database should be developed that will include zoning and raw data that will allow for analysis and can be used to make long-term projections for coastal development and management.

4.3 Capacity Building:

Action 3: Develop mechanisms to build capacity among Belizeans and Belizean institutions for the sustainable management of the country's natural resources.

Currently there are very wide capacity gaps in certain areas that are of key importance to the sustainable management of the country's natural resources. One such area is the country's ability to implement its commitments to the various Multi-lateral Environmental Agreements (MEAs) it has signed. Another such area is the area of research to inform natural resources management. Currently a large portion of research, relevant to the environment and natural resources management, is conducted by and through foreign institutions or researchers with very little coordination from and transfer of knowledge to Belizean institutions. Yet another of these gaps is the capacity for effective management. Although several national NGO's involved in protected areas management in Belize have been showing continuous progress in management effectiveness, the gap in capacity in this area is much wider in community-based organizations (CBO's) which are being looked to as playing a key role in the future management of protected areas.

Target Actions:

3.1 Support for the PCPU as the clearinghouse and coordinating unit for MEAs to which Belize is a signatory.

3.2 Support and funding for the newly created Environmental Research Institute (ERI) at the University of Belize to work in partnership with the Government of Belize, in the implementation of national plans relevant to natural resources management. The ERI's mission is to build local capacity for scientific research in order to inform decision-making for the sound management of Belize's natural resources. A key goal of the ERI is to develop and implement a national research agenda that remains relevant. Part of this research agenda involves the implementation of key portions of the NPASP, for example through the development of a national biodiversity monitoring program and the development of the appropriate mechanisms for storage, curation and exchange of data relevant to natural resources management and conservation. There are many opportunities for partnership with the ERI as it will accomplish the capacity building portion of its mission through fellowship programs, short-term and long-term training programs for professionals and students in the field of natural resources management and conservation and through research programs. In addition, the ERI will support various academic programs at the University, for example the Bachelor degree in natural resources management program, and will help to build these into graduate programs in collaboration with various partners.

3.2 Support and funding for various types of training programs that strengthen the management capacity of NGO's, and particularly CBO's that are or will become protected areas managers. Training programs should focus on administration of projects and funds, grant writing, biological assessment, biological monitoring and the provision of income generating services including tourism services.

3.3 Provision of seed money for NGO's and CBO's who are protected areas managers in the form of integrated funding packages that include basic salaries and are for a period of at least three years. This will allow these institutions a chance to succeed by developing the capacity to be effective protected areas managers and focusing on this role rather than on year-to-year grant writing as pointed out by Young and Horwitz (2007). The PACT Act will need to be amended in order for them to become solid and long-term partners.

3.4 Integration of communities buffering protected areas in the management of these areas. This includes sharing the information and decision-making for these protected areas with the communities.

3.5 Strengthen the country's capacity to report on the state on Belize's environment, through processes

such as the GEO process. This can be done by supporting and funding a program in which various institutions and agencies including the Land Information Center, the Environmental Statistics Unit, the Forest Department, the Department of Environment, the Fisheries Department, the Department of Agriculture, the Statistical Institute of Belize, the Environmental Research Institute at UB and any other GoB or private partners select and share the data gathering effort for a group of indicators for each of the environmental issues highlighted in this report. Data on the indicators would be consistently gathered so that a report on the state of the country's environment could be produced every five-year period. As the partner network and the data-gathering capacity is strengthened, new indicators can be added. All data gathered could be housed and curated at the University of Belize as well as with the Environmental Statistics Unit.

4.4 Education/Public Awareness:

Action 4: Development and adoption of a National Environmental Education Strategy targeting all levels of society.

One view of education in our country is that it is a means to getting a better job rather than a wholesome experience that can really empower individuals in all aspects of life. In a country like Belize that has a small population, education is probably the single-most important requisite to development and should not be underestimated. With strong commitment and long-term, sustained effort from GOB, academic institutions and the NGO's and other organizations involved in conservation and natural resources management, it should be possible to guide the development process to one focused on sustainability through a strong environmental ethic at all levels of society.

Target Actions:

4.1 Support and fund the development of a national environmental education center dedicated to targeting all levels of society. This center would spearhead the development of the national environmental education strategy and act as the coordinating national body for its implementation. The ERI at UB could be a key partner to this national environmental education center by sharing with it research findings relevant to natural resources management. The environmental education center could then disseminate these to specific target groups, including all levels of formal and informal education, the public at large and the media. The environmental education center would support long-term programs making the implementation of an environmental education strategy a continuous, institutionalized and sustained effort rather than an ad hoc process. The center would work closely with the Ministry of Education and should be based where it could streamline and institutionalize environmental education at all levels of the formal and informal education curriculum. The center would also help to train teachers to deliver the environmental education portions of the curriculum. Organizations working in management of protected areas and natural resources would be able to partner with this center to strengthen or develop their environmental education packages and programs allowing them to better focus on their role as managers.

4.2 Develop targeted training at the University of Belize to prepare specialist teachers in the area of environmental education.

4.3 Fund a mass education campaign for different international conventions that Belize is a signatory to. Ideally this campaign would be sustained and designed and delivered by an institution that has environmental education as a long-term priority.

4.4 Develop a program for all government agencies to update them on and discuss different international conventions that Belize is a signatory to.

4.5 Encourage public participation in decisions being made for the country that affect or impact the environment. This could be done by supporting local NGO's or institutions, which are dedicated to making public information, important to sustainable development, available. These institutions act as a "check-and-balance" mechanism and allow for greater transparency in the enforcement of the law and in the decision-making process for the country, especially with respect to the management of its natural resources.

APPENDIX 1

Declared Protected Areas in Belize by Tenure Type, 1995 - 2009

Category	1995	1998	2000	2001	2004	2005	2006	2007	2008	2009
Forest Reserves	1,067,323	1,006,599	1,015,776	1,081,943	960,114	947,710	947,710	920,889	920,889	920,889
National Parks	375,309	376,922	395,294	384,810	405,337	405,337	406,237	424,764	424,764	424,763
Nature Reserve	111,677	111,781	109,711	111,690	111,781	111,781	111,781	111,315	111,315	111,315
WildLife Sanctuaries	128,226	353,842	357,866	323,313	359,843	368,823	368,823	368,815	368,815	368,815
Natural Monument	9,776	15,560	15,570	15,641	17,375	17,375	17,375	17,375	17,375	17,375
Archaeological Reserves	26,673	28,444	28,444	28,444	28,444	28,444	28,444	28,444	28,444	28,618
Private Reserves	92,614	292,427	279,447	306,345	292,428	292,428	292,428	316,698	324,106	324,106
Marine Reserves	84,739	267,214	393,288	393,288	393,288	393,288	393,288	393,288	402,907	402,907
Spawning Sites	-	-	-	-	20,745	20,745	20,745	20,745	20,745	20,745
Nassau Grouper & Species Protection					2,848	2,848	2,848	2,848	2,848	2,848
Public/Mangrove Reserves	-	-	-	-	-	38	39	97	97	97
Bird Sanctuaries	15	15	15	15	15	15	15	15	15	15
Grand Total	**1,896,352**	**2,452,804**	**2,595,410**	**2,645,488**	**2,592,217**	**2,588,831**	**2,589,732**	**2,605,293**	**2,622,320**	**2,622,493**
Land Protected Areas	**1,801,843**	**1,984,169**	**2,000,702**	**2,050,780**	**1,964,936**	**1,961,512**	**1,962,413**	**1,977,974**	**1,995,001**	**1,985,554**
% of Total Land Area	**31.8**	**35.0**	**35.3**	**36.1**	**34.6**	**34.6**	**34.6**	**34.9**	**35.2**	**35.0**
Sea Protected Areas	**94,510**	**468,634**	**594,708**	**594,708**	**617,268**	**617,305**	**617,305**	**617,305**	**617,305**	**626,925**
% of Total Sea Area	**1.6**	**8.0**	**10.2**	**10.2**	**10.6**	**10.6**	**10.6**	**10.6**	**10.6**	**10.7**
Total Protected Area as % of Total Territorial Area	**16.5**	**21.3**	**22.5**	**23.0**	**22.5**	**22.5**	**22.5**	**22.6**	**22.8**	**22.8**

Source: Land Information Centre, MNRE

APPENDIX 2

Declared Protected Areas of Belize, 2009 (Dec. 2009)

Name	National Designation	IUCN Category	Legislation	Documented Area (acre)	GIS Area (acre)	Management
Caye Caulker	Forest Reserve	VI	Forests Act	100.000	93.680	Forest Department/Forest and Marine Resources Association of Caye Caulker
Chiquibul	Forest Reserve	VI	Forests Act	147,810.000	147,821.924	Forest Department/Friends for Conservation and Development
Columbia	Forest Reserve	VI	Forests Act	148,357.000	148,301.959	Forest Department
Deep River	Forest Reserve	VI	Forests Act	78,574	67,128.447	Forest Department
Freshwater Creek	Forest Reserve	VI	Forests Act	28,069.000	33,037.205	Forest Department
Grants Work	Forest Reserve	VI	Forests Act	7,590.000	7,906.092	Forest Department
Machaca	Forest Reserve	VI	Forests Act	3,119.000	3,118.495	Forest Department
Manatee	Forest Reserve	VI	Forests Act	90,425.000	90,360.657	Forest Department
Mango Creek 1	Forest Reserve	VI	Forests Act	10,523.049	10,508.811	Forest Department
Mango Creek 2	Forest Reserve	VI	Forests Act	213.000	193.619	Forest Department
Mango Creek 3	Forest Reserve	VI	Forests Act	4,800.000	4,822.625	Forest Department
Mango Creek 4	Forest Reserve	VI	Forests Act	14,670.000	13,108.561	Forest Department
Maya Mountain	Forest Reserve	VI	Forests Act	41,741.000	41,731.565	Forest Department
Monkey Caye	Forest Reserve	VI	Forests Act	1,460.000	1,654.432	Forest Department
Mountain Pine Ridge	Forest Reserve	VI	Forests Act	106,477.809	107,215.016	Forest Department
Sibun	Forest Reserve	VI	Forests Act	106,192.000	96,448.082	Forest Department
Sittee River	Forest Reserve	VI	Forests Act	93,920.000	92,236.139	Forest Department
Swasey Bladen	Forest Reserve	VI	Forests Act	15,000.000	14,778.511	Forest Department
Vaca	Forest Reserve	VI	Forests Act	40,375.000	40,422.838	Forest Department
Aguas Turbias	National Park	II	National Park System Act	8,950.000	8,790.643	Forest Department
Bacalar Chico	National Park	V	National Park System Act	28,148.000	12,568.141	Forest Department
Billy Barquedeer	National Park	II	National Park System Act	1,500.000	1,628.932	Forest Department/Friends of the Valley
Chiquibul	National Park	II	National Park System Act	285,937.000	263,987.830	Forest Department/Friends for Conservation and Development
Five Blues Lake	National Park	II	National Park System Act	4,250.000	4,061.167	Forest Department/Belize Audubon Society

Name	National Designation	IUCN Category	Legislation	Documented Area (acre)	GIS Area (acre)	Management
Gra Gra Lagoon	National Park	II	National Park System Act	1,197.000	1,313.453	Forest Department/Friends of GraGra
Guanacaste	National Park	II	National Park System Act	51.500	57.608	Forest Department/Belize Audubon Society
Honey Camp	National Park	II	National Park System Act	7,772.000	7,771.962	Forest Department
Laughing Bird Caye	National Park	II	National Park System Act	10,119.000	10,119.508	Forest Department/Friends of Nature
Mayflower Bocawina	National Park	II	National Park System Act	7,565.610	7,125.123	Forest Department/Friends of Mayflower/ Bocawina
Monkey Bay	National Park	II	National Park System Act	2,250.000	1,798.652	Forest Department
Noj Kaax Meen Eligio Panti	National Park	II	National Park System Act	14,124.300	12,608.722	Forest Department/Itzama Society
Paynes Creek	National Park	II	National Park System Act	37,680.000	39,530.299	Forest Department/Toledo Institute for Development & Environment
Peccary Hills	National Park	II	National Park System Act	10,744.000	10,744.274	Forest Department
Rio Blanco	National Park	II	National Park System Act	100.000	94.298	Forest Department/Friends of Rio Blanco
Sarstoon/Temash	National Park	II	National Park System Act	41,000.000	41,897.994	Forest Department/Sarstoon-Temash Institute for Indigenous Management
St. Herman's Blue Hole	National Park	II	National Park System Act	574.500	664.518	Forest Department/Belize Audubon Society
Bladen	Nature Reserve	Ia	National Park System Act	99,673.800	99,782.308	Forest Department/Bladen Management Consortium
Burdon Creek	Nature Reserve	Ia	National Park System Act	5,970.000	5,237.466	Forest Department
Tapir Mountain	Nature Reserve	II	National Park System Act	6,286.000	6,295.717	Forest Department/Belize Audubon Society
Aguacaliente (Luha)	Wildlife Sanctuary	IV	National Park System Act	5,492.000	5,492.281	Forest Department/Aguacaliente Management Team
Cockscomb Basin	Wildlife Sanctuary	IV	National Park System Act	87,318.000	122,259.314	Forest Department/Belize Audubon Society
Corozal Bay	Wildlife Sanctuary	IV	National Park System Act	180,500.000	180,507.027	Forest Department/Sarteneja Wildlife Environment and Ecosytem Team
Crooked Tree	Wildlife Sanctuary	IV	National Park System Act	41,297.000	36,479.020	Forest Department/Belize Audubon Society
Gales Point	Wildlife Sanctuary	IV	National Park System Act	9,095.000	9,095.288	Forest Department/Gales Point Consortuim and Mananagement Committee
Spanish Creek	Wildlife Sanctuary	IV	National Park System Act	5,985.000	6,001.462	Forest Department/Rancho Dolores Environmental Development Group
Swallow Caye	Wildlife Sanctuary	IV	National Park System Act	8,970.130	8,980.810	Forest Department/Friends of Swallow Caye
Actun Tunichil Muknal	Natural Monument	Ia	National Park System Act	455.000	448.442	Forest Department/Belize Audubon Society
Blue Hole	Natural Monument	III	National Park System Act	1,023.000	1,023.000	Forest Department/Belize Audubon Society
Half Moon Caye	Natural Monument	II	National Park System Act	9,700.000	9,770.882	Forest Department/Belize Audubon Society
Thousand Foot Fall	Natural Monument	III	National Park System Act	1,290.000	1,290.064	Forest Department/Belize Audubon Society

Name	National Designation	IUCN Category	Legislation	Documented Area (acre)	GIS Area (acre)	Management
Victoria Peak	Natural Monument	III	National Park System Act	4,847.000	4,842.620	Forest Department/Belize Audubon Society
Altun Ha	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	44.000	16.282	National Institute of Culture and History
Cahal Pech	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	22.390	22.401	National Institute of Culture and History
Caracol	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	25,000.000	25,556.478	National Institute of Culture and History
Cerro Maya	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	43.78	43.780	National Institute of Culture and History
El Pilar	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	1,997.000	1,770.825	National Institute of Culture and History
Lamanai	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	958.500	864.753	National Institute of Culture and History
Nim Li Punit	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	121.320	121.489	National Institute of Culture and History
Santa Rita	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	3.730	3.698	National Institute of Culture and History
Xunantunich	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	51.600	44.327	National Institute of Culture and History
Barton Creek	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	5.020	5.020	National Institute of Culture and History
Lubantun	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	40.010	40.010	National Institute of Culture and History
Nohoch Che'em	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	3.710	3.720	National Institute of Culture and History
Yarborough Cementery	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	1.500	1.477	National Institute of Culture and History
Serpon Sugar Mill	Archaeological Reserve	II	Ancient Monuments and Antiquities Act	114.000	123.260	National Institute of Culture and History
Bacalar Chico	Marine Reserve	IV	Fisheries Act	15,577.000	16,336.871	Fisheries Department
Caye Caulker	Marine Reserve	VI	Fisheries Act	9,670.000	9,670.133	Forest Department/Forest and Marine Resources Association of Caye Caulker
Gladden Spit/Silk Cayes	Marine Reserve	IV	Fisheries Act	25,600.000	25,978.083	Fisheries Department/Friends of Nature
Glover's Reef	Marine Reserve	IV	Fisheries Act	86,652.097	80,691.871	Fisheries Department
Hol Chan	Marine Reserve	II	Fisheries Act	13,336.194	13,666.606	Fisheries Department
Port Honduras	Marine Reserve	IV	Fisheries Act	101,100.000	100,095.685	Forest Department/Toledo Institute for Development & Environment

Name	National Designation	IUCN Category	Legislation	Documented Area (acre)	GIS Area (acre)	Management
Sapodilla Cayes	Marine Reserve	IV	Fisheries Act	38,594.000	38,593.744	Fisheries Department/Toledo Association for Sustainable Tourism and Empowerment
Southwater Cayes	Marine Reserve	IV	Fisheries Act	117,874.900	117,874.118	Fisheries Department
Caye Bokel, Turneffe Island Atoll	Spawning Aggregation Site Reserves	IV	Fisheries Act	1,375.994	1,378.699	Fisheries Department
Dog Flea Caye, Turneffe Island Atoll	Spawning Aggregation Site Reserves	IV	Fisheries Act	1,407.994	1,424.284	Fisheries Department
Emily or Caye Glory	Spawning Aggregation Site Reserves	IV	Fisheries Act	1,343.995	1,350.937	Fisheries Department
Gladden Spit	Spawning Aggregation Site Reserves	IV	Fisheries Act	3,590.386	3,677.344	Fisheries Department
Maugre Caye, Turneffe Atoll	Nassau Grouper & Species Protection	IV	Fisheries Act	1,918.224	1,919.461	Fisheries Department
Northern Two Cayes, Lighthouse Reef	Nassau Grouper & Species Protection	IV	Fisheries Act	927.313	928.275	Fisheries Department
Nicholas Caye, Sapodilla Cayes	Spawning Aggregation Site Reserves	IV	Fisheries Act	1,663.993	1,663.329	Fisheries Department
Northern Glover's Reef Atoll	Spawning Aggregation Site Reserves	IV	Fisheries Act	1,799.193	1,576.595	Fisheries Department
Rise and Fall Bank, Sapodilla Cayes	Spawning Aggregation Site Reserves	IV	Fisheries Act	4,249.583	4,252.273	Fisheries Department
Rocky Point, Ambergris Caye	Spawning Aggregation Site Reserves	IV	Fisheries Act	1,404.794	1,408.773	Fisheries Department
Sandbore, Lighthouse Reef Atoll	Spawning Aggregation Site Reserves	IV	Fisheries Act	1,279.995	1,104.950	Fisheries Department
Seal Caye, Sapodilla Cayes	Spawning Aggregation Site Reserves	IV	Fisheries Act	1,599.994	1,600.785	Fisheries Department
South Point, Lighthouse Reef Atoll	Spawning Aggregation Site Reserves	IV	Fisheries Act	1,343.995	1,306.895	Fisheries Department
Aguacate Lagoon	Private Reserve	IV		283.900	283.898	Mennnonite Community
Community Baboon Santuary	Private Reserve	IV			12,980.011	Communities from Flowers Bank to St. Pauls Bank (Six Communittees)
Golden Stream Corridor Preserve	Private Reserve	IV		15,000.000	15,038.105	Ya 'axche Conservation Trust
Monkey Bay Wildlife Sanctuary	Private Reserve	IV			1,473.588	Mathew Miller
Rio Bravo Conservation & Mgmt Area	Private Reserve	IV			259,134.152	Program for Belize
Runaway Creek	Private Reserve	IV		7,123.800	7,123.818	Birds Without Borders
Shipstern Nature Reserve	Private Reserve	IV			18,840.381	International Tropical Conservation Foundation

Name	National Designation	IUCN Category	Legislation	Documented Area (acre)	GIS Area (acre)	Management
TIDE Block 127	Private Reserve	IV		11,000.000	9,231.835	Toledo Institute for Development & Environment
Krooman Reserve	Public Reserve		National Lands Act	57.800	57.954	
Dolphin Park	Public Reserve	II	National Lands Act		0.688	
Seine Bight Village	Public Reserve		National Lands Act	0.750	0.440	
Cockroach Bay	Public Reserve		National Lands Act	19.988	19.990	
Grants Land, Corozal District	Public Reserve		National Lands Act	0.820	0.820	
St. George's Caye	Mangrove Reserve		National Lands Act	15.000	17.577	
Bird Caye	Bird Sanctuary	IV	Crown Lands Act		1.288	
Doubloon Bank	Bird Sanctuary	IV	Crown Lands Act		3.690	
Little Guana Caye	Bird Sanctuary	IV	Crown Lands Act		2.567	
Los Salones	Bird Sanctuary	IV	Crown Lands Act		2.928	
Man of War Caye	Bird Sanctuary	IV	Crown Lands Act		1.913	
Monkey Caye	Bird Sanctuary	IV	Crown Lands Act		1.285	
Un-named	Bird Sanctuary	IV	Crown Lands Act		1.066	

ABBREVIATIONS

AIJ	Activities Implemented Jointly
ALIDES	Central Alliance for Sustainable Development
APAMO	Association of Protected Areas Management Organization
BAHA	Belize Agriculture and Health Authority
BAPPA	Belize Association of Private Protected Areas
BAS	Belize Audubon Society
BCG	Bacille, Calmette-Guerin
BCNP	Bacalar Chico National Park
BECOL	Belize Electricity Company Limited
BEST	Belize Enterprise for Sustainable Technology
BNRM	Bachelors in Natural Resources Management
BOD	Biological Oxygen Demand
BSI	Belize Sugar Industry
BTB	Belize Tourism Board
BWSL	Belize Water Services Limited
BZ	Belize
CAR	Caracol Archaeological Reserve
CARICOM	Caribbean Community
CATHALAC	Centre for the Humids Tropics of Latin America and the Caribbean
CBD	Convention on Biological Diversity
CCAD	Central American for the Environment and Development
CCCCC	Caribbean Community Climate Change Centre
CESD	Centre on Ecotourism and Sustainable Development
CFR	Chiquibul Forest Reserve
CH4	Methane
CITES	Convention on the international Trade of Endangered Species of Wild Fauna & Flora
CMM	Chiquibul Maya Mountain
CNP	Chiquibul National Park
CO	Carbon Monoxide
CO2	Carbon Dioxide
COP	Conference of the Parties
CPA	Country Poverty Assessment
CSO	Central Statistical Office
Cu. Ft.	Cubic Feet
CZMAI	Coastal Zone Management Authority and Institute
DO	Dissolved Oxygen
DOE	Department of the Environment
DPT	Diphteria, Pertussis and Tetanus
DSSAT3	Decision Support System for Agrotechnology Transfer
EIA	Environmental Impact Assessment
EPA	Environmental Protection Act.
ESTAP	Environmental and Social Technical Assistance Project
ERI	Environmental Research Institute
FAO	Food and Agriculture Organization

FCD	Friends for Conservation and Development
FD	Forest Department
FIRMS	Fire Information for Resource Management System
FoN	Friends of Nature
FSC	Forest Stewardship Council
Gals	Gallons
GDP	Gross Domestic Product
GEF	Global Environmental Fund
Gg	Gigagrams
GHG	Greenhouse Gases
GIS	Geographic Information System
GOB	Government of Belize
Ha	Hectares
HDI	Human Development Index
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
ICRAN	International Coral Reef Action Network
IDB	Inter-American Development Bank
IMR	Infant Mortality Rate
INC	Initial National Communications
IPCC	Intergovernmental Panel on Climate Change
ISDS	Individual Sewage and disposal System
IUCN	International Union for Congress of Nature
IUU	Illegal, Unreported and Unregulated
IWRM	Integrated Water Resource Management
Km	Kilometers
Lb	Live Births
Lbs	Pounds
LIC	Land Information Centre
LUCF	Land Use Change and Forestry
MAR	Mesoamerican Reef
MARPOL	International Convention for the Prevention of Pollution from Ships
MBRS	Mesoamerican Barrier Reef System
MDG	Millennium Development Golas
MEA	Millennium Ecosystem Assessment
MMM	Maya Mountain Massif
Mn	Million
MNRE	Ministry of Natural Resources and the Environment
MNRLGE	Ministry of Natural Resources, Local Government and the Environment
MODIS	Moderate Resolution Imaging Spectroradiometer
MoH	Ministry of Health
MPAs	Marine Protected Areas
MPRFR	Mountain Pine Ridge Forest Reserve
NASA	National Aeronautics and Space Administration
NEAC	National Environmental Appraisal Committee
NEAC	National Environmental Assessment Committee
NEAP	National Environmental Action Plan
NEMO	National Emergency and Management Authority

NGOs	Non Government Organizations
NHDAC	National Human Development Advisory Committee
NMVC	Non Methane Volatile Compounds
NMVOC	Non Methane Volatile Organic Compound
NO2	Nitrous Oxide
NPAC	National Protected Areas Commission
NPAP	National Protected Areas Policy
NPAPSP	National Protected Areas Policy and System Plan
NPASP	National Protected Areas System Plan
NPESAP	National Poverty Elimination Strategy and Action Plan
NREPS	Natural Resources and Environmental Policy Subcommittee
NRM	Natural Resources Management
NTFPs	Non Timber Forest Products
NWRC	National Water Resources Commission
PACT	Protected Areas Conservation Trust
PCPU	Policy Coordination and Planning Unit
PFB	Progamme for Belize
PoWPA	Programme of Work on Protected Areas
PPP	Purchasing Power Parity
PUC	Public Utilities Commission
RAMSAR	Convention on Wetlands of International Importance Especially as Waterfowl Habitat
RBCMA	Rio Bravo Conservation and Management Area
REDD	Reduction of Emissions from Deforestation and Degradation
RIL	Reduce Impact Logging
SATIIM	Sarstoon Temash Institute for Indigenous Management
SERVIR	Regional Visualization and Monitoring System
SIB	Statistical Institute of Belize
SLMP	Sustainable Land Management program
SNC	Second National Communication
SO2	Sulphur Dioxide
SPAGs	Spawning Aggregation Sites
SWCMR	South Water Caye Marine Reserve
SWMA	Solid Waste Management Agency
TEC	Tropical Education Centre
THFI	Toledo Health Forest Initiative
TIDE	Toledo Institute for Development and Environment
TNC	The Nature Conservancy
TTU	Tourism Training Unit
UB	University of Belize
UN	United Nations
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations convention on Combating Desertification
UNEP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations High Commission for Refugees
UNICEF	United Nations
US	United States

USAID	United States Agency for International Development
VEMS	Visitors Expenditure and Motivation Surveys
WASA	Water and Sewerage Authority
WCS	Wildlife Conservation Society
WRI	World Resource Institute
WWF	World Wildlife Fund
WWF	Worldwide Fund for Nature
YCT	Ya'axche Conservation Trust

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