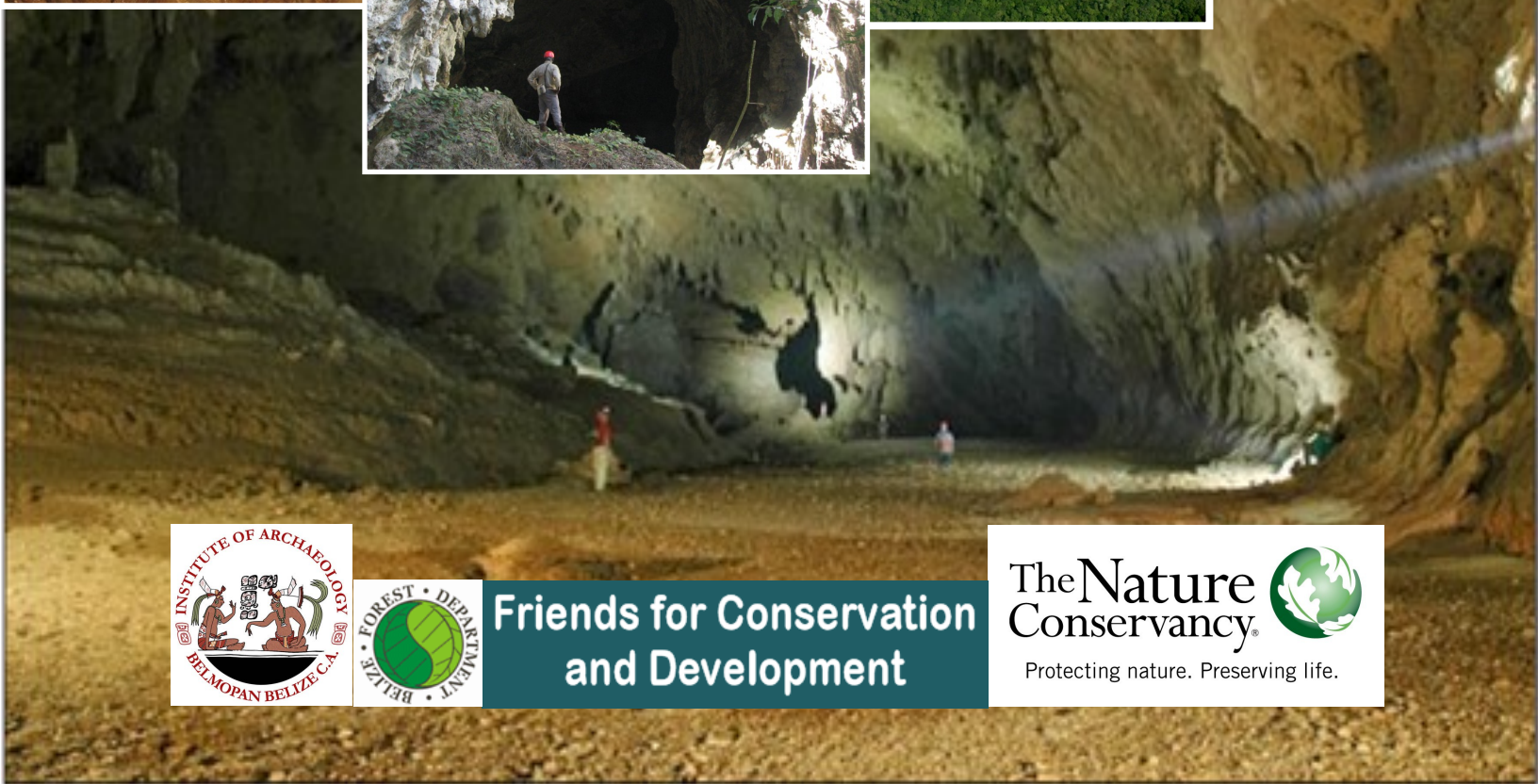
Chiquibul Cave System Management Plan 2010-2015

Meerman & Moore

2009



INSTITUTE OF ARCHAEOLOGY BELMOPAN BELIZE C.A.

BELIZE FOREST DEPARTMENT

Friends for Conservation and Development

The Nature Conservancy

Protecting nature. Preserving life.

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Executive Summary

Within the Chiquibul National Forest lies the Chiquibul Cave System (CCS), the longest and largest known network of caves in Central America. Over 55 km of passages have been mapped and surveyed, including the largest known passage and cave room in the Western Hemisphere. The CCS is a cross boundary feature as a small section reaches into Guatemala. The CCS, due to its extent and integrity represents one of those unique and prestigious cultural features worthy of national importance.

The CCS has been extensively explored over the last 30 years and one of the principal explorers noted that ....." *An Ancient Cave passage of exceptional beauty was discovered that may offer future economic benefit to Belize if properly [managed and] developed* ....." (Miller 1984:3). This 25 year old comment effectively forms the foundation for the current first CCS management plan.

Jurisdiction over the Chiquibul Cave falls under the Institute of Archaeology (IA), which has not only jurisdiction over declared Archaeological Reserves such as the Caracol Archaeological Reserve, but also over any Cultural and/or Historical site in Belize as provided by the National Institute of Culture and History Act, Chapter 331 of 2000 (Revised 2003) of the Laws of Belize.

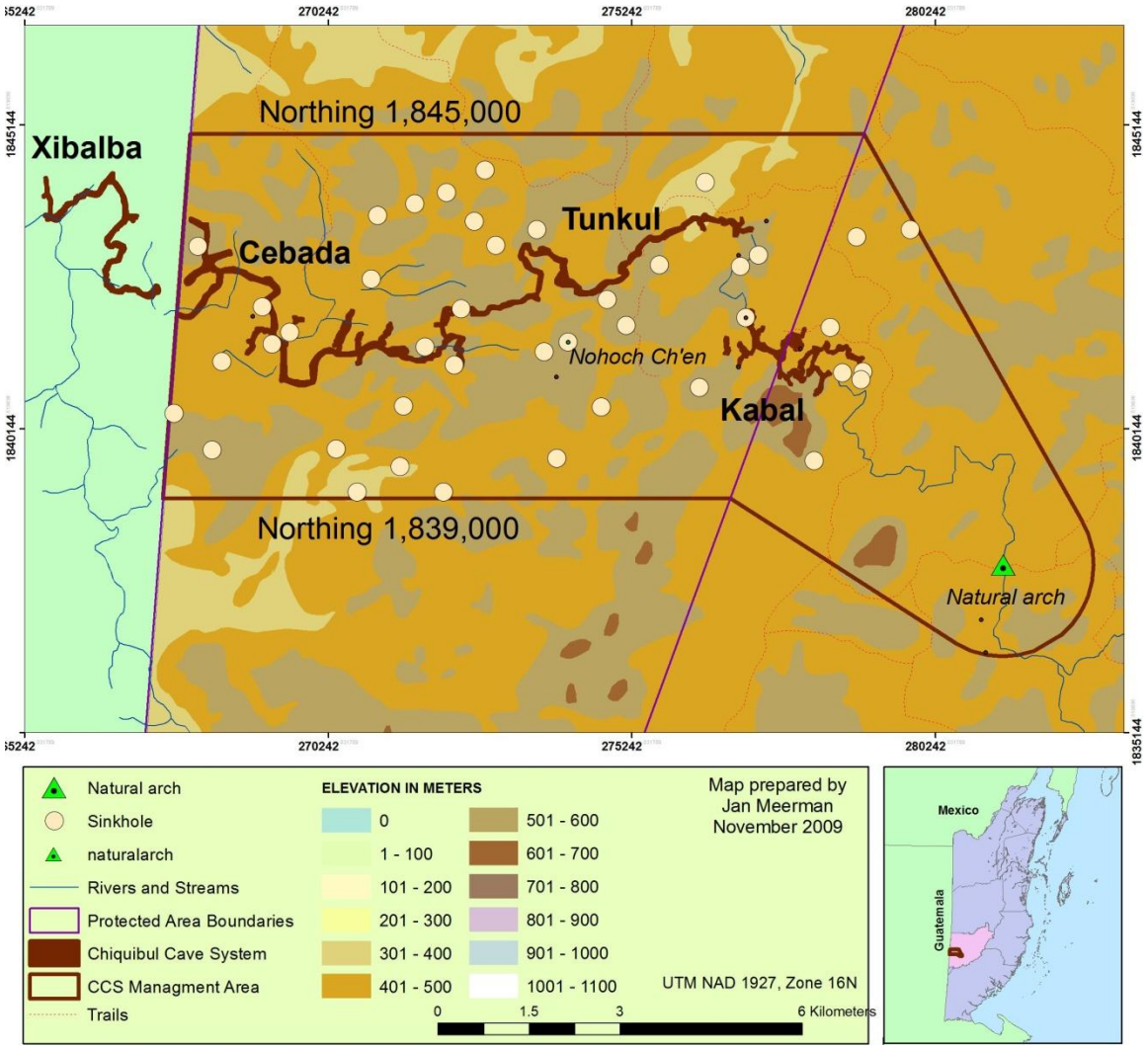
Recognizing the logistic difficulties in managing such an important but remote asset such as the Chiquibul Cave, on January 30, 2008, IA entered into a co-management agreement for the Chiquibul Cave System with Friends of Conservation and Development (FCD). FCD at moment had already entered into a co-management agreement with the Forest Department (FD) for the management of the Chiquibul National Park (CNP) in which the CCS is largely located.

Meanwhile the Forest Department retains jurisdiction over the Chiquibul National Park and the Chiquibul Forest Reserve, as provided by the Forests Act and the National Park Systems Act.

While this spread of management responsibilities appears counterproductive, it is in effect applying fields of expertise incorporated in these different departments/institutions to where it is needed, and this is in full agreement with the National Protected Areas Systems Plan (NPASP) which states: "*Simplify the existing system by consolidating adjacent protected areas into single, multi-zoned, management units.*" Following the rationale of the NPASP, excising the CCS from the CNP and CFR to declare it an independent Natural Monument or similar is not necessary. Instead, the attention can focus on the actual, on the ground, and integrated management of this important heritage.

Nevertheless, for the purposes of a management plan, the overlap between jurisdictions and site specific management can be confusing. Particularly since a management plan for the CNP is already in effect (Salas & Meerman, 2008). For this reason, this (CCS) management plan focuses on the site specific issues, while the CNP management plan remains the overarching document for those issues that affect the CNP as a whole (or the entire Chiquibul Forest for that matter).

Again for management purposes it was important to demarcate the extent of the CCS management area. Note that this demarcation is for management purposes only and does not pretend to excise any area from existing protected areas. Also note that for purposes of this management plan features such as the Chiquibul Cave proper, the surrounding sinkholes and the Natural Arch all have been identified as forming the Chiquibul Cave **System**.



Detail of Chiquibul Cave System Management Area

The management plan identifies the various threats to the CCS. These threats are highly varied ranging from agricultural activities, fires, illegal logging, wild life depletion, looting of cultural artifacts to vandalism by desecrating both cultural and geological assets. However, all threats have one common denominator: illegal incursions by Guatemalan villagers commonly referred to as "xateros". Xateros enter Belize to harvest the leaves of the Xaté palm (*Chamaedorea ernesti-augusti*), and while in Belize hardly anything that is edible or otherwise of any value is left untouched. While the activities of these xateros form a direct management issue, they also form a security issue since many xateros are armed and hostile towards Belizean law enforcement. Consequently the management of the principal

conservation targets (Forest Communities, Subterranean Biological Communities, Non-Portable Cultural Objects, Portable Cultural Objects and Geological-Paleontological Features) in some form of other must address the xatero issue.

Other management issues include controlled and uncontrolled visitation and their impacts, but for now these impacts are limited and will remain so as long as the xatero situation has not been resolved.

While the management programs in this management plan deal with topics such as institutional management and strengthening, administration, research and monitoring, cultural and natural resources management, infrastructure management and public use planning, much attention is being paid to the overall national and international awareness of the Chiquibul Cave, its tremendous national importance and potential and of course its troubles. This awareness should ideally lead to the site being nominated as a world heritage site (in conjunction with Caracol and the Chiquibul Forest). Such a nomination and subsequent declaration would strengthen the rationale for managing this first class feature and attraction.

While controlled visitation is a goal that could have the benefit of increasing the public image of the site, for now, it is the conclusion of this management plan that controlled visitation of the CCS initially should be limited to the Natural Arch and the Kabal section of the actual cave and that only on a very limited basis. Other components of the CCS are for now not safe enough to contemplate visitation.

Meanwhile, illegal access to the cave system will remain a serious issue that can only be prevented by physically blocking the cave entrances. However, given the access constraints and current security situation, and financial implications, this is not an option that is explored in this management plan.

Acknowledgements

This document is dedicated to the rangers and staff of Friends of Conservation and Development, who in spite of their numerical, infrastructural and monetary constraints persist in patrolling an unruly area the size of a small nation.

Thanks are due to Rafael Manzanero (FCD), Jaime Awe (IA) and Natalie Rosado (TNC) who were the motors behind this effort. While recognizing their role, the preparations leading to this document would not have been possible without the input of numerous stakeholders (in its broadest sense). Special mention in this sense need: Gliss Penados, Derric Chan, Allan Cob, Cory Holliday, Alex Wyss and David Larson.

Acronyms

ALIDES	Regional Alliance for Sustainable Development
APAMO	Association of Protected Area Management Organizations
BACONGO	Belize Alliance of Non Government Organizations
BATSUB	British Army Training Support Unit Belize
BDF	Belize Defense Force
BECOL	Belize Electricity Company Ltd.
BERDS	Biodiversity and Environmental Resource Data System for Belize
BF	British Forces
BNR	Bladen Nature Reserve
BTFS	Belize Tropical Forest Studies
CAP	Conservation Action Plan
CAR	Caracol Archaeological Reserve
CBWS	Cockscomb Basin Wildlife Sanctuary
CCAD	Central American Commission for Environment and Development
CCS	Chiquibul Cave System
CEPF	Critical Ecosystem Partnership Fund
CFAC	Chiquibul Forest Advisory Council
CFMC	Chiquibul Forest Management Council
CFR	Chiquibul Forest Reserve
CI	Conservation International
CMM	Chiquibul - Maya Mountains
CMMKBA	Chiquibul/Maya Mountains Key Biodiversity Area
CNP	Chiquibul National Park
CONAP	Comisión Nacional de Áreas Protegidas
CRFR	Columbia River Forest Reserve
CSO	Central Statistical Office
FD	Forest Department
FCD	Friends for Conservation and Development
GEF	Global Environmental Fund
GIS	Geographic Information System

GOB	Government of Belize
GPD	Geology and Petroleum Department
GPS	Global Positioning System
ha	Hectare
IDAEH	Instituto de Antropologia e Historia
IA	Institute of Archaeology
IPCA	Indigenous Peoples' Conservation Association
IUCN	World Conservation Union
MBCP	Mesoamerican Biological Corridor Programme
MMM	Maya Mountains Massif
MPRFR	Mountain Pine Ridge Forest Reserve
NGO	Non Governmental Organization
NHM	Natural History Museum London
NICH	National Institute of Culture and History
NPAC	National Protected Areas Commission
NPAP	National Protected Areas Policy
NPAS	National Protected Areas System
NPASP	National Protected Areas System Plan
OAS	Organization of American States
PA	Protected area
PARCA	Plan Ambiental de la Región Centroamericana
PLC	Pine Lumber Company Ltd.
SICAP	Central American System of Protected Areas
TNC	The Nature Conservancy
UNDP	United Nations Development Programme
UTM	Universal Transverse Mercator
WCPA	World Commission on Protected Areas
WCS	Wildlife Conservation Society
YEAG	Youth Environmental Action Group
XMET	Xibalba Mapping & Exploration Team

1. Introduction

1.1 Background and Context

The Chiquibul Cave System (CCS), is the longest and largest known network of caves in Central America. Over 55 km of passages have been mapped and surveyed, including the largest known passage and cave room in the Western Hemisphere. The CCS is located within the Chiquibul National Park, whose dimension consists of over 264,000 acres in the Cayo District forming a vital part of the Chiquibul-Maya Mountains Key Biodiversity Area. It is a vast broadleaf forest, not only with populations of many endangered species, but also numerous Geological and Archaeological features such as ancient Maya Sites, Caves and Sinkholes. The CCS, due to its extent and integrity represents one of those unique and prestigious cultural features of the Chiquibul forest worthy of national importance.

Figure 1-1. Chiquibul Cave: Entrance of the Kabal System (©Jan Meerman)

This huge cave system is the underground passage of the Chiquibul River. The system consists of four big caves and numerous sinkholes, which were extensively explored during the last 30 years. These caverns are known as Kabal, Tunkul, Cebada, and Xibalba.

A management plan for the Chiquibul National Park has recently been finished (Salas & Meerman, 2008) and this management plan calls for a stand-alone Management Plan for the Chiquibul Cave System. This document represents the first management plan for this unique karstic ecosystem prepared with the assistance of the Institute of Archaeology (IA), Friends for Conservation and Development (FCD) and The Nature Conservancy (TNC).

DESCRIPTION OF THE CHIQUIBUL CAVE SYSTEM

(From Reddel & Veni, 1996)

Each year, about 2.5 m of rain falls on the noncarbonate rocks of Belize's Maya Mountains and flows west toward the karstic Vaca Plateau. The resultant Chiquibul River goes underground about 1 km before reaching the Chiquibul System's Kabal Cave Group, which consists of a series of large, former stream passages that occasionally transmit flood overflows and intersect the underground Chiquibul River in one passage for about 150 m. The upper end of Kabal holds ponded floodwaters with large, washed-in rotting trees and organic debris. Downstream the system holds less water and organic material because fewer collapses intersect the cave. Passages in the cave are generally 10-60 m wide and 10-30 m high.

The downstream end of the Kabal Group is truncated by a valley which is a 1.2-km-stretch of collapsed passage that ends at the entrance of 12-km-long Actun Tunkul. Tunkul is also a former conduit for the Chiquibul River and is only seasonally flooded. With the exception of some short side passages, the cave is a large single passage averaging 40-50 m wide by 20 m high, enlarging in the Belize Chamber to more than 200 m in diameter. Approximately 1 km into the cave, a perennial stream enters from a side passage. In addition, minor seeps occur along the main passage walls. Most of the floor is a thick deposit of sand and silt laden with organic debris. The cave ends in a deep sump about 500 m from the upstream end of Cebada Cave.

The entrance to Cebada Cave is 1.5 km east of the Guatemalan border at the base of a deep collapsed sinkhole, like the other caves of the Chiquibul System. The cave contains the full flow of the underground Chiquibul River, which averages 2-4 m wide and 1-2 m deep, with a baseflow of about 2 m^3/s. Annual stream rises greater than 20 m are not unusual, and large amounts of organic debris often enter the cave. The river is flanked by large banks of sand, silt, and some breakdown. Some pools amid the silt banks contain a dark red alga. Upstream, the cave extends south, then east for over 4 km to a large collapse. The passage is similar to Actun Tunkul but has more side passages and the side passages tend to be longer. The Chiquibul River emerges from the breakdown, and a 2-4 m diameter upper level passage intersects the river 1.1 km upstream near Tunkul. Downstream from the Cebada entrance the river flows about 2.2 km and sumps just before reaching Guatemala. An overflow passage exits to the 500-m-diameter collapsed "Zactun" sinkhole just inside Guatemala, and a large, well-decorated passage intersects the main passage far above flood levels.

The resurgence segment of the cave system is Xibalba. The Chiquibul River enters the cave through breakdown near a collapse-formed "Middle Entrance," and flows down the 2.3-kmlong main passage, which averages 70-100 m wide by 30-50 m high. The river discharges from breakdown into a surface river below Xibalba's 200-m-wide by 80-m-high main entrance. Two other significant passages also occur in the cave. One is a dry, upper level, 30-m-wide by 20-m-high passage that extends north from the main entrance for 750 m. The other begins at the Zactun sinkhole and extends as a series of lakes for nearly 3 km to the upstream end of the main passage.

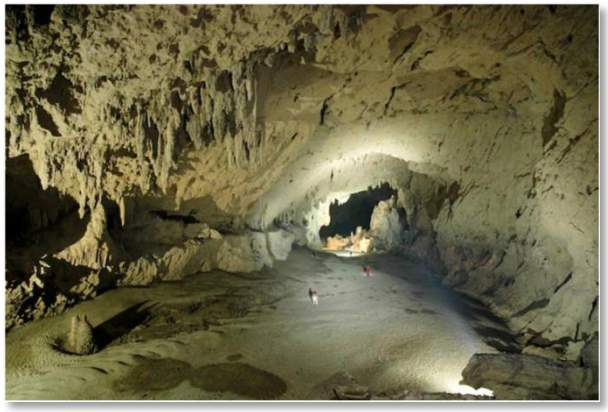


Fig. 1-2. Kabal System: The first 200 meters of the Sand Passage looking west. ©David Larson, May 2008.

Fig. 1-3. Kabal System: A telephoto view from the same location looking west. ©David Larson, May 2008.

Fig. 1-4. Kabal System: The second 200 meters of Sand Passage, looking east toward the main entrance. ©David Larson, May 2008.

Fig. 1-5. Kabal System: The first 200 meters looking east. ©David Larson, May 2008.

Apart from the many Geological Features of which the Chiquibul Cave System is only one, the Chiquibul Forest is home to numerous rare and endangered species, including Jaguar (*Panthera onca*), and Scarlet macaw (*Ara macao*). The area is subject to multiple, ongoing human activities, including illegal activities. Through a co-management agreement, Friends for Conservation and Development (FCD), a non-governmental organization based in San Jose Succotz in the Cayo District, has the legal mandate to assist the Forest Department in putting in place a viable management system for the National Park. And on January 30, 2008, FCD entered into a co-management agreement for the Chiquibul Cave System with the Institute of Archaeology.

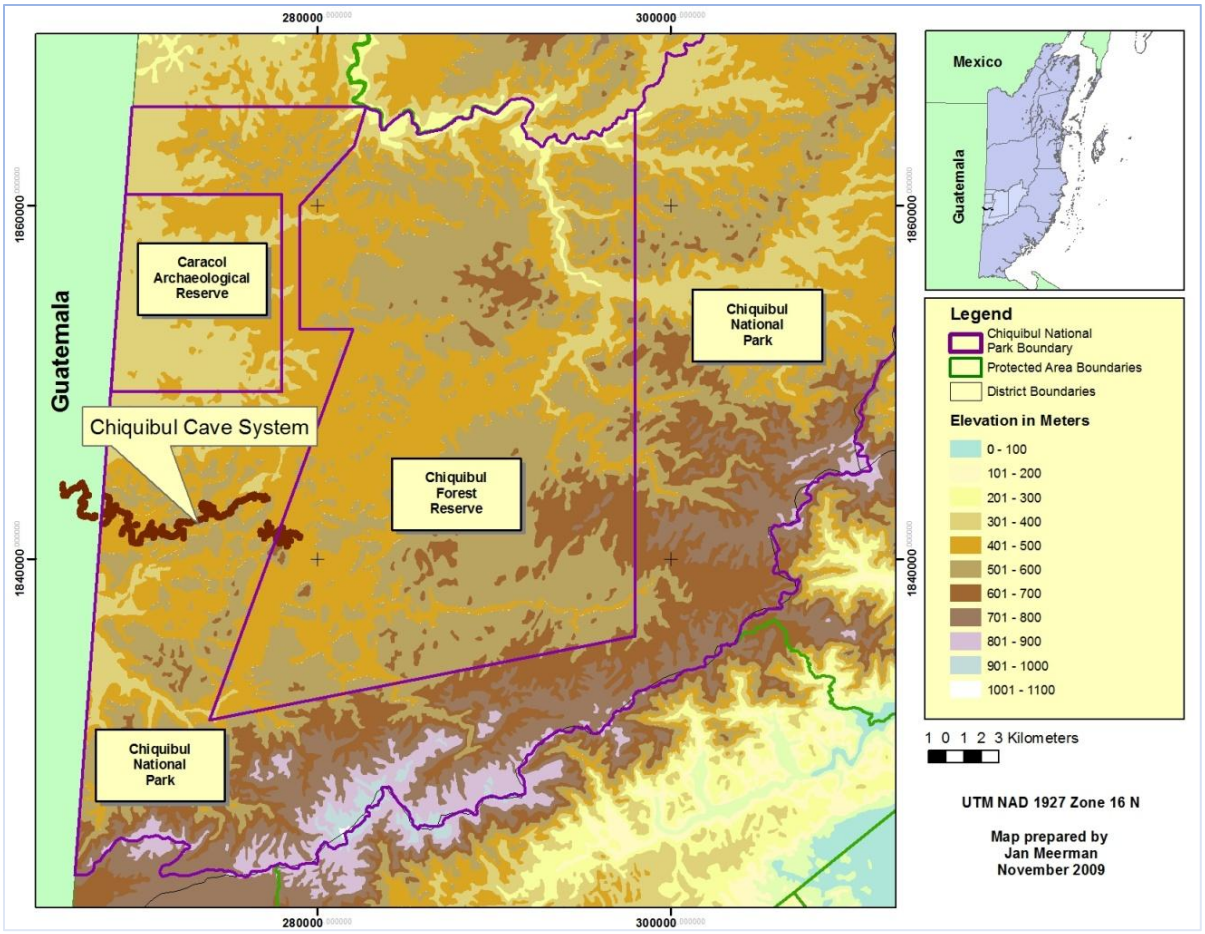


Figure 1-6 - The Chiquibul Cave System and the Chiquibul Forest Area

This CCS Management Plan has been submitted to the Forest Department and the Institute of Archaeology for review and approval as required by the National Parks System Act, which is the legislation that was used to declare the Chiquibul National Park, and under the provisions of the Co-Management Agreement between FCD and the Forest Department and the Institute of Archaeology. It must be noted that the Forest Department has jurisdiction over the Chiquibul National Park and the Chiquibul Forest Reserve, as provided by the Forests Act and the National Park Systems Act. Meanwhile the Institute of Archaeology has not only jurisdiction over the Archaeological Reserves such as the Caracol Archaeological Reserve, but also over any Cultural and/or Historical site [including the CFR] as provided by the National Institute of Culture and History Act, Chapter 331 of 2000 (Revised 2003) of the Laws of Belize.

1.2 Purpose and Scope of the Management Plan

The purpose of this document is to provide a five year management plan for the Chiquibul Cave System with the participation and endorsement of principal stakeholders [Institute of Archaeology, Forest Department and Friends for Conservation and Development, Bull Ridge, BDF and Police].

The Chiquibul Forest (which incorporates the Caracol Archaeological Reserve, Chiquibul Forest Reserve and the Chiquibul National Park), has been facing a variety of anthropogenic pressures and threats with varying degrees of intensity. The area is subject to multiple, ongoing human activities, which have caused major impacts on its wildlife and other natural resources, as well as on its cultural resources. There have even been cases of assaults on visitors, thereby undermining the tourism potential of the area.

This Management Plan has been formulated to guide the management and conservation of the Chiquibul Cave System over a five year period (2010-2015), starting off in January 2010. The Plan is based on an adaptive management framework which lists various management programs, strategies and actions that, when implemented, will address the multiple stresses that impact on the CCS. The Plan will also take advantage of the numerous opportunities that exist for strengthening the management of the CCS, and will set the stage for long-term financial and business planning geared at supporting the implementation of the management strategies and actions.

Most importantly, the Management Plan is based on the premise that the management of the CCS must be rationalized within the 2009 Chiquibul National Park Management Plan, and as such fits within the broader management needs of the Chiquibul Forest as a whole. Although the CCS is a management unit within the Chiquibul National Park, it does cross over into the Chiquibul Forest Reserve and efforts must be taken to work towards a management regime that considers the entire Chiquibul Forest area as an ecological unit, with the CCS, Caracol, CFR, and CNP playing integral roles.

The Management Plan also recognizes that the Chiquibul Forest itself forms part of an even larger ecological unit – which includes the Maya Mountains Massif (MMM) and the Reserva de la Biósfera Montañas Mayas/Chiquibul in Guatemala. This Greater Chiquibul/Maya Mountains Region, which spans both sides of the Belize-Guatemala border, and for its largest part, forms the headwaters of the Belize River watershed. This bi-national area is the largest and most important watershed in Belize, providing and supporting multiple functions such as a reservoir for biodiversity, drinking water, hydro power, agriculture, and recreation opportunities, among others. The Greater Chiquibul/Maya Mountains Region also provides opportunities for the development and utilization of non-renewable resources while taking care not to undermine the fragile ecological integrity of the area.

Vision:

To promote, conserve and protect the biological, geological, and cultural environments of the internationally recognized and unique Chiquibul Cave System in a sustainable manner for Belize and the world.

This Management Plan continues the integration of the CCS/CNP within the larger Maya Mountains Massif, and for the coordination of management efforts among all the Maya Mountain Massif stakeholder agencies. The entire planning process was guided by the National Management Plan Framework developed under the National Protected Areas System Plan project (2005), and is cognizant of specific recommendations provided by the Maya Mountain Massif assessment exercise recently finalized for the Forest Department (Wildtracks, 2008).

Much information on the pressures and challenges facing the Chiquibul Cave System has been compiled by FCD (and its predecessor – Youth Environmental Action Group) through the countless field expeditions that these organizations have conducted into the area over the last fifteen years. Over this same period, numerous scientists have conducted multiple and diverse archaeological, biological and geological studies. However, as has been noted, there has never been a management plan in place for this important cave system until now.

This Management Plan is the outcome of a series of Conservation Action Planning (CAP)[1] planning sessions which were held on June 17-19 and September 23-25, 2009 as well as a number of field visits (June, 14-16 and September 20-22). These CAP sessions were conducted by Alex Wyss (TNC) in cooperation with the consultants. These planning meetings included the participation of representatives of the core institutional stakeholder agencies of the Chiquibul Forest, such as the Forest Department, the Institute of Archaeology, and FCD as well as other stakeholders such as the BDF, Belize Tourism Board (BTB) and past researchers of the CCS.

Many scientific research reports and biodiversity data were compiled through an extensive literature search and review, and later analyzed (see Section 7 - References).

As indicated before, this Management Plan intends to be consistent with the approach recommended by the Maya Mountains Massif (MMM) Conservation Action Planning process and the subsequent CNP management plan (Salas & Meerman, 2008; Wildtracks, 2008).

[1] CAP is a collaborative, science-based framework that helps practitioners to focus their conservation strategies on clearly defined elements of biodiversity or conservation targets and fully articulated threats to these targets and to measure their success in a manner that will enable them to adapt and learn over time. The CAP process accomplishes this by prompting a conservation team to work through a series of diagnostic steps that culminate in the development of clearly defined objectives and strategic actions. Together these represent a testable hypothesis of conservation success that forms the basis of an "adaptive" approach to conservation management (TNC, 2007).

1.3. Delineation of the Chiquibul Cave System

Since the Chiquibul Cave System is not a declared protected area in itself (even though, as a cave, it is automatically protected within the IA mandate), there is no delineated boundary. For the purposes of management, boundary delineation is important. Several options were discussed during the CAP planning sessions and based on these discussions the following rationale was followed to delineate management boundaries:

1) Include as much as possible of the Chiquibul River sub-watershed. With the boundaries of this watershed uncertain, a best guess approach is unavoidable (fig 1-7).
2) It is not realistic to include the whole Chiquibul River sub-watershed.
3) Include the Natural Arch in the management area.
4) Include principal sinkholes in the Management area
5) Incorporate as much as possible zonation recommendations in the CNP management plan
6) The CNP management plan created a buffer of 1 mile along the (what was then assumed to be the) CCS.
7) The 1 mile buffer is OK, but is impractical in the field.

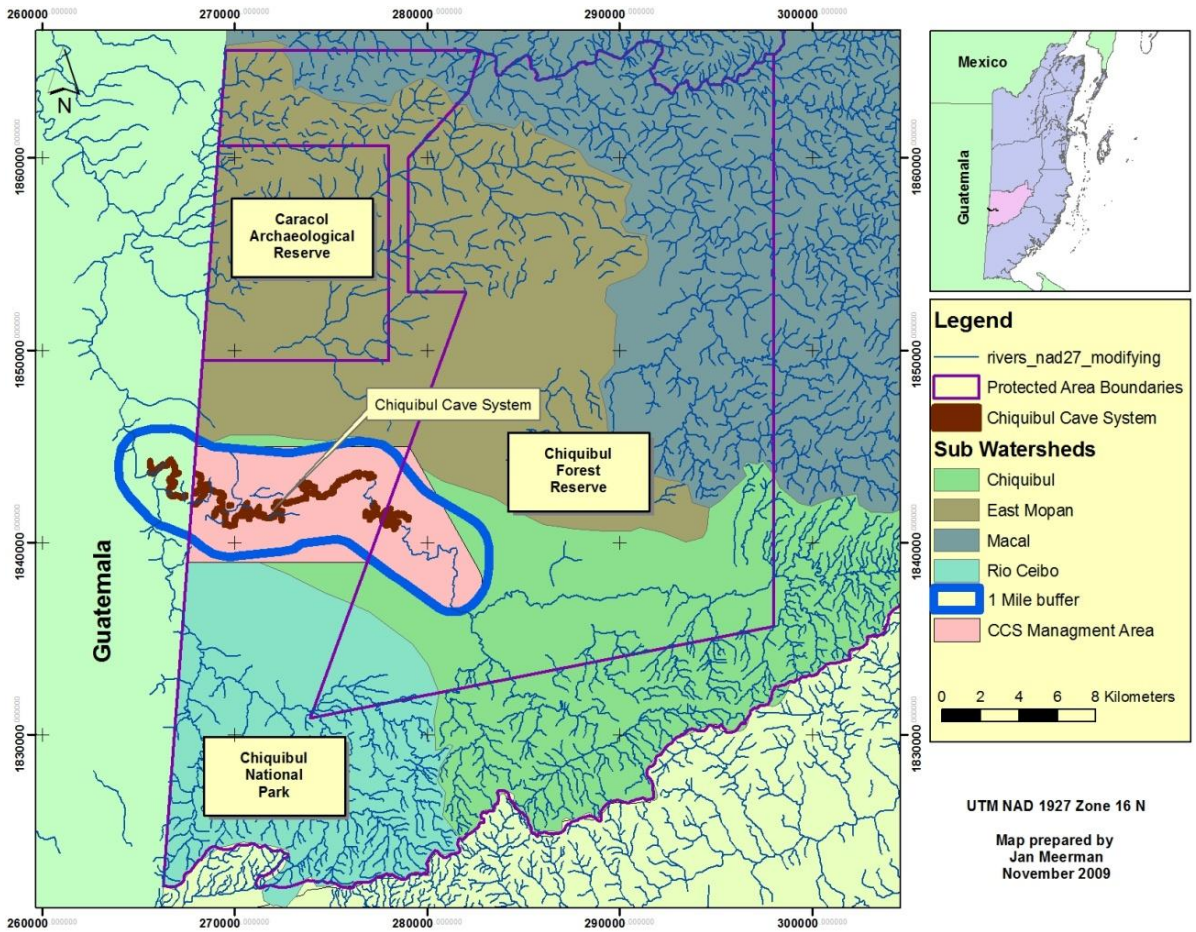


Figure 1-7. The Location of The Chiquibul Cave System With Sub-Watersheds Indicated.

Figure 1-7 shows the various sub-watersheds, the 1 mile buffer as used in the CNP management plan and the resulting CCS management area in pink. For easy management in the field, the northern boundary (inside the CNP) is at UTM Northing 1,845,000 and the southern Boundary (again within the CNP) is at UTM Northing 1,839,000.

Figure 1-8 below shows the CCS management area in greater detail. For obvious reasons, the Guatemalan portion of the CCS is not included in the Management Area.

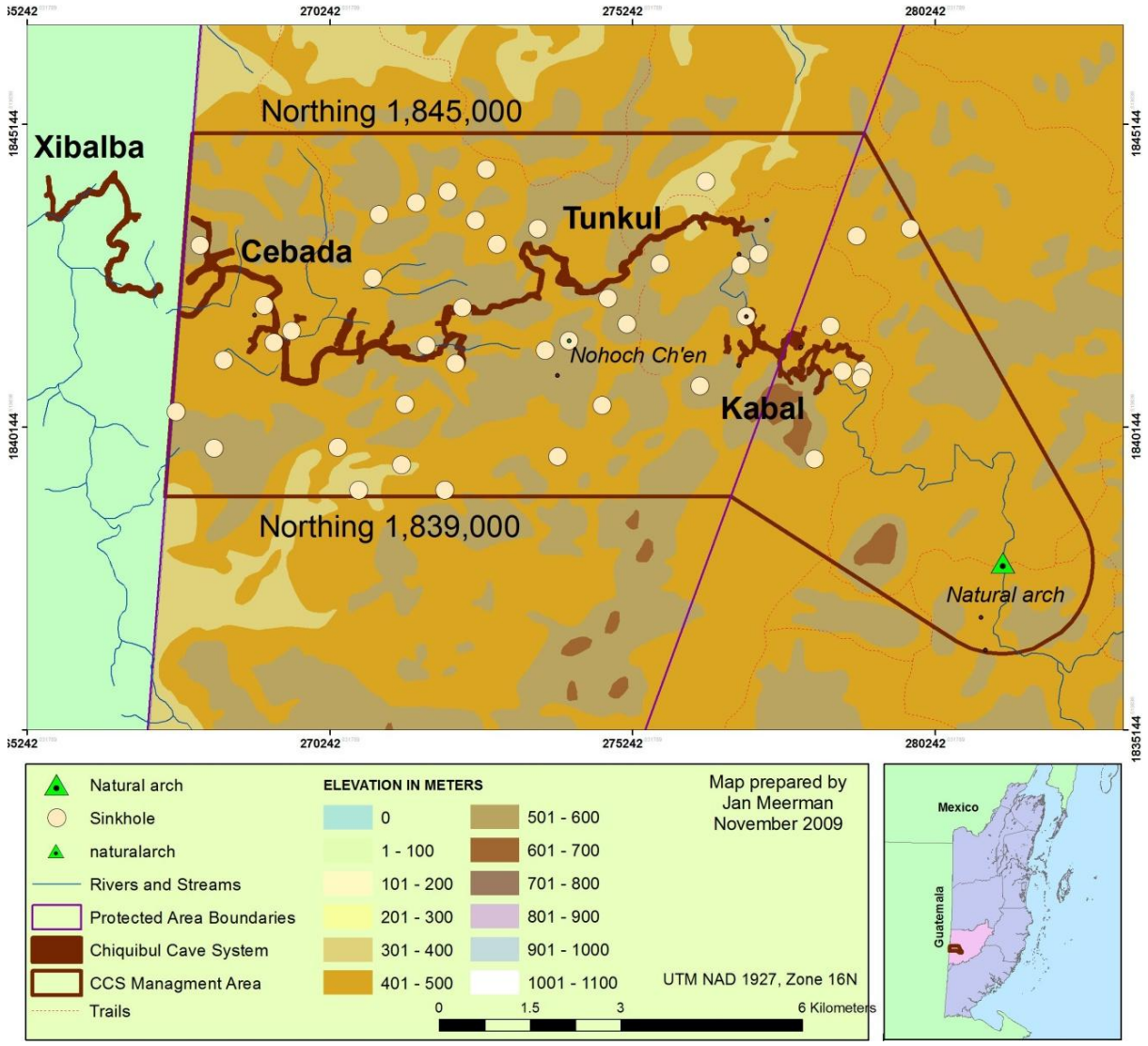


Figure 1-8. Detail of Chiquibul Cave System Management Area

2. Current Status

2.1 Location

The Chiquibul Cave System is largely situated within the Chiquibul National Park (CNP), which is a 106,838 ha (264,003 acres)[1] protected area located in the Central American country of Belize, a country consisting of 22,966 km² (8,867 sq. miles) of tropical forest, savanna, mangrove, and wetlands. With a population of just over 300,000 (CSO, 2007), 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, and with the Belize Barrier Reef running parallel along with the coastline for the entire length of the country.

The Chiquibul Cave System is approximately located between UTM coordinates[2] 1,845,000 – 1,839,000 North and 265,000 – 282,000 East. This location puts it across the Belize Guatemala Border and within Belize it straddles both the Chiquibul Forest Reserve and the Chiquibul National Park. These protected areas in their turn are part of a block of protected areas known as the "Maya Mountains Massif" or more simply just "Maya Mountains". While all these protected areas are part of the larger Maya Mountains block of protected areas and essentially form one ecological entity, this block is essentially split in two by the Maya Mountain Main Divide and for access and management purposes, the CNP forms part of the "Chiquibul Forest" which also includes the Chiquibul Forest Reserve (59,822 ha – 147,823 acres) and the Caracol Archaeological Reserve (10,339 ha – 25,549 acres). Ecologically, the Chiquibul Forest clearly forms a single entity and all boundaries within there are artificial (see Figure 2).

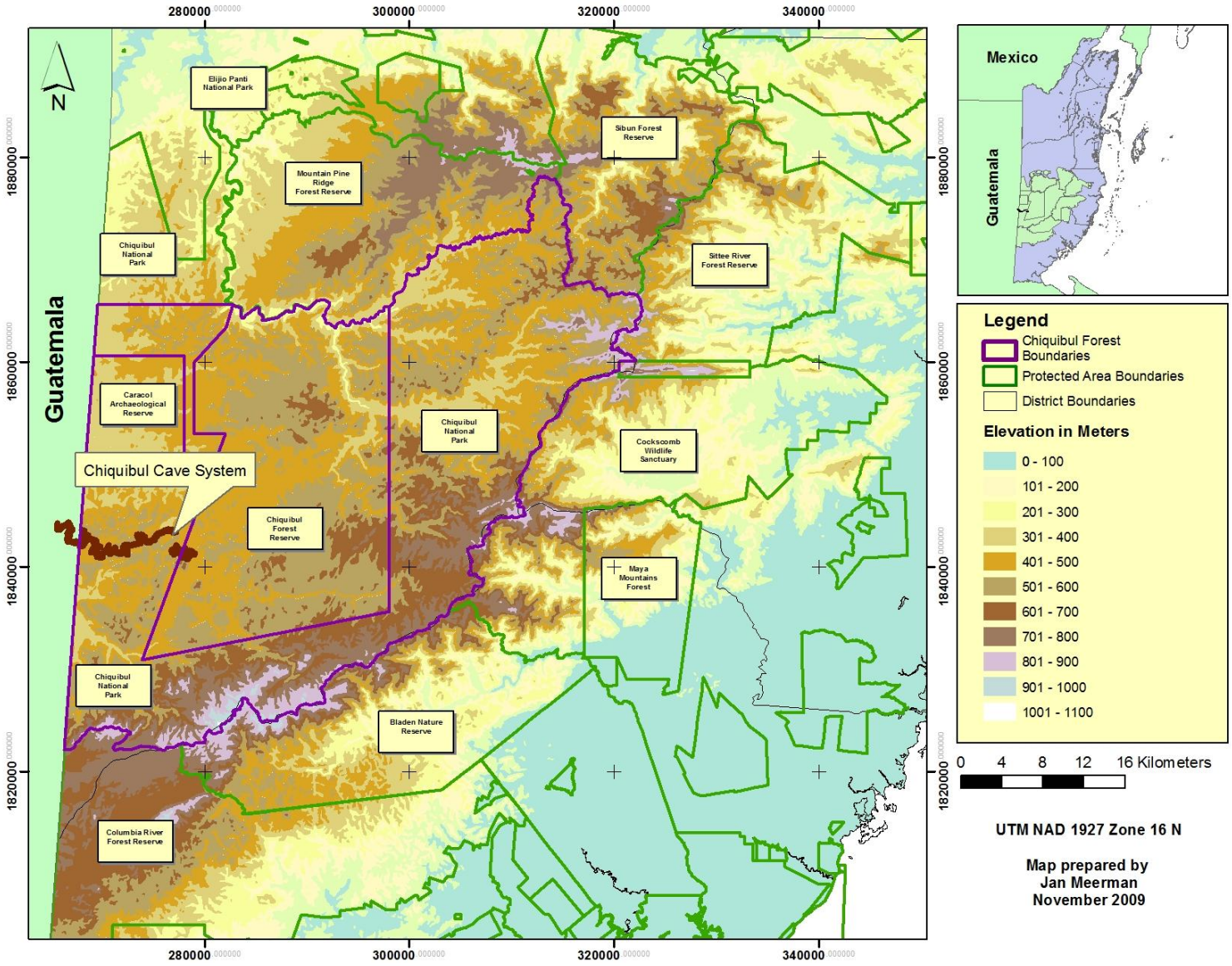
The Maya Mountains were formed by geological uplifting that formed during the Cretaceous period some 70-100 million years ago and consist of granitic, sandstone, volcanic and limestone elements. The highest point of the Maya Mountains is known as "Doyle's Delight" or "Kaan Witz" with an elevation of 1,124 meters and is located on the CNP boundary with the Columbia River Forest Reserve. The elevation range within the CCS management area varies between approximately 400-600 m.

Some of the most conspicuous elements are formed by the limestone geology which is heavily karstified as expressed by steep terrain, limited surface water, numerous sinkholes and many caves of which the Chiquibul Cave System is the current focus of our attention.

Vehicular access into the CCS is effectively limited to one road that comes from the Mountain Pine Ridge and crosses the Macal River at the Guacamallo Bridge. From there on, most of the access "roads" are really logging trails located within the CFR, the CNP itself having very few all-weather roads and trails. There is a complex system of trails into the CNP created by Guatemalans located along the border.

[1] Based on GIS measurements
[2] NAD 1927, zone 16 N.

Figure 2-1. The Chiquibul Cave System in the Context of the CMM Area



2.2 Regional Context

The Chiquibul Cave System 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. The combination of North American, South American and Caribbean elements provides for a unique assemblage of plants and animals which has resulted in a particularly rich biodiversity – with 8% of the world's known plant species, and 10% of its vertebrates.

For the above reason, the Critical Ecosystems Partnership Fund (CEPF) has recognized the Chiquibul Forest as part of a tri-national bioregion forming the largest remaining contiguous block of tropical forest north of the Amazon making it part of the Chiquibul/Maya Mountains Key Biodiversity Area (CMMKBA).

The protection of the CCS and it surrounding area, the CNP, fits within the Central American Environmental Agenda - Plan Ambiental de la Region Centroamericana (PARCA) out of which the Central American Commission for Environment and Development (CCAD) was created in 1989. The Government of Belize is a member of this Commission, as well as a signatory of 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). One of the programmes supported by the Regional Alliance for Sustainable Development is the Mesoamerican Biological Corridor Programme (MBCP). This regional program has been implemented in recent years, establishing corridors of natural vegetation throughout Central America (however with the exception of Belize) 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.

While Caves are common within the karst areas of Belize and Guatemala, they are rarely recognized as conservation objects in their own right. Instead they are more typically seen as a component of their surrounding ecosystems.

The CNP is within one of eleven priority areas highlighted under the Sistema Centroamericano de Areas Protegidas (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 while recognizing it as a Transboundary Protected Area for Peace and Conservation (WCPA, 2001).

Within the MBCP, the CNP performs an important "node" function (Herrera et al. 2002), but the link with the Guatemalan side of the Maya Mountains is quickly being lost as part of the expanding agricultural frontier in that country. Currently CNP remains a vital component of the Biological Corridor linking Belize with protected areas in the Northern Petén and in Southern Mexico (Meerman et al, 2000; Ramos, 2004) (see Figure 2-2).

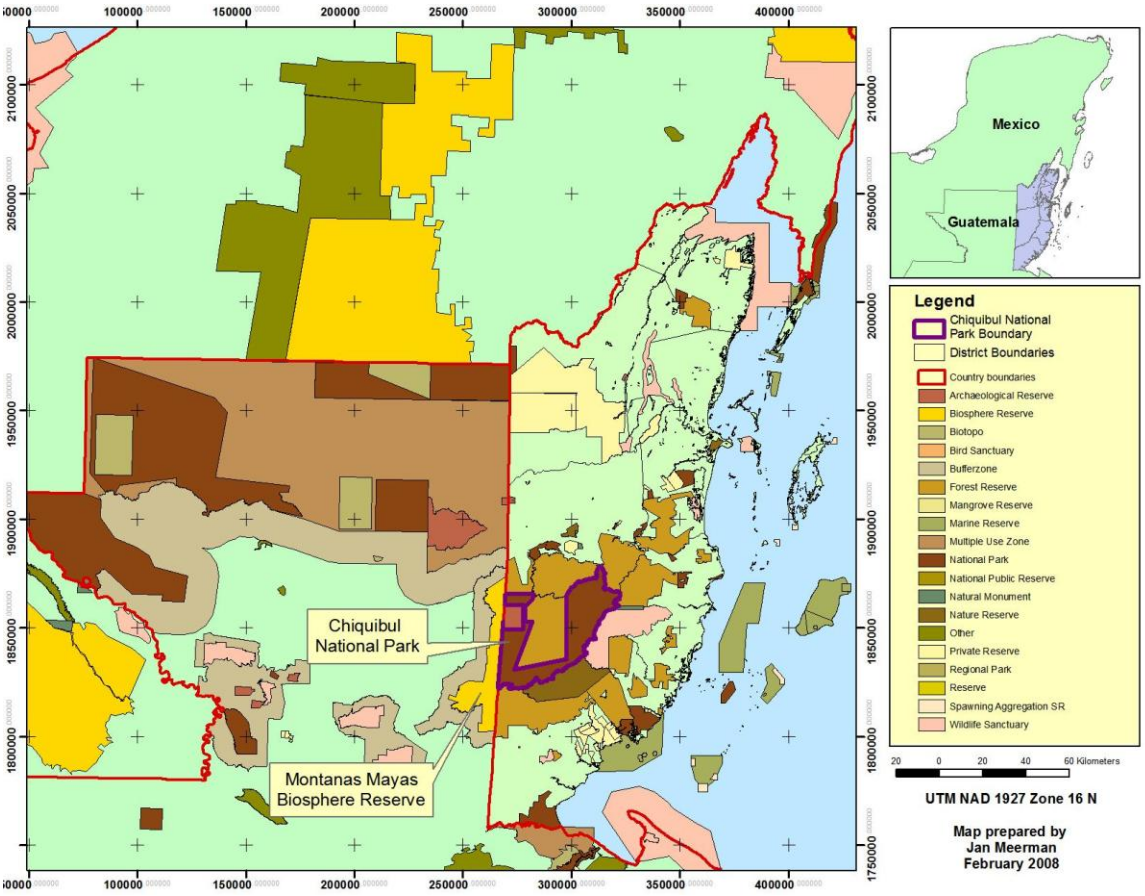


Figure 2-2. The Chiquibul NP in Relation to Protected Areas in the Region

2.3. National Context

The Belizean network of protected areas is extensive; covering approximately 26% of the national territory (see Figure 2-3). A total of 96 protected areas have been gazetted. When taken separately, these protected areas amount to approximately 37% of the country's terrestrial area and 14% of the marine territory. Belize's protected areas contribute to the historical, cultural and ecological significance of the Maya Forest Region and connect the last remaining forests in Petén, Guatemala, to the forests of Calakmul, Mexico (NPASP, 2005). The protected areas system of Belize is also integral to the maintenance of the Mesoamerican Biological Corridor (MBC), which is comprised of a network of protected areas linked by biological habitat corridors, stretching from México to Panama (NPASP, 2005). Furthermore, Belize's marine protected areas form an integral part of the Mesoamerican Barrier Reef System, which extends from the southern half of the Yucatan Peninsula to the Bay Islands of Honduras and includes the second longest barrier reef in the world. This extensive protected areas network has in great part supported Belize's tourism industry, which has become a mainstay of the economy.

Only 12.81% of Belize's land territory has been declared as conservation zones that do not allow extraction of natural resources. These conservation zones include the four protected area categories under the National Parks System Act – national parks, nature reserves, natural monuments, and wildlife sanctuaries. The Chiquibul National Park is the single

largest protected area of Belize, and comprises 29% of the terrestrial conservation zone of the country, and nearly 5% of Belize's land area. It needs mentioning that the Chiquibul Cave System is not a declared Protected Area, but rather a management entity falling within both the Chiquibul National Park (conservation management) and the Chiquibul Forest Reserve (Natural Resource Management area).

Figure 2-3 - Terrestrial Protected Areas

Of the remaining land areas under protection, 71% is open for managed extraction (such as logging operations) – these areas are the forest reserves. There are six forest reserves adjacent to the Chiquibul National Park – these include the Chiquibul Forest Reserve, the Mountain Pine Ridge Forest Reserve, the Vaca Forest Reserve, the Sibun Forest Reserve, the Sittee River Forest Reserve, and the Columbia River Forest Reserve (see Figure 2-1). The Chiquibul Forest Reserve is wedged between the Chiquibul National Park and the Mountain Pine Ridge Forest Reserve. The Forest Reserves are really areas for the management of extractive resources. Three conservation zones are adjacent to the Chiquibul National Park – Bladen Nature Reserve, Cockscomb Basin Wildlife Sanctuary, and Victoria Peak Natural Monument. The Caracol Archaeological Reserve lies within the Chiquibul National Park, just south of the Vaca Forest Reserve, and is bounded by the Guatemalan border on the west. Currently, there is one active timber harvesting license (Bull Ridge) operating within the Chiquibul Forest Reserve.

Caves as such do not form a specific focus within the National Park Systems Act, neither are they a focus in the National Protected Areas Systems Plan in which they are grouped under "Unusual features of aesthetic or cultural importance". They are however a focus of the Institute of Archaeology which has not only jurisdiction over the Archaeological Reserves, but also over any other Cultural and/or Historical sites as provided by the National Institute of Culture and History Act, Chapter 331 of the Laws of Belize. In here, however they are considered rather strictly within their context of their ritual importance for the ancient Maya and less as geological or scenic features.

2.3.1 Policy Framework

Sparked by an incisive and critical ex-post project evaluation report of a UNDP/GEF co-

management project, the Ministry of Natural Resources appointed a Task Force in 2003 and mandated it to create a national overarching policy for protected areas management and an implementation plan for the overall protected areas system in Belize[3]. Led by this Task Force, the GOB and its local non-governmental and international partners engaged in a national consultation process and a series of extensive studies during 2004-2005 to prepare a policy and strategy for its national system of protected areas.

In November 2005, this planning process culminated with the production of over 20 reports, which led to the preparation of Belize's National Protected Areas Policy and System Plan. The National Protected Areas Policy (NPAP) was subsequently endorsed and accepted by the GOB in November 2005, and the National Protected Areas System Plan (NPASP) was endorsed and accepted in January 2006. A multi-stakeholder National Protected Areas Commission (NPAC) was established in late 2007 to oversee the implementation of the NPASP.

The National Protected Areas Policy (NPAP) is the key statement on the role and management of protected areas. This policy aims to guide the establishment, management and administration of protected areas (terrestrial and marine) in Belize, and to create a National Protected Area System in which all important sites are included in one coherent framework and meet all obligations under international agreements to which Belize is a signatory. The NPAP aims for the PA system to: a) be comprehensive, with representative examples of all ecosystems in the country and including areas providing important environmental services, possessing exceptional scenic values[4] and providing critical habitat for species of conservation concern or economic importance; b) be integrated with regional and national approaches promoting biological connectivity (such as the Mesoamerican Biological Corridors Project) and with other national and regional development plans; c) be economically, socially and ecologically sustainable in order to optimize socio-economic benefits derived from the system as far as these are compatible with maintaining biodiversity values and sustainable resource management and ensure the equitable distribution of these benefits and public awareness of their importance; and d) have transparent management geared towards delivery of measurable benefits and emphasize public participation at all levels. This applies to the establishment, management, modification or de-reservation of all the protected areas included in the national network.[5]

While the NPASP as such does not make specific reference to caves, there are no problems in fitting caves into the system and treat them as any other protected area/site even though with specific administrative and management issues.

The National Protected Area System Plan (NPASP) is designed to implement the policy. The plan emphasizes the following strategic actions:

a) establish a National Protected Areas Commission to ensure coordinated action in PA system development;
b) revise and consolidate protected area legislation in order to give legislative underpinning to the plan;
c) provide support services to protected area managers across the PA system, to enhance management capacity;

[3] BCDL. 2006. Environmental Policy and Advocacy Initiatives in Belize (draft report).
[4] This is where caves fit in.
[5] NPASP 2005

d) secure comprehensive coverage by concentrating attention on gaps in the present network of protected areas; and
e) simplify the existing PA system by consolidating adjacent protected areas into single, multi-zoned, management units[6].

While the Chiquibul Cave System Management Unit appears to deviate from this, overall, this creates a smaller number of sites that are individually more important – indeed some will be of exceptional importance on a regional, even global, scale. Overall the plan aims to create a more effective protected area system that delivers and is seen to deliver tangible benefits yet is more cost-effective and simpler to administer.[7]

The completion of the NPAP and NPASP for Belize's extensive network of protected areas is a significant achievement which establishes a precedent for the Central American and Mesoamerican region.

2.3.2 Legal and Administrative Framework

The administration of the national protected area system is shared by three key government departments (see Figure 2-4). The Forest Department administers protected areas declared under the Forests Act and the National Parks System Act. These areas include most of the terrestrial protected areas and a few marine protected areas. Statutory authority over all the marine reserves declared under the Fisheries Act rests with the Fisheries Department. The Institute of Archaeology, which falls under the institutional umbrella of the National Institute of Culture and History (NICH), is in charge of the archaeological and cultural sites and reserves declared under the National Institute of Culture and History Act of 2000 (Revised 2003)..

The Institute of Archaeology within the NICH is the key agency here, but does not have sole authority over the CCS as discussed in this management plan. As the CCS is a component of the CNP and to a lesser extent also the CFR, the role of the CNP is important here. The Chiquibul National Park was declared under the National Parks System Act, which states the following definition for a "national park":

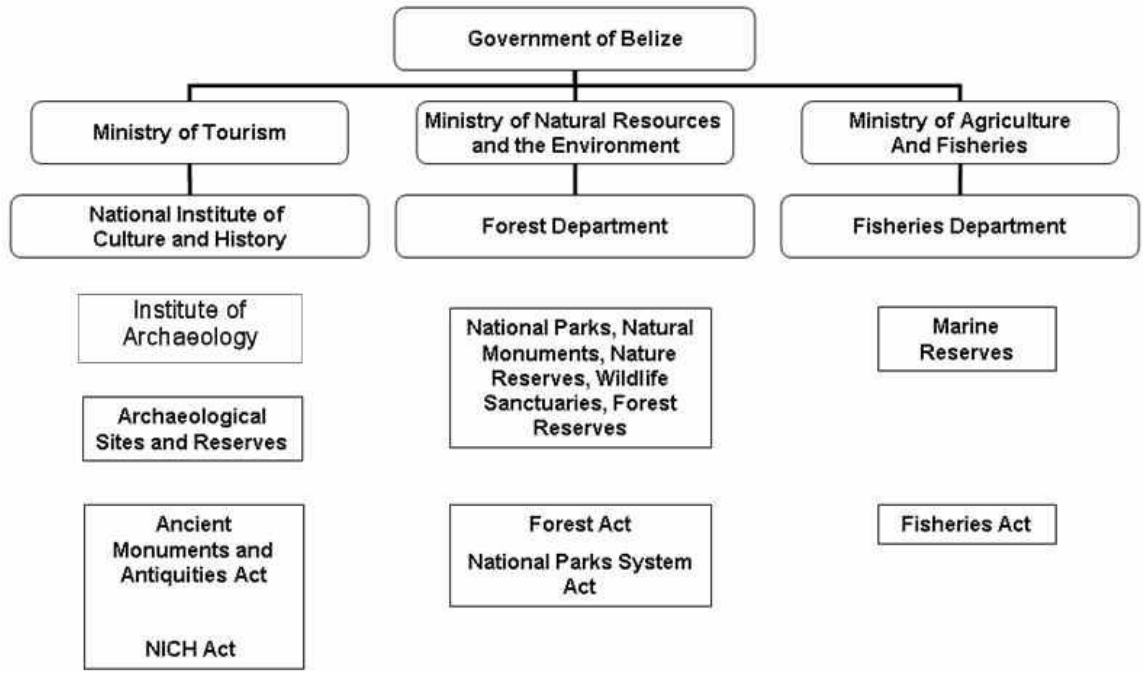
> *"[any] area established ... for the protection and preservation of natural and scenic values of national significance for the benefit and enjoyment of the general public…"*

Under guidelines defined by the World Conservation Union (IUCN), the Chiquibul National Park is a **Category II** protected area, and is defined as follows:

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

[6] Special attention will be devoted to the Belize Barrier Reef System, the Maya Mountain-Mountain Pine, Ridge massif and the north-western forests and now the Chiquibul Cave System.
[7] NPASP 2005

Figure 2-4 - Administrative Framework for the NPAS



The Chiquibul National Park, therefore, was established as an area of core protection, in which all resource extraction activities should be prohibited.

The Forest Department and NICH/IA have over the years entered into collaborative agreements with non-governmental organizations and community-based organizations for the joint management of protected areas – referred to as co-management agreements. Cave examples here include the Chechem Ha Caves, the Actun Tunichil Muknal and the Peccary Hill Caves,

2.3.3 Socio-economic Context

Stakeholder Analysis. Besides the Forest Department, NICH/IA and FCD, a small number of other governmental and non-governmental agencies, as well as private enterprises, are directly or indirectly linked to activities in or near the Chiquibul Cave System. These entities, which are considered the primary stakeholders of the area, can be grouped into five categories of stakeholders: 1) community and resource users, 2) institutional stakeholders, 3) recreation and tourism users, 4) education stakeholders, and 5) private enterprises. Given that the Chiquibul Cave System continues into the east-central Petén region of Guatemala (Reserva de la Biósfera Montañas Mayas/Chiquibul), there are stakeholders on the Guatemalan side as well. The listing below shows the various CCS (de facto) stakeholders listed under these five categories:

Community and Resource Users

- Hunters
- Looters
- Guatemalan Border Communities

Education Stakeholders

- University of Belize
- Galen University
- Dolores Tourism School
- Youth Groups

Institutional Stakeholders

- NICH/IA
- Forest Department
- FCD
- Petroleum and Geology Dept
- Belize Defence Force
- British Forces Training Support (BATSUB)
- Researchers
- Instituto de Antropologia e Historia
- Comision Nacional de Area Protegidas (CONAP)
- Mesa de Recursos Naturales
- Ministry of Foreign Affairs
- The Nature Conservancy
- Protected Areas Conservation Trust
- Critical Ecosystem Partnership Fund (CEPF)
- Guatemalan NGO's
- Guatemalan Embassy

Recreation and Tourism Stakeholders

- Tour operators
- Hotels and Lodges
- Tour Guides
- Astrum Helicopters
- EcoQuest

Private Enterprises

- Bull Ridge Company (PLC Managed)
- Blancaneaux Lodge
- XMET
- Mining Companies

Table 2-1 below provides information on the type of influences or impacts of CCS on each group of stakeholders and vice versa. A "+" sign indicates that the influence or impact is positive, while a "-" sign indicates that the influence or impact is negative or detrimental.

Table 2-1 - Stakeholder Analysis for the Chiquibul Cave System

Primary Stakeholders	Influence or impact of CCS on stakeholder		Influence or impact of stakeholder on CCS	
Communities – Guatemala and Belize	• Environmental services • Exclusion from potential hunting area • Exclusion from CNP for cutting logs/posts/leaves, and medicinal plants	+ - -	• Cooperation with conservation objectives • Unsustainable harvesting of xaté • Illegal logging • Hunting • Looting • Garbage	+ - - - - -
Resource users	• Exclusion from potential resources • Exclusion from CNP-CCS for cutting logs/posts/leaves, and medicinal plants	- -	• Security presence • Removal of broadleaf cover • Impacts on wildlife • Increased erosion on steeper slopes	+ - - -
Recreation & tourism users	• Recreation opportunities • Tourism destinations	+ +	• Potential income source • Increased visitor numbers • Vandalism • Garbage pollution	+ - - -
Education stakeholders	• CCS as a living laboratory • Promote national pride	+	• Unregulated education field projects & activities • Molesting of wildlife, geological features and artifacts	- -
Timber and NTFP concessionaires	• Potential income source • Employment for communities	+ +	• Unregulated harvesting activities • Trespass	- -
BDF & BATSUB	• Field training opportunities • Restriction on training due to use of area by other stakeholders	+ -	• Increased security presence • Increased human presence and associated impacts • Increased noise impacts • Molesting of wildlife, geological features and artifacts	+ - - -
Researchers	• Research opportunities	+	• Research findings aiding management • Unregulated research activities • Molesting of wildlife	+ - -
GPD and miners	• Conservation status may be seen as restricting	-	• Road access as a result of nearby mining activities • Access road construction • Access road restrictions • Increased accessibility for hunting, etc. • Pollution and alteration of natural processes on the headwaters • Potential environmental fund	+ - - - - +

There are no permanent settlements around the CCS. FCD maintains a ranger post but this is actually located just inside the CFR. From the Belize side, the CCS is buffered by

protected areas, primarily the CNP and CFR. There are no communities immediately adjacent to the park and there are no communities that have a direct claim on the area. On the Guatemalan side, however, there are many communities that influence the Chiquibul Forest The total number of border communities is approximately sixty-five (65), but FCD recognizes eleven (11) Guatemalan buffer-communities: Monte de Los Olivos, San Jose Las Flores, El Carrizal, Naranjo, Nueva Armenia, Las Brizas de Chiquibul, Centro Maya, San Marcos, Sacul Arriba, Las Flores de Chiquibul and El Rondón. These communities depend on agriculture for their subsistence and livelihood and are increasingly farming on the Belizean side of the international border, even within the CNP where per April 2009, as much as 3,240 ha (8,007 acres) have been impacted[8] (see Figure 2-5).

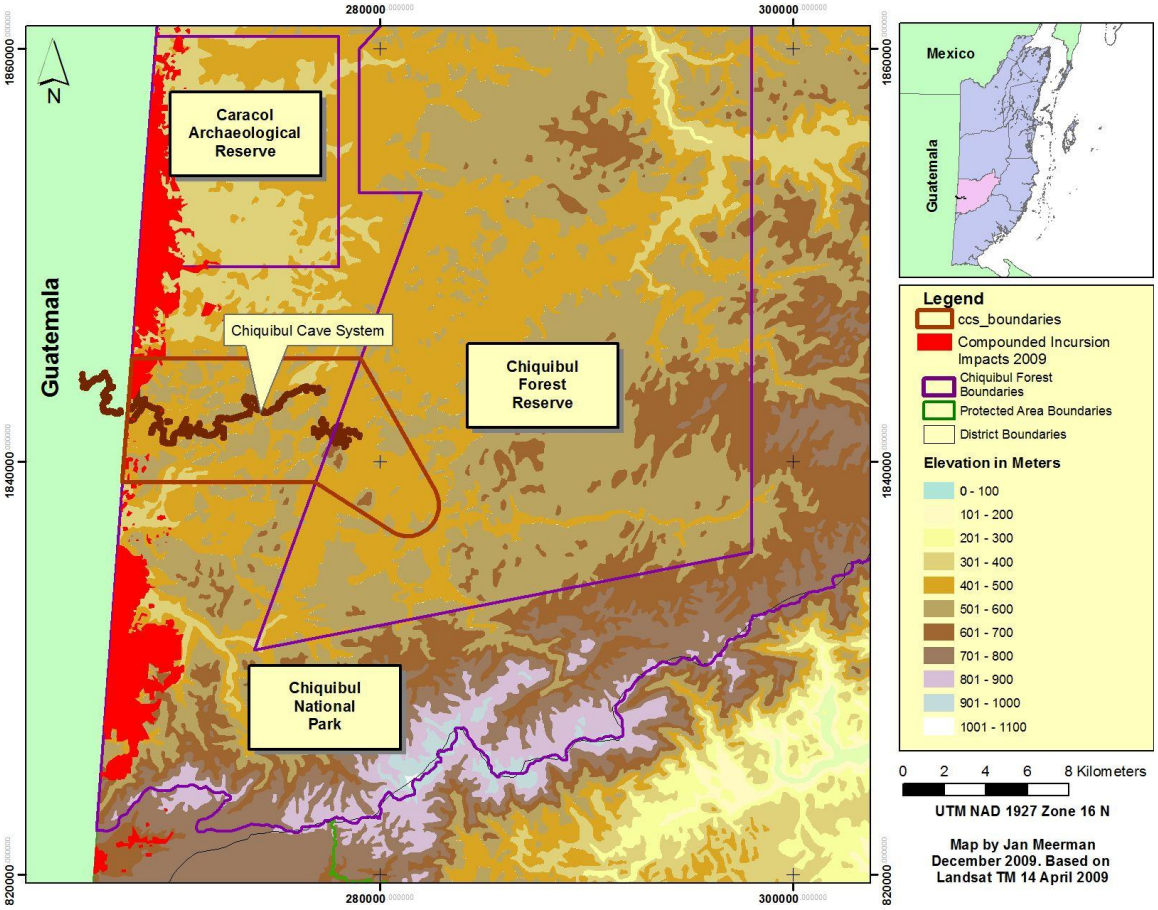


Figure 2-5 – Compounded Impact of Agricultural Incursions into the CNP (April 14, 2009 Status)

The Greater Chiquibul Maya Mountains Area, which spans both sides of the Belize-Guatemala border, forms the headwaters of the Belize River watershed. This bi-national area is the largest and most important watershed in Belize. Within this watershed, the Mopan[9] and Macal sub-watersheds are both located within the Chiquibul Forest, and provide and

[8] Impacts are not restricted to active farming activities, but include abandoned and regenerating farmland as well as forest burned as a result of agricultural fires.

[9] The Chiquibul Cave system has its own Chiquibul sub-watershed which in turn is part of the Mopan sub-watershed. See figure 2-7.

support multiple functions such as biodiversity, drinking water, hydro power, agriculture, and recreation, among others.

The Chiquibul Forest is also extremely important for its mines and minerals potential. Gold prospecting in the Ceibo Chico area of the Chiquibul National Park has been an ongoing activity since the late 1980s, and continues under Boiton Minerals/Erin Ventures Inc. (under Ceiba Resources Ltd.). The first exploration license was issued in 1999, and the operation has been slowly increasing in size since the extension of the exploration license in 2004. The company has held prospecting licenses for four contiguous blocks, covering a total of 34km², and a mining license covering 38.85 hectares (96 acres), which has recently been renewed for another 5 years, and extended in September, 2007, to cover 160.25 hectares (396 acres), to give the mining company mining rights to the total area of alluvial fan associated with the Ceibo Chico drainage system (Wildtracks, 2008). Orion Company is also known to have a long standing concession in the CNP. Figure 2-6 below, which is derived from information received from the Geology and Petroleum Department, shows the extent of mineral exploration licenses issued at one time or another. Table 2-2 gives an overview of the mining potentials in the Chiquibul National Park, Chiquibul Forest Reserve and Caracol Archaeological Reserve (adapted from Wildtracks, 2008).

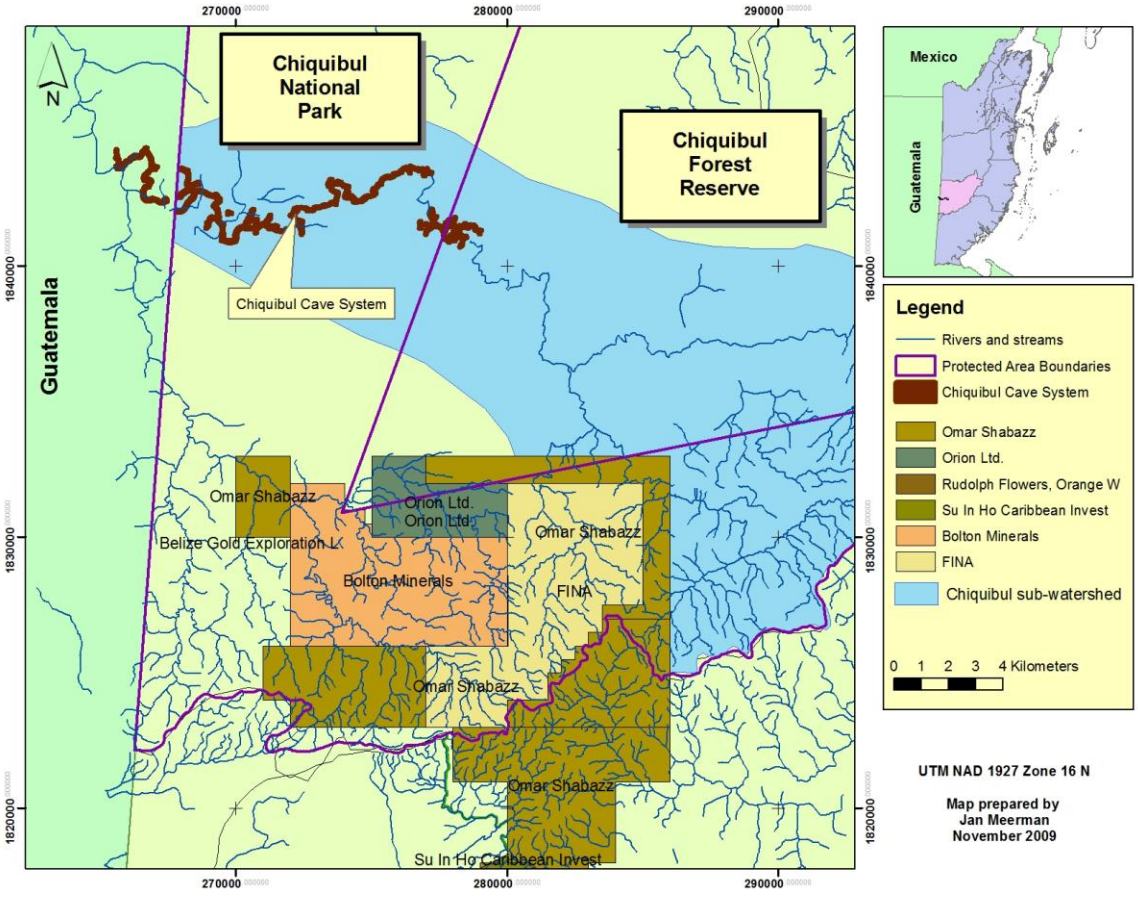


Figure 2-6 Mining interests in the Chiquibul Area

Table 2-2: Mineral potential within the Chiquibul Forest

Protected Area Name	Value	Mineral Resources
Chiquibul National Park	High	All minerals, gold, lead, zinc, base metals, heavy metals…need to be inventoried. Steeper slopes. Intrusions, igneous areas. Lower areas not as interesting.
Chiquibul Forest Reserve	High	All minerals, gold, lead, zinc, base metals, heavy metals…need to be inventoried. Steeper slopes. Intrusions, igneous areas. Lower areas not as interesting.
Caracol Archaeological Reserve	Low	None

2.4 Physical Environment of the CCS

2.4.1 Climate

Belize is a tropical country, but because of its location in the outer tropical geographical belt, there exists a noticeable variation in average monthly temperatures. Also, there exists considerable variation in the monthly amount of rainfall with a dry season from February through May and a wet season from June through January. In addition there exists considerable variation in the annual amount of rainfall in Belize, with the North-east receiving as little as 1200 mm/year (48") and the South-east as much as 4,000 mm/year (160").

Although an automated weather station has recently been installed at the FCD ranger station, no reliable long term weather data exist for the area. Generally it is believed that the Chiquibul falls with the 2000 mm/year (80") zone. But rainfall is likely to increase towards the south and in the higher areas along the Maya Mountain Divide.

The rainy season to an extent coincides with the hurricane season, associated with passing tropical storms – particularly in August, September and October. Hurricanes originate over warm seas, and develop into a cyclonic form that can be very destructive. Hurricanes have periodically caused extensive damage to the Chiquibul in the past century (see table 2-3).

- Un-named 1918: 45 mph (?)
- Anna 1961: 45 mph
- Hattie 1961: 160 mph
- Fifi 1974: 115 mph
- Greta 1978: 135 mph

Table 2-3: Hurricanes Affecting the Chiquibul in the Past 100 Years

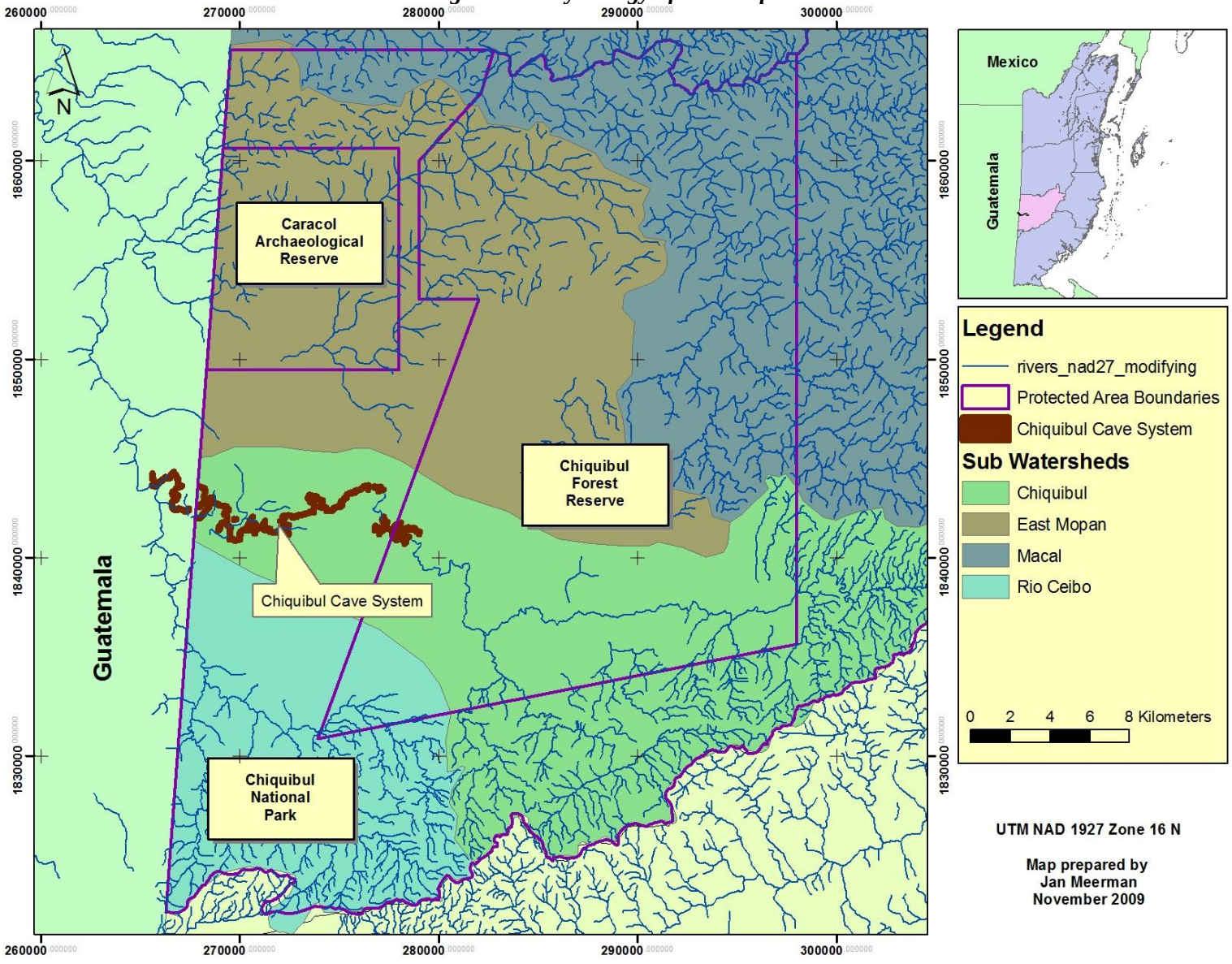
It should be noted that although the Chiquibul is on the leeward side of the Maya Mountains the impact from hurricanes is still substantial.

2.4.2 Hydrology

The CCS is most likely the old (subterranean) course of the Chiquibul River. The present course of the Chiquibul River is currently undocumented but very likely located within the CCS management area. During periods of heavy rainfall, this new course apparently is too small to absorb the flash floods that typically accompany heavy rainfall. Instead, part of these floodwaters is then diverted through the known CCS and flash through the cave system. These flash floods can be quite dramatic as is shown by copious mud deposits near the top of most passages and accessible chambers. The cave as such is a flood cave which has implications for both biological communities as well as cultural deposits.

The entire Chiquibul Forest forms part of the Belize River Watershed. But within that are 2 main sub-drainage systems formed by the Macal and the Mopan (here with the Chiquibul River as the main tributary). The division between the 2 sub-watersheds splits the Chiquibul Forest roughly in two. Notable is the difference between surface drainage patterns between the two sub-watersheds. In the Macal sub-watershed, there exists abundant surface drainage (small streams), while the Mopan sub-watershed has a large subterranean component The Mopan sub-watershed itself needs to be divided to a next level including the Mopan-East Watershed, the Chiquibul Watershed, and the Rio Ceibo Watershed (Figure 2-7). The boundaries between these three are rather arbitrary since considerable components are underground and the topography is little indication of sub-watershed boundaries. Nevertheless, these subdivisions are of great importance in understanding systems and threats.

Figure 2-7: Hydrology of the Chiquibul



2.4.3 Geology

The geology of the Chiquibul Forest splits into two main groups (Cornec, 2008). Cretaceous limestones make up the western half of which the Chiquibul Cave System is part and Permian metasediments (including sandstones of the Santa Rosa Group and volcanics) in the east and following the Maya Mountain Divide (which form the headwaters of the Chiquibul River). The general geology has consequences for the overall landscape and geology of the area. The limestones are very permeable and this is the reason why there is so little surface water in the lower sections of the Chiquibul River sub-watershed (Figure 2-7). The limestone are locally heavily karstified which explains the abundance of caves and sinkholes in that area. Karst is essentially limestone that is heavily eroded by the passage of slightly acidic waters.

Figure 2-8. Natural Arch or "Puente Natural" ©Jan Meerman

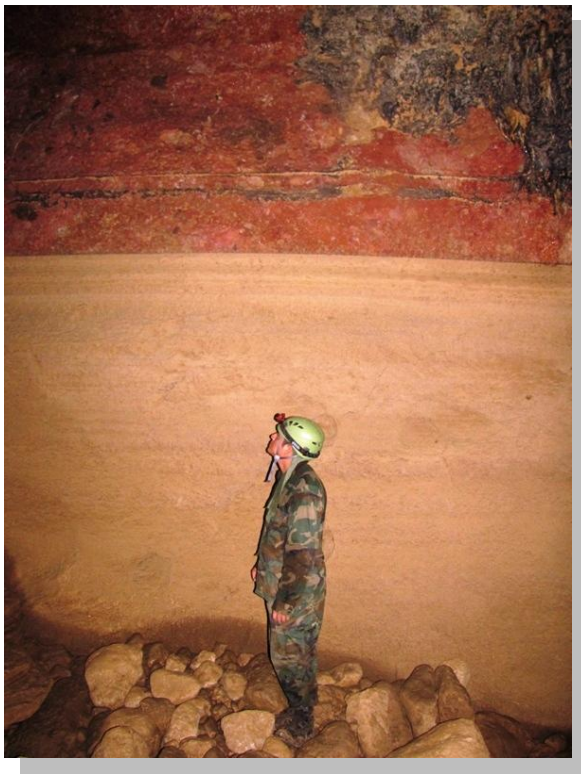


Figure 2-9: Distinct Layering with the Kabal section of the Chiquibul Cave. ©Jan Meerman

The karstification processes have created a large number of features including sinkholes (which are essentially caves from which the ceiling has collapsed), caves and natural arches. A natural arch is really a cave through which a river runs, but the cave entrance and exit are so large that you can look through it.

Within the Chiquibul Cave distinctive layering can be observed. There is one such feature in which dark red breccias overlays smoother pink limestone. This layering is probably a result of a catastrophic collapse before the formation of the current cave system. It has even been postulated that this catastrophic event could be the result of the Chicxulub meteorite impact at the Cretaceous-Tertiary boundary (Cornec, Pers.comm.). If this is the case, this layering

would add an attraction to the CCS.

Based on research using the decay of uranium isotopes in stalagmites, geologist Joyce Lundberg estimates that the Chiquibul caves began to form at least 800,000 years ago (Miller, 2000).

2.4.4 Soils

The soils of the Chiquibul Cave System reflect the geology, with the soils being on limestone, the soils tend to be basic and by tropical soil standards, relatively fertile. On the other hand, over the steeper limestone hills which comprise the CCS, the soils have been classified by Wright (1959) as skeletal. Meaning that they are very shallow and that bedrock is protruding on many places. Typically, mechanized agriculture is not possible on such soils but due to their relatively high fertility, they are quite suited for milpa agriculture. Until now the steep nature of the terrain has safeguarded the Chiquibul Cave System from a heavy influx of illegal farmers from Guatemala (Figure 2-5).

2.5 Biodiversity of the CCS

2.5.1 Ecosystems

The 2004 version of the Belize Ecosystems Map (Meerman & Sabido, 2001) recognizes 6 ecosystems for the Chiquibul Forest (Table 2-4). The majority of these ecosystems are variants of broadleaf forest over limestone, based on elevation and steepness.

Table 2-4: Ecosystems Identified within the Chiquibul Cave System Management Area.

UNESCO Code	UNESCO Ecosystem Classification	ACRES	HECTARES
IA2a(1)(a)K-r	Tropical evergreen seasonal broad-leaved lowland forest, well drained, on rolling karstic hills	1,456	589
IA2a(1)(a)K-s	Tropical evergreen seasonal broad-leaved lowland forest, well drained, on steep karstic hills	3,682	1,490
IA2b(1)K-r	Tropical evergreen seasonal broad-leaved submontane forest on rolling karstic hills	3,119	1,262
IA2b(1)K-s	Tropical evergreen seasonal broad-leaved submontane forest on steep karstic hills	11,989	4,852
IIIB1b(f)H	Deciduous broad-leaved lowland riparian shrubland in hills	915	370
SPA(1)	Agro-productive systems: non mechanized agriculture including unimproved pasture	508	206

Note that the four principal "topside" ecosystems do refer to their karstic nature and thus directly to their geological condition with caves, underground water ways etc. However, there is some need to expand into subterranean ecosystems or biological communities. Traditionally these are subdivided into different "light" zones based on light penetration into the cave. In this document we distinguish between the following:

- **Light Zone Community**. The entrance of the cave with abounded (one-sided) light and often with particular rainfall/humidity regimes where it falls under cave overhang. Typical components are:
    - Flora – cave entrance dwelling plants adapted to low light, low moisture conditions.
    - Fauna – species known as Trogloxenes that use the entrance of the cave for shelter, roosts, nesting sites. Including bats.
    - Fungi
    - Bacteria
- **Penumbral Zone Community**. Which is the area without direct sunlight, but enough stray light penetrates to allow some visibility within the cave. Typical components are:
    - Flora – Which is reduced to algae at this stage
    - Fauna – Trogloxene species that use this zone for shelter or roost. Including bats.
    - Fungi
    - Bacteria
- **Dark Zone Community**. Which is the total darkness zone. The biological communities here are highly adapted and consist of:
    - Fauna – Organisms that have adapted to the total darkness which can be divided into
        - troglophiles (Cave-dwelling species that have adapted to their dark surroundings but leave the cave to forage outside) such as bats and
        - troglobites (Cave-dwelling animals that have adapted to their dark surroundings. These live permanently underground and cannot survive outside of the cave environment. Troglobite adaptations and characteristics include a heightened sense of hearing, touch and smell. Loss of under-used senses is apparent in the lack of pigmentation as well as eyesight in many troglobites). The cave crab is a good example in the CCS.
    - Fungi
    - Bacteria

2.5.2 Flora

The flora of the CCS has barely been document to date, the composition of the Chiquibul Forest as a whole, however is relatively well documented, particularly though the implementation of several permanent sample plots in the area (Bird, 1998) and through the work of Bridgewater et al. (2006) who made a compilation of all the plant specimens collected in the Chiquibul. A total of 505 plant species is thus listed for the Chiquibul, but this list is by no means complete. For example the BERDS[10] database contains 1800 plant records from the Chiquibul Forest comprising of 662 species.

Table 2-5 - Listing of Plant species of conservation concern

Species	**English Name**	**IUCN class**	**Status in Belize**
Ceratozamia robusta		VU	VU
Zamia decumbens		CR	CR
Swietenia macrophylla	Large-Leaved Mahogany	VU	VU

Extrapolating the list of Species of Conservation Concern (Meerman, 2005), three plant species known to occur in the CCS management area are of conservation concern (see Table 2-5).

Figure 1-10. Zamia decumbens near the entrance of the Kabal system

This list is very short and probably reflects more our (lack of) knowledge on the true conservation status of Belizean plants in general. Of interest is the occurrence of *Zamia decumbens*, (Figure 2-10), a species that was described as recently as 2009 and appears to be specifically associated with Karst features such as sinkholes and cave entrances (Calonje et al, 2009). The precipitous nature of much of the CCS probably implies that most plant populations within the park can be considered "safe" at least from an ecological perspective, though it is quite likely that the economic viability of certain harvested species such as Mahogany (*Swietenia macrophylla*) and Xaté (*Chamaedorea ernesti-augusti*) is already compromised.

[10] http;//www.biodiversity.bz as per March 30, 2008

2.5.3 Fauna

As is the case with the flora, the fauna of the CCS has barely been recorded, but some deductions can be made from the species recorded from the larger Chiquibul Forest. The BERDS database contains 6,856 faunal records for this area (Table 2-6).

Table 2-6 – Chiquibul Faunal Records

Class	Records	Number of species recorded
Insects (Lepidoptera + Odonata)	4066	584
Fish	16	10
Amphibians	78	26
Reptiles	91	44
Birds	713	94
Mammals	94	28

While these numbers appear impressive, they are obviously very incomplete. For some groups such as Fish and Amphibians, the numbers above probably come close to the actual number of species that can be found in the Chiquibul Forest. For others they probably represent only a small percentage of what can be expected. The bird list for example should be able to come close to 300 species for the Chiquibul Forest.

While the species database is obviously still incomplete, the fauna of the Chiquibul Forest may be expected to house a fairly complete complement of the Belizean fauna. Some typical Northern Belize (Yucatan) elements will be absent but otherwise a large percentage of the known Belizean fauna should be expected in the Chiquibul Forest.

While exact data are lacking, there is strong anecdotal evidence that the larger vertebrate fauna has suffered heavily as a result of heavy hunting pressure by Guatemalan xateros, with "game" species such as Currasow, Crested Guan, Ocellated Turkey, White-lipped Peccary, Collared Peccary, Paca, Red Brocket Deer and White-tailed Deer bearing the brunt of the pressure but there is further anecdotal evidence indicating that other non-traditional game species such as Tapir are being targeted as well. In addition, there appears to be trade in wild species for the pet trade. Particularly Scarlet Macaws and occasionally spotted cats are reputedly being targeted.

The cave fauna of the CCS itself is not highly specialized nor extremely rich (Reddell & Veni. 1996). With such an extensive cave system a more specialized fauna would be expected. But the famous blind catfish (*Rhamdia typhla*, Pimelodidae) from other cave systems in Belize has not been encountered in the CCS, instead a fully pigmented *Rhamdia* sp. with eyes, is the most ubiquitous fish species in the CCS. There is however a specialized cave crab (Figure 2-11) that is found in the CCS. However, considering the nature of the CCS which is actually a flood-cave through which massive amounts of water flash in (– and out!) from the

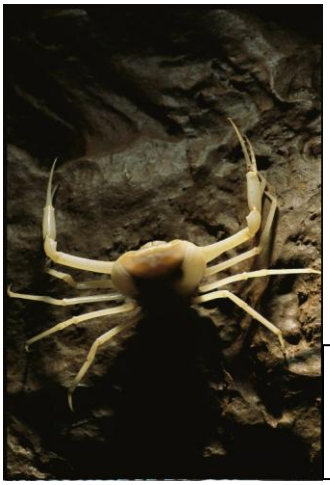


Figure 2-11. Cave Crab Typhlopseudothelphusa acanthochela from the Chiquibul Cave System. This species is not restricted to the Chiquibul Cave. Steve Alvarez, National Geographic.

Chiquibul River, cave specialization is not an option for most aquatic species. Not only do these floods carry in a regular "daylight" riverine fauna, they also flush out anything that might want to establish itself as a troglodyte species in the CCS itself. The flushing mechanism may also affect species such as bats. No bat identifications have been made in the CCS and the number of bats seen during our fieldwork was very low. Only near entrances, there was evidence of low bat activity and the presence of vertebrate prey remains appears to indicate the presence of a large predatory bat such as the Wooly False Vampire (*Chrotopterus auritus*). The deeper regions may simply be unsafe for the formation of bat roosts.

With the large amount of species occurring within the Chiquibul Forest, the amount of species of concern in the CCS management area is high as well, see table 2-7.

Table 2-7 Species of Conservation Concern expected within the CCS management area

Order	***Species***	**English Name**	**IUCN class**	**Status in Belize**
Birds	*Ara macao cyanoptera**	Scarlet Macaw		EN
Birds	*Crax rubra*	Great Curassow	NT	VU
Birds	*Dendroica cerulea*	Cerulean Warbler	VU	VU
Birds	*Electron carinatum**	Keel-Billed Motmot		VU
Birds	*Harpia harpyja*	Harpy Eagle	NT	CR
Birds	*Harpyhaliaetus solitarius*	Solitary Eagle	NT	CR
Birds	*Meleagris ocellata*	Ocellated Turkey	NT	VU
Birds	*Morphnus guianensis*	Crested Eagle	NT	CR
Birds	*Penelope purpurascens*	Crested Guan		VU
Birds	*Pionopsitta haematotis*	Brown-Hooded Parrot		DD
Birds	*Sarcoramphus papa*	King Vulture		VU
Mammals	*Alouatta pigra**	Mexican Black Howler Monkey	EN	VU
Mammals	*Ateles geoffroyi*	Central American Spider Monkey	VU	VU
Mammals	*Dicotyles pecari*	White-Lipped Peccary	VU	VU
Mammals	*Herpailurus yaguarondi*	Jaguarundi	VU	LC
Mammals	*Leopardus pardalis*	Ocelot	VU	VU
Mammals	*Leopardus wiedii*	Margay	VU	VU
Mammals	*Mazama pandora*	Yucatan Brown Brocket Deer	DD	DD
Mammals	*Panthera onca*	Jaguar	NT	NT
Mammals	*Puma concolor**	Puma	NT	NT
Mammals	*Tapirus bairdii**	Central American Tapir	EN	VU
Mammals	*Balantiopteryx io*	Thomas's Sac-winged Bat,	EN	EN
Mammals	*Bauerus dubiaquercus*	Van Gelder's Bat,	VU	NT
Mammals	*Mormoops megalphylla*	Ghost-faced Bat	NT	VU
Mammals	*Pteronotus gymnonotus*	Greater Naked-back Bat	NT	NT

* = species recorded within CCS by consultant

2.5.4 Past and Present Research

The CCS has also been researched to some extent. There is a fairly extensive library of literature on the cave. An abstract of which is incorporated in section 7 of this document. Most of the research in the cave has been conducted by T.E. Miller and L.McNatt (see literature) and has mostly focused on the exploration and mapping of the layout of the cave system, archaeology and limited zoology.

2.6. Cultural and Socio-Economic Value of CCS

2.6.1 Community and Other Stakeholder Use

Since the CCS is engulfed within other protected areas there are no Belizean communities adjacent to the management area. This means that there are no persistent and direct pressures to exploit the CCS's biodiversity, at least from the Belize side of the border. Most of the anthropogenic pressures on the CCS come from the Guatemalan side of the border, where there are an estimated 65 communities within a 45 kilometer stretch along the international frontier zone. FCD has recognized eleven Guatemalan buffer communities that depend on agriculture for their subsistence and are increasingly farming within the Chiquibul Forest where as much as 4,462 ha (11,028 acres) have so far been cleared in both the Chiquibul National Park and the Caracol Archaeological Reserve[11] but not so much within the actual CCS management area itself (see Figure 2-5). These communities have also served as staging grounds for large-scale xaté harvesting within the Chiquibul Forest resulting in extensive trail systems coming from Guatemala into the Chiquibul Forest, and through the CCS management area. It has been estimated that on peak seasons there are up to 800 Guatemalan xaté harvesters operating within the confines of the Chiquibul Forest (N. Bol, pers. comm. 2006). There is also evidence that these farmers and xaté collectors engage in widespread hunting of game species within the area, resulting in significant impact on the park's wildlife. For example, FCD Rangers have observed that the White-lipped Peccary, once abundant in the area, is now rarely observed within the CNP.

The Belize Defense Force and the British Army Training and Support Unit have for many years used the CNP as a military training area. Actually, large areas of the Chiquibul Forest are designated as military training zones, but the area around the Kabal section of the CCS appears to be inactive for the moment. At times of high activity, troop levels have reached battalion strength, with training activities crisscrossing over wide swaths of the Chiquibul Forest. Training includes the firing of live and blank ammunition, etc., which primarily results in noise pollution that may have impacts on wildlife populations and tourism activities. Other associated impacts include damage to the vegetation and forest floor through the explosion of military shells, and compaction of the soil caused by base camp operations and use of military hardware.

[11] Based on GIS analysis of 2007 Landsat tm data.

2.6.2. Archaeological Sites

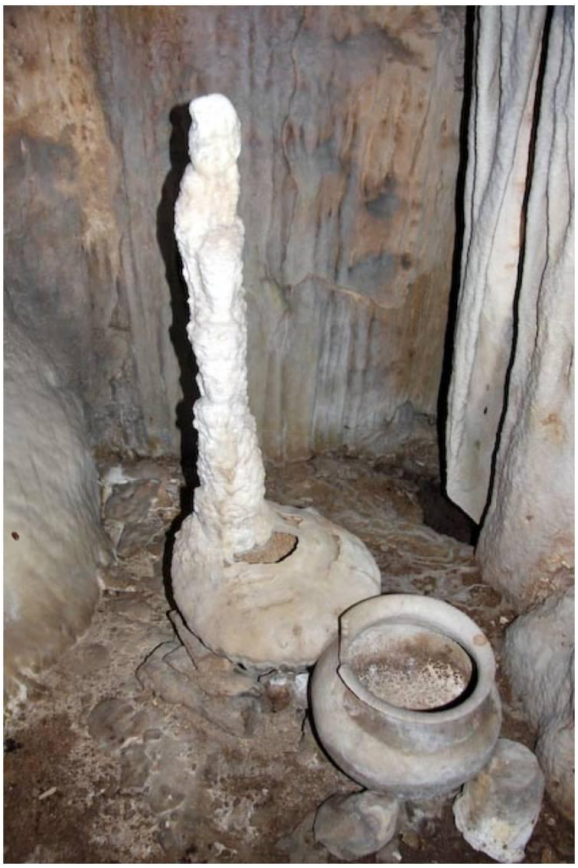


Figure 2-12. Stalagmite formed inside a Maya pot (Ledge of Offerings), a unique combination of Geology and Culture. This is a very fragile feature and could easily be destroyed by vandalism. ©David Larson

Figure 2-13. Pot as in-situ in the Kabal system. © Jan Meerman

The Institute of Archaeology considers the entire CCS an archaeological site. Within the cave system there are several chambers that hold archaeological artifacts. Many of the most accessible and valuable items have been removed. But a number of artifacts are still in place and undoubtedly, many still remain, undetected.

Some of these artifacts should be considered extremely vulnerable. A good example of this is the stalagmite growing inside a Maya vessel (figure 2-11). This unique feature is extremely exposed to vandalism, but there are very few measures that can be taken to safeguard it.

Very likely, within the entire CCS management area there are many archaeological sites waiting to be discovered. These can include offering sites and/or burial sites in caves, chultunes, terraces, house mounds or even ceremonial sites. However, if the Cave System itself is still only partly mapped and recorded, the surrounding area is essentially terra incognita. Within the entire Chiquibul forest few surveys have been carried out and, therefore, few sites have been discovered and mapped out (J. Awe, pers. comm., 2007), and this is probably more so the case for the CCS management area, where all attention so far has gone to the CCS itself.

One important research program that is currently active is the Xibalba Exploration and Mapping Team. Based in the USA, this is a volunteer team that assists the IA in exploring and mapping caves throughout Belize and has been instrumental in mapping the Kabal Section of the CCS.

2.6.3. Tourism and Recreation Use

Tourism use within the CCS management area is virtually non-existent. Access to the CCS has largely been limited to speleological and archaeological expeditions. (See pictures of 2005 XMET expedition:

http://23b.org/gallery/v/desert_dogs_0/The-Adventures-of-Cave-Doug/album113/album226/album136/album145/)

In March 2005, FCD organized the PACT challenge which visited the CCS as one of the highlights, and undoubtedly a (limited) number of intrepid tourists have managed to reach the cave, most likely guided by local experts. However, no public records of such visits exist.

However, visits to the Guatemalan section of the CCS: Xibalba, are much more common. The CCS on the Guatemalan side is much more accessible, and several reports of visits to the Chiquibul Cave are available on line:

http://www.rutahsa.com/gua-cave-07.html

http://thecaptainnemo.wordpress.com/2007/01/16/guatemala-caving/

Access to the Guatemalan side of the caves begins from the town of Dolores, 24 kilometers north of Poptún. From there, a gravel road leads to the settlement of Sacul Abajo. A rough dirt road continues to the village of Las Brisas, which is the final jumping-off point for the remaining 3–4-hour hike to the Zactun entrance.

Dr. Ric Finch, a retired geology professor, has been leading trips to Guatemala since 1987. In April 2007, together with Antigua resident caver/explorer Mike Shawcross, Finch led a cavers' trip to various sites in Guatemala, including the Chiquibul caves. Finch and Shawcross scouted the access routes and contacted local guides in the village of Las Brisas.

Movement between Xibalba on the Guatemala Side and Cebada on the Belizean side is apparently difficult and probably not attempted by the average cave enthusiast entering from the Guatemalan side.

The Natural Arch (figure 2-8) is a potential tourism attraction associated with the CCS. This site has recently not been accessible to regular 4X4 vehicles due to severe road conditions, which have been worsened due to constant use by heavy equipment from mining operations. But road upgrades for the purpose of logging operations may make that attraction somewhat more accessible, at least during the dry season.

A final potential tourism attraction is the Nohoch Che'en sinkhole. This is the largest of the many sinkholes found in the CCS management area. In 2000, the British Museum of Natural History organized an expedition into the sinkhole. Otherwise, little is known and no tourists are known to have visited the site.

The geology of the western part of the Chiquibul Forest is dominated by limestone features, which explains the abundance of caves and sinkholes in that area. As shows, the sinkholes are clustered within the southwestern part of the CNP; the best known sinkhole – Nohoch Ch'en – is located within the park. The greater part of the extensive Chiquibul Cave System, which has been featured in the National Geographic Magazine and aired on TV, is also located in this same area. These sites can only be accessed via dirt roads (tracks) and by foot, and are therefore rarely used by the average visitor). In January 2008, the Institute of Archaeology and FCD signed a collaborative agreement for the management of the

Chiquibul Cave System (Including that section located in the CFR), paving the way for higher controls over the overall management of the Cave system.

2.6.4. Other Economic Use

Legitimate economic uses within the CCS management area have been largely limited to logging operations and, recently, a xaté harvesting activity. Bull Ridge Company (managed by Pine Lumber Company) has been granted a long-term forest licence for the entire CFR. Operations within the area have been confined to irregular selective logging, but are projected to expand soon.

Gold prospecting in the Ceibo Chico area, south of the CCS has been an ongoing activity since the late 1980s, and continues under Boiton Minerals/Erin Ventures Inc. (under Ceiba Resources Ltd.). The first exploration license was issued in 1999, and the operation has been slowly increasing in size since the extension of the exploration license in 2004. The company has held prospecting licenses for four contiguous blocks, covering a total of 34km^2, and a mining license covering 38.85 hectares (96 acres), which has recently been renewed for another 5 years, and extended in September, 2007, to cover 160.25 hectares (396 acres), to give the mining company mining rights to the total area of alluvial fan associated with the Ceibo Chico drainage system (Wildtracks, 2008). A new company, Orion, is preparing to commence work in the nearby licensee area of Erin Ventures Inc.

Both economic ventures are of relevance due to potential risk to the CCS and for providing access.

2.6.5. Education Use

With the onset of management, FCD has commenced the development of an education and outreach program, which is targeting schoolchildren, youth and adults within eight communities in Guatemala, with the assistance of CONAP. The primary objective of the first year of the education outreach campaign has been to promote the importance of the Chiquibul Forest in the overall Chiquibul-Maya Mountain region and to promote awareness of the multiple benefits derived from the area such as air, water and recreational opportunities. The CCS has not been a specific focus.

In an attempt to raise awareness for the Chiquibul within Belize, FCD organized in March 2005, the "PACT challenge" which visited the CCS as one of the highlights, other educational trips are contemplated but logistical problems have so far prevented them.

3 Analysis of Conservation & Cultural Targets and Threats

3.1. Conservation and Cultural Targets

Through the CAP process, a number of conservation and cultural targets were chosen to represent and encompass the biodiversity and cultural values of the CCS management area.

Of these, the CCS planning team selected a number of focal targets, which were refined during the CAP process. Focal targets are the basis for setting goals, carrying out conservation actions, and measuring conservation effectiveness. In theory conservation of the focal targets will ensure the conservation of all native biodiversity within functional landscapes. In our case we can include "cultural diversity" in the definition of "biodiversity". And in our case there are two ecosystem-level targets:

- **Forest Communities**
- **Subterranean Biological Communities**

Two are cultural targets:

- **Non-Portable Cultural Objects**
- **Portable Cultural Objects**

And one is a Geological Target:

- **Geological-Paleontological features**

These focal targets provide a basis for setting goals, developing management strategies and actions, and monitoring success. A brief description of each target follows:

- **Forest Communities:**

Except for a relatively small section impacted by agricultural incursions, and some riverine shrublands, **broadleaved forests** cover the CCS management area. The broadleaved forests consist of a few closely related ecosystems or subtypes based on geology, elevation and inclination (see table 3-1). The transition between the various subtypes is very gradual, subtle and difficult to detect. Therefore, for the purpose of this management plan all broadleaf forests are lumped together. All they have in common is that the dominating life-form consists of broad leaved trees. The importance of this forest for the CCS is that it regulates to some degree, the humidity and hydrology on which the cave system depends. Should the forest cover be removed from the CCS management area, soil would erode; rain water would run off rather than percolate through the soil and limestone and thus affect geological activities such as stalactite/stalagmite formation.

Part of the forest communities are riparian systems which include riparian shrublands. These are broadleaf forests that are constantly being disturbed by flash floods. Because of these flash floods, the Chiquibul River is fringed by secondary, often even herbaceous growth. These riparian shrublands are very dynamic and energy rich. As a result the riparian zones are key zones for many species, including Tapir and Scarlet Macaw.

Table 3-1 Ecosystems Identified within the Chiquibul Cave System Management Area.

UNESCO Code	UNESCO Ecosystem Classification	ACRES	HECTARES
IA2a(1)(a)K-r	Tropical evergreen seasonal broad-leaved lowland forest, well drained, on rolling karstic hills	1,456	589
IA2a(1)(a)K-s	Tropical evergreen seasonal broad-leaved lowland forest, well drained, on steep karstic hills	3,682	1,490
IA2b(1)K-r	Tropical evergreen seasonal broad-leaved submontane forest on rolling karstic hills	3,119	1,262
IA2b(1)K-s	Tropical evergreen seasonal broad-leaved submontane forest on steep karstic hills	11,989	4,852
IIIB1b(f)H	Deciduous broad-leaved lowland riparian shrubland in hills	915	370
SPA(1)	Agro-productive systems: non mechanized agriculture including unimproved pasture	508	206

- **Subterranean Biological Communities:**

The subterranean Biological Communities can be subdivided in their various zones based on penetration into the cave (see also section 2.5.1):

- Light Zone Community. The entrance of the cave with abounded (one-sided) light and often with particular rainfall/humidity regimes where it falls under cave overhang. Typical components are:
    - Flora – cave entrance dwelling plants adapted to low light, low moisture conditions.
    - Fauna – species known as Trogloxenes that use the entrance of the cave for shelter, roosts, nesting sites. Including bats.
    - Fungi
    - Bacteria
- Penumbral Zone Community. Which is the area without direct sunlight, but enough stray light penetrates to allow some visibility within the cave. Typical components are:
    - Flora – Which is reduced to algae at this stage
    - Fauna – Trogloxene species that use this zone for shelter or roost. Including bats.
    - Fungi
    - Bacteria
- Dark Zone Community. Which is the total darkness zone. The biological communities here are highly adapted and consist of:

- Fauna – Organisms that have adapted to the total darkness which can be divided into
  - troglophiles (Cave-dwelling species that have adapted to their dark surroundings but leave the cave to forage outside) such as bats and
  - troglobites (Cave-dwelling animals that have adapted to their dark surroundings. These live permanently underground and cannot survive outside of the cave environment. Troglobite adaptations and characteristics include a heightened sense of hearing, touch and smell. Loss of under-used senses is apparent in the lack of pigmentation as well as eyesight in many troglobites). The cave crab is a good example in the CCS.
- Fungi
- Bacteria

The geological nature of the CCS has created some unique conditions. The limestone bedrock is very permeable which allows water to percolate into the various geological strata below. As a result surface waters tend to be scarce and in our case, the Chiquibul River goes underground for a considerable part of its trajectory. The water wears out caverns and tubes (underground waterways) and the result is a "swiss cheese" pattern of holes in the limestone known as "Karst". Karstic systems typically house unique species such as highly adapted invertebrates (blind spiders, white crayfish etc) and provide residence for species such as bats that use caves for daytime roosts. As it is, the fauna of the CCS is not highly specialized nor extremely rich (Reddell & Veni. 1996). With such an extensive cave system a more specialized fauna would be expected. There exists in the CCS a cave crab: *Typhlopseudothelpusa acanthochela*), but the famous blind catfish (*Rhamdia typhla*, Pimelodidae) from other cave systems in Belize has not been encountered in the CCS, instead a fully pigmented *Rhamdia* sp. with eyes, is the most ubiquitous fish species in the CCS. However, considering the nature of the CCS which is actually a flood-cave through which massive amounts of water flash in (– and out !) from the Chiquibul River. Not only do these floods carry in a regular "daylight" riverine fauna, they also flush out anything that might want to establish itself as a troglodyte species in the CCS itself. The flushing mechanism may also affect species such as bats. No bat identifications have been made in the CCS and the number of bats seen during our fieldwork was very low. Only near entrances, there was evidence of low bat activity and the presence of vertebrate prey remains appears to indicate the presence of a large predatory bat such as the Wooly False Vampire (*Chrotopterus auritus*). The deeper regions may simply be unsafe for the formation of bat roosts.

On the archaeological level the following targets have been identified:

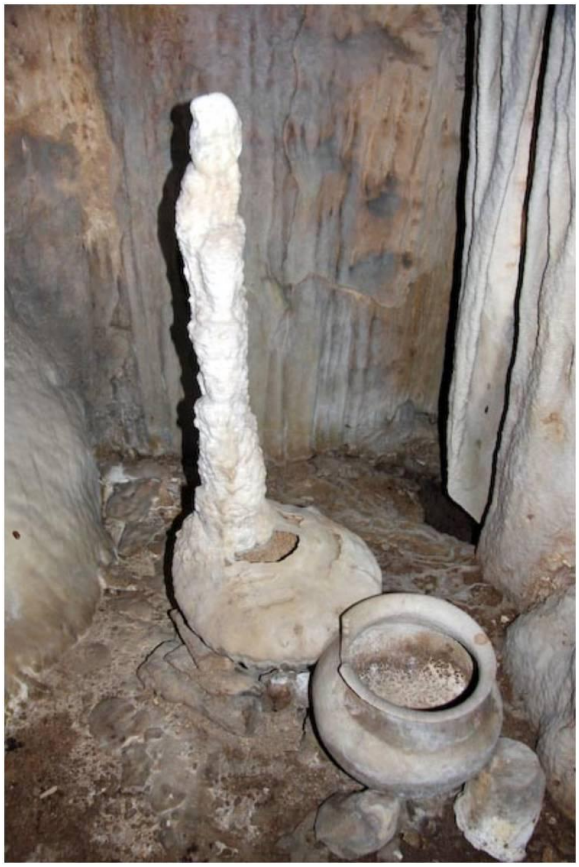


Figure 3-1. Stalagmite formed inside a Maya pot (Ledge of Offerings), a unique combination of Geology and Culture. This is a very fragile feature and could easily be destroyed by vandalism. Although cemented solid to the substrate, this could still be made "portable" ©David Larson

- **Non-Portable Cultural Objects:**

Which would be cultural artifacts such as rock/wall, stairs stucco masks or any other part of an architecture or facade, paintings, footsteps, hand prints and similar.

- **Portable Cultural Objects:**

This is the classification for any smaller artifact that can easily be carried or moved from in-situ. These would be any artifact such as pottery vessels, worked stone and tools, wood, shell, shards, skeletal remains, jewelry and Ecofacts (torches, plant and animal remains utilized in prehistoric times), that were used by the Ancient Maya. These artifacts were deposited into the cave by their users. However because they are relatively small and portable, it is quite likely that many of these artifact may have been shifted or moved around inside the cave as a result of flooding activities over the years.

- **Geological-Paleontological features:**

There are several examples of each of these sub-targets within the CCS management area. The principal geological features are pretty much known and mapped but many remains still to be discovered.

Among the better known Geological-Paleontological features are:

- The Chiquibul Caves (their geological expression) with features such as stalactites, stalagmites, columns, "straw" formation, cave pearls, travertine dams, and basins and other similar features. The Sand Passage within Kabal is an unusual geological feature and maybe unique. Similarly, the Splatermites in Kabal may be the largest known and are a rare formation
- The Natural Arch or "Puente Natural"

- The sinkholes with Nohoch Che'en as their most impressive representative.
- Fossilized remains of extinct fauna (Cave bear, Deer bones, Extinct Bats and possibly other).

Less attention has gone to the actual geology of the CCS. Distinct layering is clearly visible within the CCS but little is known about these features. One particular feature in the Kabal section is a sharp distinction between two layers of limestone, the lower a whitish/tan deposit and the top a red breccia. It has been suggested that this boundary actually marks the famous K-T boundary created during the impact of the Chicxulub meteor in the Yucatan, that ended the reign of the Dinosaurs. If correct, this demarcation would be a tourist attraction in its own.

3.2 Threats to biodiversity, geological and cultural resources

The critical threats to the CCS are summarized in the table below:

Table 3-2 – Summary of critical impacts to CCS management area's biodiversity[1]

Pressure/Threat	Impacts on Biodiversity	Causes
Illegal Hunting	• Reduced viability of game species populations, and associated impacts on trophic structure of area • Likely long-term perturbation of forest structure & dynamics because of xatero hunting impacts on seed dispersers • Likely long-term perturbation of aquatic ecosystems because of reduced populations of larger fish species	• Low income in Guatemalan communities adjacent to PA, and reliance on game meat and fish to supplement diet • Rapid human population growth with dwindling natural resources • Limited capacity of PA staff to effectively monitor and enforce within PA (limited staff / finance) • Increased access from land clearance in boundary areas, for subsistence, recreational and commercial hunters
Illegal Xaté Harvesting	• Reduced viability of xaté (*Chaemadorea ernestii-augustii*) • Associated impacts on wildlife – intensity, indiscriminate hunting, harvesting of parrots for pet trade, clearing of vegetation for camp areas, harvesting of pacaya and other plant food sources • Likely long-term perturbation of forest structure & dynamics because of xatero hunting impacts on seed dispersers • Impoverishment of genetic pool • Looting of cultural resources as a side-activity • Vandalism to geological and cultural resources • Leaving a lot of trash	• Low income in Guatemalan communities adjacent to CNP • Good market price of xaté in Guatemala and internationally • High demand from international market • Limited ability to effectively monitor and enforce within CNP (number of rangers / finance) • Weak governance and law enforcement in border areas with southern Petén, Guatemala
Agricultural Incursions	• Removal of broadleaf forest cover • Associated impacts on wildlife – indiscriminate hunting, harvesting of Scarlet Macaws for pet trade, harvesting of pacaya and other plant food sources • Fire impacts associated with forest clearance for agriculture • Leaching of soils with removal of forest canopy • Increased erosion on steeper slopes • Impact of hydrology of cavesystem	• Limited land availability for agriculture in Guatemala, • Rapid human population growth • Limited capacity of PA staff to effectively monitor and enforce within PA (limited staff / finance) • Increased access in boundary areas with Guatemala • Weak governance and law enforcement in border areas with southern Petén, Guatemala • Limited environmental awareness

[1] Source: CNP Planning Workshop (2007), MMM RAPPAM Results (2007) and CCS CAP meetings (2009)

Pressure/Threat	Impacts on Biodiversity	Causes
Land Use Change in Adjacent Areas	• Removal of buffer area vegetation • Increased accessibility for hunting, fishing, looting • Increased potential for edge effects along boundaries following clearance of forest for agricultural land • Increased fire hazard along boundary areas including vegetation above and around cave. • Increased potential for agricultural incursion and/or illegal logging	• Increased requirement for agricultural land in Guatemala • Rapid human population growth • Lack of political will to contain farmers into forest areas
Legal and Illegal Logging	• Changes in species composition within CFR with selective removal of species such as cedar, mahogany etc. • Increased fire risk • Fragmentation of forest structure through construction of logging roads and tracks • Increased access for hunting, looting and other illegal activities • Hunting/looting by logging crews • Increased risk of erosion in riparian belt	• High demand for timber and timber products, both within Belize and for export • Increasing value of timber • Use of cut logs for house and livestock fence construction • Weak enforcement of logging policies • Ineffective monitoring systems
Visitor Impacts	• Increased visitor numbers, with related impacts of soil compaction on trails, increased garbage, expanding and unofficial campsites, pressure on fragile ecosystems, increased fire risk • Vandalism (including graffiti) of archaeological and geological structures and caves • Unintended impacts to cultural and geological resources (touching, clumsiness etc.) • Unregulated education field project activities and impacts	• Lack of enforcement of 'no litter' regulations by guides • Lack of adequate incentives / fines • Limited capacity of PA staff to effectively monitor and enforce visitor regulations (number of staff / finance) • Lack of Tourism Management Plans
Research Impacts	• Unregulated research activities (eg. involving collection and experimentation on critically endangered amphibian species)	• Limited capacity of PA co-managers / research stations to oversee research relating to sensitive species • Lack of identification of research needs for management purposes
Mining / Exploration	• Removal of riparian vegetation and adjacent broadleaf forest in mining concession area • Fragmentation of broadleaf forest due to construction of access road, with increased potential for edge effects • Increased accessibility for hunting and other illegal activities • Possibility of contamination in Chiquibul/Maya Mountain headwaters • Increased siltation into the CCS	• High market value of gold and other mineral resources • Lack of well defined policies and guidelines in PA • Over-riding ability of Dept. of Geology and Petroleum to issue exploration and mining licenses within the Chiquibul Forest • Lack of integrated management

Pressure/Threat	Impacts on Biodiversity	Causes
Military Impacts	• Increased human presence in broadleaf forest areas • Increased noise impacts associated with training activities - explosions, live-firing and helicopters, for example, with disturbance of wildlife • Eye-sore impact on visitors to the CCS • Increased fire risks • Low level hunting impacts by Belize Defense Force patrols and British Forces local trackers	• Designated military training areas for British Forces, under agreement with Belize Government • Lack of strong lobbying for alternate places for live-firing training • Lack of awareness of protected area legislation and regulations among military personnel, and / or lack of respect, and / or lack of enforcement
Looting of Archaeological artifacts	• Looting of archaeological structures and caves by xateros • Loss of cultural resources • Loss of information for management purposes	• Limited capacity of PA staff to effectively monitor and enforce PA regulations (number of staff / finance) • Limited archaeological documentation for the CCS • International agreements that prevent the sale of artifacts are lacking or not enforced.

4. Management and Organizational Background

4.1. FCD Background

Friends for Conservation and Development (FCD) is a non-profit organization created in 1999, and is managed by an Executive Board (see Figure 4-1 below). Its predecessor organization, Youth Environmental Action Group (YEAG) was created since 1989, and at first conducted outdoor interpretation and eventually served as a voluntary monitoring agent reporting to the Forest Department and the then Department of Archaeology (now the Institute of Archaeology). The mission of FCD is to motivate the public to protect the environment through conservation awareness while at the same time enhance the development of the human resource. For the past 16 years, YEAG/FCD has primarily functioned as an environmental education organization, dedicated to create an awareness of environmental issues and encourage community involvement with the aim of making the general public more conscious of their actions. As a result, FCD has developed ample experience in working with communities and has developed skills for conducting impact-oriented conservation education, nature interpretation, monitoring, and research. FCD has also had a long relationship with the Forest Department due to its protected areas training component, primarily in co-management and community support programs.

FCD's strategic plan (2004-2006) provides for the organization to engage in protected areas management with an interest on the protected areas located in the Cayo District. From 1993, FCD has been conducting monitoring and research, and raising awareness about the plight of the Chiquibul Forest. And since 2002, FCD undertook discussions with the Forest Department seeking a co-management initiative for the Chiquibul forest.

In May 2005 and November 2005, FCD convened a series of Chiquibul Stakeholders Planning Workshops, and organized and conducted a fact-finding expedition into the Chiquibul Forest in March 2005. These workshops and expeditions were able to define the major challenges and management needs for the Chiquibul Forest, and in particular for the Chiquibul National Park.

The Forest Department and FCD signed a provisional co-management agreement for the CNP on the 1st June 2007. The agreement sets out the following provisions:

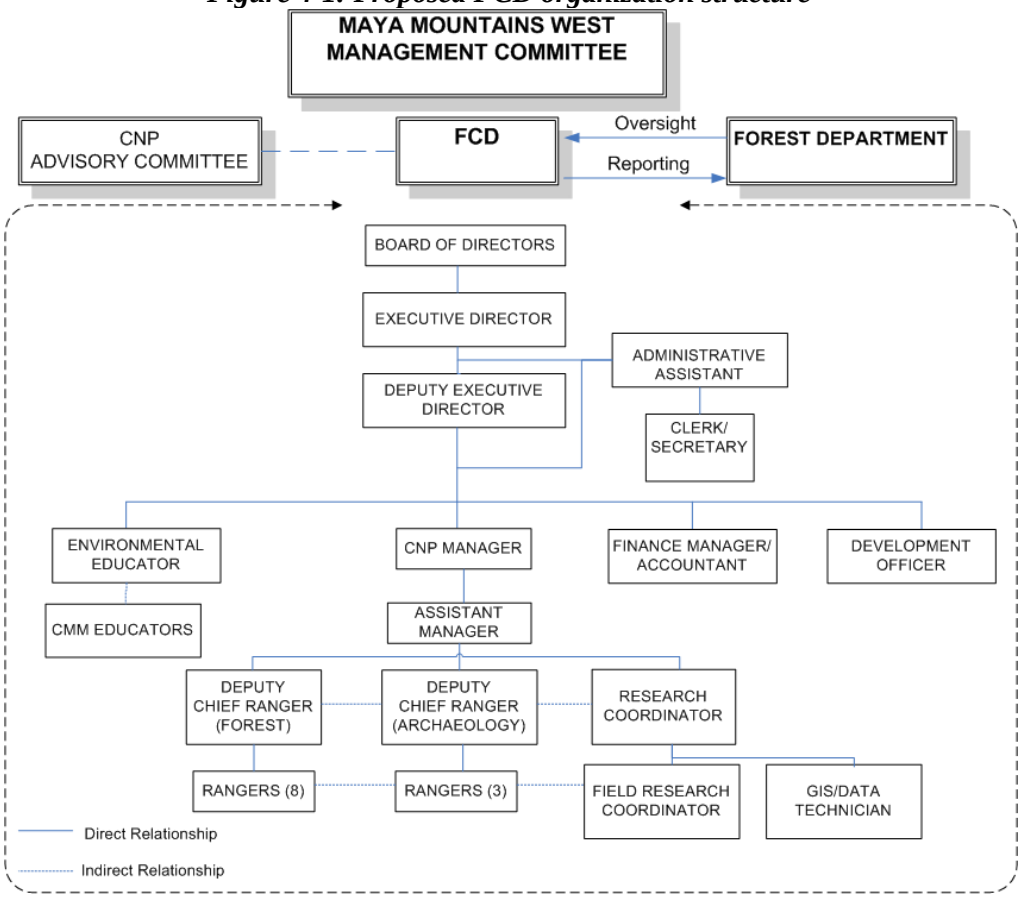
- Development of a Management Plan that provides for the protection of the natural and cultural resources of the Chiquibul National Park;
- Institution of a Protection Program for the conservation of the ecosystems and species in the Chiquibul National Park,
- Development of a Research and Monitoring Program to conserve the park's critical biodiversity;
- Implementation of a Public Awareness Campaign that promotes the importance of the Chiquibul National Park; and
- Launching of a Chiquibul National Park financial sustainability plan to enable effective long term management.

In 2009, a management plan for the Chiquibul National Park was prepared (Salas & Meerman, 2009) and this management plan calls for a stand-alone Management Plan for the Chiquibul Cave System. On January 30, 2008, FCD entered into a co-management agreement with the Institute of Archeology in order to have the legal basis for managing the CCS along with the IA. To better undertake this responsibility this management plan becomes an important component for an effective management program to be activated in the Chiquibul forest.

4.2. Current Management Structure

Based on the recommendation provided in the CNP management plan the management structure has been adapting over the last year. FCD's management structure now considers the development of a small unit to be more responsible for the CCS and provides for starting up a research component. The two major programmatic areas are environmental education and protected areas management. The aim however is to scale up to the management structure recommended below (figure 4-1) which fits within an integrated management of the entire Chiquibul/Maya Mountains. The CCS unit consists of two persons who are expected to be fully engaged once this management plan is put into effect. Both program managers' report to the Executive Director, who in turn is answerable to FCD's Board of Directors. An Administrative Assistant supports the Executive Director, and the two programme managers.

Figure 4-1: Proposed FCD organization structure



5. The Management Plan

5.1. Management Goal

Management Goal for the Chiquibul Cave System

GOAL

To maintain the Chiquibul Cave System as a world class heritage within the Chiquibul Forest National Park recognizing its great cultural, archaeological, geological and biological significance.

5.2. Management constraints and limitations

Information extracted from various workshops and consultations as well as the CNP Management Plan (Salas & Meerman, 2008) and the Chiquibul National Park Assessment of Management Effectiveness report (Wildtracks, August 2007) reveals management constraints and limitations in the following areas[1]:

Governance:

- Existing Multi-Agency initiatives need to be strengthened and expanded
- The co-management agreements with FD is provisional and need to be made secure
- FCD has no management mandate for the Chiquibul Forest Reserve although the latter contains part of the CCS as well as the Natural Arch.
- Physical input in the management of the CCS by IA is virtually non-existent

Resource Information:

- Lack of inventory information (biological, geological and cultural) restricts the use of baseline data
- Inventory information is not considered fully sufficient for management, but does serve the current purpose of dealing with most critical concerns
- GIS database is still insufficient and too few staff are sufficiently familiar with the material to allow for high quality data collection.

[1] Meanwhile, Management effective assessment updates have been taken place and several of the constraints here are currently already being addressed. Overall, the noticed constraints and limitations remain an issue.

Resource Administration, Management and Protection:

- Political issues and the existence of the 1 km Adjacency Zone complicates the issues of border demarcation and patrols resulting in reduced effectiveness in dealing with illegal incursions
- Due to distance, difficult terrain and limited staff, FCD surveillance and enforcement of the CCS is limited in scope.
- Due to distance, difficult terrain and security issues, an effective exploitation of the tourism resources of the CCS is very limited in scope.

Participation, Education and Socio-Economic Benefits:

- No Belizean Communities can claim user-benefits from the CCS, the only ones using the area are considered illegal trespassers from Guatemala over which FCD has no jurisdiction.
- No Belizean tour operators can claim to be exploiting the CCS assets.

Human Resources:

- There are gaps in the area of technical, scientific and professional staff.

Financial and Capital Management:

- The CCS management has no dedicated budget and essentially feeds off the CNP management
- Funds for CNP (and thus CCS) management come primarily from donor funding and are uncertain after existing project funding comes to an end.
- The opportunities for FCD to offset CCS management costs by Tourism related incomes (even partially) are limited.

5.3. Management zones

Zoning is an essential management tool, which defines the control of public access based on the protected area designation, natural resource use, education and research requirements, and intends to minimize potential impacts on the conservation role of the Protected Area.

Based on the Belize National Protected Area Systems Plan (NPASP) (Meerman & Wilson, 2005) which states: "*Simplify the existing system by consolidating adjacent protected areas into single, multi-zoned, management units.*" a zoning plan for the entire Chiquibul Forest was presented in the Chiquibul National Park Management Plan (Salas & Meerman, 2008) that could be implemented for the CNP only but ultimately should be extended to encompass the entire Chiquibul Forest area (Chiquibul NP, Chiquibul FR and Caracol Archaeological Reserve) and provided a tentative zoning for the Chiquibul Cave.

The guidelines for the 2008 zoning proposal were based on the following premises:

- Steepness of the terrain, with the less steep zones designated for timber management and the steeper areas for conservation. The boundaries of the current Chiquibul NP and FR were largely designed following this criterion;
- The outcomes of the Protected Area System Assessment and Analysis: Gap Analysis and MARXAN Analysis (Meerman, 2005);
- The Key Biodiversity Area Analysis (Meerman, 2007);
- The Chiquibul, Maya Mountains Conservation Action Planning (Wildtracks, 2007);
- Location of known archaeological sites and features;
- Location of known scenic landscape features;
- Location of current mining exploration and exploitation interests,
- 1 km Adjacency Zone; and
- Location of current incursions for agricultural activities.

Figure 5-1 presents these 2008 management zones where they apply to the CCS.

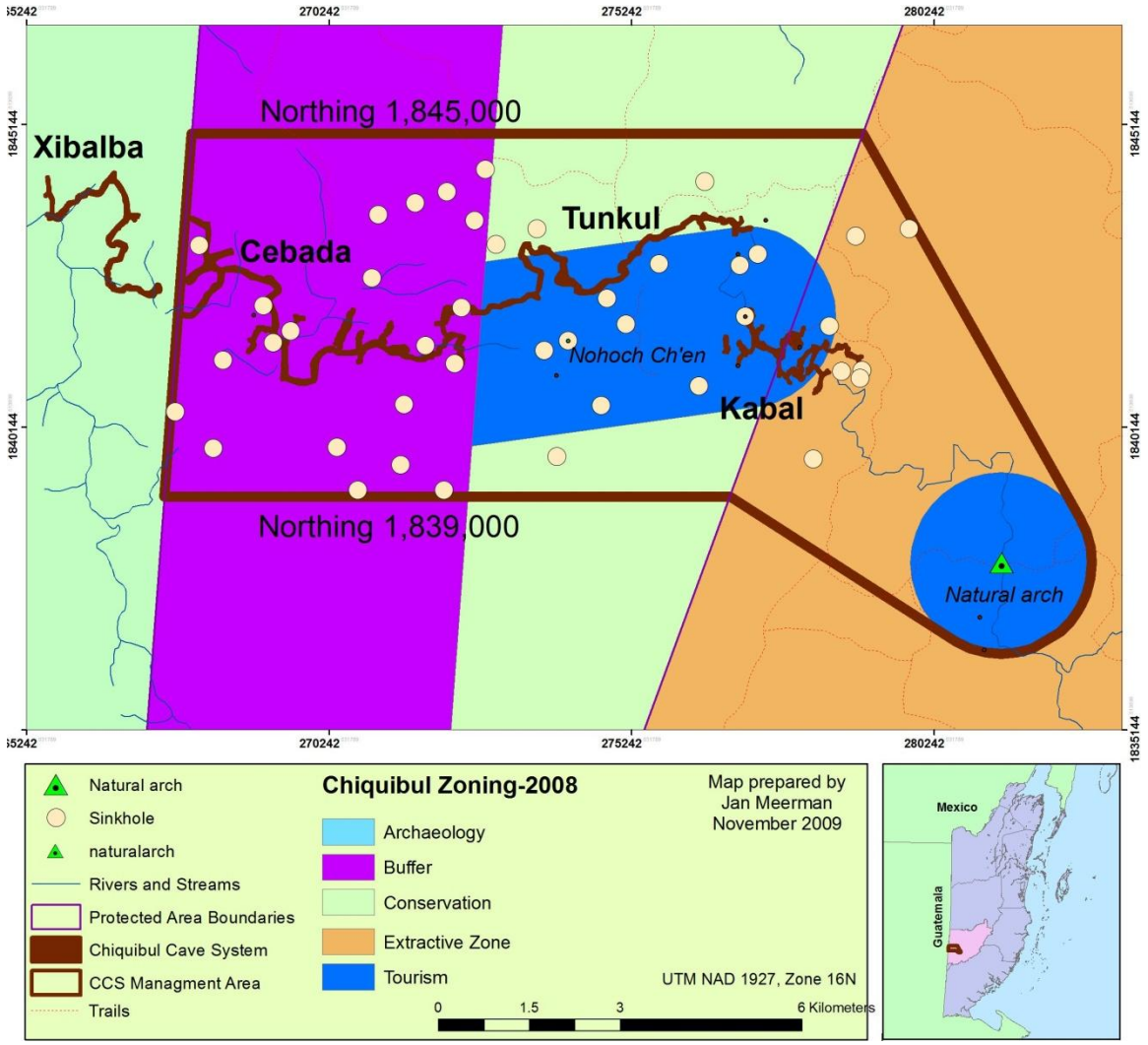


Figure5- 1. Management Zoning in the CNP management plan as it applies to the CCS

With the desire to deviate as little as possible from the 2008 CNP management plan and it's zoning proposal, but taking into consideration the outcomes of the 2009 CAP workshop outcomes a modified zoning proposal is presented in figure 5-2.

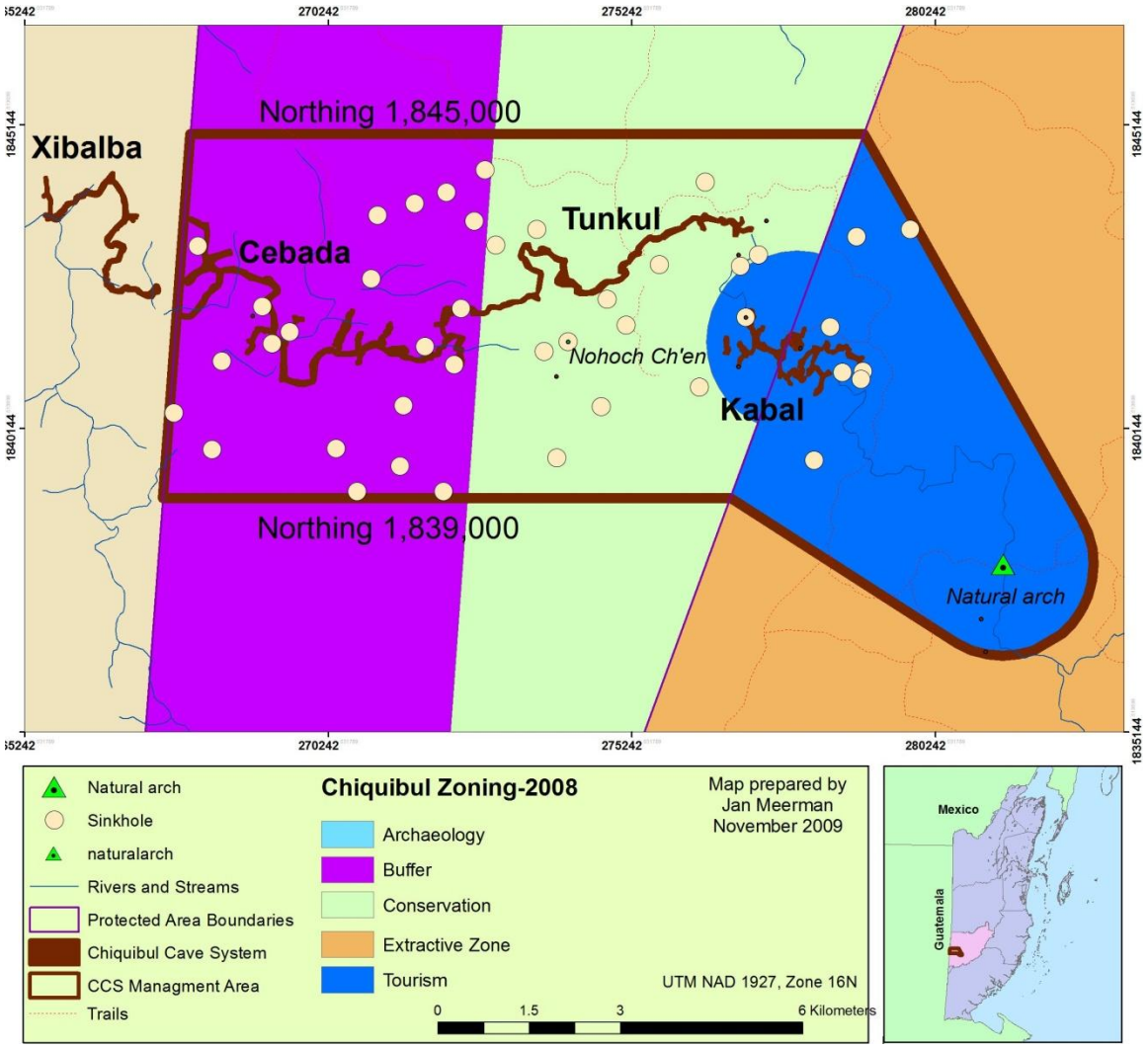


Figure 5- 2. Proposed Zoning Plan CCS

The rationale for this particular zoning plan is as follows:

- It needed to correspond as much as possible with the 2008 CNP management plan
- The parts of the Chiquibul Cave that have been explored by FCD staff are the Kabal and Cebada sections, but most attention has been given to the Kabal section and at this stage, at least for the interim, the Kabal system is the only section that should be considered for Tourism development.
- Tunkul and Cebada sections of the Cave system are the least accessible of the three sections.

It needs to be noted that the CCS as presented here extends into the Chiquibul Forest Reserve for which FCD has no mandate and no authority. And to make this zoning work, FCD will need to get into an agreement with both the FD and the current Long Term Logging License Holder.

Effectively, the part of the CCS within the CFR takes 2,600 ha (6,500 acres) away from the

CFR, with potential negative impact to the financial feasibility of this long term timber extraction operation.

The Table that follows provides a definition for each Zone, as well as objectives and regulations/guidelines for the proposed management zones (Table 5-1). The Zones are color-coded for ease of reference.

For the implementation of objectives focused towards further developing the Chiquibul Forest area as an integrated protected area with multiple use zones, 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 and rearrangement of priorities.

Table 5-1– Proposed CCS Management Zones (2010-2015)

	Zone	***Objective***	***Regulations/Guidelines***
IUCN Cat 1b	***Conservation-Research Zone*** Low use area, open to researchers, research students, natural resource students. Visitation to the Tunkul section of the Chiquibul Cave will be restricted to managers and researchers until such a time that sufficient data has been gathered to allow visitation by the general public	▪ To exclude for visitation by the general public the Tunkul section of the Chiquibul Cave that is least accessible and for which limited data exist until such a time that sufficient data has been gathered to allow visitation by the general public ▪ To allow for scientific research into the lesser known section of the CCS. ▪ To maintain a large proportion of the Protected Area in an entirely natural state, under management of the Forest Department and site-level Protected Area co-managers ▪ To maintain biodiversity and watershed functionality with minimal human impact ▪ To ensure effective surveillance and enforcement	▪ Minimal impact research under special permission from Forest Department, Institute of Archaeology (dependent on research target) and site-level protected area co-managers ▪ No collecting of flora, fauna, artifacts or inorganic material other than by approved researchers with the permission IA and/or Forest Department consultation with site-level protected area co-managers ▪ Low impact tourism, where site-level management zones permit once the Tunkul section of the CCS in this zone has been properly researched and sensitive elements have been identified. ▪ Effective Surveillance and enforcement **Management roles:** IA, FD & FCD bear principal responsibilities.

	Zone	Objective	Regulations/Guidelines
IUCN Cat. II and III	***Tourism Zone*** General cultural and biodiversity resource protection, with visitor access for tourism, education and research. Focusing on the Natural Arch and Kabal section of the Chiquibul Cave	▪ To maintain tourism assets, cultural and biodiversity resources plus watershed functionality with minimal human impact, under management of the IA, Forest Department and site-level protected area co-managers including Forest License holder(s). ▪ To maintain cultural resources with minimal human impact, under management of the IA in collaboration with site-level protected area co-managers and, where relevant, Forest Department. ▪ To allow access for scientific research, education and low-medium impact tourism ▪ To ensure effective surveillance and enforcement	▪ Minimal impact research under special permission from IA, FD, (dependent on research target) and site-level protected area co-managers ▪ No collecting of flora, fauna, artifacts or inorganic material other than by approved researchers with the permission of IA and/or FD in consultation with site-level protected area co-managers ▪ Existing Forest License stipulations affecting this zone need to be modified with full agreement of FD and Forest License Holder. ▪ Low to medium impact tourism with particularly sensitive cultural/biological and geological elements out of bounds for tourism ▪ Effective Surveillance and enforcement **Management roles:** FD, IA & FCD all sharing responsibilities with addition of the Forest License holder(s).
IUCN Cat. IV	***Buffer Zone*** Area along the border with Guatemala. Containing the Cebada section of the CCS. Whilst not a permanent zone, it is recommended that the 5km strip adjacent to the border be considered a Buffer Zone, with particular attention to surveillance and enforcement activities	• To maintain cultural and biodiversity resources, and watershed functionality with minimal human impact • To allow access for scientific research. • To prioritize surveillance and enforcement activities • To maintain and restore biodiversity and watershed functionality • To promote trans-boundary conservation efforts	• Includes adjacency zone. • Management involves input from BDF. • No entry, except by military, police, park staff and permitted researchers. • No damage, destruction or disturbance of natural habitat and cultural aspects • Surveillance and enforcement against illegal resource extraction **Management roles:** FD, IA & FCD bear principal responsibilities with addition of BDF.

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 (see Figure 5-3).

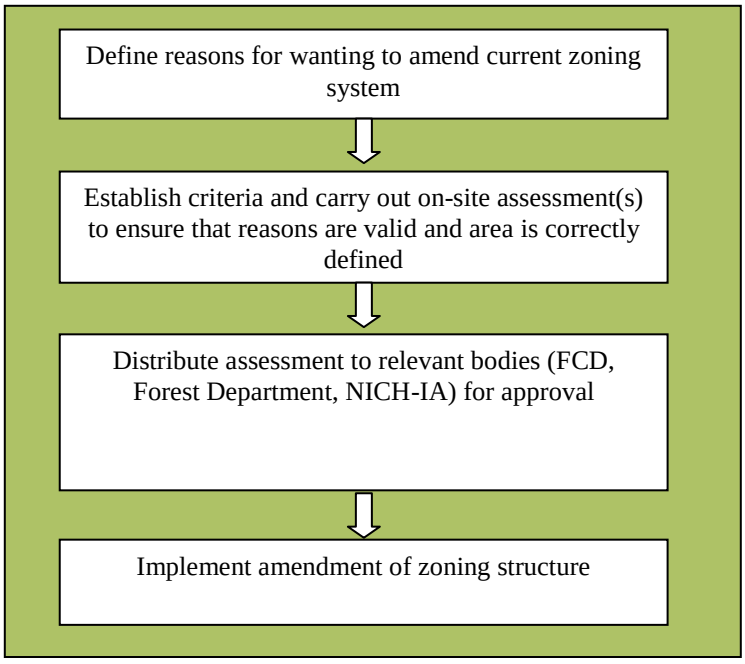


Figure5- 3 - Protocol for Alteration of Management Zones

5.4. Management Programs

A **conservation/management strategy** is a broad course of *action* intended to achieve a specific *objective* (outcome) that *abates a threat* and/or *enhances the viability* of a conservation target. Such a strategy can be divided into three distinct components:

- Objective (Outcome)
- Strategic Actions – How to achieve the objective
- Action Steps – Step by step actions that make up the strategic action.

During the course of the CCS Conservation Planning process, a number of objectives were established. Within these were a number that also apply to the Chiquibul Forest and CNP as a whole and have already been addressed in the 2008 CNP Management Plan. This particularly applies to those objectives that relate to the forest community conservation target such as:

- Objective: Reduce Illegal Logging within the CCS watershed by 90% within 5 years
- Objective: To completely eradicate and prevent future slash and burning within the CCS watershed by 2013.

As the 2008 CNP Management Plan effectively already addresses these (even if under different objectives), there is no need for potentially confusing repetition. Instead the management programmes presented here focus specifically on the CCS as such; while any overlapping programmes in the 2008 CNP management plan remain. Similarly, an important management programme as Protection and Survailance is assumed to be part of the overall CNP management plan.

Similarly, funding issues are not addressed. Currently funding for the CCS comes through the overall CNP management system. At least for the lifetime of this management plan it is not recommended to separate the two.

While the 2009 CCS Conservation Planning Process identified a number of new objectives, the existing 2008 CNP management plan was mined for applicable objectives, which were then incorporated in the management programmes.

Six management programmes have been identified for the CCS. They are as follows:

6. Institutional Management and strengthening Programme
7. Administration Programme
8. Research and Monitoring Programme
9. Cultural and Natural Resources Management Programme
10. Infrastructure Management Programme
11. Public Use Planning Programme

Each of these management programmes have a set of management objectives with associated actions that, when grouped, aim to achieve the CCS Management Goal.

5.4.1. Institutional Management and Strengthening Programme

Overall Objective: By 2011, a functional multi-stakeholder governance and management structure is in place for the Chiquibul Cave System.

Within this general objective, a number of conservation and/or management priority issues have been identified through the conservation action planning exercise:

- Management of the CCS cannot be done in isolation; for ecological and practical reasons, management of the CCS must in fact be integrated with that of the Chiquibul Forest.
- While a management plan exists for the CNP and Chiquibul Forest, this does not go into details for the CCS.
- The principal stakeholders for management of the CCS consist of the IA, FD and the CFR Forest License Holder. Management needs to take into account the interests of these stakeholders.
- FCD has no management mandate for the Chiquibul Forest Reserve although the latter contains part of the CCS as well as the Natural Arch.
- Physical input in the management of the CCS by IA is virtually non-existent
- Up to recently, the CCS was not managed at the site-specific level and still has no dedicated budget.
- Currently, funds for CCS management come primarily from donor funding through the overall CNP management programme and are uncertain after current project funding comes to an end.
- Currently there are no income generating activities, such as entry and user fees (only grant funding).
- FCD has only recently taken on the role of co-management for the CCS, and this, combined with the limited finance availability, also limits many other areas, including prioritization of identified infrastructure and signage requirements.

Based on the above priority issues, the Institutional Management and Strengthening Programme have been divided into the following sub-programmes:

- Governance Development Sub-Programme
- Fundraising Sub-Programme
- Strategic Networks and Partnerships Sub-Programme

Governance Development Sub-Programme	
Objective 1: Develop a governance structure for the CCS that incorporates the principal stakeholders (FCD, FD, IA, Forest License Holder) within the area and ensures an effective and transparent decision-making structure	
Action 1	Develop and institute a management zoning scheme for the CCS (see Table 5-1 above) Year: 2011 Responsible: FCD, FD, IA and the Forest License Holder
Objective 2: Negotiate and operationalize a permanent and secure co-management arrangement for CCS	
Action 1	While the intent of the CNP management plan is to integrate all protected areas in the Chiquibul Forest into one –multi zoned- management structure, for the time being this is not a reality. It is therefore important to negotiate FCD's co-management agreements with FD into a formal and comprehensive 5-year co-management agreement granting FCD full responsibility for the overall (collaborative) management of the CCS including those sections that are in the CFR as is already understood within the Co-Management agreement with IA. Year: 2010 Responsible: FCD, FD, IA and the Forest License Holder

Fundraising Sub-Programme	
Objective 1: Expand on the CNP fundraising program geared at diversifying FCD funding base.	
Action 1	Develop and implement a revenue generation and cost recovery scheme for the CCS, focusing on entry fees, user fees and concession fees Year: 2011 Responsible: FCD, IA.
Action 2	Prepare grant proposals to support the implementation of CCS's specific management programs Year: 2010 continuous Responsible: FCD, IA.
Action 3	Exploiting the unique features and assets of the CCS, identify potential donor agencies and cultivate/strengthen donor relations Year: 2010 Continuous Responsible: FCD, IA, FD

Strategic Networks and Partnerships Sub-Programme	
Objective 1: Strengthen collaborative relations with partner organizations, and with local and international NGOs to broaden FCD's scope of interaction	
Action 1	Expand network of partner organizations with the Instituto de Antropologia e Historia (IDAEH)(the Guatemalan Institution responsible for Archaeology), XMET and others bearing in mind that part of the CCS is located in Guatemala. Year: 2010 Responsible: FCD, IA.
Action 2	Generate support from the Foreign Affairs institutions of both Guatemala and Belize. Year: 2011 Responsible: FCD, FD, IA
Action 3	Develop a sister program of collaboration with Mesa Verde Year: 2012 Responsible: FCD, IA

5.4.2. Administration Programme

Overall Objective: By 2015, an effective and functioning administrative support structure is in place for the CCS.

Within this general objective, a number of conservation and/or management priority issues have been identified through the conservation planning exercise:

- The CCS is a remote and difficult are to reach area and cover, especially with limited staff, resources, and equipment.
- There are specific safety issues associated with caves.
- The CCS as a feature and a resource is relatively little known and underappreciated at a national and international level
- FCD staff members are limited in number but have multiple functions, not just administrating the CCS and therefore the possibility exists to stretch staff functions too thinly.

Based on the above priority issues, the Administrative Programme is divided into the following sub-programmes:

- Human Resources Management Sub-Programme
- Marketing Sub-Programme
- Monitoring and Review Sub-Programme

Human Resources Management Sub-Programme	
Objective 1: Strengthen the management of CCS's Human Resources in order to ensure that FCD has the capacity to effectively implement the CCS management as part of the overall CNP management plan.	
Action 1	Strengthen the CCS Unit with a capable Chief Ranger and assistant Year: 2009 Responsible: FCD
Action 2	Train staff in Caving and Cave Rescue techniques Year: 2010 Responsible: FCD, IA, XMET, Cave Rescue
Action 3	Evaluate effectiveness of training Year: Ongoing Responsible: FCD
Action 4	Assess potential safety and liability issues within CCS, and ensure safety of visiting researchers, students, staff and other authorized users. Year: 2010 – and ongoing Responsible: FCD, FD, IA, BDF

Marketing Sub-Programme	
Objective 1: Improve the public image of and promote CCS	
Action 1	Raise the national and international profile of CCS, and awareness of grant-giving agencies of the need for funding (The Texas Cave Association has been suggested as a partner organization in this) Year: 2010 and ongoing Responsible: FCD, IA
Action 2	Assist in the development and dissemination of the "Chiquibul-Mopan-Macal River Watershed Atlas" with specific focus on the Chiquibul resources and threats. Target group: village leaders in Belize/Guatemala Year: 2009-2010 Responsible: FCD
Action 3	Upgrade website for FCD and IA with interactive elements concerning the CCS. Year: 2010 – and ongoing Responsible: FCD

Action 4	Incorporate CCS into CNP, NICH, BTIA, CONAP, Tour Operator, Membership, Government websites. Year: 2010 – and ongoing Responsible: FCD, IA.
Action 5	Develop Media Campaign to create awareness of the greater Belizean public about the CCS, Chiquibul resources and threats and improve image of FCD and IA. o Develop campaign plan o Contact Loyola University to enlist support in preparing media campaign. o Media tour of the CCS o TV, Radio, Newspaper, Magazine, School visits, o Gather documentation materials such as maps, video's and pictures o Set up CCS photo gallery at the Caracol visitor center. o Produce television documentary targeting International audience in the USA/Europe ref. unsustainable forest products / Xate etc., including wildlife impacts. Target group > consumers, florists, distributers and any other relevant groups. o Produce CCS Logo, stickers, t-shirts, flyers etc. o Identify distribution trail of unsustainable xate harvesting work with Beltraide, Belize Botanic Garden, University of Edinburgh. Rekindle efforts to promote certified xate production (Rain forest Alliance, LightYears IP). Note: international steps are already being undertaken to curtail the trade in wild collected xate. The campaign should follow those trends. Year: 2011 Responsible: FCD, IA
Action 6	Identify a person who can champion the cause of the CCS Year: 2011 Responsible: FCD, IA
Action 7	Have the CCS together with Caracol (and preferably the entire Chiquibul Forest) declared a UNESCO World Heritage Site. Year: 2015 Responsible: IA, FCD, GOB, FCD

Monitoring and Review Sub-Programme	
Objective 1: Annual review of management activities	
Action 1	Review of management effectiveness assessments on an annual basis, for submission to the IA Year: 2010 and then annual Responsible: FCD
Action 2	Review of research and monitoring activities Year: 2010 and then annual Responsible: FCD
Action 3	Review of education and public awareness activities Year: 2010 and then annual Responsible: FCD
Objective 2: Periodic review of management plan	
Action 1	Ensure monitoring information feeds back into adaptive management planning activities. Year: Continuous Responsible: FCD
Action 2	Review Management Plan after 5 years Year: 2015 Responsible: FCD
Action 3	Full management effectiveness assessment (as per NPASP) for submission to IA at end of 5 years Year: 2015 Responsible: FCD

5.4.3. Research and Monitoring Programme

Overall Objective: By 2015 have a dynamic research database that actively assist in the management of the CCS.

Within this general objective, a number of conservation and/or management priority issues have been identified through the conservation action planning exercise:

- Lack of inventory information, as few geological, biodiversity and cultural inventories have been completed for the CCS and virtually no baseline data exist
- Much of the information that is available from CCS focuses on mapping, cultural/archaeological features.
- The karst flora and fauna is highly specialized but has been little inventoried in and around the cave system.
- Inventory data is not considered fully sufficient for management, but does serve the current purpose of dealing with critical concerns.
- Nothing is known about the carrying capacity of the cave system with respect to visitation.
- GIS database is still insufficient and too few staff is sufficiently familiar with the material to allow for high quality data collection.

Based on the above priority issues, the R&M Programme is divided into the following sub-programme:

- Research & Monitoring Sub-Programme

Research and Monitoring Sub-Programme	
Objective 1: Fill in knowledge gaps	
Action 1	Create and implement a CCS information management database to contain all research, (Geology, Archaeology, Biodiversity, etc.), to assist with adaptive management. Year: 2010 Responsible: FCD
Action 2	Identify and map locations of sensitive cave fauna, particularly bats Year: 2010 and ongoing Responsible: FCD potentially use external specialists
Action 3	Identify and map locations of sensitive portable and non-portable artifacts as well as particularly sensitive geological features Year: 2010 and ongoing Responsible: FCD, IA
Action 4	Conduct training on the recovery and maintenance of data sets for portable and non-portable artifacts Year: 2011 Responsible: IoA, XMET, Texas Cave Association
Action 5	Develop Geology baseline data for the CCS through cooperation with resident or visiting Geologists. Year: 2010 and ongoing Responsible: FCD in cooperation with external specialist(s)
Action 6	Gather biodiversity baseline data both in and around the caves. Year: 2010 and ongoing Responsible: FCD in cooperation with external specialist(s)
Action 7	GPS and Map all Sinkholes, Caves and other Karst features within the CCS management area Year: 2010 and ongoing Responsible: FCD, IA.
Action 8	Identify and map all trails in the CCS management area. Year: 2010 and ongoing Responsible: FCD

Objective 2: Develop monitoring programmes covering conservation targets	
Action 1	Develop and implement a monitoring protocol for the monitoring of the integrity of both portable and non portable artifacts as well as fragile geological features Year: 2010 Responsible: IA, FCD
Action 2	Establish long term water level monitoring programme for the CCS in order to get a grasp of flooding frequency and intensity. Year: 2010 Responsible: FCD
Action 3	Develop and implement visitor impact monitoring within CCS – covering education, research, users satisfaction and limits of acceptable change Year: 2011 or once experienced is gained with commercial visitation Responsible: IA, FCD
Objective 4: Provide incentives and infrastructure for further research	
Action 1	Coordinate with IA for further mapping, cultural/archaeological research programs and priorities Year: 2010 and ongoing Responsible: IA, FCD, XMET

5.4.4. Cultural and Natural Resources Management Programme

Overall Objective: By 2015, the cultural and natural resources of the CCS are in equal or better shape than in 2009

Within this general objective, a number of conservation and/or management priority issues have been identified through the conservation planning exercise:

- Illegal hunting;
- Illegal logging;
- Agricultural incursions;
- Fires;
- Military activities both from BDF and BATSUB;
- Looting and vandalism of cultural sites and properties;
- Illegal harvesting of xaté;
- Xaté harvesting the principal cause of illegal incursions with all associated side effects such as hunting and looting.
- Unsustainable and illegal harvesting of non-timber forest products (excluding xaté);
- Mining is not an existing issue within the Chiquibul River watershed, but may become one in the future.
- Illegal access to the cave system is a serious issue and can only be prevented by physically blocking the cave entrances. Given the access constraints and current security situation, this is not an option that is explored in this management plan. However, it should be explored in a next iteration of this management plan once the access and security issues have been resolved.

Based on the above priority issues, the NRM Programme is divided into the following sub-programmes:

- General Biodiversity Management Sub-Programme
- Archaeological Sub-Programme
- Mining Sub-Programme

General Biodiversity Management Sub-Programme	
Objective 1: Provide the enabling environment for effective biodiversity management of the CCS	
Action 1	Identify and demarcate critical biodiversity areas such as bat roosts and adjust any visitation to the cave system in order to safeguard the integrity of such critical areas. Year: 2010 and ongoing Responsible: FCD
Action 2	Integrate research and monitoring results into the adaptive management process Year: Continuous Responsible: FCD
Objective 2: By 2011 have a policy in place to prevent future incompatible licensed logging within a 1.5 km buffer of the Chiquibul Branch beginning at the Natural Arch.	
Action 1	Promote the modification of the existing Sustainable Forest Management Plan (SFMP) for the Chiquibul Forest Reserve to prevent future (incompatible with watershed function) logging within a 1.5 km buffer of the Chiquibul Branch beginning at the Natural Arch (area zoned for Tourism). Effectively implementing the CCS zoning areas. Year: 2011 Responsible: FCD, FD, License Holder

Archaeological Sub-Programme	
Objective 1: By the year 2013, conserve 25% of the known cultural sites of the Chiquibul Forest through greater knowledge of sites, more effective management, and greater collaboration with other conservation partners	
Action 1	Develop a comprehensive list, with mapping and assessment of all archaeological sites within the CCS Year: 2013 Responsible: FCD, IA
Action 2	Coordinate with IA for further mapping, cultural/archaeological research programs and priorities Year: 2010 and ongoing Responsible: FCD, IA, XMET
Action 3	Investigate Tunkul Cave system for potential tourism development Year: 2011 Responsible: FCD, IA.

Action 4	Identify and map locations of sensitive portable and non-portable artifacts as well as particularly sensitive geological features and adjust any visitation to the cave system in order to safeguard the integrity of such critical areas. Year: 2010 and ongoing Responsible: FCD, IA
Action 5	Establish and/or enforce International agreements for protection of cultural and natural resources (prevention of trans-border smuggling). Responsible: IA, GOB

Mining Sub-Programme	
Objective: To maintain the present status of mining in the CCS and to prevent future prospects (up-stream) of CCS watershed.	
Action 1	Through collaboration with the Geology and Petroleum Department, maintain the present status of (no) mining in the CCS and monitor any future mining prospects (up stream) of CCS watershed. Year: Continuous Responsible: FCD
Action 2	Monitor water quality of all streams within and emerging from prospecting/mining license areas, and act appropriately in case of issues Year: Once any mining operations come into effect upstream Responsible: FCD

5.4.5. Infrastructure Management Programme

Overall objective: By 2011 establish and maintain an infrastructure conducive to the proper management – in all aspects – of the CCS

Within this general objective, a number of conservation and/or management priority issues have been identified through the conservation planning exercise:

- Current infrastructure is inadequate to support proper management of the CCS
- Road conditions within the Chiquibul Forest are in an advanced state of deterioration, which is further exacerbated by the heavy vehicles and equipment that use the roads
- The current network of ranger stations and conservation posts are insufficient to provide adequate supervision and security coverage to the Chiquibul Forest
- There is no comprehensive radio communication coverage over the entire Chiquibul Forest
- The current network of helicopter landing sites is not upgraded

The Infrastructure Management Programme is divided into the following sub-programmes:

- Infrastructure Development Sub-Programme
- Infrastructure Use Training Sub-Programme

Infrastructure Development Sub-Programme	
Objective 1: Within the existing CNP management; ensure adequate infrastructure is in place to support CCS management and carry out protection and scientific monitoring activities while ensuring that infrastructure maintenance is compatible with CCS management plan	
Action 1	Establish an equipment base specifically for caving and cave rescue, taking into account spare/backup equipment for visitors. Year: 2010 Responsible: FCD
Action 2	Construct a conservation post at a strategic locations in the Cebada area Year: 2011 Responsible: BDF, FCD, FD
Action 3	Establish and maintain heli-pads in strategic positions in order to facilitate research, rescue and general emergency actions. Year: 2011 Responsible: FCD, FD, IA
Action 4	Maintain and/or lobby to maintain the Chiquibul Road and other designated infrastructural roads in the Chiquibul Year: 2010 and ongoing Responsible: FCD, FD, IA, Forest and Mining License Holders
Action 5	Operate the gate by the Ranger base in order to control heavy equipment Year: 2010 Responsible: FCD
Objective 2: Establish a 5 year moratorium on new road construction in CCS watershed downstream from Natural Arch.	
Action 1	Liaise with FD to ensure that no new road construction takes place within the Tourism zone of the CCS Year: 2010 and ongoing Responsible: FCD, FD, IA, Forest and Mining License Holders

Infrastructure Use Training Sub-Programme	
Objective 1: Ensure that CNP staff are adequately trained to operate and maintain CCS infrastructure and facilities	
Action 1	Provide first aid and Cave Rescue training potentially in partnership with Cave Rescue. Year: 2010 and ongoing Responsible: FCD

5.4.6. Public Use Planning Programme

Overall Objective: By 2010 have increased tourism, research and education activities within the Chiquibul Cave System and to have achieved some level of economic sustainability through expansion of tourism and research that is compatible with biodiversity conservation

At this moment, there is substantial tourism potential within the CCS but these potentials are virtually negated by current access problems and serious security issues with heavy presence of Guatemalan Xateros.

Within this general objective, a number of issues have been identified through the conservation planning exercise:

- Tourism demand and thus pressure, is still extremely low due to remoteness and under-developed attractions.
- Although the Natural Arch and the Chiquibul Cave have high tourism potential, little if nothing is known about their potential sensitivity or levels of acceptable change
- There exists a security threat to visitors as the result of the heavy presence from Guatemalan xateros

The Public Use Programme exists of only one "sub"programme:

- Public Use Sub-Programme

Public Use Planning Sub-Programme	
Objective 1: To increase tourism, research and education activity within the CCS and to achieve some level of economic sustainability through expansion of tourism and research that is compatible with cultural and biodiversity conservation	
Action 1	Develop and implement a five-year tourism development plan based on "niche-tourism" with the Kabal section of the Chiquibul Cave and the Natural Arch as main attractions. This plan needs to take into consideration access problems, monitoring and security issues. This plan could include the following action steps: o Marketing the CCS locally and internationally via a website and use of media. o Upgrading of infrastructure (roads, bridges, camping areas, communication etc) o Identify tour packages o Identify key tourism operators with sufficient high profile to attract a select (adventurous and affluent) public for visitation of the CCS, and establish a fee system for support that FCD gives to these tour operators. o Establish and enforce low-impact, no-garbage and other visitor regulations o Provide and maintain sufficient first aid materials and emergency rescue materials. o Coordinate with BTIA, BTB and tour guide associations to promote the cave as an adventure destination o Pass an SI for charging of entrance fees o Establish security measures o Have a detailed plan of emergency and evacuation o Cater for Belizean public o Development of an information center o Development of waivers o Develop interpretive materials See Archaeology Sub-Programme for development of Tunkul section Year: 2013 Responsible: FCD
Action 2	Following a certain degree of experience with visitation (after 5 commercial visits?) start to develop and implement a Limits of Acceptable Change Program including a monitoring program of user numbers (research and education), activities, and satisfaction. Year: 2015 Responsible: FCD

Action 3	Do not create new trails to access cave openings, but rather establish GPS points of entrances and follow a "unpredictable route" to reach entrances as not to draw unwanted attention to cave entrances. Year: Ongoing Responsible: FCD
Action 4	Investigate the role of Eco-Quest Expeditions as a service provider for tourism ventures in the CCS Year: 2010 Responsible: FCD, IA, FD, Tourism Stakeholders

5.5. Monitoring and review

The following monitoring and review process is presented as the mechanism for tracking progress of the management plan's implementation and ensuring compliance with assigned responsibilities within the management plan. The process is effectively the same as proposed for the CNP and includes the following steps:

- The CCS Manager, FCD Environmental Educator, FCD Executive Director and Board Chairperson collect monthly updated individual objective summary/status reports from responsible employees, members, volunteers (including Board of Directors) and consultants.
- The FCD Executive Director ensures that all objectives have been accounted for.
- The FCD Executive Director, based on consultation and in coordination with the Chairperson and Programme Managers, makes note of unfinished objectives (shortfalls), needs for readjustments of outcomes and target dates (re-forecasts), meetings to be called, etc., on a bi-monthly basis.
- The FCD Executive Director ensures that any reporting relevant to the CCS is shared with the IA.
- Based on programme managers' reports, the FCD Executive Director documents progress of strategic plan implementation in a brief inter-organizational memorandum on a quarterly basis to all management plan participants. Also a shortened non-detailed version should be included in the organizational newsletter.
- Review of management plan implementation should be a regular agenda item at staff and Board meetings.
- The management plan is to be generally monitored through quarterly meetings with the Forest Department and IA, internal planning sessions and a mid-term evaluation.
- Progress of management plan implementation is to be evaluated at annual Board Retreats.

6. Karst and Cave Glossary

Karst: Geological feature referring to limestone that is being eroded from the inside out by water. Rainwater that has become acidic under the influence of leaf litter and humus percolates through limestone, slowly dissolving it. Fissures and cracks form allowing the formation of underground waterways that carve out caves. Caves ultimately collapse, forming sinkholes.

Caves have various daylight **zones**:

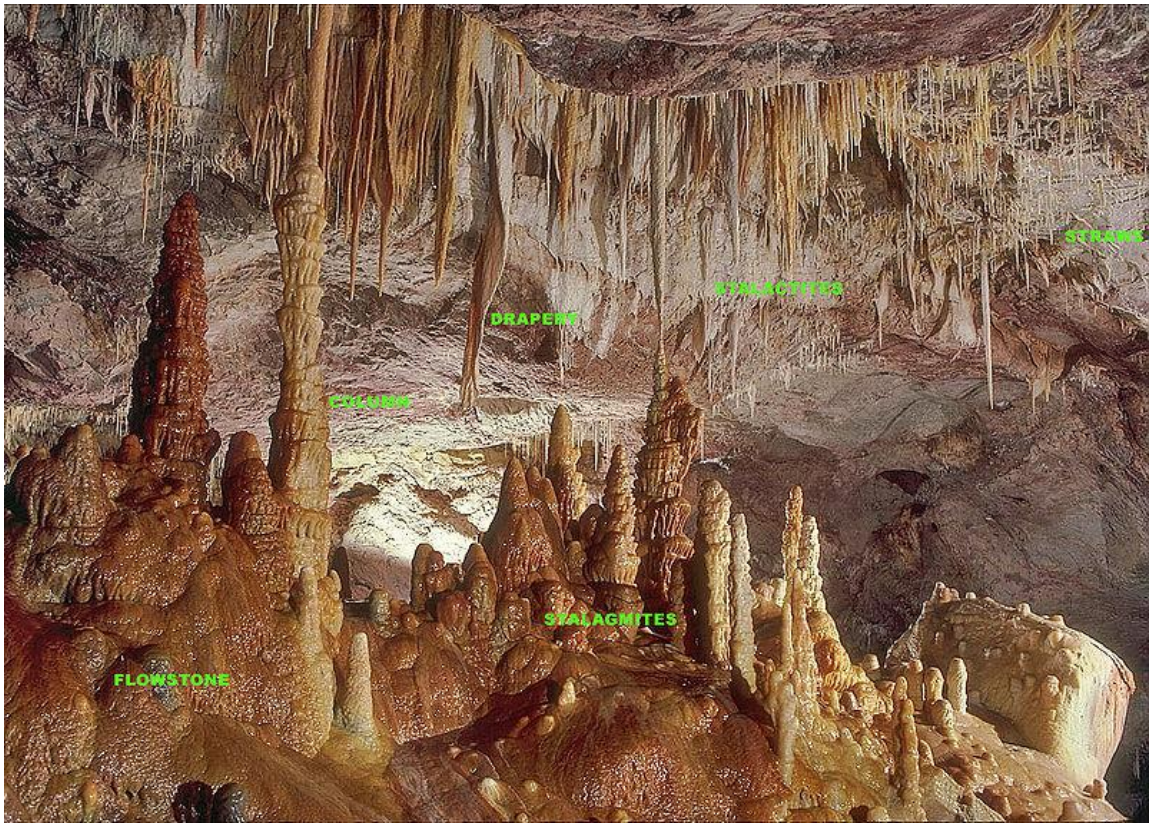
- The **Daylight Zone** includes the immediate entrance where direct sunlight penetrates and lights up the area on a daily basis for essentially constant use.

- The **penumbral zone** (twilight Zone, shadow zone) is further inside the cave, in permanent shadow past direct sunlight, but with visibility during most daylight hours. There is light, but no direct sunlight.

- The Interior **Dark Zone**, that area of total darkness far from the entrance and with no visible light orientation markers. Artificial light is necessary to move around. There is "transitional dark zone" which is located away from the entrance and is in total darkness, with absolutely no natural light, but it is an area where natural entrance glow can be seen from a distance.

The following is modified from Bunnel, D. 2009. Wikipedia. Note: Hyperlinks in Blue will only be active when connected to the internet.

A **speleothem** (from the Greek for "cave deposit"), commonly known as a **cave formation**, is a secondary mineral deposit formed in a cave. Speleothems are typically formed in limestone or dolostone solutional caves.



Dave Bunnell Wikipedia®

Speleothems take various forms, depending on whether the water drips, seeps, condenses, flows, or ponds. Many speleothems are named for their resemblance to man-made or natural objects. Types of speleothems include:

- **Dripstone** is calcium carbonate in the form of stalactites or stalagmites:
  - **Stalactites** are pointed pendants hanging from the cave ceiling, from which they grow;
    - **Soda straws** are very thin but long stalactites having an elongated cylindrical shape rather than the usual more conical shape of stalactites;
    - **Helictites** are stalactites that have a central canal with twig-like or spiral projections that appear to defy gravity;
      - Include forms known as ribbon helictites, saws, rods, butterflies, "hands", curly-fries, and "clumps of worms"
    - Chandeliers are complex clusters of ceiling decorations;

- **Stalagmites** are the "ground-up" counterparts of stalactites, often blunt mounds;
  - **Broomstick stalagmites** are very tall and spindly
  - **Totem pole stalagmites** are also tall and shaped like their namesakes
  - Fried Egg stalagmites are small, typically wider than they are tall
- **Splattermites** are effectively Stalagmites with unusual architecture as a result of "splattering" dripwaters. The following description is from Djuna Bewley http://www.goodearthgraphics.com/virtcave/splattermites/splatter.html: a peculiar type of stalagmite featuring platy, upright protusions. These protusions arc around the central axis of a splattermite, fed by rings of drip splash that rebound from the formation's growing tip. Splattermites tend to form within tall cave chambers, where ceiling drops build up lots of speed and "bounce potential." But bounce, alone, won't build a splattermite--the splash droplets must also precipitate calcite very rapidly, before streaming downward along the sides of the formation. Splattermites, are most frequently represented in the tropics, where densely vegetated soils charge cave drip waters with exceptionally high concentrations of carbon dioxide. This carbon dioxide is rapidly released as drip water enters the cave atmosphere. Calcite deposition is, likewise, prompt.
- **Columns** result when stalactites and stalagmites meet or when stalactites reach the floor of the cave;

- **Flowstone** is sheetlike and found on cave floors and walls:
  - Draperies or curtains are thin, wavy sheets of calcite hanging downward;
    - Bacon is a drapery with variously colored bands within the sheet;
  - **Rimstone dams**, or gours, occur at stream ripples and form barriers that may contain water;
  - **Stone waterfall** formations simulate frozen cascades

- **Cave crystals**:
  - **Dogtooth spar** are large calcite crystals often found near seasonal pools;
  - **Frostwork** is needle-like growths of calcite or aragonite;
  - **Moonmilk is white and cheese-like;**
  - **Anthodites** are flower-like clusters of aragonite crystals

- **Speleogens** (technically distinct from speleothems) are formations within caves that are created by the removal of bedrock, rather than as secondary deposits. These include:
  - Pillars
  - Scallops
  - Boneyard
  - Boxwork

- **Others:**
  - **Cave popcorn**, or cave coral, are small, knobby clusters of calcite;
  - **Cave pearls** are the result of water dripping from high above, causing small "seed" crystals to turn over so often that they form into near-perfect spheres of calcium carbonate;
  - **Snottites** are colonies of predominantly sulfur oxidizing bacteria and have the consistency of "snot", or mucous;[1]

Speleothems may also occur in lava tubes. Although sometimes similar in appearance to speleothems in caves formed by dissolution, these are formed by the cooling of residual lava within the lava tube.

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