BLADEN MANAGEMENT CONSORTIUM

Bladen Nature Reserve

Management Plan

2007 - 2012

Volume I

FINAL DRAFT

PACT

BMC Comanagement Partners

Conservation Area Summary Description

Site Name:	Bladen Nature Reserve
Ecoregions:	Petén-Veracruz Moist Forest Belizean Pine Forest
Country /District:	Mesoamerica - Belize / Toledo District
Acreage:	99,782 acres
Management:	Bladen Management Consortium, in partnership with the Forest Department

Conservation Planning Team

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Bladen Nature Reserve Management Plan

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Abbreviations and Acronyms

ALIDES	Regional Alliance for Sustainable Development
BAS	Belize Audubon Society
BFREE	Belize Foundation for Research and Environmental Education
BMC	Bladen Management Consortium
BNR	Bladen Nature Reserve
CCAD	Central American Commission for Environment and Development
CEPF	Critical Ecosystems Partnership Fund
CI	Conservation International
CSO	Central Statistics Office
FCD	Friends for Conservation Development
FD	Forest Department
FFI	Fauna and Flora International
IUCN	International Union for the Conservation of Nature
MBCP	Mesoamerican Biological Corridor Programme
SI	Statutory Instrument
SICAP	Central American System of Protected Areas
TIDE	Toledo Institute for Development and the Environment
TNC	The Nature Conservancy
WCS	Wildlife Conservation Society
WWF	World Wildelife Fund
YCT	Ya'axche Conservation Trust

Executive Summary

Bladen, established as a Nature Reserve in 1990 (SI 166 of 1990), has the most restrictive of categories possible under the National Parks System Act, allowing only education and research activities. It is one of three nature reserves within Belize, and is managed through a Memorandum of Understanding between the Government of Belize and the Bladen Management Consortium (BMC), a group consisting of representatives from Forest Department (Ministry of Natural Resources), Belize Audubon Society (BAS), Belize Foundation for Research and Environmental Education (BFREE), Toledo Institute for Development and Environment (TIDE), Ya'axche Conservation Trust (YCT) and Fauna and Flora International (FFI). BMC was established in 1996 to assist in the management of Bladen, and has a letter of intent to co-manage the protected area.

The Bladen area has been highlighted as one of the most pristine, biodiversity-rich areas within Belize (Brewer, pers. com.), lying within the Mesoamerican 'hotspot' for biodiversity (Conservation International, 2003), at the convergence point of the Nearctic bioregions of North America, the Neotropical bioregions of South America and the Greater Antillean bioregion of the Caribbean. It is recognised as a Core Conservation Area (Chiquibul/Maya Mountains Key Biodiversity Area) within Belize, and within Central America. At its most sheltered points, west of the karst hills, it has protection from many of the destructive storms that hit the Caribbean coastline, resulting in a forest that has a little-disturbed structure, with tall trees of impressive stature and intact ecological systems. The large number of ecosystems encompassed by the Nature Reserve adds to its value as a conservation area, as it protects species diversity across perhaps the greatest elevational range of any protected area in Belize.

In terms of importance for connectivity, Bladen Nature Reserve is a crucial component of the Maya Mountain conservation area, with Cockscomb Basin Wildlife Sanctuary to the northeast, and Columbia River Forest Reserve to the southwest, and Chiquibul National Park and Forest Reserve to the northwest, connecting Bladen to the protected areas system in Guatemala. With the rapid clearance of forested areas throughout Central America, this is part of the last remaining large, relatively intact block of forest within the region, stretching from Belize to Guatemala and Mexico. This large expanse of primarily forested uplands and valleys is essential for the survival of species such as the scarlet macaw, white-lipped peccary and harpy eagle, which need large, contiguous forest stretches in order to maintain viable populations.

The role of Bladen Nature Reserve in watershed protection within the area is also important, with four river systems starting in the protected area, and emerging to provide water for local communities and large agricultural areas on the coastal plain. The watersheds drain into the Caribbean Sea, 26km to the east, with the Belize Barrier Reef - the second largest barrier reef in the world - lying offshore, reliant on the quality of the water. Whilst Bladen is not able to give protection to the entire watershed area of the four systems, it does protect part of the upper waters, ensuring that it provides the major benefits of watershed protection and management to these coastal plain areas, including water supply, water quality, flood control, sediment control, quality of fish stocks,

biodiversity, and habitat preservation. It also protects the steeper slopes of the watershed areas, which, if cleared, would cause rapid erosion and sedimentation problems, not only within the river system downstream, but also out on the fragile coral reef.

Bladen Nature Reserve provides many other environmental benefits to humans common to intact watersheds globally – including the protection of life support systems through clean air, and as a potential carbon sink. It also has heritage and scenic values, as well as its role in the preservation of genetic diversity.

During the course of the planning cycle, a stakeholder analysis was conducted to examine the impact of Bladen on the stakeholders, and vice versa. This was developed using information drawn from all identified stakeholders and sectors with an interest in Bladen Nature Reserve, through a series of interviews, meetings and workshops with key groups – Bladen Management Consortium members, Bladen wardens, temporary wardens assisting from other protected areas, and Forest Department, as well as alcaldes, community members, and agricultural employees in adjacent areas.

The majority of the buffer communities consider themselves to be negatively impacted by Bladen Nature Reserve, perceiving no benefits from the presence of the protected area. This is reflected by the biggest current impact on Bladen - hunting within the protected area. Whilst population densities in the adjacent coastal plain are currently relatively low, many of these communities being newly developed by agricultural colonists, the pressure for access to land is increasing, and has the potential to cause considerable problems for Bladen should these communities not be supportive once land becomes harder to access. Of particular cause for concern is the expansion of the Trio agricultural area into the recently de-reserved Maya Mountain Forest Reserve area.

Bladen is in the difficult position of having less tangible benefits to offer the local stakeholder communities than many of the other protected areas, with its strict definition as a Nature Reserve – the principle benefit of protected areas is perceived by communities in Belize as the development of tourism, an activity not permitted within the area. Whilst increased international recognition in the importance of Bladen in the future will undoubtedly increase Belize's marketing value as an 'ecofriendly' destination, unless local communities can see a direct benefit to themselves, this will not change their current ambivalent or negative attitudes towards the protected area.

However there is scope for working with the communities to develop their awareness of the conservation benefits of the area, and to focus on training community members as research assistants, along with employment in the development and running of research facilities associated with the area.

Section 1: Introduction

1.1 Background and Context

Bladen, established as a Nature Reserve in 1990 (SI 166 of 1990), has the most restrictive of categories possible under the National Parks System Act, allowing only education and research activities. This is equivalent to IUCN Category Ia:

Nature Reserve: *Any area reserved as a scientific reserve…for the protection of nature be it biological communities or species and to maintain natural processes in an undisturbed state in order to have an ecologically representative example of the natural environment available for scientific study, monitoring, education and the maintenance of genetic resources*

IUCN Category Ia: *Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.*

Lying within the Peten-Veracruz Ecoregion (as defined under the WWF Terrestrial Ecoregions Initiative), the Bladen Nature Reserve has some of the highest, if not the highest, landscape-level beta-diversity in Belize (Brewer, pers. com.), with a range of ecosystems defined by not only altitudinal range, but also by geographical, geological and edaphic variation, and reflecting the site history – the type, extent and intensity of human disturbance and hurricane impacts. The area is rich in wildlife, providing protection for a recorded 250 species of bird (with over 300 being a more realistic estimate), with a current mammal list of 93 species, and 92 reptile and amphibian species recorded to date (Iremonger and Sayer, 1994). This protected area supports a well developed tropical broadleaf forest cloaking the hill slopes of the upper Bladen watershed, one of the tributaries of the Monkey River watershed – the largest watershed contained entirely in southern Belize. It encompasses many unique vegetation assemblages, including upper-elevation and limestone hill forest – two of the most unique and significant, threatened ecosystems of Central America that occur in Belize. National mapping of ecosystem coverage in Belize highlights Bladen as protecting the only known example of ***'tropical evergreen broad-leaved shrubland on steep karstic hills'*** in Belize, and as playing a critical role in the conservation of ***"tropical evergreen broad-leaved sub-montane palm forest"***, which occurs on tracts of non-calcareous soils along the Maya Divide.

Bladen is one of three nature reserves within Belize, and is managed through a Memorandum of Understanding between the Government of Belize and the Bladen Management Consortium (BMC), a group consisting of representatives from Forest Department (Ministry of Natural Resources), Belize Audubon Society (BAS), Belize Foundation for Research and Environmental Education (BFREE), Toledo Institute for Development and Environment (TIDE), Ya'axche Conservation Trust (YCT) and Fauna

and Flora International (FFI). BMC was established in 1996 to assist in the management of Bladen, and has a letter of intent to co-manage the protected area, recently extended to December 31st, 2006.

Through a partnership resulting from shared vision and goals, the organizations that make up the Bladen Management Consortium are working towards the active conservation of the Bladen Nature Reserve, thought to be one of the most pristine areas in Belize.

Overall Conservation Goals

1. To protect and preserve in perpetuity the biodiversity, cultural resources and watershed features found within the BNR, as an integral part of the National Protected Areas System and the Maya Mountain region.

2. To ensure the continued health and hydrologic processes of the Bladen River upper watershed for the continued health of aquatic biodiversity and as a continued source of clean water for human and non-human populations downstream.

3. To contribute towards other environmental services provided by conservation areas, including clean air, flood control, carbon sequestration, and temperature regulation.

4. To develop Bladen Nature Reserve as a nationally and internationally renowned research and educational site.

5. To provide an enabling and supportive environment for alternative economic opportunities in areas adjacent to BNR for local communities, towards environmentally sustainable livelihoods.

6. To explore and develop mechanisms towards a greater level of financial sustainability of management.

1.2 Purpose and Scope of Plan

The purpose of this plan is to provide a framework on which adaptive-management strategies can be developed to achieve the overlying conservation goals of biodiversity protection, to assess the threats that face ecosystems and species within the protected area. It identifies the strategies and actions that can be implemented to reduce those threats, prioritizing activities to allow focusing of resources on strategies that can make the most positive impact. It also provides a means for measuring success.

The Bladen area has been highlighted as one of the most pristine, biodiversity-rich areas within Belize, lying within the Mesoamerican 'hotspot' for biodiversity (Conservation International, 2003), at the convergence point of the Nearctic bioregions of North America, the Neotropical bioregions of South America and the Greater Antillean bioregion of the Caribbean. At its most sheltered points, west of the karst hills, it has protection from many of the destructive storms that hit the Caribbean coastline, resulting in a forest that has a little-disturbed structure, with tall trees of impressive stature and

intact ecological systems. The large number of ecosystems encompassed by the Nature Reserve adds to its value as a conservation area, with research showing that tree species richness is exceptionally high when compared with other forests of MesoAmerica (Brewer et. al. 2002), and it protects species diversity across perhaps the greatest elevational range of any protected area in Belize.

In terms of importance for connectivity, Bladen Nature Reserve is a crucial link within the natural Maya Mountain corridor, with Cockscomb Basin Wildlife Sanctuary to the northeast, and Columbia River Forest Reserve to the southwest. Chiquibul National Park and Forest Reserve lie to the northwest, connecting to the protected areas system in Guatemala. With the rapid clearance of forested areas throughout Central America, this is part of the last remaining large, relatively intact block of forest within the region – the Selva Maya - stretching from Belize to Guatemala and Mexico. This large expanse of primarily forested hill slopes and valleys is essential for the survival of species such as the scarlet macaw, white-lipped peccary and harpy eagle, which need large contiguous forest stretches in order to maintain viable populations.

Bladen Nature Reserve's role in watershed protection within the area is also important, with the river system providing water for local communities and large agricultural areas on the coastal plain. The watershed drains into the Caribbean Sea 26km to the east, with the Belize Barrier Reef - the second largest barrier reef in the world - lying offshore, reliant on the quality of the water. Whilst Bladen is not able to give protection to the entire watershed area of the Monkey River, it does protect part of the upper waters, with Cockscomb Basin Wildlife Sanctuary providing protection for the adjacent tributaries, ensuring that it provides the major benefits of watershed protection and management to these coastal plain areas, including water supply, water quality, flood control, sediment control, quality of fish stocks, biodiversity, and habitat preservation. It also protects the steeper slopes of the watershed areas, which, if cleared, would cause rapid erosion and sedimentation problems, not only within the river system downstream, but also out on the fragile coral reef.

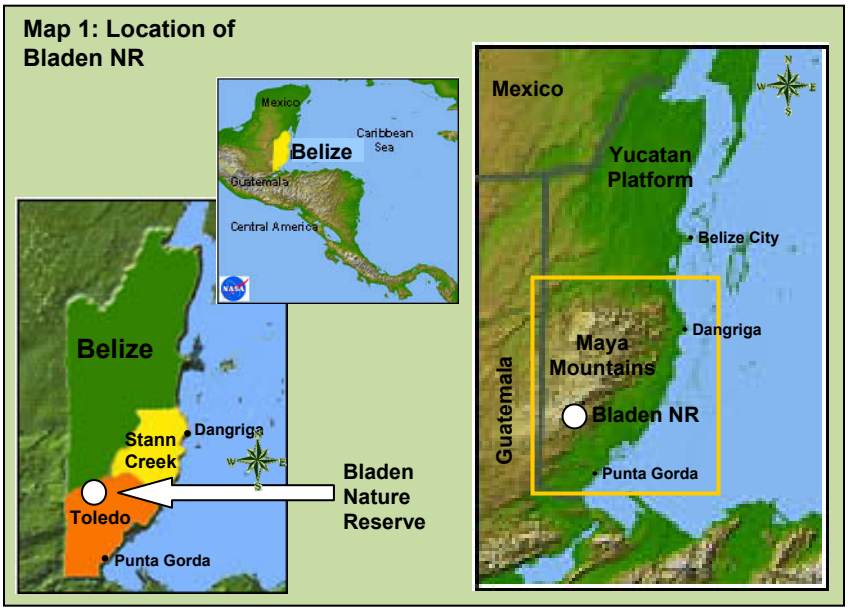
Bladen Nature Reserve provides many other environmental benefits to humans common to intact watersheds globally – including the protection of life support systems through clean air, and as a potential carbon sink. It also has heritage and scenic values, as well as its role in the preservation of genetic diversity.

Section 2: Current Status

2.1 Location

Bladen Nature Reserve is located in the Central American country of Belize, a country consisting of 8,867 sq. miles (22,966 sq. kilometers) of tropical forest, savanna, mangrove, and wetlands, with a population of approximately 282,600 (CSO, 2004). Belize is bordered by Mexico to the north and Guatemala to the west and south. To the east, it is bordered by the Caribbean Sea, with the Belize Barrier Reef running parallel with the coastline for the entire length of the country.

Topographically, Belize can be divided into two areas – with the flat, limestone Yucatan platform to the north, and the steep Maya Mountains dominating the southern region. Bladen lies in the latter, nestled into the mountain range that lies diagonally across the southern part of the country, forming a 'backbone' of granite mountains (Map 1).



Map 1: Location of Bladen NR

Geopolitically, Bladen Nature Reserve is located in Toledo District, the most southerly of the six administrative districts within the country (Map 1). The nearest communities are Trio/Trion Village, Bladen Village, Golden Stream and Medina Bank, whilst approximately 40km to the south east is Punta Gorda, the District administrative centre of Toledo. Punta Gorda has a population of approximately 4,330 (CSO, 2000) – a multicultural town surrounded by traditional Ketchi and Mopan Maya villages.

2.2 Regional Context

Bladen Nature Reserve lies within Mesoamerica, a region highlighted as a world 'hotspot for species diversity' (Conservation International, 2003), and considered critical for the preservation of the biodiversity of the Western Hemisphere. Here, the Nearctic bioregions of North America converge with the Neotropical bioregions of South America, and, in Belize in particular, also with the Greater Antillean bioregion of the Caribbean. Each of these three bring a unique assemblage of plants and animals which has resulted in a particularly rich biodiversity, with components of all three regions being represented

within the Central American land bridge – with 8% of the world's known plant species, and 10% of its vertebrates. The bridge has also enabled movement of species between the North and South American regions since the late Pliocene, and is still of vital importance today to migratory bird species, both as a corridor and as an over-wintering location.

The entire Central American region has suffered from an alarming rate of deforestation, with as much as two thirds of the forest having been converted within the last 50 years into agricultural land that has then been degraded by unsustainable agricultural practices and cattle-farming. Belize, with its relatively low population, and large areas of natural vegetation still intact, therefore plays an important role in the survival of many of the threatened species of Central America, and an important waypoint for Nearctic and Neotropical migrants. Up until recently, much of Belize had escaped most of the more destructive land clearance, but significant land use change is taking place in the coastal plain to the east of Bladen Nature Reserve, with citrus, banana and mango farms being established, bringing new settlements to the area and increasing pressure for land.

Through the Central American Environmental Agenda - Plan Ambiental de la Region Centroamericana (PARCA), several regional agreements have been reached to help balance environmental concerns and development, starting with the creation of the **Central American Commission for Environment and Development (CCAD)** in 1989. The Government of Belize is a participant in this Commission, as well as in the **Convention for the Conservation of Biodiversity and Protection of Priority Wilderness Areas in Central America** (formed in 1992)**,** and the **Regional Alliance for Sustainable Development (ALIDES)** (1994). (**Annex 8**).

One of the programmes supported by the Regional Alliance for Sustainable Development is the **Mesoamerican Biological Corridor Programme (MBCP).** This is one of the most important regional programmes to have been implemented in recent years, establishing corridors of natural vegetation throughout Central America to link protected areas, with the goal of retaining sufficient natural vegetation cover to allow gene flow between protected areas both within and between countries. A central concept of the programme is sustainable development - combining conservation and the sustainable use of biodiversity within the framework of economic development.

Within Belize, Bladen Nature Reserve is not only a core area of conservation of biodiversity, but also forms a major link within the National Biological Corridors Programme, providing both protection and connectivity for a portion of the eastern slopes of the Maya Mountains, linking Cockscomb Basin Wildlife Sanctuary and Maya Mountain Forest Reserve to the north with Columbia Forest Reserve to the south, and Chiquibul Forest Reserve to the west. It also connects with the Gulf of Honduras, through Golden Stream (under Ya'axche Conservation Trust), Block 127 and Payne's Creek (both under TIDE), and Deep River Forest Reserve (under the Forest Department). It is within one of eleven priority areas highlighted under the **Central American System of Protected Areas (SICAP)**, an initiative that has been developed in an effort to plan protected area coverage throughout the region and identify gaps in ecosystem coverage. This initiative has emphasized the importance of the addition of the Maya Mountains to the System.

2.3 National Context

At present, Belize has over 36% of the country under some form of protection (National Protected Areas System Plan, 2005) – either as national or private protected areas. Bladen Nature Reserve is one of three Nature Reserves created within Belize under the National Parks System Act, and is managed by a consortium of organizations – Forest Department (Ministry of Natural Resources), Ya'axche Conservation Trust (YCT), Toledo Institute of Development and Environment (TIDE), Belize Audubon Society (BAS), and Belize Foundation for Research and Environmental Education (BFREE) under a co-management agreement with Government.

2.3.1 Legal and Policy Framework

National Objectives for Conservation

The national objectives for conservation revolve around the protection, conservation and rational use of Belize's natural resources within the context of sustainable human development. These goals are supported by the **National Strategy on Biodiversity,** through the National Biodiversity Strategy and Action Plan (Jacobs and Castaneda, 1998), one of Belize's commitments following the signing of the Convention on Biological Diversity in 1992 (later ratified by Belize in 1995). The overall goal under the Strategy on Biodiversity reflects the national objectives - ecological and economic sustainability over the long term. It recognizes the need to build both human and institutional capacity to effectively manage the biodiversity resources within Belize. It also moves towards decentralization of the management of these resources, with a strong focus on management partnerships such as that formed with Bladen Consortium, and on community-based participation and ownership of conservation efforts. Another area highlighted is the need to coordinate conservation efforts with those of regional and global initiatives such as the ALIDES Meso-American Biological Corridors Programme, and

National Legislation Protecting Fauna, Flora, and National Heritage

The Forest Act (1990)
Promotes the forestry industry, with the implementation of conservation techniques

The Wildlife Protection Act (1981)
"to provide for the conservation, restoration and development of wildlife, for the regulation of its use and for all other matters connected therewith"

Environmental Protection Act (1992)
"to promote the preservation and improvement of the environment, the rational use of natural resources, the control of pollution, and matters connected therein"

The National Parks Systems Act (1981)
Empowers government to create or maintain a "national system" of protected areas.

The Fisheries Act (1948)
Protects the marine and freshwater environments, and the fisheries resources of Belize

The Ancient Monuments and Antiquities Act (1971)
Enables the Minister responsible for Archaeology to designate land as an Archaeological Reserve to protect Ancient Monuments

National Lands Act (1992)
Provides legislation for protecting the 66' reserve along river edges, and allows GoB permission to access minerals etc.

Figure 1

the Climate Change Programme, with an emphasis on international collaboration and a strong commitment to technological transfer between nations.

Also contributing to the conservation framework of Belize are a number of laws designed to protect wildlife and national heritage within Belize (Figure 1). Administered under the Forest Department are the Forest Act (1990), Wildlife Protection Act (1981), and the National Parks System Act (1981). These three focus on the protection of the environment and natural resources. The Fisheries Act (1948), is also of relevance, protecting the marine and freshwater resources. Most recently has been the development of the National Parks System Plan and Policy (2006), which is in the first stages of being approved by the Belize Government. This seeks to strengthen and support the current protected areas system.

The Ancient Monuments and Antiquities Act (1971) allows for the protection of archaeological sites for the preservation of Belize's national heritage, and is administered at present under the Ministry of Culture.

The Environmental Protection Act (1992) was developed under the Department of the Environment (Ministry of Natural Resources), with the aim of ensuring that development initiatives of any kind within Belize are planned for minimum environmental impact. The Mines and Minerals Act (1989) and the Petroleum Act (1991), two acts that may well have an impact on Bladen in the future, regulate the exploration and extraction of all non-renewable resources, governing natural resources other than wildlife.

National System for Protected Areas

Within Belize, three different Government Ministries currently have mandates for the creation of national protected areas. The first, the Forest Department of the Ministry of Natural Resources, is responsible for the administration of the Forest Act and the current National Parks System Act. The second, the Ministry of Agriculture and Fisheries and Cooperatives is responsible for marine reserves created under the Fisheries Act. The Ministry for Culture is responsible for the creation of Archaeological Reserves under the Ancient Monuments and Antiquities Act (Figure 2).

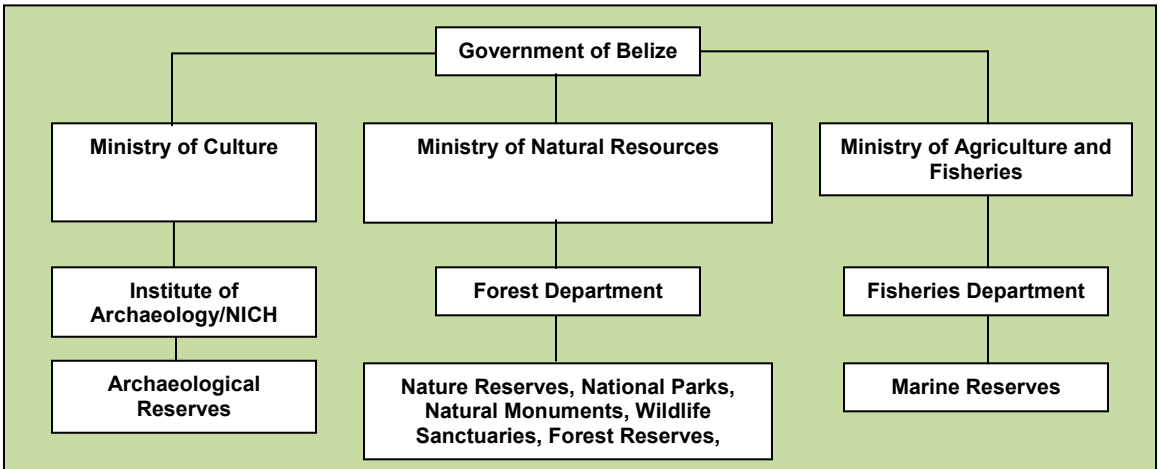


Figure 2: Government Agencies with Legal Jurisdiction over Protected Areas
(Adapted from Salas, 2003)

National protected areas formed under the Forest Department and the National Parks System Act fall within one of five distinct categories, each protected by restrictions strictly defined by law (**Annex 9**). Three of these (National Park, Natural Monument and Wildlife Sanctuary) provide full protection to the natural resources, with use concentrating on tourism, research and education. The fourth (Nature Reserve, including Bladen) is more rigid, allowing only research and education.

The fifth (Forest Reserve) is for land set aside for controlled natural resource extraction of timber and/or other forest products, to ensure an adequate supply to the people, industries and timber trade of Belize both now and in the long term. It also recognizes the importance of tourism and environmental protection.

Bladen was first designated as a Forest Reserve (SI 42 of 1997), then redefined in 1979, reducing the size of the area (SI13 of 1979). More recently it was the focus of a number of research expeditions, which led to its redesignation as a Nature Reserve in 1990 (SI66 of 1990), the most restrictive of categories, allowing only research and education activities. Under the proposed shift to IUCN categories under the National Protected Areas System Plan, it is proposed that Bladen should fall within the IUCN Ia category – Strict Nature Reserve:

> *"Area of land possessing some outstanding or representative ecosystems, geological or physiological features and / or species, available primarily for scientific research and / or environmental monitoring"*
>
> **...IUCN Protected Area Management Categories**

The **National Parks System Act** lays out the recognized protected area categories on which the **National Protected Areas System Plan** is based. The Plan, produced in 1995, was developed to identify the minimum conservation system required for Belize for the conservation of the maximum biodiversity. The Act is currently being strengthened by the formulation of a National Policy on Protected Areas, being presented to cabinet. With over 2.6 million acres presently under protection, and increasing pressure for land for economic development, the Policy has been developed to effectively guide the management of Belize's protected areas and natural resources into the future, balancing environmental protection with sustainable human development.

> *"The Government of Belize shall promote the sustainable use of Belize's protected areas by educating and encouraging resource users and the general public to properly conserve the biological diversity contained in these areas in order to maintain and enhance the quality of life for all. This shall be achieved by facilitating the participation of local communities and other stakeholders in the decision-making and the equitable distribution of benefits derived from them, through adequate institutional and human capacity building and collaborative research and development."*
>
> ***Belize National Protected Areas System Plan – November, 2005***

This is based on the recognition that protected areas in Belize provide irreplaceable public benefits from ecosystem services that contribute to the local, national and regional economies.

Development of Bladen as a Nature Reserve has to be in line with policy recommendations, with much greater focus on engaging stakeholder support than it has in the past, particularly in the local communities.

2.3.2 Land Tenure

Bladen Nature Reserve is a national protected area, designated by Statutory Instrument (SI166 of 1990), and comprising entirely of national lands. As a nature reserve, it is described as an area:

"*…reserved as a scientific reserve…for the protection of nature be it biological communities or species and to maintain natural processes in an undisturbed state in order to have ecologically representative examples of the natural environment available for scientific study, monitoring, education and the maintenance of genetic resources.*"

National Park Systems Act, 1981

Whilst this legislation protects the area from incursions, currently the Minister of Natural Resources has the ability to dereserve the land if he feels there is sufficient reason.

2.3.3 Evaluation of Bladen Nature Reserve

The Bladen area has been highlighted as one of the most pristine, biodiversity-rich areas within Belize (Weyer, 1981; Brokaw et. al., 1987; Johnson, 1989) which itself lies within the Mesoamerican 'hotspot' for biodiversity (Conservation International, 2003), at the convergence point of the Nearctic bioregions of North America, the Neotropical bioregions of South America and the Greater Antillean bioregion of the Caribbean. At its most sheltered points, west of the karst hills, Bladen has protection from many of the destructive storms that hit the Caribbean coastline, resulting in a forest that has a little-disturbed structure, with tall trees of impressive stature and intact ecological systems. The large number of ecosystems encompassed by the Nature Reserve adds to its value as a conservation area, as it protects species diversity across perhaps the greatest elevational range of any protected area in Belize.

In terms of importance for connectivity, Bladen Nature Reserve is a crucial link within the Maya Mountain corridor, with Cockscomb Basin Wildlife Sanctuary to the north, and Columbia River Forest Reserve to the south. Chiquibul National Park and Forest Reserve lie to the west, connecting to the protected areas system in Guatemala (Map 2). This large expanse of primarily forested uplands and valleys is essential for the survival of species such as scarlet macaw, white-lipped peccary and ornate hawk-eagle, which need large contiguous forest stretches in order to survive, and provides protection for populations of 19 species of international concern (including the critically endangered *Agalychnis moreletii,* IUCN, 2006), and a further two sub-species considered at risk. With the rapid clearance of forested areas throughout Central America, this is part of the

last remaining large, relatively intact block of forest within the region, stretching from Belize to Guatemala and Mexico.
Connectivity is also present to the Caribbean Sea, following a series of 'ridge to reef' projects, through Deep River Forest Reserve and Paynes Creek (TIDE), and also through Columbia Forest Reserve, Golden Stream (YCT) and Block 127 (TIDE), linking into the Port Honduras Marine Reserve.

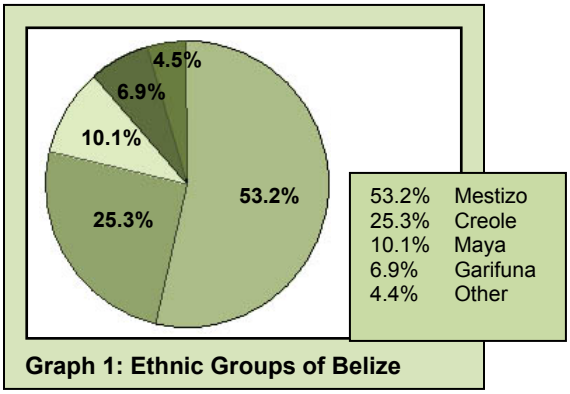
Bladen Nature Reserve's role in watershed protection within the area is also particularly important, with the Caribbean Sea 26km to the east, and the Belize Barrier Reef - the second largest barrier reef in the world - lying offshore. Whilst Bladen is not able to give protection to the entire watershed area of the Monkey River (as the rivers pass through the agricultural coastal plain before entering the sea), it does protect part of the upper waters, with Cockscomb Basin Wildlife Sanctuary protecting the adjacent tributaries, ensuring that it provides the major benefits of upper watershed protection and management to these coastal plain areas, including water supply, water quality, flood control, sediment control, quality of fish stocks, biodiversity, habitat preservation, and recreation. It also protects the steeper slopes of the watershed areas, which, if cleared, would cause rapid erosion and sedimentation problems, not only within the river system downstream, but also out on the fragile coral reef.

The Nature Reserve also provides many other environmental benefits – protecting life support systems through clean air, clean water, flood / erosion control and through acting as a potential carbon sink. The archaeological value of the area has been well documented through a series of surveys under the Maya Mountain Archaeological Project (Dunham, from 1993 to 2000). It also has heritage and scenic values, on top of its role in the preservation of genetic diversity

(See Annex One / Maps: **Map1 /** Bladen Nature Reserve: Political Boundaries; **Map 2 /**Bladen Nature Reserve: General Location; **Map 3 /** Bladen Nature Reserve: Protected Area Connectivity; **Map 4 /** Bladen Nature Reserve: Regional Priority Areas; **Map 5 /** Bladen Nature Reserve: Landscape)

2.3.4 Socio-Economic Context

Belize is a country of many ethnic cultures, with Mestizo, Creole, Maya and Garifuna being the major population groups (Graph 1, CSO, 2002). The original Maya occupants are subdivided into three ethnic groups – the Yucatec Maya of the north, the Mopan Maya of the west and south, and the Ketchi of the southern regions. Belize has a low population currently estimated at approximately 282,600, of which 52% are urban dwellers (CSO, 2004) (Figure 4). Population densities are low, with 12.3 persons per sq. km. (Figure 3) concentrated mostly within the northern plain, southern coastal plain, Belize Valley and Stann Creek Valley, with much of the remaining country being less suited in the coastal plains and steep terrain in the



Graph 1: Ethnic Groups of Belize

Figure 3: Belize Demographic Statistics	
Population estimate (2004)	282,600
Population density (2004)	12.3 /sq. km.
Annual growth rate (2000)	2.7%
Birth rate (1996)	23.2 per 1000
Mortality rate (1996)	4.3 per 1000
Fertility rate (2000)	3 children per woman
Life expectancy (2000)	76 (female); 73 (male)
Below Poverty level (2002)	33.5%
Literacy rate (2002)	94%
Unemployment rate (2004)	11.6%
GDP (bn Bz$) (2004)	2.121
Ref: CSO 2000 Census Ministry of Health CSO, Mid-term 2004 CSO, Poverty Assessment Report, 2002	

Figure 4: Toledo Demographic Statistics	
Population estimate (2004)	26,800
Urban population (2004)	4,900
Rural population (2004)	21,900
Fertility rate (2000)	5.6 children / woman
Below poverty level (2002)	79%
Unemployment rate (2004)	16.0%
% population who complete:	
Primary education (2002)	84.9%
Secondary education (2002)	10.7%
Tertiary education (2002)	2.3%
Ref: CSO 2000 Census CSO, Mid-term 2004 CSO, Poverty Assessment Report, 2002	

Maya Mountains.

There is an ongoing emigration of Belizeans to the United States – generally those from urban areas who have completed secondary school or have professional training. There is also a significant influx of Central American refugees – primarily from Guatemala and Honduras - contributing approximately 13% towards the total population of Belize and resulting in the relatively high population growth rate of 2.7% (CSO, 2000 Census). At the present rate of immigration, it has been calculated that the population of Belize will double in twenty-six years, with much of this immigrant sector tending to be rural-based with low levels of education, placing far greater stress on the natural resources than currently exists.

Toledo District, within which Bladen Nature Reserve is located, is the most southerly of the six districts, and the poorest, with 79% of the population of 26,800 considered to be unable to maintain a minimum standard of living, compared with the national average of 33.5% (CSO, 2002; CSO, 2004). With limited economic and industrial activities within this southern-most district, there is little infrastructural development, nor the associated support services. Unemployment is high (16% as compared with the national average of 11.6%), and there is a high reliance on natural resources, with much of the population living at a subsistence level, dependent on milpa farming. The population is predominantly rural-based (Figure 4), with a fertility rate of 5.6 children per woman, far above the national average of 3.0, resulting in a higher population growth rate than other districts of Belize.

Figure 5: The Belize Economy (Exports and Imports) - 2002		
Exports	US$290 million	Sugar, bananas, citrus, clothing, fish products, molasses, wood
Imports	US$430 million	Machinery and transportation equipment, manufactured goods; food, beverages, tobacco; fuels, chemicals, pharmaceuticals

The economy of Belize has been based largely on agriculture, with banana, sugar and citrus forming some of the traditional exports that contribute significantly towards the GDP (Figure 5). There is an increasing reliance on the developing tourism industry, which is rapidly becoming the major foreign exchange earner.

Figure 6: Banana and Citrus production, 2000 - 2004					
Agricultural Crop	Million lbs (approx.)				
	2000	2001	2002	2003	2004
Bananas	144	124	96	160	
Citrus	614	633	470	450	564

Citrus, banana, mango, shrimp and cattle are the major, large-scale agricultural industries within the immediate vicinity of Bladen (Figure 6).They dominate not only the land use patterns adjacent to the Nature Reserve, but also the economy of the area. Citrus is the most significant agro-industry in Belize, earning more than US$37 million for the country in the 2000/2001 crop year (Belize Citrus Growers Association, 2003). The majority of citrus produced in Belize is processed into concentrate by the two factories located in the Stann Creek Valley, the traditional heart of the citrus industry since 1926. Current world markets have, however, reduced the market price, resulting in interest in diversification towards less traditional crops and cattle.

Bladen, together with Cockscomb Basin Wildlife Sanctuary and the Maya Mountain Forest Reserve, protects the headwaters of the Monkey River watershed, which contains approximately 66% of the land cultivated for bananas in Belize (Esselman, 2001). The banana industry, the second major agricultural industry in the area, is Toledo's largest employer – and a source of about 10 per cent of total employment countrywide. It is also a major contributor to the GDP - however again market uncertainties and high production costs are affecting both production and marketing (Caribbean Banana Exporters Association, 2003). These farms are major impactors of the lower Monkey River watershed on the coastal plain, with the heavy use of agrochemicals and fertilizer, clearance of the riparian buffer and alteration of runoff patterns for irrigation and drainage. Large cattle farms are also starting to appear in the coastal plain to the north of the Bladen area, providing employment opportunities – once again, primarily to Central American immigrants, willing to work for lower wages.

The large agricultural developments of the Toledo coastal plain – banana and citrus in particular, are a focus for the immigration of Central American seasonal workers, attracted to the area by the employment opportunities presented by the farms. With low wages, there is a heavy incentive for these workers to supplement their diet with game meat, increasing the stress on the protected area through illegal hunting and fishing.

As well as this international migration of seasonal labourers, there has also been an internal migration within Belize, with Maya from the villages in southern Toledo District moving northwards in search of better farmlands, and creating new settlements along the Southern Highway. This, too, has generated greater stress on the natural resources of the area, as community development spreads into the buffer areas adjacent to Bladen. Most recently, an area immediately adjacent to Bladen Nature Reserve has been surveyed into 30-acre agricultural parcels, bringing development right to the boundaries of the protected area, increasing accessibility and the associated probability of incursions. Whilst the majority of the local migrants appear to still retain a traditional respect for the natural resources, those from other countries of Central America are seen locally to have a much more extractive view of the resources, and are thought of as less in balance with the local environment by the Belizean members of the buffer communities, with incidences of tapir kills, excessive hunting of game species etc. This may also be due to a lack of awareness of location of the protected area, and lack of respect for the laws of Belize.

Agricultural development - whether large banana or mango farms, or smaller community farmlands - is the cause of major land use changes around the Bladen area, with clear felling of both forest and pine savanna, and associated increased wildfire risks, with anthropogenic fires close to and sometimes entering the protected area on an annual basis. The employment opportunities have led to the development of a number of communities within the area, each with its own ethnic component and source of income. Some are primarily composed of seasonal Central American workers, linked to the large banana farms. Others are subsistence-level villages of Mopan or Ketchi Maya.

(See **Annex One: Map 6 /** Bladen Nature Reserve: Land Use; **Map 7 /** Bladen Nature Reserve: Land Ownership)

Stakeholder Analysis

Stakeholders include surrounding communities, but are certainly not limited to them. Stakeholders also encompass all those who are affected by the presence of Bladen Nature Reserve (either positively or negatively), and those who can assist or hinder the development of the protected area – at local, national and international level.

This includes Government bodies responsible for the implementation of protected area regulations and wildlife legislation; for the regulation of development in the adjacent areas; and for the health and welfare of stakeholder communities (Table 1).

Table 1: Government bodies highlighted as Influential Stakeholders where greater liaison would be beneficial

Ministry	Department/Office	Role
Ministry of Natural Resources and Environment, Commerce and Industry	Minister of Natural Resources	Can fully support Bladen Nature Reserve Can dereserve BNR through Ministerial fiat
	Forest Department	Co-manager of BNR Issues research permits for BNR Can help resolve boundary issues Can recognise wardens as Forestry Officers, with power to enforce regulations
	Geology and Petroleum Department	Issue exploratory and mining permits – at present can (and do) issue them for within protected areas
	Department of the Environment	Able to monitor and control some activities within buffer zone area through EIA process
Ministry of Agriculture	Department of Agriculture Cooperatives Department	Liaison to increase presence and activities within buffer communities Assistance with agricultural projects within buffer communities
Ministry of Culture	Institute of Archaeology	Liaison with respect to archaeological sites within BNR
Ministry of Education, Youth and Sports	Education Department	Liaison to increase presence and activities within buffer communities
	Youth for the Future	Liaison with respect to working with youths within the buffer communities
Ministry of Health and Communications	Health Department	Liaison to increase presence and activities within buffer communities
Ministry of Human Development		Liaison to increase presence and activities within buffer communities Assistance to Village Councils within buffer communities
Ministry of Rural Development	Rural Development	Poverty elimination projects

Stakeholder analysis allows identification of those stakeholders affected, or who think they are affected, by the protected area - whether it be positively or negatively. Three main stakeholder groups have been identified:

- The first includes those who support the conservation goals of Bladen – such as the conservation organisations of Toledo (many of whom are represented on BMC), and members of local communities who gain employment from Bladen as wardens. At present, with no previous outreach activities associated with the protected area, this sector is very small.

- The second group highlighted by the analysis is of those stakeholders who are potential supporters of the conservation goals of Bladen, and the areas in which their support can be earned – these are primarily communities targeted by YCT, where good groundwork has prepared the community for a supportive role in conservation, once the environmental benefits, such as protection of the water source, can be seen.

- The third group consists of stakeholders who may be antagonistic towards Bladen, whether it is because of an inability to perceive the benefits of the protected area, or through restriction of access to land or fish and game species. Once areas of concern have been highlighted, it is possible to work towards mitigating the problems and conflicts, with the goal of reducing their opposition, and developing a positive working relationship.

The majority of the buffer communities (Table 2) consider themselves to be negatively impacted by Bladen, perceiving no benefits from the presence of the protected area. This is reflected in the biggest current impact on Bladen - hunting within the protected area. Whilst population densities in the adjacent coastal plain are currently relatively low, many of these communities being relatively newly developed by agricultural colonists, the pressure for access to land is increasing, and has the potential to cause considerable problems for Bladen should these communities not be supportive once land becomes harder to access. Of particular cause for concern is the expansion of the Trio agricultural area into the recently de-reserved Maya Mountain Forest Reserve area.

Bladen is in the difficult position of having less to in the way of tangible benefits to offer the local stakeholder communities than many of the other protected area, with its strict definition as a Nature Reserve – the principle benefit of protected areas in Belize is perceived by communities as the development of tourism, an activity not permitted within Bladen. Whilst increased international recognition in the importance of Bladen in the future will undoubtably increase Belize's marketing value as an 'ecofriendly' destination, unless local communities can see a direct benefit to themselves, this will not change their current ambivalent or negative attitudes towards the protected area.

However, there is scope for working with the communities to develop their awareness of the conservation benefits of the protected area, and to focus on training community members as research assistants, along with employment in the development and running of research facilities associated with the area.

Table 2: Stakeholder Communities of Bladen Nature Reserve

Community	Location (UTM)	Population (approx.)	Population Components	Comments
Trio	327000 1823550	380	Central American immigrant community (principally Guatemalan, some Honduran) with a small number of Maya.	Historically a low impact community, but with the new access road and agricultural development, has the potential to be the highest impacting community in the future. Employed on banana farm / subsistence agriculture
Bladen	327100 1820800	390	Mopan and Ketchi Maya, with a growing immigrant population. Employed on banana farm / subsistence agriculture Some employment with BFREE and as research assistants	Community with the most +ve and –ve impact historically. Some hunting within Bladen, both small and large scale. Commercial hunting (reported to take 20 white-lipped peccary at a time) Anthropogenic fires set by hunters, and milpa fires
Medina Bank	313370 1820830	90	Primarily Ketchi Maya community, with some Mopan Maya and immigrant workers. Established in 1989, Participating in YCT Agroforestry Project Subsistence agriculture, hunting and fishing.	Generally low impact – hunting and fishing. Access through La Sierra road to areas of Bladen that are not well patrolled. One family logged illegally in Bladen – minimal impact
Golden Stream	309900 1807800	1,067	A combination of Ketchi and Mopan Maya community established in 1970 Participating in YCT Agroforestry Project Subsistence agriculture, hunting and fishing. Employment as wardens for Bladen	-ve Relatively low impact – hunting and fishing. Historically there was a hunting trail through to Teakettle Camp, which has been closed by tree fall during Hurricane Iris, and is no longer in use.
Bella Vista	336820 1824680	710	Hispanic immigrants Employment on banana and shrimp farms, subsistence milpas	Hunting, fishing and looting
San Juan	338656 1830911	415	Hispanic immigrants Employment on banana and shrimp farms, subsistence milpas	Hunting, fishing and looting
Jalacte (incl. San Vincente)		1,068	Primarily Mopan Maya village established in 1850	Hunting, fishing and looting. Thought to access Bladen from the west through Columbia River Forest Reserve
San Antonio		909		
Mango Creek			Creole / East Indian	
Indian Creek	04200 04600		Ketchi Maya community established in 1969	

Table 3: Stakeholder Analysis for Bladen Nature Reserve

Stakeholder	Influence or impact of Bladen on Stakeholder		Influence or Impact of Stakeholder on Bladen	
Trio	• Income guiding researchers, working as research assistants • Employment opportunities with Bladen • Environmental services • Exclusion from potential hunting/fishing area • Exclusion from Bladen for cutting logs/posts/leaves, and medicinal plants	+ + + - -	• Pool of wardens, guides and research assistants • Hunting and fishing within protected area • Demand for land within protected area	+ - -
Bladen	• Income guiding researchers, working as research assistants • Employment opportunities with Bladen and BFREE • Environmental services • Exclusion from potential hunting/fishing area • Exclusion from Bladen for cutting logs/posts/leaves, and medicinal plants	+ + + - -	• Pool of wardens, guides and research assistants • Hunting and fishing for table within protected area • Commercial hunting within protected area • Anthropogenic fire impacts from milpa clearance	+ - - -
Monkey River	• Environmental services – protection of watershed	+	• No impact	
Belize Foundation for Research and Environmental Education	• A resource for attracting researchers and international student groups • A resource for attracting funding for facilities • Provides connectivity necessary for biodiversity conservation to be feasible within limited area of BFREE • Substantially raises profile of BFREE • Benefit of collaboration with other protected area management organizations, through BMC, giving increased lobbying power	+ + + + +	• Increased knowledge of biodiversity increasing national and regional awareness of Bladen • Research infrastructure provided by BFREE • Management presence at one of the key entrance points to Bladen, with provision of some enforcement • BFREE lobbying, with generation of interest in enforcement of biodiversity protection, and development of BMC management • Benefit of collaboration with other protected area management organizations, through BMC, giving increased lobbying power • Negative relationship between BFREE and local communities impacts community view of BNR	+ + + + + –
Research Groups	• Relatively pristine, high biological diversity location • Experienced guides and research assistants	+ +	• Increased knowledge of biodiversity • Sustainability mechanism – providing income • Increase support for Bladen through employment of assistants from the stakeholder communities • Increased awareness of Bladen • Minimal impact of research	+ + + + +
Agricultural Areas	• Protection of watershed	+	• Employment of seasonal workers known to hunt within protected area • Diversion of water flow of rivers for irrigation, interfering with migratory aquatic species	- -
Adjacent Protected Areas	• Provide connectivity necessary for biodiversity conservation • Benefit of collaboration with other protected area management organizations, giving increased lobbying power	+ +	• Provide connectivity necessary for biodiversity conservation • Benefit of collaboration with other protected area management organizations, giving increased lobbying power	+ +

Bladen is in the difficult position of having less to offer the local stakeholder communities than many of the other protected areas, with its strict definition as a Nature Reserve – the principle benefit of protected areas is perceived by communities in Belize as financial, through the development of tourism, an activity not permitted under the Nature Reserve definition.

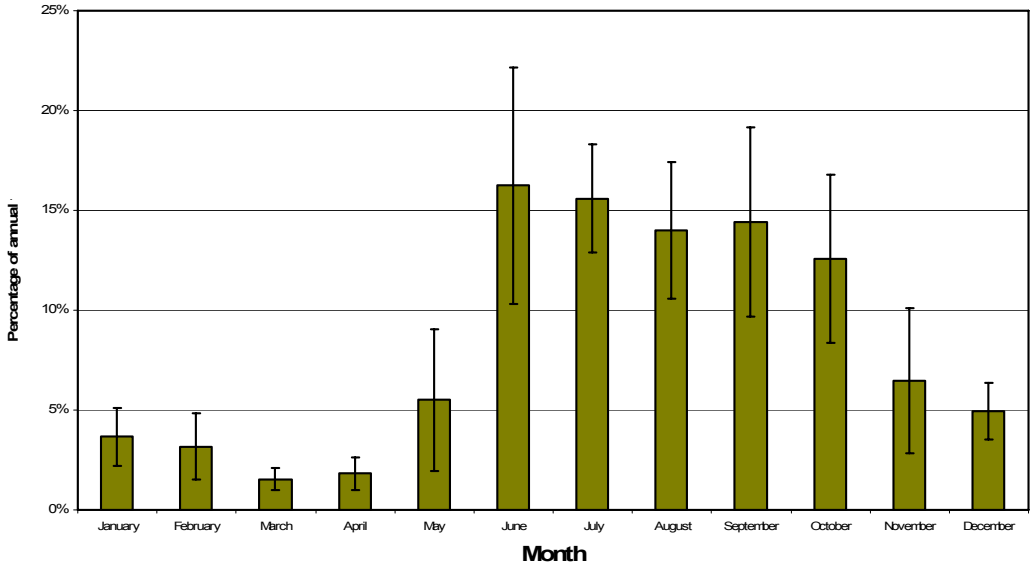
2.4 Physical Environment of Management Area

2.4.1 Climate

Belize lies within the outer tropical geographical belt, with a noticeable variation in average monthly temperatures. It can be divided into two climate regimes – ***subtropical*** in the northern lowlands and central inland areas, and ***tropical*** in the southern Stann Creek and Toledo regions. Bladen Nature Reserve is situated in the latter, on the eastern slopes of the Maya Mountains, with a climate influenced not only by its latitude, but also by its topography.

Weather data has been collected at BFREE (Belize Foundation for Research and Environmental Education, adjacent to the eastern boundary of Bladen), and from the Melinda Forest Station, a few kilometers to the north.

Rainfall: Bladen Nature Reserve lies within the wettest half of the country, with an annual rainfall averaging between 330cm and 406cm per annum (Map 4). Rainfall is further influenced by its location on the eastern slopes of the Maya Mountains, with the northeast trade winds picking up moisture over the Caribbean Sea, which then develops into heavy orographic precipitation as the moist air is forced higher as it moves eastwards over the higher regions of the Maya Mountains.



Graph 2: Mean Monthly Precipitation at BFREE, 1997 – 2002 (BFREE)

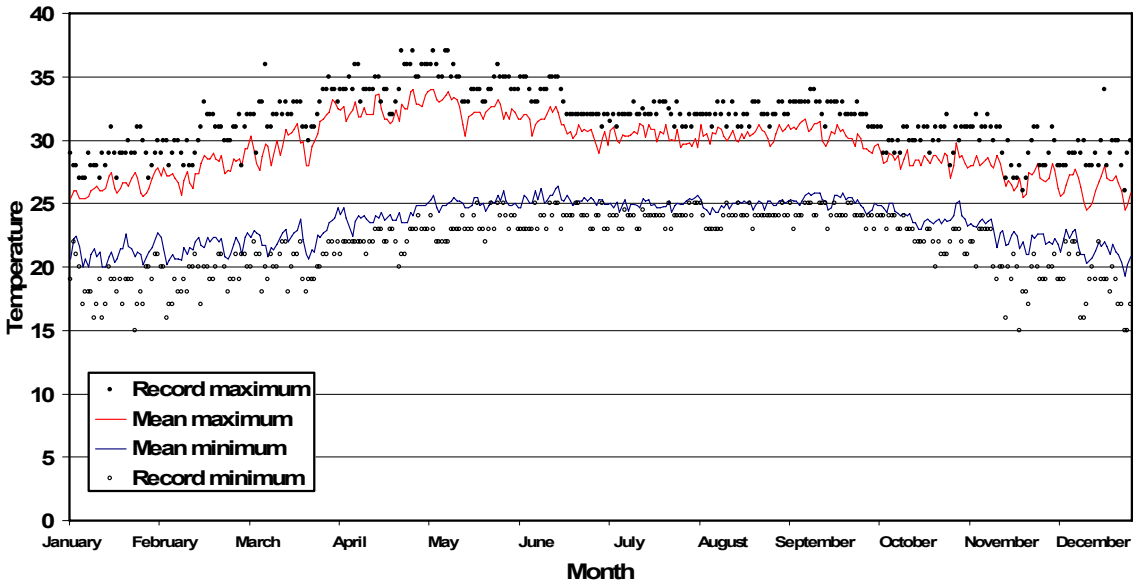
There is a noticeable dry season that stretches from February through to mid-May (BFREE, Graph 2, based on data collected from adjacent to the south east corner of Bladen, between 1997 and 2002). During this period, the minimum monthly rainfall is as low as 0.24cm (recorded in March 2002)).

The dry season is followed by a wetter season (June to December / January), with rainfall reaching a high of 54.7cm in July 2000. (Interestingly, this is not punctuated by the mini dry season seen in the more northern areas of Belize in the month of August, possibly due to the location of BFREE on the eastern slope of the Maya Mountain, catching orographic rainfall as the trade winds blow inland).

The majority of rain falls within the hurricane season, associated with passing tropical storms - particularly in July, August, September and October, though this season appears to be extending in to November as well.

(See **Annex One / Map 8 /** Bladen Nature Reserve: Rainfall)

Temperature: Lying within the outer tropics, Belize has an average annual temperature of approximately 25°C, with cooler temperatures during November to February (associated with weather systems from the north), and warmer between April and June (Graph 3). Temperature is also affected within the Bladen area by altitude, with cooler temperatures in higher parts of the Maya Mountains.



Graph 3: Average and record daily termperatures at BFREE, 1997 – 2002 (BFREE)

Northers and Tropical Storms: Belize is affected by two climatic disturbances – 'northers' and tropical storms. The former are cooler air masses that move down from North America, bringing lower temperatures and, on occasion, heavy rains and wind. Being in the southern part of the country, and inland, much of the effects of the northers are mitigated by the time this weather system reaches Bladen.

Tropical storm weather begins in June, and extends until November, bringing tropical waves, tropical storms and the more damaging hurricanes (with sustained winds

exceeding 75mph). These storms originate over warm seas, and develop into a cyclonic form that can be very destructive. Whilst Belize has escaped the majority of hurricanes spawned within the Caribbean and Atlantic in the last hundred years, hurricanes have periodically caused extensive damage to the area in the past (Table 4). Of recent note for Bladen is Hurricane Iris (2001), which caused extensive vegetation destruction and soil erosion on the east facing karst hill slopes.

Table 4: Hurricanes affecting Bladen

Year	Hurricane	Speed at Landfall/Radius	Date of Landfall	Position of Landfall
1918	Un-named			
1960	Abby	80 mph/100 miles	15/7/60	16.3N 89.0
1974	Fifi	115mph	19/9/74	16.5N 88.3
2001	Iris	140mph	9/10/01	16.3N 88.4

2.4.2 Geology

Bladen Nature Reserve encompasses much of the Upper Bladen Watershed, and is composed essentially of two geomorphological areas - the granite / volcanic slopes rising to the crest of the Maya Divide to the north west, and the limestone karst to the south, both draining into the flat, alluvial plain of the Bladen Branch itself. Between these two lies the Bladen Branch valley, draining to the northeast.

The geology of Bladen follows this general topography, being divided into two geomorphological areas running parallel to each other. To the west is the ridge of extrusive volcanic rocks, lying between the granite intrusion, of the main Maya Mountain range and the Bladen Branch. Both the Bladen volcanic rock and granite of the main Maya Mountain block have been subjected to tectonic uplift along two major fault systems – the Northern Boundary Fault to the north, and Quartz Ridge / Bladen Fault during the Triassic period, accompanied by intrusion by granite. In the early Cretaceous Period oceanic waters flooded the area and fossiliferous limestones were deposited over the entire Maya Mountains.

Table 5: Time Scale of Formation of Bladen Geology

Era	Period	Time Span (million years ago)	Geological Activity
Palaeozoic Era	Permian	225 – 570	Belize covered by a shallow ocean. Sedimentary rocks of the Santa Rosa Group deposited. Volcanic activity in the Bladen area
	Carboniferous		
Mesozoic Era	Triassic Period	190-225	Tectonic uplifts and folding of sedimentary rocks, forming Maya Mountains. Granite intrusion occurs, with contact metamorphosis of adjacent sedimentary rocks to form slate and quartzite
	Jurassic Period	136 – 190	Rift valleys form with erosion of Maya Mountains
	Cretaceous Period	65 – 136	Marine inundation by oceanic water covers the Maya Mountains with limestone.
Cenozoic Era	Tertiary Period	2 – 65	Renewed uplift of Maya Mountains creating present high relief topography. Coastal zone sediments deposited. Erosion of Cretaceous limestone
	Quaternary Period	0 – 2 million	Continued erosion of limestone sequence from Maya Mountains, incision of mountains by streams and rivers

The beginning of the Tertiary Period (65 million years ago) saw renewed tectonic uplift of the Maya Mountains (Table 5) resulting in the formation of an upland plateau, and shaping the present topography of the Maya Massif. This plateau dips gently to the west, whilst the steep eastern edge of this plateau has been eroded by numerous streams to form the series of steep sided valleys leading down from the Maya Divide, that form the relief in Cockscomb, Bladen and Columbia Forest.

The distinction between the granite and volcanic rocks is very important to resulting soil formation. Both are igneous in origin, the granite being intrusive (formed slowly, from magma, underground, resulting in large silica crystals) and the volcanic being extrusive (forms from lava above ground, with tiny crystals). The larger particles of the granitic soils results in shallow, extremely poor and "droughty" soil, versus the deeper, richer soils of the volcanics, which are less prone to edaphic drought.

To the east and south-east there lies a rugged limestone topography of steep, conical hills pocked by vertical-sided sinkholes, underground streams and caves. Water is scarce in this karst landscape, especially during the dry months, resulting in the presence of a vegetation type adapted to seasonally drier conditions, and a seasonal migration of wildlife to the lowlands. Smaller streams that emerge as springs within the hill slopes then disappear underground again after flowing a short distance – a characteristic of this limestone topography. Only the Bladen, flowing over the porphrytic Bladen Volcanic Member (an area composed of lavas and associated extrusive volcanic sediments that lies between the Santa Rosa Group and the limestone hills), runs permanently throughout the year.

(See **Annex One: Map 9 /** Bladen Nature Reserve: Topography; **Map 10 /** Bladen Nature Reserve: Geology)

2.4.3 Soils

Two major soil and land use studies have taken place in Belize – the first a comprehensive study of the whole country by Wright et. al. (1959), looking at soils and associated vegetation assemblages in great detail. The second is a more recent study by King et. al. (1986) based on Wright et. al. (1959) but using techniques such as satellite imagery to update the original report. Soils within Bladen are dependant on the underlying geology, and can be divided broadly into soils derived from limestone rocks, those with volcanic and those with granitic origins (Table 6).

Table 6: Soils of Bladen Nature Reserve (after King et. al. 1986)			
Land Region	**Land System**	**Subunit**	**Soil Type**
Toledo Foothills Land Region	Xpicilha Hills	Karst	Cabro
		Plain	Xpicilha
		Steep Hill Slopes	Cabro
Maya Mountains Land Region	Richardson Peak Mountains Land System	Hill Slope	Cockscomb Richardson Peak
Northern Coastal Plain Land Region	Toledo Floodplain	Backswamp	Caway
		Low level	Monkey River
		High flooding branch levee	Logan Bank Monkey River

Constantly Lime Enriched Soils and **Intermittently Lime Enriched Soils**

These are soils of the Toledo Foothills - densely dissected, steeply sloping limestone hills. Much of the land consists of karst topography of sloping towers and sink holes, produced by differential limestone solution. The steeper regions are very prone to erosion, and therefore unsuitable for agriculture.

Acidic Soils

These acidic soils are derived from the granite upland areas of the Richardson Peak Mountains Land System that form the western slopes of the Bladen Basin. These steep mountainous slopes of the Maya Mountains – over 25° angle between 80 and 1,120m altitude, overlie Santa Rosa Group metasediment rocks, producing non-alluvial, poor, shallow, droughty soils on the slopes, or deeper colluvial deposits that collect at the base of the hillslopes following erosion. Vegetation characteristic of this soil type is evergreen broadleaf forest, shrubland and pine at higher altitudes.

Recent Soils

The most recent soils are in the north-east of Bladen, following the line of the floodplain of Bladen Branch and Richardson Creek, and laid down by these streams as they drain the Richardson Peak Mountains and karst hills to either side, and also the volcanic porphyrite. These fertile, deep alluvial soils are built up by regular flood events, with the characteristics of the Toledo Floodplain soils, and have led to incursions into the area by people wanting to settle new farming areas.

(See **Annex One: Map 11 /** Bladen Nature Reserve: Landsystems; **Map 12 /** Bladen Nature Reserve: Soils)

2.4.4 Hydrology

The Upper Bladen drainage is a tributary of the Monkey River, the fourth largest watershed catchments in Belize with an estimated drainage area of 1,275km^2 (Lee and Stednick, 1995). In the upper reaches, on the south-east slope of the Maya Divide, the water flows off steep terrain, carving deep valleys through the landscape, and is protected within three contiguous protected areas – Bladen Nature Reserve, Cockscomb Basin Wildlife Sanctuary and Maya Mountain Forest Reserve (Map 8). To the south, this

drainage basin is bordered by karstic ridge crests. Within Bladen, this trellis of fast flowing streams meet to form Bladen Branch, draining the extruded Bladen Volcanic rock and limestone to the one side, and the granite and sedimentary rock to the other, flowing through an alluvial plain and meandering eastwards, exiting the protected area, and flowing on to join the Swasey on entering the coastal plain.

To the south-east, a limited number of the karstic streams form the headwaters of Golden Stream, and to the south east, the Rio Grande watersheds.

Of the three water system categories – upper reaches (headwaters), middle reaches, and lower reaches (estuarine) - only two (upper and middle reaches) are represented within Bladen, as the protected area has no direct contact with the coastal areas. The majority of the streams and creeks draining the hill slopes within Bladen fall within the upper, or 'headwaters' category, characterized by fast running streams, waterfalls, pools and riffles, often carved deep into the bedrock, with tropical broadleaf forest on either bank, branches meeting overhead and shading the water.

These upper reach streams then join to form Bladen Branch further downstream in the middle reaches of the river system, the water flowing through a narrow floodplain, with little variation in gradient. The character of the waterway changes from the fast moving streams of the headwaters to slower, wider, deeper, meandering rivers, interspersed in places with shallower riffles.

Dependent on the geology of the area, the river systems of the Monkey River watershed can be divided into two different categories - those rivers that drain granite and Santa Rosa Group metasediments (tributaries of South Stann Creek, Swasey Branch and Trio), and those that drain the Bladen volcanic rock and surrounding limestone (Richardson Creek and other southern tributaries of Bladen Branch). The water of rivers draining the granite and metasediments is rich in phosphorus, though with low nitrogen levels, low conductivity and a basic pH. Conversely Bladen Branch, draining the volcanic rock and adjacent limestone, is low in phosphorus, but has a higher level of nitrogen, high conductivity, and a neutral pH (Esselman, 2001).

The differing phosphorus levels have a very strong bearing on the flora and fauna found within these rivers (Esselman, pers. com.). Phosphorus is particularly important as a plant growth promoter in freshwater systems, resulting in more abundant aquatic plant life (especially *Marathrum oxycarpum*), providing greater shelter and food resources, enabling greater aquatic invertebrate abundance and biomass – which can be expected to result in an increased abundances and biomass of fish. *M. oxycarpum* is present at elevated levels in South Stann Creek, Swasey Branch and Trio Branch, all of which drain areas of granite and metasediments, and can be expected to show far greater abundance of plant life than the phosphorus-poor Bladen Branch and Richardson Creek.

(See **Annex One: Map 13 /** Bladen Nature Reserve: Hydrology)

2.5 Biodiversity of Bladen Nature Reserve

2.5.1 Ecoregions and Ecosystems

Under the WWF Terrestrial Ecoregions initiative (Dinerstein et. al. 1995), the tropical and subtropical moist forest biome of the Neotropical biogeographic region is subdivided into eighty Ecoregions, of which only one is represented within Bladen – the Petén-Veracruz Moist Forest. This large block of tropical forest stretches through Belize, Guatemala and southern Mexico, the northern limit being approximately 22°N, towards the northern extent of Veracruz State in Mexico, with the southern extent reaching approximately 15°N, just north of the southern border of Guatemala (Map 9).

Throughout their range, these forests tend to be a matrix of moist tropical forest, bajo, wetlands and riparian habitats. Species-richness is high (though the number of endemic species is low). Many tree, vertebrate and invertebrate species occur at relatively low densities, resulting in large areas being needed for the support of viable populations, particularly of the larger predators. Throughout Central America, there is much disturbance and fragmentation of this ecoregion type, resulting in not only the loss of key predators, but also secondary local extinctions and changes in species composition when these key species are removed. These tropical and sub-tropical forests are very susceptible to change, with understory species being sensitive to even small disturbances in the microclimate, and unwilling to move through more open habitats, making them particularly vulnerable to habitat fragmentation. For all these reasons, tropical moist forests such as that found in Bladen typically require large protected areas to maintain viable populations and sustain ecological processes, with buffering from edge effects, and provision for linkage through natural habitat corridors.

At the ecosystem level, relatively extensive surveys were undertaken by Brokaw (1987) and Iremonger and Sayer (1994), leading to a comprehensive overview of vegetation assemblages in the area. This was followed by mapping developed from satellite imagery interpretation by Iremonger and Brokaw in 1995, later updated by Meerman and Sabido (2001, revised 2004). More detailed research has also been conducted in the area (Brewer et. al. 2002, Brewer et. al. 2003).

Bladen Nature Reserve has been shown to be unique in Belize to date, in having plant species richness that far exceeds that predicted. Whilst there is a general trend of decreasing species richness moving northwards through Central America, tree species richness in 1 hectare plots in Bladen Nature Reserve equal or exceed that in comparable plots in Panama and Costa Rica (Brewer, S.W. & M.A.H. Webb, 2002). It is not yet known whether this unexpectedly high species richness is confined to Bladen Nature Reserve, or whether it is characteristic of this south-eastern portion of the Maya Mountains. The forest structure of Bladen Nature Reserve is also very unusual, in having a lower tree density and a higher proportion of large trees (>70cmdbh) than other wet Neotropical forests (Brewer, S.W. & M.A.H. Webb, 2002) – portraying a mature forest, with a high percentage of old trees in the canopy, presumed to reflect the relative shelter from hurricane impacts, and the very limited extent and intensity of past logging activities.

The forests of Bladen Nature Reserve are evergreen in the valleys and on the lower slopes, semi-evergreen (25-50% deciduous trees) on the upper slopes, and semi-

deciduous (5-75% deciduous trees) on the ridge. Forest stature decreases with increasing elevation from the valleys to the ridges, with a corresponding decrease in the density of large trees (Brewer, S.W., et al, 2003). This largely reflects edaphic drought associated with rapid drainage on the steep limestone topography. Recent studies of phytogeography have demonstrated a significant affinity between the flora of the Greater Antilles and the upper limestone ridges of the Bladen Nature Reserve, indicating a far more complex regional phytogeography than previously suspected (Brewer, S.W., et al, 2003).

Twenty ecosystems have been identified within the Bladen area by Meerman and Sabido (2001, 2004), ranging from broadleaf lowland hill forest to submontane forest, riparian shrubland and short grass savanna (Table 7; **Annex 2**).

Table 7: Ecosystems of the Bladen Nature Reserve Area

UNESCO classification	
Broad Ecosystems	**Ecosystem Categories**
Tropical Broadleaf Forest	Tropical evergreen broadleaved lowland hill forest over rolling karstic terrain
	Tropical evergreen broadleaved lowland hill forest over steep karstic terrain
	Tropical evergreen broadleaved lowland hill forest: Vochysia – Terminalia variant
	Tropical evergreen broadleaved lowland forest over poor or sandy soil
	Tropical evergreen broadleaved submontane forest over rolling karstic hills
	Tropical evergreen broadleaved submontane forest over steep karstic hills
	Tropical evergreen broadleaved submontane forest
	Tropical evergreen broadleaved submontane palm forest
	Tropical evergreen broadleaved lower montane forest
	Tropical evergreen broadleaved lower montane palm forest
	Tropical evergreen broadleaved alluvial forest over calcareous soils
	Tropical evergreen seasonal broadleaved lowland hill forest over rolling karstic terrain
	Tropical evergreen seasonal broadleaved submontane forest: Simarouba – Terminalia variant
	Tropical evergreen broadleaved shrubland on steep karstic hills
Pine Forest – Short grass Savanna	Deciduous broadleaved lowland shrubland, well drained, over poor soils
	Deciduous mixed submontane shrubland over poor soils
	Short grass savanna with scattered needle leaved trees
	Short grass savanna with shrubs
Aquatic and Riparian Ecosystems	Deciduous broadleaved lowland riparian shrubland in hills
	River
***Classification follows Meerman and Sabido, 2001 (revised 2004)**	

At the ecosystem level, the Bladen Nature Reserve plays a critical role as a core conservation area, protecting over 5% of the national extent of 11 ecosystems. 10 of theses ecosystems have more than 15% of their total national coverage within the protected area, 5 of which have over one third of the total national coverage occurring within the boundaries of Bladen Nature Reserve. Each of these ecosystems is confined to rugged terrain in the higher rainfall areas of southern Belize.

Table 8: % of national coverage of ecosystem found in Bladen Nature Reserve	
Ecosystem	**% of National Coverage**
Tropical evergreen broad-leaved shrubland on steep karstic hills	100
Tropical evergreen broad-leaved submontane palm forest	74.9
Tropical evergreen broad-leaved lowland hill forest, Vochysia-Terminalia variant	57.8
Tropical evergreen broad-leaved lowland hill forest on rolling karstic terrain	38.9
Tropical evergreen broad-leaved lower montane palm forest	36.1
Tropical evergreen broad-leaved alluvial forest on calcareous soils	22.2
Tropical evergreen broad-leaved lower-montane forest	20.9
Tropical evergreen broad-leaved submontane forest on steep karstic hills	19.9
Tropical evergreen broad-leaved submontane forest on rolling karstic hills	19.5
Tropical evergreen broad-leaved lowland hill forest on steep karstic terrain	16.9
Tropical evergreen broad-leaved submontane forest	6.2

(See **Annex One: Map 14 /** Bladen Nature Reserve: Ecoregions; **Map 15 /** Broad Ecosystems; **Map 16 /** Bladen Nature Reserve: Ecosystems – Potential Vegetation; **Map 17 /** Bladen Nature Reserve: Ecosystems – Actual Vegetation

2.5.2 Flora

With its diversity of altitude, geology, aspect and hydrology, Bladen Nature Reserve offers perhaps the most diverse range of conditions for plant-life of any protected area in Belize (Figure 7). A significant portion of the plants recorded to date are specialists – associated with a narrow ecological zone. This complexity is enhanced by the seasonality experienced by the limestone substrata and associated soils (Brewer et. al. 2003). Whilst the 1994 REA recognized only 9 ecosystems (as compared with the 20 mapped by Meerman & Sabido), they found that 73% of the approximately 300 plant species they identified were specific to single ecosystems (Iremonger et. al., 1995). This suggests a far higher prevalence of ecological specialization in the flora of Bladen than is typical in Belize. Plant associations are reported to link the flora of some of the upper elevations within Bladen with the flora of the Antillean archipelago (S. Brewer, pers. com.). A number of plant species that occur in these upper elevations of Bladen and the contiguous portions in Chiquibul National Park are found nowhere else in Belize (J. Marlin, pers. com.).

Whilst the lowlands of Bladen were repeatedly logged, albeit at low levels, up until about 1970 (Healy et. al, 1989), the steep terrain of much of the Reserve was not conducive to extensive logging far beyond the most accessible valleys and adjacent slopes. Snake Creek, in SW Bladen, was the most remote portion that was logged. As a result of this limitation to the extent of logging activities, and the fact that legal commercial logging has not taken place for 35 years, Bladen is now considered as one of the most pristine environments in Belize.

Figure 7:
Dominant tree species of Bladen

Mortoniella pittieri Apocyn.
Attalea cohune Arec.
Brosimum alicastrum Mor.
Schizolobium parahyba Fab.
Manilkara chicle Sapot.
Spondias mombin Anacardi.
Dialium guianense Fab.
Chrysophyllum venezuelanense Sapot.
Pouteria sapota Sapot.
Quararibea funebris Bombac.
Guarea glabra Meli.
Lonchocarpus pentaphyllus Fab.
Ceiba pentandra Bombac.
Ficus popenoei Mor.
Terminalia amazonia Combret.
Pterocarpus rohrii Fab.
Alseis yucatanensis Rubi.
Guarea grandifolia Meli.
Cassipourea guianensis Rhizophor.
Drypetes brownii Euphorbi.
Astrocaryum mexicanum Arec.
Protium schippii Burser.
Ficus sp. 3 Mor.
Pouteria durlandii Sapot.
Simira salvadorensis Rubi.
Zanthoxylum riedelianum Rut.
Mortoniodendron vestitum Tili.
Luehea speciosa Tili.
Ampelocera hottlei Ulm.
Ficus insipida

Brewer et. al. (2002)

2.5.3 Fauna

93 species of mammal, 250 species of birds and 92 herptiles are considered confirmed for Bladen, either through being recorded within the protected area, or being recorded in both the contiguous protected areas to the north and south (Cockscomb Basin Wildlife Sanctuary and Columbia River Forest Reserve - Bladen is expected to have significant species overlap with these two adjacent protected areas). Bladen is also expected to share some of the species recorded in the montane forest areas of Doyle's Delight, and the majority of those of the more intensively studied BFREE property.

The majority of species of concern listed for Cockscomb and Columbia River Forest Reserve are considered to be protected by Bladen as well (Figure 8), though in some cases this needs verification through further fieldwork in the area. Of these, 19 are considered of international concern at species level under the IUCN Red List (Critically Endangered, Endangered, Vulnerable or at Least Risk/Near Threatened).

A further 2 are considered of international concern at sub-species level (the Central American spider monkey *(Ateles geoffroyi spp. yucatanensis*) and the tayra (*Eira barbara ssp. senex*)). For more information on vertebrate species, see **Annex 3.**

Figure 8: Species of International Concern of Bladen Nature Reserve and adjacent protected areas

Critically Endangered
Morelet's Treefrog *Agalychnis moreletti*

Endangered:
Yucatan Black Howler *Alouatta pigra*
Baird's Tapir *Tapirus bairdii*
Sabrinas Rain Frog *Eleutherodactylus sabrinus*

Vulnerable
Woolly Opossum *Caluromys derbianus*
Keel-billed Motmot *Electron carinatum*
Limestone Rain Frog *Eleutherodactylus psephosypharus*

Lower Risk/ Near Threatened
Underwood's Mastiff Bat *Eumops underwoodi*
Water Opossum *Chironectes minimus*
Cacomistle *Bassiriscus sumichrasti*
Jaguar *Panthera onca*
Morelet's Crocodile *Crocodylus moreleti*
Puma *Puma concolor*
Great Curassow *Crax rubra*
Common Slider *Trachemys scripta*
Rainforest Toad *Bufo campbelli*
Chac Rain Frog *Eleutherodactylus chac*
Maya Mountain Frog *Rana Juliana*

Data Deficient
Neotropical River Otter *Lontra longicaudis*
Red Brocket *Mazama americana*

Sub-Species of International Concern

Vulnerable
Central American Spider Monkey *Ateles geofrroyi ssp. yucantensis*
Tayra *Eira Barbara ssp. senex*

IUCN Red List (2004)

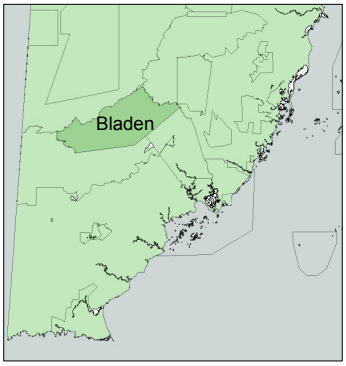
Figure 9: Vertebrate species breakdown for Bladen

Vertebrate Group	No. Species (BNR)	No. Species (BNR / CRFR/CBWS)	No. Species (Belize)
Mammals	93	110 (67%)	163
Birds	250	355 (62%)	574
Reptiles and Amphibians	92	101 (63%)	161
Freshwater Fish	19	?	119

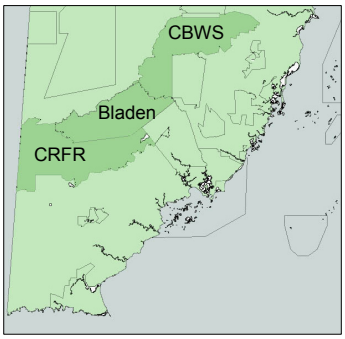
Mammals

With its forested slopes, riparian vegetation, valleys and rugged limestone landscapes, Bladen Nature Reserve is home to a wide variety of mammal species typical of tropical moist broadleaf forest. Of the 163 species of mammal recorded within Belize (Jacobs et. al. 1998) that could potentially be found in the protected area based on the assumption of similar ecosystems, 93 species are recorded as present within Bladen Nature Reserve itself.

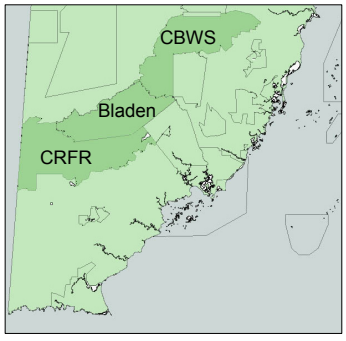
When the entire Maya Mountain block of east-slope protected areas of contiguous ecosystems is considered (Cockscomb Basin Wildlife Sanctuary, Bladen Nature Reserve and Columbia River Forest Reserve), the number of species that could be present increases to 110 species – 67% of the total number of mammal species recorded for Belize, partly as a result of specialized species surveys into groups such as the small rodents and bats (McCarthy 1987, McCarthy et. al. 1993, McCarthy and Blake 1987, Miller; 1999; Emmons 1993).



Species recorded only from Bladen Nature Reserve:
93 species are recorded within Bladen to date, of which seven are considered of global concern. Of these, two are 'endangered' under the IUCN redlist system (the Yucatan black howler monkey and Baird's tapir), and five are considered 'near threatened' (water opossum, Alston's mouse opossum, Thomas' sac-winged bat, puma and jaguar). Two further species are considered to be 'data deficient' with insufficient information to allow them to be categorised (red brocket deer and Neotropical river otter). Also present is the Central American spider monkey, listed as a sub-species considered to be of international concern (IUCN status: Vulnerable).



Species found in both Cockscomb Basin Wildlife Sanctuary and Columbia River Forest Reserve (and including those found in Bladen):
Of the 49 species projected to be within Bladen due to similarity and connectivity of ecosystems, and presence in both Cockscomb and Columbia River Forest Reserve, a further two species of international concern are listed – the Jamaican fruit-eating bat ('Lower risk') and the cacomistle ('Near threatened'), bringing the total list of species of international concern up to eleven (including the two species listed as 'data deficient').



Species found within the Maya Mountain Block (Bladen, Cockscomb, and / or Columbia River):
Of the 110 species recorded from the east of the Maya Mountain divide from the contiguous protected areas of Cockscomb Basin Wildlife Sanctuary southwards to include Bladen and Columbia River Forest reserve, a further three species are added to the list of threatened species for the area – the woolly opossum (considered 'vulnerable'), and three bat species listed as 'lower risk / near threatened' - Davis's round-eared bat, Van Gelder's bat, and Underwood's bonneted bat. Belize has a total of 21 threatened terrestrial mammal species (IUCN redlist) of which the Maya Mountain block provides protection for 15 (71%).

Bladen is therefore highlighted as a vital conservation area within the protected areas system, making a major contribution towards the maintenance of biodiversity in Belize. Its isolated nature and the lack of access have led to buffering it has with the presence

of the other protected areas and the BFREE lands should enable it to continue its role in protecting both threatened and non-threatened species.

The Yucatan black howler (*Alouatta pigra*), one of the two primate species recorded from the area, is endemic to a small area of the Yucatan Peninsula, Belize and the Peten. This species was decimated by a yellow fever epidemic in 1956/1957 that swept through the *Alouatta* population throughout most of the country. Pockets of viable populations remained, including those in Columbia River Forest Reserve and Bladen Nature Reserve, whilst in other areas further north, such as Cockscomb Basin Wildlife Reserve, the epidemic was compounded by other impacts such as the effects of Hurricane Hattie in 1961, and by local hunting pressure, extirpating the local population by 1978 (Horwich et. al 1993). There was a notable lack of howler monkeys in Bladen during both the 1987 and 1994 surveys, attributed to the yellow fever (Brokaw et. al, 1987) - however enquiries into the howler monkey populations in the area, among traditional users – chicleros and hunters – suggest that this species has been continuously present in the area, and it is presently considered to have a healthy population (Marlin, pers. com.). This may be important for the replenishment of the coastal population following the population crash and social disorganization experienced after Hurricane Iris in 2001 (Pavelka, 2004). With increasing habitat fragmentation and loss throughout its range, *Alouatta pigra* has recently been upgraded to Endangered in the IUCN Redbook.

The second species, the Central American spider monkey (*Ateles geoffroyi*), appears to be more restricted to the forested hill slopes, overlapping less with the coastal areas of human impact. The Belize sub-species, *Ateles geoffroyi yucatanensis,* is listed as 'Vulnerable' (IUCN, 2005), reflecting the decreasing population in the region, primarily through habitat destruction.

Baird's Tapir *(Tapirus bairdii)* is the largest herbivore present in Bladen, and tends to be associated particularly with riparian areas where it grazes on the herbaceous vegetation. Both the 1984 and the 1997 studies reported frequent sightings of tracks, suggesting that this species is widespread through the lowland areas of the Nature Reserve (Brokaw et. al.) Whilst listed as an 'Endangered' species internationally (IUCN, 2005), it is widespread in Belize, where it is seldom hunted (however, there have been recent reports of a tapir carcass killed adjacent to the protected area, with indications that it had been killed for the meat (Muschamp, pers. com, 2005), and there are reports that tapir is considered a traditional delicacy by the Garifuna communities (community consultations). The main threat to this species in Belize is the increasing land use change, with the destruction of suitable habitat - the protection of significant tracts of unfragmented riparian vegetation and other suitable habitat is now considered a priority for its continued survival.

The Neotropical river otter (*Lontra longicaudis*) has been recorded within the protected area, this species being closely associated with the river system, where its presence indicates healthy fish stocks and little human disturbance. All five of the cat species found in Belize are reported to be present within the Bladen area, suggesting that there is a good prey base to support these key predators (Marlin, pers. com.).

Two peccary species are recorded from Bladen, the collared peccary (*Tayassu tajacu*) and the white-lipped peccary (*Dicotyles pecari*). Whilst there is some illegal hunting pressure, populations are considered good. The larger *D. pecari*, travels in large herds, and requires extensive contiguous areas of unfragmented broadleaf forest (20,000

hectares being estimated as the minimum dynamic area to support a viable population (TNC, 2006)) – the Maya Mountain block of contiguous protected areas contributes significantly to the conservation of these species, ensuring that there is sufficient broadleaf forest in the overall area to maintain this key species. Records of white-lipped peccary in the higher altitude areas of the Maya Divide in Columbia River Forest Reserve (Meerman and Matola, 1997) suggest that they may also move from one drainage system to another over the mountain passes of the Maya Divide, maintaining a genetically diverse population throughout the Maya Mountain block of protected areas.

Mammal distribution in the karst area is reported as seasonal, with many larger species such as white lipped and collared peccary migrating to the coastal plains along the riparian forest routes as the water sources start to dry up in the steep limestone hills during the dry season (Wright et. al. 1958; Muschamp, 1995; community consultations, 1995). As the coastal savannas become flooded during the wet season, these species then move back to the foothills once again. Predators, principally jaguar, are thought to follow this migration. Whilst this has been possible in past years, the current rate of fragmentation of forest habitat and increase in human presence, with the agricultural development along the Southern Highway and the associated hunting pressure, is making this migration less viable, isolating the eastern hill slopes from the coastal areas, with their more accessible water sources. Initiatives such as YCT's Golden Stream corridor and TIDE's Block 127 provide the crucial link between the two, and will be an important factor in the long term viability of larger mammal species in this southern area of Bladen.

Birds

Bladen Nature Reserve is considered to have a particularly rich and diverse avifauna. Whilst only 250 species have been recorded to date within the boundaries (based on surveys conducted within the protected area (Brokaw and Lloyd Evans, 1987; Iremonger and Sayer, 1994)), this is anticipated to climb to as many as 357 species, from knowledge of species recorded in adjacent protected areas of similar ecosystem types (Columbia River Forest Reserve (Conservation International, 1993; Meerman, 1997), Cockscomb Basin Wildlife Sanctuary (Walker and Walker, 2005) and Doyle's Delight (Teul, 2004)) – representing 62% of the total bird species currently recorded for Belize.

Bladen Nature Reserve contains a wide variety of ecosystems, ranging from the fertile floodplain vegetation to the higher elevations of the Maya Mountains. This has resulted in the high species richness observed within the area. The majority of the species are lowland broadleaf forest generalists, found throughout much of Belize. The floodplain of Bladen Branch also attracts many of the riverine, forest edge and gallery forest species, such as the bare-throated tiger-heron (*Tigrisoma mexicanum*), the shy agami heron (*Agamia agami*) and muscovy duck (*Cairina moschata*), the white-necked Jacobin (*Florisuga mellivora)* and yellow-tailed oriole (*Icterus mesomelas*). Other species closely associated with water have also been recorded – the various kingfishers, spotted sandpiper (*Actitis macularia*) and the two species of waterthrush.

Whilst the higher elevations within Bladen have not yet been studied, those of Columbia River Forest Reserve and Doyle's Delight (within Chiquibul Forest Reserve) have both been the focus of expeditions with experienced ornithologists recording the avifauna.

These areas are contiguous with those of Bladen, and from the data at these two sites, there appears to be almost complete species overlap. With these areas being so remote and inaccessible, there has also been the addition of new species records for Belize, such as the scaly-throated foliage gleaner (*Anabacerthia variegaticeps*) (Doyle's Delight Expedition, 1989), and tawny-throated leaftosser (Doyle's Delight Expedition, 1993; Little Quartz Ridge, Jones, 1997). Two Neotropical migrants - Chuck-Will's-widow (*Caprimulgus carolinesis*) and the warbling vireo (*Vireo galvus*) - were also recorded for the first time, in Columbia River Forest Reserve in 1992 (Conservation International, 1993), and may be present in the higher altitude areas of Bladen Nature Reserve.

It is uncertain how important these upper elevations are for migratory birds – one school of thought suggests that they may be an important stopover point (Parker et. al. 1993), whilst subsequent data collected during the Little Quartz Ridge Expedition in 1997 noted the scarcity of migrants, suggesting that the lowland broadleaf forests play a more important role in the migratory routes of North American species (Jones, 1997).

Bladen has two large resident game bird species, the great curassow (*Crax rubra*) and crested guan (*Penelope purpurascens*). Both these species, along with their more common relative, the plain chachalaca, are representatives of the Cracidae family – the most threatened of the Neotropical bird families. Cracids are important seed dispersers and are a major protein source for local communities. Within Belize, both the curassow and the guan are locally common, and outside of protected areas such as Bladen, they are legal game species for those with hunting permits. However, the increase in agricultural colonists and seasonal Central American workers adjacent to the Nature Reserve has led to increased illegal hunting within the protected area, resulting in reduced populations of both species, if not already, then in the future. This was noted by the 1992 and 1997 expeditions to Columbia River Forest Reserve directly south of Bladen, with reports that game species were unexpectedly scarce in even the upper elevations, suggesting increasing hunting pressure, with relatively easy access from Guatemala. Whether this is impacting Bladen itself is currently unknown, but the implications are that these areas, once considered pristine, should now be considered under threat. This pronounced negative response to hunting pressure makes these two species especially valuable as indicator species in areas where hunting still occurs.

Of particular note is the presence of a number of species in the protected area considered endangered or vulnerable, and in need of protection within Belize. These include one of the two large game species (the great curassow), and the keel-billed motmot (*Electron carinatum*). The 'near threatened' harpy eagle (*Harpia harpyia*) has also been recorded from Bladen (Marlin, pers. com., 2006), and the rare solitary eagle (*Harpyhaliaetus solitarius*) has been recorded from the adjacent Cockscomb Basin Wildlife Sanctuary and Doyle's Delight, with a high probability that its range includes Bladen. Other birds highlighted as being of concern include the second large game species (*P. purpurascens*), the ornate hawk-eagle (*Spizaetus ornatus*), and seasonally, the regionally endangered subspecies of the scarlet macaw (*Ara macao*) (Jones et. al. 2001).

Herpetofauna

A total of 92 species have been recorded to date in Bladen Nature Reserve: 24 amphibians, 1 crocodilian, 6 freshwater turtles, 21 lizards and 40 snakes (**Annex 3**). These include ubiquitous generalists (such as *Bufo valliceps* and *Dendropsophus microcephala*, along with species with ranges restricted to the mid-to upper elevations of the Maya Mountains within their range in Belize – species such as *Agalychnis moreletti, Rana juliani, Smilisca cyanosticta* and most of the *Eleutherodactylids*. Through analysis of the known and predicted ranges of Belize's herpetofauna, and of their habitat requirements, it can be estimated that the total number of species likely to occur within Bladen Nature Reserve is between 108 and 114 species (with a maximum possibly as high as 124).

Ten species are considered to be of international concern (IUCN red-list), and of the additional 22-32 species that are likely to occur in the protected area (but which have not yet been recorded there), a further four are considered to be of international concern (IUCN red-list) – the endangered Sanderson's Rainfrog (E*leutherodactylus sandersoni*), and the near threatened Doflein's salamander (*Bolitoglossa dofleini*), broadhead rainfrog (*Craugastor laticeps*), and blue-spotted Mexican treefrog (*Smilisca cyanosticta*).

Lying across the juncture between the southern lowlands and the southern uplands, Bladen Nature Reserve has perhaps the greatest elevational range of any protected area in Belize. Combined with the geological difference between the volcanic and granitic hills of the northern portion of the reserve, and the limestone hills of the southern portion, this has resulted in a diverse range of habitats for reptiles and amphibians. Along with Cockscomb Basin Wildlife Sanctuary to the north, Chiquibul National Park and Chiquibul Forest Reserve to the northwest and Columbia River Forest Reserve to the south and west, that Bladen Nature Reserve lies within the most herpetologically rich region of Belize.

This Chiquibul / Montanas Mayas biodiversity hotspot is recognized within Conservation International's Critical Ecosystems Partnership Fund programme as being the area of Belize that is critical to the long-term survival of Belize's amphibian species of conservation concern. It is likely that 15-20% of Bladen's herpetofauna has yet to be recorded, and that some of these additional species will almost certainly be ones not yet known to occur in Belize. The actual range of some of the upper elevation species may be very limited, and the level of conservation importance of this southeastern portion of the Maya Mountains will increase with increased knowledge of its herpetofauna.

Fish of Bladen Nature Reserve

Past work in the Bladen Branch area has developed a provisional list of species within the Monkey River watershed, eighteen of which are recorded from the upper watershed area of the Bladen tributary (Esselman, 2001, Dunham, 1992) (**Annex 3**).

The Bladen Branch drainage has much lower aquatic angiosperm concentrations than that of the adjacent Trio and Swasey drainages, indicating that the geology of the drainage area, and the subsequent pH of the water, affects the biodiversity of the upper tributaries - water sampling of the Bladen Branch shows lower levels of phosphorus,

known to be an important factor controlling plant growth (Esselman, 2001). As a result, this system supports little plant growth, which in turn should negatively affect the diversity and density of aquatic vertebrate and invertebrate fauna of the water system (Esselman, pers. com.), unlike the phosphorus-rich Trio Branch.

It has also been shown that there is decreasing species richness and diversity in the river system with increasing distance from the sea (Esselman, 2001), with this being further reduced on entering the upper reaches, where the increasing number of waterfalls and riffles effectively block movement of fish upstream. Here, in the upper reaches, species diversity is low, with *Heterandria bimaculata* being the most frequently recorded (Esselman, 2001). In the middle reaches, *Heterandria* is joined by a number of the Poecilidae species, and *Astyanax aeneaus*, with the migratory *Agonostomus monticola* gathering in groups in the deeper pools, and a range of cichlid species (including *Vieja maculicauda, Cichlasoma salvini* and *Amphilophus robertsoni*) (Esselman, 2001).

There is increasing pressure on the fish populations of southern Belize, with numbers decreasing with increasing fishing with gillnets (Muschamp, pers. com., Sho, pers. comm.; E Saqui pers. comm.). This activity is particularly prevalent in the lower reaches of the Monkey River, and from Trio and Bladen Branches, with people fishing for *Agonostomum monticola, Brycon guatemalensis* and the larger cichlids (*Petenia splendida* and *V. maculicauda*) in particular (community consultations, 2006). The fish fauna of Belize is insufficiently studied for an evaluation of the importance of Bladen to be made in terms of conservation of fish species. However, there are increasing indications that throughout Belize, populations of the larger fish species – those caught for food – are declining, so Bladen may well indeed have an important role to play in the conservation and replenishment of fish populations within Belize in the future, as part of the Maya Mountain conservation area.

Also of concern is the expanding intensive agriculture along the river banks – particularly banana and citrus - with extensive agrochemical use and the potential for runoff into the Monkey River and its tributaries. This may well affect migratory fish species reliant on good water quality whilst travelling from the sea to Bladen, or vice versa

2.6 Cultural and Socio-Economic Values of Management Area

2.6.1 Community and Stakeholder Use

Bladen Nature Reserve has no communities immediately adjacent or within its boundaries, and there is no traditional use of the area, all local communities being relatively recently established. However, whilst the Bladen Nature Reserve is non-extractive (ie. no hunting, fishing, logging or looting) all these activities have taken place illegally within the protected area in the recent past.

Hunting:

According to local and written reports, Bladen has been subject to hunting pressure for many years – Dunham reports signs of extensive hunting pressure observed during the Maya Mountain Archaeological Project in 1993 / 1994 in all valleys surveyed except for Snake Creek. Local participants in the MMAP discuss hunting during the project to supplement diet, and the increase in knowledge of the area during the project would appear to have facilitated access for both hunters and looters. Hurricane Iris, in 2001, produced extensive areas of tree fall in the eastern foothills, blocking many of the access routes for hunters and relieving much of the illegal hunting pressure on the Reserve, though hunters have still accessed the area by following the course of the Bladen Branch itself. There is now a move among the local communities, however to reopen blocked trails, which will once more open the area up to increased hunting pressure.

Several terrestrial mammal and bird species, such as the crested guan, collared and white-lipped peccary, and paca, are actively hunted by local community members and by seasonal workers from the agricultural communities such as Trio, both as a protein supplement for diet in the low-income communities, and for the commercial market in game meat.

Patrol reports and consultations with local hunters suggest there is substantial hunting pressure through much of the lower lands of Bladen, and new hunting trails are appearing in the area. However, the impacts are still relatively localized, with hunters primarily hunting along the edge of the Bladen Branch, as far as Snake Creek, for specific species. Hunting is occurring at the moment, and will increase with the increased opportunities for access through Trio, and continued clearance of hurricane tree-fall from other access trails. Future pressure on these species may also increase with the potential incursion of xateros, primarily from Guatemala, who subsist on game meat and fish whilst harvesting xate leaves. There may also be increased future pressure from the Trio area, with the construction of improved access to the Bladen River upstream.

Fishing:

Species associated with the upper Bladen watershed include game fish such as the mountain mullet (*Agonostomus monticola*), bobo mullet (*Joturus pichardi*) and bay snook (*Petenia splendida*), and the smaller cichlids, livebearers and tetra. These support various vertebrate fish-eating species, including the Morelet's crocodile (*Crocodylus moreleti*) (IUCN: Lower risk /conservation dependent), the Neotropical river otter (*Lutra*

longicaudis), and a number of species of freshwater turtles, kingfishers, herons and egrets.

Illegal fishing is currently the major threat to the fish communities, and occurs along the Bladen Branch and its tributaries, principally as a means of subsistence for hunters in the area. Most patrol reports highlight signs of fishing, suggesting that it is a common activity within the protected area. However, fishing within the protected area may not be the only threat to the fish population, as there is also a migratory component, such as the mountain mullet, found in headwater streams, that connect the mountains to the sea, and rely on connectivity with the coastal plain and the coastal waters. Whilst at present there are no physical barriers to movement of species up and down the rivers, increasing organic runoff from the banana farms downstream, diversion of water for irrigation and damming of the waterways may, in future, also become a significant threat to the viability of these species.

Logging:

The broad-leaved forests of Bladen Nature Reserve are some of the most pristine in Belize. Difficult access has limited the scale of past logging activities, although it has from time to time been included within logging concession areas, before its declaration as a wildlife sanctuary. Since then, there has been limited illegal logging activity, with the removal of a small number of trees. Improved access, however, through Trio, has the potential to increase opportunities for illegal logging, and the potential for incursions by xateros, and that without increased patrolling, there is a significant probability that illegal loggers will enter the property in dry season at some point in the next five years.

The new long term logging concession issued for Deep River Reserve, on the south-eastern boundary of the Reserve will help to safeguard the most accessible protected area boundary from small independent loggers in the future.

Looting:

Anecdotal reports from as far as Gales Point suggest major looting activity has been occurring within the Bladen Nature Reserve within the last eight years, highlighting the urgent need for increased, more targeted and effective patrolling, and greater targeted monitoring of activity at the archaeological sites within the protected area.The threat of looting activity is increasing as access becomes easier through Trio.

2.6.2 Cultural Heritage

For many years it was assumed that the steep and rugged terrain of Bladen would have been of little interest to the Ancient Maya, with difficult access and little cultivatable land. Exploration in the early 1900's by chicleros and mahogany extractors suggested however that the Maya had indeed settled the Bladen system, later confirmed by the Maya Mountain Archaeological Project (MMAP), which worked in the Bladen area for two successive years (1993 and 1994).

It would appear that the Bladen area was an important extraction area particularly for mineral resources. Whilst the density of settlement is considered to have been low in

comparison with the coastal plain, during the Late Terminal Classic (AD 700 – 900) virtually all inhabitable land is considered to have been occupied, though Dunham estimates that there would have been no more than 10,000 people residing in the Bladen watershed at any one time during the Maya occupancy. The discovery of a Mixtec style vessel during the 1994 fieldwork indicates that the settlements had wide ranging contacts, even when much of the southern lowland populations were in decline (Dunham, 1994).

Three areas have been highlighted by the MMAP: Quebrada de Oro, Snake Creek and the Esperanza valley.

Two sites in the Quebrada de Oro area were discussed during early fieldwork in Bladen (Brokaw et. al. 1984). Both sites were located on the alluvial soils of the valley, one a minor settlement, the second a more structured site of plazas and structures, with outlying mounds. This second site lies on the steep bank of the Quebrada, which in 1984 was eroding inwards towards the site. Looting activity was observed at both sites. These sites were later revisited during the Maya Mountain Archaeological Project.

In 1994, further work by the MMAP located three unlooted sites of considerable complexity within the Snake Creek and Esperanza areas. Whilst the south-eastern lower valley of Snake Creek is steep sided and was uninhabited in Maya times, the good agricultural soils of the north-western upper valley was found to have supported a modest Late Terminal Classic community with well constructed house mounds in complex groupings, with two main plazas flanked by an extensive range of structures (Dunham, 1994). This site, named “Saach’olil” by the MMAP, is located on the creek bank, which is eroding its banks to gradually destroy the site.

During the same field season, Esperanza valley was discovered to have three sites, two of which are inside Bladen Nature Reserve, in its south western-most corner. “Chac Bolai,” situated on the valley floor of the Central River, is a moderately sized site found to consist of a large civic plaza, connected by a causeway to low temple mounds, with minor adjoining causeways. To the south lies “K’antulai,” located on the primary access route, straddling the mountain pass, and thought to have regulated the movement of people and goods into the Esperanza area during the Late Terminal Classic era. Unlike the majority of other sites, this fortress-like settlement, consisting of a long chain of structures (including a main, central plaza flanked by large structures), lies in an area of poor soils, distant from the nearest water supplies.

All three of these structures were unlooted in 1994; however, with the increasing knowledge of these sites, and the continued access by hunters to the area, it is unlikely that they are still intact. Anecdotal reports from as far as Gales point suggest major looting activity within the Bladen Nature Reserve within the last eight years, highlighting the urgent need for increased, more targeted and effective patrolling, and greater targeted monitoring of activity at the archaeological sites within the Reserve.

2.6.3 Recreation and Tourism Use

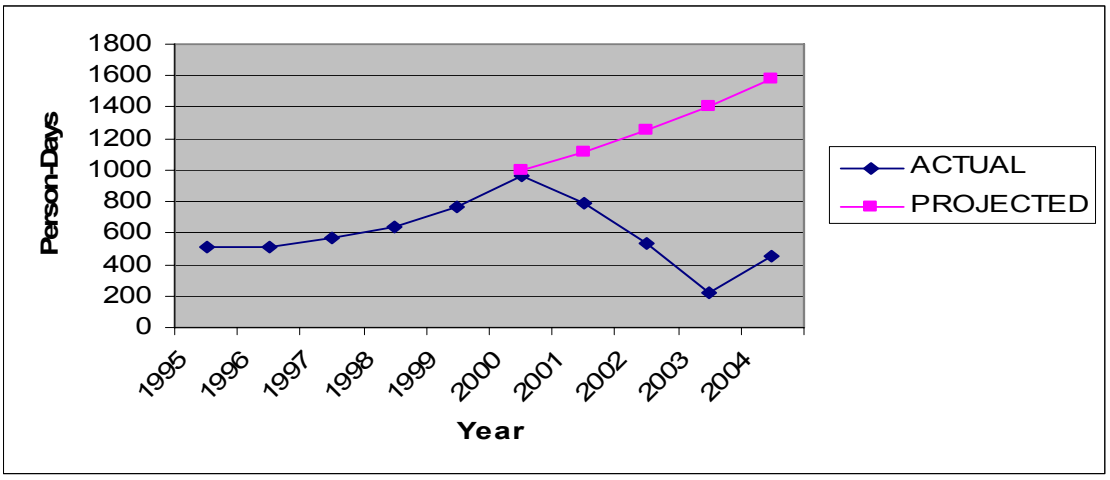
With its designation as a Nature Reserve, and with the remote location, there is not considered to be any recreational use of Bladen, though there are reports that some

families from Trio may enter the very edge of the protected area to relax, swim and fish at the Blue Pool.

2.6.4 Research and Education

The Belize Foundation for Research and Environmental Education (BFREE) has been located on the 1,153 acre property located strategically at the primary access point for Bladen for many years. Established in 1995, the BREE biological field station, focused on ecological research, environmental education, and conservation management. The station provides housing and logistical support for researchers and conservation workers, and conducts education programs for international students from around the world. Whilst much of the educational activity is conducted within the BFREE lands, some of the research is focused on Bladen, through research permits issued by the Forest Department. BFREE also uses its location and activities as a means to raise awareness of the environmental, biodiversity and economic value of the protected area, though primarily within its internation audience.

From 1995 to 2000, the BFREE field station had a mean annual use rate of increase of 11.4%, with the number of researchers, students, interns, and meeting participants doubling over that six year period (Figure 1). The cross section of users has included researchers from 23 universities and student groups from 31 universities and high schools.



Graph 4: The trend in annual use by researchers and students at the BFREE field station. Projected person-days was calculated from the mean annual growth rate from 1995-2000. The actual person-days for 2004 are for use in the first quarter of the year (January-March) only (BFREE).

Two major events caused visitor-use to decline dramatically from 2001-2003 (Graph 4). The attacks on September 11, 2001 resulted in the cancellation of many researcher and education group trips. Of even greater impact was the substantial damage to the station as a result of Hurricane Iris, a Class 4 hurricane that struck southern Belize on October 7, 2001. The hurricane passed directly over BFREE and the BNR, and virtually all of the buildings and solar power systems sustained significant damage. Much of the infrastructure, power and communication infrastructure has now been restored.

The BFREE facilities have been highlighted as one of several possible locations as the logical site for BMC facilities for housing researchers and staff accessing Bladen Nature Reserve.

2.6.5 Other Economic Uses

The designation as a Nature Reserve prohibits any extractive use (except under specific research permits), and also use as a tourism resource. This limits the potential economic use of the area.

In 2004, however, the Geology and Petroleum Department issued a reconnaissance license (No. 1 of 2004), to the Pan African International Corporation Ltd., authorizing surface surveys of the geological, geophysical and geochemical within Bladen for the purpose of testing for precious metals and stones. Whilst this license was only valid for one year, and little or no work was actually conducted, it raises the issue of mineral rights and the potential impact such surveys and subsequent prospecting may have on Bladen, especially in light of recent oil finds in northern Belize.

Section 3: Conservation Planning

3.1 Identification of Conservation Targets

As a first step in the conservation planning process, a workshop with BMC members and field staff, facilitated by the consultants, led to the selection of six conservation targets, at a coarse enough scale to encompass the diverse guilds and individual species of conservation concern (Table 9). Three of these targets are broad ecosystem categories, two are species assemblages. Also considered is a sixth target, the cultural heritage of the protected area.

Table 9: Conservation Targets for Bladen Nature Reserve

- Tropical broadleaf forest
- Lowland Pine Forest
- Aquatic and Riparian Ecosystems
- Game Species
- Upper Elevation Species
- Cultural Heritage

Of these, two targets were analysed outside of the prioritisation process:

Upper Elevation Species: Included as a priority, but insufficient information is available on these species and the potential of threats such as chytridomycosis and pesticide drift.

Cultural heritage: Included to capture the important archaeological elements of the site.

Ecosystems, plants and animals of conservation concern were nested under the broader conservation elements listed above, on the understanding that strategies designed on the broader scale would be effective on those species nested within.

Conservation Planning, Conservation Targets and nested targets are described in **Annexes 4 and 5.**

3.2 Overall Viability Summary

Five of the six conservation targets were evaluated using the TNC 5-S System, the resultant viability assessment indicating that the overall health of the species and biological systems of Bladen Nature Reserve is good – a situation that is more positive than in a high proportion of Belize's existing protected areas, and reflects the near

pristine nature of the majority of the protected area. Bladen has always been considered an important part of the Maya Mountain block, and the current biodiversity assessment demonstrates the health of the ecosystems and populations of the area. The sixth – cultural heritage – was not evaluated for viability, as it is not a component of the biodiversity of the area.

Under this system, the viability of one of the conservation targets – Lowland Pine Forest, is rated as 'Fair'; three (Aquatic and Riparian Ecosystems, Upper Elevation Species Assemblages, and Game Species) are rated as 'Good', and the remaining two targets – have a 'Very Good' viability rating.

Table 10: Viability Ranking for Selected Conservation Targets (based on TNC 5-S System)

Conservation Target	Size	Condition	Landscape Context	Overall Viability Rank
Broadleaf Forest	Very Good (4)	Very Good (4)	Very Good (4)	**Very Good (4)**
Game Species	Good (3.5)	Good (3.5))	Good (3.5)	**Good (3.50)**
Aquatic and Riparian Ecosystems	Good (3.5)	Good (3.5)	Good (3.5)	**Good (3.50)**
Upper Elevation Amphibian Species	Good (3.5)	Good (3.5)	Very Good (4)	**Good (3.67)**
Lowland Pine Forest	Fair (2.5)	Good (3.5)	Good (3.5)	**Fair (3.16)**
Overall Viability Rating of Bladen Nature Reserve				**Good (3.56)**

Very Good:	**>= 3.75**	Viability criteria at or above desired future status
Good:	**3.0 – 3.74**	Viability at or above minimum threshold for biological integrity
Fair:	**1.75 – 2.99**	Viability criteria at or above a minimum restorable level
Poor:	**<1.75**	Viability criteria below minimum restorable status (probably unrecoverable)

This gives an overall viability rank of **'Good'** for Bladen, under the TNC 5-S System (Table 10). The 'good' rather than 'very good' rating particularly reflects the increasing frequency of anthropogenic fire in the lowland pine forest, and the hunting and fishing pressure that exists on the game and fish species.

A recommended goal has been set for each conservation target, with relevant indicators that can be monitored over time to assess whether that goal has been met (Table 11).

Table 11: Viability Rating Goals			
Conservation Target	**Current Rating**	**Goal**	**Justification and Indicator**
Tropical Broadleaf forest	**Very Good**	**Very Good**	***Goal:* Very Good.** To maintain the broadleaf forest in its current condition or better, and ensure continued connectivity.
			Potential Monitoring Indicators: % of target impacted within Bladen – logging, land clearance for farms; natural disturbance, including fire originating from outside the protected area. Satellite and/or aerial photography; Mining permits and associated activities.
Game Species	**Good**	**Very Good**	***Goal:* Very Good.** To improve the current size and condition of the game species populations
			Potential Monitoring Indicators: Abundance and distribution of great curassow, white-lipped peccary; presence of key predators (jaguar/puma); Signs of hunting reported during patrols
Aquatic and Riparian Ecosystems	**Good**	**Very Good**	***Goal:* Very Good.** To improve the current condition of the natural aquatic ecosystems
			Potential Monitoring Indicators: Water quality, impacts on water flow and water quality, fish population; signs of fishing reported during patrols; migratory species (eg. *Atyid scabra* shrimps)
Upper Elevation Species	**Good**	**Very Good**	***Goal:* Very Good.** To improve the condition of viable populations of the higher elevation species
			Potential Monitoring Indicators: Size and condition of populations of highlighted upland species (particularly amphibians, birds and plants); presence of chytridomycosis in amphibian population; pesticide residues from pesticide drift
Lowland pine savanna	**Fair**	**Good**	***Goal:* Good.** To improve the conservation status of the lowland pine savanna primarily by reducing anthropogenic fire impacts
			Potential Monitoring Indicators: Number of fires per year and intensity, within pine savanna area, level of regeneration of pine
Cultural Heritage	**-**	**-**	***Goal:*** To ensure that all archaeological sites within Bladen Nature Reserve remain unimpacted by further looting in the future
			Potential Indicators: Number of incidences of looting within Bladen reported in patrol reports

3.3 Threats to Biodiversity

Assessing the threats to the biodiversity of Bladen Nature Reserve is a two-part process:

a) Identifying historical, active and potential threats (Table 12)
b) Rating threat severity, urgency, relative area, recovery and potential

This analysis, when combined with the viability assessment, produces the information required for prioritizing conservation actions and use of limited resources.

Historical and present impacts to the protected area have been identified through consultations with many of the stakeholders – stakeholder community members, BMC members, hunters and wardens on the ground.

Table 12: Threats and Conservation Targets

Threats	Conservation Targets
Historical Threats	
Hurricanes	Entire protected area
Past logging	Lowland pine forest, Broadleaf Forest
Past Hunting	Game species
Past Fishing	Aquatic and riparian ecosystem
Past Looting	Archaeological sites
Active	
Hunting	Game species
Fishing	Aquatic and riparian ecosystem
Xate collection	Tropical broadleaf forest, Game species, Aquatic and riparian ecosystems
Fire	Lowland pine savanna
Looting	Archaeological sites
Potential	
Geological prospecting	Tropical broadleaf forest. Aquatic and riparian ecosystems
User Impacts (research / education)	Tropical broadleaf forest, Lowland pine forest, Central American spider monkey
Logging	Tropical broadleaf forest, Lowland pine forest
Agricultural Incursions	Tropical broadleaf forest
Palmetto seed harvesting	Lowland pine forest
Disruption of aquatic migratory routes	Aquatic and riparian ecosystems
Pesticide Drift / Chytridomycosis	Upper elevation species assemblages
Dereservation	Entire protected area

The threats are assessed using the WCS threat assessment, through analysis of threat severity, urgency, relative area, recovery and potential (**Annex 6**).

Rating Threat Severity, Urgency, Relative Area, Recovery and Probability

This data is entered into Table 12, where those threats that have the most impact on the conservation area are identified using the equation:

(Urgency + Recovery) x Severity x Area x Probability

Table 13: Analysis of threats impacting BNR **(based on WCS Living Landscapes Programme)**

Threat	Area Score	Severity Score	Urgency Score	Recovery score	Probability Score	Total Threat Score	Rank*
Fire	3	2	2	2	1.00	24	**10**
Xate Harvesting	4	2	2	1	1.00	24	**10**
Hunting	2	2	3	1	1.00	16	**8**
Dereservation	4	3	1	3	0.25	12	**7**
Fishing	2	1	3	1	1.00	8	**6**
Seed Harvesting	1	1	3	2	1.00	5	**5**
Mining	2	2	2	2	0.25	4	**4**
User Impact	1	1	2	1	0.75	2.25	**3**
Logging	1	1	2	2	0.50	2	**1**
Agricultural Incursion	1	2	2	2	0.25	2	**1**
Non-ranked Threats							
Looting*	4	2	3	3	0.75	36	**11**
Chytridomycosis**	4	3	3	3	0.50	36	**11**

Severity	**Rank**	**Urgency**	**Rank**
None or positive	0	Won't happen in > 10 years	0
Measurable effect on density or distribution	1	Could happen between 3 – 10 years	1
Substantial effect but local eradication unlikely	2	Could (or will) happen within 1 – 3 years	2
Local eradication a possibility	3	Threat is occurring now, and needs action	3
Proportion of Local Area Affected	**Rank**	**Recovery Time**	**Rank**
0	0	Immediate	0
1-10%	1	1-10 years	1
11-25%	2	11-100 years	2
26-50%	3	100+ years or never	3
>50%	4		

Probability of threat occurring	
≤ 0.25	0.25
0.26 – 0.50	0.50
0.51 – 0.75	0.75
0.76 – 1.00	1.00

***Lowest threat score rank = 1**

* Whilst looting is recognized as a threat, it is not included within the general threat analysis and prioritization process, as Maya sites and artifacts are finite, and therefore cannot be considered to have any form of viability. Cultural heritage and the associated threat of looting is therefore considered separately from the biodiversity, as a high priority in its own right.

** Chytridomycosis and the disruption of aquatic migratory routes have been removed from the threat ranking as the level of threat (or even its presence) is currently unknown.

Chytridomycosis has caused numerous extinctions of upland amphibian species in Central America over the last 5 years, with virtually all precipitous declines and

extinctions occurring at elevations 800m or more above sea level. It has long been recognized that amphibian biology makes this taxa an especially sensitive indicator of environmental pollution. A convincing argument has been made that the fatal chytrid fungal infections are exacerbated by the impairment of amphibian immune systems by the orographic precipitation of organo-phosphate pesticides. Whilst there is a complete absence of data in Belize, there is little reason not to suspect that the declines and extinctions that are occurring elsewhere in the region are not occurring at similar elevations in Belize.

The aerial spraying of pesticides on banana crops in southern Belize is a potential source of organo-phosphates that are projected to be precipitated at upper elevations through orographic rainfall. Whilst a research project is currently being formulated to study this very situation, reliable data is unlikely to be available until late 2006 / 2007. In the meantime, data on the impacts and species extinctions observed elsewhere in Central America indicates that chytridomycosis in upper elevation amphibian species (including all of Belize's Near Threatened to Critically Endangered amphibians) could be the biggest single threat to biodiversity at the species level in BNR. This would automatically make conservation actions to tackle the situation the highest priority for the Natural Resources Management Programme for BNR. However, as there is currently a complete absence of national or site-level data, and the existence of the threat is based on extrapolation of occurrences elsewhere in similar situations throughout the region, it is not entered within the main threat analysis and prioritisation process. It is however included within the section to demonstrate the potential severity of the situation, and the urgent need to undertake assessments within high-risk hotspots within BNR (and adjacent reserves with elevations over 800m).

A similar situation exists with migratory aquatic species, with lack of knowledge and information resulting in it being difficult to quantify the threat and assess its affect on the upper watershed aquatic systems within Bladen.

(See **Annex One: Map 18 /** Bladen Nature Reserve: Critical Areas; **Map 19 /** Fire Risk)

3.4 Prioritising Conservation Actions

This management plan uses a combination of the TNC 5-S conservation target viability ranking and the WCS threat analysis to establish the priority of conservation actions for the conservation targets highlighted for Bladen Nature Reserve. The appeal of this modified TNC 5-S and WCS Living Landscape approach is that:

- it should reduce the level of subjectivity associated with the traditional threat analysis approach
- it is useable by a broader cross section of technicians and managers
- it has greater relevance to the social and management capacity issues associated with Belize's protected areas than either the TNC or WCS approaches alone.

However, to be relevant on a national scale as well as local level, the combined analysis must also adequately address two further factors:

- the national importance of a particular target
- the social implications of prioritisation

To ensure that these two factors are taken into account, it is first necessary to add a weighting factor to the target viability assessment and threat analysis respectively (Figure 10).

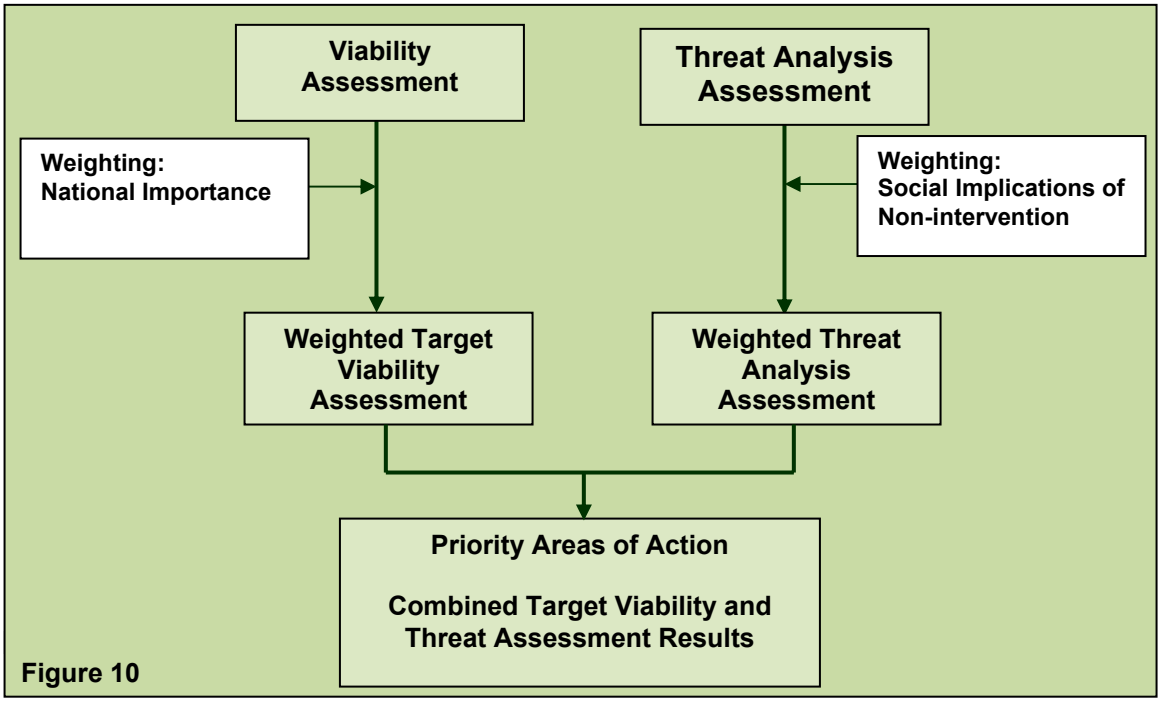


Figure 10

The TNC viability and the national priority weighting can then be combined with the weighted ranked WCS threat analysis score using the following equation to allow prioritization ranking:

$$P = (1/V) \times N \times T$$

Where:
P = Prioritization Score
V = Viability Score
N = National Priority Weighting
T = Weighted ranked WCS Threat Score

A conservation target with a high viability rating will have a lower priority for conservation action, whilst a conservation target facing a high threat will have a higher priority for conservation action. These scores are then ranked in descending order to reflect priority for conservation actions (Table 14).

Table 14: Prioritisation						
Conservation Target	**Primary Threat**	**Viability Score (V)**	**National Priority Weighting (N)**	**Weighted WCS Threat Score (T)**	**Prioritisation Score**	**Ranked Priority**
Broadleaf Forest	Xate	4	3	20	15	1
Game Species	Hunting	3.50	2	16	9.14	2
Aquatic and Riparian Ecosystems	Fishing	3.50	2	12	6.86	3
Lowland Pine Forest	Fire	3.16	1	10	3.16	4
Non-ranked Targets						
Cultural Heritage	Looting	-	-	-	-	-
Upper Elevation Species	Chytridomycosis	3.67	3	11	8.99	-

This is a relatively simple system, which gives prioritization rankings in broad general agreement with those developed through the more traditional holistic approach to threat analysis.

Through this analysis, the following prioritization order was developed for the Bladen Nature Reserve (Table 15).

Table 15: Priority Areas of Action for the Bladen Nature Reserve			
Priority	**Rank**	**Conservation Target**	**Primary Threat**
High Priority	1	Tropical Broadleaf Forest	Xateros
	2	Game Species	Hunting
Medium Priority	3	Aquatic and Riparian Ecosystems	Fishing
	4	Lowland Pine Forest	Fire
Un-ranked Conservation Targets		Cultural Heritage	Looting
		Upper elevation Species	Chytridomycosis

The two un-ranked conservation targets have not been included within the analysis for prioritisation, but are important in terms of resource management. The first of these is looting, which has not been included within the threat analysis as Maya structures have no viability rating. This is considered a medium level priority. The second, upper elevation species, has not been included as there is insufficient national and / or local information on chytridomycosis, pesticide drift and other potential threats at this time. However, this is considered a high priority area.

3.5 Conservation Strategies

Using the results from the target viability assessment and threat analysis, conservation strategies are developed that focus on threat abatement (reduction), towards the achievement of the project goals and objectives (**Annex 7**).

Of the twelve broad strategies identified, five are considered to be high leverage strategies - three are highlighted as being of the greatest impact to all conservation targets. These are primarily concerned with raising awareness at local, national and international level to prevent large-scale severe impacts such as dereservation and mining. The fourth and fifth high leverage strategies (and the first two strategies at site-level) prioritize patrolling efforts and other activities to reduce present and potential hunting, fishing, logging and looting within the protected area.

Prioritized and implemented, these five strategies will have the greatest positive long-term affect on the Bladen Nature Reserve.

Two strategies have a medium level impact – positively affecting between three and four targets, whilst the last four strategies are more specific, affecting one or two targets.

It is possible to look at the impact each strategy may have over all the conservation targets, to analyze the leverage of each activity (Table 16), in terms of the number of targets they impact.

Strategy Leverage

Strategies	Tropical Broadleaf Forest	Game Species	Aquatic and Riparian Ecosystems	Upper Elevation Species	Lowland Pine Forest	Total
Increase awareness of BMC and the environmental benefits of conserving BNR						
Raise awareness in Geology and Petroleum Dept. and Government of significance of Bladen in the protected areas system						
Develop open communications and working relationship with companies that have been issued mining licenses for Bladen by Geology and Petroleum Dept.						
Reduce hunting, fishing and logging within the protected area by direct and indirect means						
Ensure seasonal Central American workforce is aware of location and regulations of Bladen						
Facilitate complementary programmes and activities to assist local communities to develop improved sustainable income						
Ensure that there are no incursions into Bladen by xateros (either Guatemalan or Belizean)						
Ensure noise and disturbance to wildlife is minimised						
Increase knowledge of upland species – particularly amphibian populations						
Determine whether chytridomycosis exists in the upper elevation amphibian population and develop an action plan						
Develop fire management programme for the lowland pine forest						
Key	**Low** Impacts 1 targets		**Medium** Impacts 2-3 targets		**High** Impacts 4-5 targets	

Table 16: Strategy Leverage

3.6 Measures of Success

Measures of Success – Objectives and Goals				
	Target	**Trend Data**	**Activity**	**Indicator**
Tropical Broadleaf Forest				
Objective: To maintain the broadleaf forest in its current condition or better, and ensure continued connectivity.	Ensure that 100% of the unimpacted broadleaf forest remains in its present state	Number of impacts on the broadleaf forest (fires, logging, clearance), and % area affected	Monitor any impacts on the broadleaf forest – number and area	% of mature forest with no anthropogenic impacts to forest structure
Game Species				
Objective: To improve the current size and condition of the game species populations	Reduce hunting activity within the protected area	Number of hunters (or signs of hunters) encountered within protected area	Log number of encounters with hunters (or signs of hunters) within the protected area over time	Number of hunters encountered (or signs of hunters) annually within the protected area
	Increase game species densities	Frequency of camera trap incidents	Monitor game species presence over time in key locations using camera traps	Population density of game species (through camera trapping)
Aquatic and Riparian Ecosystems				
Objective: To improve the current condition of the natural aquatic ecosystems	Reduce fishing activity within the protected area	Number of fishermen (or signs of fishermen) encountered within area	Log number of encounters with fishermen (or signs of fishermen) within the area over time	Number of fishermen encountered (or signs of fishermen) annually within the area
	Increase the number and size of the indicator fish species	Density, and size of indicator fish species in monitoring locations	Monitor density of indicator species at set monitoring points every quarter	Population density of indicator species – cichlid sp., machaca and mullet
	Maintenance and improvement of migratory species populations	Population density and structure of indicator species	Monitor population density and structure of indicator species over time	Population density and structure of *Atyid* shrimps

Measures of Success – Objectives and Goals (continued)				
	Target	**Trend Data**	**Activity**	**Indicator**
Upper Elevation Species				
Objective: To improve the condition of viable populations of the higher elevation species	Increased knowledge of upper elevation species	Number of completed studies on upper elevation species	Monitor number of research studies focused on upper elevation species	No. of post-study reports submitted
	Annual monitoring for presence of chytridomycosis in upland amphibian populations	Presence / absence of chytridomycosis per year	Monitor for presence of chytridomycosis in upland amphibian populations	Annual report on monitoring for presence of chytridomycosis in upland amphibian populations
Lowland Pine Forest				
Objective: To improve the conservation status of the lowland pine forest and savanna	Ensure reduction of anthropogenic fire impacts	Number of incidents of fire within lowland pine forest, and area affected	Log fire incidents within the lowland pine forest of Bladen, in patrol reports	No. fires affecting lowland pine forest, and % area affected per year
	Ensure no further logging in the lowland pine forest of Bladen	Number of logging incidents within the lowland pine forest	Annual assessment of patrol reports of logging incidents within the lowland pine forest of Bladen	No. logging incidents and no. trees affected per year

4. Management Planning

4.1 Management Organization

Bladen Nature Reserve is managed by the Bladen Management Consortium, composed of a number of collaborating organizations – Forest Department (Ministry of Natural Resources), Ya'axche Conservation Trust (YCT), Toledo Institute of Development and Environment (TIDE), Belize Audubon Society (BAS), and Belize Foundation for Research and Environmental Education (BFREE), under a co-management agreement with Government.

The Bladen Management Consortium was officially endorsed on August 1st, 1996 by the forest Department. The concept of the BMC was conceived during the Natural Resources Managemnet and Protection project, under which the Forest Department sought to develop a more active management of the Bladen Nature Reserve.

4.2 Review of Previous Management Plan

Past and current management objectives from the 1998 Management Plan for Bladen Nature Reserve have been assessed, in close liaison with the Bladen Management Consortium and park staff, and past objectives are categorized according to the perceived success of implementation (Table 17).

Overall, the level of implementation appears to have been low, but with 52% of the 1998 management objectives showing some measure of success. However, only 10.5% of objectives were considered to have succeeded.

42% of the 1998 management objectives are considered to have partially succeeded, improving the management situation present in 1998. 47.5% of objectives showed no change or a worsening of the situation (5.5%).

Table 17: Measures of Success of Implementation of the 1998 Management Plan for Bladen Nature Reserve					
Objectives / Actions	**Measures of Success of Implementation**				**Comments**
	Succeed	Improved	No Change	Worse	
Protection Programme					
To secure an environment where the natural processes can be maintained					Managing to maintain at the current level despite increasing hunting pressure. Possibly hiring wardens has reduced impacts in patrolled area – shift in activity
To protect and maintain vegetation cover					No incursions for settlement since 1998. Current development halted at border, 2005. Fire each year, both in savanna and broken ridge. A reflection of BFREE being there, Logging, gravel mining both stopped. BFREE and wardens acting as early warning system – not necessarily a reflection of activity by BMC
To conserve wildlife populations					Signs of hunting have decreased in certain areas, possibly changing access, using other areas - unknown
To preserve cultural resources					No specific actions to protect cultural resources, some looting since 1998
To safeguard watershed					Agricultural development at Trio now accesses river – suspect that this would affect upstream..dynamics of system. Potentilal effect
Human Use Programme					
To promote an understanding and appreciation of the Bladen's rich ecosystem					No resources to address this
To generate support for the protection of Bladen					Provisional co-management agreement, grant support, international and local, FD support has strengthened, members of BMC more dedicated, scientists much more supportive…except certain sectors of communities
To provide employment and entrepreneurial opportunities for residents					Employed rangers

Human Use Programme (cont.)					
To generate local support for the maintenance of the reserve					
Research and Monitoring Programme					
To better know the biodiversity for its conservation					A lot more info known about the area
To provide an opportunity for comparative research					
To provide local Belizeans with an opportunity to develop research capabilites					Wardens trained in research skills
To monitor the stablity and integrity of the Bladen ecosystem					By product of research projects. Access to output from projects – but need central holding facility
Financial Programme					
To secure funds for the proper development and management of BNR					
To provide mechanisms that can provide for economic sustainability					
Administration Programme					
To develop human training and financial planning resources for the management of Bladen					BMC has developed financial mechanism, training of wardens
Uphold administrative support system					Structure in place, registered as an NGO
To provide the proper upkeep to the reserve infrastructure					Warden post burnt down by wildlife
To assure a safe, smooth and efficient operation of Bladen					

Table 18: Measures of Success of Implementation				
	Succeed	Improved	No Change	Worse
Total no. of objectives (of 19)	2	8	8	1
% No. of objectives	10.5%	42%	42%	5.5%
% No. of objectives +ve change	52%			
% No. of objectives no change or -ve change			47.5%	

Table 19: Programme Rating Table for Previous Bladen Management Plan					
Programme	Total No. Objectives	Succeeded	Improved	No Change	Worse
Protection	5	0	1	4	0
Human Use	4	1	1	2	0
Research and Monitoring	4	0	3	1	0
Financial	2	0	1	1	0
Administration	4	1	2	0	1

During the creation of the first management plan, Bladen had no management structure, staff or wardening in place at all. Overall, therefore, the programmes outlined in the management plan have generally shown some improvement in the status of the protected area, particularly in the area of research.

With the limited resources available, however, many objectives have not been achieved successfully, resulting in either no change (42%) or even a negative change in status. This is particularly of concern for the Protection Programme, perhaps the most important programme at this point in time. Of the five objectives under this programme, none are considered to have succeeded, and only one is thought to have shown any improvement in status.

4.3 Management Goals

Following a thorough review of past management goals and objectives, their successes and failures, present limitations, the IUCN management categorization and the long-term vision of Bladen Management Consortium for the Bladen Nature Reserve, the following goals have been developed for the next five-year period:

1. To protect and preserve in perpetuity the biodiversity, cultural resources and watershed features found within the BNR, as an integral part of the National Protected Areas System and the Maya Mountain region.

2. To ensure the continued health and hydrologic processes of the Bladen River upper watershed for the continued health of aquatic biodiversity and as a continued source of clean water for human and non-human populations downstream.

3. To contribute towards other environmental services provided by conservation areas, including clean air, flood control, carbon sequestration, and temperature regulation.

4. To develop Bladen Nature Reserve as a nationally and internationally renowned research and educational site.

5. To provide an enabling and supportive environment for alternative economic opportunities in areas adjacent to BNR for local communities, towards environmentally sustainable livelihoods.

6. To explore and develop mechanisms towards a greater level of financial sustainability of management.

Bladen Nature Reserve is also part of a larger initiative – the integrated management of the Chiquibul/Maya Mountains Key Biodiversity Area. This larger initiative has its own set of goals to be achieved, in partnership with the Bladen Management Consortium:

Long Term Goal:

The Chiquibul/Maya Mountains Key Biodiversity Area is globally recognized for its intrinsic natural and cultural values, and contributes to national development and regional cooperation while enhancing and maintaining its ecological integrity.

Targeted Conservation Outcomes:

1. The Chiquibul-Maya Mountains area are designated a Biosphere Reserve.

2. Improved management of 588,116 acres of forested lands in five protected areas, following a regional management strategy.

3. Two Critically Endangered Species will be protected.

4. Enhanced natural and cultural heritage through binational conservation activities.

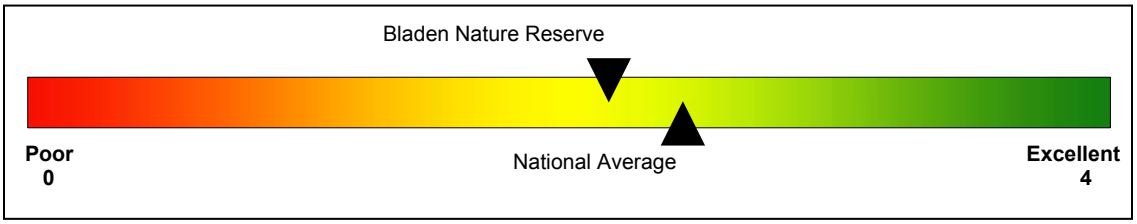
4.4 Management Strategies

4.4.1 Management Effectiveness

Following an analysis of management effectiveness using the national protocol developed under the NPAPSP (Young et. al., 2005), the following general recommendations have been made for strengthening management of Bladen, based on the analysis of the scores given for Bladen Nature Reserve during the assessment:

- Strengthening of the communication and awareness strategies and activities targeted at local stakeholder communities
- The development of a local advisory committee to increase community awareness and participation in management, by both communities and tourism stakeholders
- Increase effectiveness of enforcement and surveillance activities
- Locate funding for staff, infrastructure and equipment necessary for effective management
- Investigate and implement mechanisms for greater sustainability

Whilst this assessment is not designed to give comparisons between protected areas, it is useful to compare the performance of Bladen Nature Reserve with the average for all protected areas assessed. Overall, the assessed protected areas score a total average of **2.51**. When averaged across the seven Indicator Categories, Bladen Nature Reserve scores **2.16**.



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

Graph 5: Range of Indicator Category average scores for management effectiveness of Bladen Nature Reserve

Management of Bladen Nature Reserve, whilst relatively strong in resource information and governance, is considered to be severely constrained at present by the limited human and financial resources. This will be alleviated to some extent by the inclusion of Bladen in the Chiquibul/Maya Mountains Key Biodiversity Area project.

A more detailed breakdown of the results provided the following conclusions and recommendations

1. Resource Information

Since the first rapid environmental assessment of Bladen there has been continued research, providing much of the baseline physical and biodiversity inventory data for use in management of the area. This has been used in the development of a conservation plan, integrated into the up-dated management plan. However, there is still a need for greater incorporation of traditional knowledge, and a need to update information on the status of archaeological sites first located through the Dunham project, following reports of looting.

- Increase baseline data through focused research
- Implement environmental monitoring programme developed during management plan
- Develop infrastructure support to ensure information is managed effectively
- Increase collaboration and information sharing mechanisms with other organisations

2. Resource Administration, Management and Participation

Whilst the legal framework for the establishment of natural protected areas in Belize and the regulation of permitted activities is considered strong, surveillance and enforcement within the protected area are highlighted as weak, with xate harvesting, hunting and looting reported as threats to biodiversity. There is also concern about the changes in tenureship of adjacent lands in the dereserved Maya Mountain Forest Reserve area, and of the security of the lease held by BFREE.

Also in need of strengthening are visitor management and visitor monitoring strategies – especially if Bladen wishes to attract more researchers

- Strengthen surveillance and enforcement activities
- Ensure boundaries are maintained in areas of conflict
- Investigate options available for BMC facilities, and finalise decisions
- Ensure secure tenureship for both Bladen and BFREE (if BFREE is to be the research base)
- Ensure management body has up-to date knowledge and maps of land ownership within adjacent areas
- Develop and implement visitor / tourism management and monitoring programmes

3. Participation, Education and Socio-Economic Benefit

Whilst Bladen scores moderately well in this area (though below the national average), at present the level of recognition of protected area benefits is very low. A number of key strategies need to be strengthened as a priority – primarily linked to the participation of local communities, and the building of capacity and socio-economic benefit.

- Develop and implement participation, education and socio-economic benefit strategies targeted at local communities, and strengthen those that already exist

    - Communication strategy at community level
    - Education program at community level
    - Stakeholder participation strategies
    - Socio-economic benefit strategies

- Investigate the feasibility of using the BAS Local Advisory Committee structure as a community participation strategy, for involving local communities in management

4. Management Planning

Bladen scores well in this area, and is currently up-dating its 5-year management plan. Management planning in general, however, needs to be strengthened through the development and implementation of well structured annual Operational Plans – especially with the current structure of the Bladen Management Consortium.

- Develop 5-year management plan, submit to Forest Department for approval, and implement
-
- Create and implement well structured annual Operational Plans

- Ensure monitoring and evaluation of management activities is conducted on an annual basis, and tied into adaptive management

5. Governance

Whilst Governance is generally strong, Bladen needs strengthening in this area, as at present it lacks a structured Board of Directors and Advisory Committee

- Develop a structured Board of Directors

- Investigate the feasibility of using the BAS Local Advisory Committee structure as a community participation strategy, for involving local communities in management

- Develop clear objectives for the protected area

6. Human Resources

Bladen is currently limited by limited human resources, with no administrative or technical staff (though it has a range of scientific advisors it can call upon). Currently, administration activities are distributed between the member organizations of the Consortium

- Ensure Bladen is equipped with essential, site-specific staff required for effective management

- Strengthen technical/profession staff availability through continued collaboration with researchers, and other organizations

7. Financial and Capital Management

Currently, Bladen Nature Reserve is in the early stages of development, and lacks much of the infrastructure and equipment necessary for effective management.

- Locate funding for core activities (including biodiversity protection), essential infrastructure, equipment and maintenance

- Increase signage at site

- Investigate and implement mechanisms for greater financial sustainability

4.4.2 Management Zones

Zoning is an important management tool, allowing for the control of public access based on the protected area designation, education and research visitor requirements, and minimization of potential impacts on the conservation role of the Nature Reserve.

Review of Previous Zoning

The first management plan (1998) laid down guidelines for two management zones within Bladen Nature Reserve (Table 20), guided by the activities permitted under the 'Nature Reserve' category:

> ***'for scientific study, monitoring, education, and the maintenance of genetic resources'***

Table 20: Present Management Zones (1998 Management Plan)

Zone		Objective	Regulations/Guidelines
Zone 1	**Preservation Zone** *Total reserve area except for the north-east portion*	• To maintain the natural processes in a high level of integrity • To protect the biological diversity of the core of the Maya Mountain • To contain biological, archaeological and other natural systems conserved for scientific research	• No entry • No collecting of flora, fauna or inorganic material • No damage, destruction or disturbance of natural habitat and cultural aspects • No research and collection, except under special permission from Forest Department
Zone 2	**General Use Zone** *The northeastern tip of Bladen Nature Reserve from the point of confluence of Richardson Creek and Bladen Branch south southeast towards Runaway Creek, including the entrance road and access to BFREE entrance to the reserve – leading towards Forest Hill, namely the access route from the Deep River Forest Reserve. All that north-eastern tip will also serve for interpretation*	• To provide facilities for management • To provide for an access route to the reserve • To provide an access to BFREE's property • To provide opportunities for interpretation and education	• Every user shall be registered • No collecting of flora, fauna or inorganic material • No damage, destruction or disturbance of natural and cultural features • Swimming in designated areas only • Education activities are identified as pre-planned programmes which have the objectives of interpreting the natural environment, and promote appreciation for the unique protected area

This general zoning structure appears to have worked well for past management requirements of the Bladen Nature Reserve, though lacks any incorporation of research into the General Use zone, where in fact much of the research has taken place.

Future Zoning of Activities

The two current zones within the Bladen Nature Reserve are considered sufficient for the five years of this management plan (Map 2; Table 17).

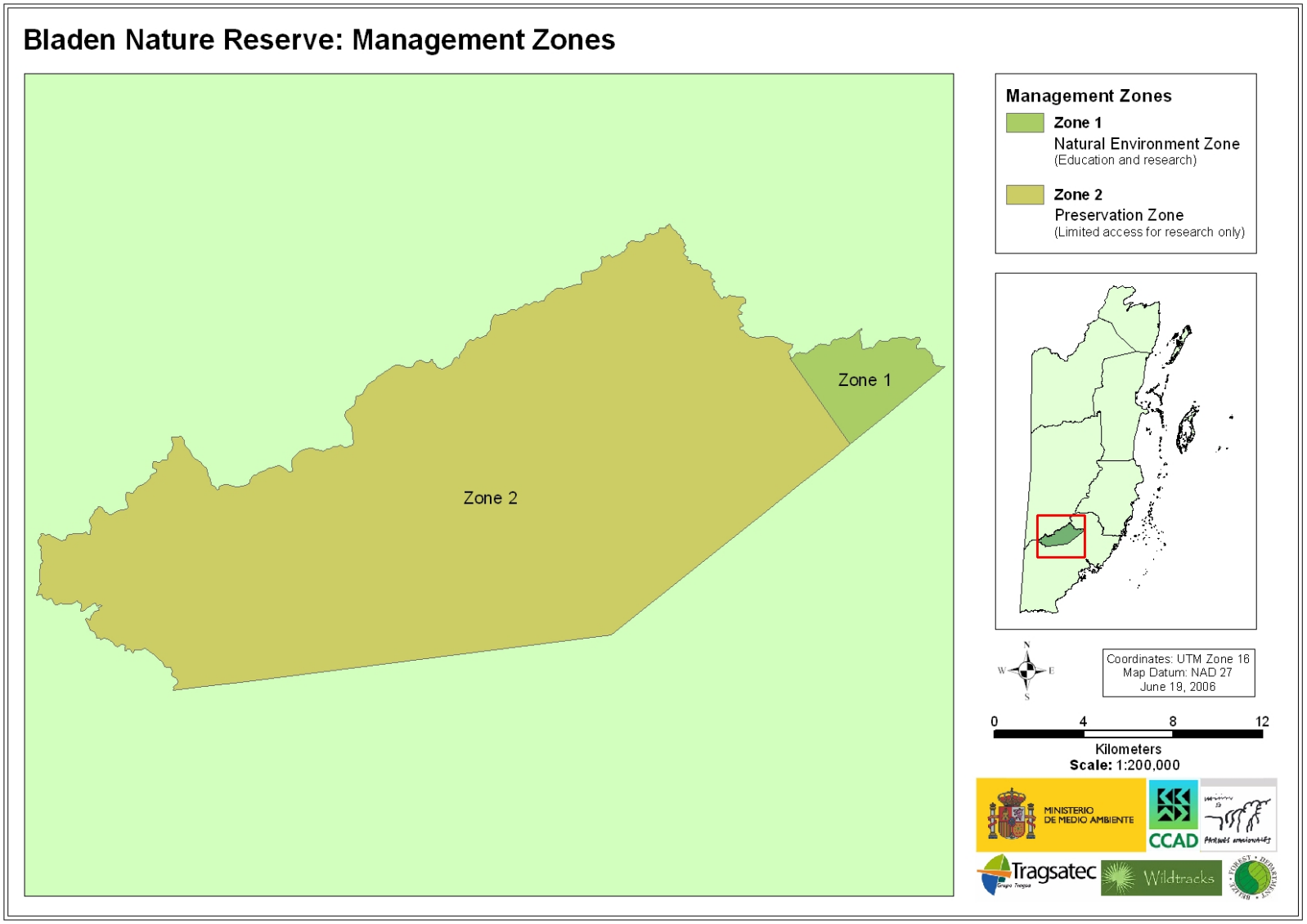
Table 21: Proposed Future Management Zones (2007 - 2011)

Zone		Objective	Regulations/Guidelines
Zone 1	**Natural Environment Zone** Low use area open to researchers, research students, and pre-booked education groups, natural resource students	• To maintain biodiversity and watershed functionality whilst minimising human impact • To provide access to BFREE • To provide access to BNR for pre-arranged researchers and education groups • To minimize impact on the environment by good trail planning, and by designating areas for education and research activities	• Education and research activities, with permission from Forest Dept. in consultation with BMC
Zone 2	**Preservation Zone** The majority of the protected area from the confluence of Curassow Creek and Bladen Branch westwards	• To maintain biodiversity and watershed functionality with minimal human impact • To include an altitudinal gradient and encompass as many of the ecosystems as possible within the design • To maintain the majority of the nature reserve in an entirely natural estate • To protect areas of particularly fragile habitat or with threatened or rare species	• No entry, except by park staff and permitted researchers • No damage, destruction or disturbance of natural habitat and cultural aspects • Non-extractive, minimal impact research under special permission from BMC and Forest Department • No collecting of flora, fauna or inorganic material other than by approved researchers (as defined within the Research Policy document) with the permission of Forest Department, in consultation with BMC

For the implementation of objectives focused towards further developing Bladen as a research site, there is a need to establish a service zone, providing an administrative, education and research base from which activities radiate. Two options exist at present:

- that these activities are taken on by BFREE;
- that these activities are developed separately within Zone 1 of Bladen itself and compliment those of BFREE.

It is important to recognize that if this service zone function is taken on by BFREE, this will be located outside of BNR on the BFREE property.



Map 2: Bladen Nature Reserve – Management Zones

Following is a brief overview of the two zones, which discusses the activities permitted within each. This is then later explored in more detail within the different Management Programmes.

Zone One – Natural Environment Zone

The Natural Environment zone provides an area that can be accessed for educational and research purposes. A well planned trail system should be developed to ensure good user management.

Within this Zone there needs to be designation of education and research areas, minimizing impact of one on the other, and a series of guidelines as to what activities can and can't be done.

Field course research, conducted by University students, whether UB or International, is confined to a designated area within this Zone, (as discussed in the Management Programmes section), and with an ability to incorporate permanent research plots into the Zone layout.

Zone Two - Preservation Zone

The remaining area is to remain pristine, with no entry to any visitors except under special permission to conduct minimal impact research, and as defined by management

It should be borne in mind that management planning is an adaptive process, and over the five- year period, it may be necessary to amend zoning to allow for new activities, such as the potential opening of an additional point of entry from La Sierra.

BMC is also currently investigating the feasibility of developing a buffer zone within the adjacent Maya Mountain Forest Reserve – between 1,500 and 2,000 acres of forest that provides protection to the entrance of the Bladen upper watershed.

To ensure, however, that Zones cannot be altered without justification for the reasons for such changes, and agreement at all levels for such alterations, the following protocol should be followed (Figure 11).

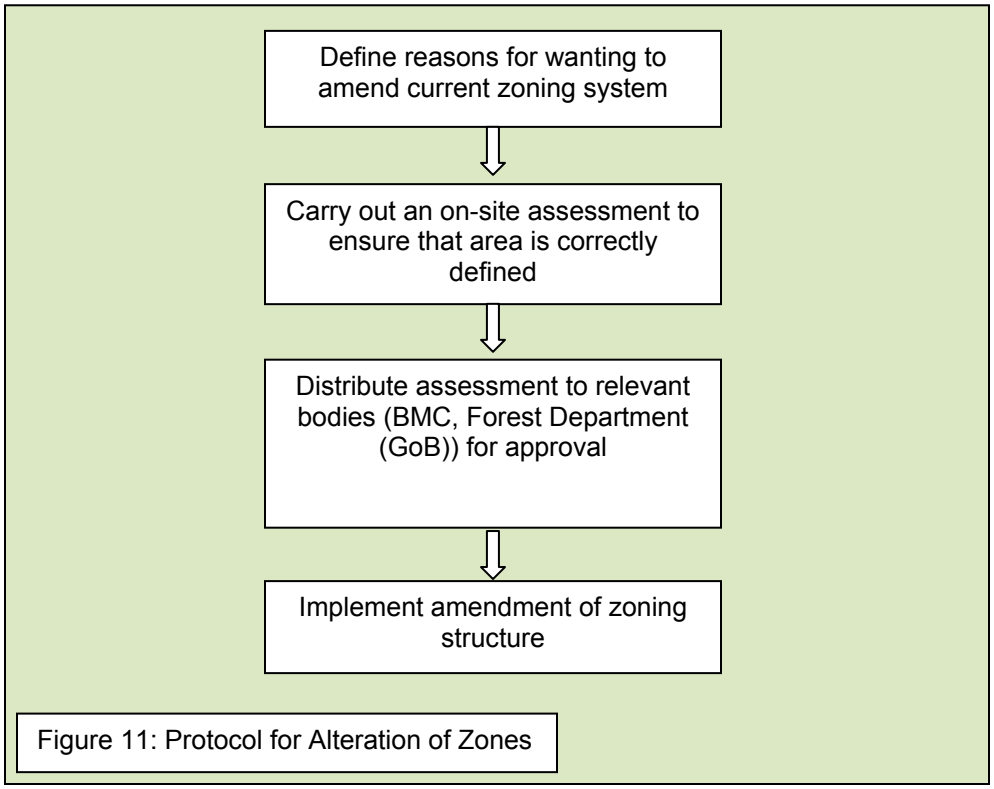


Figure 11: Protocol for Alteration of Zones

There also needs to be an ability to accommodate potential archaeological site development by Institute of Archaeology (IoA) in the future, through a fifth zone - Archaeological Zone - with its own criteria set out through close liaison with IOA. It is, however, important to ensure that access to such a zone through any of the other zones does not significantly impact the principal goal of biodiversity conservation. This is especially true for sites within Zone 2, and should not contradict the management priorities of this zone.

4.5 Management and Organizational Background

The Management Strategy for Bladen Nature Reserve is composed of a number of Management Programmes, interconnected over space and time, supporting each other and forming a whole that is greater than the sum of the single parts. As such, Management Programmes cannot be considered individually, but must be seen in terms of a bigger picture – the integrated management of Bladen Nature Reserve, towards the final goal of maintaining biodiversity, cultural resources and watershed areas within a functional conservation area, as an integral part of the National Protected Areas Policy and System Plan.

There are six programmes within the overall Management Strategy for Bladen:

A. **Natural Resource Management Programme**
B. **Research and Monitoring Programme**
C. **Community Participation Programme**
D. **Public Use Programme**
E. **Site and Infrastructure Management Programme**
F. **Administration Programme**

When prioritizing activities within the management programmes, the results of the Conservation Planning prioritization should be taken into account, and the leverage values of the different conservation strategies:

A. Natural Resource Management Programme

Overall Objective: Maintain present landscape species populations and ecosystems within the Bladen Nature Reserve

Within this general objective, a number of conservation priorities have been highlighted:

- Improve protection of game and fish species within the Bladen Nature Reserve
- Prevent logging, xate, or other extractive incursions into Bladen Nature Reserve
- Maintain archaeological sites without further damage within Bladen Nature Reserve
- Improve knowledge of status of upper elevation species
- Mitigate fire impacts on Lowland Pine Forest within the Bladen Nature Reserve

General Biodiversity Management	
Objective 1: Provide the framework for effective management of the protected area.	
Activity Group 1	Upgrade current co-management agreement between BMC and FD
Activity Group 2	Clearly demarcate the boundaries in critical areas
Activity Group 3	Implement management zones
Activity Group 4	Raise local awareness of the role of BMC, and the benefits of the protected area
Activity Group 5	Strengthen ties with GoB, NGOs and other local, national and international organisations
Activity Group 6	Liaise with large landowners and at farm managerial level to engender support and cooperation
Activity Group 7	Integrate research and monitoring results into the adaptive management process

Objective 2: Protection of biodiversity within Bladen Nature Reserve	
Activity Group 1	***Illegal hunting/fishing/logging:*** Develop and implement enforcement plan; Prioritise enforcement of no-hunting/fishing/logging regulations and encourage cooperation of communities towards this objective; Liaise with FD on enforcement issues; Liaise with management bodies of adjacent protected areas towards joint enforcement; Liaise with large landowners and logging concession holders on bringing awareness of BNR to workforce; Work more closely and effectively with local communities
Activity Group 2	***Fire:*** Develop and implement fire management plan; Develop capacity and infrastructure for fire prevention and control
Activity Group 3	***Pesticide Drift:*** Increase baseline and knowledge of impacts of pesticide drift on the protected area
Activity Group 4	***User Impacts:*** Reduce user impact through implementation of management zoning, planning of trails and monitoring of user activities and impacts Development and implementation of 'Limits of Acceptable Change' for each zone
Activity Group 5	***Development in Adjacent Areas and effects on connectivity*:** Map current land use in adjacent areas and update annually. Monitor status of adjacent private land and protected areas, and threats and potential threats to biodiversity and connectivity Support activities of other organizations in the area towards the maintenance of the Maya Mountain Marine Area Transect
Activity Group 6	***Dereservation:*** Raise awareness of BNR locally, nationally and internationally; Engage local communities in active cooperation towards conservation goals through alternative livelihoods projects Develop a business plan towards sustainability. Lobby effectively with Government to increase long term stability and security of status of BNR

Objective 3: Protection of archaeological sites within Bladen Nature Reserve	
Activity Group 1	***Protection of Archaeological Sites:*** Closer liaison with Institute of Archaeology, identification of archaeological sites within BNR, and increased patrolling efforts targeted at preventing looting and destruction of these sites; Increased awareness of national heritage through primary and secondary level education

Objective 4: Protect other key species present within Bladen Nature Reserve		
	Activity Group 1	Collaborate with other national and regional initiatives towards conservation of key species of concern, including: ***White-lipped Peccary*** ***Curassow/Guan*** ***Spider Monkeys*** ***Yellow-headed Parrot:*** Confirm whether or not Yellow-headed parrots are nesting within BNR, and if so, provide increased protection from fire and nestling theft through targeted seasonal patrolling ***Keel-billed Motmot:*** Ensure impacts on these species are minimized through knowledge of key areas within Bladen ***Scarlet Macaws:*** Ensure any key feeding areas are protected from disturbance ***Upper Elevation Amphibian Species*** …and other IUCN red-listed species
Objective 5: Prevention/mitigation of effects from mining activities within BNR (including oil prospecting)		
	Activity Group 1	***Mining:*** Liaise closely with Geology and Petroleum Dept. re. issuing of prospecting and mining licenses within BNR; Liaise with any mining company with a reconnaissance or prospecting license that covers BNR Raise national and international profile of BMC and BNR Lobby with Geology and Petroleum Dept. through formal presentation for Bladen to be excluded from prospecting licenses

Objective 6: Protect upper watershed of Bladen Branch and its tributaries within Bladen Nature Reserve		
	Activity Group 1	Raise awareness of watershed value and other environmental benefits in buffer communities
	Activity Group 2	Monitor water quality within BNR
	Activity Group 3	Prevent contamination of watershed within BNR

B. Research and Monitoring Programme

Overall Objective: Further development of Bladen as a research site, to provide biodiversity information, monitoring of highlighted species, threats, stresses and impacts, and feedback on the success of implementation of management strategies

A number of the actions under this Programme directly support identified conservation priorities:

- Develop baseline data on conservation targets and other highlighted species present within Bladen – including game species, aquatic and riparian species, upper elevation species (particularly amphibians), and archaeological sites
- Develop monitoring programme covering conservation targets
- Develop 'measures of success' monitoring protocol, to verify success of conservation strategies
- Provide infrastructure for further research

Objective 1: Develop baseline information and framework required for effective management of biodiversity and cultural heritage	
Activity Group 1	Create and implement information management database to contain all research, monitoring and socio-economic data, to assist with adaptive management
Activity Group 2	Strengthen cross linkages with other organisations involved in research in Belize and the region
Activity Group 3	***Baseline Data:*** Develop baseline data for Bladen through biodiversity surveys and mapping activities. In particular: ▪ Develop a detailed and accurate ecosystem map of Zone 1 ▪ Assess populations of game species – focused on Great Curassow, Crested Guans, White-lipped Peccary, Collared Peccary and fish species within BNR ▪ Record and map species, routes and patterns of annual migration from karst area to coastal plain ▪ Establish status of species of concern and their spatial and temporal use of protected area – including yellow-headed parrot, keel-billed motmot, scarlet macaw ▪ Develop baseline data on soaring raptor populations in liaison with other national and international initiatives ▪ Gather baseline data on flora and fauna of upper elevations ▪ Develop baseline data on pesticide use in coastal areas, and wind and precipitation patterns ▪ Develop links with other national and regional initiatives
Activity Group 4	***Spider monkeys and howler monkeys:*** Establish status of populations, and extent of use of BNR by primates. Map distribution and incorporate information into planning of trails and research areas to minimise disturbance
Activity Group 5	***Increase knowledge of upper elevation amphibian species:*** Work towards increased knowledge and monitoring of potential / actual risk of pesticide drift, and development of a plan towards mitigation
Activity Group 6	***Archaeological Sites:*** Gather baseline data on archaeological sites within BNR Map and collate information on all known and new archeological sites within Bladen, and record state
Activity Group 7	***Watershed data***: Gather baseline data on watershed dynamics and quality Develop a baseline on aquatic and riparian species, including species indicative of watershed health Monitor downstream impacts on water quality and water flow

Objective 2: Monitoring of biodiversity within BNR		
	Activity Group 1	Develop and implement standardized biodiversity monitoring protocols for vertebrates and vegetation in liaison with other national, regional and international initiatives
	Activity Group 2	Monitor hunting activity and indicator game species populations in BNR
	Activity Group 3	Monitor yellow-headed parrot, keel-billed motmot and scarlet macaw populations using BNR, in liaison with other national, regional and international initiatives
	Activity Group 4	Monitor Central American spider monkey and Yucatan howler monkey use of Bladen Nature Reserve
	Activity Group 5	Monitor other focal vertebrate species of concern within BNR, in liaison with other national and international initiatives
Objective 3: Monitoring population health of upper elevation amphibians		
	Activity Group 1	Monitor population density, size and condition of upland amphibian populations
	Activity Group 2	Develop and implement monitoring programme to detect chytridomycosis in upland amphibian populations
Objective 4: Monitoring of archaeological sites		
	Activity Group 1	Monitor status of archaeological sites and signs of looting activity
Objective 5: Water monitoring within BNR		
	Activity Group 1	Establish long term water monitoring programme for BNR, feeding into national water monitoring initiatives
	Activity Group 2	Develop and implement water monitoring for pesticide contamination in orographic rainfall areas
Objective 6: Meteorological data collection within BNR		
	Activity Group 1	Continued and extended collection of meteorological data, available for use by visiting researchers
Objective 7: Visitor monitoring within BNR		
	Activity Group 1	Develop and implement visitor impact monitoring within BNR – covering education and research users Develop and implement monitoring of user satisfaction Develop and implement limits of acceptable change for Zone 1 – for measuring the impact of education and research use Develop and implement limits of acceptable change for Zone 2
Objective 8: Monitoring of 'Measures of Success'		
	Activity Group 1	Development and implementation of 'Measures of Success' monitoring programme, to verify success of conservation strategies, incorporating limits of acceptable change

Objective 9: Further development of research opportunities at Bladen Nature Reserve	
Activity Group 1	Identify and assess options for facility location and operation
Activity Group 2	Rationalise access fees and permit process. Development of protocol for collaboration between BMC and FD for research permitting process
Activity Group 3	Active recruitment of researchers in priority research areas
Activity Group 4	Provide baseline data maps for researchers where available, including GIS data
Activity Group 5	Train local pool of community members as research assistants
Activity Group 6	Develop links with other national and international organisations conducting similar research activities
Activity Group 7	Review and refine BFREE research policy for acceptance and adoption by BMC

C. Community Participation

Objective: To increase awareness and participation in conservation activities of Bladen Nature Reserve

With the restrictive status of Nature Reserve, with no tourism activities permitted, there is little scope for local communities to derive economic benefits from the protected area in the way that communities such as Maya Centre have done. However there are opportunities for community participation in management, following the BAS co-management model of Local Advisory Committees, and in the provision of goods, services and staff to the increased scale of research activities that are planned.

There is also a need for active environmental education and awareness activities in the adjacent communities, these will also benefit from Bladen's function as part of the Maya Mountains, an area highlighted as a critical forest node in Central America, and currently about to receive long term funding for strengthening management and community awareness.

Objective 1: Develop a working relationship with local communities through clearly defining the role and policy of BMC and BNR within the communities	
Activity Group 1	Raise the profile of BMC and BNR within the local communities
Activity Group 2	Clearly define the role BMC should play within the community, through collaborative efforts with BMC member organizations, ensuring realistic and accurate expectations
Activity Group 3	Maintain strong links, collaboration, and open communication between collaborating organisations within BMC
Activity Group 4	Develop Blden local advisory committee with cross sectoral community membership, and clearly defined TOR
Objective 2: Ensure that local communities benefit directly and indirectly from Bladen Nature Reserve	
Activity Group 1	Raise awareness within local communities of the environmental benefits from Bladen Nature Reserve
Activity Group 2	Facilitate and support local sustainable development initiatives within communities, in collaboration with BMC member organizations
Activity Group 3	Assist local community members to benefit directly from BNR through training programme for development of pool of local research assistants
Activity Group 4	Liaise with government agencies and NGOs that can assist buffer community development, in collaboration with BMC member organizations
Activity Group 5	Ensure preferential employment opportunities for buffer communities
Objective 3: Increase efforts to incorporate youth and education into BNR activities	
Activity Group 1	Develop and implement dynamic conservation education outreach and on-site programme for schools in the buffer communities
Activity Group 2	Develop collaborative links with UB in Punta Gorda, and encourage use of Bladen as a study site
Activity Group 3	Structured on-site conservation field activities within Bladen providing inspiration education experiences (hikes, summer camps etc.) for all levels of education, targeted at the stakeholder communities, UB, Galen and other national and international institutions
Activity Group 4	Initiate local counterpart programme for visiting international student groups

D. Public Use Programme

Overall Objectives:

1. To increase approved research and education activity within the Bladen Nature Reserve

2. To increase visitor satisfaction by all visitors (researchers and education groups), with the development of research and education facilities

3. To strive towards a greater level of economic sustainability through expansion of research, compatible with biodiversity conservation

Bladen Nature Reserve is not open to tourism, use being restricted to research and educational purposes, as outlined in the National Parks System Act.

General Public Use Management Sub-Programme		
Objective 1: Develop specific protocols for hosting research and educational visitors		
	Activity Group 1	Ensure that each visitor group is able to gain the maximum benefit from their visit to BNR
	Activity Group 2	Promote and enforce low-noise, no-garbage and other protected area visitor regulations
	Activity Group 3	Inintiate local counterpart programme for for visiting international student groups, to be funded within costs of visiting groups, in liaison with UB
Objective 2: Review, finalise and implement the BNR Master Plan for Service Zone, with research and education facilities as a central focus		
	Activity Group 1	Evaluate options and finalise the decision on the location of facilities associated with education and research
	Activity Group 2	Locate funding, construct (or upgrade) and equip research and education facilities
Objective 3: Design and implement Zone 1 Trail System		
	Activity Group 1	Design and implement the Zone 1 education and research access trail system

Objective 4: Ensure full knowledge of visitor data through a monitoring programme of visitor numbers, activities, impacts and satisfaction within BNR, for use in management planning		
	Activity Group 1	Develop and implement a monitoring programme of user numbers (research and education), activities, and satisfaction

Objective 5: Develop Bladen as an educational venue		
	Activity Group 1	Increase educational visits by local community schools
	Activity Group 2	Develop trail system and literature specifically for education purposes
	Activity Group 3	Designate a research area for use by school and university groups

E. Site Support and Infrastructure Management Programme

Objective: To ensure that the necessary infrastructure is present for the support of management activities within BNR

The Infrastructure Programme (**Programme E**) covers a number of specific areas:

- Access Road Maintenance
- Safety and Emergency Infrastructure
- Future Infrastructure Development

Objective 1: Upgrade and maintain Access Road in good condition		
	Activity Group 1	Upgrade and maintain Bladen Access Road
	Activity Group 2	Ensure that where possible, the width of the road is minimized to limit fragmentation of forest habitat
Objective 2: Develop main entry point to BNR		
	Activity Group 1	Investigate feasibility of constructing BNR Information Centre by Southern Highway entry point

Safety and Emergency Infrastructure		
Objective 3: Ensure Hurricane preparations are in place		
	Activity Group 1	Ensure that any buildings constructed are hurricane proofed where possible
Objective 4: Ensure safety procedures and emergency rescue systems are in place		
	Activity Group 1	Ensure BNR is equipped with emergency rescue equipment and has an emergency rescue system in place
	Activity Group 2	Ensure user trails all meet a minimum safety standard
Objective 5: Ensure safety of staff on patrol		
	Activity Group 1	Ensure staff have good communications backup (satphone) whilst on patrol

Future Infrastructure Development		
Objective 6: Ensure BNR is adequately equipped with the necessary infrastructure		
	Activity Group 1	Create an Infrastructure Development plan for BNR, covering accommodation, research and education facilities, administration facilities
	Activity Group 2	Locate funds for and construct any necessary facilities
	Activity Group 3	Ensure office and work facilities are adequately equipped
	Activity Group 4	Ensure BNR is equipped with necessary vehicles, which are maintained, and replaced when necessary
	Activity Group 5	Ensure research, education and accommodation facilities are adequately equipped
Objective 7: Infrastructure Development in Protected Area Services Zone		
	Activity Group 1	Further investigate options for development of Research and Education facilities – BNR, BFREE, La Sierra and CBWS
	Activity Group 2	Develop and implement development plan for infrastructure in Zone 1, to include research facilities, education facilities, accommodation and associated maintenance, staff and support facilities
Objective 8: Infrastructure Development in Zone 1 (Education and Research Zone)		
	Activity Group 1	Plan and implement Zone 1 trail systems and policies
Objective 9: Infrastructure Development in Zone 2 (Preservation Zone)		
	Activity Group 1	Plan and implement access trail for Zone 2, and associated policies
	Activity Group 2	Maintain access trail for Zone 2 to set safety standards

F. Administration Programme

Objective: To ensure that the necessary administration structure is in place for the support of management activities within BNR

The Administration Programme (**Programme F**) covers a number of areas:

- General administration
- Staff employment and training
- Issues and concerns with visitor use
- Marketing
- Monitoring

Bladen Staff

Bladen Reserve Manager: The Reserve Manager post will be created and funded under the CEPF grant, and it is anticipated that the Reserve Manager will oversee all activities pertaining to the implementation of the Bladen Nature Reserve management plan. S/he will be responsible for coordinating and managing the monitoring activities of the Bladen Rangers, and will also work with staff members of the relevant enforcement agencies (e.g., Forest Department, Belize Defense Force, Police Department, etc.) to assist with coordination of joint patrols.

Other responsibilities include providing transport and logistical support to the rangers, attending meetings, other administrative duties, communicating directly with the Bladen Management Consortium and the Forest Department, the Chiquibul Reserve Manager, the Environmental Educator, and liaising closely with Friends for Conservationand Development, the CEPF project management organization, as well as other key stakeholders. It is anticipated that Jacob Marlin, currently Vice-President of the Bladen Management Consortium, will fill this post.

Environmental Educator: BMC currently employs an Environmental Educator (Oscar Hernandez), whose role is to design and coordinate the implementation of all the community outreach activities within the Bladen area.

Rangers: Currently, the following Ranger posts for Bladen Nature Reserve are filled:

Bladen Ranger: Sipriano Canti
Bladen Ranger: Clemente Pop
Bladen Ranger: Martin Coy

These Rangers undertake routine patrols within the Bladen Nature Reserve, in line with instructions from BMC (and in the future, the Reserve Manager) and in cooperation with the staff members of the relevant enforcement agencies.

F. Administration Programme

General Administration		
Objective 1: Develop an effective management structure		
	Activity Group 1	Ensure that BNR has sufficient staff for effective management
	Activity Group 2	Ensure effective management structure for BNR
	Activity Group 3	Ensure close liaison and co-operation in management efforts with the Maya Mountain Massif conservation area initiative, under the NPAPSP
	Activity Group 4	Develop Memorandum of Agreement between BMC and BFREE for co-ordination of research, education and patrolling activities
Objective 2: Ensure adequate administration infrastructure and planning		
	Activity Group 1	Develop and implement five year infrastructure development plan
	Activity Group 2	Construction and equipping of administration facilities
	Activity Group 3	Develop and implement five year financial plan towards sustainability
	Activity Group 4	Develop and implement Human Resource plan
Objective 3: Maintain baseline administration activities		
	Activity Group 1	Maintain baseline administration activities
	Activity Group 2	Prepare Annual Workplans

Staff Employment and Training	
Objective 4: Ensure that Bladen has sufficient staff for biodiversity conservation and research / education role	
Activity Group 1	Ensure that taff have clear roles defined by TORs
Activity Group 2	Develop and implement Reserve Manager post by 2011
Activity Group 3	Develop Admin / Finance / human resource post by 2011
Activity Group 4	Develop Education / Community Liaison post by 2011
Activity Group 5	Increase number of wardens to twelve by 2011
Activity Group 6	Hire of casual labour when required
Activity Group 7	Develop and implement preferential hiring policy for employment from local communities
Objective 5: Provide Orientation Package for all staff	
Activity Group 1	Develop formal Orientation Package for new staff
Activity Group 2	Ensure that all new staff take part in orientation activities
Objective 6: Ensure that BNR staff receive training	
Activity Group 1	Staff trained in areas where training is required in hospitality and maintenance, as well as in BMC and BNR background, wildlife identification, and understanding of conservation

Issues and Concerns with Visitor Use	
Objective 7: Ensure safety of visitors and staff	
Activity Group 1	Assess potential safety and liability issues within BNR, and ensure safety of visiting researchers, students and staff

Limits of Acceptable Change Programme	
Objective 8: Develop and implement Limits of Acceptable Change Programme	
Activity Group 1	Develop and implement Limits of Acceptable Change Programme

Marketing		
Objective 9: Improve marketing of BNR		
	Activity Group 1	Market BNR effectively as a prime research location
	Activity Group 2	Raise international profile of BNR, and awareness of grant-giving agencies of the need for funding
	Activity Group 3	Development of web site

Monitoring		
Objective 10: Annual review of work		
	Activity Group 1	Review management effectiveness on annual basis, for submission to Forest Department
	Activity Group 2	Review of 'Measures of Success' monitoring
	Activity Group 3	Review of annual workplan
	Activity Group 4	Review of research and monitoring activities
	Activity Group 5	Review of education activities
	Activity Group 6	Review of community participation activities
Objective 11: Review of Management Plan		
	Activity Group 1	Ensure monitoring information feeds back into adaptive management planning activities
	Activity Group 2	Review Management Plan after 2½ years
	Activity Group 3	Review Management Plan after 5 years
	Activity Group 4	Full management effectiveness assessment (as per NPAPSP) for submission to Forest Department at end of 5 years

4.6 Management Actions

At the request of the Bladen Management Consortium, this management plan outlines activity groups, or areas, under each objective, but does not go as far as to specify management actions for achieving the objectives. However the following table (Table 18) has been included to provide guidelines on management action creation for the first objective of the Natural Resource Management Programme during the development of annual operation plans.

Table 22: Management Action (Example) General Biodiversity Management						
Management Actions		**Present Status**	**Desired Status**	**Year**	**People**	**Limitations/Requirements**
Objective 1: Provide the framework for effective management of the protected area.						
Activity Group 1: Upgrade current co-management agreement between BMC and FD						
A1	**Upgrade current co-management agreement between BMC and FD**	Co-management agreement is not fully formalised, due to NPAPSP moratorium	Signed 5-year co-management agreement	1st Year	BMC members, BNRReserve Manager	In process
Activity Group 2: Clearly demarcate the boundaries in critical areas						
A2	Identify major illegal entry points to protected area	Current illegal entry points have largely been identified, have adequate signage and clear boundary lines	Current illegal entry points defined. Annual review to ensure that all illegal entry points are identified	Ongoing	BNR Reserve Manager, Head Warden	In past, signs have been damaged and destroyed. Will only work if combined with more effective wardening, increased respect for the protected area through increased awareness of protected area benefits
A3	**Clearly demarcate the boundaries in critical areas**	Boundary lines defined in many key areas, but not all	Boundary lines defined and maintained in all identified key areas, with annual review	Ongoing	BNR Reserve Manager, Head Warden	
A4	Create awareness of location of boundaries in local communities	Community consultations suggest that many community members are not aware of BNR, nor of the location of boundaries	Local communities are aware of BNR boundary location	1st to 2nd	BNR Reserve Manager, Education Officer	
Activity Group 3: Implement Management Zones						
A5	Ensure awareness of management zones among staff and researchers – both on the map and on the ground	Management zones exist but are not used as a management tool	Staff and researchers are aware of the management zones, and activities are co-ordinated appropriately. Signs indicate boundary of Zone 1 and Zone 2	Ongoing	BNR Reserve Manager, Head warden	
Activity Group 4: Raise local awareness of the role of BMC, and the benefits of the protected area						
A6	Raise community awareness of BMC, and the environmental benefits of BNR - clean water etc.	Communities are not aware of BMC, and don't see the environmental benefits of BNR	Communities are aware of BMC, and appreciate the environmental benefits of BNR as a protected area and assist in protection	Ongoing	BMC members, BNR Reserve Manager, Education Officer	

General Biodiversity Management						
Management Actions		**Present Status**	**Desired Status**	**Year**	**People**	**Limitations/Requirements**
Activity Group 4: Raise local awareness of BMC, and the benefits of the protected area (continued)						
A7	Raise operational staff awareness of the environmental benefits of BNR - clean water etc.	Operational staff aware of BMC role in protecting wildlife, but may not have a complete understanding of the environmental benefits of the protected area	Ongoing and continuous staff awareness programme, and part of orientation for any new staff (including casual workers)	Ongoing	BNR Reserve Manager, Education Officer	
Activity Group 5: Strengthen ties with GoB, NGOs and other local, national and international organisations						
A8	Strengthen links with other organisations and Government agencies involved in protected areas management	Ongoing	Stronger links with other organisations and Government agencies involved in protected areas management	Ongoing	BMC members, BNR Reserve Manager	Strengthen collaboration with BMC member organization, especially in areas of community awareness
A9	Maintain and strengthen collaboration with BMC member organization, especially in areas of community awareness	Collaboration between member organizations through the BMC, but no collaboration currently in implementing activities	Effective working partnership in areas of wardening and community awareness programmes	Ongoing	BMC members, BNR Reserve Manager	
A10	Maintain and strengthen collaboration with other organizations involved in the Maya Mountain Conservation Area	Some collaboration in development of CEPF proposal	Effective working partnership with other organizations involved in the Maya Mountain Conservation Area	Ongoing	BMC members, BNR Reserve Manager	Eg. Gomez Brothers, Trio Farm
A11	Increase and strengthen collaborative partnerships with national and international research and education institutions	Some links exist between BFREE and international research/ education institutions	BMC increases and strengthens links and collaborative partnerships with national and international research and education institutions	Ongoing	BMC members, BNR Reserve Manager	
Activity Group 6: Liaise with large landowners and at farm managerial level to engender support and cooperation						
A12	Explore best means of liaising with logging concession holders and large agricultural landowners - areas of conflict and mutual assistance	Some liaison but little collaboration with logging concession holders and large landowners,	Good liaison, with active support from logging concession holders and large landowners in tackling hunting, looting, and fire	Ongoing	BMC members, BNR Reserve Manager	

4.7 Monitoring and Review

Monitoring and review is essential in order to ensure that management is effective in achieving its objectives. This can be achieved through measurement of success:

- the measurement of success of in implementing the management actions
- the measurement of success of the conservation strategies in addressing the threats

Two matrices are used to facilitate this process:

- the Measures of Success of Implementation (whether the actions have been implemented successfully)

- the Measures of Success of Status (whether the actions, following implementations, have positively altered the status of the situation - ie. Been successful).

These matrices form the basis for the annual review of the management plan, so time should be taken to complete each one fully and as accurately as possible during the annual review, using data from the monitoring programme.

Included is an example of the suggested structure for both matrices (Table 19 and Table 20).

Table 23: A. Natural Resource Management Programme - Implementation

Measure of Success of Implementation

N.B. It is important to note that the numerical values ascribed to the measures of success are not scores, but indicators of the stage of implementation		Comments: Justification for Measure of Success score. Problems, concerns. Notes for inclusion in updated Management Plan
	1 No improvement on present status	
	2 Planning has started, but no implementation	
	3 Planning is completed, but no implementation	
	4 Implementation is started, but not yet completed	
	5 Implementation is completed or ongoing (continuous activities), activity has succeeded	

General Biodiversity Management

Management Activities		Measure of Success						Comments: Justification for Measure of Success score. Problems, concerns. Notes for inclusion in updated Management Plan
		Year						
	Activity	**1**	**2**	**3**	**4**	**5**	**Desired Status**	
Activity Group 1: Upgrade current co-management agreement between BMC and FD								
A1	**Upgrade current co-management agreement between BMC and FD**						Signed 5-year co-management agreement	
Activity Group 2: Clearly demarcate the boundaries in critical areas								
A2	Identify major illegal entry points to protected area						Current illegal entry points defined. Annual review to ensure that all illegal entry points are identified	
A3	**Clearly demarcate the boundaries in critical areas**						Boundary lines defined and maintained in all identified key areas, with annual review	
A4	Create awareness of location of boundaries in local communities						Local communities are aware of BNR boundary location	
Activity Group 3: Implement Management Zones								
A5	Ensure awareness of management zones among staff and researchers – both on the map and on the ground						Staff and researchers are aware of the management zones, and activities are co-ordinated appropriately. Signs indicate boundary of Zone 1 and Zone 2	

Table 24: A. Natural Resource Management Programme - Status								
Measure of Success - Status								
It is important to document clearly the status of each Activity whilst developing Annual Operation Plans, as this allows highlighting of areas that need prioritization								
Management Activities		**Present Status (2004)**	**Status (2005)**	**Status (2006)**	**Status (2007)**	**Status (2008)**	**Status (2009)**	**Desired Status**
	Activity							
General Biodiversity Management								
Activity Group 1: Upgrade current co-management agreement between BMC and FD								
A1	Upgrade current co-management agreement between BMC and FD	Co-management agreement is not fully formalised, due to NPAPSP moratorium						Signed 5-year co-management agreement
Activity Group 2: Clearly demarcate the boundaries in critical areas								
A2	Identify major illegal entry points to protected area	Current illegal entry points have largely been identified, have adequate signage and clear boundary lines						Current illegal entry points defined. Annual review to ensure that all illegal entry points are identified
A3	Clearly demarcate the boundaries in critical areas	Boundary lines defined in many key areas, but not all						Boundary lines defined and maintained in all identified key areas, with annual review
A4	Create awareness of location of boundaries in local communities	Community consultations suggest that many community members are not aware of BNR, nor of the location of boundaries						Local communities are aware of BNR boundary location
Activity Group 3: Implement Management Zones								
A4	Ensure awareness of management zones among staff and researchers – both on the map and on the ground	Staff and researchers are aware of the management zones, and activities are co-ordinated appropriately. Signs indicate boundary of Zone 1 and Zone 2						

4.8 Timeline
4.9 Finance

Until earlier this year (2006), Bladen Nature Reserve had no real funding base. This has changed with grant funding currently from PACT and the Spanish Government for the development of the management plan, and soon from CEPF and PACT for the management of the Chiquibul/ Maya Mountain Key Biodiversity Area. These grants dictate the timeline and financial distribution to the BMC. An outline summary of the CEPF grant for Bladen is included (Table 25), but other grants are still in the process of being finalised. This section will be updated during the first annual review (2007).

Table 25: CEPF Grant Summary for Bladen*

Cost Category (US$)	2006	2007	2008	Total
BNR Manager	4,500.00	18,000.00	0.00	22,500.00
Ranger One	1,500.00	6,600.00	6,600.00	14,700.00
Ranger Two	1,500.00	6,600.00	6,600.00	14,700.00
Ranger Three	1,500.00	6,600.00	6,600.00	14,700.00
Office Supplies	900.00	1,800.00	1,800.00	4,500.00
Field Equipment	6,595.00	2,780.00	1,780.00	11,155.00
Hardware	1,400.00	0.00	0.00	1,400.00
Infrastruture	6,345.00	0.00	0.00	6,345.00
Vehicle	15,000.00	0.00	0.00	15,000.00
Maintenance	1,800.00	1,800.00	1,800.00	5,400.00
Vehicle Insurance	250.00	250.00	250.00	750.00
SUBTOTAL:	41,290.00	44,430.00	25,430.00	111,150.00
			CEPFTotal (US$):	**111,150.00**

***Summary only – does not include all grant areas**

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