Management Plan 2015-2019

Rio Bravo Conservation and Management Area

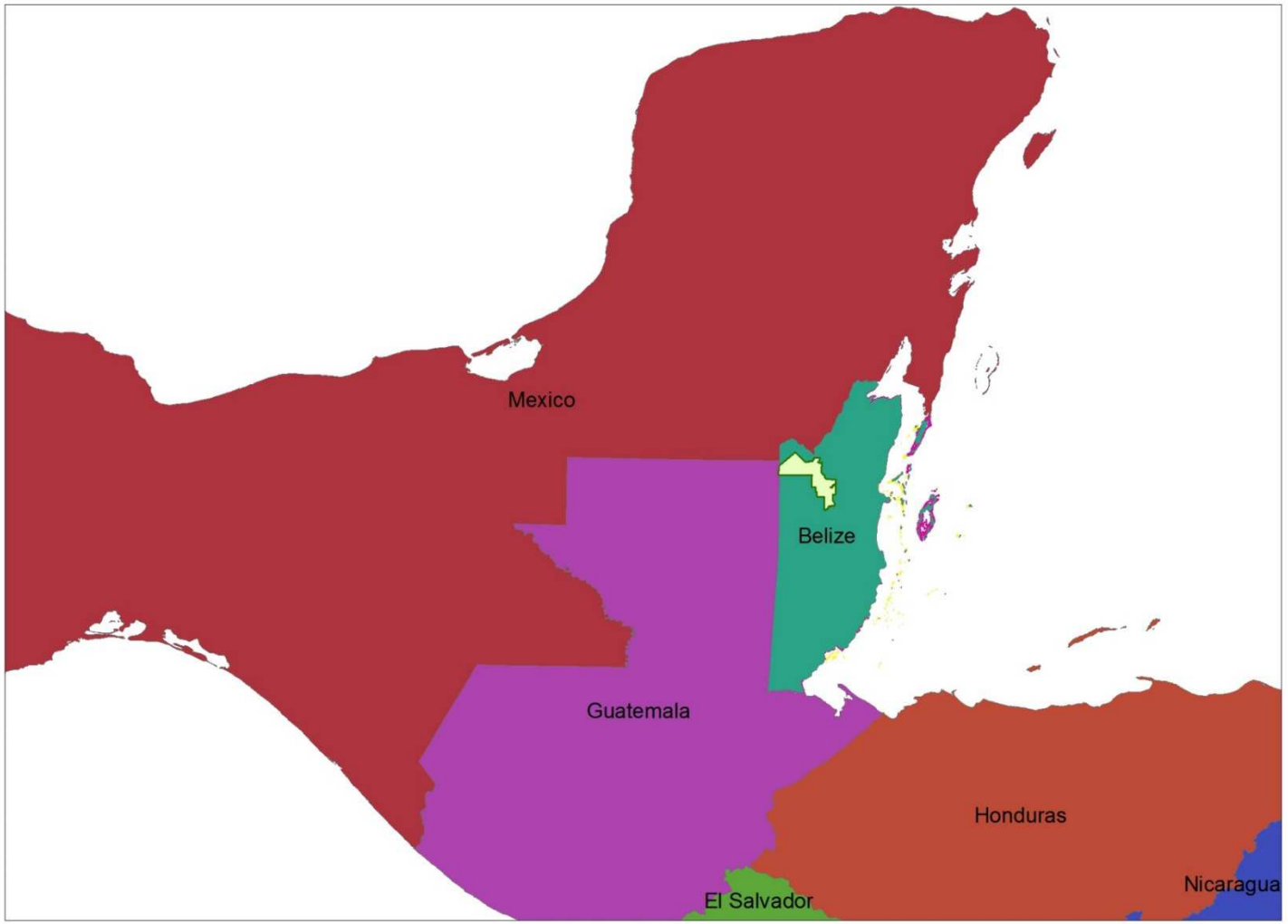
VOLUME I

Protected Area Data Sheet		
Date	24.11.14	
Name of Protected Area	Rio Bravo Conservation and Management Area	
Location of Protected Area	Orange Walk District, north-western Belize	
Date of establishment	1989	
Size of Protected Area	Acres: 254,000 (Hectares: 100,400)	
Land Tenure	Private Freehold	
Management Authority	Programme for Belize	
Affiliations / Partnerships with other organizations	Government of Belize (under formal Memorandum of Understanding)	
Number of Staff	Permanent: 35	Temporary: 10 - 28
Annual Budget (Bz$) for management of protected area	c. BZ$ 2.7 million (This is the average for 2010-2014.)	
Designation (Belize or IUCN category, World Heritage Site, RAMSAR etc.)	Private Protected Area – IUCN Category VI	
Reasons for Designation	Conservation of important forest area threatened with fragmentation and clearance	
Brief Details of Past Funding	Mix of donor agency, private donation and funding via international conservation organizations plus self-generated income	
Brief Details of Present Funding	As above	
Brief Details of Future Funding	Self-generated income prioritized, supplemented by donor/charitable support.	
List the two primary protected area objectives		
Conservation of biodiversity and cultural (archaeological) heritage		
Demonstration of sustainable management of forest resources compatible with biodiversity conservation		
List the top two most important threats to the protected area (and indicate why these were chosen)		
Unmanaged fire associated with unauthorized hunting – most extensive direct threat, with serious impacts on broadleaf forest and especially on lowland pine savannah.		
Illegal logging – the single greatest of all threats to conservation targets, affecting primarily the broad-leaved lowland forest.		
List the top two critical management activities		
'Financial sustainability strategy' – ecotourism and sustainable timber harvesting to give secure/reliable budgetary underpinning to sustain conservation management programmes		
Pine savannah and fire management – addresses key threat and most degraded ecosystem		

Name/s of assessors and people consulted: Osmany Salas, Valentino Shal, and Michael F. Somerville in consultation with senior PfB administrative and field staff

Contact details: The Executive Director, PfB, 1 Eyre St, Belize City

Location Map
Rio Bravo Conservation & Management Area



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EXECUTIVE SUMMARY

The Rio Bravo Conservation and Management Area (RBCMA) is one of the largest protected area in Belize, covering over hundred and two thousand seven hundred and ninety (102,790) hectares in the north-western section of the country. It is owned by Programme for Belize (PfB), a non-governmental organization, and managed based on the UNESCO Man and Biosphere Reserve Principle -- to conserve its biodiversity and archaeological heritage, while demonstrating sustainable use of its forest resources and contributing to the local and national economy. The RBCMA management regime corresponds to IUCN protected area category VI and complements that of the adjoining Maya Biosphere Reserve located in Guatemala.

This management plan covers the period 2015 – 2019 and is the sixth plan for the RBCMA. It was developed in consult with PfB's administrative and technical field staff and provides the basis and direction for the future management of the protected area.

The plan examines the current situation and past experiences, and sets out a more systematic approach for management actions over the coming five years, adopting the outline for terrestrial protected areas developed under the National Protected Areas Policy and System Plan (NPAPSP). This management plan forms part of many planning documents, supplemented by more detailed sectoral plans and implemented through annual work-plans developed by the programme managers.

The following statement forms the core of the RBCMA Management Goal for the next five years:

"The RBCMA is a model private protected area that maintains its biological integrity, regionally significant cultural and landscape features, and fosters a sense of civic appreciation, while providing a sustainable flow of ecological goods and services, and economic benefits to its stakeholders."

Following the NPAPSP outline for terrestrial protected areas, the RBCMA management plan is divided into 4 main sections: Section 1 provides the background and context of the protected area, and the purpose and scope of the management plan; and Section 2 gives the RBCMA's location, national and regional context, and includes its physical, biological, and cultural aspects. Sections three and four are the heart of the plan, comprising the conservation and management planning aspects, while providing for the other essential activities such as decision making, administration, resourcing, and operation of the RBCMA.

At the heart of the plan are the seven conservation targets that have been identified for the RBCMA, namely Savannah, Broad-leaved Lowland Forest, and Aquatic Ecosystem, and four others that can be considered nested targets such as the Yellow-headed Parrot, Central American River Turtle (Hicatee), Jaguar, and Bay Snook. The RBCMA is of very high conservation importance and past management has succeeded in keeping its conservation targets in overall good condition. The overarching objective for this new management planning period is thus to also maintain the conservation targets in this good state.

Based on the conservation target viability assessment, the two targets that are in the worst condition (ranked as fair) are the aquatic ecosystem (threatened mainly by agrochemicals and invasive species) and yellow-headed parrot (threatened mainly by felling of nest trees and uncontrolled/unmanaged fires). The other five targets are all in a good to very good state but are still vulnerable to the threats already mentioned plus others including poaching, oil development, roads, and illegal logging. Illegal logging is currently the single greatest threat (ranked as high), affecting mainly the broad-leaved lowland forest conservation target.

Threats to RBCMA conservation targets will be combatted through four overarching management strategies:

1. Stakeholder Outreach, Education and Advocacy
2. Ecosystems Protection and Management
3. Research and Monitoring
4. Institutional Strengthening and Management

Each of these management strategies has its associated strategic objectives and tactical objectives/actions for guiding the strategies and monitor management implementation.

- The facilitation of RBCMA outreach and awareness activities involving local communities, over the last planning period, has been minimal. One of the approaches of the **stakeholder outreach, education and advocacy strategy** would be to strengthen the relationship between PfB and the RBCMA's neighboring communities that traditionally depended on the natural resources of the area for subsistence, by 2019. This would include establishing alternative livelihood projects in the key RBCMA buffer communities; conducting regular assessments of the economic benefits of RBCMA to communities; supporting the provision of access to training and funding opportunities in agricultural best practices, creating linkages to micro-financing, agro-processing, and marketing opportunities; develop entrepreneurship through partnership with BELTRAIDE,

etc.; and developing and instituting a disaster relief plan for Lemonal and San Carlos by 2017.

Another aim would be to develop and implement a public awareness strategy that focuses on the ecological importance and economic contributions of the RBCMA to make local communities and the general public understand the ecological and economic value of the RBCMA and its resources. To accomplish this, social media platforms can be utilized to bring awareness to the Yellow-headed Parrot programme and other conservation efforts within the RBCMA. Other management actions could include highlighting the tourism benefits and potential of the RBCMA, as well as the potential for NTFPs and alternative livelihood initiatives for communities that surround the RBCMA, and utilizing the print and electronic media to highlight the RBCMA management challenges as well as the opportunities.

The development and implementation of an environmental education strategy for the RBCMA is also key to building knowledge, skills, and experience that would foster appreciation for nature and protected areas among the buffer communities. This can be accomplished through the development and implementation of a community education and outreach campaign to develop appreciation for flora and fauna; establishment of a volunteer program to support the various RBCMA programs; and conducting one annual training for neighboring farmers on the proper use of pesticides and fertilizers to reduce chemical runoffs around the RBCMA.

Another major objective under this management strategy would be to foster an understanding among policy makers and community leaders about the importance of maintaining the RBCMA's natural resources, to ensure that enabling policies are in place and applied for their protection and effective management. Specific management actions include lobbying the government for the formulation and/or enactment, or updating of legislation and regulations pertaining to the harvesting of and trade in endangered species (e.g., Mahogany); lobbying the government for the formulation and/or enactment of legislation and regulations pertaining to the use of sawmills; and continuously lobbying for improved policy and legislation as it relates to law enforcement and institution of higher penalties for trespassing, illegal logging, and poaching in private protected areas.

- The **ecosystems protection and management strategy** will focus on instituting a strengthened and expanded resource protection and enforcement program at

the RBCMA. This is one of the main objectives and will help to deter and eliminate encroachments and illegal incursions into the protected area. This objective aims to develop a ranger protection and surveillance plan, install two additional ranger/conservation posts at strategic locations in the San Felipe savannah and Lemonal area, reinforce boundary demarcation through the use of proper signage, and acquire new patrol vehicles and equipment, among others.

Another major objective of this management strategy is to develop and institute a fire management program by the end of 2016, guided by the National Fire Management Strategy, to reduce the frequency of uncontrolled/unmanaged fires, which have the potential to affect the population structure and composition of native species, particularly the Caribbean Pine. Major management action include updating the fire management plan, developing a hurricane response plan, and establishing and training a community fire brigade (rapid response team) that will act as a support in RBCMA and the communities.

Strengthening the savannah protection program to reduce threats to this ecosystem is also a main priority. This will entail developing and implementing a Yellow-headed Parrot (YHP) conservation program, including developing a media awareness campaign on the YHP and the RBCMA, improving monitoring of YHP nests/breeding success, and developing a YHP adopt-a-parrot initiative, among others.

The broad-leaved forest management program could be strengthened through reducing illegal logging within the RBCMA and directing funds from confiscated logs directly for fuel for patrols. The broad-leaved forest ecosystem is affected by the most threats compared to the other RBCMA ecosystems, including timber extraction, illegal logging (the highest ranked of all the other conservation target threats), illegal agriculture, poaching of wildlife, uncontrolled burning, and road infrastructure and oil development.

Strengthening the management and protection of the aquatic ecosystem within the RBCMA is essential to respond to the increasing threats of pollution (pesticides and fertilizers) and invasive species that could affect the population of Central American River Turtles (Hicatees) and cichlids. Many of the water resources are outside the boundaries of the RBCMA and thus beyond the control of PfB, so their management becomes difficult to adequately address. Some important management actions include implementing a training session with the Pesticides Control Board (PCB) for farmers in pesticides and fertilizer use, implementing an invasive species education and outreach programme,

developing and implementing a water quality monitoring program by 2016, and conducting fish surveys in the New River Lagoon and associated waterways.

By 2019, this management strategy also hopes to develop and implement a water conservation program to optimize the ability of the RBCMA hydrological systems to catch and store water. Ideally, this will be achieved through maintaining adequate protection efforts to prevent deforestation, establishing partnerships with local authorities, instituting an education program on watershed management and protection, monitoring forest cover change around the RBCMA, and working with land holders for forest connectivity.

- Past RBCMA research activities have been mostly opportunistic and indirect, and occasionally may be steered by a particular donor-aided project. An effective **research and monitoring strategy** is therefore recognized as a necessity, and that can serve the needs of the other management strategy programmes. Currently, adequate research facilities do not exist at the RBCMA, and PfB's support and field assistance to researchers might be limited due to budgetary constraints. Presently, the PfB offers a discounted rate to researchers who want to conduct research within the RBCMA, and this should be maintained.

  A major objective under this strategy would include developing and instituting a research and monitoring program for the RBCMA by 2017 to integrate science-based decision-making for adaptive management of the RBCMA. This would include conducting feasibility studies on the production of NTFP goods and services; developing and implementing standardized biodiversity monitoring protocols in liaison with other national, regional and international initiatives; developing and implementing a fish survey monitoring programme; promoting the field stations as central bases for research activities in the RBCMA; facilitating research into population structure and composition of key wildlife species, in particular the Mahogany, Jaguar, Yellow-headed Parrot, Central American River Turtle, and cichlids; and developing and implementing a microclimate change monitoring plan for RBCMA target habitats.

  There is also the need to develop and institute a monitoring, reporting and verification (MRV) system to maintain Rainforest Alliance Forest Stewardship Council (FSC) certification of the RBCMA's timber harvesting operation. Ideally, this would be done through monitoring of High Conservation Value Forests (HCVFs) and development of a database and format for monitoring and reporting activities.

- A major objective of the **institutional strengthening and management strategy** is to develop a resource mobilization strategy for the RBCMA by mid-2016. This will help to diversify the RBCMA's funding base and ensure the continuity and sustainability of its management programs, and will entail strengthening the tourism management and development programme (through conducting research on the tourism potential of the RBCMA, development of the archaeology sites, development of Hill Bank to showcase its colonial history, development of a Creole Heritage Center for St. Paul's Bank, and recruiting a public relations officer to focus on building the image and culture of PfB and the RBCMA). Other management actions under this objective includes developing and implementing a financial sustainability and fundraising strategy for the RBCMA; exploring innovative financing mechanisms, such as carbon sequestration and REDD+; identifying and maintaining donor agencies and cultivate/strengthen donor relations; and strengthening the implementation of the sustainable timber management program.

  Other objectives under this management strategy include improving the branding and marketing of the RBCMA to generate greater support for the RBCMA and its management programs (including developing and implement a marketing strategy for the RBCMA); managing and enhancing the human resources of the RBCMA to optimize employee performance in service of the RBCMA's conservation objectives (including conducting a comprehensive training needs assessment and developing and implementing a training program for RBCMA staff); strengthening staff recruitment and retention for the RBCMA to ensure that RBCMA has sufficient staff for effective management and biodiversity conservation; developing and/or strengthening the equipment procurement system for the RBCMA to ensure adequate administration, infrastructure and planning (including developing and implementing a five-year infrastructure development and equipment procurement plan); and conducting annual review of management activities to ensure compliance with the management plan and make adjustments as necessary.

- **Contingency plans for oil and roads** would be fairly new to the RBCMA management planning process, and is necessary should there be significant oil finds within or adjacent to the protected area. Ideally the plans would address the opening up of new habitats due to seismic survey lines, road opening and usage, increasing access to illegal activities, chance of fires due to increased human presence, potential reduction of the areas tourism potential as a result of

loss of charismatic wildlife species, and potential contamination of surface and groundwater supplies as a result of oil spills or fracking activities.

ACKNOWLEDGEMENTS

Special appreciation goes to the staff members of Programme for Belize and, in particular, the Executive Director, Edilberto Romero, for going beyond the call of duty to support our work throughout the management planning process.

Thank you also to the Ramon Pacheco for providing us with the maps that were needed for the management plan, as well as sharing his extensive knowledge pertaining to the RBCMA's forestry and biodiversity management operations.

Special mention goes to Ruby Nicholas and the staff of the Tourism Development Unit for providing the financial and tourism information that was required.

We extend our appreciation to the field staff of the RBCMA who contributed some of their valuable time to share their ideas, views, concerns and aspirations pertaining to the management of the RBCMA. Your dynamic participation at the various meetings was invaluable to the planning effort, and resulted in the updating of the RBCMA managemnent plan for the next five years and beyond.

And last but certainly not least, we extend our gratitude to the Protected Areas Conservation Trust for its financial support.

ACRONYMS

APM	Administration & Planning Manager
asl	Above sea level
ATNP	Aguas Turbias National Park
BEC	Belize Estate and Produce
CAP	Conservation Action Planning
CEOO	Community Education and Outreach Officer
Cm	Centimeter
CONAP	Comision Nacional de Areas Protegidas
CPA	Country Poverty Assessment
Dbh	Diameter-breast-height
ED	Executive Director
ERA	Eco-regional Assessment
EU	European Union
FD	Finance Director
GDP	Gross Domestic Product
GPS	Global positioning system
ICR	Indirect Cost Rate
IUCN	World Conservation Union
METT	Monitoring Effectiveness Tracking Tool
MOU	Memorandum of Understanding
NGO	Non-governmental organization
OPM	Office of the Prime Minister
p.a.	Per annum
PfB	Programme for Belize
RANP	Rio Azul National Park
RBCAP	Rio Bravo Climate Action Project
RBCMA	Rio Bravo Conservation and Management Area
RDEG	Rancho Dolores Environmental and Development Group

REDD	Reducing Emissions from Deforestation and Forest Degradation
SCWS	Spanish Creek Wildlife Sanctuary
TC	Technical Coordinator
TDU	Tourism Development Unit
VCS	Verified Carbon Standard
YHP	Yellow-Headed Parrot

1. INTRODUCTION

1.1 BACKGROUND AND CONTEXT

The Rio Bravo Conservation and Management Area (RBCMA) was established in 1989 as a private reserve to conserve forested land in north-western Belize threatened with fragmentation and clearance following the break-up of the Belize Estate and Produce (BEC) holdings in the area. It now covers 254,000 acres (102,790.56 ha's), secured through a series of transactions involving the original BEC property which also includes Yalbac, Gallon Jug and parts of the New Hope area.

The RBCMA is owned and managed by Programme for Belize (PfB), a local NGO, under the terms of a formal Memorandum of Understanding with the Government of Belize. The management regime is based on ecosystem protection and sustainable use of forest resources, therefore corresponding to an IUCN category VI protected area. The area is also an important component of the Belize National Protected Area System and a natural cross-border extension of the Maya Biosphere Reserve in Guatemala.

1.2 PURPOSE AND SCOPE OF PLAN

The primary purpose of the management plan is to set out the strategic framework for site management over the five year period from 2015-2019. This is the sixth plan for the RBCMA, the antecedents being an initial establishment of management principles in 1990, a provisional plan for their application in 1992, and full plans in 1995, 2000 and 2006. Like the previous management plan, the methodology used for this planning cycle also follows that adopted for general use in the national protected areas system (Wildtracks 2005).

The management plan is a guiding document, setting out the main directions for RBCMA management over the planning period while retaining operational flexibility in implementation. It is therefore part of a suite of documents with operations detailed in:

- Sectoral plans for the larger, more complex, programmes
- Annual plans developed by the programme managers and tailored to meet terms of individual funding agreements as well as meeting organizational needs

Adaptive management takes place at this level, with the overall management plan assuring continuity of purpose and coherence between strategies. It is based on the founding principles of RBCMA management – to preserve biodiversity and archaeological heritage while producing sufficient return from sustainable resource use

to pay for its perpetual care and to participate in the economic development of the surrounding area.

The management plan also serves two subsidiary but extremely important functions as:

- A reference document summarizing information on the ecological and socio-economic context within which management strategies are developed
- An aid to fund-raising, assuring supporters (funding agencies, donors, partners) that their input forms part of a coherent development agenda and facilitating identification of the most strategic areas for assistance

2. CURRENT STATUS

2.1 LOCATION

The Rio Bravo Conservation Area (RBCMA or Rio Bravo) covers 254,000 acres (102,790.56 ha) in the Orange Walk District of north-western Belize, centered on coordinates 17°45'N 88°50'W. It is therefore one of the largest protected areas in the country, covering 4.4% of its total land area and some 21.2% of Orange Walk District. The RBCMA lies in the international frontier, so linking directly onto the Rio Azul National Park in Guatemala as well as Aguas Turbias National Park (which also adjoins the international frontier with Quintana Roo, Mexico), and Spanish Creek Wildlife Sanctuary. To the south and east it shares property boundaries with Gallon Jug and Yalbac, to the north with the Blue Creek Mennonite Community, and to the east with the San Felipe and New Hope areas.

2.2 REGIONAL CONTEXT

The area is part of a trans-boundary complex of protected areas including the Calakmul and Maya Biosphere Reserves (respectively in Mexico and Guatemala) and lying within a forest bloc extending over 4 million acres (1.5 million ha), the largest remaining forested area in Central America. The core zones (including the Rio Azul National Park) of the Maya Biosphere Reserve are designated World Heritage Sites on combined cultural and natural criteria. The RBCMA shares these qualities. Management as a functional extension of the Maya/Calakmul complex is reinforced by management zoning on the Biosphere Reserve model.

The area is therefore not only important in itself but also in maintaining trans-boundary biological connectivity. Its qualities on a regional scale are therefore recognized in the Ecoregional Assessment (ERA) for the Peten-Vera Cruz area (further strengthened by the presence of the lowland pine savannahs as a characteristic but restricted ecosystem on a regional level) and the site is integral to the Mesoamerican Biological Corridor programme. Conservation management on the RBCMA thus forms part of tri-national conservation strategy, formalized under international agreement. As a key site in the National Protected Area System, the Rio Bravo also plays an important role in meeting national commitments to the Convention on Biodiversity.

2.3 NATIONAL CONTEXT

2.3.1 LEGAL AND POLICY FRAMEWORK

The Rio Bravo is a private protected area, secured through a series of land purchases, and land donations between 1989 and 1998. It is owned and managed by Programme for Belize (PfB), established in 1988 for this specific purpose and operating under the terms of a formal Memorandum of Understanding with the Government of Belize. In effect the PfB is a private body with a public trust, dedicated to holding the land in perpetuity to conserve national heritage and contribute, through sustainable management of the area, to the economic development of northern Belize. In return, the government waives land taxes. The terms of the MoU define a management regime designed to ensure long-term protection and maintenance of biological diversity while at the same time providing a sustainable flow of natural products and services, corresponding to an IUCN category VI managed resource area. The management approach is, however, very conservative with about 60% of the area under full protection.

The RBCMA is a very important element within the National Protected Area System Plan (see Section 2.3.3.). It has also been consciously designed to maximize its importance in maintaining biological connectivity at a landscape level. This not only maintains the linkage with the Petén but extends it into north-central Belize as a"bridge-head" to maintain corridor linkages across the northern coastal plain, into the lower Belize Valley, and down the New and Hondo Rivers. It therefore plays a role in the Mesoamerican Biological Corridor Programme at a national as well as regional level. The MoU specifically states that the management regime must further national policy towards protected areas and proper resource use.

2.3.2 LAND TENURE

PfB holds unencumbered title to the land and there are no other rights or claims to the use of resources on the property. The terms of the MoU govern its use – land held in trust must be managed for biodiversity conservation and sustainable use of natural resources but with wide scope of action to achieve those ends. If PfB is for any reason unable to continue in that duty, its successor must follow the same objectives, so assuring permanence of management regime.

2.3.3 EVALUATION OF PROTECTED AREA

The Rio Bravo is the highest-scoring single site within the National Protected Area System on both biophysical and management/land use criteria (Meerman, 2005, summarized in Table 1).

Table 1: RBCMA - National PA System Site Scores on biophysical characteristics (Meerman, 2005)

Characteristic	**Max score**	**Site score**	**Comment**
Location/connectivity	10	10	Key contributor to the main Maya Biosphere Reserve linkage and to northern Belize corridors.
Size of area	15	15	> 2000 acres
Special habitats	12	10	Includes 10 ecosystems under-represented in national system.
Special features			
- Refuge/source	10	10	Extensive core zone maintaining viable populations in characteristic communities
- High scenic values	5	4	Important archaeological sites ; the New River Lagoon
- Environmental services	5	2	Protects a significant part of the headwaters of the New and Hondo river systems.
State of habitat	10	8	In good condition but partly modified through extractive use.
Special species			
- breeding/nursery	15	15	Important breeding populations
- roosting/feeding	8	8	Important breeding/foraging areas
- Belizean endemics	8	8	Belizean endemic species present
- Endangered species	6	6	Endangered species present
- Critical habitat	4	4	Critical habitat for endangered species
Total Score	**108**	**100**	
% Score		**93**	**Very high**

The principal features conferring high value (and developed further in later sections) include:

- Key role in biological connectivity at a regional level
- Size: The evaluation gives a maximum score to any area above 2000 acres in extent. The RBCMA is over 150 times that size, conferring special importance by conserving ecosystem processes operating at a landscape scale. This is further

enhanced by being part of a single forested bloc including the neighbouring Yalbac, Gallon Jug, Aguas Turbias National Park and Colby property

- Special habitats: 16 major habitats are recognized in the area. Of these (Table 2), the RBCMA contributes over 90% of the national protected area coverage of four types. It also makes a significant contribution in conserving extensive tracts of a further three that are poorly represented (i.e. > 25% shortfall on target coverage) and another one that is under-represented (i.e. >10% shortfall on target coverage) in the national system
- An important wildlife refugium, serving as a source area for the surrounding region. This is essentially a function of size, allowing the area to support viable populations, characteristic of the region. Many of these species are of conservation concern and under pressure elsewhere, with the area acting as a source of replenishment
- Although the flat to rolling terrain over much of the area is not particularly scenic, the sheer extent of good-quality natural habitat is exceptional while the New River Lagoon -- the largest inland water-body in the country -- is outstanding. The area also contains an array of archaeological sites including La Milpa, one of the largest Maya sites of the Classic period
- A large proportion of the headwaters of the New River lie within the eastern Rio Bravo and a substantial area of those of the Hondo (Rio Azul, Rio Bravo, Booth's River) lie in the west. The area can therefore be assumed to provide significant environmental services in protecting these watersheds.

Table 2: Contribution of the RBCMA to ecosystem coverage in the National PA System[1]

Ecosystem	National area	Total area protected	RBCMA area	% Target coverage	% off target	RBCMA contribution to national protected coverage
Tropical evergreen seasonal broadleaf lowland forest over limestone – 1A2a(1) (b)K	84181	20649	174	40	-15	Minor contribution
Tropical evergreen seasonal broadleaf forest over calcareous soils – central eastern variant - 1A2a(1)(b)K - CE	147368	18229	10928	40	-28	Important contribution – 60% of total protected area of poorly represented type
Tropical evergreen seasonal broadleaf forest over calcareous soils – central western variant - 1A2a(1)(b)K - CW	133983	63914	63164	50	-2	Very important contribution – only area with significant representation
Tropical evergreen seasonal broadleaf forest over calcareous soils – Tehuantepec-Petén variant - 1A2a(1)(b)K - TP	337577	89538	82877	50	-23	Very important contribution – 93% coverage of under-represented type
Tropical evergreen seasonal broadleaf lowland forest on poor or sandy soil – 1A2a(1)(b)S	65910	20544	319	50	-19	Small contribution
Tropical evergreen seasonal broad-leaved alluvial forest – 1A2f (2)(a)	34485	6825	6825	50	-30	Very important contribution – only area with representation of poorly represented type
Tropical evergreen seasonal broadleaf swamp forest – high variant – 1A2.g.(1)(a)-T	305539	27977	16414	40	-31	Important contribution – 58% of total protected area of poorly represented type.
Caribbean mangrove scrub: freshwater mangrove scrub – 1A5A(1) b	28112	14736	2678	50	+2	Most inland representation
Evergreen lowland broad-leaved shrubland dominated by leguminous shrubs – IIIA1b(a) LE	78295	37644	35444	40	+8	Very important contribution – 95% of national protected coverage, giving good protected status.
Evergreen lowland broad-leaved shrubland –	51470	7203	3463	30	-16	Useful contribution – 47% of protected

[1] Areas in acres – derived from Meerman 2005

Miconia variant – IIIA1b(a) MI						coverage of under-represented type
Broadleaved lowland disturbed shrubland – IIIB1b(a)2	45651	10622	519	20	+3	Anthropogenic, largely reverting to high forest.
Deciduous lowland riparian shrubland of the plains – IIIB1b(f)P	11122	2543	6	40	-17	Contributes – patches mostly too small to map.
Open water (lake) – SA1b(4)(b)	15909	3830	63	60	-36	Minor contribution by smaller lagoons (NB New River Lagoon technically not part of RBCMA)
Short-grass savannah with scattered needle-leaf trees – VA2a(1)(2)	218739	41718	15548	40	-21	Useful contribution – 37% of coverage. Areas reverting under management to closed pine forest, also under-represented in national PA system.
Short-grass savannah with shrubs – VA2b(2)	251561	66103	7520	20	+6	Contributes.
Tropical lowland tall herbaceous swamp – VII B 4	92947	27069	11794	30	-1	Useful contribution – 44% of total protected coverage.

2.3.4 SOCIO-ECONOMIC CONTEXT

This section outlines the socio-economic context in which the protected area operates, both at local and national levels. Economic and social factors are assessed to highlight the actual and potential bearing they may have on the integrity and management of the RBCMA.

2.3.4.1 NATIONAL ECONOMY AND REGIONAL CONTEXT

Overall, Belize is a small open economy that is supported primarily by natural resources with major sectors being agriculture (citrus, sugar, bananas, fisheries), manufacturing (including petroleum) and tourism (tertiary sector). This dependence on rich but fragile terrestrial and marine ecosystems underscores the importance of sound environmental management and ensuring sustainable development priorities. Over the last 30 years the economy has been slowly shifting over from "traditional" commodity exports to service exports mainly through tourism and petroleum exports[2]. A historical review since Independence shows that Belize's economic growth has been driven mainly by fiscal stimulus which shows up in regular boom and bust cycles linked with booms in public spending[3], credit to the private sector, and deterioration in the current account. Belize's current GDP is estimated at BZ$3.2 billion with GDP per capita[4] at about BZ$9,300.00[5]. Belize's real GDP growth however has been on a declining trend since 2003. It has showed some signs of recovery and was at 5.3% in 2012. This however is still significantly lower than the position in 2003 when it was a 9.3%. Real GDP growth is currently estimated at 0.7%[6].

Though physically located within the northern district of Orange Walk, the RBCMA is located within the complex interactions of important national sectors of the economy identified. As can be expected, the national economic sectors and context is reflected in those sectors that have a direct bearing on the RBCMA. These sectors specifically include a) agriculture, b) forestry, c) tourism, and d) petroleum. Of these four, the agriculture sector poses the most significant set

[2] BNE wells have plateaued and oil production and exports are now on a declining trend.

[3] This trend continues now with extensive public spending supported by the Petro-Caribe Initiative sponsored by Venezuela.

[4] An approximation of the value of goods produced per person in the country, equal to the country's GDP divided by the total number of people in the country.

[5] Central Bank of Belize. Major Economic Indicators Table, 2013.

[6] Ibid

of challenges to the RBCMA especially in terms of landscape connectivity, habitat perseveration and maintenance of biodiversity in the buffer areas. The least significant is petroleum, which for the most part is currently focused only on exploratory activities. This of course could change quickly if and when there is a discovery that is deemed commercially viable.

There is significant agricultural production in the region where the RBCMA is located and, in several instances, productive lands directly abut the protected area. The agriculture production is driven mainly by intensive agro-pastoral holdings by members of the Mennonite communities of Blue Creek, Shipyard and Indian Creek. Agricultural products and commodities produced in the area include mainly grains, vegetables and livestock. Other agricultural activities include sugar cane farming in the south end of the sugar cane belt of northern Belize.

Forestry activities, mainly timber extraction, are other important economic features of the area. These activities are mainly undertaken by adjacent landholdings who own large acreage of lands which they manage in line with sustainable forest management approaches. As noted elsewhere, the RBCMA indeed was once part of a large timber operation. There is a portion of the protected area where timber is being sustainably harvested by PfB under certification by the Forest Stewardship Council (FSC). The timber harvested is sold to local saw mill operators and manufacturers of furniture and other wood products.

There is also a growing tourism sector in the region. Tourism remains one of the main engines of growth in the Belizean economy and the principal source of foreign exchange for the country. Locally, the nearby archeological site of Lamanai brings in hundreds of mainly foreign tourists annually to the area. In the south of the RBCMA, several Belize River Valley Communities have established a community-based protected area called the Community Baboon Sanctuary which attracts many visitors, locals and foreigners alike. Within the RBCMA itself, PfB has established the La Milpa Eco-Lodge which also attracts foreign visitors keen on enjoying a nature-based experience. A private eco-resort, namely Chan Chich Lodge located in Gallon Jug, also draws private guests to the area. While the tourism sector in the area is relatively small compared to other areas of the country, the full potential of the area is yet to be fully realized.

An emerging sector is the petroleum sector which saw commercial production of oil starting in 2006 with Belize Natural Energy (BNE) Ltd. making the first commercial find in Spanish Lookout, Cayo District. A significant portion of the RBCMA is currently licensed for exploration to Maranco Belize Ltd. and the remaining portion to the Blue Creek Exploration Ltd (now the New World Oil and Gas Ltd). There have been several exploratory tests conducted but to date no commercial find has been identified. Nonetheless, in the event that a commercial discovery is made, it will have both direct and indirect impact on the RBMCA and its management.

2.3.4.2 LOCAL COMMUNITY LIVELIHOODS

Aside from some of the northern Mestizo communities being involved in sugar cane production at a commercial scale, most of the remaining agricultural activities of local communities in both northern and southern areas are small scale. Most of the commodities produced are generally for household consumption with the excess being sold for extra income. There are some cash crops and livestock produced by the same buffer communities. Aside from land cultivation for agriculture, communities especially in the southern area exhibit considerably more dependence on forest resources both inside and outside of the RBCMA. An important source of household income for many residents in the southern region is remittances from relatives abroad, especially from the United States of America. The depressed economic growth and activities of communities in the Belize River Valley has been noted by the Ministry of Rural Development in its Belize District Development Plan.

2.3.4.3 HUMAN SETTLEMENTS & ADJACENT LANDS

There are several local communities, private landholdings and even other protected areas that are adjacent to the RBCMA (Table 3). In the north are five Mestizo and three Mennonite communities. In the south are eight Creole communities from the Belize River Valley. Together these villages have a combined population of about 9,597 persons made up of approximately 2,089 households. As can be inferred from the table below, southern Creole communities have lower population densities as compared to other communities in the area.

Table 3: Human Settlements Adjacent to the RBCMA[7]

Village	District	No. of Households	Population
Northern Communities			
August Pine Ridge	Orange Walk	400	1,794
Indian Church	Orange Walk	66	267
San Carlos	Orange Walk	29	138
San Felipe	Orange Walk	332	1,499
Trinidad	Orange Walk	145	570
	Sub-total	***972***	***4,268***
Mennonite Communities			
Blue Creek	Orange Walk	111	407
Indian Creek	Orange Walk	No data	No data
Shipyard	Orange Walk	621	3,345
	Sub-total	***732***	***3,752***
Southern Communities			
Bermudian Landing	Belize	43	183
Double Head Cabbage	Belize	102	406
Flowers Bank,	Belize	31	121
Isabella Bank	Belize	37	143
Lemonal	Belize	41	169
Rancho Dolores	Belize	48	217
St. Paul's Bank	Belize	37	153
Willows Bank	Belize	46	185
	Sub-total	***385***	***1577***
TOTAL		**2,089**	**9,597**

In addition to the rural communities, there are several protected areas that are adjacent to or in the vicinity of the RBCMA. These include the a) Aguas Turbias National Park (ATNP), a statutory protected area under the management authority of the Forest Department, b) Rio Azul National Park (RANP), a cross-border protected area under CONAP, the Guatemalan national park authority, and the c) Spanish Creek Wildlife Sanctuary (SCWS) managed by the Rancho Dolores Environmental and Development Group (RDEG), a community-based organization. There is shared and common interest between PfB and all three entities in the good management of their respective protected areas. PfB has assisted in developing a management plan for the ATNP and attempts to cover the area under its protection

[7] Source: Statistical Institute of Belize, 2010

programme. It also assisted the Rancho Dolores group in establishing the Spanish Creek Wildlife Sanctuary and cooperates with CONAP on regional issues.

There are also several adjacent large private land-holdings that retain extensive forested lands in mixed systems that include combinations of extractive use (primarily timber), tourism and agriculture. These properties include: a) the Colby property, b) Gallon Jug, c) Yalbac, d) Spanish Lookout Community property, and e) the New River Enterprises (NRE) 'enclave.' While the Gallon Jug properties remain in private hands, the ownership has changed recently after Gallon Jug divested itself of all but 30,000 acres of its original holdings to Yalbac. Yalbac on the other hand has sold some of its property to Spanish Lookout Mennonites of which 18,000 acre is adjacent to the southern tip of the RBCMA. A portion of this particular area has already been cleared for cultivation and the entire area will likely be cleared in a short period for farming activities.

Both the adjacent private properties and protected areas play a very important role in ensuring landscape connectivity and change in land use could have repercussions on the viability of the area, notably for species with wide ranges at low density such as jaguars. The PfB maintains a close business relationship with New River Enterprises (NRE) for timber supply and has purchased substantial tracts of land from them such as the NRE enclave near Governor Creek. Relationships with other land owners are neutral, mainly concerning practical arrangements (such as road maintenance) between neighboring properties. It should be noted, however, that the owners of Gallon Jug played a key role in the establishment of the RBCMA and facilitated the first land acquisition.

2.3.4.4 SOCIAL DEVELOPMENT

All communities that are adjacent to the RBCMA are all officially recognized as rural settlements. While the population of the country is divided almost equally between urban and rural areas, the rural areas generally lag behind in social, economic and infrastructural development. The Country Poverty Assessment (CPA) 2010[8] shows that 43% of the national population falls below the official poverty line of which 16% are considered indigent. Rural Belizeans are almost twice as likely to be poor as compared to urban Belizeans. Poverty is most pronounced among agricultural workers including small scale and subsistence farmers and people with unskilled jobs as they are more likely to be poor or indigent. The buffer communities of the RBCMA to varying degrees meet this social characterization.

[8] Country Poverty Assessment, Ministry of Human Development. 2010.

While demonstrating considerable interaction and dependence on the natural resources, several rural communities in the Belize District including those in the southern region of the RBCMA can be considered peri-urban extensions of an urban center as many residents commute to work mainly in Belize City. This additional layer of the social fabric has affected growth in the area as residents depend on amenities, services and markets available to them a short distance away. This limits the need to invest locally within their communities.

Nonetheless, all communities that are adjacent to the RBCMA have access to important social services such as primary education and health services. Health services are either available within the community or within a maximum of one hour travel time. There is access to telecommunication services though access to potable running water remains a challenge mainly for southern River Valley communities. A current government project underway should address this situation very soon. Rural communities in the area enjoy a high level of citizen security with a low crime rate.

2.3.4.5 CULTURE AND ENVIRONMENTAL VALUES

The forest and its uses continues to form a fundamental aspect of the culture of Creole communities in the south having lived in the area for a very long time. Their historical relationship with forest sector (mainly Mahogany extraction) in the area extends back for over a hundred years. While there is no longer the level of extraction that once was, the communities remain dependent on the forest and forest resources as a part of their livelihoods strategies. Their cultural identity is tied to their relationship with the natural environment. Communities continue to use it a source of food, materials for local construction and health and wellness. Northern Mestizo communities on the other hand lament the significant loss of forest cover and biodiversity in the Orange Walk district over the last 30 years. All their lands have been parceled and privatized to community members who use them for sugar cane production or cattle which invariably leads to deforestation. Having all their community lands privatized and mostly deforested means that their dependence on forest resources due to unavailability.

Meanwhile, Mennonite communities generally see the land mainly as an input in the agricultural production process as they are heavily engaged in large scale industrial agriculture. They are of the view that protected areas should be concentrated on hilly and mountainous areas while open areas and flat land should be made available for farming. Their pattern of land use has contributed to deforestation in the general area of the RBCMA. They are fully dependent on farming rather than on the forest resources. While they do benefit from ecosystem goods and services from the RBCMA, the connection between the protected area and their productive activities seem to be under-appreciated.

2.3.4.6 STAKEHOLDERS OF RBCMA

In assessing the ecological services and benefits of and the socio-economic relationships with the RBCMA the following key stakeholders were identified and classified according to organizational interests and characteristics.

- **Government of Belize**

The sheer number of government ministries and agencies that have an interest in the RBCMA makes the Government of Belize a significant stakeholder of the protected area. This is due to the unique relationship that Programme for Belize has with the government in terms of the ownership and management of the RBCMA and characteristic of the RBMCA itself as a protected area of national signficance. The RBMCA is entrusted to PfB for management with certain rights and privileges in the interest of ecological conservation and the society. There are several important Ministries that sit directly on the Board of the PfB in addition to other key departments such as the Forest Department having a direct regulatory and oversight role in relation to the protected area and forest management. The Forest Department for example is responsible both for terrestrial protected areas and for timber resources and therefore has a substantial interest in the management of the most important private reserve in the country and the only area with a forest management regime recognized through certification to meet highest international standards. The interest of the Ministry of Finance lies in the extent of the area placed in protective management and in the waiver of land taxes under the MoU. Representatives of both government bodies therefore have ex officio seats on the Board of Directors. The management of the RBCMA is meant to contribute to national policy in natural resource management.

Beyond the conservation consideration, the RBCMA has been assigned as an oil prospecting block to petroleum companies. This is an extremely important consideration for the management of the RBCMA given that all terrestrial protected areas are being licensed for oil exploration. The Government of Belize has had a history of support to the RBCMA however its current oil exploration policy in protected areas may be incongruent with the vision of the RBCMA. This is a key issue that will need serious attention and dialogue in order to resolve it.

- **Partners and Donors**

While funders in general are important to the continued management of the RBCMA, the partners are donors being considered here are longstanding partners who have invested heavily in establishing the RBCMA including the purchasing of land. The Rio Bravo Climate Action Project (RBCAP) has continuous support from The Nature Conservancy and donors who now have vested interests in the carbon sequestration project and its related rights and privileges. The land on which the RBCAP is being implemented is part and parcel of the RBCMA and as such these stakeholders have an interest in the overall management of the RBCMA.

- **Adjacent Property Owners**

There are several large private land-holdings adjacent to the RBCMA that effectively act as buffers and allow for there to be a large contiguous area that has no significant permanent human settlements. There are some areas of the private landholdings that are under use and cultivation. In general these properties have or potentially have significant level of influence over the RBCMA mainly through on-going protection and control of access to the area. These are positive for the most part as they help to safeguard ecosystems across the region. While the land owners do not have significant interests in the RBCMA itself future land use regimes instituted on these adjacent properties can have negative repercussions on the RBCMA. As noted elsewhere, a new comer to the area is the Spanish Lookout Mennonite community that has purchased 18,000 acres of land from Yalbac and other lands adjacent to the RBCMA. The Mennonites' use of this land could have long term effects on the integrity of the RBCMA.

Even though it is across an international border, the Rio Azul National Park in Guatemala managed by CONAP is an important connection to the RBCMA as it is held as a conservation area with World Heritage and Biosphere Reserve core zone status. This park is the main point of connectivity between RBCMA and the greater Peten Department of Guatemala both of which are complementary to each other in terms of biodiversity conservation.

- **Industry/Business Interests**

The two main categories of private sector enterprises that have a direct interest in the RBMCA are the timber-related enterprises and petroleum companies. PfB operates a sustainable forestry program under which timber is harvested and sold. Local timber product manufacturers benefit directly from raw timber extracted from the RBCMA which are then processed into furniture. The two largest timber merchants/manufacturers in Orange Walk and one of the largest in Shipyard, with a combined workforce of over 100 benefits from timber harvested at the RBCMA. It is also becoming an important source of supply (primarily through timber recuperated through branches etc.) to the small furniture workshops operating out of the Indian Creek and Shipyard Mennonite Communities. The sustainable forestry program is certified by the Rainforest Alliance (RA) under the Forestry Stewardship Council's principles and criteria and as such the RA is an important stakeholder as it relates to timber extraction for business purposes.

The hardwood timber program employs local people as field crews and also sub-contracts extraction and haulage to local enterprise. This provides modest employment opportunities for about 15 permanent and seasonal workers. More importantly, however, the RBCMA is now the largest and most regular source of high-quality hardwood timber in northern Belize with a model sustainable timber harvesting programme. Overall the timber volumes are fairly low but, in a general situation of dwindling resources, the reliability of supply is a key issue.

The interests of two petroleum companies with exploration licenses covering significant portions of the RBMCA are obviously in subsurface hydrocarbons. While the licensees are currently active in the area, there is yet to be a commercially viable find. This threat to the integrity of the RBCMA as a conservation area is an ongoing and persistent one. A commercial oil find would transform the use and management of the RBCMA.

PfB independently operates two eco-tourism facilities at La Milpa and Hill Bank within the RBCMA and it is run as an income generating arm by providing tourism services. This operation generates significant financial resources that it warrants classification under the business interest category. It nonetheless contributes to the sector at a national level and provides about 12 extra full-time jobs.

- **Local Communities**

Interactions with local communities are quite complex. Given that the RBCMA has historically been privately held, it has never really been used and occupied by local communities as compared to other protected areas in Belize. The land itself is not at issue but there is a long tradition of unauthorized use of various forms – hunting, extraction of secondary forest products (poles, thatch), occasional timber theft, and illicit clearance often linked to marijuana cultivation, prior to the land being established as a protected area. Local communities that are adjacent to and interact directly with the area such as Lemonal, Rancho Dolores and San Felipe have always been aware of this and as such there is limited interaction between them and the RBCMA. Nonetheless, being adjacent to the area still means that there is some degree of engagement and this occurs mostly through limited employment and illicit extraction activities within the protected area such as the sourcing of timber, non-timber materials and game hunting for commercial and subsistence purposes. Commercial fishing is also a traditional extractive activity in the Lemonal community, extending to the New River Lagoon and the lower reaches of Irish Creek.

PfB also tries to recruit staff from these communities especially in the Belize River Valley, which are economically depressed. Given this reality, local communities exhibit a high dependence on subsistence agriculture and limited employment opportunities. Other communities in the area include Mennonite communities who are generally commercial farmers. While they do not necessarily encroach on the RBCMA there is much concern for agricultural run-offs from their activities that may negatively affect the protected area. The communities in the area also benefit indirectly from the ecosystem services such as clean air and freshwater provided by the RBCMA but this generally goes unrecognized. Being a historically private protected area, the stake or interests of local communities in its management is currently very limited.

- **Educational Institutions**

There are several local schools and international universities who organize trips to the RBCMA and generally benefit from its information function. These educational institutions use the area mainly for its educational, scientific and research benefit. US based universities come to the RBCMA, to conduct biodiversity and archeological research. Some of these relationships are longstanding and need to be considered in overall management of the protected area.

2.3.4.7 ANALYSIS OF STAKEHOLDERS' INTEREST AND INFLUENCE ON THE RBCMA

- **High Influence/High Interest Stakeholders**

Based on results of the assessment of key stakeholders it can be inferred that majority of the stakeholders of the RBCMA fall in the medium to high interest/influence category. This is especially true for stakeholders with extractive and economic interests in the RBCMA. Incidentally, the petroleum interests and the responsible government agency, namely the Geology and Petroleum Department are high in this category. In line with the economic characteristics of this group, the timber extraction and tourism activities of the PfB itself fall in this category as well. This is complemented by those private sector and international partner organizations that participate directly in the extraction and processing of sustainable timber and carbon sequestration represented mainly by The Nature Conservancy and the Rio Bravo Climate Action Project (RBCAP) donors. As expected, the Government of Belize is an important stakeholder and is represented by a subset of government of regulatory agencies including the Department of the Environment and the Forest Department who have a direct interest in the management of the RBCMA. As is usually the case with high interest/high influence stakeholders, it is important for PfB to monitor and manage these stakeholders very closely.

- **High Influence/Low Interest Stakeholders**

Stakeholders with high influence but low interest are mainly nearby Mennonite communities of Blue Creek, Indian Creek, and Shipyard and CONAP who manages the Rio Azul National Park. This category of stakeholder also includes private adjacent properties. Their categorization as high influence stakeholders has mainly to do with the potential impact they present to the ecological integrity of the RBCMA through landscape connectivity. The Rio Azul National Park acts as a buffer while the Mennonite communities though maintaining their farming activities on their private lands poses risks to the RBCMA through agricultural run-offs and the pushing of the agriculture frontier towards it increasing the likelihood of it becoming an "island" within the overall landscape. It is important for PfB to maintain good relationships with these stakeholders in order to enhance the positive benefits of their presence and minimize potential negative impacts wherever they appear. PfB will need to monitor and attempt to influence the activities on the adjacent lands in terms of land use and management regimes that are being pursued and implemented there.

- **High Interest/Low Influence Stakeholders**

Local communities adjacent to the RBCMA can be considered to be a part of this group of stakeholders even though they can at times presents a moderate degree of influence on the RBCMA especially through illicit activities. Local communities see the natural resources abundant in the RBCMA as a source of livelihoods. The management measures in place currently limit their ability to access and utilize those resources. Their capacity to challenge and influence the management measures are limited and as such they are likely to continue to resort to illicit means to access the resources. Given this dynamic it should be expected that they will continue to put pressure on the resources within the protected area.

Considering the size and location of the RBCMA, it is unsurprising that sixty archeological sites from the Mayan civilization have been documented within the area. The Institute of Archeology (IOA) is primarily responsible for the excavation and management of these sites. The current activities of the IOA have been limited. Although the IOA is officially the custodian of these important national patrimony, PfB monitors these sites regularly and informs the IOA of any signs of illegal activities or unauthorized disturbances. Consequently, IOA does not exert much influence over the overall management of the RBCMA. The Office of the Prime Minister and the Ministry of Finance also falls within this category given the government's continuous support for the RBCMA. The Office of the Prime Minister (OPM) is the main signatory to the custodial agreement with PfB, and officially supported the carbon sequestration project; however it maintains a hands-off approach leaving the management of the protected area up to PfB. This low level of influence however could change very quickly given the level of power the State wields through its various agencies that engages directly with the PfB. Other stakeholders that fall in this category include educational institutions that utilize the area for their interest but do not have significant influence. It is important for PfB to continuously communicate with local communities to make them aware of the management measures in place. It should also engage other stakeholders in this group by regularly updating on activities in the RBCMA related to their interests especially its government partners.

- **Low Interest/Low Influence Stakeholders**

The Aguas Turbias National Park (ATNP) owned by GOB falls within this category. While an officially declared protected area, the ATNP has no effective management. It does provide some level of connectivity between the RBCMA and the Calakmul buffer zone towards Mexico. Enhancing the management of the ATNP or its de-reservation would have significant effect on the RBCMA given its proximity. This however is not the case at this time. Nonetheless, it is important for PfB to monitor the activities in these areas but this exercise should not require any significant expenditure of resources and efforts. The Belize Tourism Board similarly has an interest in the ecotourism activities at La Milpa given its oversight role in the industry. This

however does not necessarily translate into significant influence or interest in the overall management of the RBCMA given its own sectoral mandate.

2.4 PHYSICAL ENVIRONMENT OF MANAGEMENT AREA

2.4.1 CLIMATE

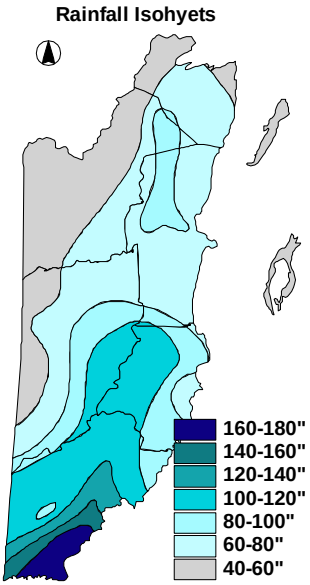
Weather data provided by the Belize National Meteorological Service (Figures 1 and 2) is collected at La Milpa Field Station on the north-western RBCMA. Overall, the area experiences a sub-tropical moist climate with marked wet and dry seasons, dominated by weather systems moving through the Gulf of Mexico and western Caribbean. Temperatures are fairly constant across inland northern Belize, averaging 27°C (81°F), but rainfall increases from north-west to south-east. Mean annual rainfall at La Milpa over the period 1995-2005 was 1239 mm (49") and for the period 2006-2014 was 1505 mm (59"), suggesting a slightly wetter trend over the past decade.

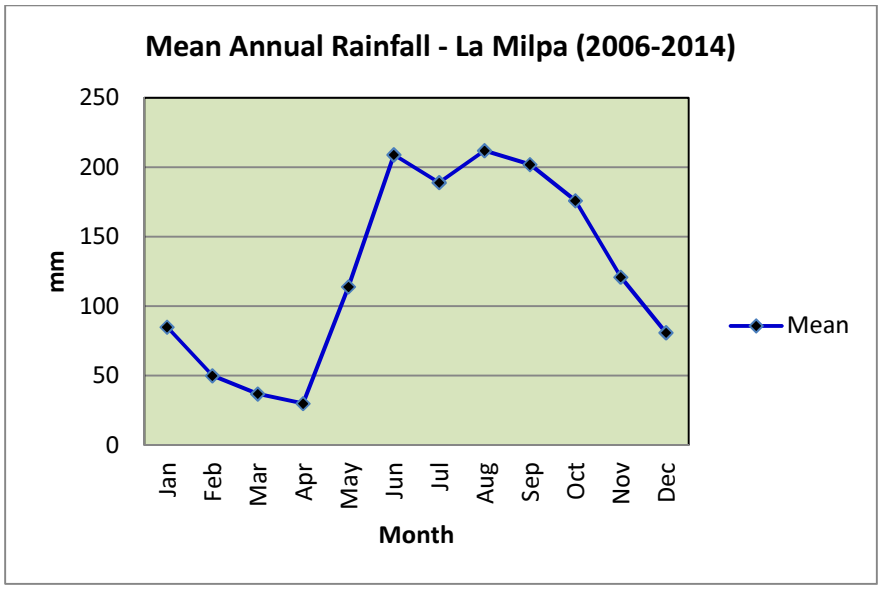
There are two main seasons:

- The wet season
    - The wet season is bimodal, normally beginning in late May – early June and rapidly increasing to a peak in late June-July, moderating and then peaking again in October before tailing off through November. Average temperatures are fairly high at approximately 28°C (82°F), though falling from October
- The dry season can be subdivided into two phases
    - The cool dry season, from November to February. This is a transitional period during which the rainfall declines and the land dries out, usually by December. It is also characterized by a succession of cold fronts, starting in the late wet season but occurring most frequently from December to January. These are the coolest months, with average temperatures of 23-24°C (73-75°F). Temperatures below 12°C (54°F) have been recorded at La Milpa Field Station in all months between November and April. Extremes of 9°C (48°F) have been noted at La Milpa though the record low (7.5 °C, 45°F) is from Tower Hill on March 12, 1996

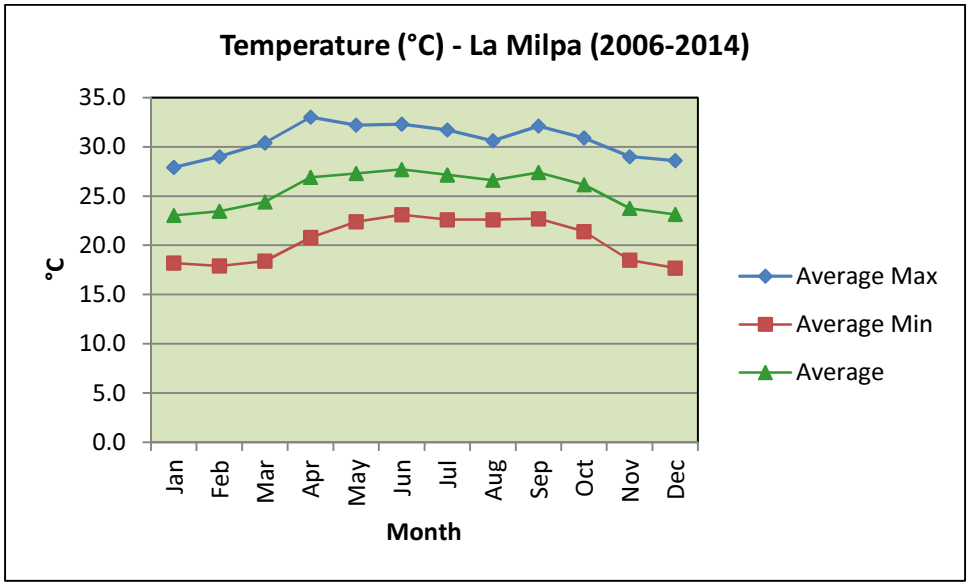
    - The warm dry season, from March to May. March and April are the driest months and temperatures rise during this period, peaking in May. The highest temperature recorded to date is 40.5°C (105°F), from Tower Hill on 26 April, 2003

Figure 1: RBCMA weather data – mean annual rainfall and temperature





Rainfall distribution across Belize



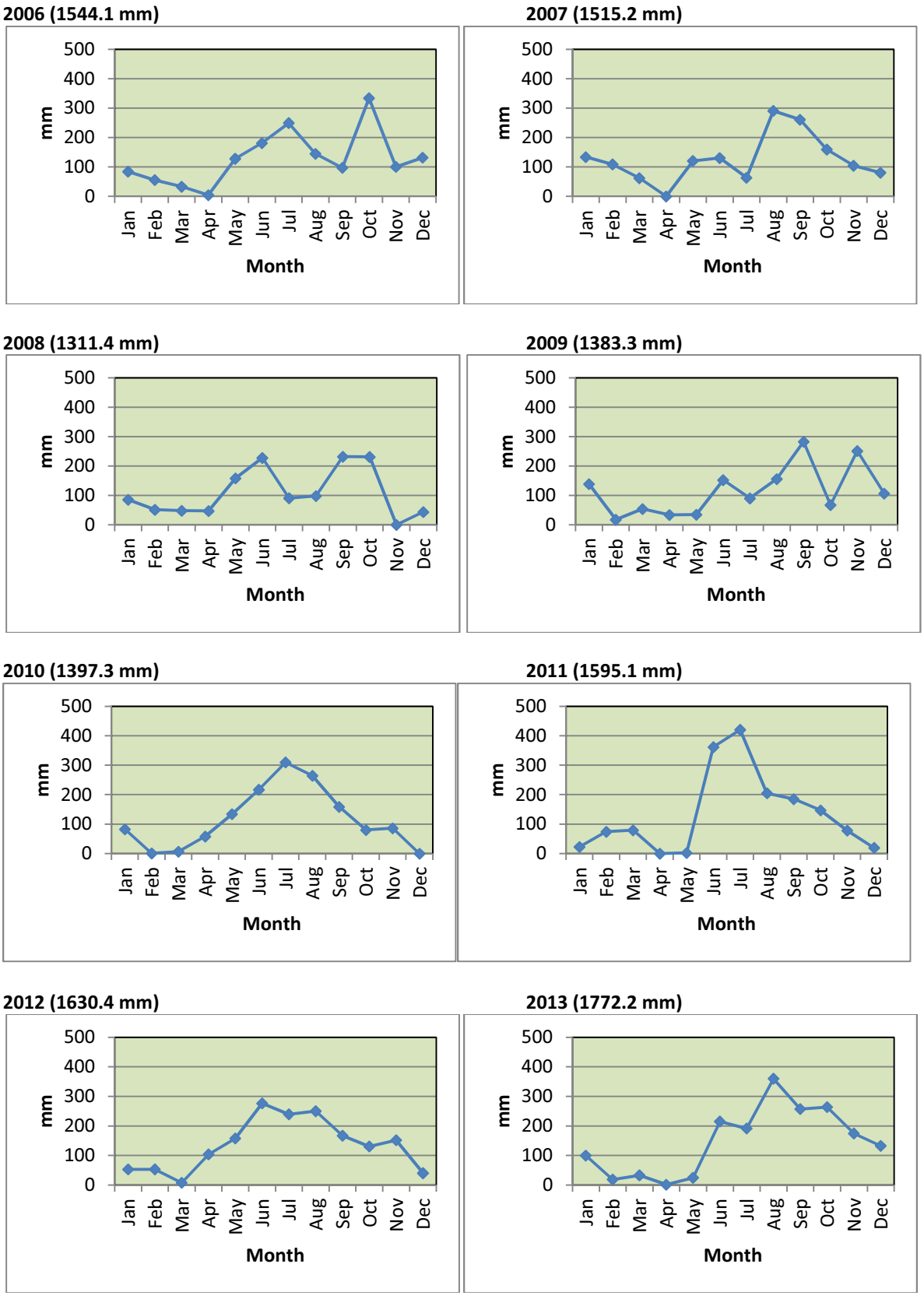
Annual Temperatures at La Milpa

These patterns are based on long-term averages but annual variability in timing, total rainfall and rainfall distribution is a marked characteristic. The annual rainfall is strongly influenced by short periods of heavy rain from low-pressure systems and the pattern reflects their passage. Over the past nine years (2006-2014) annual rainfall at La Milpa has varied between 1311 mm and 1772 mm (51.6” and 69.8” respectively) while rainfall peaks can be early, late, heavy, moderate, or failing totally. This unpredictability has an important bearing on operational management.

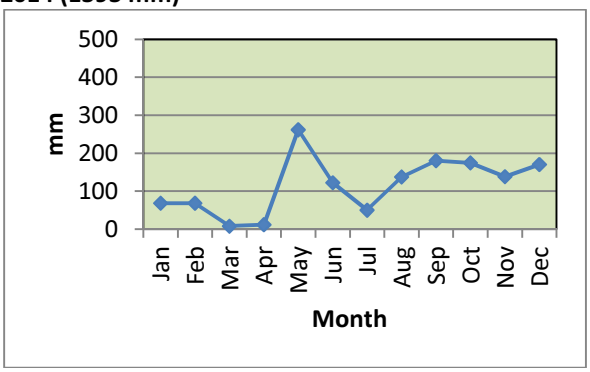
A general water deficit prevails through the warm dry season and exceptional drought periods occur every few years, usually associated with an exceptionally pronounced dry season rather than an exceptionally dry year. The pine savannahs burn regularly, as do the herbaceous swamps in areas accessible to hunters. Fire risk in broad-leaved forest is usually low but becomes significant in drought years. Some fires are set by people, whether by accident or design, though natural outbreaks due to lightning strikes are also possible, both on pine savannah and in broad-leaf forest. The most recent extensive broad-leaf forest fires occurred in 1995 in the West Botes area on the eastern RBCMA and there are reports of similar outbreaks in the past.

Periodic storms are a natural feature of the region. Most lose force inland but three have tracked at hurricane force within 30 km of the RBCMA since records began in the late 19th century. In 2010 Hurricane Richard impacted the southern portion of the RBCMA (Map 1); the eye of the 1942 hurricane passed over Shipyard and Blue Creek, immediately to the north of the RBCMA; while the 1892 hurricane passed directly through the south-eastern RBCMA and the forested land of the adjoining Yalbac and Gallon Jug properties. The centers of tropical storms have traversed the area in 1916 and 1931 while others have passed within 45 km of the RBCMA boundaries in 1889, 1898, 1921, 1924, 1931 (the second of the year), 1932 and 1945. All of these, but especially the three hurricanes, have impacted the forest (Hurricane Richard damaged 18,000 hectares) while more distant storms can also cause localized damage. The New River escarpment is the first significant break of slope on the northern coastal plain and appears particularly susceptible. Due to the debris, the risk of extensive forest fire is very high in the immediate aftermath of a hurricane, accentuating the impact on the forest.

Figure 2: Annual rainfall patters and La Milpa (2006-2014)



2014 (1393 mm)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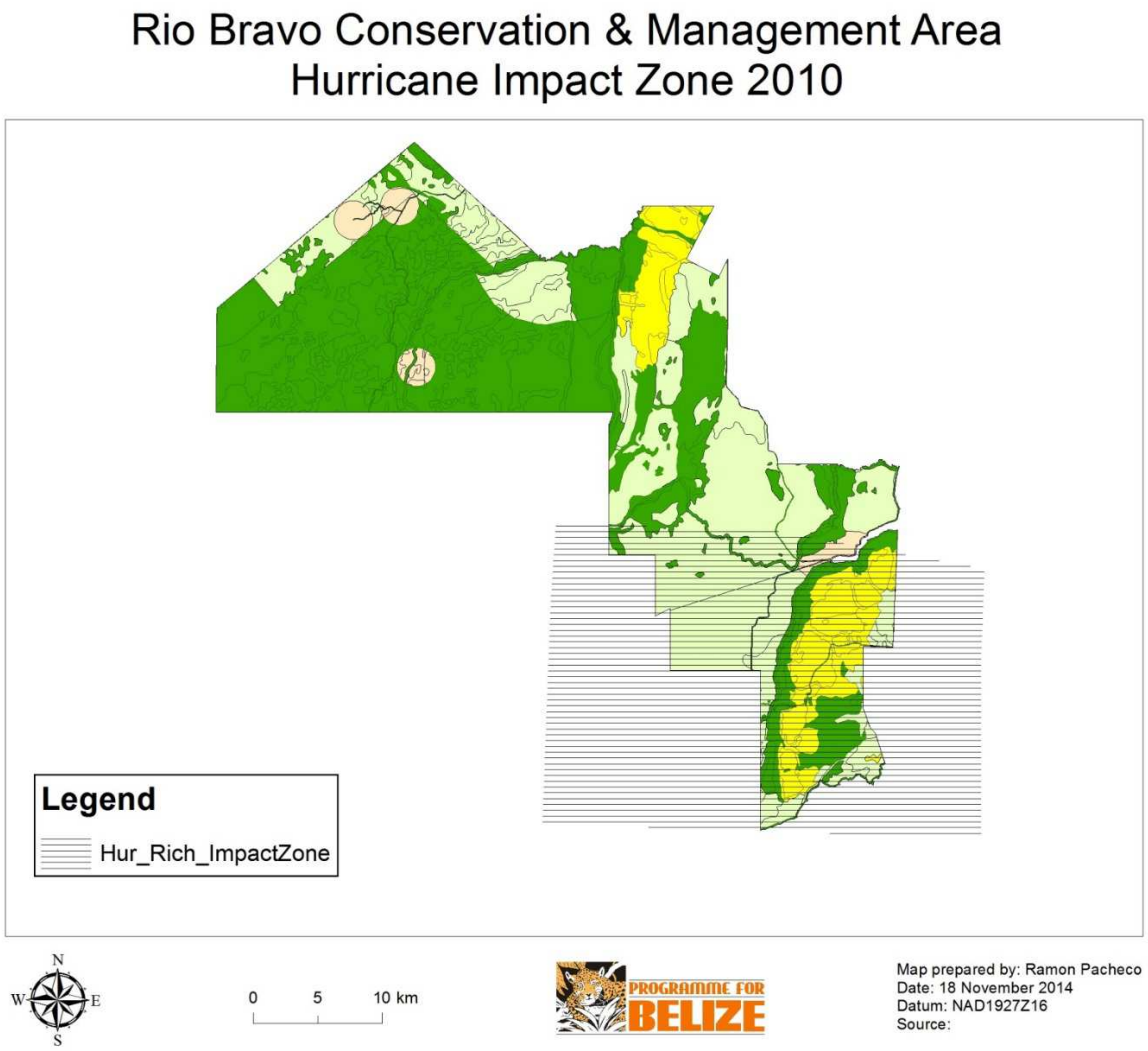


Map 1: RBCMA Hurricane Richard impact zone 2010

2.4.2 GEOLOGY AND SOILS

Detailed land assessments have been undertaken in the area (King et al, 1992). The methodology combines climate, topography, geology and soils to identify land regions, systems and sub-units for planning purposes at a medium (1: 100,000) scale (Map 2 and Map 3). These, along with the vegetation studies that complement them, are derived from:

- Landsat (30 m resolution) and SPOT (10 m resolution) satellite imagery (regularly updated in successive surveys, most recently to 2014)
- Radar imagery (Shuttle and SeaSat for land systems, Aerial Synthetic Aperture Sidescan Radar or AIRSAT for ecosystems)
- Aerial photography (1969-70 at 1:48,000, 1972 at 1:39,000, 1988 at 1:42,000)
- Topographical maps at 1:50,000 scale
- Extensive ground survey

Special attention has been given to the soils (Baillie et al, 1993), using a local classification system correlated with international systems.

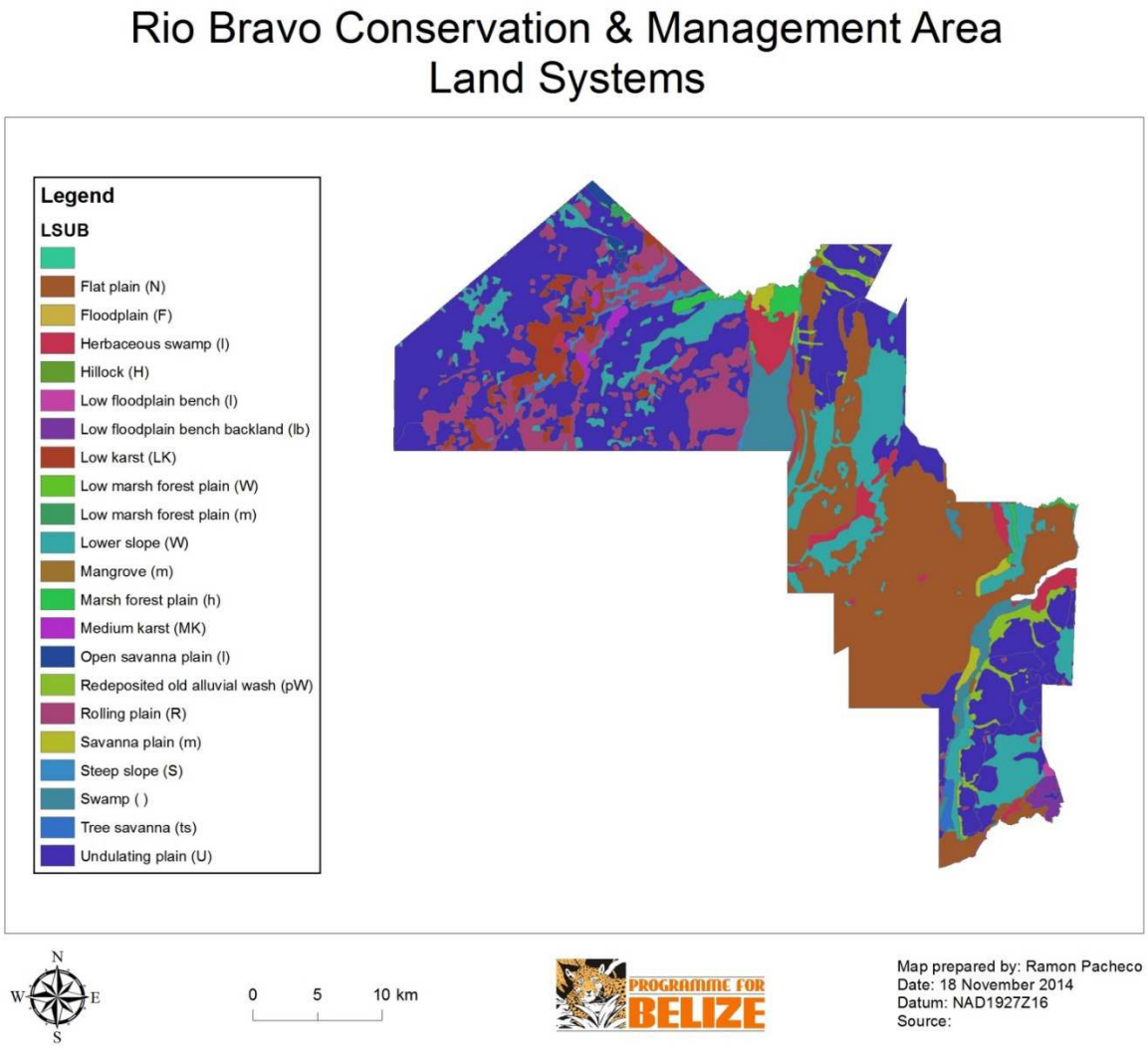
Generally speaking the entire area forms part of the Yucatan Platform and is underlain by massive beds of limestone. Faulting on a NE-SW alignment has created a series of blocks that are slipping downwards to the east, resulting in a series of escarpments across the landscape – Lalucha, Rio Bravo, Booth's River and New River within the RBCMA with the sequence continuing eastwards to the outer cayes. The Booth's River escarpment divides the RBCMA between two land regions each with a number of land systems, briefly described below and in more detail in Map 2 and Map 3.

- The *Bravo Hills* – the upland (20-300 m above sea level) region west of the Booth's River, underlain by hard limestone
    - *Gallon Jug Plain with Hills* – the most extensive system
    - *Neustadt Plain* – limited to the extreme north-west, with less hilly terrain and soils tending to acidity
    - *Neustadt Swamps* – also limited to the north-west, consisting of broad shallow depressions created by solution of underlying limestone. Again, the soils tend to acidity
- The *Northern Coastal Plain* – the lowland (0-20 m asl) region east of Booth's River, mainly underlain by softer limestone and covered with leached

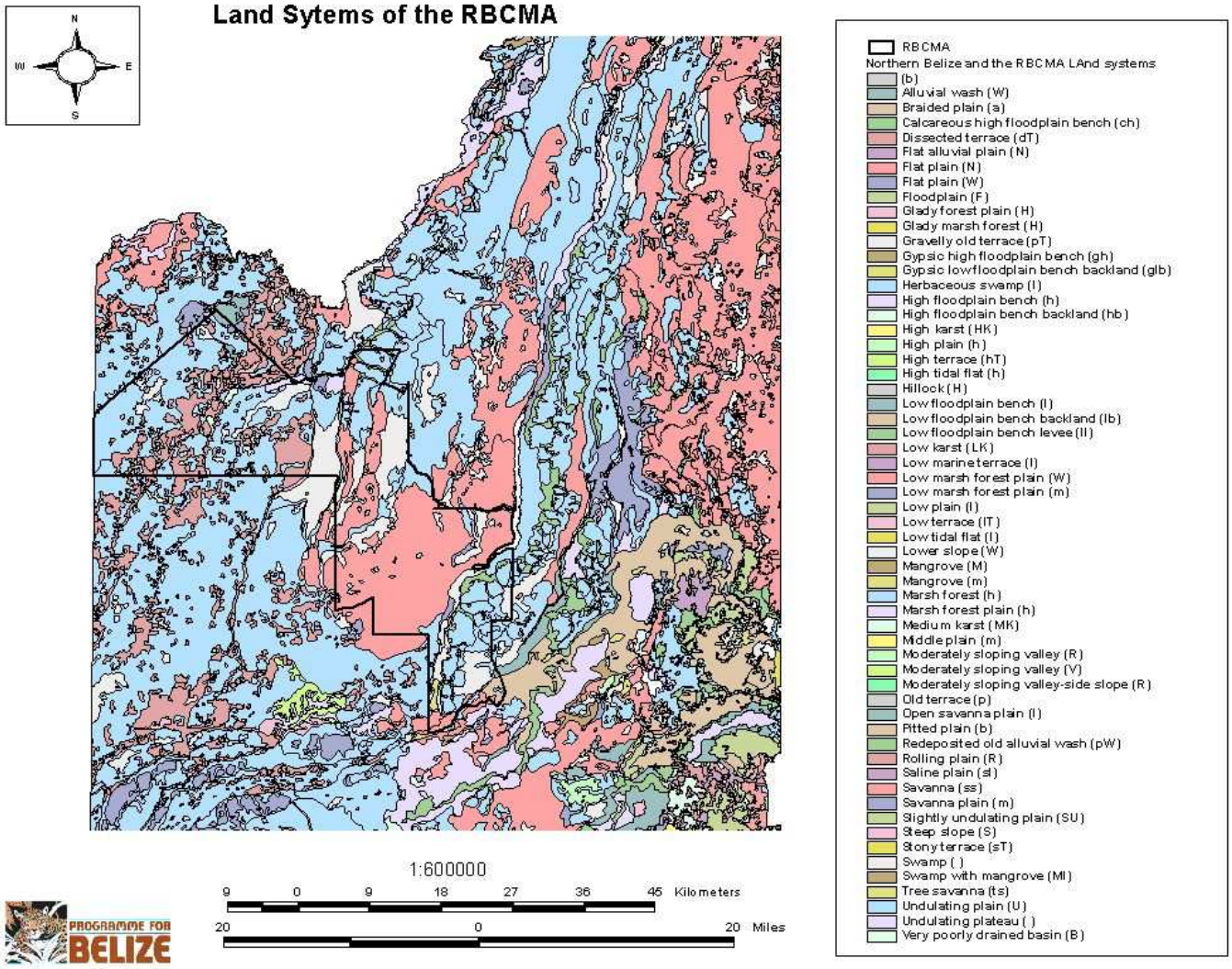
Pleistocene alluvia over extensive areas. The land systems can be divided into three basic types:

- *Broad-leaf forest areas* – typically over limestone with neutral to alkaline clay soils
    - *Hill Bank Plain* – the most extensive system in the south-eastern RBCMA, typically of level land over hard limestone
    - *Shipyard Plain* – similar to Hill Bank Plain, extending to the north and even more level. The main difference is in soil type – red Chucluum as against (here) dark Yalbac sub-series
    - *Lower Belize Valley Floodplain*. Limited to the extreme south-eastern RBCMA and extending into the Belize River Valley land region. This is an upper river terrace system, seasonally swampy with alluvial soil
    - *Beaver Dam Plain*. An alluvial system, only represented on the banks of Labouring Creek
    - *Lazaro Plain*. The main sugar-producing land system of northern Belize, just reaching the extreme north-eastern RBCMA. Typically level, over soft limestone with dark sandy to loamy soil
- *Pine savannah areas* – forming over leached Pleistocene alluvia, with nutrient-poor acid soils
    - *San Felipe Plain* – typically transitionary, with thin acid ancient alluvial deposits over the underlying limestone. Vegetation ranges from mixed pine-oak woodland to true pine savannah formations. It also includes alluvial areas with slightly enriched soils and stunted broad-leaf patches and galleries
    - *August Pine Plain*. The typical pine savannah system, gently undulating and developing on deep deposits of leached Pleistocene alluvia with poor drainage
    - *Crooked Tree Plain*. Similar to August Pine Plain but with rather higher relief and deep sandy soils, often carrying dense stands of Pine *Pinus caribaea*
- *Swamps* – permanently waterlogged with organic mud over sand or clay
    - *Sibal Swamps* – used for all freshwater swamps

- *Corozal Saline Swamp* – used for all saline swamps in northern Belize, usually recognized by presence of mangroves (NB – RBCMA inland mangroves appear to be maintained by mineral salts in ground water)



Map 2: RBCMA land systems



Map 3: RBCMA detailed land systems

2.4.3 HYDROLOGY

Parts of three watersheds lie within the RBCMA (Map 4):

- Some 60% of the area lies in the Rio Hondo watershed, including the mid-reaches of Booth's River and the Rio Bravo and the headwaters of Blue Creek/Rio Azul. The latter flow westwards before turning back through Guatemala and Mexico to form the international frontier. The RBCMA thus covers a significant part (22%) of the Belizean part of the basin although this is a small part of the whole – only 18% of the Hondo system lies within Belize and only 4% on the RBCMA

- The remaining 40% of the RBCMA lies in the New River basin, representing 21% of the entire system including most of the upper reaches of its main tributaries. The RBCMA also covers both banks of the southern third of the New River Lagoon, the largest inland water body in the country

- The extreme south-eastern boundary of the RBCMA runs onto Labouring Creek, which is part of the Belize River system but represents an insignificant part of the total

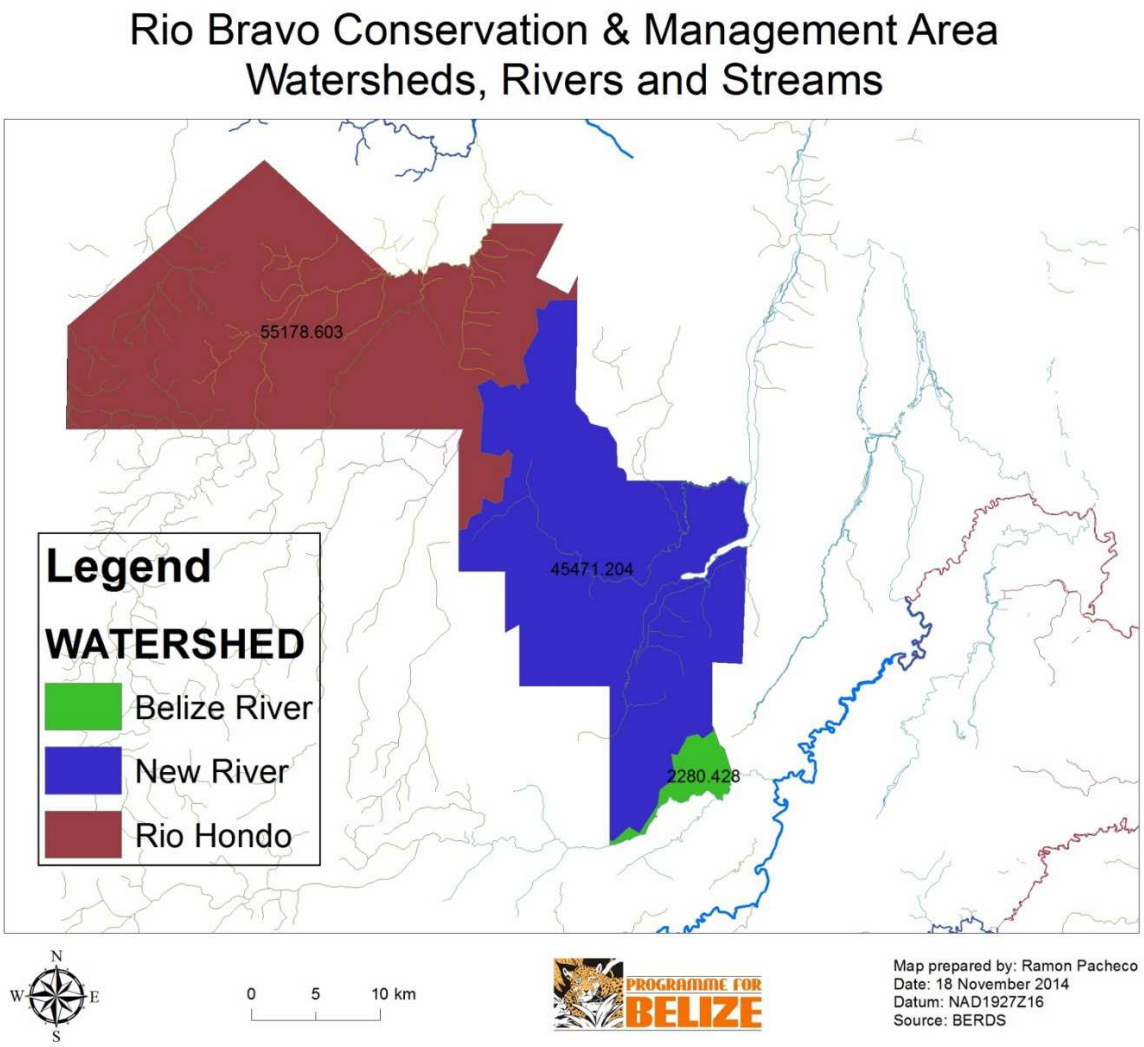
All these systems have common characteristics:

- All the headwaters and smaller marshes are seasonal. Lack of water during the dry season is a serious constraint over wide areas, particularly in the limestone uplands. Historically this was relieved by maintaining aguadas, more recently supplemented by bore-holes. The lower reaches are permanent, fed by surface run-off often supplemented by springs along the base of the escarpments that guide their flow

- Uplift towards the coast, perhaps caused by tilting of the fault blocks across the coastal plain (King et al, 1992), has ponded back all the rivers at some point on the courses. This has created extensive swamps on the lower Rio Bravo (the Booth's River marshes) and on Irish Creek. Along the deeper fault of the New River Escarpment, it has formed the New River Lagoon

- There are substantial seasonal differences in water levels. The main streams can rise several meters in the wet season and all low-lying ground is subject to widespread seasonal flooding. At these times the different systems may become

connected. During the dry season the soils of these same seasonally flooded areas become hard and deeply cracked.



Map 4: RBCMA watersheds

2.5 BIODIVERSITY OF MANAGEMENT AREA

2.5.1 ECOSYSTEMS

Belizean ecosystems have been described and mapped in a series of exercises over the past 50 years. The most recent work (Meerman & Sabido, 2001) classifies and maps the vegetation under a scheme applied across Central America (Map 5 and Map 6). It also incorporates previous work including Brokaw 1998 (in Mallory et al, 1998), the most recent and most detailed habitat characterization and mapping specific to the RBCMA. In turn, Brokaw incorporates a vegetation map specific to the Rancho Dolores Savannah. The ecosystems are briefly described here and in more detail in Map 6. Their contribution to the national protected area system is given in Table 2.

Natural ecosystems on limestone areas

- *Tropical evergreen seasonal broadleaf forest over calcareous soils: Tehuantepec-Peten variant* – the main high broad-leaf forest type of the western RBCMA. Brokaw distinguishes:
  - *Upland dry forest* – on upper slopes and ridges
  - *Upland mesic forest* – on lower slopes and in valleys
  - *Upland forest with oak* – limited to the extreme north-west, on more acid Jolja soils
  - *Transition forest* – forests tending towards high swamp forest, on poorly-drained level land
  - *Cohune forest* – forest patches dominated by cohune palm *Attalea cohune*
- *Tropical evergreen seasonal broadleaf forest over calcareous soils: central-western variant* – The main high broad-leaf forest type on the eastern RBCMA. Brokaw classes this forest as *upland mesic* but also distinguishes:
  - *Upland mesic forest – swamp forest mosaic* for areas where gradations between the mesic and swamp forest are too fine to map
- *Tropical evergreen seasonal broadleaf forest over calcareous soils: central-eastern* variant – Limited to the extreme south-eastern RBCMA.

Brokaw lumps this with the other upland mesic forests of the eastern RBCMA

- *Tropical evergreen seasonal broadleaf lowland swamp forest: tall variant* – forests subject to seasonal flooding. Brokaw classes them as transitional forest on the western RBCMA but assigns them to a variety of vegetation types on the east

- *Tropical evergreen seasonal broadleaf lowland swamp forest: low variant* – widespread throughout the RBCMA as small patches too small to map and so assigned to a variety of vegetation types of seasonally flooded areas

- *Evergreen lowland broadleaf shrubland dominated by leguminous shrubs* - called *bajo forest* or *bajo thicket* by Brokaw

- *Tropical evergreen seasonal broadleaf forest over lime-rich alluvium* – used for the forests along the Rio Bravo. Many patches along rivers actually correspond to *tropical evergreen seasonal broadleaf alluvial forest* but are not mapped as such (again corrected in Meerman 2005)

  Brokaw distinguishes:

  - *Riparian forest*

  - *Swamp forest,* specifically for the area at the head of the Booth's River marshes

- ***Pine savannah formations***

  - *Evergreen lowland broadleaf shrubland: Miconia variant* – used for a range of brushy mixed forest types transitional with the pine savannahs. Some areas qualify as *tropical evergreen seasonal broadleaf forest on poor or sandy soils* but are not mapped as such (though corrected in Meerman 2005)

    Brokaw also distinguishes:

    - *Hammock forest* for patches of broadleaved woodland within pine savannah

    - *Gallery forests for narrow lines of broadleaved woodland along drainage lines*

- *Booth's River Forest*, specifically for broadleaved woodland patches on the San Felipe savannah

- *Short-grass savannah with shrubs* - the open savannahs with variable cover of broad-leaved shrubs

- *Short-grass savannah with scattered needle-leaved trees* – the open savannahs with scattered pine. Some of the pine stands are sufficiently well developed to qualify as *tropical evergreen seasonal needle-leaf dense forest* but are not mapped as such

  Brokaw lumps both short-grass savannah types as 'savannah' but does recognize two further sub-types:

  - *Orchard savannah* – swampy savannah with shrubs and small scattered trees

  - *Palmetto savannah* – restricted to the north-west, on acid Jolja soil and thus entirely different in origin to the other savannah formations

- ***Wetland and aquatic ecosystems***

  - *Tropical lowland tall herbaceous swamp* – used for all extensive swamps and actually also including areas of *tropical lowland reed-swamp*. Brokaw distinguishes the two (as *tall* and *short grass marsh*). *Eleocharis marsh* occurs on the savannah but is not mapped by Meerman and Sabido and Brokaw also distinguishes *levee forest* for the low gallery woodlands and thickets occurring along stream-banks in the marshes

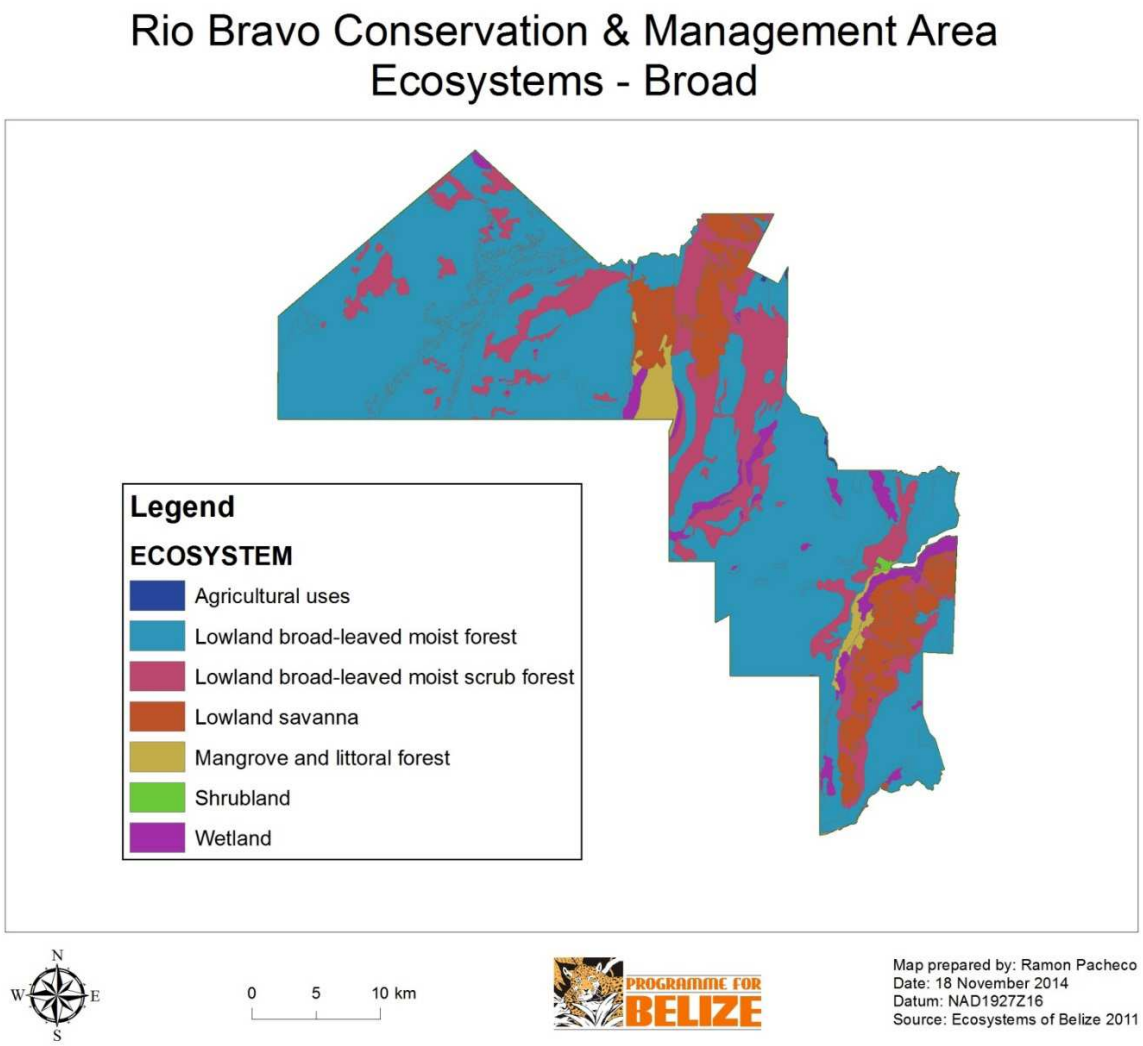
  - *Freshwater mangrove scrub* – mapped on the Booth's River marshes though patches occur on other rivers, especially on Ramgoat Creek where they are associated with *marl flats* (distinguished by Brokaw)

  The national ecosystems also include aquatic communities, distinguishing *rooted floating-leaved* and *underwater communities in freshwater lakes* and *rooted underwater communities in flowing water.* All three occur on the RBCMA.

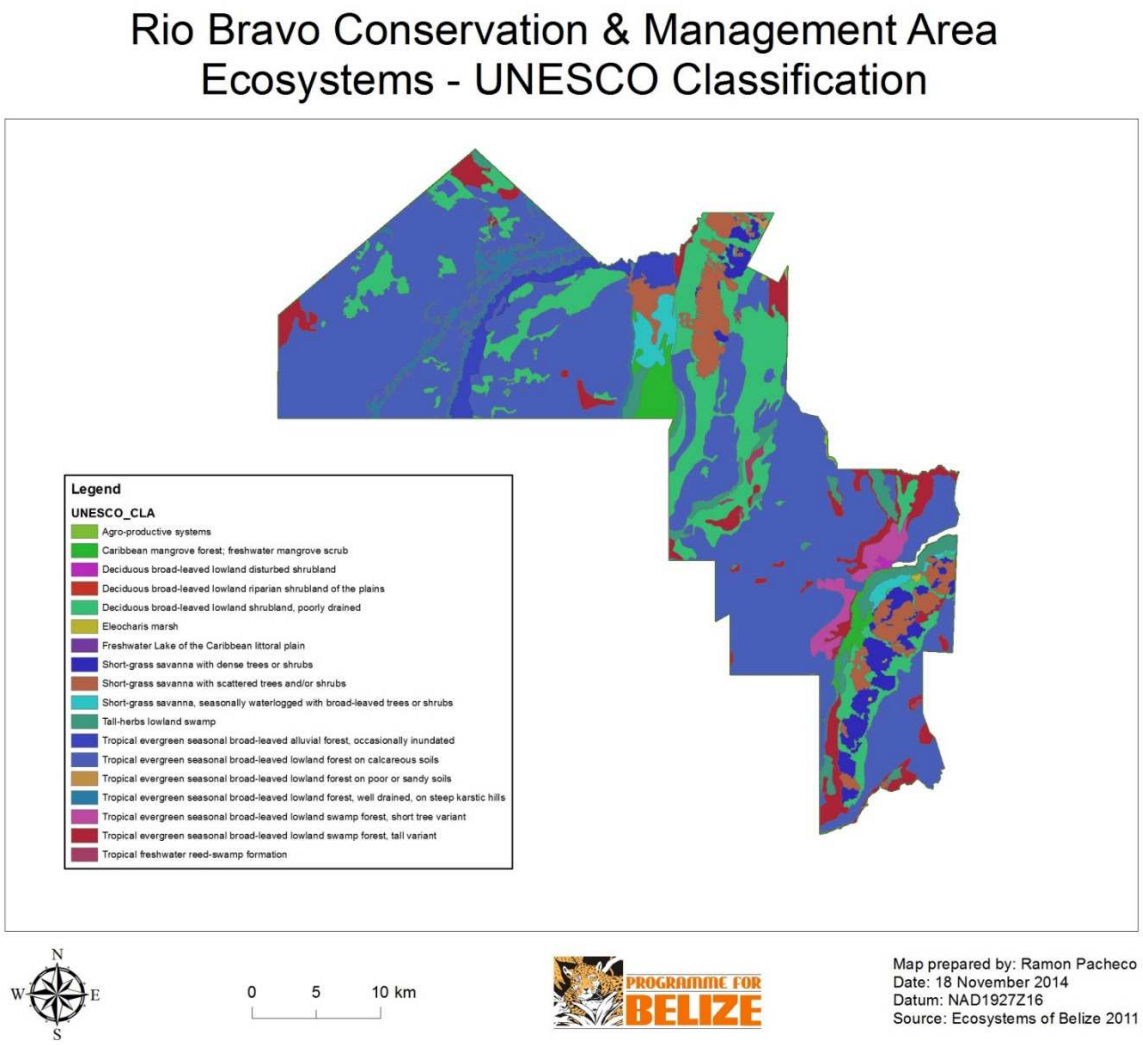
- ***Disturbed habitats***

  - *Broad-leaved lowland disturbed shrubland* - re-growth (generally now well advanced) of areas cleared in the 1980s. Brokaw calls it *second*

growth forest and uses *upland forest-wamil mosaic* where the old fields are numerous



Map 5: RBCMA broad ecosystems



Map 6: RBCMA ecosystems (UNESCO classification)

2.5.2 FLORA

Long-term research programmes on the RBCMA ecosystems mean that the flora, and especially the woody flora, is relatively well known with some 745 species recorded to date (Appendix 1). Diversity is average for a tropical system (50-60 woody species/ha in mesic forest) and the outstanding feature is that the area contains extensive tracts of land with complete and characteristic communities in fully functioning ecosystems. These include species characteristic of both the Peten and, especially in the northern RBCMA, to the dryer moist forests of the Yucatan. The pine savannah ecosystems are noteworthy as a rare vegetation type at a regional level (occurring in the Belizean coastal plains and the Mosquitia region of Honduras/Nicaragua), with a number of species known only from Belize. Several species are listed as being of conservation concern at national or international level (Wildtracks, 2005), often occurring as common species within their communities (Appendix 2).

2.5.3 FAUNA

The fauna (Appendices 3-7) has also been well-studied with research and survey projects covering all the major groups. In general terms diversity is high (e.g. 79 mammals, over 350 bird species), including foraging and breeding habitat for a range of species of conservation concern (Appendix 2). As with the flora, the most important characteristic is that they occur in fully functioning communities' characteristic of the area, most clearly demonstrated by the diversity and relative commonness of top predators (large cats, birds of prey). The RBCMA was the site of a Harpy Eagle Restoration Program, where 15 captive birds were released into the wild with the goal that they would pair up with wild birds of this globally threatened species and produce offspring, which would help establish a viable population in the Mayan Biosphere Reserve. The Harpy Eagle *Harpia harpyja*, is highly dependent on extensive areas of unbroken forest.

2.5.4 Past and Present Research

The RBCMA is well-suited as a base for research and both field stations at Hill Bank and La Milpa host several visiting research and survey projects each year. As a result the ecological characteristics and dynamics of the area are perhaps the best known in the country. The most important multi-year efforts undertaken in partnership with international institutions and underlying present management programmes include:

- *Avifaunal surveys (from 1989):* These were undertaken in partnership with Manomet Observatory for the Conservation Sciences and later with The Nature Conservancy, starting with an emphasis on nearctic migrants and expanding to include the

distribution and status of the avifauna as a whole. Subsequent studies have concentrated on species of special conservation concern, notably the Yellow-headed Parrot. The Harpy eagle re-introduction work (in partnership with the Peregrine Fund and Belize Zoo) was a continuation of this programme

- *Archaeological Programme (from 1989):* Two parallel programmes on the La Milpa site and on the archaeological landscape of the RBCMA, conducted by the Universities of Boston and Texas

- *Broad-leaved forest ecological dynamics (from 1989):* Studies began in partnership with Manomet Observatory and were expanded in partnership with Duke University and the UK-funded Forest Management and Planning Project. They have included detailed vegetation mapping, forest phenology, monitoring and experimentation on recruitment, growth and mortality, and logging impacts on biodiversity indicator groups

- *Carbon sequestration (from 1995):* These studies are linked to the Carbon Sequestration Pilot Project and undertaken with The Nature Conservancy and Winrock International. The programme includes assessment and monitoring of biomass in different vegetation types, tracking of land use trends in north-west Belize and development of techniques for biomass assessment at different scales

- *Pine savannah management (from 2001):* Initiated by studies on savannah vegetation and ecology with the Royal Botanical Gardens (Edinburgh) and continued in conjunction with The Nature Conservancy Fire Management Programme and the Carbon Sequestration Programme

- *The Freshwater Programme (from 2004):* Monitoring of water quality indicators in the New River Lagoon and its tributaries, in conjunction with The Nature Conservancy

- *Survey of Hawk-Eagles in Belize (2008):* Spearheaded by the Belize Raptor Research Institute, the project hoped to generate needed baseline data and natural history information on the three hawk-eagle species

- *Pilot monitoring project for bats (2010):* This project's main goal was to determine the efficacy of using acoustic monitoring stations with bats as targets for PfB Smart Wood program. Secondarily this provided an opportunity to conduct a brief survey of the habitats in and around the Hillbank Field Station to fill in species distributions

- *Assessment of Savanna Ecosystems (2010):* Belize Botanic Gardens collected seed from the savanna ecosystem as part of an effort to recreate a savanna habitat at the Belize

Botanic Gardens to educate the public on savanna systems and use as an interpretive savanna trail

- *Microclimate research (2011):* Students from the University of Oklahoma studied microclimate in tropical forests as a mechanism for avian extirpation
- *Ocellated Turkey (2011):* Compare the mating system of the Ocellated Turkey with that of the relatively well-studied North American Wild Turkey, in conjunction with the University of Mississippi
- *Jaguar research (2013):* A continuation of long-term jaguar monitoring via remotely-triggered, infrared camera traps in Belize, in conjunction with Virginia Tech

2.6 CULTURAL AND SOCIO-ECONOMIC VALUES OF MANAGEMENT AREA

2.6.1 COMMUNITY AND STAKEHOLDER USE

The RBCMA has a long history of extractive use. English place-names and marked camps on early maps suggest that the logwood-cutting industry penetrated up the New River as far as the lagoon by the late 18th century. Further west the area remained under the control of Maya groups (hence the name Rio Bravo) but was parceled out as mahogany works by the early 19th century. These holdings were first consolidated under local companies and then amalgamated into the main mahogany forest of the Belize Estate and Produce Company during the second half of the century. This enterprise dominated the economy of British Honduras throughout the colonial period, based on 'state of the art' timber operations. Hill Bank acted as the main base and the point from which mahogany logs were rafted down-river to Chetumal Bay and then Belize City. Gallon Jug was established later as operations penetrated deeper into the hinterland, connected to Hill Bank by a railway. The area thus holds an important place in the colonial history of Belize both economically and as the site of the last armed conflicts with the Maya – who raided Hill Bank and Indian Church and confronted colonial forces at Cedar Crossing before settling in the Yalbac Hills in the 1860s.

The chicle-tapping industry rivaled mahogany in importance from the late 19th century to the mid-20th, continuing into the 1990s. The entire area was given out in annual concessions and all sapodilla *Manilkara zapote* trees of any size show signs of being tapped once to several times. The chicleros effectively explored the forest in advance of the logging operations, which reached the last unexploited stands in the mid-1950s. Throughout this period the RBCMA was undoubtedly a busy place with a substantial population of forest workers mostly recruited from the Belize River Valley villages. The disturbance created by the logging operations was compounded by establishment of fields (provision grounds) for food, widespread hunting,

cutting of firewood for the steam engines, lopping of tree forage (mainly red breadnut *Brosimum alicastrum*) for mules and the trampling effect of the mule- and ox-trains used for transport.

The Belize Estate and Produce Company became moribund in the 1980s, removing the principal source of employment in the area. Logging under annual contracts with minimal oversight continued but the area was effectively neglected. During this period many small clearings were made for agriculture, including marijuana cultivation. This was brought under control in the early 1990s and the last of the settlers around the North Gate left as late as 1994. The present forest reflects this history and present stakeholder use is based on this legacy.

The ownership and ownership of the land and the RBCMA is not in question. The main point of conflict is where management measures collide with a long tradition of uncontrolled and illicit use. These activities include:

- *Hunting* - This is based on subsistence hunting for domestic consumption with a strong recreational element and partial commercialization. It is also strongly rooted in the rural tradition and widely accepted as a legitimate activity. The RBCMA is one of the better protected areas in the country but hunting remains a persistent problem on the eastern boundary, in the San Felipe area and along the Gallon Jug road. The poaching of Yellow-headed Parrots on the savannahs for sale by locals is also a recurrent problem

- *Timber theft* - This takes two forms. In the first, legitimate timber operations operating in concessions on the edge of the Rio Bravo habitually take the opportunity to cross the boundary line. This has occurred on southern Duck Ridge, on the north-western property line, and in the south-east in the Rancho Dolores area, but is readily detectable and halted. The second consists of organized illegal raids where a number of trees are swiftly felled and transported out. This is more difficult to control as the timber is cut and moved over to adjacent private properties and then moved out of the area under the cover of darkness. Typically it is a problem on Irish Creek and along the eastern boundary. This type of illicit resource use also extends to sabal thatch and fence-posts cutting

- *Marijuana cultivation* - Even though the hey-day of marijuana cultivation is long over it remains a recurrent problem in the Cacao area on the northern RBCMA despite repeated raids by national security personnel working with PfB rangers. Other areas on the eastern RBCMA sees similar illicity activity whenever surveillance is relaxed

- *Human trafficking on the international frontier* - This was a serious issue in the early 1990s. While it currently appears not to be a major problem communities reported

during consultation meetings that such activities occur from time to time. While old logging roads have closed over, the surge in agricultural activities in the region have open new points of access

- *Fishing* - The New River Lagoon supports a significant *freshwater fishery* both recreational and for local subsistence. Even though the lagoon is not part of the RBCMA freshwater bodies either extend or originates from within the protected area

2.6.2 ARCHAEOLOGICAL SITES

Being within the Mesoamerican region, the RBCMA carries a rich Mayan archaeological heritage. The La Milpa archaeological site is one of the largest in Belize and another 60 sites have been identified along with evidence of agricultural areas, water management systems and tool-making at an industrial scale. The two archaeological programs have been carried out under the aegis of the Institute of Archaeology for some 15 years. A trail system has been established for La Milpa and guided visits form part of the tourism offerings for the RBCMA. PfB actively helps to prevent the looting (last detected and halted on the RBCMA in 1992) of these sites by making it a part of the protection program. Some consolidation work has been carried out at the La Milpa site but it has been determined that the most appropriate (and practical) approach is to leave the sites largely unexposed in their forested context.

2.6.3 TOURISM AND RECREATION USE

Tourism within the RBCMA is directed and led by PfB's Tourism Development Unit (TDU) based in Belize City. The La Milpa Eco-Lodge is primarily a tourist facility for student courses and mid-range visitors. Hill Bank is more orientated towards research and management activity but also hosts student courses and is promoting mid-range visitors. The La Milpa Eco-Lodge is the most developed of the two sites in terms of amenities provided. Both sites however offer full board and lodging in cabanas and dormitories, have resident naturalist-guides on staff and have well-developed trail networks. Tourism and tourism-related activity is one of the principal sources of self-generated income for PfB, with the other major income stream coming in from sustainable timber harvesting operations. 'High-end' tourism schemes based on Warree Camp (on the Rio Bravo) and Punta Gorda (on New River Lagoon) have failed to come to fruition but remain an option if suitable partners are identified. Arrangements for visits to the RBCMA are made through the Belize City Office. The stations rarely see walk-ins and this mostly has to do with the remote location. When these occur they are not refused so long as circumstances make it possible to accommodate them. There is some local visitation, especially to La Milpa, but this is generally on an *ad hoc* basis

Tourism is a very competitive sector and therefore more can be done to develop the product. Overall tourism activities have become stagnant and have not been generating sufficient revenue to further reinvest in developing the product and destination. Marketing can be improved in both in terms of communication and budget. In the past, international conservation organizations like The Nature Conservancy promoted La Milpa but this is no longer the case. Competition from regional countries offering similar products has also increased. There is a need for a clearer plan for the development of tourism. More can be done for Hill Bank for instance as it has eco-cultural potential. Road condition however is currently in a poor state and so access and transportation needs to be improved. Nonetheless, land use during the colonial period has not yet been explored for heritage tourism purposes but the physical evidence at Hill Bank, when taken with documentary records and oral history of living residents holds the potential to give valuable experience to both local and foreign visitors. The main effort, however, is currently directed towards optimizing use of existing facilities. Recent renovations have been carried out at the La Milpa Eco-lodge

2.6.4 OTHER ECONOMIC USE

The terms of the Memorandum of Understanding (MOU) with the Government of Belize reflect the aim of recreating a modern version of the working forest of the BEC days, conserving biodiversity while contributing to the local economy. This is therefore a key management objective in itself as well as a conservation strategy that can help to displace illegal and unauthorized activities. Other economic activities of the RBCMA include ongoing timber harvesting and carbon sequestration.

2.6.4.1 TIMBER AND BIOMASS

- *Hardwood timber*. After tourism, the sustainable timber harvesting program is the second largest gross revenue earner on the RBCMA, making an important contribution to management costs. The regime, which was developed through two EU-funded projects and in association with the World Land Trust and the UK-funded FPMP, is certified by the Forest Stewardship Council, through the Rainforest Allaince,and has a strong science base including impact assessment and monitoring. It also places heavy emphasis on retaining the regenerative capacity of the forest. The basic system, which is set out in full in the forest management sectoral plan, is fully operational and producing 700,000 to 800,000 bd. Ft. of round-wood per annum, primarily of mahogany but including a range of other hardwoods and currently worth BZ$1,000,000 p.a.. Future prospects are good. The present annual coupe is 750 ha p.a. to 1,000 ha p.a. (but this may need to be revised based on new information. Furthermore, given the program has been operating below the permissible level for the past 10 years, an additional 100 ha p.a. can safely be utilized over the

remaining 30 years of the current 40 year felling cycle. These gains do not take account of the improving quality of the standing resource through natural growth nor the potential for harvesting of additional species and marketing under ''green' labeling.

- *Carbon Sequestration*. The Rio Bravo Climate Action Project (RBCAP) started in 1996 (the Original Project) and expanded in 1997 (the Expansion project). It consists of two contiguous avoided deforestation projects in northwest Belize totaling just over 15,000 hectares. The main objectives of the 40-year initiative were to protect biodiversity sub-tropical forest threatened by industrial agriculture, while at the same time keeping harmful carbon dioxide out of the atmosphere. The projects received a total of US$5.82 million in funding by Wisconsin Electric Power Company (now WE Energies), Duke Power, Detroit Edison (now DTE Energy), PacifiCorp, Utilitree Carbon Company, Suncor Energy Inc. and Canadian Occidental Petroleum Ltd. (now Nexen Inc) and Programme for Belize. In exchange, these financial participants received the rights to any carbon credits generated from the properties. In 2000, a new agreement was drafted that consolidated the management and financial accounting for the two projects, as well as created a joint board to oversee activities. In 2012, the original project successfully underwent verification to the Verified Carbon Standard (VCS), resulting in the creation of 1,660,260 carbon credits that could be sold on the voluntary market to help raise funds for a project endowment. To date, the project has sold about 8,000 metric tons of offsets on the voluntary market.

2.6.4.2 NON-TIMBER FOREST PRODUCTS (NTFPS)

A range of other "sustainable use" approaches have been explored within the RBCMA. These include the following:

- *Seeds, fruits and conserves*: Allspice was formerly commercialized but is now essentially defunct as an industry, at least in Belize. Cohune oil is used in small quantities but obtaining it is labor intensive. Generally speaking, collecting the raw materials poses problems in natural habitat and prospective income is low for considerable effort expended. The best results come from species easily obtained around villages and developed as small-scale activities through outreach programs. PfB has successfully promoted handicraft production for the tourist trade, with a local entrepreneur now running a self-supporting workshop at August Pine Ridge using a range of gourds, seeds, palm nuts (including cohune), tie-tie and other items. Promotion of conserves using local fruits at Isabella Bank produced good product, undermined by insufficient attention to marketing and distribution. Attempts to stimulate honey production at Lemonal were unsuccessful for a variety of reasons (social, managerial and economic)

- *Chicle*: The chicle industry is historically important but is now virtually moribund. Sapodilla (the source of chicle latex) is one of the commonest trees on the western RBCMA but fairly uncommon in the east where it is replaced by chicle macho, producing the inferior crown gum. A full program was developed by PfB in the early 1990s including research into impacts (low if slashing is careful), sustainable harvesting (seven year rotation optimal) and a monitoring protocol. It also reached an experimental production stage using a team of local chicleros, producing c. 1 ton of raw material exported to Florida where it was turned into finished product and marketed for several years. The major problems at the time were lack of capacity for field management by PfB (the most serious difficulty, since addressed), inadequate access to a specialized market and high costs relative to identical material from Mexico and Guatemala

- *Sabal palm thatch*: The issues surrounding sustainable production of sabal thatch have been investigated, essentially involving a rotation of 5 years for a given stand, limiting extraction to young trees with accessible crowns and leaving the growing point with at least one (preferably two) good leaves untouched. There is substantial demand for sabal thatch, especially for tourist facilities, which is usually met from more accessible sources in the country. Sabal is, however, patchily common throughout the RBCMA, is used by PfB for its own buildings and is occasionally extracted without authorization. It definitely has promise as a subsidiary income stream

- *Xate and houseplants*: Xate (*Chamaedorea spp*) leaf is commercialized in the Peten and heavily exploited to the point of local depletion. It is not, however, very common in the RBCMA except in rocky areas and then not in the most sought-for species. The potential for houseplants, orchids etc. was investigated in detail through the EU-funded micropropagation project and its associated nursery. Although the production techniques were mastered, the technology and running costs were too expensive for the value of the material produced – especially from Hill Bank. Furthermore, the most promising line – orchids – was hindered by the bureaucracy involved in export despite being raised and shipped in sealed sterile containers.

2.6.4.3 'NON-TRADITIONAL' ECONOMIC FUNCTIONS

- *Existence value*: The RBCMA continues to attract significant grant support from private foundations and donors including the statutory funding agency, the Protected Areas Conservation Trust (PACT). The management of the area was indeed totally dependent on such support initially and it still plays a crucial role in bridging the gap between self-generated income and annual budgets. Even if self-sufficiency is achieved it will always be a useful addition and in economic terms represents the willingness of civil society and

government, at an international and local level, to contribute to the continued existence of biodiversity. An average revenue of about BZ$800,000 per annum has been maintained from this source over the past 15 years all of which is expended in the local economy

- *Provision of environmental goods and services*: The carbon sequestration pilot project mentioned above is one means of capturing payment for an environmental service. The RBCMA also serves other, though yet un-quantified, environmental functions supporting the economic and social life of northern Belize. The RBCMA is a key link in the northern biological corridor and supports plant and wildlife species. It provides key environmental goods and services for buffer communities and the country of Belize on a whole, including food, fiber and freshwater. It further provides support services such as carbon sequestration, soil formation and stabilization, climate regulation and water catchment/storage ability. It also provides cultural services such as scenic beauty and tourism values. These services may not be revenue-generating currently but their contribution should be assessed and certainly recognized by all stakeholders

2.6.5 EDUCATION USE

As noted, student courses are an important element of the tourism program at the RBMCA, catering primarily to North American schools at the secondary and tertiary level. These account for both the majority of visitors and a substantial proportion of revenue generated. They are arranged around set curricula, usually combining the marine as well as the terrestrial environment. Visits by local schools and community groups are also arranged though in a less systematic manner. Local schools often lack the funding to cover transportation expenses to get to the RBCMA. Lastly, both La Milpa Eco-Lodge and Hill Bank Station are used to host workshops and training courses in conservation management. The promotion of this particular service can be further enhanced.

3. ANALYSIS OF CONSERVATION TARGETS AND THREATS

The conservation planning follows the Conservation Action Planning (CAP) process developed by The Nature Conservancy and adopted by the National Protected Areas Policy and System Plan. It is detailed in Appendix 8 and only summarized here.

3.1 CONSERVATION TARGETS

3.1.1 IDENTIFICATION OF CONSERVATION TARGETS

Seven conservation targets have been identified for the RBCMA:

1. Savannah
2. Broad-leaved Lowland Forest
3. Aquatic Ecosystem
4. Yellow-headed Parrot
5. Central American River Turtle (Hicatee)
6. Jaguar
7. Bay Snook

Each of these conservation targets is governed by fundamentally differing ecological processes, experience different types of threat and thus require different strategies. These conservation targets also capture all of the biodiversity and ecological processes within the protected area and conserving these seven conservation targets will ultimately ensure the conservation of all the biodiversity and ecological processes within the RBCMA.

3.1.2 ASSESSMENT OF CONSERVATION TARGET VIABILITY

The viability assessment (Appendix 8) indicates that:

- The Savannah is in overall good health, despite having a fair fire regime and Caribbean Pine population structure and composition. Their greatest advantage is that they are extensive and still with good landscape connectivity. Fire is a natural ecological process on this conservation target but is over-frequent, affecting population structure and composition of native species, particularly the Caribbean Pine. These impacts can be addressed through management.

- The Broad-leaved Lowland Forest is in good health. It is extensive, with fair connectivity at the landscape level, and basic ecological processes are intact. Structure and species composition are mostly modified by past and present timber extraction, illegal logging, illegal agriculture, uncontrolled burning, and road and oil development but impacts overall are moderate, leaving the natural communities in functional condition.

- The health of the Aquatic Ecosystem is currently fair. The upper reaches of some streams are beyond the RBCMA boundary, and the presence of some barriers (BOD, contamination, gill nets, etc.) may have compromised downstream connectivity. The population structure and composition of some fish species may also have been impacted as a result of tilapia introduction and proliferation.

- The Yellow-headed Parrot population is currently fairly healthy. This species is highly dependent on the overall good health of the pine savannah ecosystem. Nesting success is moderately impacted by poaching, frequent and uncontrolled fires, and loss of suitable nesting pine trees. Management can help to address these impacts to this endangered species.

- The Hicatee population is believed to be currently healthy, despite its dependence on a currently fairly healthy aquatic ecosystem. Species population size is impacted to a low extent by poaching, illegal and unregulated fishing, and contamination of habitat. Management can help to address these impacts to this endangered species.

- The Jaguar population is believed to be in a very healthy state. Poaching of its prey species and killing of problem animals appear to be currently to a low extent. Adequate and healthy habitat appears to be currently available for this fairly wide-ranging species of international concern.

- The current Bay Snook population size and age structure appear to be in good health. Like the Hicatee, this species is also currently dependent on a fairly healthy aquatic ecosystem, and is being moderately impacted by poaching, illegal and unregulated fishing, and contamination of habitat. Management can help to address these impacts.

3.2 THREATS TO BIODIVERSITY

The assessment indicates that all seven conservation targets are subject to a number of threats, some of which are shared with other conservation targets and some that are specific.

- The Savannah is one of the most threatened of the conservation targets for the RBCMA, with uncontrolled / unmanaged fires and poaching of wildlife being its most important

threats. Illegal logging is also a threat of particular consideration although the extent of its occurrence is low.

- The Broad-leaved Lowland Forest conservation target is affected by the largest number of threats, including timber extraction, illegal logging, illegal agriculture, poaching of wildlife, uncontrolled burning, and road infrastructure and oil development. All of these threats are considered low at the moment, with the exception of uncontrolled fires and oil development that are medium and illegal logging that is high.

- The Aquatic Ecosystem is among the most threatened of the conservation targets presently, with pollution (pesticides and fertilizers) and invasive species being the two most prominent threats. Unregulated fishing is also a threat of particular consideration although the extent of its occurrence is currently low.

- The Yellow-headed Parrot is also among the most threatened of the conservation targets presently, being threatened mainly by felling of nest trees and uncontrolled/ unmanaged fires. Poaching is also a notable threat, although this is currently ranked low.

- The Hicatee is among the least threatened of the conservation targets. Current threats to this species are low and include poaching, illegal and unregulated fishing, and pollution from pesticides and fertilizers.

- The Jaguar is affected by the least number of threats, including poaching of prey species and killing of problem animals. These threats are currently considered low.

- The Bay Snook is also among the least threatened of the conservation targets. The current threats to this species include poaching, illegal and unregulated fishing, and pollution from pesticides and fertilizers, and are all considered low.

Some of the more highly ranked threats appear to affect more than one of the conservation targets and include uncontrolled / unmanaged fires (affecting the Yellow-headed Parrot and the Savannah) and pesticides and fertilizers (affecting the Bay Snook and the Aquatic Ecosystem). Other higher ranked threats affecting only one conservation target include poaching of wildlife, felling of nest trees, and invasive species. The lower ranked threats also appear to affect more than one of the conservation targets or a single conservation target and include: unregulated fishing, illegal logging, illegal agriculture, killing of Jaguars, oil development, poaching, poaching of prey species, road development, and uncontrolled burning.

The goal of the RBCMA is to manage threats to the conservation targets through a range of programmes designed to maintain the conservation targets in a “good” to “very good” state.

From the assessment, most of the threats are ranked medium and only one of them (illegal logging -- acting on the broad-leaved lowland forest conservation target) is ranked “high” or “very high” to be classified as a critical threat. This one critical threat, however, will require priority management intervention. Threats that rank “medium” and “low” will, fortunately, require less management intervention but nevertheless are conservation issues that should be tackled.

3.3 STRATEGIES TO REDUCE THREATS

Each conservation target is subject to one or more threats and some threats affect more than one conservation target. Furthermore, the proximate source of threat is usually propelled, or at least facilitated, by one or more factors acting indirectly. Strategies must address both, acting on direct sources to gain immediate relief and on indirect sources to alleviate the condition over the long term. The following general strategies will be employed to reduce threats to the RBCMA conservation targets:

- Institutional strengthening
    - To obtain proper work equipment, resource mobilization, and training of staff to be proactive and reactive to illegal activities
- Protection of ecosystems
    - Involving boundary demarcation, surveillance through aerial and ground patrols, and legal action when appropriate
- Managed resource use
    - To enhance the relevance of the area for the local economy and augment its reputation as a key site through delivery of concrete benefits, giving the basis for a constituency of support for the area. This also acts as a form of passive protection by occupying the ground and visibly demonstrating an active presence
- Outreach, education and advocacy
    - To engage with neighbouring land owners and communities to gain support for RBCMA management and protection of the protected area, and to preserve the RBCMA resources to maintain biological connectivity in the wider landscape
- Research and monitoring

- To obtain and disseminate information on the area, reinforcing awareness of its importance, and to monitor the success of management actions

3.4 MONITORING SUCCESS OF CONSERVATION STRATEGIES

The conservation strategies in place to reduce the threats to the conservation targets should be monitored continuously throughout the management period. The status of the conservation targets will provide management with a clear indication whether the conservation strategies are working or not. The RBCMA research and monitoring programme (section 4.7.4) provides a list of monitoring actions and activities. These actions and activities can then be tabulated and analyzed based on a "measures of success" scale to determine their success.

3.5 CLIMATE CHANGE ADAPTATION PLANNING

Protected areas are essential for safeguarding biodiversity and ecological processes, but they face many human-caused stresses such as pollution, farming, poaching and logging. These existing pressures are now being exacerbated by the effects of climate change (Hannah et al, 2007). For protected areas to effectively safeguard biodiversity and life-giving ecosystem services into the future, their vulnerability to climate change must be evaluated as a basis for conservation planning.

3.5.1 VULNERABILITY FACTORS AND RESILIENCE FEATURES

The RBCMA, comprising about 4 percent of Belize's total land area and a high level of permanent land cover, plays a critical role in building ecological resilience to long-term changes, disturbances and the impacts of climate change by regulating climate, reducing vulnerability to floods and droughts, protecting communities from sudden climate events, and supporting species to adapt to changing climate patterns by providing refuge and migration corridors. The RBCMA provides other important ecosystem goods and services including carbon sequestration, non-timber forest products, aesthetic and tourism values, and water catchment/storage ability and water protection.

Some of the most significant threats to the viability of the RBCMA and its biodiversity and ecological processes include agricultural intensification, mainly driven by the expansion of cattle and cash and subsistence crops; uncontrolled and unmanaged fires; illegal logging; poaching of wildlife; illegal agriculture, mainly in the form of illicit drugs; road infrastructure development; oil development; pesticides and fertilizers, mainly from farms; unregulated fishing (fishing out of season, use of fishing nets, etc.); invasive species; felling of Yellow-headed Parrot nest trees; and killing of Jaguars that wander onto adjacent properties.

Without a doubt, the negative effects of climate change on the RBCMA's biodiversity and ecological processes will be compounded by these threats, especially where they are caused by humans; and the biodiversity, ecological processes, and ecosystem goods and services of the area that may already be vulnerable because of these human threats may be even more quickly or more severely affected by climate change (U.S. Climate Change Science Program, 2008).

A 9 to 22 percent reduction in precipitation and a mean annual air temperature increase of 3.5°C will have profound impacts on water resources in Belize, mainly through reduced surface water availability for direct use by communities, agriculture, and economic processes; decreased groundwater recharge rates, which could substantially affect dry season flows; disappearance or reduced discharge rates of springs, which are an important water supply for communities; possible increased use of irrigation upstream, leading to increased water competition and potential water conflicts among competing users; reduced soil moisture due to higher evaporation levels; and increased water pollution with potential impacts on human health and ecosystems. In addition, these changes will interact with and exacerbate other human-induced pressures affecting water quantity and quality, particularly in communities where population growth rates and urbanization are higher.

3.5.2 PRIORITY CLIMATE CHANGE ADAPTATION PLANNING TARGETS

A series of Focal Targets on which to base climate change adaptation planning is identified to ensure that financial and human resource investments in adaptation strategies are prioritized for maximum effectiveness. Not all focal climate change targets will be equally affected by or be equally resilient to climate change impacts.

- Priority conservation targets
- Key environmental services
- Priority stakeholder communities
- Key socio-economic activities

3.5.2.1 PRIORITY CLIMATE CHANGE CONSERVATION TARGETS

Of the seven conservation targets identified during the conservation planning session, three of these were selected as priority conservation targets that would be most affected by climate change, namely, broad-leaved lowland forest, savannah, and the aquatic ecosystem (Table 4). These were selected through a prioritization process based on a rating (on a scale of 1 to 4) (Table 5) of the impacts of the relevant predicted climate change elements for Belize. As the RBCMA is located away from the coast, the sea was looked at in terms of water bodies for the aquatic ecosystem existing within the protected area, and given a score of 2. An increase in intensity of storms on the aquatic ecosystem was given a score of 3, as it is believed that these

will contribute to agrochemical contamination, prolonged flooding, and the introduction of exotic species. The sea level rise impact on the Hicatee was given a score of 3, as Hicatee nests would more than likely be submerged and eggs may not hatch.

Table 4: Climate change threat matrix for prioritizing conservation targets

	Predicted Climate Change Elements	Broad-leaved Lowland Forest	Savannah	Aquatic Ecosystem	Jaguar	Yellow-headed Parrot	Hicatee	Bay Snook
1	Increased Air Temperature	3	3	2	2.5	2.5	3	1
2	Decreased Precipitation	2.5	3	2	2	2.5	2	3
3	Increased Intensity of Storms	4	3	3	3	3	2	1
4	Sea Level Rise	1	2	3	1	1	3	1
5	Sea Temperature Rise	1	1	2	1	1	1	2
	Average Score	2.3	2.4	2.4	1.9	2	2.2	1.6
		Selected	Selected	Selected				

Table 5: Ratings for prioritization of conservation targets

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

3.5.2.2 KEY ENVIRONMENTAL GOODS AND SERVICES

The RBCMA is a key link in the northern biological corridor and supports fifteen (15) threatened and endangered species such as the Jaguar, Yellow-headed Parrot and Central American River Turtle (Hicatee). It is critical for providing key environmental goods and services for buffer

communities and the country of Belize on a whole, including food, fiber and freshwater; cultural services such as scenic beauty and tourism values; support services such as biodiversity, biomass, carbon sequestration, soil formation and stabilization; climate regulation and water catchment/storage ability and water protection; and is a gene bank for medicine, agriculture, and forestry. In addition, the RBCMA's rich ecosystems also play a vital role in buffering communities against storms and hurricanes by reducing potential physical damage to houses and other infrastructure during storm events, and in filtering out sediments and agrochemicals from unsustainable development and agricultural practices.

Through group consensus, two priority environmental services considered to be at greatest risk from climate change were selected:

- Climate regulation
- Water catchment/storage ability and protection

3.5.2.3 PRIORITY STAKEHOLDER COMMUNITIES

Priority stakeholder communities were selected from those identified in the RBCMA stakeholder analysis. They were chosen based on their significant dependence on the natural resources and ecosystem services of the protected area, and lowest capacity for adaptation. Then they were analyzed and prioritized based on three (3) vulnerability factors:

1. Exposure: The extent to which a community comes into contact with climate events or specific climate impacts

2. Sensitivity: The degree to which a community is negatively affected by changes in climate

3. Adaptive Capacity: The potential or capability of a community to adjust to impacts of changing climate, and to minimize, cope with and recover from the consequences of changes

Lemonal and San Carlos were both chosen as priority stakeholder communities for the RBCMA climate change planning. Of these two communities, Lemonal was thought to be the most vulnerable -- being the most exposed and sensitive to climate change, and having a low potential or capability to adjust to and recover from impacts due to its perceived lower economy. While San Carlos and Rancho Dolores were both considered equally vulnerable in their exposure and sensitivity to climate change impacts, San Carlos was chosen as the other priority community due to its distance away from the buffering protection of the RBCMA and due to Rancho Dolores' higher adaptive capacity and overall lower vulnerability.

3.5.2.4 KEY SOCIO-ECONOMIC ACTIVITIES

The stakeholder analysis and community consultations revealed that the RBCMA communities are dependent on the natural resources of the protected area. Socio-economic activities such as fishing, hunting, extraction of non-timber forest products, logging, cash crop and sugarcane production, cattle rearing, and land-based tourism contribute to the local and national economy.

Small-scale farming (vegetables, grains, and small livestock including pig, poultry and sheep) were selected as the key socio-economic activity based on its dependence on the natural resources of the protected area and that will be most affected by climate change. Changes in temperature, amount of carbon dioxide, and the frequency and intensity of extreme weather could have significant impacts on crop yields. Heat stresses can increase the vulnerability of farm animals to disease, reduce fertility, and reduce milk production. Droughts may reduce the amount of quality forage available to grazing farm animals, and changes in crop production due to drought could also become a problem for animals that rely on grain. Climate change may also increase the prevalence of parasites and diseases that affect farm animals, and increases in carbon dioxide may increase the productivity of pastures, but may also decrease their quality and nutritional benefits.

3.5.3 THREAT ASSESSMENT

3.5.3.1 SITUATION ANALYSIS

To achieve conservation, the impacts of climate change must be mitigated. This can be achieved through an understanding of the changes that will come about in Belize and at the RBCMA, and identifying conditions that may lead to solutions (Table 6).

Table 6: Predicted climate change impacts for Belize

Predicted Climate Change Impacts	Current Status	25 - 50 years	100 years
Sea level rise	• Increased global average sea level rise rate of 1.8mm per year from 1961 – 2003 (IPCC, 2007). Current average increase in sea level rise in the Mesoamerican region is estimated at 3.1mm per year (IPCC, 2007).		• Predicted increase of between 0.6m and 1.0m over next 100 years, though could be higher (up to 3.3m), dependent on the rate of melt of ice sheets (Simpson et al., 2009)
Sea surface temperature rise	• Water temperature has increased by 0.74˚C		• Predicted regional increase of temperature by up to 5˚C

	between 1906 and 2005 • Current levels of increase are estimated at 0.4˚C per decade (Simpson et al., 2009)		by 2080, with the greatest warming being experienced in the north-west Caribbean (including Belize) (WWF, 2009).
Increased intensity of storms	• Increased storms from 1999 onwards, with annual fluctuations. More storms during La Nina, fewer El Nino. Stronger storms >Cat 4 / 5		•
Ocean acidification (corals, lobster / conch)	• Atmospheric CO_2 concentration has increased from 280 parts per million (ppm) in 1880 to 385 ppm in 2008 - 35% increase in hydrogen (Simpson et al., 2009). • 48% of all atmospheric CO_2 resulting from burning of fossil fuels has been taken up by the ocean (Hartley, 2010)	• Predicted atmospheric CO_2 levels of 450 by 2040 (Simpson et al., 2009) • Predicted 30% decrease in pH • Predicted decrease in calcification rate by 20 - 50% by 2050	• Decrease of between 0.3 and 0.5 units by 2100 (Hartley et. al. 2010). • Some experts predict a 35% reduction in coral growth by 2100 (Simpson et al., 2009)
Decreased Precipitation	• Mean annual rainfall over Belize has decreased at an average rate of 3.1mm per month per decade since 1960 (NCSP/UNDP)	• Predicted ecological shifts up the altitudinal gradient of the Maya Mountains Massif may remove the cloud forest, and the catchment functionality important for maintaining rivers in dry season in the south of Belize, and providing nutrients to the reef environment. • Increased concentration and seasonality of agrochemical delivery	• Predicted decrease in precipitation of 9% by 2099 (IPCC, 2007), with significant fluctuations, attributed to El Niño • Some models predict a decrease of as much as 22% (IPCC 2007)
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).	•	• Predicted mean annual temperature increase is 3.5° by 2099 (UNDP, 2009).

Using this information about the predicted climate change impacts for Belize, a "Hypothesis of Change" was developed to identify threats to the climate change adaptation targets considered important for the RBCMA (Table 7).

Table 7: Hypothesis of change for climate change adaptation targets

IMPACT	HYPOTHESIS OF CHANGE: BROAD-LEAVED FOREST
Increased Air Temperature	• Increased frequency and intensity of fires
	• Changes in species composition (birds) due to micro-climate changes
Decreased Precipitation	• Upward movement of the moisture gradient (shifting of ecosystems)
	• Changes in species composition (flora and fauna)
Increased Intensity of Storms	• Loss of trees
	• Changes in species composition (flora and fauna)

IMPACT	HYPOTHESIS OF CHANGE -- SAVANNA
Increased Air Temperature	• Increased frequency and intensity of fires
Decreased Precipitation	• Increased frequency and intensity of fires
Increased Intensity of Storms	• Loss of standing trees
	• Loss of nutrients (washed away by flood waters after fires)

IMPACT	HYPOTHESIS OF CHANGE: AQUATIC ECOSYSTEMS
Increased Air Temperature	• Increased burning of the vegetation top layer
	• Changes to Hicatee reproductive potential
Decreased Precipitation	• Drying up of marshes
Increased Intensity of Storms	• Increased numbers, variety, and spread of invasive species
	• Changes in water quality (saltwater intrusion and nutrient loading)
Sea Level Rise	• Saltwater intrusion
	• Changes to Hicatee reproductive potential

IMPACT	HYPOTHESIS OF CHANGE: KEY ENVIRONMENTAL SERVICES -- CLIMATE REGULATION
Increased Air Temperature	Increased evapotranspiration cycles
Decreased Precipitation	Warmer/drier micro-climates (which affects habitats & species)
Increased Intensity of Storms	Disruption of evapotranspiration cycles
	Warmer/drier micro-climates (which affects habitats & species)

IMPACT	HYPOTHESIS OF CHANGE: KEY ENVIRONMENTAL SERVICES -- WATER CATCHMENT/PROTECTION
Increased Air Temperature	Reduced ability to catch and store water
	Reduced availability of fresh water
Decreased Precipitation	Reduced availability of fresh water
Increased Intensity of Storms	Contamination of water bodies
	Increased erosion
	Increased loading of nutrients into water bodies

IMPACT	HYPOTHESIS OF CHANGE: PRIORITY STAKEHOLDER COMMUNITIES -- LEMONAL
Increased Air Temperature	Increased health problems (respiratory and infectious diseases)
	Increased cost of living (non-food items, health, energy, etc.)
Decreased Precipitation	Decreased availability of drinking water
	Decreased food production capacity
	Increased intensity of droughts
	Increased poverty rates
Increased Intensity of Storms	Damage to infrastructure caused by flooding
	Damage to housing and farm infrastructure
	Increased health problems (water contamination)
	Increased cost of living (non-food items, health, energy, etc.)
	Increased poverty rates
	Increased cost of crop insurance

IMPACT	HYPOTHESIS OF CHANGE: PRIORITY STAKEHOLDER COMMUNITIES -- SAN CARLOS
Increased Air Temperature	Increased health problems (respiratory and infectious diseases)
	Increased cost of living (non-food items, health, energy, etc.)
Decreased Precipitation	Decreased food production capacity
	Increased intensity of droughts
	Increased poverty rates
Increased Intensity of Storms	Damage to infrastructure caused by flooding (access to markets)
	Damage to housing and farm infrastructure
	Increased health problems (water contamination)
	Increased cost of living (non-food items, health, energy, etc.)
	Increased poverty rates
	Increased cost of crop insurance

IMPACT	HYPOTHESIS OF CHANGE: KEY SOCIO-ECONOMIC ACTIVITIES -- SMALL-SCALE FARMING
Increased Air Temperature	Reduction in crop yields
	Increased production input costs due to increased crop pests and diseases
Decreased Precipitation	Reduction in crop yields due to increased droughts
	Increase in crop pests and diseases
	Increased production input costs (irrigation, pesticides, herbicides, etc.)
Increased Intensity of Storms	Damage to farms due to flooding and wind damage -- increased crop and livestock loss
	Increased cost of crop insurance
	Reduced access to markets due to infrastructure damage

3.5.3.2 PRIORITIZING IDENTIFIED THREATS

The highest priority threats from the "Hypothesis of Change" were selected for addressing with management strategies and actions (Table 8).

Table 8: Priority threats for climate change focal targets

Cross Cutting Priority Threats	Climate Change Focal Targets							
	Focal Conservation Targets			Key Environmental Services		Priority Stakeholder Communities		Key Socio-economic Activities
	Savannah	Aquatic Ecosystem	Broad-leaved Lowland Forest	Climate Regulation	Water Catchment / protection	Lemonal	San Carlos	Small-scale farming
Changes in water quality (saltwater intrusion and nutrient loading)								
Increased frequency and intensity of fires								
Changes in species composition (flora and fauna)								
Warmer/drier micro-climates (which affects habitats & species)								
Reduced ability to catch and store water								
Decreased food production capacity								
Damage to infrastructure caused by flooding (access to markets)								
Increased production input costs (irrigation, pesticides, herbicides, etc.)								

3.5.4 OBJECTIVES AND STRATEGIES TOWARDS CLIMATE CHANGE ADAPTATION

3.5.4.1 DEFINING OBJECTIVES

A climate change-related objective was developed based on the high-priority threats identified for each Climate Change Adaptation Target, for integration into the RBCMA management programmes (Table 9).

Table 9: Objectives for climate change focal targets

Cross Cutting Objectives	Climate Change Focal Targets							
	Focal Conservation Targets			Key Environmental Services		Priority Stakeholder Communities		Key Socio-economic Activities
	Savannah	Aquatic Ecosystem	Broad-leaved Lowland Forest	Climate Regulation	Water Catchment/ protection	Lemonal	San Carlos	Small-scale farming
By 2019, strengthen the relationship between PfB and the RBCMA's neighboring communities that traditionally depended on the area for subsistence								
Develop and institute a fire management program by the end of 2016 guided by the National Fire Management Strategy								
Strengthen the management and protection of the aquatic ecosystem within the RBCMA								
By 2019, develop and implement a water conservation program								
By 2017, develop and institute a research and monitoring program for the RBCMA								

3.5.4.2 DEVELOPING ADAPTATION STRATEGIES

Key strategies were identified for achieving the objectives identified for integration into the RBCMA management programmes (Table 10).

Table 10: Strategies for climate change focal targets

Objective	Strategy	Priority Threat
By 2019, strengthen the relationship between PfB and the RBCMA's neighboring communities that traditionally depended on the area for subsistence	Establish alternative livelihood projects in the key RBCMA buffer communities (i.e., Lemonal and San Carlos)	Changes in species composition (flora and fauna) Warmer/drier micro-climates (which affects habitats & species) Reduced ability to catch and store water Decreased food production capacity Damage to infrastructure caused by flooding (access to markets) Increased production input costs (irrigation, pesticides, herbicides, etc.)
	Design projects and seek funding to create alternative livelihood opportunities for communities	
	Explore, develop and implement a game meat farming pilot project (e.g., gibnut, white-tailed deer)	
	Explore, develop and implement viable and sustainable harvesting of NTFPs as a pilot project (e.g., popta seeds - palmetto)	
	Conduct regular assessments of the economic benefits of RBCMA to communities	
	Support the provision of access to training and funding opportunities in agricultural best practices	
	Implement capacity building training programs on best farming practices	
	Establish partnership with agriculture research institutions to assist in providing better crop varieties, increase yields and reduce cost (farming methods)	
	Promote water conservation	
	Create linkages to micro-financing, agro-processing, and marketing opportunities	
	Develop entrepreneurship through partnership with BELTRAIDE, etc.	
	Develop and institute a disaster relief plan Lemonal and San Carlos by 2019	
	Provide disaster relief assistance	
Develop and institute a fire management program by the end of 2016 guided by the National Fire Management Strategy	Conduct training sessions on burning techniques and other fire management systems	Increased frequency and intensity of fires Warmer/drier micro-climates (which affects habitats & species)
	Institute fire response protocol commensurate with the level of threat	
	Implement prescribed burns of pine savannah on a maintained schedule (rangers and forestry staff)	
	Maintain adequate equipment for fire management (tractor, swatters, fire gauges, etc.)	
	Establish and train a community fire brigade (rapid response team) that will act as a support in RBCMA and the communities	
By 2015, develop and implement a water quality monitoring program	Conduct water quality testing in the New River watershed	Changes in water quality (saltwater intrusion and nutrient loading)

	Conduct studies to determine levels and methods of agrochemicals use in neighboring farms	Changes in species composition (flora and fauna) Reduced ability to catch and store water Damage to infrastructure caused by flooding (access to markets)
	Implement education programs for best farming practices	
	Lobby GOB for increased and sustained monitoring of pesticides and fertilizer use within the New River watershed	
By 2019, develop and implement a water conservation program	Maintain adequate protection efforts to prevent deforestation	Changes in water quality (saltwater intrusion and nutrient loading) Reduced ability to catch and store water Damage to infrastructure caused by flooding (access to markets)
	Establish partnership with local authorities	
	Institute an education program on watershed management and protection	
	Monitor forest cover change around the RBCMA	
	Work with land holders for forest connectivity	
By 2017, develop and institute a research and monitoring program for the RBCMA	Facilitate research into population structure and composition of key wildlife species, in particular the Mahogany, Jaguar, Yellow-headed Parrot, Central American River Turtle, and cichlids.	Increased frequency and intensity of fires Changes in species composition (flora and fauna) Warmer/drier micro-climates (which affects habitats & species) Reduced ability to catch and store water Decreased food production capacity Increased production input costs (irrigation, pesticides, herbicides, etc.)

4. MANAGEMENT PLANNING

4.1 MANAGEMENT AND ORGANIZATIONAL BACKGROUND

The PfB is now well-established as one of the leading conservation NGOs acting on a regional as well as national scale. The PfB mission is:

"to conserve the biodiversity and promote the sustainable development of Belize through the proper management of the RBCMA and other lands entrusted to it."

Management is now in its twenty-sixth year and has run through five planning cycles in that time. The annual operating budget is c. BZ$ 2.7 million and the organization maintains a head-office in Belize City in addition to the two field stations at La Milpa and Hill Bank. The administrative structure (as of 2014) comprises:

- The Board of Directors including the Executive Director, responsible for day-to-day management.
- An accounts department headed by the Financial Controller with line management of the Senior Accounts Clerk and Accounts Clerk.
- Administration and Planning Manager, a key post with line management responsibility for all operations save forestry and carbon sequestration. This includes:
    - La Milpa Ecolodge and Research Station, including the station manager, with a tour guide, catering and maintenance staff;
    - Hill Bank Field station, also including the station manager, a naturalist/guide, catering and maintenance staff
    - The rangers, including a head and eight ordinary rangers plus a permanent security man at the North Gate.
    - The Tourism Manager is responsible for the overall mamagement and marketing of the Tourism Programme including two additional Belize City staff, La Milpa and Hill Bank Managers, tour guides and support staff.Belize City office support staff (including the Records Manager).
- Technical Coordinator, managing the forest management program with line management responsibility for the Staff Forester, the Assistant Forester, Forest ecologist and the other forestry staff.

These posts are supplemented by temporary and short-term contract staff to cover specific tasks in the annual work cycle. Skill levels and qualifications are high and the organizational culture encourages career development, facilitating opportunities for further training and education often followed by re-hiring in a more senior position.

Recognized constraints, however, consist of a heavy multi-tasking workload falling on senior management staff and difficulties in covering the full range of work programs with available field staff. Furthermore, there is a consistent shortfall of BZ$ 200,000 – 300,000 between the operating budget and reliable income streams. This tends to be covered by grant-funding but is nonetheless debilitating, with constant uncertainty regarding overall funding and more particularly for cash flow. Grant-funding is normally for specific projects and reliance on this support to secure basic operating costs from the administrative overhead tends to pull PfB off its own priority areas. Sustained multi-year financial planning is difficult and re-investment in maintenance and replacement of capital items (buildings and other infrastructure, transport) tend to suffer, hindering day-to-day operations and eventually undermining on-ground management effectiveness and quality.

4.2 REVIEW OF PREVIOUS MANAGEMENT

The most recent self-assessment (2014) conducted for the RBCMA indicates that overall management effectiveness is good (Appendix 9), despite notable weaknesses in law enforcement, education and awareness, community involvement, and monitoring and evaluation. The method used for the self-assessment is adopted from procedures set out by the World Bank and is a rapid assessment that utilizes a scorecard questionnaire that includes the six elements of management (context, planning, inputs, process, outputs and outcomes). The method provides a mechanism to identify needs, constraints and priority actions, and for monitoring progress towards more effective management of protected areas over time.

A review of the management success of implementation of the programmes set out in the 2006-2010 management plan (Appendix 10) shows that while all of the objectives have been met with some overall level of progress, many of the strategic actions were not undertaken.

- Most of the progress was made in the eco-tourism development, hardwood timber management, and research programmes, while the savannah management, freshwater, and outreach programmes showed the least progress. The protection programme showed moderate progress.
- The eco-tourism development programme has maintained occupancy level and infrastructure and catering arrangements at La Milpa, and also made major reinvestments

there, but lagging behind with Hill Bank, especially in diversification and specialization of offerings.

- The hardwood timber management programme has made significant progress in its introduction of silvicultural techniques in routine RBCMA operations, and good progress in stock surveys and re-measurement of permanent sample plots, but nevertheless needs to improve reconnaissance inventory of the RBCMA forest management zones.

- While the savannah management programme has a fire management plan in place, frequent training of staff in fire management is lacking. In addition, savannah management plans have not been developed for the Rancho and San Felipe savannahs, and little or no progress has been made to stratify the savannahs areas and inventory the standing pine stocks. For the biodiversity management sub-programme, the cogon grass control was not instituted, and no experimental nest boxes for the Yellow-headed Parrot were put in place. Good efforts, however, were made in monitoring and controlling pine bark beetle outbreaks.

- Good progress was made in the protection programme, in installing signs at the RBCMA boundary lines, but lines are yet to be cleared. Patrols and overflights were conducted but recognized as insufficient. More rangers, a reliable patrol vehicle, and a standardized monthly reporting system are needed. (Note: A reliable vehicle was provided at the time of writing this document).

- No formal monitoring programme (to monitor human impact parameters) has been instituted for the freshwater programme. Only one entity (Defiance College) is presently conducting water quality testing.

- The outreach programme made no progress in promoting the RBCMA as a venue for training and working seminars and in facilitation of awareness and involvement of local community groups in its management.

- Significant research projects and programmes have been undertaken within the RBCMA, and some improvement has been made by PfB staff to regularly monitor these.

Success of implementation of some management programmes were hindered primarily by management constraints such as availability of field personnel, project financing, and reallocation of funds to other priority areas. The results of the conservation target viability assessment indicate, however, that the RBCMA conservation targets are in overall good health – implying that management and conservation actions over the past management planning period continue to be adequate.

4.3 MANAGEMENT GOAL

The mission of PfB as an organization is given in Section 4.1. On the RBCMA itself, the management goal is:

"The RBCMA is a model private protected area that maintains its biological integrity, regionally significant cultural and landscape features, and fosters a sense of civic appreciation, while providing a sustainable flow of ecological goods and services, and economic benefits to its stakeholders."

Meeting this goal will also meet the conservation target of maintaining RBCMA ecosystems in good condition.

4.4 MANAGEMENT CONSTRAINTS AND LIMITATIONS

4.4.1 REVENUE GENERATION

PfB is always under-funded in relation to general administration (recurrent expenses), which in turn impacts the tourism and timber harvesting programs. Many of the grants do not include a portion for general administration, which tends to be 10-18% ICR. The NGO characteristic of PfB constrains the profitability of the tourism program, since the organization cannot approach tourism as a "for profit" business venture. Consequently, a tourism marketing budget is in place but is under-funded, which results in limited tourism marketing of the La Milpa Ecolodge and Research Station and the Hill Bank Field Station. This is compounded by the fact that integrated budget planning does not occur at PfB; the TDU is not intricately involved in budget planning for the tourism programme. Previous marketing partners (e.g., TNC and STR) have discontinued their program that provided marketing for PfB's tourism.

A tourism marketing and development plan is not in place, and therefore PfB has not capitalized on the opportunity to certify its tourism program (e.g., through Green Globe). While the TDU has continued to be in operation at the Belize City office, there have been tourism personnel limitations in the field in relation to the number of available naturalist guides. Recently, the La Milpa Station Manager and station staff members have had to serve as naturalist guides given staff shortfalls.

The tourism product development budget is also virtually non-existent. As a result, investment in infrastructure and equipment has been very slow in coming at Hill Bank. Therefore, visitor expectations in terms of tourism amenities are sometimes not met at that field station. Additionally, the passenger bus is in a sub-standard condition having been in operations for

many years; there is a need to modernize the tourism unit transportation vehicle. The road access to Hill Bank has been in a deplorable state for many years.

Coupled with these constraints and limitations to the tourism program, as well as increased competition in the sector, tourism visits to the RBCMA have decreased over the past 10 years and is operating well below its potential.

In terms of the timber harvesting program, forestry staff have been unable to gather stock-taking data two to three years in advance to prepare for the rainy season and reduce health risks to staff. This is due to limited staff, infrastructure and equipment. Forest management certification (Forest Stewardship Council/Rainforest Alliance), however, has been maintained, albeit for the overall encompassing management of the RBCMA. The maintenance of the certification has been a challenge because it comes with a significant cost but does not guarantee a higher price for the timber. Certification has been mostly to demonstrate that PfB's timber harvesting is being carried in a sustainable manner.

4.4.2 CONSERVATION PROGRAMS

The major focus of RBCMA work is conservation. However, the field staff have been severely constrained in carrying out their protection work due to shortages of personnel and equipment (vehicles and communications). Over the past five years, there have been numerous instances when transportation has not been available for patrols due to disrepair. The deteriorating condition of the roads and bridges within the RBCMA has contributed to the disrepair of the PfB vehicles. Even when transportation is available, there may be only one vehicle at the disposal of the Rangers at any given time to patrol a huge geographic area. According to the RBCMA staff, illegal logging and hunting have been on the increase within the protected area.

Neighboring resource users are aware of PfB's personnel and equipment limitations, and seem bolder to encroach into the protected area without much fear of being caught. With the use of cellular phone technology, these trespassers are always a step ahead of the RBCMA patrols. This is compounded by the fact that help from the relevant authorities (Forest Department, and the Police Department) is rarely guaranteed due to the transportation limitations of those agencies.

At the time of the preparation of this management plan, there were only eight active Rangers employed, including a gate man who is very advanced in age and frailty. There is a dire need to not only recruit additional Rangers, but to also conduct a review of the performance of the current Ranger force. There are capacity building needs among the RBCMA field staff – e.g.,

special constable designation and training, cross-training, and training in established protocols and chain-of-command.

4.4.3 CROSS-CUTTING PROGRAMS

The previous management plan did not include a focus on community education and outreach, and therefore a budget was not allocated for such. Consequently, PfB and RBCMA staff had little contact with the communities surrounding the protected area. The community consultations held as part of the development of the new management plan (Appendix 12) determined that in general, there are some people from the adjacent communities that depend on the RBCMA resources (timber and non-timber) to generate financial income, physical assets and food. This, of course, is done through illicit means. While local community members extract various forest materials and hunt and fish in the area, the most damaging activity seems to be the illegal extraction of timber resources. Few persons consulted, however, were familiar with the RBCMA and its goal. There appears to be limited knowledge of the RBCMA's purpose and national significance in terms of biodiversity conservation. Community members were aware about the protected area's location (being the historical BEC lands) but an understanding of why it is there and what happens in the protected area is not well understood. The current limited presence of PfB within the communities does little to change this situation. As the communities grow in population and forest resources diminish in community lands, the pressure on the RBCMA is likely to increase. The communities will increase their stake in the RBMCA but it will be for the short term gratification of needs rather than for the long term benefits of conservation.

Scientific research has been mostly an opportunistic and/or indirect activity and has not been programmatic except for timber related research and archaeological reserach. The RBCMA has therefore not benefitted from scientific data strategic (with the exception of timber-related monitoring) to inform its management decision-making and adaptive management.

There have been some critical constraints in administration and planning. Management information and decisions does not filter down to all the PfB departments, thereby hindering the involvement of staff in planning of budgets and work plans. This lack of communication has resulted in inadequate programmatic integration across all departments; cross-fertilization of programs has been missing. The use of information technology at the organization has not been up to par and needs to be improved.

Another critical gap has been the staff compensation framework. Annual compensation increments to account for cost of living increases are not assured.

4.5 MANAGEMENT ZONES

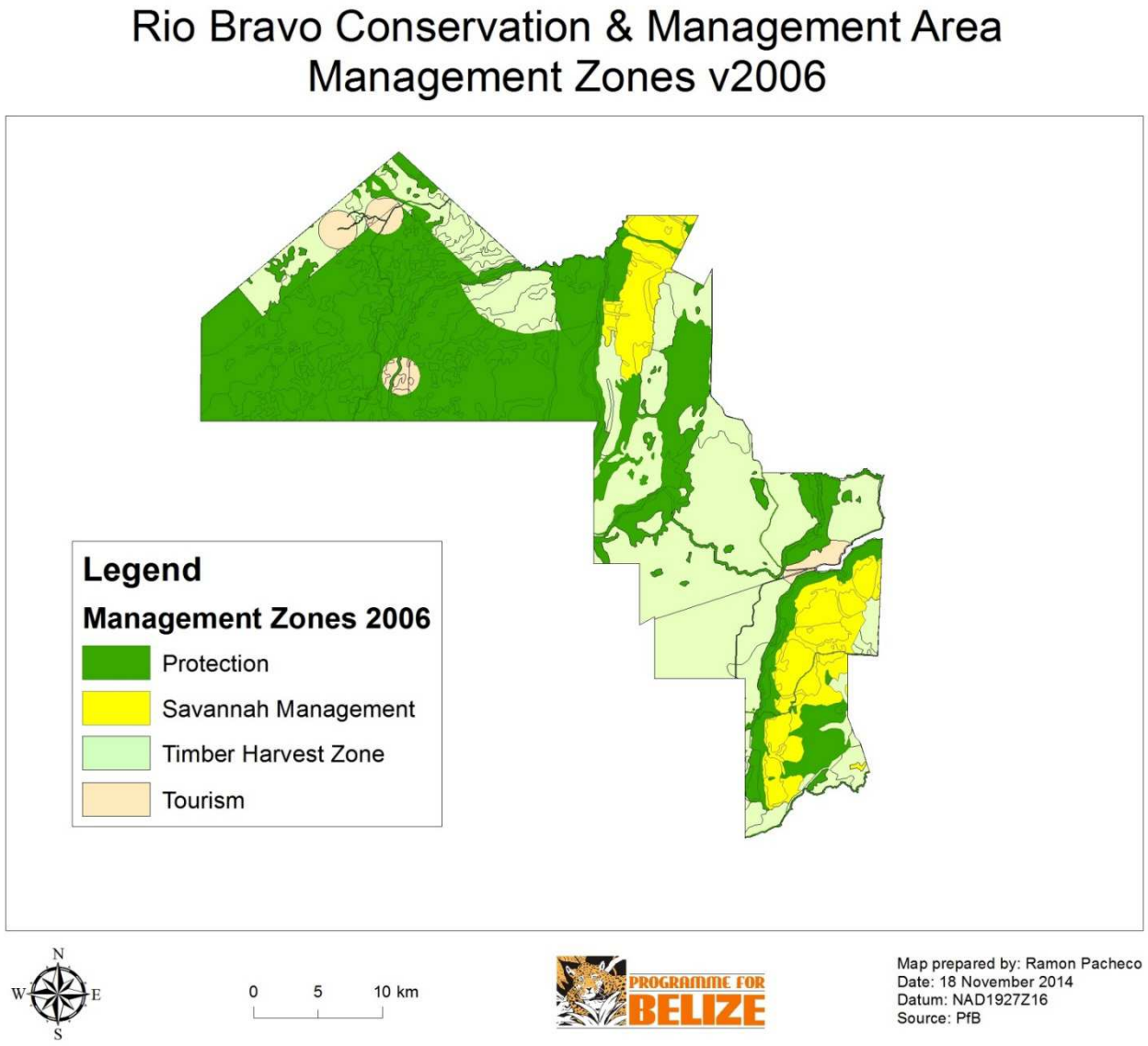
The Rio Bravo Conservation and Management Area is managed based on the Man and Biosphere Reserve Principle and is based on sound scientific research carried out by PfB and its partners. Approximately 65 percent of Rio Bravo is managed as a strict preserve for the protection of biodiversity and natural habitats representing the core protected area (Map 7). Only non-extractive activities and non-destructive tourism can be conducted in this core area. The remainder of the land is managed as the buffer to the core area where PfB experiments and develops sustainable economic land uses that leave the forest and its environmental values intact.

Any economic activity must meet the following criteria:

1. The activity must not have a significant negative impact on the biodiversity and environmental services of the forest; and
2. The activity must be economically feasible so that it can generate revenue for the protection and management of the RBCMA.

The major zonation categories include:

- Protection Zone (the Core Area)
- Sustainable Timber Extraction Zone
- Pine Savannah Management Zone
- Infrastructural Development Zone



Map 7: RBCMA management zones

4.5.1 PROTECTION ZONE

This is an extensive area managed on national park precepts and comprising:

- The entire RBCMA west of the Rio Bravo escarpment excepting the buffer zone on the northern property boundary

- All lands (ecosystems and land facets) recommended by King et al (1992) for conservation due to environmental constraints. These constraints are usually due to slope (primarily in sub-karst areas) and, more extensively, to soil wetness

- Corridors 250 m wide along major water bodies (i.e. permanent rivers and lagoons). This is a relaxation of the previous 500 m guideline around any wetland (including bajos and swamp thickets) but serves the same purpose and is more generous than the 30 m buffer used as a national standard

The result is to create a large protected zone extending throughout the RBCMA and connected along the main streams. It covers a large area of high (upland) forest and all the wetlands, swamp forests and thickets on the area. Permitted activities include:

- Protective patrolling
- Biological and archaeological survey and monitoring
- Non-manipulative research, primarily observational but permitting collection for identification purposes using selective techniques
- Low impact tourism and educational visits

In reality most of these activities will be localized, leaving much of the area as a wilderness where ecological processes are undisturbed. It connects to and shares its management regime with the Rio Azul and Aguas Turbias National Parks.

4.5.2 BROADLEAF FOREST MANAGEMENT ZONE

This zone combines the original “secondary forest products” and “experimental timber extraction” zones. It represents the production forest area within the RBCMA, covering all the taller broad-leaved forest formations on level to moderately sloping ground with firm calcareous soils:

- To the east of Booth’s River (comprising the original experimental forestry area)
- On the north-western RBCMA boundary to a depth of 3 km, excepting the La Milpa EcoLodge and Research Center and Archaeological Site (zoned for tourism), the

immediate frontier area (zoned for protection to complement Rio Azul and Aguas Turbias N.P. management regimes) and the area between the Rio Bravo and Booth's River marshes (where extended to 5 km). The provisional "secondary forest products" zone along the south-western boundary (i.e. against the Gallon Jug boundary) is now included in the protection zone as a 'safe' boundary under current management

The zone has the effect of creating a broad buffer around the protected core. Its extension is justified on the basis of increased confidence that well-managed timber operations are compatible with biodiversity conservation values and can be effectively managed by PfB. It also pushes an active management presence into recognized 'hot-spots' of illicit activity. Spot-zones are used to conserve specific features at a finer scale. These are identified during compartment stock survey and applied during annual operations. Spot-zoning guidelines (Wilson, 2006) provide for:

- A standard 50 m buffer:
    - On both sides of all-weather roads. This is primarily for aesthetic reasons but also minimize the potential fuel load from off-cuts and limbs alongside the road where fire risk is greatest
    - Around sites of exceptional importance to biodiversity (nesting trees, exceptional but localized plant associations, etc.)
- A buffer area with boundaries set by the Staff Forester according to local conditions to exclude:
    - Areas within the high forest unsuitable for heavy machinery. These will usually consist of drainage lines and small bajo and swamp forest patches within the high forest. Slope may also be local constraint on the escarpments and broken terrain of the western Rio Bravo, where a protective spot zone should be established wherever steepness exceeds 20^{o}
    - Archaeological sites with distinct structures that could be damaged during operations

Management programmes include all those applied to the protection forest plus:

- Research, demonstration and experimental programmes involving habitat manipulations (patch cuts, liberation thinning, etc.) in defined study plots
- Extraction of timber and non-timber forest products following sustainable management guidelines established by PfB and subject to certification

4.5.3 SAVANNAH MANAGEMENT ZONE

For zoning purposes the pine savannahs can be defined as those areas where fire is a key part of the system, both for management and as an ecological process. They correspond to the Puletan soil areas covered by the short-grass savannah vegetation types carrying shrubby and pine/oak formations. They also include the transitional woodlands on the savannah fringe.

Savannah management is aimed at:

- Conserving their outstanding qualities for biodiversity conservation
- Rehabilitating pine stands as a potential resource that can act as the basis for:
    - A management regime with wider application across northern Belize (i.e. analogous to the development of the broadleaf forest regime)
    - Revenue generation for conservation management by PfB
    - Kyoto-compliant carbon sequestration through restoration of tree cover

Capacity to control and manage fire is critical to savannah management and assists management of broadleaf forest and herbaceous swamp.

4.5.4 TOURISM ZONES

Visitor levels are not high in any part of the RBCMA but areas in the vicinity of the field stations are in regular use. The zones include an area extending to 3 km around both field stations, with a network of maintained interpretative trails. On the western RBCMA it also includes an area with a 3 km radius centered on the La Milpa Archaeological site, which also has an interpretative trail system, and on the Dos Hombres Archaeological site. At Hill Bank the tourism zone is extended to cover the areas used for water-based activities, separated from the production forest by the 100 m buffers and including:

- The southern end of the lagoon (i.e. the section surrounded by the RBCMA)
- Ramgoat Creek southward to the marl flats
- Irish Creek, from its mouth to the old Belize Timber saw-mill

Tourism takes priority in these zones, which are managed to maximize visit quality and educational value. The La Milpa Archaeological site is a special case in that it integrates tourism with archaeological survey and research. Similar zones may be created in future wherever archaeological sites are developed for visitation. On the RBCMA this consists of retaining the

sites in their forested setting, using trails, guides and literature for interpretation. Leaving them unrestored except for minor consolidation is the most practical way of protecting them for the future.

4.6 LIMITS OF ACCEPTABLE CHANGE

In order to better protect the RBCMA from human activities, the acceptable kinds of resource, social conditions and managerial conditions must be understood. Management actions that can be tracked and traced can then be prescribed to protect or achieve those conditions and allow for stability over time.

Limits of acceptable change, then, are basically the amount of change within the protected area that is considered acceptable as a result of human use. Any amount of human activity will have an impact on the protected area and therefore management should be based on constant monitoring of the site as well as the objectives established for it. It is also possible that within the limits of acceptable change framework, a visitor limit can be established but such limits are only one tool available. The framework is generally outlined in a number of steps and a detailed methodology is set out in the NPAPSP management planning guidelines.

For the RBCMA, guidelines serving the same purpose have been set out in the tourism development plans dating back to 1994 and the general approach is well-established. Essentially the immediate vicinity (to approximately 3km from the field stations) support trail systems that can be used by visitors with or without a guide. The La Milpa archaeological site also has all-weather road access and a trail system. Plans have always allowed for longer hikes involving overnight camping and hides/look-out towers, using the old forest trails – these have never been developed on a regular basis but are again proposed as part of the Ecotourism Development Plan (Haylock, 2006). No formal monitoring of impacts has ever been conducted but visitor numbers remain low and no subjective observations of adverse impacts have been noted at La Milpa, the most heavily used area. Indeed the indications are the opposite – wildlife is in fact now much more commonly encountered and visitor appreciation (as informally expressed and formally assessed through questionnaires) is high. The evolution of Hill Bank, though a different type of site, is following the same general pattern. The assumption is that visitation in terrestrial ecosystems is well within its acceptable limits and – given that La Milpa visitation levels are not planned to rise above their 2000 levels and that Hill Bank targets are set at the same level – are expected to remain so for the foreseeable future.

This is not necessarily the case for the aquatic system where wildlife concentrations (e.g. bat colonies, bird roosts) may be more sensitive to disturbance, especially along the rivers. The Hill Bank plans emphasize increased visitor use of the aquatic systems and it is important to

monitor potential impacts (see section 4.7.4) so that practices can be modified if adverse impacts are detected.

The general concept can also be applied to other forms of actual and potential resource use:

- Hardwood timber management
    - Impact assessment shows that extraction at current levels has extremely low impacts on wildlife populations. Furthermore the system is designed around maintaining the natural ecological dynamics including regenerative capacity while retention of seed trees allows the reconstitution of a forest structure with a good density of large trees. As the retained trees also include all small, non-commercial and misshapen (including hollow) trees, structural complexity and species richness is also maintained. It should be noted that the 40 year logging cycle allows for a rest period at least twice as long as any part of the RBCMA, including its fully protected core zone, has yet enjoyed. The primary purpose of certification is to assure external audit that these safeguards are maintained. Similar considerations apply to NTFPs, if they are included in the management regime
- Savannah management
    - This is still in its infancy but the general principles also apply. Certification applies to the entire RBCMA and will again be used to keep the intensity of management within the limits assuring protection of biodiversity and sustainable production

Limits of acceptable change for the RBCMA can be updated as new or more information becomes available, and exceeding or not meeting limits of acceptable change for any component of the site may not necessarily indicate that there has been a change in the protected area's ecosystem components, processes, benefits and services. However, when a limit of acceptable change is not met or has been exceeded this may require investigation to determine whether there has indeed been a change in the protected area's ecological character.

4.7 MANAGEMENT STRATEGIES AND OBJECTIVES

Four management strategies have been envisioned for the RBCMA 2015-2019 management period:

5. Stakeholder Outreach, Education and Advocacy
6. Ecosystems Protection and Management

7. Research and Monitoring
8. Institutional Strengthening and Management

These four strategies are mutually-supporting, and each has its own set of strategic objectives and tactical objectives/actions that are used to guide the programmes and monitor management implementation. Their background and rationale are summarized here.

4.7.1 STAKEHOLDER OUTREACH, EDUCATION AND ADVOCACY

Programme for Belize's RBCMA outreach and awareness activities involving local communities has been minimal and, hence, a Stakeholder Outreach, Education and Advocacy Strategy is needed. The objectives of this strategy are as follows:

- By 2019, strengthen the relationship between PfB and the RBCMA's neighboring communities that traditionally depended on the area for subsistence in order to generate community support for the achievement of the conservation objectives of the RBCMA;
- Develop and implement a public awareness strategy that focuses on the ecological importance and economic contributions of the RBCMA in order to make local communities and the general public understand the ecological and economic value of the RBCMA and its resources;
- Develop and implement an environmental education strategy for the RBCMA in order to build knowledge, skills, and experience that would foster appreciation for nature and protected areas among the buffer communities;
- Foster an understanding among policy makers and community leaders about the importance of maintaining the RBCMA's natural resources in order to ensure that enabling policies are in place and applied for the protection and effective management of the natural resources of the RBCMA.

The first objective is to strengthen the relationship between PfB and the RBCMA's neighboring communities that traditionally depended on the area for subsistence, by 2019. This would include establishing alternative livelihood projects in the key RBCMA buffer communities; conducting regular assessments of the economic benefits of RBCMA to communities; supporting the provision of access to training and funding opportunities in agricultural best practices, creating linkages to micro-financing, agro-processing, and marketing opportunities; develop entrepreneurship through partnership with BELTRAIDE, etc.; and developing and instituting a disaster relief plan for Lemonal and San Carlos by 2017.

Another objective would be to develop and implement a public awareness strategy that focuses on the ecological importance and economic contributions of the RBCMA to make local

communities and the general public understand the ecological and economic value of the RBCMA and its resources. To accomplish this, social media platforms can be utilized to bring awareness to the Yellow-headed Parrot programme and other conservation efforts within the RBCMA. Other management actions will also include highlighting the tourism benefits and potential of the RBCMA, as well as the potential for NTFPs and alternative livelihood initiatives for communities that surround the RBCMA, and utilizing the print and electronic media to highlight the RBCMA management challenges as well as the opportunities.

The development and implementation of an environmental education strategy for the RBCMA is another objective under this strategy. This objective is key to building knowledge, skills, and experience that would foster appreciation for nature and protected areas among the buffer communities. This will be accomplished through the development and implementation of a community education and outreach campaign to develop appreciation for flora and fauna; establishment of a volunteer program to support the various RBCMA programs; and conducting one annual training for neighboring farmers on the proper use of pesticides and fertilizers to reduce chemical runoffs around the RBCMA.

The last major objective under this particular strategy is to foster an understanding among policy makers and community leaders about the importance of maintaining the RBCMA's natural resources, to ensure that enabling policies are in place and applied for their protection and effective management. Specific actions include lobbying the government for the formulation and/or enactment, or updating of legislation and regulations pertaining to the harvesting of and trade in endangered species (e.g., Mahogany); lobbying the government for the formulation and/or enactment of legislation and regulations pertaining to the use of sawmills; and continuously lobbying for improved policy and legislation as it relates to law enforcement and institution of higher penalties for trespassing, illegal logging, and poaching in private protected areas.

4.7.2 ECOSYSTEMS PROTECTION AND MANAGEMENT

This strategy has to do with improving and maintaining the ecological integrity of the RBCMA through effective protected areas management.

The following six key programmes form the main elements of the Ecosystems Protection and Management Strategy for the next five years: 1) Resource Protection and Enforcement, 2) Fire Management, 3) Savannah Management, 4) Broad-Leaved Forest Management, 5) Aquatic Ecosystem Management, and 6) Contingency Plans for Oil and Roads.

The ecosystems protection and management strategy will focus on achieving the following objectives:

- By mid-2015, institute a strengthened and expanded resource protection and enforcement program at the RBCMA in order to deter and eliminate encroachments and illegal incursions into the protected area;
- Develop and institute a fire management program by the end of 2016 guided by the National Fire Management Strategy in order to which have the potential to affect the population structure and composition of native species, particularly the Caribbean Pine;
- Strengthen the savannah protection program in order to reduce the poaching of Yellow-headed Parrots and other wildlife that is threatening this ecosystem within the RBCMA;
- Strengthen the broad-leaved forest management program since the broad-leaved forest ecosystem is affected by the most threats compared to the other RBCMA ecosystems, including timber extraction, illegal logging, illegal agriculture, poaching of wildlife, uncontrolled burning, and road infrastructure and oil development;
- Strengthen the management and protection of the aquatic ecosystem within the RBCMA in order to respond to the increasing threats of pollution (pesticides and fertilizers) and invasive species that could affect the population of Central American River Turtles (Hicatees) and cichlids;
- By 2019, develop and implement a water conservation program in order to optimize the ability of the RBCMA hydrological systems to catch and store water.

4.7.2.1 RESOURCE PROTECTION AND ENFORCEMENT PROGRAMME

This programme has the following objective:

- By mid-2015, institute a strengthened and expanded resource protection and enforcement program at the RBCMA in order to deter and eliminate encroachments and illegal incursions into the protected area.

A ranger protection and surveillance plan is envisioned, to include increasing the number of rangers to an optimal size (year 1 = 10, year 2 = 16, year 5 = 23) to ensure more frequent patrols, and to cover hot spots and sensitive areas; conducting four aerial patrols per year; and organizing and undertaking regular training of rangers in conjunction with the Police, BDF, and Forest Department, and to confer special constable designation. Ideally, two ranger/conservation posts will be installed at strategic locations in the San Felipe savannah and Lemonal area; RBCMA boundary demarcation will be reinforced through the use of proper signage; and new patrol vehicles and equipment will be acquired.

Protection of the RBCMA is through the team of rangers, stationed at Hill Bank. The rangers' primary tasks are to maintain a permanent presence at the gates and conduct patrols (including aerial patrols) to detect possible encroachment, deforestation, illegal logging, illegal agriculture

(mainly marijuana cultivation), and to monitor fires. When necessary and appropriate, enforcement interventions (particularly involving illegal drug cultivation and timber theft) are made in conjunction with the Belize Defense Force (BDF), Forest Department (FD) and the Police.

Maintaining a full contingent of rangers with the necessary equipment is expensive, and the PfB is often faced with challenges obtaining funding. It is important, therefore, that the most efficient use of the full range of resources already available be made. Resource use programmes would therefore extend into the sensitive areas as passive protection, essentially demonstrating occupancy of the land. Key areas are:

- For the broad-leaved forest management, extending forest inventory into the northern 'roof' area, the Cacao area between the Booth's River marshes and the Rio Bravo, Duck Ridge and the forested lands on the south-eastern boundary

- For the savannah management programme, undertaking pine inventory across both savannahs and establishing one of the fully managed demonstration areas astride the access to the San Felipe savannah

As these are labor-intensive tasks, the ranger team could collaborate with the forestry team to accomplish them. This will also reinforce security of the areas and allow for the sharing of resources (notably vehicles and radios) between programmes. As protection goes, this activity counts as patrolling.

Another area requiring attention is boundary cleaning and demarcation. To date, some signs have been installed in strategic locations but manpower and other resources have been insufficient to carry out this work and to put lines in place. This activity can be accomplished and maintained in conjunction with the forestry team and in association with the hardwood and pine inventories.

Patrols are thus supplementary in areas where management programmes do not provide regular ground presence and the policy of mutual reinforcement between field programmes still operates. More than one patrol per month (in additional to involvement in forestry and savannah management work) is desired, and additional patrols in the two savannahs are necessary in order to detect and discourage or otherwise address:

- Setting of fires
- Parrot theft (and monitoring of nest-boxes and known yellow-headed parrot nesting holes)
- Local infestations of cogon grass and pine bark beetle

Patrols should continue to cover areas deemed at risk such as the frontier area (including its approach through Aguas Turbias), Cacao, the northern Duck Ridge and lower Booth's River area, lower Irish Creek and the south-eastern part of the boundary.

Throughout, the general aim is to integrate protection and resource management more closely to make better use of available staff, equipment and transport. Annual and monthly planning must therefore be a joint activity, with strong input from the Forester as the most senior staff member with direct responsibility for field operations.

In addition, the size of the area means that ground presence is thinly spread. Monitoring of effectiveness therefore becomes extremely important, to ensure available resources are directed most strategically. This in turn implies care in reporting. A standardized monthly reporting system is needed and should include date, time, personnel, route and specific objectives for the patrol. In forested areas, evidence of the following should be recorded:

- Entry (e.g. vehicle and horse tracks, foot-prints, cut trails)
- Hunting (e.g. camps, torch batteries, cartridge cases)
- Logging (e.g. stumps, logs, extraction trails)
- NTFP extraction (e.g. cut sabal or palmetto, chicle slash-marks)
- Land clearance within the RBCMA boundaries

The points made above should also be included for savannah areas. In each case the type of illicit use or other observation must be noted along with an estimate of its age (> 6 months, 6-1 month, < 1 month). Each separate incident must be noted along with its location, by GPS if possible but otherwise as closely approximated as possible. Observations involving hunting will be points but other threats usually affect an area such as a patch of forest or stretch of road – in these cases both the location and the estimated area affected should be estimated. The evidence should be removed where appropriate (e.g. cartridges and camp rubbish, camp shelters knocked down) to avoid 'double-counting' on later patrols.

A formal system must also be instituted for over-flights, including the specific issues/localities to be verified and the results. Here the emphasis is upon unauthorized entry by vehicles, boundary integrity and forest clearance, extent of fire damage and detection of pine bark beetle outbreaks. Particular attention must be given to set flight lines and use of GPS to avoid disorientation.

4.7.2.2 FIRE MANAGEMENT PROGRAMME

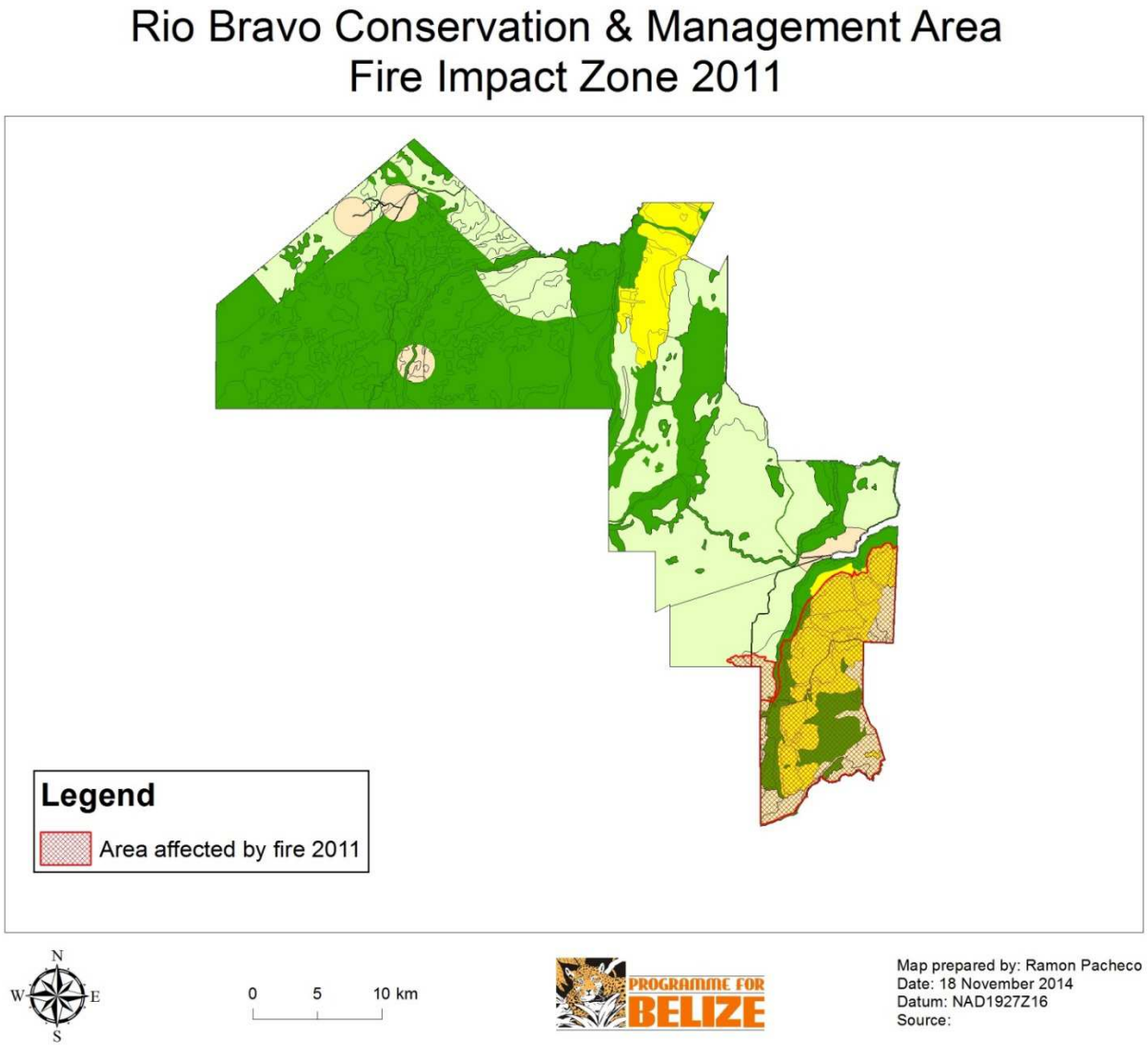
The main objective of the fire management programme is as follows:

- Develop and institute a fire management program by the end of 2016 guided by the National Fire Management Strategy in order to which have the potential to affect the population structure and composition of native species, particularly the Caribbean Pine.

This will serve to reduce the frequency of uncontrolled/unmanaged fires, which have the potential to affect the population structure and composition of native species, particularly the Caribbean Pine. Major management actions include updating the fire management plan, developing a hurricane response plan, and establishing and training a community fire brigade (rapid response team) that will act as a support in RBCMA and the communities.

While natural fires are a necessary part of the RBCMA landscape, unnatural and unmanaged fires pose a threat to its ecological integrity (Map 8). Hurricanes may also fell trees and significantly increase fire risk due to the increased fuel load from fallen and dead trees. The RBCMA fire management programme aims to maintain the current capacity to detect and suppress wildfire and to use fire as a management tool.

Fire management training should be conducted for rangers, forestry personnel, and the buffer communities, with the participation of other entities responsible for managing fire-prone areas. It should include control of savannah fires as well as hardwood forest fires. Training exercises with prescribed burns should also be maintained and carried out according to a schedule, and integrated into the overall savannah management plan. The fire management plan is to be fully revised by year one and fully implemented by year two.



Map 8: RBCMA fire impact zone (2011)

4.7.2.3 SAVANNAH MANAGEMENT PROGRAMME

This programme seeks to accomplish the following objective:

- Strengthen the savannah protection program in order to reduce the poaching of Yellow-headed Parrots and other wildlife that is threatening this ecosystem within the RBCMA.

This will include finalizing and implementing the savannah management plan, developing and implementing a Yellow-headed Parrot (YHP) conservation program, developing a media awareness campaign on the YHP and the RBCMA, improving monitoring of YHP nests/breeding success, and developing a YHP adopt-a-parrot initiative, among others.

Pine savannah covers approximately 10,000 ha of the RBCMA, in two separate areas of approximately equal extent – the Rancho Dolores savannah covering most of the area between the East Gate and The New River escarpment and the San Felipe savannah in the northern part of the RBCMA between Duck Ridge and the Booth's River marshes. Both form the southern part of extensive bands of pine savannah habitat extending north-eastwards across the northern coastal plain. Several vegetation types are typical of these areas (see section 2.5.1) but for practical purposes it is useful to distinguish open grassland with scattered trees, pine woodland (with >10% canopy cover, becoming closed in denser stands) and mixed pine-oak woodland. It is limited to the Puletan soils but fire is a critical part of its ecological dynamics and the drainage regime also appears important. Essentially poor drainage appears to favor open formations while the better drained areas tend towards woodland. Fire inhibits woody colonizers in the grassland and opens up the woodlands. The open and degraded aspect of many savannahs is usually attributed to over-frequent burning, exacerbated by unmanaged logging of the larger pines.

The San Felipe area covers 3394 ha and is very open, with some 90% covered by short-grass savannah with scattered pine. The remaining area consists of pine or pine-oak woodland with the wetter savannah fringe which includes several poorly described swamp or riparian woodlands. The San Felipe savannah has always been a problem area for hunting and other illicit activities and burns frequently (estimated at approximately 1000 ha p.a.). More attention remains needed in this area, including regular patrol and monitoring.

In contrast, the Rancho Dolores savannah is more wooded, with 87% of its 5531 ha area under open pine-oak or pine woodland with some patches now tending towards closed canopy forest. This is partly due to terrain, with better-drained rises covering a larger part of the area supporting pine stands that were regularly logged until 1995, but is also due to better management. Fire control to encourage pine regeneration is an important component of the Rio Bravo Carbon Sequestration Pilot Project and has been applied here. Essentially, crews

trained and equipped under the project were able to suppress eleven out of fourteen fires set between 1996 and 2003 while controlled burns associated with fire management training (in concert with The Nature Conservancy) have been maintained over 1000 ha in the Big Pond and 'Tillet and Potts' areas – i.e. along the East Gate-Ramgoat Creek road. Although unmeasured, this has produced considerable growth with well-grown stands and abundant though patchy regeneration over the past decades. In 2011, after hurricane Richard, the entire Rancho Dolores savanna was burnt despite serious efforts to suppress the fires in this area.

Pine Bark Beetles (*Dendroctorus spp* and *Ips spp*.) are a natural part of the savannah ecosystem and damaging infestations occur when conditions allow – notably when stands become over-dense and/or with an abundance of old, weakened and injured trees. Outbreaks have been recorded in the early 20th century and that in 2001 caused heavy pine mortality in Mountain Pine Ridge and the southern coastal plain. A ground and aerial monitoring programme was mounted on the RBCMA, allowing control of some 15 centers of infestation before serious damage resulted.

The pine savannahs also have a characteristic community and the Rancho Dolores savannah is considered a stronghold for the endangered Yellow-headed Parrot. Traditional nest-sites have been located and are regularly checked during the breeding season. Research has also been carried out on nest-site requirements – essentially old hollow pines standing in open areas.

While considerable progress has been made in savannah management during the previous management period, the development of a savannah management plan has not been completed. A consideration would be to develop detailed plans for the two demonstration areas (Rancho Dolores and San Felipe).

<u>Stratification of the savannah under a management-related classification system</u>

The national vegetation map has been adopted and more work needs to be done to stratify the RBCMA savannah to sub-units to indicate those needing management intervention. The aim is to use remote imagery and the videography (undertaken as part of the Carbon Sequestration Pilot Project) to give a finer level of stratification, mapped at 1:25,000 scale and separate areas out in terms of biomass, density of pine stocking and fuel model – relating them to management issues involving carbon sequestration, pine stocking and fire regime. This exercise should cover the entire pine savannah ecosystem.

<u>Forest inventory</u>

The Rancho Dolores pine stands were regularly logged up to 1995 and there is pressure – especially after the loss of national stocks in the 2001 pine bark beetle outbreak – to allow some degree of off-take leading to extraction over a 120 ha area in 2002. Pine is indeed a

potential revenue-generating resource both from Kyoto-compliant carbon sequestration schemes based on rehabilitating degraded pine stands and as a timber resource. Regeneration has been good in recent years and some stands may be in need of thinning. A full inventory of the standing pine stocks is needed, but the extent to this getting done may depend on pine prices on the market. If pine prices are low, PfB might find that it doesn't make sense to invest in this activity. In addition, maintaining a healthy well-managed forest is the best defense against future pine bark beetle outbreaks. Management of pine has always been envisaged and is indeed an important component of the carbon sequestration programme but must be part of a comprehensive plan based on good information. The inventory is part of this process.

The outline savannah plan indicates that a 5% inventory based on 0.5 ha plots regularly spaced within each pine-bearing stratum over the savannah (i.e. savannah grassland with scattered pine, pine woodland and pine-oak formations) is ideal. This should be applied to the two demonstration areas and, if workloads allow, extended over the remaining savannah at 2% coverage. The protocol follows that used for the southern coastal plain (Johson & Chaffey, 1972), measuring all trees of 10 cm dbh and above to give the density, size class distribution and standing volume as well the general characteristics of the plot (slope, aspect, drainage, canopy cover, general stand conditions). A 0.1 ha nested plot is used to assess regeneration, counting all trees < 10 cm dbh in the 0-1.5m, 1.5-3.0 m and < 3 m height classes. The inventory plots are permanently marked and maintained as permanent sample plots (PSPs) for re-measurement for growth, mortality and recruitment after 5 years and then at 10 year intervals.

<u>Savannah management planning and implementation</u>

The 2015-2019 aim is to produce a detailed management plan for the two demonstration areas, using the stratification and inventory to identify management units, each with prescriptions aimed at achieving specific management objectives. These must be developed in consultation with technical input from the carbon sequestration and fire management training programmes, but the following guidelines apply:

- All existing parrot nesting trees must be protected and management must allow for retention of sufficient old and unsound trees to offer new sites for the future
- Drainage appears equally important as fire in determining pine stocking
- Experimental plots to determine the effect of improved drainage on pine regeneration are desirable but the general rule at this stage is not to engage in large scale interventions in the drainage system, so retaining structural and community diversity
- The carbon sequestration project aims at enhanced biomass, which may be pine and/or broadleaf and palm species. Fire management should take this into account (i.e. preservation/promotion of broadleaf patches should be taken into account as well as

pine regeneration) and the carbon monitoring programme must be integrated into the overall system

- In areas designated for pine, the fire plans may aim at promoting or reducing regeneration according to the age of the stand. Some stands are, however, already sufficiently developed to require other silvicultural interventions such as thinning and may even be found capable of supporting some degree of extraction. The following principles should be taken into account:

    - Growth rates on the southern coastal plain have been estimated at 1 cm dbh p.a. Rainfall on the RBCMA is approximately half that of the southern part of the country and a mean annual growth increment of 0.5 cm dbh p.a. should be used for projecting stand development and allowable cut until the permanent plots give site-specific data

    - The approach used on Mountain Pine Ridge and the southern coastal plain aims to produce even aged stands with seed trees left on felling to provide for regeneration. The implication is that older and unsound trees should now be cleaned out from regenerating pine groves and that larger sound trees could constitute an exploitable resource. This must be treated with caution on the RBCMA – enough old and unsound trees should be left to offer structural diversity in the stands and for parrot nesting sites

In conserving biodiversity on the savannah ecosystem, the following activities should also be pursued and integrated with the management plan:

<u>Experimentation with nest-boxes for yellow-headed parrots</u>

Provision has already been made for retaining and protecting yellow-headed parrot nest-sites but the species nonetheless remains under pressure. Studies elsewhere have shown that nest-site availability is a limiting factor in some parrot populations and that provision of nest-boxes allows populations to expand. This becomes especially important as management prescriptions tending towards denser, more homogenous, pine stands – which may limit the conditions creating suitable nesting trees in the future – are promoted.

No experimental nest box arrays were installed during the previous management period. This undertaking is difficult to do as an isolated activity and needs active management presence, complemented by an education and awareness program.

Control of Cogon Grass (*Imperata cylindrica*)

At least 40 patches of this invasive grass have been identified in the savannah, ranging in size from 16-1000 sq m in area. No control was instituted during the last management period, on advice that it is best to leave this grass untouched or it may spread faster and get out of control unless herbicides are applied. Totally uprooting this grass manually is ideal but very expensive.

Pine Bark Beetles

These species are native and occasional outbreaks are probably part of the natural ecological dynamics of pine woodland. They are nonetheless capable of significant damage to timber resources and subject to a control programme on a regional scale. Regular thinning of pine stands is the most effective preventive measure. This will be supplemented by:

- Coverage of the savannahs in the aerial patrols to locate outbreaks
- Reporting of outbreaks in routine patrol reports
- Prompt action to fell the affected trees plus an immediate buffer, using the protocol successfully implemented in the 2001 season. If cost-effective, the felled material can be transported and sold, or otherwise left on site

No outbreaks or dying trees were observed or reported by RBCMA rangers during the last management period. No control was therefore instituted.

4.7.2.4 BROAD-LEAVED FOREST MANAGEMENT

The PfB recognizes, though, that the following objective must be achieved:

- Strengthen the broad-leaved forest management program since the broad-leaved forest ecosystem is affected by the most threats compared to the other RBCMA ecosystems, including timber extraction, illegal logging, illegal agriculture, poaching of wildlife, uncontrolled burning, and road infrastructure and oil development.

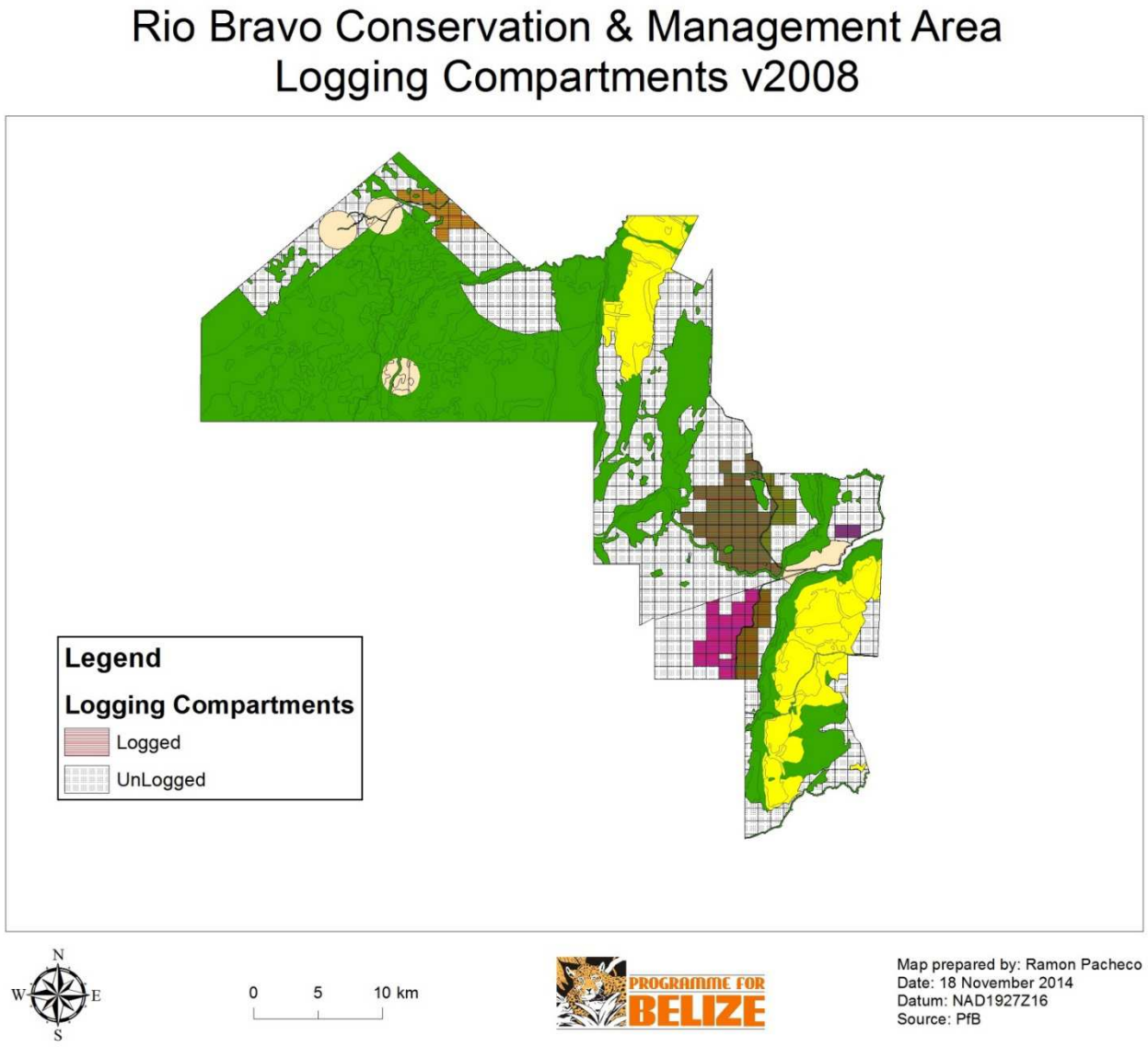
As mentioned in the conservation planning section, the RBCMA broad-leaved lowland forest is still in good health. It is extensive, with fair connectivity at the landscape level, and basic ecological processes are intact. Structure and species composition are mostly modified by past and present timber extraction, illegal logging, illegal agriculture, uncontrolled burning, and road and oil development but impacts overall are moderate, leaving the natural communities in functional condition. Oil development, however, especially in its latter stages can have a significant impact in the broad-leaved forest.

During the past management period, the PfB has continued with its RBCMA hardwood timber management programme. This programme started in its experimental phase in 1997 and was

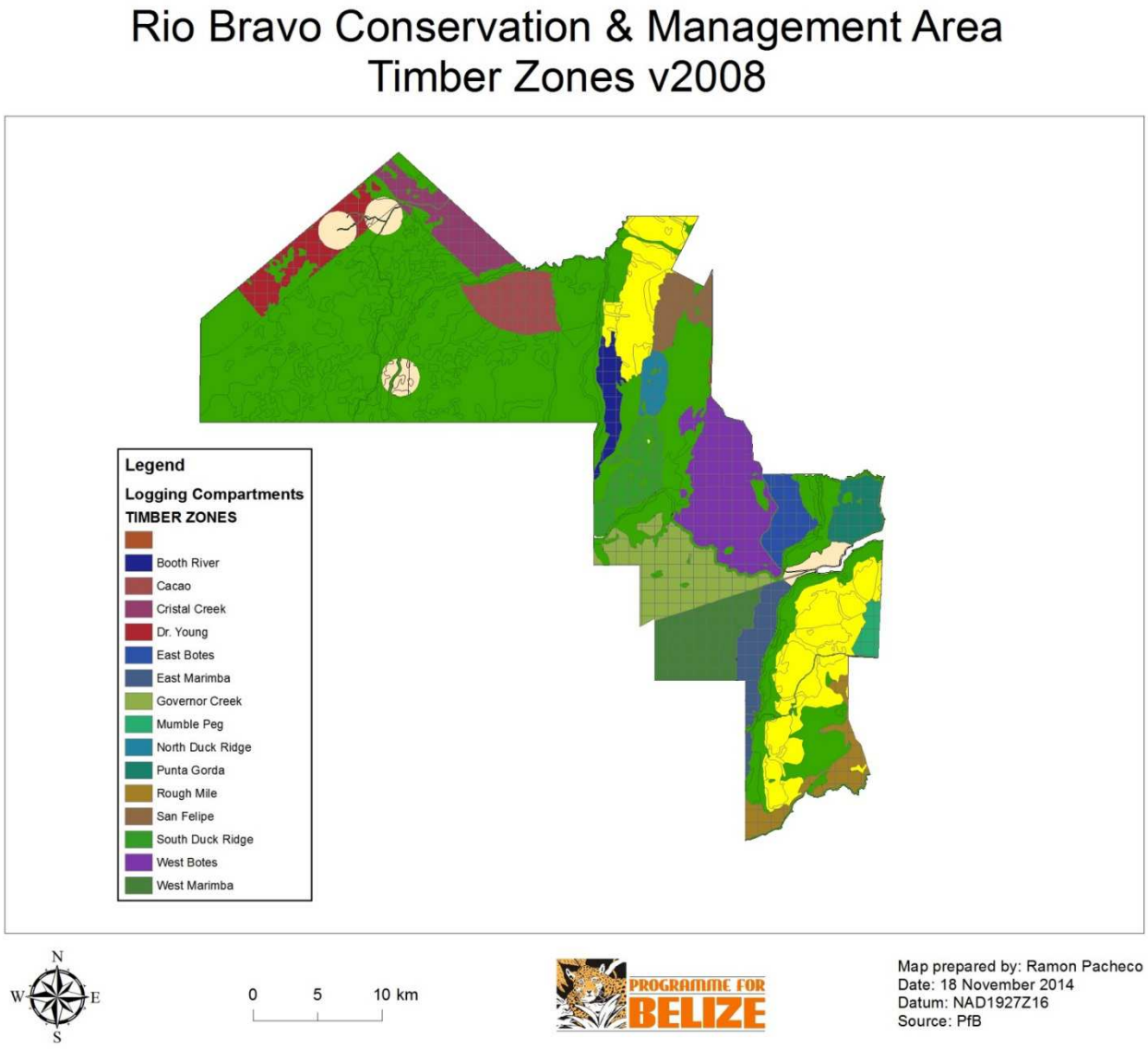
put on hold in 1999. It was resumed in 2004 and is now in full operation apart from it providing a valuable source of income for the PfB, it demonstrates good forest management practices, combining silvicultural techniques, stock surveys and monitoring of permanent sample plots, and forest inventory (Map 9 and Map 10).

Of all the conservation targets defined in the conservation planning process, the broad-leaved lowland forest is affected by the largest number of threats, including timber extraction, illegal logging, illegal agriculture, poaching of wildlife, uncontrolled burning, and road infrastructure and oil development. Impacts from some of these threats (poaching of wildlife and illegal agriculture) have been fairly low, but other threats such as uncontrolled fires and oil development have been moderate, and the threat of illegal logging has been high.

The broad-leaved forest management program could be further strengthened by reducing illegal logging within the RBCMA and directing funds from confiscated logs directly for fuel to enable additional protection patrols.



Map 9: RBCMA logging compartment (2008)



Map 10: RBCMA timber zones (2008)

4.7.2.5 AQUATIC ECOSYSTEM MANAGEMENT

Many of the water resources are outside the boundaries of the RBCMA and thus beyond the control of PfB, so their management becomes difficult to adequately address. This programme therefore aims to achieve the following objectives:

- Strengthen the management and protection of the aquatic ecosystem within the RBCMA in order to respond to the increasing threats of pollution (pesticides and fertilizers) and invasive species that could affect the population of Central American River Turtles (Hicatees) and cichlids; and
- By 2019, develop and implement a water conservation program in order to optimize the ability of the RBCMA hydrological systems to catch and store water.

Some important management actions include a training session with the Pesticides Control Board (PCB) for farmers in pesticides and fertilizer use, implementing an invasive species education and outreach programme, develop and implement a water quality monitoring program by 2016, and fish surveys in the New River Lagoon and associated waterways. The invasive species education and outreach programme will be geared at raising awareness about the ecological impacts wrought by invasive species, such as tilapia.

By 2019, the aquatic ecosystem management programme also hopes to develop and implement a water conservation program to optimize the ability of the RBCMA hydrological systems to catch and store water. Ideally, this will be achieved through maintaining adequate protection efforts to prevent deforestation; establishing partnerships with local authorities; instituting an education program on watershed management and protection; monitoring forest cover change around the RBCMA; and working with land holders for forest connectivity.

A freshwater programme was established in partnership with The Nature Conservancy, concentrating on the New River Lagoon and its main tributaries. Work included characterization of the New River Basin's ecological and physico-chemical parameters and development of computer models of the upper watershed. This programme was discontinued due to budgetary constraints. Presently, no formal monitoring programme (to monitor human impact parameters) has been instituted for the aquatic ecosystem management programme. The only on-going research work being conducted is water quality testing in the New River Lagoon by Defiance College. Past monitoring has detected high levels of nitrogen in the New River Lagoon and the presence of e-coli bacteria in wells in the San Carlos area.

The aquatic systems are integral to the ecology of the RBCMA but water bodies are national land and do not therefore form part of the area. PfB controls their banks but if these are

accessible the river system itself is a right of way. Furthermore, by their nature the aquatic bodies are open systems – their quality within the RBCMA is dependent upon upstream land use as well as management actions by PfB. Furthermore some potential pressures (such as biological connectivity downstream) are linked to threats with sources where PfB influence is relatively slight. In effect, the aquatic systems epitomize ecological, social and economic connectivity across the landscape and PfB management of aquatic systems must be integrated with wider efforts at a national and (given the trans-boundary issues) regional scale. Meanwhile responsibility for water management issues is diffused and compartmentalized – different statutory bodies have different responsibilities and coordination is weak.

The aquatic ecosystem represents a conservation target that is in fairly good condition. The upper reaches of some streams are beyond the RBCMA boundary, and the presence of some barriers (BOD, contamination, gill nets, etc.) may have compromised downstream connectivity. In addition, the population structure and composition of some fish species may also have been impacted as a result of tilapia introduction and proliferation.

4.7.3 RESEARCH AND MONITORING

Programme for Belize encourages research in the RBCMA especially if it is going to develop information to assist the management of the reserve and is compatible with the management regime – example: Jaguar research by Dr. Marcella Kelly of Virginia Tech University which has generated important information on sustainable timber harvesting and its impacts on Jaguars. However, RBCMA research activities have been mostly opportunistic and indirect, or occasionally may be built into a particular donor-aided project. PfB recognizes the importance and necessity of research and thus envisions developing an effective research and monitoring programme, and that can also cross-cut the other RBCMA management programmes. Currently, adequate research facilities do not exist at the RBCMA, and PfB's support and field assistance to researchers might be limited due to budgetary constraints. Presently, the PfB offers a discounted rate to researchers who want to conduct research within the RBCMA, and this should be maintained

The objectives of the research and monitoring strategy are therefore as follows:

- By 2017, develop and institute a research and monitoring program for the RBCMA in order to integrate science-based decision-making for adaptive management of the RBCMA; and
- Develop and institute a monitoring, reporting and verification (MRV) system for the RBCMA in order to Rainforest Alliance (FCS) certification of the RBCMA's timber harvesting operation.

Achieving the first objective would include conducting feasibility studies on the production of NTFP goods and services; developing and implementing standardized biodiversity monitoring protocols in liaison with other national, regional and international initiatives; developing and implementing a fish survey monitoring programme; promoting the field stations as central bases for research activities in the RBCMA; facilitating research into population structure and composition of key wildlife species, in particular the Mahogany, Jaguar, Yellow-headed Parrot, Central American River Turtle, and cichlids; and developing and implementing a microclimate change monitoring plan for RBCMA target habitats.

There is also the need to develop and institute a monitoring, reporting and verification (MRV) system to maintain Rainforest Alliance Forest Stewardship Council (FSC) certification of the RBCMA's timber harvesting operation. Ideally, this would be done through monitoring of High Conservation Value Forests (HCVFs) and development of a database and format for monitoring and reporting activities.

Two areas should be emphasized:

- Selective promotion of research projects and programs; and
- Initiation of regular monitoring programs by PfB staff.

4.7.3.1 SELECTIVE PROMOTION OF RESEARCH PROJECTS AND PROGRAMS

PfB receives a steady stream of research proposals that are supported with lodging (at the researcher accommodation rate) and as much field support as other management programmes allow. Research interests included bats, Jaguar, Ocellated Turkey, micro-climate, logging transects, mist-netting, swallows, and pine savannah. In this management period, PfB will take a more pro-active role in initiatives with any of the following characteristics:

- Direct application to management programmes. This places a priority rating on topics relating to: eco-tourism impacts, distribution of charismatic species with ecotourism potential, ecological dynamics of forest ecosystems and populations of timber species (including species other than mahogany), forestry impacts, issues relating to greenhouse gas emission, sequestration and mitigation of climate change, the ecological dynamics of pine savannah, fire impacts and role in ecological dynamics, and topics related to aquatic systems and their management. In these cases, the research project should be integrated with the management programme, allowing sharing of resources including PfB equipment and staff time. In view of the eco-tourism development plans, particular attention is drawn to studies on fish populations and impact assessments of inland fisheries including sport fishing

- Potential for development as a multi-year programme based on formal agreement with the institutions concerned, especially where participation of local and regional institutions is included

- Part of a national or regional initiative related to areas of PfB activity and expertise and where PfB can make a useful and recognized contribution

- Follow-up programmes to previous research and survey initiatives. A number of research and survey programmes have been designed around long-term monitoring. The forestry plots are a case in point and are now integrated with the forest management programme. The carbon sequestration monitoring plots are another example, associated with both the hardwood forest and pine savannah programmes with a PfB commitment to maintain data collection. A third case concerns bird surveys, including a five year sequence of surveys intended as a baseline to track population trends especially in nearctic migrant species

- PfB management structure will assign specific responsibility for addressing research as a specific activity area including the identification and promotion of the synergies between projects and management programmes

4.7.3.2 INITIATION OF REGULAR MONITORING PROGRAMS BY PFB STAFF

The following objective is geared at strengthening the RBCMA's monitoring processes and systems:

- Develop and implement a staff-led monitoring plan for the RBCMA so as to generate reliable and consistent information that feeds back into RBCMA management and decision-making.

Regular monitoring programmes been improving and field staff continues to collect weather data at La Milpa and conduct post-harvest assessments for the forestry programme. Other programmes that require regular data collection (e.g. amphibians and other wildlife at the field stations) can be re-invigorated, and these could provide valuable information on tourism impacts. Senior management can continue to encourage field staff to carry out regular monitoring.

The following programmes appear both to meet identified management issues and capable of integration with the normal duties of the station field guides and other staff:

- Regular recording of sightings of large mammals, raptors, game-birds and other notable species, by species and by number, on spot-lighting and guided tours of the tourist

trails, lagoon and rivers. Records should be made on a standardized data-sheet to allow comparison;

- Location of wildlife concentrations (e.g. bat and bird roosts, feeding areas and breeding sites) along the main rivers, with regular records of levels of use by time of day and by season. Again, these observations can be combined with tourist visits and are indeed intended to act as a check on tourist impacts;
- Regular checks on traditional breeding sites to obtain data on seasonality and breeding success. Examples include raptors, jabiru storks and yellow-headed parrot;
- Establishment of regular weather records at Hill Bank to complement those at La Milpa. This may be integrated with the national system (as at La Milpa).

4.7.4 INSTITUTIONAL STRENGTHENING AND MANAGEMENT

This strategy has to do with enhancing and improving the RBCMA's organizational structure and processes, improving executive decision-making, as well as building a strong support structure to enable the work at the protected area to be effectively and efficiently carried out.

The following five key programmes form the main elements of this Institutional Strengthening and Management Strategy for the next five years: 1) Resource Mobilization Strategy, 2) Marketing, 3) Human Resources, 4) Equipment Procurement, and 5) Review of Management Performance.

The objectives of this strategy are as follows:

- Develop a resource mobilization strategy for the RBCMA by mid-2016 and implement thereafter in order to diversify the RBCMA's funding base and ensure the continuity and sustainability of its management programs;
- Improve the branding and marketing of the RBCMA in order to generate greater support for the RBCMA and its management programs;
- Manage and enhance the human resources of the RBCMA in order to optimize employee performance in service of the RBCMA's conservation objectives;
- Strengthen staff recruitment and retention for the RBCMA in order to ensure that RBCMA has sufficient staff for effective management and biodiversity conservation;
- Develop and/or strengthen the equipment procurement system for the RBCMA in order to ensure adequate administration infrastructure and planning; and
- Conduct annual review of management activities in order to ensure compliance with the management plan and make adjustments as necessary (adaptive management).

4.7.4.1 RESOURCE MOBILIZATION STRATEGY PROGRAMME

Some years ago, the tourism development programme was the principal means of covering costs to maintain the two field stations, their core staff and general equipment. La Milpa was in fact a net revenue earner, with Hill Bank lagging well behind and the two together just breaking even in financial terms. The aim now is as follows:

- To boost the tourism development programme so that it can again generate at least $1.5 million in gross revenue to re-invest in RBCMA management (e.g., operating cost of the administration and conservation programmes).

This will include maintenance of infrastructure, core field staff costs, general equipment maintenance and replacement (including vehicles) and a proportion of costs to maintain the head office and general support staff as well as to support conservation programmes. The main focus of the programme will be to explore the viability of rehabilitating portions of the La Milpa Archaeological Site and opening it to visitation, develop the Hill Bank Field Station to showcase its colonial history and put it on par with the La Milpa Ecolodge and Field Station, support the development of a Creole Heritage Centre at St. Paul's Bank, and conduct research on the tourism potential of the RBCMA. With these investments, tourism can once again become a net revenue-earner. This will require securing the necessary investment as a priority fund-raising action, as follows:

- Regular and adequate re-investment in infrastructure and capital equipment (buildings, services, roads, vehicles) to maintain visit quality;

- Specialization in particular areas, notably ornithology (where La Milpa already stands in good repute) supplemented at Hill Bank by water-based activities on the lagoon and main rivers, while maintaining high standards in current offerings (e.g. student courses, guiding in archaeology and general natural history);

- Upgrading the catering facilities (currently too basic) at Hill Bank, following the strategies already proven at La Milpa.

The timber harvesting programme has surpassed tourism as the major revenue-earner at the RBCMA. The programme has been in full operational form since 2004. Its objective is to demonstrate good forest management meeting highest international standards (as set by the Forest Stewardship Council), to contribute to the local economy, and to create a supplementary self-generated revenue stream. Currently, timber operations bring a gross income of BZ$1,048,000 per annum, helping maintain technical staff in the office and at Hill Bank, maintenance of Hill Bank, contribution to Main Office costs, general purpose field vehicles as well as support for the protection and other conservation programmes.

Resource mobilization will also focus on exploring innovative financing mechanisms, such as carbon sequestration and REDD+, establishing an Endowment Fund, and develop merchandizing, all as part of a financial sustainability and fundraising strategy for the RBCMA.

4.7.4.2 MARKETING PROGRAMME

A marketing strategy will be developed and implemented for the RBCMA, focusing on increasing the visibility of the protected area and increasing visitation to the area. One of the major marketing goals will be as follows:

- To increase the visibility of La Milpa and Hill Bank in order to increase visitation and maintain occupancy rates at La Milpa above 60% and raise them at Hill Bank to 35%.

As part of increasing visibility, the PfB and RBCMA website will be upgraded and linked to the websites of other protected area management and tourism agencies. The branding of the RBCMA will be improved by developing professional and attractive organizational and RBCMA logos, which will be featured on the website, and social media platforms and on promotional materials.

4.7.4.3 HUMAN RESOURCES PROGRAMME

The human resources programme of the RBCMA will focus on training, improving staff performance, and developing a fair compensation framework for staff. Major actions will be as follows:

- Conduct a comprehensive training needs assessment (identification of gaps) for effective management of the RBCMA;
- Develop and implement a training program for RBCMA staff in the following: use and maintenance of equipment, pertinent Laws of Belize, protocols for patrols;
- Prepare clear and detailed Terms of Reference (job descriptions) for all staff posts;
- Develop and implement a Staff Recruitment Policy and Plan (including Succession Planning) to fill vacant RBCMA staff posts;
- Develop and implement preferential hiring policy for employment from local communities;
- Develop a Compensation Framework including compensation philosophy and pay policy;
- Review and strengthen an Administrative and Personnel Policy Manual; and
- Strengthen performance evaluation framework for staff.

Instituting a hiring policy at the RBCMA that favors residents from neighboring communities would go a long way to generate local support for the RBCMA and its management.

4.7.4.4 EQUIPMENT PROCUREMENT PROGRAMME

The management of the RBCMA is severely constrained by limitations in infrastructure and equipment. Almost every facet of RBCMA management depends on the availability of equipment in order to be effective. This programme will therefore aim to:

- Develop and/or strengthen the equipment procurement system for the RBCMA in order to ensure adequate administration infrastructure and planning.

This programme will therefore focus on developing and implementing a five-year infrastructure development and equipment procurement plan that will include the following major actions:

- Procure equipment for patrols;
- Procure two 4X4 vehicles and two ATVs for protection patrols and outreach activities;
- Procure one heavy-duty tractor with trailer; and
- Maintain large boat in a “sea-worthy” state at all times.

4.7.4.5 REVIEW OF MANAGEMENT PERFORMANCE

For management of the RBCMA to be effective and on track, there will need to be periodic review of the management plan. This will be carried out as follows:

- Conduct management effectiveness assessments on an annual basis (using the METT tool), for submission to the Forest Department;
- Conduct "Measures of Success" monitoring;
- Preparation and review of annual work plans; and
- Comprehensive review of the management plan after 2.5 years and after 5 years.

4.7.5 CONTINGENCY PLANS FOR OIL AND ROADS

Contingency plans for oil and roads would be fairly new to the RBCMA management planning process, and is necessary should there be significant oil finds within or adjacent to the protected area. The objective of this strategy as as follows:

- By 2017, develop a contingency plan for oil and roads in order to adequately prepare in the event of a commercial oil find within or adjacent to the RBCMA.

Ideally the contingency plans would address the opening up/disturbance of new habitats due to seismic survey lines, other oil exploration activities, road usage, chance of fires due to increased human presence, potential reduction of the areas tourism potential as a result of loss or displacement of charismatic wildlife species, and potential contamination of surface and groundwater supplies as a result of oil spills or fracking activities.

Oil exploration and production in the RBCMA is a relatively new threat to this protected area. To date, two petroleum companies (Maranco Belize Ltd. and Blue Creek Exploration Ltd.) have been granted exploration license covering extensive portions of the RBCMA, and while there is yet to be a commercial oil find by any one of these companies, a find of commercial quantity would impact the viability of this protected area greatly.

Oil exploration in the RBCMA core area (the strict preservation zone that is comprised of 65% of the protected area, and where only non-extractive activities and non-destructive tourism can be conducted) can create significant negative impacts, particularly from seismic surveys and roads, increase illegal activities, degradation and disruption of ecosystem services, and loss of potential revenue for PfB and local communities due to impacts to ecotourism services. Significant impacts can also be caused to the buffer zone area (where PfB allows experiments and develops sustainable economic land uses that leave the forest and its environmental values intact) if the two basic criteria for economic activities in the RBCMA are not met:

1. It must not create significant negative impact on the biodiversity and environmental services of the forest

2. It must be economically viable

Seismic surveys can create transect lines through RBCMA ecosystems that can have lasting impacts on habitats and biodiversity long after the surveys are completed. In addition, mistakes made by un-attentive survey crews could result in wider than necessary transect lines and more unnecessary clearing of habitats.

The threat from road usage is also clearly defined. Oil exploration activities can bring about an increase in road traffic through the core zone of the RBCMA, increasing impacts to biodiversity, damaging roads, and create garbage pollution. This may result in added expense to the PfB who would have to monitor work crews, control access to the area, and provide other logistical support.

Having an open access to new areas of the RBCMA may also encourage illegal activities. Seismic lines can provide conduits for illegal hunting, poaching, and illegal logging. Rangers have reported that between 30 to 40 Yellow-headed Parrots were poached via seismic transect lines. Using seismic lines, illegal loggers and marijuana growers would also be able to penetrate further inside the RBCMA to extract logs and cultivate marijuana. Aerial surveys conducted in 2011 discovered five marijuana fields. Illegal logging can also reduce the designated tree stocks used for sequestering carbon. These impacts may go beyond the duration of the oil exploration activities, and apart from straining the field protection staff, can also significantly increase PfB's monitoring and protection expenses.

Un-natural fires is also a big threat to the RBCMA, and the risk of fires increases with seismic surveys opening new areas, coupled with increased vehicle usage and the presence of more individuals.

Three watersheds drain the RBCMA, namely the Belize River, New River and Rio Hondo watersheds. These drainage systems supply surface and groundwater for RBCMA buffer communities for recreational, agricultural, and domestic use. Oil exploration and production activities (including accidental spills, fracking activities, etc.) could potentially contaminate and degrade these natural systems.

Oil exploration and production could also negatively impact RBCMA charismatic wildlife species. As a result, eco-tourism related activities such as bird-watching and nature tours could potentially decrease, resulting in a loss of revenue for the PfB's management programmes.

Oil exploration and development ideally should not be allowed in the Rio Bravo Conservation and Management Area, especially in the core area managed as a strict preserve. Consideration for oil exploration should only be given for the buffer area if it can be proven that it will not have a significant impact on protected areas, and the additional cost for monitoring, protection

and personnel for at least three years beyond the actual exploration is covered by the oil exploration company, and Programme for Belize is compensated for the losses it may incur in road damage, tourism and in carbon sequestration.

Ideally, the PfB envisions developing contingency plans for oil and roads, to include:

- What is acceptable and what is not acceptable regarging oil exploration and road development within the different zones of the RBCMA;
- Directing where new roads can be built;
- Implementing the monitoring plan for seismic lines;
- Working with government and the seismic company to ensure they respect the management regime of the RBCMA and cover the additional management and protection expenses imposed in the RBCMA; and
- Developing a plan for dealing with oil exploration and determining the additional costs (including additional rangers, vehicles, and equipment needed) to minimize the impact of oil exploration

4.8 MANAGEMENT ACTIONS AND TIMELINE

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
A. STRATEGY: STAKEHOLDER OUTREACH, EDUCATION AND ADVOCACY							
Objective #1: By 2019, strengthen the relationship between PfB and the RBCMA's neighboring communities that traditionally depended on the area for subsistence							
Rationale: To generate community support for the achievement of the conservation objectives of the RBCMA							
1. Establish alternative livelihood projects in the key RBCMA buffer communities (i.e., Lemonal and San Carlos)	Administration & Planning Manager (APM) with support from: Station Managers, Agriculture Department, Forest Department						
a) Design projects and seek funding to create alternative livelihood opportunities for communities							
b) Explore, develop and implement a game meat farming pilot project (e.g., gibnut, white-tailed deer)							
c) Explore, develop and implement viable and sustainable harvesting of NTFPs as a pilot project (e.g., popta seeds)							
2. Conduct regular assessments of the economic benefits of RBCMA to communities	Consultant						
3. Support the provision of access to training and funding opportunities in agricultural best practices	APM with support from: Technical Coordinator (TC)						
a) Implement capacity building training programs on best farming practices							
b) Establish partnership with agriculture research institutions to assist in providing better crop varieties, increase yields and reduce cost (farming methods)							
c) Promote water conservation							
4. Create linkages to micro-financing, agro-processing, and marketing opportunities	APM with support from						

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
	TC						
5. Develop entrepreneurship development through partnership with BELTRAIDE, etc.	APM with support from TC						
6. Develop and institute a disaster relief plan for Lemonal and San Carlos by 2017	APM with support from TC and Rangers						
a) Provide disaster relief assistance (as needed)							
<u>Objective #2</u>: Develop and implement a public awareness strategy that focuses on the ecological importance and economic contributions of the RBCMA							
<u>Rationale</u>: To make local communities and the general public understand the ecological and economic value of the RBCMA and its resources							
1. Use social media platforms to bring awareness to the Yellow-headed Parrot programme and other conservation efforts within the RBCMA	APM with support of the Tourism Development Unit (TDU)						
2. Highlight the tourism benefits and potential of the RBCMA, as well as the potential for NTFPs and alternative livelihood initiatives for communities that surround the RBCMA	APM with support of the TDU						
3. Utilize the print and electronic media to highlight the RBCMA management challenges as well as the opportunities	APM						
<u>Objective #3</u>: Develop and implement an environmental education strategy for the RBCMA							
<u>Rationale</u>: To build knowledge, skills, and experience that would foster appreciation for nature and protected areas among the buffer communities							
1. Develop and implement a community education and outreach campaign to develop appreciation for flora and fauna	Community Education and Outreach Officer						

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
	(CEOO) with support of Executive Director (ED) and STC						
a) Recruit an Community Education and Outreach Officer	ED with support from APM and FD						
b) Visit at least 2 RBCMA community primary schools annually to make presentations	CEOO with support from Station Managers and Rangers						
c) Conduct one annual Community Open Day, with competitions, etc.	CEOO with support from Station Managers and Rangers						
d) Foster a sense of civic pride for the RBCMA through the promotion and support of tree planting, and so on	CEOO with support from Station Managers and Rangers						
2. Establish a volunteer program to support the various RBCMA programs	APM						
3. Conduct one annual training for neighboring farmers on the proper use of pesticides and fertilizers to reduce chemical runoffs around the RBCMA	TC						
<u>Objective #4</u>: Foster an understanding among policy makers and community leaders about the importance of maintaining the RBCMA's natural resources							
<u>Rationale</u>: To ensure that enabling policies are in place and applied for the protection and effective management of the natural resources of the RBCMA							

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
1. Lobby the government for the formulation and/or enactment, or updating of legislation and regulations pertaining to the harvesting of and trade in endangered species (e.g., Mahogany)	ED with support from APM and TC						
2. Lobby the government for the formulation and/or enactment of legislation and regulations pertaining to the use of sawmills	ED with support from APM and TC						
3. Continuously lobby for improved policy and legislation as it relates to law enforcement and institution of higher penalties for trespassing, illegal logging, and poaching in private protected areas	ED with support from APM and TC						
B. STRATEGY: ECOSYSTEMS PROTECTION AND MANAGEMENT							
Objective #5: By mid-2015, institute a strengthened and expanded resource protection and enforcement program at the RBCMA							
Rationale: To deter and eliminate encroachments and illegal incursions into the protected area							
1. Create a ranger protection and surveillance plan	TC with support from ED, APM and Finance Director (FD)						
a) Increase the number of rangers to an optimal size (year 1 = 10, year 3 = 16, and year 5/ongoing = 23)							
b) Increase the number of RBCMA patrols							
c) Conduct proper, regular scheduled protection patrols							
d) Properly equip the ranger team (by year 2)							
e) Provide adequate supervision and coordination of patrols (scheduling, implementation, monitoring, reporting)							
2. Install two ranger/conservation posts at strategic locations (San Felipe savannah, Lemonal area)	ED with support from APM and Finance						

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
	Director FD						
3. Acquire new patrol vehicles and equipment	ED with support from FD						
4. Reinforce boundary demarcation through the use of proper signage	TC and Rangers						
5. Maintain access year round of the San Felipe/Bergen road	ED with support from APM and TC						
6. Provide logistical support to the Forest Department when possible	ED with support from APM and TC						
7. Formulate policy on the use of firearms within the RBCMA	ED with support from APM, TC, FD and Board Of Directors						
<u>Objective #6</u>: Develop and institute a fire management program by the end of 2016 guided by the National Fire Management Strategy							
<u>Rationale</u>: To reduce the frequency of uncontrolled/unmanaged fires, which have the potential to affect the population structure and composition of native species, particularly the Caribbean Pine.							
1. Update the fire management plan (for the savannah and broad-leaved forests) by year 1 and implement fully by year 2 and beyond	TC with support from ED, APM and FD						
a) Re-institutionalize the fire management team with clear roles and chain of command							
b) Conduct training sessions on burning techniques and other fire management systems							

Management Actions	**Responsibility**	**Year**					
		2015	**2016**	**2017**	**2018**	**2019**	**→**
c) Institute fire response protocol commensurate with the level of threat							
d) Implement prescribed burns of pine savannah on a maintained schedule (rangers and forestry staff)							
e) Document every fire in RBCMA – size, location, impact/damage, etc., regardless of size/location							
f) Increase the number of patrols in the hot spots to prevent and maintain fires							
g) Conduct routine training of rangers, forestry personnel and community members							
h) Maintain adequate equipment for fire management (tractor, swatters, fire gauges, etc.)							
i) Conduct an annual review of fire-fighting equipment – acquire adequate fire-fighting equipment							
j) Education and awareness on fire management for communities, staff, and guests							
2. Establish and train a community fire brigade (rapid response team) that will act as a support in RBCMA and the communities	TC with support from ED, APM and FD						
3. Develop a hurricane response plan in the event of damage/impact from tropical storm winds	TC with support from ED, APM and FD						
<u>Objective #7</u>: Strengthen the savannah protection program							
<u>Rationale</u>: To reduce the poaching of Yellow-headed Parrots and other wildlife that is threatening this ecosystem within the RBCMA.							

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
1. Develop and implement a Yellow-headed Parrot (YHP) conservation program	TC with support from ED, APM and FD						
a) Develop and implement a media awareness campaign on the YHP and the RBCMA (including print and electronic media, as well as social media)	APM with support from TC and TDU						
b) Assign rangers seasonally for YHP protection (year 2 = 2, year 5 = 4)	TC and Rangers						
c) Schedule and implement regular patrols to the pine savannahs	TC and Rangers						
d) Improve monitoring of YHP nests/breeding success (February to June)	Rangers						
e) Establish a community volunteer program for YHP monitoring	TC with support from APM and Rangers						
f) Develop a YHP adopt-a-parrot initiative (nesting site/parrot family)	TC with support from APM and Rangers						
g) Establish and strengthen partnerships with interested organizations, such as Defiance College, Reigate college, Francisco Villella	ED with support from APM and TC						
Objective #8: Strengthen the broad-leaved forest management program							
Rationale: The broad-leaved forest ecosystem is affected by the most threats compared to the other RBCMA ecosystems, including timber extraction, illegal logging, illegal agriculture, poaching of wildlife, uncontrolled burning, and road infrastructure and oil development.							
1. Reduce illegal logging within the RBCMA (see the resource protection and enforcement program)	TC and Rangers						

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
2. Direct funds from confiscated logs directly for fuel for patrols	FD						
Objective #9: Strengthen the management and protection of the aquatic ecosystem within the RBCMA							
Rationale: To respond to the increasing threats of pollution (pesticides and fertilizers) and invasive species that could affect the population of Central American River Turtles (Hicatees) and cichlids.							
1. Implement training session with the Pesticides Control Board for farmers in pesticides and fertilizer use	TC with support from ED and APM						
2. Develop and implement an invasive species education and outreach programme	TC with support from ED, APM and Station Managers						
3. By 2016, develop and implement a water quality monitoring program	TC with support from Station Managers, Rangers, Volunteers and Researchers						
a) Conduct water quality testing in the New River watershed							
b) Conduct studies to determine levels and methods of agrochemicals use in neighboring farms							
c) Implement education programs for best farming practices							
d) Lobby GOB for increased and sustained monitoring of pesticides and fertilizer use within the New River watershed							
4. Conduct fish surveys in the New River Lagoon and associated waterways	TC with support from Rangers, Volunteers and Researchers						
Objective #10: By 2019, develop and implement a water conservation program							

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
***Rationale*: To optimize the ability of the RBCMA hydrological systems to catch and store water.**							
1. Maintain adequate protection efforts to prevent deforestation	TC, Forestry Staff and Rangers						
2. Establish partnerships with local authorities	TC with support from ED and APM						
3. Institute an education program on watershed management and protection	CEOO with support from TC and Station Managers						
4. Monitor forest cover change around the RBCMA	TC						
5. Work with land holders for forest connectivity	TC with support from ED and APM						
C. STRATEGY: RESEARCH AND MONITORING							
Objective #11: By 2017, develop and institute a research and monitoring program for the RBCMA							
***Rationale*: To integrate science-based decision-making for adaptive management of the RBCMA.**							
1. Conduct feasibility studies on the production of NTFP goods and services	Researchers with support from TC and Forestry Staff						
2. Develop and implement standardized biodiversity monitoring protocols in liaison with other national, regional and international initiatives	TC with support from Consultants						

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
3. Develop and implement a fish survey monitoring programme	TC with support from Volunteers, Interns and Researchers						
4. Promote the field stations as central bases for research activities in the RBCMA	APM with support from ED, FD, and TDU						
5. Facilitate research into population structure and composition of key wildlife species, in particular the Mahogany, Jaguar, Yellow-headed Parrot, Central American River Turtle, and cichlids.	TC with support from Forestry Staff, Rangers, Interns and Researchers						
6. Develop and implement a microclimate change monitoring plan for RBCMA target habitats.	TC with support from Interns and Researchers						
Objective #12: Develop and institute a monitoring, reporting and verification (MRV) system for the RBCMA							
Rationale: To maintain Rainforest Alliance (FCS) certification of the RBCMA's timber harvesting operation.							
1. Conduct monitoring of High Conservation Value Forests	TC and Forestry Staff						
2. Develop a database and format for monitoring and reporting activities	TC						
D. STRATEGY: INSTITUTIONAL STRENGTHENING AND MANAGEMENT							
Objective #13: Develop a resource mobilization strategy for the RBCMA by mid-2016 and implement thereafter							
Rationale: To diversify the RBCMA's funding base and ensure the continuity and sustainability of its management programs.							
1. Develop and implement a financial sustainability and fundraising strategy for the RBCMA, including provisions for the establishment of an Endowment Fund and for merchandizing	ED with support from Consultants, FD, APM, TDU and Board						

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
2. Explore innovative financing mechanisms, such as carbon sequestration and REDD+	ED with support from APM, TC and FD						
3. Identify and maintain donor agencies and cultivate/strengthen donor relations	ED with support from APM and FD						
4. Strengthen and expand the implementation of the sustainable timber management program	TC with support from ED and FD						
5. Strengthen the tourism management and development program	APM with support from ED, FD and TDU						
a) Conduct research on the tourism potential of the RBCMA	APM and TDU						
b) Based on the results of the research, revise the RBCMA tourism development plan to adequately incorporate Hill Bank, marketing, etc	APM and TDU						
c) Explore the viability of rehabilitating portions of the La Milpa Archaeological Site	ED with support from APM and TDU						
d) Develop the Hill Bank Field Station to showcase its colonial history and put it on par with the La Milpa Ecolodge and Field Station	APM with support from ED, FD and TDU						
e) Support the development of a Creole Heritage Centre at St. Paul's Bank	APM with support from ED, FD and TDU						

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
f) Recruit a Public Relations Officer to focus on building the image and culture of PfB and the RBCMA	ED with support from APM and FD						
Objective #14: Improve the branding and marketing of the RBCMA							
Rationale: To generate greater support for the RBCMA and its management programs.							
1. Develop and implement a marketing strategy for the RBCMA	APM with support from ED, FD, and TDU						
2. Upgrade website for PfB and the RBCMA, linked to the websites of other protected area management and tourism agencies	APM with support from TDU						
3. Develop professional and attractive organizational and RBCMA logos	APM with support from TDU						
Objective #15: Manage and enhance the human resources of the RBCMA							
Rationale: To optimize employee performance in service of the RBCMA's conservation objectives							
1. Conduct a comprehensive training needs assessment (identification of gaps) for effective management of the RBCMA	APM with support from FD						
2. Develop and implement a training program for RBCMA staff	APM and TC						
a) Train staff on the use and maintenance of equipment							
b) Train field staff on the pertinent Laws of Belize (e.g., the Wildlife Protection Act, EPA and regulations, Forests Act and regulations, etc.)							

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
c) Train rangers in protocols for patrols							
Objective #16: Strengthen staff recruitment and retention for the RBCMA							
Rationale: To ensure that RBCMA has sufficient staff for effective management and biodiversity conservation							
1. Prepare clear and detailed Terms of Reference (job descriptions) for all staff posts	APM with support from ED, FD and TC						
2. Develop and implement a Staff Recruitment Policy and Plan (including Succession Planning) to fill vacant RBCMA staff posts	ED with support from APM and FD						
3. Develop and implement preferential hiring policy for employment from local communities	ED with support from APM and FD						
4. Develop Compensation Framework including compensation philosophy and pay policy	ED with support from APM and FD						
5. Review and strengthen an Administrative and Personnel Policy Manual	APM with support from TDU						
6. Strengthen performance evaluation framework for staff	APM with support from TDU						
Objective #17: Develop and/or strengthen the equipment procurement system for the RBCMA							
Rationale: To ensure adequate administration infrastructure and planning							
1. Develop and implement a five-year infrastructure development and equipment procurement plan	APM with support from						

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
a) Procure equipment for patrols	ED, FD and TC						
b) Procure 4X4 vehicles and ATVs for protection patrols and outreach activities							
c) Procure one heavy-duty tractor with trailer							
d) Maintain large boat in a "sea-worthy" state at all times							
Objective #18: Conduct annual review of management activities							
Rationale: To ensure compliance with the management plan and make adjustments as necessary (adaptive management)							
1. Conduct management effectiveness assessments on an annual basis (using the METT tool), for submission to the Forest Department	ED and APM						
2. Conduct "Measures of Success" monitoring	ED and APM						
3. Preparation and review of annual work plans	Senior Managers						
4. Review of management plan after 2.5 years and after 5 years	ED with support of all staff						
E. OIL AND ROADS CONTINGENCY PLAN							
Objective #19: By 2017, develop a contingency plan for oil and roads.							
Rationale: To adequately prepare in the event of a commercial oil find within or adjacent to the RBCMA.							
1. Direct where new roads can be built	TC with support from ED						
2. Implement the monitoring plan for seismic lines	TC with support from ED						
3. Work with GOB and the seismic company(ies) to adequately fund the monitoring plan	TC with support from ED						

Management Actions	Responsibility	Year					
		2015	2016	2017	2018	2019	→
4. Develop a "needs" plan related to seismic lines (to include additional rangers, vehicles, and equipment).	TC with support from ED						

4.9 MONITORING AND REVIEW

Monitoring and review still operates at three levels:

- Managerial efficiency in implementing planned activities – i.e. is what is planned under each programme actually carried out?
- Overall effectiveness of the management regime as organized under the management plan – do these activities add up to a better managed site?
- Success of conservation strategies in containing or reducing levels of threat acting on conservation targets – are the strategies properly targeted, with management improvement leading to improvement in conservation status?

4.9.1 MONITORING MANAGERIAL EFFECTIVENESS

The management plan is only a guiding document, setting out a framework for the different actions. Actual implementation is affected by a range of factors that cannot be foreseen up to five years ahead, notably funding availability and the need in practice to modify detailed actions to the terms of financing agreements while maintaining the overall policy thrust.

The principal working documents at this level are the annual plans covering the budget for the organization and for individual programmes. These are then supported by periodic reports, submitted to the Board of Directors and usually also required by the funding agency concerned. The cross-check is the key monitoring mechanism for management efficiency, allowing timely remedial action as and when necessary.

4.9.2 MONITORING MANAGEMENT EFFECTIVENESS

Two primary means of assessing overall management effectiveness have been used for this plan (Appendix 9 and 10). These exercises should be repeated at the end of the first and third years of the lifetime of the plan, and again in the fifth in preparation for the subsequent plan.

Ideally, the goal is to lift management scores from 72% to over 80% under the World Bank system (Appendix 9) and to obtain a consistent B rating or above for planned programmes (Appendix 10). The first assessment gives the opportunity for early revision/overhaul of programmes where necessary and the second is essentially a mid-term review, allowing re-orientation as required. The third assessment represents the final assessment of management performance over the planning period.

4.9.3 MONITORING CONSERVATION SUCCESS

The aim here is to check that management effectiveness results in conservation gains and is checked by repeating the conservation planning analysis during the third year as a mid-term review and again in the fifth as a final assessment. The target is to maintain an overall 'good' score for the site, with particular attention to raising the score for landscape context, assessed as the weakest, for savannah, broad-leaved lowland forest, and the aquatic ecosystem. Key indicators are given in Appendix 8 and the assessment must include any new assessments that may have been undertaken on the conservation status of RBCMA ecosystems. Indications during the mid-term assessment of slippage in individual scores for viability assessment of conservation targets signal the need for urgent reappraisal of management actions, if necessary extending to strategic review.

4.10 FINANCING – INDICATIVE BUDGET

The budget figures presented here are only indicative, and reflect budgetary needs over the duration of this management plan. Where budget figures are based on annual needs, this figure has been multiplied by the number of years (see Section 4.8 – Management Actions and Timeline) to reflect the management plan time periods. Furthermore, where a budgetary figure is shown as "-----", this suggests that salaries outlay covers the cost of the activity. Where the costs of projects (e.g., alternative livelihood initiatives) are not yet known, these are indicated as "Project Funding" meaning that the costs are to be determined.

To understand the projected budgetary outlays for the respective annual time periods, refer to Section 4.8 (Management Actions and Timeline).

It must be noted also that the indicative budget is specified as "non-staff" or "investments".

The non-staff budget refers to operations, training, materials and equipment, travel and per diem, and contracting and consulting fees.

The investment budget denotes budgetary requirements for capital investments in infrastructure, vehicles, major equipment, and so on.

Please refer to Section 4.10.1 for the summary of the non-staff and investments indicative budget.

Finally, the staff budget is shown separately (Section 4.10.2), and is based on the Administrative Structure presented in Section 4.1.

Management Actions	Indicative Budget
A. STRATEGY: STAKEHOLDER OUTREACH, EDUCATION AND ADVOCACY	
Objective #1: By 2019, strengthen the relationship between PfB and the RBCMA's neighboring communities that traditionally depended on the area for subsistence	
1. Establish alternative livelihood projects in the key RBCMA buffer communities (i.e., Lemonal and San Carlos)	----- (see Staff Salaries)
a) Design projects and seek funding to create alternative livelihood opportunities for communities	----- (see Staff Salaries)
b) Explore, develop and implement a game meat farming pilot project (e.g., gibnut, white-tailed deer)	----- (see Staff Salaries) + Plus project funding
c) Explore, develop and implement viable and sustainable harvesting of NTFPs as a pilot project (e.g., popta seeds)	----- (see Staff Salaries) Plus project funding
2. Conduct regular assessments of the economic benefits of RBCMA to communities	----- (see Staff Salaries)
3. Support the provision of access to training and funding opportunities in agricultural best practices	----- (see Staff Salaries)
a) Implement capacity building training programs on best farming practices	----- (see Staff Salaries) + Plus project funding
b) Establish partnership with agriculture research institutions to assist in providing better crop varieties, increase yields and reduce cost (farming methods)	----- (see Staff Salaries)
c) Promote water conservation	----- (see Staff Salaries)
4. Create linkages to micro-financing, agro-processing, and marketing opportunities	----- (see Staff Salaries)
5. Develop entrepreneurship development through partnership with BELTRAIDE, etc.	----- (see Staff Salaries)
6. Develop and institute a disaster relief plan for Lemonal and San Carlos by 2017	----- (see Staff Salaries)
a) Provide disaster relief assistance (as needed)	To be determined

Management Actions	**Indicative Budget**
Sub-total Objective #1	***-----*** ***(see Staff Salaries)***
<u>Objective #2</u>: Develop and implement a public awareness strategy that focuses on the ecological importance and economic contributions of the RBCMA	
1. Use social media platforms to bring awareness to the Yellow-headed Parrot programme and other conservation efforts within the RBCMA	----- (see Staff Salaries)
2. Highlight the tourism benefits and potential of the RBCMA, as well as the potential for NTFPs and alternative livelihood initiatives for communities that surround the RBCMA	----- (see Staff Salaries)
3. Utilize the print and electronic media to highlight the RBCMA management challenges as well as the opportunities	----- (see Staff Salaries)
Sub-total Objective #2	***-----*** ***(see Staff Salaries)***
<u>Objective #3</u>: Develop and implement an environmental education strategy for the RBCMA	
4. Develop and implement a community education and outreach campaign to develop appreciation for flora and fauna	
a) Recruit a Community Education and Outreach Officer	----- (see Staff Salaries)
b) Visit at least 2 RBCMA community primary schools annually to make presentations	$1,000 (annual X 5 = $5,000)
c) Conduct one annual Community Open Day, with competitions, etc.	$5,000 (annual X 5 = $25,000)
d) Foster a sense of civic pride for the RBCMA through the promotion and support of tree planting, and so on	Combined with 1 b)
5. Establish a volunteer program to support the various RBCMA programs	----- (see Staff Salaries)
6. Conduct one annual training for neighboring farmers on the proper use of pesticides and fertilizers to reduce chemical runoffs around the RBCMA	----- (see Staff Salaries)
Sub-total Objective #3	***-----*** ***(see Staff Salaries)*** ***+*** ***$30,000*** ***(non-staff)***
<u>Objective #4</u>: Foster an understanding among policy makers and community leaders about the importance of maintaining the RBCMA's natural resources	
1. Lobby the government for the formulation and/or enactment, or updating of legislation and regulations pertaining to the harvesting of and trade in endangered species (e.g., Mahogany)	----- (see Staff Salaries)

Management Actions	**Indicative Budget**
2. Lobby the government for the formulation and/or enactment of legislation and regulations pertaining to the use of sawmills	----- (see Staff Salaries)
3. Continuously lobby for improved policy and legislation as it relates to law enforcement and institution of higher penalties for trespassing, illegal logging, and poaching in private protected areas	----- (see Staff Salaries)
Sub-total Objective #4	***----- (see Staff Salaries)***
B. STRATEGY: ECOSYSTEMS PROTECTION AND MANAGEMENT	
Objective #5: By mid-2015, institute a strengthened and expanded resource protection and enforcement program at the RBCMA	
1. Create a ranger protection and surveillance plan	
a) Increase the number of rangers to an optimal size (year 1 = 10, year 3 = 16, and year 5/ongoing = 23)	----- (see Staff Salaries)
b) Increase the number of RBCMA patrols	$20,000 (annual X 5 = $100,000)
c) Conduct proper, regular scheduled protection patrols	
d) Properly equip the ranger team (by year 2)	See 2 below
e) Provide adequate supervision and coordination of patrols (scheduling, implementation, monitoring, reporting)	----- (see Staff Salaries)
2. Install two ranger/conservation posts at strategic locations (San Felipe savannah, Lemonal area)	$100,000 (investment)
3. Acquire new patrol vehicles and equipment	See Objective #17
4. Reinforce boundary demarcation through the use of proper signage	$5,000 (annual X 4 = $20,000)
5. Maintain access year round of the San Felipe/Bergen road	???
6. Provide logistical support to the Forest Department when possible	Covered in 1 b) and c)
7. Formulate policy on the use of firearms within the RBCMA	----- (see Staff Salaries)
Sub-total Objective #5	***----- (see Staff Salaries) + $120,000 (non-staff) + $100,000 (investment)***
Objective #6: Develop and institute a fire management program by the end of 2016 guided by the National Fire Management Strategy	
1. Update the fire management plan (for the savannah and broad-leaved forests) by year 1 and implement fully by year 2 and beyond	----- (see Staff Salaries)
a) Re-institutionalize the fire management team with clear roles and	-----

Management Actions	**Indicative Budget**
chain of command	(see Staff Salaries)
b) Conduct training sessions on burning techniques and other fire management systems	$1,000 (annual X 4 = $4,000)
c) Institute fire response protocol commensurate with the level of threat	----- (see Staff Salaries)
d) Implement prescribed burns of pine savannah on a maintained schedule (rangers and forestry staff)	$1,000 (annual X 5 = $5,000)
e) Document every fire in RBCMA – size, location, impact/damage, etc., regardless of size/location	----- (see Staff Salaries)
f) Increase the number of patrols in the hot spots to prevent and maintain fires	Covered elsewhere
g) Conduct routine training of rangers, forestry personnel and community members	$1,000 (annual X 4 = $4,000)
h) Maintain adequate equipment for fire management (tractor, swatters, fire gauges, etc.)	$5,000 (annual X 4 = $20,000)
i) Conduct an annual review of fire-fighting equipment – acquire adequate fire-fighting equipment	TBD
j) Education and awareness on fire management for communities, staff, and guests	$1,000 (annual X 4 = $4,000)
4. Establish and train a community fire brigade (rapid response team) that will act as a support in RBCMA and the communities	$1,000 (bi-annual X 3 = $3,000)
5. Develop a hurricane response plan in the event of damage/impact from tropical storm winds	----- (see Staff Salaries)
Sub-total Objective #6	***----- (see Staff Salaries) + $40,000 (non-staff) + $ (investment)***
<u>Objective #7</u>: Strengthen the savannah protection program	
1. Develop and implement a Yellow-headed Parrot (YHP) conservation program	
a) Develop a media awareness campaign on the YHP and the RBCMA (including print and electronic media, as well as social media)	$5,000 (annual X 4 = $20,000)
b) Assign rangers seasonally for YHP protection (year 2 = 2, year 5 = 4)	----- (see Staff Salaries)
c) Schedule and implement regular patrols to the pine savannahs	Covered elsewhere
d) Improve monitoring of YHP nests/breeding success (February to June)	----- (see Staff Salaries)

Management Actions	**Indicative Budget**
e) Establish a community volunteer program for YHP monitoring	$5,000 (non-staff)
f) Develop a YHP adopt-a-parrot initiative (nesting site/parrot family)	$5,000 (non-staff)
g) Establish and strengthen partnerships with interested organizations, such as Defiance College, Reigate college, Francisco Villella	----- (see Staff Salaries)
Sub-total Objective #7	***-----*** ***(see Staff Salaries)*** ***+*** ***$30,000*** ***(non-staff)***
<u>Objective #8</u>: Strengthen the broad-leaved forest management program	
1. Reduce illegal logging within the RBCMA (see the resource protection and enforcement program)	Covered elsewhere
2. Direct funds from confiscated logs directly for fuel for patrols	----- (see Staff Salaries)
Sub-total Objective #8	***-----*** ***(see Staff Salaries)***
<u>Objective #9</u>: Strengthen the management and protection of the aquatic ecosystem within the RBCMA	
1. Implement training session with the Pesticides Control Board for farmers in pesticides and fertilizer use	$2,000 (annual X 4 = $8,000)
2. Develop and implement an invasive species education and outreach programme	$1,000 (annual X 3 = $3,000)
3. By 2016, develop and implement a water quality monitoring program	
a) Conduct water quality testing in the New River watershed	$1,000 (annual X 4 = $4,000)
b) Conduct studies to determine levels and methods of agrochemicals use in neighboring farms	$1,000 (annual X 4 = $4,000)
c) Implement education programs for best farming practices	Covered elsewhere
d) Lobby GOB for increased and sustained monitoring of pesticides and fertilizer use within the New River watershed	----- (see Staff Salaries)
4. Conduct fish surveys in the New River Lagoon and associated waterways	$1,000 (annual X 4 = $4,000)
Sub-total Objective #9	***$23,000*** ***(non-staff)***
<u>Objective #10</u>: By 2019, develop and implement a water conservation program	
1. Maintain adequate protection efforts to prevent deforestation	Covered elsewhere
2. Establish partnerships with local authorities	----- (see Staff Salaries)

Management Actions	**Indicative Budget**
3. Institute an education program on watershed management and protection	$1,000 (annual X 4 = $4,000)
4. Monitor forest cover change around the RBCMA	----- (see Staff Salaries)
5. Work with land holders for forest connectivity	----- (see Staff Salaries)
Sub-total Objective #10	***-----*** ***(see Staff Salaries)*** ***+*** ***$4,000*** ***(non-staff)***
C. STRATEGY: RESEARCH AND MONITORING	
Objective #11: By 2017, develop and institute a research and monitoring program for the RBCMA	
1. Conduct feasibility studies on the production of NTFP goods and services	$25,000 (Consultant X 2 = $50,000)
2. Develop and implement standardized biodiversity monitoring protocols in liaison with other national, regional and international initiatives	----- (see Staff Salaries)
3. Develop and implement a fish survey monitoring programme	$5,000 (annual X 3 = $15,000)
4. Promote the field stations as central bases for research activities in the RBCMA	----- (see Staff Salaries)
5. Facilitate research into population structure and composition of key wildlife species, in particular the Mahogany, Jaguar, Yellow-headed Parrot, Central American River Turtle, and cichlids.	----- (see Staff Salaries)
6. Develop and implement a microclimate change monitoring plan for RBCMA target habitats.	$10,000 (annual X 3 = $30,000)
Sub-total Objective #11	***$50,000*** ***(Consultant)*** ***+*** ***$45,000*** ***(non-staff)***
Objective #12: Develop and institute a monitoring, reporting and verification (MRV) system for the RBCMA	
1. Conduct monitoring of High Conservation Value Forests	$5,000 (annual X 5 = $25,000)
2. Develop a database and format for monitoring and reporting activities	----- (see Staff Salaries)
Sub-total Objective #12	***-----*** ***(see Staff Salaries)*** ***+*** ***$25,000***

Management Actions	**Indicative Budget**
	(non-staff)
D. <u>STRATEGY</u>: INSTITUTIONAL STRENGTHENING AND MANAGEMENT	
<u>Objective #13</u>: Develop a resource mobilization strategy for the RBCMA by mid-2016 and implement thereafter	
1. Develop and implement a financial sustainability and fundraising strategy for the RBCMA, including provisions for the establishment of an Endowment Fund and for merchandizing	----- (see Staff Salaries) + $25,000 (Consultant X 2 = $50,000)
2. Explore innovative financing mechanisms, such as carbon sequestration and REDD+	----- (see Staff Salaries)
3. Identify and maintain donor agencies and cultivate/strengthen donor relations	----- (see Staff Salaries)
4. Strengthen and expand the implementation of the sustainable timber management program	----- (see Staff Salaries) + $ (annual X $ = $)
5. Strengthen the tourism management and development program	
a) Conduct research on the tourism potential of the RBCMA	----- (see Staff Salaries) + $25,000 (Consultant X 2 = $50,000)
b) Based on the results of the research, revise the RBCMA tourism development plan to adequately incorporate Hill Bank, marketing, etc	
c) Explore the viability of rehabilitating portions of the La Milpa Archaeological Site	
d) Develop the Hill Bank Field Station to showcase its colonial history and put it on par with the La Milpa Ecolodge and Field Station	$150,000 (investment)
e) Support the development of a Creole Heritage Centre at St. Paul's Bank	Project funding
f) Recruit a Public Relations Officer to focus on building the image and culture of PfB and the RBCMA	----- (see Staff Salaries)
Sub-total Objective #13	***$100,000 (Consultant) + $ (non-staff) + $150,000 (investment)***
<u>Objective #14</u>: Improve the branding and marketing of the RBCMA	
1. Develop and implement a marketing strategy for the RBCMA	$40,000

Management Actions	**Indicative Budget**
2. Upgrade website for PfB and the RBCMA, linked to the websites of other protected area management and tourism agencies	(Consultant) + $10,000 (annual X 5 = $50,000)
3. Develop professional and attractive organizational and RBCMA logos	
Sub-total Objective #14	***$40,000 (Consultant) + $50,000 (non-staff)***
<u>Objective #15</u>: Manage and enhance the human resources of the RBCMA	
1. Conduct a comprehensive training needs assessment (identification of gaps) for effective management of the RBCMA	----- (see Staff Salaries)
2. Develop and implement a training program for RBCMA staff	
a) Train staff on the use and maintenance of equipment	----- (see Staff Salaries)
b) Train field staff on the pertinent Laws of Belize (e.g., the Wildlife Protection Act, EPA and regulations, Forests Act and regulations, etc.)	----- (see Staff Salaries)
c) Train rangers in protocols for patrols	----- (see Staff Salaries)
Sub-total Objective #15	***----- (see Staff Salaries)***
<u>Objective #16</u>: Strengthen staff recruitment and retention for the RBCMA	
1. Prepare clear and detailed Terms of Reference (job descriptions) for all staff posts	----- (see Staff Salaries)
2. Develop and implement a Staff Recruitment Policy and Plan (including Succession Planning) to fill vacant RBCMA staff posts	----- (see Staff Salaries)
3. Develop and implement preferential hiring policy for employment from local communities	----- (see Staff Salaries)
4. Develop Compensation Framework including compensation philosophy and pay policy	----- (see Staff Salaries)
5. Review and strengthen an Administrative and Personnel Policy Manual	----- (see Staff Salaries)
6. Strengthen performance evaluation framework for staff	----- (see Staff Salaries)
Sub-total Objective #16	***----- (see Staff Salaries)***
<u>Objective #17</u>: Develop and/or strengthen the equipment procurement system for the RBCMA	
1. Develop and implement a five-year infrastructure development and equipment procurement plan	

Management Actions	**Indicative Budget**
a) Procure equipment for patrols	$25,000 X 2 = $50,000 (investment)
b) Procure 4X4 vehicles and ATVs for protection patrols and outreach activities	$125,000 X 2 = $250,000 (investment)
c) Procure one heavy-duty tractor with trailer	$50,000 (investment)
d) Maintain large boat in a "sea-worthy" state at all times	TBD
Sub-total Objective #17	***$350,000 (investment)***
Objective #18: Conduct annual review of management activities	
1. Conduct management effectiveness assessments on an annual basis (using the METT tool), for submission to the Forest Department	----- (see Staff Salaries)
2. Conduct "Measures of Success" monitoring	----- (see Staff Salaries)
3. Preparation and review of annual work plans	----- (see Staff Salaries)
4. Review of management plan after 2.5 years and after 5 years	$10,000 X 2 = $20,000 (Consultant)
Sub-total Objective #18	***----- (see Staff Salaries) + $20,000 (Consultant)***
OIL AND ROADS CONTINGENCY PLAN	
Objective #19: By 2017, develop a contingency plan for oil and roads.	
1. Direct where new roads can be built	----- (see Staff Salaries)
2. Implement the monitoring plan for seismic lines	----- (see Staff Salaries)
3. Work with GOB and the seismic company(ies) to adequately fund the monitoring plan	----- (see Staff Salaries)
4. Develop a "needs" plan related to seismic lines (to include additional rangers, vehicles, and equipment).	----- (see Staff Salaries)
Sub-total Objective #19	***----- (see Staff Salaries)***

4.10.1 INDICATIVE BUDGET – NON-STAFF & INVESTMENTS (SUMMARY)

Management Actions	Indicative Budget
A. STRATEGY: STAKEHOLDER OUTREACH, EDUCATION AND ADVOCACY	
Objective #1: By 2019, strengthen the relationship between PfB and the RBCMA's neighboring communities that traditionally depended on the area for subsistence	-----
Objective #2: Develop and implement a public awareness strategy that focuses on the ecological importance and economic contributions of the RBCMA	-----
Objective #3: Develop and implement an environmental education strategy for the RBCMA	$30,000 (non-staff)
Objective #4: Foster an understanding among policy makers and community leaders about the importance of maintaining the RBCMA's natural resources	-----
B. STRATEGY: ECOSYSTEMS PROTECTION AND MANAGEMENT	
Objective #5: By mid-2015, institute a strengthened and expanded resource protection and enforcement program at the RBCMA	$120,000 (non-staff) + $100,000 (investment)
Objective #6: Develop and institute a fire management program by the end of 2016 guided by the National Fire Management Strategy	$40,000 (non-staff) + $ (investment)
Objective #7: Strengthen the savannah protection program	$30,000 (non-staff)
Objective #8: Strengthen the broad-leaved forest management program	-----
Objective #9: Strengthen the management and protection of the aquatic ecosystem within the RBCMA	$23,000 (non-staff)
Objective #10: By 2019, develop and implement a water conservation program	$4,000 (non-staff)
C. STRATEGY: RESEARCH AND MONITORING	
Objective #11: By 2017, develop and institute a research and monitoring program for the RBCMA	$50,000 (Consultant) + $45,000 (non-staff)
Objective #12: Develop and institute a monitoring, reporting and verification (MRV) system for the RBCMA	$25,000 (non-staff)
D. STRATEGY: INSTITUTIONAL STRENGTHENING AND MANAGEMENT	
Objective #13: Develop a resource mobilization strategy for the RBCMA by mid-2016 and implement thereafter	$100,000 (Consultant) + $150,000 (investment)
Objective #14: Improve the branding and marketing of the RBCMA	$40,000 (Consultant) + $50,000 (non-staff)
Objective #15: Manage and enhance the human resources of the RBCMA	-----
Objective #16: Strengthen staff recruitment and retention for the RBCMA	-----
Objective #17: Develop and/or strengthen the equipment procurement system for the RBCMA	$350,000 (investment)

Management Actions	**Indicative Budget**
Objective #18: Conduct annual review of management activities	$20,000 (Consultant)

4.10.2 INDICATIVE BUDGET (STAFF SALARIES)

The indicative staff budget is shown below, and is based on the current Administrative Structure presented in Section 4.1. Annual figures are shown.

Staff Post	**Indicative Annual Budget (Gross Salaries)**
Executive Director	
Administration and Planning Manager	
Technical Coordinator	
Financial Controller	
Senior Accounts Clerk	
Accounts Clerk	
Community Education and Outreach Officer	
Tourism Development Officer	
Tourism Officer	
Station Manager – La Milpa	
Station Manager – Hill Bank	
Clerk/Secretary	
Staff Forester	
Assistant Forester	
Forestry Staff	
Head Ranger	
Rangers ($14,400 X 10) -- Year 1	
+ Rangers ($14,400 X 6) -- Year 3	
+ Rangers ($14,400 X 7) -- Year 5	
Field Naturalists (Tour Guides)	
Field Research Coordinator	
GIS/Data Technician	
La Milpa Station Staff (catering & maintenance)	
Hill Bank Station Staff (catering & maintenance)	
GRAND TOTAL	**$**

REFERENCES

Baillie, I.C., A.C.S. Wright, M.A. Holder and E.A. Fitzpatrick. 1993. Revised Classification of the Soils of Belize. Natural Resources Institute Bulletin 59, Chatham, UK. pp 69.

Bennett, A. 1998. Linkages In The Landscape: The Role Of Corridors And Connectivity In Wildlife Conservation. International Union for Conservation of Nature (IUCN), Gland, Switzerland.

Bumler-Thomas, B and Bulmer-Thomas, V. 2012. The Economic History of Belize: From the 17th Century to Post-Independence. Cubola Productions. Benque Viejo Del Carmen.

Country Poverty Assessment, Ministry of Human Development. Belmopan. 2010.

Dasgupta, S., B. Laplante, C. Meisner, D. Wheeler and J. Yan. 2007. The impact of sea level rise on developing countries: a comparative analysis. World Bank Policy Research Working Paper 4136. Washington, DC, USA.

Hannah, L., Midgley, G., Andelman, S., Araújo, M., Hughes, G., Martinez-Meyer, E., et al. 2007. Protected area needs in a changing climate. Frontiers In Ecology And The Environment, 5(3): 131–138.

Haylock, H. 2005. Proposed ecotourism development business plan and financial strategy. 2005-2009. PfB internal report. 26 pp + annexes.

Haylock, H., D. Haylock, O. Sabido and J.C. Meerman, 2005. Hill Bank Ecolodge and Research Center Development Project. EU Demonstration Project Report, PfB. 63 pp + appendices.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007 – Impacts, Adaptation And Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC. Cambridge, UK: Cambridge University Press.

King, R.B., I.C. Baillie, T.M.B. Abel, J.R.Dunsmore, D.A.Gray, J.H.Pratt, H.R.Vesey, A.C.S. Wright and S.A. Zisman. 1992. Land Resource Assessment of Northern Belize. Natural Resources Institute Bulletin 43, Chatham, UK. 2 vols pp 174+ 513 with maps.

Mallory, E.P., A.C. Vallely & N.Brokaw. 1998. Rapid Bird Assessment of the Rio Bravo Conservation and Management Area. 'Wings of the Americas' project report. Manomet Center for Conservation Sciences, Massachusetts. 30 pp + appendices (including updated vegetation classification by N. Brokaw).

Mansourian, S., Vallauri, D. & Dudley, N., eds. 2005. Forest Restoration In Landscapes: Beyond Planting Trees. New York: Springer.

Meerman, J.C. & W. Sabido. 2001. Central American Ecosystems Mapping Project: Belize. 2 vols. Programme for Belize

Meerman, J.C. 2005. Protected Area System Assessment and Analysis: Site Scoring System. National Protected Area System Policy and Plan Project Consultancy Report, 18 pp.

Meerman, J.C. & Cherrington, E.A. 2005. Preliminary survey of land degradation in Belize. Report to the Ministry of Natural Resources, Local Government and the Environment under the UN Convention to Combat Desertification. 49 pp + annexes.

Programme for Belize, 2003. Rio Bravo Pine Savannah Management Plan. Draft internal report. 28pp.

U.S. Climate Change Science Program. 2008. The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States .A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. U.S. Environmental Protection Agency, Washington, DC, USA.

Wildtracks, 2005. Guidelines for Developing a Management Plan: Level 2 – conservation organizations/non-governmental organizations. National Protected Area System Policy and Plan Project Consultancy Report, 29 pp + appendices.

Wilson, J.R. 2004. A Business Plan for Sustainable Timber Extraction on the Rio Bravo Conservation and Management Area. PfB report – Integrated Forest Management Demonstration Project – EU Project no B7-6201/00-14. 28 pp + annexes.

Wilson, J.R. 2006. Rio Bravo Conservation and Management Area Forest Management Plan and operational guidelines 2006-2010. PfB internal document. 69 pp + annexes.

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