

Forest Conservation Management Plan for the Guava to Morant River & Moore Town Sites, Rio Grande Valley, Portland.



Prepared for the Jamaica Conservation and Development Trust (JCDDT)

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List of Acronyms

BJCMNP	Blue and John Crow Mountains National Park
CITES	Convention for International Trade in Endangered Species
CO ₂	Carbon Dioxide
CMP	Conservation Management Plan
FD	Forestry Department
GIS	Geographic Information System
IAS	Invasive Alien Species
IUCN	International Union for Conservation of Nature
JCDT	Jamaica Conservation and Development Trust
JNHT	Jamaica National Heritage Trust
LFMC	Local Forest Management Committee(s)
LFMP	Local Forest Management Plan
LICJ	Land Information Council of Jamaica
LUDC	Land Utilities Development Commission
M&E	Monitoring and Evaluation
MEGJC	Ministry of Economic Growth and Job Creation
MOF	Ministry of Finance
MOU	Memorandum of Understanding
NEPA	National Environmental Planning Agency
NFAP	National Forestry Action Plan
NFMCP	National Forest Management and Conservation Plan
NGO	Non-Governmental Organisation(s)
NLA	National Land Agency
NRCA	Natural Resources Conservation Authority
NSWMA	National Solid Waste Management Authority
NWC	National Water Commission

PIOJ	Planning Institute of Jamaica
RADA	Rural Agricultural Development Authority
SPAW	Specially Protected Areas and Wildlife
TEF	Tourism Enhancement Fund
UNESCO	United Nations Educational, Scientific and Cultural Organization
WRA	Water Resources Authority

Executive Summary

Conservation Management Plans (CMPs) are important tools that allow managers of protected area to understand the ecological values of an area of interest in detail, and how the values can be best conserved given the particular management context of the place. This CMP was designed for the management of the Moore Town and Guava to Morant River areas of the Blue and John Crow Mountain National Park and World Heritage Site. It will also investigate the constraints and opportunities that may arise or impact on the area.

The Blue and John Crow Mountains National Park (BJCMNP) is located in the eastern end of the island of Jamaica and is Jamaica's first and only United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site. The Park is found in the eastern parishes of Portland, St. Thomas, St. Andrew and a small section of south-east St. Mary.

The (BJCMNP) is managed by the Jamaica Conservation and Development Trust (JCDDT), a non-government organisation (NGO) on behalf of the Natural Resources Conservation Authority (NRCA) through the National Environment and Planning Agency (NEPA) through a collaborative management agreement. This agreement seeks to guide operational management of the park by identifying different roles and responsibilities for the various organizations involved.

The drafting of the CMP included the execution of a survey to get a snapshot of the cultural and socio- economic status of the communities. The overall objectives of the survey were to understand the livelihood strategies and the degree of dependence on natural resources of the affected communities, while also identifying glaring needs or problems.

The major threats to the protected area have been identified as deforestation, forest degradation, pollution and effects due to climate change. Various environmental management measures have been recommended to treat with the threats identified. These management efforts include an invasive species management programme, a comprehensive public education programme, improvement in enforcement activities, improved demarcation of forest boundaries and increased use of GIS based technology.

Introduction

Background to and Context of the Management Plan

A Conservation Management Plan (CMP) is an important document that allows managers of protected area to understand the ecological values of an area in detail, and how those values can be best conserved given the particular management context of the place. More importantly, a CMP helps to manage change, and is a widely used tool in protected areas management.

This CMP was designed for the management of the Moore Town and Guava to Morant River areas of the Blue and John Crow Mountain National Park and World Heritage Site. It seeks to explain why the Blue and John Crow Mountains National Park and World Heritage Site is considered to be significant. It will also investigate the constraints and opportunities that may arise or impact on the area. These, with the detailed understanding of the significance of the National Park, will then be used to develop policies to guide the conservation efforts of in real-world management context. Policies will cover a range of matters such as changes, future use (including adaptive re-use), development, management and maintenance.

Site Description

The Blue and John Crow Mountains National Park (BJCMNP) [Figure 2] is located in the eastern end of the island of Jamaica and is Jamaica's first and only United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site. The Park found in the parishes of Portland, St. Thomas, St. Andrew and a small section of south-east St. Mary (figure 3). The National Park covers an area of 41,198 hectares (101, 802 acres) and includes Jamaica's highest point – the Blue Mountain Peak at 2,256 metres (JCDT, 2018). The park accounts for 4.4% of Jamaica's land surface. The steep mountain slopes form the upper sections of ten (10) of

the island's twenty-six (26) watershed management units. The Blue and John Crow Mountains National Park comprises three mountain ranges – the Port Royal Mountains to the west, the Blue Mountains, and John Crow Mountains in the east; divided by the Buff Bay and Rio Grande Valleys on the north side of the ranges. Surrounded by a buffer zone of 28,494 hectares, the pristine primary forest of the Blue and John Crow Mountains was designated a UNESCO World Heritage Site in 2015 for the outstanding universal value of its natural and cultural heritage. The BJCMNP is surrounded by a 'Community' Buffer Zone which is not legally defined (as it is outside the BJCMNP boundary) but extends 2 km from the boundary covering an area of 267 km² (26,711ha) incorporating 51 communities.



Figure 1: A section of the Blue and John Crow Mountains National Park. (Photo credit: Denise Chin)

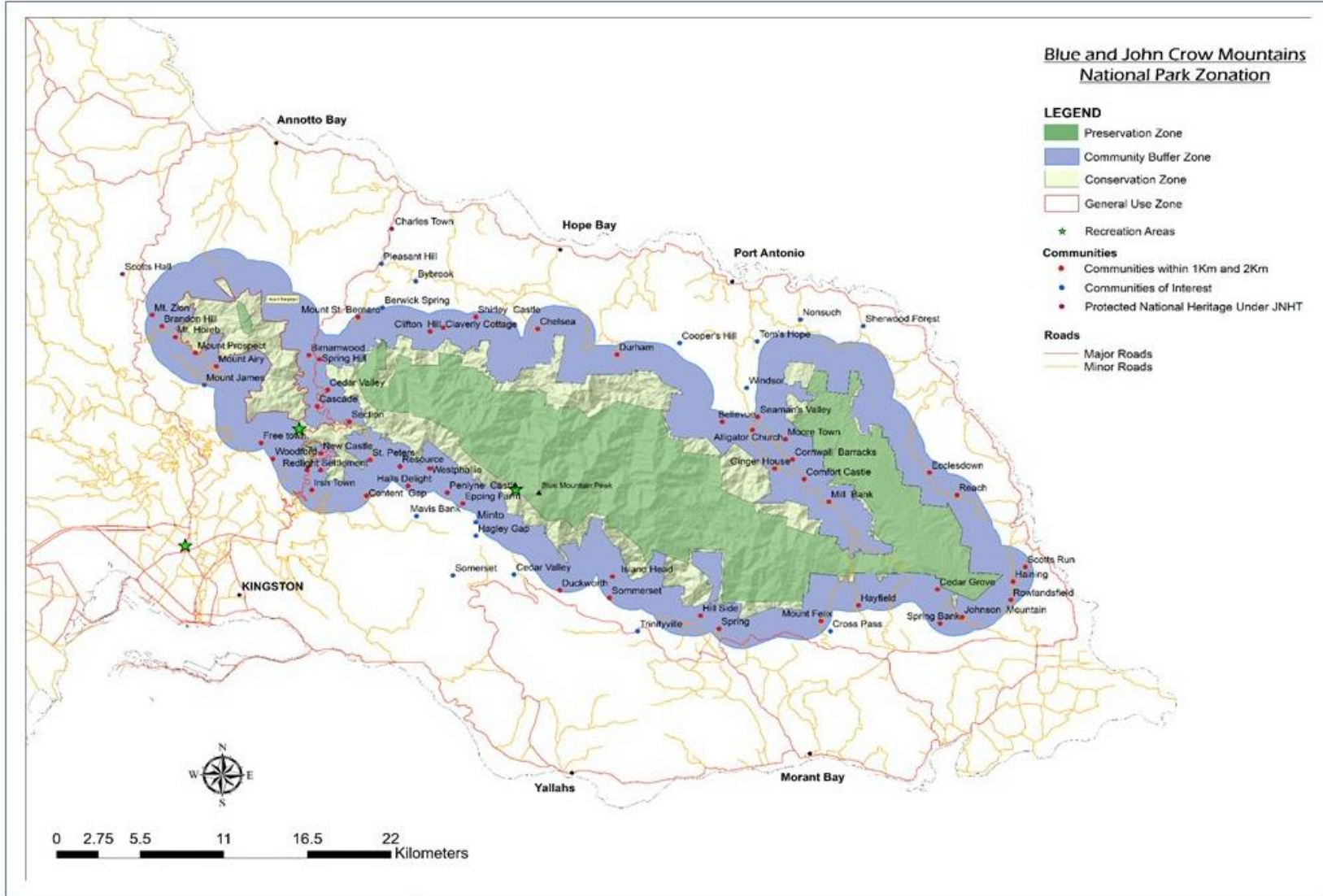


Figure 2: Blue and John Crow Mountains National Park. (Reproduced from JCDT, 2018)

Study Sites

This study was conducted in two communities found within the BJCMNP, Moore Town and Guava to Morant River (Figure 3).

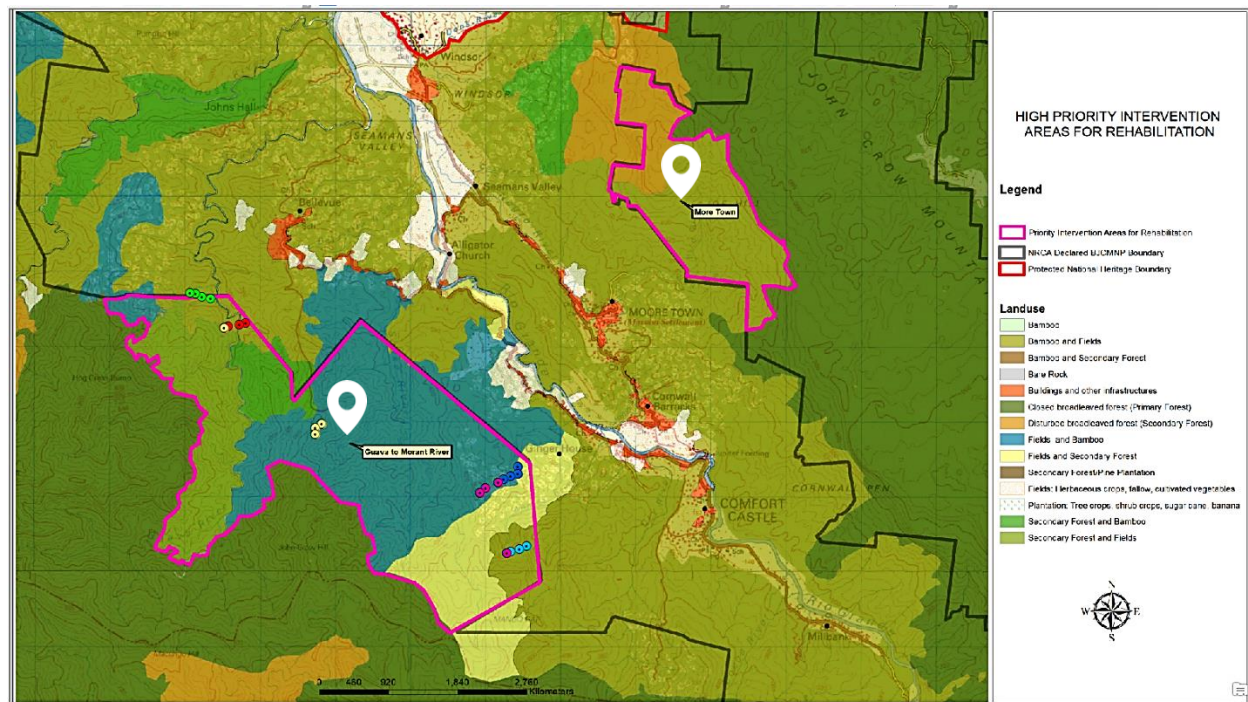
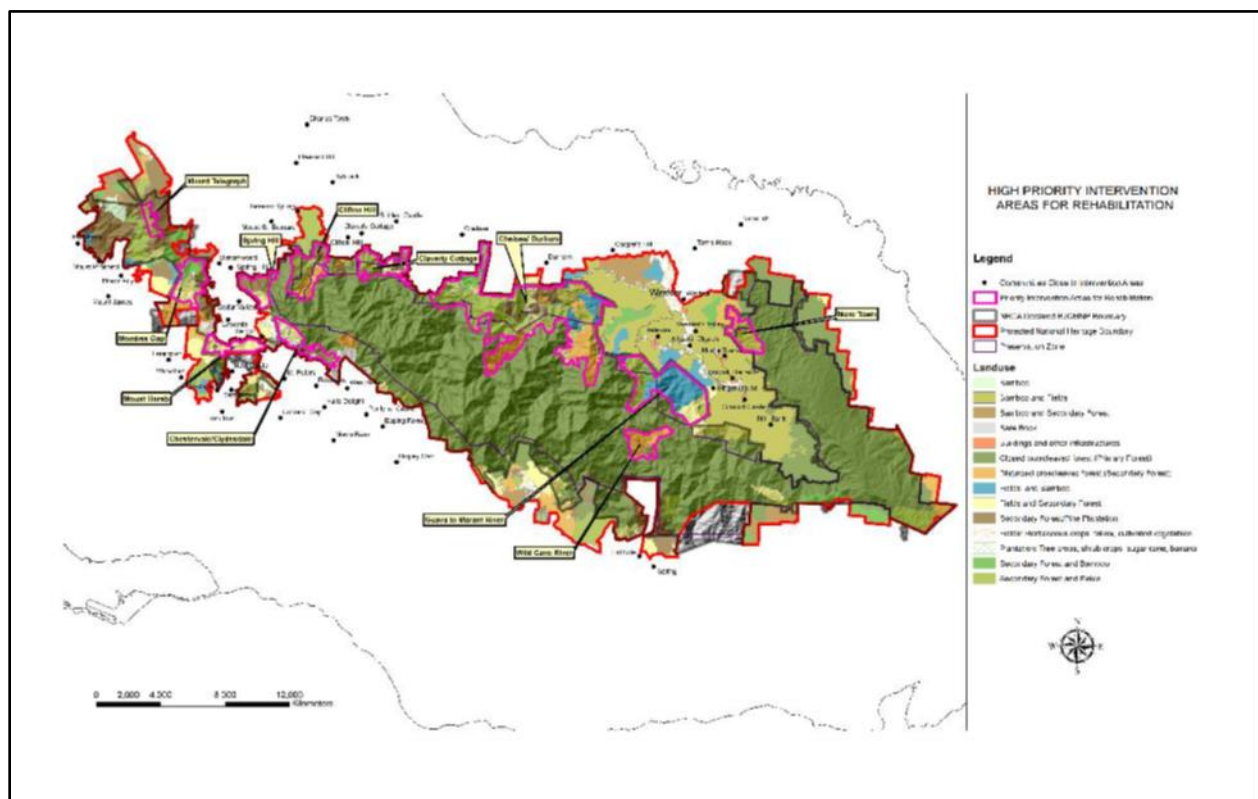


Figure 3: Location Map of the study sites: Guava to Morant River and Moore Town.

The Management of the Blue and John Crow Mountains National Park (BJCMNP)

The (BJCMNP) is managed by the Jamaica Conservation and Development Trust (JCDT), a non-government organisation (NGO) and registered company and charity (1988) on behalf of the Natural Resources Conservation Authority (NRCA) through the National Environment and Planning Agency (NEPA) through a collaborative management agreement. The Management agreement was signed in 2000 by the Forestry Department, JNHT, NRCA and JCDT. This agreement seeks to guide operational management of the park by identifying different roles and

responsibilities for the various organizations involved. The National Park is closed broadleaf or primary forest (the area designated as a World Heritage Site – about 26,000 ha) but there are pockets of degraded areas e.g. disturbed broadleaf or secondary forest, bamboo and fields located mostly around the core primary forest.



Biodiversity

Jamaica's Blue and John Crow Mountains sustain biodiversity of global significance. It is among the Caribbean's 290 Key Biodiversity Areas and the 48 Wholly Irreplaceable Sites. The National Park is also on the International Union for Conservation of Nature and World Wildlife Fund list of 200 globally important sites for the conservation of plant biological diversity and is noted as an irreplaceable protected area for the conservation of the world's amphibian, bird and mammal species. The BJCMNP consists of a wide array of ecosystems that contain high flora diversity, as a result of a combination of the diverse substrate types, soils, high rainfall patterns and variations in altitude throughout the area.

Forest on Shale and Limestone are two major conservation targets for the National Park. Deforestation and degradation for agriculture, logging and harvesting of non-timber products as well as the overgrowth of invasive plant species are the main threats to this valuable natural heritage. The Conservation of Natural Heritage Programme in the draft 2017 – 2027 management plan recommends more detailed analysis and ground-truthing of the land cover analysis of satellite imagery to assess the status of degraded forest ecosystems to guide conservation programmes and activities. The variety of ecosystems present in the BJCMNP, coupled with the diverse vegetation of the area gives rise to diverse fauna.

Plants

Over half the flowering plants in the national park are found only in Jamaica and about one third are endemic to the national park. At least 40% of the higher plants (flowering and non-flowering) are also endemic to Jamaica. The forest is made up of large trees such as Juniper Cedar (*Juniperus lucayana*), Blue Mahoe (*Hibiscus elatus*) and Soapwood (*Clethra occidentalis*) and smaller shrubs such as Hot-lips (*Cephaelis elata*) and Jamaican Rose (*Blakea trinervia*) [figure

5]. To capture sunlight in the thick forest, many plants climb up the trees, like Climbing Bamboo (*Chusquea altifolia*) whilst others spend all their lives on the branches of trees, like orchids and bromeliads. Tree ferns and other plants that like a lot of water are common in the Blue and John Crow Mountains.

The trunks and branches of the trees are covered with a wide variety of other plants such as lichens (a combination of algae and fungi) which are usually grey-ish green and are either flat against the tree (or even on rocks) or hang from tree branches like Old Man's Beard.



Figure 5: Hot-lips (*Cephaelis elata*) and Jamaican Rose (*Blakea trinervia*).

Animals

For most Jamaican land animals, the Blue and John Crow Mountains National Park is their last refuge - a large area of natural forest where they are protected from human disturbance. The region is one of two known habitats of the Giant Swallowtail Butterfly (*Papilio homerus*) – the largest butterfly in the Western Hemisphere (figure 6). The Cockpit Country is the other location.

To support the population of this endangered butterfly species, the Jamaica Conservation and Development Trust has worked with members of the Bowden Pen Farmers' Association, which is based near the habitat of the Giant Swallowtail, to establish a plant nursery that grows the Water Mahoe (*Hernandia catalpifolia*). This plant is the only source of food for the *Homerus* butterfly caterpillars. The seedlings have been used to reforest several degraded areas, and this has likely contributed to the increasing numbers of the butterflies seen in the area.



Figure 6: Giant Swallowtail Butterfly (*Papilio homerus*) and Doctor Bird (*Trochilus polytmus*).

The national park is one of the largest bird migratory sites in the Caribbean. Along with Jamaica's endemic birds, it hosts over 200 bird species throughout the year; making it a great location for bird-watching. It is the only place on the island where all Jamaica's unique birds can be observed, including the endangered Jamaican Blackbird (*Nesopsar nigerrimus*). Other highlights for bird enthusiasts include: Rufous-throated Solitaire (*Myadestes genibarbis*) Mountain Witch (*Geotrygon versicolor*); and the Jamaican Tody or Robin Redbreast (*Todus todus*).

While there are no large or poisonous animals in the Blue and John Crow Mountains National Park, it is home to four of Jamaica's six endemic snakes. The Jamaican Boa (*Epicrates subflavus*) is the largest and can grow up to 2 metres (6 feet). The BJCMNP is a major habitat for Jamaica's amphibian population; supporting 11 of the 23 species of endemic frogs; five of which are only found in the BJCMNP. The Jamaican Coney, (*Geocapromys brownii*), is the island's largest endemic animal which was once thought to be extinct is found within the Park (figure 7).



Figure 7: The Jamaican Coney (*Geocapromys brownii*).

National Policy and Legal Framework

Applicable Local Environmental Legislation

Natural Resources Conservation Authority (NRCA) Act 1991

Provides for the management, conservation and protection of the natural resources of Jamaica.

The Natural Resources Conservation (Permit and Licences) Regulations (1996)

Prohibits businesses from discharging emissions, effluent or solid waste without a license from the NRCA, a register of information regarding these permits and licenses will be maintained by the NRCA and will be open for inspection free of charge.

Wild Life Protection Act 1945 (and various amendment Orders and Regulations)

Prohibits removal, sale, or possession of protected animals (e.g. turtles and turtle eggs, crocodiles, coral) and prohibits the use of dynamite, poisons or other noxious material to kill or injure fish.

The Watershed Protection Act (1963) and Amendments

Provides protection to watersheds and areas adjoining watersheds and promote the conservation of water resources. Makes provisions for conservation through the implementation of provisional improvement schemes whereby soil conservation practices are carried out on land.

The National Solid Waste Management Act (2001)

Mandates the National Solid Waste Management Authority (NSWMA) to take all necessary steps to effect the management of solid waste in Jamaica to safeguard public health and ensure that the waste is collected, stored, transported, recycled, reused or disposed of, in an environmentally sound manner.

The Forest Act, 1995

This Act addresses the sustainable management of forests on lands in the possession of the crown and vests management responsibility in the Conservator of Forests. The Act provides for the establishment of forests reserves, the establishment of protected areas, the promotion of forestry research areas, reforestation initiatives and the preparation of a forestry management plan. The latter has been prepared and is being implemented.

The Natural Resources Conservation (Blue and John Crow Mountains National Parks) Regulations, 2003

This is the first declared national park in Jamaica and was so declared pursuant to Section 5 of the Natural Resources Conservation Authority Act. The regulations speak to the establishment of a parks management system.

The Endangered Species (Conservation and Regulation of Trade) Act, 2000

This Act was promulgated to ensure the codification of Jamaica's obligations under the Convention for the International Trade in Endangered Species of Wild Fauna and Flora. The Endangered Species Act governs international and domestic trade in endangered species in and from Jamaica. The Act defines the functions of a Management Authority and Scientific Authority. The Natural Resources Conservation Authority is the Management Authority

International Multilateral Environmental Agreements

Convention on International Trade in Endangered Species of Wild Flora and Fauna

Jamaica's obligations under this convention are now addressed by The Endangered Species (Conservation and Regulation of Trade) Act, 2000.

Protocol on Specially Protected Areas and Wildlife (SPAW Protocol)

Jamaica signed the SPAW Protocol on January 18, 1990. This Convention addresses inter alia the sustainable use of biological resources and recognizes the need for international cooperation in accessing Natural Resources. SPAW provides obligations on State Parties to establish protected areas and management protection measures including buffer zones.

Montreal Protocol (Under the Vienna Convention on the Protection of the Ozone Layer)

Jamaica became a party to the Montreal Protocol on March 31, 1993. The Convention requires State Parties to gradually phase out the production and consumption of CFC's and other ozone depleting substances. Jamaica commenced implementation of its "country program" in March 1997. The Country Program sets out the projects that need to be implemented to achieve the phase out under the Protocol.

The World Cultural and Heritage Convention, 1972

Jamaica accepted this convention on June 14, 1983. The convention identifies and protects the world's natural and cultural heritage considered to be of Outstanding Universal Value. The Jamaica National Heritage Trust is the national focal point.

Physical Environment and Features of the BJCMNP

Climate, weather and trends

Jamaica has a tropical climate, which is defined in the Köppen climate classification as a non-arid climate in which the annual mean temperatures is at least 18°C. As a result of a tropical climate, in Jamaica there are only two seasons: a wet season and a dry season. The main dry season lasts from December to April, and peaks in rainfall occur in May and October. Much of the rainfall results from the moisture-laden northeast trade winds, which, when forced upward over the mountain ranges, deposit most of their precipitation on the northern slopes.

The climate in Jamaica is somewhat moderated by the cool waters of the surrounding Caribbean Sea and highlands of the interior. Average daily temperatures along the coast and lowlands average about 26°C and range only about 1°C to 2°C, from a seasonal low of 26°C in February to a high of 28°C in August. In general, the temperature decreases about 1°C with each 1,000-foot (300-meter) increase in elevation, in addition night time cooling is also more pronounced at higher elevations.

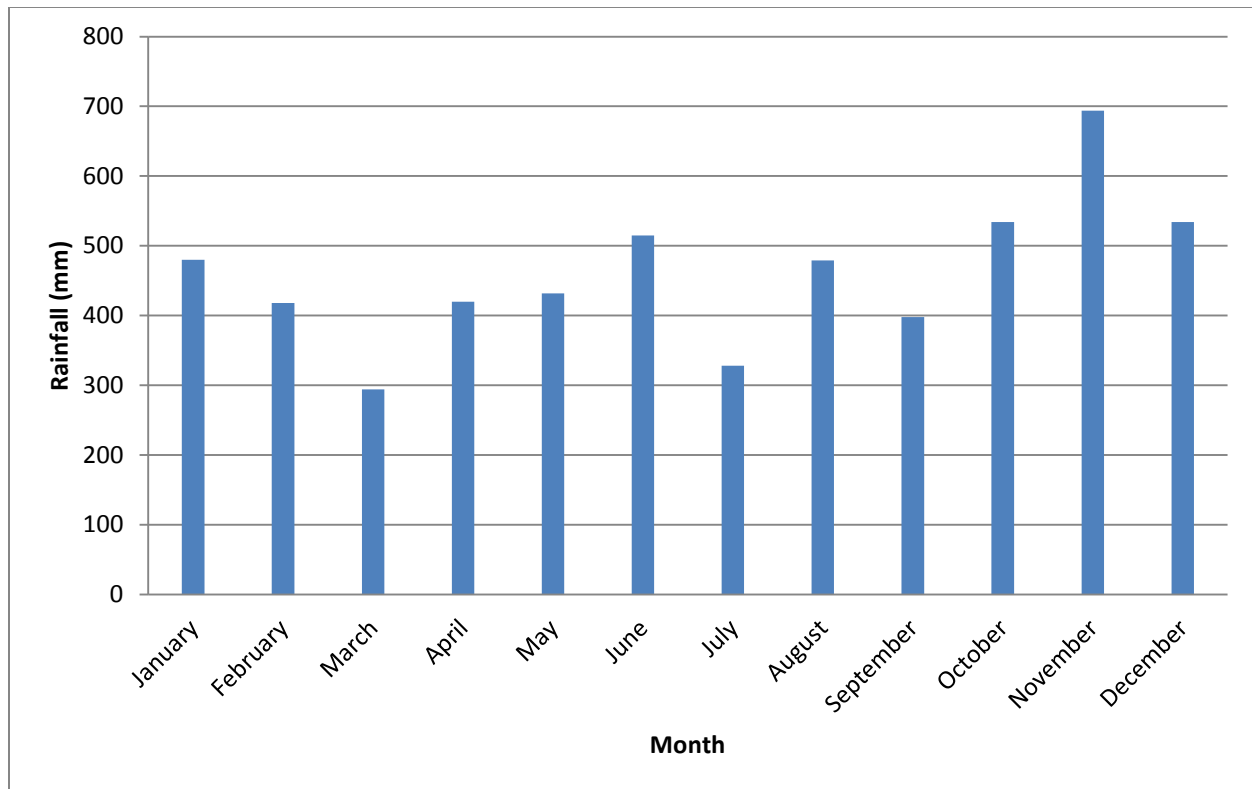


Figure 8: Mean monthly rainfall recorded at the mill bank weather station 1971 - 2000.

The mean monthly rainfall in Millbank ranges from 294mm to 694mm (figure 8). The mean monthly rainfall for Jamaica ranges between 81mm to 317mm per month. The southern half of the island experiences a rain shadow effect, receiving notably lower amounts of rainfall. Rainfall on the north-eastern slopes of the Blue Mountains ranges from a total of 3,000 to 5,000 millimetres per year.

Geology and Geomorphology

The BJCMNP consists of diverse geological features that are a result of sedimentation, volcanism, plutonism, and metamorphic activity. The eastern section of Jamaica can be divided into four regions: the John Crow Mountains Belt, the Blue Mountains Block, the Wagwater Belt, and St. Thomas Shelf. The BJCMNP are comprised of the John Crow Mountains Belt, the Blue

Mountains Block and the Wagwater Belt. The Blue Mountain Block consists of cretaceous, volcanic and igneous rocks, with minor sedimentary (limestone) and metamorphic units. The John Crow Mountain Block is situated to the east of the Blue Mountain Block and the Wagwater Block is toward the west. Both the John Crow Mountain and the Wagwater Blocks are characterized by younger rock formations than the ones found in the Blue Mountain Block. The Wagwater Block consists of sandstones, conglomerates, lavas and shales, while the John Crow Mountain Block consists of sandstones and shales (also called Moore Town Shales) and white limestone (Grubb et. al, 1976).

There are two different types of soils that are found in the BJCMNP namely Blue Mountain and Port Royal Mountain soil types. Blue Mountain soil type is generally highly porous and subject to heavy leaching, resulting in a low nutrient content (especially nitrogen & phosphorus), and low pH. As is characteristic of forest soils, decomposition of organic matter is slow in the Blue Mountain forest, especially at higher altitudes and soils on steep slopes are highly susceptible to erosion. The bedrock limestone of the John Crow Mountain is often at or just below the surface. Soils are shallow and stony, forming pockets between outcrops of rock. Deeper soils, usually in the form of sticky clay, are found in hollows and on ridge tops and there is only a thin litter layer above the humus enriched stratum. The soil types of the John Crow Mountain are all derived from either limestone or calcareous shale.

Biological Environment – Description, Trends and Status

Findings of the Forest Ecosystem Assessment

The Jamaica Conservations and Development Trust (JCDT) in its bid to sustainably manage the Blue and John Crow Mountains National Park (BJCMNP) engaged a team of consultants to conduct a forest ecosystem assessment and report on the findings.

The forest ecosystem assessment was conducted within the Guava to Morant River and Moore Town communities found within the Rio Grande Valley in the parish of Portland, Jamaica. Based on the information gathered from this assessment as well as observations on the ground, the team of consultants has identified the following recommendations that could be implemented for improving the conservation efforts in the study areas of the BJMNP:

- There should be an ongoing public education programme within the BJCMNP geared towards all stakeholders within the Rio Grande Valley.
- Increased monitoring/patrolling of the area should be considered to monitor/prevent further encroachment within the Park.
- Additional signs should be installed across the BJCMNP highlighting the boundaries of the forest reserve.
- More effort should be placed in creating groups within each community that will play an active role in assisting the JCDT with the day to day monitoring and on the ground management of the protected area to reduce the shortfalls relating to the co-management of the natural resources in the study areas.

It has been concluded that the diversity of both sample sites were both relatively low with the Guava to Morant River area being more diverse than the Moore Town area that has been observed to be more degraded by negative human influences. Both areas however, were significantly affected by anthropogenic disturbances, some evidently having occurred many decades ago. The primary human driven adverse effects include unsustainable harvesting of forest products (example lumber), land clearing for agricultural expansion and improper waste disposal.

Based on the ratio of juvenile trees to adults as well as the vegetation identified and recorded at the sites both areas can be classified as secondary forests. The forest is regenerating; this process is known to be a very slow, gradual process (ecological succession) as the forest moves from its current stage to the climax stage of succession. Intervention is needed by the management of the area to decrease the level of deleterious human influences, which may inhibit the succession of the forest in the areas of interest.

Invasive Alien Species

An invasive alien species (IAS) is a species that is established outside of its natural past or present distribution, whose introduction and/or spread may cause economic or environmental harm or adversely affect human health. Invasive alien species are a major driver of biodiversity loss worldwide. An analysis of the IUCN Red List shows that IAS are the second most common threat associated with species that have gone completely extinct, and are the most common threat associated with extinctions of amphibians, reptiles and mammals (IUCN, 2018).

The Forest Ecosystem Assessment showed that in the Guava to Morant River and Moore Town areas, 6 invasive plant species were observed during the study that affected both sites. The most

dominant IAS in the areas were *Bambusa vulgaris* and *Panicum maximum*. The IAS' affecting the study area are primarily affecting native species by out-competing them for space.

The IAS pose a significant threat to the regeneration of the forest as the presence of fast growing grasses such as *Bambusa vulgaris* and *Panicum maximum*, can impede or prevent the growth of seedlings or sapling by shading out sunlight, using up nutrients and water, or by competing for root space below ground. The *Bambusa vulgaris* in many cases begin to grow in the area in which it is introduced and becomes established. Wild ginger and wild hops are not widespread (mostly associated with animal husbandry) and should be targeted for control.

Species with Special Conservation Status

Jamaican plants are highly threatened and endemic species even more so than non-endemic species (Kelly, 1988). According to the IUCN Red List, there are 324 taxa of threatened and near-threatened trees that occur in Jamaica, 106 of which are found in the BJCMNP. In addition to flora there are protected animals that inhabit the BJCMNP, most notable the Giant Swallowtail Butterfly and the Jamaican Coney.

Threatened and Protected Species in Study area

Giant Swallowtail Butterfly

The Giant Swallowtail Butterfly also called Homerus swallowtail (*Papilio homerus*), family Papilionidae, is the largest butterfly in the Western Hemisphere and is endemic to Jamaica (Brown *et al.*, 1994). The species is listed in the IUCN Red Data Book, *Threatened Swallowtail Butterflies of the World* (Collins, 1985), and is protected as an Appendix I species by the Convention for International Trade in Endangered Species (CITES) and the Jamaican Wildlife

Act of 1988. There are two known populations of *Papilio homerus* in Jamaica, the Cockpit Country in western Jamaica, and the Blue and John Crow Mountains in eastern Jamaica.

In Eastern Jamaica, the only confirmed host plant for the larvae of *P. homerus* is the native plant *Hernandia catalpifolia*, locally known as water mahoe and pumpkin wood (Emmel et al., 1990). Adult *P. Homerus* lay their eggs on these plants, and during the larval stage of its life cycle, the plant is used as the food source. The presence of *H. catalpifolia* is therefore important for the survival of this critically endangered species of butterfly.

A major threat to the survival of *P. homerus* is habitat destruction. Loss on intact forests due to clear cutting and agricultural expansion not only decreases the size of the habitat available, but also influences the micro-climate needed for the survival of this species.

Another significant threat to the habitat of *P. homerus* is the presence of invasive alien species such as *Bambusa vulgaris*. *B. Vulgaris* grows rapidly and survives in a wide variety of environmental conditions; these invasive plants could potentially out-compete the larval food of *P. homerus* (Laurance, 2004).

Throughout this study, no *P. homerus* individuals were observed in the study area, however the presence of *H. catalpifolia* is an indication that the sites highlighted in figure 9 may be in the range of the butterfly species.

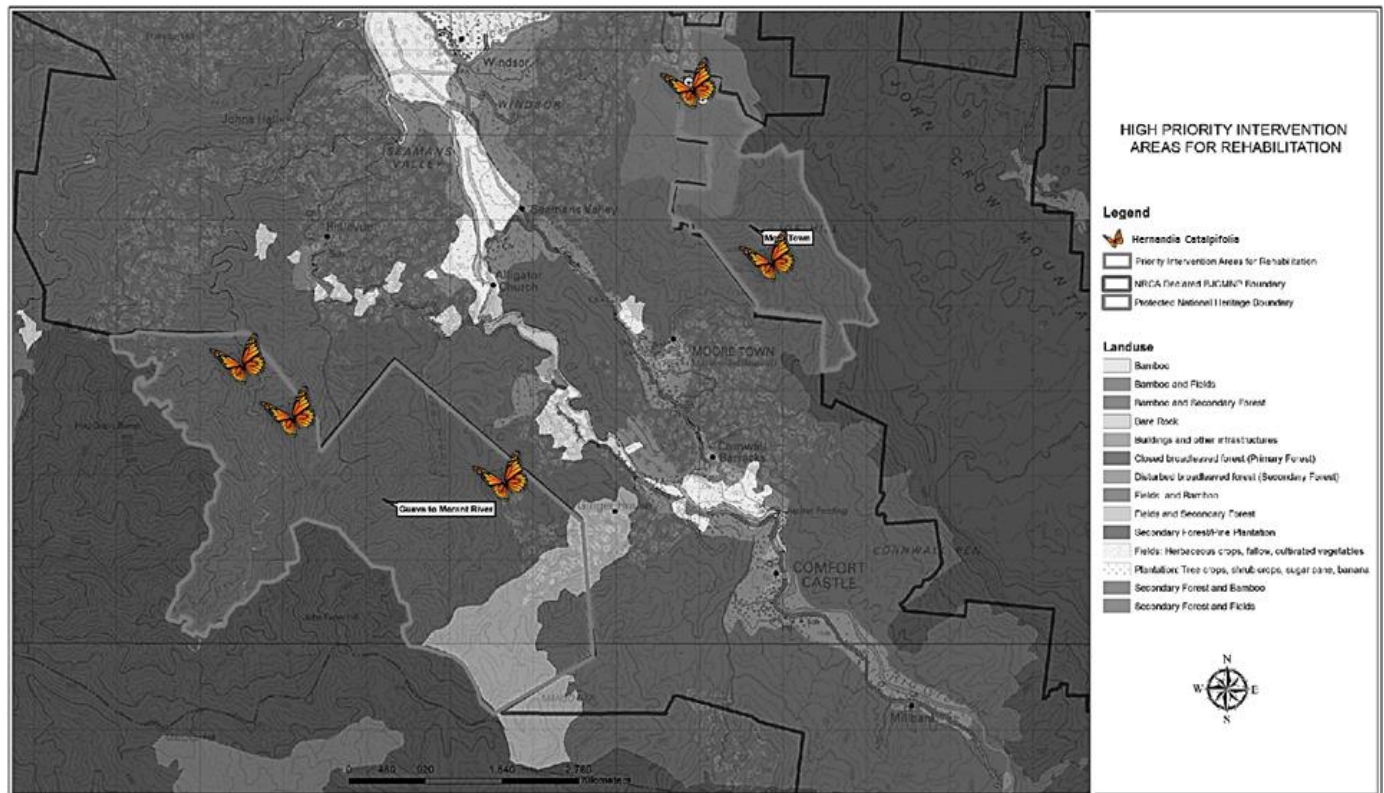


Figure 9: Distribution of *H. catalpifolia* in the study area.

Jamaican Coney

The Jamaican Coney (*Geocapromys brownii*), also known as the Jamaican hutia and the Browns hutia belongs to the order Rodentia and the family Capromyidae. It is a nocturnal, terrestrial land mammal found in the rocky, forested areas of Jamaica, and is endemic to Jamaica. The Jamaican Coney has sixteen population sites that have been located on the island, including the John Crow and Blue Mountains of Portland in the east, the Hellshire Hills and the Brazilletto Mountains in the south and the Cockpit Country in the northwest. It is classified as an endangered species (Kennerley, Turvey & Young 2018). Within the study sites of the BJCMNP, the Jamaican Coney has been observed and/or hunted by the locals. Though this study is focused on the general forest ecosystem of the sample area, figure 10 illustrates an informal distribution map of the Jamaican

Coney based on the personal communications with various locals. It should be noted that the points highlighted were within sampling areas.

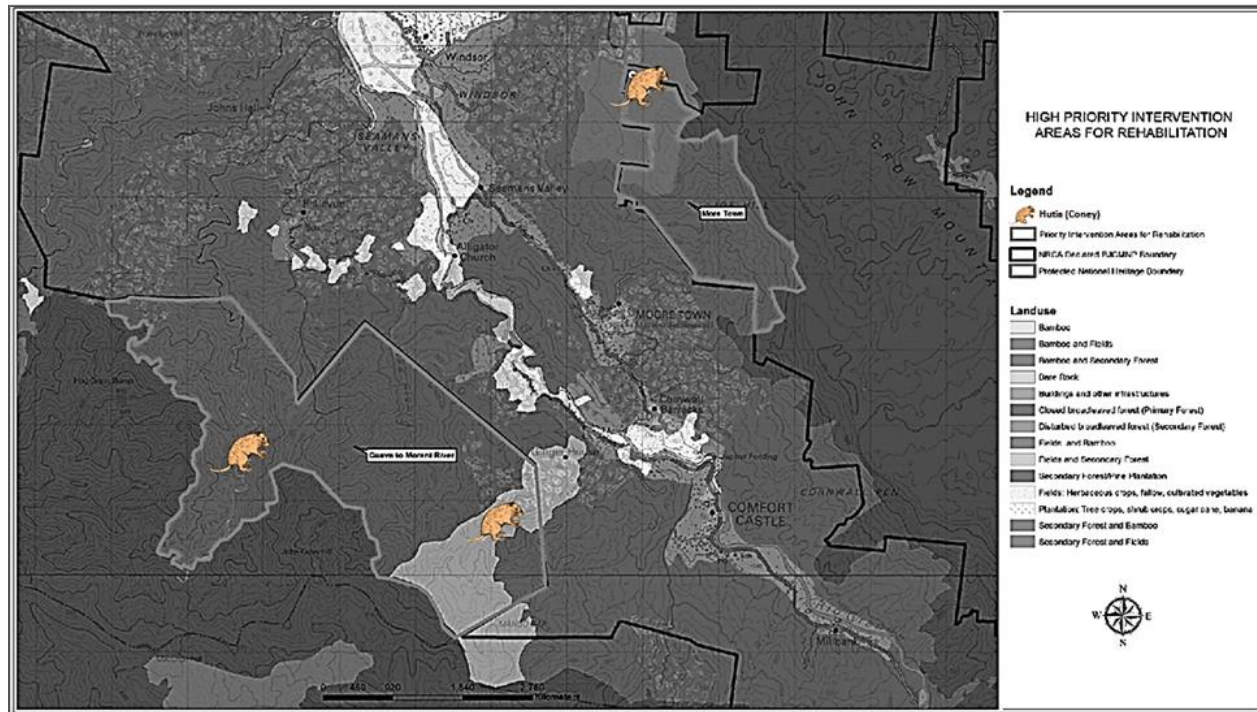


Figure 10: Distribution of the Jamaican Coney within sampling area.

Birds

The BJCMNP is one of the most important habitats for birds in Jamaica. The area is habitat for several species of Jamaican and migratory birds; most of the Jamaica's 256 species of indigenous land birds can be found within the boundaries of the protected area and its environs, in addition to approximately 40 species of migrant birds from North America. The BJCMNP is the only area in Jamaica that all of Jamaica's 28 endemic species of birds can be found in one place. Common endemic birds of the Park include the Mountain Witch (*Geotrygon versicolor*), the Jamaican Woodpecker (*Melanerpes radiolatus*), Red-billed Streamertail (*Trochilus polytmus*), Jamaican Tody (*Todus todus*) and Blue Mountain Vireo (*Vireo osburni*).



Figure 11: Jamaican Tody, Rufous-throated Solitaire and Mountain Witch birds.

The BJCMNP is also haven to 8 of the 28 Jamaican endemics that have special conservation status (as they have reducing populations), these include Yellow-billed Parrot (*Amazona collaria*), Black-billed Parrot (*Amazona agilis*), Ring-tailed Pigeon (*Patagioenas caribaea*) and Jamaican Mango (*Anthracothonax mango*) [figure 12].



Figure 12: Endemic birds found within the BJCMNP (Top row L-R: yellow-billed Parrot, Black-billed parrot, bottom row L-R: Jamaican Mango and Ring-tailed Pigeon).

Jamaican Boa

The Jamaican Boa (*Epicrates subflavus*) [figure 13] is classified as a vulnerable species according to the IUCN Red List. The Jamaican Boa is an endangered species in the island and is protected by several laws and regulations. The Jamaican Boa is also referred to as the yellow snake and is endemic to Jamaica (Tzika et al. 2009). They feed on birds, bats, rats, lizards, frogs and insects (NEPA, 2008). They are the largest snakes in Jamaica, reaching lengths of eight feet or longer.

In the BJCMNP, there have been reports of boas sighted in the eastern Blue Mountain, the north-eastern slopes of the Back Rio Grande catchment and the southeastern slopes of the Plantain Garden River catchment. While in the John Crow Mountains, boas were reported in the Rio Grande Valley. Jamaican Boas are known to depend on low altitude forest of elevations, less than 900m. Hence, there should be some consideration for the protection of the remaining forests in these threatened lower altitudinal areas. Though boas appear to be adaptable to non-natural forest areas, they depend on large tracts of forest to maintain a viable breeding population. There have been reports of boas being hunted for their skin and meat; though this may not be on a large scale. Culturally, Jamaicans share a morbid fear of snakes including the misconception that that they are poisonous, causing the animal to be often killed on sight. Other sources of snake mortality include predation by dogs, cats and mongoose.



Figure 13: Jamaican Boa (*Epicrates subflavus*).

Cultural and Socio-Economic Status

Methods

Data were collected by means of household questionnaires during a field trip to the study area in June 2018. The household survey was conducted by the project team members via in-depth questionnaires, taking approximately 30 – 45 minutes each, to complete. Focus group discussions consisted of 2 – 4 male and female participants, exploring community level information on a broad range of issues not covered in the questionnaire.

A total of 30 households with an average of 4 persons per household were surveyed, representing 120 individuals.

Socio-Economic finding for Moore Town & 'Guava to Morant River Area'

The Blue and John Crow Mountains National Park (BJCMNP) Conservation Area will incorporate a baseline understanding of the socio-economic status of the population, and their relationship with the area's biodiversity.

The overall objectives of the research were to understand the livelihood strategies and the degree of dependence on natural resources of the affected communities, while also identifying glaring needs or problems. The terms of reference for the study were to investigate:

- General household demographics
- Educational background and expectations for children
- Primary means of livelihood
- Average level of income per person/ per family and how many people this income supports
- Trends in socio-economic status over time
- Average distance of the family to the nearest health clinic and school
- Health concerns
- Importance of biodiversity and wildlife to residents
- Perceptions of and problems with supporting infrastructure for communities
- Perceptions of primary needs

This study focuses on the Moore Town and ‘Guava to Morant River Area’ with a total of 30 persons within both communities surveyed as per figure 14 below:

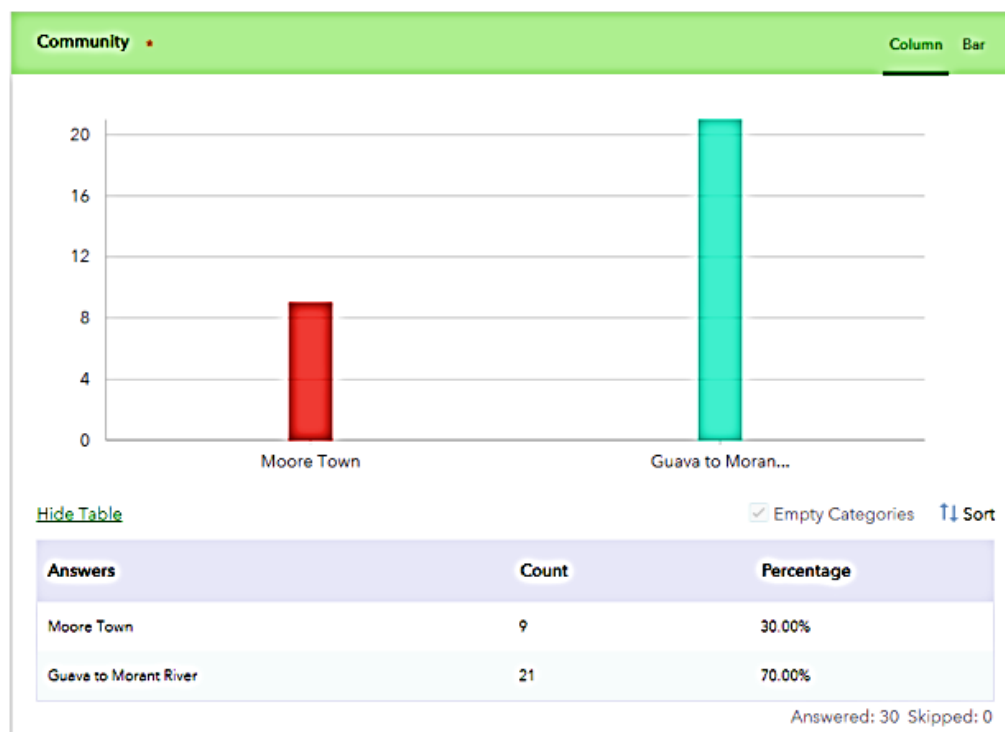


Figure 14: Survey participation in Moore Town and Guava to Morant River Communities.

General household demographics

The sample population had an even gender balance in both study areas and 80% of households were headed by males. 83.33% of the individuals interviewed were aged 30 – 64 years (working age) with the remaining 16.67 % being over the age of 65 (figure 15).

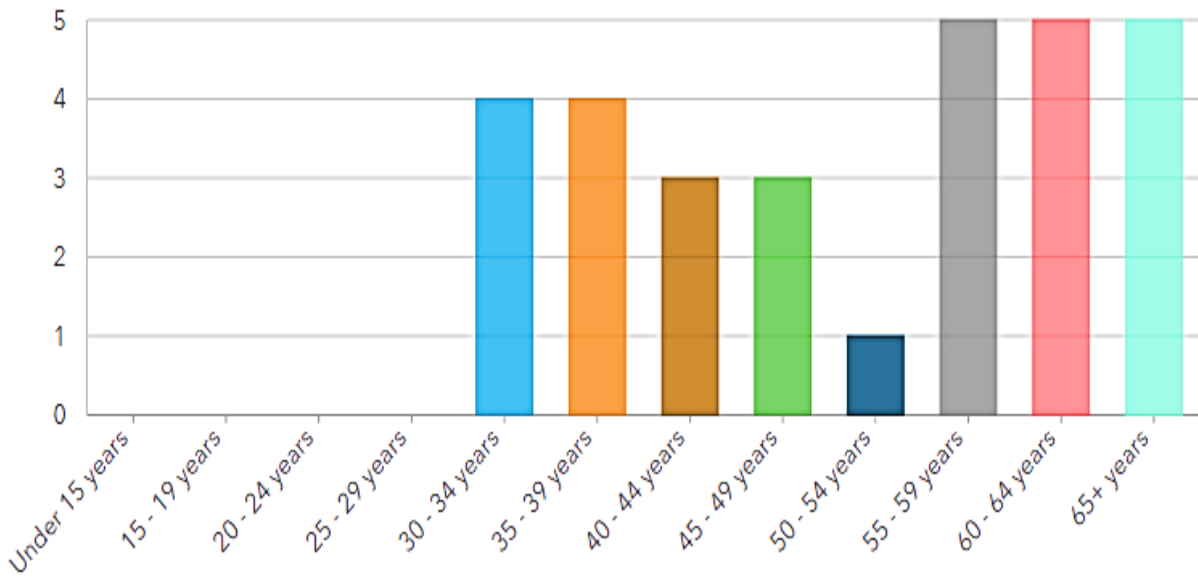


Figure 15: Age group of household heads in Moore Town and Guava to Morant River communities.

Of the total households sampled, the main union status for the head of the household was single (36.67%) followed by common-law (33.33%), married (23.33%) and lastly separated (6.67%) [figure 16].

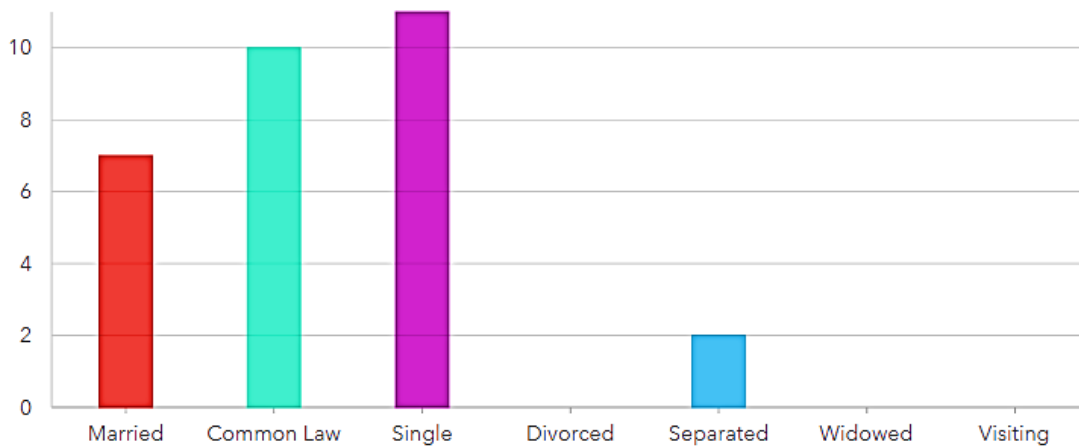


Figure 16: Marital status of household heads.

The family predominant family structure of the households surveyed has been identified as nuclear (40%) followed by extended and single family tied at 26.67%.

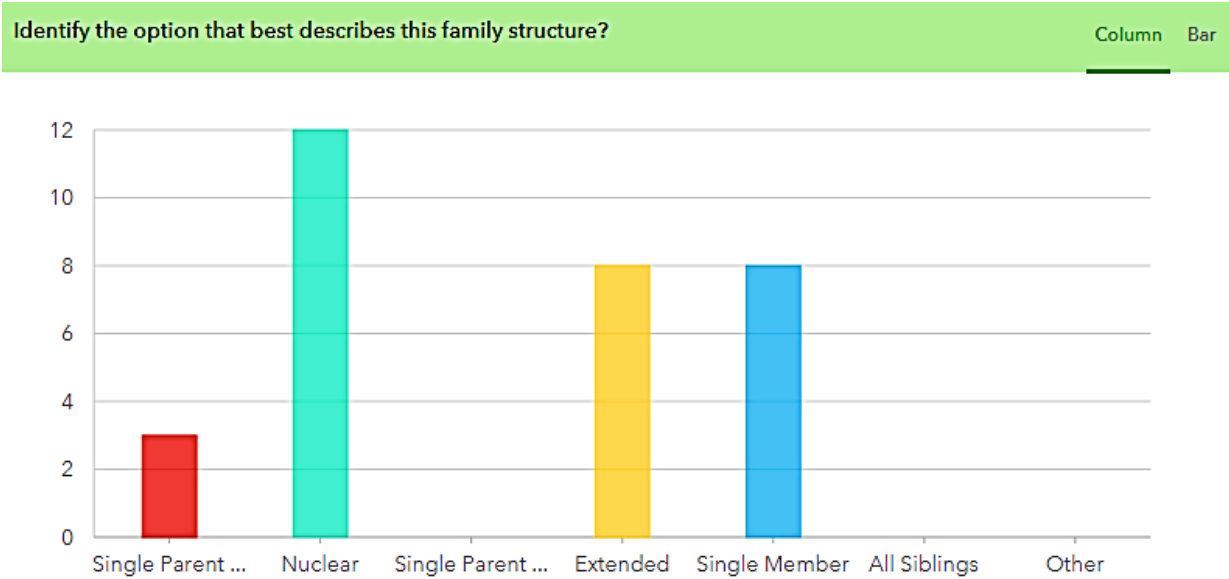


Figure 17: Survey showing the family structure of participants in Moore Town and Guava to Morant River Communities.

Education

The majority of both males and females interviewed have attained primary level education (56.67%) with 30 % at the secondary level and the remainder (13.33%) has never attended school. Overall, education was perceived as important, but the costs involved with school fees, uniforms, food, shoes and other related items have been cited as reasons for non-attendance.

Educational Attainment

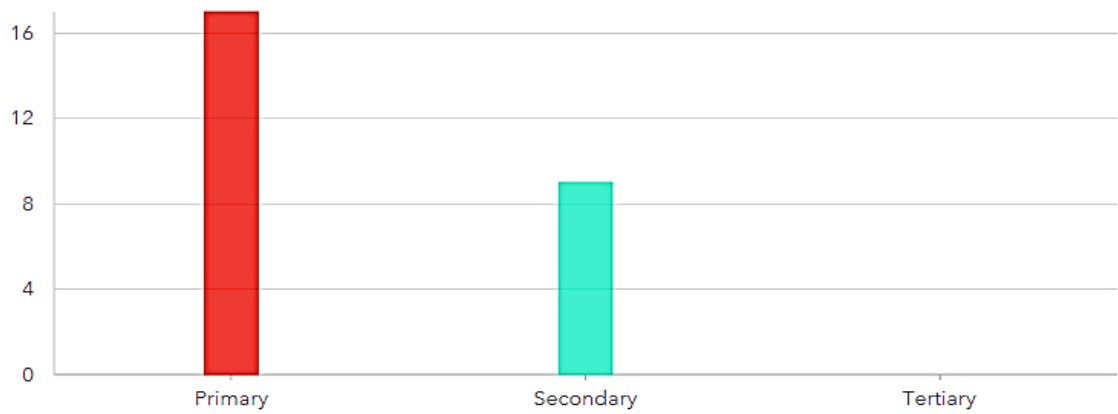


Figure 18: Survey showing the educational achievements of participants in Moore Town and Guava to Morant River Communities.

Livelihoods and household income

The primary livelihood strategy of the population in the area was subsistence farming, however, the main type of business enterprise solution in the community has been identified as shopkeeping at 70% followed by agricultural contractors, tour guides and labourers.

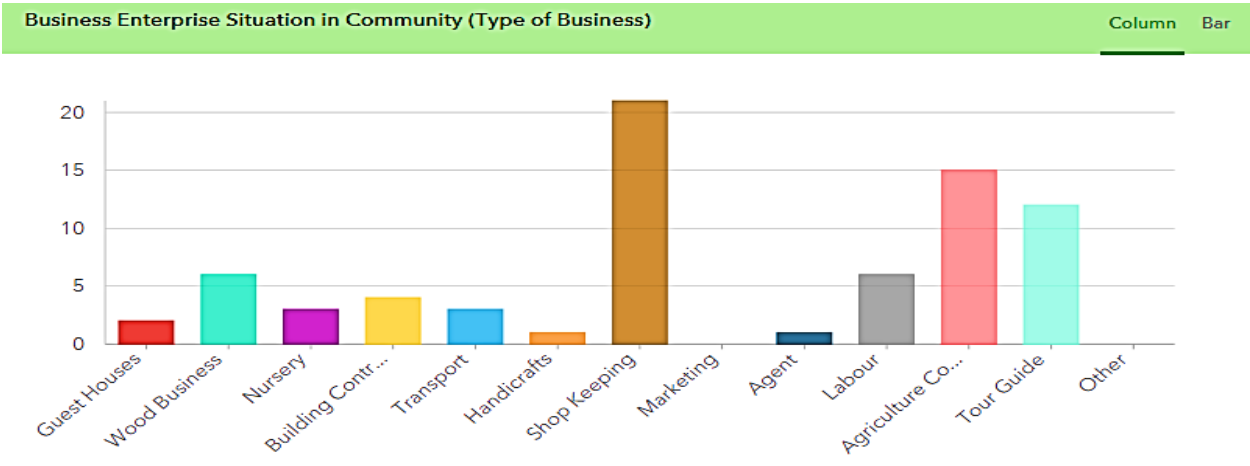


Figure 19: Survey showing the types of business/trades owned/carried out by participants in Moore Town and Guava to Morant River Communities.

For the majority of households in the study area, growing crops was the most important source of food. The main crop type being cultivated within the area is banana (66.67%) followed by ground provisions, coffee and pimento. The predominant animal husbandry being practised involves goats followed by pigs, cows and hunting of the wild boars. The predominant average cost for production per year for these farmers is less than \$50,000.00 Jamaican dollars as per table below:

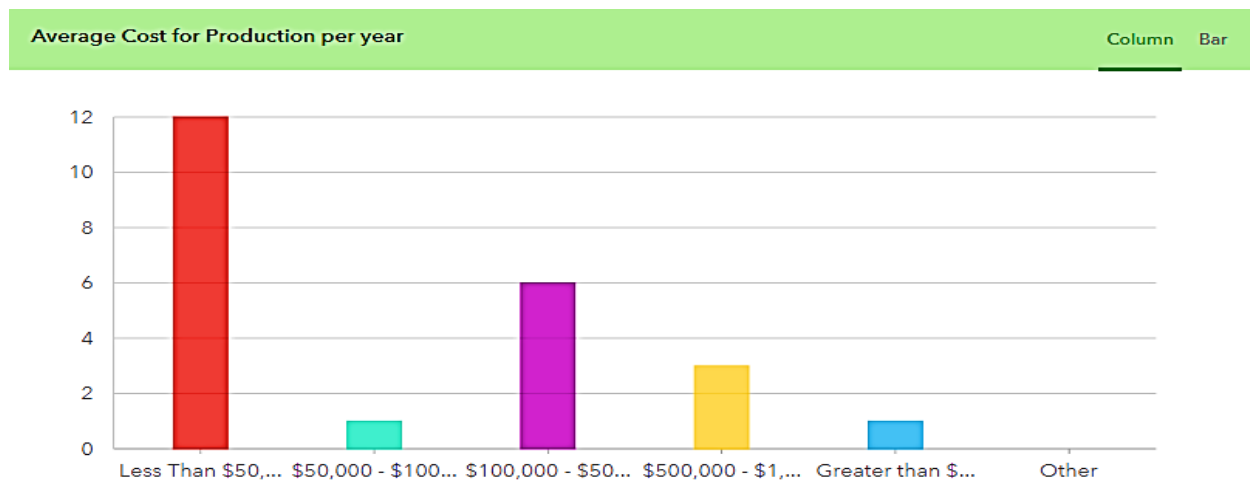


Figure 20: Survey showing the investment cost for agricultural crops for participants in Moore Town and Guava to Morant River Communities.

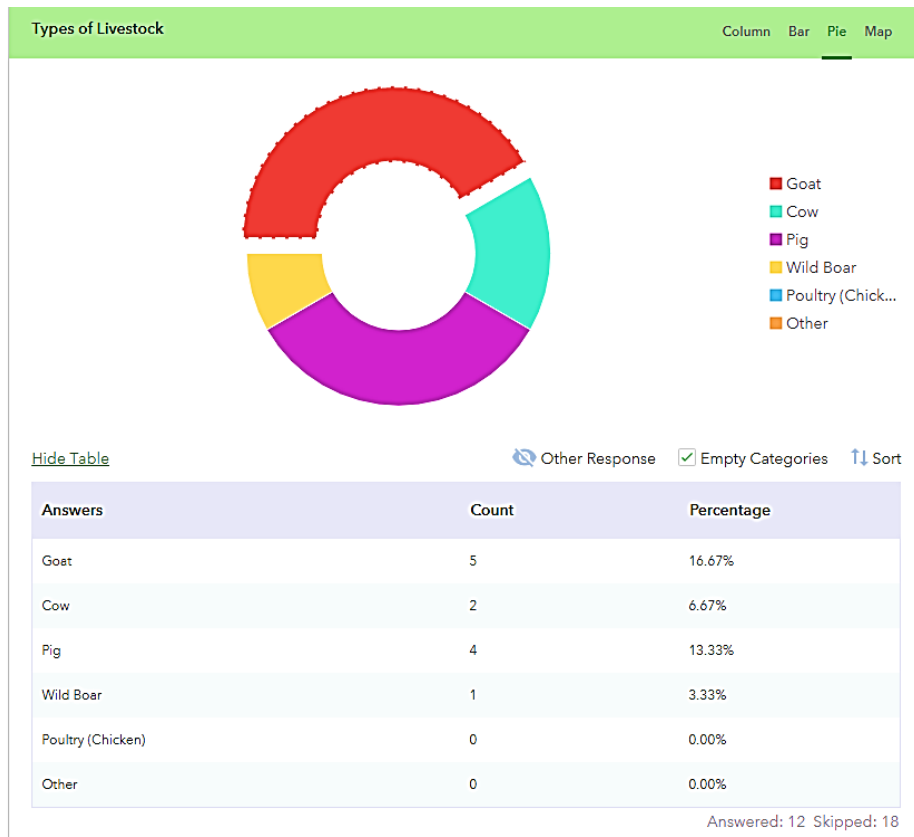


Figure 21: Survey showing the breakdown of types of animal husbandry done by participants in Moore Town and Guava to Morant River Communities.

Importance of biodiversity & wildlife to residents

An overwhelming 80% of persons interviewed have stated that forestry is important, very important or extremely important to their overall livelihoods.

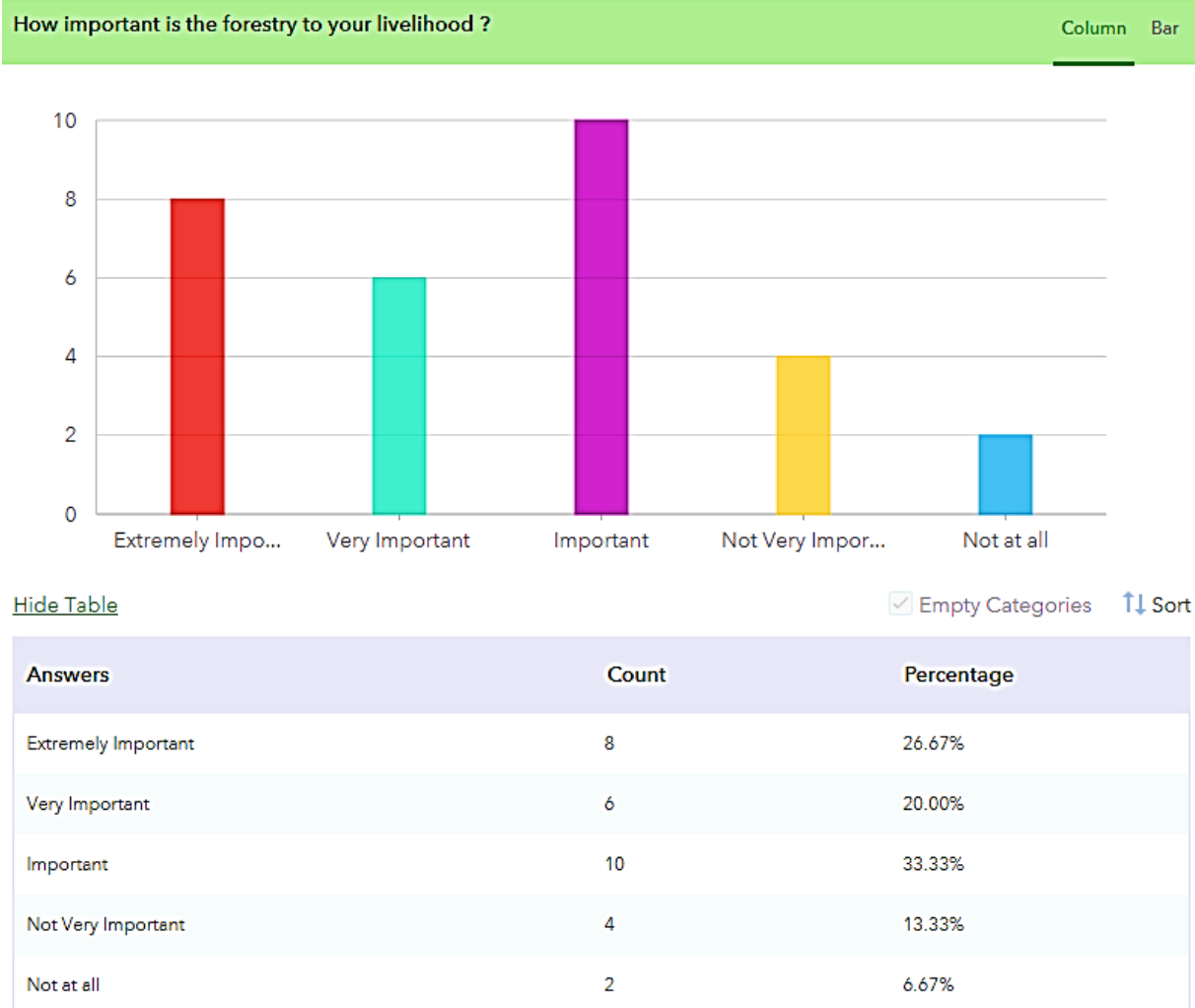


Figure 22: Survey showing the perceived importance of the forested areas to participants in Moore Town and Guava to Morant River Communities.

Primary needs and challenges

An open-ended question in the household survey asked respondents to identify the current social, economic and environmental problems faced by the community. Poor road conditions were revealed to be the number one constraint for the community and its long term sustainable development. Unemployment was stated to be the second greatest impediment to community’s livelihood with natural disasters coming in a close third.

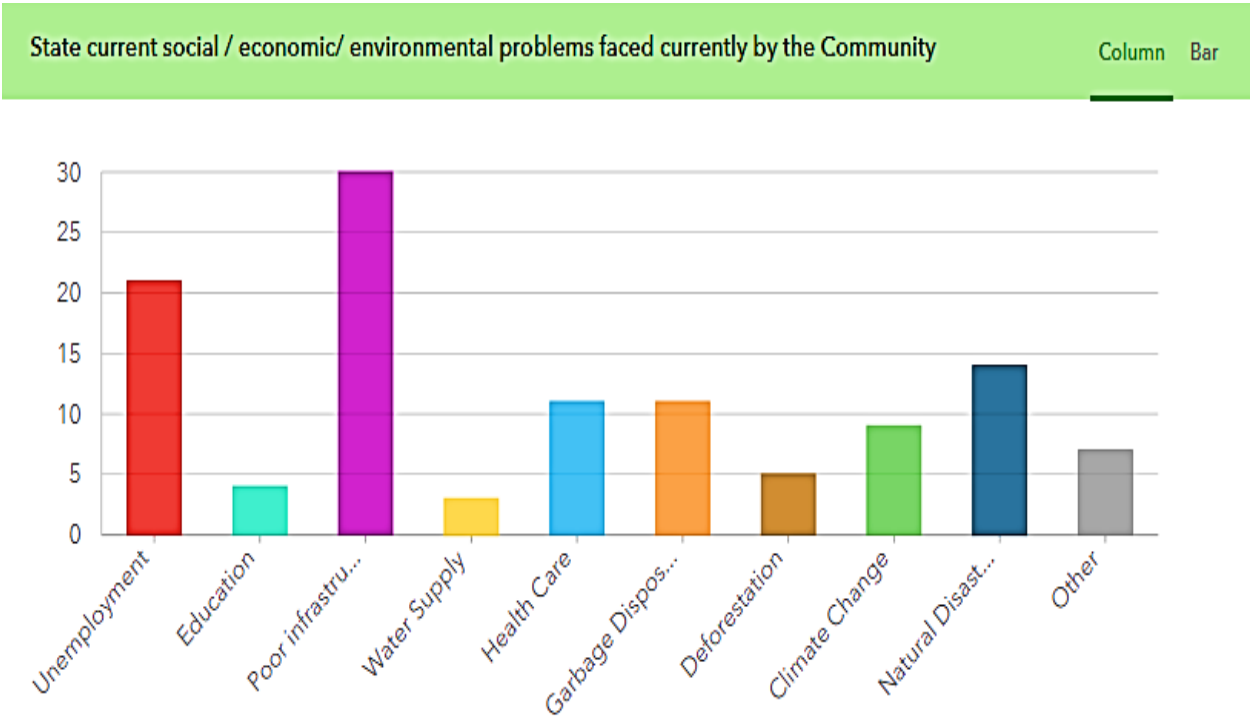


Figure 23: Survey showing the social, economic & environmental problems faced by participants in Moore Town and Guava to Morant River Communities.

Table 1: Survey showing the participation in Moore Town and Guava to Morant River Communities.

Answers	Count	Percentage
Unemployment	21	70.00%
Education	4	13.33%
Poor infrastructure (Roads)	30	100.00%
Water Supply	3	10.00%
Health Care	11	36.67%
Garbage Disposal	11	36.67%
Deforestation	5	16.67%
Climate Change	9	30.00%
Natural Disasters (Landslides, Flooding, Hurricanes, Drought)	14	46.67%

Physical Infrastructure

(Water supply, sewage disposal, electricity, telecommunications, internet)

Water Supply

Majority of the households interviewed have stated that their water supply is potable (piped from a catchment maintained by the Portland Municipal Corporation) and this is reflected in the previous table which alludes to water supply have the lowest score in terms of current problems being faced by the community.

Water Resources

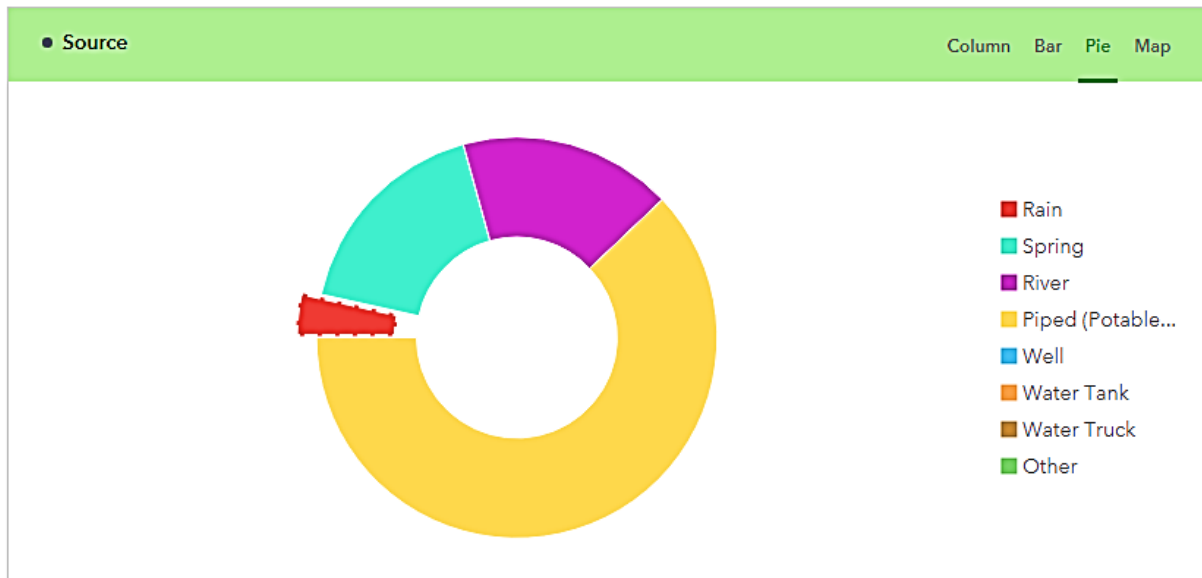


Figure 24: Survey the primary source of water for participants in Moore Town and Guava to Morant River Communities.

Sewage Disposal

Majority of the sewage disposed in the households interviewed is via septic tank and absorption pit (66.67%) and the remainder via pit latrines.

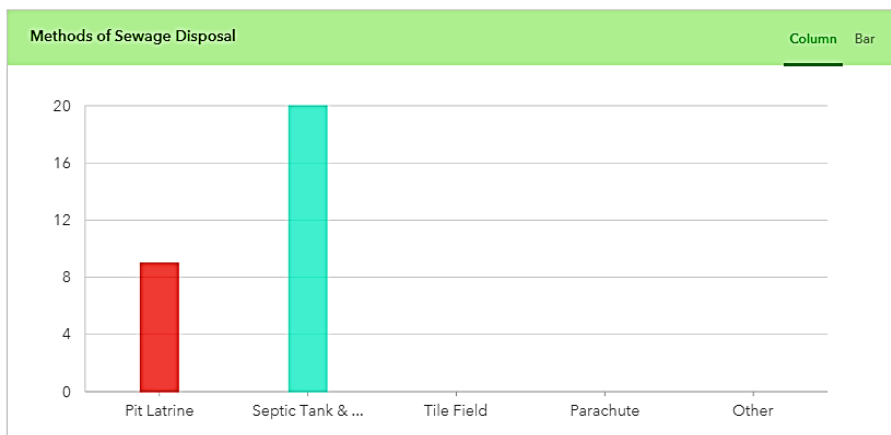


Figure 25: Survey showing the primary mode of sewage disposal for participants in Moore Town and Guava to Morant River Communities.

Housing Stock

Over 75% of the houses in the community are made from concrete with the remainder being Timber (16.67%) and very small percentage being wattle & daub (3.33%).

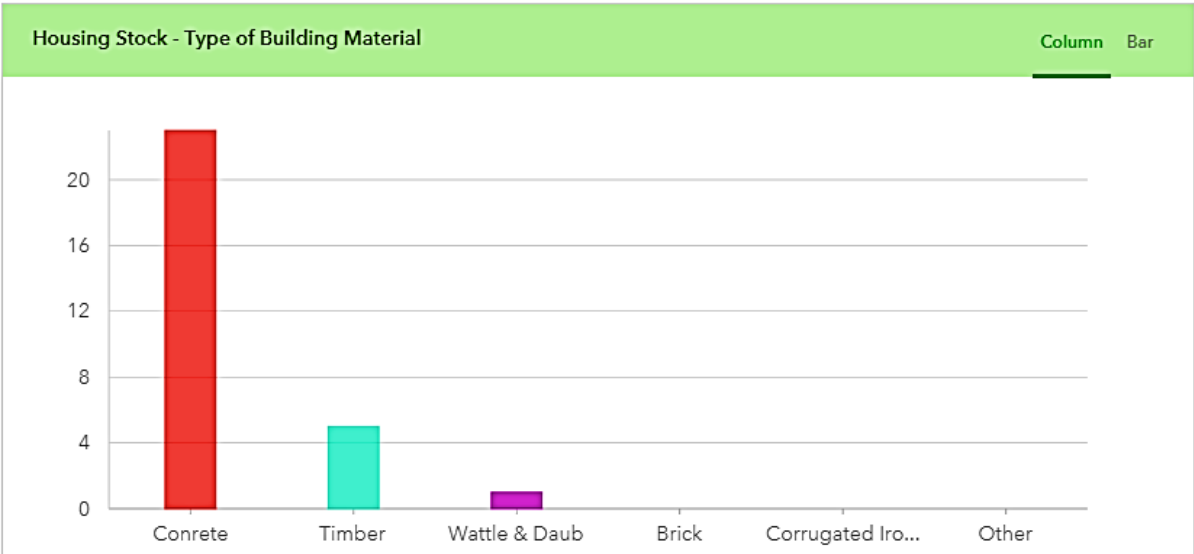


Figure 26: Survey showing the types of building material participants’ houses are made of in Moore Town and Guava to Morant River Communities.

Electricity, telecoms & internet

100% of respondents have electricity, whereas 60% have internet and 83.33% have mobile phones.

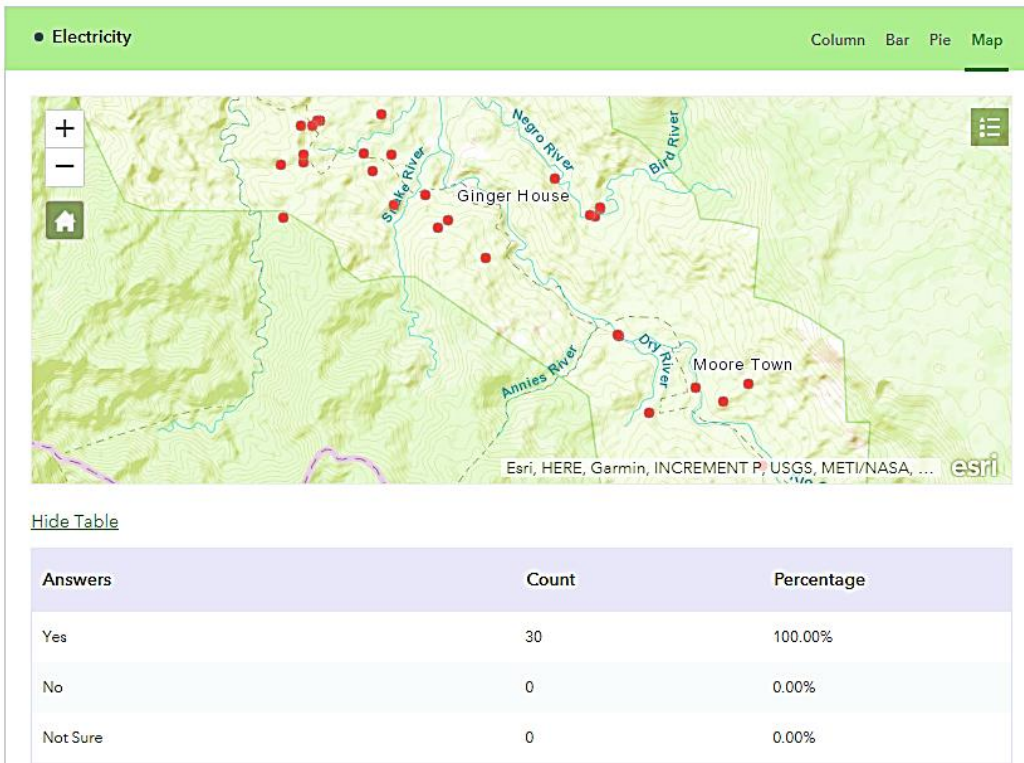


Figure 27: Survey showing the presence of electricity in participants' households in Moore Town and Guava to Morant River Communities.

The population of the BJCMNP has good potable water supply in addition to a wealth of secondary sources via rivers and streams. The area also has good access to electricity with the majority of residents being able to communicate via mobile phones and the internet. The majority of residents however, have mid to low levels of education which are exacerbated by the costs and distances involved in schooling. Group focus sessions also revealed that 'brain drain' has impacted educational attainment levels negatively with persons achieving tertiary level education not returning to the community due to a general lack of employment opportunities.

Economic development is held back by a lack of infrastructure, such as roads, and basic services. Households throughout the study area appear derive low incomes from employment and business

and are highly reliant on agriculture and natural resources for their livelihoods. Agriculture is mainly a subsistence activity, and livestock are kept primarily as a store of wealth.

The lack of skills and infrastructure could also inhibit tourist development and perpetuate the existing disparity in income between areas of different capacity. These impediments can be resolved with much needed skills training, infrastructure improvement and raising public awareness in disaster mitigation and management at the community level.

Regardless of the impediments, and given the low household incomes, tourism development has the potential to make a significant positive impact on people's livelihoods in the study area. With a significant number of residents earning an income via work as tour guides, further training in the importance of the existing biodiversity and its benefits will serve to enhance the tour experience for both visitor and tour guide alike.

Environmental issues and risks

The major threats to protected area have been identified are deforestation, forest degradation, pollution and effects due to climate change. There are various drivers that contribute to each of the major threats identified; however most of these are anthropogenic.

Major Environmental Issues & Risks

Deforestation and Forest Degradation

Deforestation is defined as the conversion of forested lands to other land uses that result in the permanent destruction of the natural forest. Forest degradation on the other hand is defined as a

reduction in the capacity of a forest to produce ecosystem services such as carbon storage and wood products as a result of anthropogenic and environmental changes.

There are a number of human activities within the study area that have the historically and currently have been identified as the main drivers of deforestation and forest degradation. The primary cause of deforestation in the study area is the conversion of forest to agriculture. The main types of farming observed in the area were small scaled subsistence farming and animal husbandry.

During the Forest Ecosystem Assessment, small scale subsistence farming was observed in several spots, well within the park boundaries, where there was removal of primary forest to cultivate crops. Fire is largely used to remove low vegetation and debris; no fire management techniques are generally used. These fires pose a significant risk to forest cover and the faunal species present; there is great potential for the fires to move from disturbed forest into Closed Broad-leaf forest with disastrous effects on the forest cover.



Figure 28: Photograph of land that was cleared by fire for agricultural expansion, within the protected area.

Another dangerous trend is that farmers tend to move onto new patches of land as soon as the plots are being used declines in fertility. The use of bamboo as yams sticks is a common practice by farmers; this is believed to be a primary mode of spreading the IAS to new areas within the protected area. Another disastrous practice that was observed is the use of trees with small DBH (<10cm) in the cultivation (such as yam sticks, fence building) and for the construction of temporary shelters.

The pasturing of animals just outside the boundary of the study area and within the boundary of the study area, present a major challenge to the regeneration of the forest in the study area. Farmers cut the poles from the forest to make fencing for the pastures, poles are routinely cut to repair fences damaged by weather and the animals. The removal of poles interferes with the process of forest succession. To a greater extent however pasturing of animals mainly cattle but also goats and pigs within the study area pose even greater risk and is doing much more damage to forest regeneration. Cattle held in pastures outside study area boundaries have limited range and unless either are released from or escape these pastures do not pose additional threat to the forest. Animals are allowed to roam freely within the forest boundaries with very little concern about their range. These animals tend to graze on the vegetation extensively moving into more accessible areas as grazing becomes harder closer to inhabited area. The cattle severely depress the understory vegetation by grazing and no edible vegetation is spared and could include endemics and or threatened species. The constant movement of animals also makes the ground unstable on some slopes additionally frequently used paths create channels leading to increased water runoff causing soil erosion and land slippages. The presence of cattle within the study is likely to be negatively impact forest dynamics.



Figure 29: Photograph of an area of land that has been cleared and fenced off to be used as a goat pen, within the protected area.

Wild yams are being harvested widely across the both areas as evident by the many holes left after these yams are removed. In order to get to the yams trails are being created and as it becomes more difficult to find yams, movements are made even further in to the core of the undisturbed forest. Trails that are created allow greater access to other individuals for other activity such as the hunting of both wild boars and domesticated pigs that have escaped into the wild. The movement of persons in and out of the forest increases the possibility for the introduction of IAS to new areas.

Juvenile trees (poles) are also being removed from the forest to be used for construction purposes within the surrounding communities, poles are also cut to construct pasture fencing both on privately owned lands and within the protected areas. The removal of the poles has reduced the number of stem available to replace older trees to enable smooth succession of the forest especially seeing that many of the areas within the study is already highly disturbed and clearly has a small number of large stems. The species that are frequently removed are *Clethra occidentalis*, *Cocolobia spp.*, *Nectrandra spp.* and *Miconia spp.*; they are sought for their durability or straight pole for ease of use.

The removal of poles also allows for space that could be readily occupied if invasive is introduced or areas that IAS present can expand their presence.

The harvesting of other non-forest produce if not managed which clearly is the case reduces biodiversity while at the same time makes the harvesting of these produces unsustainable leading to decline and ultimately impacting the livelihood of individuals that depend on such produce.

Climate Change

Climate change is defined as statistical change in the average of the climate of a region or a climatic system; this change includes variations in the atmosphere, the water cycle, the land surface, ice and the living components of Earth. Scientists have been observing since the 1980's that human activities are accelerating climate change globally. The use of fossil based fuels and deforestation have been identified as leading factors that are driving climate change as they exponentially cause an increase in the concentration of atmospheric carbon dioxide (CO₂) which causes the greenhouse effect.

Research has shown that as a result of climate change, several major environmental changes are occurring or are expected to occur. Some of the major impacts on forests due to the effects of climate change include:

- On average, temperatures around the world are expected to increase. Higher temperatures may result in a shift in the vegetation structure of forest; there may be a decrease in the presence of species that are intolerant to high temperatures, and an increase in species that are temperature tolerant.
- Unpredictable precipitation is another effect of climate change. There has been a shift in the last decade in the annual rainfall trends. It has become difficult to predict rainfall patterns, as it has become highly variable. In Jamaica the traditional rainy seasons (April, May, June and August, September, October) has shifted, with rain not being a guarantee in some instances. Reduced rainfall can significantly affect forests, especially “wet forests”, which have species that require frequent watering to survive.
- The matter of forest diseases and insects (pests) is a major concern. It is widely accepted that an increase in temperatures may result in the proliferation of new diseases and pests that may affect plants.
- In recent years, it has been observed that there is an increase in the intensity and the frequency of tropical cyclones that are affecting the Caribbean region. Based on the projections from climate experts, this trend is expected to continue. Mature forest, inclusive of high floral biodiversity (complex forest structure) native vegetation that is associated with climax succession are more resilient to the effects of hurricanes.

Secondary forests on the other hand are less resilient as they tend to have significantly less mature trees, which can withstand heavy gusts, and also display relatively low species diversity, with native species that tend to be “hurricane resistant”.

- Rising sea levels may result in the loss of land from coastal areas to inundation. In addition, rising sea levels may affect agricultural lands in low lying areas through saline intrusion. The majority of agricultural lands in Jamaica are located in alluvial plains (such as South Manchester and St. Elizabeth); forests could be affected by this by migration of people from coastal areas to resettle in the interior of the island or by a major shift of agricultural primarily from coastal areas to inland areas.

Pollution

Pollution is defined as the introduction of substances into the environment that causes adverse change. Pollution is classified into different categories; they take the form of chemical substances, noise and light.

During the assessment of the study area, the major instances of pollution that were identified are as follows:

Improper Garbage disposal/burning

It was observed that improper garbage disposal was a major issue in several communities in the Rio Grande Valley. It was observed in several instances, where garbage was dumped in the river (Rio Grande), burnt in the community or close to the forest reserve. This observation is backed up by complaints by residents during the socio-economic survey, that infrequent garbage collection is an ongoing issue in the community. Garbage is also improperly disposed of within

the forest reserve, primarily by people passing through the reserve and those taking part in illegal farming within the reserve. The main types of garbage observed within the reserve are refuse food packaging, fertilizer/pesticide containers, and discarded farming equipment.

Freshwater Contamination

On the ground feedback suggests that there is a practice of using chemicals such as “tick wash” and chlorine to harvest freshwater crawfish. Both of these chemicals are highly toxic and they also affect non-target species such as river eel, mudfish and bussu; in addition to degrading the water quality of the river. Residents of the communities complain that this unsustainable practice is affecting recreational fishing that has been practiced in the area for many generations. It has been reported that the chemicals are normally injected in the upper reaches of the river, and a mesh is set up further downstream to catch the dead crawfish. This practice does not only pose a serious environmental issue, but is also a potential health risk, as the chemicals used can severely harm humans.

The freshwater resources are also being negatively impacted by the seepage of untreated sewage from septic tanks which are the primary sewage disposal method in the area. The extent of this impact is unknown, and would require rigorous water quality monitoring of parameters that are associated with sewage contamination (Biological Oxygen Demand, Chemical Oxygen Demand, pH, Phosphates, Residual Chlorine, Total Nitrogen and Total Suspended Solids).

Assessment of the Causative Factors of Environmental Issues

Lack of Sufficient Environmental Awareness

Based on the socio-economic survey as well as on the ground observations, there is a need for increased environmental awareness for the communities in the Rio Grande Valley. This can be achieved through increasing public education campaigns in these communities, inclusive of public forums, community environmental events and the distribution of environmental related material.

The key focus areas should be:

- The importance of forest conservation (the biodiversity of the BJCMNP, endemics of the BJCMNP, protected species of the BJCMNP)
- Increased education on the role of forest boundaries and where the boundaries are located.
- Education on IAS: what they are, how they are spread, their negative impact and what can be done to reduce their population
- The importance sustainable agricultural practices, e.g. agro-forestry and use of terracing; the negative impacts of unsustainable practices such as slash and burn, forest clearance for agricultural expansion and overuse of fertilizers and pesticides.

It is also noted that there is a need for capacity building in the community, the introduction of roles such as “Forest Monitors” may inspire positive change in these communities.

Poor Socio - economic State of Satellite Communities

For many people living around the BJCMNP boundaries, farming and resource extraction are the primary means of making a living. There is an increasing trend, where young people, once they reach adulthood, migrate to urbanized areas in effort to gain higher education and employment. In many instances, these rural communities are dominated by older age cohorts.

The socio-economic survey highlighted that community members identify unemployment as a major issue. The lack of employment options in these rural communities is a primary factor leading to the prevalence of environmentally unsustainable activities. With several natural resources that are highly sensitive to human influences, highlights the need for effective management of BJCMNP.

Insufficient Enforcement

Based on observations and feedback from on the ground it has been concluded that there needs to be increased patrolling within the protected area. Most infringements that were observed occurred deep into the forest reserve (>6 km from the boundary), which many community members are of the belief is out of the range of patrol of forest rangers.

Insufficient marking of reserve boundaries

There are signs that inform people when they are in close proximity of the forest reserve boundary, in addition there are markers that outline the forest boundary; however the presence of these signs and markers (monuments) is grossly deficient.

Environmental management measures

Invasive Alien Species Management Programme

The management of the IAS in the area should be a priority for the management of the Moore Town and Guava to Morant River areas. The main areas to be explored should include but are not limited to:

Implementation of an IAS management plan

An implementation of an IAS management plan should be carried out by the management of the protected area. A plan is needed to identify resources and the threats to them, and the ability to prioritize by threat, by geographic area or resource being threatened, and by individual plants.

The implementation of the IAS management plan should involve the following steps:

- The monitoring of current IAS and the effects they have on the natural resources in the protected area.
 - Inventory, survey, and map invasive species and management efforts
 - Document in a written Invasive Plant Management Plan
- Prevention of new IAS from coming into the area.
 - Identify species known to be invasive in the areas close to the protected area.
 - Minimize deforestation by activities such as land clearance for agricultural expansion.
- Reduce the impact of invasive plants on the protected area.

- Prioritize management efforts
 - by geographic location
 - by species, including its ecological impact
- Research best management practices for control methods
- Evaluate the effect of ongoing control efforts (adaptive management)
- Restore sites or promote natural succession as needed
 - Reforestation of bare lands with native vegetation
- Capacity - labour (volunteer and/or paid staff) and equipment
 - Labour – Identify, train, coordinate, and mobilize personnel appropriate to the tasks required. If entirely or partially a volunteer labour force, then a volunteer coordinator position will be necessary to ensure focused and appropriate invasive species management.
 - Equipment – Secure such tools and equipment that will ensure safe and simplest accomplishment of the scale of the tasks at hand.

Reduction in the density of the IAS

The possibility of an IAS eradication programme should be explored. This may entail the employment of people from the surrounding communities who will physically remove IAS from within the protected area. Machetes can be used to cut down/dislodge these species, after which

they can be carefully packaged and removed from the reserve to be disposed of in an appropriate manner. The areas that have been cleared of IAS can then be revegetated with native forest species.

Public education against the spread of IAS

It was observed during the Forest Ecosystem Assessment for the Moore Town and Guava to Morant River areas, that there is a relationship between agricultural expansion and the spread of some IAS (*Bambusa vulgaris*, *Panicum maximum* and *Flemingia strobiliflora*) in those areas. Bamboo for example is primarily spread by farmers, who introduce the plant to areas, via using them as yam sticks or for construction of shelters. A programme should be designed and implemented to engage the farmers and educate them on the adverse effects of IAS, the ways they are spread and discourage them from activities that allow for the further spread of these species.

Implementation of a comprehensive public education programme

This can be achieved through increasing public education campaigns in these communities, inclusive of public forums, community environmental events and the distribution of environmental related material.

The key focus areas should be:

- The importance of forest conservation (the biodiversity of the BJCMNP, endemics of the BJCMNP, protected species of the BJCMNP)
- Increased education on the role of forest boundaries and where the boundaries are located.

- Education on IAS: what they are, how they are spread, their negative impact and what can be done to reduce their population
- The importance sustainable agricultural practices, e.g. agro-forestry and use of terracing; the negative impacts of unsustainable practices such as slash and burn, forest clearance for agricultural expansion and overuse of fertilizers and pesticides.

It is also noted that there is a need for capacity building in the community, the introduction of roles such as “Forest Monitors” may inspire positive change in these communities.

Improvement in Enforcement activities

The management of the BJCMNP needs to ensure that patrols of the area do not only involve the periphery of the boundary, but also the interior of the reserve as this is where most environmental breaches seem to occur. Due to limited resources, there may be inadequate number of forest rangers, which is a limiting factor. Avenues should be explored for the possibility of hiring additional enforcement personnel. In the interim, all efforts should be made to roster the staff currently present, in a manner that allows for increased presence in the protected area.

There is also a need for the amendment of the various environmental legislation to allow for an increase in the fines of various environmental breaches. In most cases, the fine for breaking environmental related laws are punitive and does not effectively act as a deterrent for potential perpetrators.

Improved demarcation of forest boundary

There is a need to increase the number of boundary related signage in the area.

In addition there needs to be increase the number of boundary markers, the possibility of increasing the visibility of these markers should be explored. Installing and modifications to boundary markers is a function of a commissioned land surveyor, which is a limitation as this may result in implementation being costly and time consuming.

Increased use of GIS based Technology

In recent years, the value of adapting GIS based technology such as ArcGIS has proven to be unrivaled in natural resource management. In instances such as with forest reserve management, which requires the oversight of large parcels of land, the technology allows for ease in comprehending a variety of spatial parameters associated with the management area.

Environmental management performance targets

Environmental management plan review

The environmental management plan should specify the schedule or triggers for reviews of the plan. A review should assess whether the plan is achieving its objectives and the requirements of any relevant approval conditions. A review should take into account environmental monitoring records, corrective actions and the results of any audits. The plan should also identify who will be responsible for undertaking the review. During the review process, any reasons for varying the environmental management plan should be documented.

Review of an environmental management plan would typically be undertaken:

- Following significant environmental incidents
- When there is a need to improve performance in an area of environmental impact
- Periodically for actions undertaken over long timeframes such as one, two or five years.

Environmental auditing

The environmental management plan should include the schedule or triggers for auditing the implementation and effectiveness of the plan. It should address both internal and external audit requirements including who is responsible for undertaking the audits and reporting the results.

Actions & Responsible Agencies

The actions will focus on improving public education and environmental awareness within the BJCMNP. Forest boundaries of state-owned lands will be better demarcated and enforcement strengthened.

While the JCDDT will have overall responsibility for the execution of these actions, the lead Ministry will be the Ministry of Economic Growth and Job Creation (MEGJC). All the entities with a lead or supporting role — FD, NEPA, NLA — report to the MEGJC. The actions are detailed in the table below:

Table 2: Showing the actions and responsible agencies needed for the environmental management initiatives in Moore Town and Guava to Morant River Communities.

Action #	Action	Start and End Date	Responsibility	KPI Link	Key Risks/ Assumptions
1.	Implementation of an ongoing comprehensive public education programme and environmental awareness programme within the BJCMNP geared towards all stakeholders within the Rio Grande Valley	Dec. 2018 – May 2019	JCDDT, NEPA	Number of Community members participating in outreach programme. Status of implementation of private farmer outreach programme	Support for programme not sufficient
2.	Improvement in enforcement activities	Jan. 2019 – Dec. 2019	FD, NEPA, JCDDT, JCF	Reduction in the instances of violations of	RISK: Insufficient funding to support hiring

				environmental laws	of more staff & to buy patrol vehicles. Sustained/increase in unemployment.
3.	Improved demarcation of forest boundary	Dec. 2019 onwards	JCDT	Number/percent of forest estates or regions covered in the boundary verification programme	RISKS: Activity needs to be projectized to be completed. Funding a major constraint.
4.	Amend the Forest Act and its regulations along with related legislation to ensure harmonisation in order to: (i) fill existing gaps in the current act; (ii) add additional offences; and (iii) improve the Agency's ability to protect, and regulate the forested areas.	Ongoing	MEGJC, FD, NEPA, Cabinet Office	Amended Forest Act approved, promulgated	RISK: Length of time taken to revise legislation. Final process outside Agency control
5.	Implementation of an Invasive Alien Species Management Programme (Design project and seek funding)	Jan. 2019 – Dec. 2019	JCDT	Reduced deforestation by activities such as land clearance for agricultural expansion. Diversification of employment opportunities.	RISK: Funding support for programme
6.	Increased use of GIS based Technology	Jan. 2019 – Dec. 2019	JCDT	Increased spatial analysis leading to	RISK: Failure of Agency's ICT hardware.

				better management of the BJCMNP via production of comprehensive spatial data to inform the process	Corruption of data. Unreliability and unavailability of corroborating data from NLA
7.	Improvement in solid waste disposal/management activities. Communicate with relevant authorities.	Ongoing	Community based groups, NSWMA, Portland Municipal Corporation	Increased efforts to treat with solid waste in an environmentally sustainable manner.	RISK: Poor quality of road network limiting access for disposal trucks.
8.	Environmental management plan review	June & Dec. 2019	JCDT	Environment management efforts outlined in the management plan being implemented and maintained.	RISK: Insufficient funds for implementation of environmental management initiatives. Poor responsiveness to environmental outreach/education activities.

References

- Allen R.B. 1993 : A permanent plot method for monitoring changes in indigenous forests. 88', in: Kauppi, P. (ed.), *Acidification in Finland*, Springer-Verlag Berlin Heidelberg, pp. 523–560.
Ambio 24, 280–285.
- Anderson, S., Woods, C.A., Morgan, G.S. and Oliver, W.L.R. (1983) *Geocapromys brownii*. *Mammalian Species*, **201**: 1-5. Available at:
Barker, D., 1998. Yam farmers on the forest edge of the Cockpit Country: aspects of resource use and sustainability. In: McGregor, D.F.M., Barker, D., Evans, S.L. (Eds.), *Resource Sustainability and Caribbean Development*. The Press, University of the West Indies, Kingston, Jamaica, pp.357-372.
- Brunig, E.F., 1983. Vegetation structure and growth. In: Golley, F.B. (Ed.), *Tropical Rainforest Ecosystems: Structure and Function*. Elsevier, Amsterdam, pp. 49–76.
- Brown, F. M., and B. Heineman 1972. *Jamaica and its Butterflies*. E. W. Classey, Ltd., London. 478 pp.
- Caughley, G. and Gunn, A. (1996) *Conservation Biology in Theory and Practice*. Blackwell Science, Oxford
CBD, 2006. *Global Biodiversity Outlook 2* Secretariat of the Convention on Biological Diversity, Montreal, 81 + vii pages.
- Collins, N.M.; Morris, M.G. (1985). *Threatened Swallowtail Butterflies of the World: The IUCN Red Data Book*; International Union for Conservation of Nature: Gland, Switzerland; Cambridge, UK, 1985; p. 401.
- Davis, L.S., Johnson, K.N., 1987. *Forest Management*, third ed. McGraw-Hill, New York.
- Denslow, J.S., 1995. Disturbance and diversity in tropical rain forests: the density effect. *Ecol. Appl.* 5 (4), 962–968.
- Ecological Diversity, Biosystematics, and Conservation*; Scientific Publishers: Gainesville, FL, USA, 1994; p. 376.
- Emmel, T.C.; Garraway, E. Ecology and conservation biology of the *Homerus* swallowtail in Jamaica (Lepidoptera: Papilionidae). *Trop. Lepidoptera* 1990, 1, 63–76.
- FAO. 2016. *State of the World's Forests 2016. Forests and agriculture: land-use challenges and opportunities*. Rome.

Gómez-Pompa, A. and C. Vázquez-Yanes. 1981. Sucessional Studies of a rain forest in México. Forest Sucession Concepts and Application (eds. D. C. West, H. H. Shugart and D. B. Butkin), 246-266.

Grubb, P.J. & E.V.J Tanner. 1976 *The Montane Forests and Soils of Jamaica: A Reassessment*.

Hett, J.M., Loucks, O.L., 1976. Age structure models of balsam fir and eastern hemlock. J. Ecol. 64, 1029–1044.

Hitimana, J., 2000. Structure, composition, regeneration of Mt. Elgon moist lower montane forest (Kenya) with particular interest in *Olea capensis* subsp. *welwitschii*. M.Phil. Thesis, Moi University, Eldoret, Kenya.

<http://www.science.smith.edu/msi/pdf/i0076-3519-201-01-0001.pdf>

Innes, J. L.: 1993, 'Methods to Estimate Forest Health', *Silva Fennica* 27, 145–157.

Jukola-Sulonen, E. L., Mikkola, K. and Salemaa, M.: 1990, 'The Vitality of Conifers in Finland, 1986

Kelly, D.L., 1988. The threatened flowering plants of Jamaica. Biological Conservation. Volume 46, Issue 3, 1988, 201 – 216.

Kennerley, R., Turvey, S.T. & Young, R. 2018. *Geocapromys brownii*. The IUCN Red List of Threatened Species 2018: e.T9001A22186569. <http://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T9001A22186569.en>. Downloaded on 06 September 2018.

Laurance, W.F. Forest-climate interactions in fragmented tropical landscapes. Philos. Trans. R. Soc. Lond. B Biol. Sci. 2004, 359, 345–352.

Manaaki Whenua Landcare Research NZ Ltd, Christchurch, New Zealand, 35p.

Miller, D.J., 1998. Invasion of the cockpits: patterns of encroachment into the wet limestone rainforest of Cockpit Country Jamaica. In McGregor, D.F.M., Barker, D., Evans, S.L. (Eds.), Resource Sustainability and Caribbean Development. The Press, University of the West Indies, Kingston, Jamaica, pp. 373-389.

NEPA (2008). Endangered yellow snakes-Press Release. http://nepa.gov.jm/newscenter/Press_releases/Archive/2008/PR20080605-Endangered-Yellow-Snakes.asp

Newman, M.E. Assessing deforestation and fragmentation in a tropical moist forest over 68 years; the impact of roads and legal protection in the Cockpit Country, Jamaica. *Forest Ecology and Management* 315 (2014) 138-152.

Porter, L., Bongers, F., van Rompaey, R.S.A.R., de Klerk, M., 1996. Regeneration of canopy tree species at five sites in West African moist forest. *For. Ecol. Manage.* 84, 61–69.

Strand, G.-H.: 1995, 'The Geography of Changing Crown Vigor in Norwegian Conifer Forests, Tyler, H.; Brown, K.S.; Wilson, K.H. Swallowtail Butterflies of the Americas. A Study in Biological Dynamics, Springer-Verlag, New York, USA Long, E. 1774. The History of Jamaica. Lowndes, London.

Tzika, A.C., Remy, C., Gibson, R. et al. *Conserve Genet* (2009) 10: 69. <https://doi.org/10.1007/s10592-008-9519-z>.

Appendix I

TERMS OF REFERENCE

Forest Ecosystem Assessment and Conservation Plans for four main locations in the Rio Grande Valley area of the BJCM National Park

OVERVIEW

The Jamaica Conservation and Development Trust (JCDT) manages the Blue and John Crow Mountains (BJCM) National Park and World Heritage Site on behalf of the Government of Jamaica. The draft 2017 – 2027 management plan for this globally significant protected area recommends more detailed analysis and ground-truthing of the land cover analysis of satellite imagery (completed by the Forestry Department in 2015) to assess the status of degraded forest ecosystems in order to guide conservation programmes and activities. The JCDT has funds from the Global Environment Facility – Small Grant Programme (GEF-SGP) for a project in the Rio Grande Valley area. The project includes funds for the contracting of a consultant or team of consultants for the preparation of Forest Ecosystem Assessment and Conservation Plans for at least two main locations in the Rio Grande Valley area of the BJCM National Park. The JCDT therefore invites proposals from interested parties for the preparation of a Forest Ecosystem Assessment and Conservation Plans in the Rio Grande Valley area of the BJCM National Park. This document provides the Terms of Reference for the Assessment and Plans and should guide

prospective consultants or teams of consultants in the preparation of their Technical and Financial Proposals. Proposals must include 2 of the main locations proposed (Moore Town and Guava to Morant River) however proposals that provide some consideration to the Chelsea/Durham, Wild Cane and Cunha Cunha Pass Trail areas will be at an advantage (Figure 1). JCDDT intends to seek helicopter reconnaissance assistance from the Jamaica Defence Force to aid in the assessment.

BACKGROUND AND GENERAL INFORMATION

The Jamaica Conservation and Development Trust (JCDDT) is a non-government organisation and registered company and charity (1988). We manage the Blue and John Crow Mountains National Park (Jamaica's first and only UNESCO World Heritage Site) on behalf of the Natural Resources Conservation Authority (NRCA) through the National Environment and Planning Agency (NEPA). The National Park overlaps with other protected areas and therefore JCDDT coordinates the collaborative management of the site with other entities including the Forestry Department. In 2015, the Forestry Department completed work on the analysis of satellite imagery of the island and this information was used to prepare a map showing land-cover in the National Park. The National Park is about 41,000 ha and the information from the satellite imagery analysis indicates that whilst the vast majority at the core of the National Park is closed broadleaf or primary forest (the area designated as a World Heritage Site – about 26,000 ha) there are pockets of degraded areas e.g. disturbed broadleaf or secondary forest, bamboo and fields. Forest on Shale and Limestone are two major conservation targets for the National Park. Deforestation and degradation for agriculture, logging and harvesting of non-timber products as well as the

overgrowth of invasive plant species are the main threats to this valuable natural heritage. The Conservation of Natural Heritage Programme in the draft 2017 – 2027 management plan recommends more detailed analysis and ground- truthing of the land cover analysis of satellite imagery to assess the status of degraded forest ecosystems to guide conservation programmes and activities.

THE PROJECT

The JCDDT has funds from the Global Environment Facility – Small Grant Programme (GEF-SGP) for a project in the Rio Grande Valley area. The project includes funds to contract personnel for:-

- (i) Forest Ecosystem Assessment and Restoration Plans for at least two sites;
- (ii) Conservation and Visitor Impact Management Plans for four sites;
- (iii) Coney Population Study and Conservation Management Plan;
- (iv) Reforestation in the Moore Town area and
- (v) Agro-forestry training in 4 communities.

SITES

The GEF-SGP Project is focused on the conservation of natural and cultural heritage in the Rio Grande Valley and therefore the sites for consideration under this consultancy are (as identified in Figure 1):-

- (i) Moore Town
- (ii) Guava to Morant River and possibly,
- (iii) Chelsea/Durham
- (iv) Wild Cane River

OBJECTIVES OF THE CONSULTANCY

The purpose of this Consultancy is to prepare a Forest Ecosystem Conservation Plan covering the sites identified. The first phase of the study is expected to include assessment of the forest ecosystem at the selected sites in terms of species, health, specific threats and trends towards recovery of the closed broadleaf forest. The second phase will use information from the first phase to recommend conservation programmes for the sites including possible reforestation, invasive species control and forest restoration. Funds are available during the project for some reforestation in the Moore Town area which is definitely invaded by bamboo (*Bambusa vulgaris*) and which the Moore Town Maroon Council has indicated its interest in reforesting.

SCOPE OF WORK

The Consultant will provide the necessary technical input into all phases of the Consultancy. The Consultant will work closely with the JCDD to request all required information and to ensure common understanding and produce the Assessment and Plans that meets the objective described above. Specifically, the Consulting Team will undertake the activities outlined below:-

1. Develop a work plan and implementation schedule for the Consultancy;
2. Request and source relevant technical information, liaising with the JCDD to source local information as needed;
3. Visit the site with the assistance of the JCDD in terms of local arrangements and logistics;
4. Engage with key stakeholders, with the assistance of the JCDD e.g. community meetings and workshops;
5. Conduct the necessary forest ecosystem assessment procedures inclusive use of a drone camera and helicopter reconnaissance and field work, which the JCDD will play a key role in organising and participating in;
6. Liaise with the JCDD, Forestry Department and community members to help locate boundaries so that markers can be placed to reduce encroachment;
7. Prepare a Report on the status of the forest ecosystems in the targeted areas inclusive plant and animal species and cultural heritage values present, condition of the forest ecosystem (recovering, under invasion, being deforested), threats to the forest ecosystem and cultural heritage, with photographs; and
8. Prepare a Conservation Plan for the targeted areas providing strategies and an action plan to secure the complete restoration of the areas to closed broadleaf forest and ensure conservation of

the wildlife, inclusive consideration of possible visitor use – make recommendations regarding the number of types of visitors and activities and recommendation of species for reforestation.

EXPECTED DELIVERABLES

The Consultant will be responsible for satisfactory delivery of:-

1. A detailed methodology with work-plan for the Forest Ecosystem Assessment and Conservation Plan Consultancy by the first month of the contract.
2. Forest Ecosystem Assessment Report, as described above for the targeted sites (draft by the beginning of the fifth month and final report by the beginning of the sixth month of the contract).
3. Conservation Plan for the targeted sites, as described above (draft by the end of the fifth month and final report by the end of the sixth month of the contract).