Management Plan

Cockscomb Basin Wildlife Sanctuary

2019 - 2023

Belize Audubon Society

Cockscomb Basin Wildlife Sanctuary

GOAL

"To maintain biodiversity, ecosystems, cultural resources and watershed areas within a functional conservation area, as an integral part of the National Protected Areas System, providing benefits to Belize"

OBJECTIVES

Objective 1: Improved local support for conservation / environmental stewardship in local communities and stakeholders

Objective 2: Sound research informing public perceptions and management decisions

Objective 3: Contribution towards the environmental services provided by conservation areas – clean air, clean water, and climate change amelioration

Objective 4: Provision of a resource that is valued by visitors

Cockscomb Basin Wildlife Sanctuary

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Wildtracks, 2018

Acknowledgments

We would like to thank all those who participated in the development of this management plan including the community representatives, tour guides, and researchers who took time to attend the workshops and provided their views, information and recommendations to ensure that the management plan reflects the socio-economic needs of the communities as well as the protection of biodiversity and ecosystem services.

Thank you also to all the Belize Audubon Society personnel, both those working at Cockscomb and those in the Belize City office for sharing time and information.

Management Plan facilitated by:
Wildtracks
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Wildtracks, 2018

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Introduction

Background and Context

A cornerstone of Belize's present National Protected Areas System, Cockscomb Basin Wildlife Sanctuary encompasses 122,260 acres (49,477 ha) of the east-facing slopes of the Maya Mountains Massif – a landscape of ridge crests, rolling hills and river flood plains, cloaked primarily in tropical broadleaf evergreen forest. It was established following research work in the area in the 1980's, which highlighted its value for jaguars (Rabinowitz, 1983). The area has continued to be a focal point for research into this species to this day. As the foremost of Belize's terrestrial national protected areas, it is one of six of the highest priority protected areas in the National Protected Areas System, based on environmental values, biodiversity status, socio-economic values, and key climate change resilience factors (Walker et al., 2013). It is also a valuable asset for the tourism stakeholders within the area, as well as for the local and national economy. Day to day management of the area is the responsibility of the Belize Audubon Society (BAS) through a co-management agreement with the Forest Department.

The Cockscomb Range, a well-known national landmark within Belize, lies within the contiguous Victoria Peak Natural Monument. This series of peaks forms the northern-most wall of the Cockscomb Basins, and dominates the landscape. The highest point is Victoria Peak, at 3,675 feet (1,120m), flanked on both sides by lower peaks – Mount Allan and Mount Escott to the west, and Mount Holland, Jerningham Peak and The Molar to the east. The 4,847 acres of the Natural Monument are also managed by BAS as part of a single management unit with the Cockscomb Basin Wildlife Sanctuary.

Between them, the Wildlife Sanctuary and the Natural Monument protect an estimated 17 ecosystems (15 terrestrial and 2 aquatic) over a broad altitudinal range, from lowland broadleaf forest to sub-montane elfin woodland. This large expanse of forested uplands and valleys is a critical part of the Maya Mountains Massif, one of the last remaining large, intact blocks of forest within the Mesoamerican region. The Massif is considered essential for the survival of wide-ranging species such as scarlet macaw, white-lipped peccary, and Yucatan black-handed spider monkeys, all of which need large blocks of contiguous forest to maintain viable populations. The protected areas are a critical stronghold for many other species of national and international concern, including the endangered Baird's tapir, black howler and spider monkeys, two species of rain frog, and the regionally important population of scarlet macaws. At least 17 globally threatened species (Critically Endangered, Endangered and Vulnerable (Table 1; IUCN, 2018))are reported from the area, and Cockscomb Basin Wildlife Sanctuary also plays an important role in

the maintenance of game species in the area – both mammals and birds – replenishing the areas outside where hunting is permitted.

The forested slopes provide a measure of water security and reduce the risk of flash floods for the agricultural areas and communities of the coastal plain. The protected watersheds also maintain the water quality of rivers flowing to the Caribbean Sea, essential for the health of the Belize Barrier Reef.

Cockscomb Basin Wildlife Sanctuary and Victoria Peak Natural Monument are two of twenty protected areas that form the Maya Mountains Massif, the largest remaining intact forest block in Belize. The upper elevation areas also provide protection for part of Belize's highest priority Key Biodiversity Area.

THREATENED SPECIES	
Critically Endangered	
Cycad	*Zamia prasina*
Endangered	
Yucatan Black Howler Monkey	*Alouatta pigra*
Central American Black-handed Spider Monkey	*Ateles geoffroyi*[*]
Sanderson's Rain Frog	*Craugastor sandersoni*
Baird's Tapir	*Tapirus bairdi*
Bromeliad Treefrog	*Bromeliohyla bromeliacia*
Vulnerable	
Agami Heron	*Agamia agami*
Spanish Cedar	*Cedrela odorata*
Xate Macho	*Chamaedorea oblongata*
Limestone Rainfrog	*Craugastor psephosypharus*
Great Curassow	*Crax rubra*
Cerulean Warbler	*Dendroica cerulea*
Keel-billed Motmot	*Electron carinatum*
Leprus Chirping Frog	*Eleutherodactylus leprus*
Mountain Palmeto	*Schippia concolor*
Big-leaf Mahogany	*Swietenia macrophylla*
White-lipped Peccary	*Tayassu pecari*

Note: *A. geoffroyi yucatanensis, the subspecies in Belize, is now considered genetically identical to A. g. vellerosus, a Critically Endangered sub-species (Moralez-Jiminez et al., 2015).*

TABLE 1: THREATENED SPECIES OF CBWS / VPNM (IUCN, 2018)

The Wildlife Sanctuary and Natural Monument are each defined by a site specific statutory instrument that defines the resource use permitted within the two protected areas. The core area of the Wildlife Sanctuary was established as a Forest Reserve in 1984 (93 of 1984), and then extended to its current extent as a Wildlife Sanctuary in 1997 (SI 113 of 1997). The management regime is considered to be equivalent to IUCN Category IV. The Natural Monument was established in 1998, through SI 47 of 1998), and is considered to be equivalent to IUCN Category III. In 1998, the 4,847 acres of the adjacent Victoria Peak Natural Monument came under Belize Audubon Society management, bringing the total area of the two contiguous protected areas to an estimated 127,107 acres.

Summary of Key Characteristics:

- Large tract of undisturbed forest
- Watershed protection and water security
- Ecosystem representation
- Protection of riparian vegetation

Summary of Resilience Features

- Large, intact forest cover and
- Protective ridges on all sides – particularly the east (seaward)-facing side, provide a level of protection from increased storm intensity,
- Maintenance of water catchment functionality
- Altitudinal connectivity for forest ecosystems

National Protected Areas System Rationalization Report (Walker et al., 2012)

Purpose and Scope of Management Plan

This Management Plan provides the contextual background for informed management decision making and a structured framework of activities to assist the Belize Audubon Society, as the co-management partner, the Forest Department (as the management authority), and other partners to ensure Cockscomb Basin Wildlife Sanctuary (CBWS) and Victoria Peak Natural Monument (VPNM) continue to support both biodiversity, water security and other environmental services, and livelihoods.

The management of the Cockscomb Basin is guided by its categorization as a Wildlife Sanctuary, designated under the National Protected Areas System Act:

"To protect nationally significant species, biotic communities or physical features."

Victoria Peak, as a Natural Monument, was designated:

"To protect and preserve natural features of national significance."

This Management Plan has been developed by Belize Audubon Society, as the co-management partner, to guide the management of the two protected areas as a single unit[1] through the next five years (2019 – 2023). In line with the National Protected Areas Policy and System Plan, it reflects the participatory approach to management being adopted in Belize today, with the input of key stakeholders of CBWS, through focal group meetings, interviews with a wide variety of individuals (including key buffer communities and tourism stakeholders), and the CBWS staff (both at management and field level).

The Plan includes information on the physical and biological attributes of the protected areas, based on past and current research conducted in the area, and documents the legislative framework. It summarises current uses and management challenges, and integrates support for tourism, research and education whilst balancing this with protection of the resources of the area whilst implementing Managed Access as a mechanism for continued use.

The Management Plan summarises the outputs of the conservation planning processes - for the Wildlife Sanctuary itself, and for the larger landscape, and integrates climate change assessment outputs. It identifies the management challenges, and defines the goals and objectives of management for the five-year period.

[1] NB: Throughout this document, the terms 'Cockscomb' or 'CBWS' refer to both Cockscomb Basin Wildlife Sanctuary and Victoria Peak Natural Monument, unless otherwise specified,

The Plan provides a framework for both broad management strategies as well as more specific activities to achieve the goals of maintaining ecosystem functions and natural resource values. It outlines specific management programs based on the best available data and scientific knowledge, integrating conservation planning strategies, as well as relevant strategies of national and regional plans. It also sets in place the means for measuring management effectiveness, and recommends an implementation schedule. It is recommended that detailed annual operational plans be developed based on the framework provided by this management plan, with an annual review of implementation success, allowing for adaptive management over the five-year period – 2019 to 2023.

Section One

Current Status

1. CURRENT STATUS

1.1 LOCATION

The approximately 127,000 acres of the Cockscomb Basin Wildlife Sanctuary (including Victoria Peak Natural Monument) is perhaps the best known of Belize's terrestrial protected areas. Located on the east facing slopes of the Maya Mountains, 15 km from the Caribbean coastline, Cockscomb Basin Wildlife Sanctuary (including the Victoria Peak Natural Monument) is a core component of the Maya Mountains Massif, a block of continuous protected areas that cover the upper elevation. Geopolitically, the combined Cockscomb Basin Wildlife Sanctuary and Victoria Peak Natural Monument straddle both Stann Creek and Toledo Districts, two of six administrative districts within the country (Map 2), with the north west corner of the Natural Monument projecting into a third - Cayo District.

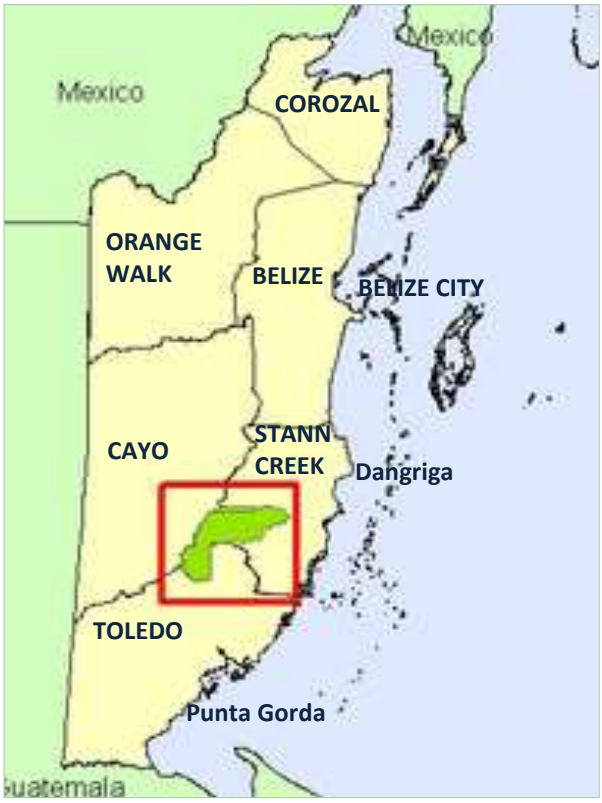


FIGURE 1: LOCATION OF CBWS / VPNM IN BELIZE

ACCESS

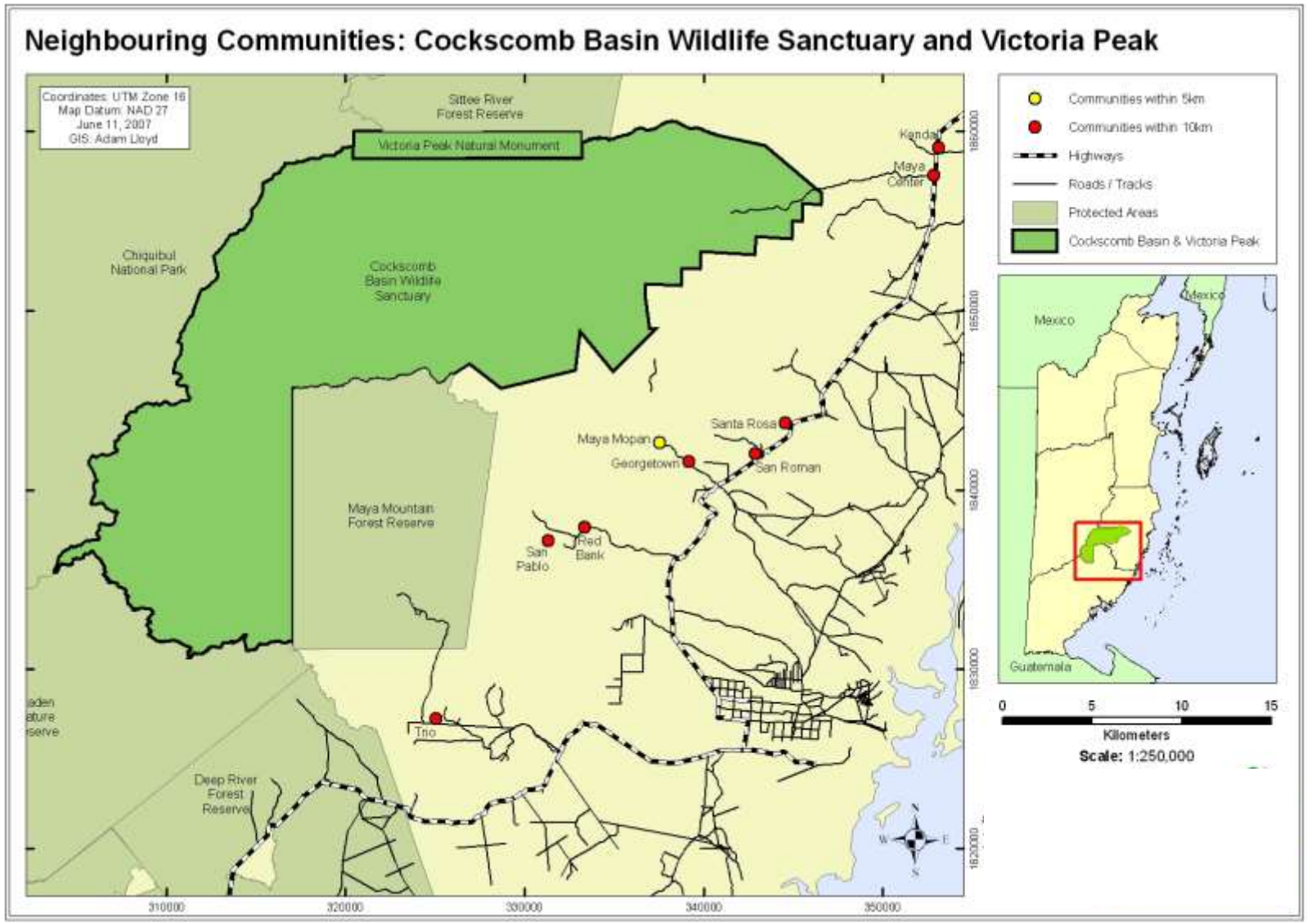
Cockscomb Basin Wildlife Sanctuary is approximately 20 miles south of Dangriga, accessed from the junction with the southern highway at Maya Centre. There are two access points. The first is a non-paved road entering from the east, from the Southern Highway, through Maya Centre. This ends at the Headquarters, where a series of buildings form the administration and accommodation complex, and visitor facilities. From here, a series of trails around the central Headquarters area are maintained for visitor use, with a focus on scenic features such as Tiger Fern and Ben's Bluff, both of which look out over the East Basin towards Victoria Peak, and provide access to waterfalls. There are also a number of longer trails that allow access to **MAP 1:** Victoria Peak, Outlier and Mexican Branch.

The second access point is through Maya Mopan, with an old logging track allowing foot and All-Terrain Vehicle access to the Juan Branch warden outpost, which is manned against poaching.

The unpaved road that winds its way for 6 miles (10 km) westwards into the Cockscomb Basin is generally all-year access for high-ground vehicles, unless impacted by extreme storm events. The road enters the Wildlife Sanctuary at the White House, and ends at the CBWS Headquarters.

COMMUNITIES ADJACENT TO COCKSCOMB BASIN WILDLIFE SANCTUARY

Ten stakeholder communities have been identified within the immediate Cockscomb landscape, with Maya Centre and Maya Mopan most closely linked to the protected area. Others include Red Bank, San Roman, Santa Rosa, San Pablo, Trio Farm, Bladen Village and George Town. A further three (Dangriga (the Stann Creek district administrative center), Hopkins and Placencia) benefit from the attraction of Cockscomb as a tourism destination (Map 2).



MAP 2: THE LOCATION OF COCKSCOMB BASIN WILDLIFE SANCTUARY AND VICTORIA PEAK NATURAL MONUMENT

1.2 REGIONAL AND INTERNATIONAL CONTEXT

Belize, recognized as part of the Mesoamerican biodiversity hotspot, was founded on its biodiversity wealth, and it is this natural capital that continues to support today's economy. Cockscomb Basin Wildlife Sanctuary and Victoria Peak Natural Monument are core components of the Maya Mountains Massif (MMM), a regional important forest node that covers an estimated 1,260,800 acres (approximately 510,330 hectares), and one of the largest remaining intact forested blocks in the region. The MMM stretches from the Vaca Forest Reserve at its most northerly extent to Columbia River Forest Reserve in the south, and encompasses a total of fourteen protected areas, the majority administered by the Forest Department, and one by the Institute of Archaeology. It is considered critical for the long term viability of forest species in the region. The protected upper watersheds also maintain the water security (both quality and quantity) of rivers flowing to the southern coastal plain, and m there onto the Caribbean Sea, essential for the health of the Belize Barrier Reef. The forested slopes of the Wildlife Sanctuary also reduce the risk of flash floods for the agricultural areas and communities of the coastal plain.

Unlike many of its larger Central American neighbors, the natural landscapes and seascapes of Belize still support viable populations of large ranging species. CBWS, as part of the MMM, includes a portion of Belize's highest priority Key Biodiversity Area, and protects species of international concern, including the critically endangered sub-species of the Central American black-handed spider monkey, endangered Baird's tapir, Yucatan black howler, two species of rain frog, as well as a regionally important population of scarlet macaws, making it a critical component of the regions effort in maintaining biodiversity.

Belize is party to a number of global Multilateral Environmental Agreements (MEAs) that focus on biodiversity issues (Table 2). Many of these are legally binding, and are required to be integrated within the national legislative framework. As a signatory of the **Convention on Biological Diversity (CBD) (1992),** Belize is committed to ensuring it has measures in place to protect biodiversity, with promotion of sustainable use, contributing to the 2011 – 2020 CBD strategic goals.

More specific targets of the CDB relevant to Cockscomb Basin Wildlife Sanctuary include:

- promoting the conservation of the biological diversity of ecosystems, habitats and biomes;
- promoting sustainable use and consumption, by encouraging use of products derived from sources that are sustainably managed;
- addressing threats to biodiversity related to the pressures of habitat loss, land use change and degradation, and unsustainable water use;
- addressing challenges to biodiversity from climate change, and pollution;
- maintaining the capacity of ecosystems to deliver goods and services that support sustainable livelihoods, local food security and health care, especially of poor people

Key International and Regional Conventions and Agreements of Relevance to Cockscomb Basin Wildlife Sanctuary	
Convention on Biological Diversity (Rio de Janeiro, 1992) Ratified in 1993	**To conserve biological diversity to promote the sustainable use of its components, and encourage equitable sharing of benefits arising from the utilization of natural resources** *CBWS is an important and integral part of Belize's national protected areas system, protecting biodiversity and threatened species, as per Belize's commitment under the CBD.*
Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972)	**The World Heritage Convention requires parties to take steps to identify, protect and conserve the cultural and natural heritage within their territories.** *With several watershed originating in the CBWS / VPNM, the protected areas play a key role in maintaining water flow and water quality of the rivers that flow into the coastal waters of Belize*
Alliance for the Sustainable Development of Central America (ALIDES) (1994)	**Regional alliance supporting sustainable development initiatives.** *As a national protected area, CBWS provides sustainable benefits to local communities through ecosystem services (including water security) and tourism, whilst also protecting biodiversity and threatened species, as per Belize's commitment under ALIDES.*
Central American Commission for Environment and Development (CCAD) (1989)	**Regional organization of Heads of State formed under ALIDES, responsible for the environment of Central America. Initiated Mesoamerican Biological Corridors and Mesoamerican Barrier Reef Systems Programs.** *Belize has worked with other ALIDES members towards the implementation of the Mesoamerican Biological Corridors Programme towards long term biodiversity viability. CBWS is part of one of the critical forest nodes connected by the MBC.*
Convention on the Conservation of Biodiversity and the Protection of Priority Wilderness Areas in Central America (Managua, 1992)	**To conserve biological diversity and the biological resources of the Central American region by means of sustainable development** *CBWS, as part of the MMM, is one of the few remaining large tracts of forest able to support wide-ranging umbrella and key stone species such as white lipped peccary and jaguar*

TABLE 2: KEY INTERNATIONAL CONVENTIONS AND AGREEMENTS OF RELEVANCE TO COCKSCOMB BASIN WILDLIFE SANCTUARY

As a requirement of the CBD (Article VI (a)), the CBD focal point in Belize, the Forest Department, is required to develop and implement the National Biodiversity Strategy and Action Plan (NBSAP) to regulate and manage activities that have or are likely to have significant adverse impacts on the conservation, sustainable use and the sharing of the benefits of Belize's biological diversity. All of these targets are reflected in the goal and objectives for the Wildlife Sanctuary / Natural Monument, and in the wider goal, mission and activities of the Belize Audubon Society and the Belize Forest Department. Belize has largely met global protection targets for almost all terrestrial

ecosystems within the National Protected Areas System, with identification of required actions for those that are under-represented.

Belize is a party to the **United Nations Framework Convention on Climate Change (UNFCCC)** which, whilst not an MEA, is closely associated to the environment, and sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. Belize is considered a Small Island Developing State under this convention, with the impacts of climate change far outweighing the contribution to emissions, and at high risk of negative impacts from climate change.

Under the **Convention Concerning the Protection of the World Cultural and Natural Heritage,** Belize has a serial nomination of seven sites, designated in 1996 as components of the Belize Barrier Reef Reserve System - World Heritage Site. These seven sites are seen as representative of the Belize Barrier Reef and are impacted by land-based pollution and watershed impacts. CBWS is important in maintaining the watershed functionality and protecting water quality in the upper watershed, though the coastal plain has significant agricultural development that does impact the water quality of the rivers and therefore the reef. As a signatory to the regional **Cartagena Convention**, Belize has also ratified the **Land-Based Sources of Pollution Protocol** as part of a concerted global effort to address the potential impacts of land-based sources of pollution on the marine environment. Under this Convention, Belize is required to address the issues of agrochemical pollution, nutrient runoff, deforestation and land use change.

Belize has not yet signed on to the **Convention on Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979)**, though this is a target of the current five-year National Biodiversity Strategy and Action Plan.

At the regional level, Belize is included in both Central American and Wider Caribbean agreements. The **Central American Integration System (SICA)**, provides a regional coordination and collaboration framework for Central America. Under this is the **Central American Commission for Environment and Development (CCAD)**, the regional organization of Heads of State formed under SICA, responsible for the environment of Central America. CCAD initiated the regional Mesoamerican Biological Corridors and Mesoamerican Barrier Reef Systems Programs. The **Alliance for the Sustainable Development of Central America (ALIDES)** calls for sustainable development with strategies for improved management of more sustainable resource extraction. The Maya Mountains Massif is one of the last remaining large blocks of intact forest to be linked through the Mesoamerican Biological Corridors Programme to improve long term biodiversity viability. It is also particularly important in the region in its role of watershed protection. The headwaters of fourteen watersheds - the majority of Belize's river systems - originate within the Maya Mountains, providing water security for 55% of the total land mass of Belize and over 128 communities, as well as supplying water to over 180 communities in Guatemala (Walker et al., 2008).

1.3 NATIONAL CONTEXT

1.3.1 NATIONAL PLANNING STRATEGIES

The national goals and objectives for conservation revolve around the sustainable use, conservation and protection of Belize's natural resources within the context of sustainable human development. These objectives are implemented through the **National Biodiversity Strategy and Action Plan** (GoB, 2016), which recognizes the importance of protected areas such as CBWS, and the need to mainstream biodiversity across all sectors in Belize, improve integration of biodiversity and protected areas into national planning strategies, and build both human and institutional capacity to effectively manage the biodiversity resources. It provides a framework for strategies under five national goals:

> ***GOAL A. MAINSTREAMING:*** *Improved environmental stewardship is demonstrated across all society in Belize, as is an understanding and appreciation of marine, freshwater and terrestrial biodiversity, its benefits and values.*
>
> ***GOAL B. REDUCING PRESSURES:*** *Direct and indirect pressures on Belize's marine, freshwater and terrestrial ecosystems are reduced to sustain and enhance national biodiversity and ecosystem services*
>
> ***GOAL C. PROTECTION:*** *Functional ecosystems and viable populations of Belize's biodiversity are maintained and strengthened*
>
> ***GOAL D. BENEFITS:*** *Strengthened provision of ecosystem services, ecosystem-based management and the equitable sharing of benefits from biodiversity*
>
> ***GOAL E. IMPLEMENTATION:*** *Effective implementation of the NBSAP through capacity building, strategic decision making and integrated public participation*

The most relevant to CBWS is **Goal C: PROTECTION,** (*TARGET C4. By 2020, average management effectiveness of the National Protected Areas System has increased to 80%)* (Figure …). Implementation is through the **National Protected Areas Policy and System Plan (NPAPSP**) (GoB, 2005; revised: 2015). This guides system-level and individual protected area management efforts to support the national objectives of ecological and economic sustainability over the long term, with the development of human and institutional capacity to effectively manage biodiversity resources within the NPAS. The NPAPSP centres on the following policy statement, which has been taken into consideration in the development of this plan:

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

GOAL C: PROTECTION

TARGET C4. By 2025, average management effectiveness of the National Protected Areas System has improved to 80%

C4.1 Implement the revised National Protected Area System Plan (NPASP) and supporting NPAS Rationalization Report

C4.2 Improve financial sustainability mechanisms for the NPAS

C4.3 Conduct 2016 and 2020 Assessments of management effectiveness of protected areas and implement recommendations

C4.4 10% of PAs have demonstrated economic value and direct

C4.5 Engage buffer communities for collaborative stewardship of the NPAS

KEY STRATEGIES OF GOAL C: PROTECTION OF THE NATIONAL BIODIVERSITY STRATEGY AND ACTION PLAN

Cockscomb Basin Wildlife Sanctuary contributes towards a key goal of the NPAPSP - to ensure that the "*National Protected Areas System includes high quality examples of the full range of environment types within Belize, with balanced representation of the ecosystem types they represent*" (NPAPSP, 2005). It provides representative coverage of several ecosystems of limited distribution in Belize, including the upper montane elfin woodland. It also harbors a significant percentage of the species found in Belize - over 58% of Belize's mammals, 56% of its birds, 42% of non-marine reptiles and 69% of the amphibians have been recorded to date,

Under a National Protected Areas System rationalization exercise, a number of recommendations were made for CBWS / VPNM to improve representation or protection of specific national targets:

Priority Ecosystem / Species Protection

- Should be considered for priority investment for tourism infrastructure – or for tourism concessions, in collaboration with Belize Audubon Society.

- Finalization of realignment of Mango Creek Forest Reserve (1) to cover the foothills of Cabbage Haul, providing increased protection from fires and increased watershed protection for CBWS
- Revise the SIs to remove the current north-eastern portion of proposed realignment of Mango Creek Forest Reserve(1) from MCFR(1), and integrate into Cockscomb Basin Wildlife Sanctuary as per 2008 initiative for full protection of Cockscomb Basin watershed functionality and tourism focal points of Tiger Fern and Ben's Bluff.
- Cockscomb Basin may actually qualify as IUCN Category Ib, based on public use being within 10% or less of the protected area - consider realignment under IUCN Category 1b, II, or retain as Category IV.
- Retain Wildlife Sanctuary status and no-take regulations (Wildlife Sanctuary (1)).

National Protected Areas System Rationalization Recommendations (Walker et al., 2012)

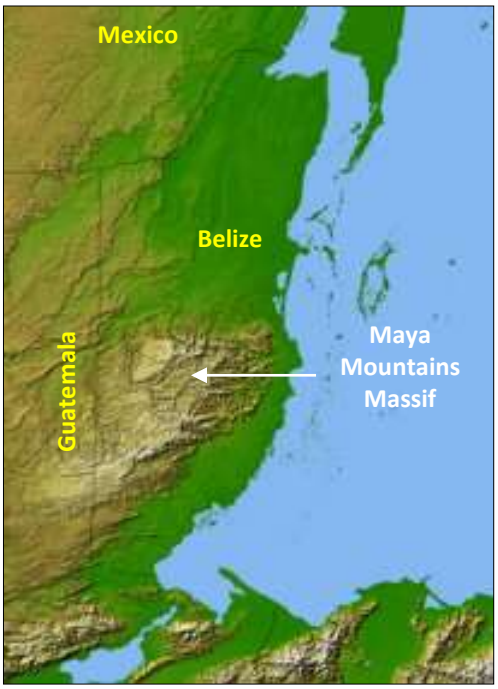
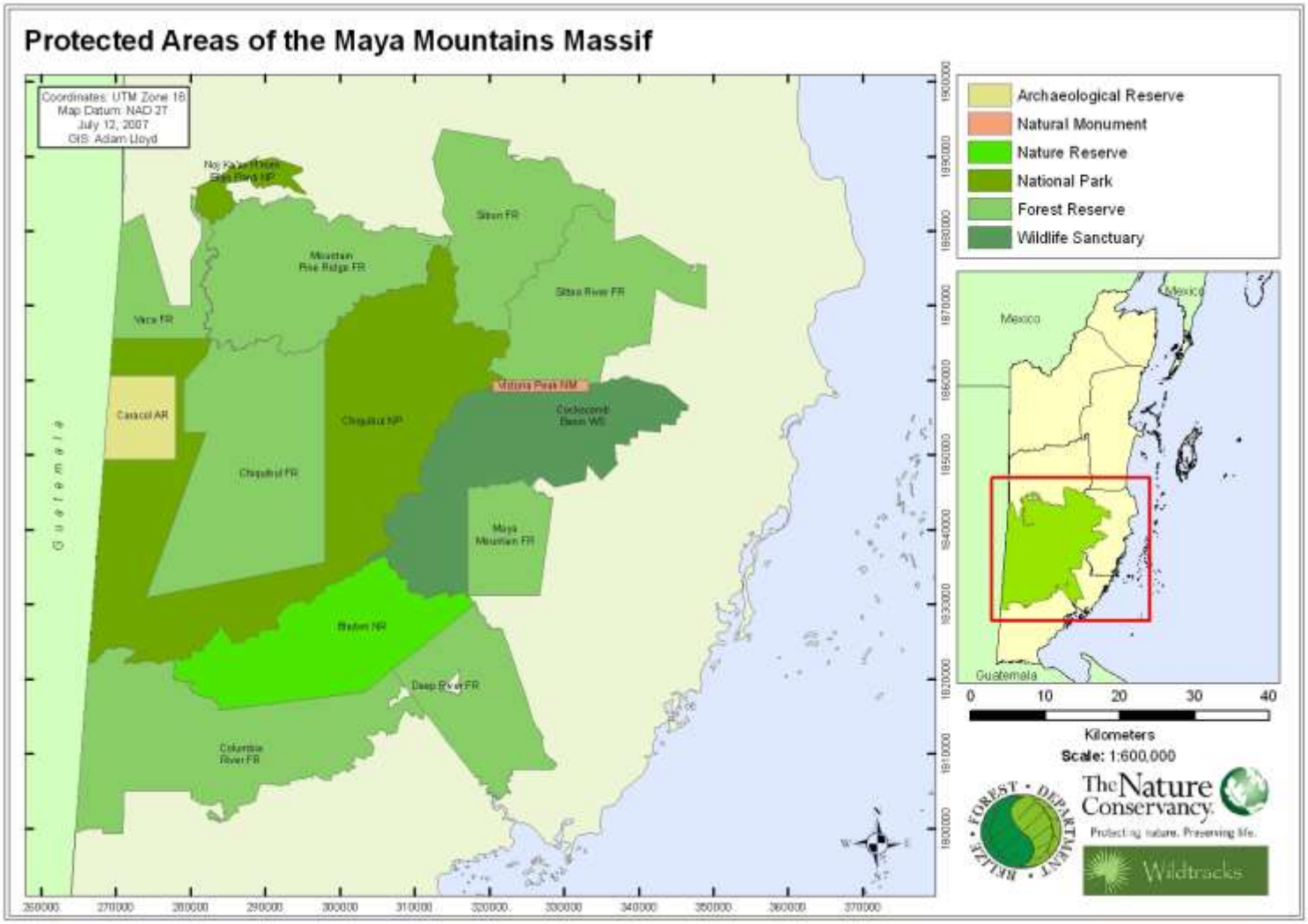


FIGURE 2: THE MAYA MOUNTAINS MASSIF

The Maya Mountains Massif (MMM) forms the prominent, elevated area to the south west of Belize (Figure 2; Map 3). Cockscomb Basin Wildlife Sanctuary and Victoria Peak Natural Monument are two of twenty protected areas that, together, form the Maya Mountains Massif, transcending site-level administrative categories. It has been identified as a system-level management unit, in recognition of the fact that resources and threats exist in a larger landscape beyond the boundaries of the individual protected areas themselves. Under the NPAPSP, government seeks to increase management effectiveness through grouping protected areas into system-level management units, with improved communication and collaboration between protected areas in similar landscapes and facing similar threats.



MAP 3: PROTECTED AREAS OF THE MAYA MOUNTAINS MASSIF

MMM Vision Statement

The Maya Mountains Massif of Belize and Guatemala is internationally recognized for its exceptional natural and cultural values. This vast, contiguous forest and complex of watersheds, contributes to national development, regional cooperation and international conservation. The Massif is managed as an exemplary model of integrated management that maintains ecological integrity and preserves cultural heritage for future generations.

Vision Statement
Maya Mountains Massif Conservation Planning Outputs (2008)

The MMM Conservation Action Plan (Walker et al., 2008) set out discrete goals and objectives at system rather than site-level, towards increasing management effectiveness, through improved collaboration for surveillance and enforcement, biodiversity monitoring, education, outreach, and management across MMM protected areas. Whilst the MMM CAP was not implemented at the time, the benefits of communication and collaboration are now being promoted at national level.

As such, management strategy development for Cockscomb Basin and Victoria Peak need to take into account the MMM vision, as well as the MMM goals and objectives for system-level management. Whilst these are now outdated and in need of revision, they are still important in ensuring that these protected areas are managed not only for their site-level significance, but also for their contribution to national conservation goals and commitments.

Both the NBSAP and the NPAPSP support Belize's **Growth and Sustainable Development Plan** (GSDS), part of the 15-year national development framework under Horizon 2030. The GSDS recognizes effective implementation of both the NBSAP and NPAPSP as critical in achieving national development goals.

The national objective of the **National Sustainable Tourism Master Plan** is to *"more than double overnight tourist arrivals while enhancing average length of stay and daily expenditure"***.** The qualities of the environment and the need to conserve these qualities are recognised in the MasterPlan, with the sustainable development program providing the framework that will *"ensure the NSTMP maintains a balance of the three pillars of sustainable development: social accountability, environmental conservation and economic prosperity."* Whilst the NSTMP is primarily focused on destination development, financing and marketing, but does recognize the importance of conservation and environmental management in supporting Belize's tourism industry.

1.3.2 LEGAL FRAMEWORK

Several key laws have been enacted to protect ecosystems, ecosystem services and biodiversity, contributing to the conservation framework of Belize. The Ministry of Agriculture, Fisheries,

Forestry, Environment and Sustainable Development is the administrative agency for the **National Protected Areas System Act (revised, 2015), Forest Act (1927), Fisheries Act (1948),** and the **Wildlife Protection Act (1981).**

KEY NATIONAL LEGISLATION PROTECTING FAUNA, FLORA, AND NATIONAL HERITAGE

The National Protected Areas System Act (2015)
Provides a framework for establishment and maintenance of the national protected areas system.

The Wildlife Protection Act (1981)
Provides for the conservation, restoration and development of wildlife and regulation of its use.

The Forest Act (1927)
Promotes the forestry industry, with the implementation of conservation techniques, Responsible for forestry activities in all types of forest, including littoral forests and mangroves.

The Fisheries Act (1980)
Principal governing legislation regulating the fishing industry, and is directly concerned with maintaining sustainable fish stocks and protecting the marine and freshwater environments.

Environmental Protection Act (1992)
Promotes the preservation and improvement of the environment, the rational use of natural resources, the control of pollution, and associated actions. This is achieved through the EIA / ECP process.

The National Integrated Water Resources Act (2011)
Provides for management of water resources. Its role includes estimating water availability and value, and implementing measures to ensure wise use and long term sustainability of Belize's water resources.

The **National Protected Areas System Act** provides the framework for management of the national protected areas in Belize, and is the primary tool for biodiversity planning and management, implemented through the Ministry of Agriculture, Forestry, Fisheries and Sustainable Development. It defines the various categories of protected area, including Wildlife Sanctuary and Natural Monument, and the activities that can be conducted in each area. It provides the framework for on-going effective management of Belize's natural resources within protected areas.

As non-extractive protected areas, hunting is not permitted within the boundaries of CBWS / VPNM under the NPAS Act, and wildlife is also managed outside the protected areas through the **Wildlife Protection Act (1982),** which regulates hunting, as well as providing protection for many terrestrial species in Belize. Regulated and protected species are listed in the Schedule. This Act is scheduled for revision and significant strengthening in 2018.

The **Fisheries Act** (being revised as the Aquatic Resource Bill), is administered under the Fisheries Department and is the principal governing legislation regulating the fishing industry. It is directly concerned with maintaining sustainable fish stocks and protecting the marine and freshwater environments. This includes the inland fisheries, with regulations that provide for sustainability of freshwater fish resources

(though these are seldom implemented outside the National Protected Areas System).

The **National Integrated Water Resources Act (2011)** recognizes that:

"Belizeans have a fundamental right to water ", safeguarded through the "planned development, coordinated management, sustainable use and protection of Belize's water resources consistent with the social, economic and environmental needs of present and future generations, and to ensure that all Belizeans have access to affordable, safe, adequate and reliable water."

It also integrates climate change as a key theme. There is recognition of the role of protected areas in the maintenance of water security in the Integrated Water Resource Management Policy and the Act.

In the area of "Gathering Grounds", the Act strengthens the protection provided to the forests managed under the Forestry Department:

50. (1) The Authority shall ensure that all gathering grounds shall …

(a) be retained as forest reserves or national parks, as the case may be, in accordance with the provisions of the Forests Act and the National Parks System Act;

The **Pesticides Control Act (1990)** provides a mechanism for the registration and regulation of pesticide importation and use through the Pesticide Control Board, important for improving pesticide management, and reducing contamination of the rivers. Studies have already shown the presence of glyphosates and organophosphates in standing water on Outlier and Victoria Peak (Kaiser, 2011), as a result of orographic drift from the southern coastal plain, where aerial spraying of agrochemicals on banana and other crops is ongoing.

Tourism legislation in Belize falls under the mandate of the Ministry of Tourism through the **Belize Tourism Board (BTB).** This regulates tourism activities such as guide:visitor ratios, guide training and certification, and licensing of tour operators and accommodation and is focused on maintaining standards for tourism in Belize. Regulations developed in collaboration with BTB are in place for climbing Victoria Peak, and regulate accommodation standards at the CBWS Headquarters.

The **Protected Areas Conservation Trust** (PACT) is the primary national financial sustainability mechanism for support of the National Protected Areas System. The Protected Areas Conservation Trust Act was passed in 1995 (Act 15 of 1995), and PACT was established as a statutory body in 1996. Over its 20 years of existence, PACT has assisted local conservation

organizations, including BAS, with funding for projects assisting in the maintenance of effective protected areas and providing leverage for funding from external sources. PACT's investments are aligned to the operational framework of the National Protected Areas Policy and System Plan (NPAPSP), focused on building management effectiveness of the NPAS, and strengthening biodiversity conservation in Belize.

The functions of PACT are:

"…to contribute to the sustainable management and development of Belize's natural and cultural assets for the benefit of Belizeans and the global community, both now and for future generations."

Protected Areas Conservation Trust (Amendment) Act, 2015)

1.3.3 LAND TENURE

SITE LEVEL LEGISLATION

Cockscomb Basin Wildlife Sanctuary is national land, designated by Statutory Instrument under the National Protected Areas System Act. The core area has had protected status since 1984 (first as a Forest Reserve, then as a Wildlife Sanctuary), and as such, there are restrictions on activities that can take place within the area. Research, educational and recreational activities are permitted, but no extractive use (sustainable or otherwise) is currently allowed. The initial core area was extended in 1990, and again in 1997, to include part of the Maya Mountain Forest Reserve, to give connectivity to Bladen (Table 3). Then more recently, in 1999, Belize Audubon Society was given management responsibilities for the adjacent Victoria Peak Natural Monument, set aside for the protection and preservation of Victoria Peak, the second highest point in Belize, and a nationally recognized natural feature.

During the development of the protected area from 1984 to 2003, estimates of the area have changed dependent on the location of the survey lines defined by the statutory instruments, and with the advent of more accurate GIS methods.

The evolution of Cockscomb Basin Wildlife Sanctuary			
Date	**Statutory Instrument**	**Area as defined in SI (acres)**	**Objective**
1984	93 of 1984	93,860	*Declared a Forest Reserve under Forest Act*
1984	94 of 1984		*Declared a No Hunting Area under the Wildlife Protection Act*
1986	32 of 1986	3,640	*Core area declared a Wildlife Sanctuary under the National Parks System Act*[1]
1990	127 of 1990	102,400	*Extended as a Wildlife Sanctuary under the National Parks System Act*[1]
1997	113 of 1997	122,260	*Extended as a Wildlife Sanctuary under the National Parks System Act*[1]
1998	47 of 1998	(4,847)	*Declaration of Victoria Peak Natural Monument under the National parks System Act*[1]
1999		127,107	*Victoria Peak Natural Monument under BAS/Cockscomb management*

NB. Estimates of areas have changed with different SIs. The area used in this Management Plan is based on the most recent SI – 113 of 1997.
[1]Now revised as the National Protected Areas System Act (2015)

TABLE 3: THE EVOLUTION OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Whilst the majority of the survey lines to the north, west and south have remained fixed, those to the east have been redefined several times, and have not yet been finalized in a revised Statutory Instrument. Their present location does not give protection to Ben's Bluff and Tiger Fern Double Falls, two of the most frequently visited tourist attractions of the Sanctuary. Nor does it include Cabbage Haul Lookout (included in the original Forest Reserve definition) which has caused concerns in the past, with the area being targeted by both mining and resort development in the mid 1990's - at that point, BAS and GoB agreed to redefine the boundaries to again match the original outline of the protected area (Figure 3).

More recently, a realignment of Mango Creek Forest Reserve (1) has provided some measure of protection to these areas of concern, though the key tourism sites are still not within the direct management scope of BAS.

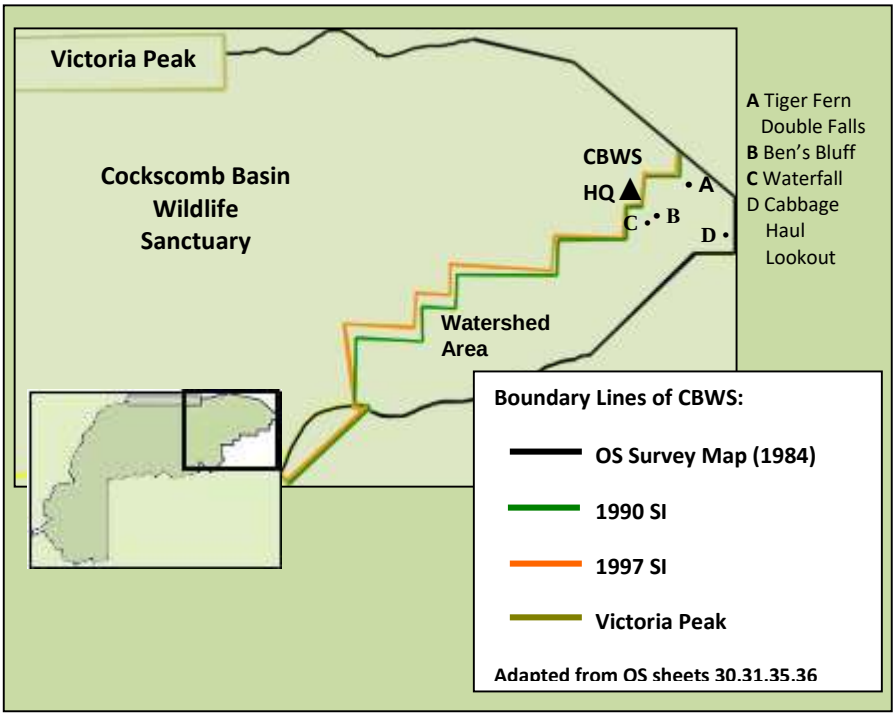


FIGURE 3: BOUNDARY LINES OF CBWS, SHOWING EXCLUDED WATERSHED

In keeping with their designations, both CBWS and VPNP are non-extractive protected areas, with use being restricted to tourism, research and education (Table 4). The management regime is aligned with IUCN designation **Category II: Protected areas managed primarily for ecosystem protection and recreation.** This is defined as:

> *"Natural areas 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 detrimental to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible."*

With the following management objectives:

1. To protect natural and scenic areas of national and international significance for spiritual, scientific, educational, recreational or tourist purposes;

2. To perpetuate, in as natural a state as possible, representative examples of physiographic regions, biotic communities, genetic resources, and species, to provide ecological stability and diversity;

3. To manage visitor use for inspirational, educational, cultural and recreational

purposes at a level which will maintain the area in a natural or near natural state;

4. To eliminate, and thereafter prevent, exploitation or occupation detrimental to the purposes of designation

5. To maintain respect for the ecological, geomorphologic, sacred or aesthetic attributes which warranted designation; and

6. To take into account the needs of indigenous people, including subsistence resource use, in so far as these will not adversely affect the other objectives of management.

Categories of Protected Areas in Belize			
Category	**Legal Foundation***	**Purpose**	**Activities Permitted**
Nature Reserve	National Parks System Act, 1981	To protect biological communities or species, and maintain natural processes in an undisturbed state.	Research, education
National Park	National Parks System Act, 1981	To protect and preserve natural and scenic values of national significance for the benefit and enjoyment of the general public.	Research, education, tourism
Natural Monument *Victoria Peak*	**National Parks System Act, 1981**	**To protect and preserve natural features of national significance.**	**Research, education, tourism**
Wildlife Sanctuary (1) *Cockscomb Basin*	**National Protected Areas System Act, 2015**	**To protect nationally significant species, biotic communities or physical features.**	**Research, education, tourism**
Wildlife Sanctuary(2)	National Protected Areas System Act, 2015	To protect nationally significant species, biotic communities or physical features whilst allowing for sustainable traditional use, following an accepted sustainable use plan.	Research, education, tourism, sustainable traditional use extraction
Forest Reserve	Forests Act, 1927	To protect forests for management of timber extraction and/or the conservation of soils, watersheds and wildlife resources.	Research, education, tourism, sustainable extraction
Marine Reserve	Fisheries Act, 1948	To assist in the management, maintenance and sustainable yield of fisheries resources	Sustainable extraction, research, education, tourism

* The National Parks System Act of 1981 has been revised as the National Protected Areas System Act of 2015

TABLE 4: CATEGORIES OF PROTECTED AREAS IN BELIZE

1.3.4 EVALUATION OF NATIONAL AND INTERNATIONAL IMPORTANCE

Cockscomb Basin Wildlife Sanctuary and Victoria Peak Natural Monument contribute to Belize's commitments under the Convention on Biological Diversity - towards the maintenance of viable populations of at least sixteen threatened species of international concern, recognized under the IUCN Redlist as Critically Endangered, Endangered or Vulnerable (Table 1; IUCN, 2018). This includes two species of primate (the Yucatan black howler monkey and Central American black handed spider monkey), and Baird's tapir.

Cockscomb Basin Wildlife Sanctuary is a crucial part of the Maya Mountain Massif, with Sittee River and Sibun Forest Reserves to the north, and Bladen Nature Reserve and Columbia River Forest Reserve to the south. Chiquibul National Park and Forest Reserve lie to the west, connecting to the protected areas system in Guatemala (Map ..). This large expanse of primarily forested uplands and valleys is essential for the survival of species such as scarlet macaw, white-lipped peccary and ornate hawk-eagle, which need large contiguous forest areas in order to survive. With the rapid clearance of forested areas throughout Central America, this is part of the last remaining large, relatively intact block of forest within the region.

ECOSYSTEM SERVICES OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Whilst Cockscomb is not able to give protection to the entire watershed area of those river systems originating from within the Wildlife Sanctuary (as the rivers pass through the agricultural coastal plain before entering the sea), it does protect the upper watershed, ensuring that it provides the major benefits of watershed protection and management to these coastal plain areas, including water security, water quality, flood control, sediment control, quality of fish stocks, biodiversity, habitat preservation, and recreation. It also protects the steeper slopes of the watershed areas, which, if cleared, would cause rapid erosion and sedimentation impacts, not only in the river system downstream, but also out on the fragile Belize Barrier Reef - the second largest barrier reef in the world and a World Heritage Site – which lies offshore.

The protected area also protects life support systems through clean air, clean water, flood / erosion control and through acting as a carbon sink. It also has heritage, scenic, recreation and tourism values, on top of its role in the preservation of genetic diversity Table 5).

Ecosystem Services of Cockscomb Basin Wildlife Sanctuary / Victoria Peak Natural Monument	
Regulation	▪ Water Regulation: The forest cover of the watersheds protected by Cockscomb and Victoria Peak is important in ensuring orographic rainfall, and regulating the timing and magnitude of runoff, flooding, and aquifer recharge. ▪ Erosion Regulation: Retention of forest cover on the steep slopes prevents excessive soil erosion and sedimentation of rivers and creeks, assisting in prevention of sedimentation impacts downstream. ▪ Ecosystem Regulation of Natural Hazards: The forest cover of CBWS and VPNM provides protection against natural hazards, anchoring soils against landslides in tropical storm events, and providing a buffering flood control function. ▪ Climate regulation: Changes in land cover have negatively affected regional and local climates, with tropical deforestation reducing local rainfall. CBWS and VPNM retain their natural vegetation cover, and assist in mitigation of some of the effects of climate change. ▪ Pollination: Pollination is a critical ecosystem function for the reproduction of most plants, including crops. Viability of pollinators is essential to the long term existence of plant species (and therefore biodiversity in general) of CBWS and VPNM, and of the agricultural crops in the adjacent area.
Recruitment	▪ Game Species Reservoir: The forest acts as a reservoir for game species such as great curassow, white-tailed deer and collared peccary, re-stocking the adjacent landscape and providing game, an important protein source, for the buffer communities of the Southern Coastal Plain
Cultural and Socio-Economic	▪ National Significance: Victoria Peak is of national significance as the most iconic peak in Belize - – the highest 'peak' in the country, and part of the ridge that resembles the distinctive cock's comb, as seen by sailors arriving from the East in the Dangriga / Placencia area. ▪ Recreation and Tourism: The scenic beauty of the forests, waterfalls, scenic vistas and wildlife are important as recreational and tourism resources. ▪ Socio-economic benefit: Tourism-based income associated with CBWS / VPNM is an important activity in the adjacent communities – particularly for Maya Centre It also helps supports the tourism sector in Placencia and Hopkins ▪ Education: Cockscomb Basin Wildlife Sanctuary is an important educational resource for Belize schools and international students
Support	▪ Tropical forests are very productive, playing an important role in the cycling of nutrients and providing ecosystems necessary for different life stages of commercial and non-commercial species ▪ Tropical forests are effective as a CO_2 sink ▪ Cockscomb Basin provide important stop-over habitat for migratory bird species ▪ Victoria Peak protects upper elevation ecosystems and species

TABLE 5: ECOSYSTEM SERVICES OF COCKSCOMB BASIN WILDLIFE SANCTUARY AND VICTORIA PEAK NATURAL MONUMENT (ADAPTED FROM MILLENNIUM ECOSYSTEM ASSESSMENT, 2005)

1.3.5 SOCIO-ECONOMIC CONTEXT

NATIONAL CONTEXT

Belize has a population currently estimated at approximately 380,030 (Table 6; SIB, 2016), with the lowest population density in Central America, at just over 14.6 persons per sq. km., concentrated primarily on the northern plain, southern coastal plain (including Toledo), Belize and Stann Creek Valley. Much of the remaining country is less suited to habitation, with swampy lowlands and steep terrain in the Maya Mountains.

Belize Demographic Statistics (Average)	
Population (2016 est.)	380,030
Population density (2015)	14.6/sq. km.
Urban Population (2015)	43.1%
Annual growth rate (2015 est.)	2.1%
Life expectancy (2015 est.)	70.1
Below Poverty Level	33.5% (2002) 43% (2010)
Literacy rate (2015)	82.3%
Unemployment rate (2016)	10.1%
GDP (per capita, 2015)	Bz$9,813.88 per capita
Annual GDP Growth (2015)	1.9%

TABLE 6: BELIZE DEMOGRAPHIC STATISTICS, (SIB, 2016)

It is a country of many cultures, with Mestizo, Creole, Maya and Garifuna forming the major population groups. Dangriga and Hopkins, the two key south-central communities closest to Cockscomb Basin Wildlife Sanctuary, were settled in the early 1800s, by the Garifuna people - immigrants of Amerindian and African ancestry who arrived from St. Vincent via the Roatan Islands, fleeing persecution. The Creole also settled in Stann Creek in the 18th century, when working in the logging industry in the area.

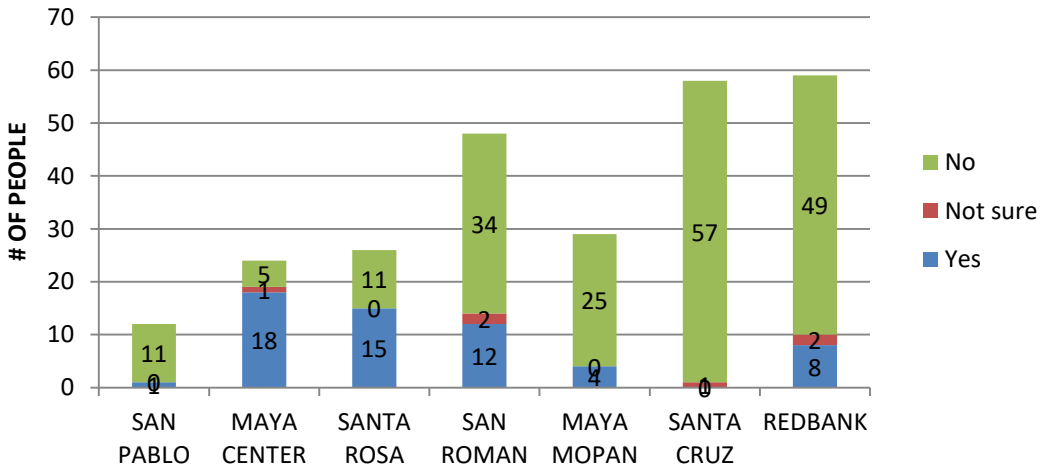
Over the last 30 years, there has been a shift in the cultural demographic of the country as a whole, with a significant influx of Central American refugees – primarily from Guatemala and Honduras – in 2010, an estimated 20% of heads of households were born outside of Belize (SIB, 2010). There is also an ongoing emigration of Belizeans to the United States – generally those from urban areas who have completed secondary school or have professional training, and an immigration of people to Hopkins and other coastal communities, predominantly from the USA, Canada and Europe, either as seasonal residents or as retirees.

The economy of Belize has been based largely on agriculture, with fisheries, banana, sugar and citrus forming some of the key traditional exports that have contributed significantly towards the GDP. More recently, revenue from oil extraction has been significant in supporting the economy, but this has now declined. The central southern coastal plain lying between Cockscomb and the sea supports an expanding human landscape, with a matrix of agricultural areas on the deeper alluvial soils, and aquaculture closer to the coast. Cattle farms, banana, citrus and (most recently) coconut plantations provide an important income source. These, along with the aquaculture facilities, provide employment for a significant number of people, bringing seasonal migrants and permanent workers to the area. However, with the recent closure of shrimp and banana farms,

fewer job opportunities, lower incomes and the effects of recent natural disasters, the tourism industry has become one of the leading employers in the area.

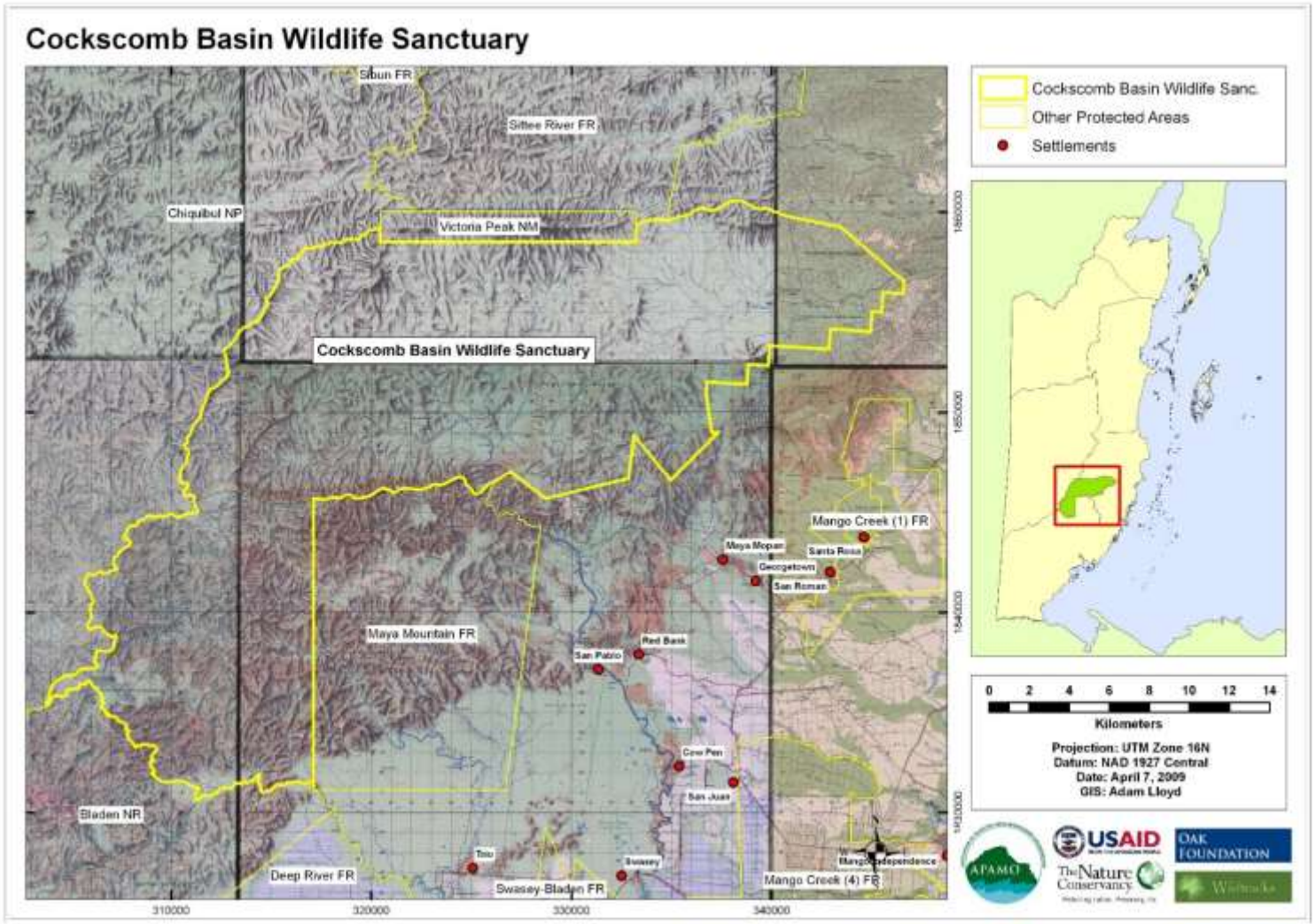
Seven key buffer communities lie within the CBWS landscape (Table 7), with populations that are predominantly Maya (Mopan & Ketchi), with the exception of Santa Cruz with a population that is Hispanic/Latino from Central American countries. with an additional three communities, located on the coast, are linked through tourism – Placencia, Hopkins and Dangriga. Self-employed milpa and citrus farming is important for keeping food on the table, and employment opportunities in the area are with the banana, cattle shrimp farms, resorts in Placencia and Hopkins, and self-employed work in construction, and tour-guiding.

The communities demonstrated varying degrees of support for the protected area. Maya Centre shows the greatest recognition of benefits from CBWS / BAS, with 75% positive respondents. However, in other communities, such as San Roman, Maya Mopan, Santa Cruz and Red Bank, the majority of respondents responded negatively when asked about CBWS / BAS impact on their lives. towards.



EFFECTS OF BAS/CBWS ON LIVELIHOODS (G. Casillo, 2014)

Community farmlands are expanding in the landscape, and new communities being formed. One such community is Roseville, a Mennonite farming community that is opening up farmland close to the CBWS boundary, improving access for hunting. These new communities are not currently being addressed by BAS outreach activities.



MAP 4: KEY STAKEHOLDER COMMUNITIES OF CBWS

Stakeholder Communities of CBWS

Community	Location (UTM) Distance (km)	Population (approx.)	Population Components	Comments
Maya Centre	E16 0354030 N18 57500 (6.5 km)	386	Mopan Maya	Originally from San Antonio (originally from Guatemala). Benefit from the presence of CBWS, so supportive of protected area. Milpa farming, citrus with tour guiding, local crafts, and hospitality services. Some employment at CBWS, and in agricultural industries
Maya Mopan	E16 0337600 N 42500 (5.5km)	632	Mopan Maya	Originally from San Antonio and San Jose in Toledo. Primarily milpa farmers- some rice and citrus, and some employment on plantations and shrimp farms. Have established a cocoa farming project and honey cooperative. Some hunting and fishing in the Juan Branch area. Some employment at CBWS
Red Bank	E16 0336000 N18 38000 (9km)	1,201	Ketchi and Mopan Maya, as well as Central American immigrant workers	First settled 20 years ago by Mopan Maya, who were then joined by Ketchi Maya originating from Guatemala, relocated by GoB from Chiquibul. The village is not cohesive, with in-fighting between ethnic groups. Each farmer has a milpa. Some citrus. Some hunting and fishing in Sale-Si-Puede area, for home consumption. Possible encroachment of CBWS with illegal milpas.
San Roman	E16 0354500 N18 60000 (7km)	894	Immigrant workers, resident Maya	Primarily a settlement of plantation workers, with a small amount of agriculture
Santa Rosa	E16 0343000 N18 41800 (9km)	542	Maya	Work on plantations and shrimp farms, but supplement this with subsistence milpa farming. Hunting and fishing within Cockscomb for domestic consumption and commercially, particularly in the Juan Branch area.
San Pablo	E16 0331510 N18 37253	250	Maya	Founded in 1997 by farmers from Aguas Calientes (Toledo District). Subsistence farming and seasonal plantation work. Hunting and fishing for home consumption.
Georgetown	**E16 0339200 N18 413000 (13.5km)**	**473**	**Garifuna**	50% of the working population has farms, whilst the other 50% works on the banana plantations. Some hunting for recreation and for home consumption. Not thought to impact Cockscomb. Being reassessed.

TABLE 7: STAKEHOLDER COMMUNITIES OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Stakeholder Communities of CBWS

Community	Location (UTM) Distance (km)	Population (approx.)	Population Components	Comments
Trio Farm	E16 0353000 N18 270000 (8km)	899	Central American (Guatemala, Honduran)	Some farming, with large land clearance near CBWS boundary. Large hunting parties of 8+ near CBWS boundary, and probably within CBWS. Illegal logging from within CBWS (mostly mahogany) using chainsaws and horses.
Bladen Village		466	Ketchi and Mopan Maya, and a growing immigrant community	Most work in banana farm at Bladen and practice subsistence farming up the Bladen River. Hunting and fishing, within CBWS, both for home consumption, and commercially

TABLE 7: STAKEHOLDER COMMUNITIES OF COCKSCOMB BASIN WILDLIFE SANCTUARY

The majority of communities on the coast are now focusing on tourism – Hopkins and the Placencia Peninsula have both developed as tourism centers, with much of the visitation to Cockscomb originating from hotels and resorts in these areas. Tourism is also very important for Maya Centre, lying at the entrance to Cockscomb, providing employment for tour guides and taxi drivers, as well as supporting local hotels, restaurants and crafts.

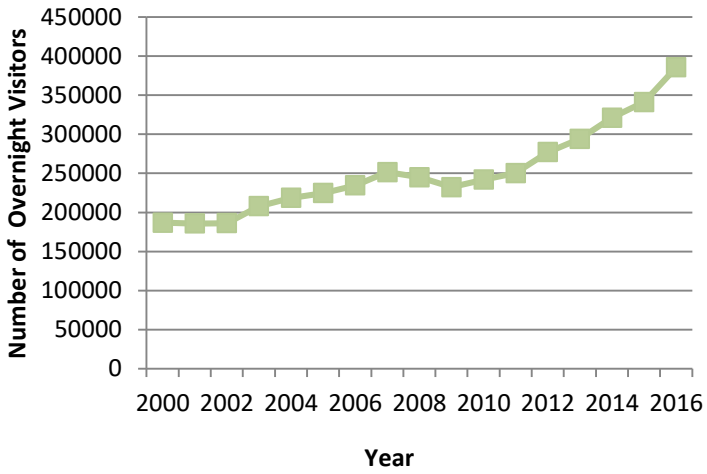


FIGURE 4: BELIZE OVERNIGHT TOURISM ARRIVALS 2000 - 2016

Belize's tourism industry, one of the fastest growing sectors in Belize, is rapidly becoming the major foreign exchange earner, with over 1,390,000 tourists arriving in Belize in 2016. 385,580 of these were overnight visitors, the remaining approximately 1 million are day visitors through the cruise industry (Figure 4; BTB, 2017). Tourism is primarily natural- and cultural-resource based, with visitors focusing on the cayes, coastal communities and coral reef (particularly snorkelling, diving and sport fishing activities), and inland protected areas.

Overnight tourism in Belize shows a distinct seasonality, with the majority of visitors arriving in the first quarter of the year (BTB, 2017). The lowest months are September and October, the main tropical storm season (Figure 5).

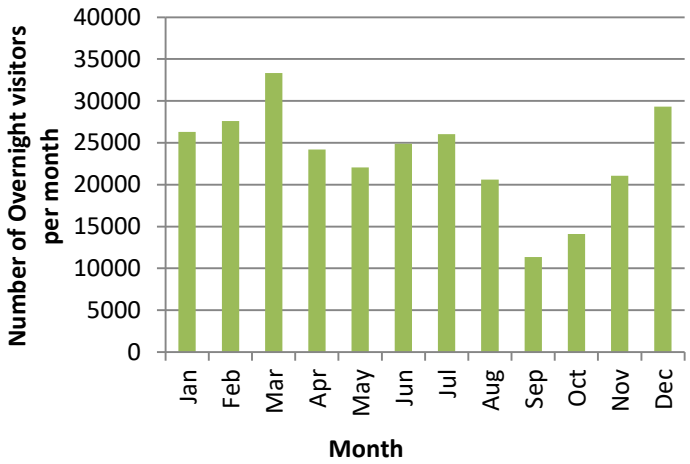


FIGURE 5: BELIZE OVERNIGHT TOURISM ARRIVALS PER MONTH (AVERAGE: 2000 – 2016) (BTB, 2017)

Direct tourism expenditure in Belize exceeded Bz$489 million in 2016 – 14.1% of the total GDP (WTTC, 2017). When indirect contributions are taken into account from related support industries, this rises to 38.1% of the GDP. In 2016, the tourism industry supported over 18,500 direct jobs – 12.6% of total employment, expanding to 34.3% of total employment when related support industries are taken into account (WTTC, 2017).

1.4 PHYSICAL CHARACTERISTICS

1.4.1 CLIMATE

WIND SYSTEMS

Belize is affected by three very distinct seasonal weather systems: trade winds, northers and tropical storms. All three have an influence on the rainfall and temperature patterns. The predominant winds are the ***Trade Winds***, blowing from the east and south-east from April to October, interspersed by tropical storms. ***Northers*** - high-pressure fronts moving down from the north - occur between October and April, bringing cooler weather.

RAINFALL

Cockscomb basin Wildlife Sanctuary receives between approximately 2,540 – 3,048 mm of rain per year (Figure 6). There is a pronounced dry season stretching from January through to May, with only 36 mm recorded in April, the driest month. This is followed by a wetter season (June to October) with total rainfalls in the region of 212 to 228 mm, associated with passing tropical storms, particularly between October and November.

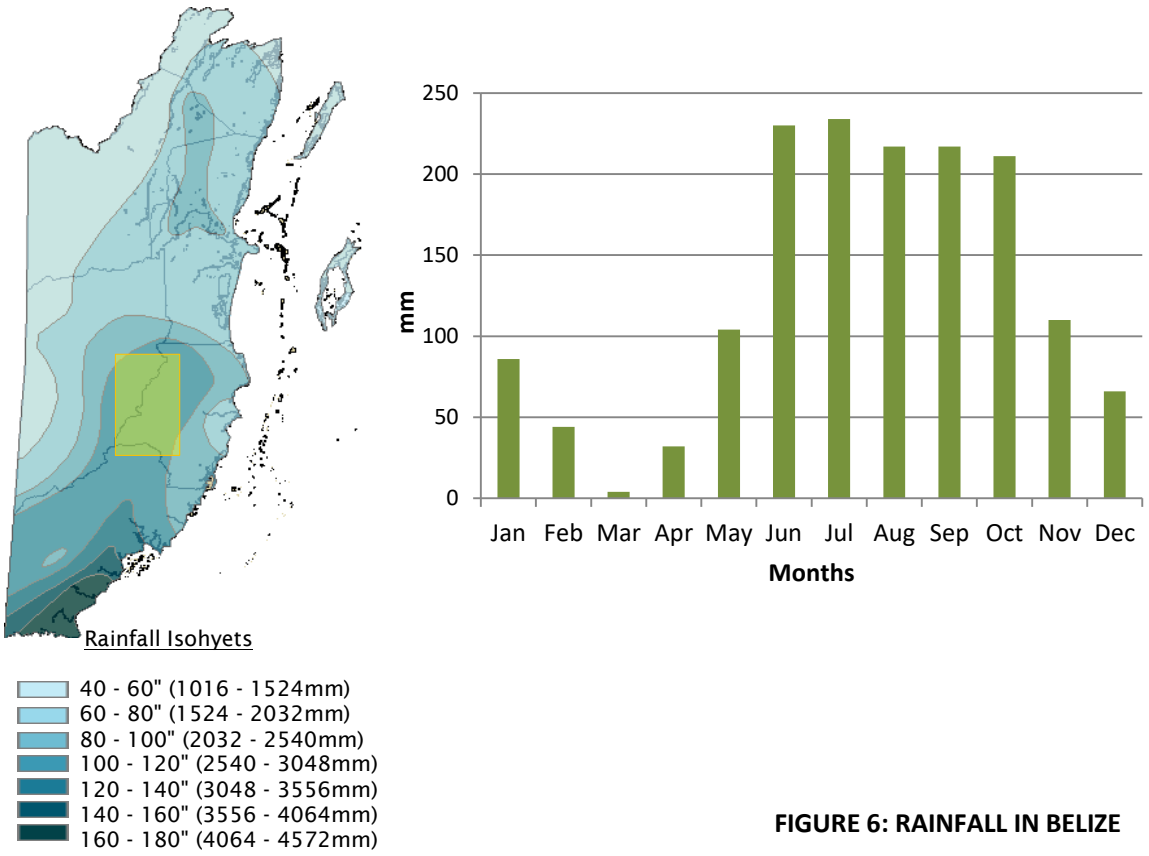


FIGURE 6: RAINFALL IN BELIZE

TEMPERATURE

The annual mean temperature in the CBWS area is 21.6°C, fluctuating throughout the year from a minimum monthly average of 19.5°C in January, during the cold fronts, and a maximum average in May of 26.0°C (Figure 7). Highest daily temperatures of 31°C are recorded in April, with lowest night temperatures of 13°C in January.

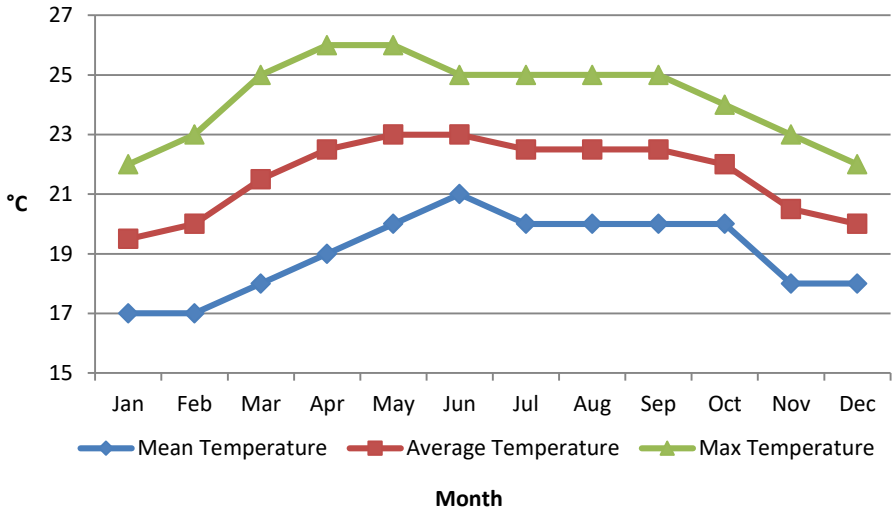


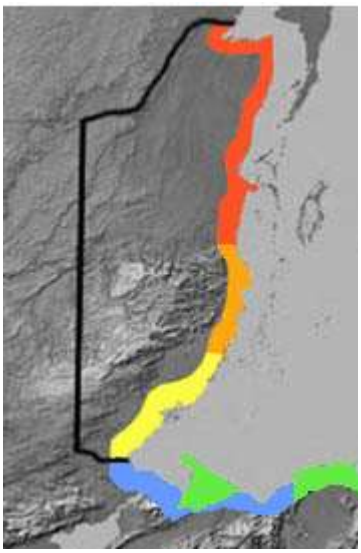
FIGURE 7: MAXIMUM, MINIMUM AND MEAN TEMPERATURE AVERAGE PER MONTH

Average rainfall per month for the Cockscomb Basin Wildlife Sanctuary landscape

(based on 30 year simulated data, www.meteoblue.com)

TROPICAL STORMS

Tropical storms affect Belize every year between the beginning of June and end of November, with potential for landfall being particularly high in northern Belize. Originating in the Atlantic Ocean over warm, tropical waters, these storms are non-frontal, developing highly organized circulations, and ranging in scale from tropical depressions and tropical storms (with sustained wind speed < 74 mph) to hurricanes (with sustained wind speed > 74 mph). These storms move westward towards the Caribbean and Central American coastline, gathering strength until they hit land. They generally bring extreme weather conditions – heavy rains, destructive winds.



	0 hurricane strikes
	1-2
	3-4
	5-6
	7-9
	10-14
	15-16
	17-19
	20-25
	26-48

FIGURE 8: HURRICANE STRIKES IN BELIZE, 1851 – 2009
After Anderson, 2016

Whilst many hurricanes have very focused paths of destruction, their effects are wide ranging. This part of Belize has been hit by hurricanes between 20 and 25 time between 1851 and 2009, averaging approximately 2.25 hurricanes every 10 years. However, in reality, hurricanes are not evenly distributed over time, and the last 25 years have seen an increase in activity (Figure 8). Despite the protective ridges that stand between CBWS and the east coast, and the distance from the coastline, both CBWS and VPNM have been

affected on an almost annual basis by tropical storms, some of these reaching hurricane strength (Figures 9 and 10; Table 8;). The strong winds associated with hurricanes cause mechanical damage to the forest, affecting habitat quality for wildlife for months and sometimes years afterwards. Tropical storms and hurricanes, even tropical depressions, can bring significant increases in rainfall, causing extensive flooding and increased water flow in the rivers, impacting aquatic organisms, riparian vegetation and causing erosion of river banks.

FIGURE 9: HURRICANES AND TROPICAL STORM PATHS PASSING THROUGH OR WITHIN 50KM OF CBWS / VPNM (WWW.COAST.NOAA.GOV, 2017)

Historical records identify 18 tropical storms / hurricanes that have impacted CBWS / VPNM between 1900 and 2016, either passing directly across the Protected areas, or coming within a 50 km radius. This includes 9 tropical storms, 5 Category One hurricanes, 1 Category Two, 1 Category Three, and 2 Category Four.

A number of storms passed directly through the protected area – the paths of Anna (H1, 1961) and Gilda (TS, 1954) crossed both Cockscomb's West and East Basins before crossing the Maya Divide, and the path of an unnamed tropical storm in 1942 passed over the southern slopes of Victoria Peak Natural Monument.

Name	Cat.	Date Passed <50km of CBWS	Name	Cat.	Date Passed <50km of CBWS
Harvey	TS	Aug 20 2011	Abby	H1	Jul 15, 1960
Richard	H1	Oct 25, 2010	Gilda	TS	Sep 27, 1954
Matthew	TS	Sep 25, 2010	Unnamed	TS	Aug 3,1942
Iris	H4	Oct 9, 2001	Unnamed	TS	Sep 22, 1942
Greta	H3	Sep 19, 1978	Unnamed	H1	Sep 28, 1941
Fifi	H2	Sep 19, 1974	Unnamed	TS	Oct 11, 1938
Laura	TS	Nov 21, 1971	Unnamed	TS	June 5, 1934
Hattie	H4	Oct 31, 1961	Unnamed	TS	Oct 1, 1932
Anna	H1	July 24, 1961	Unnamed	H1	Aug 26, 1918
Other large storms affecting the area (>50km)					
Earl	H1	Aug 4, 2016			
Iris	H5	Oct 9, 2001			

TABLE 8: TROPICAL STOMS PASSING WITHIN 50KM OF CBWS / VPNM (WWW.COAST.NOAA.GOV)

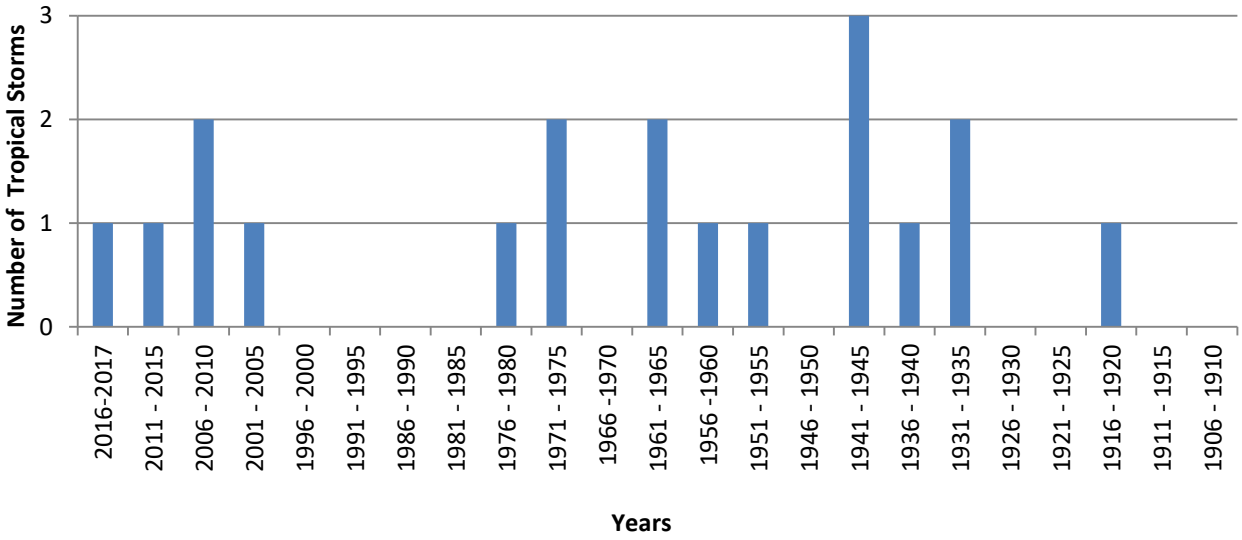


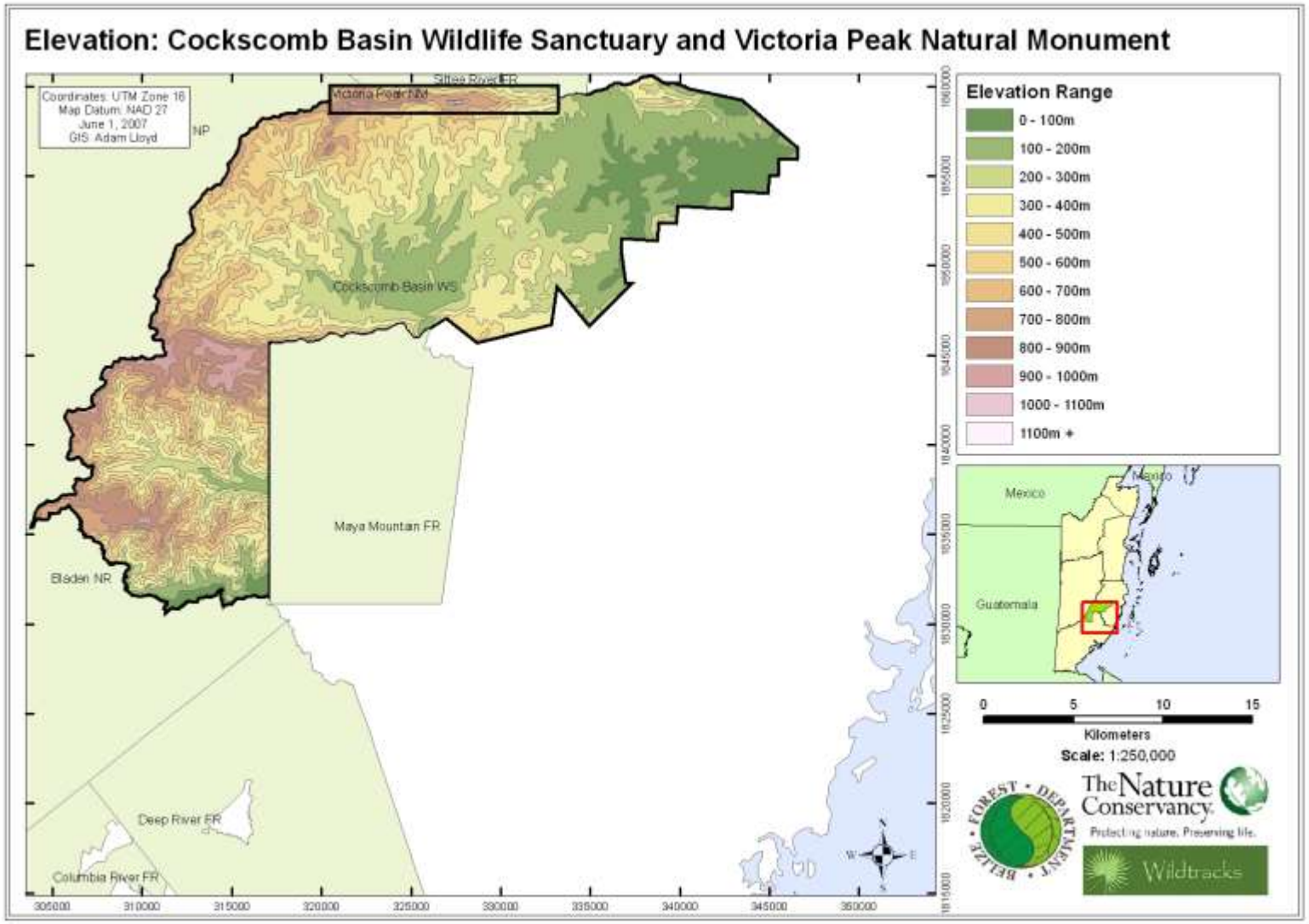
FIGURE 10: FREQUENCY OF HURRICANE EVENTS PASSING WITHIN 50KM OF CBWS / VPNM (TROPICAL STORMS / HURRICANES; WWW.COAST.NOAA.GOV)

Other storms may also cause damage despite passing beyond the 50 km used to define storm influence. Hurricane Earl, for example, a Category 1 hurricane that passed north of Cockscomb in 2016, caused significant tree fall. Hurricane Hattie (1961), too, caused extensive devastation to both the East and, to a lesser extent, the West Basin of Cockscomb and to the more southerly Trio Branch area. Impacts can sometimes be more from the associated rainfall, as with Hurricane Iris (H5, 2001), which made landfall to the south of Cockscomb.

1.4.2 GEOLOGY

Cockscomb Basin Wildlife Sanctuary lies on the eastern slopes of the Maya Mountains, which stretch diagonally across southern Belize. It has a varied terrain of river valleys and flood plains, forested lowlands, slopes, and ridge crests, providing protection for prime jaguar habitat (this being a keystone species and focus of the protected area).

CBWS also includes some of the highest elevations in Belize. Whilst the East and West Basins have elevations ranging between 100 m and 800 m, with the majority of the land being below 600m, the surrounding mountains rise higher - the highest point of the Cockscomb Range has an elevation of 1,120 m (Victoria Peak - the second highest point in Belize), and Mount Copetilla, nearby, reaches an estimated 999 m. To the south, in the Maya Mountain extension, the terrain is more rugged, with deeply dissected valleys - Richardson Peak is the highest point in this region, at an estimated elevation of 965 m (Map 5).



MAP 5: ELEVATION: COCKSCOMB BASIN WILDLIFE SANCTUARY AND VICTORIA PEAK NATURAL MONUMENT

The Santa Rosa Group of rocks forming these mountains are some of the oldest in Central America, the mostly metamorphosed rock being deposited in the Carboniferous and Permian Periods some 225 to 350 million years ago (Ower, 1928; Dixon, 1956; Bateson and Hall, 1977). Tectonic uplift In early Triassic times occurred along two major fault systems – the Northern Boundary Fault to the north, and Quartz Ridge - Bladen Fault to the south, was accompanied by granite intrusions (Table 9). Dating of Maya Mountains rocks indicates two distinct periods of granite intrusions. The earliest granite, intruded in the Silurian-Devonian Periods (380 to 460 million years ago), predates the deposition of the Santa Rosa Group, which overlays it. The second intrusion is a younger granite, and occurred in the Late Triassic (220 to 230 million years ago), and formed outcrops in the Cockscomb Basins (Bateson and Hall, 1977). This intrusion has resulted in contact metamorphism of the Santa Rosa Group sediments where they occur in proximity to the granite. By the end of the Jurassic Period, the landmass began to subside and rift valley-type basins began to form. In the early Cretaceous Period these rift valleys were flooded by oceanic waters, with the growth of reefs, resulting in limestone being deposited over the entire Maya Mountains area.

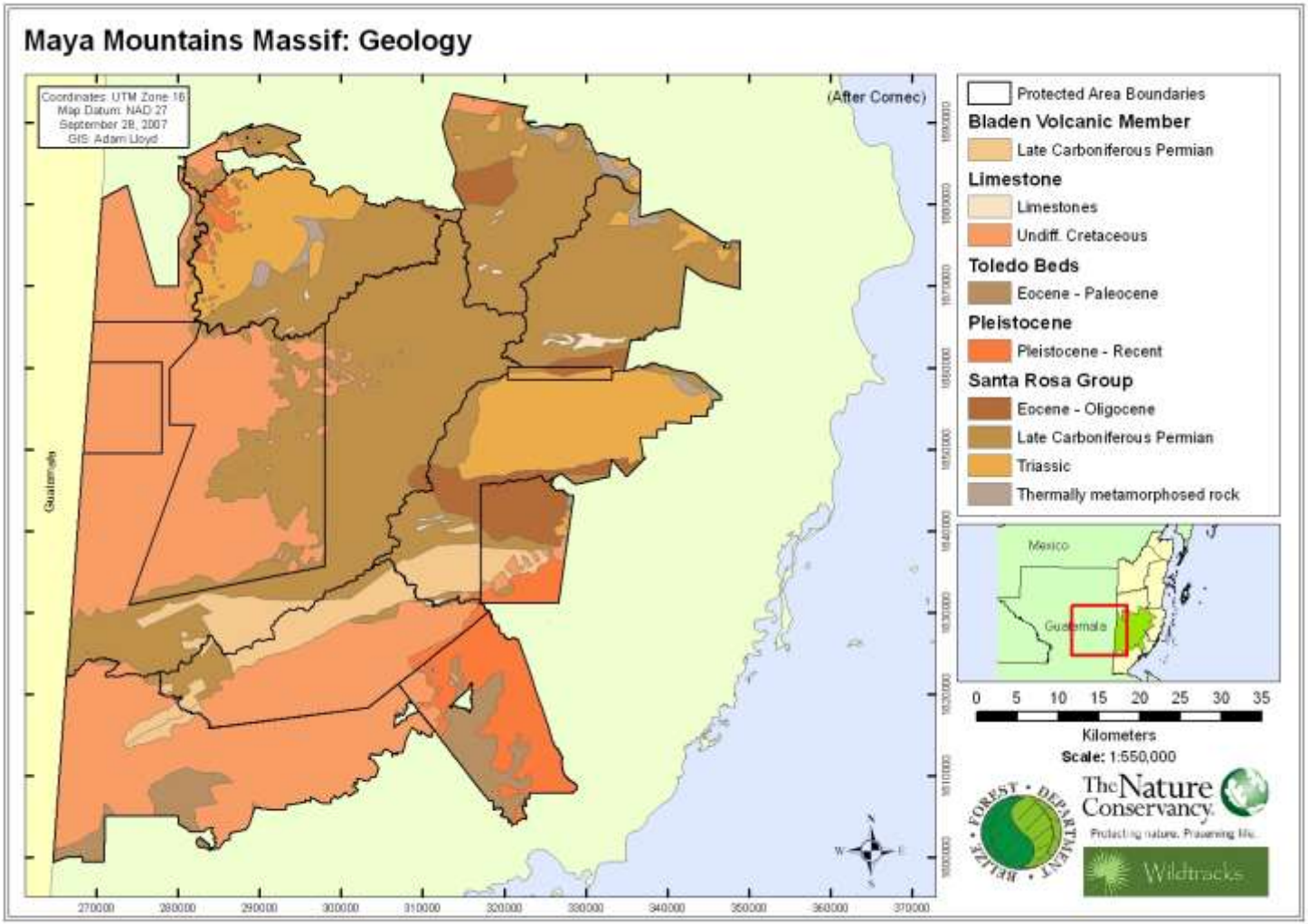
Time Scale of Formation of CBWS Geology			
Era	**Period**	**Time Span (million years ago)**	**Geological Activity**
Palaeozoic Era	Permian	225 – 570	Belize covered by a shallow ocean. Sedimentary rocks of the Santa Rosa Group) deposited. Volcanic activity in the Bladen area in the south of Cockscomb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

TABLE 9: TIME SCALE FORMATION OF CBWS GEOLOGY

The beginning of the Tertiary Period (65 million years ago) saw renewed tectonic uplift of the Maya Mountains and it is this uplift that has shaped the present topography, resulting in the

formation of an upland plateau. This plateau dips gently to the west, and has developed through time by weathering and erosion to become the present day Maya Mountains.

There are two main rock associations within the area – granite and Santa Rosa Group metamorphosed sediments ('metasediments'). The more easily eroded granite forms the gently rounded low areas of Cockscomb East and West Basins, and is surrounded by the less easily eroded fine-grained metasediments of the Santa Rosa Group. This includes the Cockscomb Range, an erosion-resistant ridge of coarse-grained sandstone and quartzite (Map 6). The transition can be seen on the Victoria Peak trail, with exposed granite on the lower, less steep regions of the Cockscomb Range, whilst towards the peak, the exposed rock is quartzite and fine grained sandstone (Meerman and Minty, 2001).



MAP 6: GEOLOGY OF THE MAYA MOUNTAINS MASSIF

Since the uplift in the Tertiary Period, much of the Cretaceous limestone, underlying sediments, and the granite (and porphyry in the Trio Branch area) have been eroded from the eastern slopes of the Maya Mountains, and the bedrock has been deeply incised by streams. However, remnants of the Cretaceous limestone that once blanketed the Maya Mountains can still be seen in one small area within the Sanctuary, in the southeastern corner, south of Trio Branch.

1.4.3 SOILS

Two major soil and land use studies have taken place in Belize – the first a comprehensive study of the whole country (Wright et. al., 1959), looking at soils and associated vegetation assemblages in great detail. The second is a more recent study based on the initial Wright study, but using satellite imagery to update the original report (King et. al., 1989). Under this system, four Land Regions and nine Land Systems are recognized within Cockscomb (Table 10, Map 7).

There are very defined boundaries between Land Regions in CBWS, as seen in the southern Maya Mountain Extension, with the steep terrain of the Maya Mountain Land Region giving way abruptly to the coastal plain and its associated Land Regions. Within Land Regions, Land System classify soil types - their boundaries are slightly less well defined, but still sufficiently clear to allow classification.

Land Regions are broad-scale divisions of the landscape into different units based primarily on topography.

Land Systems classify soil types within Land Regions. and are more heavily influenced by the geology and topography of the area, with the parent bedrock and steepness of the terrain playing an important part in soil characteristics.

Soils of Cockscomb Basin Wildlife Sanctuary are derived from three sources, dependent on the geology of the parent rock:

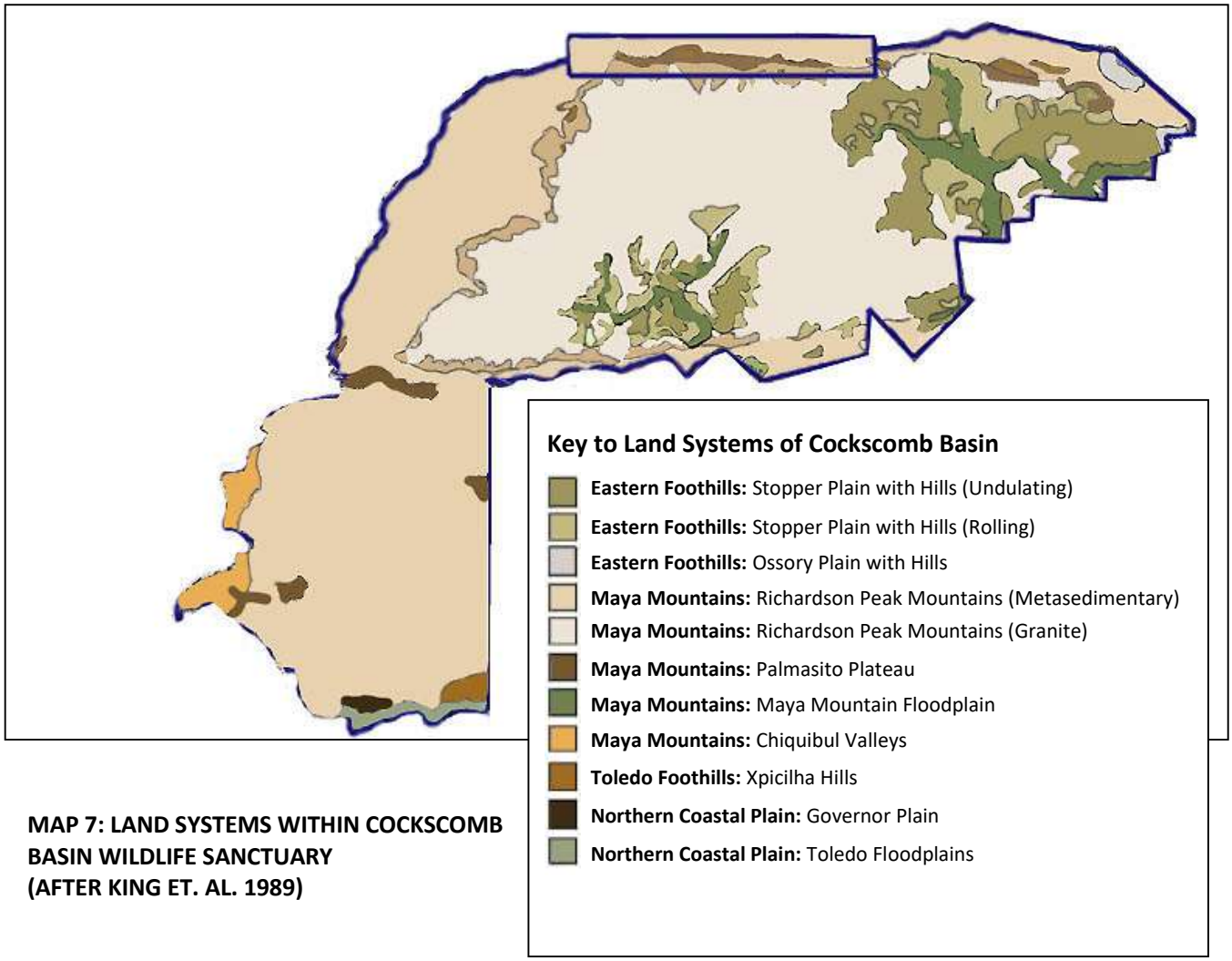
- Granite
- Santa Rosa Metasediments
- Limestone

The majority of soils within Cockscomb (over 90% of the area) are formed from the first two, non-calcareous rocks (granite and metasediments), the granite forming the lower rolling hills of the East and West Basins, whilst the more resistant Santa Rosa Metasediments form the mountainous scenery of the surrounding peaks – the Cockscomb Range, the Maya Divide, and the rugged terrain of the Maya Mountain extension. In the Maya Mountains extension to the south, south of Trio Branch, the southern karst limestone mass of the Bladen area extends into CBWS, overlying a volcanic porphyritic rock, and influencing soil characteristics in this area.

The soils themselves are can be divided into four different categories, covering the majority of the soils present within the protected area:

- Soils of the Maya Mountains
- Soils influenced by calcareous rocks
- Soils of the western Chiquibul
- Alluvial Soils

They are classified into suites and sub-suites according to their individual characteristics (Tables 10 and 11), defined according to the parent rock, whereas subsuites are classified according to morphological characteristics. While a single Land System may contain a single soil suite, there may be a combination of soil sub-suites within that suite, within a single area.



MAP 7: LAND SYSTEMS WITHIN COCKSCOMB BASIN WILDLIFE SANCTUARY (AFTER KING ET. AL. 1989)

LAND REGIONS, LAND SYSTEMS AND SOIL TYPES OF COCKSCOMB BASIN WILDLIFE SANCTUARY				
Land Region	**Land System**	**Soil Type** ***Suite:*** Sub-suite	**Characteristics**	**Location within Cockscomb**
Eastern Foothills Land Region	Stopper Plain with Hills	***Stopper:*** Canada Hill	***Granite. Undulating Plain (1-5°) and Rolling Plain (5-25 °).*** Land with less than a 25° angle, overlying granite, between 20 and 320 m altitude. Semi-evergreen seasonal broadleaf forest and transitional broadleaf forest. Deep soil – up to 6' deep	Present in the central drainage areas of South Stann Creek and Swasey Branch, adjacent to the lower lying Maya Mountain Floodplain, following the course of the river and the larger tributaries (such as Cockscomb Branch, Juan Branch and Mare's Nest Branch). Not found in the Maya Mountain Extension
	Ossory Plain with Hill System	***Ossory:*** Pippen + Dancing Pool + Curassow	***Santa Rosa Metasediments. Gently sloping footslopes.*** Land with less than a 25° angle of slope, in the footslopes of the Maya Mountains. Between 40 and 200 m altitude	Three small, localized areas – the first east of Quam Bank, on either side of the Access Road, as far as Cabbage Haul Gap. The second in the north east corner of CBWS. It also occurs in a very small location within the Juan Branch area.
Maya Mountains Land Region	Richardson Peak Mountains Land System	***Ossory:*** Cabbage Haul>Curassow	***Santa Rosa Metasediments***. The steep mountainous slopes of the Maya Mountains – slopes over 25° angle between 80 and 1,120 m altitude, overlying Santa Rosa Group metasediment rocks, producing shallow soils. Vegetation is semi-evergreen seasonal broadleaf and transitional broadleaf forest, shrubland and pine at higher altitudes	Found on the steep slopes surrounding the lower, central drainage basins of South Stann Creek and Swasey Branch, and throughout the Maya Mountain Extension
	Richardson Peak Mountains Land System	***Stopper:*** Powder Hill + Mayflower	***Granite.*** Mountain slopes overlying granite	Found on the lower slopes of the central drainage basins of South Stann Creek and Swasey Branch

TABLE 10: LAND REGIONS AND LAND SYSTEMS AND SOIL TYPES OF CBWS

LAND REGIONS, LAND SYSTEMS AND SOIL TYPES OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Land Region	Land System	Soil Type ***Suite:*** Sub-suite	Characteristics	Location within Cockscomb
Maya Mountains Land Region	Palmasito Plateau	***Chiquibul:*** Chiquibul	***Santa Rosa Metasediments. Steep slopes.*** A high-level land system that caps the Richardson Peak Mountain System on the steeper slopes. Wright et. al. also recognize the sub-suite Copetilla, a very shallow, infertile stony sandy clay loam of upland areas, derived from Maya quartzite and sandstone	Found within the Maya Mountain extension to the northwest, adjacent to the Maya Mountain Divide, and to the border between Stann Creek and Toledo Districts. Copetilla subsuite is found on the higher peaks – Mount Copetilla, Victoria Peak and associated mountains, and Outlier
		Chiquibul: Chiquibul	***Santa Rosa Metasediments. Plateau.*** A high-level land system derived from Maya shale that caps the Richardson Peak Mountain System on higher plateau areas. Found in areas likely to have Chiquibul suite soils	Found in the plateau area to the west of Richardson Peak, in the south west of CBWS, adjacent to an eastward protrusion of the Chiquibul plateau into the eastern Maya Mountains. Also located just south of the boundary between the original Cockscomb Basin Forest Reserve and the Maya Mountain Extension. There is also a small intrusion from the east in the Maya Mountain Extension
	Maya Mountain Floodplains	***Melinda:*** Canquin + Old Bank	***Alluvium. Dissected Terrace:*** A floodplain terrace found 8 to 30 m above the river, of fine sandy, silty loam. It is fragmented ('dissected') through the meandering actions of the river, which carves new paths over time within the limited width of the floodplain	Only found immediately adjacent to the larger rivers and creeks of the Swasey and South Stann Creek. This is the floodplain, consisting of alluvial materials
	Chiquibul Valleys	***Chiquibul:*** Chiquibul	***Metasediments.*** Small areas of high plateau of deeply weathered metasedimentary rock	Located on the western border of the Maya Mountain Extension, extending the western Chiquibul characteristics into the eastern Maya Mountains

TABLE 10: LAND REGIONS AND LAND SYSTEMS AND SOIL TYPES OF CBWS

LAND REGIONS, LAND SYSTEMS AND SOIL TYPES OF COCKSCOMB BASIN WILDLIFE SANCTUARY				
Land Region	**Land System**	**Soil Type** ***Suite:*** Sub-suite	**Characteristics**	**Location within Cockscomb**
Toledo Foothills Land Region	Xpicilha Hills	***Chacalte:*** Cabro	***Hillslopes, Karst:*** Skeletal soils formed on rugged limestone topography	The only area to show karst characteristics within CBWS (in King's mapping). This occurs in a localized area to the south east of the Maya Mountain Extension, between Bladen Branch, in its floodplain, and the slopes of the upland area
Northern Coastal Plain Land Region	Toledo Floodplain	***Melinda:*** Monkey River	***Alluvium:*** A regularly flooded alluvial floodplain adjacent to the middle reaches of the main river systems within the protected area. A fine sandy silty loam.	Once Richardson Creek leaves the mountains and joins Bladen Branch to flow eastwards, the soils show the alluvial characteristics of the Toledo floodplain.
	Governor Plain	***Stopper:*** Governor	***Alluvium:*** Old deposits from the limestone and prophyritic rocks drained by Richardson Creek. Represents a former alluvial fan from geological times when sea levels were higher and the coastal plain was flooded. The calcium content of the soils has leached out, leaving it mildly acidic	Located to the east of the confluence of Richardson Creek and Bladen Branch, towards the southern boundary of the Maya Mountain Extension, adjacent to the Bladen Branch floodplain.

TABLE 10: LAND REGIONS AND LAND SYSTEMS AND SOIL TYPES OF CBWS

SOIL SUITES AND SUB-SUITES OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Soil Suite	Characteristics	Sub-suite	Characteristics	Land Region/System
Stopper	Non-alluvial sedentary and hill wash soils derived from granite and related rocks. Have high concentrations of muscovite flakes. Soils are prone to erosion once the protective forest cover is removed	Powder Hill	Shallow (>60 cm depth), grey, sandy soils derived from granite, on actively eroding slopes occurring on steep mountain slopes, with 'high cohune ridge' forest (semi-deciduous broadleaf forest). Leaching tends to be only moderate, as the soils are young, and nutrients being replenished from the bedrock	**Maya Mountain Land System** Richardson Peak Mountain System (Granite Hills)
		Mayflower	Moderately deep (<60 cm depth), pale colored sedentary soils derived from granite. Well drained, but nutrient poor	**Maya Mountain Land Region** Richardson Peak Mountain System (Granite Hills)
		Canada Hill	Deeply weathered and intensely leached granitic soils with high iron content, occurring generally on stable sites with gradients less than 20 degrees. High levels of haematite are found towards the soil surface, giving the soils an intense red color. High quartz content leads to problem of erosion	**Eastern Foothills Land Region** Stopper Plain with Hills
		Governer	Red granitic soils found on gently sloping foothills with a distinctive fragipan layer, which inhibits root penetration	**Northern Coastal Plain Land Region** Governer Plain
Ossory	Sedentary and hillwash soils derived from Santa Rosa metasediments, quartzites and sandstones, which are all fairly resistant to weathering, therefore forming rugged mountainous terrain. These soils are less erodable than granitic soils, having a lower content of anugular quartz grit.	Cabbage Haul	Shallow, stony soils occurring on the steeper slopes of Richardson Peak Mountains Land System. This is a wide-ranging soil suite. As seen in the Cabbage Haul area, the thin soil supports a semi-deciduous broadleaf forest that is prone to drought and fire. When fires are frequent, the forest degenerates into a scrub dominated by the fern *Dicranopteris pectinata*. Regenerating forest on this soil has a tendency towards an increase in proportionally higher concentrations of pine. These soils are limited by the steep slope, drought and nutrient deficiency	**Maya Mountain Land Region** Richardson Peak Mountain Land System (Metasedimentary)

TABLE 11: SOIL SUITES AND SUB-SUITES OF CBWS

SOIL SUITES AND SUB-SUITES OF COCKSCOMB BASIN WILDLIFE SANCTUARY				
Soil Suite	**Characteristics**	**Sub-suite**	**Characteristics**	**Land Region/System**
Ossory	Sedentary and hillwash soils derived from Santa Rosa metasediments, quartzites and sandstones, which are all fairly resistant to weathering, mountainous terrain. These soils are less erodable than granitic soils, having a lower content of anugular quartz grit..	Curassow	Formed where bedrock is of shale, the loam is clay in nature, with the dark topsoil grading into a yellow – yellowish red clay upper subsoil. Erosion can be a problem in steep terrain. Areas with quartzite bedrock have resulted in shallower, sandy loams, and are not very fertile, unless enriched by colluvial or alluvial deposits. They tend to be leached, acidic, and low in iron content	**Eastern Foothills Land Region** Ossory Plain with Hills System **Maya Mountain Land Region** Richardson Peak Mountain Land System (Metasedimentary)
		Pippen	Moderately deep coarse and medium textured residual and hillwash soils. Low clay content, nutrient absorption capacity and free drainage can lead to heavy leaching, which is combined with low nutrient content. They are capable of higher available water content than some other soils within the area	**Eastern Foothills Land Region** Ossory Plain with Hills System
		Dancing Pool	Found in isolated pockets within the valleys of the Richardson Peak Mountain System, and developed from deep, recent hillwash. Soils are immature, and reasonably permeable	**Eastern Foothills Land Region** Ossory Plain with Hills System
Melinda	Includes alluvial soils developed recently (current floodplains) or subrecently (higher terraces from former floodplains). The older the soil, the greater the leaching. The main source of alluvium are the granites and Santa Rosa metasediments, proportions of each being dependent on the geology of the drainage area	Monkey River	Young, mixed siliceous alluvium, in areas subject to annual flooding. Tall riparian forest subject to disturbance from flash floods in some places. Relatively high fertility, permeability, good drainage and good rooting depth. Problem of flooding	**Northern Coastal Plain Land Region** Toledo Floodplain
		Canquin	Old mixed silicaceous alluvium occurring on upper flat terraces of steep sided valleys. Soils are silty loams and silty clay loams, and tend to be weathered and leached, with a reddish colour due to presence of liberated iron sesquioxides. Good drainage, few stones or rocks, high water holding capacity and moderate nutrient levels	**Maya Mountain Land Region** Maya Mountain Floodplains (Dissected Terrace)

TABLE 11: SOIL SUITES AND SUB-SUITES OF CBWS

SOIL SUITES AND SUB-SUITES OF COCKSCOMB BASIN WILDLIFE SANCTUARY				
Soil Suite	**Characteristics**	**Sub-suite**	**Characteristics**	**Land Region/System**
Melinda	Includes alluvial soils developed recently (current floodplains) or subrecently (higher terraces from former floodplains). The older the soil, the greater the leaching. The main source of alluvium are the granites and Santa Rosa metasediments, proportions of each being dependent on the geology of the drainage area	Old Bank	Old mixed silicaceous alluvium occurring on upper flat terraces of steep sided valleys (as for the Canquin subsuite). It differs in the texture of the subsoil – Old Bank has hardened soil horizons (fragipans) not present within the Canquin subsuit, which can impede root penetration, so forest structure tends to be slightly stunted	**Maya Mountain Land Region** Maya Mountain Floodplains (Dissected Terrace)
Chiquibul			Low to moderate fertility	
Palmasito			Formed on hillslopes – very susceptible to erosion	
Chacalte	Residual and hillwash soils formed on limestone, with vegetation associations favoring lime-loving species	Cabro	A shallow, stony soil found on the steep slopes of karst landscapes, with many surface boulders and protruding limestone outcrops. In CBWS, found in the south east corner, south of Trio Branch	**Toledo Foothills** Xipicilha Hills (Hills and Karst)

TABLE 11: SOIL SUITES AND SUB-SUITES OF CBWS

1.4.4 WATERSHEDS

The protected area encompasses two major upper watersheds - the South Stann Creek and parts of Monkey River, with four distinct drainage areas: Cockscomb East Basin, West Basin, Trio Branch and Richardson Creek (Figure 11). Each is composed of many streams and creeks, flowing into the central area of each respective drainage basin – to then flow eastwards over the coastal plain, and onward into the Caribbean Sea. There is also a single tributary of the Sittee River (Mitchell Creek), which flows northward out of Cockscomb

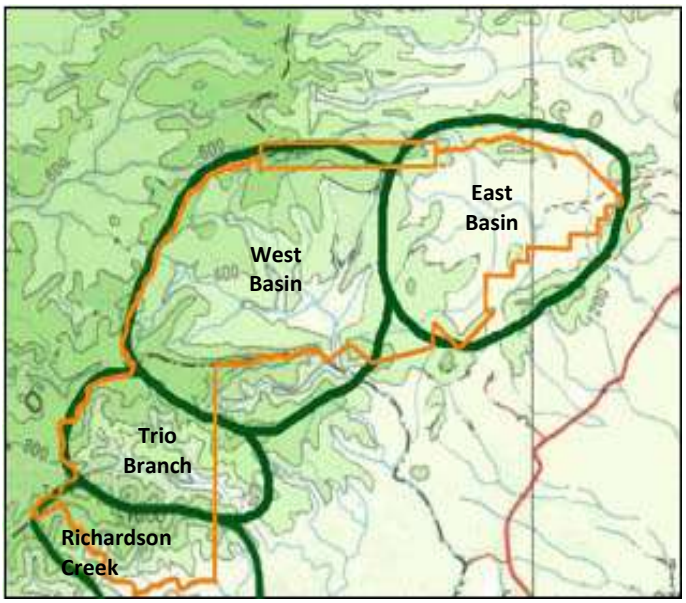


FIGURE 11: THE FOUR MAJOR DRAINAGE AREAS THAT FORM THE BASIC TOPOGRAPHY OF THE CBWS

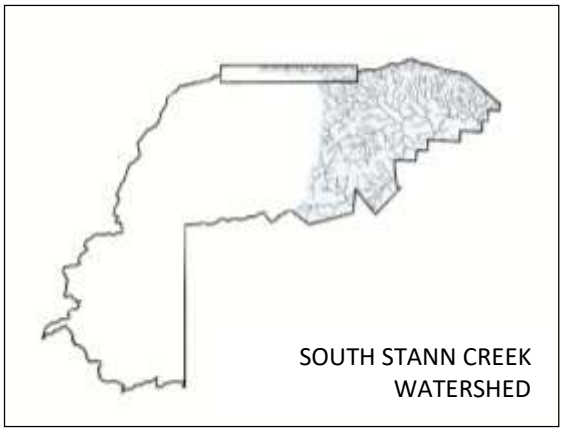
DRAINAGE BASIN	RIVER
East Basin	South Stann Creek
West Basin	Swasey River then Monkey River
Trio Branch	Trio Branch, then ultimately Monkey River
Richardson Creek	Richardson Creek, then ultimately Monkey River

Cockscomb East Basin drains into South Stann Creek River, and is bordered to the north by a low lateral ridge offshoot of the Cockscomb range. This Basin is relatively flat, with 75% of the area lying below 200 m (Kamstra, 1987), and is divided from the West Basin by a low ridge rising to less than 400 m (Figure 11). The upper tributaries of the South Stann Creek are normally shaded by the forest canopy. These lie on a clay or bedrock substrate, in steeper terrain, and are characterized by a fast flow, with waterfalls and small pools, as demonstrated by the Ben's Bluff stream (Kamstra, 1987).

Moving to the middle reaches, the river is shallow and relatively slow flowing, with a sand / fine gravel base, and deeper pools in some places, such as Snook's Eddy, contrasting with shallow rapids in the steeper terrain.

The creek meanders through the relatively flat, low-lying East Basin, thought in part to be a depositional flood plain, with the stream course varying at times to create oxbow lakes. This creek and its tributaries (Juan, Mexican, East Cockscomb and Sittee Branches) are all wide enough to allow the watercourse to be fully exposed to the sun.

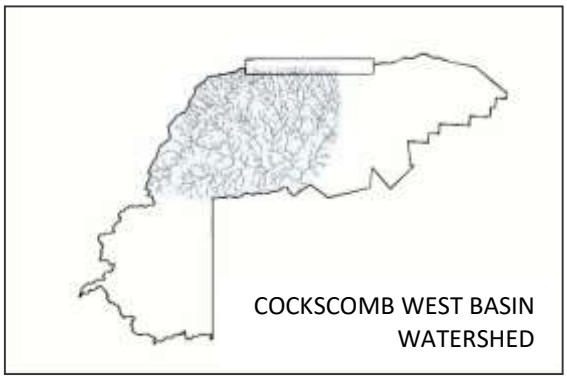
Two parts of the upper South Stann Creek watershed lie outside the present protection of Cockscomb. The first is to the east, where the Cabbage Haul Ridge and South Stann Ridge form



the southeast wall of the eastern portion of CBWS. Originally, this drainage area was included within the Cockscomb Basin Forest Reserve boundaries, but successive amendments to the SI now leave these hills outside Cockscomb, and therefore with the watershed not fully protected. Following failed attempts at one point to establish mining operations within the area, it was realized that full protection of the upper watershed area, one of the main goals of Cockscomb, cannot be achieved without the inclusion of this important area.

The second is to the north, flowing from the northern slopes of the Cockscomb Range and draining eastwards as Sittee Branch, until finally joining South Stann Creek. The majority of this watershed branch is protected at present within the Sittee River Forest Reserve, but it does pass briefly through unprotected land before entering CBWS. However, the rugged terrain is thought sufficient to deter development within this area – agricultural or otherwise.

South Stann Creek exits East Basin through the South Stann Gap in the Snook Eddy area, a valley that separates the Cabbage Haul Ridge from the South Stann Creek Ridge.

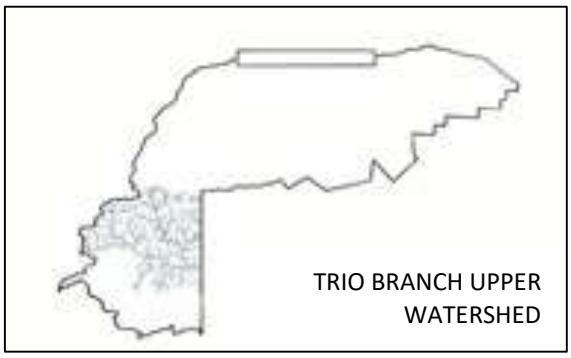


Cockscomb West Basin drains into the Swasey River, a tributary of the Monkey River, and has a more irregular topography than the more accessible East Basin, with 80% lying above 200 m. It is bordered to the west by the main ridge of the Maya Mountain block, the Maya Divide, the ridgeline acting as the western boundary of the protected area, separating it from the adjacent Chiquibul National Park. This Basin is delineated to the north by the higher and more rugged mountainous wall of the Cockscomb Range, including Victoria Peak.

Swasey Branch flows faster and with greater volume of water than South Stann Creek, the West Basin catchment area being larger than the East and, with a more rugged topography, as well as possibly receiving more rainfall (Kamstra, 1987). Five major tributaries drain into Swasey Branch – West Cockscomb, Victoria, Middle, Mare's Nest, and Left Hand Branches.

The steep slopes lead to a typically dendritic drainage patterns, with numerous small, fast flowing streams draining the hill slopes of the Cockscomb Range to the north, the Maya Divide to the west, as well as the north facing slopes of the mountainous Maya Mountain extension and the

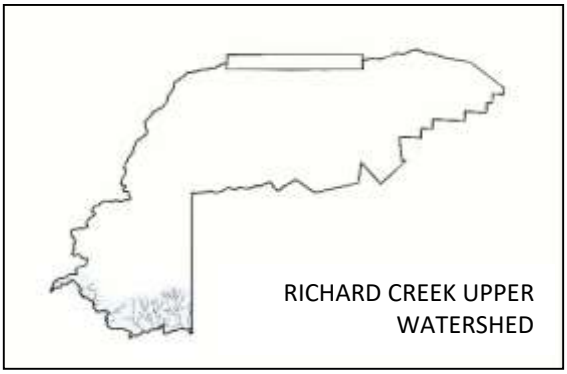
east slopes of the hills that divide West Basin from East Basin. The whole area is surrounded by ridges, except for at the one exit - a 300 m deep gorge through which the Swasey Branch runs southwards, before joining up with the Monkey River and flowing east to the coast.



Trio Branch Upper Watershed is the third of the four upper watershed areas within CBWS, and flows through the southern extension annexed in 1997 from the Maya Mountain Forest Reserve. As with the Swasey River of West Basin, this is also an upper drainage area of the Monkey River, and drains ultimately into Monkey River via the Bladen Branch. It flows along the fault between the Santa Rosa basement shales and quartzite to the north and the limestone and porphyrite geology to the south.

This extension area is separated from West Basin by a lateral ridge to the north, and backs onto the Maya Divide to the west. It has a very rugged terrain, with steep sided valleys and fast-flowing streams. A wide ridge system runs west-east from the Divide, separating this watershed from that of Richardson Creek.

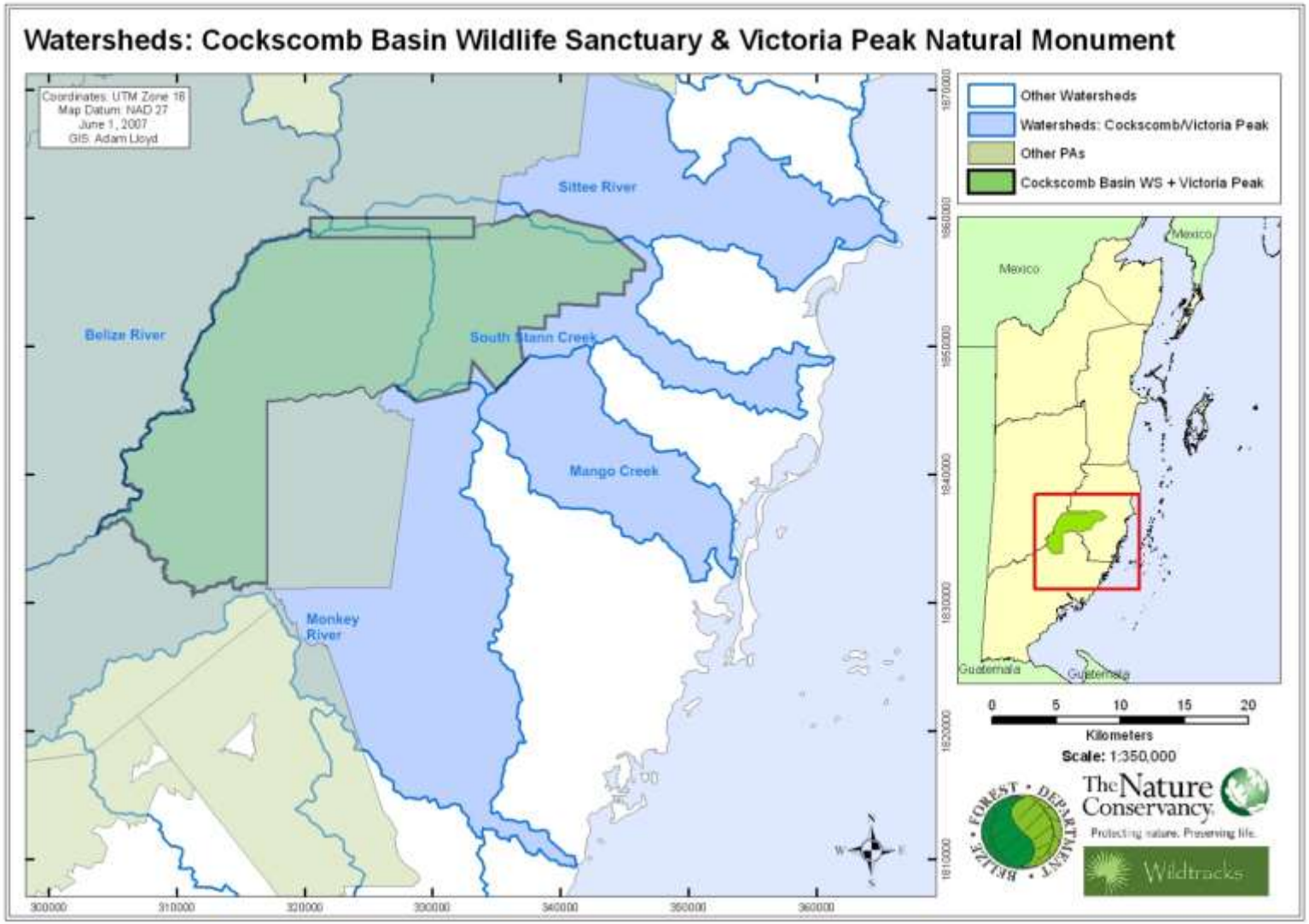
(map 15). (see Section 2.2.3: Geology).



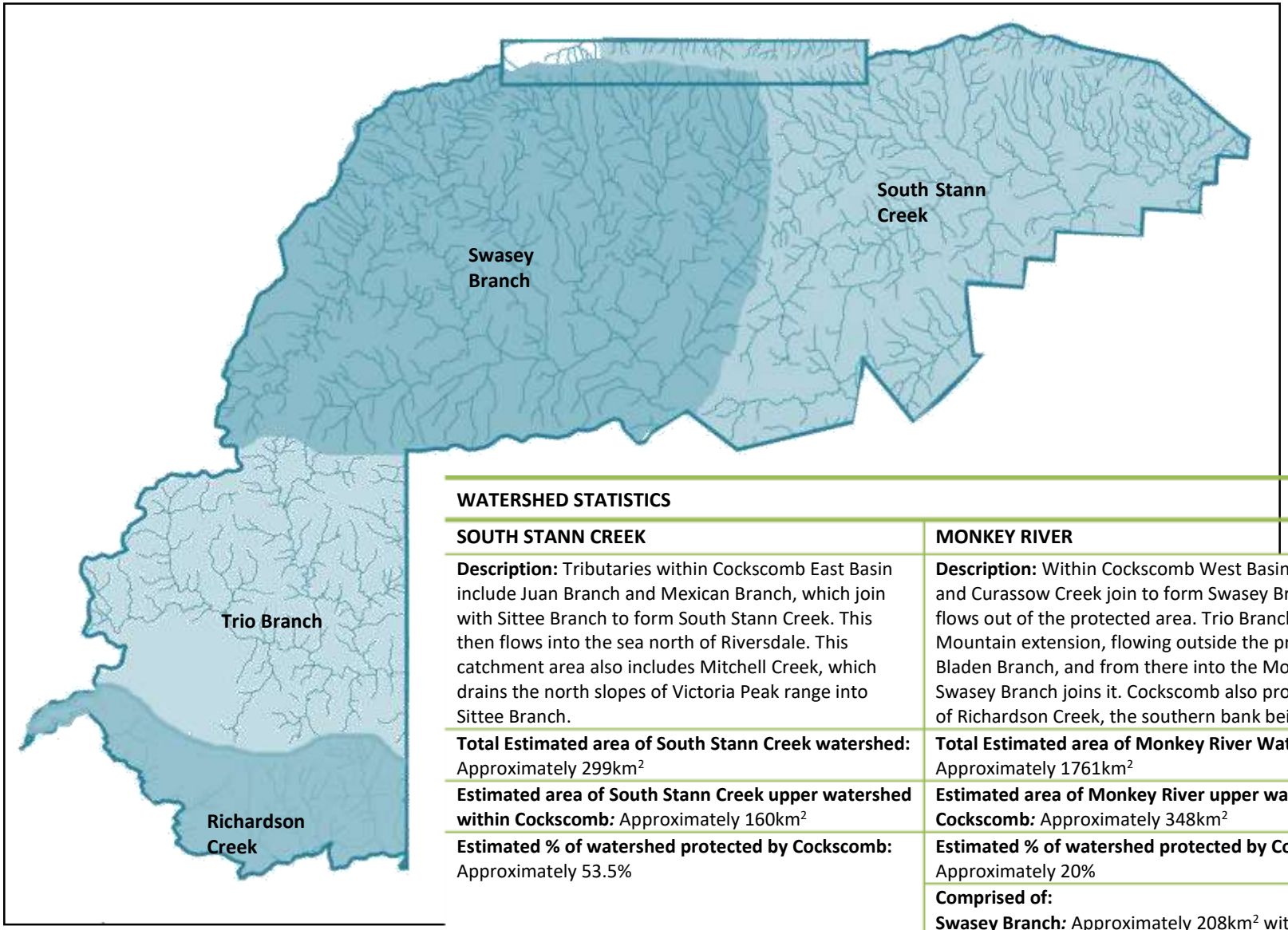
Richardson Creek Upper Watershed is partly contained within the Sanctuary, and drains the southernmost portion of the protected area in the Maya Mountain Extension. In the upper reaches, the fast moving streams that flow off steep terrain, carving deep valleys through the landscape They join to form a single creek that flows into Bladen Branch and ultimately into Monkey River. Richardson Creek forms the southern-most boundary of CBWS, where it meets Bladen Nature Reserve, with both slopes of the valley protected within the National Protected Areas System. On entering Bladen Branch, however, the topography changes to that of a lower river valley, with a large alluvial floodplain in the Solomon Camp area. Here, the river course meanders eastwards before leaving Cockscomb and entering the coastal plain. To the west of this drainage area lies a large plateau at approximately 800 to 860 m, with Richardson Peak rising to 965 m from its south eastern corner.

To the north of these four upper watersheds, the protected area touches on another watershed area - the Victoria Peak Natural Monument protecting the headwaters of several creeks that drain into the Sittee River system.

JUAN BRANCH, SOUTH STANN CREEK WATERSHED



MAP 8: WATERSHEDS OF CBWS / VPNM



MAP 9: DRAINAGE AREAS OF CBWS / VPNM

WATERSHED STATISTICS	
SOUTH STANN CREEK	**MONKEY RIVER**
Description: Tributaries within Cockscomb East Basin include Juan Branch and Mexican Branch, which join with Sittee Branch to form South Stann Creek. This then flows into the sea north of Riversdale. This catchment area also includes Mitchell Creek, which drains the north slopes of Victoria Peak range into Sittee Branch.	**Description:** Within Cockscomb West Basin, Mare's Nest Branch and Curassow Creek join to form Swasey Branch, which then flows out of the protected area. Trio Branch drains the Maya Mountain extension, flowing outside the protected area into Bladen Branch, and from there into the Monkey River, where the Swasey Branch joins it. Cockscomb also protects the north bank of Richardson Creek, the southern bank being within Bladen.
Total Estimated area of South Stann Creek watershed: Approximately 299km^2	**Total Estimated area of Monkey River Watershed:** Approximately 1761km^2
Estimated area of South Stann Creek upper watershed within Cockscomb*:* Approximately 160km^2	**Estimated area of Monkey River upper watershed within Cockscomb*:*** Approximately 348km^2
Estimated % of watershed protected by Cockscomb: Approximately 53.5%	**Estimated % of watershed protected by Cockscomb:** Approximately 20%
	Comprised of: **Swasey Branch*:*** Approximately 208km^2 within CBWS **Trio Branch*:*** Approximately 98km^2 within CBWS **Richardson Creek:** Approximately 42km^2 within CBWS
Communities/Industries serviced by Watershed area: Mayan King banana industry Shrimp farms	***Communities/Industries serviced by Watershed area:*** San Juan Trio Village Monkey River Bladen Village

1.5 BIODIVERSITY OF MANAGEMENT AREA

1.5.1 ECOREGIONS / KEY BIODIVERSITY AREAS

ECOREGIONS

Ecoregions can be defined as "*Relatively large units of land containing a distinct assemblage of natural communities sharing a large majority of species, dynamics, and environmental conditions…with boundaries that approximate the original extent of natural communities prior to land use."* (WWF Conservation Science Programme, 2001). Of the six ecoregions that occur in Belize, only one is represented in Cockscomb, defined by its altitude, rainfall and temperature. Cockscomb itself falls within only one of ecoregion – the Petén-Veracruz Moist Forest (Figure 12). This large block of tropical forest stretches through Belize, Guatemala and southern Mexico.

FIGURE 12: DISTRIBUTION OF PETÉN-VERACRUZ MOIST FOREST ECOREGION IN CENTRAL AMERICA AND BELIZE

Throughout their range, these forests tend to be a matrix of moist tropical forest, bajo, wetlands and riparian habitats. Species-richness is high (though the number of endemic species is low) with a high proportion of tightly linked ecological interactions such as symbiosis. Many tree, vertebrate and invertebrate species occur at relatively low densities, resulting in large areas being needed for the support of viable populations, particularly of the larger predators. These tropical and sub-tropical forests are very susceptible to change, with understory species being sensitive to even small disturbances in the microclimate, and unwilling to move through more open habitats, making them particularly vulnerable to habitat fragmentation. For all these reasons, tropical moist forests such as that of Cockscomb typically require large protected areas to maintain viable populations and sustain ecological processes, with buffering from edge effects, and provision for linkage through natural habitat corridors.

KEY BIODIVERSITY AREAS

Priority areas for key biodiversity protection were identified under the Key Biodiversity Areas (KBA) Assessment (Figure 13; Meerman, 2007) based on a Marxan analysis, with two outputs – the first focused on the presence of globally threatened species as per the IUCN redlist criteria; the second included species of national concern, such as birds that concentrate at highly vulnerable nesting colonies and sub species of national concern such as the scarlet macaw.

Upper elevation areas of Cockscomb form a component of the highest priority biodiversity areas of global concern in Belize (Global Key Biodiversity Area 1) which is located in the protected areas of the Maya Mountains Massif. The second highest priority areas are also primarily within the Maya Mountains Massif, though there are significant areas highlighted in the privately owned Gallon Jug and Yalbac areas as well.

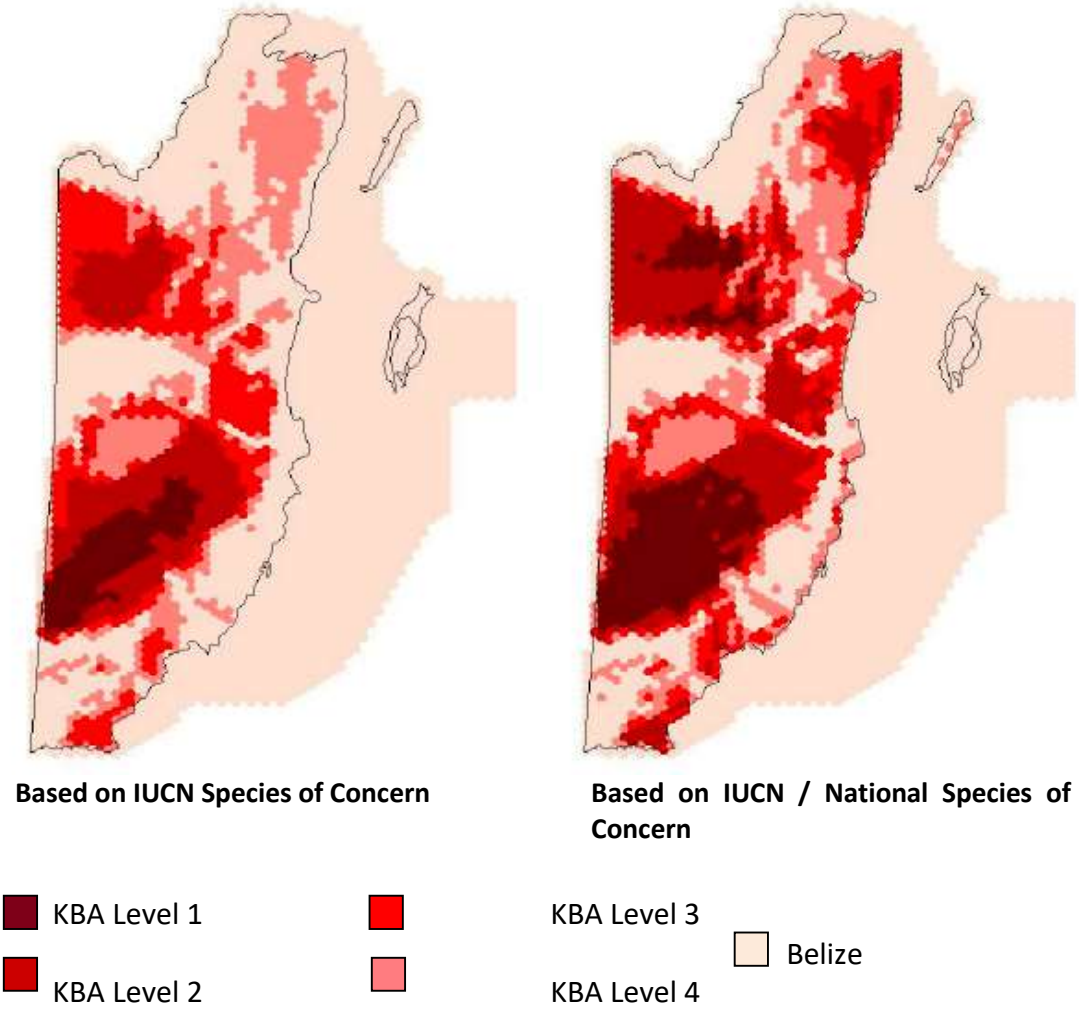


FIGURE 13: KEY BIODIVERSITY AREA OUTPUTS (MARXAN OUTPUTS, MEERMAN, 2007)

1.5.2 ECOSYSTEMS OF COCKSCOMB

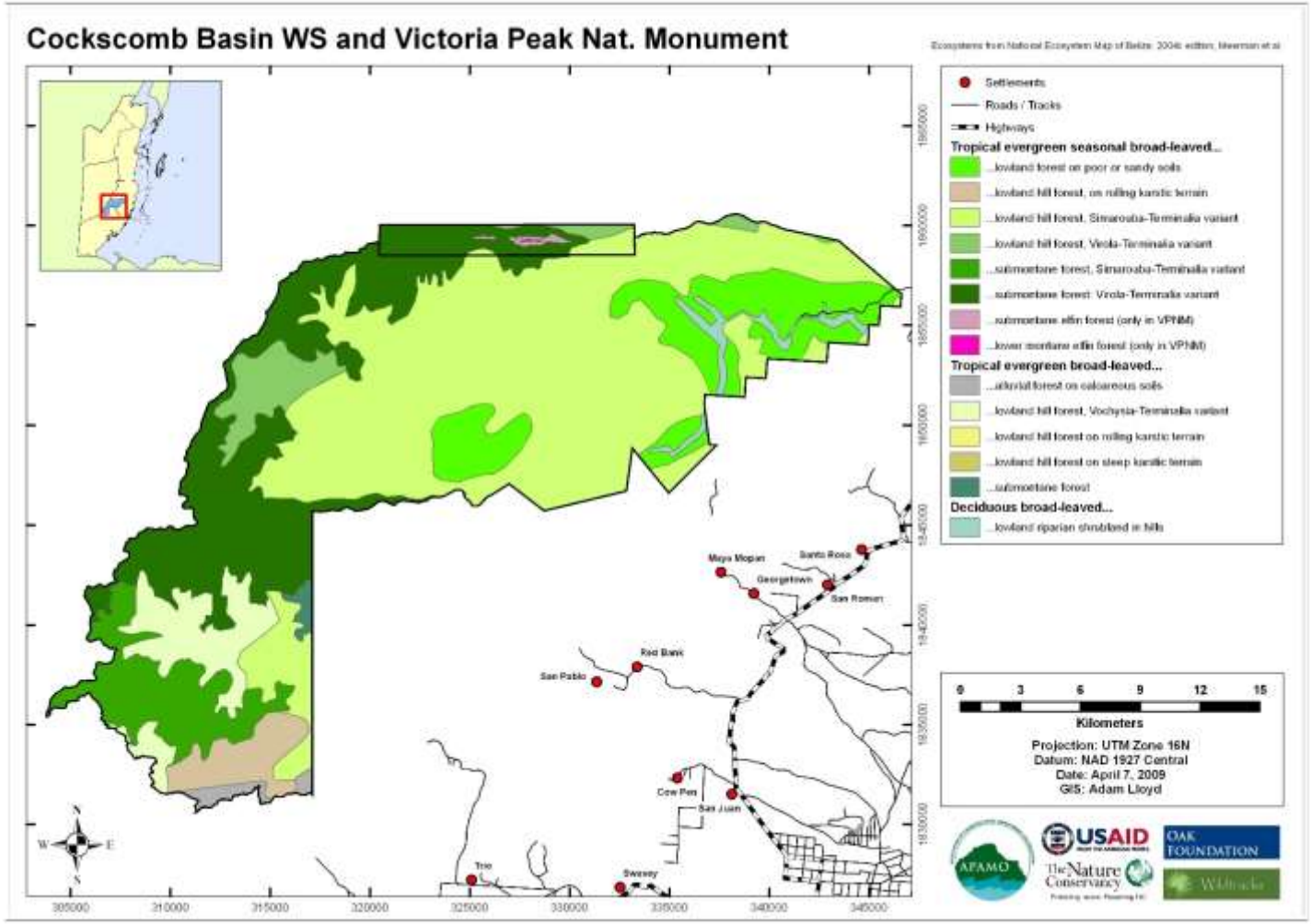
A total of 15 terrestrial and 1 aquatic ecosystems have been mapped in CBWS (Meerman et al., 2015), and 1 more aquatic ecosystem (water body) described (Table 12; Map 10 and 11).

ECOSYSTEMS

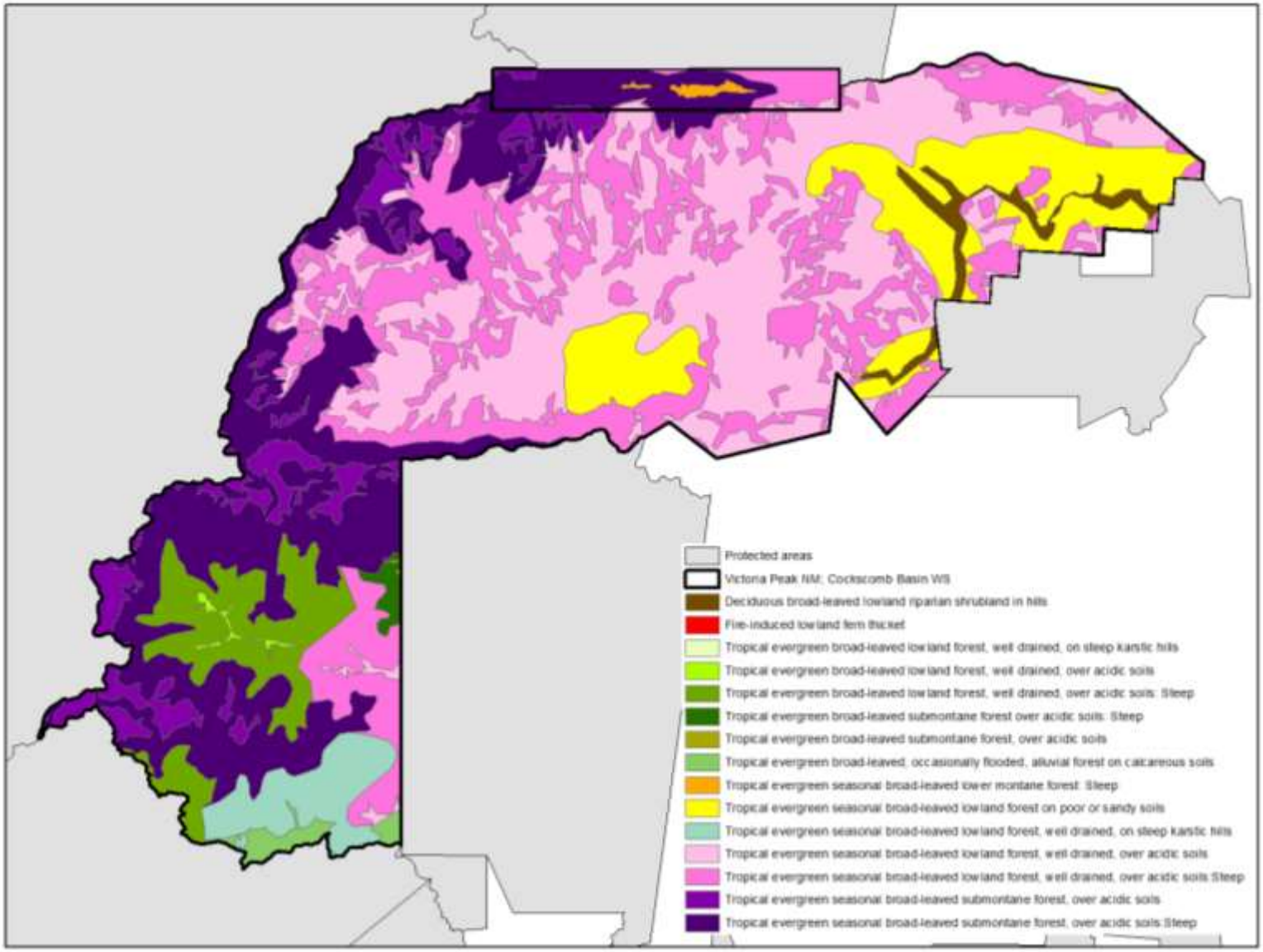
- Deciduous broad-leaved lowland riparian shrubland in hills
- Fire-induced lowland fern thicket
- Tropical evergreen broad-leaved lowland forest, well drained, on steep karstic hills
- Tropical evergreen broad-leaved lowland forest, well drained, over acidic soils
- Tropical evergreen broad-leaved lowland forest, well drained, over acidic soils steep
- Tropical evergreen broad-leaved submontane forest, over acidic soils: steep
- Tropical evergreen broad-leaved submontane forest, over acidic soils
- Tropical evergreen broad-leaved, occasionally flooded, alluvial forest on calcareous soils
- Tropical evergreen seasonal broad-leaved lower montane forest: steep
- Tropical evergreen seasonal broad-leaved lowland forest on poor or sandy soils
- Tropical evergreen seasonal broad-leaved lowland forest, well drained, on steep karstic hills
- Tropical evergreen seasonal broad-leaved lowland forest, over acidic soils
- Tropical evergreen seasonal broad-leaved lowland forest, over acidic soils: steep
- Tropical evergreen seasonal broad-leaved submontane forest over acidic soils
- Tropical evergreen seasonal broad-leaved submontane forest over acidic soils: steep
- River
- Rooted underwater communities of freshwater lakes / water bodies

TABLE 12: ECOSYSTEMS OF CBWS / VPNM

The most current ecosystem classification and mapping (Meerman, 2015) is based on soils, seasonality, elevation and gradient and excludes the species predominance of earlier classifications (e.g. Wright, et al., 1959; Iremonger et al., 1995 and Meerman et al., 2001). As such it is a more realistic system that is supported by remote sensing and landscape mapping, rather than requiring field survey data that is often not available. It is therefore quite a broad-scale approach and cannot be expected to reflect small-scale variations and features: tracts of swamp forest (such as the kaway swamp on the Wari Loop Trail) are not captured at this scale, but this and other smaller-scale ecosystems may be considered as species associations within a broader ecosystem. Lowland tropical forest ecosystems are rarely discrete units with clearly defined borders, but form a spectrum, with one gradually merging into the next, with a transitional area in between. Distinctions between two closely related ecosystems based solely on topographical steepness may therefore be difficult to detect on the ground, with changes in canopy height or species predominance being gradual rather than along sharply defined boundaries.



MAP 10: BROAD ECOSYSTEMS OF CBWS (Meerman, 2015)



MAP 11: DETAILED ECOSYSTEMS OF CBWS (Meerman, 2015)

1. DECIDUOUS BROAD-LEAVED LOWLAND RIPARIAN SHRUBLAND IN HILLS

This ecosystem occurs in areas along riverbanks that are subject to seasonal flash floods, with fast growing grasses, vines and herbaceous shrubs often dominating the vegetation, as trees are prone to being swept away. Good examples of this ecosystem can be seen on the banks of the South Stann Creek, at the end of the River Path, with much of the ground and shrub layer being dominated by dumb cane and vine tangles. Dumb cane and other grasses tolerate the most waterlogged soils relatively well, whereas vines and herbaceous shrubs tend to be more common in slightly better drained areas. On marginally more elevated riverbanks, trees such as *Cecropia obtusifolia*, *Ceiba pentandra*, *Inga affinis*, and *Schizolobium parahyba* become established. This is a preferred habitat for Baird's tapir, and solitary quam wood (*Schizolobium parahyba*) are potential nesting sites for scarlet macaws in Cockscomb, but which have not yet been confirmed to breed there. 670 hectares of this ecosystem are mapped as occurring in the Sanctuary (Meerman, 2015).

2. FIRE-INDUCED LOWLAND FERN THICKET

Dicranopteris (tiger fern) is a remarkably resilient plant, it is highly flammable, but withstands fires as underground rhizomes. It is highly invasive in severely leached and damaged soils, and is thought to suppress the growth of other species in the immediate vicinity through the release of plant toxins from its roots. Once *Dicranopteris* has become established, it is an extremely difficult and slow process for broadleaved shrubs or trees to become re-established.

The most extensive areas of this habitat are located in the Ben's Bluff / Tiger Fern / Cabbage Haul area, but it is also found in isolated patches near hill-tops deeper into the protected areas. Tiger fern occurs naturally where lightning strikes burn small areas of the broadleaf forest which it rapidly colonizes before forest trees can regenerate. It is able to suppress tree growth for many years (possibly decades). Its underground rhizomes are very tolerant to subsequent fires, but if fires can be prevented, it will gradually be overgrown by trees encroaching from the edges of the clearings. Less than 1 hectare of this ecosystem is mapped as occurring in the Sanctuary

(Meerman, 2015), but its coverage is greater – occurring in small patches that fall below the threshold normally detected in remote sensing mapping.

Cabbage Haul Ridge was originally cloaked in broadleaf lowland hill forest (Wright et al, 1959), but a combination of frequent fires from lighting strikes and anthropogenic causes (hunter-ignited fires and escaped agricultural fires spreading up from the coastal plain) degraded the ecosystem to allow fire-tolerant pines to become established and increasingly dominant with the increasing fire frequency. However, pine seedlings are vulnerable to fires till they reach 3-4 years old, so once the threshold of anthropogenic fire frequency overtook this timeframe, the pine population became negatively impacted and largely replaced by tiger fern.

3. TROPICAL EVERGREEN BROAD-LEAVED LOWLAND FOREST, WELL DRAINED, ON STEEP KARSTIC HILLS

Mapped as occurring in three tiny intrusions at the western periphery of the Maya Mountain Extension (Meerman, 2015), and covering only 3.6 hectares within the Wildlife Sanctuary, it is not known whether its recorded presence is more than an artefact of mapping.

4. TROPICAL EVERGREEN BROAD-LEAVED LOWLAND FOREST, WELL DRAINED, OVER ACIDIC SOILS

Approximately 85 hectares of this ecosystem is mapped as occurring in the protected area (Meerman, 2015). It was originally mapped as "tropical evergreen broad-leaved lowland hill forest, Vochysia – Terminalia variant" in a central portion of the Maya Mountain Extension, within the Trio Branch watershed – along the river valley and those of its main tributaries. Its revised name and mapping is a reflection of underlying geology, soils, topography and rainfall rather than a reflection of species dominance – a more realistic approach than trying to tailor earlier classification systems (e.g. Wright, et al, 1952, Iremonger and Brokaw, 1992?) into the more detailed physical mapping that has become possible for very remote areas through remote sensing.

5. TROPICAL EVERGREEN BROAD-LEAVED LOWLAND FOREST, WELL DRAINED, OVER ACIDIC SOILS STEEP

Very closely associated with the above ecosystem, approximately 2,850 hectares of this ecosystem are mapped as occurring over a far larger area of steep, mountainous terrain of the Trio Branch watershed, and also in the extremely rugged terrain of Richardson Creek's watershed. (Meerman, 2015).

6. TROPICAL EVERGREEN BROAD-LEAVED SUBMONTANE FOREST, OVER ACIDIC SOILS: STEEP

Approximately 215 hectares of this ecosystem occurs on the very steep hills of the upper watershed of Double Fall Creek of the Swasey Branch – an area that is to remote for ground-truthing assessments (Meerman, 2015). In this steep terrain, the forest canopy tends to be rather lower than that of forest on the more sheltered and deeper soils of the valleys and lower slopes. Lacking on-the-ground survey data, actual species composition is not known, but can be expected to include the hairy palm (*Colpothrinax cookii*) and mountain cabbage palm (*Euterpe precatoria*) on the higher slopes and ridges, along with other submontane species such as *Podocarpus guatemalensis* and *Symphonia globulifera*. A dense understory of assorted palm species is anticipated in some of the sheltered gullies where especially humid conditions occur.

7. TROPICAL EVERGREEN BROAD-LEAVED SUBMONTANE FOREST, OVER ACIDIC SOILS

Two small areas, approximately 10 hectares, of this ecosystem have been mapped as occurring in valleys in the upper watershed of Double Fall Creek of the Swasey Branch, at an elevation of around 700 m, encircled on three sides by very steep non-calcareous hills (Meerman, 2015). A dense understory of assorted palm species can be anticipated in areas where especially humid conditions occur.

8. TROPICAL EVERGREEN BROAD-LEAVED, OCCASIONALLY FLOODED, ALLUVIAL FOREST ON CALCAREOUS SOILS

Approximately 410 hectares of this forest type have been mapped as occurring in two areas at the southern extremity of the Maya Mountain Extension, bordering the Bladen Branch (Meerman, 2015). This forest type is very variable in stature, with tall trees occurring on better drained soils and much shorter ones being found in more waterlogged soils along some of the small creeks and seepages that drain into the Bladen Branch and Richardson Creek. In such areas there is often a dense understory of palms (*Astrocaryum mexicanum* and *Bactris sp.*). Occurring on deep humid calcareous soils, primary productivity in the non-waterlogged areas is likely to be especially high, and the forest can be expected to be higher in species diversity than on the steeper hills immediately to the north. It is one of the few localities in Belize where the vulnerable limestone rain frog (*Craugastor psephosypharus*) has been recorded.

9. TROPICAL EVERGREEN SEASONAL BROAD-LEAVED LOWER MONTANE FOREST: STEEP

Previously called “tropical evergreen seasonal broad-leaved submontane elfin woodland and shrubland”, approximately 115 hectares of this ecosystem are mapped as occurring at and above the 1,000 m contour in the Cockscomb Range, including Victoria Peak (Meerman, 2015). Much of the ecosystem on the southern slope was severely damaged by fire the year after Hurricane Hattie impacted the area, with significant soil loss and degradation limiting and slowing regeneration.

Insights into the stature and nature of the pre-hurricane forest can be seen in sheltered saddles on the trail as it climbs Victoria Peak. These areas, which appear to have escaped fire damage, have *Clusia sp., Myrica cerifa* stands between 3-6 m high, with a dense matt of mosses, bromeliads and orchids on the ground. Regeneration of this very limited habitat has been further hampered in the past on Victoria Peak by unsanctioned pruning by tour guides to maintain open vistas for visitors, and clearance for an informal helicopter landing site. More mature stands of this ecosystem are presumed to occur along the ridgeline east and west of Victoria Peak, including on The Molar – another significant peak, though very little scientific data is available.

OUTLIER

An insight into the likely historical appearance of this forest type can be seen on the much lower (585 m) Outlier Peak, where the isolated peak experiences environmental conditions similar to those at higher elevations, and form part of an elevated landscape. A 'mass elevation effect' causes the altitudinal zonation of vegetation types on isolated and exposed mountains to occur at much lower elevations than in exposed areas of higher mountains (Stadtmüller, 1987). In line with the conclusions of this review of tropical cloud forests, the vegetation on Outlier can be considered as a cloud forest – as first identified by Kamstra (1987). Determinants for the distribution of these submontane elfin woodlands include not only altitude, but also a number of edaphic features and exposure to wind. Stadtmüller explains how 'horizontal precipitation' ("the entry of water into the ecosystem…. by the condensation process of the humidity of clouds or fog on vegetation surfaces, …or by direct contact of cloud droplets with the vegetation") in cloud forests increases with increased winds, and may exceed actual rainfall, especially during the dry season. The complexity of the balance of these factors is evident on Outlier, where the ecosystem boundaries are sharply defined, and where the vegetation structure of the elfin woodland varies significantly depending upon degree of exposure to the wind, and the associated increased horizontal precipitation.

10. TROPICAL EVERGREEN SEASONAL BROAD-LEAVED LOWLAND FOREST ON POOR OR SANDY SOILS

The predominant ecosystem in the South Stann Creek watershed beyond the riparian zones, and in the Mares Nest Branch area of West Basin, is lowland seasonal forest over poor or sandy soils. Approximately 5,185 hectares of this ecosystem are mapped as occurring in the protected area (Meerman, 2015), and can be characterized as medium height forest occurring on moderately

well drained acidic soils that are of low fertility. *Miconia spp., Simarouba glauca, Terminalia amazonia, Vochysia hondurensis* and *Xylopia frutescens* are generally abundant throughout this ecosystem, and are good indicators of soil of low fertility (Wright et al, 1959). *Attalea cohune* is also quite widespread in this vegetation type, though is generally of lower stature and in lower densities than when found on richer soils.

11. TROPICAL EVERGREEN SEASONAL BROAD-LEAVED LOWLAND FOREST, WELL DRAINED, ON STEEP KARSTIC HILLS

Approximately 1,550 hectares of this ecosystem are mapped as occurring in the southern portion of the Maya Mountain Extension, ending in the foothills immediately north of the Solomon Camp area, where it gives way to lowland forest over calcium-rich alluvium (Meerman 2015). This ecosystem type is characterized as having a distinctly deciduous element, and a canopy from low/medium (15 m) to very high (40 m), with a broad suite of species, without dominance by a small number of species, and an abundance of palms and Rubiaceae in the shrub layer.

12. TROPICAL EVERGREEN SEASONAL BROAD-LEAVED LOWLAND FOREST, OVER ACIDIC SOILS

This has been identified as the most extensive forest type of CBWS (Wright et al, 1959; Iremonger & Brokaw, 1995; Meerman & Sabido, 2001, Meerman, 2015), with approximately 14,090 hectares covering a large portion of both East and West Basins as well as an eastern section of the Maya Mountain Extension (Meerman, 2015). As described by it has a high representation of *Castilla elastica, Ficus spp.* and *Pouteria sapota* (Wright et al, 1959), and is a species-rich ecosystem with considerable variation in species composition and appearance from one locality to another, depending upon soil, aspect, elevation, water regime, past impacts, etc. *Cyathea sp.* and *Euterpe precatoria* are common in the upper slopes, often accompanied by the endemic palm *Schippia concolor*. As with the other broadleaf hill forests, the upper levels of this ecosystem are very susceptible to fire.

13. TROPICAL EVERGREEN SEASONAL BROAD-LEAVED LOWLAND FOREST, OVER ACIDIC SOILS: STEEP

Approximately 12,245 hectares of this ecosystem are mapped as occurring in CBWS (Meerman, 2015). Previously classed as “Tropical evergreen seasonal broad-leaved lowland hill forest Simarouba-Terminalia variant”, this has now been separated, based on topography and the associated differences in stature and species composition of the forest. As with most other forest types, the trees on the steep slopes and ridgelines tend to be noticeably shorter than those on the flatter terrain between the slopes.

14. TROPICAL EVERGREEN SEASONAL BROAD-LEAVED SUBMONTANE FOREST OVER ACIDIC SOILS

and

15. TROPICAL EVERGREEN SEASONAL BROAD-LEAVED SUBMONTANE FOREST OVER ACIDIC SOILS: STEEP

These ecosystems are a continuum up an elevational gradient, and occur at elevations between 500 m – 1,000 m along the entire western boundary of Cockscomb, stretching from about 2 km east of Victoria Peak westwards to the Main Divide, following the Divide along West Basin's western limit and southwards along the western portion of the Maya Mountain Extension as far as Richardson Peak. Two wide swathes extend eastwards, one across the boundary between West Basin and the Maya Mountain Extension, and the other just north of Richardson Peak. Approximately 2,650 and 111,360 hectares respectively of these ecosystems are mapped as occurring in CBWS (Meerman, 2015).

Meerman and Sabido (2001) list numerous tree species as being frequent in this ecosystem including some of Wright's (1959) requiring nutrient rich soils (e.g. *Castilla mazoni* and *Schizolobium parahyba*), indicators of lower fertility (e.g. *Simarouba glauca, Terminalia mazonia* and *Xylopia frutescens*) and of even lower soil fertility (e.g. *Vochysia hondurensis*), suggesting significant variation in forest stature and structure within this ecosystem type. Whilst *Attalea cohune* occurs up to 600 m above sea level elsewhere in its range (Kamstra, 1987), and is listed by as being a frequent component of this ecosystem type (Meerman et al., 2001), it is rarely found above the 200-250 m contours in CBWS and is presumed to be largely absent from this ecosystem.

Meerman & Minty (2001) describe this ecosystem on the mid-upper elevations (500-750 m) of the Cockscomb Range as "Fairly low forest found above the 500 m contour line over non-calcareous rock in steep terrain. Typical plants include: *Colpothrinax mazon*, *Cyathea sp., Euterpe precatoria*, *Helosis sp*., *Podocarpus guatemalensis, Pourouma bicolor, Psychotria alata, Symphonia globulifera, Terminalia mazonia* and *Virola brachycarpa*.

16. RIVER

This broad categorization of aquatic habitats includes the South Stann Creek and its tributaries in East Basin, Swasey Branch and its tributaries in West Basin along with tributaries of Bladen Branch that flow into Monkey River beyond the boundaries of the Sanctuary. Such river ecosystems are under-represented within the National Protected Areas System (Walker et al., 2012), underscoring the importance of their protection in Cockscomb. Apart from being habitat for the fish fauna,

these rivers and streams are also critical habitat for the Central American river otter and the water opossum, and create the preferred habitat for Baird's tapir – riparian shrubland.

17. AQUATIC - INCLUDING "ROOTED UNDERWATER COMMUNITIES OF FRESHWATER LAKES / WATER BODIES"

Seasonal and non-seasonal freshwater pools are biologically important ecosystems within Cockscomb. Those that are ephemeral (vernal) are critical habitats for many species of amphibian and reptile, and can be important overall habitat components for a number of bird and mammal species. For several amphibians, ephemeral pools 1-5 m in diameter are favored breeding sites, whereas medium sized (5-15 m) and large (over 15 m diameter) pools can form the breeding grounds for huge numbers of amphibians – particularly if there are dense reed-beds, or if they dry out during the dry season (and therefore have few fish predators of frog eggs and larvae).

Ephemeral pools are typically too small to be readily mapped, or even recorded – despite the important role they play in the life cycle of many vertebrate and invertebrate species. They may occur at varying elevations, though are uncommon above the valleys, though a large one used by several species of frogs, many numbering in their thousands, was observed on a ridge-top near Mare's Nest Branch during the 1990 REA (Walker, P. 1990 ref for REA. The "Frog Pond" located adjacent to the Access Road is typical of such habitat and regularly visited as part of the night tours during wet season.

1.5.3 FAUNA

INTRODUCTION

Cockscomb Basin Wildlife Sanctuary is known for its rich wildlife, particularly for the jaguars it protects. It is home to a very significant percentage of the species found in Belize - a critical stronghold for many species, with over 58% of Belize's mammals, 56% of its birds and 69% of its amphibians recorded to date within the boundaries (Table 13).

VERTEBRATE SPECIES BREAKDOWN FOR COCKSCOMB

Vertebrate Group	No. Species (CBWS)	No. Species (Belize)
Mammals	96*	163
Birds	353	587
Reptiles	53	121
Amphibians	26	40
Freshwater Fish	19	119

***97** if presence of coyote is confirmed

Baseline References:
Mammals - Jacobs and Castaneda, 1998
Birds - Jones and Vallely, 2001; R. Martinez, 2017
Reptiles and Amphibians – Paul Walker, 2004; Lee, 2000
Fish – Greenfield and Thomerson, 1997

TABLE 13: VERTEBRATE SPECIES BREAKDOWN FOR COCKSCOMB

Fish have received less attention in Cockscomb, with only 19 species recorded to date, though as the upland streams of the Maya Mountains are recognized as not being species-rich, it is unlikely that this total will increase significantly during further surveys.

Of the invertebrates, Lepidoptera and Odonata are the taxa to have received the most attention, with baseline species lists compiled, though it is expected that additional species will be added during further surveys. Higher elevations, and more remote regions of Cockscomb have barely been sampled – and at least for Lepidoptera, these are the areas most likely to harbour specialist species with limited distributions in Belize.

MAMMALS OF COCKSCOMB

With its forested river valleys and rugged landscapes, Cockscomb Basin Wildlife Sanctuary is home to a wide variety of mammal species typical of tropical moist broadleaf forest. Of the 163 species of mammal recorded in Belize (Jacobs et. al. 1998), 96 have been recorded during various surveys conducted in CBWS over the last 40 years (Annex 1).

Three species – Baird's tapir, Central American black-handed spider monkey and Yucatan black howler monkey – are globally 'endangered' under IUCN classification, and one (the white-lipped peccary) is classified as 'vulnerable' (IUCN, 2017). Other species of conservation concern include two of Belize's five wild cats (the jaguar and margay), as well as the Neotropical river otter and Van Gelder's bat (IUCN, 2018; Table 14). Cockscomb also protects a number of species endemic to the Mesoamerican or Yucatan region – the Yucatan black howler, Yucatan squirrel, big-eared climbing rat and vesper rat being examples.

THREATENED SPECIES	
Endangered	
Yucatan Black Howler Monkey	*Alouatta pigra*
Central American Black-handed Spider Monkey	*Ateles geoffroyi*[*]
Baird's Tapir	*Tapirus bairdi*
Vulnerable	
White-lipped Peccary	*Tayassu pecari*

Note: *A. geoffroyi yucatanensis, the subspecies in Belize, is now considered genetically identical to A. g. vellerosus, elevating it to a Critically Endangered sub-species (Moralez-Jiminez et al., 2015).*

TABLE 14: THREATENED MAMMALS OF CBWS / VPNM (IUCN, 2018)

Both Yucatan black howler monkeys and Central American spider monkeys are present within the protected area. Spider monkeys inhabit the more remote areas of Cockscomb West Basin, generally being observed from 12 km onwards on the Victoria Peak Trail onwards. The sub-species in Belize, is now considered genetically identical to *Ateles geoffroyi vellerosus*, elevating it to Critically Endangered, and recently identified as one of 25 globally most threatened primate species, as a result of the

CENTRAL AMERICAN SPIDER MONKEY

increasing level of deforestation within its range, and the demand for the pet trade (Schwitzer et al., 2017).

Yucatan black howler monkeys, endemic to a small area of the Yucatan Peninsula, Belize and the Peten, were decimated by yellow fever in 1956/1957, compounded by the effects of Hurricane Hattie in 1961, and by local hunting pressure. A resident troop was known to have lived adjacent to Quam Bank between 1978 and 1980, but was thought to have been hunted to local extirpation by people from the logging camp (Kamstra et al., 1986). Following their disappearance, the topography of Cockscomb, with its protective mountain ranges on three sides and citrus farms on the fourth, made it unlikely that howler monkeys would return to the area on their own.

A successful reintroduction programme began in 1992, focused on repopulating Cockscomb Basin with 14 howler monkey troops were translocated from the Community Baboon Sanctuary over a three-year period (1992 – 1994) – a total of 62 individuals. Monitoring in subsequent years has shown that the translocation has been successful, with *Alouatta* firmly established within much of the Cockscomb Basin, and now extending into surrounding areas. The population is now thought to number over 170 individuals, in an estimated 36 troops, based on a confirmed count of 66 individuals from 15 or more troops (Silver et al., 2017).

Wide ranging species such as white-lipped peccary, collared peccary and Baird's tapir, are also highlighted as of concern because of their dwindling populations in Central America, as hunting pressure increases and the necessary forested habitat decreases outside of the protected areas. Baird's tapir is the largest herbivore present in the Cockscomb Basin, and is associated with the riverine areas, where this large herbivore grazes on the herbaceous vegetation. It is shy, and seen infrequently, though tracks can be commonly found.

The five cat species present in Belize have all been recorded within the Cockscomb boundaries, through both direct sightings and camera trapping. All are relatively difficult to observe, as they are generally nocturnal and elusive, and go to great lengths to avoid contact with humans. The jaguar population of Cockscomb appears stable. A 14-year monitoring program stretching from 2002 to 2015 identified 105 individual adults over that time (Harmsen et al., 2017) and demonstrated that the population has a high density relative to other Central American forests, with an upper estimate of 11 individuals per 100 km^2 (Harmsen et al., 2010). Within

OCELOT

Cockscomb, the average male territory is thought to be between 25 and 38 km^2 – about twice that of the female, with male ranges often overlapping each other (Rabinowitz et al., 1986).

Jaguars are thought to prefer the lower slopes and valleys, where there is good forest cover, prey species are abundant, and water is easily available. Armadillo accounted for 53% of prey items identified in scats during the establishment of Cockscomb as a protected area, with the identification of paca, anteater, red brocket deer and agouti as additional prey species (Rabinowitz et al., 1986). More recently, studies suggest that there has been a shift, with less evidence of armadillo, but a four-fold increase in peccary as the prey base, thought to be a result of the improved protection over time, and increased availability of peccary (Foster et al., 2008). The two larger cat species, jaguar and puma, whilst being sympatric, are considered to have a relatively limited overlap in their diets in Cockscomb. The favoured prey for jaguars has been identified as armadillo, while pumas predominately eat paca. Both species also take larger prey, puma targeting red brocket deer whilst the larger, more powerful jaguars target white-lipped peccaries (Foster et al., 1987).

Whilst Cockscomb is proving to provide effective, long term protection for this species, outside the protected area, jaguars are coming into increasing conflict with local communities as forest and prey disappear, targeting livestock such as cattle, pigs, chickens and dogs. There is also concern of the growing demand for jaguar parts – skins and teeth – both in Belize and potentially overseas, as international wildlife crime increases throughout neighbouring countries.

Of the non-Felidae Carnivora present in Cockscomb, the grey fox is the most frequently observed, with habituated individuals foraging around the campsite and accommodation areas. Coyotes have recently been observed in agricultural lands around Kendal, adjacent to the protected area – this species is thought to be increasing in Belize as forests become increasingly degraded and the landscape more suitable for its requirements. The Mustelidae are also well represented, with two species of skunk recorded (spotted and the hog-nosed skunks), as well as the distinctive tayra and the Neotropical river otter. For medium-sized mammals that are difficult to observe, such as the cacomistle and grison, or even more frequently observed species, including tayra, Neotropical river otters, white-nosed coati, raccoon and kinkajou, comprehensive knowledge of population numbers and densities is limited, and it is assumed that protection of sufficient area and habitat to ensure viable populations of key species such as the jaguar will also ensure the survival of these lesser known species. are all present.

Large game species recorded within the protected area include the two deer species – white-tailed deer and red brocket. Whilst the white-tailed deer prefers more open pine forest areas such as Cabbage Haul, the red brocket is frequently seen on the forest trails around the Cockscomb HQ, and appears to have become semi-habituated, moving slowly off the tracks when seen rather than fleeing rapidly. Both collared and white-lipped peccary populations are considered viable with hunting pressure now confined to low levels along the river courses (Cockscomb staff, pers. comm., 2017)).

COLLARED PECCARY

Of the 96 mammal species present within Cockscomb, bats form the largest order (Chiroptera - 47 species - just under 49% of mammal species listed for the area) - recorded through a series of surveys (Rabinowitz et al., 1989; Kamstra et al., 1996; Miller et al., 1999; and Silver et. al., 2001).

Seven of the eight species of opossum present in Belize have been recorded in CBWS. The distribution map for the eighth, Alston's mouse opossum, suggests that it may also occur in the area, but being highly arboreal, and more insectivorous than the other species, it may be missed in short-term trapping sessions. It has been recorded in both Bladen Nature Reserve and Columbia River Forest Reserve (Iremonger et al., 1994). Three species of Edentata (northern tamandua, silky anteater and the nine-banded armadillo) have been recorded in the protected area. Whilst the tamandua and armadillo are relatively frequently observed during nocturnal transects, confirmed records of the silky anteater are absent from the literature. However, a dead specimen was recorded within CBWS in 2001/2002, and identification was confirmed (E. Saqui, pers. comm.).

Of the smaller, non-volant mammals, a single species of shrew – the least shrew - and sixteen species of rodent have been recorded (Silver, 2001). These small mammals form an important prey base for Neotropical carnivores, and it would appear that densities are sufficient to support a healthy predator population, particularly of the smaller felids such as the margay and ocelot. In common with other Neotropical sites, there appear to be three locally common rodent species, and a number of less common species. The spiny pocket mouse and two species of climbing rat made up 67% of the species (Rabinowitz et al., 1989), though there does appear to be some seasonal variation in species proportions trapped (Foster, pers. comm., 2004). The larger rodents – paca and agouti – are also important prey species for the larger cats (particularly jaguar). The Mexican hairy porcupine is also present, but has only been observed infrequently.

BIRDS OF COCKSCOMB

Belize has approximately 587 species of birds (Fagan et al., 2016), of which at least 353 (60%) have been recorded within the boundaries of Cockscomb Basin Wildlife Sanctuary (Annex 1). Of these, 3 species are unique to Belize and 12 are northern Central American regional endemics. The many ecosystems of Cockscomb have led to a rich and varied bird fauna, with forest, pine woodland and savannah species, species restricted to riverine areas, and birds associated with higher elevations.

Of particular note is the presence of a number of species in the protected area considered endangered or vulnerable, and in need of protection within Belize (Table 15). These include the great curassow (one of the two large game species), the keel-billed Motmot, and the migratory cerulean warbler. The endangered yellow headed parrot, is potentially present in the pine savannah areas, but has not yet been reported from inside CBWS. Other birds highlighted as being of concern include the second large game species (the crested guan), the ornate hawk-eagle, harpy, solitary and crested eagles, indicative of the intact, healthy forest of the Maya Mountains Massif, and the regionally endangered subspecies of the scarlet macaw.

IUCN Birds of International Concern

Endangered	
Yellow-headed Parrot	*Amazona oratrix*
Vulnerable	
Agami Heron	*Agamia agami*
Great Curassow	*Crax rubra*
Keel-billed Motmot	*Electron carinatum*
Cerulean Warbler	*Setophaga cerulea*
Lower Risk/ Near Threatened / Conservation Dependent	
Northern Mealey Parrot	*Amazona guatemalae*
Black Solitary Eagle	*Buteogallus solitarius*
Olive-sided Flycatcher	*Contopus cooperi*
Harpy Eagle	*Harpia harpyia*
Wood Thrush	*Hylocichla mustelina*
Crested Eagle	*Morphnus guianensis*
Painted Bunting	*Passerina ciris*
Ornate Hawk-Eagle	*Spizaetus ornatus*
Great Tinamou	*Tinamous major*
Golden-winged Warbler	*Vermivora chrysoptera*

IUCN Red List, 2018

GREAT CURASSOW

Around the Headquarters site, maintenance of secondary scrub habitat has ensured the presence of edge-species - birds that favour disturbed habitats, including blue-grey, yellow-winged, crimson-collared, and Passerini's tanagers, Morelet's and variable seedeaters, and greyish, buff-throated, and black-headed saltators.

BIRD SPECIES CHARACTERISTIC OF PINE WOODLAND OF CBWS

Black-throated Bobwhite
Yellow-headed Parrot
Azure-crowned Hummingbird
Vermilion Flycatcher
Plumbeous Vireo
Blue-gray Gnatcatcher
Grace's Warbler
Gray-crowned Yellowthroat
Rufous-capped Warbler
Hepatic Tanager
Rusty Sparrow
Yellow-backed Oriole

HIGHER ELEVATION BIRD SPECIES OF CBWS

Brown Violet-Ear
Stripe-tailed Hummingbird
Keel-billed Motmot
Emerald Toucanet
Plain Antvireo
Slate-colored Solitaire
White-throated Robin
Common Bush-Tanager
White-winged Tanager
Elegant Euphonia
White-vented Euphonia
Shining Honeycreeper

In areas where forest regeneration is underway, there is a gradual shift of species composition towards those that prefer higher, second-growth forest or, further from the Headquarters, deep forest habitat. In comparison, the pine woodland and associated grasslands and savannahs to the east, in the Ben's Bluff and Cabbage Haul area, are relatively species poor, but with a very distinctive bird community.

The floodplains of the major creeks attract many of the riverine, forest edge and gallery forest species, such as the bare-throated tiger-heron, grey-headed kite, russet-naped wood-rail, white-necked jacobin, and yellow-tailed oriole. Whilst Cockscomb does not have many permanent ponds, lakes or swamps, there are semi-permanent ponds, and slow moving pools in the wider sections of creeks, that attract least grebe, anhinga, several species of herons and egrets (including the vulnerable agami heron), muscovy duck, sungrebe, spotted sandpiper, the various kingfishers, and northern and Louisiana waterthrushes.

The higher elevations of the Maya Mountains in the western portion of the Cockscomb Basin have a small number of species typically not found at lower elevations, although some of these may wander down into the foothills during the non-breeding season.

The presence of the yellow-headed parrot in the eastern-most reaches of Cockscomb has recently been confirmed, in pine woodland and savannah areas of Cabbage Haul and Ben's Bluff, and flying overhead above the White House. This parrot species is considered globally 'endangered' (IUCN, 2017; BirdLife International, 2017) following a very rapid 90% population decline throughout its range since the 1970's, to an estimated 7,000 individuals in 1994. In the last ten years alone, the population has declined by a further 68%, and significant rates of decline are expected in the future with increased habitat destruction for development, hurricane impacts, increased man-made fires over the pine savannah areas, and the theft of nestlings for the pet trade. Although its preferred pine woodland and savannah habitat is only marginally represented within Cockscomb East Basin, it is still relatively common in the extensive tracts of suitable habitat east and south of the Basin, where it breeds.

Another parrot of national concern found in Cockscomb is the scarlet macaw, the largest of the parrots in Belize, with a countrywide population thought to number fewer than 200 individuals. Although the scarlet macaw is found throughout Central America and much of northern South

America, where it is still common in many places, the distinctive subspecies (*Ara macao cyanoptera*) is found only in Belize, adjacent northern Guatemala, and a tiny portion of south-eastern Mexico, where it is believed that fewer than 2,000 individuals remain in the wild. BirdLife International classifies it as 'Least Threatened', while recognizing that the Central American subspecies can be considered 'endangered', and that any further fragmentation of its nesting habitat could elevate it to the status of 'critically endangered', with the possibility of the remaining population disappearing in the next 10 years outside of highly protected areas.

Flocks are seen flying over Cockscomb from time to time, particularly in the more remote Mexican Branch, Sale-Si-Puede and Mare's Nest Branch areas, where they have been reported foraging. Over the last three years, their range appears to have been extending, and they have also been seen with increasing frequency over the Headquarters site, and even Maya Centre, especially during the months of January, February, and March, when the wild annatto and polewood trees are in fruit at Red Bank. It is thought that these birds fly from their principal nesting area in the Raspaculo River valley through passes in the Maya Mountains to the hillslopes above Red Bank and San Pablo, where as many as 100 have been observed at one time (D. Gardiner, pers. com., 2017). Over the last fifteen years, feeding grounds near Red Bank and San Pablo have become recognized for their importance, and have been highlighted as a major birding venue. This has brought awareness of the touristic value of this species, especially in the Red Bank area.

This species favours nesting in dead quamwood trees with hollow centres sufficiently large to allow for the entrance of the adult, found in close proximity to a river. The scarcity of such trees appears to be the major limiting factor to scarlet macaw distribution in Belize. The nesting range is thought to be largely confined to the Raspaculo River area due west of the Cockscomb Basin, on the other side of the Maya Mountain Divide. There have been significant efforts to protect these nest sites from Guatemalan poachers, resulting in increased fledgling success. There are also unconfirmed reports of nesting in Cockscomb West Basin and in the forest behind Red Bank.

Cockscomb has two large resident game bird species, the great curassow (considered globally "vulnerable") and the crested guan. The crested guan, in particular, is commonly observed around the Headquarters site and nearby trails, adapting readily to the presence of humans when effective protection is in place. The great curassow, on the other hand, remains shy and reclusive, and is encountered much less frequently. Both these species, along with their more common relative, the plain chachalaca, are representatives of the Cracidae family – the most threatened of the Neotropical bird families. Cracids are important seed dispersers and are a major protein source for local communities. As these birds are large, visible, showy,

CRESTED GUAN

and charismatic, their harvesting for food can also result in conflict with tourism interests.

The keel-billed motmot, another species of significant conservation concern, is considered 'vulnerable' (IUCN, 2017), though is relatively widespread in Belize. It is limited geographically to Central America, where it was found historically from south-eastern Mexico to western Costa Rica. It is now very rare or absent throughout most of its historic range, with remaining populations concentrated in Belize and Nicaragua. It occurs in relatively low densities, even within optimal habitat, and requires large expanses of undisturbed habitat to ensure viable populations. In Belize it appears to be associated with areas of steep terrain intersected by streams, the banks of which are excavated for nest sites. Within Cockscomb, it has been observed at higher elevations, along the Victoria Peak trail. It is thought that there may be fewer than 10,000 individuals remaining in the wild, with some estimates placing this figure at closer to 2,500 (BirdLife International, 2000). The population is facing a continuing decline as its forest habitat continues to be fragmented and destroyed, and is reliant on connectivity of protected areas, such as those of Cockscomb Basin Wildlife Sanctuary, the Bladen River Nature Reserve, and the Chiquibul Forest Reserve / National Park for its survival.

The ornate hawk-eagle, the rarest of the three hawk-eagles found in Belize, is found in very low densities and requires vast areas of unbroken forest in order to survive. The larger harpy eagle is breeding in the adjacent Blade Nature Reserve, and can be expected to soar over the southern part of Cockscomb when hunting. There is serious concern over the continued survival of these apex predator species at the northern extreme of their ranges (Belize, Guatemala, and possibly southern Mexico), as their numbers have been declining rapidly over the last two decades with increased deforestation and forest fragmentation.

A number of species are expected to occur within Cockscomb Basin Wildlife Reserve, but have not yet been recorded (Table 16). These include species that may occur within the more remote forested reaches of the protected area, in the mid- and higher elevations where visitation is very low, or may drift inland from coastal areas. A number of migrants, too, can be expected to be added in the future.

In 2014, BAS established bird monitoring sites across CBWS (Figure 14), to monitor the long-term integrity of ecosystems within the protected area using abundance and distribution of avian species and communities as indicators to detect

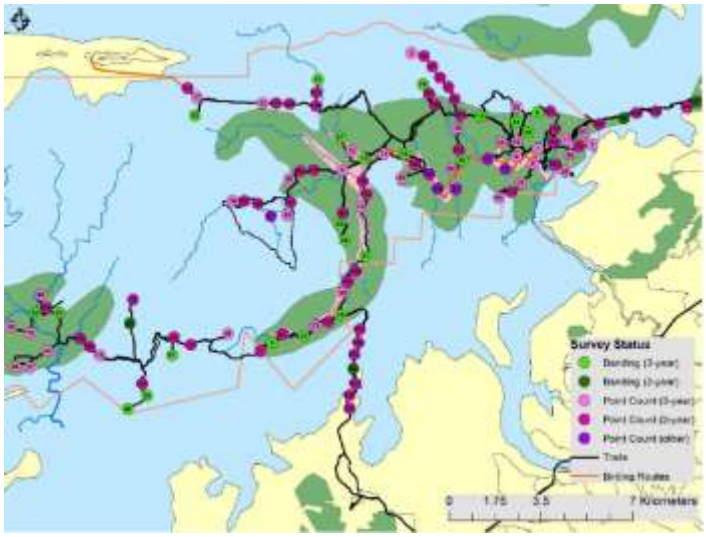


FIGURE 14: BIRD MONITORING SITES IN CBWS (BAILEY ET AL., 2016)

changes over time (Figure 15 and 16; Bailey et al., 2017). The survey covered three key vegetation types:

- Deciduous broad-leaved lowland riparian shrubland in hills
- Tropical evergreen seasonal broad-leaved lowland forest on poor or sandy soils
- Tropical evergreen seasonal broad-leaved lowland forest, well drained, over acidic soils

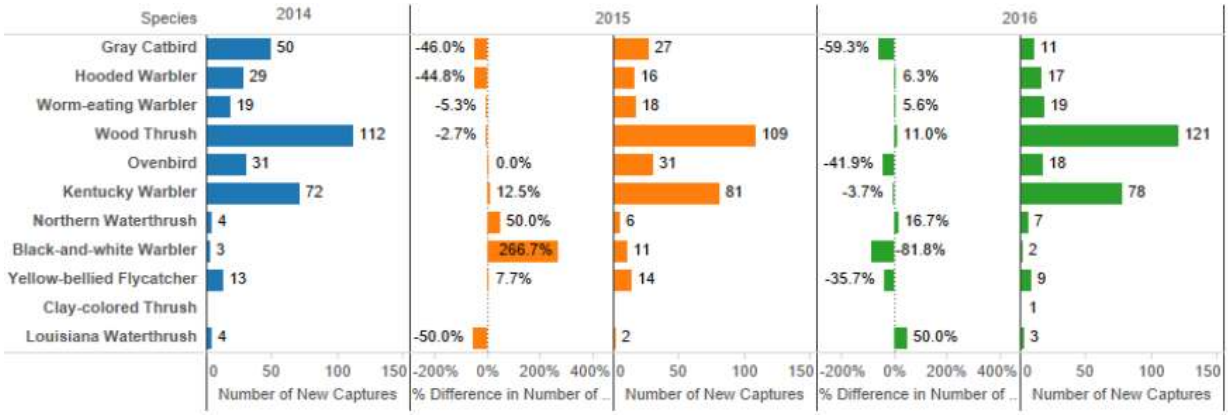


FIGURE 15: MOST COMMON MIGRATORY SPECIES CAPTURED, 2014, 2015, 2016 (BAILEY ET AL., 2017)

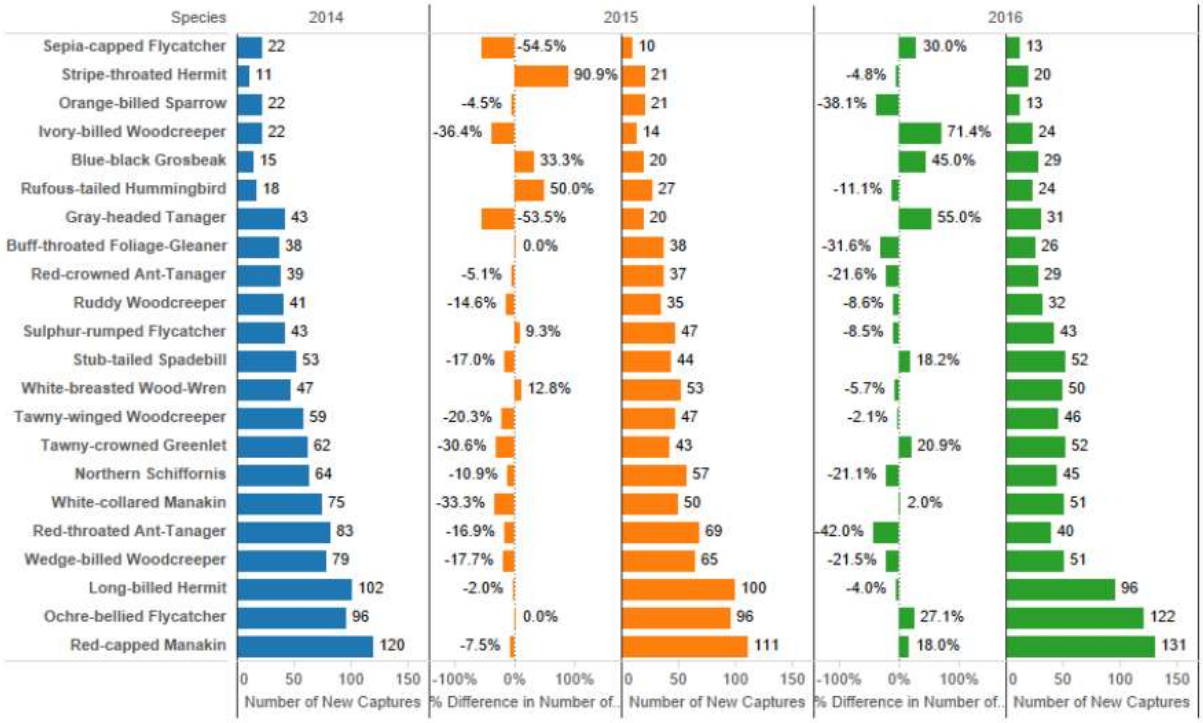


FIGURE 16: MOST COMMON RESIDENT SPECIES CAPTURED, 2014, 2015, 2016 (BAILEY ET AL., 2017)

SPECIES EXPECTED TO OCCUR WITHIN CBWS BUT NOT YET RECORDED		
Species	**Scientific Name**	**Notes**
Northern Harrier	*Circus cyaneus*	Open areas during migration
Sharp-shinned Hawk	*Accipiter striatus*	Possibly an occasional migrant
Cooper's Hawk	*Accipiter cooperii*	Should be a rare migrant
Broad-winged Hawk	*Buteo platypterus*	Possibly an occasional migrant
Greater Yellowlegs	*Tringa melanoleuca*	May be heard flying over during migration
Least Sandpiper	*Calidris minutilla*	Possibly found around edges of seasonally ponded areas
Mourning Dove	*Zenaida macroura*	Might be seen as an occasional fall transient in open areas
Yellow-billed Cuckoo	*Coccyzus americanus*	Should be an occasional transient, but is secretive and easily overlooked
Chimney Swift (NT)	*Chaetura pelagica*	May occur in fall migrations (but easily confused with Vaux's Swift).
Acorn Woodpecker	*Melanerpes formicivorus*	Should be found in eastern pine areas
Bank Swallow	*Riparia riparia*	Should occur during migration
Cliff Swallow	*Petrochelidon pyrrhonota*	Should occur during migration
Mourning Warbler	*Oporornis philadelphia*	Should occur in spring migration

TABLE 16: SPECIES EXPECTED TO OCCUR WITHIN CBWS BUT NOT YET RECORDED

HERPETOFAUNA OF COCKSCOMB

Cockscomb Basin Wildlife Sanctuary harbours a rich herpetofauna, with a total of 83 species of reptiles and amphibians recorded to date (Table 17; Annex 1). Of these, 10 are species of international conservation concern. Analysis of known species distributions and habitat requirements indicates that a further 31 to 33 species of herpetofauna are likely to occur within the Sanctuary, but have not yet been recorded. Two species (Sanderson's Streamfrog and Leprus Chirping Frog) are considered species of global concern (Table 18).

TABLE 17: HERPETOFAUNA SPECIES BREAKDOWN FOR COCKSCOMB

	No. Species
Salamanders	3
Anurans (frogs and toads)	27
Turtles	4
Crocodilians	1
Lizards	23
Snakes	25

HERPTILE SPECIES OF CONCERN

ENDANGERED	
Sanderson's Streamfrog	*Craugastor sandersoni*
VULNERABLE	
Leprus Chirping Rain Frog	*Eleutherodactylus leprus*
	Craugastor psephosypharus
NEAR THREATENED / CONSERVATION DEPENDENT	
Long-legged Streamfrog	*Craugastor sabrinus*
Maya Rainfrog	*Craugastor chac*
Broadhead Rainfrog	*Craugastor laticeps*
Cambell's Rainforest Toad	*Incilius campbelli*
Maya Mountain Frog	*Lithobates juliana*
Furrowed wood turtle	*Rhinoclemmys areolata*
Blue-spotted Treefrog	*Smilisca cyanosticta*

IUCN Red List of Threatened Species (2017)

TABLE 18: HERPTLES OF INTERNATIONAL CONCERN

In terms of herpetofauna species conservation, Cockscomb plays a major role in Belize and the region – with the likely total species tally being between 112 and 114, approximately 70% of all reptile and amphibian species in the country. Whilst Cockscomb covers only 2.2% of the total area of mainland Belize, it helps protect a disproportionately high percentage of the country's herpetofauna. This very high diversity reflects the broad array of habitats and elevations within the two protected areas, from the relatively tall lowland and swamp forests to the dwarf ridge-top elfin forest at the uppermost elevations, from seasonally mesic areas to those that are permanently wet. This very high diversity is reflected in the inclusion of much of Cockscomb West Basin as KBA 1 – the area of highest national biodiversity importance under the Key Biodiversity Areas assessment (Meerman, et al. 2007). The majority of the rest of the Wildlife Sanctuary falls under KBA 2 – the second highest of the 5 categories.

The amphibian community is notable for its good representation of Craugastorid "rain" frogs – a genus of ground nesting frogs that are characteristic of the more humid Neotropical forests (with their damp leaf litter for much of the year), and which are absent from the less humid broadleaf forests of northern Belize. Five out of the seven species of Craugastor recorded in Belize have already

been identified within Cockscomb. Even within the very humid conditions of Cockscomb's West Basin, surveys demonstrated higher densities of Craugastorids in the moist leaf litter within 10 m of creek edges during the dry season – with the animals evidently disbursing more widely across the forest floor during the rest of the year (Walker et al, 2009). Belize's only *Eleutherodactylus* species (*E. leprus*) is also present in the easternmost area of the Sanctuary. Several charismatic amphibians are found within the Sanctuary, including the red-eyed tree frog, the glass frog and several of the other hylids, along with the Mexican burrowing toad. High densities of multiple amphibian species at readily accessible breeding aggregations such as "The Frog Pond" on the Access Road have become popular for night tours in the wet season, with guides able to show visitors thousands of frogs calling together in a deafening breeding frenzy.

Eleutherodactylus leprus

Morphological variation across specimens of the northern banana salamander in Cockscomb (Walker, et al. 2009), are in line with current taxonomic thought that this represents a species group rather than a single species. It is highly likely that a taxonomic revision of this group, and further field collections, will reveal multiple new salamander species, occurring at the higher elevations of Outlier, Victoria Peak, Mount Copetilla, and along the Main Divide itself. Interestingly, Morelet's treefrog (*Agalychnis moreletii*) has not yet been recorded as far east as Cockscomb, though its habitat requirements (including its ability to breed in small in-stream pools) and range elsewhere in the region suggest a high possibility that it does occur there.

Morelet's crocodile is recorded within the protected area. This species has been recolonizing its historical range, and is likely to re-establish a breeding population within the Sanctuary. Crocodile surveys in Stann Creek District have indicated the occurrence of hybridization between Morelet's crocodile and the American crocodile (Platt, pers. comm.), with more recent work (Tellez, pers. com.) suggesting that all *C. moreletii* in Belize's coastal plane and coastal waters exhibit characteristics of hybridization.

To date only three of Belize's freshwater turtles have been formally recorded within Cockscomb: *Kinosternon acutum, Rhinoclemmys areolata* and *Trachemys venusta* – though this is likely to be a reflection of the limited extent of reptile surveys rather than of the absence of the other species. Both *Kinosternon leucostomum* and *K. scorpoides* almost certainly occur within the Sanctuary, along with the freshwater loggerhead – *Claudius angustatus*. The Central American snapping turtle (*Chelydra rossignonii*) has been hunted out from most of its former range in southern Belize, but may still occur in the remote waters of the Swasey Branch, having been observed in similar stream habitat in Bladen Nature Reserve (Walker, et al, 2009). The critically endangered Central American river turtle or hicatee (*Dermatemys mawii*) almost certainly previously occurred in the

South Stann Creek in the Sanctuary, but has not been recorded there in many years, having been extirpated from most of its former range by over-hunting.

Of the various species of lizards occurring within CBWS, three are more commonly seen than most others - the striped basilisk and two species of anole. The striped basilisk and *Anolis lemurinus* – are both common around the Headquarters, whilst in the taller, more mature forest of the Antelope and Outlier trails, *Anolis uniformis* is the most commonly encountered lizard.
Cockscomb has a diverse assemblage of colubrid snakes, the most abundant snake taxon, ranging from the diminutive coffee snake to the impressive black-tailed indigo. All three species of Belize's coral snakes are present, brightly coloured specimens sometimes being seen around the Headquarters facilities. The fer-de-lance tends to be found at higher densities in secondary forests and regenerating farmlands than in more mature forest, and an apparent decrease in fer-de-lance sightings around the Headquarters in recent years could be a reflection of the maturation of this forested area – or the policy of removing this species when encountered. The jumping viper is largely restricted to the more rugged mountainous areas above 300 m elevation, and has been recorded on Outlier. The secretive eyelash viper has not been recorded in Cockscomb, but is likely to occur in the remote wetter old-growth forests of West Basin, having been observed in broadly comparable habitat in Columbia River Forest Reserve (Walker et al 2009).

Despite Cockscomb Basin Wildlife Sanctuary protecting a vast tract of diverse tropical forest within the Maya Mountains Massif, its amphibian and reptile inhabitants face a number of significant threats – as indeed they do across the wider landscape. Chytrid infection has been linked to widespread amphibian population crashes around the world, and even extinctions in the region. Testing for chytrid infection across the Maya Mountains, including multiple sites in Cockscomb demonstrated chytrid infection of the amphibian populations at every site tested (Walker et al, 2009). Although pre-chytrid infection data is lacking in Belize, it appears that population health appeared to remain largely unaffected despite the prevalence of this fungal infection, with recruitment appearing normal. It had been argued that chytrid infection was symptomatic rather than causal, with agrochemical pollution hypothesised to suppress amphibian immune systems, making them more vulnerable to chytrid infection (Gunther Kohler, pers. comm.). Testing for glyphosate pollution (Walker et al, 2009; Kaiser, 2011) identified high levels of glyphosate at all sites tested within the protected areas of the Maya Mountains Massif, presumably transported from the agricultural areas of the coastal plain by direct drift and through orographic rainfall. The full impact of such landscape-scale environmental contamination on biodiversity is not known, but it is very clear that the seemingly pristine ecosystems of the remotest forests of Belize, such as those of the far-westernmost portions of Cockscomb, are in fact far from free from anthropogenic impacts. Whilst amphibians are the most sensitive of terrestrial vertebrates to environmental pollution, research in Costa Rica has attributed reptilian and avian population crashes to similar agrochemical pollution across the landscape. It is also recognized that climate change impacts pose potentially catastrophic threats to amphibian populations, with predicted temperature rises likely to exceed species environmental tolerances within a matter of a few decades. Undocumented observations suggest that decreasing reliability

of rainfall is also likely to negatively impact amphibian fecundity and survivorship over a far shorter timeframe (Walker, pers. obs.).

Some reptile species, such as the Central American river turtle and the Central American snapping turtle, have been extirpated from much of their former ranges in the region, including in Belize. Whilst the current level of enforcement and protection afforded to the biodiversity of Cockscomb now largely protects such species from further impacts, it is questionable whether these two remain within the protected areas and, if so, whether their populations are ecologically viable. Natural re-colonization is not likely to take place, given the lack of connectivity resulting from extremely high hunting pressures along river courses outside the protected areas.

FISH OF COCKSCOMB BASIN WILDLIFE SANCTUARY

A total of nineteen fish species have been recorded to date within Cockscomb Basin Wildlife Sanctuary, from eight different families (Annex 1). Whilst the fish of Cockscomb have not yet been studied in detail, two of the river systems - Swasey and Trio Branches (both tributaries of Monkey River) – have been investigated in some depth, in terms of water parameters and fish fauna (Esselman, 2001). For the purpose of this report, data from Esselman has been supplemented with observations of fish fauna from the South Stann Creek and tributaries within the protected area, and from data collected by the Maya Mountain Archaeological Project, working in Trio Branch/Swasey areas (1992) and East Basin (1995) (MMAP, Dunham). The most extensive fish species distribution study within Belize, by Greenfield and Thomerson (1997), concentrated on the coastal zone areas, with no monitoring points in the Cockscomb/Maya Mountain extension areas, and therefore provides little information on the fish fauna of the protected area.

Central America is in a relatively unique position with regards its fish fauna. It was an island prior to the late Pliocene, isolated from the north and south American landmasses by seawater. The freshwater bodies within the area were colonized by only those fish species able to disperse through the surrounding saltwater barrier (Greenfield and Thomerson, 1997). It was only after Central America became attached to the two larger landmasses that other freshwater species were able to colonize the area from north and south. As this was a relatively recent event (2 to 5 million years ago), the primary freshwater species - those species with no salt tolerance - are poorly represented within the Central American land bridge, and account for only 16% of the fish species within Cockscomb. The majority of families recorded within the area are secondary and peripheral freshwater fish, both being tolerant to a certain degree of salinity - 22% of the fish are secondary freshwater species, whilst the majority (62%) belong to the

Primary Freshwater Fish – Freshwater species with no salt tolerance

Secondary Freshwater Fish – Freshwater species only able to cope to a certain degree with saline conditions

Peripheral Freshwater Fish – Species with a greater salt tolerance, capable of moving between fresh and salt water

peripheral freshwater fish group. This is the opposite pattern to that of all other landmasses except Australia.

Of the nineteen species recorded within the protected area, three are Characidae species (*Astyanax aeneus*, *Brycon guatemalensis* and *Hyphessobrycon compressus*) - primary freshwater fish originally radiating northwards into Belize from South America following the formation of the land bridge. Three families represent the secondary freshwater fish recorded within Cockscomb Basin – Poecilidae (represented by five species), Synbranchidae (one species) and Cichlidae (six species). Of the peripheral freshwater fish, four species from three families have been recorded – Haemulidae (one species), Mugilidae (two species) and Eleotridae (one species).

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

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

This is supported by studies in the area showing that pool habitats in granite areas supported significantly greater densities of fish (Esselman, 2001), with fish such as *Xiphophorus helleri* – a species that prefers densely vegetated habitat - expected to be present. The rivers draining the volcanic porphyrite – Richardson Creek and Bladen Branch – are nitrogen rich but low in phosphorus, and as a result, have little macrophytic growth, and can therefore be expected to have lower abundances of fish, although richness has been shown to be similar between stream types (Esselman 2001).

Water System Categories within Cockscomb

Upper Reaches/Headwaters
Fast moving creeks and streams, with waterfalls, pools and riffles, draining steeper slopes. Vegetation often meeting overhead.

Middle Reaches
Slower moving, wider creeks and rivers meandering along the valley bottom. Some wider, faster flowing riffles in places, but no waterfalls. Little gradient. Open to sun.

Of the three water system categories – upper reaches (headwaters), middle reaches, and lower reaches (estuarine) -

only two (upper and middle reaches) are represented within Cockscomb, as the protected area has no direct contact with the coastal areas. The majority of the streams and creeks within Cockscomb fall within the upper, or 'headwaters' category, characterized by fast running streams, waterfalls, pools and riffles, often carved deep into the bedrock, with tropical broadleaf forest on either bank, branches meeting overhead and shading the water. There is a decreasing species richness and diversity with increasing distance from the sea (Esselman, 2001), with this being further reduced on entering the upper reaches, with increasing number of waterfalls and riffles effectively blocking movement of fish upstream. The headwaters areas do, indeed, appear to be species depauparate - in the waterfall pools of Tiger Fern and Ben's Bluff, for example, the only species observed was the twospot livebearer (*Heterandria bimaculata*). *Agonostomus monticola* is reported to be present in some of the fast flowing upper reach streams of Juan Branch and Sale-Si-Puede areas, where it is sought by fishermen (G. Sho, pers. comm.), though its presence in these streams is yet to be confirmed.

Moving downstream, to the middle reaches of the river systems, water flows through the floodplains, with little variation in gradient. The character of the waterway changes from the fast moving streams of the headwaters to slower, wider, deeper, meandering rivers, interspersed in places with shallower riffles, as seen in the South Stann Creek as it flows past the River Walk in East Basin. *Heterandria* is joined by a number of the Poecilidae species, and *Astyanax aeneaus*, this latter being the most abundant fish observed within the protected area. Schooling mountain mullet (*Agonostomus monticola*) were observed gathering in groups of between ten and fifteen in the deeper pools. The Cichlidae and species such as *Poecilia mexicana*, appear to be confined to the middle reaches within Cockscomb, before the first of the major waterfalls that impede movement up-stream.

Nine kilometres to the east of Cockscomb, the Access Road passes through an adjacent watershed area (Cabbage Haul Watershed), crossing Cabbage Haul Creek. Whilst this entire watershed is outside of the Cockscomb area, it is interesting to note that as well as observing several species recorded within the protected area (*Astyanax aeneus* and *Cichlasoma salvini* among them), two further species were recorded here that have not yet been recorded for Cockscomb – *Cichlasoma octofasciatum* and a *Rhamdia sp.* (*laticauda or guatemalensis*), possibly the same species as was identified to genus in Trio Branch by the MMAP (1992). As Cabbage Haul Creek runs parallel with South Stann Creek, and lies only 10 km north, flowing over similar terrain, it would seem likely that these species may also occur within South Stann Creek, dependent on the ability of these species to move beyond the first set of falls, as the river passes through the Cabbage Haul Ridge.

One species of cichlid requires further investigation. It was observed but not caught in South Stann Creek at the end of the River Path, where it appeared to be abundant, and is thought to be *Vieja synspilum,* in a particularly golden-yellow form. This species was also recorded from upper Swasey Branch (G. Sho pers. comm.) and from Trio/Swasey area during the MMAP, being referred to by the local name 'tuba' (MMAP, 1992). Esselman, however, saw no sign of this species whilst working in Trio Branch, and Greenfield and Thomerson (1997) show the range as extending only

as far south as North Stann Creek valley. It therefore requires confirmation before being added to the species list.

There is pressure on the fish populations of Cockscomb, with numbers decreasing with increasing fishing with gillnets (Sho, pers. comm.; E Saqui pers. comm.; J Saqui pers. comm.). This activity is particularly prevalent in the Snooks Eddy area (and west along South Stann Creek, further into Cockscomb), Double Falls area, Juan Branch, and Sale-Si-Puede in the north, and Trio and Bladen Branches in the south, with people fishing for *Agonostomum monticola*, *Brycon guatemalensis* and the larger cichlids (*Petenia splendida* and *V. maculicauda*) in particular. The presence of *Joturus pichardi*, previously recorded only as far north as Honduras (Greenfield and Thomerson, 1997), is a definite attraction to the local fishermen, being one of the most coveted mullet species in the region, and therefore encouraging greater up river incursions (Esselman, pers. comm.). The fish fauna of Belize is insufficiently studied for an evaluation of the importance of Cockscomb to be made, in terms of conservation of fish species. However, there are increasing indications that throughout Belize, populations of the larger fish species – those caught for food – are declining, a problem facing Cockscomb, with the present levels of fishing within the protected area. If this illegal fishing can be halted by effective patrolling, Cockscomb does indeed have an important role to play in the conservation of fish within Belize in the future.

LEPIDOPTERA OF COCKSCOMB BASIN

162 species of butterflies and 26 moth species have been recorded within Cockscomb Basin Wildlife Sanctuary, ranging from the miniature beauty of the Lycaenidae to the metallic blue of the morpho species.

BUTTERFLIES

A number of researchers have studied the butterflies of the Wildlife Sanctuary over the years, starting with Godman and Salvin (1901), Boomsma and Measey (1992), J. Young (2003, 2004), J. Shuey (1988, 1999) and most recently C. Schutte (2004) on behalf of Shuey (pers.com.) (Annex 1). Sampling techniques used within the Sanctuary for butterfly species have focused on two techniques – collecting with a net, and using fruit-baited traps in both open and forest environment. Much of the work has concentrated around the headquarters and trails close by which, over the timeframe of the more recent work, has been in a state of regeneration since the closure of the sawmill and the move of the Quam Bank community to Maya Centre in 1985.

BREAKDOWN OF BUTTERFLY FAMILIES AT CBWS

Family	No. of Species
Hesperidae	44
Lycaenidae	17
Nymphalidae	82
Papilionidae	10
Pieridae	9
Total	**161**

TABLE 19: BUTTERFLY FAMILIES REPRESENTED IN CBWS

This updated species list includes several range extensions, such as *Heliconius sapho*,

recorded for the first time in Stann Creek (Meerman, 2001), and *Remalia vopiscus*, *Memphis proserpina* and *Agrias aedon* all being new additions to the overall Belize species inventory, from data collected during the most recent survey (Schutte / Shuey, pers. com., 2004). *Agrias aedon rodriguezi*, the sub-species found within Belize, is recorded from Mexico south to Costa Rica, and is highlighted as particularly rare within the region (Shuey, pers. com., 2004). Before 1980, this species was known only from a single specimen from Guatemala, and references from Costa Rica suggest that it is only known from two localities, both above 600 m (DeVries, 1987).

Indicator species of disturbed and forest edge habitats – *Agraulis vanillae, Mestra amymone* and *Anartia fatima*, for example – are present in the maintained open areas and trails of the Headquarters site (Walker, pers. obs.). Studies in the Amazon show that butterflies such as these can be a good indicator of edge effect, penetrating into the first 250 m or more of forest habitat (Brown and Hutchings, 1997). This can provide a useful means of monitoring disturbance levels along roads, trails or clearings, and should be borne in mind when allocating areas for research of designating transect routes for monitoring butterfly distribution or abundance.

A number of forest obligate species have also been recorded from the area, both from the secondary regenerating forest, and the more remote, more pristine forested trails further from the Headquarters - though in both they were observed in very low numbers (Boomsma and Measey, 1992). One of these, *Fountainea eurypyle*, is identified in the Selva Maya monitoring protocol (Pozo de la Tijera, 1999) as an important indicator of primary forest habitat throughout the Selva Maya region, though this species can be lured into small clearings, having been recorded from fruit traps set in the CBWS HQ clearing, and along forest edges. Other species indicative of these habitats include the clearwing *Aeria eurimedia*, the Heliconiinae *Heliconius sapho* (noted as intolerant of disturbance by DeVries, 1987), and *Euptychia mollis*, a Satyrinae that seldom leave the shade of the forest.

Also recorded from Cockscomb is the flamboyant *Morpho peleides*, which shows a preference for the forest trails, being observed frequently on the River Path and Victoria Peak Trail (Walker, pers. obs.). A second species of morpho – *Morpho theseus* – was also recorded at the Headquarters (Shuey, pers. comm., from a record by Andrew Neild, 1997), though this species is more commonly associated with upland areas of forest, where they typically fly high over the forest canopy (DeVries, 1987).

At present the species list for Cockscomb is incomplete, with the majority of the research work being located in East Basin. Since the establishment of the protected area, it appears that no survey work has been done in the less disturbed, more mature forest of West Basin, in the limestone hills of the southern parts of the Maya Mountain Extension, nor in the Elfin ecosystem of higher elevations. This latter ecosystem, in particular, should yield some interesting, highly specialised species - it is expected that a greater proportion of the Lepidoptera of these upland areas will feed primarily on nectar (as fruit is a relatively scarce resource in these upper elevations), compared with the many primarily fruit feeding species of the lowland forests recorded to date.

Butterflies have great visitor appeal, whether they are rare forest species or the common 'weed species' found in disturbed areas. Actions within the management plan deal with ways in which these species can be encouraged within the landscaping of the Cockscomb Headquarters site.

MOTHS

Moth surveys in the Wildlife Sanctuary have focused primarily on Saturniidae and Sphingidae – the Silkmoths and the Hawkmoths – over a five-day period (Boomsma and Measey, 1992). This resulted in the identification of a total of 26 species – 10 Saturniidae and 15 Sphinigidae (of 27 Saturniidae and 106 Sphingidae listed for the country, (Table 20; Meerman, 1999). This suggests that further Sphingidae can be expected to be added to the species list through a more intensive survey.

Moth Species recorded for CBWS (Boomsma, 1992)	
Sphinigidae	
Sphinginae	***Macroglossinae***
Agrias cingulatus	Isognathus rimosa
Cocytius duponchel	Erinnys alope
Neococytius cluentius	Erinnys ello
Manduca hannibal	Xylophanes chiron
Manduca rustica	Xylophanes tersa
Manduca corallina	Xylophanes libya
Protambulyx strigilis	Xylophanes neoptolemus
	Xylophanes undata
Saturniidae	
Arsenurinae	***Hemileucinae***
Rhescyntis hippodamia	Automeris zozine
Ceratocampinae	Automeris rubescens
Eacles ormondei	Periphoba arcaei
Adeloneivaia jason	***Saturniinae***
Syssphinx quadrilineata	Copaxa escalantei
Syssphinx molina	Copaxa rufinans
	Xylophanes undata

TABLE 20: MOTH SPECIES OF CBWS

1.5.4 PAST AND PRESENT RESEARCH AND MONITORING OF BIODIVERSITY

Cockscomb Basin Wildlife Sanctuary has hosted a number of research studies and biodiversity inventories since first highlighted as a potential conservation area, following research into jaguar populations by Rabinowitz (1983). The majority of these studies have focused on two key mammal species – the jaguar and black howler monkey.

The World Conservation Society (WCS) has supported Cockscomb since its inception, particularly with long-term involvement in studies on jaguar. The present Camera Trap Project is utilizing Cockscomb as one of five pilot sites to develop quick and relatively cheap, non-intervention techniques for estimating numbers of jaguars within an area (Harmsen, pers. comm. 2004), and is having some success in being able to identify individuals from photographs, enabling the project to build up a picture of how many jaguars live within Cockscomb, and how they utilize the area (Silver et. al, 2004). Current studies are also commencing into jaguar depredation in adjacent large cattle farms (Foster, pers. comm.).

Following the initial reintroduction of black howler monkeys into Cockscomb (Horwich et al., 1993), studies into the behaviour and progress of the translocated groups resulted in several papers, providing feedback on the success of the initial WCS release project (Crozier, 1995; Silver, 1997; Ostro, 1998; Ostro et. al., 1999). This has recently been updated following a 2017 survey by Silver.

A 1999 survey into the bat species of the protected area developed the baseline data for this group of mammals (Miller and Miller, 1999), as did the subsequent small mammal survey (Silver et. al., 2001), which covered a wider array of mammal species, building on the original biodiversity data collected by Kamstra (1987), and Rabinowitz and B. Nottingham (1989). WCS also established two 2 km transects within Cockscomb East Basin – a transect in disturbed habitat on the Access Road, and a transect in relatively undisturbed forest on the Outlier Trail - for continuous monitoring of mammals as part of the regional network of Mesoamerican sites using the Selva Maya protocol. These transects have subsequently been relocated for easier access, and staff training for monitoring of mammals and birds is presently underway.

Stephen Russell collected birds within the Cockscomb area in 1958/1959 (Emmons et. al. 1996), but the bird species of the Sanctuary were first formally inventoried by Kamstra (1987), with a number of ornithologists visiting the area since then, adding to the species list. However apart from a single research project into hematzoan parasites of birds (Booth, 2002), no serious research studies appear to have taken place on this vertebrate group. This has now been addressed through the establishment of a series of bird monitoring and banding sites in 2014, and annual monitoring.

A comprehensive assessment of the upper elevation amphibians was completed between 2008 – 2009, providing a baseline for these species in the protected area (Paul Walker). By necessity, much of the work has been conducted within the more accessible East Basin, with only an initial survey of West Basin, conducted in 1990, including preliminary surveys of the herpetofauna (Walker) and plants (Meadows). Balick conducted a more general survey into the conservation status of a specific palm species, *Schippia concolor*, within Belize. The New York Botanical Gardens compiled a preliminary list of plants identified within the Sanctuary, which has been extended within this report. The present development of the Juan Branch site makes the practicalities of investigating wildlife populations in the West Basin area far more feasible.

Very little work has been conducted within the Maya Mountain extension in the southern end of the Sanctuary. The Maya Mountain Archaeological Project worked within the Trio Branch and Swasey Branch areas in 1992, looking primarily at the archaeological sites within the area, but also including baseline observation on wildlife species. This long-term study also investigated the sites of East Basin in 1995. The Trio and Swasey Branch areas were also incorporated into a study on the freshwater ecology and fish communities of Monkey River and its tributaries (Esselman, 2001).

Invertebrates have not been studied in depth – an initial report on the Lepidoptera and Odonata of the area (Boomsma and Measey, 1992) provide an inventory of these species observed on trails and along streams near the Cockscomb HQ. Further research on Lepidoptera within the protected area is currently underway (J. Shuey, 2004, pers. com.), and has updated and enlarged the species list for this group, as well as adding several new records for Belize.

Research within Cockscomb Basin Wildlife Sanctuary

Year	Subject	Author
1983	A preliminary jaguar survey in Belize	A. Rabinowitz
1986	Ecology and behaviour of the jaguar (*Panthera onca*) in Belize, Central America	A. Rabinowitz and B. Nottingham
1987	An ecological survey of the Cockscomb Basin, Belize	J. Kamstra
1989	Movement patterns and food habits of four sympatric carnivore species in Belize, Central America.	M.J. Konecny et. al.
1989	Mammal species richness and relative abundance of small mammals in a subtropical wet forest in Central America	A. Rabinowitz and B. Nottingham
1990	The Cockscomb Basin Expedition, 11-17th June, 1990: Final Report	Rath et. al.
1992	Cockscomb Basin Wildlife Sanctuary Lepidoptera and Odonata Survey	T. Boomsma and G. Measey
1992	Maya Mountain Archaeological Project - 1992	Dunham et. al.
1993	A reintroduction program for the conservation of the black howler monkey in Belize	Horwich et. al.
1994	Reintroduction of black howler monkeys (*Alouatta pigra*) into the Cockscomb Basin Wildlife Sanctuary, Belize.	Koontz F. W. et. al.
1994	The conservation status of *Schippia concolor* in Belize.	Balick, M.J. & D. Johnson
1995	Black Howler Monkey survey in Cockscomb Basin	M. Crozier
1995	Maya Mountain Archaeological Project	Dunham et. al.
1997	The feeding of translocated howler monkeys (*Alouatta pigra*) in Belize, Central America	S.C. Silver
1998	The spatial ecology of translocated Black Howler Monkeys in Belize	L.E.T. Ostro
1999	Ranging behaviour of translocated and established groups of Black Howler Monkeys *Alouatta pigra* in Belize, Central America	L.E.T. Ostro et al.
1999	Results of a survey of the bats of Cockscomb Basin Wildlife Sanctuary	B. Miller and C. Miller
2001	Victoria Peak National Monument – Rapid Management Appraisal	Meerman, J.C. & Minty, C.
2001	The Monkey River Baseline Study: Basic and applied research for monitoring and assessment in southern Belize	Esselman, P.
2001	Cockscomb Basin Mammal Survey	S.C. Silver et. al.
2002	Hematological responses to hematozoa in North American and neotropical songbirds	Booth, C.E. & P. F. Elliott.
2004	Survey of CBWS butterfly fauna (in prep.)	C. Schutte & J. Shuey

Research within Cockscomb Basin Wildlife Sanctuary

Year	Subject	Author
2005	Monitoring jaguar and other mammals in the Cockscomb Basin Wildlife Sanctuary, Belize, C.A.	Silver S. & Ostro L.
2005	Jaguars on the Edge: Investigating jaguar – human conflict in Belize	Foster, Rebecca
2006	Pilot Assessment of the Status of Belize's Endangered Amphibian Species, with associated Threat Analysis	Walker, Paul
2006	The Use of Camera Traps for Estimating Abundance and Studying the Ecology of Jaguars (*Panthera onca*)	Harmsen, Bart
2006	Cockscomb Basin Wildlife Sanctuary/Victoria Peak Natural Monument Management Plan 2006-2011	Walker, Paul
2006	Designing methods for population assessment of jaguar (*Panthera onca*), and extrapolating results to new areas	Higginbottom, Paul
2007	Enhancing site specific and national population viability of threatened upper elevation amphibian species of the Maya Mountain Massif in Belize	Walker P., Kaiser K., Edgar P., Garcia E.
2006	Developing integrated assessment of biodiversity in secondary forest in Belize	Maskell L., Walker P., Goodwin Z., Chan I.
2006	Effects of Topography on forest structure and composition in the Cockscomb Basin Wildlife Sanctuary	Brewer, Steven
2006	Density Estimates of Jaguars in Belize as Derived from Camera Trapping Data	Silver, Scott C. , Linde Ostro, Jennifer Davies
2007 -2016	Insect communities of Belize-Assessment of selected families of Lepidoptera and Coleoptera at Cockscomb Basin, Columbia Forest Reserve and Sarstoon-Temash National Park and nearby habitats	Shuey, John
2007	The Dynastinae (Coleoptera: Scarabaeidae) of Mexico, Guatemala and Belize	Brett C. Ratcliffe, Ronald D. Cave, & Enio Cano
2007	Scat Dog Project in Cockscomb Basin Wildlife Sanctuary (CBWS)	Devlin, Allison
2007	Competition in Carnivores: The Ecology of Co-existence. Jaguar, puma, and ocelot surveys in the Chiquibul Forest Reserve and in four other reserves in Belize	Kelly, Marcela
2007	Patterns of Seasonal Variation in Diet and Movement of Scarlet Macaws (*Ara macao*) in the Western Flank of the Maya Mountains, Belize	McReynolds, Mark
2007	Checklist of the Vascular Plants of the Cockscomb Basin Wildlife Sanctuary	Akers, Ruth
2007	Noninvasive tracking of jaguars (Panthera onca) and co-occurring feline species in Belize by genotyping feces and remote camera trapping	Wultsch, Claudia
2007	The evolutionary ecology of the facultatively clonal ant, *Platythyrea punctata*	Seal, Jon Nicholas
2008	Fragmentation Effects on the mammals of Belize	Rex Medlin and Thomas Risch
2008	Survey of Hawk-Eagles in Belize	Phillips, Ryan

Research within Cockscomb Basin Wildlife Sanctuary

Year	Subject	Author
2008	Field Investigations of Cycads and Palms in Belize: Diversity, Distribution, Ecology and Conservation Assessment.	Calonje, Michael
2008	Field Investigations of Cycads and Palms in Belize: Diversity, Distribution, Ecology and Conservation Assessment.	Calonje, Michael
2011+	Bird Monitoring using Point Counts	Belize Audubon Society
2012	Spiders of CBWS	Thomas, Aimee
2012	Coarse-grained Lithologies used to Determine Tectonic Setting and Possible Source areas of the Santa Rosa Group, Cockscomb Basin and Bladen Preserve, Maya Mountains, Belize	Elswick, Erika R.
2012	The function and evolution of terrestrial reproduction (Hour glass tree frogs)	Touchon, Justin
2013	Identification of woody plants by means of their vegetative characters	Keller, Roland
2013	An Integrated Pedogeomorphologic-Vegetation Survey of the Cockscomb Basin Wildlife Sanctuary, Stann Creek District, Belize	Fisher, Fred
2013	Prey assessment for jaguar, puma and human consumption	Harmsen, Bart (UBERI)
2013	Freshwater Invertebrate Taxa Richness Survey for Five Protected Areas co-managed by the Belize Audubon Society	Valladarez,Jair (UB-NRM)
2014	Establishing Permanent Sample Plots in CBWS	Cho, P. (Forest Dept)
2014	Bromeliads and other Vascular Epiphytes of Belize	Holst, Bruce, E. Baron, et al.
2015	Long term entomofaunistic response to hurricane disturbance of natural tropical forest in a region with strongly increased hurricane activity: Belize	Thomaes, Arno
2015	Diversity and Behavior of Solitary Bees and Wasps of Belize	O'Neil, Kevin
2015	Survey of the Scorpions of the genus Diplocentrus Peters, 1861 Scorpions: Diplocentridae from Central America	Santibanez-Lopez, Carlos
2016	Review of Arthopod Diversity	Bundy, Charles
2016	Comparisons of Plant Composition and Species Diversity in Belizean Forests over Multiple Geological Substrata	Brewer, Steven
2016	Local and non-locals' Willingness to Pay to access a Belizean Terrestrial Protected Area: A Case Study	Teul, Ismael
2017	A preliminary survey of long-legged flies (Diptera: Dolichopodidae) and bees (Hymenoptera: Apoidea) in Belize: Part II	Runyon, Justin
2017	Howler Monkey Survey in Cockscomb Basin, 2017	Silver, Scott
2017	Long-term monitoring of jaguars and pumas and their prey in the Cockscomb Basin Wildlife Sanctuary	Harmsen, Bart (UB-ERI)

1.5.5 ARCHAEOLOGICAL INTEREST

Belize was settled extensively by the Maya, with a civilization that expanded from 2,000BC to 900 AD before declining prior to the arrival of the Spanish. This is seen within Cockscomb, with the presence of a number of sites, all of potential interest to visitors. However at present, visitation to these sites is non-existent except by illegal looters.

The Maya favoured the lowland areas, with settlements focused on river trade routes and good farming land. For this reason, little attention has been paid to the Maya Mountains in the past, until the 1990's, when a series of archaeological explorations were carried out in the area under the Maya Mountains Archaeological Project (MMAP, Dunham). Both Cockscomb Basin and Trio Branch were explored, and evidence of Maya settlement was confirmed, with numerous small sites scattered throughout the lower lying areas. Six larger sites were also located and mapped, three being within Cockscomb Basin itself, and a further three on Trio Branch, all dating from the Late or Terminal Classic (AD700 – 900).

NOTABLE MAYA STRUCTURES WITHIN CBWS

PEARCE RUINS

Ballcourt
4 major courtyards
Main plaza larger than a football field
At least 6 reservoirs
9 plain granite monuments
1 egg shaped monolith
Monument workshop

HUNTUL MO ('ONE MACAW')

Terraced hillside
Circular alter stone with 2 Oval monuments at base
Large plaza
Several plain granite monument slabs

XA'AYILHA ('MANY WATERS')

Large plaza
3 Plain granite monuments
Ball court

The most important of the sites are the Pearce Ruins, which were first recorded in 1931 by Lee Pearce, whilst searching for mahogany in the area. Following their initial discovery, they then faded into legend until being rediscovered in 1995 under the MMAP. This ceremonial site (one of the largest in southern Belize) is thought to have been the most important settlement in Eastern Cockscomb, and is situated at the junction of the main tributaries. This gave it control of the surrounding area, and of movement of natural resources such as granite and trade goods in and out of the South Stann Creek watershed. All other sites within the protected area are considered to be satellites of the Pearce Ruins (MMAP 1995).

Huntul Mo ('One Macaw') is a smaller ceremonial centre located on Sittee Branch. There is some debate as to whether this site may include Kuchil Balum, originally highlighted by Rabinowitz (1986), though descriptions of the two appear to differ in some respects. A third site, Xa'ayilha ('Many Waters') is found at the junction of the major feeder creeks of the upper Swasey Branch – again, located close to the river system that was so essential for trade links.

These three sites, and many of the smaller sites of lesser complexity, have signs of looting – some just with minor damage, whilst others have whole buildings destroyed, as seen at the Pearce Ruins and Xa'ayilha.

1.6 CULTURAL AND STAKEHOLDER USE OF COCKSCOMB BASIN WILDLIFE SANCTUARY

1.6.1 TOURISM USE

Cockscomb is well positioned to offer visitors a tropical forest "jungle" experience, with opportunities for seeing abundant, diverse wildlife, accessible scenic vistas of unbroken forest canopy, well maintained trails rich in palms and scattered trees of giant proportions, lianas, epiphytes, buttress roots and the fleeting glimpses of a broad assortment of birds; jungle streams and inviting crystal clear waterfalls – all the natural components for breath-taking jungle experiences. Jungle streams and waterfalls figure highly in visitor expectations, often providing a focus for walks through the forest - this appeal of streams and waterfalls has been recognized in the planning and routing of the present trail system around the HQ, which offer stream crossings or views of scenic waterfalls. However, these features figure less prominently on the longer trails to Outlier and Victoria Peak – trails focused more on the stunning vistas and wilderness values of the Cockscomb Basins.

From its start as a re-furbished logging camp, the facilities have been developed over time to meet the required role of resource protection and provision of an important natural-resource based tourism destination, through the renovation of the old logging buildings and construction of new facilities. The majority of the protected area infrastructure is located in a centralized area at the Headquarters site, the Protected Area Service Zone, with the exception of the White House at the entrance to the Wildlife Sanctuary. There are opportunities for overnight stays, with a central campsite located at the Headquarters site and a number of smaller designated basic camping facilities scattered through the Sanctuary (at Tiger Fern, Outlier, and at 12 km and 19 km on the Victoria Peak trail, and on the Outlier trail). It is recognised, however, that the current tourism structure doesn't optimise financial sustainability.

VISITATION

Over the years, visitation has increased, from just over 4,000 in 2006 to over 10,340 in 2016 (Figure 17). The tourism base is primarily international visitors from the USA, Canada and Europe accessing the area through day tours from nearby coastal resorts, or as individual travellers, staying either in Cockscomb or in Maya Centre.

Trends in tourism numbers over the years are affected by the state of the global economy and impacts from natural disasters. Visitation is also seasonal, with peak numbers between January and March, and lowest visitation in August and September (Figure 18).

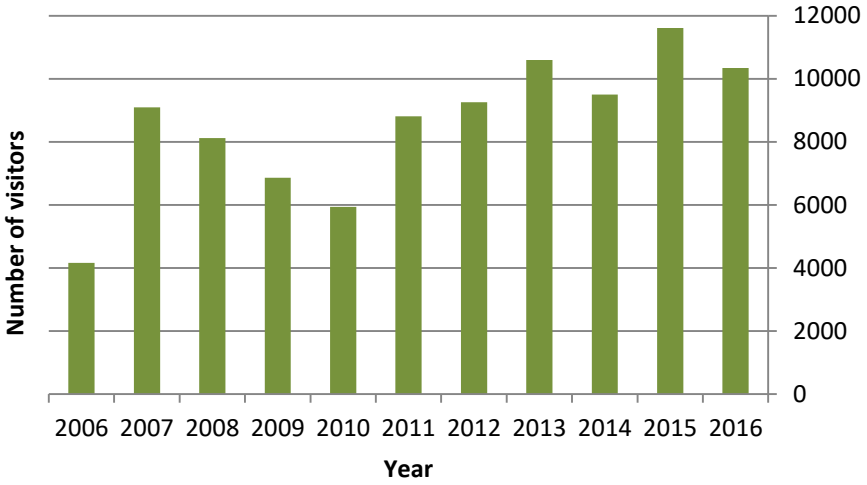


FIGURE 17: VISITATION TO COCKSCOMB BASIN WILDLIFE SANCTUARY (BAS, 2017; BTB TRAVEL AND TOURISM STATISTICS DIGEST, 2015)

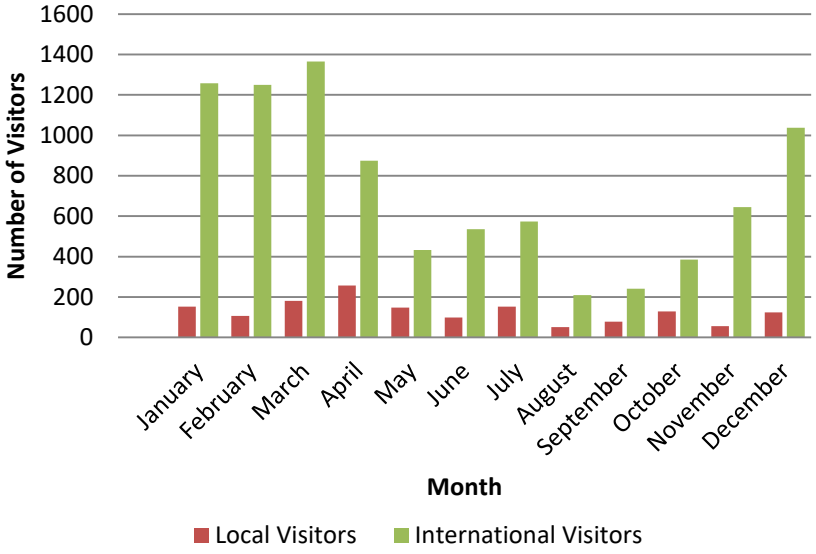


FIGURE 15: VISITATION TO COCKSCOMB BASIN WILDLIFE SANCTUARY PER MONTH, 2016 (BAS, 2017)

Recreational use by local communities is very limited, and visitation by Belizean nationals accounts for only 14% of total visitor numbers - very few people in the local communities see Cockscomb Basin Wildlife Sanctuary as a resource for their use. The majority of visitors are non-Belizean, participating in organized tours or excursions, most often based from coastal communities or resorts (Placencia, Hopkins, Dangriga). The highest demand activity for such groups is river-tubing down the South Stann Creek, with other popular activities including

walking some of the shorter trails (particularly Ben's Bluff, to the waterfall), and bird watching around the Headquarters and nearby trails. These groups are generally day visitors, typically in the Wildlife Sanctuary for only 2 to 4 hours (Table 21).

Independent visitors, generally with rental vehicles, are a steady but relatively small portion of the visitor cross-section – but account for a high percentage of the overnight visitors using accommodation facilities in Zone 1. Many of these are interested in natural history, sometimes with a focus on birds, as Cockscomb becomes increasingly well known for its avifauna.

The Victoria Peak Trail, considered one of the most challenging climbs in Central America, attracts adventure visitation from both Belizean and international teams. In 2018, a total of 10 groups and 128 participants (not including guides) completed the 3-4 day hike.

Low budget backpackers account for only a tiny fraction of the total visitors to CBWS - the absence of public transport to the site, and the relatively high cost of private taxis from Maya Centre puts a visit to CBWS beyond the budget of many backpackers.

Small-scale cruise ship tourism groups are currently accessing the area on a regular basis, with a primary focus on fun and river-tubing. There is significant interest for increased use of Cockscomb Basin Wildlife Sanctuary from cruise ship tours originating from the Harvest Caye cruise ship terminal, with the potential to improve financial sustainability of the protected area.

CBWS VISITOR PROFILES			
VISITOR TYPE	**PRIMARY REASON(S) FOR VISITING**	**SECONDARY REASON FOR VISIT**	**VISITOR FLOW**
Nature Lovers	Wildlife and scenic values	Wilderness area	Low
Researchers	Scientific research, specific species / groups of species	Scenic values and wildlife	Low. 1 or 2 individual researchers or small groups a year
Birders / Birdwatching groups	Birds, looking for specific birds – "e-birding"	Scenic values and other wildlife	Low – increasing. 7 – 8 groups a year. Increasing number of local birders
Night Hikes	Wildlife		Low but increasing
Families	Wildlife, learning experience, fun	Scenic values and wildlife	Low - small number of groups each year
Local Visitors	Scenic values, waterfalls	Wildlife	Low
Mountain Biking	Fun / sport	Scenic values and wildlife	Low
Kayaking	Fun / sport	Scenic values and wildlife	Low
School Groups Overnight	Learning experience	Scenic values and wildlife	Low 7-10 groups a year– smaller groups –spend the night
Extreme Adventure Groups	Victoria Peak (Wilderness, challenging)	Adventure, scenic values	Medium (seasonal) 2016: 15 groups (174 people) 60% Belizean and 40% international. 2018: 10 groups (128 people)
Hikers and Campers	Overnight camping trips – Tiger Fern, Ben's Bluff, Outlier, 12 km – usually eco-tourists	Scenic values and wildlife, adventure	Medium
University Groups / International Students	Wildlife, learning experience	Scenic values and wildlife	Medium 2016: 18 groups of international students (18-20 people) –increasing
Recreational Student Groups	Fun, recreation	Scenic values and wildlife	Medium 2016: Fewer than 15 groups
Cruise Ship Visitors	Fun	Scenic values and wildlife	Medium
General Interest Tours	Scenic values and wildlife	Wilderness Area	High
River tubing	Fun	Scenic values and wildlife	High
School groups Day trip	Learning experience	Fun	High (2016: 25 groups with up to 180 students per group)

TABLE 21: VISITOR PROFILES

1.6.2 COMMUNITY AND STAKEHOLDER USE

Visitation to the protected area by community members is limited, though there is general recognition of the ecosystem services the protected areas provide to the communities. In 2016, fewer than 15% of visitors were Belizean, and very few of these were from the local communities. During community consultations, it was found that very few of the village leaders had visited Cockscomb Basin Wildlife Sanctuary, and the general perception is that it is a tourism resource managed for international visitors. This is reflected in the high percentage (47.9%) of peoples surveyed who ranged from having no opinion to strongly disagreeing to the statement "*I visit and enjoy the protected area nearby, no matter if I go often or rarely",* as part of a Knowledge and Attitudes survey conducted in 2015. Households were surveyed in five of the CBWS buffer communities: Maya Centre (6 households), Red Bank (16), Santa Rosa (6), San Roman (9) and Maya Mopan (9). 65% of respondents had a positive attitude towards the natural capital of CBWS. The survey, however, also showed that almost half of the participants showed a disconnect from the protected area – 43.5% considered that people in their communities don't care about the protected area. Conversely, however, 80.4% strongly agreed that protecting the natural resources in their communities will improve their quality of life.

During community consultations, Maya Center had the most positive attitude towards CBWS, with participants seeing the benefits, ranging from tourism income and sale of crafts to protection of the watershed. Other communities, however, feel less positive – participants from Red Bank and Maya Mopan, see how Maya Center is benefitting, and understand how a protected can benefit communities, but don't see these benefits spreading to their communities, with the exception of a small number of individuals either employed by BAS or as tour guides. This translates to lower support for BAS and its objectives.

The level of illegal use of the protected area by hunters and fishermen has declined significantly since the first management plan, but still continues at low levels along the rivers (Conservation planning workshop, 2017). It is thought to be higher in areas such as Juan Branch, where access for patrolling is harder, and there are concerns about improved access for illegal activities in the Roseville area, where forest clearance is closer to the CBWS boundary.

Community consultations suggest that approximately 10 fishers / hunters are active in the area, and are willing to enter CBWS even though they know it is illegal and well patrolled. Concerns about the health of fish downstream in waters contaminated by agrochemicals, the decreased catch in the deeper lower reaches of the rivers, perceived community ownership of various stretches of river, and heavy overfishing are all cited as reasons for illegally incursions. Impacts from the communities also come from poor agricultural fire management, with escaped fires travelling up the hill slopes in the Cabbage Haul area, impacting the pine forests and degrading broadleaf forest.

BAS has been improving engagement of communities through increasing effective communication with community leaders and working with community groups to build capacity for alternative livelihoods that will have less impact on the landscape. The organization has also continued implementation of bird groups in the schools, class presentations, and BAS Guardian Camps in Red Bank, Maya Mopan, and Maya Centre, working to engage the teachers and the next generation. However, the increasing issues of declining employment opportunities and the expanding human footprint will lead to more rather than less conflict between the communities and the protected area, unless the connection can be made, and communities take on greater stewardship.

1.6.3 EDUCATIONAL USE

Cockscomb Basin is an important day trip activity for many schools, providing an opportunity to introduce younger students to the forest and wildlife, and engage them in good stewardship of the environment. In 2016, 25 school groups visited Cockscomb, with individual groups of up to 180 students. Belize Audubon Society has a strong environmental education programme that is focused at all levels of society, with the goal of inspiring respect and responsibility for the natural environment. In the schools around CBWS, awareness activities are centered on the establishment of bird clubs that introduce students to the natural environment. This is supplemented by activities at CBWS through the BAS Nature School programme, with CBWS hosting over 920 students in 2017. Community presentations, publications, and special events are also used to improve knowledge and develop the values, skills, attitudes, and commitment needed to address environment and development issues. We hope to among all Belizeans.

Schools from across Belize visit Cockscomb each year as part of the BAS Nature School programme. Nature School provides students with hands-on experiences, teaching environmental stewardship skills, problem solving and critical thinking skills in a natural environment. In 2017, CBWS hosted over 920 students under this programme.

Section Two

Conservation Planning

COCKSCOMB RANGE

2. CONSERVATION PLANNING

Conservation planning is a structured process that identifies and assesses the species and ecosystems of concern, the threats that impact them, and the strategies that can be used within the management of the area to mitigate these threats.

Conservation Targets for Cockscomb Basin Wildlife Sanctuary

- Tropical Forest
- Pine Forest
- Upper Elevation Ecosystems
- Freshwater
- Game Species
- Charismatic Species
- Cultural Values

2.1 MANAGEMENT TARGETS

Conservation targets are species, species assemblages or ecosystems that have been selected as representing the biodiversity of a protected area – such that strategic actions, taken to ensure their continued viability and reduce the pressures impacting them, will adequately address the conservation management needs of the protected area as a whole. For the purposes of the Management Action Planning process, the selected biodiversity targets were required to meet the following criteria, where possible:

- **Targets should represent the biodiversity of the site.** The focal targets should represent or capture the array of ecological systems, communities, and species of importance at the project area and the multiple spatial scales at which they occur.

- **Targets reflect ecoregion or other existing conservation goals.** Focal targets should reflect efforts at the regional and national level where they exist, such as landscape level, the planning for the Maya Mountains Massif, the National Protected Areas System Plan, the NPAPSP Rationalization recommendations, and the National Biodiversity Strategy and Action Plan. Focal targets that are grounded in the reasons for the project area's current status of protection, and the identification of the Maya Mountains Massif as one of the regions key remaining intact forest areas, and of Cockscomb Basin Wildlife Sanctuary as a national priority area.

- **Targets are viable or at least feasibly restorable.** Viability (or integrity) indicates the ability of a conservation target to persist for many generations. If a target is on the threshold of collapse, or conserving a proposed target requires extraordinary human intervention, it may not represent the best use of limited conservation resources.

- **Targets are highly threatened.** All else being equal, focusing on highly threatened targets will help ensure that critical threats are identified and addressed through conservation actions.

2.1.1 IDENTIFICATION OF MANAGEMENT TARGETS

Seven Management Targets were chosen to represent and encompass the biodiversity values of Cockscomb Basin Wildlife Sanctuary / Victoria Peak Natural Monument, and to provide a basis for setting goals, developing strategies and actions, and monitoring success.

Ecosystem Level Targets: Ecological communities that occur together, share common ecological processes, and have similar characteristics:

- ***Tropical Forest***
- ***Pine Forest***
- ***Upper Elevation Ecosystems***
- ***Freshwater***

Species Assemblages: Groups of species that share common natural process or have similar conservation requirements:

- ***Game Species***
- ***Charismatic Species***

Cultural Values – the cultural values of Victoria Peak, the scenic beauty, and the spiritual value of the forest - are also represented

Each of these seven targets has a series of associated nested targets – species or species assemblages considered of particular conservation importance that are represented by the target (Table 22).

Conservation Targets and Nested Targets for Cockscomb Basin Wildlife Sanctuary	
Conservation Target	**Nested Target**
Tropical Forest	Tropical forest ecosystems Tropical forest mammal species Tropical forest bird species
Upper Elevation Ecosystems	Upper elevation forests Upper elevation amphibian species Upper elevation orchids and other epiphytes Upper elevation bird species
Pine Forest	Yellow-headed parrot Caribbean pine
Game Species	Paca White-lipped peccary Collared peccary Great curassow Crested guan Great tinamou Red brocket deer Nine-banded armadillo Agouti
Charismatic Species	Jaguar Tapir Scarlet Macaw
Freshwater	Neotropical river otter Food fish: ▪ Mountain mullet ▪ Machaca ▪ Large Cichlids Hunted freshwater turtles: ▪ *Trachemys scripta*
Cultural Values	Victoria Peak Scenic values Medicinal / spiritual plants Aesthetic values Spiritual values Archaeological sites: ▪ Pearce Ruins, ▪ Huntul Mo, ▪ Xa'ayilha Plane crash

TABLE 22: CONSERVATION TARGETS AND KEY NESTED TARGETS

2.1.2 ASSESSING BIODIVERSITY VIABILITY

The Viability Assessment conducted under the Conservation Planning process provides:

- A means for determining changes in the status of each focal target over time, to measure success of conservation strategies, compare the status of a specific conservation target with future conditions, and with other projects in Belize / Central America that focus on that target

- A basis for the identification of current and potential threats to a target and identification of past impacts that require mitigation actions

- A basis for strategy design and the foundation for monitoring

Each Conservation Target was assessed using the following viability ratings:

- **Very Good** – The Indicator is considered to have an ecologically desirable status, requiring little or no intervention for maintenance.

- **Good** – The indicator lies within the acceptable range of variation, though some intervention is required for maintenance.

- **Fair** – The indicator lies outside the acceptable range of variation, and human intervention is required if the viability of the target is to be maintained

- **Poor** – Restoration of the conservation target is increasingly difficult, and impacts may result in extirpation from the conservation area

The overall viability rating for the conservation area is **GOOD**, with four targets rating as **VERY GOOD**, two as **GOOD** and one as **FAIR**. No target rates as **POOR** (Table 23).

CONSERVATION TARGET	LANDSCAPE CONTEXT	CONDITION	SIZE	VIABILITY RANK
Tropical Forest	Good	Very Good	Very Good	**VERY GOOD**
Upper Elevation Vegetation	Good	Very Good	Very Good	**VERY GOOD**
Pine Forest	Fair	Fair	Fair	**FAIR**
Game Species	Good	Very Good	Very Good	**VERY GOOD**
Charismatic Species	Very Good	Fair	Good	**GOOD**
Freshwater	Good	Good	Good	**GOOD**
Cultural Values	Very Good	Good	Very Good	**VERY GOOD**
Project Biodiversity Health Rank				**GOOD**

VERY GOOD	Ecologically desirable status. Requires little or no intervention for maintenance
GOOD	Within acceptable range of variation. Some human intervention required for maintenance
FAIR	Outside acceptable range of variation. Requires human intervention
POOR	May result in local extinction. Restoration difficult / impossible

TABLE 23: CONSERVATION TARGET VIABILITY

ECOSYSTEMS: TROPICAL FOREST			
Status 2006	**Current Status**	**Goal**	***Objectives:*** ▪ *To protect and maintain the ecosystem services for Cockscomb communities* ▪ *To protect viable populations of species of the Cockscomb tropical forest ecosystem* ▪ *To contribute towards the overall value of the Maya Mountains Massif* ▪ *To maintain the aesthetic and spiritual values of Cockscomb and Victoria Peak*
GOOD	**VERY GOOD**	**VERY GOOD**	

Justification	**Species / ecosystems nested in this target**
The tropical forest ecosystems of CBWS are important in their role in water catchment and water security. This large expanse of forested uplands and valleys is a critical part of the Maya Mountains Massif, one of the last remaining large, intact blocks of forest within the Mesoamerican region, with high levels of forest connectivity. The Massif is considered essential for the survival of wide-ranging species such as scarlet macaw, white-lipped peccary, and Yucatan black-handed spider monkeys, all of which need large blocks of contiguous forest to maintain viable populations. The broadleaf forest of CBWS is an umbrella for many species, communities and ecological systems, are a critical stronghold for many other species of national and international concern and the regionally important population of scarlet macaws. Cockscomb Basin Wildlife Sanctuary also plays an important role in the maintenance of game species in the area – both mammals and birds – replenishing the areas outside where hunting is permitted. The protected area is important in its role in terrestrial tourism, particularly with its recognition as a tropical wilderness area.	Tropical forest ecosystems ▪ Tropical evergreen seasonal broadleaf forest ▪ Deciduous broadleaf lowland riparian shrubland in hills ▪ Tropical evergreen seasonal broadleaf swamp forest ▪ Deciduous broad-leaved lowland disturbed shrubland ▪ Tropical evergreen seasonal broadleaf lowland forest Forest Plant Species including... ▪ *Zamia prasina* (CR) ▪ Spanish Cedar (VU) ▪ Mountain Pimento (VU) ▪ Big-leaf Mahogany (VU) ▪ Xate (EN) Tropical forest mammal species, including… ▪ Yucatan black howler monkey (EN) ▪ Central American black-handed spider monkey (EN) ▪ Baird's Tapir (EN) ▪ White-lipped Peccary (EN) Tropical forest bird species, including… ▪ Agami Heron (VU) ▪ Cerulean Warbler (VU) ▪ Keel-billed Motmot (VU) Tropical forest amphibian species, including… ▪ Sanderson Rain Frog (EN)

Ecosystems: Upper Elevation Ecosystems (Elfin Forest)

Status 2006	Current Status	Goal
GOOD	VERY GOOD	VERY GOOD

Objectives:

- *To protect and maintain upper elevation ecosystems and species*
- *To maintain the ecosystem values of Victoria Peak*

Justification

At approximately 480 m a.s.l., the tall evergreen lowland hill forest ends abruptly, and Tropical evergreen seasonal broad-leaved lower montane elfin woodland encircles the ridge rim and peak of Outlier and Victoria Peak. Elfin forest has a canopy at 5-7 m and a predominance of *Clusia* sp. and Myrica sp. with dense mats of terrestrial *Philodendron* sp., patches of sphagnum moss. With increasing elevation / exposure on the peak, the terrestrial philodendrons and bromeliads largely give way to thicker mats of sphagnum mosses, growing both on the ground and epiphytically on the trees, along with abundant bromeliads and orchids, including the flamboyant *Sobralia macrantha*, as well as *Dimerandra emarginata, Encyclia polybulbon, Jacquiniella globosa, Kegeliella* sp., and *Scaphyglottis lindeniana*.

Species / ecosystems nested in this target

Upper elevation ecosystems

- Tropical evergreen broadleaf submontane forest over non-calcareous rocks
- Tropical evergreen seasonal broadleaf submontane forest: Virola-Terminalia variant
- Tropical evergreen seasonal broadleaf submontane forest: Simarouba-Terminalia variant
- Tropical evergreen seasonal broad-leaved lower montane elfin woodland

Upper elevation amphibian species

- Bromeliad Treefrog (EN)

Upper elevation orchids and other epiphytes

- *Epidendrum ibaguense*
- *Sobralia macrantha*

Upper elevation bird species…

- Brown Violet-ear
- Stripe-tailed Hummingbird
- Keel-billed Motmot (VU)
- Emerald Toucanet
- Plain Antvireo
- Slate-colored Solitaire
- White-throated Thrush
- Common Clorospingus
- White-winged Tanager
- Elegant Euphonia
- White-vented Euphonia
- Shining Honeycreeper

ECOSYSTEMS: PINE FOREST

Status 2006	Current Status	Goal
FAIR	FAIR	GOOD

Objectives:

- *To protect and maintain Pine Forest and pine forest species in Cockscomb Basin Wildlife Sanctuary*
- *To minimize fire impacts in the CBWS pine forest ecosystem*

Justification

Tropical Evergreen Seasonal needle-leaved lowland hill forest is highlighted as one of the ecosystems considered as under-represented within the National Protected Areas System in Belize. It is part of the Belizean Pine Forest ecoregion, highlighted as one of the few regional fragments of tropical lowland pine forests (WWF, 2001). It shows a gradient from fully developed pine forest through short grass savannah and pine, to short grass savannah (without pine) dependant on soil type and frequency of fires, transitioning to tiger fern in areas where forest fires have been too frequent and too intense. Under the WWF categories, it is considered a critical / endangered ecosystem.

The pine forests have been severely impacted in the past by southern pine bark beetle in 2001/2002, and increasing frequency and intensity of fire, affecting recruitment. A fire in 1998 caused significant degradation to the pine forest in CBWS, and subsequent fires have continued to cause significant impact to the ecosystem.

With no recent impacts from pine bark beetles and greater capacity for addressing fires, BAS has been able to improve the status of the pine forest within the protected area.

Species / ecosystems nested in this target

Tropical evergreen seasonal needle-leaf lowland hill forest

- *Pinus caribaea*

Mammals associated with pine forest include:

- White-tailed deer
- Collared peccary
- Nine-banded armadillo

Birds associated with the Pine Forest include:

- Yellow-headed parrot (EN)
- Black-throated Bobwhite
- Azure-crowned Hummingbird
- Vermilion Flycatcher
- Plumbeous Vireo
- Blue-gray Gnatcatcher
- Grace's Warbler
- Gray-crowned Yellowthroat
- Rufous-capped Warbler
- Hepatic Tanager
- Rusty Sparrow
- Yellow-backed Oriole

Endemic sub-species of the sedge wren (*Cistothorus platensis russelli*) is only found on seasonally wet grasslands of northern Toledo/central Stann Creek.

Commercial plant species include Caribbean pine, palmetto

Endemic plant species closely associated with the pine / savanna ecosystem complex:

- *Anemia bartletti*
- *Axonopus ciliatifolius*
- *Telanthophora bartletti*
- *Dalechampia schippii*
- *Galactia anomala*
- *Koanophyllon sorensenii*
- *Mimosa pinetorum*
- *Oxandra proctorii*
- *Pisonea proctorii*
- *Schippia concolor*
- *Syngonanthus bartlettii*
- *Zinowiewi pallida*

ECOSYSTEMS: FRESHWATER			
Status 2006	**Current Status**	**Goal**	***Objectives:*** ▪ *To maintain and improve the quality of freshwater systems in Cockscomb Basin Wildlife Sanctuary* ▪ *To ensure continued water security for local communities* ▪ *To maintain and improve the fish populations and viability in CBWS*
GOOD	**FAIR**	**GOOD**	

Justification	**Species / ecosystems nested in this target**
The protected area encompasses two major upper watersheds, South Stann Creek and parts of Monkey River, with four distinct drainage areas: ▪ Cockscomb East Basin (South Stann Creek) ▪ Cockscomb West Basin (Swasey River, a tributary of the Monkey River) ▪ Trio Branch (Trio Branch, a tributary of the Monkey River) ▪ Richardson Creek (Richardson Creek flows into Bladen Branch, a tributary of the Monkey River) The rivers and creeks support healthy freshwater upper river fauna, providing habitats for freshwater fish, including the migratory white mullet. Waterbodies (both permanent and ephemeral) provide breeding habitats for amphibian species. The rivers and creeks, support predators such as the Neotropical river otter, kingfishers, and agami herons. The waterfalls are important scenic features for tourism, and river tubing is a key tourism activity, not only within the protected area, but also in private sector initiatives downstream of the protected area. There are, however, concerns about impacts on water quality from the increasing number of visitors using the river for tubing. Water quality and security is important for downstream communities and agricultural areas.	Rooted underwater communities of freshwater lakes / water bodies Mammals associated with freshwater: ▪ Neotropical river otter ▪ Baird's tapir (EN) ▪ Water opossum (Yapok) ▪ Greater fishing bat Birds associated with freshwater ▪ Anhinga ▪ Neotropic cormorant ▪ Agami heron ▪ Least grebe ▪ Yellow-crowned night-heron ▪ Boat-billed heron ▪ Muscovy duck ▪ Amazon kingfisher ▪ Pigmy American kingfisher Food fish: ▪ Mountain mullet ▪ Machaca ▪ Larger Cichlids Hunted freshwater turtles: ▪ *Trachemys scripta*

SPECIES ASSEMBLAGES: GAME SPECIES			
Status 2006	**Current Status**	**Goal**	***Objectives:*** ▪ *To maintain and improve the viability of game species in Cockscomb Basin Wildlife Sanctuary*
GOOD	**VERY GOOD**	**VERY GOOD**	

Justification	**Species / ecosystems nested in this target**
Game species are those animals (mammals, birds and reptiles) that can be hunted for meat in Belize. Cockscomb is recognized for its relatively high population densities of game species when compared with the forest in the adjacent landscape, acting as a reservoir for these species, indicative of low hunting pressure. Game species populations are expanding, with spill over into adjacent forest areas replenishing populations outside the protected area, ensuring that these species continue to be available for rural communities in the future. This includes the white-lipped peccary, which has disappeared from forest over much of Belize as a result of hunting pressure. Approximately 45% of community members surveyed in CBWS stakeholder communities do buy or sell wildlife products such as game meat (BAS, 2015). A small number of community hunters hunt illegally within the boundaries of Cockscomb, accessing the area through the rivers. Since 2006, however, surveillance and enforcement has made a significant difference to the hunting impacts, with joint patrols and effective convictions increasing respect for the protected area. Identification of game species as a conservation target is largely to further prioritize the enforcement of the no-hunting regulations, and facilitate the measurement of success of the associated conservation actions.	Game species: ▪ Paca ▪ White-lipped peccary ▪ Collared peccary ▪ Great curassow ▪ Crested guan ▪ Great dynamo ▪ Red brocket deer ▪ Nine-banded armadillo ▪ Agouti

SPECIES ASSEMBLAGES: CHARISMATIC SPECIES			
Status 2006	**Current Status**	**Goal**	***Objectives:*** ▪ *To maintain and improve the viability of Charismatic Species in cockscomb Basin Wildlife Sanctuary*
FAIR / GOOD	**GOOD**	**VERY GOOD**	

Justification	**Species / ecosystems nested in this target**
Charismatic species are those that have a high value in terms of appreciation for their beauty, strength or ecological life style. Species such as the jaguar and scarlet macaw, that draw tourism to the area, and the Yucatan black howler monkey, with even the sound of its howling increasing visitor satisfaction. Iconic species such as the red-eyed treefrog and highly visible species in Zone 1, such as keel-billed toucans and crested guans, all add to the excitement of seeing wildlife in a natural setting.	Charismatic species: ▪ Jaguar ▪ Yucatan black howler monkey ▪ Central American black-handed spider monkey ▪ Tapir ▪ Scarlet Macaw ▪ Red eyed treefrog

CULTURAL VALUES			
Status 2006	**Current Status**	**Goal**	***Objectives:*** ▪ *To maintain the cultural values of Cockscomb Basin Wildlife Sanctuary*
NOT RATED	**VERY GOOD**	**VERY GOOD**	

Justification	**Species / ecosystems nested in this target**
CBWS has an important cultural role in the landscape. Victoria Peak is recognized as a national land mark, and this the ridges that protect the Cockscomb Basins dominate the landscape. The forest has spiritual values for both local community members and for tourists, as well as containing plants and animals of medicinal and / or spiritual value. The aesthetic values of the protected area are high – the views from Ben's Bluff and Tiger Fern trail overlook both of Cockscomb's basins, and stretch as far as the Maya Divide and Cockscomb Range. The waterfalls and rivers provide opportunities for swimming and relaxation, valued by visitors.	Victoria Peak Scenic values Medicinal / spiritual plants Aesthetic values Spiritual values Archaeological sites: ▪ Pearce Ruins, ▪ Huntul Mo, ▪ Xa'ayilha Plane crash

2.2 ASSESSMENT OF CRITICAL THREATS

2.2.1 CAP ASSESSMENT OF CRITICAL THREATS

CBWS / VPNM has an overall threat rating of **LOW.** The Threat Assessment workshop for was conducted in 2017, with input from a broad range of stakeholders. It focused on the assessment of stresses and threats affecting the key ecological attributes and the targets, and providing each focal target with a threat status rating.

Identified Threats to Cockscomb Basin Wildlife Sanctuary

Medium

- Fire

Low

- Illegal Hunting
- Illegal Fishing
- Tourism Impacts
- Illegal Wildlife Trade

Outputs from the workshop facilitated prioritization of management actions and resources towards the most critical threats. This was achieved through analyzing the stresses in terms of scope and severity, and the sources of stress through assessment of contribution and irreversibility.

Only one target, **Pine Forest,** has a threat rating of **Medium**, based on the threat of fire, generally spreading from the coastal plain tot eh east.

The remaining targets have a threat status of **Low**.

Two external threats were assessed separately:

- **Climate Change**
- **External landscape change**

Threats to the external landscape rate as **High**, with the threat of external landscape change as Very High, and Climate Change as Medium.

Definitions for Stress and Source of Stress

Stress – The impaired aspects of conservation targets that result directly or indirectly from human activities (e.g., low population size, reduced extent of littoral forest; increased sedimentation; lowered groundwater table level). Generally equivalent to degraded key attributes / characteristics (e.g., habitat loss).

Source of Stress (Direct Threat) – The proximate activities or processes that directly have caused, are causing or may cause stresses and thus the destruction, degradation and/or impairment of focal conservation targets (e.g., Unsustainable caye development).

TNC, 2007

Rating Criteria for Stresses

Severity - The level of damage to the conservation target that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation).

- **Very High:** The threat is likely to destroy or eliminate the conservation target over some portion of the target's occurrence at the site.
- **High:** The threat is likely to seriously degrade the conservation target over some portion of the target's occurrence at the site.
- **Medium:** The threat is likely to moderately degrade the conservation target over some portion of the target's occurrence at the site.
- **Low:** The threat is likely to only slightly impair the conservation target over some portion of the target's occurrence at the site.

Scope - The geographic scope of impact on the conservation target at the site that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation).

- **Very High:** The threat is likely to be widespread or pervasive in its scope and affect the conservation target throughout the target's occurrences at the site.
- **High:** The threat is likely to be widespread in its scope and affect the conservation target at many of its locations at the site.
- **Medium:** The threat is likely to be localized in its scope and affect the conservation target at some of the target's locations at the site.
- **Low:** The threat is likely to be very localized in its scope and affect the conservation target at a limited portion of the target's location at the site.

Rating Criteria for Sources of Stress

Contribution - The expected contribution of the source, acting alone, to the full expression of a stress (as determined in the stress assessment) under current circumstances (i.e., given the continuation of the existing management/conservation situation).

- **Very High**: The source is a very large contributor of the particular stress.
- **High**: The source is a large contributor of the particular stress.
- **Medium**: The source is a moderate contributor of the particular stress.
- **Low**: The source is a low contributor of the particular stress.

Irreversibility - The degree to which the effects of a source of stress can be restored.

- **Very High**: The source produces a stress that is not reversible (e.g., wetlands converted to a shopping centre).
- **High**: The source produces a stress that is reversible, but not practically affordable (e.g., wetland converted to agriculture).
- **Medium**: The source produces a stress that is reversible with a reasonable commitment of resources (e.g., ditching and draining of wetland).
- **Low**: The source a stress that is easily reversible at relatively low cost (e.g., off-road vehicles trespassing in wetland).

Threats Across Targets within CBWS	Tropical Forest	Upper Elevation Ecosystems	Pine Forest	Freshwater	Game Species	Charismatic Species	Cultural Values	Overall Threat Rank
Fire	Low	Low	High				Low	Medium
Illegal Hunting	Low				Low	Medium		Low
Illegal Fishing				Low				**Low**
Tourism Impacts	Low	Low	Low	Low			Low	**Low**
Forest clearance	Low				Low	Low	Low	**Low**
Illegal wildlife trade					Low	Low		**Low**
Overall Threat Status for Targets	**Low**	**Low**	**Medium**	**Low**	**Low**	**Low**	**Low**	**Low**

TABLE 24: THREATS ACROSS TARGETS WITHIN CBWS

Threats Across Targets in the CBWS Landscape, beyond the control of BAS	Tropical Forest	Upper Elevation Ecosystems	Pine Forest	Freshwater	Game Species	Charismatic Species	Cultural Values	Overall Threat Rank
Expanding Human Footprint	Very High	Low	Medium	Medium	Very High	Medium		**Very High**
Climate Change	Low	Medium	Medium	Medium	High	Low	Low	**Medium**
Overall Threat Status for Targets with external threats	**High**	**Low**	**Medium**	**Medium**	**High**	**Medium**	**Low**	**High**

TABLE 25: THREATS ACROSS TARGETS IN CBWS LANDSCAPE

IDENTIFIED ANTHROPOGENIC THREATS TO COCKSCOMB BASIN WILDLIFE SANCTUARY		
THREATS TO BIODIVERSITY IN CBWS		
Threat	**Impact on Biodiversity**	**Cause**
Fire	▪ Reduced condition of pine forest and possible transition to degraded tiger fern ▪ Reduced species populations in pine ecosystems	▪ Escaped agricultural fires on the coastal plain that jump the Cabbage Haul road if the fuel load builds up. ▪ Exacerbated by hurricanes and pine bark beetle ▪ Savannah fires set illegally by hunters to promote new shoots
Illegal Hunting	▪ Reduced game species populations within CBWS along the rivers (paca, curassow, tinamou, peccary, armadillo etc.)	▪ Protein source to supplement diet ▪ Poverty in local communities ▪ Culture ▪ Increased accessibility as land clearance and road system approaches CBWS boundaries ▪ This issue is going to increase with expanding human footprint and population.
Illegal Fishing	▪ Reduced fish populations of those species targeted (mountain mullet, machaca, larger cichlids) ▪ Fishers target CBWS as the water is considered less contaminated ▪ Fishing pressure downstream of CBWS is very high, impacting numbers and population viability of migratory fish species that move upriver to CBWS to spawn.	▪ Protein source to supplement diet ▪ Poverty in local communities ▪ Culture ▪ Increased accessibility as land clearance and road system approaches CBWS boundaries ▪ Reduced access to fishing areas outside of CBWS as each community demonstrated ownership of their river sections for fishing, with increased pressure to fish illegally within CBWS ▪ Increased fish catch within CBWS ▪ This issue is going to increase with expanding human footprint and population.
Tourism Impacts	▪ Changes in distribution of wildlife species (analysis of camera trap data demonstrates that wildlife is more abundant with distance from trails). ▪ High human traffic / ATV presence will reduce jaguar trap records, as will activities such as trail maintenance.	▪ Impacts are limited primarily to noise / human activity on the trails and the river section used for tubing. ▪ Some edge effect from wider trails.

TABLE 26: ANTHROPOGENIC THREATS TO CBWS AND THE CBWS LANDSCAPE

IDENTIFIED ANTHROPOGENIC THREATS TO COCKSCOMB BASIN WILDLIFE SANCTUARY		
THREATS TO BIODIVERSITY IN CBWS		
Threat	**Impact on Biodiversity**	**Cause**
Illegal Wildlife Trade	▪ Reduced populations of target species with removal of young (howler monkeys, peccary, wild cats, curassow etc.) ▪ Targeting of wild cats for skin and teeth	▪ Poverty in local communities ▪ Culture ▪ Increased accessibility as land clearance and road system approaches CBWS boundaries ▪ Demand created by tourism establishments and individuals. ▪ The majority of illegal capture for the wildlife trade, however, is thought to occur outside the boundaries of the protected area, and includes reported nest theft of scarlet macaws and yellow headed parrots.
External Threats that will impact biodiversity of CBWS		
Threat	**Impact on Biodiversity**	**Cause**
Expanding Human Footprint	▪ Removal of forest and associated biodiversity. ▪ Agricultural and urban contamination of water systems ▪ Reduced forest cover on the coastal plain, altering rainfall patterns ▪ Pesticide drift impact on upper elevation ecosystems and amphibians	▪ Expanding human footprint (agriculture and human settlements) are removing forest cover adjacent to Cockscomb. ▪ Increasing population also drives this trend ▪ Increased accessibility for hunting and fishing in the buffer areas.
Climate Change	▪ Impact on rainfall patterns, tree flowering and fruiting times, water security, species distributions and abundance. ▪ Potential to result in disappearance of Elfin forest, ▪ Impacts on upper elevation amphibians	▪ Global climate change driven by anthropogenic factors.

TABLE 26: ANTHROPOGENIC THREATS TO CBWS AND THE CBWS LANDSCAPE

Threats to biodiversity of Cockscomb Basin Wildlife Sanctuary : Fire

Fire	***Status:***	***Historical***	***Active***	***Potential***
	Conservation Target(s): Pine Forest			
	Stresses (*Direct*)*:* ▪ Degradation of pine forest ecosystem to tiger fern ▪ Reduced extent of pine forest ▪ Reduced populations of species associated with the pine forest ecosystem			
	Sources of Stress (Indirect)***:*** ▪ Poor fire management in agricultural buffer ▪ Savannah fires set by hunters outside the protected area to attract deer to new shoots			
Scope	***Very High***	The majority of the pine forest in the Cabbage Haul Ridge area of CBWS has been impacted by fire		
Severity	***Very High***	The entire Cabbage Haul Ridge was burnt in 1998, with increasing fire impacts since then. In places, the fire has killed regenerating pines, replacing it with tiger fern		
Contribution	***Very High***	Fire is the primary cause of pine forest degradation, exacerbated by hurricanes and pine bark beetle		
Irreversibility	***High***	It would be feasible to restore the pine forest through replanting and active fire management, but this would be expensive on both human and financial resources		

Management Strategies:

Strategy 1: Continue to strengthen capacity of CBWS rangers for fire management through training and equipment

Strategy 2: Continue to improve fire management in the wider landscape, with strengthened engagement and capacity building of communities and adjacent landowners, with prescribed burns every 3 to 4 years

Strategy 3: Continue to partner / form strategic alliances with other NGOs in the landscape towards effective fire monitoring and management

Strategy 4: Investigate the cost-benefit of maintaining the Cabbage Haul road as a fire break / fire management access road

Threats to biodiversity of Cockscomb Basin Wildlife Sanctuary : Illegal Hunting

Illegal Hunting	***Status:***	***Historical***	***Active***	***Potential***
	Conservation Target(s): Game Species			
	Stresses (*Direct*)*:* ▪ Reduced game species populations ▪ Trophic shifts in tropical forest communities			
	Sources of Stress (Indirect)***:*** ▪ Low income in local communities ▪ Traditional / cultural occupation ▪ Market demand from local communities and towns ▪ Increased local and tourism demand for game meat			
Scope	***Low***	Hunting only occurs along the rivers (which are used for access) – hunting trails are not encountered away from the rivers. However there is predicted to be an increase in pressure as access improves with clearance by Mennonites in Roseville area		
Severity	***Low***	As only a small percentage of CBWS is accessed for illegal hunting, only a small percentage of game species populations are impacted		
Contribution	***Medium***	Hunting is the primary threat to game species in CBWS		
Irreversibility	***Medium***	It would be feasible to reduce the illegal hunting pressure with strengthened, dedicated patrols and the strengthening of the prosecution system		

Management Strategies:

Strategy 1: Strengthen the surveillance and enforcement activities in CBWS through increasing the number of staff dedicated to full-time to surveillance and enforcement, number of patrols per month and continued capacity building

Strategy 2: Extend key surveillance and enforcement activities to boundary in Roseville area

Strategy 3: Continue to strengthen strategic partnerships for surveillance and enforcement (Police, BDF, Forest Department)

Strategy 4: Continue to ensure communities are aware of the CBWS boundaries and the no hunting regulations – including Roseville

Strategy 5: Partner / form strategic alliances with landowners of adjacent properties for maintenance of forest cover and collaborative surveillance and enforcement

Threats to biodiversity of Cockscomb Basin Wildlife Sanctuary : Illegal Fishing

Illegal Fishing	***Status:***	***Historical***	***Active***	***Potential***
	Conservation Target(s): Freshwater (fish species)			
	Stresses (*Direct*)*:* ▪ Reduced fish populations (particularly mountain mullet / machaca and large cichlids) ▪ Trophic shifts in freshwater communities			
	Sources of Stress (Indirect)***:*** ▪ Low income in local communities ▪ Traditional / cultural occupation ▪ Market demand from local communities and towns			
Scope	***Medium***	Fishing occurs along the main rivers, with preferential use as fish are considered less contaminated than in rivers of the coastal plain. Fishing also occurs in the coastal plains, preventing migratory species from reaching CBWS to spawn,		
Severity	***Medium***	Fishing pressure both inside CBWS and downstream reduces both the short term and long term population viability of fish species		
Contribution	***Very High***	Fishing is the primary threat to fish species in CBWS		
Irreversibility	***Medium***	It would be feasible to reduce the illegal fishing with strengthened, dedicated patrols and the strengthening of the prosecution system		

Management Strategies:

Strategy 1: Strengthen the surveillance and enforcement activities in CBWS through increasing the number of staff dedicated full-time to surveillance and enforcement, number of patrols per month and continued capacity building

Strategy 2: Continue to strengthen strategic partnerships for surveillance and enforcement (police, BDF, Forest Department, other NGOs)

Strategy 3: Continue to ensure communities are aware of the CBWS boundaries and the no fishing regulations

Threats to biodiversity of Cockscomb Basin Wildlife Sanctuary : Tourism Impacts

Tourism Impacts	***Status:***	***Historical***	***Active***	***Potential***
	Conservation Target(s): Charismatic Species, Game Species, Freshwater			
	Stresses (*Direct*)*:* ▪ Reduced wildlife in tourism areas (by trails river tubing route) ▪ Potential water contamination from river-based activities (swimming in waterfalls, river-tubing) ▪ Reduced aesthetic beauty of wilderness ▪ Impacts on fragile elfin forest ecosystems			
	Sources of Stress (Indirect)***:*** ▪ Noise pollution ▪ Number of visitors on trails ▪ Size of groups ▪ Use of chemicals during water-based activities (insect repellent, sun screen) ▪ Garbage ▪ Trail maintenance activities ▪ Traffic on the access road			
Scope	***Low***	Whilst tourism is having an impact on wildlife distribution, it is contained in a small percentage of the protected area		
Severity	***Low***	Whilst tourism is having an impact on wildlife distribution, wildlife is adapting by avoiding the tourism areas		
Contribution	***High***	Tourism is the primary impact on wildlife distribution in CBWS		
Irreversibility	***Medium***	It would be feasible to reduce tourism impacts but this would need to be balanced with the need for financial sustainability		

Management Strategies:

Strategy 1: Continue to manage tourism effectively within CBWS, with enforcement of tourism regulations and guidelines, and promotion of best practices

Strategy 2: Engage tour guides for encouraging best tourism practices with their guests, building capacity for sustainable tourism

Strategy 3: Ensure all visitors to CBWS are aware of regulations and guidelines through effective signage and introductory briefing

Strategy 4: Identify and implement mechanisms for keeping cruise tourism from impacting those visitors seeking a wilderness experience and wildlife sightings

Strategy 5: Ensure continued effective management of solid waste / garbage within CBWS

Strategy 6: Implement the CBWS Public Use plan

Threats to biodiversity of Cockscomb Basin Wildlife Sanctuary : Illegal Wildlife Trade

Illegal Wildlife Trade	***Status:***	***Historical***	***Active***	***Potential***
	Conservation Target(s): Charismatic Species, Game Species			
	Stresses (*Direct*)*:* ▪ Reduced population of target species with capture of young, associated killing of mothers (particularly primates) ▪ Reduced populations of cats in the larger landscape for skins and teeth			
	Sources of Stress (Indirect)***:*** ▪ Low income in local communities ▪ Tradition / culture ▪ Emerging Chinese market for wildlife parts (especially jaguars) ▪ Market demand from local communities and tourism establishments			
Scope	***Low***	In CBWS, limited to the area affected by illegal hunting and fishing		
Severity	***Low***	Would be opportunistic – if it is happening, would be a very small number of individuals. However, there are reports of communities near CBWS being approached recently for sale of young animals, so the market demand is present. Wildlife trade outside CBWS will impact populations inside CBWS, particularly for species such as jaguar and scarlet macaw		
Contribution	***Low***	The wildlife trade is a much lower impact than illegal hunting		
Irreversibility	***Medium***	It would be feasible to reduce the illegal hunting pressure with strengthened, dedicated patrols and the strengthening of the prosecution system		

Management Strategies:

Strategy 1: Strengthen the surveillance and enforcement activities in CBWS through increasing the number of staff dedicated full-time to surveillance and enforcement, number of patrols per month and continued capacity building

Strategy 2: Continue to strengthen strategic partnerships for surveillance and enforcement (police, BDF, Forest Department)

Strategy 3: Continue to ensure communities are aware of the CBWS boundaries and national regulations relevant to wildlife crime

Strategy 4: Partner / form strategic alliances with landowners of adjacent properties for maintenance of forest buffer and collaborative surveillance and enforcement

Threats to biodiversity of Cockscomb Basin Wildlife Sanctuary : Expanding Human Footprint

Expanding Human Footprint	***Status:***	***Historical***	***Active***	***Potential***
	Conservation Target(s): All Targets			
	Stresses (*Direct*)*:* ▪ Reduced wildlife in the CBWS landscape ▪ Reduced forest extent in the CBWS landscape ▪ Reduced fish abundance ▪ Increased agricultural and urban contamination of rivers			
	Sources of Stress (Indirect)***:*** ▪ Unsustainable / illegal hunting ▪ Unsustainable / illegal fishing ▪ Wildlife conflict ▪ Land use change - agricultural and urban expansion ▪ Poor practices in agrochemical application and removal of riparian vegetation			
Scope	***Very High***	Urban expansion and the conversion of tropical forest to agriculture is rapidly changing the CBWS wider landscape and will be altering rainfall patterns. Human impacts on wildlife outside CBWS are widespread. Agro-chemical use is ongoing.		
Severity	***Very High***	Land use change is removing ecosystems and species. Unsustainable / illegal hunting and fishing is widespread outside of CBWS		
Contribution	***High***	Removal of tropical forest and associated species has a relatively high impact, and may alter rainfall patterns in the future, exacerbating climate change impacts on CBWS itself		
Irreversibility	***Very High***	It would not be socially or economically feasible to reduce the human footprint in the wider landscape		

Management Strategies:

Strategy 1: Collaborate with adjacent landowners for maintenance of a forested buffer

Strategy 2: Engage communities and build their understanding and capacity for improving sustainable use of their natural resources

Strategy 3: Identify and implement mechanisms to assist those communities closest to CBWS to retain forested areas potentially through capacity building for tourism initiatives / agroforestry

Strategy 4: Improve awareness in communities of the CBWS wider landscape of the role of tropical forest in ensuring water security

Strategy 5: Continue to improve fire management in the wider landscape, with engagement of communities and adjacent landowners

2.3 MONITORING OF SUCCESS OF CONSERVATION STRATEGIES

The series of indicators allocated to each conservation target during the planning process provides a measures of success framework for site level monitoring. Monitoring the success of conservation strategies is an integrated component of the Conservation Action Planning process (Table 27).

Key Cross-Cutting Conservation Strategies	**Tropical Forest**	**Upper Elevation Ecosystems**	**Pine Forest**	**Freshwater**	**Game Species**	**Charismatic Species**	**Cultural Values**	**Indicators for Measuring Success of Outputs and Outcomes**
Strengthen surveillance and enforcement activities in CBWS through continued capacity building, and by increasing the number of staff dedicated full-time to surveillance and enforcement, and number of patrols per month								▪ *Target game/ fish species abundance* ▪ *% of time spent by rangers on surveillance and enforcement* ▪ *% of rangers dedicated full time to surveillance and enforcement* ▪ *Number of hunting / fishing incidences reported*
Continue to manage tourism effectively within CBWS, with enforcement of tourism regulations and guidelines, and promotion of best practices								▪ *Abundance of wildlife in tourism use areas compared with non-tourism use areas (camera trap data)* ▪ *% of tour guides following regulations / guidelines* ▪ *Number of tourism infractions reported* ▪ *Reduced tourism impacts* ▪ *Level of non-cruise visitor satisfaction (TripAdvisor)* ▪ *Level of cruise visitor satisfaction*
Engage tour guides for encouraging best tourism practices with their guests, building capacity for sustainable tourism								
Ensure all visitors to CBWS are aware of regulations, guidelines and best practices								
Implement the CBWS Public Use plan								
Partner with landowners of adjacent properties for maintenance of forest cover, a forest buffer and collaborative surveillance and enforcement								▪ *Abundance of wildlife in buffer areas (camera traps)* ▪ *Annual rainfall patterns* ▪ *% of boundary adjacent to CBWS that is managed for maintenance of forest cover* ▪ *% of boundary adjacent to CBWS that is managed with collaborative surveillance and enforcement* ▪ *Number of hunting / fishing incidences reported in buffer areas*

TABLE 27: KEY CROSS CUTTING CONSERVATION STRATEGIES

Key Cross-Cutting Conservation Strategies	**Tropical Forest**	**Upper Elevation Ecosystems**	**Pine Forest**	**Freshwater**	**Game Species**	**Charismatic Species**	**Cultural Values**	**Indicators for Measuring Success of Outputs and Outcomes**
Identify and implement mechanisms to assist those communities closest to CBWS to retain forested areas (capacity building for tourism initiatives / agroforestry etc.)								▪ *Annual rainfall patterns* ▪ *Extent of forest cover protected by community initiatives* ▪ *% of communities that implement initiatives to retain forest cover in the community landscape* ▪ *Perception of and actual benefit in communities to maintaining forest areas*
Continue to strengthen strategic partnerships for surveillance and enforcement (Police, BDF, Forest Department, other NGOs)								▪ *Target game/ fish species abundance* ▪ *% of patrols conducted with strategic partners* ▪ *Number of hunting / fishing incidences reported*
Engage communities and build their understanding and capacity for improved sustainable use of their natural resources								▪ *% of participants demonstrating increased understanding and capacity for improved sustainable use of their natural resources* ▪ *% of communities demonstrating initiatives that integrate knowledge into action in the landscape*
Continue to ensure communities are aware of the CBWS boundaries, the no hunting/fishing regulations and Forest Department regulations relevant to wildlife crime								▪ *Number of community participants demonstrating an improved knowledge of CBWS boundaries, hunting / fishing and other regulations relevant to wildlife crime* ▪ *Number of known hunters / fishers per community* ▪ *% of known hunters / fishers per community known to enter CBWS*
Improve awareness in communities of the CBWS wider landscape of the role of tropical forest in ensuring water security								▪ *Annual rainfall patterns* ▪ *% of participants demonstrating increased understanding of the role of tropical forest in ensuring water security* ▪ *% of communities implementing initiatives that integrate knowledge into action in the landscape*

Key Cross-Cutting Conservation Strategies	**Tropical Forest**	**Upper Elevation Ecosystems**	**Pine Forest**	**Freshwater**	**Game Species**	**Charismatic Species**	**Cultural Values**	**Indicators for Measuring Success of Outputs and Outcomes**
Continue to strengthen capacity of CBWS rangers for fire management through training and equipment								▪ *Area of CBWS impacted by non-prescriptive burn fires per year* ▪ *Area in the CBWS wider landscape impacted by non-prescriptive burn fires per year* ▪ *% of rangers that have the capacity for effective fire management* ▪ *Equipment availability for effective fire management*
Identify and implement mechanisms for minimizing cruise tourism impacts on those visitors seeking a wilderness experience and wildlife sightings								▪ *Abundance of wildlife in tourism use areas pre- and post-regular cruise tourism visitation (camera trap data)* ▪ *Level of non-cruise tourism visitor satisfaction (TripAdvisor)* ▪ *Reduced tourism impacts*
Continue to improve fire monitoring and management in the wider landscape, with strengthened engagement and capacity building of communities, landowners and other NGOs								▪ *Area of CBWS impacted by non-prescriptive burn fires per year* ▪ *Number of community participants demonstrating an improved knowledge of the issues of fire and actions for reducing fires in the community landscape* ▪ *Number of community participants with the capacity to effectively participate in fire management* ▪ *Equipment availability for effective fire management* ▪ *Area of CBWS impacted by non-prescriptive burn fires per year* ▪ *Area in the CBWS wider landscape impacted by non-prescriptive burn fires per year*

Key Cross-Cutting Conservation Strategies	**Tropical Forest**	**Upper Elevation Ecosystems**	**Pine Forest**	**Freshwater**	**Game Species**	**Charismatic Species**	**Cultural Values**	**Indicators for Measuring Success of Outputs and Outcomes**
Continue to ensure communities are aware of the CBWS boundaries, the no hunting/fishing regulations and Forest Department regulations relevant to wildlife crime								▪ *Number of community participants demonstrating an improved knowledge of CBWS boundaries, hunting / fishing regulations and regulations relevant to wildlife crime* ▪ *Number of known hunters / fishers per community* ▪ *% of known hunters / fishers per community known to enter CBWS*
Ensure continued effective management of solid waste / garbage within CBWS								▪ *Level of garbage on the trails/ at campsites / viewpoints / in river per month*

TABLE 27: CROSS-CUTTING STRATEGIES AND MEASURING SUCCESS

2.4 PLANNING FOR CLIMATE CHANGE

2.4.1 SITE RESILIENCE ASSESSMENT

Planning for climate change is based on determining the protected area resilience and vulnerability, and identifying adaptive strategies that can assist in maintaining the viability of biodiversity and increase social resilience at both site and stakeholder community level. This assessment of the predicted implications of climate change has been conducted for Cockscomb Basin Wildlife Sanctuary / Victoria Peak Natural Monument, based on the ***conservation targets*** identified during conservation planning, and on the ***environmental services*** provided by the protected area, identified in the management plan context.

The following assessment has been based on Belize's "***Guidelines for Integrating Climate Change Adaptation Strategies into Protected Areas Management Plans"*** management planning framework, and provides a mechanism for assessing the implications of climate change through a series of steps:

1. Understanding climate change projections for the Wildlife Sanctuary
2. Identifying vulnerability factors and resilience features
3. Identifying focal targets threatened by climate change
4. Assessing, rating and prioritizing the threat of climate change for each focal target
5. Situation Analysis and baseline
6. Development of adaptation objectives and strategies

IDENTIFICATION OF THE PRIMARY CLIMATE CHANGE ELEMENTS

The primary climate change elements associated with Cockscomb Basin Wildlife Sanctuary and the associated landscape are identified as:

- Increased intensity of storms
- Increased flood / drought events
- Increased air temperature
- Increased water temperature

IDENTIFIED RESOURCES OF COCKSCOMB BASIN WILDLIFE SANCTUARY

An initial assessment was conducted of the primary resources important to Cockscomb Basin Wildlife Sanctuary (Table 28). Also reviewed were the conservation targets identified during the conservation planning workshop.

IDENTIFIED RESOURCES OF COCKSCOMB BASIN WILDLIFE SANCTUARY	
The Tourism Sector in central / southern Belize sees Cockscomb as an important tourism destination. For Maya Centre, at the gateway to the protected area, tourism is important for supporting the local economy. Visitors are attracted by the wilderness / wildlife experience and by the aesthetic and spiritual values of the tropical forest, waterfalls and scenic viewpoints.	
Victoria Peak	Victoria Peak is considered an important part of Belize's national and cultural landscape, recognized in its designation as a Natural Monument. As one of the hardest mountains to hike/climb in the region, it is only open during dry season, and is considered a challenge, attracting adventure groups from Belize and around the world.
South Stann Creek River	River tubing provides fun in a natural environment, with the potential for wildlife sightings. This activity is popular with many visitors.
Healthy Forest	The extensive, intact tropical forest is part of one of the last remaining large, healthy forests in Central America
Waterfalls	Scenic waterfalls provide visitors with opportunities for swimming in clear, freshwater pools
Scenic views	The open vistas from the tops of Tiger Fern and Ben's Bluff provide scenic vistas of the Cockscomb Basins, with views of vast, intact tropical forest and the Cockscomb Range / Victoria Peak
Jaguars and other mammals	CBWS provides opportunities for wildlife sightings. Jaguar and tapir footprints, peccary, howler monkeys calling – there is the potential to see and hear wildlife along a series of well-maintained trails.
Diverse Bird Species	Cockscomb has a range of ecosystems that provide habitats for more than 320 bird species, including the scarlet macaw, keel billed toucan, and crested guans. 45 are endemic to the Middle America region, two are globally endangered, and four vulnerable.
Ecosystem Service: The health of the forest environment of Cockscomb is critical to the social and economic health of communities on the southern plain.	
Forest	Steep slope protection of soils
	Watershed functionality and water security
	Supporting game species, acting as a replenishment zone for local hunters
	Flood water control for upper rivers that flow out of CBWS, reducing vulnerability to flooding
Rivers	Water security for southern plain communities – quality and quantity
	Importance for maintenance of extracted aquatic species – the mountain mullet / machaca, cichlid species
	Maintenance of species of conservation concern downstream, and impacts on the Belize reef

TABLE 28: IDENTIFIED KEY RESOURCES OF CBWS

For each target, the impacts of the identified primary climate change elements (increased intensity of storms, decreased precipitation, increased air temperature and increased water temperature), were rated on a scale of 1 to 4 (Table 29). Ratings took into account taking into consideration factors such as the severity, scope, contribution and irreversibility of each climate change element.

Rating		Description
Very High	**4**	The climate change element is (or is predicted to be) the major contributing factor to the reduced viability, or possible local extinction, of the target over the majority of its extent within the project area over the next 50 years, and cannot be reversed
High	**3**	The climate change element is (or is predicted to be) a significant contributing factor to the reduced viability of the target over a significant part of its extent within the project area over the next 50 years, but can be reversed at high cost or over a long time period
Medium	**2**	The climate change element is (or is predicted to be) a moderate contributing factor to the reduced viability of the target over part of its extent within the project area over the next 50 years, and can be reversed at moderate cost
Low	**1**	The climate change element is (or is predicted to be) a minor contributing factor to the reduced viability of the target in localized areas within the project area over the next 50 years, and will reverse naturally or at limited cost

TABLE 29: CLIMATE CHANGE IMPACT RATINGS

The climate change predictions for Cockscomb Basin Wildlife Sanctuary landscape were identified from recent literature and climate change models, and an assessment was conducted on the expected impacts on the selected conservation targets (Table 30).

Predicted climate change element	**CONSERVATION TARGETS**					
	Tropical Forest	***Upper Elevation Ecosystems***	***Pine Forest***	***Freshwater***	***Game /Charismatic Species***	***Cultural Values***
Increased Intensity of Storms	High (3)	High (3)	High (3)	Low (1)	Low (1)	Low (1)
Increased Floods / Droughts	Medium (2)	High (3)	Very High (4)	Medium (2)	Low (1)	Medium (2)
Increased Air / Water Temperature	Medium (2)	Medium (2)	Medium (2)	Low (1)	Low (1)	Low (1)
Averaged Rating	2.33 Selected	2.67 Selected	3.00 Selected	1.33	1.00	1.33

TABLE 30: ASSESSMENT OF PREDICTED IMPACTS OF CLIMATE CHANGE ON CONSERVATION TARGETS

Three conservation targets were identified as at highest risk from climate change impacts, and were selected for the assessment:

- Tropical Forest
- Upper Elevation Ecosystems
- Pine Forest

CLIMATE CHANGE PREDICTIONS (B2 SCENARIO) FOR COCKSCOMB BASIN WILDLIFE SANCTUARY AND ADJACENT LANDSCAPE			
	Current Status	**25 – 50 yrs**	**100 yrs**
Increased frequency of storms	Increased storm activity from 1999 onwards, with annual fluctuations. More storms during El Nina, fewer El Nino. Stronger storms (more Cat 4 / 5).		
Decreased reliability of precipitation / Increased flood and droughts	Mean annual rainfall over Belize has decreased at an average rate of 3.1 mm per month per decade since 1960 (UNDP). Reliability of rainfall is decreasing, resulting in increased droughts and floods	Predicted annual rainfall decrease of approximately 10%, with increasing unpredictability. Ecological shifts up the altitudinal gradient of the Maya Mountains Massif may reduce the catchment functionality important for orographic rainfall, and for the maintenance of rivers in dry season. Significant changes in rainfall patterns are predicted.	Predicted decrease in precipitation of up to 26% by 2099 (IPCC, 2007), with significant fluctuations attributed to El Niño
Air Temperature	Mean annual temperature has increased in Belize by 0.45°C since 1960, an average rate of 0.10°C per decade. Average number of 'hot' days per year in Belize (days exceeding 10% of current average temperature) has increased by 18.3% between 1960 and 2003 (NCSP/UNDP).	Both seasonal and annual air temperatures are predicted to increase by approximately 2°C	Predicted mean annual temperature increase is 3.5° by 2099 (UNDP, 2009)

TABLE 31: CLIMATE CHANGE PREDICTIONS FOR CBWS AND ADJACENT LANDSCAPE

Climate Change Impacts	Management Features		
	Tropical Forest	Upper Elevation Ecosystems	Pine Forest
Increased frequency of storms	Whilst forests in Belize are adapted to be relatively resilient to tropical storm damage, the increased hurricane intensity will cause increased damage, impacting forest stature and structure and will remove some species less tolerant of landscape-scale impacts, with a decrease in biodiversity. Resilience to recover may well decrease, leading to a degraded forest ecosystem. Cockscomb Basin is sheltered to some extent from storms coming in from the east, with the presence of the Cabbage Haul Ridge. This doesn't, however, prevent all storm impacts, especially if the storm path goes over Cockscomb. Reduced forest cover on the steep slopes will result in increased soil erosion with an increased vulnerability downstream to flooding, with reduced water retention during storm events. Increased soil erosion will also reduce water clarity downstream, and has the potential to affect the health of the coral reef ecosystem offshore.	The upper elevation ecosystems of the Cockscomb Range, the Maya Divide and Outlier are very exposed to tropical storms, which have swept through the area in the past. Physical storm damage to the forest can result in heavy fuel load, and subsequent fires, leading to ecosystem degradation.	The majority of the pine forest ecosystem is located on the ridge and ridge top facing the coast and bears the brunt of incoming storm impacts, resulting in damage ranging from loss of tree limbs to removal of all standing trees. Post-hurricane fires, fueled by the increased fuel load, then exacerbate the impacts and can cause the transition from pine forest to tiger fern.

TABLE 32: CLIMATE CHANGE IMPACTS ON MANAGEMENT FEATURES

Climate Change Impacts	Management Features		
	Tropical Forest	Upper Elevation Ecosystems	Pine Forest
Decreased Reliability of Precipitation – Increased drought and floods	Decreased reliability of rainfall will impact both the forest tree species composition, with a shift towards more drought tolerant species, as well as an associated shift in forest fauna. Reduced rainfall will impact aquatic life, with potential to alter life cycles of species such as amphibians, which will be the first vertebrate taxa to show these impacts. There may also be a reduction of species diversity of water-reliant forest species.	Upper elevation elfin forest is maintained by the presence of cloud cover on the upper peaks, resulting in the moss and epiphyte-rich shrubland. The restricted climatic requirements and their narrow and fragmented distribution make these forests among the most vulnerable terrestrial ecosystems to climate change. Species are exceptionally vulnerable to the loss of the cool, moist environment that sustains them. Climate predictions suggest that forests will migrate upwards as the climate gets hotter – for elfin forests, already distributed at the highest elevations, there is nowhere to migrate to, so they will be replaced by other upper elevation forests.	Increasing drought in pine forest areas will increase fire risk and the associated degradation of the ecosystem eventually to an almost single-species tiger fern composition. This change has been occurring across the Cabbage Haul Ridge and is impacting the scenic beauty at the lookout points of Ben's Bluff and Tiger Fern, as well as degrading the broadleaf forest transition area.

TABLE 32: CLIMATE CHANGE IMPACTS ON MANAGEMENT FEATURES

Climate Change Impacts	Management Features		
	Tropical Forest	Upper Elevation Ecosystems	Pine Forest
Air Temperature	Increasing temperatures will take some forest species outside their tolerance zone, with general ecosystem shifts towards more drought tolerant species. CBWS may lose the humid end of the species spectrum. The increased fire risk may degrade or remove forest, particularly where it transitions into a more pine-dominated ecosystem.	Increasing air temperatures have the potential to significantly impact the cloud environment required for maintenance of elfin forest and cloud elfin forest species. The higher temperatures may result in the clouds being lifted higher, and therefore moving over the peaks rather than encompassing them, resulting in a much drier environment. Increasing temperatures will also take some elfin forest species outside their tolerance zone, with general ecosystem shifts towards more drought tolerant species.	Increasing air temperatures will impact pine forest species – *Pinus caribaea* has an average upper tolerance level of 34°C. If high temperatures exceed this for lengthy periods, pines will be outside their tolerance zone, with general ecosystem shifts towards more drought tolerant species. The warmer air temperatures may also exacerbate the issue of southern pine bark beetle and other disease.

TABLE 32: CLIMATE CHANGE IMPACTS ON MANAGEMENT FEATURES

2.4.2 CLIMATE CHANGE-RELATED THREAT ASSESSMENT

A threat assessment was conducted highlighting the highest current anthropogenic threats to each of the key conservation targets. Potential threats that may evolve as a result of climate change were also identified (Table 33). The threats were then assessed using a series of ratings (Table 34).

Key Conservation Target	Current Anthropogenic Threats	Potential Key Climate Change-Related Anthropogenic Threats
Tropical Forest	▪ Forest Clearance ▪ Forest Fragmentation ▪ Illegal Logging ▪ Agrochemical Pollution ▪ Poorly Managed Agricultural Fire	▪ Clearance of adjacent forests for agriculture and urban settlements as population migrates away from coastal areas as a result of sea level rise ▪ Increased pressure for land within protected areas, with migration away from coastal areas ▪ Increased potential for fires in boundary area
Upper-Elevation Ecosystems	▪ Visitor Impacts ▪ Agrochemical Pollution ▪ Visitor-Set Fire	▪ Clearance of adjacent forests for agriculture and urban settlements as population migrates away from coastal areas as a result of sea level rise – changing rainfall patterns ▪ Hurricane impacts increasing fuel load, with increased potential for fires ▪ Increased agrochemical pollution to counter emerging diseases and invasive pests associated with climate change, with pesticide drift to upper elevation ecosystems, impacting amphibians and other aquatic species
Pine Forest	▪ Poorly Managed Agricultural Fires ▪ Hunter-Set Fires ▪ Agrochemical Pollution ▪ Forest Clearance ▪ Legal and Illegal Logging	▪ Increased storms result in increased fuel load, increasing the fire risk ▪ Clearance of adjacent forests for agriculture and urban settlements as population migrates away from coastal areas as a result of sea level rise, with pressure to move into pine areas

TABLE 33: CURRENT AND POTENTIAL KEY CLIMATE CHANGE-RELATED ANTHROPOGENIC THREATS

Ranking Criteria	Rating		Rating Definitions
Certainty: The certainty that the effect of Climate Change will occur or the cause of the described impact will affect the target	Very High	4	Confirmed
	High	3	Considered very probable but not confirmed
	Medium	2	Considered probable
	Low	1	Considered a limited probability, much debate
Severity: Level or damage to this key element, which can destroy it in **50 years**	Very High	4	Destroys the ecosystems or its production activities
	High	3	Seriously degrades the target
	Medium	2	Moderately degrades the target
	Low	1	Slightly impairs the target
Scope: Geographical coverage of the target that will be impacted in **50 years**	Very High	4	75% - 100% of the geographic coverage
	High	3	50% - 75% of the geographic coverage
	Medium	2	25% - 50% of the geographic coverage
	Low	1	<25% of the geographic coverage
Irreversibility: The impact is permanent or cannot be reversed naturally or through human action	Very High	4	Not reversible, even with human intervention
	High	3	Reversible but at high cost or very long term (> 100 yrs)
	Medium	2	Reversible with human intervention
	Low	1	Naturally reversible or with little human intervention and / or little cost

TABLE 34: RATING CRITERIA FOR ASSESSING CLIMATE CHANGE ADAPTATION THREATS PER TARGET (AFTER TNC)

TABLE 35: ASSESSMENT OF CLIMATE CHANGE ADAPTATION THREATS					
	Certainty	***Severity***	***Scope***	***Irreversibility***	***Averaged Score***
Tropical Broad-leaved Forest					
Clearance of adjacent broadleaved forests for agriculture and urban settlements	***High (3):*** Much of the adjacent land is already under agriculture – particularly citrus, bananas, coconuts and cattle. Much of the remaining buffer forest is under private ownership. Current plans are for maintenance of forest cover, but some areas still have a high likelihood of being converted to agriculture in the future	***Very High (4):*** Clearance of forest to the protected area boundary will increase edge effect and increase accessibility for illegal activities. The presence of Mango Creek Forest Reserve will help in minimizing this. Forest clearance on the southern coastal plain is predicted to alter rainfall patterns, reducing rainfall over Cockscomb. This may result in changes in forest species.	***High (3):*** Predicted increases in population pressure in the area as people move away from the coastline, the pressure for land will increase adjacent to the Wildlife Sanctuary, leading to clearance for agriculture	***High (3):*** Once forest has been cleared for agriculture, it would take significant time and/or effort to return it to forest	***3.25***
Increased fire risk	***High (3):*** Increased drought conditions will also increase the risk of fire in the adjacent pine forest	***High (3):*** Fire will seriously degrade forest structure and increase edge effect in boundary areas. Predicted decreased rainfall and increased dry conditions may lead to fire damage, and could significantly degrade forest viability in the long term	***Low (1):*** Fires will degrade the transition zone of the forest, but won't pas far into the forest	***High (3):*** Reversible, but would require effective fire management, and engagement of farmers and hunters to minimize fire risk	***2.50***

TABLE 35: ASSESSMENT OF CLIMATE CHANGE ADAPTATION THREATS					
	Certainty	***Severity***	***Scope***	***Irreversibility***	***Averaged Score***
Upper Elevation Ecosystems					
Clearance of adjacent forests for agriculture and urban settlements	***High (3):*** Much of the adjacent land is already under agriculture – particularly citrus, bananas, coconuts and cattle. Much of the remaining forest is under private ownership. Current plans are for maintenance of forest cover, but some areas still have a high likelihood of being converted to agriculture in the future.	***Very High (4):*** Clearance of forest to the CBWS boundary will increase edge effect and accessibility for illegal activities. The Forest Reserve will help to buffer against this. Forest clearance on southern coastal plain will alter rainfall patterns, reducing rainfall over CBWS. This may result in loss of the cloud cover required for elfin forest, and therefore of the elfin forest itself.	***Very High (4):*** All elfin forest will be affected	***Very High (4):*** Not reversible	***3.75***
Increased fire risk	***Medium (2):*** More intense dry seasons will increase fire risk from lightening or poor tourism practices (upper elevation areas are away from the impacts of fires on the southern coastal plain)	***High (3):*** If fire occurs, it may significantly degrade the upper elevation forest	***Medium (2):*** As elfin forest is fragmented, fire on one peak is unlikely to impact other peaks	***High (3):*** Recovery will take many tens of years, and full recovery may not be achieved within 100 years	***2.50***

TABLE 35: ASSESSMENT OF CLIMATE CHANGE ADAPTATION THREATS					
	Certainty	***Severity***	***Scope***	***Irreversibility***	***Averaged Score***
Upper Elevation Ecosystems					
Increased use of agrochemicals in the landscape	***High (3):*** While agricultural practices are shifting towards more organic and better practices, increased pest predictions suggest that agrochemical use may increase in the future.	***High (3):*** Agrochemical contamination of water in the upper elevation forest may impact upper elevation amphibian health, and impact water quality in the watershed.	***Very High (4):*** Agrochemical pesticide deposition has been identified across the Maya Mountains	***High (3):*** Changes in agricultural practices / pesticide use could reduce this impact in the long term, but may be expensive and require a shift in perception of farmers.	***3.25***

TABLE 35: ASSESSMENT OF CLIMATE CHANGE ADAPTATION THREATS					
	Certainty	***Severity***	***Scope***	***Irreversibility***	***Averaged Score***
Pine Forest					
Increased fire risk	***High (3):*** Fires occur in the landscape every year, though not all reach CBWS	***High (3):*** Degradation of the pine forest, loss of pine forest species (including *Pinus caribaea* and yellow headed parrots)	***Very High (4):*** There is a high potential for over 75% of the ecosystem to be impacted in the Cabbage Haul Ridge area	***High (3):*** The impacts are reversible, but would take significant time, funds and human resources. Focus is on prevention.	***3.25***
Clearance of adjacent pine forest for agriculture and urban settlements	***High (3):*** Buffering pine forest in Mango Creek Forest Reserve gives some level of protection. On the southern coastal plain, pine forest is being removed at an increasing rate	***Very High (4):*** Clearance will remove the ecosystem completely	***Medium (2):*** Significant % of pine forest adjacent to CBWS is in Mango Creek Forest Reserve, so currently protected. However, removal of pine forest outside of the FR is widespread	***High (3):*** It is reversible, but would take significant time, funds and human resources.	***3.00***

RANKED OUTPUTS

The assessment provides a prioritization for potential threats that may occur as a result of changes in climate, based on the level of impact they would have on the specific targets (Table 36). The highest ranked threat is the predicted (and already occurring) deforestation of broadleaved forest on the Southern Plain, which has the potential to significantly negatively impact orographic rainfall patterns, with the potential loss of elfin forest, and the shift towards more drought –resistant forest compositions in the basins.

Pine forest, too, is at high risk from increased forest fires, with the increasing frequency and intensity of storms, increasing drought periods and increasing temperatures. Of equal risk is the impact of agrochemical drift and deposition in the upper elevation areas, with famers predicted to increase their use of pesticides as temperatures increase, bringing in new crop pests.

CLIMATE CHANGE RELATED THREAT	RELEVANT TARGET(S)	AVERAGED SCORE
Clearance of adjacent broadleaved forests for agriculture and urban settlements	Upper Elevation Ecosystems (3.75) Tropical Broadleaf forest (3.25)	3.50
Increased fire risk to pine forest	Tropical Pine Forest (3.25)	3.25
Increased use of agrochemicals in the landscape	Upper Elevation Ecosystems (2.50)	3.25
Clearance of adjacent pine forest for agriculture and urban settlements	Tropical Pine Forest (3.00)	3.00
Increased fire risk to broadleaf forest	Upper Elevation Ecosystems (2.50) Tropical Broadleaf forest (2.50)	2.50

TABLE 36: SUMMARY OF CLIMATE CHANGE-RELATED THREAT ASSESSMENT OUTPUTS

2.4.3 BUILDING RESILIENCE TO CLIMATE CHANGE

A series of climate change adaptation strategies were then developed based on the assessment outputs, and including performance indicators for measuring success of implementation.

TABLE 37: CLIMATE CHANGE ADAPTATION STRATEGIES				*Indicators*
Goal	Reduce risk of potential water security issues through maintenance of forest in the wider CBWS landscape			▪ % of wider CBWS landscape under broadleaf forest cover
Objective	Engage stakeholders (communities and landowners) in the maintenance of broadleaf forest cover in the CBWS wider landscape			▪ Level of community understanding of the role of Southern Plain broadleaf forest in maintaining water security
Strategy	***Strategic Actions***	***Complimentary Activities***	***Timeline***	
Reduce the rate of deforestation in the CBWS wider landscape	Engage communities in maintenance of broadleaf forests in the CBWS landscape ▪ Increase awareness of critical importance of forests in water security ▪ Support community projects that maintain forest cover (including agroforestry) ▪ Partner with Ya'axché Conservation Trust in areas of overlap	Maya Golden Landscape	Ongoing (5 years +)	▪ Level of community understanding of the role of Southern Plain broadleaf forest in maintaining water security ▪ Extent of forest cover in the wider CBWS landscape ▪ Map of broadleaf forest cover in the wider CBWS landscape, between CBWS and the coast
	Engage private landowners of large forest tracts for continued maintenance of broadleaf and pine forest cover in the CBWS landscape	Maya Golden Landscape	Ongoing (5 years +)	▪ Level of understanding of private landowners of large forest tracts of the role of Southern Plain broadleaf forest in maintaining water security
	Improve understanding of large scale farmers of the role of Southern Coastal Plain broadleaf forest in maintaining water security		Ongoing (5 years +)	▪ Level of understanding of large scale farmers of the role of Southern Plain broadleaf forest in maintaining water security
Goal	Reduce incidence of fires in the CBWS landscape			▪ Number of fires that impact CBWS per year
Objective	Engage stakeholders in active fire monitoring and management			
Reduce fire damage to forests in CBWS and CBWS landscape	▪ Ensure CBWS has fire-fighting equipment on site and accessible ▪ Provide training for local farmers and staff in effective fire management ▪ Partner with landowners and other NGOs in the landscape to ensure effective fire monitoring and communication	National Fire Management initiative	3 years	▪ % of farmers considered to be engaged in reducing fires in the Southern Coastal Plain ▪ Number of farmers / landowners completing fire management training ▪ Number of farmers / landowners active in fire monitoring network ▪ Presence of firefighting equipment

TABLE 37: CLIMATE CHANGE ADAPTATION STRATEGIES				*Indicators*
Goal	**Reduce risk of pesticide contamination in Upper Elevation Ecosystems**			▪ Presence of pesticides / pesticide breakdown products in photolytic water on Outlier / Victoria Peak
Objective	**Engage farmers in best practices for reduced agrochemical use in the CBWS wider landscape**			▪ Level of understanding of farmers of the impacts of pesticides on biodiversity and the human health implications of pesticide drift
Strategy	***Strategic Actions***	***Complimentary Activities***	***Timeline***	
Encourage best practices for agrochemical use in the CBWS Wider landscape	Engage farmers in best practices for agrochemical use in the CBWS Wider landscape ▪ Build capacity of BAS for addressing the issue of pesticide use and pesticide drift ▪ Partner with PCB to improve information availability on pesticides and pesticide use best practices for farmers through workshops / meetings ▪ Partner with farming associations and other NGOs with similar objectives of agrochemical best practices ▪ Partner with Ya'axché Conservation Trust ▪ Support community projects that reduce pesticide use (e.g. organic farming) ▪ Develop a baseline for the level of pesticide contamination in water bodies of the Upper Elevation Ecosystems and in rivers inside and outside CBWS	Pesticide Control Board (PCB) Maya Golden Landscape	Ongoing (5 years +)	▪ % of agricultural associations provided with information on the issues associated with pesticide use and pesticide drift ▪ % of agricultural associations considered to be engaged in reducing pesticide use in the CBWS wider landscape ▪ % farmers provided with information on the issues associated with pesticide use and pesticide drift ▪ % of farmers considered to be engaged in reducing pesticide use in the CBWS wider landscape

Section Three

Management Planning

COCKSCOMB STAFF

3. MANAGEMENT PLANNING

3.1 MANAGEMENT AND ORGANIZATIONAL BACKGROUND

Regulatory authority for CBWS / VPNM lies with the Forest Department (Ministry of Agriculture, Forestry, Fisheries and Sustainable Development), supported by national legislation. As with many national protected areas in Belize, site manangement lies with a co-management agency, with responsibilities presented in a co-management agreement. Cockscomb Basin Wildlife Sanctuary and Victoria Peak Natural Monument are managed as a joint unit by Belize Audubon Society (BAS), a non-governmental organization under a co-management agreement with the Forest Department. Over the years, since its establishment in 1969, BAS has grown into a leading conservation organisation in Belize, co-managing seven national protected areas. With a vision and a mission that reflects the need for sustainable management of natural resources and a balance between people and the environment, BAS focuses on providing not only protection for wildlife and the environment, but also benefits to adjacent communities and other stakeholders.

Belize Audubon Society

Vision: Belize Audubon Society is a national conservation leader and development partner that inspires people to live in harmony with and benefit from the environment

Mission: The Belize Audubon Society is a non-governmental, membership-based organization dedicated to the sustainable management of our natural resources through leadership and strategic partnerships with stakeholders for the benefit of people and the environment.

The Belize Audubon Society is a membership organization guided by a multi-sectoral Board of Directors and led by the Executive Director. With approximately 40 staff, effective organizational management is achieved through a framework of internal policies and procedures. In 2014, BAS revised its Strategic Plan, to develop a "comprehensive roadmap setting the direction of BAS' work over the next five years, with a ten-year outlook" (BAS Strategic Plan, 2014). The focus is on four critical strategies.

FOCAL AREAS OF BAS 2014 STRATEGIC PLAN

- **Sustainable Natural Resources Management:** To continue to work toward improving the environmental integrity of key marine and terrestrial protected areas in Belize through effective, collaborative natural resources management.
    - *Protected areas management*
- **Research and Monitoring:** To integrate science-based decision-making for adaptive management of protected areas and buffering environs
    - *Sustained Monitoring Program for marine and terrestrial systems*
    - *Integrate science-based decision-making for adaptive management*
- **Environmental Education and Awareness:** To develop and implement an environmental education strategy for BAS to build knowledge, skills, and experience that would help to create more environmentally responsible citizens
    - *Environmental Education*
    - *Community Outreach*
- **Organizational Development:** To strengthen the capacity of BAS to continue as a conservation leader and key development partner for the country of Belize.
    - *Improving Organizational Effectiveness*
    - *Branding and Marketing of BAS*

CO-MANAGEMENT

BAS has a five-year co-management agreement with the Forest Department for Cockscomb Basin Wildlife Sanctuary / Victoria Peak Natural Monument, as two of the seven protected areas managed by the NGO, and signed on December, 2013. This has been extended in 2018 under a letter of commitment from the Forest Department. Under this agreement, BAS is responsible for:

> *"the day-to-day management and administration of the protected area(s), preparation and implementation of management and operational plans for the protected area(s), and the management and development of the finances of the protected area(s), as detailed in the National Protected Areas Co-Management Framework.*

a) Day-to-day management and administration of the protected area(s) shall include, but not be limited to, the following: staff recruitment and retention, staff supervision and development, expenditures and accounting, equipment and procurement, and management and financial audits with oversight provided by the Regulatory Agency.

b) The management and operational plans shall be developed as per the Management Plan template in conjunction with the Regulatory Agency.

c) The management and development of finances of the protected area(s) shall include, but not be limited to, the following: identifying and securing grant funding, and working to diversify financing mechanisms jointly with the Regulatory Agency and in partnership with other third parties.

The Forest Department (Government of Belize), as the regulatory agency, is responsible for:

"… providing management oversight with respect to the management of the protected area(s) and patrolling and law enforcement support.

a) Management oversight shall include, but not be limited to, the following: technical input in the development of protected area management and development plans, approval of management plans, training in legal proceedings and monitoring and evaluation of protected area management activities.

b) Patrolling and law enforcement support shall be in collaboration with the national law enforcement agencies and shall include the following: participation in protection patrols when requested by the Manager, including leading search, seizure and arrest operations when necessary; and the necessary support for the prosecution of offenses.

c) Financing support shall include to the extent possible, but not be limited to, the following: budget appropriations, project funding, and fiscal incentives such as tax exemptions."

The day-to-day management of the Belize Audubon Society is the responsibility of the Executive Director and senior management staff. The Executive Director oversees the Protected Area Directors, who are in turn responsible for the effective implementation of the programme activities at site level. Management of Cockscomb Basin Wildlife Sanctuary / Victoria Peak Natural Monument falls under the Sustainable Natural Resource Management Program, supported by the other Programmatic Areas (the Administration and Operations Unit, and the Environmental Education and Community Outreach Unit). Management strategies and activities for the protected areas are implemented by the Protected Area Manager, based from the BAS office in Belize City, with the support of the other Program managers (Environmental Education, Science and Administration). Day to day activities (staff supervision, patrolling, infrastructure

maintenance and upkeep, fee collection etc.) are the responsibility of the on-site manager, supported by an assistant site manager and nine wardens, with roles ranging from surveillance and enforcement, community outreach assisting with research, and housekeeping. The site manager reports to the Protected Areas Manager.

Management activities are framed by a series of site-level objectives towards a goal defined by the five-year management plan:

GOAL

To maintain biodiversity, ecosystems, cultural resources and watershed areas within a functional conservation area, as an integral part of the National Protected Areas System, providing benefits to Belize"

OBJECTIVES

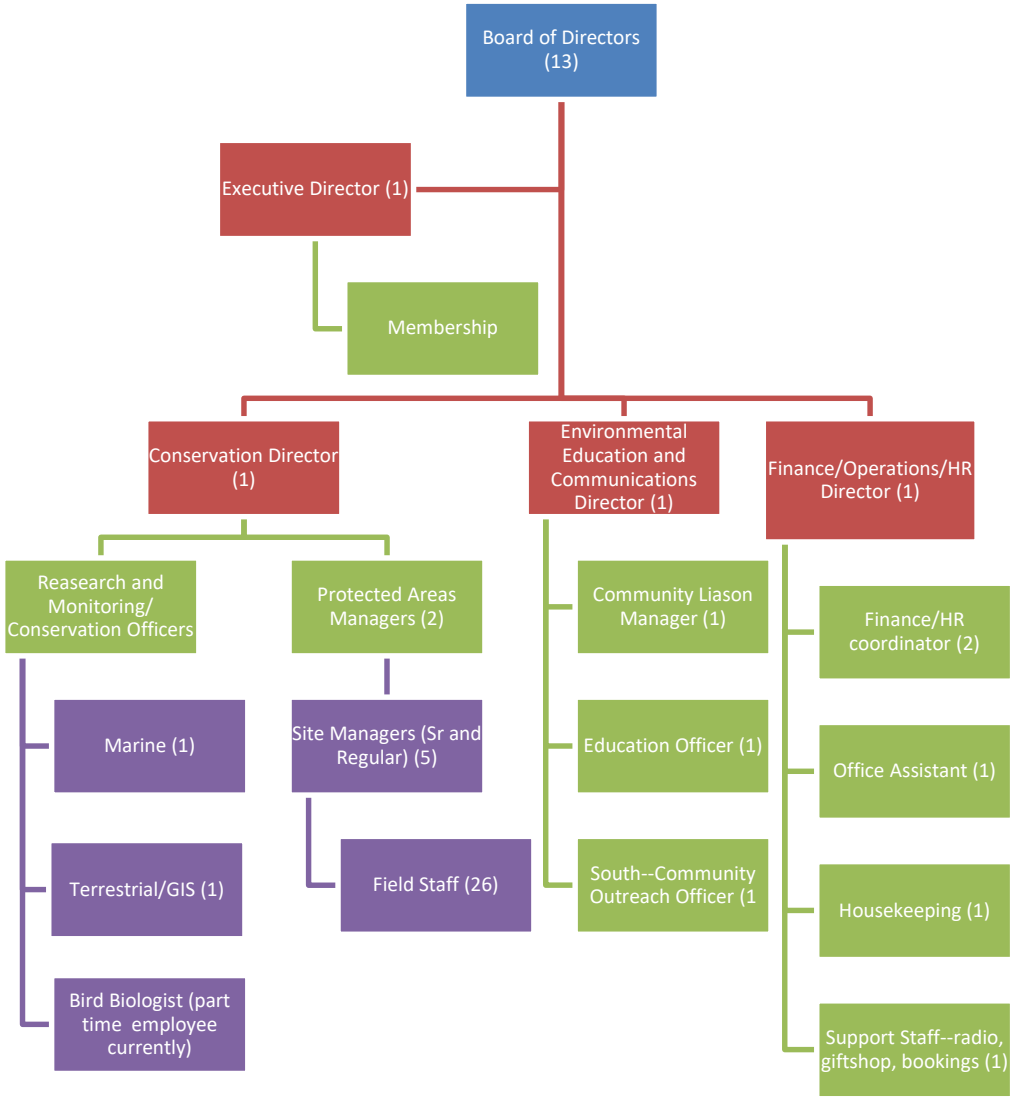
Objective 1:
Improved local support for conservation / environmental stewardship in local communities and stakeholders

Objective 2:
Sound research informing public perceptions and management decisions

Objective 3:
Contribution towards the environmental services provided by conservation areas – clean air, clean water, and climate change amelioration

Objective 4:
Provision of a resource that is valued by visitors

Belize Audubon Society
Organizational Diagram (December, 2018)



3.1.1 REVIEW OF PREVIOUS MANAGEMENT PLAN

The previous management plan was developed for Cockscomb Basin Wildlife Sanctuary / Victoria Peak Natural Monument in 2006, before the development of the National Management Planning Framework. This current management plan is the first revision since then.

The original plan included six discrete objectives that have been evaluated here to provide an indication of implementation success in the past ten years. These were rated out of a possible total of 4, based on the level of achievement. BAS achieves an average score of 3.25 out of a possible score of 4.00 (81.3%).

Objective	Score	Comments
To maintain biodiversity, ecosystems, cultural resources and watershed areas within a functional conservation area, as an integral part of the National Protected Areas System	4	There has been consistent protection of CBWS / VPNM and the ecosystem services, with a reduction of illegal fishing and hunting. Ecosystem services have been maintained, and improved, with the realignment of Mango Creek Forest Reserve
To provide an enabling environment for economic opportunities for local communities and society, towards sustainability	3	CBWS has been able to build a positive relationship with Maya Centre in particular, with a shift to supporting livelihoods based on tourism. It is also contributing towards the support of tour guides and tour operators in coastal communities and resorts. However, many buffer communities do not benefit to the same extent.
To engender greater public support, public awareness and participation to increase acceptance and security	3	BAS has been able to reach out to a wider audience through its education and outreach activities but has only fully engaged those communities that have direct benefit.
To develop Cockscomb Basin Wildlife Sanctuary as a nationally and internationally known research site	2.5	Research use has continued, and CBWS is used as a teaching field site for ERI and some international university groups, but there has been no significant increase in the level of scientific research being conducted. Facilities still need to be established to host research groups
To strive towards a greater level of sustainability through expansion and further development of tourism, compatible with biodiversity	3	Visitation has expanded, with high levels of visitor satisfaction. A Public Use Plan is being developed to ensure continued tourism compatible with biodiversity, particularly with the potential for larger-scale cruise tourism
To contribute towards the environmental services provided by conservation areas	4	There has been consistent protection of CBWS / VPNM and the ecosystem services it provides
Average	**3.25**	

Scores
1: No change
2. Implementation has started, but there are no successful outputs to date
3. Partial success of implementation and outputs
4. The objective and expected outputs have been successfully achieved

3.1.2 MANAGEMENT EFFECTIVENESS

An evaluation of management effectiveness was conducted in 2017 using the modified national management effectiveness indicators (Young et. al., 2005), and provides a snapshot of the state of management effectiveness, to identify key strategies for strengthening management, for integration into the updating of the management plan.

National Indicators

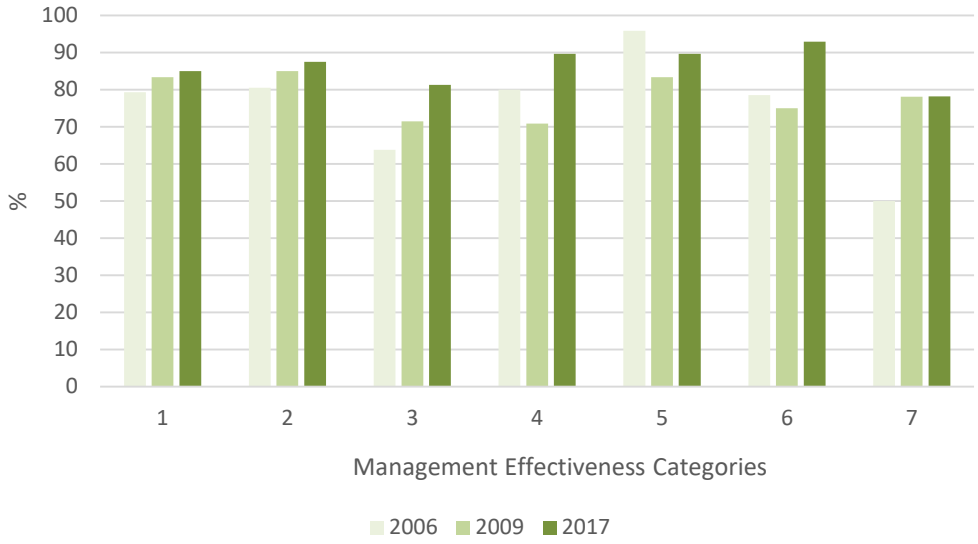
Under the National Protected Areas Policy and System Plan, management effectiveness is evaluated through the **Monitoring Package for Assessing Management Effectiveness of Protected Areas** (Young et. al. 2005, modified by Walker et al., 2009), based on seven different indicator categories (Table 38).

Indicator Categories			
Indicator Category	**Average Score 2006**	**Average Score 2009**	**Average Score 2017**
1. Resource Information	79.3	83.3	**85.2%**
2. Resource Administration, Management and Protection	80.5	85.0	**87.5%**
3. Participation, Education and Socio-Economic Benefit	63.8	71.4	**81.3%**
4. Management Planning	80.0	70.8	**89.6%**
5. Governance	95.8	83.3	**89.6%**
6. Human Resources	78.5	75.0	**92.9%**
7. Financial and Capital Management	50.0	78.1	**78.2%**
Overall	**75.5%**	**78.1%**	**86.8%**

***** Indicators and Indicator categories used are from Young et. al. (2005), and scored on a scale of 1 – 4: Poor (1: ≤25%); Fair (2: >25 - 50%); Good (3: >50% - 75%); Very Good (4: >75%)

TABLE 38: RESULTS PER INDICATOR CATEGORY FOR CBWS – 2006, 2009, AND 2017

The current management effectiveness of the combined Cockscomb Basin Wildlife Sanctuary / Victoria Peak Natural Monument is rated as **VERY GOOD,** with an overall Management Effectiveness score of **86.8%** (3.47 out of 4.00) – a significant increase from the 2009 rating of 78.1% (though both rate as **VERY GOOD**) (Figure 19, 20 and 21). All indicator categories have increased since the 2009 assessment, and are rated as **VERY GOOD**. Financial and Capital Management is identified as the weakest area, rating at the lower end of **VERY GOOD**, with 78.2% (Table 39).



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

FIGURE 19: MANAGEMENT EFFECTIVENESS OF MANAGEMENT CATEGORIES

Cockscomb Basin Wildlife Sanctuary / : Strengths and Weaknesses of Indicator Categories			
Rating	**Range**	**Indicator Category**	**2009 / 2017**
VERY GOOD	>75%	1. Resource Information	▲
		2. Resource Administration, Management and Protection	▲
		3. Participation, Education and Socio-Economic Benefit	▲
		4. Management Planning	▲
		5. Governance	▲
		6. Human Resources	▲
		7. Financial and Capital Management	▲
GOOD	>50 – 75%	No indicator Categories rate as Good	
FAIR	>25 – 50%	No indicator Categories rate as Fair	
POOR	≤ 25%	No indicator Categories rate as Critical	
Assessment using modified National Indicators (Young et. al., 2005)			

TABLE 39: STRENGTHS AND WEAKNESSES OF INDICATOR CATEGORIES

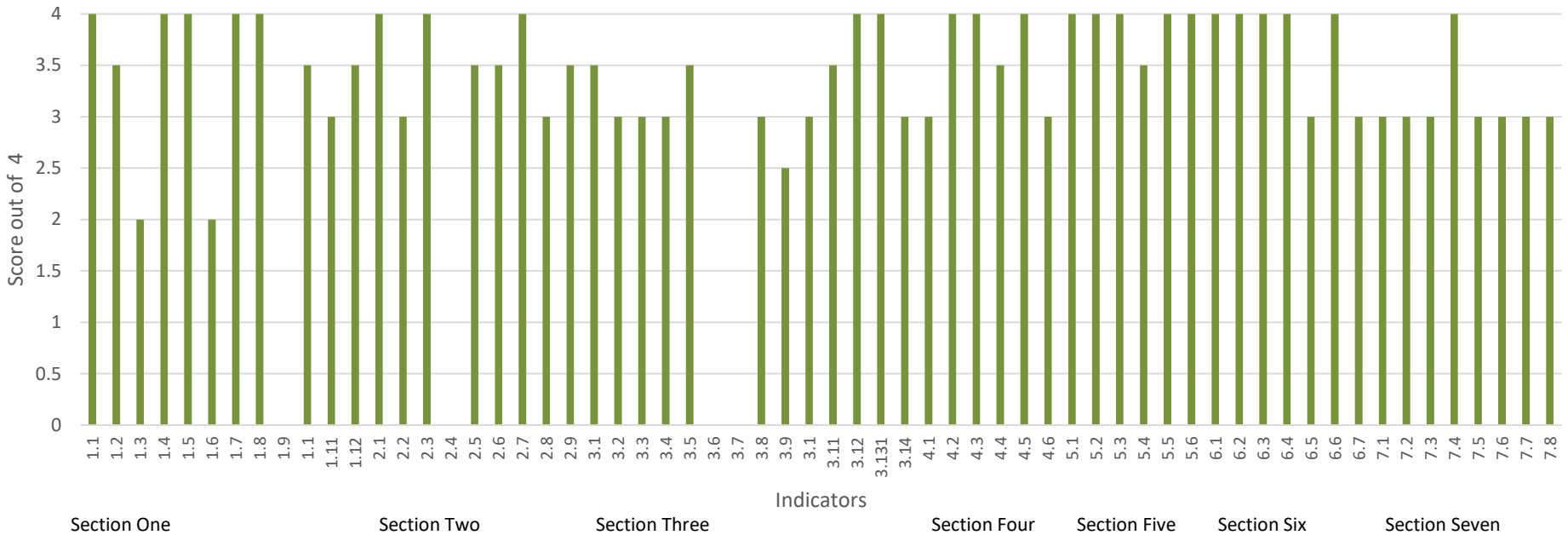


FIGURE 20: MEAN SCORE BY INDICATOR – SORTED BY INDICATOR SECTION

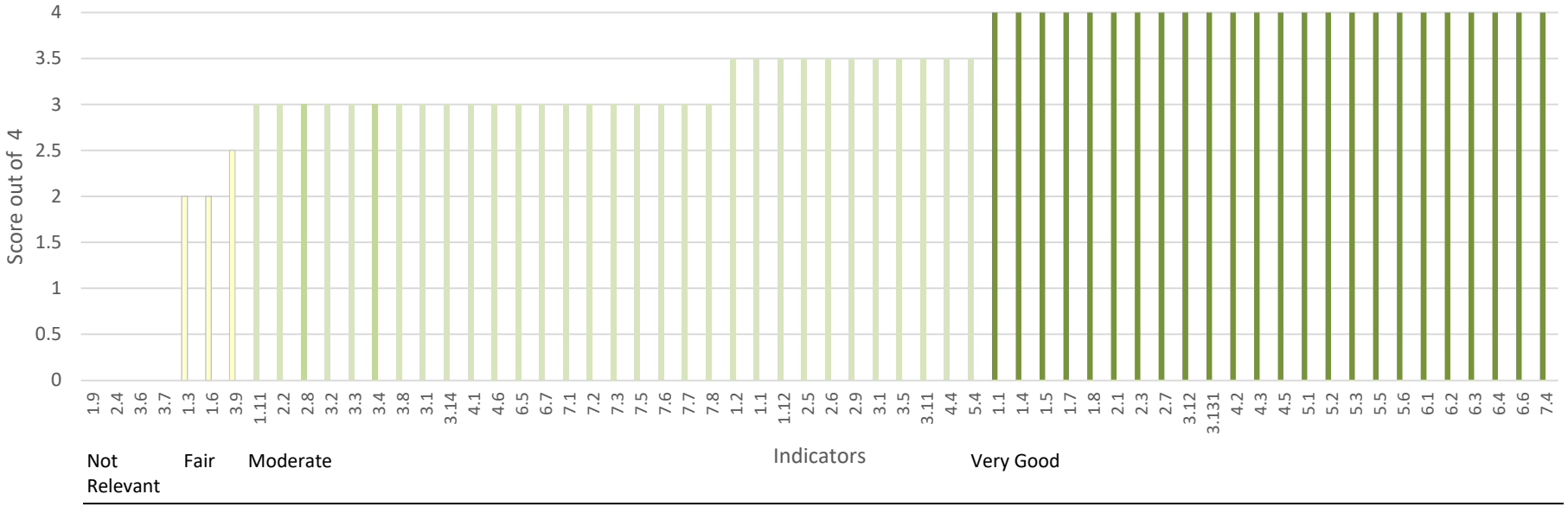


FIGURE 21: MEAN SCORE BY INDICATOR – SORTED BY SCORE

NOT RELEVANT:	Four indicators rate as NOT RELEVANT	
POOR:	No indicators rate as POOR	
FAIR:	Three indicators rate as FAIR	1.3 Inventory of Archaeological Resources
		1.6 Information on Tenures and Claims
		3.9 Capacity Building Strategies

MODERATE / GOOD:	Thirty-one indicators rate as MODERATE / GOOD
VERY GOOD:	Twenty-four indicators rate as VERY GOOD

NON-BIODIVERSITY INDICATORS (YOUNG ET. AL. 2005)		
1. Resource Information 1.1 Physical Environment 1.2 Biotic Environment 1.3 Archaeological Resources 1.4 Social, Cultural and Economic Context 1.5 Resource Use and Occupancy 1.6 Tenures and Claims 1.7 Conservation Target 1.8 Systematic Threat Assessment 1.9 Traditional Knowledge 1.10 Information Management Systems 1.11 Environmental Monitoring Activities 1.12 Functional Scientific Research Activities **2. Resource Management** 2.1 Legal: Legal Status 2.2 Legal: Boundary Survey and Demarcation 2.3 Legal: Permit, and Approval Processes 2.4 Tenure Claim Conflict Resolution 2.5 Guidelines and Best Management Practices 2.6 Protection: Surveillance Activities 2.7 Protection: Enforcement Activities 2.8 Visitor and Tourism Management Activities 2.9 Visitor and Tourism Monitoring Activities	**3. Community Participation and Benefits** 3.1 Communication Activities 3.2 Stakeholder Engagement 3.3 Educational Activities 3.4 Dissemination of Knowledge and Information 3.5 Level of Stakeholder Participation in Management 3.6 Local Actors Leading Management 3.7 Volunteer Activities 3.8 Strength of Social Capital 3.9 Capacity Building Strategies 3.10 Socio-Economic Benefits Strategy 3.11 Extent of Local Economic Benefits 3.12 Sustainable Use for Economic Benefit 3.13 Employment in activities related to the protected area 3.14 Local Recognition of Protected Area Benefits **4. Management Planning** 4.1 Management Plan Implementation 4.2 Operational Plan Implementation 4.3 Regulation and Zoning Implementation 4.4 Long Term Management Needs Identification 4.5 Program Monitoring and Evaluation 4.6 Research Programme	**5. Governance** 5.1 Protected area objectives 5.2 Co-management agreements 5.3 Administrative autonomy 5.4 Advisory Committee 5.5 Board of Directors 5.6 Inter-organizational mechanisms **6. Human Resources** 6.1 Qualified Site Manager 6.2 Site Manager Availability 6.3 Administrative Staff Availability 6.4 Technical, Scientific, and Professional Staff Availability 6.5 Operations Staff Availability 6.6 Human Resource Assessment 6.7 Training and Development **7. Financial and Capital Management** 7.1 Funding Adequacy 7.2 Long term Funding Plan 7.3 Financial Management 7.4 Infrastructure Adequacy 7.5 Equipment Adequacy 7.6 Internal Access Adequacy 7.7 Signage Adequacy 7.8 Maintenance Adequacy

FIGURE 22: NON-BIODIVERSITY INDICATORS

3.2 MANAGEMENT STRATEGIES

3.2.1 POLICY AND LEGAL FRAMEWORK

Management strategies are guided by national protected area legislation and objectives, and the goals and objectives of the Forest Department.

Cockscomb Basin Wildlife Sanctuary and Victoria Peak Natural Monument are both designated as non-extractive protected areas under the **National Protected Areas System Act** (2015) (Table 40). Legislative authority for both is held by the Forest Department (Ministry of Agriculture, Forestry, Fisheries and Sustainable Development), with a co-management agreement with the Belize Audubon Society (BAS), the NGO co-management partner, which is responsible for day-to-day management of the two protected areas as a single unit through a co-management agreement.

CBWS PROTECTED AREAS CATEGORIES		
Category	**Purpose**	**Activities Permitted**
Wildlife Sanctuary (1) Cockscomb Basin Wildlife Sanctuary	To protect nationally significant species, biotic communities or physical features.	Research, education, tourism
Natural Monument Victoria Peak Natural Monument	To protect and preserve natural features of national significance.	Research, education, tourism

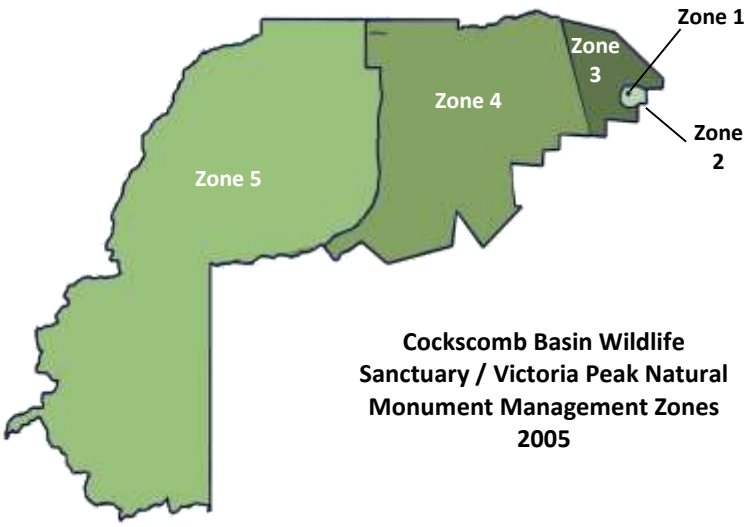
TABLE 40: CBWS PROTECTED AREA CATEGORIES

3.2.2 MANAGEMENT ZONES

As well as maintaining the facilities and trails, visitor management is directed at ensuring the needs of individual visitors and small groups looking for opportunities for wildlife experiences and solitude can be met, and that the wilderness quality of Cockscomb is maintained, whilst also catering for the larger, noisier groups that use the Wildlife Sanctuary for more active, recreational pursuits, particularly river tubing. This has resulted in a need to review and revise the zones to reflect use in 2017 / 2018, to ensure that visitor expectations are met as far as possible whilst also minimizing environmental impacts.

2005 CONTEXT

Management zones were first defined for Cockscomb Basin Wildlife Sanctuary in 2005 (Figure 23), as part of the original management plan (BAS, 2005). Five management zones were identified, based on visitor use at that time



Zone 1 Protected Areas Service Zone (Core area)

Zone 2 Education and Recreation Zone (High use trails)

Zone 3 Natural Environment Zone (Low use trails)

Zone 4 Wilderness Zone (Low use trails – guide required)

Zone 5 Preservation Zone (Limited access – patrols, research)

FIGURE 23*:* COCKSCOMB BASIN WILDLIFE SANCTUARY / VICTORIA PEAK NATURAL MONUMENT MANAGEMENT ZONES, 2005

JUSTIFICATION FOR ZONE AMENDMENT

Since the establishment of the five zones more than 12 years ago, Cockscomb has evolved, with visitor use increasing, with a need to re-evaluate the zoning system to address a number of current and future challenges:

- maintaining the biodiversity and ecosystem services for which Cockscomb was first established
- maintaining wilderness conditions – the essence of Cockscomb – for independent travelers and naturalists
- maximizing the potential for wildlife sightings whilst minimizing impact on the protected area's wildlife
- ensuring visitor satisfaction for the increasing number of both visitors and tour guides using the current trail system
- the need to cater for the increasing popularity of river tubing in the protected area whilst preserving environmental integrity
- the need to address the increasing pressure for access for large-scale cruise ship tourism originating from Harvest Caye / Independence.

As a result, the zoning has been amended, with many of the trails in the original Zone Three now merged with those of Zone Two to form a larger Zone Two (Figure 24).

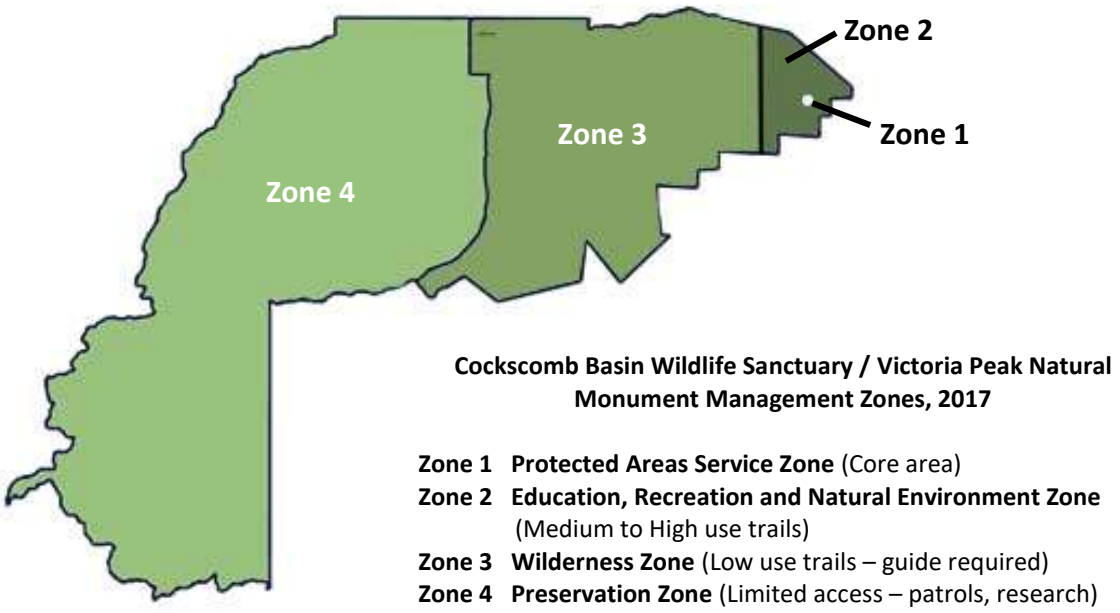


FIGURE 24: COCKSCOMB BASIN WILDLIFE SANCTUARY / VICTORIA PEAK NATURAL MONUMENT MANAGEMENT ZONES, 2017

AMENDMENTS TO EXISTING CBWS MANAGEMENT ZONES	
Action	***Justification***
Expand Zone 1: Protected Areas Service Zone	Zone 1 covers the administrative and visitor arrival and welcome area, with car parking, the Visitors Centre, visitor and staff accommodation, visitor facilities and the protected area office. A Concept Master Plan is being developed to upgrade the Zone 1 facilities, which requires the expansion of the Zone 1 area to accommodate a larger car park, expanded on-site accommodation, and relocation / construction of staff and research facilities. This is taken into account in the amended Zone 1, with expansion of the footprint to encompass these upgrades.
Merge Zones 2 and 3 as Zone 2, and realignment of the Zone western boundary. Remove Outlier from Zone 2.	Zones 2 and 3 contain the high use trails that radiate out from the Protected Areas Zone. These were originally divided into high use and low use zones, but increased activity and visitation, and increasing use of low-use trails by tour guides to avoid meeting other groups has led to both zones requiring similar management of trail conditions and visitor traffic. The increased river-tubing has also resulted in high use of trails in both zones, contradicting the original zoning. The two zones have therefore been merged, and the western boundary aligned north-south for ease of management. All trails except those requiring guides are now within the amended Zone 2. Victoria Peak and Outlier, in Zone 3, will both require a guide and an additional climbing fee to better manage trail maintenance and safety (this is already a requirement for Victoria Peak).
Identification of an area for development of a cruise ship forest destination	There is increased cruise ship demand for visitation to CBWS with the establishment of the Harvest Caye port. However, integration into the current tourism footprint is not recommended. It is suggested that an additional Zone 1 (Zone 1 (2)) be created adjacent to the White House but out of sight of existing non-cruise traffic to the protected area.

TABLE 41: AMENDMENTS TO EXISTING CBWS MANAGEMENT ZONES

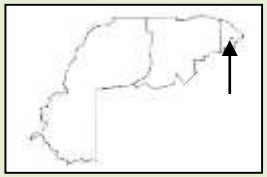
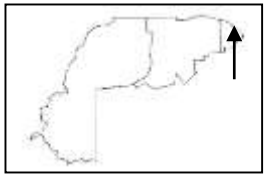
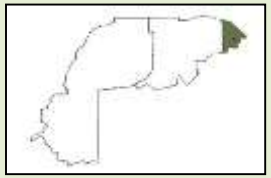
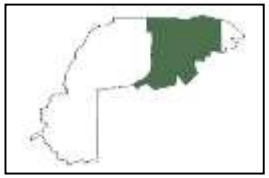
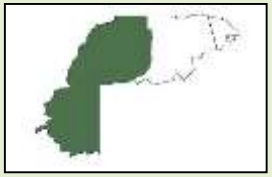
CBWS ZONES		OBJECTIVES
Zone One 	**Protected Areas Services Zone (1)** Core area with car / coach parking, administration, Visitors Centre, and accommodation facilities	▪ To provide administration and support facilities for CBWS ▪ To provide an access point, visitor information and protected area interpretation ▪ To provide accommodation for visitors ▪ To provide research facilities ▪ To maintain user impacts within pre-defined acceptable limits
	**Protected Areas Services Zone (2)** Core area with car / coach parking and Visitors Centre for cruise ship visitation, and accommodation (the White House) for protected area staff manning the entrance gate.	▪ To provide an access point, visitor information and protected area interpretation ▪ To maintain user impacts within pre-defined acceptable limits ▪ To provide accommodation for rangers manning the gated entrance point where the access road crosses the protected area boundary
Zone Two 	**Education, Recreation and Natural Environment Zone** Medium to Heavy use trails leading from Zone One (1) and (2), designed for high visitation and education activities	▪ To provide access to large numbers of visitors whilst minimizing impact through landscape alteration ▪ To increase protected area and wildlife interpretation opportunities for visitors ▪ To maintain user impacts within pre-defined acceptable limits ▪ To provide opportunities for established uses and activities within a natural environment ▪ To provide opportunities for solitude ▪ To maintain biodiversity and watershed functionality with minimal human impact ▪ To maintain user impacts within pre-defined acceptable limits
Zone Three 	**Wilderness Zone** The wilderness area of Cockscomb – East Basin. Access requires a guide.	▪ To maintain biodiversity and watershed functionality with minimal human impact ▪ To provide an access route to Victoria Peak Natural Monument and Outlier whilst minimising user impact ▪ To include an altitudinal gradient and representation of as many ecosystems as possible within the design of the zone ▪ Presence of required guide assists in minimizing impacts and provides safety backup
Zone Four 	**Preservation Zone** The western part of the sanctuary – West Basin and the Maya Mountain extension	▪ To maintain biodiversity and watershed functionality with minimal human impact ▪ To include an altitudinal gradient and representation of as many ecosystems as possible within the design of the zone ▪ To provide areas within the Wildlife Sanctuary that are preserved in an entirely natural state ▪ To protect areas of particularly fragile habitat and threatened or rare species

FIGURE 25: CBWS MANAGEMENT ZONES (2018)

PROPOSED CTZ (CRUISE TOURISM ZONE) OPTIONS

Cruise Tourism Zone – Option 1: The White

Establishing a site adjacent to the White House. The coach park, associated visitor facilities and trail system can be established adjacent to the White House, set back in the forest to reduce visual impact for other users of CBWS. This is already in Zone 1 (2) and Zone 2 so would not require any further re-zoning.

Cruise Tourism Zone – Option 2: Mango Creek Forest Reserve 1

Mango Creek Forest Reserve 1 has been realigned to protect the southern buffer of Cockscomb Basin Wildlife Sanctuary and the two key scenic view and waterfall sites of Tiger Fern and Ben's Bluff trails, considered a core part of Cockscomb Basin's appeal. There may be an opportunity for opening a co-management or concession agreement for a portion of the Forest Reserve, with identification of other sites that may be able to provide the resource opportunities identified for a CTZ site. The South Stann Creek river system, for example, flows through the Forest Reserve, south of Snook Eddy and the private lands, and is accessible from the Snook Eddy road.

FIGURE 26: POTENTIAL LOCATIONS FOR CRUISE TOURISM ZONE OPTIONS

ANALYSIS OF CTZ OPTIONS		
Proposed Site	**Pros**	**Cons**
Option 1: White House	▪ There is maintained road access to the White House ▪ The White House will be staffed once the entrance gate has been installed, with the establishment of Zone 1 (2) ▪ The White House area is over 2 km from the CBWS Zone 1, reducing and potential impact on other CBWS users ▪ It would provide easy access for staff associated with management of the CTZ ▪ Logistics are better for medical evacuations ▪ Creeks in the area could form the focus for scenic forest paths with interpretive information ▪ Increased presence in the White House area will reduce illegal incursions ▪ The White House is within the current CBWS management footprint	▪ There is no known access to water features – rivers, waterfalls etc. or overview points. Activities would need to focus on the forest ▪ The level of coach traffic may impact road quality ▪ The level of coach traffic may impact the wilderness feel of CBWS for other visitors (though the coach park could be hidden from view in the forest) ▪ Construction of the facilities required for hosting CT visitors would potentially disrupt road access during the construction period ▪ Increased presence in the area may result in a shift in wildlife out of the protected area, into the adjacent private land
Option 2: MCFR 1	▪ There is maintained road access to the South Stann Creek, south of Snook Eddy ▪ There are other areas of the MCFR1 that may provide good recreational opportunities for cruise ship visitors	▪ Mango Creek Forest Reserve 1 is currently outside of the management footprint of Belize Audubon Society and would require a co-management agreement or management concession ▪ The access road passes through private property ▪ There may be conflicting concessions already existing for use of the area, under the Sustainable Forest Management programme ▪ No potential site has been identified or assessed for suitability. BAS currently has no facilities in the area and would need to develop a trail system from scratch that meets cruise ship visitor recreational expectations ▪ Daily logistics for moving staff and resources would be expensive ▪ Even if the South Stann Creek provides a navigable waterway for river-tubing, there would be less of a wilderness feel in the Forest Reserve along the river course

TABLE 42: ASSESSMENT OF PROS AND CONS FOR TWO CTZ LOCATION OPTIONS

RECOMMENDATION

The recommended option is the establishment of Zone 1 (2) by the White House to encompass both the projected increased use of the White House by the ranger following the installation of the entrance gate, and the development of cruise visitor facilities in the same area (Figure 27).

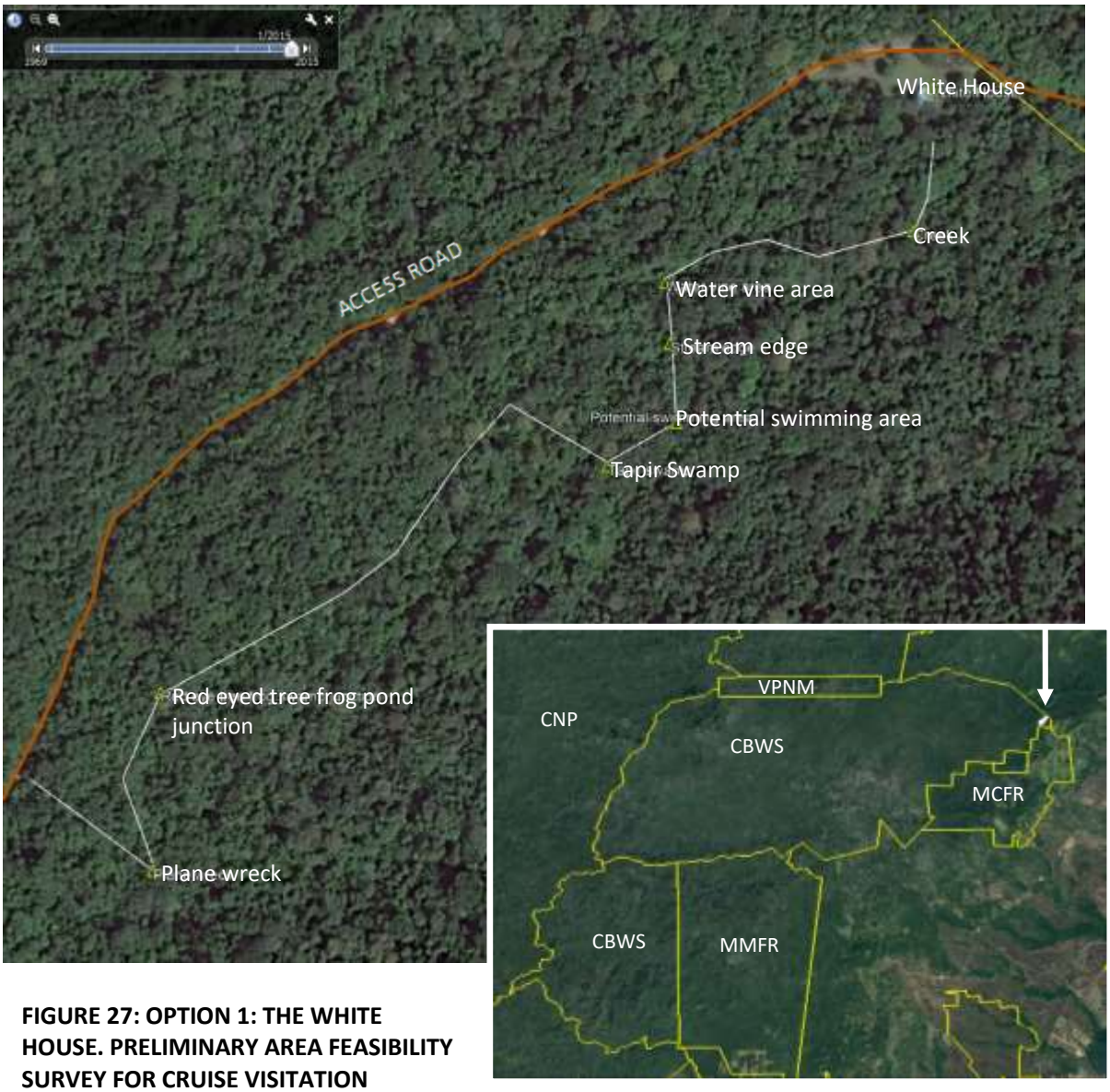


FIGURE 27: OPTION 1: THE WHITE HOUSE. PRELIMINARY AREA FEASIBILITY SURVEY FOR CRUISE VISITATION

3.3 MANAGEMENT PROGRAMS AND OBJECTIVES

Management Programmes are a means of grouping management objectives within related areas – for example, those related to natural resource management, or to environmental education. The strength of the combined programmes is greater than the sum of the individual Programmes, as each supports the others over space and time, with areas of overlap that strengthen the overall management of the protected area. The inclusion of strategies to strengthen communication and collaboration between Program areas is also important, with inter-Program collaboration mechanisms for greater adaptive management effectiveness.

Six Management Programmes are identified to provide the framework for management of the marine protected area (Table 43):

A. **Natural Resource Management and Protection**
B. **Research and Monitoring**
C. **Community Development and Outreach**
D. **Tourism and Recreation**
E. **Management and Administration**
F. **Facility Operations and Maintenance**

The plan identifies intervention strategies for improving conservation target viability and mitigation of threats identified during the planning process – strategies that are incorporated into the management programmes, and into the measures of success programme for effective management. As well as site-specific strategies, the strategies defined during the conservation planning process for the Maya Mountains Massif (of which CBWS is a component), whilst outdated, are also taken into account, contributing towards landscape management.

Programme Areas					
NATURAL RESOURCE MANAGEMENT AND PROTECTION	**RESEARCH AND MONITORING**	**COMMUNITY DEVELOPMENT AND OUTREACH**	**TOURISM MANAGEMENT**	**MANAGEMENT AND ADMINISTRATION**	**INFRASTRUCTURE, EQUIPMENT AND MAINTENANCE**
▪ *Surveillance and Enforcement* ▪ *Zoning and Boundaries* ▪ *Conservation Target Management* ▪ *Addressing Specific Threats*	▪ *Biodiversity Monitoring* ▪ *Biodiversity Research* ▪ *Dissemination of results*	▪ *Environmental Education* ▪ *Stakeholder Outreach and Engagement* ▪ *Resilient Livelihoods*	▪ *Visitor Management* ▪ *Visitor Safety and Protection* ▪ *Visitor Education and Interpretation*	▪ *Planning* ▪ *General Management and Administration* ▪ *Financial Management* ▪ *Communication / Collaboration*	▪ *Operational Infrastructure* ▪ *Equipment* ▪ *Visitor Infrastructure* ▪ *Vehicle and Equipment Maintenance*

TABLE 43: MANAGEMENT PROGRAMMES OF COCKSCOMB BASIN WILDLIFE SANCTUARY

3.5.1 NATURAL RESOURCE MANAGEMENT AND PROTECTION PROGRAMME

The Resource Management and Protection Program focuses on ensuring the maintenance of healthy, functional ecosystems, through direct management of the environment, surveillance and enforcement and direct biodiversity management interventions. This Programme falls under the responsibility of the site manager. Four sub-programmes have been identified under this program.

NATURAL RESOURCE MANAGEMENT AND PROTECTION
Maintaining the integrity of species, ecosystems and ecosystem services
NRM 1: Surveillance and Enforcement **NRM 2:** Boundaries and Zones **NRM 3:** Management of Conservation Targets **NRM 4:** Addressing Specific Threats

Over the last ten years, the Resource Protection Program has been strengthened in several ways:

- Use of SMART technology (Spatial Monitoring and Reporting Tool), allowing patrol staff and managers to plan and implement intelligence-based patrols through collection and analysis of georeferenced data to assist in identification of hotspots and peak times for illegal activities, for more strategic surveillance and enforcement.
- Partnering with the Police Force and Belize Defense Force, providing security for the patrol team of CBWS and increasing respect for the patrol team.
- Staff training for fire management
- Improving awareness in the communities of the role of CBWS rangers and the reasons behind surveillance and enforcement activities

The **Surveillance and Enforcement** sub-program for CBWS is focused on maintaining the integrity of the protected area and its biodiversity primarily through effective surveillance and enforcement, and tourism management. Priority strategies for 2019 – 2023 include:

- Ensuring CBWS has the human resources, equipment and training for effective surveillance and enforcement
- Strengthening collaborative enforcement with enforcement agencies (Police Department, BDF)
- Ensuring the safety of BAS rangers in the field
- Strengthening enforcement of tourism regulations through collaboration with BTB and tourism police
- Strengthening partnerships with tour guides
- Strengthening partnerships with adjacent landowners
- Building capacity for navigation, GPS use, successful prosecution

Revision of **Zoning and Boundaries** is an important strategy, providing tourism opportunities continues to be an important function of the protected area. Priority strategies include:

- Revision of the management zones as part of the Public Use Planning
- Realignment of the boundaries to include Ben's Bluff and Tiger Fern

The **Habitat and Species Management** sub-program include strategies highlighted under the Conservation Planning section and addresses threats to the viability of biodiversity within the protected areas. Priority strategies for for 2019 – 2023 include:

- Continue building capacity in BAS and in the wider CBWS landscape for effective fire management
- Strengthen management actions and strategies to address the future impacts of climate change and build resilience, based on the Climate Change Adaptation outputs
- Develop in-house and collaborative strategies with other organizations with similar agendas for:
    - maintenance of forest cover in the coastal plain
    - addressing threats from land-based pollution
    - strengthening coordinated assistance to communities towards improved natural resource stewardship

NATURAL RESOURCE MANAGEMENT PROGRAM

NRM 1: EFFECTIVE SURVEILLANCE AND ENFORCEMENT

- ☐ Ensure CBWS has the human resources for effective surveillance and enforcement
- ☐ Ensure CBWS rangers have the communication, equipment support and back up for their safety in the field
- ☐ Ensure surveillance activities are strategic and effective, based on BAS enforcement data, incidence mapping and identification of hotspots, intelligence information and integration of SMART technology
- ☐ Expand surveillance and enforcement activities and resources to key boundary areas and new / potential hotspots e.g. Roseville
- ☐ Maintain and strengthen collaborative partnerships with Forest Department, BDF and Police Department towards effective surveillance and enforcement within CBWS
- ☐ Investigate potential for assistance from Fisheries Department (Inland Waters) for increasing armed patrols in illegal fishing hotspots
- ☐ Partner / form strategic alliances with landowners of adjacent properties for maintenance of forest cover and collaborative surveillance and enforcement
- ☐ Maintain and strengthen engagement and communication with communities, with particular focus on known hunters
- ☐ Ensure Roseville is aware of CBWS boundaries and regulations
- ☐ Implement effective enforcement of visitor regulations in CBWS / VPNM, in collaboration with BTB (e.g. tour guide-guest ratios, licenses) and enforcement of BAS regulations (e.g. life jackets for river tubing, need for guides in Zone 3)
- ☐ Increase night patrols in key areas with improved capacity through use of night vision equipment
- ☐ Improve security at the Headquarters and White House
- ☐ Increase surveillance and enforcement at rivers during times of peak fishing incursions
- ☐ Integrate surveillance and enforcement requirements for conservation strategies – e.g. surveillance for fire
- ☐ Strengthen surveillance and enforcement of research regulations within the PAs, in collaboration with the Forest Dept.
- ☐ Install a gate house and gate at the entrance to the protected area to improve monitoring of visitors and fee collection

NRM 2: BOUNDARIES AND ZONES

NRM 2.1: BOUNDARIES

- ☐ Demarcation of boundaries in key areas, with adequate signage to ensure visual recognition of boundaries at all key points
- ☐ Address the boundary situation for the waterfalls and viewpoints (Tiger Fern and Ben's Bluff)
- ☐ Collaborate with the Lands Information Centre to update the shapefiles for CBWS in the National Protected Areas System dataset
- ☐ Ensure all visitors to CBWS are aware of regulations and guidelines through effective signage and introductory briefing
- ☐ Ensure all staff, enforcement partners, community and tourism stakeholders are aware of boundaries CBWS / VPNM boundaries and regulations

NATURAL RESOURCE MANAGEMENT PROGRAM

NRM 2: BOUNDARIES AND ZONES

NRM 2.2: MANAGEMENT ZONES

- ☐ Revise Management Zones following the CBWS Public Use Plan and demarcate in key areas, with clearer signage with relevant rules and regulations
- ☐ Establish a second Zone 1 (Zone 1 (2)) at the White House, extending into the adjacent forest, to accommodate facilities for cruise tourism visitation.
- ☐ Ensure all tour guides and staff are aware of the locations and regulations for each zone, and the underlying concerns and reasons
- ☐ Engage tour guides in the implementation of zone regulations

NRM 3: MANAGEMENT OF CONSERVATION TARGETS

NRM 3.1 TROPICAL FOREST

- ☐ Collaborate with adjacent landowners for maintenance of a forested buffer
- ☐ Engage communities and build their understanding and capacity for improving sustainable use of their natural resources
- ☐ Improve awareness in communities of the CBWS wider landscape of the role of tropical forest in ensuring water security
- ☐ Identify and implement mechanisms to assist those communities closest to CBWS to retain forested areas potentially through capacity building for tourism initiatives / agroforestry
- ☐ Improve understanding of large scale farmers of the role of Southern Coastal Plain broadleaf forest in maintaining water security
- ☐ Map and track annual deforestation / land use change in the landscape

NRM 3.2 PINE FOREST

- ☐ Continue to strengthen capacity of CBWS rangers for fire management through training and equipment
- ☐ Continue to improve fire management in the wider landscape, with strengthened engagement and capacity building of communities and adjacent landowners, with prescribed burns every 3 to 4 years
- ☐ Continue to partner / form strategic alliances with other NGOs in the landscape towards effective fire monitoring and management
- ☐ Investigate the cost-benefit of maintaining the Cabbage Haul road as a fire break / fire management access road
- ☐ Ensure adequate signage to inform visitors of fires risks in key locations (e.g. Ben's Bluff and Tiger Fern lookout, Elfin forest (Outlier and Victoria Peak)

NRM 3.3 UPPER ELEVATION ECOSYSTEMS

- ☐ Ensure all individuals / groups accessing upper elevation ecosystems (Outlier / Victoria Peak) are accompanied by a tour guide and assistant tour guide trained in minimizing impacts in elfin forest areas
- ☐ Ensure visitors do not remove upper elevation orchids or other plant species from the elfin forest areas
- ☐ Ensure adequate signage to inform visitors of fires risks in key locations (e.g. Ben's Bluff and Tiger Fern lookout, Elfin forest (Outlier and Victoria Peak)

NATURAL RESOURCE MANAGEMENT PROGRAM

NRM 3: MANAGEMENT OF CONSERVATION TARGETS

NRM 3.4 FRESHWATER

- ☐ Ensure tour guides minimise the use of sun screen and insect repellent by their groups in the river and waterfall pools
- ☐ Effective surveillance and enforcement against illegal fishing (See surveillance and enforcement strategies)

NRM 3.5 GAME SPECIES

- ☐ Effective surveillance and enforcement against illegal hunting (See surveillance and enforcement strategies)

NRM 3.6 CHARISMATIC SPECIES

- ☐ Engage stakeholder communities in protection of charismatic species beyond the boundaries of CBWS – e.g. activities addressing jaguar conflicts, conflicts impacting scarlet macaw feeding areas adjacent to Red Bank, addressing wildlife crime generally (illegal wildlife trade in pets and animal parts)

NRM 3.7 CULTURAL VALUES

- ☐ Effective tourism management to ensure CBWS retains its wilderness values, opportunities for solitude and maximizes opportunities for seeing wildlife
- ☐ Effective fire management to ensure visual impacts on forest are minimized where possible
- ☐ Effective solid waste management

NRM 4: ADDRESSING CONSERVATION THREATS

- ☐ Continue building capacity in BAS and in the wider CBWS landscape for effective fire management
- ☐ Ensure CBWS has fire-fighting equipment on site and accessible
- ☐ Provide opportunities for farmers to participate in training for improved fire management practices
- ☐ Partner with landowners and other NGOs in the landscape to ensure effective fire monitoring and communication
- ☐ Engage farmers in best practices for agrochemical use in the CBWS Wider landscape
- ☐ Build capacity of BAS for addressing the issue of pesticide use and pesticide drift
- ☐ Partner with PCB to improve information availability on pesticides and pesticide use best practices for farmers through workshops / meetings
- ☐ Support community projects that reduce pesticide use (e.g. organic farming)
- ☐ Strengthen management actions and strategies to address the future impacts of climate change and build resilience, based on the Climate Change Adaptation outputs
- ☐ Develop in-house and collaborative strategies with other organizations with similar agendas for:
    - maintenance of forest cover in the coastal plain
    - addressing threats from land-based pollution
    - strengthening coordinated assistance to communities towards improved natural resource stewardship
- ☐ Revise boundaries to protect key feature within CBWS (Tiger Fern and Ben's Bluff lookout points)

3.5.2 RESEARCH AND MONITORING PROGRAMME

RESEARCH AND MONITORING
Sound monitoring and research informing public perceptions and management decisions
RM1: Biodiversity Monitoring
RM2: Biodiversity Research
RM3: Limits of Acceptable Change Monitoring
RM4: Dissemination of results

Research and monitoring are essential activities to ensure informed, effective management, to inform public perceptions, and to assess the effectiveness of the protected areas in achieving its objectives. CBWS has long term monitoring data sets, and acts as a role model, with bird, jaguar and sample plot monitoring programmes in place that are now being implemented in other protected areas. Cockscomb also acts as an outdoor classroom for both local and international students and researchers.

The Research and Monitoring Programme falls under the responsibility of the Science Director, and provides data for national biodiversity monitoring, to inform and influence policy at the national level, and informing recommendations by the national working groups (jaguars and birds). There is accommodation on site for researchers, and staff are trained in monitoring in these two areas, but are stretched when trying to balance research activities with surveillance and enforcement and visitor management.

As well as conducting its own monitoring program, BAS also hosts independent researchers at CBWS - proposals are reviewed by the Forest Department, and if approved, a research license is granted. BAS is an integral part of this process, with proposals requiring a letter of support from the organization.

Key Strategic Goals

- Develop and institute a standardized biodiversity monitoring program and research guidelines for BAS staff and external researchers to ensure that researchers follow procedures and protocol to guide research and minimize disturbance in the protected areas
- Build structural and technical capacity for biodiversity research and monitoring to develop in-house biodiversity research and monitoring expertise/capacity, and ensure quality of data.
- Provide information towards addressing research priorities of the National Research Agenda

Priority strategies for 2019 – 2023

- Establish a dedicated research facility
- Continue and strengthen the research partnership with ERI
- Training in monitoring of Scarlet macaw and Yellow headed parrot
- Improved technical capacity and equipment for monitoring of visitor impacts – water quality, LOAC
- Improved technical capacity for monitoring for mammals / wildlife in general, with standardized data collection through SMART

RESEARCH AND MONITORING PROGRAM

RM1: BIODIVERSITY AND SOCIO ECONOMIC MONITORING

RM 1.1 BIODIVERSITY

- ☐ Ensure the BAS Research and Monitoring Program is equipped and staffed for effective program management and strategy implementation
- ☐ Maintain database of GIS data, research and monitoring information for use in enhancing the level of coordination between researchers, identifying information gaps, and providing a platform from which the results can be communicated to a wider audience
- ☐ Continue implementing an effective, standardized monitoring and data management program for the CBWS
- ☐ Ensure all staff (particularly rangers) understand the reasons behind research and monitoring and are engaged and supportive
- ☐ Ensure all staff are aware of, and can articulate, basic research and monitoring outputs (e.g. conch population increasing / decreasing)
- ☐ Continue developing indices of ecological integrity through use of bird monitoring
- ☐ Continue supporting jaguar monitoring at CBWS
- ☐ Continue supporting monitoring of forest sample plots at CBWS
- ☐ Monitoring of scarlet macaw and yellow headed parrot
- ☐ Standardise data collection through SMART for monitoring of key species
- ☐ Collection of meteorological data
- ☐ Conduct an ecosystem service evaluation for the protected area **RM1.2 THREATS**
- ☐ Water quality monitoring in high use sites (river, waterfall pools)
- ☐ Mapping of land use change / forest in the landscape, updated on an annual basis
- ☐ Develop a baseline for the level of pesticide contamination in water bodies of the Upper Elevation Ecosystems and in rivers inside and outside CBWS

RM1.3 SOCIO-ECONOMIC MONITORING

- ☐ Repeat the KAP survey
- ☐ Monitor tourism impact on the local economy
- ☐ Continue to monitor visitation

RM1.3 CAPACITY BUILDING FOR STAFF

- ☐ Training in use of SMART for biodiversity monitoring data collection
- ☐ Training in water quality monitoring
- ☐ Training in other biodiversity monitoring areas

RM2: RESEARCH

- ☐ Engage in identified research that informs public perceptions and management decisions
- ☐ Continue and strengthen the research partnership with ERI
- ☐ Establish a dedicated research facility
- ☐ Active recruitment of researchers to fill prioritized baseline, monitoring and research gaps
- ☐ Market research and educational research opportunities at CBWS
- ☐ Baseline surveys of aquatic invertebrate species, and identification of possible indicator species for water quality monitoring

RESEARCH AND MONITORING PROGRAM

RM3: LIMITS OF ACCEPTABLE CHANGE MONITORING

- ☐ Improve technical capacity and equipment for monitoring of visitor impacts
- ☐ Implement the PRUP Limits of Acceptable Change monitoring programme that provides data for informed management decisions

RM4: USE AND DISSEMINATION OF RESULTS

- ☐ Use available forums for dissemination of results (e.g. workshops, national and international conferences, school visits, community and tour guide meetings)
- ☐ Develop digital library of all published work on CBWS / VPNM and make available, where feasible, for download on line
- ☐ Ensure results of monitoring and research outputs are available to staff at CBWS and other BAS Program Managers
- ☐ Provide CBWS data on national biodiversity indicators to the National Biodiversity Monitoring Programme
- ☐ Integrate science-based decision-making for adaptive management
- ☐ Ensure mechanisms are in place for easy access to monitoring data
- ☐ Effectively integrate monitoring and research results into the adaptive management process
- ☐ Ensure quarterly / annual data summaries / reports
- ☐ Continue building capacity of rangers for participation in monitoring activities
- ☐ Provide internship opportunities for UB students, assisting with baseline data development and biodiversity monitoring

3.5.3 COMMUNITY DEVELOPMENT AND OUTREACH PROGRAMME

COMMUNITY DEVELOPMENT AND OUTREACH
Improved local support for conservation / environmental stewardship in local communities and stakeholders
CDO 1: Environmental Education
CDO 2: Stakeholder Outreach and Engagement
CDO 4: Resilient Livelihoods

BAS firmly believes that "education is at the heart of environmentally sustainable development" (BAS Strategic Plan, 2014), and that building awareness and understanding of the environment and the benefits communities receive from it will encourage better environmental stewardship. The BAS Environmental Education and Awareness Programme is focused primarily on the following areas:

- Environmental Education
- Stakeholder Outreach Engagement
- Strengthening Livelihoods

Key Strategic Goals

- Inform the general public of the ecosystem services, community benefits and biodiversity protection provided by protected areas
- Encourage the involvement of local communities in the management of Cockscomb
- Build capacity among community members, enabling them to actively participate in protected areas management
- Strengthen livelihoods associated with the protected area

Implementation of BAS's environmental strategy and the management of Environmental Education activities are centralized within the Belize City office and reaches out to communities buffering all BAS protected areas. For Cockscomb Basin Wildlife Sanctuary, the emphasis is on Environmental Education and the implementation of Nature School activities. In 2016, CBWS hosted 25 school groups with up to 180 students per group, giving hands-on experiences of nature, teaching environmental stewardship skills, and fostering problem solving and critical thinking skills. It also supports the national curriculum standards. BAS has invested significantly in reaching out to its CBWS stakeholder communities. A KAP survey of people from five stakeholder communities (Maya Center, Maya Mopan, Red Bank, Santa Rosa and San Roman) demonstrated that outreach is influencing attitudes, with a strong concern in communities about the destruction of forests and extraction of wildlife, a significant level of recognition of the protected area (71.7%), and of BAS, as the co-management organization (70%).

Priority strategies for 2019 – 2023

- Build the capacity of the staff to participate in outreach and education activities
- Continue engaging stakeholder communities
- Continue implementing the BAS Nature School programme at CBWS
- Continue inspiring students through BAS CBWS Summer Camps
- Maintain engagement of students in the stakeholder communities through the junior bird clubs

COMMUNITY DEVELOPMENT AND OUTREACH PROGRAMME

CDO 1: ENVIRONMENTAL EDUCATION

CDO 1.1: SCHOOLS

- ☐ Continue strengthening the Nature School program in CBWS for visiting school groups
- ☐ Ensure adequate facilities, equipment and human resources are available for effective management of Nature School activities at CBWS
- ☐ Ensure adequate equipment (binoculars, bird books etc.) and replacement of supplies (pens, paint brushes, paints, crayon, glue, paper etc.) for education in the schools
- ☐ Strengthen engagement of stakeholder schools though increased teacher engagement
- ☐ Engage teachers and increase capacity to teach basic environmental services concepts, biodiversity value, conservation, and climate change
- ☐ Increase engagement of students through regular presentations in schools, site visits to CBWS, open days and opportunities to participate in management activities
- ☐ Participate in school / community days with activities designed to engage community members
- ☐ Continue partnering with other local organizations working in the CBWS communities for cost-effective delivery of education and outreach programs and activities to schools
- ☐ Continue to encourage youth participation in conservation through bird clubs
- ☐ Build capacity of staff to be able to implement school visits supported by equipment and materials for implementing interpretive experiences
- ☐ Improve information and displays in Visitor Centre to provide learning opportunities for students, aligned with the curriculum

CDO 2: STAKEHOLDER OUTREACH AND ENGAGEMENT

CDO 2.1 COMMUNITIES

- ☐ Strengthen mechanisms for ongoing, open communication with community leaders
- ☐ Provide community leaders with a guided day of activities in CBWS to show them why people visit CBWS
- ☐ Identify ways in which community leaders and their communities can be more engaged and involved in tourism and management activities at CBWS.
- ☐ Increase community awareness of basic environment services concepts, biodiversity values of CBWS, climate change and building climate change resilience in the landscape
- ☐ Continue to build capacity of communities for good stewardship of biodiversity
- ☐ Increase opportunities and incentives for community visitation to Cockscomb – family days / guided walks / family activities
- ☐ Continue providing support to the Maya Center Women's Cooperative
- ☐ Produce relevant posters and videos that highlight CBWS / VPNM and their socio-economic benefits, for presentation in CBWS communities
- ☐ Provide opportunities for increasing community knowledge of climate change and building climate change resilience in the landscape
- ☐ Engage developing community groups and provide opportunities for active participation in protected area activities
- ☐ Participate in Forest Department activities for increasing awareness of wildlife and wildlife legislation in the communities

COMMUNITY DEVELOPMENT AND OUTREACH PROGRAMME

CDO 2: STAKEHOLDER OUTREACH AND ENGAGEMENT

CDO 2.2 TOURISM SECTOR

- ☐ Strengthen engagement of tour guides, tour operators and resorts through improved communication, trainings and workshops
- ☐ Provide opportunities for increasing tour guide knowledge of basic environment services concepts, biodiversity values of CBWS, climate change and building climate change resilience in the landscape
- ☐ Continue to build capacity of tour guides for good environmental stewardship
- ☐ Ensure tour guide participation in decisions relating to implementation of zonation and LoAC
- ☐ Create an environment of greater ownership and stewardship of CBWS by tour guides - encouraging them to introduce their families to CBWS through an incentives package – e.g. overnight accommodation and food, or covering transport costs
- ☐ Identify mechanisms that can facilitate active guide participation in CBWS activities (e.g. river clean-ups)
- ☐ Investigate potential for provision of structured community service opportunities for local students and High School students from schools in the area
- ☐ Engage land owners and farmers in the CBWS landscape in improved agricultural practices with reduced pesticide use and maintenance of forest cover, linked to water security

CDO 3: INCOME DIVERSIFICATION

CDO 3.1 PLANNING AND PARTNERSHIPS

- ☐ Develop an Income Diversification Strategy that reduces pressure on CBWS (e.g. agro-forestry, reduced dependence on agro-chemicals)
- ☐ Assess communities for primary development needs, including needs for strengthening resilience for predicted climate change impacts, and identify those priority areas where BAS can provide support, or facilitate support through partnerships
- ☐ Establish strong, consistent partnerships with identified target groups and individuals, with clear understanding of their vision and goals, and dialogue on synergies and potential investment opportunities
- ☐ Partner with Ya'axché Conservation Trust and other relevant community groups for building climate resilience in community agriculture in the landscape

CDO 3.2 CAPACITY BUILDING

- ☐ Provide capacity building opportunities for communities in areas such as best practices, governance, marketing, financial management, organizational management, First Aid / CPR
- ☐ Identify and support exchange visits and capacity building sessions for potential participants to increase knowledge/ understanding and success rate of income diversification projects, with follow-on investment to implement lessons learnt
- ☐ Build capacity for climate resilient communities and addressing natural disasters

3.5.4 TOURISM MANAGEMENT PROGRAMME

TOURISM MANAGEMENT PROGRAMME
CBWS provides a visitor destination that is appreciated and valued by the tourism sector and visitors
TMP 1: Visitor Management **TMP 2:** Visitor Safety and Protection **TMP 2:** Visitor Education and Interpretation

Tourism management is a key activity of the site-level staff at Cockscomb, which is considered one of the best tropical forest tourism destinations in the country. The Tourism and Recreation Programme encompasses three primary activity areas: Visitor Management, Visitor Safety and Protection, and Interpretation and Education.

Five objectives were identified during the public use planning:

Objective 1: CBWS provides a visitor destination that is appreciated and valued by the tourism sector and visitors for its wildlife and wilderness

- By 2023, CBWS has the infrastructure to effectively support internationally-respected tourism that maintains its wilderness values
- Between 2019 and 2023, CBWS maintains its visitor safety record through pro-active accident prevention
- Between 2019 and 2023, CBWS maintains its environmental sustainability through effective planning of tourism activities
- By 2023, BAS has improved the financial sustainability of CBWS by at least 20% from the 2017 baseline of Bz$316,355

Objective 2: Improved local support for conservation / environmental stewardship in local communities and stakeholders

- By 2023, 75% or more of the local tour guides using Cockscomb support the vision and objectives of the protected area (50% at the moment)
- By 2023, 90% or more of the local tour guides using Cockscomb are active partners in maintaining the values of the protected area

Objective 3: Sound research informing public perceptions and management decisions

- By 2023, BAS is implementing a PRUP limits of acceptable change monitoring programme that provides data for informed management decisions
- By 2023, BAS is effectively communicating information on the status of the resources and environmental services to its tourism stakeholders

Objective 4: Contribution towards the environmental services provided by conservation areas – clean air, clean water, socio-economic benefit and climate change amelioration

- By 2023, BAS has assessed the financial value of Cockscomb tourism and contribution to the local economy
- By 2023, less than 3-4% of the environmental services of Cockscomb have been affected by tourism impacts

Objective 5: Provision of a resource that is valued by visitors

- By 2023, 90% or more of the tour guides using Cockscomb are active partners, ensuring Cockscomb provides high visitor satisfaction
- By 2023, 90% or more of visitors to Cockscomb consider the protected area meets their expectations

A number of key recommendations have been identified during the public use planning process that would improve visitor management:

- Realignment of Visitor Management Zones to better reflect current use
- Seek a co-management agreement for a portion of Mango Creek Forest Reserve 1 to secure the protection of two key, well established tourism sites (Tiger Fern and Ben's Bluff scenic overlooks)
- Improve visitor monitoring and financial sustainability through the establishment of a manned gate at the White House
- In recognition that cruise ship tourism has the potential to significantly impact the very values for which Cockscomb has been established, ensure the predicted increase in cruise ship tourism is carefully managed to avoid conflict with the values of Cockscomb Basin Wildlife Sanctuary whilst still providing improved financial sustainability for the area.
- Explore options for establishing cruise-ship dedicated trails and activities outside of the current scope of tourism activities, adjacent to the White House.
- To address safety concerns, with requirement for a guide for all activities beyond Zone 2 – including Victoria Peak, Outlier and mountain biking to 12 km.

TOURISM MANAGEMENT PROGRAMME

TMP 1: VISITOR MANAGEMENT

- ☐ Continue to provide orientation talk to visitors on arrival at CBWS to ensure awareness of regulations and update on any safety warnings
- ☐ Continued maintenance of trails to acceptable LoAC / safety standards
- ☐ Ensure that all guides only use designated camp sites for overnight camping
- ☐ Ensure adequate communication on fire risks are provided at the Headquarters for Tiger Fern, Ben's Bluff viewpoints and Victoria Peak
- ☐ All site-certified guides should be trained in minimizing impacts in the upper elevation elfin forest
- ☐ Tiger Fern: Investigate potential for relocating the lookout point to more intact forested vegetation
- ☐ Antelope Trail: Improve directional signage
- ☐ 12 km: Investigate potential for developing a parallel trail for hiking to minimize visual and noise impacts of ATVs and mountain bikes
- ☐ 12 km: Investigate alternate trail for mountain bikes
- ☐ Outlier: Clear trail definition in elfin forest to prevent climbers from leaving trail

TMP 2: VISITOR SAFETY AND PROTECTION

TMP 2.1: TOUR GUIDE BEST PRACTICES

- ☐ Ensure all tour guides guiding in CBWS have valid licenses when arriving in CBWS (license number written down at the White House gate)
- ☐ Improve communication for emergency procedures

TMP 2.2: RIVER TUBING

- ☐ Review safety policies for river tubing – number of guests, age, night tubing etc.
- ☐ Strengthen decision making process for when conditions are unsafe for tubing, and mechanism for transferring this information to visitors
- ☐ Installation of a standardized green, yellow and red water level to be used to indicate safe and dangerous river levels, backed by written protocol and regulations as to when the river is closed to tubing groups
- ☐ Ensure that all BAS tubes meet professional grade / quality standards
- ☐ Ensure that all people doing river tubing are required to wear life jackets
- ☐ Improved signage in the river to indicate river tubing route and exit
- ☐ Ensure adequate maintenance of river entry point

TMP 2.3: ZONE 2

- ☐ Continued maintenance of trails following Limits of Acceptable Change guidelines
- ☐ Tiger Fern: Improve steps from top of cliff down to first waterfall
- ☐ Tiger Fern: Improve signage warning of slippery rocks at base of lower waterfall
- ☐ Tiger Fern: Investigate potential for making entry to the swimming pool easier for more elderly visitors, reducing risk of falls
- ☐ Ben's Bluff: Provide a safe, natural-looking stream crossing

TOURISM MANAGEMENT PROGRAMME

TMP 2: VISITOR SAFETY AND PROTECTION

TMP 2.3: ZONE 2

- ☐ Ben's Bluff: Increase trail safety above the waterfall, and between the waterfall and the view point
- ☐ Antelope Trail: Maintain bridges at the two river crossings
- ☐ Antelope Trail: Install more benches at scenic points
- ☐ Antelope Trail: Improve the crossing at the junction with Gibnut

TMP 2.4: ZONE 3: VICTORIA PEAK / OUTLIER

- ☐ Conduct an annual safety assessment for the Victoria Peak and Outlier climbs, and replace infrastructure where required before the trail is opened
- ☐ Set standards for certification and ensure that all guides for Victoria Peak and Outlier are certified for guiding these two peaks
- ☐ Conduct training workshops for site-specific guide certification for Victoria Peak and Outlier
- ☐ Signage at start of Zone 3 on requirement for all individuals / groups to have a site-certified guide and assistant / apprentice guide
- ☐ Ensure that each group attempting Victoria Peak / Outlier has a guide and assistant licensed guide regardless of group size
- ☐ Ensure all guides submit an emergency plan for climbing Victoria Peak (workshop with guides to develop emergency plans)
- ☐ Maintain current opening times for Victoria Peak
- ☐ Impose maximum group size regulations for both Victoria Peak and Outlier of ten (inclusive of guides), and requirement for a site-certified guide and a second assistant or apprentice guide
- ☐ Develop specific safety-based regulations for Outlier
- ☐ Require a certified and assistant / apprentice guides for Outlier
- ☐ Victoria Peak: Maintain anchor points and ropes in identified high risk areas
- ☐ Victoria Peak: Install stepping stones or similar for crossing river
- ☐ Outlier: Improve trail width - it is considered too narrow in some areas
- ☐ Outlier: Install anchor points and ropes in identified high risk areas and ensure that guides carry ropes
- ☐ Outlier: Signage at last stream to highlight that this is last access to drinking water
- ☐ Outlier: Ensure people are prepared for level of fitness required

TMP 2.5: ZONE 3: JUAN BRANCH

- ☐ Restrict access to research / expedition groups and staff
- ☐ Require all individuals / groups to have a site-certified guide with knowledge of CBWS and research regulations
- ☐ Ensure all groups have back-up communication and safety equipment
- ☐ Provide training for Maya Mopan in research assistant support for research expeditions
- ☐ Encourage or require research groups to include a research assistant in their group engaged from Maya Mopan
- ☐ Maintain trail access for ATV

TMP 3: VISITOR EDUCATION AND INTERPRETATION
☐ Review and update information in Visitor's Centre Review and revise information and signage on Green Knowledge Trail ☐ Review and revise self-guided leaflet for Green Knowledge Trail ☐ Maintain signs and information for Royal Flycatcher Trail ☐ Engage visitors in reporting biodiversity - maintain wildlife sightings book ☐ Identify the target audiences and key messages, and develop engaging interpretive displays that address these ☐ Produce posters that highlight CBWS, for distribution in local communities, schools and to local families ☐ Produce leaflets and posters that highlight St. Herman's Blue Hole National Park, for distribution in other tourism destinations

3.5.5 MANAGEMENT AND ADMINISTRATION

MANAGEMENT AND ADMINISTRATION
Effective management and administration of CBWS
MAP 1: Planning **MAP 2:** General Management and Administration **MAP 3:** Financial Management **MAP 4:** Communication and Collaboration

The Management and Administration programme is focused on ensuring that the necessary administration structure is in place for the support of management activities for CBWS and associated programme activities. Organizational, financial and human resource administration is centralized at the Belize Audubon Society office in Belize City. Park-specific administration is also managed from here, as part of the Protected Areas portfolio, though with frequent visits to the site by the protected area manager.

Belize Audubon Society has a number of standard policies in place to assist in effective management, contained within the BAS Policy and Operations Manual. This includes well defined policies in the areas of transport, health and safety, community relations and advocacy, and also provides guidance on incident management and standard operating procedures.

Site-level administration, the majority of fee collection activities and management of field staff is based from the office at Cockscomb Basin Wildlife Sanctuary itself.

As part of its ongoing strategic goals for 2014 – 2019, BAS is seeking to improve financial sustainability and increase general awareness of and support for BAS's work.

MANAGEMENT AND ADMINISTRTATION PROGRAMME

MAP 1: PLANNING

MAP 1.1 OPERATIONAL AND STRATEGIC PLANNING

- ☐ Develop Annual Workplan and budget each October, based on the management plan and previous work plan measures of success recommendations, and submit each November
- ☐ Finalize and implement Public Use Plan, and review and revise every 2 years
- ☐ Develop / update community communication and engagement strategy for effective engagement of CBWS communities

MPA 1.2: EMERGENCY PLANNING

- ☐ Assess liability issues at CBWS on an annual basis and integrate risk reduction, where feasible, into the annual workplan
- ☐ Ensure all staff have basic first aid training
- ☐ Ensure upkeep of all emergency and safety equipment
- ☐ Develop / update hurricane plan for CBWS, when necessary
- ☐ Ensure that all staff are aware of hurricane procedures before start of each hurricane season

MPA 1.3: MONITORING AND EVALUATION

Conduct rapid annual management effectiveness assessment and submit to PA administration authority

- ☐ Conduct monitoring and evaluation assessment of CBWS Management Plan at mid-point (2.5 years) and adapt where necessary
- ☐ Evaluation of Operations Plan outputs at the end of each year

MPA 1.4: REPORTING

- ☐ Keep daily log of activities for CBWS, and prepare monthly report on enforcement activities, general situation report.
- ☐ Prepare site-level annual report as part of BAS protected areas reporting framework

MAP 2: GENERAL ADMINISTRATION AND MANAGEMENT

MAP 2.1 HUMAN RESOURCES

- ☐ Ensure there are sufficient staff for effective visitor and natural resource management and monitoring – at least critical, but preferably optimal level
- ☐ Ensure adequate communication and two-way flow of information between CBWS and BAS in Belize City
- ☐ Develop formal Orientation Package for all permanent staff, specific to CBWS
- ☐ Develop and implement site level Human Resource Development plan to maximize on present staff abilities, identifying key trainings (e.g. Hospitality training, Green Laws training, presentation skills etc.)
- ☐ Build capacity of staff to understand the role CBWS plays in the landscape and NPAS
- ☐ Ensure that relevant staff are trained in simple accounting procedures, and use of computer
- ☐ Staff training in conducting visitor surveys and biodiversity monitoring
- ☐ Provide a structured framework of activities for involvement of volunteers

MANAGEMENT AND ADMINISTRATION PROGRAMME

MAP 3: FINANCIAL MANAGEMENT

MAP 3.1: FINANCIAL MANAGEMENT

- ☐ Prepare timely financial and management accounts and submit monthly
- ☐ Prepare, as necessary, project budgets and financial reports
- ☐ Prepare quarterly report on use of annual budget, for submission to Executive Director and funding agencies
- ☐ Prepare annual accounts and summary for Annual Report and auditing requirements
- ☐ Continue maintaining accurate staff payment records

MAP 3.2: FINANCIAL SUSTAINABILITY

- ☐ Conduct a financial review / cost-benefit analysis of past program activities and outcomes to identify cost-effective, high-impact activities and inform future strategies and activities
- ☐ Develop and implement financial plan for CBWS for the next five years to set course for economic sustainability
- ☐ Improve signage at Maya Centre to ensure more visitors stop to pay entrance fee here
- ☐ Continue ticket system in Maya Centre that is easy for the women's group to use and for CBWS staff to check
- ☐ Install a gate house and gate at the entrance to the protected area to improve monitoring of visitors and fee collection
- ☐ Upgrade tubing equipment (tubes, life jackets etc.) to professional quality and make available for rent for Bz$10 per person (standardised with St. Herman's Blue Hole National Park), allowing for maintenance and repair of tubes
- ☐ Increase fees for river tubing to $15, with separate fees for use of the river and for hiring tubes - equipment would need to be upgraded to justify the increased fees, would need to ensure that there are sufficient inner tubes for demand – or use
- ☐ Market Outlier as an achievement, as something that can be charged a fee for
- ☐ The per person fee for climbing Victoria Peak should be increased to at least US$$50 for non-Belizeans to reduce pressure on the trail and upper elevation ecosystems
- ☐ Increase the ATV use fee to US$200 to prevent misuse of BAS equipment for non-injury situations (it is currently US$50)
- ☐ Value added…Investigate marketing of other local tourism venues in stakeholder communities - "chocolate outlet" in Maya Centre, Red Bank scarlet macaws as trips from CBWS
- ☐ Ensure key travel guides to Belize and Central America are provided with accurate, updated information
- ☐ Investigate options for financial sustainability through souvenir / snack sales linked to the establishment of a cruise visitor area
- ☐ Increase accommodation to support researchers and expeditions

MANAGEMENT AND ADMINISTRATION PROGRAMME

MAP 4: COMMUNICATION AND COLLABORATION

MAP 4.1 GENERAL

- ☐ Improve cross sectoral communication and collaborative partnerships through a structured Communication / Collaboration Plan targeting:
  - Forest Department
  - Belize Tourism Board
  - Partner organizations in the Maya Mountains Massif (e.g. Ya'axché Conservation Trust)
  - Stakeholder communities (leaders, community groups, women, teachers, youths)
  - Tour Operators / tour guides
  - Adjacent land owners / resort managers

3.5.6 INFRASTRUCTURE, EQUIPMENT AND MAINTENANCE PROGRAMME

INFRASTRUCTURE, EQUIPMENT AND MAINTENANCE

- Operational Infrastructure and Equipment
- Visitor Infrastructure
- Fleet Operations
- Maintenance

The Infrastructure, Equipment and Maintenance Programme covers activities such as future infrastructure and equipment, and maintenance of present infrastructure (buildings etc.).

The HQ site can currently accommodate a maximum of 47 visitors in rooms, with more at the campsite, and an additional 6 at the White House, by the entrance gate. Overnight visitors have access to bathroom facilities and a shared kitchen. Electricity is generated on-site by solar panels, and water is pumped from a well and stored in a header tank for supplying those buildings requiring water. The staff house can accommodate 4 staff members - whilst not all of the staff are resident, at least two are present each night.

ZONE 1

Overnight Accommodations

- Dorm building w/4 rooms (30 people)
- Rustic cabin w/3 rooms (7 people)
- Private cabin w/1 room (6 people)
- Mujan Naj (4 people)
- Staff house
- Camp Site

Outside Zone 1

- White House (6 people)
- Juan Branch

Support Facilities

- Main office/front desk
- Visitor Centre (~20 people)
- Dining Room and Kitchen (25 people)
- Toilet and shower blocks (x2)
- Conference facility

Visitor accommodation is basic, and in cabins, the bunkhouse or at the campsite.

A Visitor's Centre provides interpretation for visitors and school groups, and a Conference Room strengthens the ability of CBWS to be able to support national and international student groups engaged in project work. An original building from the logging camp once provided accommodation for researchers, but this has recently been demolished and needs to be replaced for continued support of research and facilitation of the use of CBWS by university groups.

A second Zone 1 is proposed by the White House / Entrance Gate, for the establishment of a cruise visitor facility, to maintain a visual and sound separation between these larger groups and the regular visitors seeking wilderness and solitude. The construction of an entrance gate and booth for improved visitor management and ticket sales / collection has also been recommended.

A CBWS Master Plan presents a concept for expansion within the current Zone 1 with the following goal and objectives (Laasner Architects ltd.):

GOAL [*SHORT TERM (1-2 years)*]: CBWS provides better functionality, visual appeal and improve overall visitor experience for the core user-groups, that is, day trippers, overnight visitors and student groups.

Specific Objectives:

1. To re-organize, retrofit and upgrade the 'Welcome Area' to create a more visually appealing, user-friendly, indoor-outdoor, plaza-like, educational, greeting area particularly for day visitors
2. To improve the quality and functionality of the amenities offered to overnight visitors in particular campers, student groups, budget travelers and small/family groups.

GOAL [MEDIUM TERM (3-6 years)]: CBWS enhances facilities to provide expanded capacity and services for student groups and researchers and over-night visitors.

Specific Objectives:

1. To build new facilities including
   - A self-contained dormitory with kitchen and bathroom facilities for student groups.
   - A two-story facility for researchers with living area (bedrooms, kitchen, and bathrooms), storage for equipment and specimens, meeting room, and possibly a laboratory.
   - Construction of two additional self-contained cabins with kitchenettes near Mujan Naj to increase the total to four (4)
   - Ensure that the new facilities meet all the standards for 'greening design and building' and fit into the overall ambiance of the site.

2. To improve staff facilities to accommodate for improved functionality and efficiency and increase staffing as new services are provided.
   - Build a new, self-contained staff house
   - New, concealed parking lot near the staff area for use by staff and researchers

INFRASTRUCTURE, EQUIPMENT AND MAINTENANCE PROGRAMME

IEMP 1: OPERATIONAL INFRASTRUCTURE

- ☐ Construct new Staff Building, as per the Master Plan for CBWS
- ☐ Install a gate house and gate at the entrance to the protected area to improve monitoring of visitors and fee collection
- ☐ Lobby for continued maintenance of the access road

IEMP 2: VISITOR INFRASTRUCTURE

- ☐ Upgrade main office / guest shop
- ☐ Upgrade bathrooms
- ☐ Re-design the Information Centre
- ☐ Expand the conference facility
- ☐ Construct student dormitory facility with kitchen and bathrooms
- ☐ Construct research facilities (bedrooms, bathroom, kitchen, lab / bench space, specimen / equipment storage space
- ☐ Establish a second Zone 1 at the White House, extending into the adjacent forest, to accommodate facilities for cruise tourism visitation.
- ☐ Increase accessibility for disabled visitors

IEMP 3: VEHICLES AND EQUIPMENT

- ☐ Ensure CBWS staff have the vehicles and equipment for effective site management of CBWS
- ☐ Ensure there is adequate storage available for CBWS equipment

IEMP 4: MAINTENANCE

- ☐ Schedule preventative maintenance and upkeep of all infrastructure and equipment
- ☐ Prioritise maintenance of utility infrastructure (solar panels, water pumps and communication)
- ☐ Employment of skilled casual labour to maintain infrastructure
- ☐ Build capacity of staff for care and basic maintenance of equipment and vehicles
- ☐ Renovate and upgrade accommodation as needed
- ☐ Maintain and replace bridges, benches and other trail infrastructure as needed
- ☐ Ensure trail safety infrastructure is adequately maintained (by river, waterfalls, Victoria Peak, Outlier)

3.4 TIMELINE, EVALUATION AND REVIEW

The Management Program forms the development of an implementation plan, to include present and desired status, responsible parties, a timeline based on the 5-year implementation period, and highlighting any limitations or context conditions that would need to be taken into consideration for successful implementation.

Monitoring and evaluation are integral components of any management system and annual evaluations of protected area management are recommended. In the development of this management plan, the action areas are relatively specific, simplifying the process of monitoring success of implementation, and providing a mechanism for continual tracking of management activities, through annual review by Belize Audubon Society.

The management plan should not be considered static, and the annual review should ensure that strategies and activities are still relevant for the changing socio-economic and climatic contexts. Some management strategies may become obsolete, whilst new management activities may need to be included.

3.4.1 MONITORING AND REVIEW

Monitoring and review of the management plan and the Annual Work Plans is essential in order to ensure that management is effective in achieving its objectives. This can be achieved through use of a 'measures of success' framework:

- measuring success in implementing the management actions
- measuring success of the conservation strategies in addressing threats and increasing target viability.

Two matrices have been developed to facilitate this process, forming the basis for the annual review of the management plan. Time should be taken to complete each one fully and as accurately as possible at the end of each year, to track using data from the monitoring program. If this is maintained on an annual basis, then this will greatly facilitate any management staff transition handover.

Included is an example of the suggested structure for the implementation Plan (Table 44) and both Measures of Success matrices (Table 45, 46 and 47). The key indicators have also been identified from the Conservation Planning section, and been integrated into an Indicator framework for measuring success (Table 48).

IMPEMENTATION PLAN EXAMPLE: RESOURCE PROTECTION PROGRAM								
MANAGEMENT ACTIVITY	**CURRENT STATUS**	**DESIRED STATUS**	**RESPONSIBILITY**	**YEAR**				
				1st	**2nd**	**3rd**	**4th**	**5th**
SURVEILLANCE AND ENFORCEMENT								
Ensure CBWS has the human resources for effective surveillance and enforcement	Have 5 park wardens, but role includes visitor management – not dedicated solely to surveillance and enforcement	Ranger team dedicated to surveillance and enforcement of CBWS	PA Director; CBWS Site Manager					
Ensure CBWS rangers have the communication, equipment support and back up for their safety in the field	Rangers are concerned for their safety during surveillance and enforcement	Rangers have adequate communication systems, capacity building for unarmed combat with emergency protocols in place	PA Director; CBWS Site					
Ensure surveillance activities are strategic and effective, based on BAS enforcement data, incidence mapping and identification of hotspots, intelligence information and integration of SMART technology	Rangers are trained for effective use of SMART for data collection and starting to integrate it into surveillance activities	SMART is being used effectively to collect surveillance data and used for intelligence-based surveillance and enforcement	PA Director; CBWS Manager					
Expand surveillance and enforcement activities and resources to key boundary areas and new / potential hotspots e.g. Roseville	Key traditional areas being covered by surveillance and enforcement, but new threat areas are hard to access	Effective surveillance and enforcement in all key areas	CBWS Manager					

TABLE 44: LAYOUT FOR IMPLEMENTATION PLAN FOR MANAGEMENT STRATEGIES AND ACTIVITIES

NATURAL RESOURCE MANAGEMENT PROGRAM - IMPLEMENTATION							
Measure of Success of Implementation							
N.B. It is important to note that the numerical values ascribed to the measures of success are not scores, but indicators of the stage of implementation	**1** No improvement on present status						
	2 Planning has started, but no implementation						
	3 Planning is completed, but no implementation						
	4 Implementation is started, but not yet completed						
	5 Implementation is completed or ongoing (continuous activities), activity has succeeded						
Management Activities	**Measure of Success**						**Comments:** Justification for Measure of Success score. Problems, concerns. Notes for inclusion in updated Management Plan
	Year						
Activity	**1**	**2**	**3**	**4**	**5**	**Desired Status**	
Surveillance and Enforcement							
Ensure CBWS has the human resources for effective surveillance and enforcement						Ranger team dedicated to surveillance and enforcement of CBWS	Have 5 park wardens, but role includes visitor management – not dedicated solely to surveillance and enforcement
Ensure CBWS rangers have the communication, equipment support and back up for their safety in the field						Rangers have adequate communication systems, capacity building for unarmed combat with emergency protocols in place	Rangers are concerned for their safety during surveillance and enforcement
Ensure surveillance activities are strategic and effective, based on BAS enforcement data, incidence mapping and identification of hotspots, intelligence information and integration of SMART technology						SMART is being used effectively to collect surveillance data and used for intelligence-based surveillance and enforcement	Rangers are trained for effective use of SMART for data collection and starting to integrate it into surveillance activities

TABLE 45: MATRIX FOR MEASURING IMPLEMENTATION SUCCESS OF MANAGEMENT STRATEGIES AND ACTIVITIES

NATURAL RESOURCE MANAGEMENT PROGRAM - OUTPUT							
Measure of Success - Status							
It is important to document clearly the status of each Activity whilst developing Annual Operation Plans, as this allows highlighting of areas that need prioritization							
Management Activities **Activity**	**Present Status (2018)**	**Status (2019)**	**Status (2020)**	**Status (2021)**	**Status (2022)**	**Status (2023)**	**Desired Status (Outputs)**
Surveillance and Enforcement							
Ensure CBWS has the human resources and equipment for effective surveillance and enforcement	Regular illegal incursions into CBWS along the rivers (*state level – number of incursions? Number of incidents? Number of known hunters / fishers entering CBWS?*)						Reduced illegal activity inside the protected area. (*reduced by what %)*
Strengthen intelligence-based enforcement, with input from the enforcement team and integration of analyzed SMART data							
Conduct daily patrols and surveillance to enforce rules and regulations of CBWS to prevent illegal activities							

TABLE 46: MATRIX FOR MEASURING OUTPUT SUCCESS OF MANAGEMENT STRATEGIES AND ACTIVITIES

NATURAL RESOURCE MANAGEMENT PROGRAM - OUTCOME							
Measure of Success - Status							
It is important to document clearly the status of each Activity whilst developing Annual Operation Plans, as this allows highlighting of areas that need prioritization							
Management Activities / **Activity**	**Present Status (2018)**	**Status (2019)**	**Status (2020)**	**Status (2021)**	**Status (2022)**	**Status (2023)**	**Desired Status (Outcome)**
Surveillance and Enforcement							
Ensure CBWS has the human resources and equipment for effective surveillance and enforcement	Current game species populations (GOOD)						Improved game species populations
Strengthen intelligence-based enforcement, with input from the enforcement team and integration of analyzed SMART data							
Conduct daily patrols and surveillance to enforce rules and regulations of CBWS to prevent illegal activities							

TABLE 47: MATRIX FOR MEASURING OUTCOME SUCCESS OF MANAGEMENT STRATEGIES AND ACTIVITIES

INDICATOR	FREQUENCY	CURRENT STATUS (END OF 2018)
BIODIVERSITY / THREAT INDICATORS		
BROADLEAF FOREST		
% of wider CBWS landscape under broadleaf forest cover	Annual	
% of boundary adjacent to CBWS that is managed for maintenance of forest cover	Annual	
Extent of forest cover protected by community initiatives	Every two years	
% of communities that implement initiatives to retain forest cover in the community landscape	Annual	
GAME SPECIES / HUNTING / FISHING		
Target game/ fish species abundance (camera traps)	Ongoing – analyse annually	
Abundance of wildlife in buffer areas (camera traps)	Ongoing – analyse annually	
% of patrols conducted with strategic partners	Annual	
% of rangers dedicated full time to surveillance and enforcement	Annual	
% of time spent by rangers on surveillance and enforcement	Annual	
Number of hunting / fishing incidences reported	Annual	
% of boundary adjacent to CBWS that is managed with collaborative surveillance and enforcement	Annual	
FIRE		
Area of CBWS impacted by non-prescriptive burn fires per year	Annual	
Area in the CBWS wider landscape impacted by non-prescriptive burn fires per year	Annual	
% of rangers that have the capacity for effective fire management	Annual	
Equipment availability for effective fire management	Annual	
FRESHWATER		
Annual rainfall patterns	Ongoing	
Presence of pesticides / pesticide breakdown products in photolytic water on Outlier / Victoria Peak	Every 5 years or as per research interest	
Level of understanding of farmers of the impacts of pesticides on biodiversity and the human health implications of pesticide drift	Every two years	

INDICATOR	FREQUENCY	CURRENT STATUS (END OF 2018)
BIODIVERSITY / THREAT INDICATORS		
FRESHWATER		
% of agricultural associations provided with information on the issues associated with pesticide use and pesticide drift	Every two years	
% of agricultural associations considered to be engaged in reducing pesticide use in the CBWS wider landscape	Every two years	
% farmers provided with information on the issues associated with pesticide use and pesticide drift	Every two years	
% of farmers considered to be engaged in reducing pesticide use in the CBWS wider landscape	Every two years	
COMMUNITY / SOCIO-ECONOMIC INDICATORS		
% of participants demonstrating increased understanding of the role of tropical forest in ensuring water security	Every three years (KAP)	
Level of community understanding of the role of Southern Plain broadleaf forest in maintaining water security	Every three years (KAP)	
Level of understanding of private landowners of large forest tracts of the role of Southern Plain broadleaf forest in maintaining water security	Every three years (KAP)	
Level of understanding of large scale farmers of the role of Southern Plain broadleaf forest in maintaining water security	Every three years (KAP)	
Number of community participants demonstrating an improved knowledge of CBWS boundaries, hunting / fishing and other regulations relevant to wildlife crime		
% of participants demonstrating increased understanding and capacity for improved sustainable use of their natural resources	Every three years (KAP)	
% of communities demonstrating initiatives that integrate good stewardship knowledge into action in the landscape	Every three years (KAP)	
Perception of and actual benefit in communities to maintaining forest areas	Every three years (KAP)	
% of known hunters / fishers per community known to enter CBWS	Annual	

INDICATOR	FREQUENCY	CURRENT STATUS (END OF 2018)
COMMUNITY / SOCIO-ECONOMIC INDICATORS		
Number of community participants demonstrating an improved knowledge of the issues of fire and actions for reducing fires in the community landscape	Every two years	
Number of community participants with the capacity to effectively participate in fire management	Every two years	
Number of farmers / landowners completing fire management training	Every two years	
Number of farmers / landowners active in fire monitoring network	Every two years	
Number of farmers / landowners completing fire management training	Every two years	
Number of farmers / landowners active in fire monitoring network	Every two years	
VISITOR INDICATORS		
Abundance of wildlife in tourism use areas pre- and post-regular cruise tourism visitation (camera trap data)	Ongoing – analyse annually	
Level of non-cruise tourism visitor satisfaction (TripAdvisor)	Annual	
% of tour guides following regulations / guidelines	Annual	
Number of tourism infractions reported	Annual	
Level of non-cruise visitor satisfaction (TripAdvisor)	Annual	
Level of cruise visitor satisfaction	Annual	

TABLE 48: INDICATOR FRAMEWORK

3.5 FINANCING

BAS faces ongoing challenges in securing the necessary finances to continue and further develop its management of the protected areas under its custodianship. As with most participants in the conservation process in Belize, BAS has developed the management of the protected areas under its mandate, its staff and as an institution, largely upon external grants and, more recently, with the re-investment of entrance fees. As the leading national environmental NGO, entrusted by the Government of Belize to manage some of the most prominent national protected areas, BAS has a good record of success in securing international funding to support its management of the parks.

FINANCIAL ASSESSMENT

This analysis uses income and expenditures in 2017 to provide a financial snapshot of the protected area.

Income: In 2017, the combined Cockscomb Basin Wildlife Sanctuary / Victoria Peak Natural Monument was able to generate approximately 68% the funds required for implementation of activities within the protected area. 31% of income was derived from entrance fees, with a further 39% generated by camping / accommodation fees. Gift shop sales, donations and miscellaneous income (Other) contributed approximately 0.8% towards total protected area income (Figure 28; BAS data, 2017).

The income from entrance fees and other direct sources is supplemented by grant support from a variety of sources. BAS is also able to access funds from international agencies for implementation of cross-cutting strategies through the BAS program areas - Research and Monitoring and Education and Awareness, with activities supported through inclusion of Cockscomb Basin Wildlife Sanctuary. Belize Audubon Society has been able to maintain loyal donor support, with consecutive grants from a number of international donor agencies over the years.

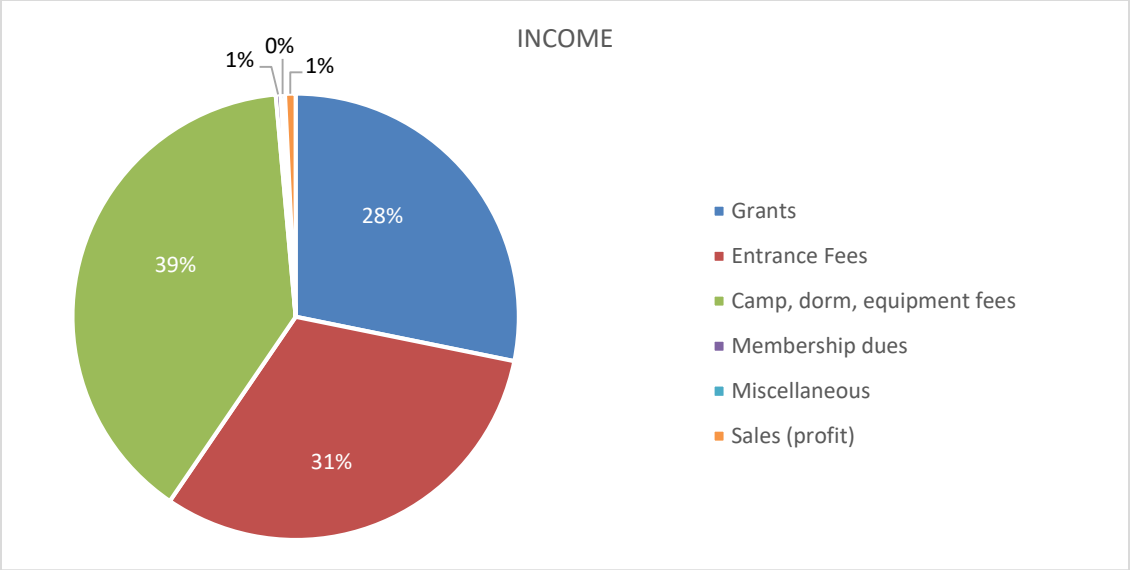


FIGURE 28: BREAKDOWN OF INCOME FOR CBWS / VPNM (BAS DATA, 2017)

Expenditures: In 2017, total joint expenditure for Cockscomb Basin Wildlife Sanctuary and Victoria Peak Natural Monument is estimated at approximately Bz$436,658 (excluding depreciation). A breakdown of site-specific expenditures across six general accounting areas shows that funds are focused primarily on two primary expenditure categories (Figure 29). Staff costs (48% - salaries, social security, insurance and casual labour) and operational costs (21%) (BAS data, 2017). The investment in both the operational costs and the human resources are expected to increase as BAS expands to be able to host cruise ship visitors.

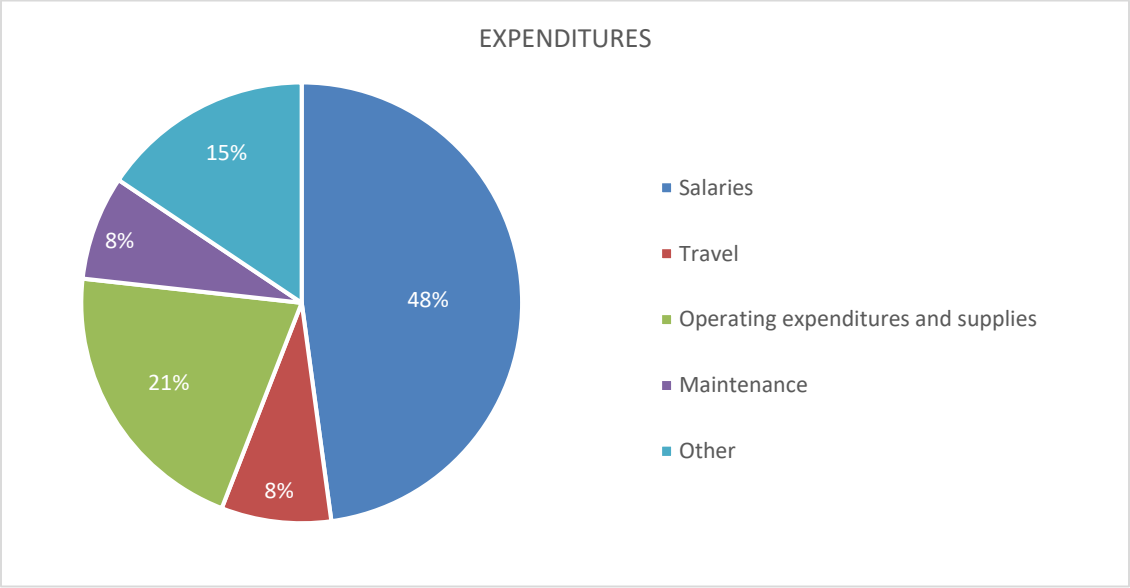


FIGURE 29: BREAKDOWN OF EXPENDITURES FOR CBWS / VPNM (BAS DATA, 2017)

4. IMPLEMENTING THE PLAN

The following outline presents the first steps toward implementing the management plan.

At the Start of the Management Plan Period

1. Develop the implementation plan and timeline for all program areas and activities (Table 44)

2. Develop the three Measures of Success tables for all program areas and activities, defining the current and desired status, and developing implementation and outcome indicators (Tables 45 to 47)

3. Identify those activities scheduled for implementation in the first year and develop the first annual workplan

4. Develop a baseline for the indicators (Table 48), and for information gaps, identify which year this baseline information will be gathered in

5. Implement the Annual Workplan

At the End of the First Year…

1. Update the two Measures of Success tables for all program areas and activities, and measure the success of implementation

2. Define the current status, and status of implementation, output and outcome indicators

3. Review the workplan, and identify challenges and adaptive strategies, for inclusion in the next workplan (this should be a participatory exercise)

4. Update the status of the indicators and develop a report on the outputs, to be integrated into the Annual Report

3. Identify those activities scheduled for implementation in the second year and develop the second annual workplan, incorporating adaptive strategies from the workplan review

5. Implement the second Annual Workplan

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ANNNEX ONE: SPECIES LISTS

MAMMALS OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Common Name	Species Name	IUCN Status
Didelphimorphia		
Didelphidae		
Common Opossum	*Didelphis marsupialis*	
Virginia Opossum	*Didelphis virginiana*	
Grey Four-eyed Opossum	*Philander opossum*	
Water Opossum	*Chironectes minimus*	
Mexican Mouse Opossum	*Marmosa mexicana*	
Robinson's Mouse Opossum	*Marmosa robinsoni*	
Wooly Opossum	*Caluromys derbianus*	
Edentata		
Myrmecophagidae		
Northern Tamandua	*Tamandua mexicana*	
Silky Anteater	*Cyclopes didactylus*	
Dasypodidae		
Nine-banded Armadillo	*Dasypus novemcinctus*	
Insectivora		
Soricidae		
Least Shrew	*Cryptotis parva*	
Chiroptera		
Emballonuridae		
Proboscis Bat	*Rhynchonycteris naso*	
Greater White-lined Bat	*Saccopteryx bilineata*	
Lesser White-lined Bat	*Saccopteryx leptura*	
Shaggy Bat	*Centronycteris centralis*	
Lesser Dog-like Bat	*Peropteryx macrotis*	
Greater Dog-like Bat	*Peropteryx kappleri*	
Northern Ghost Bat	*Diclidurus albus*	
Noctilionidae		
Greater Fishing Bat	*Noctilio leporinus*	
Mormoopidae		
Ghost-faced Bat	*Mormoops megalophylla*	
Common Mustached Bat	*Pteronotus parnellii*	
Lesser Mustached Bat	*Pteronotus personatus*	
Davy's Naked-backed Bat	*Pteronotus davyi*	

MAMMALS OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Common Name	Species Name	Status
Chiroptera		
Phyllostomidae		
Common Big-eared Bat	*Micronycteris microtis*	
Schmidt's Big-eared Bat	*Micronycteris schmidtorum*	
Common Sword-nosed Bat	*Lonchorhina aurita*	
Pale Spear-nosed Bat	*Phyllostoma discolor*	
Fringe-lipped Bat	*Trachops cirrhosus*	
Woolly False Vampire Bat	*Chrotopterus auritus*	
Common Long-tongued Bat	*Glossophaga soricina*	
Brown Long-tongued Bat	*Glossophaga commissarisi*	
Silky Short-tailed Bat	*Carollia brevicauda*	
Seba's Short-tailed Bat	*Carollia perspicillata*	
Little Yellow-shouldered Bat	*Sturnira lilium*	
Great Fruit-eating Bat	*Artibeus lituratus*	
Intermediate Fruit-eating Bat	*Artibeus intermedius*	
Jamaican Fruit-eating Bat	*Artibeus jamaicensis*	
Toltec Fruit-eating Bat	*Artibeus toltecus*	
Pygmy Fruit-eating Bat	*Artibeus phaeotis*	
Thomas' Fruit-eating Bat	*Artibeus watsoni*	
Common Tent-making Bat	*Uroderma bilobatum*	
Heller's Broad-nosed Bat	*Platyrrhinus helleri*	
Little Yellow-eared Bat	*Vampyressa pusilla*	
Common Vampire Bat	*Desmodus rotundus*	
Natalidae		
Mexican Funnel-eared Bat	*Natalus stramineus*	
Thyropteridae		
Spix's Disc-winged Bat	*Thryoptera tricolor*	
Vespertilionidae		
Hairy-legged Myotis	*Myotis keaysi*	
Argentine Brown Bat	*Eptesicus furinalis*	
Van Gelder's Bat	*Bauerus dubiaquercus*	Near Threatened
Western Red Bat	*Lasiurus blossevillii*	
Southern Yellow Bat	*Lasiurus ega*	
Molossidae		
Broad-eared Bat	*Nyctinomops laticaudatus*	
Black Bonneted Bat	*Eumops auripendulus*	
Underwood's Mastiff Bat	*Eumops underwoodi*	
Greenhall's Dog-faced Bat	*Cynomops greenhalli*	
Black Mastiff Bat	*Molossus rufus*	
Sinaloan Mastiff Bat	*Molossus sinaloae*	
Little Mastiff Bat	*Molossus molossus*	

MAMMALS OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Common Name	Species Name	Status
Primates		
Cebidae		
Yucatan Black Howler	*Alouatta pigra*	Endangered
Yucatan Black-handed Spider Monkey	*Ateles geoffroyi*	Endangered (sub-species is Critically Endangered)
Rodentia		
Sciuridae		
Yucatan Squirrel	*Sciurus yucatanenis*	
Deppe's Squirrel	*Sciurus deppei*	
Goemyidae		
Hispid Pocket Gopher	*Orthogeomys hispidus*	
Heteromyidae		
Forest Spiny Pocket Mouse	*Heteromys desmarestianus*	
Muridae		
Coues' Rice Rat	*Oryzomys couesi*	
Alfaro's Rice Rat	*Oryzomys alfaroi*	
Rusty Rice Rat	*Oryzomys rostratus*	
Hispid Cotton Rat	*Sigmodon hispidus*	
Northern Climbing Rat	*Tylomys nudicaudis*	
Big-eared Climbing Rat	*Ototylomys phyllotis*	
Vesper Rat	*Nyctomys sumichrasti*	
Slender Harvest Mouse	*Reithrodontomys gracilius*	
Brown Rat / Roof Rat	*Rattus rattus*	Possibly no longer present
Erethizontidae		
Mexican Porcupine	*Coendou mexicanus*	
Dasyproctidae		
Central American Agouti	*Dasyprocta punctata*	
Agoutidae		
Paca	*Agouti paca*	
Carnivora		
Canidae		
Grey Fox	*Urocyon cinereoargenteus*	
Coyote	*Canis latrans*	Presence confirmed?
Procyonidae		
Cacomistle	*Bassariscus sumichrasti*	
Northern Raccoon	*Procyon lotor*	
White-nosed Coati	*Nasua narica*	
Kinkajou	*Potos flavus*	

MAMMALS OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Common Name	Species Name	Status
Carnivora		
Mustelidae		
Grison	*Galictis vittata*	
Tayra	*Eira barbara*	
Spotted Skunk	*Conepatus putorius*	
Striped Hog-nosed Skunk	*Conepatus semistriatus*	
Neotropical River Otter	*Lutra longicaudis*	Near Threatened
Felidae		
Ocelot	*Leopardus pardalis*	
Margay	*Leopardus wiedii*	Near Threatened
Jaguarundi	*Herpailurus yagouaroundi*	
Puma	*Puma concolor*	
Jaguar	*Panthera onca*	Near Threatened
Perissodactyla		
Tapiridae		
Baird's tapir	*Tapirus bairdii*	Endangered
Artiodactyla		
Tayassuidae		
Collard Peccary	*Tayassu tajacu*	
White-lipped Peccary	*Dicotyles pecari*	Vulnerable
Cervidae		
White-tailed Deer	*Odocoileus virginianus*	
Red brocket Deer	*Mazama americana*	Data Deficient

References: Kamstra (1987), Rabinowitz A. and B. Nottingham (1986), Rath (1990), Emmons et. al. (1996), Miller B. and Miller C. (1999), Silver, S.C. and L. Ostro (2001), Harmsen, B. J., Foster, R. J., Silver, S. C., Ostro, L. E. T., & Doncaster, C. P. (2010), Sanchez E, Gutierrez-Gonza´lez CE, Silver SC, Ostro LET, et al. (2017) Foster RJ, Harmsen BJ, Valdes B, Pomilla C, Doncaster CP. (1987), Cockscomb Basin Wildlife Sanctuary Staff Consultations, 2017, Community Consultations, 2017.

Birds of Cockscomb Basin Wildlife Sanctuary

Species	Scientific Name	Status	Habitats	IUCN / Endemism
Great Tinamou	*Tinamus major*	fP	BFM,BFL	NT
Little Tinamou	*Crypturellus soui*	fP	SC	MA
Slaty-breasted Tinamou	*Crypturellus boucardi*	fP	BFM,BFL	MA
Least Grebe	*Tachybaptus dominicus*	lP	WL,LA	
Neotropic Cormorant	*Phalacrocorax brasilianus*	oV	LA	
Anhinga	*Anhinga anhinga*	oV	LA	
Magnificent Frigatebird	*Fregata magnificens*	rV	O	
Brown Pelican	*Pelecanus occidentalis*	r	O	
Bare-throated Tiger-Heron	*Tigrisoma mexicanum*	uP	WL,LA	
Great Blue Heron	*Ardea herodias*	oV	WL,LA	
Great Egret	*Ardea alba*	oV	WL,LA	
Snowy Egret	*Egretta thula*	oV	WL,LA	
Little Blue Heron	*Egretta caerula*	oV	WL,LA	
Cattle Egret	*Bubulcus ibis*	fV	SC	
Green Heron	*Butorides virescens*	fV	LA	
Agami Heron	*Agamia agami*	uV	LA	VU
Yellow-crowned Night-Heron	*Nyctanassa violacea*	lP	LA	
Boat-billed Heron	*Cochlearius cochlearius*	lP	LA	
Wood Stork	*Mycteria americana*	oV	LA	
Black Vulture	*Coragyps atratus*	cP	SA,O	
Turkey Vulture	*Cathartes aura*	cP	SA,O	
Lesser Yellow-headed Vulture	*Cathartes burrovianus*			
King Vulture	*Sarcoramphus papa*	uP	BFM,BFL	
Muscovy Duck	*Cairina moschata*	oV	LA	
Blue-winged Teal	*Anas discors*	oV	WL,LA	
Osprey	*Pandion haliaetus*	oV	LA,O	
Gray-headed Kite	*Leptodon cayanensis*	uP	BFM,BFL	
Hook-billed Kite	*Chondrohierax uncinatus*	uP	BFM,BFL	
Swallow-tailed Kite	*Elanoides forficatus*	uS	O	
White-tailed Kite	*Elanus leucurus*	uP	WL,SC	
Double-toothed Kite	*Harpagus bidentatus*	uP	BFM,BFL	
Plumbeous Kite	*Ictinia plumbea*	uS	O	
Bicolored Hawk	*Accipiter bicolor*		O	
Crane Hawk	*Geranospiza caerulescens*		O	
White Hawk	*Leucopternis albicollis*	uP	BFL,O	
White-tailed Hawk	*Buteo albicaudatus*			
Gray Hawk	*Asturina nitida*	fP	BFL,SC,O	
Common Black-Hawk	*Buteogallus anthracinus*	uP	SC,O	
Great Black-Hawk	*Buteogallus urubitinga*	uP	O	

Birds of Cockscomb Basin Wildlife Sanctuary

Species	Scientific Name	Status	Habitats	IUCN / Endemism
Solitary Eagle	*Buteogalluss solitarius*	rV	BFM,O	NT
Roadside Hawk	*Buteo magnirostris*	fP	SC,SA,O	
Short-tailed Hawk	*Buteo brachyurus*	fP	BFM,BFL,O	
Zone-tailed Hawk	*Buteo albonotatus*			
Red-tailed Hawk	*Buteo jamaicensis*	rV	O	
Black-and-white Hawk-Eagle	*Spizastur melanoleucus*	uP	BFM,BFL,O	
Black Hawk-Eagle	*Spizaetus tyrannus*	uP	BFM,BFL,O	
Ornate Hawk-Eagle	*Spizaetus ornatus*	rP	BFM,BFL,O	NT
Harpy Eagle	*Harpia harpyia*		BFM,BFL, O	NT
Crested Eagle	*Morphnus guianensis*		BFM,BFL, O	NT
Barred Forest-Falcon	*Micrastur ruficollis*	uP	BFM,BFL	
Collared Forest-Falcom	*Micrastur semitorquatus*	uP	BFM,BFL	
Laughing Falcon	*Herpetotheres cachinnans*	fP	PW,SC,SA	
American Kestrel	*Falco sparverius*	oW	SA,O	
Bat Falcon	*Falco rufigularis*	uP	SC,O	
Merlin	*Falco columbarius*			
Aplomado Falcon	*Falco femoralis*			
Peregrine Falcon	*Falco peregrinus*	oW	LA,O	
Plain Chachalaca	*Ortalis vetula*	cP	BFL,BFM,SC	
Crested Guan	*Penelope purpurascens*	cP	BFM,BFL	
Great Curassow	*Crax rubra*	uP	BFM,BFL	VU
Black-throated Bobwhite	*Colinus nigrogularis*	lP	PW,SA	MA
Spotted Wood-Quail	*Odontophorus guttatus*	uP	BFM,BFL	MA
Ruddy Crake	*Laterallus ruber*	lP	SC	MA
Russet-naped Wood-Rail	*Aramides cajanea*	uP	WL	
Uniform Crake	*Amaurolimnas concolor*	rP	BFL	
Sungrebe	*Heliornis fulica*	lP	LA	
Limpkin	*Aramus guarauna*	lP	WL,LA	
Killdeer	*Charadrius vociferus*			
Solitary Sandpiper	*Tringa solitaria*	oT	WL	
Spotted Sandpiper	*Actitis macularia*	fW	LA	
Pale-vented Pigeon	*Columba cayennensis*	cP	BFL,PW,SC	
Scaled Pigeon	*Columba speciosa*	fP	BFM.BFL	
Red-billed Pigeon	*Columba flavirostris*	oV	BFL,PW	
Short-billed Pigeon	*Columba nigrirostris*	cP	BFM,BFL	
Ruddy Ground-Dove	*Columbina talpacoti*	cP	SC	
Blue Ground-Dove	*Claravis pretiosa*	cP	BFM,BFL	
White-winged Dove	*Zenaida asiatica*			
White-tipped Dove	*Leptotila verreauxi*	lP	BFM,BFL	

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Species	Scientific Name	Status	Habitats	IUCN / Endemism
Gray-fronted Dove	*Leptotila rufaxilla*	cP	BFM,BFL	
Gray-chested Dove	*Leptotila cassini*	cP	BFM,BFL	
Ruddy Quail-Dove	*Geotrygon montana*	uP	BFM,BFL	
Olive-throated Parakeet	*Aratinga nana*	cP	BFM,BFL,SC	MA
Scarlet Macaw	*Ara macao*	oV	BFL	
Brown-hooded Parrot	*Pionopsitta haematotis*	cP	BFM,BF	
White-crowned Parrot	*Pionus senilis*	cP	BFM,BFL	MA
White-fronted Parrot	*Amazona albifrons*	rV	BFL,SA	MA
Red-lored Parrot	*Amazona autumnalis*	cP	BFL	
Northern Mealy Parrot	*Amazona guatemalae*	cP	BFM,BFL	NT
Yellow-headed Parrot	*Amazona oratrix*	fP	PW	EN
Squirrel Cuckoo	*Piaya cayana*	cP	BFM,BFL	
Striped Cuckoo	*Tapera naevia*	uP	SC	
Pheasant Cuckoo	*Dromococcyx phasianellus*	rP	BFM,BFL,SC	
Groove-billed Ani	*Crotophaga sulcirostris*	cP	SC	
Barn Owl	*Tyto alba*	uP	SC	
Vermiculated Screech-Owl	*Otus guatemalae*	uP	BFM,BFL	
Crested Owl	*Lophostrix cristata*	rP	BFM,BFL	
Spectacled Owl	*Pulsatrix perspicillata*	uP	BFM,BFL	
Central American Pygmy-Owl	*Glaucidium griseiceps*	uP	BFM.BFL	
Ferruginous Pygmy-Owl	*Glaucidium brasilianum*	lP	BFM,BFL,SC	
Mottled Owl	*Ciccaba virgata*	cP	BFM.BFL	
Black-and-white Owl	*Ciccaba nigrolineata*	uP	BFL	
Striped Owl	*Pseudoscops clamator*	uP	SA	
Short-tailed Nighthawk	*Lurocalis semitorquatus*	X	LA	
Lesser Nighthawk	*Chordeiles acutipennis*	fW	SA,O	
Common Nighthawk	*Chordeiles minor*	oT	SA,O	
Common Pauraque	*Nyctidromus albicollis*	cP	BFM,BFL	
Northern Potoo	*Nyctibius jamaicensis*	uP	SA	
Chestnut-collared Swift	*Streptoprocne rutila*	X	O	
White-collared Swift	*Streptoprocne zonaris*	fP	O	
Vaux's Swift	*Chaetura vauxi*	cP	O	
Lesser Swallow-tailed Swift	*Panyptila cayennensis*	fP	O	
Band-tailed Barbthroat	*Threnetes ruckeri*	rP	BFL	
Long-billed Hermit	*Phaethornis longirostris*	cP		
Stripe-throated Hermit	*Phaethornis striigularis*	cP		
Scaly-breasted Hummingbird	*Phaeochroa cuvieri*	uP	BFM,BFL	
Cinnamon Hummingbird				
Wedge-tailed Sabrewing	*Campylopterus curvipennis*	cP	BFM,BFL	NMA

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Species	Scientific Name	Status	Habitats	IUCN / Endemism
Violet Sabrewing	*Campylopterus hemileucurus*	uP	BFM	MA
White-necked Jacobin	*Florisuga mellivora*	fP	BFM.BFL,LA	
Brown Violet-ear	*Colibri delphinae*	uP	BFM	
Green-breasted Mango	*Anthracothorax prevostii*	uP	SC	
Canivet's Emerald	*Chlorostilbon canivetii*	uP	SA,SC	NMA
White-bellied Emerald	*Amazilia candida*	cP	BFM,BFL	MA
Azure-crowned Hummingbird	*Amazilia cyanocephala*	lP	PW	MA
White-bellied Emerald	*Amazilia candida*	cP	BFM,BFL	MA
Azure-crowned Hummingbird	*Amazilia cyanocephala*	lP	PW	MA
Rufous-tailed Hummingbird	*Amazilia tzacatl*	cP	SC,SA	
Buff-bellied Hummingbird	*Amazilia yucatanensis*	lP	SC,SA	
Stripe-tailed Hummingbird	*Eupherusa eximia*	cP	BFM	MA
Ruby-throated Hummingbird	*Archilochus colibris*	uW	SC	
Crowned Woodnymph	*Thalurania colombica*			
Purple-crowned Fairy	*Heliothryx barroti*			
Black-crested coquette	*Lophornis helenae*			
Black-headed Trogon	*Trogon melanocephalus*	cP	BFL.BFM,PW	MA
Gartered Trogon	*Trogon violaceus*	cP	BFM,BFL	
Collared Trogon	*Trogon collaris*	fP	BFM,BFL	
Slaty-tailed Trogon	*Trogon massena*	cP	BFM,BFL	
Tody Motmot	*Hylomanes momotula*	fP	BFM,BFL	
Lesson's Motmot	*Momotus momota*	cP	BFM,BFL	
Keel-billed Motmot	*Electron carinatum*	lP	BFM,BFL	MA, VU
Ringed Kingfisher	*Ceryle torquata*	lP	LA	
Belted Kingfisher	*Ceryle alcyon*	fW	LA	
Amazon Kingfisher	*Chloroceryle amazona*	lP	LA	
Green Kingfisher	*Chloroceryle americana*	cP	LA	
American Pygmy Kingfisher	*Chloroceryle aenea*	uP	LA	
White-necked Puffbird	*Notharchus macrorhynchos*	uP	SC	
White-whiskered Puffbird	*Malacoptila panamensis*	uP	BFM,BFL	
Rufous-tailed Jacamar	*Galbula ruficauda*	fP	BFM,BFL	
Northern Emerald Toucanet	*Aulacorhynchus prasinus*	fP	BFM	
Collared Aracari	*Pteroglossus torquatus*	cP	BFM,BFL	
Keel-billed Toucan	*Ramphastos sulfuratus*	cP	BFM,BFL	
Black-cheeked Woodpecker	*Melanerpes pucherani*	cP	BFM,BFL	
Golden-fronted Woodpecker	*Melanerpes aurifrons*	cP	SC	
Yellow-bellied Sapsucker	*Sphyrapicus varius*	uW	BFM,BFL	
Smoky-brown Woodpecker	*Veniliornis fumigatus*	fP	BFM,BFL	
Golden-olive Woodpecker	*Piculus rubiginosus*	fP	BFM,BFL	

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Species	Scientific Name	Status	Habitats	IUCN / Endemism
Chestnut-colored Woodpecker	*Celeus castaneus*	uP	BFM,BFL	MA
Lineated Woodpecker	*Dryocopus lineatus*	cP	BFM,BFL	
Pale-billed Woodpecker	*Campephilus guatemalensis*	cP	BFM,BFL	MA
Rufous-breasted Spinetail	*Synallaxis erythrothorax*	fP	SC	MA
Buff-throated Foliage-gleaner	*Automolus ochrolaemus*	fP	BFM,BFL	
Plain Xenops	*Xenops minutus*	cP	BFM,BFL	
Scaly-throated Leaftosser	*Sclerurus guatemalensis*	uP	FM,BFL	
Tawny-throated Leaftosser	*Sclerurus mexicanus*			
Tawny-winged Woodcreeper	*Dendrocincla anabatina*	fP	BFM,BFL	MA
Ruddy Woodcreeper	*Dendrocincla homochroa*	fP	BFM,BFL	
Olivaceous Woodcreeper	*Sittasomus griseicapillus*	fP	BFM,BFL	
Wedge-billed Woodcreeper	*Glyphorynchus spirurus*	fP	BFM,BFL	
Northern Barred-Woodcreeper	*Dendrocolaptes sanctihomae*	fP	BFM,BFL,PW	
Ivory-billed Woodcreeper	*Xiphorhynchus flavigaster*	cP	BFM,BFL	MA
Streak-headed Woodcreeper	*Lepidocolaptes souleyetii*	uP	BFM,BFL	
Spotted Woodcreeper	*Xiphorhynchus erythropygius*			
Great Antshrike	*Taraba major*	lP	SC	
Barred Antshrike	*Thamnophilus doliatus*	cP	SC	
Plain Antvireo	*Dysithamnus mentalis*	fP	BFM,BFL	
Dot-winged Antwren	*Microrhopias quixensis*	cP	BFL	
Dusky Antbird	*Cercomacra tyrannina*	cP	SC	
Bare-crowned Antbird	*Gymnocichla nudiceps*	rP	SC	
Black-faced Antthursh	*Formicarius analis*	cP	BFM,BFL	
Yellow-bellied Tyrannulet	*Ornithion semiflavum*	fP	BFM,BFL	MA
Greenish Elaenia	*Myiopagis viridicata*	fP	BFM,BFL	
Yellow-bellied Elaenia	*Elaenia flavogaster*	cP	PW,SA	
Ochre-bellied Flycatcher	*Mionectes oleagineus*	cP	BFM,BFL	
Sepia-capped Flycatcher	*Leptopogon amaurocephalus*	fP	BFM,BFL	
Northern Bentbill	*Oncostoma cinereigulare*	cP	BFM,BFL	MA
Slate-headed Tody-Flycatcher	*Poecilotriccus sylvia*	uP	SC	
Common Tody-Flycatcher	*Todirostrum cinereum*	cP	SC,SA	
Eye-ringed Flatbill	*Rhynchocyclus brevirostris*	uP	BFM,BFL	MA
Yellow-olive Flycatcher	*Tolmomyias suphurescens*	cP	BFM,BFL	
Stub-tailed Spadebill	*Platyrinchus cancrominus*	cP	BFM,BFL	MA
Royal Flycatcher	*Onychorhynchus coronatus*	uP	BFM,BFL	
Ruddy-tailed Flycatcher	*Terenotriccus erythrurus*	uP	BFM,BFL	
Sulphur-rumped Flycatcher	*Myiobius sulphureipygius*	cP	BFM,BFL	

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Species	Scientific Name	Status	Habitats	IUCN / Endemism
Olive-sided Flycatcher	*Contopus cooperi*	uT	BFM,BFL	
Eastern Wood-Pewee	*Contopus virens*	cT	BFM,BFL	
Tropical Pewee	*Contopus cinereus*	fP	BFM,BFL	
Yellow-bellied Flycatcher	*Empidonax flaviventris*	fW	BFM,BFL	
Acadian Flycatcher	*Empidonax virescens*	oT	SC	
Willow Flycatcer	*Empidonax traillii*	oT	SC	
Least Flycatcher	*Empidonax minimus*	fW	SC	
Black Phoebe	*Sayornis nigricans*	lP	LA	
Vermilion Flycatcher	*Pyrocephalus rubinus*	lP	SA,SC	
Bright-rumped Attila	*Attila spadiceus*	cP	BFM,BFL	
Rufous Mourner	*Rhytipterna holerythra*	uP	BFM,BFL	
Speckled Mourner	*Laniocera rufescens*			
Dusky-capped Flycatcher	*Myiarchus tuberculifer*	cP	BFM,BFL	
Great Crested Flycatcher	*Myiarchus crinitus*	fW	BFM,BFL	
Brown-crested Flycatcher	*Myiarchus tyrannulus*	cS	BFL,PW	
Great Kiskadee	*Pitangus sulphuratus*	cP	SC	
Boat-billed Flycatcher	*Megarynchus pitangua*	cP	BFM,BFL	
Social Flycatcher	*Myiozetetes similis*	vP	SC	
Streaked Flycatcher	*Myiodynastes maculatus*	uS	BFM,BFL	
Sulphur-bellied Flycatcher	*Myiodynastes luteiventris*	cS	BFM,BFL	
Fork-tailed Flycatcher	*Tyrannus savana*			
Piratic Flycatcher	*Legatus leucophaius*	cS	BFL	
Tropical Kingbird	*Tyrannus melancholicus*	cP	PW,SA	
Couch's Kingbird	*Tyrannus couchii*	cP	PW,SA	
Eastern Kingbird	*Tyrannus tyrannus*	fT	BFL	
Western Kingbird	*Tyrannus verticalis*			
Northern Schiffornis	*Schiffornis veraepacis*	cP	BFM,BFL	
Rufous Piha	*Lipaugus unirufus*	uP	BFM,BFL	
Cinnamon Becard	*Pachyramphus cinnamomeus*	fP	BFM,BFL	
Gray-collared Becard	*Pachyramphus major*			
White-winged Becard	*Pachyramphus polychopterus*	uP	SC	
Rose-throated Becard	*Pachyramphus aglaiae*	uP	BFL,PW	
Masked Tityra	*Tityra semifasciata*	cP	BFM,BFL	
Black-crowned Tityra	*Tityra inquisitor*	uP	BFL	
Lovely Cotinga	*Cotinga amabilis*	rP	BFM,BFL	MA
White-collared Manakin	*Manacus candei*	cP	BFL	MA
Red-capped Manakin	*Pipra mentalis*	cP	BFM,BFL	
White-eyed Vireo	*Vireo griseus*	cW	SC	
Mangrove Vireo	*Vireo pallens*	cP	SC	MA

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Species	Scientific Name	Status	Habitats	IUCN / Endemism
Yellow-throated Vireo	*Vireo flavifrons*	cW	BFM,BFL	
Plumbeous Vireo	*Vireo plumbeus*	lP	PW	
Philadelphia Vireo	*Vireo philadelphicus*	uT	BFL	
Red-eyed Vireo	*Vireo olivaceus*	cT	BFM,BFL	
Yellow-green Vireo	*Vireo flavoviridis*	cS	BFM,BFL	
Tawny-crowned Greenlet	*Hylophilus ochraceiceps*	cP	BFM,BFL	
Lesser Greenlet	*Hylophilus decurtatus*	vP	BFM,BFL	
Green Shrike-Vireo	*Vireolanius pulchellus*	fP	BFM,BFL	MA
Green Jay	*Cyanocorax yncas*	uP	BFL,PW	
Brown Jay	*Cyanocorax morio*	cP	BFL,PW	MA
Purple Martin	*Progne subis*	cT	O	
Gray-breasted Martin	*Progne chalybea*	cS	O	
Tree Swallow	*Tachycineta bicolor*	oW	LA	
Mangrove Swallow	*Tachycineta albilinea*	lP	LA	
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	fP	BFM,BFL	
Barn Swallow	*Hirundo rustica*	fT	SA	
Band-backed Wren	*Campylorhynchus zonatus*	lP	BFM,BFL	
Spot-breasted Wren	*Thryothorus maculipectus*	vP	BFM,BFL	MA
House Wren	*Troglodytes aedon*	cP	SC	
White-breasted Wood-Wren	*Henicorhina leucosticta*	vP	BFM,BFL	
Nightingale Wren	*Microcerculus philomela*			
Long-billed Gnatwren	*Ramphocaenus melanurus*	cP	BFM,BFL	
Blue-gray Gnatcatcher	*Polioptila caerulea*	lP	PW	
Tropical Gnatcatcher	*Polioptila plumbea*	fP	BFM,BFL	
Slate-colored Solitaire	*Myadestes unicolor*	cP	BFM	MA
Veery	*Catharus fuscescens*	oT	BFM,BFL	
Swainson's Thrush	*Catharus ustulatus*	uT	BFM,BFL	
Gray-cheeked Thrush	*Catharus minimus*			
Wood Thrush	*Hylocichla mustelina*	cW	BFM,BFL	NT
Clay-colored Thrush	*Turdus grayi*	cP	BFL,SC	
White-throated Thrush	*Turdus assimilis*	cP	BFM	
Gray Catbird	*Dumetella carolinensis*	cW	BFM,BFL	
Tropical Mockingbird	*Mimus gilvus*			
Cedar Waxwing	*Bombycilla cedrorum*	oW	SC	
Blue-winged Warbler	*Vermivora pinus*	uW	BFM,BFL,SC	
Golden-winged Warbler	*Vermivora chrysoptera*	uT	BFM,BFL,SC	NT
Tennessee Warbler	*Vermivora peregrina*	cT	BFM,BFL,SC	
Northern Parula	*Parula americana*	oT	BFL,PW	

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Species	Scientific Name	Status	Habitats	IUCN / Endemism
Yellow Warbler	*Dendroica petechia*	cW	SC	
Chestnut-sided Warbler	*Dendroica pensylvanica*	cW	BFM,BFL,SC	
Magnolia Warbler	*Dendroica magnolia*	cW	BFM,BFL,SC	
Yellow-rumped Warbler	*Dendroica coronata*	uW	PW,SA	
Black-throated Green Warbler	*Dendroica virens*	fW	PW,SC	
Blackburnian Warbler	*Dendroica fusca*	uT	BFM,BFL	
Yellow-throated Warbler	*Dendroica dominica*	fW	BFL,PW	
Grace's Warbler	*Dendroica graciae*	lP	PW	
Palm Warbler	*Dendroica palmarum*	oW	PW,SA	
Bay-breasted Warbler	*Dendroica castanea*	uT	BFM,BFL	
Cerulean Warbler	*Dendroica cerulea*	uT	BFM,BFL	VU
Black-and-white Warbler	*Mniotilta varia*	cW	BFM,BFL	
American Redstart	*Setophaga ruticilla*	cW	BFM,BFL	
Prothonotary Warbler	*Protonotaria citrea*	uT	BFL,LA	
Worm-eating Warbler	*Helmitheros vermivorus*	uW	BFM,BFL	
Swainson's Warbler	*Limnothlypis swainsonii*	rW	BFL	
Ovenbird	*Seiurus aurocapillus*	fW	BFM,BFL	
Northern Waterthrush	*Seiurus noveboracensis*	cW	LA	
Louisiana Waterthrush	*Seiurus motacilla*	uW	LA	
Kentucky Warbler	*Oporornis formosus*	cW	BFM,BFL	
Common Yellowthroat	*Geothlypis trichas*	cW	SC	
Gray-crowned Yellowthroat	*Geothlypis poliocephala*	lP	PW,SA	MA
Hooded Warbler	*Wilsonia citrina*	cW	BFM,BFL	
Wilson's Warbler	*Wilsonia pusilla*	uW	BFM,BFL	
Golden-crowned Warbler	*Basileuterus culicivorus*	cP	BFM,BFL	
Rufous-capped Warbler	*Basileuterus rufifrons*	lP	PW	
Yellow-breasted Chat	*Icteria virens*	uW	SC	
Bananaquit	*Coereba flaveola*	cP	BFM,BFL	
Common Clorospingus	*Chlorospingus ophthalmicus*	cP	BFM	
Gray-headed Tanager	*Eucometis penicillata*	fP	BFM,BFL	
Black-throated Shrike-Tanager	*Lanio aurantius*	uP	BFM,BFL	NMA
Red-crowned Ant-Tanager	*Habia rubica*	cP	BFM,BFL	
Red-throated Ant-Tanager	*Habia fuscicauda*	vP	BFM,BFL	
Hepatic Tanager	*Piranga flava*	lP	PW	
Summer Tanager	*Piranga rubra*	cW	BFM,BFL	
Scarlet Tanager	*Piranga olivacea*	fT	BFM,BFL	
White-winged Tanager	*Piranga leucoptera*	uP	BFM	

Birds of Cockscomb Basin Wildlife Sanctuary

Species	Scientific Name	Status	Habitats	IUCN / Endemism
Crimson-collared Tanager	*Ramphocelus sanguinolentus*	fP	SC	MA
Passerini's Tanager	*Ramphocelus passerinii*	fP	SC	MA
Blue-gray Tanager	*Thraupis episcopus*	cP	BFL,PW	
Yellow-winged Tanager	*Thraupis abbas*	cP	BFM,BFL	MA
Scrub Euphonia	*Euphonia affinis*	fP	SC,SA	MA
Yellow-throated Euphonia	*Euphonia hirundinacea*	cP	BFM,BFL	MA
Elegant Euphonia	*Euphonia elegantissima*	rP	BFM	MA
Olive-backed Euphonia	*Euphonia gouldi*	cP	BFM,BFL	MA
White-vented Euphonia	*Euphonia minuta*	uP	BFM,BFL	
Golden-hooded Tanager	*Tangara larvata*	cP	BFL,PW	
White-vented Euphonia	*Euphonia minuta*	uP	BFM,BFL	
Golden-hooded Tanager	*Tangara larvata*	cP	BFL,PW	
Green Honeycreeper	*Chlorophanes spiza*	fP	BFM,BFL	
Shining Honeycreeper	*Cyanerpes lucidus*	uP	BFM	
Red-legged Honeycreeper	*Cyanerpes cyaneus*	cP	BFM,BFL	
Blue-black Grassquit	*Volatinia jacarina*	cP	SC	
Variable Seedeater	*Sporophila americana*	cP	SC,SA	
White-collared Seedeater	*Sporophila torqueola*	vP	SC,SA	MA
Thick-billed Seed-Finch	*Oryzoborus funereus*	fP	PW,SC,SA	
Yellow-faced Grassquit	*Tiaris olivacea*	lP	SC	
Orange-billed Sparrow	*Arremon aurantiirostris*	cP	BFM,BFL	
Green-backed Sparrow	*Arremonops chloronotus*	cP	BFL,SC	NMA
Rusty Sparrow	*Aimophila rufescens*	lP	PW	MA
Chipping Sparrow	*Spizella passerina*	o		
Grayish Saltator	*Saltator coerulescens*	fP	SC	
Buff-throated Saltator	*Saltator maximus*	cP	BFL	
Black-headed Saltator	*Saltator atriceps*	cP	BFL	MA
Black-faced Grosbeak	*Caryothraustes poliogaster*	cP	BFM,BFL	MA
Rose-breasted Grosbeak	*Pheuticus ludovicianus*	cT	BFM,BFL	
Blue-black Grosbeak	*Cyanocompsa cyanoides*	cP	BFM,BFL	
Blue Grosbeak	*Passerina caerulea*	cT	SC	
Indigo Bunting	*Passerina cyanea*	cT	SC	
Painted Bunting	*Passerina ciris*	oT	SC	NT
Dickcissel	*Spiza americana*	uT	SC,WL	
Melodious Blackbird	*Dives dives*	vP	SC	MA
Great-tailed Grackle	*Quiscalus mexicanus*	oV	SC	
Bronzed Cowbird	*Molothrus aeneus*	uP	SC	
Giant Cowbird	*Molothrus oryzivorus*	uP	SC	
Black-cowled Oriole	*Icterus prosthemelas*	cP	BFL,PW,SA	MA

Birds of Cockscomb Basin Wildlife Sanctuary

Species	Scientific Name	Status	Habitats	IUCN / Endemism
Orchard Oriole	*Icterus spurius*	cW	SC	
Yellow-backed Oriole	*Icterus chrysater*	lP	PW	
Yellow-tailed Oriole	*Icterus mesomelas*	cP	SC,LA	
Baltimore Oriole	*Icterus galbula*	cW	BFM,BFL	
Yellow-billed Cacique	*Amblycercus holosericeus*	cP	BFL,PW	
Chestnut-headed Oropendola	*Psarocolius wagleri*	lP	BFL	
Montezuma Oropendola	*Psarocolius montezuma*	cP	BFL	MA

Key for Bird Table

Status Legend

v = very common
c = common
f = fairly common
u = uncommon
o = occasional
l = local

P = permanent resident
S = seasonal resident
V = visitor
T = transient (migrant)
W = winter resident
X = one or two records only

Regional Endemics Legend (L. Jones)

MA Middle America Endemic
NMA Northern Middle America Endemic

Habitat Preferences within CBWS Legend (Adapted from Jones and Vallely, 2001)

BFM Submontane broadleaf forest
BFL Lowland broadleaf forest
PFM Submontane pine forest
PFL Lowland pine forest
SC Scrub, low second growth
SA Savanna
WL Wetland habitats with emergent vegetation
LA Lagoons, ponds, rivers, streams
O Overhead/aerial

IUCN Status: **EN** Endangered **VU** Vulnerable **NT** Near Threatened

Reference Sources for Species List:

Kamstra (1987): Ecological Survey of Cockscomb, Kamstra (1987)
Meadows et. al. (1990). The Cockscomb Basin Expedition Report.
Jones L. and A. Vallely (2001). An annotated checklist of the Birds of Belize.
BBIS: Belize Biodiversity Information System.
Cockscomb Basin Wildlife Sanctuary Staff / Community Consultations, 2017

REPTILES AND AMPHIBIANS OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Species Common Name	Scientific Name	Kamstra 1987	Walker West Basin 1990	Reynolds 1995	Emmons et al. 1996	BAS BBIS	Walker et al. 2007/ 2008/9
Mexican Mushroom-tongue Salamander	*Bolitoglossa mexicana*				x	x	x
Northern Banana salamander	*Bolitoglossa rufescens*			x	x	x	x
Central American worm salamander	*Oedipina elongata*				x	x	x
Rainforest toad	*Incilius campbelli*			x	x		x
Gulf Coast toad	*Incilius valliceps*	x			x	x	x
Cane toad	*Rhinella marinus*	x	x	x	x	x	x
Mexican burrowing toad	*Rhinophrynus dorsalis*		x	x	x	x	
Chac's rain frog	*Craugastor chac*			x	x	x	x
Broad-headed Rainfrog	*Craugastor laticeps*						x
Lowland rain frog	*Craugastor loki*		x		x		
Sabrinus rain frog	*Craugastor sabrinus*			x	x		x
Sanderson's rain frog	*Craugastor sandersoni*						x
Leprus chirping rain frog	*Eleutherodactylus leprus*			x			x
White-lipped frog	*Leptodactylus labialis*				x	x	x
Black-backed Frog	*Leptodactylus melanonotus*						x
Red-eyed treefrog	*Agalychnis callidryas*		x		x	x	x
Hourglass treefrog	*Dendropsophus ebraccatus*		x		x	x	x
Small-headed treefrog	*Dendropsophus microcephalus*		x		x	x	x
Stauffer's treefrog	*Scinax staufferi*				x		x
Mexican treefrog	*Smilisca baudinii*		x	x	x	x	x
Blue-spotted treefrog	*Smilisca cyanosticta*		x		x	x	x
Mahogany treefrog	*Tlalocohyla loquax*				x	x	x
Painted treefrog	*Tlalocohyla picta*		x		x	x	x
Veined treefrog	*Trachycephalus typhonius*						x
Narrowmouth frog	*Gastrophryne elegans*		x		x	x	x

REPTILES AND AMPHIBIANS OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Species Common Name	Scientific Name	Kamstra 1987	Walker (West Basin) 1990	Reynolds 1995	Emmons et. al. 1996	BAS BBIS	Walker et al 2007/ 2008/9
Veined treefrog	*Trachycephalus typhonius*						x
Narrowmouth frog	*Gastrophryne elegans*		x		x	x	x
Fleishman's glass frog	*Hyalinobatrachium fleischmanni*				x	x	x
Sheep frog	*Hypopachus variolosus*		x		x	x	x
Rio Grande leopard frog	*Lithobates berlandieri*	x		x	x		x
Maya Mountain frog	*Lithobates juliani*		x		x	x	x
Rainforest frog	*Lithobates vaillanti*	x	x	x	x	x	x
Tabasco mud turtle	*Kinosternon acutum*				x	x	
White-lipped mud turtle	*Kinosternon leucostomum*			x	x	x	
Tabasco mud turtle	*Kinosternon acutum*				x	x	
Black-bellied turtle	*Rhinoclemmys areolata*				x		
Red-eared slider	*Trachemys venusta*				x		
Morelet's crocodile	*Crocodylus moreleti*				x		
Banded gecko	*Coleonyx elegans*	x	x	x	x	x	
Spotted gecko	*Sphaerodactylus millepunctatus*				x	x	
Dwarf gecko	*Sphaerodactylus glaucus*	x			x		
Turnip-tail gecko	*Thecadactylus rapicauda*			x		x	
Big-headed anole	*Anolis capito*		x		x	x	
Ghost Anole	*Anolis lemurinus*		x	x	x	x	
Smooth anole	*Anolis rodriguezii*	x					
Silky anole	*Anolis sericeus*		x		x	x	
Greater scaly anole	*Anolis tropidonotus*	x			x		
Lesser scaly anole	*Anolis uniformis*		x	x	x	x	
Striped basilisk	*Basiliscus vittatus*	x	x	x	x	x	
Old man lizard	*Corytophanes cristatus*	x	x	x	x	x	
Spiny-tailed iguana	*Ctenosaura similis*				x		
Green iguana	*Iguana iguana*	x	x		x	x	
Casque-headed iguana	*Laemanctus longipes*				x		

REPTILES AND AMPHIBIANS OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Species Common Name	Scientific Name	Kamstra 1987	Walker (West Basin) 1990	Reynolds 1995	Emmons et. al. 1996	BAS BBIS	Walker et al 2007/ 2008/9
Spiny lizard	*Sceloporus chrysostictus*	x			x		
Bronze skink	*Marisora brachypoda*		x		x	x	
Sumichrast's skink	*Plestiodon sumichrasti*	x			x		
Cherrie's skink	*Sphenomorphus cherriei*	x		x	x	x	
Central American whiptail	*Holcosus festiva*	x	x	x	x	x	
Barred whiptail	*Holcosus undulata*	x	x		x	x	
Yellow-spotted night lizard	*Lepidophyma flavimaculatum*		x		x	x	
Alligator lizard	*Celestus rozellae*			x	x	x	
Boa constrictor	*Boa constrictor*	x			x		
Crowned snake	*Coniophanes bipunctatus*				x	x	
Black-striped snake	*Coniophanes imperialis*				x	x	
Black-tailed indigo snake	*Drymarchon corais*	x	x		x	x	
Speckled racer	*Drymobius margaritiferus*	x			x	x	
Blunt-headed tree snake	*Imantodes cenchoa*		x	x	x	x	
Tropical kingsnake	*Lampropeltis triangulum*				x		
Cat-eyed snake	*Leptodeira frenata*				x	x	
Cat-eyed snake	*Leptodeira septentrionalis*		x		x	x	
Green tree snake	*Leptophis ahaetulla*				x	x	
Green-headed tree snake	*Leptophis mexicanus*			x	x	x	
Coach whip	*Masticophis mentovarius*				x		
Red coffee snake	*Ninia sebae*	x			x	x	
Grey vine snake	*Oxybelis aeneus*		x		x	x	
Green vine snake	*Oxybelis fulgidus*	x			x		
Puffing snake	*Phrynonax poecilonotus*				x	x	
False coral snake	*Pliocercus elapoides*				x		
Shovel-toothed snake	*Scaphiodontophis annulatus*				x	x	
Snail-eating snake	*Sibon nebulata*		x		x	x	
Spotted rat snake	*Spilotes pullatus*	x	x	x	x	x	

REPTILES AND AMPHIBIANS OF COCKSCOMB BASIN WILDLIFE SANCTUARY

Species Common Name	Scientific Name	Kamstra 1987	Walker (West Basin) 1990	Reynolds 1995	Emmons et. al. 1996	BAS BBIS	Walker et al 2007/ 2008/9
Coral snake	*Micrurus diastema*				x		
Coral snake	*Micrurus hippocrepis*		x		x	x	
Coral snake	*Micrurus nigrocinctus*	x			x		
Fer-de-Lance	*Bothrops asper*	x	x	x	x	x	
Jumping Viper	*Atropoides mexicanus*				x		

References:
Kamstra (1987): An Ecological Survey of the Cockscomb Basin
Walker (1990): In: The Cockscomb Basin Expedition Report (Rath)
Reynolds (1995): In: Maya Mountain Archaeological Project (Dunham)
Emmons et. al (1996): Cockscomb Basin Wildlife Sanctuary
BBIS: Belize Biodiversity Information System

NB: Walker's 1990 record for *Eleutherodactylus rostralis* is accepted as *Craugastor loki*
Reynolds' record of *Anolis bourgeaei* is considered a race of *A. lemurinus* (Lee, 1996)
Kamstra's 1987 record of *Anolis limifrons* is accepted as *A. rodriguezii*
Emmons' 1996 record of *Eleutherodactylus rugulosus* is accepted as *Craugastor sabrinus*

FISH OF COCKSCOMB BASIN WILDLIFE SANCTUARY	
CHARACIDAE	
Central Tetra, Bilum ***Astyanax aeneus*** Trio Branch (Esselman, 2001) South Stann Creek and middle reach tributaries (Walker, 2004) Trio Branch/Swasey (MMAP, 1992) East Basin (MMAP, 1995)	Widespread and ubiquitous in Belize Observed schooling in the majority of streams and creeks within the floodplain of East Basin. Presumed to be in rivers and stream of West Basin and Maya Mountain Extension as well. Is thought to be found as high as 1,000m in its range, but at Cockscomb does not appear to be present in the upper headwaters, beyond the first major waterfalls (not observed in waterfall pools of Ben's Bluff or Tiger Fern, for example), though it was observed in Juan Branch. It feeds on algae, seeds, leaves, aquatic and terrestrial insects and fish fry of any species, and is itself an important food source for larger fish.
Machaca ***Brycon guatemalensis*** Trio Branch (Esselman, 2001) Trio Branch/Swasey (MMAP, 1992) East Basin (MMAP, 1995)	In Belize Greenfield and Thomerson (1997) found South Stann Creek to be the northern extent of this species within Belize, though the Central American range does extend into Mexico. Fished by buffer community members from the middle reaches of rivers and streams within Cockscomb, below the first major waterfall barriers. The young are thought to feed on terrestrial and aquatic insects, leaves, fruits and seeds but become mainly herbivorous when adult.
Mayan Tetra ***Hyphessobrycon compressus*** Trio Branch/Swasey (MMAP, 1992) East Basin (MMAP, 1995)	Found throughout Belize, particularly in lowland areas. Esselman only reported this from the middle reaches of the Monkey River, which would have been outside the protected area. However, MMAP recorded this species from both Trio Branch/Swasey Branch, and from East Basin.
Pike Killifish ***Belonesox belizanus*** Trio Branch/Swasey (MMAP, 1992) East Basin (MMAP, 1995)	Found throughout Belize, particularly in areas of heavy vegetation, where it lives as a predator, preying on smaller Poecilidae and fish fry.
Sleek Mosquitofish ***Gambusia luma*** Trio Branch (Esselman, 2001) East Basin (MMAP, 1995)	This species is most common in southern Belize, though it has been recorded from the New River and the River Hondo (Greenfield and Thomerson, 1997). This is, to date, the only mosquitofish recorded within Cockscomb, being observed by Esselman (2001) in the Trio area, and in East Basin (MMAP).
Twospot Livebearer ***Heterandria bimaculata*** Trio Branch (Esselman, 2001) South Stann Creek tributaries (Walker) Trio Branch/Swasey (MMAP, 1992) East Basin (MMAP, 1995)	Widespread in Belize, and the only species to be observed in the waterfall pools in the headwaters of streams within the protected area (eg. Ben's Bluff and Tiger Fern waterfalls). It is also seen downstream in the middle reaches of the East Basin floodplain, and can be expected to occur under similar conditions in all other river systems within Cockscomb.

FISH OF COCKSCOMB BASIN WILDLIFE SANCTUARY

CHARACIDAE	
Shortfin Molly ***Poecilia mexicana*** Trio Branch (Esselman, 2001) Trio Branch/Swasey (MMAP, 1992) East Basin (MMAP, 1995)	Widespread in Belize, and within Cockscomb is noted as preferring standing or slow moving water, though this species can also be observed in faster flowing streams. Greenfield and Thomerson (1997) observe that this species tends to occur in vegetated pools, so can be expected to occur in greater abundance in those streams and rivers that drain the granite and metasediments, and therefore have higher phosphorus levels, leading to greater abundance of aquatic vegetation – South Stann Creek, Swasey Branch and Trio Branch.
Green Swordtail ***Xiphophorus hellerii*** Trio Branch (Esselman, 2001) Trio Branch/Swasey (MMAP, 1992) East Basin (MMAP, 1995)	Has been recorded within Belize from Gallon Jug southwards (Greenfield and Thomerson, 1997), preferring a slightly basic pH range. It is reported to favour rapidly flowing streams and rivers in heavily vegetated habitats, and is recorded by Esselman from the more southern areas of Cockscomb, such as Trio Branch. And by the MMAP in East Basin, where it is thought to occur within the South Stann Creek and Swasey Branch river systems, below the major waterfalls.
SYNBRANCHIDAE	
Obscure Swamp Eel ***Ophisternon aenigmaticum*** Trio Branch (Esselman, 2001)	Found in a variety of habitats from standing water in small muddy pools to clear running water in streams and larger bodies of water such as lakes. Air breathing and sometimes found crossing land or burrowed into mud. To date, only recorded from the Trio Branch area (Esselman).
HAEMULIDAE	
Burro Grunt ***Pomadasys crocro*** Trio Branch (Esselman, 2001)	Greenfield and Thomerson (1997) have observed this species in Belize, in fast flowing water, feeding over gravel in the company of shortfin mollies and mountain mullet. Inhabits rivers and creeks of low to high current velocity. Found along sandy shores and over mud bottoms in shallow water, quite common in brackish mangrove-lined lagoons. Often ascends rivers more than 100 miles from the sea. Feeds on crustaceans and small fishes.
CICHLIDAE	
Bay Snook ***Petenia splendida*** South Stann Creek and tributaries (Walker)	Found in middle and lower sections of rivers, and is therefore not expected to occur above the first major waterfall barrier. A pair with newly hatched young observed in the slow moving edge waters of South Stann Creek at the end of the River Walk. Reported to be under pressure from fishermen in the majority of the middle and lower river areas throughout Belize.
False Firemouth Cichclid ***Amphilophus robertsoni*** Trio Branch (Esselman, 2001)	In Belize, this species is widely distributed but seldom found in large numbers. Recorded from Trio Branch, but not yet observed in South Stann Creek, this species inhabits lower and middle sections of rivers in slower moving waters, preferring a soft substrate of sand, mud and small stones, where it feeds by sifting bottom sand and mud.
Blue-eye Cichlid ***Archocentrus spilurum*** Trio Branch (Esselman, 2001)	Found throughout Belize, occurring in a range of habitats, from lowland swamps to clear, cool mountain streams. Observed in South Stann Creek, and recorded from Trio Branch (Esselman, 2001). It prefers the slower moving waters of the lower river valleys.

FISH OF COCKSCOMB BASIN WILDLIFE SANCTUARY

CICHLIDAE	
Blackbelt Cichlid ***Vieja maculicauda*** Trio Branch (Esselman, 2001)	Recorded in clear, slow-flowing, freshwater waters at Trio Branch (Esselman, 2001). Within Cockscomb East and West Basins, it should be found particularly in the slower moving sections of the rivers where they pass through a flat floodplain area, preferring shady bank areas with a muddy or sandy substrate, and with submerged trees and logs for protection.
Yellow belly Cichlid ***Cichlasoma salvini*** Trio Branch (Esselman, 2001) South Stann Creek and tributaries (Walker) East Basin (MMAP, 1995)	Prefers moderate to fast flowing waters of the lower and middle river valleys. It was observed in Trio Branch (Esselman, 2001), at the end of River Walk in the South Stann Creek, and also at the bridge on the Access Road, outside the protected area.
MUGILIDAE	
Mountain Mullet ***Agonostomus monitcola*** Trio Branch (Esselman, 2001) South Stann Creek and tributaries (Walker) Trio Branch/Swasey (MMAP, 1992)	Adults live in the freshwater rivers and streams of Cockscomb, in rapid flowing water of the riffles as well as quieter pools and slower flowing water. Young grow at sea, then ascend far inland up the Monkey River and South Stann Creek, to spend all their adult life in tributaries of these rivers. They tend to be few and solitary in upper streams, but form uneven schools in larger streams at lower elevations, as seen at the end of River Walk. Feeds on crustaceans, a variety of insects. Heavily impacted by fishing activities of the buffer communities. Dunham (1995) reports that fish caught locally weigh up to 7kg or more.
Bobo Mullet ***Joturus pichardi*** Trio Branch (Esselman, 2001)	Adults inhabit the upper reaches of rivers such as Monkey River, Swasey and South Stann Creek, but seasonally move downriver to brackish waters where spawning is thought to occur. An important food-fish that is impacted by local illegal fishing activities within the protected area. This herbivorous fish primarily scrapes algae from stones on the bottom with its fleshy lips, though will sometimes eat prawns.
ELEOTRIDAE	
Bigmouth Sleeper ***Gobiomorus dormitory*** Trio Branch (Esselman, 2001) *Trio Branch/Swasey (MMAP, 1992)*	A large, nocturnal, carnivorous and benthic fish that inhabits larger free flowing clear water streams. Recorded in Trio Branch (Esselman, 2001). It is generally recorded lying on the bottom in slower moving part of streams, sometimes on logs or large stones and on leaf debris or gravel.
GOBIDAE	
River Goby ***Awaous banana*** Trio Branch (Esselman, 2001)	Recorded at Trio Branch (Esselman 2001). This species prefers clear, fast flowing, well oxygenated streams.

FISH SPECIES REQUIRING VERIFICATION	
Jack Dempsey ***Cichlasoma octofasciatum*** Cabbage Haul Creek (Walker, pers. obs.)	Widespread in Belize, but normally preferring pools and swamps in the middle and lower reaches of rivers. Breeding pairs observed in the slow flowing pools of Cabbage Haul Creek at the point where it is crossed by the Access Road.
Redhead Cichlid ***Vieja synspilum*** South Stann Creek and tributaries? (Walker) East Basin (MMAP)	Observed in South Stann Creek, at the end of River Walk…however identification not yet confirmed. If confirmed, this would be a range extension to the south for this species.
Atherinella sp. Trio Branch/Swasey (MMAP, 1992)	Recorded by MMAP from Trio Branch/Swasey Branch
Rhamdia sp. Trio Branch/Swasey (MMAP, 1992) Cabbage Haul Creek (Walker, pers. obs.)	A small, shoaling catfish observed in the fast flowing riffles of Cabbage Haul Creek. Probably *Rhamdia laticauda*

BUTTERFLY SPECIES OF COCKSCOMB BASIN WILDLIFE SANCTUARY J. SHUEY (PERS. COMM. 2004)			
HESPERIIDAE		**HESPERIIDAE (CONT.)**	
Pyrrhopyginae	*Elbella scylla*	***Hesperiinae***	*Pompeius pompeius*
	Jemadia hospita		*Conga chydaea*
	Pyrrhopyge zenodorus		*Anthoptus epictetus*
	Pyrrhopyge erythrosticta		*Corticea corticea*
Pyrginae	*Heliopetes arsalte*	**Papilionidae**	
	Pyrgus adepta	***Papilioninae***	*Eurytide ilus*
	Pyrgus oileus		*Eurytides phaon*
	Aguna aurunce		*Parides eurimedes*
	Astraptes aulestes		*Parides sesostris*
	Astraptes phalaecus		*Parides panares*
	Astraptes fulgerator		*Parides erithalion*
	Autochton neis		*Battus laodamas*
	Autochton zarex		*Battus chalceus*
	Autochton longipennis		*Papilio thoas*
	Autochton bipunctatus		*Papilio cresphontes*
	Epargyreus exadeus	**Pieriidae**	
	Polygonus manueli	***Coliadinae***	*Anteos maerula*
	Urbanus tanna		*Eurema albula*
	Urbanus pronta		*Eurema nise*
	Urbanus albimargo		*Eurema lisa*
	Udranomia kikkawai		*Eurema daira*
	Eantis thraso		*Phoebis argante*
	Grais stigmaticus		*Phoebis agarithe*
	Helias cama		*Aphrissa statira*
	Antigonus nearchus		*Aphrissa boisduvalii*
	Carrhenes fuscesens	**LYCAENIDAE**	
	Mylon pelopidas	***Riodininae***	*Leucochimona nivalis*
	Nisoniades godma		*Mesosemia lamachus*
	Pachyneuria licisca		*Eurybia lycisca*
	Paches loxus		*Lyropteryx lyra*
	Ouleus fridericus		*Charis gynaea*
	Spathilepia clonius		*Charis velutina*
Hesperiinae	*Callimormus saturnus*		*Thisbe irenea*
	Remella vopiscus		*Juditha molpe*
	Remella remus		*Menander purpurata*
			Argyrogrammana
	Vehilius illudens		*holosticta*
	Lerema accius	***Lycaeninae***	*Zizula cyna*
	Panoquina evansi		*Arawacus togarna*
	Damas clavus		*Eumaeus toxea*
	Perichares philetes		*Pseudolycaena damo*

BUTTERFLY SPECIES OF COCKSCOMB BASIN WILDLIFE SANCTUARY J. SHUEY (PERS. COMM. 2004)			
LYCAENIDAE (cont.)		**NYMPHALIDAE (cont.)**	
			Archaeoprepona
Lycaeninae	*Strymon mulucha*	***Charaxinae***	*demophon*
			Archaeoprepona
	Celmia celmus		*demophoon*
			Archaeoprepona
	Mercedes demonassa		*amphimachus*
NYMPHALIDAE			*Prepona dexamenus*
Heliconiinae	*Actinote guatemalena*		*Prepona omphale*
	Dione juno		*Agrias aedon*
	Agraulis vanillae		*Siderone galanthus*
	Dryadula phaetusa		*Fountainea eurypyle*
	Dryas iulia		*Memphis oenomais*
	Eueides aliphera		*Memphis herbaceae*
	Eueides Isabella		*Memphis pithyusa*
	Heliconius charithonia		*Memphis proserpina*
	Heliconius erato	***Morphinae***	*Antirrhea miltiades*
	Heliconius ismenius		*Morpho theseus*
	*Heliconius sapho**		*Morpho peleides*
Nymphalinae	*Historis odius*	***Brassolinae***	*Opsiphanes boisduvalii*
	Historis acheronta		*Opsiphanes tamarindi*
	Smyrna blomfildia		*Opsiphanes quiteria*
	Colobura dirce		*Opsiphanes cassina*
	Anartia fatima		*Caligo illioneus*
	Junonia genoveva		*Caligo memnon*
	Chlosyne janais		*Caligo uranus*
	Anthanassa tulcis	***Satyrinae***	*Pierella luna*
	Tegosa guatemalena		*Cissia pseudoconfusa*
	Eresia clara		*Cissia labe*
	Mestra amymone		*Cissia libyoidea*
	Myscelia cyaniris		*Cissia renata*
	Myscelia ethusa		*Euptychia westwoodi*
	Catonephele mexicana		*Euptychia mollis*
	Catonephele numilia		*Hermeuptychia hermes*
			Pareuptychia
	Hamadryas februa		*metaleuca*
	Hamadryas feronia		*Pareuptychia ocirrhoe*
	Hamadryas		
	guatemalena		*Taygetis andromeda*
	Hamadryas ipthime	***Ithomiinae***	*Aeria eurimedia*
			Mechanitis lysimnia
	Hamadryas amphinome		

BUTTERFLY SPECIES OF COCKSCOMB BASIN WILDLIFE SANCTUARY J. SHUEY (PERS. COMM. 2004)			
NYMPHALIDAE			
Nymphalinae (cont.)		***Ithomiinae (cont.)***	
	Hamadryas laodamia		*Mechanitis polymnia*
	Temenis laothoe		*Ithomia patilla*
	Nica flavilla		*Episcada salvinia*
	Dynamine mylitta		*Pteronymia cotytto*
	Callicore patelina		*Greta oto*
	Adelpha cytherea		*Greta anette*
	Adelpha basiloides		*Hypoleria cassotis*
	Adelpha iphiclus	*Heliconius sapho recorded by Meerman (2001)	
	Marpesia Chiron		

Based on fieldwork by: Godman and Salvin (1901); J. Shuey (1988, 1999); Boomsma (1992); Meerman (2001); Young (2003, 2004); Schutte (2004)