

Vaca Forest Reserve Management Plan 2017-2022



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Prepared for the Belize Forest Department



Vaca Forest Reserve Management Plan 2017-2022

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Executive Summary

The Vaca Forest Reserve was declared in 1991 with amendments in 2003 and 2010 resulting in an area of approximately 40,313 acres or 16,314 hectares, of these 3,165 acres or 1,280 ha is under cultivation. Mostly illegally.

The designation as Forest Reserve implies that the principal rationale for the declaration is to protect the forest for the management of timber extraction and/or the conservation of soils, watersheds and wildlife resources. Forest Reserves allow multiple compatible land use practices apart from timber extraction but also include Non-Timber Forest Products extraction, military exercises, ecotourism, short and long-term research and education. All these occur when specific zonations for productions, protection and recreation areas have been identified. Extraction activities are regulated under an approved Natural Resource Management and harvesting/extraction Plan.

With this designation in mind and after consultations with the various stakeholders, the following management goal for the Vaca Forest Reserve was established:

Management Goal for the Vaca Forest Reserve
GOAL The Vaca Forest Reserve continues to function as a key buffer for the Chiquibul National Park and continues to contribute to the functioning of the Belize River watershed whilst maintaining its intrinsic natural values, and contributing to local development.

This Management Plan has been formulated to guide the management and conservation of the Vaca Forest Reserve (VFR) over a five-year period (2017-2022), starting off in the end of 2017. The Plan can be seen as a framework for adaptive management which lists various management programs, strategies and actions that, when implemented, will address the multiple stresses that impact the management of the VFR. The Plan will also take advantage of the numerous opportunities that exist to strengthening the management of the protected area, and will set the stage for long-term financial planning geared at supporting the implementation of the management strategies and actions.

The Management Plan also recognizes that the Vaca Forest Reserve itself is effectively an extension of an even larger ecological unit – commonly known as the “Chiquibul” which includes the Chiquibul Forest Reserve, Chiquibul National Park and the Caracol Archaeological Reserve. This Chiquibul unit itself is connected with the Mountain Pine Ridge Forest Reserve, the Nojkaaxmeen Elijio Panti National Park and the protected areas east of the Maya Mountain Divide: Sibun Forest Reserve, Sittée River Forest

Reserve, Victoria Peak National Monument, Cockscomb Basin Wildlife Sanctuary, Maya Mountains Forest Reserve, Bladen National Park and the Columbia River Forest Reserve. Ultimately, it would be beneficial to merge the VFR with the Chiquibul NP and the Chiquibul FR. This would allow for greater management flexibility including a possibly more commercially viable timber extraction plan.

The principal threat to the VFR is presented by agricultural incursions. Although the total area currently under cultivation is less than 1%, the footprint due to hunting and fire risk is much greater. These agricultural incursions originate both in Guatemala and Belize. Both parties have benefitted from a lack of enforcement in the past. Recent monitoring as part of this management plan preparation, indicates that the amount of illegal incursions is rapidly increasing over the past two years. Steepness of the terrain is so far the main inhibitor of large scale farm incursions.

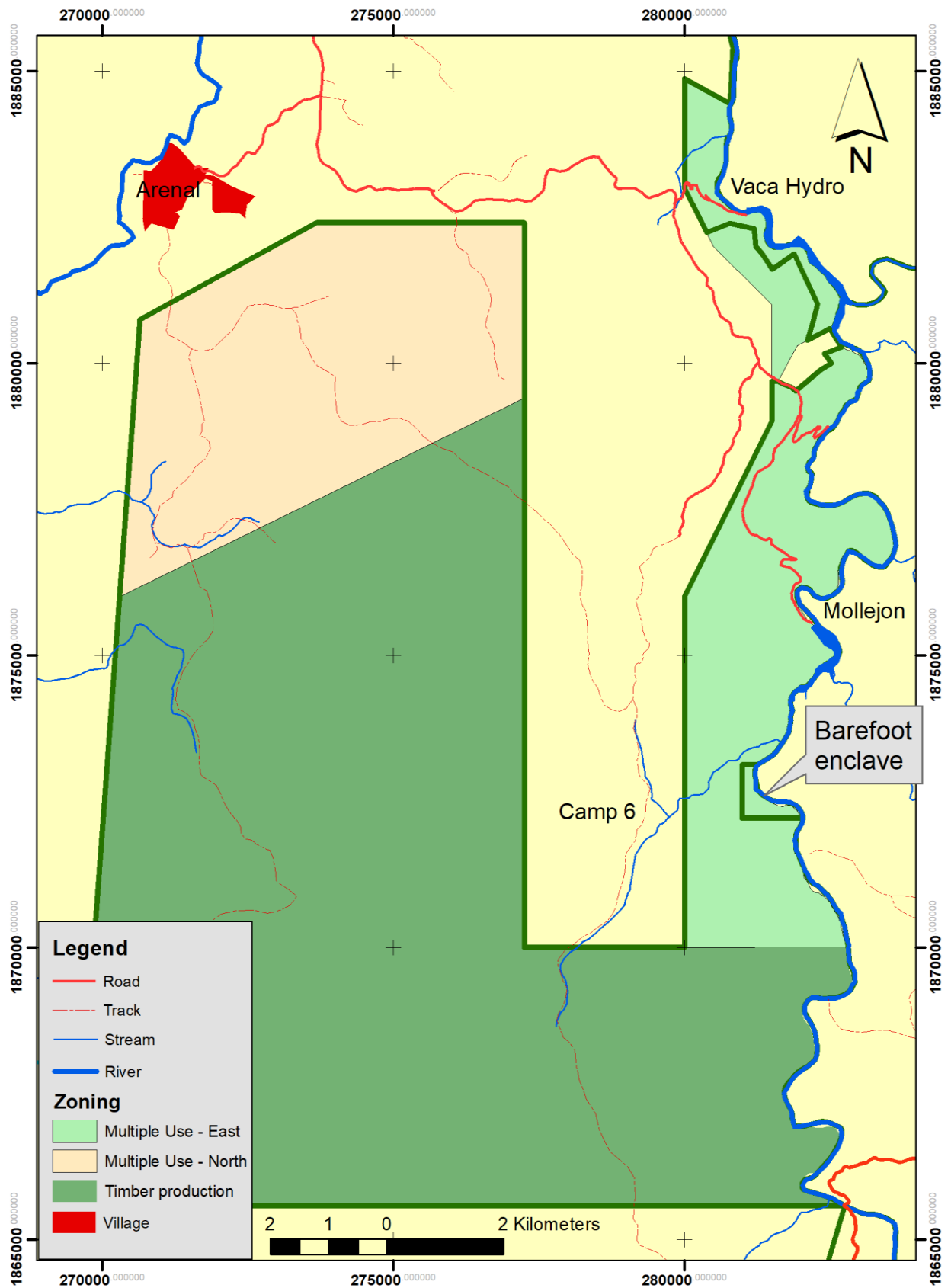
The agricultural incursions in the Eastern section of the VFR are relatively well understood and more or less under control. The Farmers group "Friends of Vaca Forest Reserve" has received substantial assistance towards organizing themselves and receiving training towards sustainable farming techniques. As a result, this group has evolved as a viable partner in the management of the agricultural sections of the eastern Vaca.

The situation is different in the Northern section of the VFR, where there is no handle on the agricultural activities and one of the recommendations of this management plan is therefore to encourage a farmer's organization similar to Friends of Vaca Forest Reserve, but then for the Northern section. The establishment of such an organization and the subsequent allocation of condoned farmland, will be one of the most time consuming, and complicated efforts within the management plan.

Timber extraction activities (which are currently under a moratorium) are complicated by a lack of understanding of the actual timber resources and the overall steepness of the terrain, the latter excluding heavy equipment and thereby excluding efficient extraction such as carried out by several long-term license holders in Belize. In effect, the logging is only possible on a more artisanal basis, using a minimum of heavy equipment. The amount of logs thus extracted are relatively small and the benefit for the state through the payment of royalties is nearly non-existent. Any timber extraction would therefore principally serve a need to demonstrate a "value" for the community.

Given the complexity of the issues involving the Vaca Forest Reserve it is recommended that the Forest Reserve will be split up in three zones. This proposed zonation plan consists of 3 zones:

- Timber Production – Reserved for sustainable timber extraction once an inventory has been carried out and the timber stock judged sufficient to allow sustainable extraction.
- Multiple use – East – Conservation zone, but with other uses such as tourism, hydro – management and limited agriculture activities allowed
- Multiple use – North – Landscape management area focusing on sustainable agriculture and retention of important environmental services.



Each of these zones will have a distinct but partially overlapping management:

1. Conservation Management for the overall area (all three zones but with the main focus on the Timber production zone) which will be the responsibility of the co-management agency.
2. General Use Zone Management which will be under a separate agency with NGO and funding agency support and dealing with the management of the specific uses (other than conservation) of the multiple use zones. This separation from the conservation management is important as the two tasks are quite different and a co-management agency may not be willing/capable of taking them on both. This general use management will work with the farmers organization “Friends of Vaca Forest Reserve” in the multiple use zone – east, and with a similar, yet to be established group of farmers in the multiple use zone – north.
3. Timber Management which will remain within the Forest Department

The implementation of these three management zones each with its own implementing agencies that still need to interact will not be straightforward. Ultimately, the VFR may be merged with the other Chiquibul Forest protected areas and a zoning could then be implemented for this entire combined forest block and make an end to the current fragmentation of protected areas in the Chiquibul – Maya Mountain massif.

The overall management plan details 9 distinct management programs:

- Institutional Management and Strengthening Program
- Fundraising Program
- Strategic Networks and Partnerships Program
- Administrative Program
- Research and Monitoring Program
- Natural Resource Management Program
- Protection and Surveillance Program
- Infrastructure Management Program
- Community Development and Environmental Education Program

Each of these management programs has a set of management objectives that, when grouped aim to achieve the VFR Management Goal.

While all management programs are important and achieving the management goal is of paramount importance, it needs to be stressed that the institutional management and strengthening program is key to it all. Currently there is no co-manager for the VFR and the overall management therefore remains with the Forest Department.

While institutional strengthening is key, the most important actual management effort lies in the immediate documentation and subsequent formalization and de-facto “legalization” of their presence of the users of the Multiple Use Zone – East. Only in this way increased incursions won’t be able to be stopped. A similar process will need to take place in the Multiple Use Zone – North, but this will be a longer process.

While the management plan aims to achieve maximum effects, it realizes that funding realities make it unlikely that the full program can attract the required funding. If the total management program could be implemented over the next 5 years, the combined costs would be approximately B\$ 250,000 based on the size of the reserve, and the high costs for some of the action points. In combination with the current management capacity of the Forest Department, it is unlikely that this amount of funding will be realized. Therefore, the management program listing represents a full scale of activities that should be undertaken when sufficient human and financial resources are available. Meanwhile, the most critical components of the management programs and strategies have been highlighted. This should allow for flexible levels of management, including management variants that do not include the forest officers.

Acknowledgements

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Special appreciation goes to the Friends of Vaca Forest Reserve board and members for the multiple consultations and planning sessions that were undertaken.

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And last but certainly not least, the Consultants extend sincere appreciation to the Key Biodiversity Secretariat and the Protected Areas Conservation Trust for financial support.

Acronyms

ALIDES	Regional Alliance for Sustainable Development
APAMO	Association of Protected Area Management Organizations
BACONGO	Belize Alliance of Non-Government Organizations
BECOL	Belize Electric Company Ltd.
BEL	Belize Electricity Ltd.
BDF	Belize Defense Force
BTFS	Belize Tropical Forest Studies
CAP	Conservation Action Plan
CBC	Central Belize Corridor
CBO	Community Based Organization
CCAD	Central American Commission for Environment and Development
CEPF	Critical Ecosystem Partnership Fund
CI	Conservation International
CSO	Central Statistical Office (Now SIB)
EE	Environmental Education
ERI	Environmental Research Institute of the University of Belize
FCD	Friends for Conservation and Development
FD	Forest Department
FFSD	Ministry of Forestry, Fisheries and Sustainable Development
FOV	Friends of Vaca
FVFR	Friends of Vaca Forest Reserve (same as above)
GEF	Global Environmental Fund
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GOB	Government of Belize
GPD	Geology and Petroleum Department
GPS	Global Positioning System
ha	Hectare

HAS	Harvest Suitability Assessment
IoA	Institute of Archaeology
IUCN	World Conservation Union
KBA	Key Biodiversity Area
MBCP	Mesoamerican Biological Corridor Programme
NEPN	Nojkaaxmeen Elijio Panti National Park
NGO	Non-Governmental Organization
NICH	National Institute of Culture and History
NPAC	National Protected Areas Commission
NPAP	National Protected Areas Policy
NPAS	National Protected Areas System
NPASP	National Protected Areas System Plan
NTFP	Non-Timber Forest Products
PA	Protected area
PACT	Protected Areas Conservation Trust
PAM	Protected Area Management
S.M.A.R.T.	Spatial Monitoring and Reporting Tool
SI	Statutory Instrument
SIB	Statistical Institute of Belize
TNC	The Nature Conservancy
UB	University of Belize
UNDP	United Nations Development Programme
UTM	Universal Transverse Mercator
VFR	Vaca Forest Reserve
WB	World Bank
WCPA	World Commission on Protected Areas
WCS	Wildlife Conservation Society

1 Introduction

1.1. Background and context

The Vaca Forest Reserve (VFR) was declared in 1991. The original Reserve was 52,000 acres, it was bordered in the south by the (then) Chiquibul Forest Reserve, in the west by the border with Guatemala, in the east by the Macal River. In the north, it was bordered by the village of Arenal and its farm fields. The main reason of protection was to protect the watershed of the Macal River, and more specifically, to protect the water supply of the planned hydro power plant of Mollejon.

In Statutory Instrument No. 137 of 2003, the original VFR was amended; approx. 11,625 acres were excised with the objective to provide agriculture land to farmers who had settled in this area. The excised area was made away from the Macal River to ensure that the Macal remain protected from erosion and sedimentation.

In Statutory Instrument No. 45 of 2010, the S.I. 137 of 2003 was repealed and replaced by an updated description, correcting earlier errors in the description and excizing amongst others the 'Better in Belize' housing enclave.

The designation as Forest Reserve implies that the principal rationale for the declaration is to protect the forest for the management of timber extraction and/or the conservation of soils, watersheds and wildlife resources. Forest Reserves allow multiple compatible land use practices apart from timber extraction but also include Non-Timber Forest Products (NTFP) extraction, military exercises, ecotourism, short and long-term research, education and in some cases even controlled hunting. All these occur when specific zonations for production, protection and recreation areas have been identified. Extraction activities are regulated under an approved Natural Resource Management and Extraction Plan.

The maintenance of the Vaca Forest Reserve is also a commitment under the 3rd Master Agreement between the Government of Belize and the Belize Electric Company Limited (BECOL) and Belize Electricity Limited (BEL) which states amongst others "to take reasonable steps to manage and protect Mountain Pine Ridge, Chiquibul and Vaca watersheds and to prohibit building, farming, logging and other activities within the said watershed areas which will impair or prejudice that catchment capacity of the said watersheds;"

The Government of Belize, with the assistance of the World Bank is implementing the project entitled "Management and Protection of Key Biodiversity Areas in Belize" with funding from the Global Environment Facility (GEF). The project development objective is to strengthen natural resource management and biodiversity conservation in Key Biodiversity Areas (KBAs) of Belize. Implementation of the KBAs project will be over a five (5) year period. The project has four components:

- Component 1- Supporting Forest Protection and Sustainable Forest Management Activities in Key Biodiversity Areas,
- Component 2- Promoting Effective Management of Key Biodiversity Areas,

- Component 3- Institutional Strengthening & Capacity Building for Enhanced Enforcement of Environmental Regulations,
- Component 4- Project Management, Monitoring and Assessment

Belize counts numerous protected areas (including Archaeological Reserves and some recognized Private Reserves), Meerman (2005). In 2007, in a collaborative effort with Government of Belize, Conservation International and the Critical Ecosystem Partnership Fund, the Key Biodiversity Areas (KBAs) of Belize were defined. These KBAs are presented in Figure 1.

During an extensive, participatory process¹, six KBAs were selected to become the subject of the Project Management and Protection of Key Biodiversity Areas in Belize. The Vaca Forest Reserve was one of the six selected KBAs to participate in the current project.

The Project’s Development Objective is to strengthen natural resource management and biodiversity conservation through the mitigation of threats to Key Biodiversity Areas (KBAs) in Belize. These threats include:

- Illegal logging, hunting, farming, and extraction of Non-Timber Forest Products (NTFP);
- Inadequate management structures, institutional arrangements, policy and legislative instruments, and capacities for forest governance, including understanding and application of sustainable forest management, sustainable land management, biodiversity conservation and sustainable human development;
- Poverty amongst the local population
- Limited awareness among resource users and resource managers that the potential benefits from the management and protection of Belize’s natural capital could be harnessed for human development, and the advancement of Belize and Belizeans

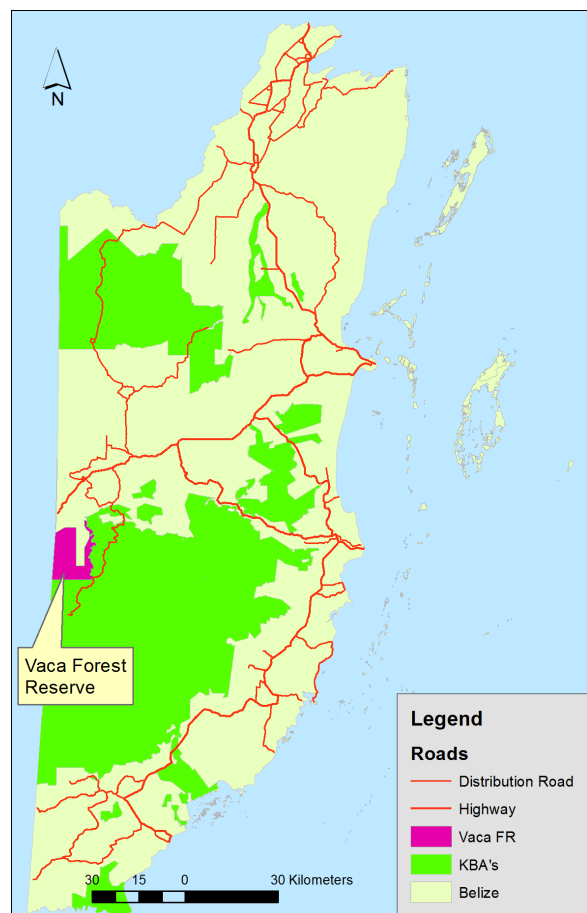


Figure 1. Belize Key Biodiversity Areas, Meerman 2017

One of the target project sites is the Vaca Forest

¹ Documented in: Management and Protection of Key Biodiversity Areas in Belize Project. Social Safeguards, Operational Policy 4.10. July 31st, 2014. 89 pp.

Reserve, located along the Guatemalan border in the Cayo district.

This document formulates a new management plan for the VFR. As part of the same consultancy, a Social and Livelihood Assessment was carried out (Boomsma, 2017) which analyzed the current natural resources based livelihood activities in the adjacent communities and within the KBA. This assessment followed the Livelihood Restoration Process Framework (KBA, 2014) which was formulated as part of the KBA program. The communities included in the analysis are Arenal, Benque Viejo del Carmen and San Jose Succotz. For further details, particularly on the social aspects of the Vaca Forest Reserve, we refer to this document.

1.2. Purpose and Scope of the Management Plan

This Management Plan has been formulated to guide the management and conservation of the Vaca Forest Reserve over a five-year period (2017-2022), starting off in any time in 2017. The Plan can be seen as a framework for adaptive management which lists various management programs, strategies and actions that, when implemented, will address the multiple stresses that have an impact on the VFR. The Plan will also take advantage of the numerous opportunities that exist for strengthening the management of the protected area, and will set the stage for long-term financial and business planning geared at supporting the implementation of the management strategies and actions.

The Management Plan also recognizes that the Vaca Forest Reserve itself is effectively an extension of an even larger ecological unit – commonly known as the “Chiquibul” which includes the Chiquibul Forest Reserve, Chiquibul National Park and the Caracol Archaeological Reserve. This Chiquibul unit itself is connected with the Mountain Pine Ridge Forest Reserve, the Nojkaxxmeen Elijo Panti National Park and the protected areas east of the Maya Mountain Divide: Sibun Forest Reserve, Sittee River Forest Reserve, Victoria Peak National Monument, Cockscomb Basin Wildlife Sanctuary, Maya Mountains North Forest Reserve, Bladen National Park and the Columbia River Forest Reserve.

This Management Plan sets the stage for the integration of the VFR within the network of Belizean conservation areas. The entire planning process was guided by the National Management Plan Framework developed under the National Protected Areas System Plan project (2005).

Much information on the pressures and challenges facing the VFR was provided by the Friends of Vaca Forest Reserve (FOV). This Management Plan is the outcome of a series of meetings and planning sessions held during 2017 including field visits and planning meetings conducted by the consultants. The series of management planning sessions included the participation of the board of the FOV as well as representatives of the core stakeholder agencies including the Forest Department, Selva Maya (GIZ), and Friends for Conservation and Development (FCD).

2 Current Status

2.1. Location

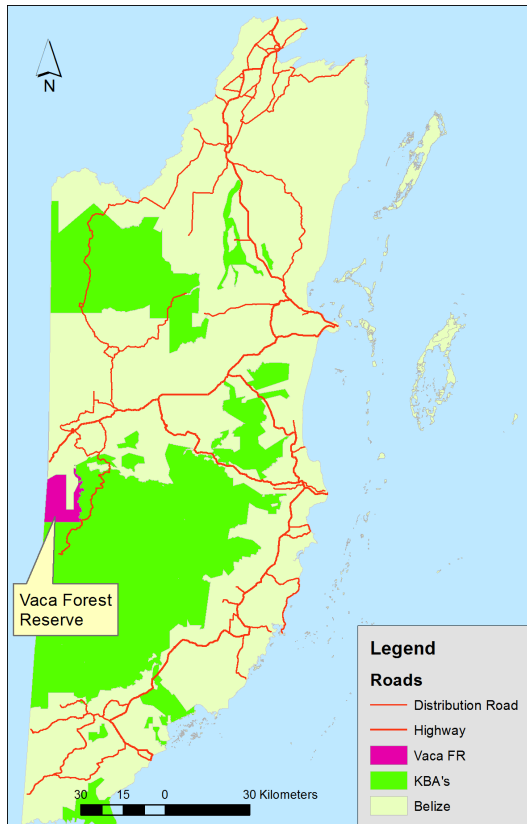


Figure 2. Location of the VFR in Belize with other KBA's

The Vaca Forest Reserve was declared in 1991. The original reserve was 52,000 acres, it was bordered in the south by the (then) Chiquibul Forest Reserve, in the west by the border with Guatemala, in the east by the Macal River. In the north, it was bordered by the village of Arenal and its farm fields. The main reason for protecting this forest was to protect the watershed of the Macal River, and more specifically, to protect the water supply of the planned hydro power plant of Mollejon.

In Statutory Instrument No. 137 of 2003, the original VFR was amended; approx. 11,625 acres were excised with the objective to provide agriculture land to farmers who had settled in this area. The excised area was made away from the Macal River to ensure that the Macal remain protected from erosion and sedimentation.

In Statutory Instrument No. 45 of 2010, the S.I. 137 of 2003 was repealed and replaced by an updated description, correcting earlier errors in the description and excizing amongst others the 'Better in Belize' housing enclave.

2.2. Regional Context

The Vaca Forest Reserve is bordered in the north by the villages of Arenal and San Jose Succotz and the small town Benque Viejo del Carmen. The zone between the VFR and the communities is a mixture of farm land and forested land, the latter mostly secondary growth in all stages.

The Vaca Forest Reserve is a component of the larger Chiquibul – Maya Mountain massif, most of which is under some form of conservation. Immediate neighbours of the Vaca Forest Reserve are:

Nojkaaxmeen Eligio Panti National Park: this Park is the geological extension of the Vaca Forest Reserve to the North East. It is under the jurisdiction of the Forest Department but currently there is no legal co-management agency, nor is there a functional management plan.

Mountain Pine Ridge Forest Reserve: although directly adjacent to the Vaca Forest Reserve it is geologically completely different. Most of the MPRFR is covered in upland savanna type vegetation with abundant Caribbean Pine. The forest reserve is managed for pine extraction by the Forest Department.

Chiquibul National Park: the park borders the Vaca Forest Reserve directly on the south. It is co-managed by the Friends for Conservation and Development (FCD) for strict conservation.

Chiquibul Forest Reserve: in the extreme South East of the Vaca Forest Reserve there is one point where the VFR, the MPFR, the CNP and the CFR meet. The Chiquibul Forest Reserve is managed by the Forest Department for hardwood extraction.

The Caracol Archaeological Reserve does not border the Vaca Forest Reserve but is separated from it by a 5-km wide strip of the Chiquibul National Park. The Caracol Archaeological Reserve is home to the ancient Maya site of Caracol and managed by the Institute of Archaeology.

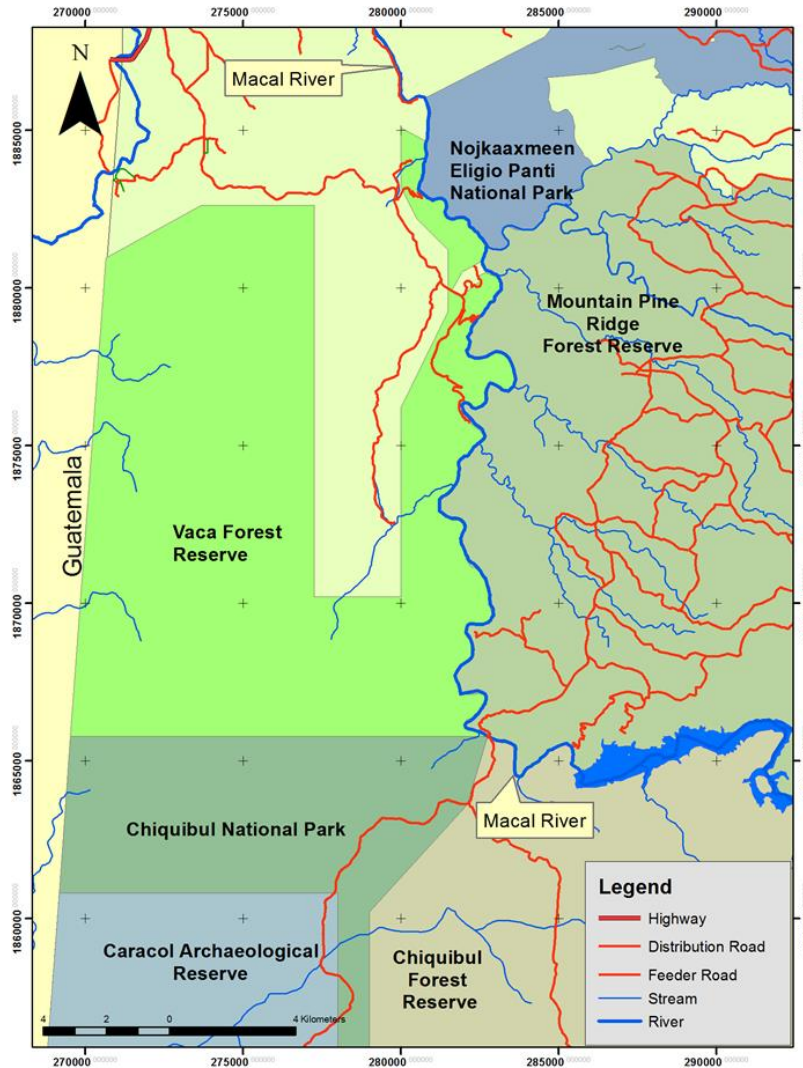
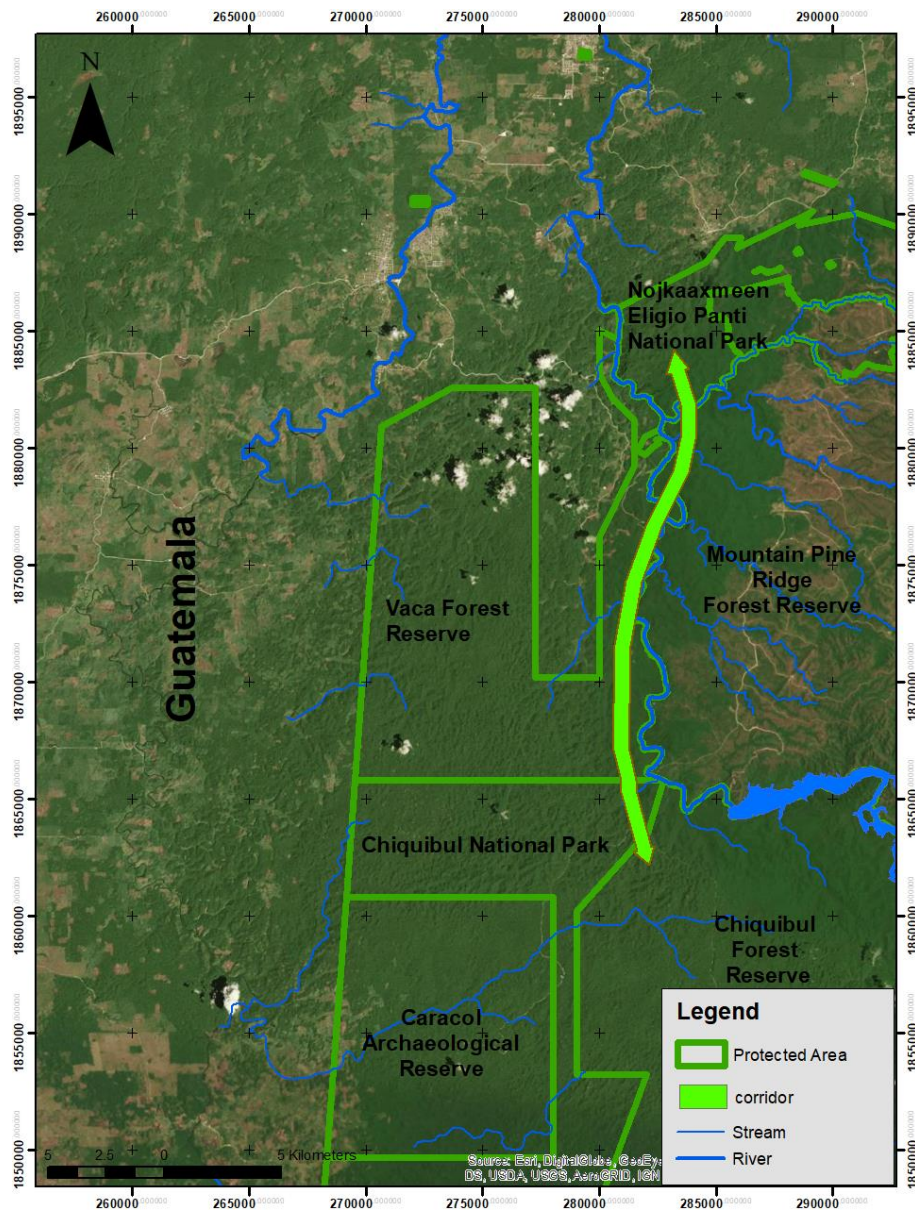


Figure 3. Vaca Forest Reserve in relation to other protected areas in the general vicinity

While the Vaca Reserve connects to these various protected areas, it provides a corridor function for wildlife movements between these protected areas. Wildlife movements are dependent on suitable habitats and as such the broadleaf forest dependent species in the Nojkaaxmeen Eligio Panti National Park would be isolated from the greater Chiquibul broadleaf forests (by the Mountain Pine Ridge, which is a hostile habitat for many broadleaf forest species) if it was not for the broadleaf forest corridor that runs along the Macal River (Figure 4). The Vaca Forest Reserve is as such not a link in the Central Belize Corridor, and it does not link to any intact protected areas in Guatemala.

Figure 4. Biological corridor linking the Eligio Panti Park with the Chiquibul



2.3. National Context

2.3.1. Protected Areas Prioritization

With limited financial and human resources, it is important to be able to prioritize where investments are focused within the National Protected Areas System. In 2013, a prioritization exercise was

<p><i>Terrestrial Prioritization Criteria</i></p> <p>1.0 Environmental Values</p> <ul style="list-style-type: none">1.1 Watershed Catchment and Protection1.2 Wetland Flood Sink Function1.3 Coastal / River Bank Protection1.4 Steep Slope Erosion Control <p>2.0 Biodiversity Status</p> <ul style="list-style-type: none">2.1 Global Recognition for Biodiversity Values2.2 Value for Under Represented Ecosystems or Ecosystems of Limited Extent <p>3.0 Socio-Economic Value</p> <ul style="list-style-type: none">3.1 Value for Commercial Extractive Use (timber / non-timber forest products)3.2 Value for Non-Renewable Resource Extraction - minerals3.3 Value for Non-Renewable Resource Extraction – petroleum3.4 Importance for Water Security3.5 Value for Hydro-electricity Generation3.6 Traditional Resource Use Dependence3.7 Tourism / Recreational / Cultural Values <p>4.0 Key Resilience Features</p> <ul style="list-style-type: none">4.1 Forest Connectivity4.2 Altitudinal / Lateral Connectivity

conducted (Wildtracks, 2013) with the development of a series of criteria (see inset) considered to be of most importance: environmental and biodiversity values, socio-economic values and climate change resilience values. Each protected area was assessed based on these criteria in order to provide a baseline for prioritization.

Fifteen criteria were used to guide prioritization of the terrestrial protected areas system, allocated to four categories. These criteria were developed with input from Forest Department personnel and through feedback from protected area managers who were asked to ‘field test’ the assessment, to ensure it provided a valid output. Each of these criteria was rated out of a total possible score of 4, with scores then totaled and averaged per protected area.

Vaca Forest Reserve came out relatively high in the category with “*High Prioritization, Low Management Effectiveness*”

The most important justification for the retention of the VFR in the protected areas system was that “Clearance of steep hill slopes in areas of agriculture and / or settlement will increase the risk to property and human life. Climate change predictions suggest an increased intensity of storms, which will destabilise soils on cleared,

steep slopes, resulting in the mud slides and landslides seen in Guatemala and Honduras. All these protected areas [in this category] have steep slopes unsuitable for agriculture or habitation”.

2.3.2. Legal, Administrative and Policy Framework

The National Protected Areas Policy (NPAP) is the key statement on the role and management of protected areas (PAs). This policy aims to guide the establishment, management, and administration of

protected areas (terrestrial and marine) in Belize, and to create a National Protected Area System (NPAS) in which all important sites are included in one coherent framework and meet all obligations under international agreements to which Belize is a signatory. The NPAP aims for the PA system to: a) be comprehensive, with representative examples of all ecosystems in the country and including areas providing important environmental services, possessing exceptional scenic values and providing critical habitat for species of conservation concern or economic importance; b) be integrated with regional and national approaches promoting biological connectivity (such as the Mesoamerican Biological Corridors Project) and with other national and regional development plans; c) be economically, socially and ecologically sustainable in order to optimize socio-economic benefits derived from the system as far as these are compatible with maintaining biodiversity values and sustainable resource management and ensure the equitable distribution of these benefits and public awareness of their importance; and d) have transparent management geared towards delivery of measurable benefits and emphasize public participation at all levels. This applies to the establishment, management, modification or de-reservation of all the protected areas included in the national network.²

Table 1. Applicable IUCN Protected Area Category for Vaca Forest Reserve

CATEGORY	Primary Objective:
VI: Conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.	To protect natural ecosystems and use natural resources sustainably, when conservation and sustainable use can be mutually beneficial.

The current status of the VFR is a Forest Reserve which classification matches IUCN category VI (See Table 1). Forest Reserves are established under the Forest Act (Chapter 213, Revised Edition 2000)

The revised National Protected Areas System Act (NPASA) was gazetted and published in the Government Gazette on October 21, 2015 (SI 17 of 2015), it is the overarching legislation regulating the management of protected areas but the VFR as a Forest Reserve is governed under the Forest Act.

Other important changes in the new legislation are the recognition of Private Protected Areas and the option for the declaration of Biological Corridors.

² NPASP 2005

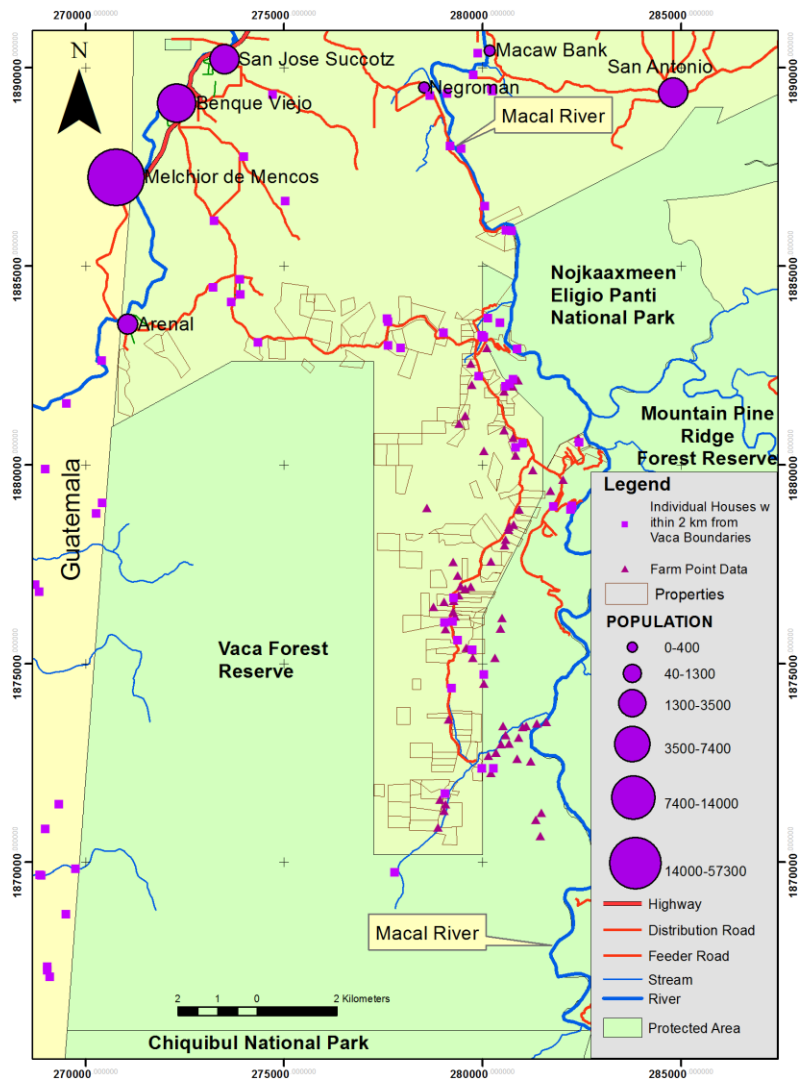
2.4. Socio-economic Context³

2.4.1. Population

The population in the wider Vaca area is concentrated in three centres: the villages Arenal and San Jose Succotz and the town Benque Viejo del Carmen. Besides these three population centres, a number of people are living away from these centres. Figure 5 shows the location of the three population centres and the location of individual houses as noticed on 2017 satellite imagery, farm point data were derived from the 2017 FD/FCD survey.

Figure 5. Population distribution near the Vaca Forest Reserve

(Population figures as per 2010 Census, farm entrances based on 2017 survey by FCD/FD, Houses based on high resolution satellite imagery). Property boundaries courtesy of Land Information Centre - 2011 (LIC).



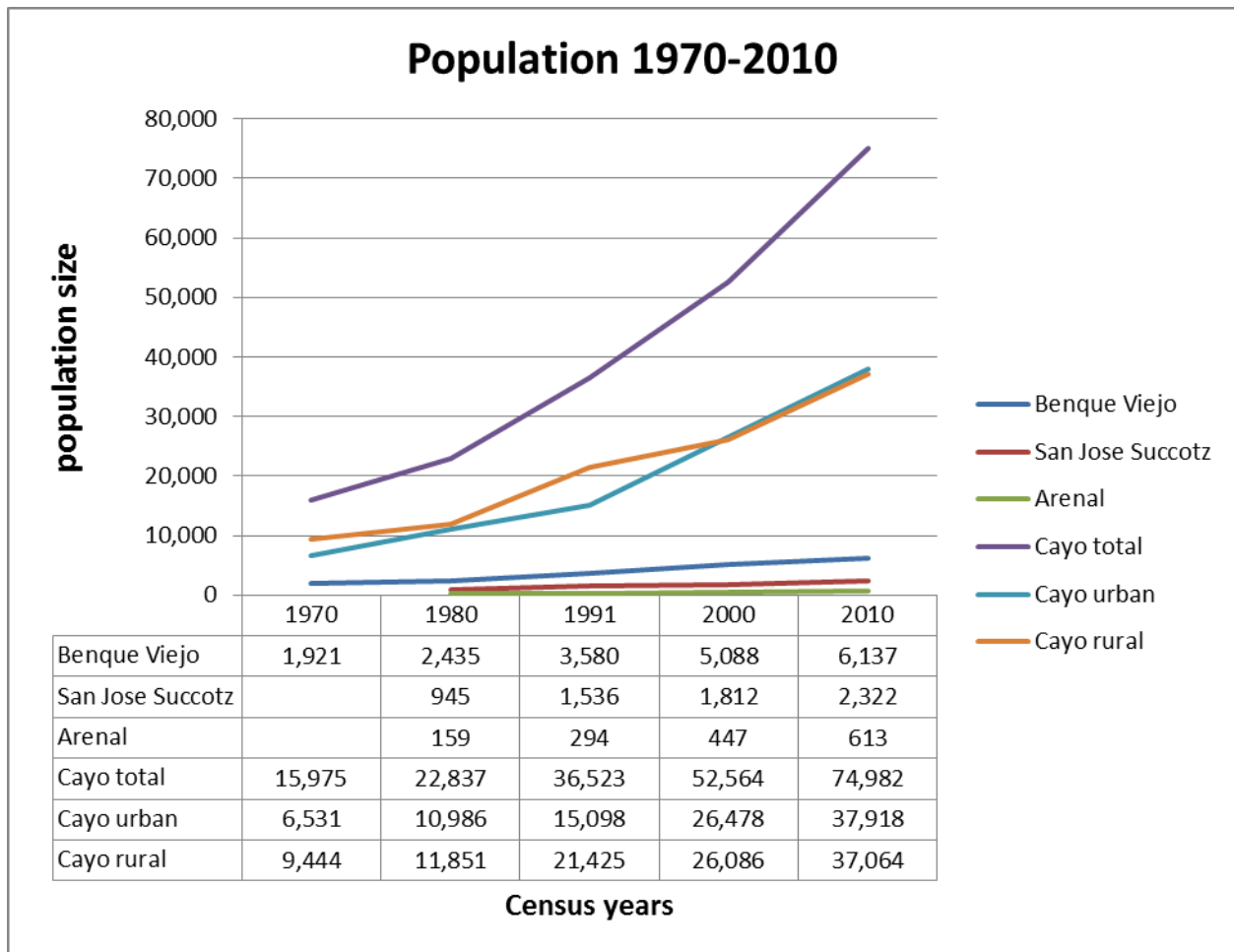
³ See also Boomsma, 2017.

The population of all three communities has increased over the period 1970-2010 (1980-2010 for Arenal and San Jose Succotz). The populations of Benque and Succotz increased proportionally less than the population of Cayo, urban and rural respectively.

There is no information available about the population of the Vaca area; most likely a number of residents have been included in the Arenal count, but there are some farmers who reside in Benque or Succotz and have been included in the count for these communities.

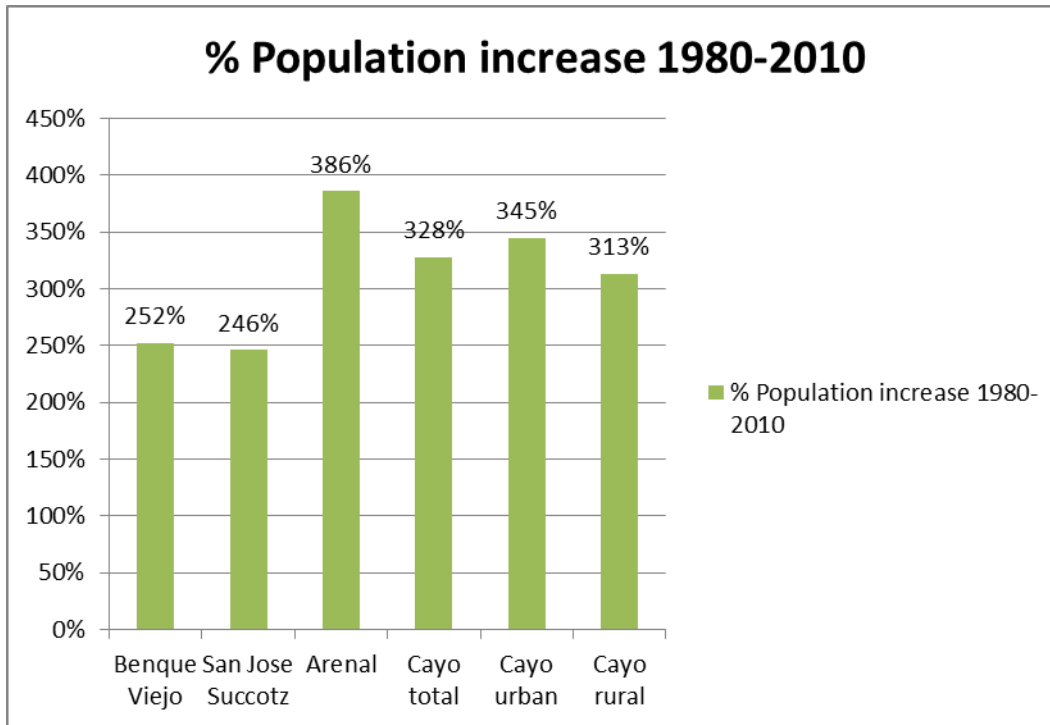
Figure 6 Population sizes of the communities in the project area over the period 1970-2010.

(CSO, SIB: Census results of the various Censuses)



In the beginning of 2017, the Forest Department with assistance of FCD staff, conducted a farm assessment in the Vaca area, the spatial results of which are represented in Figure 5. It should be noted that not every farm entry implies a permanent or semi-permanent residential presence. Nevertheless, the map presents a visual representation of human activities in the area.

Figure 7. Proportional population growth over the period 1980-2010



2.4.2. Main Income Generating Activities

Dominant land use in the project area is agriculture, expressed through the cultivation of crops as well as by cattle ranching. Due to the limitations of the terrain, mechanized farming is not prominent in the area, although small machinery is used to prepare suitable soils for the growing of crops.

The economic activities in Benque Viejo del Carmen are growing. Recently several large shops including hardware stores have been opened in the town. These new economic activities will assist in retaining the available disposable income in the town while previously it would have flowed into neighbouring towns such as Melchor in Guatemala and San Ignacio in Belize.

An area between the international border and Benque, south of the George Price Highway is designated to be developed as an Import Duty Free Zone. The zone is still under development.

Succotz is a medium sized village located on the southern bank of the Mopan River. The village has practically amalgamated with Benque, but the village has its own administration. Succotz is just like Benque, characterized by the absence of major primary and secondary level economic activities. Tourism activities are limited to some restaurants catering to tourists that visit the archaeological site of Xunantunich or by-passers on their way to other destinations. Succotz counts a primary school. The office of the NGO Friends for Conservation and Development is in this village.

Arenal is a small village located right on the international border with Guatemala, therefore the village consists of two sections: the western half in Guatemala and the eastern half in Belize. No information is

available for the Guatemalan side of the village. The Belize side which used to depend largely on agriculture is increasingly dependent on jobs outside the village. Recently, many inhabitants found employment at the Santander sugar plantation and mill, just north east of Belmopan. Employees are commuting to the workplace by means of company buses. This employment offers many families a steady source of income and has reduced the relative importance of farming for the community.

Farming in and near the Vaca Forest Reserve

The FD/FCD January/February 2017 inventory in the excised area found activities on 72 pieces of land (73 pieces were documented, but two entries were found to refer to the same piece of land). One piece was occupied by a sawmill, one piece was intended to house a lodge and another was a residential subdivision. A total of 69 farms were encountered.

Of 63 of these 69 farms, the name of the farmer could be established; of 6 farms, the occupants were unknown. These 6 farms seemed not to be in an active state. Of the 63 farms, 8 farms were described as ‘abandoned’ (were not recently worked), but two of the farmers were present during the September 2016 meeting, apparently still having an interest in their farm. The following information is available for the in-active farms:

- Occupants unknown: 3 farms are located on a slope, 1 in flat terrain and of 2 farms the topography is not described. There is no information regarding the source of water for the farm (creek, pond, or none)
- Abandoned farms: 6 farms are located on a slope; the topography of 2 farms is not described. No information is available about the water source if any for these abandoned farms.

The FCD inventory collected information regarding the acreage of 44 of the 69 farms, ranging from 16 to 250 acres, the average size of the farms is 70.5 acres, see also Fig 32.

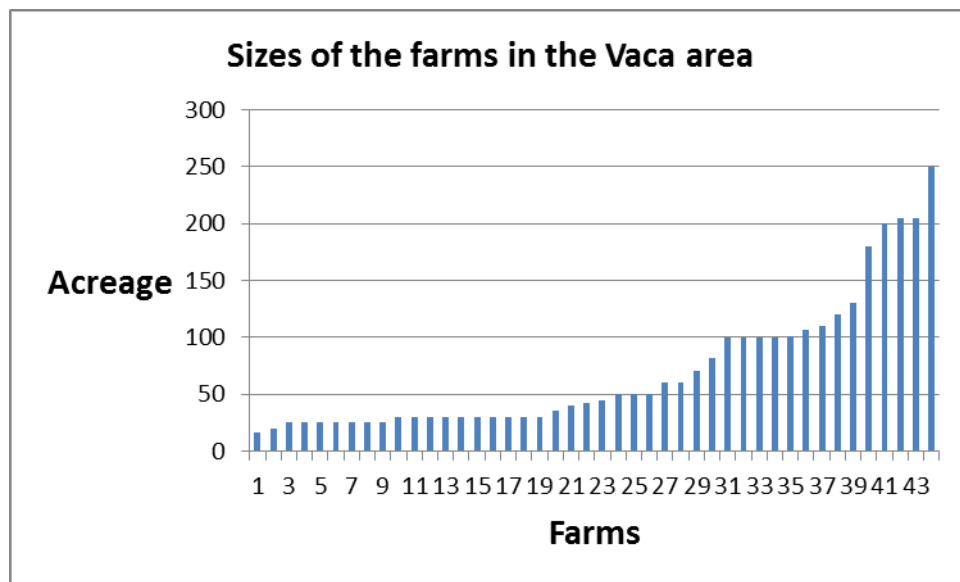


Figure 8. Farm sizes in the Vaca area

The nationality of 47 farmers is known, these are as follows (FD/FCD survey 2017):

- Belizean: 27 farmers
- Guatemalan (incl. Belize residents): 17
- Salvadorian (incl. Belize residents): 3
- Not known (incl. the abandoned farms and the unknown occupants): 22

Of 37 families living at the farms with on average 5.9 persons per farm, a total of 217 persons were benefitting from the farm, (FCD survey).

The FCD survey asked the farmers how many years they had been in the area. It is unclear if this is also the number of years the land has been used: it is possible that a farmer has only been in the area for for example 5 years, but the farm he/she is working on was established before the person took up management of the farm. The September 2016 survey asked more specifically about the number of years the land had been used. See Figure 9 for the outcome.

The outcome of this question was arranged in three groups:

1. Present in the area before 1991, the year the Vaca Forest Reserve was established and also the period the work on the Mollejon hydro plant started
2. Arriving in the area between 1991 and 2003; 2003 being the year a section of the VFR was excised for the purpose of creating land for farmers.
3. Arriving in the area after 2003

Timeline	FCD survey 2017: 41 respondents	September 2016 survey: 19 respondents
Before 1991	10 (24.4 %)	2 (10.5 %)
Between 1991 and 2003	11 (26.8 %)	5 (26.3 %)
After 2003	20 (48.8 %)	12 (63.2 %)

Figure 9. Years of occupation of surveyed farms

The conclusion of this analysis being that the occupation of farms has steadily been growing, with the largest number arriving after 2003 with people making an advantage of better access and land that appeared just to be available.

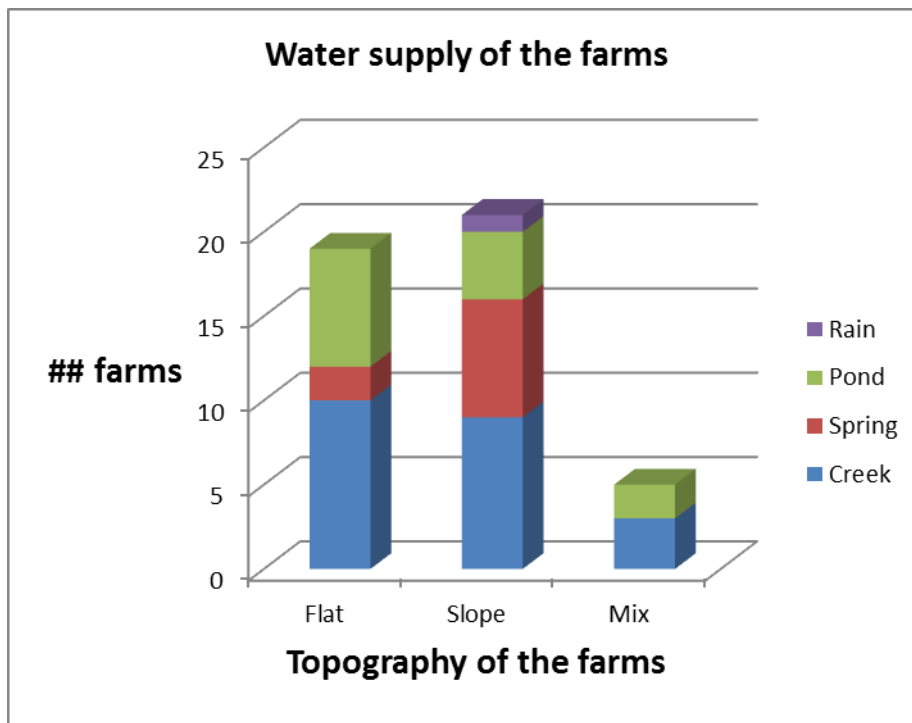
Information about the topography of the terrain the farms are using is available for 59 of the 69 farms (Figure 10).

Topography of the terrain of the 69 farms			
Flat terrain	Slope	Flat and slope	Unknown
22	31	6	10

Figure 10. Topography of farms

These data show that although many of the farms are in flat terrain, but since flat terrain is scarce, most of the farms are on a slope.

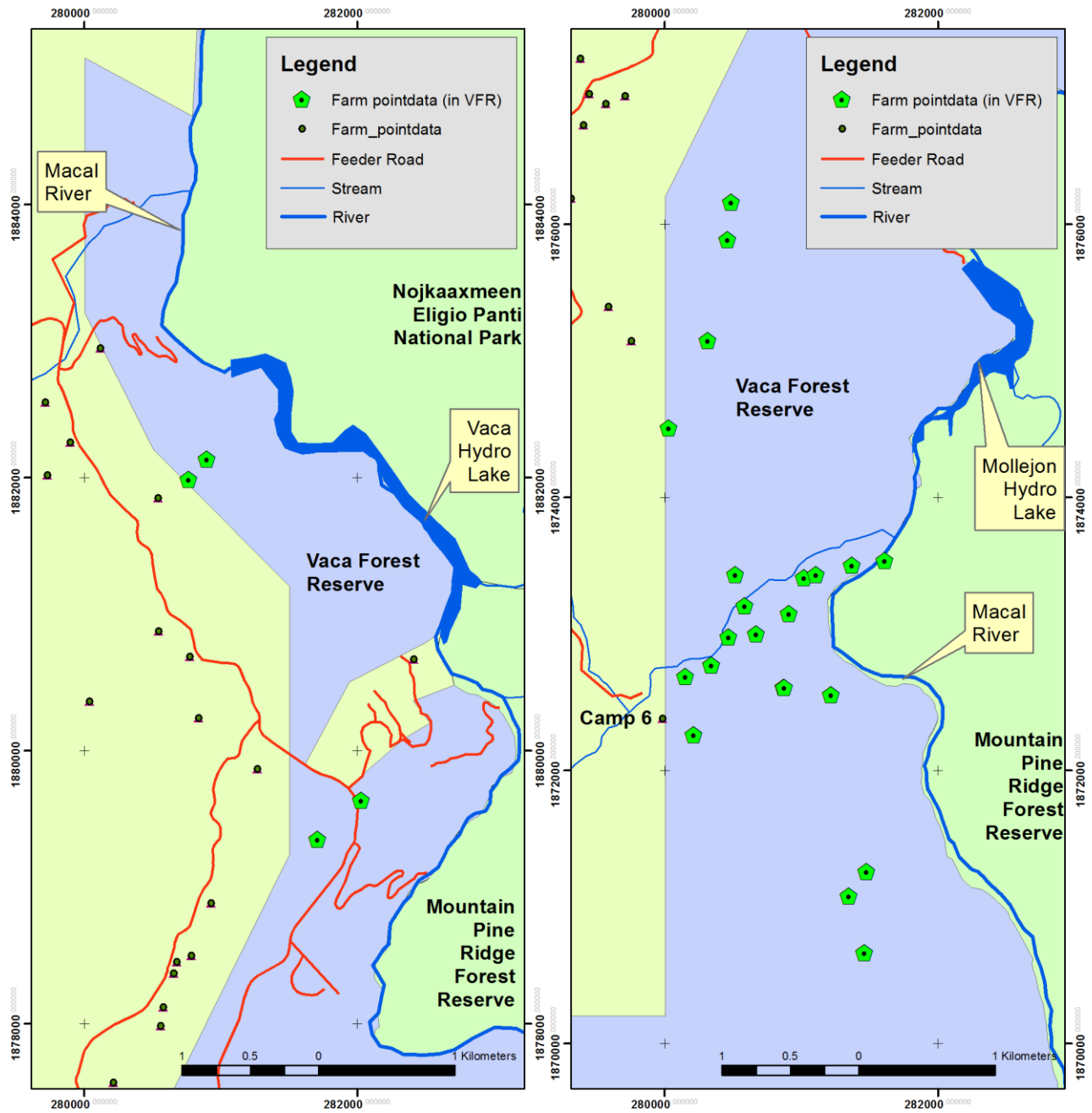
Figure 11. Water supply for farming purposes



Of 45 farms information was available about the topography of the terrain of the farm and the water supply. Natural water features such as springs and creeks are the most frequent water sources, 31 farms relied on these. A pond where rainwater is collected and stored is the other important water source. The prevalence of such water sources on the farms indicates their importance and specifically the presence of a spring or creek served as an important incentive to occupy this specific piece of land.

Figure 12. Farms inside the Vaca FR (2017).

(left map for northern portion, right map for the southern portion)



The FD/FCD survey made some notes when farms were fully or partially in the VFR. Four farmers had part of the farm in the reserve; another farmer explained that he was taking land in the reserve for his sons. Since GPS coordinates at the farm sites were taken, mapping of these point locations provided a more accurate picture, see Figure 12. Unfortunately, the point data do not necessarily present a

standardised point such as entrance or centre-point. Instead the GPS point mostly reflects a structure, the end of a trail or just the spot where a farmer was interviewed. Of the interviewed, 26 farms were thus found to be within the reserve, while 35 farms were outside the reserve. Also on the September 2016 survey, 20 farmers were asked if their farm was fully or partially in the VFR. 17 farmers answered that their farm was in the reserve, of which 2 only partially.

The combined survey outcomes indicate that agricultural interest in the area is not driven by poverty. A large number of interviewed stakeholders were not dependent on the farm but instead treated it as a weekend activity (while hiring Guatemalan labour to tend to the farm during their absence) and see the farm as an investment for the future. The area is relatively remote and market oriented farming is only possible when having access to transportation, which most farmers appear to have access to.

2.4.3. Use of Natural Resources

Based on the interviews and other feedback of the stakeholders the principal uses of natural resources by these stakeholders are (in order of importance):

Farming: From all the interviews and surveys the element that surfaces immediately is that for the stakeholders, the farming is the principal interest and that the Vaca area is merely seen as a source of farm land. Related to the farming issue is the use of water as a natural resource. Water is widely used for irrigation of the farm lands and occasionally for the creating of fish ponds.

Logging: Given the fact that until mid-July 2017 there were three active logging licenses within the FR indicates that for a limited group of stakeholders, logging is a use of natural resources. However, the analysis of the available data indicates that logging in the Vaca FR is not a very lucrative business, yet it provided a reasonable income for a small number of people. The accentuated terrain prevents the use of heavy machinery; instead logging operations were low key, with low volumes of timber produced on demand using chainsaws and then extraction by tractor. Undoubtedly some individual farmers are also involved in some logging, either for direct use on the farm (posts, building materials) or through the sale of salvaged timber to the local sawmill.

Hunting: Some of the interviewed stated to be hunting on and around their farm, even with one person claiming to be hunting for the market. However, most hunting will be opportunistic as most interviewed people claimed that the Vaca FR was very poor in game species.

Secondary forest products: There was very little information to be gotten from the various interviews. Secondary forest products clearly did not feature very high with the stakeholders. Secondary forest products from the Vaca FR include:

- **Xate:** The terrain is good habitat for the Xate palm. However, the Xate industry is in decline probably because of overharvesting and plantation efforts.
- **Bayleaf:** The leaves of the Bayleaf palm as well as the leaves of the Cohune palm were mentioned as being extracted. But especially cohune is widely available overall and people don't need to go into the Forest Reserve to have access to this resource.

- **Bush sticks:** Another natural resource that is available in secondary forest and people don't need the Forest Reserve to access this resource.
- **Honey:** Beekeeping is a viable activity in the project area but hampered by a lack of access and security.

Other Socio-economic benefits: None listed which reflects the findings of the 2008 Technical Assessment (Wildtracks, 2008) of the area.

2.5. Physical environment of VFR

2.5.1. Climate

Belize is a tropical country, but because of its location in the outer tropical geographical belt, there exists a noticeable variation in average monthly temperatures. Also, there exists considerable variation in the monthly amount of rainfall with a dry season from February through May and a wet season from June through January. In addition, there exists considerable variation in the average annual amount of rainfall in Belize, with the North-east receiving as little as 1200 mm/year (48") and the South-east as much as 4,000 mm/year (160"). The VFR lies in the 40-60" (1,000 - 1,500 mm) zone.

Little detailed weather data are available for the project area, due to the fact that no weather stations were present in or near it. Hartshorn et al. 1984, composed a general rainfall isohyet map for the country, extrapolated from available rainfall data in the north and west of the country. The Vaca general area receives less rainfall than other sections of the southern half of Belize, the Vaca is in the rainshadow of the Maya Mountains and the Mountine Pine Ridge which receive more orographic rainfall resulting from their higer elevations.

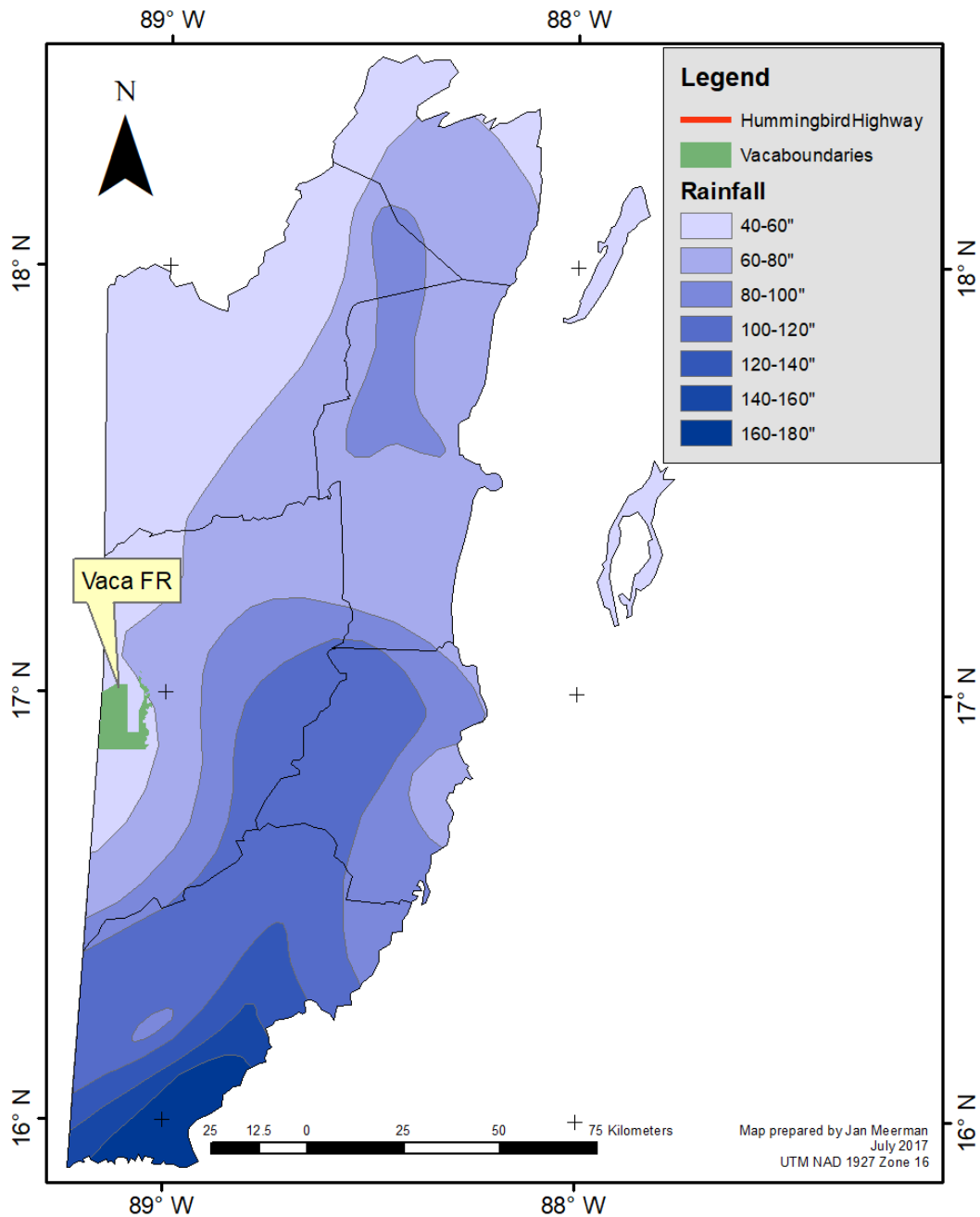
King et al. 1992 (Land Resource Assessment of Northern Belize, which included the Vaca area), made the following observations based on the rainfall data collected three active stations and five discontinued ones: there is a clear reduction of rainfall from east to west, and from north to the south. Rainfall figures for the months February-April for Augustine in the Mountain Pine Ridge (nowadays called DaSilva Forest Station) was in some years only 12% of the annual total. The month May generally receives more rain than the previous months but this rain usually falls in the last week of this month.

Although no exact weather data is available, the following conclusions are drawn:

- Low amount of annual rainfall
- Extreme dry season that can last several months

See Chapter 2.5.8. Soils for the implication of the rainfall for potential landuse of the Vaca area.

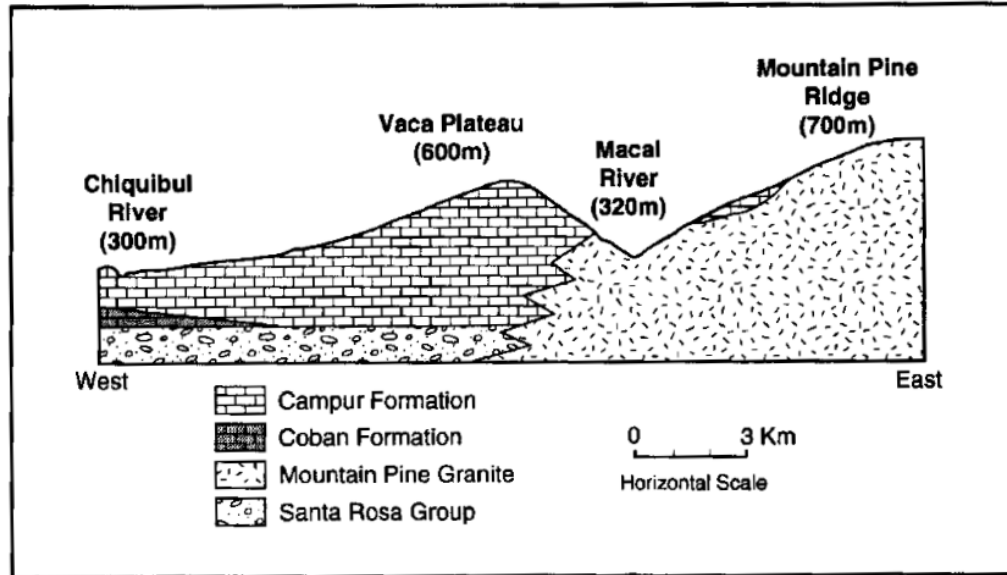
Figure 13. Rainfall isohyets, Belize (after Hartshorn et al., 1984)



2.5.2. Geology

The general bedrock of the Vaca area consists of Campur limestone; this was deposited during the Cretaceous as evaporates and marine carbonates. The underlying bedrock is granite and Santa Rosa sediments, the latter is not surfacing in the Vaca, but the granite bedrock is exposed in the Macal River valley where the limestone has been eroded by the river. Small outcrops of limestone are still present on the east bank of the river (see Figure 14).

Figure 14. Generalized lithologic section across the western flank of the Mountain Pine Ridge and the Northern Vaca Plateau (structural features are not shown)⁴.



Campur limestone is characterized by numerous karstification features: sinkholes, poljes, dolines, underground rivers, caves for instance. King et al. described that the majority of the land, more than 70%, is characterized by high and medium karst: terrain with steep local relief (height difference between valley bottom and top of the nearest crest), varying from > 75 m for high karst and between 25-75 m for medium karst. Between the steep hills, valleys are located. King et al. mapped 24 valleys, the smallest 11.4 acres and the largest 257.2 acres, but no doubt numerous other valleys are present but were too small to be mapped. Accessibility of these valleys is difficult, and the cost (financially and environmentally) of accessing these valleys is high compared to the financial gains that might be achieved from farming practices. The valley bottom described by King, are solution valleys, resulting from the solution of limestone resulting in depressions in the landscape. These depressions are characterized by an accumulation of soil on the bottom.

2.5.3. Elevation

The Vaca Forest Reserve ranges in elevation from approximately 60 m above sea-level directly along the Macal River in the very northern tip of the PA to approximately 650 m above sea-level on the highest hills in the SE corner of the PA.

⁴ Reeder, Philip, Brinkmann, Robert, and Alt, Edward—Karstification on the Northern Vaca Plateau, Belize. *Journal of Cave and Karst Studies* 58(2):121-130

2.5.4. Slopes

The Vaca Forest Reserve is a karstic terrain with steep slopes. The maps below (figures 15) indicate how steep based on two calculations: 15-degree slopes and 20-degree slopes.

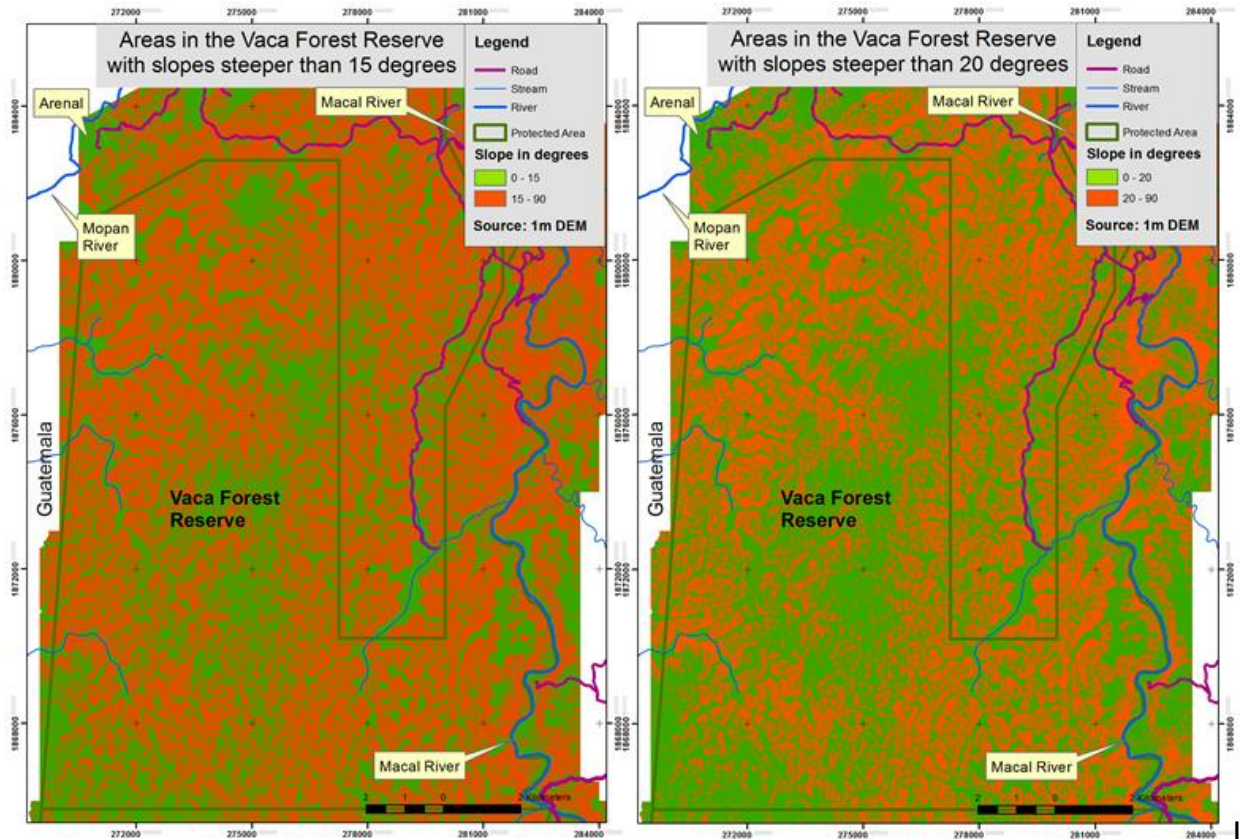


Figure 15 Slopes or respectively ≥ 15 and ≥ 20 degrees based on 1 m Digital Elevation Model

VFR is a Forest Reserve and as such set aside for the extraction of timber. However, a complicating factor in the commercially viable running of a logging operation is the terrain itself. Some authors consider all areas with an estimated slope ≥ 15 degrees the limit for safe operation of logging machinery⁵. Others have maintained a slightly more conservative figure of ≥ 20 degrees⁶ or even 25 degrees⁷. conservative

⁵ Cho, P. in: U.B/ERI 2015. Ecosystems Service Mapping and Review. Mainstreaming Biodiversity, Ecosystems Services And Coastal Resilience In Tourism Development. Report for The Ministry Of Tourism, Culture And Civil Aviation And The Inter-American Development Bank. 160 pp.

⁶ Meerman, J. 2015. Belize: Laguna Seca High Conservation Value Forest Analysis. Report to The Forestland Group and the Forest Stewardship Council. 86 pp.

⁷ Peter van Hout – (2017 Management plan for Chiquiquibul Forest Reserve) pers. com.

Based on a calculation of slope using a 1 m resolution Digital Elevation Model (DEM)(Figure 16), the percentage of the Vaca Forest Reserve accessible for logging would be:

- At a cut-off point of 15 degrees 39 % would be accessible for logging
- At a cut-off point of 20 degrees 52 % would be accessible for logging

These figures severely reduce the opportunities for a commercially viable logging operation.

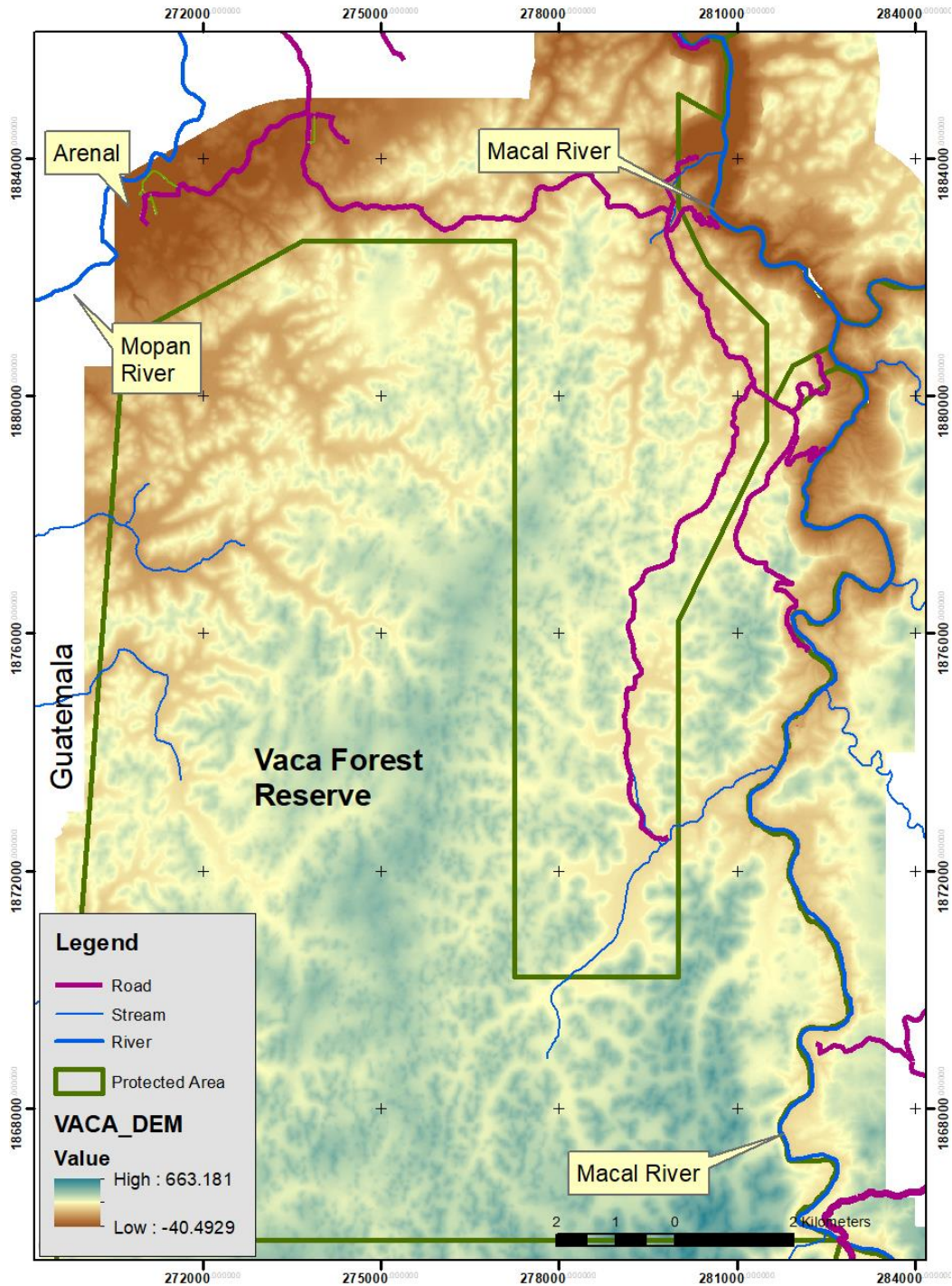


Figure 16. 1m DEM for the Vaca area

2.5.5. Land systems in the project area

King et al in the Land Resource Assessment of Northern Belize (1992) described a system of three hierarchical levels of land units. The highest level being the land region, for example the Western Uplands, the second tier are the land systems (areas with similar characteristics, for example landform, soils and vegetation) and the third tier are the subunits (for example high karst, valley bottom).

Two land regions are distinguished in the Vaca Forest Reserve:

- The Western Uplands: represented by the Vaca Hills (CX) and the Stopper Plain with Hills (SS) land systems
- The Maya Mountains: represented by the Richardson Peak Mountains (TR) land system

Figure 17 shows that the Vaca Forest Reserve is almost completely in the Vaca Hills land system; between the northern border of the VFR and Arenal a sharp boundary line is visible, with north of this line the land system Xcipilha Hills (TX) land system. The Vaca Hills land system is dissected by the Macal River, the eastern section of the Vaca Hills land system borders the Mountain Pine Ridge Plateau. A small strip of land along the Macal is actually part of the Maya Mountains land region; here granitic hills are exposed after erosion of the limestone layers that covered them initially.

The majority of the land, more than 70%, is characterized by high and medium karst: terrain with steep local relief (height difference between valley bottom and top of the nearest crest), varying from > 75 m for high karst and between 25-75 m for medium karst. Between the steep hills, valleys are located. King et al. mapped 24 valleys, the smallest 11.4 acres and the largest 257.2 acres, but no doubt numerous other valleys are present but were too small to be mapped. Accessibility of these valleys is difficult, and the cost (financially and environmentally) of accessing these valleys is high compared to the financial gains that maybe achieved.

Figures 17-19 presents an overview of the subunits of the land systems existing in the VFR (King et al. 1992).

King et al (1992) mentioned the use of the Western Uplands being confined to the extraction of forest products (timber, medicinal plants, hunting). The area was virtually unpopulated when the Land Resource Assessment was carried out, nowadays scattered farm holdings dotting the area but no villages are present. King recommended the area for conservation, but acknowledged a potential future land pressure on the area. King regarded the area unsuitable for large scale mechanized agriculture, because of the complex soil patterns and the rugged terrain. King was of the opinion that small farmers would have a greater chance of successful farming because they would be able to adjust their farming practices to the local conditions.

Figure 17. Landsystems in the project area (King et al, 1992)

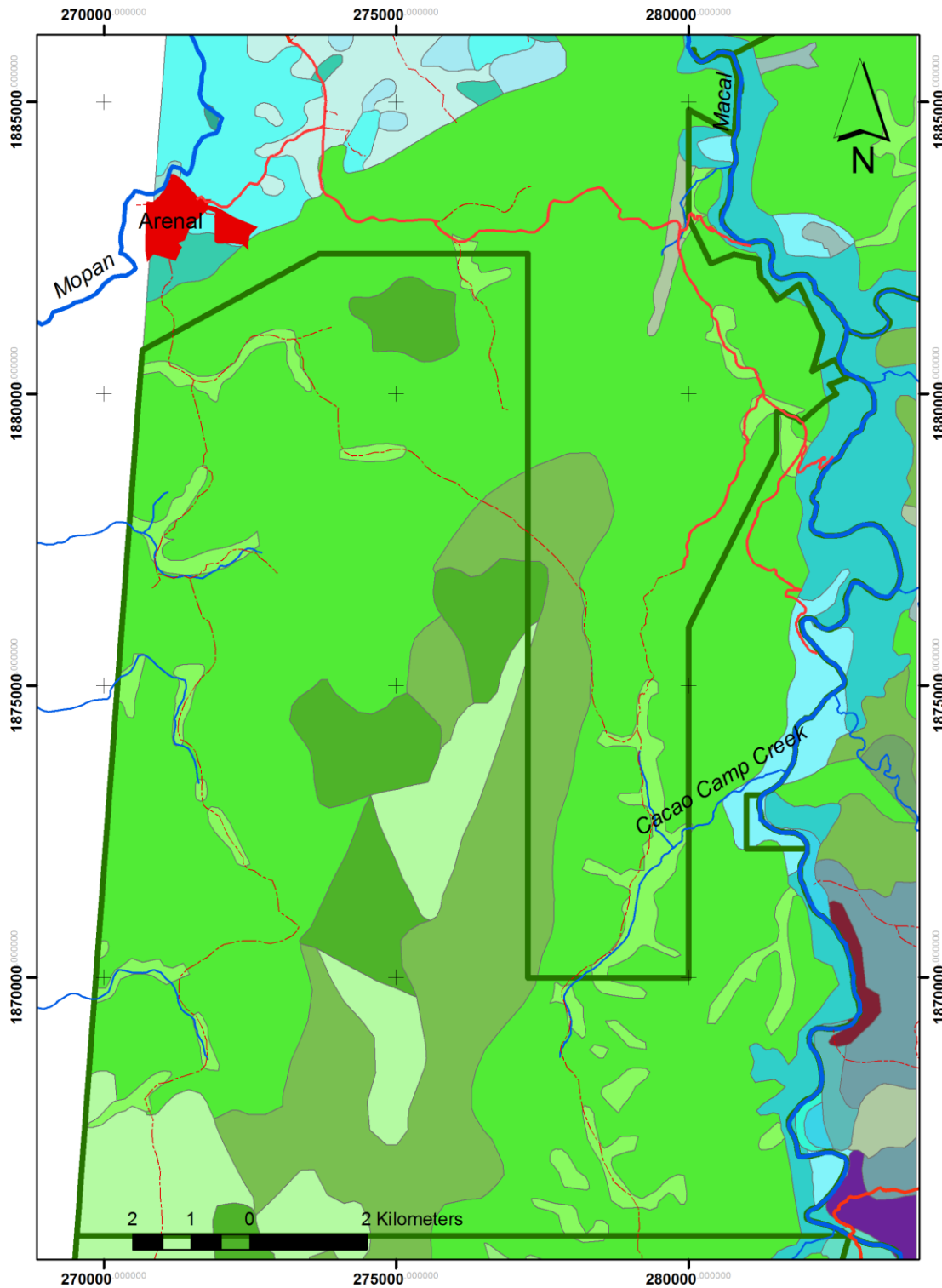
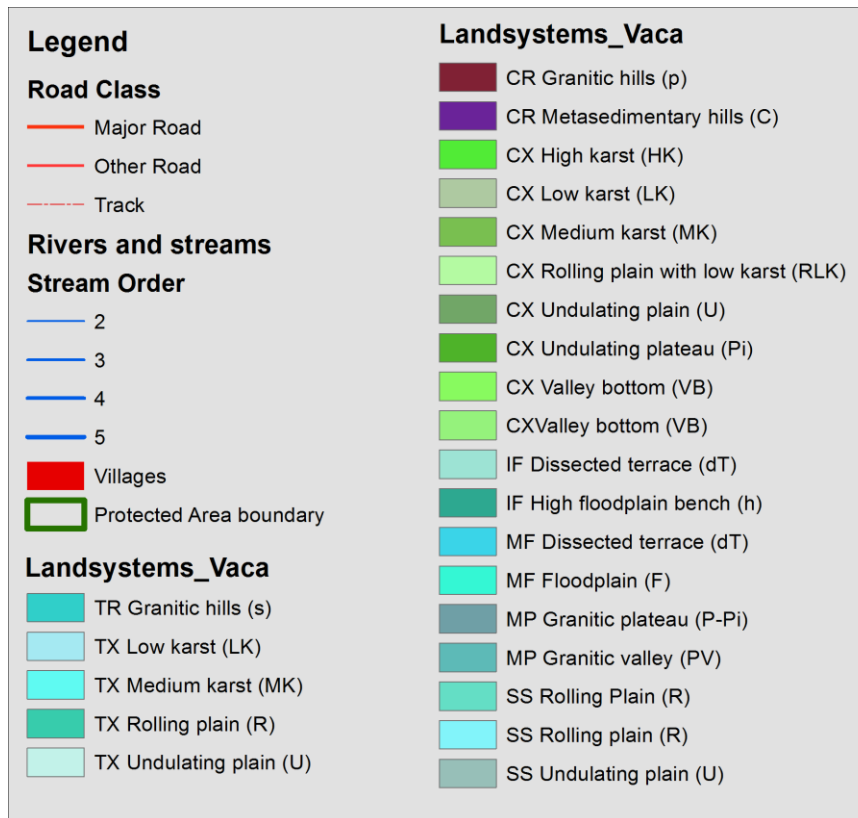


Figure 18. Legend of the land systems map



**Figure 19. Land systems, their area and agricultural value (King et al, 1992).
Colours reflect agricultural land value from red (unsuitable) to green (good)**

Land Region	Land system	Subunits King et al 1992	Description	Total acreage within the Vaca FR	% of the Vaca FR	Agricultural value	Main limiting factors	Provisional recommendations
Western Uplands	Vaca Hills	CX HK	High karst (steep karst hills, local relief > 75 m) HK	24,103	59.8	5	Erosion and shallow soils.	Conservation
		CX MK	Medium karst (local relief 25-75 m, minimal gentle foot slopes) MK	5,284	13,1	5>4	Erosion and shallow soils	Conservation
		CX LK	Low karst	5	<0.1	3-5	Moisture, workability, erosion, nutrients	Conservation
		CX RLK	Rolling plain with low karst (slope 5-25°) RLK	3,455	8.6	4-5	Erosion and shallow soils	Conservation
		CX VB	Valley bottom VB	2,062	5.1	3	Moisture, workability and nutrients	Conservation
		CX π	Undulating plateau π	2,913	7.2	4	Shallow soils	Conservation
	Stopper Plain with Hills	SS R	Rolling plain	728	1.8	3	Erosion (nutrients)	Conservation

Land Region	Land system	Subunits King et al 1992	Description	Total acreage within the Vaca FR	% of the Vaca FR	Agricultural value	Main limiting factors	Provisional recommendations
Maya Mountains	Richardson Peak Mountains	TR s	Granitic hills	1,748	4.3	5	Nutrients, erosion	Conservation
	Mountain Pine Plateau	MP pV	Granitic valley	8	<0.1	4-5	Moisture, nutrients, erosion	Conservation
	Maya Mountains Floodplain	MF F	Floodplain	2	<0.1	1	Access, fragmentation, flooding	Conservation

2.5.6. Agricultural value of land in the project area

The agricultural value of the land in the project area is based on the land suitability of the land systems and subunits, as described in the Land Resource Assessment of Northern Belize (King et. al., 1992).

Figure 20. Agricultural value of the land in the project area.
Colours reflect agricultural land value from red (unsuitable) to green (good)

Agricultural value	Description	Sub units presents in the VFR	Total acreage	Notes
1	Major proportion of the area has high to very high-income potential	Floodplain	2	
2	Chances for financial success good	Not present	0	
3	Chances for financial success moderate with the probability subject to skilled management	Valley bottom and Rolling plain	2,790	24 valley bottoms mapped by King in the VFR, size ranges from 11.4-257.2 acres, average size of the valleys is 85.9 acres. There are 8 sections that were considered to be 'rolling plain', five were less than three acres, the remaining three varied in size between 55.3-592 acres
4	Chances for financial success marginal even with skilled management and high inputs	Low karst Undulating plateau	2,918	
5	Chances for financial success extremely small	High karst Medium karst Rolling plain with low karst Granitic hills Granitic valley	34,598	

The agricultural land value system, consists of five categories, based on the potential financial success of the farming endeavors:

1. Major proportion of the area has high to very high-income potential
2. Chances for financial success are good
3. Chances for financial success moderate with the probability subject to skilled management
4. Chances for financial success marginal even with skilled management and high inputs
5. Chances for financial success extremely small

These definitions are important as they put a lot of weight on management and financial inputs and while the actual soil characteristics (erosion hazard, flood hazard, soil workability, moisture and nutrient availability, mechanisation potential, slope and wetness) do not change, the management and financial inputs may change over time. New techniques may become available and farmers may have access to sufficient capital that allows them to tackle even less favourable soils.

A famous case in point is formed by the Blue Creek (Orange Walk) area where category 4 and 5 soils were successfully converted to productive rice fields. However, these conversions were made by co-operating farmers with ample financial resources and the technical and mechanical skills to carry them out. In general, such conversion from low quality soil to productive agricultural land is possible through intensive mechanical management and thus subject to the economy of scale. For complex/small scale landscapes such as in the Vaca, the agricultural land values as assessed by King et al (1992) remain very much intact.

Figure 21 shows the areas in and near the VFR that are used for farming, based on satellite imagery of 2016. Although the area of land with high income potential in the VFR is limited, many small to medium sized farm fields (not necessarily active) can be observed. Some of these “fields” are very small, up to only ½ acre.

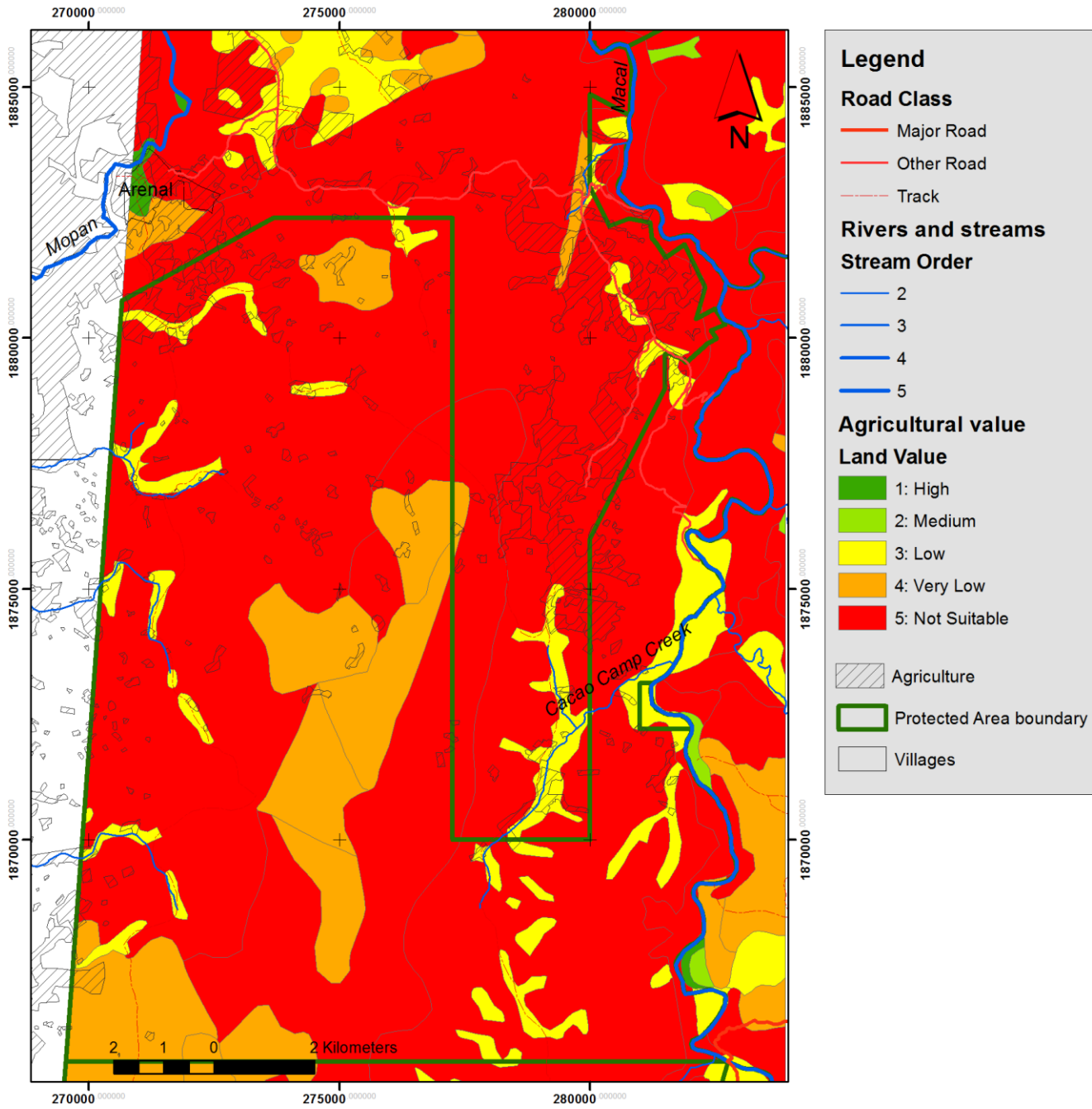


Figure 21. Agricultural value of the land in the project area and agricultural activities in 2017.

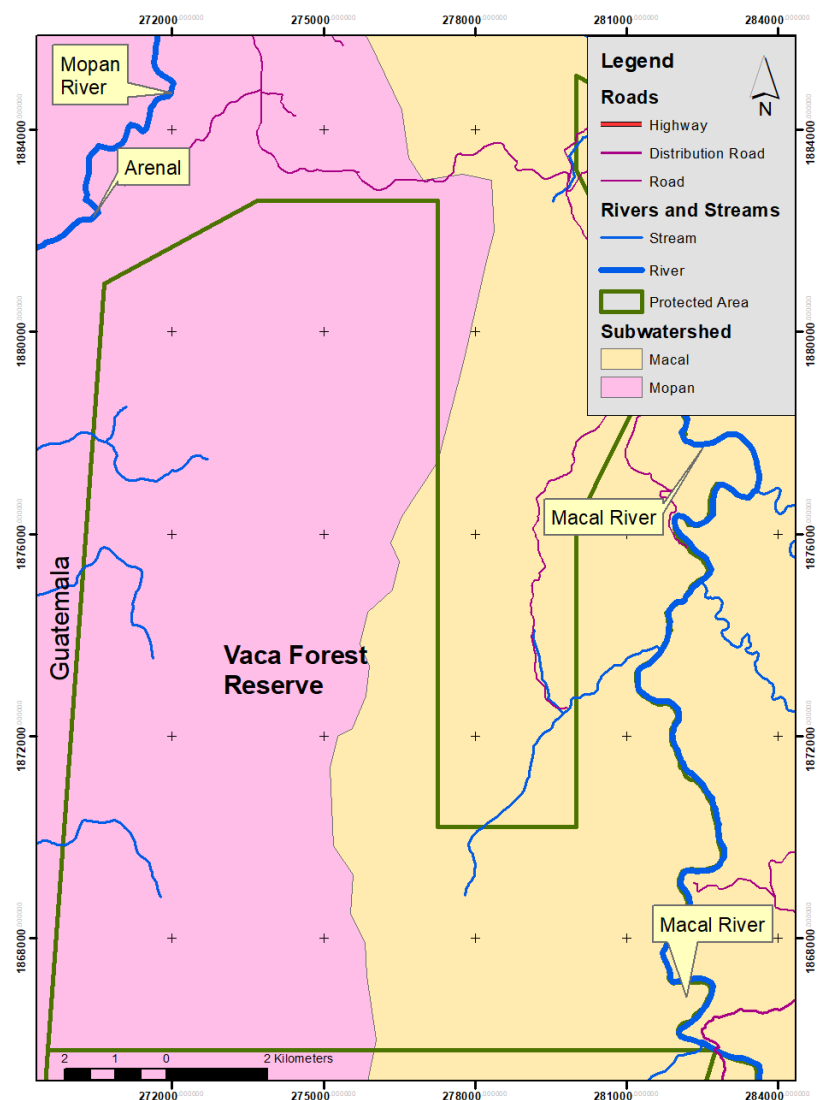
(King et al, 1992 and Landsat 8, 29 January 2017)

2.5.7. Hydrology

The hydrology of the Vaca area is dominated by the Macal River that originates in the Maya Mountains, flows through the Vaca Forest Reserve from south to north. Just north of San Ignacio the river confluences with the Mopan River, from here on the river is called the Belize River.

In the Vaca Reserve a small number of perennial streams are found, the best known is the Cacao Creek at Camp Six. This part of the Vaca area is the location of numerous farms, in the excised enclave as well as within the FR boundaries. These yearround streams originate from springs along the plateau that forms the mid ridge of the FVR, see Figure 22.

Figure 22. Permanent streams in the Vaca Forest Reserve



Numerous intermittent (seasonal) creeks are found in the Vaca area, these streams fall dry during the driest months of the year (February through May). The availability of year round water is of great importance to the farmers, it allows them to produce crops the whole year even in the dry season when the general supply of vegetables is reduced.

Cattle rearing is even more dependable on open water sources which allow the animals to drink. Apart from natural streams and creeks, cattle ponds dug out in deep clay will provide the animals with water.

2.5.8. Soils

As was extensively described in the Social and Livelihood Assessment (Boomsma, 2017), the agricultural value of the soils in the VFR is low. See also the chapters on Landsystems (2.5.4.) and Agricultural Land Value (2.5.5.). This agricultural value was drawn up by King et al (1992), and although modern technologies and an increased access to capital may have offered more options for farmers to make a productive farm, the terrain has the following limitations:

- Erosion
- Shallow soils
- Limited nutrients
- Soil moisture
- Workability
- Access and fragmentation
- Flooding

Although the area of land with high income potential in the VFR is limited, many small to medium sized farm fields (not necessarily active) were observed on recent satellite imagery and during an overflight conducted in June 2017. Some of these “fields” are very small, up to only ½ acre, and often not accessible by vehicle but only on foot or with pack animals.

2.6. Biodiversity of the VFR

2.6.1. Ecosystems and Flora

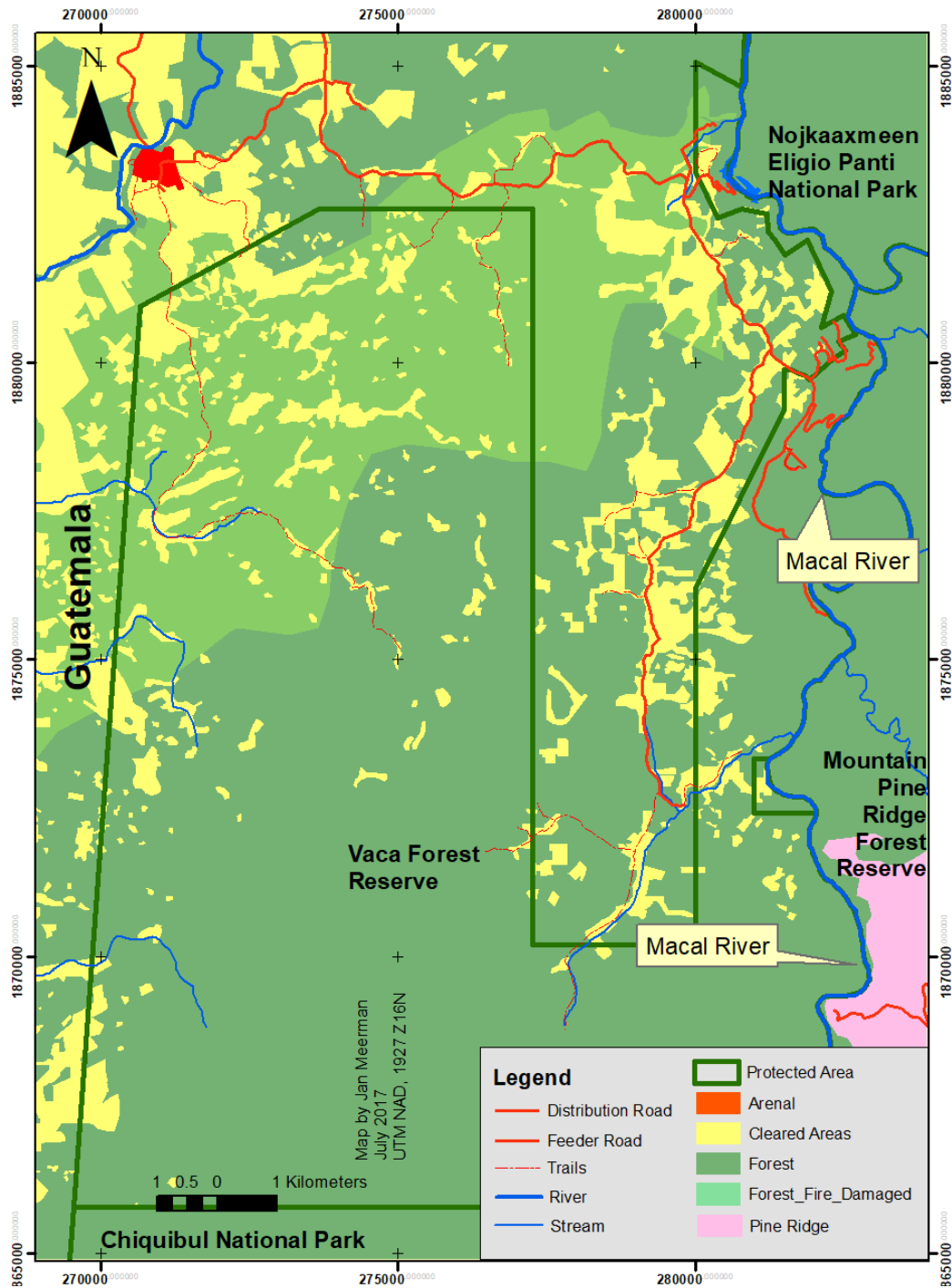


Figure 23. Ecosystems of VFR

The original ecosystems in the VFR existed of two principal types, distinguished mostly by their topography:

- Tropical evergreen seasonal broadleaf lowland forest over rolling calcareous hills
- Tropical evergreen seasonal broadleaf lowland forest over steep calcareous hills

Table 2. Ecosystem Descriptions (Based on Meerman & Sabido, 2001)

UNESCO Code	<u>I.A.2.a.(1).(a).K-r</u>
Name	<u>Tropical evergreen seasonal broadleaf lowland forest over rolling calcareous hills</u>
Altitude	< 500 m.
Geology and soil	Soils over limestone rock.
Water regime	Mostly well drained
Rainfall	Average rainfall less than 2500 mm per year with a pronounced dry season from February through May.
Fire exposure	Fires can do tremendous damage to this ecosystem. The soil at the base of these hills is often quite fertile and sought after for slash and burn agriculture. Agricultural fires associated with this practice frequently escape and creep up the hills, commonly doing relatively minor damage at the lower elevations but destroying the tops of the hills.
Description	These forests are distinguished by topography because there are distinct differences between the lowland forests in Belize and those covering the hills probably because of differences in drainage. These forests display characteristics intermediate between lowland tropical forests and the submontane forests of higher altitudes in the Maya Mountains. The canopy trees 15-40 m tall. There is a distinct deciduous element.
Frequent plant species	Common woody plants are; <i>Acacia dolychostachya</i> , <i>Alseis yucatenensis</i> , <i>Ampelocera hottlei</i> , <i>Annona primigenia</i> , <i>Aspidosperma cruenta</i> , <i>Attalea cohune</i> , <i>Bourreria oxyphylla</i> , <i>Brosimum alicastrum</i> , <i>Calophyllum brasiliense</i> , <i>Casearia bartlettii</i> , <i>Cedrela odorata</i> , <i>Cordia gerescanthus</i> , <i>Crysophila stauracantha</i> , <i>Cupania belizensis</i> , <i>Cymbopetalum mayanum</i> , <i>Exothea paniculata</i> , <i>Guarea glabra</i> , <i>Hirtella americana</i> , <i>Licaria peckii</i> , <i>Lysiloma acapulcense</i> , <i>Manilkara zapota</i> , <i>Sideroxylon foetidissimum</i> , <i>Matayba oppositifolia</i> , <i>Ouratea lucens</i> , <i>Pimenta dioica</i> , <i>Pouteria amygdalina</i> , <i>Pouteria durlandii</i> , <i>Protium copal</i> , <i>Pseudolmedia oxyphyllaria</i> , <i>Rehdera penninervia</i> , <i>Sabal mauritiiformis</i> , <i>Sebastiana tuerckheimiana</i> , <i>Simira salvadorensis</i> , <i>Spondias mombin</i> , <i>Stemmadenia donnell-smithii</i> , <i>Tabebuia guayacan</i> , <i>Trichilia havanensis</i> , <i>Trichilia moschata</i> , <i>Trophis racemosa</i> , <i>Vatairea lundellii</i> , <i>Vitex gaumeri</i> , <i>Wimmeria concolor</i> , <i>Zanthoxyulum procerum</i> , <i>Zuleania guidonia</i> and Myrtaceae. Palms and Rubiaceae are abundant in the shrub layer and lianas are frequent.

UNESCO code	<u>I.A.2.a.(1).(a).K-s</u>
Name	<u>Tropical evergreen seasonal broadleaf lowland forest over steep calcareous hills</u>
Altitude	< 500 m.
Geology and soil	Over calcareous rock. Soils may be extremely organic due to the leaching of the mineral soil and the build-up of organic matter in the limestone cracks and fissures.
Water regime	Well drained
Rainfall	Average rainfall less than 2500 mm per year with a pronounced dry season from February through May.
Fire exposure	Fires can do tremendous damage to this ecosystem. The soil at the base of steep limestone hills is often quite fertile and sought after for slash and burn agriculture. Agricultural fires associated with this practice frequently escape and creep up the hills, commonly doing relatively minor damage at the lower elevations but completely destroying the tops of the hills.
Description	Found in steep terrain, often where there is more non-vegetated ground surface, particularly bare rock. Altitude is less important than steepness and the vegetation cover is dictated by the seasonally extreme droughtiness. Normally the valleys between these steep hills have an ecosystem that should be termed IA2a(1)(a)K-r but the current mapping effort does not allow this type of detail. The canopy tends to reach 25-30 m.
Frequent plant species	Distinctive species include: <i>Acalypha</i> sp., <i>Achimenes erecta</i> , <i>Alseis yucatenensis</i> , <i>Aphelandra scabra</i> , <i>Astronium graveolens</i> , <i>Bauhinia divaricata</i> , <i>Bernoullia flammea</i> , <i>Brosimum</i> spp., <i>Bursera simaruba</i> , <i>Cedrela odorata</i> , <i>Ceiba aesculifolia</i> , <i>Clusia</i> sp., <i>Coccoloba acapulcensis</i> , <i>Costus pictus</i> , <i>Crysophila stauracantha</i> , <i>Cupania belizensis</i> , <i>Cymbopetalum mayanum</i> , <i>Dendropanax arboreus</i> , <i>Desmoncus orthacanthos</i> , <i>Dracaena americana</i> , <i>Deherainia smaragdina</i> , <i>Drypetes laterifolia</i> , <i>Gausia maya</i> , <i>Heliconia spissa</i> , <i>Louteridium chartaceum</i> , <i>Louteridium donnell-smithii</i> , <i>Manilkara zapota</i> , <i>Malmea depressa</i> , <i>Metopium brownei</i> , <i>Oreopanax obtusifolius</i> , <i>Passiflora cobanensis</i> , <i>Passiflora xiikzodz</i> , <i>Pimenta dioica</i> , <i>Piper psilorrhachis</i> , <i>Piper</i> spp., <i>Pithecellobium arboreum</i> , <i>Plumeria rubra</i> , <i>Pouteria campechiana</i> , <i>Pouteria reticulata</i> , <i>Protium copal</i> , <i>Pseudobombax ellipticum</i> , <i>Rhus</i> sp., <i>Sapindus saponaria</i> , <i>Sebastiania tuerckheimiana</i> , <i>Swartzia cubensis</i> , <i>Talisia oliviformis</i> , <i>Thouinia paucidentata</i> , <i>Trichilia havanensis</i> , <i>Trichilia minutiflora</i> , <i>Vitex gaumeri</i> and <i>Zanthoxylum</i> sp. Epilithic herbs are locally abundant, e.g. <i>Anthurium slechtendahlii</i> , <i>Anthurium verapazense</i> , <i>Tradescantia discolor</i> , and <i>Begonia sericoneura</i> . The vegetation of burned hilltops is replaced by vines such as <i>Bidens squarrosa</i> and <i>Calea</i> sp. or more commonly with the fern <i>Pteridium caudatum</i> .

Table 2 describes those ecosystems. In the field, and then particularly in the VFR, the two ecosystems can be difficult to distinguish, but overall, the rolling variant is characterized by

abundant Cohune Palms (*Attalea cohune*) while the steep variant shows an abundance of Nargusta (*Terminalia Amazonia*). Mahogany (*Swietenia macrophylla*) is present mostly in the rolling variant while Cedar (*Cedrela odorata*) is mostly found on the steeper slopes.

Higher trees and presumably trees of higher timber value, are found mainly in the valleys and on the lower slopes, while the hill tops have a much lower and denser vegetation type as a result of recurring issues with drought on these karstic hilltops and possibly also from winds that affect the hilltops but not the valleys.



Figure 24. Typical vegetation pattern on the Vaca hills. Large trees in the valleys and on the lower slopes but the hill-crests with a very dense, low shrubby tree cover mostly as a result of repeated drought conditions and possibly windshear.

2.6.2. Tree species

Although the Table 2 gives an overall view of the flora, the commercial timber species have been assessed for a number of forest licenses within the VFR. The encountered species, in order of frequency of appearance are listed in Table 3. See also Appendix 4 for a full listing of individual trees measured.

Table 3. Timber species identified during 2014 and 2016 Harvest Suitability Assessments for 4 forest licence applicants for the Vaca Forest Reserve (Source FD)

Colloquial	Scientific	Number
Salmwood	<i>Cordia alliodora</i>	89
Fiddle Wood	<i>Vitex gaumeri</i>	82
Cabbage bark	<i>Lonchocarpus castilloi</i>	52
Nargusta	<i>Terminalia amazonia</i>	49
Granadillo	<i>Dalbergia sp./Platymiscium dimorphandrum</i>	39
White Poisonwood	<i>Sebastiana tuerkheimiana</i>	37
Bastard Mahogany	<i>Lysiloma acapulcense</i>	36
Prickly yellow	<i>Zanthoxylum spp.</i>	35
Barba Jolote	<i>Cojoba arborea</i>	31
Bull Hoof	<i>Drypetes brownii</i>	31
Santa Maria	<i>Calophyllum brasiliense</i>	28
Bread Nut	<i>Brosimum alicastrum</i>	26
Cedar	<i>Cedrela odorata</i>	25
Quam Wood	<i>Schizolobium parahyba</i>	24
Hog Plum	<i>Spondias radlkoferi</i>	14
Bitter Wood	<i>Vatairea lundellii</i>	13
Mahogany	<i>Swietenia macrophylla</i>	13
Mylady	<i>Aspidosperma sp.</i>	12
Sapodilla	<i>Manilkara zapota</i>	10
Fig	<i>Ficus spp.</i>	9
Jobitlo	<i>Astronium graveolens</i>	9
Tempiste	<i>Sideroxylon floribundum</i>	9
Balsam	<i>Myroxylon balsamum</i>	8
Llora sangre	<i>Swartzia cubensis</i>	7
Palo de sangre	<i>Pterocarpus rohrii</i>	6
Tzon	<i>Alseis yucatenensis?</i>	6
Black Poisonwood	<i>Metopium brownei</i>	4

Colloquial	Scientific	Number
Ceiba	<i>Ceiba pentandra</i>	4
Quero de sapo	<i>Heisteria media?</i>	4
Silly Young	<i>Sideroxylon salicifolium</i>	4
Fiddle Wood	<i>Vitex gaumeri</i>	3
Red wood/ saltemuch	<i>Simira salvadorensis</i>	3
Hesmo	<i>Acacia dolichostachya?</i>	2
Cortez	<i>Tabebuia chrysantha</i>	1
Hahagua	?	1
Negrto	<i>Simarouba glauca</i>	1
Sapote hoja fina	<i>Pouteria sp.?</i>	1
Tzalam/ Illora sangre	<i>Acacia glomerosa?</i>	1

2.6.3. Aquatic Ecosystems

The only sizeable aquatic ecosystem in the VFR is formed by the Macal River. This ecosystem was identified in the Belize Ecosystems Map (Meerman & Sabido, 2001) simply as “River”

The Macal River drops from an elevation of 350m in the SE corner of the VFR to 50m where it leaves the VFR. As such it is a fast-flowing river, now tamed by a series of hydro structures.

The only higher plant encountered in the Macal river is a *Marathrum* sp. (Podostemmaceae), but other species such as *Cabomba palaeformis* (Cabombaceae) can be expected as well.

The Macal River is known for an isolated population of the Morelet’s Crocodile (*Crocodylus moreletii*), which is remarkable because it shows no evidence of hybridization with American Crocodile (*Crocodylus acutus*), with is common in the rest of Belize. Morelet’s Crocodiles are particularly evident in the Vaca and Mollejon hydrolakes.

2.6.4. Fauna

Based on data from the private Biodiversity and Environmental Resource Database, most of the larger Belizean mammals occur here, these include:

- *Didelphis marsupialis*. Common Opossum
- *Alouatta pigra* Yucatan Black Howler-Monkey
- *Ateles geoffroyi* Central-American Spider-Monkey
- *Urocyon cinereoargenteus* Gray Fox

- *Leopardus pardalis* Ocelot
- *Leopardus wiedii* Margay
- *Puma concolor* Puma
- *Panthera onca* Jaguar
- *Tapirus bairdii* Baird's Tapir
- *Pecari tajacu* Collared Peccary
- *Tayassu pecari* White-lipped Peccary
- *Mazama americana* Red Brocket
- *Odocoileus virginianus* White-tailed Deer

These records were confirmed in interviews with FOV members. However, they commonly stated that wildlife populations were low, probably because of uncontrolled hunting.

The bird fauna is relatively well known, with 244 species recorded (Appendix 1), but more dedicated research should be able to elevate this number to over 300 species. The VFR has somewhat a reputation for being one of the few places in Belize where Elegant Euphonias (*Euphonia elegantissima*) have been encountered.

See Appendix 1-4 for list with flora and fauna species.

2.6.5. Past and Present Research

There are very few records of past or ongoing scientific research within the confines of the VFR but students from University of Tennessee are engaged on a three-year research/practical program ranging from social to biology disciplines. Archaeological surveys have been done in the area before. And finally, a student from Mexico has started a program of social-nature interactions. Also, BECOL conducts surveys as part of their monitoring requirements along the Macal.

2.7. Cultural and socio-economic value of VFR

A Social and Livelihood Assessment was carried out for the VFR area by Boomsma⁸ and the reader is referred to this document.

2.7.1. Archaeological Sites

The FOV members report numerous small Maya sites in the area, but nothing substantial and none are recorded with the Institute of Archaeology. The cave systems along the Macal River that are being exploited touristically are considered Archaeological sites.

⁸ Boomsma, T. 2017 Social and Livelihood Assessment Vaca Forest Reserve. Component of the Development of a Management Plan for the Vaca Forest Reserve, Cayo district, Belize. CONTRACT No. KBA/SER/OCS-14 Report to the KBA secretariat, 74 pp.

3 Analysis of Conservation Targets and Threats

3.1. Conservation Target

3.1.1. Identification of Conservation Targets

It is difficult to address all conservation issues in order to maintain biodiversity and ecosystem services within any given protected area. It is more effective to focus management activities around Conservation Targets (specific subjects such as an ecosystem or species). Thus, Conservation Targets are important for developing, implementing, assessing an adaptive management of protected areas. For the VFR, a total of four (4) Conservation Targets have been identified. These are summarized in Table 5.

The designation as Forest Reserve implies that the principal rationale for the declaration is to protect the forest for the management of timber extraction and/or the conservation of soils, watersheds and wildlife resources. Forest Reserves allow multiple compatible land use practices apart from timber extraction but also include NTFP extraction, military exercises, ecotourism, short and long-term research, education and in some cases even controlled hunting. All these occur when specific zonations for productions, protection and recreation areas have been identified. Extraction activities are regulated under an approved Natural Resource Management and Extraction Plan.

With this designation in mind and after consultations with the various stakeholders, the following management goal for the Vaca Forest Reserve was established:

Management Goal for the Vaca Forest Reserve

The Vaca Forest Reserve continues to function as a key buffer for the Chiquibul National Park and continues to contribute to the functioning of the Belize River watershed whilst maintaining its intrinsic natural values, and contributing to local development.

Conservation targets follow the identification of the Management Goal, conservation targets were identified in consultation with the Friends of Vaca Forest Reserve on June 23, 2017.

Table 4. The VFR Conservation Targets summary, justification and ecosystem impact

Conservation Target	Justification	Species, communities or Ecological Systems represented by Conservation Target
Biological connectivity - biological corridor	Habitat fragmentation is a constant threat to biodiversity conservation. The VFR forms a modest part in providing a biological corridor between PA's directly north-east and south of the in the south and north of the VFR. Particularly important is the forested section along the Macal River in the east of the VFR.	Keeping biological connectivity will help in maintaining viable wildlife populations that are of conservation concern and or important to local communities. It will also provide for the migration of species from the Nojkaaxmeen Elijio Panti National Park in the north to the Chiquibul Forests towards the south and vise-versa.
Buffer for the Chiquibul Forests	The Chiquibul Forests (CFR, CNP & Caracol Archaeological Reserve), form a valuable block of forest harboring viable wildlife populations, critical water catchment areas, scenic geological features and world level archaeological sites. This area is currently receiving both national and international attention and investments. The Vaca Forest Reserve forms an important buffer area, safeguarding from incursions (hunting, illegal logging, clearing) from the north.	All forest communities and their inherent flora and fauna are represented in this target.

Conservation Target	Justification	Species, communities or Ecological Systems represented by Conservation Target
Watershed Protection	The VFR serves as a catchment area for sections of the Macal and Mopan Rivers and thus for the Belize River. This catchment area is particularly important for the agricultural activities in the immediate area.	Protection of the watershed will lead directly to the conservation of endangered species but also will serve as an enabler of agriculture activities that are dependent on irrigation activities
Game Species	Local users have traditionally been harvesting bush meat for subsistence purposes. Within the VFR and immediate forested areas are known to still have populations of large game animals such as White-lipped Peccary, White-tail Deer, Ocellated Turkey, Crested Guan and Great Curassow but these populations are in decline due to hunting pressure and habitat destruction.	Declines in abundance of large game species is symptomatic of hunting pressure and/or habitat fragmentation. Effective protection of large game species will benefit other large mammals such as Jaguar, Puma and Tapir. Decline in game species will lead to an increase in human – predator conflicts.

3.1.2. Assessment of Conservation Target Viability

Conservation planning requires the ability to assess the status of conservation targets over time, to enable planners and PA managers to monitor whether management actions are successful in bringing about the desired changes. A Viability Rating System has been used to describe the present status of the VFR Conservation Targets in section 3.1.1 in a standardized manner allowing comparison over time and between sites.

Conservation target status has been assessed using the viability ranking below.

Viability Ratings (Adapted from TNC 5-S System)	
Very Good	Requires little of no human intervention to maintain conservation targets at an acceptable level (eg. healthy breeding populations, minimally impacted ecosystems)
Good	May require some human intervention to maintain conservation target at acceptable level (eg. reducing/ preventing hunting pressure)
Fair	Requires human intervention - if unchecked, the conservation target will be seriously degraded
Poor	If allowed to remain in the present status, restoration or preventing local extinction will be impossible

The Conservation Targets Viability Ranking Assessment is presented in Table 6. It represents the best realistic assessment possible based on information provided.

Table 5. The VFR Conservation Target viability assessment summary.

VFR Conservation Targets - Indicators for Viability Ranking			
Conservation Target	Current Rating	Goal	Justification for Rating, Goal and Indicator
Biological connectivity - biological corridor	Good	Good	<p>Justification: Forest cover within the PA and associated riparian forests along the Macal are contiguous with other adjacent protected areas such as the Nojkaaxmeen Elijio Panti Nation Park (NEPNP) and the Chiquibul Forests but there is some fragmentation is occurring as a result of the Mollejon and Vaca hydro dams and agricultural activities around the Camp 6 Cacao Creek.</p> <p>Goal: Good. To maintain forest cover and connectivity that facilitates the movement of wildlife.</p> <p>Indicators: Forest cover change within the VFR and its immediate surroundings from year to year. Number and area (size/acereage) of deforested patches.</p>

VFR Conservation Targets - Indicators for Viability Ranking			
Conservation Target	Current Rating	Goal	Justification for Rating, Goal and Indicator
Buffer for the Chiquibul Forests	Very Good	Very Good	<p>Justification: There is still no overflow of incursions from the Vaca Forest Reserve into the northern boundaries of the Chiquibul Forests.</p> <p>Goal: Very Good. To maintain the VFR as a buffer against incursions into the Chiquibul Forests from the north.</p> <p>Indicators: Change in forest cover from year to year. Any new roads and trails crossing from the VFR into the Chiquibul.</p>

VFR Conservation Targets - Indicators for Viability Ranking			
Conservation Target	Current Rating	Goal	Justification for Rating, Goal and Indicator
Watershed Protection	Good	Very Good	<p>Justification: General forest cover and riparian forest cover is contiguous within the VFR but with many small agricultural clearings; no apparent anthropogenic water contaminants within the VFR</p> <p>Goal: Very Good. To maintain healthy forest cover and riparian forests.</p> <p>Indicators: Change (recovery) in forest cover and riparian forest cover from year to year. Number and area of riparian forest clearings from year to year.</p>

VFR Conservation Targets - Indicators for Viability Ranking			
Conservation Target	Current Rating	Goal	Justification for Rating, Goal and Indicator
Game Species	Fair	Good	<p>Justification: White-lipped Peccary are still being recorded within the VFR but all game species are under pressure from hunting which is believed to be seriously affecting population viability</p> <p>Goal: Good. To maintain viable game species population by significantly reducing hunting pressure.</p> <p>Indicators: Number and percentage of patrols per year in which hunting evidence is recorded. Species and abundance of wildlife recorded per patrol</p>

3.2. Threats to biodiversity

Understanding the historical, active, and potential threats to conservation targets and biodiversity in general is important to devise sound conservation and management strategies by PA managers.

Following is a review of the main threats more specifically for within and around the VFR following the criteria developed by WCS.

Table 6. (Three tables) Criteria and scoring for biodiversity threats

Area	Rate the area of the threat (how much of the conservation target area it affects) using the following ranking - each ranking is associated with a score that is incorporated into the analysis	
Proportion of Area Affected Ranking		
Criteria	Score	
Area	4	Will affect throughout >50% of area
	3	Widespread impact, affecting 26 - 50% of the area
	2	Localized impact, affecting 11 - 25% of the area
	1	Very localized impact, affecting 1 - 10% of the area
Severity		
Severity	Rate the severity of the threat - how intense or great the impact is - using the following ranking	
Severity Ranking		
Criteria	Score	
Severity	3	Local eradication of target possible
	2	Substantial effect but local eradication unlikely
	1	Measurable effect on density or distribution
	0	None or positive

Urgency	What is the likelihood of the threat occurring over the next five years? This can be ranked on a scale of:	
Urgency Ranking		
Criteria	Score	
Urgency	3	The threat is occurring now and requires action
	2	The threat could or will happen between 1 - 3 years
	1	The threat could happen between 3 - 10 years
	0	Won't happen in > 10 years

3.2.1. Deforestation

Deforestation is by en large the most important threat to biodiversity in Belize. Belize has traditionally boasted a healthy forest cover. Around Belize’s Independence in 1981, forest cover was at 1.6 million hectares or nearly 75%. By 2005, there still were as much as 1,338,577 ha of forest in Belize (Meerman et all. 2005) and the annual deforestation rate was 0.5%.

Since then, deforestation in Belize appears to have accelerated. It is estimated that between March 24, 2013, and January 30, 2014, a total of 9,290 hectares of Belize’s forest have been stripped, putting Belize’s forest cover at about 60% in early 2014 (Cherrington, pers. comm.). Although much of this deforestation has occurred within the Belize River Valley area, the rest of Belize has not been spared and deforestation within the VFR is certainly an issue. The February 2017 Landsat 8 image suggest that at that moment 8% of the Vaca FR has been deforested for agricultural uses, this figure does not take into account extensive areas of secondary growth.

This 8% deforestation in the Vaca Forest Reserve is spread over the entire area and affects mostly the valleys throughout the Forest Reserve. While deforestation in these areas do affect biodiversity, it does not particularly affect the ecological functioning of the reserve. Instead the deforestation along the western shores of the Macal River does have the potential to disrupt the functioning of the area as a biological corridor linking the Nojkaaxmeen Elijio Panti National Park through the VFR to the Chiquibul Forest.

Table 7 Threat Analysis: Deforestation

Threat: Loss of Biological Connection through deforestation/ habitat fragmentation		
Ongoing pressure to convert natural forest systems into cattle pasture, agricultural lands, human settlements and other anthropogenic uses		
Status	Active	
Target	All forested areas (forest types): Anthropogenic deforestation within the VFR is widespread and threatens the forest link from the Nojkaaxmeen Elijio Panti National Park through the VFR to the Chiquibul Forest.	
Source	Direct: Illegal conversion of forested areas into other agricultural lands Indirect: demand for cattle and agricultural products on the international market and enabled by the cattle sweep	
Area	Score = 4	Land is still being cleared within the VFR for agriculture purposes with large parcels of land are being cleared for cattle ranching being the most impacting. This pattern of deforestation will have negative impacts on biological corridor functioning and watershed protection
Severity	Score = 2	As yet the corridor is still functioning but deforestation levels are increasing.
Urgency	Score = 3	Deforestation is ongoing both on a small and medium scale
Management Action	Stop further incursions into the VFR Enforce limitations to expand farms into the VFR Liaison with FOV to respect regulations and involve them in the management of the area immediately around their farms Recognize Biological Corridor Function	

3.2.2. Wildfires

Wildfires are a major issue in the management of the VFR. Virtually all fires in the area start as agricultural fires. And many of those fires get out of hand. Essentially the whole northern section of the VFR has been affected by fires for so long that the forest structure has changed to the extent that it is detectable from Satellite imagery.

Using the FIRMS⁹ resource, fire points detected by various satellites were gathered. These data clearly link fires with the areas affected by agriculture. Important to notice is the fact that since 2016 the amount of fires has increased dramatically. This increase is not linked to weather conditions, or to the impact of hurricanes, but rather to a rapidly increasing amount of land clearing within the VFR (Fig 25).

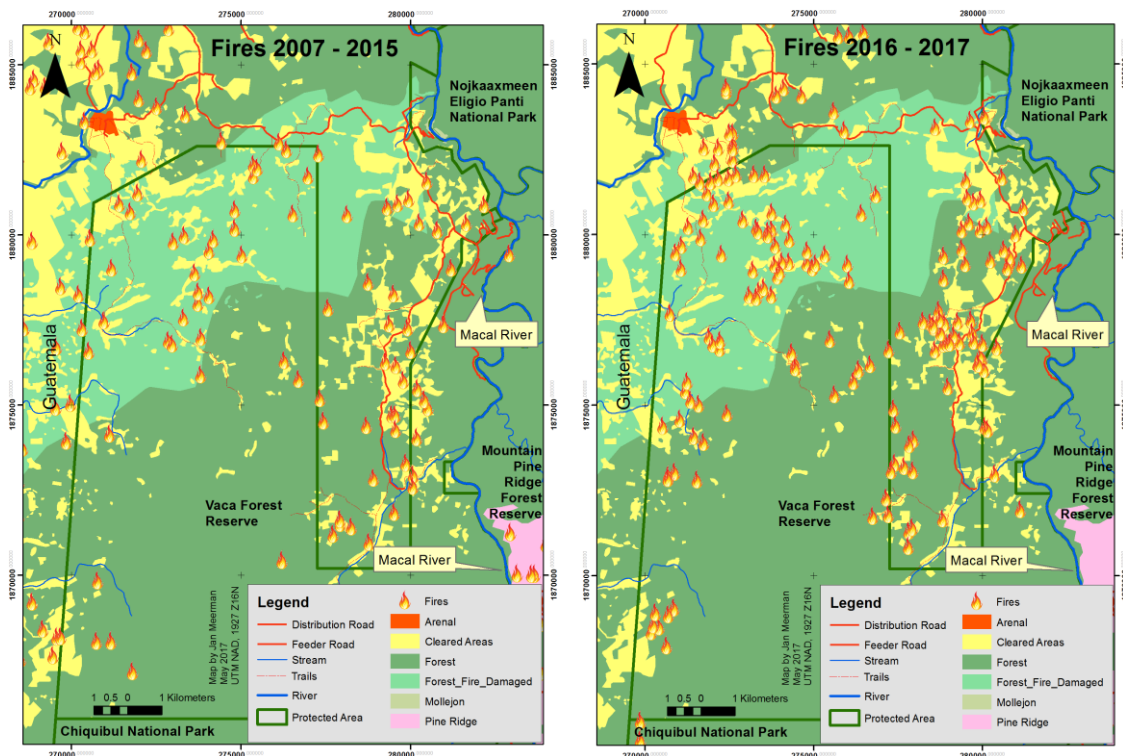


Figure 25. Extent of fires for the periods 2007-2015 and 2016-2017.

⁹ <https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms>

Table 8. Threat Analysis: Fires

Threat: Fires		
Forest fires are common in areas at close proximity to agricultural lands, deforested areas and hurricane damaged forests.		
Status	Active	
Target	Forested areas in and around the general area of VFR, all forested areas near cattle pastures and agricultural lands.	
Source	<p>Direct: Land holders clearing forested areas for other land uses</p> <p>Indirect: Forests damaged by hurricanes and tropical storms, international demand for cattle and agricultural products.</p>	
Area	Score = 3	Normally broad-leaved forests are not at risk of forest fires but due to hurricane damage and agricultural development in and outside of PA, large areas are at risk.
Severity	Score = 2	Fire damaged areas reforest relatively quickly but composition alters dramatically and biodiversity levels drop. Frequently recurring fires will lead to a further decline.
Urgency	Score = 2	Normally broad-leaved forests are not at risk of forest fires but due to hurricane damage and agricultural development, large areas are at risk. Climate change consequences may also lead to extended dryer periods and higher hurricane risk.
Management Action	<p>Developing early warning systems. Development of fire prevention and fighting unit. Education with farmers and cattle ranchers fire prevention systems. Opening and maintenance of fire lines at wildfire risk areas</p> <p>Training in fire fighting regulations and techniques</p>	

3.2.3. Hunting

The FOV members mention that unsustainable hunting is active in the VFR. While they don't see a problem with occasional hunting for household use, they do report that commercial hunting is taking place within the VFR. At the same time, they do mention that wildlife levels within the VFR are low.

Table 9. Threat Analysis: Hunting

Threat: Hunting		
Increasing demand for game meat combined with habitat destruction is leading to unsustainable extraction levels of game species.		
Status	Active	
Target	Game species: large and medium size game species such as Paca, Armadillo, White-lipped Peccary, Collared Peccary, Red-brocket Deer, White-tail Deer, Crested Guan, Curassow, Ocellated Turkey	
Source	<p>Direct: Hunters from community and surrounding villages and seasonal workers from larger land holdings, lack of enforcement</p> <p>Indirect: For many people hunting is a traditional activity</p>	
Area	Score = 4	Illegal hunting is occurring throughout the area and on neighbouring lands
Severity	Score = 2	Hunting has been on a traditional basis by community members but reports indicate that individuals from other villages are more frequently engaging in hunting for a commercial purpose.
Urgency	Score = 2	It is constantly occurring and if not addressed hunters will have major impacts on the abundance of target game species
Management Action	Demarcation of PA boundaries. Erection of 'No Hunting' signs at hot spot areas such as entrance roads. Increase patrols in hunting areas. Public awareness on hunting regulations. Monitoring of relative abundance of target species. Liaison with FOV to monitor enforcement of no hunting regulations.	

3.2.4. Threat Ranking

It is important to prioritize threats to indicate where financial and human resources need to be focused by managers. Based on the criteria ratings used above, the threat to the identified conservation targets that has the greatest impact is deforestation (Table 11).

Hunting also has a high impact and many of the game species may already be at very low population thresholds.

Wildfires may completely change the dynamics and species composition of an area and are of considerable concern and are mostly related with agricultural land clearing using fire. But wildfires can also happen following the passing of hurricanes and tropical storms. This was the case during the dry season of 2011 following the year hurricane Richard devastated central Belize, even though the VFR was unaffected at that time.

Table 10. Ranking of threats to the VFR conservation targets

Threats	Criteria Rating			Total: Area x Severity x Urgency	Rank
	Area	Severity	Urgency		
Deforestation/habitat fragmentation	4	2	3	24	1
Hunting	4	2	2	16	2
Wildfires	3	2	2	12	3

3.3. Strategies to reduce threats

Table 12 presents the strategies and actions to reduce the identified threats to Conservation Targets.

Table 11. Strategies and actions to reduce threats to Conservation Targets

Strategies and actions to reduce threats	Deforestation	Hunting	Wildfires
<p>Strategy: Capacity building and institutional strengthening of the VFR management.</p> <p>Actions:</p> <p>Appointing/creating a co-management body</p> <p>Capacity building of FD, FCD, FOV; Involve FOV in localized management activities where feasible.</p> <p>Develop early fire warning system and fire fighting training</p>			
<p>Strategy: Become efficient in law enforcement activities within VFR and reverse incursions into the VFR.</p> <p>Actions:</p> <p>Appointing/creating a co-management body</p> <p>Coordinate with FD, FCD, BDF and Police Department to conduct strategic patrols,</p> <p>Conduct annual aerial flight for illegal activity detection,</p> <p>Capacity building of FD, FCD, FOV,</p> <p>Acquisition of appropriate warden equipment</p>			
<p>Strategy: Implement a watershed management plan for the VFR</p> <p>Actions:</p> <p>identify and map land use activities in and around the PA,</p> <p>public education on watershed protection and management;</p> <p>Promote environmental friendly land uses with FOV</p>			

Strategies and actions to reduce threats	Deforestation	Hunting	Wildfires
<p>Strategy: Reduce hunting within the VFR</p> <p>Actions:</p> <p>control access to the VFR</p> <p>increase patrolling in hunting hot spots,</p> <p>build public awareness on objectives of PA,</p> <p>Demarcate and signpost FVR boundaries</p> <p>erect no hunting signs,</p>			
<p>Strategy: Implement management zones</p> <p>Actions:</p> <p>Recognize biological corridor</p> <p>implement the proposed management zones for the VFR,</p>			
<p>Strategy: Liaise with FOV to implement best land development and management practices</p> <p>Actions:</p> <p>liaison with landowners to develop and implement land development maps;</p> <p>Develop early fire warning system and fire fighting training</p> <p>build public awareness on environmental friendly development activities;</p>			
<p>Strategy: Strengthening of the position of VFR within the national protected areas system of Belize</p> <p>Actions:</p> <p>identify potential conservation partners and NGOs, develop partnership with appropriate conservation partners and NGO, carry out exchange programs with partners</p> <p>foster collaboration with local, national and regional conservation partners and NGOs</p>			

3.4. Monitoring of Success of Conservation Targets

Table 12 can be used by the protected area managing authorities to monitor the success of their management actions towards achieving the conservation of the identified conservation targets.

Table 12. Matrix for the monitoring of success of conservation targets

Strategy	Target	What to monitor	How to monitor	Indicator
Capacity building and institutional strengthening of the VFR management	Co-management organization is capable of conducting day to day management	Monthly reports of VFR Management body	VFR situation reports	Establishment of co-management body FOV completed training in management assistance activities Number of reports.
Become efficient in law enforcement activities within VFR	To reduce/prevent illegal activities committed in the VFR	Illegal activities within the VFR	Incorporation of FOV reporting Review of patrol reports Use of S.M.A.R.T ¹⁰ Patrol reports	Number of illegal activities reported on in the PA

¹⁰ The Spatial Monitoring and Reporting Tool (SMART) is designed to improve overall law enforcement effectiveness in established conservation areas and management zones. SMART enables the collection, storage, communication, and evaluation of data on: patrol efforts (e.g. time spent on patrols, areas visited and distances covered), patrol results (e.g. snares removed, arrests made), and threat levels. When effectively employed to create and sustain information flow between ranger teams, analysts, and conservation managers, the SMART Approach can help to substantially improve protection of wildlife and their habitats.

Strategy	Target	What to monitor	How to monitor	Indicator
Implement a watershed management plan for the VFR	FOV successful in addressing watershed related issues. Reverse deforestation of Cacao Creek.	Activities within the watershed that have detrimental effect on the Cacao creek and Macal River	Minutes of meetings of FOV Participation in National/regional watershed initiatives	Levels of deforestation along Cacao Creek and Macal River
Reduce hunting and fishing within the PA	Protect fauna of the VFR	Monitor number of patrols to hotspot area.	Patrol reports.	Patrols reporting illegal hunting
Implement management zones	Implementation of specific management for identified management zones	Management activities based on management zones	Implementation of management plan activities	Adherence to specific management plans of management zones
Liaise with FOV to implement best land development and management practices	Lessen the negative environmental impact from land development	Extend of agricultural activities in the Reserve Meetings with landowners. Stakeholder involvement	Minutes of meetings. VFR Manager reports Pledges signed	Number of land owners participating in environmentally sustainable development activities
Strengthening of the position of VFR within the national protected areas system of Belize	Develop working partnerships with recognized national and or international conservation entities	Meetings with partners. Partnerships documents e-bird reports.	Minutes of meetings with partners.	Increased public exposure and recognition as expressed in guidebooks and websites Number of partnerships developed.

4 Management and Organizational Background

4.1. Belize Forest Department

The de-facto manager of the VFR is the Belize Forest Department. The Forest Department describes its mission as: “The Forest Department, as a public oriented entity, fosters Belize’s economic and human development by effectively enforcing relevant policies and regulations for the sustainable management of its natural resources through strategic alliances and efficient coordination with relevant stakeholders”. But on a whole the principal function of the Forest Department is to oversee logging activities and is also responsible for the implementation of the Wildlife Protection Act, 1981; the National Parks Systems Act 2015 and the Forest Act 2017.

As such, the Forest Department is currently the sole manager of the VFR. From time to time it receives assistance and input from FCD with whom it has a written agreement, and the GIZ-Selva Maya project which has been active in the VFR by coordinating the FOV activities but GIZ-Selva Maya has not management mandate.

The Forest Department does not have any “boots on the ground” in the Vaca Forest Reserve and activities are restricted to regulating the timber activities (stamping logs etc.), although they also have been active on and off in trying to liaise with the farmers that are in the Vaca excised area and many of whom have ventured into the remains of the Vaca Forest Reserve.

The weaknesses/ challenges that the FD faces are:

- ✓ Remote location of the Forest Reserve
- ✓ Understaffing
- ✓ Weak and inconsistent communication between FD and land users
- ✓ Absence of enforcement of the Vaca Forest Reserve boundaries
- ✓ No actual management activities in the past
- ✓ Revenues from logging activities not sufficient to support actual management

4.2. Friends for Conservation and Development

The Friends for Conservation and Development (FCD) has the mandate to manage the Chiquibul National Park, and as such it has a vested interest in the Vaca Forest Reserve which it considers a buffer area for the Chiquibul Forest. For this reason, FCD has had several periods of activity within the VFR¹¹ but there is no management mandate, nor does FCD aspire that task (for now).

¹¹ Boomsma, T. 2017. Social and Livelihood Assessment Vaca Forest Reserve. Component of the Development of a Management Plan for the Vaca Forest Reserve, Cayo district, Belize. Report to the KBA Office. 79 pp.

Nevertheless, FCD has a written agreement with FD to undertake several responsibilities in the VFR. CFII also provided FCD with support with 2 field assistants to operate in the VFR. FCD in addition has been working in the VFR in support of FVFR for a period of over 5 years and investments have been of over B\$ 300,000 mainly through GEF grants.

4.3. Friends of Vaca Forest Reserve

The Friends of Vaca Forest Reserve (FVFR or simply FOV) is an Community Based Organization (CBO) registered under the business act, consisting of farmers that are farming in the excised area leading up to camp 6. The farmers have been organized through efforts from FCD and Forest Department and most recently, the GIZ-Selva Maya project has invested a lot in getting the farmers organized and making them familiar with sustainable farming techniques¹².

The FOV have often been touted as potential candidates for a co-manager role. The consultants have attended several meetings with the FOV and have concluded that although the FOV may have a role to play in the management of the VFR, they do not have the technical capacity, the means nor the ambition to take on a role as PA co-management organization. The principal interest of the FOV members is their farms and their livelihoods. They do however have an interest in the environmental services provided by the VFR, which in their case are mostly water related. And as such they have shown an interest in applying more sustainable farming techniques. They also have shown an interest in controlling the access road to camp 6, which could be a very beneficial management activity. But at the same time, it would open them up to revenge actions from persons that they did exclude. Without sufficient capacity training and support from the Forest Department, the FOV is not yet ready to take on such a role.

4.4. Review of Previous Management Programs

No past management program exists.

¹² Boomsma, T. 2017. Social and Livelihood Assessment Vaca Forest Reserve. Component of the Development of a Management Plan for the Vaca Forest Reserve, Cayo district, Belize. Report to the KBA Office. 79 pp.

5 The Management Plan

5.1. Management Goal

Management Goal for the Vaca Forest Reserve

The Vaca Forest Reserve continues to function as a key buffer for the Chiquibul National Park and continues to contribute to the functioning of the Belize River watershed whilst maintaining its intrinsic natural values, and contributing to local development.

The stated management goal puts emphasis on maintaining much of the status quo of the VFR and focusses on the buffer function and the watershed protection function. Note that it does not focus on the usual more “fashionable” goals such as the protection of specific species.

5.2. Management Constraints and Limitations

As indicated under Chapter 4.1., the de-facto manager of the VFR is the Belize Forest Department. From time to time it receives assistance and input from FCD, and the GIZ-Selva Maya project which has been active in the VFR by coordinating the FOV activities but neither of which have an actual management mandate for the VFR.

The Forest Department does not have any “boots on the ground” in the Vaca Forest Reserve and activities are restricted to regulating the timber activities (stamping logs etc.), although they also have been active on and off in trying to liaise with the farmers that are in the Vaca excised area and many of whom have ventured into the remains of the Vaca Forest Reserve.

The weaknesses/ challenges that the FD faces are:

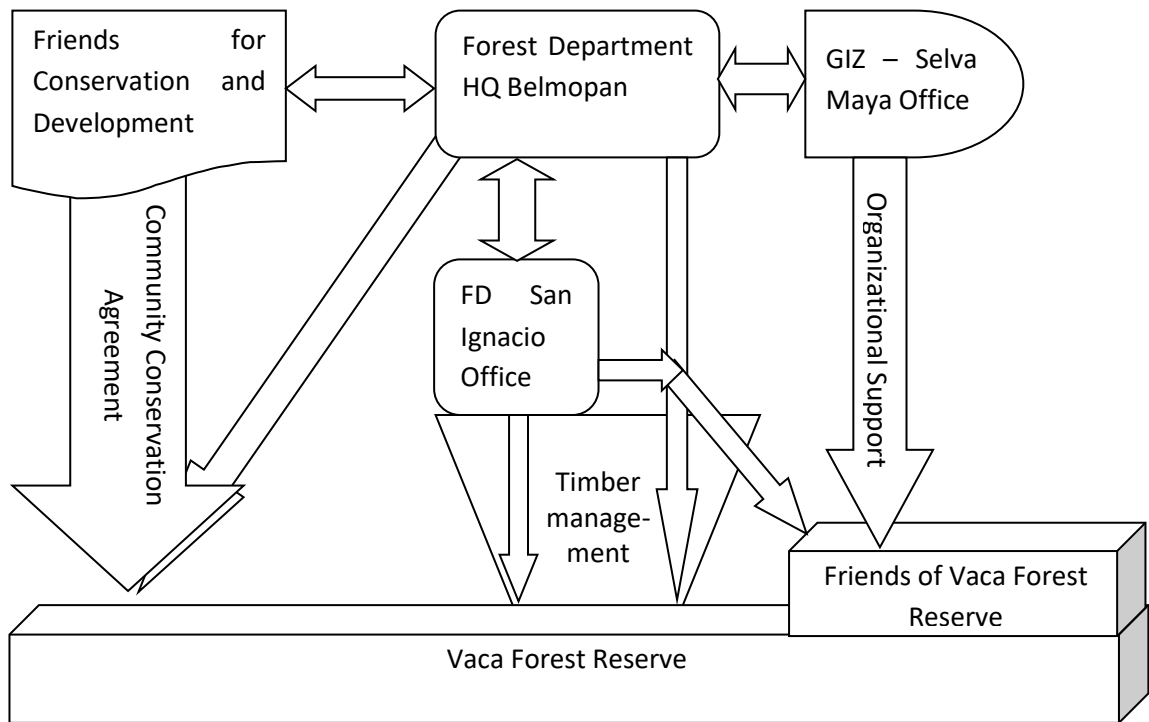
- ✓ Remote location of the Forest Reserve
- ✓ Understaffing
- ✓ Weak and inconsistent communication between FD and land users
- ✓ Absence of enforcement of the Vaca Forest Reserve boundaries
- ✓ No actual management activities in the past
- ✓ Revenues from logging activities not sufficient to support actual management

Currently, there may be little knowledge the Vaca Forest Reserve amongst the public and therefore little “Love”, and challenges for the management of the VFR will be to create a level of

appreciation for the VFR and to initiate some level of sustainability. While the VFR is unlikely to become anywhere close to self-sustainable, it is too important as a buffer for the Chiquibul Forest and as a water catchment area for the greater Belize River to allow it to falter and therefore some level of self-sustainability needs to be created. There are currently few active tourism assets in the Vaca Forest Reserve and tourism will not be the savior of the Vaca Forest Reserve. Timber extraction can generate funds for the Government of Belize but over the past couple of years, royalties received from extracted timber have been very low and insufficient to cover even the most basic of management interventions¹³.

5.3. Management Structure

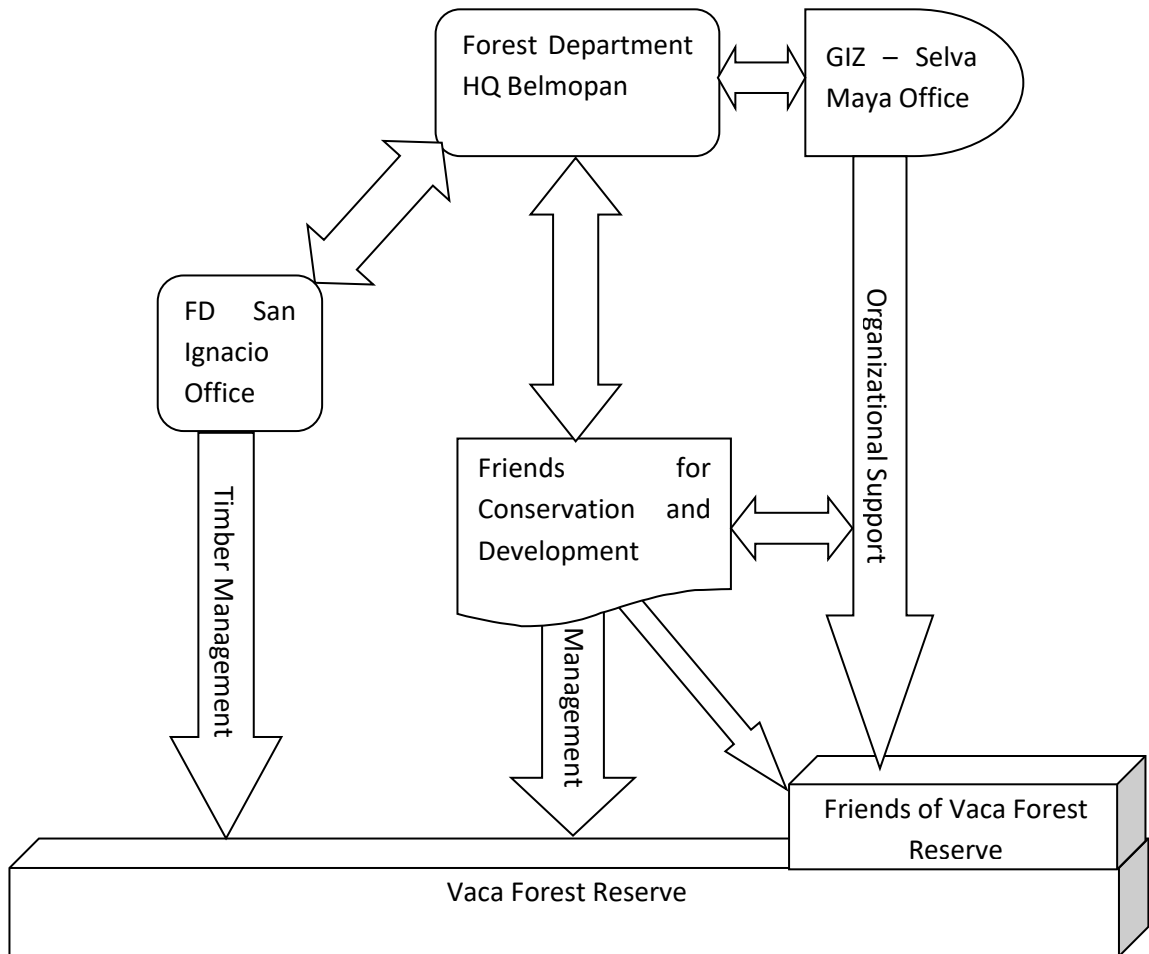
The current management plan must start with a nearly empty slate. The current management activities of the FD are minimal, unstructured and on an ad hoc basis only.



¹³ Boomsma, T. 2017. Social and Livelihood Assessment Vaca Forest Reserve. Component of the Development of a Management Plan for the Vaca Forest Reserve, Cayo district, Belize. Report to the KBA Office. 79 pp.

But considering the other stakeholders, the VFR management structure resembles the flowchart above with the FD being the actual manager with GIZ and FCD in supporting roles.

While this structure could continue to function, a different structure in which FCD (or any other suitable NGO) takes the role of co-manager. The management structure would then look similar to the image below.



This scenario puts the co-manager (FCD in this case) in charge of the overall management of the VFR, while FD remains in a lead position and technically retains any timber management functions, even though a moratorium on timber extraction will remain in place at least until a next management plan cycle. The GIZ-Selva Maya project for the duration of the project continues support for the FOV while interacting with the co-manager.

Note that in neither vision there is an actual management role for the FOV. Although the FOV have often been touted as potential co-managers, there is neither the technical capacity nor any desire with this organization to take on such a task. The FOV needs to be encouraged to function as a friendly buffer organization that has a stake in retaining the environmental services (water) supplied by the VFR.

As this management plan is for 5 years only, this first actual management period should be focusing on consolidating the VFR and get an actual management going. First order of business should be to get a co-management agency willing to step in here. The only realistic co-management organization is the FCD which already manages the adjacent Chiquibul National Park. FCD has its base in San Jose Succotz which is relatively close and in the past, FCD has been involved in various activities in and around the VFR. At the same time, they have shied away from a more active and formal management role. Recent discussions with FCD have indicated that they are interested in the long-term protection of the area. However, this is dependent on further analysis and discussions with the state. If so then, a revisit of the agreement reached between FD/FCD in 2016 may warrant as a first step.

Whether the FD remains the sole management body, or whether a co-management can be initiated, the actual management activities will be limited and focused on consolidation of the Forest Reserve. Such limited focus will encompass the first 5-year lifespan of the management plan. For example, there will be no specific activities to promote tourism, and the only infrastructure development to be established will be a conservation post along the border, no visitor's center or headquarters will need to be established for this first 5 year period.

With respect to the "consolidation" this refers to the needs to "legalize" acceptable activities that are currently taking place within its boundaries, and pushing back unacceptable activities. And pending the outcomes of thorough timber stock surveys, logging could ultimately be an acceptable activity as well even though this will probably not materialize until a next management plan cycle.

5.4. Management Zones

One tool for effective management of any protected area is a zonation plan. Based on the information gathered during the current management plan exercise, the consultants come to some concrete zonation proposals.

This proposed zonation plan consists of 3 zones (Figure 28 and see text on following pages for further explanation):

- Timber Production - Conservation
- Multiple use - East
- Multiple use - North

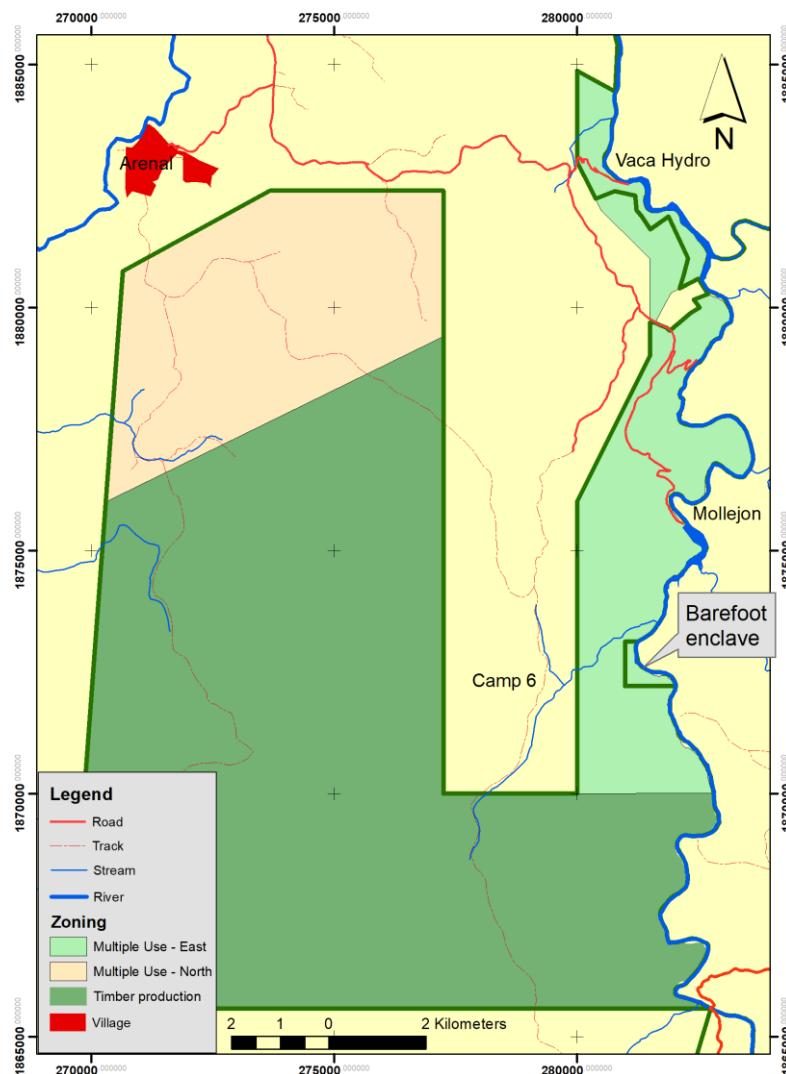


Figure 28. Proposed zonation of the VFR.

The rationale for these three zones is as follows:

5.4.1. Timber Production

The Vaca Forest Reserve is a Forest Reserve and as such its purpose is to produce timber. Until recently the VFR had several forest concessions. It is recommended here that this purpose will be maintained and re-instated once an inventory has been carried out and the timber stock judged sufficient to allow sustainable extraction. This reinstatement can even be if the resulting royalties can not cover management costs. It will however, attach a “value” to the FR in the eyes of the general populace. Also, timber extraction does not impact the role of the VFR as a buffer of the Chiquibul Forest.

The bulk of the VFR will be suitable for timber licenses in the future.

However, there will be some conditions to the reinstatement of any logging concessions:

- The VFR is mostly steep and not suitable for timber extraction with heavy machinery. A more artisanal method of timber extraction will be more suitable for working on the steep slopes
- The exclusion of heavy machinery, effectively disqualifies the area for extraction regimes under a long-term license. Long term licenses require high turnover and highly efficient extraction methods.
- There may be a need to extract timber from the immediate boundary area with Guatemala, this to discourage Guatemalan incursions focusing on timber theft.
- There is no proper understanding of the timber resources that can be sustainably extracted from the VFR. And an intensive timber survey will need to be carried out.

5.4.2. Multiple Use - East

The entire eastern section between the excised area and the Macal River is effectively a multiple use zone with activities such as:

- Agriculture (mostly by FOV members)
- Tourism (focusing on day tourism to the Vaca Hydro Lake, but also overnight tourism in the Better in Belize enclave)
- Power generation (management by BECOL of the Vaca and Mollejon Hydro lakes)

Agriculture activities within this zone can be tolerated within the Forest Reserve concept, but will need to be more tightly controlled and limited. Suggested control and limitation measures would include:

- Agriculture activities would be following sustainable methodologies including agroforestry, organic agriculture and similar. Cattle ranching is not to be allowed.
- Current agriculture clearings need to be properly demarcated and documented. No new clearings or expansion of existing clearings will be allowed
- Agriculture fields will be granted permission to current users, but no official lease will be granted and transfer to property will not be allowed and grants will not be transferrable.
- Any cleared areas within the 66ft from both the Macal River and the Cacao Camp Creek or any other semi-permanent creek, will be reforested using fruit trees. No new riverine buffer areas can be cleared for the establishment of fruit trees.

Tourism activities in the multiple use zone will need to be monitored and subjected to licenses. But currently they don't appear to be a principal impact to the VFR and any future management activities may ultimately be developed based on the monitoring results.

Power Generation activities by BECOL don't appear to be a principal impact to the VFR and serve as an extra level of protection to the riverine area. Any future management activities may ultimately be developed based on monitoring results.

Barefoot Enclave: The multiple use zone also includes a survey that was originally intended for the 2007 Barefoot lodge development. It is understood that this site has been abandoned. Research needs to be carried out to establish whether the title was ever transferred and whether any taxes have been paid. If not, then that survey needs to be annulled and the area returned to the VFR. No transfers to private entities can be allowed.

5.4.3. Multiple Use - North

The area proposed for this zone a block of approximately 7,100 acres or 2874 hectares immediately south of Arenal Village. This area is characterized by the following attributes;

- The area in question has been farmed for decades¹⁴
- The forest in the area is marked by decades of forest fires, recognizable from satellite imagery.
- Commercial timber resources are expected to be extinguished in this zone, with little chances for recovery.

¹⁴ Boomsma, T. 2017. Social and Livelihood Assessment Vaca Forest Reserve. Component of the Development of a Management Plan for the Vaca Forest Reserve, Cayo district, Belize. Report to the KBA Office. 79 pp.

- Trying to get a handle on agricultural activities will be time consuming, expensive and potentially lead to conflict with the Arenal community.
- Contains some of the steepest areas in the VFR, warranting exclusion from agricultural activities and strict conservation.

De-reservation of this section of the Vaca Forest Reserve would appear to be the easy way out. But not a realistic option since the maintenance of the Vaca Forest Reserve is a commitment under the 3rd Master Agreement between the Government of Belize and the Belize Electric Company Limited (BECOL) and Belize Electricity Limited (BEL) which states amongst others “to take reasonable steps to manage and protect Mountain Pine Ridge, Chiquibul and Vaca watersheds and to prohibit building, farming, logging and other activities within the said watershed areas which will impair or prejudice that catchment capacity of the said watersheds;”

In addition, de-reservation has been used in the past and is generally seen as not providing a long-term solution to encroachment issues.

In addition, this particular section is that it contains some very steep areas unsuitable for cultivation which are likely to degrade even further as a result of escaped agricultural fires.

Proposed acceptable activities in this zone will be limited to Agriculture

Agriculture activities within this zone can be tolerated within the Forest Reserve concept, but will need to be more tightly controlled and limited. Suggested control and limitation measures would include:

- A group of farmers (CBO/COOP) could qualify for a “grant” under a 15 year permit allowing agroforestry activities. Transfer of this “grant” to property will not be allowed and grants will not be transferrable.
- This “grant” would need to be granted to a farmers group/collective/CBO/Coop not unlike the “Friends of Vaca Forest Reserve”. This group will need to be formed.
- Agriculture activities would be following sustainable methodologies including agroforestry, organic agriculture and similar. Cattle ranching is not to be allowed.
- Current agriculture clearings need to be properly demarcated and documented. No new clearings or expansion of existing clearings will be allowed.
- Steep slopes >20 degrees will be off limit for farming.
- Agriculture fields will be granted to current users, as long as they are part of the overarching group.
- Any cleared areas within the 66ft from any semi-permanent creek, will be reforested using fruit trees. No new riverine buffer areas can be cleared for the establishment of fruit trees.

5.5. Limits of Acceptable Change

Limits of acceptable change is used mostly as a tool to reduce the impact of tourism activities. Presently tourism visitation within the VFR is almost non-existent and has not been identified as one of the strategies in the sustainable management of the VFR. Any tourism development calls for an identification of limits of acceptable change because of tourism activities. As such a very basic set of limits of acceptable change has been identified (Table 13) but it needs to be noted that at this moment the enforcement of these is not a priority. If any, illegal incursions for tourism operations (involving land clearing) need to be halted.

Table 13. Limits of acceptable change

Environmental Impacts			
Management concerns	Acceptable limits	Monitoring Indicators	Management Actions
Deterioration of access sites	No deterioration of access routes or river	Physical damage to trees within and around access sites Garbage left behind Soil erosion at access sites	Monitoring of visitors while at visitation sites Inspection of soil conditions at visitation sites
Poor solid waste management by tour operators	No improper disposal of waste on trails, access points, camping grounds and similar	Abundance and quantity of trash collected at trails, access sites and designated tourist areas	Enforce no littering policy; Enforce a "pack it out and pack it all in" policy, meaning no trash to be left in area by visitors; Inform tour guides and tour operators about littering policy before they bring tourists to site.

5.6. Management Programs, Strategies and Objectives with a co-manager

The listing below represents a full scale of activities that should be undertaken when sufficient human and financial resources are available. Realizing that this will not always be the case, the most **critical** components of the management programs and strategies are marked in **red**.

Note that there is a great input projected for FCD, either as “associated” organization or more directly as co-manager. In the latter case where the people/entities will indicate “Co-manager” this could be FCD if that organization is invited and willing to take on this role.

Since the acceptance of the the co-management role by FCD can not be guaranteed at this stage, two management program versions are being presented her. One with the ideal situation that involves a co-manager and the second version in which FD remains the only management agency.

5.6.1. Institutional Management and Strengthening Program

Governance Development Sub-Program				
Objective 1: By 2018, Strengthen the FD involvement in the management of the VFR and develop a governance structure for the VFR that incorporates the multiple stakeholders within the area and ensures an effective and transparent decision-making structure				
Management Actions	Present Status	Desired Status	Year	People/entities
Strengthen FD involvement in the management of the VFR	Management capacity of the FD is limited	Improved management involvement of the FD	2018	FD.
Examine greater role of FCD in the management of the VFR, preferably as co-management agency	FCD has no management mandate	Co-management entity in place	2018	FD, FCD
Identify and give legal status to farmers for the use of the farmed land adjacent to the excised area	Presently there are some 7 active farmers inside the reserve who are FVFR	Containment of incursions with users having secure use of the land	2017	FD
Regulate farming in Multiple use zone - north	Current status not tenable	Sustainable farming without additional damage to environment	2018	GOB, FD, NGO's, funding agencies

5.6.2. Fundraising Program

Fundraising Program				
Objective 1: Develop and institute a fundraising program geared at diversifying VFR's funding base				
Management Actions	Present Status	Desired Status	Year	People
Prepare grant proposals to support the implementation of VFR's management programs	Presently FD's grant proposal writing capacity is limited	FD's grant portfolio is expanded and diversified	2018 and beyond	FD, FCD (when taking on co-management role), consultants
Identify potential donor agencies and cultivate/strengthen donor relations	Donor portfolio for FD is limited	FD's grant portfolio is expanded and diversified	2018 and beyond	FD, FCD (when taking on co-management role),

5.6.3. Administrative Program

General Administration Sub-Program				
Objective 1: Develop an effective management structure				
Management Actions	Present Status	Desired Status	Year	People/entities
Develop an effective management structure for VFR based on this management plan	FD's management structure is insufficient to address VFR's management	Effective co-management organization in place.	2018	FD, FCD.
Examine greater role of FCD in the management of the VFR, preferably as co-management agency or associated manager	FCD has no management mandate	Co-management entity in place	2018 and ongoing	FD, FCD
Objective 2: Maintain baseline administration activities				
Maintain baseline administration activities	Minimal administration by FD	Administration in the hands of an effective co-management entity	2018 and ongoing	FD, FCD
Prepare Annual Work Plans Monitoring and	No medium-term strategic plan or	Annual work plans are based on co-	2018 and	FCD (when taking on co-

General Administration Sub-Program				
Objective 1: Develop an effective management structure				
Management Actions	Present Status	Desired Status	Year	People/entities
Review Sub-Program)	management plan is in place	manager's strategic plan and VFR's management plan	ongoing	management role),

Staff Recruitment and Retention Sub-Program				
Objective 1: Ensure that VFR has sufficient qualified staff for effective management and biodiversity conservation, depending on the available budget				
Management Actions	Present Status	Desired Status	Year	People/entities
Conduct a comprehensive staff needs assessment for effective management of the VFR	No dedicated staff	There is a clear understanding of the ideal staff composition for the VFR	2019	FD, co-manager
Prepare clear and detailed Terms of Reference (job descriptions) for all staff posts and minimum qualifications	None	Detailed job descriptions and minimum qualifications for each staff post	2019	FD, co-manager

Equipment Procurement and maintenance Sub-Program				
Objective 1: Ensure adequate administration infrastructure and planning				
Management Actions	Present Status	Desired Status	Year	People/entities
Develop and implement a five-year infrastructure development plan	Infrastructure present with both FD and FCD	New VFR infrastructure and facilities follow guidelines of the infrastructure development plan	2019	FD, co-manager, donor agencies
Develop equipment procurement procedure manual	None	Implementing equipment procurement procedures	2018	FD, co-manager

Monitoring and Review Sub-Program				
Objective 1: Annual review of management activities				
Management Actions	Present Status	Desired Status	Year	People/entities
Review of management effectiveness on annual basis, for submission to Forest Department	None	Improved VFR management, based on annual management effectiveness reports	2018 and ongoing	FD, co-manager
Review of 'Measures of Success' monitoring (linked to Research and Monitoring Sub-Program)	Occasional self-analysis	Annual measures of success analysis using standardized (national) methodology	2018 and ongoing	FD, co-manager
Review of monitoring activities	Not applicable	Focused research and monitoring, based on management effectiveness evaluation	2018 and ongoing	FD, co-manager, consultants
Review of education and public awareness activities	Monitoring success is done through 'RARE' methodology	Focused education and public awareness,	2016 and ongoing	FD, co-manager

Objective 2: Periodic review of management plan				
Management Actions	Present Status	Desired Status	Year	People/entities
Monitoring information feeds back into adaptive management planning activities	Not applicable	Updated VFR Management Plan	Ongoing	FD, co-manager
Review Management Plan after 5 years	Not applicable	Management Plan reviewed in 2022	2022	FD, co-manager consultants
Full management effectiveness assessment submission to Forest Department at end of 5 years	Baseline management effectiveness report completed	Comprehensive management effectiveness report submitted to FD	2020	FD, co-manager, consultants

5.6.4. Research and Monitoring Program

Research & Monitoring Sub-Program				
See also Natural Resource Management Program.				
Objective 1: Fill in knowledge gaps				
Management Actions	Present Status	Desired Status	Year	People/entities
Create and implement information management database to contain all research, monitoring and socio-economic data, to assist with adaptive management	No effective in-house system for own data and external data scattered	In house data management system links with National Monitoring Institute if and when implemented	2018	FD, co-manager
Develop baseline data for the VFR through biodiversity surveys and mapping activities.	Abundant data but dispersed throughout Belize and abroad.	Complete spread of Geo-referenced biodiversity data	2018	As part of regular patrol and monitoring activities; tourguides, Consultants
Develop in house skills in database and GIS management	Skills available in both FD and FCD	Co-management staff have received training in Database and GIS management	2018	FD, co-manager
Objective 2: Develop monitoring programs covering conservation targets				
Management Actions	Present Status	Desired Status	Year	People/entities
Develop and implement Biodiversity Research Inventory and Monitoring (BRIM) Framework for identified conservation targets in the VFR	None	BRIM developed and implemented; serving local and national needs	2018	FD, Co-manager

Objective 3: Develop “measures of success” monitoring protocol, to verify success of conservation strategies

Development and implementation of ‘Measures of Success’ monitoring program, to verify success of conservation strategies, incorporating limits of acceptable change	None	Annual measures of success analysis using standardized (national) methodology	2019	Co-manager
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5.6.5. Natural Resource Management Program

General Biodiversity Management Sub-Program				
Objective 1: Provide the framework for effective biodiversity management of the protected area				
Management Actions	Present Status	Desired Status	Year	People/entities
Verify commercial timber stocks	Localized, but outdated data available from previous logging concessions	Proper understanding of the commercial timber stocks within the VFR	2018	FD
Patrol the PA	No wardens	Dedicated staff present for management activities	2018	FD, Co-manager
Clearly demarcate the boundaries in critical areas	Partly completed	All critical areas identified and boundary demarcated. Note that there is uncertainty whether clearing boundary lines is a good action in all cases	2018	FD, GOB
Implement management zones	No management zones	Management zones implemented	2018 and beyond	Long term project
Monitor on an annual basis using GIS tools, land use change (deforestation) within the general area	Occasional overflights, on foot patrols	Annual analysis of land use change using remote sensing methods in combination with overflights and patrols	2018 and beyond	Manager, Monitoring Consultant, National Monitoring Institute if and when in place
Integrate research and monitoring results into the adaptive management process	NA	Formalized data exchange protocols, mechanism in place to incorporate results in management	2018 and beyond	Co-manager

General Biodiversity Management Sub-Program				
Objective 1: Provide the framework for effective biodiversity management of the protected area				
Management Actions	Present Status	Desired Status	Year	People/entities
Training of staff as special constables, in green laws and evidence collection and reporting	None	Staff is verse with green laws and evidence gathering and reporting	2018 and beyond	Co-manager
Develop and implement enforcement plan	None	Formalized enforcement plan incorporating FD, Fisheries, and Police.	2018	FD, BDF, co-manager
Prioritize enforcement of existing regulations and encourage cooperation of FOV and communities towards this objective	Ad hoc	Effective enforcement with support from FOV and communities	2018 >	Co-manager, FCD, BDF, FOV, FD, Police
Use of Spatial Monitoring and Reporting Tool (S.M.A.R.T.) for protected areas management	Not used	S.M.A.R.T is fully integrated into the law enforcement patrols and used for analyzing effectiveness of management	2018 and beyond	FD, co-manager
Liaise with FD on enforcement issues	Done but not effective	FD active and effective in enforcement issues	2018 and beyond	FD, co-manager
Work closely and effectively with local communities	Some meetings held but not structured	Communities recognize and respect VFR and its regulations	2018>	FD, co-manager

5.6.6. Protection and Surveillance Program

Demarcation Sub-Program				
Objective 1: Clearly identify the VFR as a protected area to prevent incursions based on ignorance				
Management Actions	Present Status	Desired Status	Year	People/entities
<p>Clearly demarcate the boundaries in critical areas</p> <p>NOTE-See Natural Resource Management Program</p>	Partly completed	All critical areas identified and boundary demarcated. Note that there is uncertainty whether clearing boundary lines is a good action in all cases and locations	2018	FD
<p>Identify ALL incursions into the VFR</p>	Focus has been on the area in and around the excised area, no physical boundaries of land in use has taken place, only point data exist.	Exact boundaries of agricultural and other incursions mapped and owner identified.	2018	FD, co-manager
<p>Patrol the PA</p> <p>Note. As in Natural Resource Management Program</p>	No wardens	Staff present for day to day management activities	2018	FD, Co-manager

Fire Management Sub-Program				
Objective 1: Prevent damage to conservation targets as a result from wildfires (either through lightning strike, escaped agricultural fires, campfires and/or arson)				
Management Actions	Present Status	Desired Status	Year	People/entities
<p>Develop and implement fire management plan; develop capacity and infrastructure for fire prevention/control</p>	Non-existent but there are funds available within the KBA project.	<p>Fire management plan implemented with infrastructure in place</p> <p>Staff trained in basic fire fighting techniques</p>	2017 and beyond	Co-manager, FOV, FD

Institute a community based fire watch and suppression program	Non-existent, some villagers have training in natural disaster management. PFB is eager to establish a fire watch relationship	Operational community fire watch program with basic equipment present	2017 >	FOV
Develop and implement fire early warning systems	Non-existent	Functional early warning fire system	2017 and beyond	FOV, FD, FCD

5.6.7. Infrastructure Management Program

Infrastructure Development Sub-Program				
Objective 1: Ensure adequate infrastructure is in place to support VFR management and carry out protection and scientific monitoring activities				
Management Actions	Present Status	Desired Status	Year	People/entities
Evaluate office and administrative needs to support operational efficiency by co-manager	None	Office and Administrative needs documented	2018	Co-manager
Establish hard and software infrastructure to be able to maintain an information mngmt database which contain all research, monitoring and socio-economic data, to assist with adaptive management	Infrastructure present with both FD and FCD	Sufficient hard and software available to start and maintain VFR databases and trained staff available	2018	Co-Manager, FD, Funding agencies.
Objective 2: Ensure adequate equipment is in place to support VFR management and carry out enforcement and monitoring activities				
Management Actions	Present Status	Desired Status	Year	People/entities
Improve enforcement equipment and capabilities	Basic equipment	Communication structure in place, tested, functional.	2018 and beyond	FOV, FD, FCD, Police
Equip and maintain staff, surveillance,	Basic infrastructure	Seamless "catering"	2018 > ongoing	FD, Co-manager

research, education and accommodation facilities	present	mechanism in place		
Provide sufficient first aid materials and emergency rescue materials at key points within the management area	Limited infrastructure	Main office equipped with appropriate first aid and rescue materials + trained staff	2018 and beyond	FD, Co-manager
Maintain an efficient inventory of equipment and supplies	Present for both FD and FCD	Efficient inventory of equipment and supplies in place and maintained	2018 and beyond	FD, Co-manager
Obtain and maintain adequate transportation means for enforcement and monitoring	Present for both FD and FCD	Transportation infrastructure in synch with needs assessment	2018 and beyond	FD, Co-manager

Infrastructure Use Training Sub-Program				
Objective 1: Ensure that VFR staff are adequately trained to operate and maintain VFR infrastructure and facilities				
Management Actions	Present Status	Desired Status	Year	People/entities
Develop in house skills in database and GIS management See also Administrative Program	One staff member has basic skills	Data-manager + 1 back up staff have received training in Database and GIS	2018	FD, Co-manager
Develop in house skills in S.M.A.R.T. See also Protection and surveillance programme	Skills available with FCD	Data-manager + 1 back up staff have received training in Database and GIS	2018	FD, Co-manager
Provide first aid and Jungle Rescue training	Basic skills present	Members trained in jungle rescue and first aid	2018 and beyond	FD, Co-manager, FOV
Provide training in law enforcement patrolling tactics	Skills available with FD and FCD	Basic skills present with FOV for controlling their own area	2018 and beyond	FD, Co-manager, FOV, Police

5.6.8. Community Development and Environmental Education Program

Community Development and Outreach Subprogram				
Objective 1: By 2019, at least 2 communities representing buffering communities of the VFR are involved in conservation and sustainable livelihood activities				
Management Actions	Present Status	Desired Status	Year	People/entities
Develop community development action plan	Activities with FOV through GIZ-Selva Maya	Community development action plan developed and implemented in Arenal and with FOV	2018 and beyond	GIZ-Selva Maya, KBA, FD, FCD, Co-manager, Agriculture, FOV, Ministry of Rural Development
Establish a farmers group/CBO/Coop similar to FOV for the Multiple Use – North Zone.	Uncontrolled farming in the Forest Reserve	Farming group established and its individual members practicing sustainable agriculture	2018 and beyond	GIZ-Selva Maya, KBA, FD, FCD, Co-manager, Agriculture, FOV, Ministry of Rural Development
Sustainable agriculture outreach to Arenal community and FOV	Underway for FOV	Developed and implemented community outreach program	2018 and beyond	GIZ-Selva Maya, KBA, FD, FCD, Co-manager, Agriculture, FOV, Ministry of Rural Development

Environmental Education Sub-Program				
Objective 1: By 2020, 75% of the inhabitants of the target communities will know that the VFR performs valuable environmental functions.				
Management Actions	Present Status	Desired Status	Year	People/entities
Community consultations via surveys and focal group meetings	No coordinated community consultation	Community consultation processed, developed and implemented	2018 and beyond	Co-manager
Develop environmental education (EE) outreach plan	Abundant experience with FCD	Environmental education action plan developed and implemented	2018 and beyond	FD, co-manager

5.7. Management Programs, Strategies and Objectives without a co-manager

The listing below represents scaled down list of activities that should be undertaken in case FD remains the only management authority for the VFR and in case sufficient human and financial resources are available within the FD. Realizing that this will not always be the case, the most **critical** components of the management programs and strategies are marked in **red**.

Governance Development Sub-Program				
Objective 1: By 2018, Strengthen the FD involvement in the management of the VFR and develop a governance structure for the VFR that incorporates the multiple stakeholders within the area and ensures an effective and transparent decision-making structure				
Management Actions	Present Status	Desired Status	Year	People/entities
Regulate farming in Multiple use zone - north	Current status not tenable	Sustainable farming without additional damage to environment	2018	GOB, FD, NGO's, funding agencies
Identify and give legal status to farmers for the use of the farmed land adjacent to the excised area	Presently there are some 7 active farmers inside the reserve who are FVFR	Containment of incursions with users having secure use of the land	2017	FD

General Administration Sub-Program				
Objective 1: Develop an effective management structure				
Management Actions	Present Status	Desired Status	Year	People/entities
Develop an effective management structure for VFR based on the minimal objectives of this management plan	FD's management structure is insufficient to address VFR's management	Effective co-management organization in place.	2018	FD
Objective 2: Maintain baseline administration activities				
Maintain baseline administration activities	Minimal administration by FD	Administration in the hands of an effective co-management entity	2018 and ongoing	FD

Staff Recruitment and Retention Sub-Program				
Objective 1: Ensure that VFR has sufficient qualified staff for effective management and biodiversity conservation, depending on the available budget				
Management Actions	Present Status	Desired Status	Year	People/entities
Prepare clear and detailed Terms of Reference (job descriptions) for all staff posts and minimum qualifications	None	Detailed job descriptions and minimum qualifications for each staff post	2019	FD

Research & Monitoring Sub-Program				
See also Natural Resource Management Program.				
Objective 1: Fill in knowledge gaps				
Management Actions	Present Status	Desired Status	Year	People/entities
Create and implement information management database to contain all research, monitoring and socio-economic data, to assist with adaptive management	No effective in-house system for own data and external data scattered	In house data management system links with National Monitoring Institute if and when implemented	2018	FD

General Biodiversity Management Sub-Program				
Objective 1: Provide the framework for effective biodiversity management of the protected area				
Management Actions	Present Status	Desired Status	Year	People/entities
Verify commercial timber stocks	Localized, but outdated data available from previous logging concessions	Proper understanding of the commercial timber stocks within the VFR	2018	FD
Patrol the PA	No wardens	Dedicated staff present for	2018	FD

General Biodiversity Management Sub-Program				
Objective 1: Provide the framework for effective biodiversity management of the protected area				
Management Actions	Present Status	Desired Status	Year	People/entities
		management activities		
Clearly demarcate the boundaries in critical areas	Partly completed	All critical areas identified and boundary demarcated. Note that there is uncertainty whether clearing boundary lines is a good action in all cases	2018	FD, GOB
Implement management zones	No management zones	Management zones implemented	2018 and beyond	Long term project
Monitor on an annual basis using GIS tools, land use change (deforestation) within the general area	Occasional overflights, on foot patrols	Annual analysis of land use change using remote sensing methods in combination with overflights and patrols	2018 and beyond	Manager, Monitoring Consultant, National Monitoring Institute if and when in place
Develop and implement enforcement plan	None	Formalized enforcement plan incorporating FD, Fisheries, and Police.	2018	FD, BDF
Prioritize enforcement of existing regulations and encourage cooperation of FOV and communities towards this objective	Ad hoc	Effective enforcement with support from FOV and communities	2018 >	BDF, FOV, FD, Police
Work closely and effectively with local communities	Some meetings held but not structured	Communities recognize and respect VFR and its regulations	2018>	FD

Demarcation Sub-Program				
Objective 1: Clearly identify the VFR as a protected area to prevent incursions based on ignorance				
Management Actions	Present Status	Desired Status	Year	People/entities
<p>Clearly demarcate the boundaries in critical areas</p> <p>NOTE-See Natural Resource Management Program</p>	Partly completed	All critical areas identified and boundary demarcated. Note that there is uncertainty whether clearing boundary lines is a good action in all cases and locations	2018	FD
<p>Identify ALL incursions into the VFR</p>	Focus has been on the area in and around the excised area, no physical boundaries of land in use has taken place, only point data exist.	Exact boundaries of agricultural and other incursions mapped and owner identified.	2018	FD
<p>Patrol the PA</p> <p>Note. As in Natural Resource Management Program</p>	No wardens	Staff present for day to day management activities	2018	FD

Fire Management Sub-Program				
Objective 1: Prevent damage to conservation targets as a result from wildfires (either through lightning strike, escaped agricultural fires, campfires and/or arson)				
Management Actions	Present Status	Desired Status	Year	People/entities
<p>Develop and implement fire management plan; develop capacity and infrastructure for fire prevention/control</p>	Non-existent but there are funds available within the KBA project.	<p>Fire management plan implemented with infrastructure in place</p> <p>Staff trained in basic fire fighting techniques</p>	2017 and beyond	FOV, FD

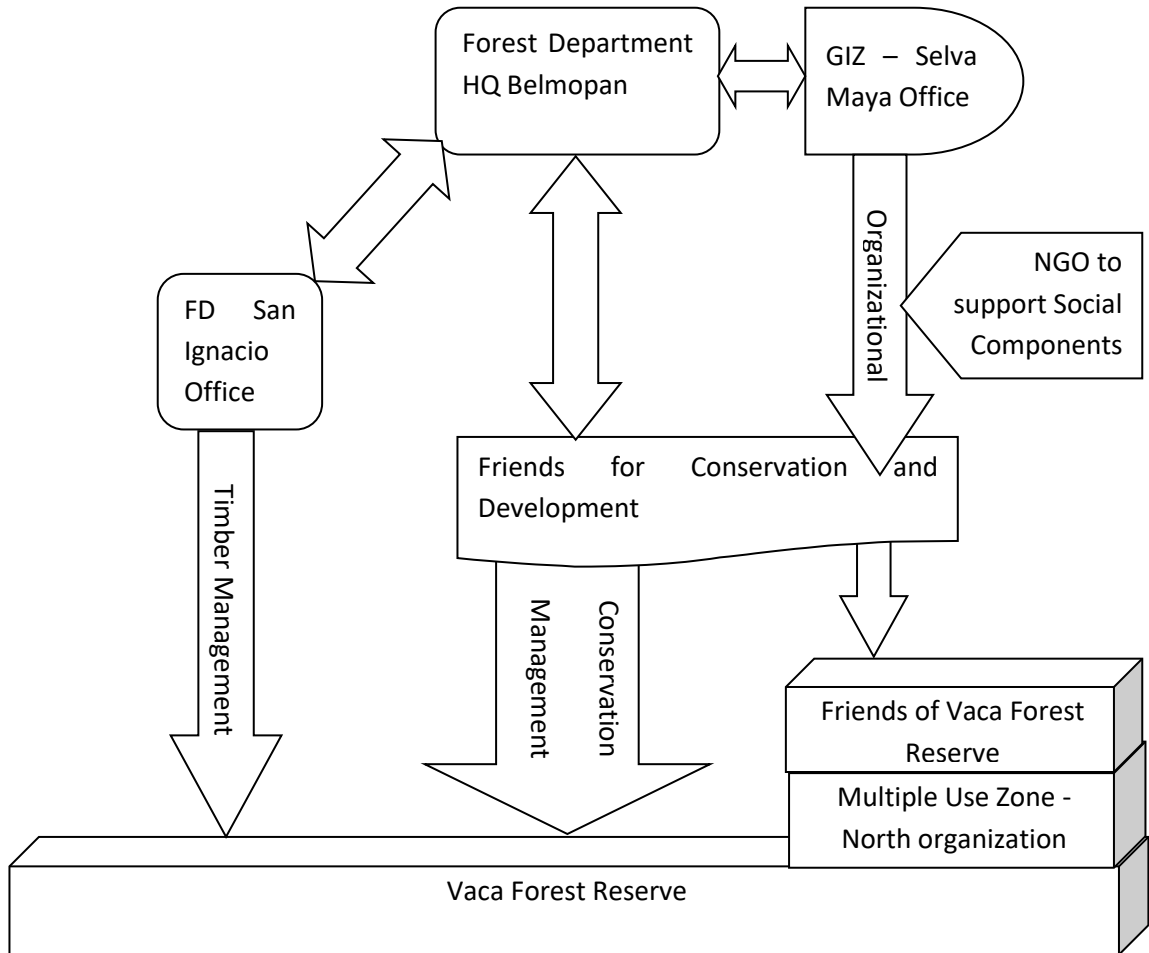
Institute a community based fire watch and suppression program	Non-existent, some villagers have training in natural disaster management. PFB is eager to establish a fire watch relationship	Operational community fire watch program with basic equipment present	2017 >	FD, FOV
Develop and implement fire early warning systems	Non-existent	Functional early warning fire system	2017 and beyond	FOV, FD

Community Development and Outreach Subprogram				
Objective 1: By 2019, at least 2 communities representing buffering communities of the VFR are involved in conservation and sustainable livelihood activities				
Management Actions	Present Status	Desired Status	Year	People/entities
Develop community development action plan	Activities with FOV through GIZ-Selva Maya	Community development action plan developed and implemented in Arenal and with FOV	2018 and beyond	GIZ-Selva Maya, KBA, FD, Agriculture, FOV, Ministry of Rural Development
Establish a farmers group/CBO/Coop similar to FOV for the Multiple Use – North Zone.	Uncontrolled farming in the Forest Reserve	Farming group established and its individual members practicing sustainable agriculture	2018 and beyond	GIZ-Selva Maya, KBA, FD, FCD, Co-manager, Agriculture, FOV, Ministry of Rural Development
Sustainable agriculture outreach to Arenal community and FOV	Underway for FOV	Developed and implemented community outreach program	2018 and beyond	GIZ-Selva Maya, KBA, FD, Agriculture, FOV, Rural Dev'lopmt

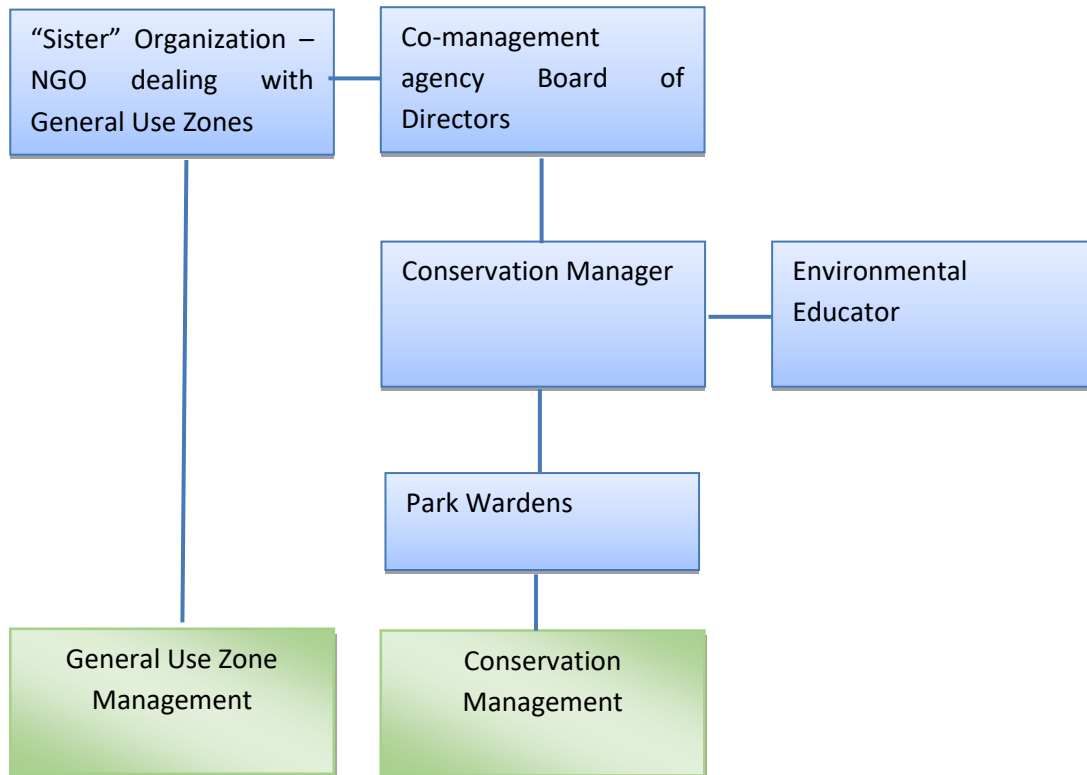
Environmental Education Sub-Program				
Objective 1: By 2020, 75% of the inhabitants of the target communities will know that the VFR performs valuable environmental functions.				
Management Actions	Present Status	Desired Status	Year	People/entities
Community consultations via surveys and focal group meetings	No coordinated community consultation	Community consultation processed, developed and implemented	2018 and beyond	FD
Develop environmental education (EE) outreach plan	Abundant experience with FCD	Environmental education action plan developed and implemented	2018 and beyond	FD

5.8. Recommended Management Structure

The following is an idealized management structure in case a co-management agency can be appointed and a maximum human and financial resource is available. See also chapter 5.3 for an in-depth discussion of this structure



The co-management agency within this structure could implement a VFR management structure as indicated below:



The functions of the various positions are summarized in Table 14. This table is indicative only.

Notice that there are effectively three “departments” within this management structure:

4. Conservation Management which will be the responsibility of the co-management agency.
5. General Use Zone Management which will be under a separate agency with NGO and funding agency support and dealing with the management of the specific uses (other than conservation) of the multiple use zones. This separation from the conservation management is important as the two tasks are quite different and a co-management agency may not be willing/capable of taking them on both.
6. Timber Management which will remain within the Forest Department

Clearly there needs to be sufficient communication between the three “departments”.

Table 14. Management Functions and Tasks – Co-management agency

Position	Responsibilities/ Duties
Co-manager Board of Directors	<ul style="list-style-type: none"> • Oversee and guide all activities.
Conservation Manager	<ul style="list-style-type: none"> • Oversees daily management of VFR • Coordinate with FD and Multiple Use zone management • Daily supervision of any park wardens • Organize, oversee and support contractors and or consultants • Authorized staff payments and other expenses • Manage financial resources • Oversee field and transportation equipment proper usage and maintenance. • Execution of project activities as related to VFR management • Design patrol surveillance routes • Analyze patrol data on S.M.A.R.T. • Develop adaptive management actions base on patrol results and environmental conditions • Oversee monitoring of conservation target threats • Develop action plans for project execution • Development and oversee enforcement of users regulations • Liaison with Forest Department, BDF and Police Department to improve law enforcement • Develop and foster partnership and working relationship with other national, regional and international organizations • Coordinate community fire prevention and suppression unit meetings and activities • Coordinate joint enforcement surveillance patrols

Position	Responsibilities/ Duties
	<ul style="list-style-type: none"> • Preparation of annual reports • Prepare project proposals • Reporting to Donors • Develop partnership agreements • Identify and foster funding sources • Coordinate special activities such as AGM
Park Wardens	<ul style="list-style-type: none"> • Demarcation of the VFR boundaries • Conduct surveillance patrols • Prepare reports of surveillance activities • Enforce regulations • Collect biodiversity data • Conduct biodiversity surveys based on conservation targets • Monitor visitor's activities will in the VFR • Assist researchers in the field

Table 15. Functions Multiple Use Zone Management Unit

Position	Responsibilities/ Duties
Board of Directors	<ul style="list-style-type: none"> • Oversee and guide all activities.
Manager	<ul style="list-style-type: none"> • Oversees daily management of Multiple Use Zones • Coordinate with FD and VFR co-management • Daily supervision of any staff • Organize, oversee and support contractors and or consultants • Authorized staff payments and other expenses • Manage financial resources • Oversee field and transportation equipment proper usage and maintenance. • Execution of project activities as related to landscape management • Design surveillance routes • Analyze patrol data on S.M.A.R.T. • Develop adaptive management actions base on patrol results and environmental conditions • Oversee monitoring of conservation target threats • Develop action plans for project execution • Development and oversee enforcement of users regulations • Liaison with Forest Department, BDF and Police Department to improve law enforcement • Develop and foster partnership and working relationship with other national, regional and international organizations • Coordinate community fire prevention and suppression unit meetings and activities • Coordinate joint enforcement surveillance patrols

Position	Responsibilities/ Duties
	<ul style="list-style-type: none"> • Preparation of annual reports • Prepare project proposals • Reporting to Donors • Develop partnership agreements • Identify and foster funding sources • Coordinate special activities such as AGM
Environmental Educator	<ul style="list-style-type: none"> • Environmental Education Action Plan execution • Coordinate school and community visits to the VFR • Develop environmental education material • Conduct environmental education presentation in schools and communities • Design signs to be place in community and the VFR • Conduct environmental awareness surveys • Promote the importance of the VFR by conducting presentations to key stakeholders • Public outreach of environmental laws • Develop trail interpretive material

5.9. Monitoring and Review

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

- The VFR (co-)manager and Board Chairperson collect monthly updated individual objective summary/status reports from responsible employees, members, volunteers (including Board of Directors), multiple use zone management and consultants where applicable.
- The PA (co-)manager ensures that all objectives have been accounted for.
- The PA (co-)manager, based on consultation and in coordination with the Chairperson and any Program Manager(s), makes note of unfinished objectives (shortfalls), needs for readjustments of outcomes and target dates (re-forecasts), meetings to be called, etc., on a bi-monthly basis.
- Based on program managers' reports, the PA (co-)manager documents progress of strategic plan implementation in a brief inter-organizational memorandum on a quarterly basis to all management plan participants. Also, a shortened non-detailed version should be included in the organizational newsletter.
- Review of management plan implementation should be a regular agenda item at staff and Board meetings.
- The management plan is to be generally monitored through quarterly meetings with the Forest Department, internal planning sessions and a mid-term evaluation.
- Progress of management plan implementation is to be evaluated annually by the Board. Such evaluation may be facilitated by external consultants.

The management plan is a living document and the (co-) manager needs to constantly review its management actions through the development of annual operation plans and engage in adaptive management. The table below (Table 15) is a matrix that can be easily used to monitor the progress of the management by comparing the present status against the desired outcomes (desired status) of the outlined management actions. To be more effective the matrix needs to be developed following the program and sub-program management actions layout. This will allow identifying strong and weak management programs, and thus focusing resources into the right areas.

Table 16. Monitoring and evaluation matrix to assess management plan implementation progress (for option with co-manager only)

Management Action	Current Status	Year 1	Year 2	Year 3	Year 4	Year 5	Desired outcome
Strengthen FD involvement in the management of the VFR	Management capacity of the FD is limited						Improved management involvement of the FD
Examine greater role of FCD in the management of the VFR, preferably as co-management agency	FCD has no management mandate						Co-management entity in place
Regulate farming in Multiple use zone - north	Current status not tenable						Sustainable farming without additional damage to environment
Prepare grant proposals to support the implementation of VFR's management programs	Presently grant proposal writing capacity is limited						FD's grant portfolio is expanded and diversified
Identify potential donor agencies and cultivate/strengthen donor relations	Donor portfolio for FD is limited						FD's grant portfolio is expanded and diversified
Maintain baseline administration activities	Minimal administration by FD						Administration in the hands of an effective co-manager
Prepare Annual Work Plans Monitoring and Review Sub-Program)	No medium-term strategic plan or management plan is in place						Annual work plans are based on co-manager's strategic plan and VFR's management plan

Management Action	Current Status	Year 1	Year 2	Year 3	Year 4	Year 5	Desired outcome
Conduct a comprehensive staff needs assessment for effective management of the VFR	No dedicated staff						There is a clear understanding of the ideal staff composition for the VFR
Prepare clear and detailed Terms of Reference (job descriptions) for all staff posts and minimum qualifications	None						Detailed job descriptions and minimum qualifications for each staff post
Develop and implement a five-year infrastructure development plan	Infrastructure present with both FD and FCD						New VFR infrastructure and facilities follow guidelines of the infrastructure development plan
Develop equipment procurement procedure manual	None						Implementing equipment procurement procedures
Review of management effectiveness on annual basis, for submission to Forest Department	None						Improved VFR management, based on annual management effectiveness reports
Review of 'Measures of Success' monitoring (linked to Research and Monitoring Sub-Program)	Occasional self-analysis						Annual measures of success analysis using standardized methodology
Review of monitoring activities	Not applicable						Focused research and monitoring, based on management effectiveness evaluation

Management Action	Current Status	Year 1	Year 2	Year 3	Year 4	Year 5	Desired outcome
Review of education and public awareness activities	Monitoring success is done through 'RARE' methodology						Focused education and public awareness,
Monitoring information feeds back into adaptive management planning activities	Not applicable						Updated VFR Management Plan
Review Management Plan after 5 years	Not applicable						Management Plan reviewed in 2022
Full management effectiveness assessment for submission to Forest Department at end of 5 years	Baseline management effectiveness report completed						Comprehensive management effectiveness report submitted to FD
Create and implement information management database to contain all research, monitoring and socio-economic data, to assist with adaptive management	No effective in-house system for own data and external data scattered						In house data management system links with National Monitoring Institute if and when implemented
Develop baseline data for the VFR through biodiversity surveys and mapping activities.	Abundant data but dispersed throughout Belize and abroad.						Complete spread of Geo-referenced biodiversity data

Management Action	Current Status	Year 1	Year 2	Year 3	Year 4	Year 5	Desired outcome
Develop and implement Biodiversity Research Inventory and Monitoring (BRIM) Framework for identified conservation targets in the VFR	None						BRIM developed and implemented; serving local and national needs
Development and implementation of 'Measures of Success' monitoring program, to verify success of conservation strategies, incorporating limits of acceptable change	None						Annual measures of success analysis using standardized (national) methodology
Verify commercial timber stocks	Localized, but outdated data available from previous logging concessions						Proper understanding of the commercial timber stocks within the VFR
Patrol the PA	No wardens						Dedicated staff present for management activities
Clearly demarcate the boundaries in critical areas	Partly completed						All critical areas identified and boundary demarcated. Note that there is uncertainty whether clearing boundary lines is a good action in all cases

Management Action	Current Status	Year 1	Year 2	Year 3	Year 4	Year 5	Desired outcome
Implement management zones	No management zones						Management zones implemented
Monitor on an annual basis using GIS tools, land use change (deforestation) within the general area	Occasional overflights, on foot patrols						Annual analysis of land use change using remote sensing methods in combination with overflights and patrols
Integrate research and monitoring results into the adaptive management process	NA						Formalized data exchange protocols, mechanism in place to incorporate results in management
Training of staff as special constables, in green laws and evidence collection and reporting	None						Staff is verse with green laws and evidence gathering and reporting
Develop and implement enforcement plan	None						Formalized enforcement plan incorporating FD, Fisheries, and Police.
Prioritize enforcement of existing regulations and encourage cooperation of FOV and communities towards this objective	Ad hoc						Effective enforcement with support from FOV and communities

Management Action	Current Status	Year 1	Year 2	Year 3	Year 4	Year 5	Desired outcome
Use of Spatial Monitoring and Reporting Tool (S.M.A.R.T.) for protected areas management	Not used						S.M.A.R.T is fully integrated into the law enforcement patrols and used for analyzing effectiveness of management
Liaise with FD on enforcement issues	Done but not effective						FD active and effective in enforcement issues
Identify ALL incursions into the VFR	Focus has been on the area in and around the excised area, no physical boundaries of land in use has taken place, only point data exist.						Exact boundaries of agricultural and other incursions mapped and owner identified.
Develop and implement fire management plan; develop capacity and infrastructure for fire prevention/control	Non-existent but there are funds available within the KBA project.						Fire management plan implemented with infrastructure in place Staff trained in basic fire fighting techniques
Institute a community based fire watch and suppression program	Non-existent, some persons have training in natural disaster management. PfB is eager to establish a fire watch relationship						Operational community fire watch program with basic equipment present

Management Action	Current Status	Year 1	Year 2	Year 3	Year 4	Year 5	Desired outcome
Develop and implement fire early warning systems	Non existent						Functional early warning fire system
Evaluate office and administrative needs to support operational efficiency by co-manager	None						Office and Administrative needs documented
Establish hard and software infrastructure to be able to maintain an information management database which contain all research, monitoring and socio-economic data, to assist with adaptive management	Infrastructure present with both FD and FCD						Sufficient hard and software available to start and maintain VFR databases and trained staff available
Improve enforcement equipment and capabilities	Basic equipment						Communication structure in place, tested and functional.
Equip and maintain staff, surveillance, research, education and accommodation facilities	Basic infrastructure present						Seamless "catering" mechanism in place
Provide sufficient first aid materials and emergency rescue materials at key points within the management area	Limited infrastructure						Main office equipped with appropriate first aid and rescue materials + trained staff

Management Action	Current Status	Year 1	Year 2	Year 3	Year 4	Year 5	Desired outcome
Maintain an efficient inventory of equipment and supplies	Present for both FD and FCD						Efficient inventory of equipment and supplies in place and maintained
Obtain and maintain adequate transportation means for enforcement and monitoring	Present for both FD and FCD						Transportation infrastructure in synch with needs assessment
Develop in house skills in database and GIS management	One staff member has basic skills						Data-manager + 1 back up staff have received training in Database and GIS
Provide first aid and Jungle Rescue training	Basic skills present						Members trained in jungle rescue and first aid
Provide training in law enforcement patrolling tactics	Skills available with FD and FCD						Basic skills present with FOV for controlling their own area
Community consultations via surveys and focal group meetings	No coordinated community consultation						Community consultation processed, developed and implemented
Develop environmental education (EE) outreach plan	Abundant experience with FCD						Environmental education action plan developed and implemented
Work closely and effectively with local communities	Some meetings held but not structured						Communities recognize and respect VFR and its regulations

Management Action	Current Status	Year 1	Year 2	Year 3	Year 4	Year 5	Desired outcome
Develop community development action plan	Activities with FOV through GIZ-Selva Maya						Community development action plan developed and implemented in Arenal and with FOV
Sustainable agriculture outreach to Arenal community and FOV	Underway for FOV						Developed and implemented community outreach program

5.10. Timeline-Activity Schedule

To be effective and efficient in the management of the SCW it is important to set timeframes for conducting strategic actions. The strategic management actions are those previously identified in Section 3.3 Strategies to Reduce Threats, which are umbrella like and aim to achieve the VFR conservation goals. Table 17 presents the timeframe necessary to achieve management strategies. It is important to keep in mind that the management plan is a living document and thus leads to adaptive management. Thus, the time frame of some of the management strategies may change based on present or future circumstances.

Table 17. Timeline by year for the implementation of management strategies in section 3.3. to reduce threats

Strategies for Management	Year of implementation				
	Year 1	Year 2	Year 3	Year 4	Year 5
Appointing/creating a co-management body	X				
identify and map land use activities in and around the VFR,	X				
Legalize existing land users in the Multiple Use Zone – East area	X				
Control access to the VFR	X	X			
Demarcate and signpost FVR boundaries		X			
Erect no hunting signs,		X			
Implement the proposed management zones for the VFR,	X	X			
Capacity building of FD, FCD, FOV;	X	X	X		
Coordinate with FD, FCD, BDF and Police Department to conduct strategic patrols,	X	X	X	X	X
Conduct annual aerial flight for illegal activity detection,	X	X	X	X	X
Public education on watershed protection and management;	X	X	X	X	X
Promote environmental friendly land uses with FOV and Arenal	X	X	X	X	X

Strategies for Management	Year of implementation				
	Year 1	Year 2	Year 3	Year 4	Year 5
Build public awareness on objectives of VFR,	x	x	x	x	x
identify potential conservation partners and NGOs, develop partnership with appropriate conservation partners and NGO, carry out exchange programs with partners	x	x	x	x	x

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7 Appendices

7.1. Appendix 1: Bird Species Recorded

Birds recorded from the Vaca Forest Reserve based on data in <http://www.ebird.org> as accessed on July 10, 2017. Note that records from Black Rock Lodge are NOT included in this list.

English Name	Scientific name	Recorded	Notes
Brown Jay	<i>Psilorhinus morio</i>	83	
Red-legged Honeycreeper	<i>Cyanerpes cyaneus</i>	78	
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	69	
Black-faced Grosbeak	<i>Caryothraustes poliogaster</i>	68	
Black Vulture	<i>Coragyps atratus</i>	63	
Melodious Blackbird	<i>Dives dives</i>	59	
Red-throated Ant-Tanager	<i>Habia fuscicauda</i>	54	
Keel-billed Toucan	<i>Ramphastos sulfuratus</i>	49	
Spot-breasted Wren	<i>Pheugopedius maculipectus</i>	47	
Turkey Vulture	<i>Cathartes aura</i>	44	
Green-backed Sparrow	<i>Arremonops chloronotus</i>	44	
Yellow-green Vireo	<i>Vireo flavoviridis</i>	41	
Lesser Greenlet	<i>Pachysylvia decurtata</i>	40	
Social Flycatcher	<i>Myiozetetes similis</i>	39	
White-collared Seedeater	<i>Sporophila torqueola</i>	36	
Gray-breasted Martin	<i>Progne chalybea</i>	36	
Vaux's Swift	<i>Chaetura vauxi</i>	31	
Magnolia Warbler	<i>Setophaga magnolia</i>	31	
White-breasted Wood-Wren	<i>Henicorhina leucosticta</i>	29	
Black-headed Saltator	<i>Saltator atriceps</i>	29	
Yellow-throated Euphonia	<i>Euphonia hirundinacea</i>	28	
Rufous-tailed Hummingbird	<i>Amazilia tzacatl</i>	27	

Blue-black Grosbeak	<i>Cyanocompsa cyanoides</i>	26
White-crowned Parrot	<i>Pionus senilis</i>	25
Gartered Trogon	<i>Trogon caligatus</i>	25
Tennessee Warbler	<i>Oreothlypis peregrina</i>	25
Olive-backed Euphonia	<i>Euphonia gouldi</i>	24
White-tipped Dove	<i>Leptotila verreauxi</i>	23
Squirrel Cuckoo	<i>Piaya cayana</i>	23
Masked Tityra	<i>Tityra semifasciata</i>	23
Collared Aracari	<i>Pteroglossus torquatus</i>	22
Ivory-billed Woodcreeper	<i>Xiphorhynchus flavigaster</i>	22
White-bellied Emerald	<i>Amazilia candida</i>	21
Yellow-olive Flycatcher	<i>Tolmomyias sulphurescens</i>	21
Wood Thrush	<i>Hylocichla mustelina</i>	21
Yellow-faced Grassquit	<i>Tiaris olivaceus</i>	20
Tropical Kingbird	<i>Tyrannus melancholicus</i>	20
Greenish Elaenia	<i>Myiopagis viridicata</i>	20
Long-billed Gnatwren	<i>Ramphocaenus melanurus</i>	20
Yellow-winged Tanager	<i>Thraupis abbas</i>	20
King Vulture	<i>Sarcoramphus papa</i>	19
Dusky-capped Flycatcher	<i>Myiarchus tuberculifer</i>	19
White Hawk	<i>Pseudastur albicollis</i>	19
Yellow-bellied Elaenia	<i>Elaenia flavogaster</i>	18
Blue-black Grassquit	<i>Volatinia jacarina</i>	18
Olive-throated Parakeet	<i>Eupsittula nana</i>	18
Indigo Bunting	<i>Passerina cyanea</i>	18
Plain Chachalaca	<i>Ortalis vetula</i>	17
Yellow-billed Caciue	<i>Amblycercus holosericeus</i>	17
Northern Schiffornis	<i>Schiffornis veraepacis</i>	17

Short-billed Pigeon	<i>Patagioenas nigrirostris</i>	17
Tawny-crowned Greenlet	<i>Tunchiornis ochraceiceps</i>	17
American Redstart	<i>Setophaga ruticilla</i>	17
Northern Waterthrush	<i>Parkesia noveboracensis</i>	17
Orchard Oriole	<i>Icterus spurius</i>	17
Great Kiskadee	<i>Pitangus sulphuratus</i>	16
Blue-gray Tanager	<i>Thraupis episcopus</i>	16
Gray Catbird	<i>Dumetella carolinensis</i>	16
Sulphur-bellied Flycatcher	<i>Myiodynastes luteiventris</i>	15
Red-lored Parrot	<i>Amazona autumnalis</i>	15
Golden-crowned Warbler	<i>Basileuterus culicivorus</i>	15
Red-capped Manakin	<i>Ceratopipra mentalis</i>	15
Groove-billed Ani	<i>Crotophaga sulcirostris</i>	14
Black-headed Trogon	<i>Trogon melanocephalus</i>	14
Plumbeous Kite	<i>Ictinia plumbea</i>	14
Eastern Wood-Pewee	<i>Contopus virens</i>	14
Golden-fronted Woodpecker	<i>Melanerpes aurifrons</i>	13
Black-cowled Oriole	<i>Icterus prothemelas</i>	13
Summer Tanager	<i>Piranga rubra</i>	13
Gray Hawk	<i>Buteo plagiatus</i>	12
Black-faced Antthrush	<i>Formicarius analis</i>	12
White-fronted Parrot	<i>Amazona albifrons</i>	12
White-collared Manakin	<i>Manacus candei</i>	12
Buff-throated Saltator	<i>Saltator maximus</i>	12
Baltimore Oriole	<i>Icterus galbula</i>	12
Clay-colored Thrush	<i>Turdus grayi</i>	11
Olivaceous Woodcreeper	<i>Sittasomus griseicapillus</i>	11
Tawny-winged Woodcreeper	<i>Dendrocincla anabatina</i>	11

Dusky Antbird	<i>Cercomacroides tyrannina</i>	11
White-eyed Vireo	<i>Vireo griseus</i>	11
Brown-crested Flycatcher	<i>Myiarchus tyrannulus</i>	10
Great-tailed Grackle	<i>Quiscalus mexicanus</i>	10
Stub-tailed Spadebill	<i>Platyrinchus cancrinus</i>	10
Piratic Flycatcher	<i>Legatus leucophaeus</i>	10
Crimson-collared Tanager	<i>Ramphocelus sanguinolentus</i>	10
Boat-billed Flycatcher	<i>Megarynchus pitangua</i>	10
Ochre-bellied Flycatcher	<i>Mionectes oleagineus</i>	10
Swallow-tailed Kite	<i>Elanoides forficatus</i>	10
Slaty-breasted Tinamou	<i>Crypturellus boucardi</i>	10
Red-eyed Vireo	<i>Vireo olivaceus</i>	10
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	10
Tropical Pewee	<i>Contopus cinereus</i>	9
Bright-rumped Attila	<i>Attila spadiceus</i>	9
Spotted Wood-Quail	<i>Odontophorus guttatus</i>	9
Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>	9
Barn Swallow	<i>Hirundo rustica</i>	9
Chestnut-sided Warbler	<i>Setophaga pensylvanica</i>	9
Least Flycatcher	<i>Empidonax minimus</i>	9
Yellow-throated Vireo	<i>Vireo flavifrons</i>	9
Pale-billed Woodpecker	<i>Campephilus guatemalensis</i>	8
Pale-vented Pigeon	<i>Patagioenas cayennensis</i>	8
White-collared Swift	<i>Streptoprocne zonaris</i>	8
Wedge-tailed Sabrewing	<i>Campylopterus curvipennis</i>	8
Lesson's Motmot	<i>Momotus lessonii</i>	8
Green Kingfisher	<i>Chloroceryle americana</i>	8
Mangrove Vireo	<i>Vireo pallens</i>	8

Yellow-tailed Oriole	<i>Icterus mesomelas</i>	8
Plain Xenops	<i>Xenops minutus</i>	8
Stripe-throated Hermit	<i>Phaethornis striigularis</i>	8
Scrub Euphonia	<i>Euphonia affinis</i>	8
Yellow-bellied Tyrannulet	<i>Ornithion semiflavum</i>	8
Ruddy Quail-Dove	<i>Geotrygon montana</i>	8
Ocellated Turkey	<i>Meleagris ocellata</i>	8
Black-and-white Warbler	<i>Mniotilta varia</i>	8
Roadside Hawk	<i>Rupornis magnirostris</i>	7
Long-billed Hermit	<i>Phaethornis longirostris</i>	7
Slaty-tailed Trogon	<i>Trogon massena</i>	7
Northern Bentbill	<i>Oncostoma cinereigulare</i>	7
House Wren	<i>Troglodytes aedon</i>	7
White-bellied Wren	<i>Uropsila leucogastra</i>	7
Tropical Gnatcatcher	<i>Polioptila plumbea</i>	7
Blue Bunting	<i>Cyanocompsa parellina</i>	7
Royal Flycatcher	<i>Onychorhynchus coronatus</i>	7
Black Hawk-Eagle	<i>Spizaetus tyrannus</i>	7
Ovenbird	<i>Seiurus aurocapilla</i>	7
Hooded Warbler	<i>Setophaga citrina</i>	7
Black-throated Green Warbler	<i>Setophaga virens</i>	7
Golden-olive Woodpecker	<i>Colaptes rubiginosus</i>	6
Ruddy Ground-Dove	<i>Columbina talpacoti</i>	6
Barred Antshrike	<i>Thamnophilus doliatus</i>	6
Rose-throated Becard	<i>Pachyramphus aglaiae</i>	6
Montezuma Oropendola	<i>Psarocolius montezuma</i>	6
Blue Ground-Dove	<i>Claravis pretiosa</i>	6
Eye-ringed Flatbill	<i>Rhynchocyclus brevirostris</i>	6

Red-crowned Ant-Tanager	<i>Habia rubica</i>	6	
Lineated Woodpecker	<i>Dryocopus lineatus</i>	6	
Dot-winged Antwren	<i>Microrhophias quixensis</i>	6	
Common Yellowthroat	<i>Geothlypis trichas</i>	6	
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	6	Macal
Russet-naped Wood-Rail	<i>Aramides albiventris</i>	5	
White-necked Jacobin	<i>Florisuga mellivora</i>	5	
Grayish Saltator	<i>Saltator coerulescens</i>	5	
Collared Forest-Falcon	<i>Micrastur semitorquatus</i>	5	
Canivet's Emerald	<i>Chlorostilbon canivetii</i>	5	
Green Jay	<i>Cyanocorax yncas</i>	5	
Mealy Parrot	<i>Amazona farinosa</i>	5	
Neotropic Cormorant	<i>Phalacrocorax brasilianus</i>	5	Macal
Black Phoebe	<i>Sayornis nigricans</i>	5	
Slate-headed Tody-Flycatcher	<i>Poecilatriccus sylvia</i>	5	
Green Shrike-Vireo	<i>Vireolanius pulchellus</i>	5	
Double-toothed Kite	<i>Harpagus bidentatus</i>	5	
Great Black Hawk	<i>Buteogallus urubitinga</i>	5	
Black-throated Shrike-Tanager	<i>Lanio aurantius</i>	5	
Northern Barred-Woodcreeper	<i>Dendrocolaptes sanctithomae</i>	5	
Ornate Hawk-Eagle	<i>Spizaetus ornatus</i>	5	
Yellow Warbler	<i>Setophaga petechia</i>	5	
Couch's Kingbird	<i>Tyrannus couchii</i>	4	
Short-tailed Hawk	<i>Buteo brachyurus</i>	4	
Green-breasted Mango	<i>Anthracothorax prevostii</i>	4	
Black-cheeked Woodpecker	<i>Melanerpes pucherani</i>	4	
Common Tody-Flycatcher	<i>Todirostrum cinereum</i>	4	
Gray-headed Dove	<i>Leptotila plumbeiceps</i>	4	

Chestnut-colored Woodpecker	<i>Ceuleus castaneus</i>	4	
Gray-headed Tanager	<i>Eucometis penicillata</i>	4	
Gray-chested Dove	<i>Leptotila cassinii</i>	4	
Buff-throated Foliage-gleaner	<i>Automolus ochrolaemus</i>	4	
Lesser Swallow-tailed Swift	<i>Panyptila cayennensis</i>	4	
Wedge-billed Woodcreeper	<i>Glyphorhynchus spirurus</i>	4	
White-whiskered Puffbird	<i>Malacoptila panamensis</i>	4	
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	4	
Brown-hooded Parrot	<i>Pytilia haematotis</i>	4	
Elegant Euphonia	<i>Euphonia elegantissima</i>	4	
Spotted Sandpiper	<i>Actitis macularius</i>	4	Macal
Swainson's Thrush	<i>Catharus ustulatus</i>	4	
Worm-eating Warbler	<i>Helmitheros vermivorum</i>	4	
Kentucky Warbler	<i>Geothlypis formosa</i>	4	
Bat Falcon	<i>Falco ruficularis</i>	3	
Band-backed Wren	<i>Campylorhynchus zonatus</i>	3	
Carolina Wren	<i>Thryothorus ludovicianus</i>	3	
Tody Motmot	<i>Hylomanes momotula</i>	3	
Great Tinamou	<i>Tinamus major</i>	3	
Sulphur-rumped Flycatcher	<i>Myiobius sulphureipygius</i>	3	
Sepia-capped Flycatcher	<i>Leptopogon amaurocephalus</i>	3	
Barred Forest-Falcon	<i>Micrastur ruficollis</i>	3	
Mangrove Swallow	<i>Tachycineta albilinea</i>	3	Macal
Gray-headed Kite	<i>Leptodon cayanensis</i>	3	
White-winged Tanager	<i>Piranga leucoptera</i>	3	
Streak-headed Woodcreeper	<i>Lepidocolaptes souleyetii</i>	3	
Bay-breasted Warbler	<i>Setophaga castanea</i>	3	
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	3	

Yellow-throated Warbler	<i>Setophaga dominica</i>	3	
Louisiana Waterthrush	<i>Parkesia motacilla</i>	3	
Red-billed Pigeon	<i>Patagioenas flavirostris</i>	2	
Little Tinamou	<i>Crypturellus soui</i>	2	
Ruddy Woodcreeper	<i>Dendrocincla homochroa</i>	2	
Thicket Tinamou	<i>Crypturellus cinnamomeus</i>	2	
Emerald Toucanet	<i>Aulacorhynchus prasinus</i>	2	
White-necked Puffbird	<i>Notharchus hyperrhynchus</i>	2	
Rufous-breasted Spinetail	<i>Synallaxis erythrothorax</i>	2	
Orange-billed Sparrow	<i>Arremon aurantirostris</i>	2	
Great Antshrike	<i>Taraba major</i>	2	
Cattle Egret	<i>Bubulcus ibis</i>	2	
Purple-crowned Fairy	<i>Heliotheryx barroti</i>	2	
Collared Trogon	<i>Trogon collaris</i>	2	
Streaked Flycatcher	<i>Myiodynastes maculatus</i>	2	
Cinnamon Becard	<i>Pachyramphus cinnamomeus</i>	2	
Scaled Pigeon	<i>Patagioenas speciosa</i>	2	
Great Curassow	<i>Crax rubra</i>	2	
Bicolored Hawk	<i>Accipiter bicolor</i>	2	
Pheasant Cuckoo	<i>Dromococcyx phasianellus</i>	2	
White-throated Thrush	<i>Turdus assimilis</i>	2	
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	2	
Eastern Kingbird	<i>Tyrannus tyrannus</i>	2	
Crane Hawk	<i>Geranospiza caerulescens</i>	2	
Blackburnian Warbler	<i>Setophaga fusca</i>	2	
Blue-winged Warbler	<i>Vermivora cyanoptera</i>	2	
Olive-sided Flycatcher	<i>Contopus cooperi</i>	2	
Killdeer	<i>Charadrius vociferus</i>	2	Macal

Broad-winged Hawk	<i>Buteo platypterus</i>	2	
Bank Swallow	<i>Riparia riparia</i>	2	Macal
Ferruginous Pygmy-Owl	<i>Glaucidium brasilianum</i>	1	
Common Pauraque	<i>Nyctidromus albicollis</i>	1	
Scaly-breasted Hummingbird	<i>Phaeochroa cuvierii</i>	1	
Bronzed Cowbird	<i>Molothrus aeneus</i>	1	
Bare-throated Tiger-Heron	<i>Tigrisoma mexicanum</i>	1	
Nightingale Wren	<i>Microcerculus philomela</i>	1	
Variable Seedeater (Black)	<i>Sporophila corvina</i>	1	
American Pygmy Kingfisher	<i>Chloroceryle aenea</i>	1	Macal
Wood Stork	<i>Mycteria americana</i>	1	Macal
Rufous-tailed Jacamar	<i>Galbula ruficauda</i>	1	
Northern Beardless-Tyrannulet	<i>Camptostoma imberbe</i>	1	
Gray-throated Chat	<i>Granatellus sallaei</i>	1	
Rufous Mourner	<i>Rhytipterna holerythra</i>	1	
Osprey	<i>Pandion haliaetus</i>	1	Macal
Least Grebe	<i>Tachybaptus dominicus</i>	1	Macal
Thick-billed Seed-Finch	<i>Sporophila funerea</i>	1	
Scaly-throated Leaf-tosser	<i>Sclerurus guatemalensis</i>	1	
Black-and-white Owl	<i>Ciccaba nigrolineata</i>	1	
Philadelphia Vireo	<i>Vireo philadelphicus</i>	1	
Lovely Cotinga	<i>Cotinga amabilis</i>	1	
Scarlet Tanager	<i>Piranga olivacea</i>	1	
Acadian Flycatcher	<i>Empidonax virescens</i>	1	
Yellow-breasted Chat	<i>Icteria virens</i>	1	
Orange-breasted Falcon	<i>Falco deiroleucus</i>	1	Macal

Appendix 2: Plant Species from the Vaca Forest Reserve as listed in the Biodiversity and Environmental Resource Database System for Belize.

FAMILY	GENUS SPECIES SUBSPECIES	COLLOQUIAL
Zamiaceae	Zamia prasina	Bullrush, Palmita
Amaryllidaceae	Hymenocallis littoralis	
Araceae	Anthurium scandens	
Araceae	Anthurium schlechtendalii	
Araceae	Dieffenbachia oerstedii	
Araceae	Philodendron radiatum	
Araceae	Philodendron sagittifolium	
Araceae	Philodendron smithii	
Arecaceae	Chamaedorea oblongata	Jade
Arecaceae	Cryosophila stauracantha	
Arecaceae	Schippia concolor	Mountain Pimento
Bromeliaceae	Bromelia pinguin	
Costaceae	Costus pulverulentus	
Cyperaceae	Scleria latifolia	
Dioscoreaceae	Dioscorea densiflora	
Heliconiaceae	Heliconia latispatha	
Heliconiaceae	Heliconia librata	
Marantaceae	Calathea lutea	Waha Leaf
Marantaceae	Maranta gibba	
Marantaceae	Stromanthe hjalmarssonii	
Orchidaceae	Dimerandra emarginata	
Orchidaceae	Scaphyglottis behrii	
Poaceae	Eragrostis rufescens	
Poaceae	Olyra latifolia	
Actinidiaceae	Saurauia yasicae	
Apocynaceae	Prestonia mexicana	
Araliaceae	Dendropanax arboreus	
Asclepiadaceae	Asclepias curassavica	

Asteraceae	Calea jamaicensis	
Asteraceae	Condylidium iresinoides	
Asteraceae	Goldmanella sarmentosa	
Asteraceae	Schistocarpha eupatorioides	
Bignoniaceae	Amphitecna breedlovei	
Bignoniaceae	Martinella obovata	
Bignoniaceae	Parmentiera aculeata	
Bignoniaceae	Pseudocatalpa caudiculata	
Bignoniaceae	Tabebuia guayacan	Cortez
Bignoniaceae	Tynanthus guatemalensis	
Bignoniaceae	Xylophragma seemannianum	
Boraginaceae	Rochefortia lundellii	
Chrysobalanaceae	Hirtella racemosa	
Chrysobalanaceae	Licania platypus	
Combretaceae	Bucida buceras	
Combretaceae	Terminalia amazonia	Nargusta
Convolvulaceae	Ipomoea sepacuitensis	
Euphorbiaceae	Acalypha macrostachya	
Euphorbiaceae	Croton xalapensis	
Euphorbiaceae	Gymnanthes belizensis	
Fabaceae: Mimosoideae	Acacia globulifera	
Fabaceae: Mimosoideae	Cojoba graciliflora	
Fabaceae: Papilionoideae	Indigofera trita scabra	
Fabaceae: Papilionoideae	Lonchocarpus castilloi	
Fabaceae: Papilionoideae	Myroxylon balsamum	
Flacourtiaceae	Casearia corymbosa	
Hippocrateaceae	Cheiloclinium belizense	
Lacistemataceae	Lacistema aggregatum	
Lamiaceae	Catoferia capitata	
Lauraceae	Cinnamomum triplinerve	
Lauraceae	Licaria misantlae	
Lauraceae	Nectandra nitida	
Lauraceae	Nectandra salicifolia	

Lauraceae	Persea americana	
Malvaceae	Allosidastrum pyramidatum	
Malvaceae	Pavonia schiedeana	
Melastomataceae	Miconia argentea	
Meliaceae	Guarea glabra	
Moraceae	Castilla elastica elastica	
Moraceae	Ficus obtusifolia	
Myrsinaceae	Parathesis donnell-smithii	
Myrtaceae	Pimenta dioica	Allspice
Ochnaceae	Ouratea lucens	
Papaveraceae	Bocconia frutescens	
Passifloraceae	Passiflora adenopoda	Granadilla de monte
Passifloraceae	Passiflora biflora	
Passifloraceae	Passiflora guatemalensis	
Passifloraceae	Passiflora serratifolia	
Passifloraceae	Passiflora xiikzodz	
Piperaceae	Piper aduncum	
Piperaceae	Piper aequale	
Piperaceae	Piper jacquemontianum	
Piperaceae	Piper pseudofulgineum	
Piperaceae	Piper tuberculatum	
Polygalaceae	Polygala paniculata	
Polygonaceae	Coccoloba belizensis	
Sapindaceae	Paullinia clavigera	
Sapindaceae	Serjania mexicana	
Sapotaceae	Pouteria sapota	
Scrophulariaceae	Stemodia fruticosa	
Solanaceae	Solanum lanceifolium	
Sterculiaceae	Helicteres baruensis	
Tiliaceae	Heliocarpus americanus	
Tiliaceae	Heliocarpus mexicanus	
Verbenaceae	Citharexylum caudatum	
Verbenaceae	Petrea volubilis	

Vochysiaceae	Vochysia hondurensis	Yemeri
Adiantaceae	Adiantum petiolatum	
Adiantaceae	Adiantum trapeziforme	
Adiantaceae	Adiantum villosum	

7.2. Appendix 3: Animal Species from the Vaca Forest Reserve as listed in the Biodiversity and Environmental Resource Database System for Belize.

CLASS	FAMILY	GENUS SPECIES SUBSPECIES	COLLOQUIAL
Insecta	Lycaenidae	Arawacus togarna	Chiapas Stripe-streak
Insecta	Lycaenidae	Eumaeus toxea	Mexican Cycadian
Insecta	Nymphalidae	Adelpha iphiclus iphiclus	
Insecta	Nymphalidae	Aeria eurimedia pacifica	
Insecta	Nymphalidae	Agraulis vanillae incarnata	
Insecta	Nymphalidae	Archaeoprepona demophoon gulina	
Insecta	Nymphalidae	Biblis hyperia aganisa	
Insecta	Nymphalidae	Caligo uranus	
Insecta	Nymphalidae	Dryas iulia moderata	
Insecta	Nymphalidae	Eueides isabella eva	
Insecta	Nymphalidae	Greta oto	
Insecta	Nymphalidae	Heliconius charithonia vazquezae	
Insecta	Nymphalidae	Heliconius cydno galanthus	
Insecta	Nymphalidae	Heliconius erato petiverana	
Insecta	Nymphalidae	Heliconius ismenius telchinia	
Insecta	Nymphalidae	Heliconius sapho leuce	
Insecta	Nymphalidae	Laparus doris transiens	
Insecta	Nymphalidae	Marpesia chiron marius	Banded Daggerwing
Insecta	Nymphalidae	Mechanitis lysimnia doryssus	
Insecta	Nymphalidae	Melinaea ethra imitata	
Insecta	Nymphalidae	Memphis artacaena	
Insecta	Nymphalidae	Morpho polyphemus luna	White Morpho
Insecta	Nymphalidae	Morpho theseus justitiae	Brown Morpho
Insecta	Nymphalidae	Myscelia cyaniris cyaniris	
Insecta	Nymphalidae	Nica flavilla canthara	
Insecta	Nymphalidae	Pierella luna heracles	
Insecta	Nymphalidae	Pteronymia cotytto	
Insecta	Papilionidae	Battus laodamas copanae	Yellow-spotted Swallowtail

Insecta	Papilionidae	Heraclides androgeus epidaurus	Queen Swallowtail
Insecta	Papilionidae	Mimoides ilus branchus	Dual-spotted Swallowtail
Insecta	Papilionidae	Parides iphidamas iphidamas	Transandean Cattleheart
Insecta	Papilionidae	Parides photinus	Pink-spotted Cattleheart
Insecta	Pieridae	Aphrissa statira jada	Jada Sulphur
Insecta	Pieridae	Appias drussilla drussilla	Florida White
Insecta	Pieridae	Eurema albula	Ghost Yellow
Insecta	Pieridae	Eurema proterpia	Tailed Orange
Insecta	Pieridae	Itaballia demophile calydonia	Crossbarred White
Insecta	Pieridae	Phoebis argante argante	Apricot Sulphur
Insecta	Pieridae	Pieriballia viardi laogore	Painted White
Insecta	Riodinidae	Rhetus periander	Variable Beautymark
Insecta	Riodinidae	Synargis nymphidioides	Greater Lemmark
Insecta	Sphingidae	Manduca ochus	
Aves	Cardinalidae	Caryothraustes polioaster	Black-faced Grosbeak
Aves	Cardinalidae	Habia fuscicauda	Red-throated Ant-Tanager
Aves	Corvidae	Cyanocorax yncas	Green Jay
Aves	Corvidae	Psilorhinus morio	Brown Jay
Aves	Furnariidae	Automolus ochrolaemus	Buff-throated Foliage-gleaner
Aves	Icteridae	Icterus mesomelas	Yellow-tailed Oriole
Aves	Icteridae	Psarocolius wagleri	Chesnut-headed Oropendola
Aves	Pipridae	Manacus candei	White-collared Manakin
Aves	Rallidae	Amaurolimnas concolor	Uniform Crake
Aves	Thamnophilidae	Microrhopias quixensis	Dot-winged Antwren
Aves	Tityridae	Schiffornis turdina	Thrush-like Schiffornis
Aves	Tityridae	Tityra semifasciata	Masked Tityra
Aves	Troglodytidae	Henicorhina leucosticta	White-breasted Wood-Wren
Aves	Tyrannidae	Megarynchus pitangua	Boat-billed Flycatcher
Aves	Tyrannidae	Myiarchus tyrannulus	Brown-crested Flycatcher
Aves	Tyrannidae	Platyrinchus cancrominus	Stub-tailed Spadebill

Mammals						
Order	Family	Species	Common Name		Local Name	
MARSUPIALS - DIDELPHIMORPHIA						
Opossums - Didelphidae						
		Didelphis marsupialis.	Common Opossum		Possum, Zorro, Tlacuache	
		Philander opossum	Gray Opossum	Four-eyed	Common Gray Four-eyed Opossum, Four-eyes	
XENARTHANS - XENARTHRA						
Anteaters - Myrmecophagidae						
		Tamandua mexicana	Northern Tamandua		Antsbear, Oso hormiguero	
Armandillos - Dasypodidae						
		Dasypus novemcinctus	Nine-banded Armadillo		Nine-banded Long-nosed Armandillo, Armadilly, Dilly, Ouetch	
MONKEYS - PRIMATES						
Cebidae						
		Alouatta pigra	Yucatan Howler-Monkey	Black	Mexican Monkey, Saraguato	Black Howler Baboon,
		Ateles geoffroyi	Central-American Spider-Monkey		Monkey, Mono	
CARNIVORES - CARNIVORA						
Dogs - Canidae						
		Urocyon cinereoargenteus	Gray Fox		Gato de Monte	
Cats - Felidae						
		Herpailurus yagouaroundi	Jaguarondi		Halari, Onza, Leoncillo	

Mammals				
Order	Family	Species	Common Name	Local Name
		<i>Leopardus pardalis</i>	Ocelot	Tiger-cat, Tigrillo
		<i>Leopardus wiedii</i>	Margay	Tiger-cat, Tigrillo, Tigrillito
		<i>Puma concolor</i>	Puma	Red Tiger, Leon
		<i>Panthera onca</i>	Jaguar	Tiger, Tigre, Balum
Weasels - Mustelidae				
		<i>Lontra longicaudis</i>	Neotropical River Otter	<i>Lutra longicaudis</i> , Southern River Otter, Water dog, Perro de Agua
		<i>Conepatus semistriatus</i>	Striped Hog-nosed Skunk	Polecat, Zorrillo
		<i>Eira barbara</i>	Tayra	Bush dog, Perro del monte, Cabeza blanca
		<i>Galictis vittata</i>	Grison	Bushdog, Waterdog, Huron
		<i>Mustela frenata</i>	Weasel	Long-tailed Weasel
Raccoon Family - Procyonidae				
		<i>Potos flavus</i>	Kinkajou	Nightwalker, Mico de noche, Martucha
		<i>Nasua narica</i>	Coatimundi	White-nosed Coati, Coati mundi, Quash, Pisote, Tejon
		<i>Procyon lotor</i>	Raccoon	Northern Raccoon, Raccoon, Mapache
PERISSODACTYLS - PERISSODACTYLA				
Tapir - Tapiridae				
		<i>Tapirus bairdii</i>	Baird's Tapir	Central American Tapir, Mountain Cow, Danto, Tzimin
ARTIODACTYLS - ARTIODACTYLA				
Peccaries - Tayassuidae				
		<i>Pecari tajacu</i>	Collared Peccary	<i>Tayassu tajacu</i> , Peccary, Queqeo
		<i>Tayassu pecari</i>	White-lipped Peccary	Wari, Warree, Jawilla

Mammals				
Order	Family	Species	Common Name	Local Name
Deer - Cervidae				
		Mazama americana	Red Brocket	Antelope, Cabrito
		Odocoileus virginianus	White-tailed Deer	Savanna Deer, Venado.
RODENTS - RODENTIA				
Porcupines - Erethizontidae				
		Coendou mexicanus	Mexican Porcupine	Mexican hairy Porcupine, Puercoespín
Pacas - Agoutidae				
		Agouti paca	Paca	Gibnut, Tepesquintle
Squirrels - Sciuridae				
		Sciurus deppei	Deppei's Squirrel	Squirrel
Agoutis - Dasyproctidae				
		Dasyprocta punctata	Central American Agouti	Rabbit, Indian Rabbit, Guatusa, Liebre

7.3. Appendix 4. Timber species identified during 2014 and 2016 Harvest Suitability Assessments for 4 forest licence applicants for the Vaca Forest Reserve (Source FD) with DBH for each identified tree.

Colloquial	Scientific	DBH
Balsam	Myroxylon balsamum	50
Balsam	Myroxylon balsamum	36
Balsam	Myroxylon balsamum	78
Balsam	Myroxylon balsamum	82
Balsam	Myroxylon balsamum	40
Balsam	Myroxylon balsamum	58
Balsam	Myroxylon balsamum	72
Balsam	Myroxylon balsamum	72
Barba jolote	Cojoba arborea	72
Barba Jolote	Cojoba arborea	48
Barba Jolote	Cojoba arborea	68
Barba Jolote	Cojoba arborea	54
Barba Jolote	Cojoba arborea	64
Barba Jolote	Cojoba arborea	47
Barba Jolote	Cojoba arborea	53
Barba Jolote	Cojoba arborea	78
Barba Jolote	Cojoba arborea	48
Barba Jolote	Cojoba arborea	66
Barba Jolote	Cojoba arborea	155
Barba Jolote	Cojoba arborea	53
Barba Jolote	Cojoba arborea	72
Barba Jolote	Cojoba arborea	58
Barba Jolote	Cojoba arborea	51
Barba Jolote	Cojoba arborea	63
Barba Jolote	Cojoba arborea	72
Barba Jolote	Cojoba arborea	46
Barba Jolote	Cojoba arborea	48
Barba Jolote	Cojoba arborea	44
Barba Jolote	Cojoba arborea	48
Barba Jolote	Cojoba arborea	48

Barba Jolote	Cojoba arborea	54
Barba Jolote	Cojoba arborea	54
Barba Jolote	Cojoba arborea	44
Barba Jolote	Cojoba arborea	42
Barba Jolote	Cojoba arborea	40
Barba Jolote	Cojoba arborea	42
Barba Jolote	Cojoba arborea	46
Barba Jolote	Cojoba arborea	46
Barba Jolote	Cojoba arborea	46
Bastard Mahogany	Lysiloma acapulcense	72
Bastard Mahogany	Lysiloma acapulcense	72
Bastard Mahogany	Lysiloma acapulcense	74
Bastard Mahogany	Lysiloma acapulcense	84
Bastard Mahogany	Lysiloma acapulcense	43
Bastard Mahogany	Lysiloma acapulcense	39
Bastard Mahogany	Lysiloma acapulcense	48
Bastard Mahogany	Lysiloma acapulcense	34
Bastard Mahogany	Lysiloma acapulcense	84
Bastard Mahogany	Lysiloma acapulcense	64
Bastard Mahogany	Lysiloma acapulcense	64
Bastard Mahogany	Lysiloma acapulcense	51
Bastard Mahogany	Lysiloma acapulcense	39
Bastard Mahogany	Lysiloma acapulcense	44
Bastard Mahogany	Lysiloma acapulcense	68
Bastard Mahogany	Lysiloma acapulcense	72
Bastard Mahogany	Lysiloma acapulcense	68
Bastard Mahogany	Lysiloma acapulcense	56
Bastard Mahogany	Lysiloma acapulcense	69
Bastard Mahogany	Lysiloma acapulcense	84
Bastard Mahogany	Lysiloma acapulcense	54
Bastard Mahogany	Lysiloma acapulcense	84
Bastard Mahogany	Lysiloma acapulcense	72
Bastard Mahogany	Lysiloma acapulcense	54
Bastard Mahogany	Lysiloma acapulcense	65
Bastard Mahogany	Lysiloma acapulcense	65
Bastard Mahogany	Lysiloma acapulcense	Aug-00
Bastard Mahogany	Lysiloma acapulcense	49

Bastard Mahogany	Lysiloma acapulcense	54
Bastard Mahogany	Lysiloma acapulcense	43
Bastard Mahogany	Lysiloma acapulcense	65
Bastard Mahogany	Lysiloma acapulcense	80
Bastard Mahogany	Lysiloma acapulcense	60
Bastard Mahogany	Lysiloma acapulcense	49
Bastard Mahogany	Lysiloma acapulcense	65
Bastard Mahogany	Lysiloma acapulcense	70
Bitter Wood	Vatairea lundellii	57
Bitter Wood	Vatairea lundellii	40
Bitter Wood	Vatairea lundellii	66
Bitter Wood	Vatairea lundellii	58
Bitter Wood	Vatairea lundellii	40
Bitter Wood	Vatairea lundellii	57
Bitter Wood	Vatairea lundellii	56
Bitter Wood	Vatairea lundellii	64
Bitter Wood	Vatairea lundellii	58
Bitter Wood	Vatairea lundellii	40
Bitter Wood	Vatairea lundellii	57
Bitter Wood	Vatairea lundellii	56
Bitter Wood	Vatairea lundellii	54
Black Poisonwood	Metopium brownei	28
Black Poisonwood	Metopium brownei	38
Black Poisonwood	Metopium brownei	36
Black Poisonwood	Metopium brownei	34
Bread Nut	Brosimum alicastrum	66
Bread Nut	Brosimum alicastrum	35
Bread Nut	Brosimum alicastrum	68
Bread Nut	Brosimum alicastrum	31
Bread Nut	Brosimum alicastrum	43
Bread Nut	Brosimum alicastrum	38
Bread Nut	Brosimum alicastrum	42
Bread Nut	Brosimum alicastrum	42
Bread Nut	Brosimum alicastrum	42
Bread Nut	Brosimum alicastrum	63
Bread Nut	Brosimum alicastrum	32
Bread Nut	Brosimum alicastrum	32

Bread Nut	Brosimum alicastrum	62
Bread Nut	Brosimum alicastrum	58
Bread Nut	Brosimum alicastrum	38
Bread Nut	Brosimum alicastrum	43
Bread Nut	Brosimum alicastrum	41
Bread Nut	Brosimum alicastrum	28
Bread Nut	Brosimum alicastrum	54
Bread Nut	Brosimum alicastrum	25
Bread Nut	Brosimum alicastrum	49
Bread Nut	Brosimum alicastrum	47
Bread Nut	Brosimum alicastrum	56
Bread Nut	Brosimum alicastrum	25
Bread Nut	Brosimum alicastrum	73
Bread Nut	Brosimum alicastrum	54
Bull Hoof	Drypetes brownii	28
Bull Hoof	Drypetes brownii	43
Bull Hoof	Drypetes brownii	38
Bull Hoof	Drypetes brownii	34
Bull Hoof	Drypetes brownii	26
Bull Hoof	Drypetes brownii	28
Bull Hoof	Drypetes brownii	38
Bull Hoof	Drypetes brownii	26
Bull Hoof	Drypetes brownii	40
Bull Hoof	Drypetes brownii	38
Bull Hoof	Drypetes brownii	54
Bull Hoof	Drypetes brownii	58
Bull Hoof	Drypetes brownii	33
Bull Hoof	Drypetes brownii	36
Bull Hoof	Drypetes brownii	39
Bull Hoof	Drypetes brownii	38
Bull Hoof	Drypetes brownii	36
Bull Hoof	Drypetes brownii	39
Bull Hoof	Drypetes brownii	34
Bull Hoof	Drypetes brownii	34
Bull Hoof	Drypetes brownii	34
Bull Hoof	Drypetes brownii	60
Bull Hoof	Drypetes brownii	54

Bull Hoof	Drypetes brownii	58
Bull Hoof	Drypetes brownii	33
Bull Hoof	Drypetes brownii	42
Bull Hoof	Drypetes brownii	53
Bull Hoof	Drypetes brownii	45
Bull Hoof	Drypetes brownii	43
Bull Hoof	Drypetes brownii	48
Bull Hoof	Drypetes brownii	38
Cabbage bark	Lonchocarpus castilloi	58
Cabbage bark	Lonchocarpus castilloi	33
Cabbage bark	Lonchocarpus castilloi	38
Cabbage bark	Lonchocarpus castilloi	41
Cabbage bark	Lonchocarpus castilloi	40
Cabbage bark	Lonchocarpus castilloi	54
Cabbage bark	Lonchocarpus castilloi	53
Cabbage bark	Lonchocarpus castilloi	34
Cabbage bark	Lonchocarpus castilloi	38
Cabbage bark	Lonchocarpus castilloi	24
Cabbage bark	Lonchocarpus castilloi	25
Cabbage bark	Lonchocarpus castilloi	88
Cabbage bark	Lonchocarpus castilloi	32
Cabbage bark	Lonchocarpus castilloi	61
Cabbage bark	Lonchocarpus castilloi	74
Cabbage bark	Lonchocarpus castilloi	58
Cabbage bark	Lonchocarpus castilloi	64
Cabbage bark	Lonchocarpus castilloi	50
Cabbage bark	Lonchocarpus castilloi	53
Cabbage bark	Lonchocarpus castilloi	57
Cabbage bark	Lonchocarpus castilloi	68
Cabbage bark	Lonchocarpus castilloi	54
Cabbage bark	Lonchocarpus castilloi	70
Cabbage bark	Lonchocarpus castilloi	52
Cabbage bark	Lonchocarpus castilloi	62
Cabbage bark	Lonchocarpus castilloi	48
Cabbage bark	Lonchocarpus castilloi	34
Cabbage bark	Lonchocarpus castilloi	54
Cabbage bark	Lonchocarpus castilloi	50

Cabbage bark	Lonchocarpus castilloi	44
Cabbage bark	Lonchocarpus castilloi	54
Cabbage bark	Lonchocarpus castilloi	54
Cabbage bark	Lonchocarpus castilloi	53
Cabbage bark	Lonchocarpus castilloi	55
Cabbage bark	Lonchocarpus castilloi	54
Cabbage bark	Lonchocarpus castilloi	57
Cabbage bark	Lonchocarpus castilloi	62
Cabbage bark	Lonchocarpus castilloi	48
Cabbage bark	Lonchocarpus castilloi	54
Cabbage bark	Lonchocarpus castilloi	70
Cabbage bark	Lonchocarpus castilloi	68
Cabbage bark	Lonchocarpus castilloi	68
Cabbage bark	Lonchocarpus castilloi	52
Cabbage bark	Lonchocarpus castilloi	58
Cabbage bark	Lonchocarpus castilloi	56
Cabbage bark	Lonchocarpus castilloi	56
Cabbage bark	Lonchocarpus castilloi	34
Cabbage bark	Lonchocarpus castilloi	52
Cabbage bark	Lonchocarpus castilloi	51
Cabbage bark	Lonchocarpus castilloi	54
Cabbage bark	Lonchocarpus castilloi	55
Cabbage bark	Lonchocarpus castilloi	54
Cedar	Cedrela odorata	89
Cedar	Cedrela odorata	48
Cedar	Cedrela odorata	45
Cedar	Cedrela odorata	28
Cedar	Cedrela odorata	34
Cedar	Cedrela odorata	42
Cedar	Cedrela odorata	32
Cedar	Cedrela odorata	32
Cedar	Cedrela odorata	48
Cedar	Cedrela odorata	28
Cedar	Cedrela odorata	46
Cedar	Cedrela odorata	48
Cedar	Cedrela odorata	58
Cedar	Cedrela odorata	56

Cedar	Cedrela odorata		62
Cedar	Cedrela odorata		28
Cedar	Cedrela odorata		28
Cedar	Cedrela odorata		26
Cedar	Cedrela odorata		43
Cedar	Cedrela odorata		30
Cedar	Cedrela odorata		44
Cedar	Cedrela odorata		25
Cedar	Cedrela odorata		43
Cedar	Cedrela odorata		62
Cedar	Cedrela odorata		78
Cedar	Cedrela odorata		30
Ceiba	Ceiba pentandra		62
Ceiba	Ceiba pentandra		121
Ceiba	Ceiba pentandra		84
Cortez	Tabebuia chrysantha		38
Fiddle Wood	Vitex gaumeri		68
Fiddle Wood	Vitex gaumeri		82
Fiddle Wood	Vitex gaumeri		82
Fig	Ficus spp.		58
Fig	Ficus spp.		58
Fig	Ficus spp.		84
Fig	Ficus spp.		34
Fig	Ficus spp.		114
Fig	Ficus spp.		112
Fig	Ficus spp.		58
Fig	Ficus spp.		84
Fig	Ficus spp.		34
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	33
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	60
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	32
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	44
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	83

Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	42
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	64
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	84
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	48
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	54
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	54
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	34
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	31
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	50
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	54
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	58
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	52
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	54
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	58
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	59
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	52
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	54
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	37
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	33
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	35
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	42
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	41

Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	38
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	36
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	38
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	52
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	54
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	37
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	33
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	35
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	58
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	52
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	42
Granadillo	Dalbergia dimorphandrum	sp./Platymiscium	54
Hahagua	?		37
Hesmo	Acacia dolichostachya?		43
Hesmo	Acacia dolichostachya?		48
Hog Plum	Spondias radlkoferi		60
Hog Plum	Spondias radlkoferi		40
Hog Plum	Spondias radlkoferi		38
Hog Plum	Spondias radlkoferi		58
Hog Plum	Spondias radlkoferi		58
Hog Plum	Spondias radlkoferi		32
Hog Plum	Spondias radlkoferi		24
Hog Plum	Spondias radlkoferi		58
Hog Plum	Spondias radlkoferi		59
Hog Plum	Spondias radlkoferi		60
Hog Plum	Spondias radlkoferi		58
Hog Plum	Spondias radlkoferi		32
Hog Plum	Spondias radlkoferi		24
Hog Plum	Spondias radlkoferi		60

Jobillo	<i>Astronium graveolens</i>	40
Jobillo	<i>Astronium graveolens</i>	38
Jobillo	<i>Astronium graveolens</i>	48
Jobillo	<i>Astronium graveolens</i>	72
Jobillo	<i>Astronium graveolens</i>	36
Jobillo	<i>Astronium graveolens</i>	38
Jobillo	<i>Astronium graveolens</i>	34
Jobillo	<i>Astronium graveolens</i>	38
Jobitlo	<i>Astronium graveolens</i>	34
Llora sangre	<i>Swartzia cubensis</i>	59
Llora sangre	<i>Swartzia cubensis</i>	70
Llora sangre	<i>Swartzia cubensis</i>	84
Llora sangre	<i>Swartzia cubensis</i>	70
Llora sangre	<i>Swartzia cubensis</i>	69
Llora sangre	<i>Swartzia cubensis</i>	69
Llora sangre	<i>Swartzia cubensis</i>	70
Mahogany	<i>Swietenia macrophylla</i>	40
Mahogany	<i>Swietenia macrophylla</i>	28
Mahogany	<i>Swietenia macrophylla</i>	28
Mahogany	<i>Swietenia macrophylla</i>	28
Mahogany	<i>Swietenia macrophylla</i>	54
Mahogany	<i>Swietenia macrophylla</i>	43
Mahogany	<i>Swietenia macrophylla</i>	37
Mahogany	<i>Swietenia macrophylla</i>	28
Mahogany	<i>Swietenia macrophylla</i>	26
Mahogany	<i>Swietenia macrophylla</i>	25
Mahogany	<i>Swietenia macrophylla</i>	41
Mahogany	<i>Swietenia macrophylla</i>	38
Mahogany	<i>Swietenia macrophylla</i>	25
Mylady	<i>Aspidosperma</i> sp.	40
Mylady	<i>Aspidosperma</i> sp.	38
Mylady	<i>Aspidosperma</i> sp.	36
Mylady	<i>Aspidosperma</i> sp.	49
Mylady	<i>Aspidosperma</i> sp.	45
Mylady	<i>Aspidosperma</i> sp.	63
Mylady	<i>Aspidosperma</i> sp.	64
Mylady	<i>Aspidosperma</i> sp.	38

Mylady	Aspidosperma sp.	32
Mylady	Aspidosperma sp.	38
Mylady	Aspidosperma sp.	34
Mylady	Aspidosperma sp.	54
Nargusta	Terminalia amazonia	34
Nargusta	Terminalia amazonia	70
Nargusta	Terminalia amazonia	58
Nargusta	Terminalia amazonia	73
Nargusta	Terminalia amazonia	48
Nargusta	Terminalia amazonia	78
Nargusta	Terminalia amazonia	94
Nargusta	Terminalia amazonia	52
Nargusta	Terminalia amazonia	28
Nargusta	Terminalia amazonia	42
Nargusta	Terminalia amazonia	62
Nargusta	Terminalia amazonia	60
Nargusta	Terminalia amazonia	32
Nargusta	Terminalia amazonia	55
Nargusta	Terminalia amazonia	82
Nargusta	Terminalia amazonia	62
Nargusta	Terminalia amazonia	56
Nargusta	Terminalia amazonia	60
Nargusta	Terminalia amazonia	112
Nargusta	Terminalia amazonia	64
Nargusta	Terminalia amazonia	48
Nargusta	Terminalia amazonia	42
Nargusta	Terminalia amazonia	32
Nargusta	Terminalia amazonia	54
Nargusta	Terminalia amazonia	42
Nargusta	Terminalia amazonia	28
Nargusta	Terminalia amazonia	34
Nargusta	Terminalia amazonia	63
Nargusta	Terminalia amazonia	63
Nargusta	Terminalia amazonia	60
Nargusta	Terminalia amazonia	32
Nargusta	Terminalia amazonia	72
Nargusta	Terminalia amazonia	48

Nargusta	Terminalia amazonia	55
Nargusta	Terminalia amazonia	51
Nargusta	Terminalia amazonia	52
Nargusta	Terminalia amazonia	82
Nargusta	Terminalia amazonia	60
Nargusta	Terminalia amazonia	112
Nargusta	Terminalia amazonia	64
Nargusta	Terminalia amazonia	48
Nargusta	Terminalia amazonia	42
Nargusta	Terminalia amazonia	60
Nargusta	Terminalia amazonia	72
Nargusta	Terminalia amazonia	55
Nargusta	Terminalia amazonia	44
Nargusta	Terminalia amazonia	48
Nargusta	Terminalia amazonia	53
Nargusta	Terminalia amazonia	38
Negrilo	Simarouba glauca	41
Palo de sangre	Pterocarpus rohrii	53
Palo de sangre	Pterocarpus rohrii	48
Palo de sangre	Pterocarpus rohrii	123
Palo de sangre	Pterocarpus rohrii	98
Palo de sangre	Pterocarpus rohrii	82
Palo de sangre	Pterocarpus rohrii	82
Prickly yellow	Zanthoxylum spp.	42
Prickly yellow	Zanthoxylum spp.	42
Prickly yellow	Zanthoxylum spp.	48
Prickly yellow	Zanthoxylum spp.	74
Prickly yellow	Zanthoxylum spp.	62
Prickly yellow	Zanthoxylum spp.	61
Prickly yellow	Zanthoxylum spp.	38
Prickly yellow	Zanthoxylum spp.	58
Prickly yellow	Zanthoxylum spp.	47
Prickly yellow	Zanthoxylum spp.	55
Prickly yellow	Zanthoxylum spp.	54
Prickly yellow	Zanthoxylum spp.	62
Prickly yellow	Zanthoxylum spp.	54
Prickly yellow	Zanthoxylum spp.	54

Prickly yellow	Zanthoxylum spp.	32
Prickly yellow	Zanthoxylum spp.	55
Prickly yellow	Zanthoxylum spp.	46
Prickly yellow	Zanthoxylum spp.	64
Prickly yellow	Zanthoxylum spp.	54
Prickly yellow	Zanthoxylum spp.	43
Prickly yellow	Zanthoxylum spp.	44
Prickly yellow	Zanthoxylum spp.	32
Prickly yellow	Zanthoxylum spp.	40
Prickly yellow	Zanthoxylum spp.	72
Prickly yellow	Zanthoxylum spp.	56
Prickly yellow	Zanthoxylum spp.	48
Prickly yellow	Zanthoxylum spp.	37
Prickly yellow	Zanthoxylum spp.	27
Prickly yellow	Zanthoxylum spp.	39
Prickly yellow	Zanthoxylum spp.	38
Prickly yellow	Zanthoxylum spp.	37
Prickly yellow	Zanthoxylum spp.	27
Prickly yellow	Zanthoxylum spp.	39
Prickly yellow	Zanthoxylum spp.	38
Prickly yellow	Zanthoxylum spp.	37
Quam Wood	Schizolobium parahyba	81
Quam Wood	Schizolobium parahyba	92
Quam Wood	Schizolobium parahyba	84
Quam Wood	Schizolobium parahyba	64
Quam Wood	Schizolobium parahyba	72
Quam Wood	Schizolobium parahyba	70
Quam Wood	Schizolobium parahyba	64
Quam Wood	Schizolobium parahyba	68
Quam Wood	Schizolobium parahyba	62
Quam Wood	Schizolobium parahyba	81
Quam Wood	Schizolobium parahyba	92
Quam Wood	Schizolobium parahyba	64
Quam Wood	Schizolobium parahyba	74
Quam Wood	Schizolobium parahyba	65
Quam Wood	Schizolobium parahyba	62
Quam Wood	Schizolobium parahyba	68

Quam Wood	Schizolobium parahyba	74
Quam Wood	Schizolobium parahyba	84
Quam Wood	Schizolobium parahyba	74
Quam Wood	Schizolobium parahyba	54
Quam Wood	Schizolobium parahyba	70
Quam Wood	Schizolobium parahyba	74
Quam Wood	Schizolobium parahyba	54
Quam Wood	Schizolobium parahyba	70
Quero de sapo	Heisteria media?	42
Quero de sapo	Heisteria media?	43
Quero de sapo	Heisteria media?	42
Quero de sapo	Heisteria media?	42
Red wood/ saltemuch	Simira salvadorensis	84
Red wood/ saltemuch	Simira salvadorensis	44
Red wood/ saltemuch	Simira salvadorensis	65
Salm wood	Cordia alliodora	48
salm wood	Cordia alliodora	34
Salmwood	Cordia alliodora	24
Salmwood	Cordia alliodora	32
Salmwood	Cordia alliodora	38
Salmwood	Cordia alliodora	24
Salmwood	Cordia alliodora	28
Salmwood	Cordia alliodora	44
Salmwood	Cordia alliodora	46
Salmwood	Cordia alliodora	34
Salmwood	Cordia alliodora	18
Salmwood	Cordia alliodora	22
Salmwood	Cordia alliodora	42
Salmwood	Cordia alliodora	25
Salmwood	Cordia alliodora	24
Salmwood	Cordia alliodora	42
Salmwood	Cordia alliodora	42
Salmwood	Cordia alliodora	42
Salmwood	Cordia alliodora	25
Salmwood	Cordia alliodora	32
Salmwood	Cordia alliodora	30
Salmwood	Cordia alliodora	28

Salmwood	<i>Cordia alliodora</i>	25
Salmwood	<i>Cordia alliodora</i>	25
Salmwood	<i>Cordia alliodora</i>	25
Salmwood	<i>Cordia alliodora</i>	41
Salmwood	<i>Cordia alliodora</i>	35
Salmwood	<i>Cordia alliodora</i>	41
Salmwood	<i>Cordia alliodora</i>	36
Salmwood	<i>Cordia alliodora</i>	32
Salmwood	<i>Cordia alliodora</i>	32
Salmwood	<i>Cordia alliodora</i>	32
Salmwood	<i>Cordia alliodora</i>	34
Salmwood	<i>Cordia alliodora</i>	41
Salmwood	<i>Cordia alliodora</i>	32
Salmwood	<i>Cordia alliodora</i>	32
Salmwood	<i>Cordia alliodora</i>	31
Salmwood	<i>Cordia alliodora</i>	32
Salmwood	<i>Cordia alliodora</i>	34
Salmwood	<i>Cordia alliodora</i>	38
Salmwood	<i>Cordia alliodora</i>	53
Salmwood	<i>Cordia alliodora</i>	22
Salmwood	<i>Cordia alliodora</i>	28
Salmwood	<i>Cordia alliodora</i>	34
Salmwood	<i>Cordia alliodora</i>	38
Salmwood	<i>Cordia alliodora</i>	30
Salmwood	<i>Cordia alliodora</i>	28
Salmwood	<i>Cordia alliodora</i>	32
Salmwood	<i>Cordia alliodora</i>	25
Salmwood	<i>Cordia alliodora</i>	48
Salmwood	<i>Cordia alliodora</i>	34
Salmwood	<i>Cordia alliodora</i>	36
Salmwood	<i>Cordia alliodora</i>	36
Salmwood	<i>Cordia alliodora</i>	34
Salmwood	<i>Cordia alliodora</i>	36
Salmwood	<i>Cordia alliodora</i>	27
Salmwood	<i>Cordia alliodora</i>	31
Salmwood	<i>Cordia alliodora</i>	38
Salmwood	<i>Cordia alliodora</i>	42

Salmwood	<i>Cordia alliodora</i>	38
Salmwood	<i>Cordia alliodora</i>	36
Salmwood	<i>Cordia alliodora</i>	48
Salmwood	<i>Cordia alliodora</i>	24
Salmwood	<i>Cordia alliodora</i>	31
Salmwood	<i>Cordia alliodora</i>	36
Salmwood	<i>Cordia alliodora</i>	22
Salmwood	<i>Cordia alliodora</i>	27
Salmwood	<i>Cordia alliodora</i>	35
Salmwood	<i>Cordia alliodora</i>	32
Salmwood	<i>Cordia alliodora</i>	22
Salmwood	<i>Cordia alliodora</i>	18
Salmwood	<i>Cordia alliodora</i>	24
Salmwood	<i>Cordia alliodora</i>	24
Salmwood	<i>Cordia alliodora</i>	30
Salmwood	<i>Cordia alliodora</i>	32
Salmwood	<i>Cordia alliodora</i>	30
Salmwood	<i>Cordia alliodora</i>	48
Salmwood	<i>Cordia alliodora</i>	48
Salmwood	<i>Cordia alliodora</i>	24
Salmwood	<i>Cordia alliodora</i>	31
Salmwood	<i>Cordia alliodora</i>	36
Salmwood	<i>Cordia alliodora</i>	22
Salmwood	<i>Cordia alliodora</i>	27
Salmwood	<i>Cordia alliodora</i>	35
Salmwood	<i>Cordia alliodora</i>	32
Salmwood	<i>Cordia alliodora</i>	22
Salmwood	<i>Cordia alliodora</i>	18
Salmwood	<i>Cordia alliodora</i>	128
Salmwood	<i>Cordia alliodora</i>	31
Santa Maria	<i>Calophyllum brasiliense</i>	25
Santa Maria	<i>Calophyllum brasiliense</i>	28
Santa Maria	<i>Calophyllum brasiliense</i>	49
Santa Maria	<i>Calophyllum brasiliense</i>	48
Santa Maria	<i>Calophyllum brasiliense</i>	22
Santa Maria	<i>Calophyllum brasiliense</i>	24
Santa Maria	<i>Calophyllum brasiliense</i>	63

Santa Maria	Calophyllum brasiliense	18
Santa Maria	Calophyllum brasiliense	28
Santa Maria	Calophyllum brasiliense	49
Santa Maria	Calophyllum brasiliense	42
Santa Maria	Calophyllum brasiliense	28
Santa Maria	Calophyllum brasiliense	48
Santa Maria	Calophyllum brasiliense	38
Santa Maria	Calophyllum brasiliense	39
Santa Maria	Calophyllum brasiliense	39
Santa Maria	Calophyllum brasiliense	63
Santa Maria	Calophyllum brasiliense	22
Santa Maria	Calophyllum brasiliense	24
Santa Maria	Calophyllum brasiliense	84
Santa Maria	Calophyllum brasiliense	58
Santa Maria	Calophyllum brasiliense	84
Santa Maria	Calophyllum brasiliense	84
Santa Maria	Calophyllum brasiliense	74
Santa Maria	Calophyllum brasiliense	76
Santa Maria	Calophyllum brasiliense	18
Santa Maria	Calophyllum brasiliense	28
Santa Maria	Calophyllum brasiliense	49
Sapodilla	Manilkara zapota	54
Sapodilla	Manilkara zapota	35
Sapodilla	Manilkara zapota	40
Sapodilla	Manilkara zapota	66
Sapodilla	Manilkara zapota	40
Sapodilla	Manilkara zapota	66
Sapodilla	Manilkara zapota	40
Sapodilla	Manilkara zapota	40
Sapodilla	Manilkara zapota	40
Sapodilla	Manilkara zapota	58
Sapote hoja fina	Pouteria sp.?	36
Silly Young	Sideroxylon salicifolium	34
Silly Young	Sideroxylon salicifolium	34
Silly Young	Sideroxylon salicifolium	50
Silly Young	Sideroxylon salicifolium	31
Tempiste	Sideroxylon floribundum	54

Tempiste	Sideroxylon floribundum	57
Tempiste	Sideroxylon floribundum	60
Tempiste	Sideroxylon floribundum	57
Tempiste	Sideroxylon floribundum	54
Tempiste	Sideroxylon floribundum	55
Tempiste	Sideroxylon floribundum	57
Tempiste	Sideroxylon floribundum	60
Tempiste	Sideroxylon floribundum	57
Tzalam/ Illora sangre	Acacia glomerosa?	76
Tzon	Alseis yucatenensis?	38
Tzon	Alseis yucatenensis?	32
Tzon	Alseis yucatenensis?	38
Tzon	Alseis yucatenensis?	28
Tzon	Alseis yucatenensis?	42
Tzon	Alseis yucatenensis?	47
Tzon	Alseis yucatenensis?	36
White Poisonwood	Sebastiana tuerkheimiana	62
White Poisonwood	Sebastiana tuerkheimiana	59
White Poisonwood	Sebastiana tuerkheimiana	55
White Poisonwood	Sebastiana tuerkheimiana	55
White Poisonwood	Sebastiana tuerkheimiana	58
White Poisonwood	Sebastiana tuerkheimiana	32
White Poisonwood	Sebastiana tuerkheimiana	25
White Poisonwood	Sebastiana tuerkheimiana	60
White Poisonwood	Sebastiana tuerkheimiana	50
White Poisonwood	Sebastiana tuerkheimiana	42
White Poisonwood	Sebastiana tuerkheimiana	60
White Poisonwood	Sebastiana tuerkheimiana	60
White Poisonwood	Sebastiana tuerkheimiana	48
White Poisonwood	Sebastiana tuerkheimiana	45
White Poisonwood	Sebastiana tuerkheimiana	44
White Poisonwood	Sebastiana tuerkheimiana	24
White Poisonwood	Sebastiana tuerkheimiana	34
White Poisonwood	Sebastiana tuerkheimiana	48
White Poisonwood	Sebastiana tuerkheimiana	50
White Poisonwood	Sebastiana tuerkheimiana	55
White Poisonwood	Sebastiana tuerkheimiana	55

White Poisonwood	Sebastiana tuerkheimiana	138
White Poisonwood	Sebastiana tuerkheimiana	40
White Poisonwood	Sebastiana tuerkheimiana	58
White Poisonwood	Sebastiana tuerkheimiana	58
White Poisonwood	Sebastiana tuerkheimiana	60
White Poisonwood	Sebastiana tuerkheimiana	64
White Poisonwood	Sebastiana tuerkheimiana	58
White Poisonwood	Sebastiana tuerkheimiana	57
White Poisonwood	Sebastiana tuerkheimiana	67
White Poisonwood	Sebastiana tuerkheimiana	58
White Poisonwood	Sebastiana tuerkheimiana	58
White Poisonwood	Sebastiana tuerkheimiana	60
White Poisonwood	Sebastiana tuerkheimiana	64
White Poisonwood	Sebastiana tuerkheimiana	58
White Poisonwood	Sebastiana tuerkheimiana	57
White Poisonwood	Sebastiana tuerkheimiana	67

7.4. List of interviews and records of the various stakeholder's meetings.

7.4.1. Meeting with Montserrat Casademunt, representative of the Cayo Quality Honey Producers: 26 July 2016.

The honey producers are interested in the Vaca, but distance, road access and above all, security are the main problems. For this reason, there are currently few hives within the park. A presence with rangers would help. The group has a concession from FD, but no exclusive use.

The beekeepers have no intention to step into a management of the FR. They are looking towards FCD to step into this. The Martinez Family of MARS would be interested in a management involvement. Another good contact would be the Morales family of Chechem Ha. Mr. Kimo Jolly is also a person to talk to.

There are few economic opportunities within the park. Ecotourism might hold promises. Also, sustainable farming including Cacao, Vanilla, Ramon.

7.4.2. Meeting with the Cayo Quality Honey Producers: Friday 29 July, 2016 in Cahal Pech, San Ignacio.

This meeting was a follow up of the meeting with Montserrat Casademunt earlier in the week. The Group had business training and time was freed to introduce the VACA management plan project. Several members of the Friends of Vaca Forest Reserve were also present.

The meeting was organized by Jenny Saqui of the GIZ-Selva Maya Program. The program has contact with the Friends of Vaca Forest Reserve and can assist in organizing contacts.

Contacts:

- Chairman of the Cayo Quality Honey Producers Coop: Maximiliano Garcia – 669-9880, maxcayoquality@gmail.com
- Manuel Tzalam – Benque Viejo – 630-8331.
- Ricky Cunil – 637-7069, ricky.cunil@gmail.com
- Jules Ramos – 668-5210
- Wendy Tesucum – 632-2390, wendytesucum2@gmail.com
- Domingo Sandero – 604-6097, Lundero2010@yahoo.com
- Carlos Serrano – 635-0220
- Vicente Kak, Benque Viejo – 629-1702

7.4.3. Meeting with FCD, September 2, 2016

- Rafael Manzanero
- Tineke Boomsma
- Jan Meerman

Jan Meerman told that he already had preliminary meetings with both the beekeepers and some Friends of Vaca Forest Reserve members.

Question to FCD was how FCD sees any management of the VACA FR.

Response is “how flexible will the FD/KBA be with any alternative management proposals”

FCD has a long history of involvement with the Vaca, even from the days of the Succotz youth group. FCD was instrumental in getting the Friends of Vaca Forest Reserve registered under the business act in January 2015 (?), the step to a registration as an NGO has not been made as yet.

The Vaca is still important, and still has biodiversity value even though there are no data. The interesting thing is that the Vaca has community stakeholders, this against the Chiquibul, which does not really have any local stakeholders. For FCD, the Vaca is an important “buffer” zone for influences from the north.

There are opportunities for community participation in management, as part of an FAO project it was investigated whether there are any legal obstacles against that. But the law is silent on the point and therefore it is assumed that there are no legal obstacles.

There is an interesting situation in the Petén where communities have forest concessions. These concessions are very large and all sorts of forest products are being extracted such as timber, allspice, breadnut, chicle and xate. Problem is that the Vaca is probably too small and fragmented to allow for similar concessions.

A precedent may be in the Maya Mountain FR, where there are a lot of incursions, but YCT is working with the farmers using the concession idea. The Management Plan will investigate whether this could be applied to the Vaca.

The problem in the Vaca is part that there is illegal occupation. A couple of years ago, Rafael went twice with Marcello Windsor into the Vaca to inform farmers that they would be tolerated as long as there is no expansion and a move to sustainable agricultural methods. There was also the need to focus on restoration of degraded areas. A survey was done to find out the acreage under cultivation. There is an issue with demarcation; the boundaries of the FR are not indicated. The farmers appeared open to these ideas, but, there was no follow up, and effectively GOB allows the squatters to do as they please. For anything to work, the FD will have to assume a more active and prominent role.

Political interference has traditionally been a problem. Early on this was through a politician (Kendel Mendez) and later through Edwin Contreras. The fact remains that if such politicians do not find an opposition they will take control.

The Vaca does produce a lot of income. There are mostly cattle and vegetable production and the returns are supposedly quite high (personal interpretation).

In 2007, the Barefoot Lodge development took place but the EIA was ultimately rejected and the project was abandoned. All buildings and infrastructure is now being reclaimed by the forest.

In the past as part of a project, FCD had one extension officer active in the Vaca, even the fact that there was this simple presence of a higher authority, did already help in containing expansion, as the farmers felt that they were being observed.

Under the new Chiquibul Forest Initiative, there will be 2 rangers and 1 technician for the Vaca (stationed at FCD). They will have mostly a monitoring/research function for at least 2 years.

There is also a very small fund from the British High Commission for some pilot projects (farmers exchange program) in the Vaca (administered by FCD?).

One of the options to handle the management of the Vaca would be to merge it with the Chiquibul NP, but this would add a new dimension to the management of the Chiquibul and FCD is not ready for that. Effectively, FCD is not interested in a co-management role here. FCD applied with KBA for funds for the Friends of Vaca Forest Reserve. But this was refused because of the lack of capacities within the FoV.

One of the issues with the Vaca is the large amount of illegal activities taking place, not just the squatting but also marijuana growing, smuggling and even human trafficking. The involvement of organized crime makes it very difficult to manage. Effectively the western border area is a no-go area for FCD and law enforcement. It is simply too dangerous.

Arenal and then mostly its agricultural activity, is slowly growing into the Vaca which is partly caused by a lack of demarcation of the FR boundaries, even for other sites such as Chechem Ha, is this in or outside the FR? Melchior and Rondol(?) are also making inroads into the Vaca.

The Landscape management approach project does address the management of the Vaca to a degree and comes up with a large number of recommendations. This approach includes many human activities including BECOL, beekeepers, Martz Farms (<http://www.martzfarm.com/>), Chechem Ha (Anthony Morales), Martinez Family, Tourism etc.

It may be possible to get the farmers interested from a watershed perspective. They feel the water situation is very important. The many creeks and ponds (?) are valuable for them. Recognized use of public land may be possible under certain conditions.

There are 3 timber concessions in the area and a 4th coming up, but the stocking level is essentially unknown. It is questionable whether there is enough stock to allow for a long term

logging licence. The farmers complain that they are not allowed to take trees, while the concessionaires can.

7.4.4. Friends of Vaca Farmers Meeting – September 7, 2016

An inception meeting was held with the FoV in order to introduce the project. The meeting was organized by Jennie Saqui from the GIZ Selva Maya project with assistance from the KBA project. Also in attendance was the Forest Department and the Agriculture Department. In total 35 people attended the meeting.

7.4.5. Meeting at Forest Department (San Ignacio) – September 20, 2016

Meeting with Chief Forest officer Wilber Sabido, Rasheda Garcia, Landy, Andrea Tillett, Eugene Waight and Jan Meerman.

The purpose of the meeting was to discuss the inclusion of a forest survey into the management plan. Forest Department would carry out the survey but the consultant would have to include the results in the management plan. The survey would focus particularly on commercial species such as Mahogany, Cedar but also on Ramon, Xate, Allspice and Beaucarnea (which would be non-timber species). This forest survey would greatly extend the timeframe for the consultancy. It was agreed that Forest Department would develop a methodology and that the KBA project would look into extra funding.

On November 8, 2016, word was received that due to a lack of funding the preparation of the Management Plan was to proceed as per the original TOR without the inclusion of a forest inventory.

7.4.6. Friends of Vaca Farmers Meeting – September 25, 2016

This meeting was called for by the Selva Maya Project in order to elect a new FoV board of directors. The new member list of FoV:

- President – Mr. Orlando Itza
- Vice-President – Mrs. Wilma de la Fuente
- Treasurer – Mr. Oscar Gonzalez
- Secretary- Mr. Ermejildo Veliz
- Advisor- Mr. Hector de la Fuente
- Advisor – Mr. Tomas Castellanos
- Advisor- Mr. Eric Can

At this meeting with the FoV also the following Questionnaire was circulated:

- Name/Nombre
- Where on the map is your farm/¿Dónde está su rancho (mapa)?
- How many acres do you have/¿Cuántos acres tiene usted?
- How many acres is developed?/¿Cuántos acres se desarrolla?
- Do you farm in the reserve?/¿Tiene (parte) sue rancho en la reserve?
- For how many years have you used the land?/¿Por cuántos años ha utilizado los terrenos?
- Is the farm your only source of income?/¿Es la granja de su única fuente de ingresos?
- Can you make a living from the farm?/¿Se puede hacer una vida de la granja?

The results of 20 Questionnaires have been collated into an Excel worksheet in the livelihood assessment (Boomsma, 2017).

7.4.7. Meeting with Arenal Village Council

January 17, 2017.

- Lucio Ruiz: Candidate Chair
- Abhama Ramos: Councilor
- David Patt: Councilor
- Hilario D. Guerra: Councilor
- Jessica Pleytez: Secretary

There are two village councils in Arenal, one on the Belize side and one on the Guatemala side. Belize Arenal gets government assistance to maintain roads and other infrastructure. On the Guatemalan side road maintenance is by hand.

On both sides of the border both Belize Dollars and Quetzales are accepted.

The councillors stated to be familiar with the VFR, but stated that there is confusion about the exact boundary even though one councillor stated that there was a cut line demarcating the FR.

According the councillors, the use of natural resources by the villagers of Arenal is very limited. Discussed were:

- Cohune nuts: No uses
- Cohune leaves: Found around the village
- Bayleaf (Guanu): Collected from both the farms and the reserve
- Botan: No uses
- Iguana: Not collected
- Fish: From the Mopan River
- Construction sticks: From the farms

- Hardwoods: Mostly bought
- Bush meat: Very little
- Other: Nowadays people don't go into the bush anymore. People have other things such as jobs. Also the bush is depleted from anything valuable. Many people have jobs in Benque or even further away. Santander Farms (Sugercane) comes with 2 busses to pick up 90 people every day.

The people of Arenal are not involved in tourism. There used to be a guesthouse but that failed. Farming is still important for some people; some farms are as far away as the Macal. Cattle ranching is becoming very important. No one from Arenal is apparently member of the Friends of Vaca Forest Reserve.

The councillors feel that the Vaca FR needs to be remained under protection and that it needs a good management authority. When it is managed by government it will just be sold.

One way that farmers and forest management could cooperate is by providing tree seedlings to farmers. Planting timber trees is seen as a good investment for the future.

Many Guatemalans come to the Vaca area to farm or cut timber, Arenal village is not the main access point as the entire boundary is wide open. The BDF does not do anything to deter this. There is no BDF presence in Arenal.

People in Arenal are a bit suspicious about outside groups coming in, including GOB. There is dissatisfaction with FCD that does not do anything for them and dissatisfaction with the Agriculture Department because they did not receive any help after hurricane Earl in 2016. Too many empty promises.

Additionally there was a visit made to YADE (Youth of Arenal for Development and Equity). Maritza Barrera. The Womens group centre with library and woodworking workshop was visited.

7.4.8. Meeting with FCD 17 January 2017

Present: Rafael Manzanero and David Tzul.

Introducing David Tzul as the landscape manager for two years. FD with assistance of FCD is currently collecting data on people and farm locations. FCD is simply assisting FD, and not doing any enforcement. The focus is on data gathering. Once the farmer situation is under control, only then, actual management is possible.

7.4.9. Vaca meeting at CET, San Ignacio, January 26, 2017

Meeting organized by GIZ

Oscar Gonzalez from the Tilapiafarm acts as secretary for the FoV.

FCD presents the field data collection effort:

- Total acreage
- Type crops
- Practices
- Topography
- Water Sources
- Agrochemicals used

The University of Tennessee will start in February as part of a counterpart exchange and gather baseline data on the species composition and a timber inventory. Their work will include but not be restricted to the Vaca. FCD would like to use this resource to gather data.

Overall, FCD does not want to push projects to the farmers, the farmers will have to choose themselves.

Jenny Garcia (GIZ) presents GIZ components

GIZ had a consultant (Cardona) doing an assessment under the farmers and based on that report the current efforts are coming forth:

- Strengthening of the FoV
- Agricultural assistance including Green Fertilizer

GIZ has a list with members of FoV including who is in/out the reserve. FCD with FD are updating this list.

Victoria and Rasheeda present that Forest Department has for 6 years recommended not to give out forest concessions but this has always been overruled by ministers.

A new Forest Act is in the making (has meanwhile passed) which gives a new schedule for fines.

WCS presents their projects that includes conservation agreements between communities, NGO's in forested areas by offering grants for private initiatives (businesses) for sustainable initiatives.

Members of the group complain that some of the forest officers are crooked. This is being recognized by Rasheeda and German who confirm that corruption is a problem. The FoV are afraid to report corrupt officers since they believe it will put them at risk. In the past they claim that there have been repercussions.

Victoria responds that FoV needs to organize themselves because together they can stand up against political interference and corruption.

The FoV secretary brings up that it is not clear who is actually part of the initiative. Who is in, who is out? The FoV seems to be split into factions. There even seems to be a competition group called "Vaca Falls".

Rafael Manzanero identifies that some members of the FoV are just coming because they think there is money to be gotten.

Jenny (GIZ) brings up that the organizations (FD, FCD, GIZ, WCS) will have to meet amongst themselves in order to coordinate their efforts which until now have been very disjointed.

Rafael gives contact Cynthia Gomez Cynthia.sosa@waldbau.uni-freiburg.de

Junglesplash Ecotours <http://www.junglesplashtours.com> junglesplash.ecotours@gmail.com
824-0935/666-0935 does tours on the Vaca lake.

GEF-SGP provided funding for innovative agro-ecology practices in the VFR

Drought is discussed. Do satellite images support greater deciduousness on the plateau?

Vaca is covered under the Chiquibul Forest Investment Initiative CFII, which could include services to farmers.

7.4.10. Meeting with FCD 9 February, 2017

Present: Rafael Manzanero and David Tzul.

Discussing some preliminary findings of the FD/FCD survey that is under way.

There is a need for a database with the farmers and their exact location + crops they grow. This needs to be an actively managed database. Also keeping track of the sale of land. People are buying and selling land, these people are not poor as such, and land is a commodity for them. In addition, people are hiring Guatemalan workers to do the actual farm work.

7.4.11. Interview with BECOL

BECOL – corporate@becol.com.bz 824-3016

Spoke with Mr. Hernandez, Plant Operator and Oscar Alonzo (615-0010) Environmental and Health Manager (31 August 2017). Discussed management for the VFR, but BECOL focusses on fulfilling their monitoring requirements within their Environmental Compliance Plan.

7.4.12. Interview with Cynthia Sosa-Gomes 28 April 2017

Transcript of interview (28 April 2017) with Cynthia Sosa-Gomez, PhD candidate, Albert-Ludwigs Universität Freiburg – Germany. PhD research is focused on analysing the potential of forests on delivering livelihoods to the rural communities. First set of fieldwork carried out in early 2017. A follow up field session is planned for early 2018. The study will finalize in late 2018, early 2019.

During the 2017 fieldwork 12 farmers were interviewed in both individual sessions and in a focus group session. Interviewees were selected on the basis of them being physically present on the land. No effort was made to reach farmers not present on the land during the interview period.

The majority of people interviewed stated to be either Belizean by birth or naturalized. However, many had Guatemalan labourers. There were two cases where farmers stated that they were foreigners (they stated their nationality and made no further comments on whether they are naturalized Belizeans; one of them was land owner and the other one was given the land by Belizeans to take care of and produce in it) and one case where it was unclear He stated to be the owner of the land and he had a Guatemalan helper.

The interviews revealed a lot of rumours going around with the most prevalent one that non-Belizeans would soon be removed from the land.

Overall it was found that the concept of “conservation” was not entirely clear amongst the farmers. For many having a nice looking crop would constitute conservation when compared to hurricane bush or fire damaged forest. There is clearly room for educational activities to deal with that.

Nevertheless, many of the interviewees were aware of the fact they were working inside a reserve and there was an overall willingness to assist in conservation efforts, but only if there was some reward/payment put against that. In general there was some suspicion amongst the farmers; they felt abandoned by both government and NGO’s. There had been many surveys, many meetings, by many organizations and although expectations had been raised, nothing tangible had come forward from their perspective. They were familiar with Friends of Vaca Forest Reserve but felt that they were left out of that and FoV was being controlled by people that were not actually working the land.

7.4.13. Vaca FR. Stakeholder Validation Meeting.

At the request of the Consultant team, a stakeholder meeting was called to order at Log Cabins, San Ignacio, August 25, 2017. Attendees included representatives of the Forest Department (FD), Friends of Vaca (FOV), Friends for Conservation and Development (FCD), National Protected Areas Secretariat (NPAS), Key Biodiversity Areas (KBA) Secretariat, Selva Maya (IP consulting).

Some comments:

Options for “title” for users is a 15 year permit allowing agroforestry activities, but this is for a group, not individuals.

FOV and/or similar group for the west need to be able to come up with a management plan for the permitted area.

The group(s) activities need to be monitored.

KBA and Selva Maya can assist in getting a second group going for the Arenal area, but KBA ends in 2019 although it is possible to request for an extension. Selva Maya ends in 2020.

There are possibilities in merging the area with the Chiquibul. Based on the idea to rationalize the use of the Chiquibul block.

Think of the Chiquibul as a larger entity which includes the VACA.

Logging for the VACA could be a community type based activity, but which community?

A forest inventory is needed no matter what

GOB has a commitment with BECOL to protect the water resources in the watershed. This is in the 3rd master agreement. Copy received from the CFO.

Need to discuss with BECOL about Chalillo 2 or any other planned hydro structures.

**Ministry of Agriculture, Fisheries, Forestry, the Environment, Sustainable Development and
Immigration
Management and Protection of Key Biodiversity Areas Project (KBA)
The Log Cabins Inn, Benque Road
August 25, 2017**

Review of Draft Management Plan for the Vaca Forest Reserve





Agenda

9:00 – 9:15 am	Registration of Participants
9:15 – 9:20 am	Opening Remarks (German Novelo)
9:20 – 9:30 am	Welcome Remarks (Chief Forest Officer)
9:30 – 10:30 am	Presentation of Draft Management Plan (Consultant)
10:30 – 10:45 am	Break
10:45 – 11:30 am	Presentation Continues (Consultant)
11:30 – 12 noon	Questions & Comments
12 noon – 1:00 pm	Lunch

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Management and Protection of Key Biodiversity Areas Project (KBA)
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Review of Draft Management Plan for the Vaca Forest Reserve

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