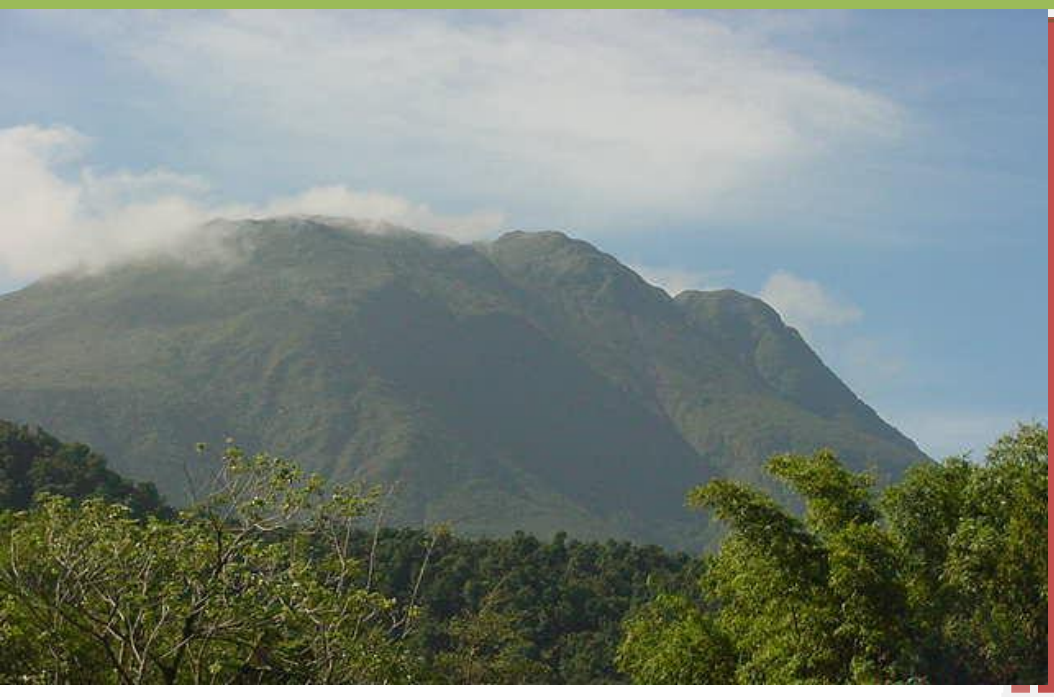
CARIBBEAN COMMUNITY CLIMATE CHANGE CENTRE/ SPACC

TECHNICAL REPORT

MANAGEMENT STRATEGY FOR ADAPTATION TO CLIMATE CHANGE ANNEX- THE MORNE DIABLOTIN NATIONAL PARK AND MORNE TROIS PITONS NATIONAL PARK WORLD HERITAGE SITE



Prepared for the Government of the Commonwealth of Dominica

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TECHNICAL REPORT

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1.0 BACKGROUND

The impact of climate change is universal and has its effect on large continents as well as small island states like Dominica. Global climate change is predicted to have devastating effects on the Caribbean because it triggers increased frequency and intensity of hurricanes and tropical storms, sea level rise, and temperature changes. All of these can have a negative impact on the economic, physical, social and cultural landscape of the islands.

Dominica has a total land area of 750.6sq. Km (290 sq. ml) and is 48 km long and 24 km wide at its point. 66% of the land area in Dominica is covered by vegetation ranging from coastal dry scrub woodland to lush tropical forest in the interior. Dominica's climate is influenced by the north east trade winds. Because of its rugged topography and high moisture content of air masses from the Atlantic Ocean, there is micro- climatic variability within very short distances. It is also located in the tropical Atlantic hurricane belt and is vulnerable to hurricanes and tropical storms.

The predicted changes in intensity and seasonality of hurricanes, the intensity, frequency and seasonality of fires, floods and droughts can potentially destroy the island's biodiversity in addition to the crippling effects on the social and economic fabric of the society especially in communities on the low- lying coastal areas. The size of the islands also makes it very vulnerable to climate change as a result the predicted rise in sea levels which can affect coastal villages, towns and major infrastructure, marine and fresh water resources. The natural resources are particularly vulnerable to the impacts of climate change because of the discreteness of the island, its unique ecosystem, large number of endemic species, expansive biodiversity and micro climate variability all of which can be easily destroyed.

Dominica's park system comprises 3 national parks – Morne Trois Pitons National Park World Heritage Site, MTNPWHS which consists of 6879.8 ha, the Morne Diablotin National Park, MDNP,- 3335.49 ha and the Cabrits National park , 531 ha. This assignment relates only to the MTNPWHS and the MDNP. Management of national parks falls under the Forestry, Wildlife & National Parks of the Ministry of Agriculture

The forest types of the Parks range from semi-evergreen forest to elfin woodland or cloud forest and exhibit a pronounced altitudinal zonation due to climate. Any changes in climate are likely to affect these. The ecosystems of the Parks are at risk because of the impact of climate that will trigger changes in species distribution, community composition and configuration, ecosystem functions as well as changes in land use.

The Management Plans for the Morne Trois Pitons National Park World Heritage Site, MTNPWHS, as well as that for the Morne Diablotin National Park, MDNP, do not address the impact of climate change on the Parks. As such, there are no management recommendations dealing with the impact of climate change.

Institutional responsibility for Climate Change rests with the Environmental Coordination Unit (ECU) of the Ministry of Fisheries and the Environment in concert with other departments. ECU is the major implementing

agency for most of the major international environmental conventions including the UNFCCC, United Nations Framework Convention on Climate Change.

Other agencies with significant responsibilities relating to climate change include the meteorological service responsible for the collection, analysis, and dissemination of information relating to weather and climate and the departments of agriculture, fisheries and forestry that are more concerned with sectoral impacts and actions of climate change.

This project is being undertaken within the framework of the Convention on Climate Change. The overall objective of the United Nations Framework Convention on Climate Change (UNFCC) is to manage climate change through "***stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system***". The Convention establishes a framework for intergovernmental efforts to tackle climate change, acknowledging the rate of change in natural systems. As such the Convention allows for "a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."

Vulnerability is defined by the Intergovernmental Panel on Climate Change **(**IPCC**)** as *"the extent to which climate change may damage or harm a system. It depends not only on a system's sensitivity but also on its ability to adapt to new climatic conditions"* (IPCC, 1995). Vulnerability is a function of the character, magnitude and rate of climate variation to which a system (or location) is exposed, it's sensitivity, and it's adaptive capacity. Vulnerability to climate change can be seen as a complex mixture of ecological, economic and societal factors. Consequently, it is important that measures are taken to monitor the impact of climate change on the natural resources and to put in place mitigation measures to combat its effects on national parks and forest reserves.

2.0 IMPACT OF CLIMATE CHANGE

2.1 Dominica: Climate Trends and Projections

Model simulations of future climate change scenarios for the last half of the twenty first (21st) century for the Caribbean was carried out using data obtained from a super-high resolution Atmospheric General Circulation Model (AGCM) developed at the Meteorological Research Institute MRI, Tsukuba, Japan. [1] Model simulations were done for 25 years present day scenario 1979 - 2003 and projections were made for the 25 year period 2075 – 2099 following the SRES A1B scenario.

The following was predicted with respect to future climate for the Caribbean and by extension Dominica
In terms of rainfall, the rainfall annual cycle of the Caribbean is characterized by four distinct rainfall regimes, namely an early dry season, an early wet season, a mid dry season and a late wet season
In terms of annual rainfall projections, the central Caribbean including Dominica will become drier by 10-20% which is statistically significant. Gradual rainfall is predicted from the early dry season in December to March with steady increases from April to June, a lessening of the rainfall in July /August and the subsequent second rainy season from September to November. For future projections the annualized pentad (5-day running mean) rainfall shows that the early dry season for the Caribbean will become slightly wetter in November to January and from January to March northward of 15˚N.

It is projected on a seasonal level that the early dry season will become drier by 10%. In the early wet season the entire Caribbean will become drier by 10-20%.

In terms of temperature, the report indicates that future projection from the annual cycle suggests that surface temperature over the Caribbean will rise by 2.5°C. In terms of temperature extremes, there are projections of extremely hot days and tropical nights for the Caribbean.

Overall the report concluded the following:

- There is projected overall rainfall deficiency for most of the Caribbean during rainy seasons of 10-20%.
- The early dry season is expected to get wetter by 10%
- The model shows warming over the region by 2-2.5°C, which is a yearlong signal.
- There is a hint that rainfall deficits for the future might be consequential of changing large-scale dynamics.

[1] Future climate for the Caribbean in the late 21st Century using a super-high resolution AGCM at MRI, Trevor C Hall Climate Studies Group Mona (CSGM) Department of Physics.UWI, Mona Campus Meteorological Research Institute (MRI).Tsukuba, Japan, September 6-17, 2010

Storms/Hurricanes/Earthquakes

A report undertaken by Brian Challenger 2004, “Climate Change Technology Transfer Needs Assessment for the Commonwealth of Dominica -Environmental Coordination Unit Ministry of Agriculture”, indicated that Dominica’s location in the hurricane belt makes it susceptible to tropical storms and hurricanes. Since 1979, tropical systems of note (storms and hurricanes) which have impacted Dominica include David (1979), Gert (1981), Gilbert (1988), Hugo (1989), Iris (1995), Marilyn (1995), Hortense (1996), Lenny (1999) and Dean (2007). The island is impacted (brushed or hit) approximately once every four years. The severity of the impact on both the social and economic infrastructure is dependent on the approach, proximity and intensity of the system at the time of passing.

It is to be noted that, in general, north Atlantic hurricane frequency is characterized by a multidecadal cycle which yields active and inactive phases lasting 10 or more years (Goldenberg et al. 2001). Since 1995, the north Atlantic has swung into an active hurricane phase. Some of the country’s most devastating recent hurricane experiences (e.g. Marilyn, Lenny, Dean) have occurred in the current active phase of the north tropical Atlantic.

There is also significant year to year modulation of hurricane frequency and track by El Niño Southern Oscillation (ENSO) events.

Table 1: The Impact of Natural Disasters from 1979 – 2008

Item	1979	1989	1994	1995	1999	2004	2007	2008
Type of Disaster	Hurricane David	Hurricane Hugo	Tropical Storm Debbie	Hurricane	Hurricane Lenny	Earthquake /landslide	Hurricane	Hurricane
Date started	29/08/79	17/09/89		27/8 05/9 18/9	18-19/11/	21/11	17/08	16/10
Total Casualties: **Number** **Of which: dead** **Of which: injured** **Of which: missing** **Of which: homeless**	63,042 42 3000 …….. 60,000	……. …….. …….. …… ……..	…… …… …… …… ……..	…… 1 …… …….. ……	…… …… …… …….. ……..	…….. 0 …….. 0 ……	29 3 26 0 50	0 0 …… 0 ……
Total Population affected	75,000	…….	…….	……	602	19,527		253
Mean population	77,057	72,055	72,413	72,603	71,815	70,417	71,285	71,545
Damage (in millions) **$ E.C**	86.8	69.0	30.0	366.0	31.0	90.0	173.7	4.5

Source: Central statistical Office (Source: Disaster Coordinating Unit and OECS Macro-socio-economic Assessment)

Fire Regimes

Reports from the Dominica Fire and Ambulance Service indicate an increasing trend in the number of forest fires in Dominica. Lead Fireman, Philbert Samuel, indicated that forest fires are occurring more frequently with a surge in fire during the period January to April which is considered the "drier season" in Dominica

Most of these "bush fires" occur in the drier side of Dominica on the west coast. While these numbers may not be significant due to the fact that the Fire service cannot verify the cause, (some of them are deliberately set by humans, some are naturally ignited), this should be monitored over a period of time.

Table 2: Frequency of Forest Fires 2007 - 2010

Year	No. of fires
2007	158
2008	79
2009	104
2010 (1st Quarter)	194

Ocean Changes

Sea Levels

The International Panel on Climate Change, IPCCC, predicts an increase in global sea level of 0.09 to 0.88 m by 2100. Regional rates of sea-level rise are affected by a variety of factors including the processes of tectonic movement of the Earth. In the Caribbean, the picture in relation to historical trends with regard to sea-level rise is complicated by lack of available data. Hendry (1993) indicates that regionally, relative sea level is increasing at an average of 3mm/yr but with considerable regional variation. The 3mm figure does however indicate a rate of increase quite significantly above the global average.

Sea levels can therefore be expected to continue to rise, resulting in increased erosion in coastal areas. Ocean sea surface temperatures are expected to be higher. Storm surges are likely to increase as sea levels rise and shifts occur in storm activity and ocean currents".

2.2 Green House Gas Inventory for Dominica (1994)

The GHG inventory indicates the following:

Dominica's Initial National Communication, INC (October 2001) described Dominica as a net sink of Greenhouse Gases (GHG). The data showed that Dominica had gross emissions of 76.53Gg of CO_2, which were offset by removals from changes in forest and other woody biomass stock and from the abandonment of managed lands, resulting in a net sink of 295.14 Gg of carbon dioxide.
There were also small quantities of methane, nitrous oxide and non-methane volatile organic compounds – 2.73 Gg, 0.042 Gg and 6.13 Gg respectively. The following are the key sources of carbon dioxide emissions:

- Transport – 50%.
- Energy Industries – 26%.
- Commercial and Industrial Uses – 10%.
- Industry – 5%.
- Residential – 4%.
- Other – 5%

2.3 POTENTIAL IMPLICATIONS OF CLIMATE CHANGE ON THE NATIONAL PARKS

The information on climate change is very important with respect to developing policies and programmes to conserve forest resources. It is difficult to determine the effects of climate on Dominica's forest ecology and landscapes because of very little research and available scientific data.

Evaluation of the extent of monitoring of climatic variables in the National park indicates that there has been some monitoring of rainfall. The Forestry and Wildlife Division monitors rainfall in the vicinity of the Park in the areas of Emerald Pool, Delices and Pont Cassé utilizing standard rain gauges to do so. Rainfall data is also measured by Dominica Electricity Services, Domlec. in the areas of Laudat, Trafalgar and the Fresh Water Lake while Yale University currently has ten recording rainfall stations installed at La Plaine, Freshwater Lake, Springfield, Canefield Airport, Rosalie, Botanical Gardens, Pont Cassé, Grand Fond, Laudat Village and Boeri Lake. However none of these are harmonized or coordinated to meet the needs of the Park

Various vegetation types are characterized by specific species composition and various plant associations that determine its structure and function and these can be disrupted by extreme activities like hurricanes, landslides and other extreme weather conditions. When this happens, it paves the way for pests, diseases and invasive species which will weaken the adaptive capacity of the species and the ecosystem.

There are a number of factors that determine the adaptive capacity of species as follows:

- Genetic variability
- Dispersal mechanisms
- The capacity of species to migrate
- Stress factors

Anthropogenic activities on ecosystems will decrease their adaptive capacity and make them more susceptible to climate change. A range of such activities have been identified in the national parks. These range from agricultural encroachment, illegal hunting, fires, infrastructural development and in some cases the use of pesticides.

The following are some of the implications for climate change that can affect national parks. The report "The Impacts of Climate Change on World Heritage Properties" by UNESCO for the Expert meeting of the *World Heritage Convention* on "Climate Change and World Heritage" indicates that climate change will impact a range of biomes and outlines the following potential impacts on terrestrial biodiversity as a result of climate:

- Changes in species distribution as a result of changing climatic conditions/ extreme conditions
- Impact on endemic and threatened species through loss of food sources and nesting site and habitats
- Increase in invasive and alien species through migrations-
- Changes in species composition and configuration
- Impact on ecosystems functioning and services through changes in phenology, nutrient cycling and pest- predator relations and plant pollination and dispersal mechanism
- Increase in pathogens and disease and its impact on plants
- Changes in the intensity, frequency and seasonality of extreme events such as fires, floods, droughts
- Changes in human land use pressures
- Closure of parks in response to extreme events and its impact on tourism
- Increased expenditure on the maintenance of park infrastructure

Also of importance is the fact that Dominica relies on the conservation of its forest resources to maintain the ecotourism concept as the main product of the tourism industry.

Potable water sources are threatened by drought and flooding and this could affect watersheds in parks that are primary sources of potable water for the various communities.

Sea level rise can have an impact on National parks especially in coastal areas adjacent to the Park which can trigger encroachment of coastal population in the Park for housing, squatting and farming.

3. KEY ECOLOGICAL VALUES FOR WHICH THE PARKS WERE ESTABLISHED

3.1 Morne Diablotin National Park

- The Park contains most of the sequence of natural moist forests types (rainforest, elfin woodland, and montane thicket) that occurs on the volcanic islands of the Eastern Caribbean.

- The extent of primary forest, especially elfin woodland and montane thicket, is regionally significant.

- It contains 31.7 % of the Dominica's total area of elfin woodland and montane thicket.

- It has some of the highest diversity of flora and fauna of any area in Dominica.

- The Park boasts healthy populations of the endemic and endangered Imperial Parrot and Red-neck Parrot, and the largest remaining populations of the Imperial Parrot.

- It is designated as an “Important Bird Area, IBA”

- It is the home to endemic plants: *Chromolaena impetiolaris* and *Chromolaena macrodon.*

- A large number of species that are restricted to Dominica or the Lesser Antilles occur within the Park including 11 species of birds, 4 species of mammals, 2 species of amphibians, 4 species of reptiles, and 4 species of plants.

- Protection of the watersheds of 12 rivers. Five of the rivers (Picard, Hodges, Coulibistrie, Dublanc and Tweed) are tapped for domestic, commercial, and industrial uses by the Dominica Water and Sewage Company (DOWASCO). This represents about 35% of the Park's watersheds.

3.2 Morne Trois Pitons National Park WHS

- The Park contains the largest and most diverse and pristine forest in the Eastern Caribbean.

- It has been listed by Birdlife International as “Important Bird Areas, IBA” because it supports
  3 globally threatened species- two endemic species of the Amazona parrots and the Forest thrush, *Cichlherminia lherminieri* thus reinforcing the critical biodiversity of the area.
  19 Lesser Antilles, EBA, Endemic Bird Area- restricted ranges birds.

- The Park lies within a Conservation International-designated Conservation Hotspot, a WWF/IUCN Centre of Plant Diversity and a Birdlife-designated Endemic Bird Area.

- Protection of watersheds - Contains the headwaters of most of the major streams and rivers in the southern half of the island.

- It has been designated a World Heritage Site based on the following criteria:

  - Under Criteria VIII - "*to be outstanding examples representing major stages of the earth's history, including the record of life, significant on-going geological processes in the development of landforms or significant geomorphic or physiographic features*" **and**

  - Under criteria X - "*To contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation*".

4.0 IMPACT OF CLIMATE CHANGE ON KEY ECOLOGICAL VALUES OF THE NATIONAL PARKS

Both Parks are characterized by outstanding plant diversity, density and endemism. They are the largest source of potable water for more than 70% of the population of Dominica.

Climate and weather conditions including elevated temperatures, drought, storm surges, hurricanes, Volcanic activity and landslides periodically affect or threaten Dominica.

The impacts of climatic changes on the forests and ecosystems of National Parks are as follows:

- Changes in species composition.
- Impact on vegetation types especially elfin woodland
- Reduced water flow in watersheds or increased water flow and silting of watersheds.
- Increase in forest pests and disease.
- Reduced food availability for wildlife.
- Destruction of endemic species
- Increased species competition for scarce resources.
- Greater vulnerability to extreme events

Hurricanes and tropical Storms

While there is no scientific data to establish the effects of climate change on national parks, some observation on the impacts of hurricane David on the biodiversity of the Park will be outlined.

High winds negatively impact wildlife through destruction of feeding grounds, nesting sites and roosting areas. This can be further exacerbated by droughts, floods and increased hurricanes. Some of this was manifested in the Parks post hurricane David in 1979.

Hurricane David in 1979 did significant damage to the forest resource by damaging 50% of the trees in the southern half of the island inclusive of the MTNPWHS. With respect to the vegetation of the MDNP, Dr Nichols (1979) indicated that the lower slopes of the Park suffered 10% damage but the upper slopes of Morne Diablotin into the Elfin woodland suffered 30- 40 % damage with trees being uprooted; while in the slopes east and south of the Park there was heavy damage with the majority of the trees being mutilated or uprooted.

The resultant loss of habitat and food supplies for wildlife species resulted in wildlife mortality. Studies have shown that after Hurricanes David in 1979 the populations of the 2 endemic parrot species, Imperial and Red-Necked Parrots fell for several years, dropping from pre- hurricane levels of 200 and 400 respectively to as low as 200-250 for the Red-necked parrots and 75 the Imperial Parrots post hurricane David (Thomas Duncan Nichols. PhD, MD-November 1979).

Forestry and Parks personnel also indicated signs in the change in phenology of some plant species after hurricanes. There were changes in the flushing of flowers and fruits with implications of reduced food supplies for some bird species especially the Amazona species. However, this has not been documented. Following this, management protection measures have ensured a surge in the population of the parrots.

The impact on elfin woodland or "cloud forest" was also noted by the Forestry Division. This forest type decreased as a result of impact of the hurricanes, mainly because of the slow process of natural re-vegetation since this area is exposed to wind erosion, soil erosion and landslides especially when stripped of its vegetation as was the case after hurricane David. Observation from some of forestry personnel also noted excessive dryness and cracking of the soil in some areas in the elfin woodland. Additionally, elfin woodland occupies a narrow range which is influenced by climate and geography. Major changes in temperatures and rainfall could shift the range and /or cause destruction of this ecosystem.

Dominica's INC under the UNFCC 2001 indicates the following with respect to the impact of climate change on Dominica's vegetation types:
"Dominica's vegetation type, especially in its mountainous interior exhibits a pronounced altitudinal zonation due to climate. Any changes in climate are likely to affect these. For example, assuming a lapse rate of 1^{O} C per 500 ft, the low scenario of 1.7^{O}C would elevate vegetative zones by 850 ft and the high scenario (3.5^{O}C) by 1750 ft. Under the high temperature scenarios elfin woodlands could disappear completely, and some species unique to Dominica could be lost. (Parry, 2001. personal communication)".

An indirect effect of tropical weather systems such as Hurricane David is the conversion of wildlife habitat to agriculture. In accessible areas the toppled trees provided an opportunity to more easily clear land for farming thus resulting in a further reduction and fragmentation of wildlife habitat. These natural disasters particularly hurricanes can be attributed to one of the root causes of land degradation in Dominica.

Flooding

Watersheds emanating from the Parks feed almost the entire south, south east and south west of the island. Most of the small radial streams from the various peaks respond very quickly to rainfall events and may dry up completely within thirty six (36) hours of a heavy rainfall. The larger streams of higher order which form the major headstreams of the various watersheds, while mostly perennial, are also subject to large variations in flow and sudden floods (flash floods) and can be a source of danger to unwary walkers in the Park.

Additionally, flooding will have an impact on potable water supply as a result of soil erosion and silting of rivers and streams.

Drought on the other hand can lead to fires, increase in disease and invasive species as well as decrease availability of water for hydroelectricity as well as reduction in the volume of potable water

Landslides and Soil Erosion

These are triggered by extreme rainfall. Overall, Dominica is susceptible to major landslides because of its rugged terrain and high precipitation. In terms of the geomorphology of the Park, large areas of the park are prone to landslides as was evidenced in the number of landslides which have occurred in the Park.

Landslide analysis indicates that the majority of the MTPNP is susceptible to high risk landslide especially in the west, south and east of the Park. West and South of Morne Micotrin are within the high landslide risk including the entire village of Laudat. South central areas of the Park- the Boiling Lake, Fresh Water Lake and Boeri Lake fall within medium risk. To the south of the park away from the 600m buffer an extreme landslide risk zone is noticed at Perdu Temps.

MDNP can be also be described as a centralized high landslide risk area specifically in the east, west and southern areas. The majority of the park is at medium risk with the exception of three low risk areas. The adjoining Syndicate and Dyer estates are at low and medium landslide risks.

Overall, the area can be described a high erosion hazard.

Sea-Level Rise

There has been no documented evidence of sea level rise in Dominica. However, extreme weather conditions have had a negative impact on coastal communities. The 2 national Parks are located in the interior of the island however there are some coastal villages adjacent to both parks which are vulnerable to sea level rise. Impact of this can force these communities to encroach on the park specifically with respect to agricultural production and housing

Conclusion

Because of the size of the island, endemic plant and animal species can be easily wiped out through major natural disasters if mitigation measures are not put in place to reduce the impact of climate change.

Forests will become increasingly vulnerable to the problems associated with global warming and climate change. There have been no studies to determine the impact of global climate change on the island's biodiversity. However, it is anticipated that the increased severity and frequency of hurricanes will have significant impacts on the island's ecosystem which could affect the status of the Park as a World Heritage Site. It is therefore important that measures are put in place to reduce human –induced stress factors on the park and to protect the ecosystems of the Parks.

In addition to this, the socio-economic value of the Park can be affected by climate change through closure of parks in response to extreme events and lost income from visitation as well as increased expenditure on the maintenance of park infrastructure in the event of damage.

Extensive research in the park is required to effectively monitor these trends and to manage them. Conservation planning should be integrated with climate risk assessment and a coordinated national and regional effort should be established to analyse information and assess the risk of biodiversity loss. Other recommendations include strengthening the Park authority and improving its financial and human resources to allow for effective management; strengthening cooperation between Forestry and National Parks Service, land owners and the private sector as well as implementing a number of specific projects in public awareness and education at the national level to sensitize persons to climate change issues.

5. ANTHROPOGENIC ACTIVITIES IN THE PARKS

Morne Trois Pitons National Park WHS

The following represents some anthropogenic activities in the park which make the park more susceptible to the impacts of climate change:

- Agricultural encroachment
- Ecosystem manipulation –diversions of rivers
- Installation of commercial and industrial infrastructure
- Debarking of trees
- Fires
- Illegal hunting

WESTERN SECTION OF THE PARK

In the western area of the Park in the Corona/Sylvania there are visible signs of landslides present into the 300m inside the boundary of the Park and signs of agricultural activity within 600 m of the Park boundary.

In the Freshwater Lake area approximately one parcel of 17 acres of land is privately owned. Some agricultural activities are still being undertaken on some of these lands.

Hydro power infrastructure is also located at the Freshwater Lake. The drainage flow of Boeri and Freshwater Lakes have been diverted via a weir and pipeline, to feed the hydroelectric power stations at Laudat and Trafalgar Falls at the headwaters of the Roseau River.

Other infrastructure include Communication Towers erected in the highest area of the park commonly vegetated by Elfin woodland. Trails were developed in these areas (as in the construction of a trail at Morne Micotrin) for installation of towers and related structures. These contribute to land degradation and soil erosion and may have an impact on elfin woodland.

In terms of human settlement, there is one residential building within the Park in the Corona area.

The village of Giraudel, WSW of the Park, is well into the 600m external to the Park boundary where encroachment of human activities is seen with newly developing houses there.

EASTERN SECTION OF THE PARK

In the community of La Plaine intense farming is taking place within the boundaries of the Park on private land. In the village of Grand Fond 98% of which is located within 600m of the boundary of the Park, there are approximately 9 squatters farming within the boundaries of the Park.

NORTHERN SECTION OF THE PARK

In the Northern section of the Park in the Pont Casse' area bordering the MTNPWHS there has been clearing of land and provision of access to facilitate residential development in the area as a result of government's approval to a land owner to sub-divide land for residential purposes. This is also evident in the Crete Palmiste area where sparse residential settlement is visible very close to the boundary of the Park and in Sylvania NNW of the Park. Any further development in that region will enter the national park boundary.

Marginal agricultural production is evident in the Brantridge and William settlements adjacent to the Park as well as shifting agriculture in the "William Settlement" where agriculture occurred previously but has been abandoned for over 20 years.

In the area of Emerald Pool, there is an active quarry where tarrish is extracted for road construction. This area is a constant source of silting of the Emerald Pool. The Government of Dominica has established a shooting range in the northern area of the park in "Williams Area" which can have an effect on the wildlife.

In spite of the fact that felling of trees or other such activities are prohibited in the Park, there is still illegal activities like debarking of Gommier- *Dacryodes excelsa*, Bwa Bande'- *Richeria grandis* trees as well as felling of the Gommier tree for boat construction. There is also a major problem of clearing of forest land for the growth and cultivation of *Cannabis sativa*.
There was also evidence of fire on the Morne Trois Pitons Trail.

SOUTHERN SECTION OF THE PARK

South of the Park in the Geneva/ Perdu Temps area, land adjacent to the park is predominantly untouched forest except for the clearing to a cell site area owned by Cable & Wireless. Agriculture is seen with very scattered human settlement. In the other communities of Bagatelle, Pointe Mulatre and Delices agricultural activities are taking place within 600m of the boundary lines.

In the communities of Petite Savanne, La Roche, Victoria intense farming is taking place within the boundaries of the Park. The main cash crop in Petite Savanne is Bay oil. Farmers have expanded into extremely steep land into the National park to farm thus increasing the high erosion risk associated with the area.

In the communities of Laroche and Victoria some small scale human settlement is taking place within 600m of the Park boundary lines.

Southeast of the Park, the main access road to the villages of Delices and Point Mulatre is constructed on the Boundary of the Park.

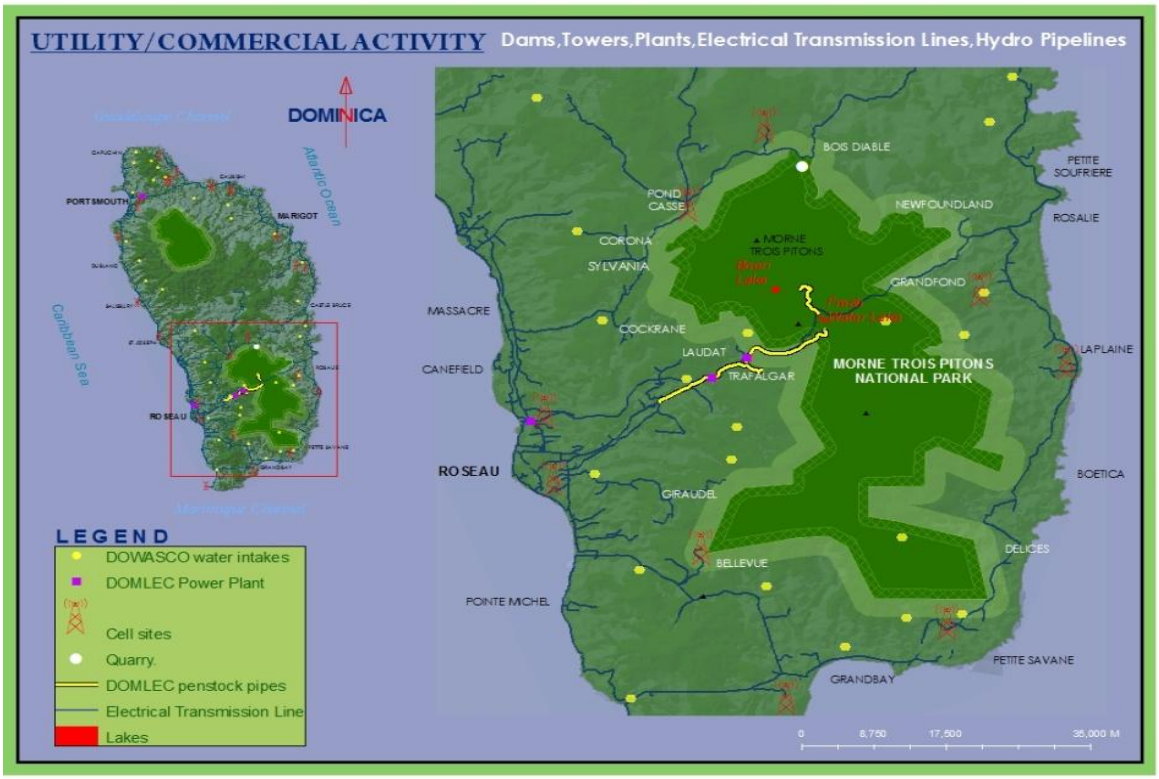

Figure 1: Map of Morne Trois Piton National Park Indicating Utility and Commercial Activity In and Around the Area

MORNE DIABLOTIN NATIONAL PARK

Agriculture is the major activity affecting the Park. Intensive agricultural activities are taking place within 600m external to the park boundary at all surveyed points especially in Syndicate and Dyer estates. These agricultural plots consisted mainly of citrus plants, mango, root crops (ground provisions) and bananas. Signs of pesticide use were observed on many farms bordering the park as well as weedicides for the control of grass.

6.0 STRATEGY FOR ADAPTATION TO CLIMATE CHANGE

6.1 GUIDING PRINCIPLES

Climate change can wreak havoc on the natural, cultural and socio-economic assets of a country or community. With respect to national Parks, the biodiversity of the Parks must be protected by putting in place measures to reduce the anthropogenic activities in the park so as to increase its resilience to the impact of climate change. A robust research and monitoring programme must be developed to improve knowledge of the physical and biological characteristics of the park, to compile and make available hydro-meteorological data in support of park management and to identify current and future trends in resource condition as a result of climate change.

A multi-pronged, integrated approach is required that includes preventive and corrective actions, exchange of information and development of mitigation measures, based on sound scientific principles. As such, the Government of Dominica will consider the following guiding principles with respect to managing the impact of climate change on national parks:

- Utilizing available scientific information and traditional knowledge in the decision making.
- Assessment of impacts through appropriate research, monitoring, vulnerability assessment and risk preparedness measures.
- Building of public support through the establishment of partnerships with policy makers , the communities and other stakeholders in the development and implementation of programmes to manage the impact of climate change.
- Minimize the impact on gene pool, on species and their diverse habitat.
- Increasing the resilience of sites by reducing non-climatic sources of stress.
- Undertaking capacity building, research, and sharing of information.
- Developing successful and appropriate management responses to include climate change vulnerability analysis, risk assessment and preparedness and adaptation management strategies.
- Develop and implement best practices and share this information with management partners and key stakeholders.

6.2 OBJECTIVES

- To understand the impact of climate change and to sensitize and inform policy makers, communities and other stakeholders on climate change and its environmental, economic and social impacts and to collaborate, cooperate and share best practice and knowledge.

- To work with all stakeholders to undertake research and monitoring so as to evaluate the impact of climate change on the Parks as a basis for developing adaptation measures to increase the resilience of the parks to the impact of climate change.

- To increase the resilience of the Parks by reducing non-climatic sources of stress, re-designing boundaries and buffer zones to facilitate migration of species, and reduce the carbon footprint.

- To undertake ex-situ research to maintain the genome of endemic and indicator species of the Parks

6.3 STRATEGIES

Objective 1

To understand the impact of climate change and to sensitize and inform policy makers, communities and other stakeholders on climate change and its possible impacts and to collaborate, cooperate and share best practices

There is very limited knowledge and understanding at the national level on the phenomenon of climate change and its impact on biodiversity and ecological processes of the parks as well as its effect on the economic and social development of Dominica. As such, a public awareness and sensitization programme on climate change and its impacts must be developed to sensitize policy makers, stakeholders and the communities so as to solicit collaboration in effecting adaptation measures for climate changes and to reduce anthropogenic activities on the Park in an effort to increase the resilience of the Park.

At the same time there must be open access to information on climate change by the public and private sector. This will require dissemination of information to all stakeholders in a timely manner and such that there is general understanding of the issues. Effectively collaboration with all relevant agencies in public education, data dissemination information sharing is important in achieving this.

Information exchange, the sharing best practices and technical co-operation with regional and international organizations will be important in achieving the objectives of managing the impacts of climate change.

Strategies

- Identify information gaps with respect to the climate change and its impact

- Collaborate with national, regional, or global research institutions for information exchange on meteorological and hydrological data.

- Sensitize and inform policy makers, stakeholders, local communities, users of the sites, site managers, and other heritage specialists on climate change and its possible impacts on sites, and proposed management responses to climate change.

- Assess the effectiveness of traditional skills and use of traditional materials and traditional practices utilized by communities to adapt to or mitigate the effects of climate change as a basis for developing strategies for managing/coping with climate change.

- Collaborate with communities and other relevant agencies to develop effective disaster management strategies to combat climate change.

- Network with other regional and international park authorities to share expertise and information on best practices and lessons learnt

Objective 2

To work with all stakeholders to undertake research and monitoring so as to evaluate the impact of climate change on the Park as a basis for developing adaptation measures to increase the resilience of the parks to the impact of climate change.

There is very limited monitoring of climatic variables in the Park or in-depth research on the resources of the Park. As such a research and monitoring programme will be developed which seeks to improve knowledge of the physical and biological characteristics of the park, to monitor, collate and make available hydro-meteorological data in support of park management and to identify current and future trends in resource condition.

The objective is the preservation of ecosystem function through the stabilization of key flagship species that are affected by climate change- the endemic species of animal and plants e.g. The Amazona species of parrots, indicator species and the vegetation types typical of the various forest types.

Climatic and hydrological parameters of the park must be measured so as to monitor the present and future climates within the Parks and to provide information on changes in rainfall patterns, air temperature etc as well as to assess microclimates within the Park and to better understand the impact of global climates on these microclimates and on the Parks in general.

A report by Shawn Boyce[2] indicates that a thorough understanding of the current and future fluctuation in the weather, climate and river water levels within the Park must be a prerequisite for managing the impact of climate change.

Consequently, he recommends the following:

- Data collection, monitoring and estimation of evapo-transpiration fluxes which are necessary for water budget calculations.

- To monitor and study the rainfall interception process.

- Continuous monitoring of water levels within the National Parks is recommended in order to provide data on water level trends that are needed to manage the resource

- The determination of rainfall trigger values and soil moisture content required for the initiation of landslides so as to manage fresh water resources both within and exterior to the confines of the National Park System.

In order to achieve this, database management software for storing, querying and retrieving hydro - meteorological data must be procured

Boyce noted that the Forestry Division did not have the capacity to efficiently manage rainfall gauges nor to efficiently store rainfall data for analysis, retrieval and dissemination. As such there is a need to undertake capacity building within the department

Monitoring of trends in the Park will be an integral component of this programme. Hence park managers should be encouraged to establish indicators for the World heritage sites and the MDNP utilizing information from the Indicator Group of the "Intergovernmental Panel on Climate Change" IPCC, and link with their reporting and monitoring process.

Strategies

- Develop the necessary capacity at the level of the implementing agency and at the community level, to undertake hydro- meteorological monitoring, research climate change vulnerability analysis, risk assessment, adaptation.

- Enhance data storage, management and retrieval systems to enable effective information exchange.

[2] Shawn A. Boyce - Data Collection and Management Strategy for the Commonwealth of Dominica Final report (Prepared by Caribbean Institute for Meteorology and Hydrology), 2010

- To improve data collection on park ecology to include endemic plant and animal species, research and evaluate existing processes that will provide a baseline data for assessing the impact of climate change on the biodiversity of the forest

- Establishment of monitoring of indicators to assess impacts and trends

Objective 3

Increase the resilience of the Parks by reducing non-climatic sources of stress, re-designing boundaries and buffer zones to facilitate migration of species, and reducing the carbon footprint.

Strategies

- To understand and educate the population, policy makers and stakeholders on how they contribute to the carbon cycle.

- To develop strategies that minimize our contribution to greenhouse gas emissions.

- To reduce non-climatic stress factors in and around the site so as to enhance the resilience to the climate change impacts. This would mean reducing and or elimination of anthropogenic activities in the protected areas.

- To investigate and utilize the use of alternative energy technology in park management operations.

- To investigate the development strategies that would reduce emission of green house gases at the level of the site.

- To encourage the policy makers and the relevant departments to continue the Green Globe Destination Programme for Dominica which promotes actions to reduce greenhouse gas emissions through energy efficiency, conservation, and switching to renewable energy sources.

- Encourage policy makers to pursue the policy of converting Dominica into an “Organic island”

Objective 4

To undertake in situ and ex-situ research to maintain the genome of endemic and indicator species of the Parks.

Biotic factors, anthropogenic activities as well as climate change effects can initiate extinction of species if mitigation measures are not taken to slow down or stop the process. It is therefore essential to establish programmes to reduce the threat of extinction. The Forestry Division has an ongoing programme with RARE Species Conservation Foundation to undertake the breeding of the 2 Amazona species of parrots. This should continue. A similar programme with respect to other endemic species of wildlife should be considered.

The establishment of seed- gene banks is a recognized method for conserving the biodiversity of the forest through the conservation of the germ plasm of endemic, indicator and endangered plant species. This should be considered. However this will require capacity building within the Forestry department and the creation of ideal conditions required for seed storage so as to maintain their viability and vigour as well as the required conditions to prolong seed longevity.

The policy of National Parks is to allow nature to renew itself so as to encourage natural regeneration. However, with increasing storm intensity and the potential impact on the biodiversity of the Park, some system must be instituted for the collection and storage of seeds and other genetic materials of plant species for in- situ and ex- situ conservation to ensure that the genetic material of the forest is preserved.

Strategies

- Conserve the germ plasm of plant species through the establishment of a seed unit.
- Capacity building for seed collection, storage methodology and management.
- Establish a living collection of plants – ex-situ field gene banks.
- Developing propagation strategies.
- Enhance protection of existing wildlife and associated habitats.
- Engage in habitat restoration.
- To promote and develop silvicutural activities and programmes

7. IMPLEMENTATION PLAN – ACTIVITIES

Objective 1

To understand the impact of climate change and to sensitize policy makers, communities and other stakeholders

Activities

To develop public awareness and community outreach programmes so as to sensitize and educate the stakeholders and communities adjacent to the Park to manage the impact with climate change.

- Establish community outreach programmes and develop community –based programmes to mainstream climate change into community development programmes
- Build capacity within communities for collaboration on monitoring and evaluating the impact of climate change within the national parks
- Develop public awareness and education programmes targeted at policy makers, the general population, communities and stakeholders on the issues of climate change
- Educate the communities, general population, policy makers and stakeholders on how they contribute to the carbon cycle
- Establish a clearing house for access to information on climate change
- Collaborate with the various organizations and stakeholders to prepare a disaster management plan for the Parks to include forecasting capability, early warning systems, information dissemination and public awareness for the National Parks to ensure visitor safety

Objective 2

To work with all stakeholders to undertake research and monitoring and to develop and implement adaptation measures to increase the resilience of the parks to the impact of climate change.

Activities

Monitor the present and future climates within the Park by collating hydro meteorological data in the park-rainfall amounts and intensity, temperature, humidity, solar radiation and river water levels.

- Upgrade the current monitoring programme and instrumentation of the Forestry Division
- Establish an efficient data collection, management and retrieval system in the Forestry Division
- Improve data collection on hydrological and meteorological data
- Install weather stations one in each Park to monitor and assess hydro--meteorological data as a long term strategy

- Install one rain gauge above each of the forest canopies of the Morne Diablotin and Morne Trois Pitons National Parks to monitor and study the rainfall interception process.
- Evaluate the capacity needs of the Forestry Division to deal with Climate change- research, monitoring and implementation and train staff in these disciplines
- Strengthen the meteorological office to scientifically collate, archive and disseminate information
- Develop a disaster management and mitigation plan for the Parks to include the installation and maintenance of weather prediction and hazard warning systems especially during the hurricane season
- Establish mechanism to monitor sea level rise
- Establish inter agency coordination with respect to monitoring climate change parameters- at the public and private sector levels and establish a system for communication and information sharing

No.	Instruments / hardware for monitoring hydro-meteorological data	Global Water	
		Unit	**Total**
2	Weather Station	3,235.00	6,470.00
2	Mounting Tripod	292.00	594.00
2	Solar Radiation Sensor	807.00	1,614.00
2	Soil Moisture Sensor	291.00	582.00
2	Barometric Pressure Sensor	426.00	952.00
4	Recording Rain Gauge	459.00	1,836.00
2	Satellite Telemetry System	2,047.00	4,094.00
2	Ultrasonic Water Level Recorder	856.00	1,712.00
2	Boost Regulator+Water Level Logger+Enclosure	600.00	1,200.00
4	Solar Panels	367.00	1,468.00
		$ 9,380.00 = 25, 479.00	**20,522.00 = 55,743.91**

Reference Shawn Boyce- Assessment of Hydro-meteorological Sensors to Support Dominica's National Park Management- Final report.

Objective 3

Increase the resilience of the Parks by reducing non-climatic sources of stress, re-designing boundaries and buffer zones to facilitate migration of species, and reducing the carbon footprint.

Activities

- Review the policy of the National Park to allow for restoration of degraded areas of the Park following potential successive hurricanes
- Establish boundaries and buffer zones to facilitate migration of species
- Retrofit all buildings in the park to make them energy efficient.
- Reforest buffer zones
- Encourage land owners with land adjacent to the Parks to reduce impact on the Park
- Develop and implement silvicultural techniques to promote forest productivity, maintain genetic diversity and promote ecosystem health via restoration
- Manage entire watersheds and regulate extractive water use
- Develop underutilized sources of water
- Undertake water conservation programmes
- Close down and rehabilitate quarry in the north of the MTNPWHS
- Relocate the shooting range out of the National Park area
- Educate the public and enforce laws with respect to illegal activities in the Park
- Strengthen the co-operation between the department of Forestry & National parks service, land owners and the private sector.
- Encourage the 3 R's- reduce, reuse and recycle - especially in communities adjacent to the Park and nationally

Objective 4

To undertake ex-situ and in-situ research to maintain the genome of endemic and indicator species of the Parks

In-situ research

To update and develop baseline data on the physical characteristics and biodiversity of the Parks as a basis for measuring changes

Activities

- Develop baseline data on species and ecosystems
- Undertake research and map all endemic and endangered species in the Parks.
- Record and monitor any biological invasions (presence of any invasive plant or animal species) and implement mitigation measure to reduce or stop this process
- Establish or adopt indicators for biodiversity and establish a programme to monitor these indicators

- Evaluate and monitor elfin woodland and develop baseline information for assessing the impact of climate change-
- Undertake Vulnerability Assessment of the Parks
- Develop and implement policies and programmes to protect these critical habitats.

The monitoring information generated will be stored in a data base and will be analyzed to detect trends and patterns that require mitigation. The following data will be of special concern and will trigger a search of remedial actions:

- Disturbance of parrot nesting sites or other critical habitats by visitors;
- Loss of endemic plants or animals
- Trail erosion;
- Declining water quality and water level trends in the parks
- Agricultural encroachment; and/or, indications of hunting within the Park.
- Hydro-meteorological data
- Other changes in the physical and biological resources of the Park.
- Rainfall trigger values and soil moisture content required for the initiation of landslides so as to manage fresh water resources both within and exterior to the confines of the Park.

Ex-situ research – to maintain the germplasm of plant and animal species

Activities

- Establish physical infrastructure for housing of seed bank
- Establish seed-gene bank unit- responsible for seed collection, import , management and seed distribution
- Collect the seeds of trees
- Initiate and establish a local seed collection and storage of plant materials of all endemic, endangered and indicator plant species
- Establish a living collection of plants – ex-situ field gene banks
- Develop plant nurseries
- Continue breeding programmes of endemic parrot species and establish similar programmes for other endemic wildlife species
- Develop social forestry programmes
- Collaborate, co-operate and share best practices and knowledge regionally and internationally
- Review laws and regulations to allow some level of reforestation in the National Park following potential successive hurricanes.

7.1 Project Delivery, plan and budget

Project Outputs & Activities	Responsible Division	Partners	Year 1	Year 2	Year 3	Year 4	Yr.5	Total Budget $ ECD
Objectives :To understand the impact of climate change and to sensitize policy makers, communities and other stakeholders								160,000
Public awareness and education • Develop public awareness and education programmes targeted at policy makers, the general population, communities and stakeholders on the issues of climate change	Forestry, Wildlife and National Parks (FWP)	Environmental Coordination Unit. (ECU)	**30, 000**	**30, 000**	**20, 000**	**20, 000**	**20, 000**	120, 000
• Establish communication mechanism between local communities and relevant institutions	Forestry, Wildlife and National Parks (FWP)	Environmental Coordination Unit. ECU/ Govt. Information Service, GIS , Village Councils	❖	❖				
• Organize workshops/ seminars / training programmes to build capacity	FWP	Village Councils	❖	❖	❖			
• Develop community –based programmes to mainstream climate change into community development programmes	FWPD	Office of Disaster management, ODM/ Local Govt./Village Council	❖	❖	❖	❖	❖	

• Evaluate the capacity needs of the Forestry Division to deal with Climate change- research, monitoring and implementation and implement training programmes	FWPD	DOMLEC/ DOWASCO. ECU	❖	❖				40, 0000
• Networking, advocacy and building alliances with and among communities	FWPD		❖	❖	❖			
Objectives: To work with all stakeholders to undertake research and monitoring and to develop and implement adaptation measures to increase the resilience of the parks to the impact of climate change.								**<u>26, 289.00</u>**
Activities **1. Monitor the present and future climates within the Park by collating hydro meteorological data in the park-rainfall amounts and intensity, temperature, humidity, solar radiation and river water levels.**	FWPD	Meteorological Office- MET office						***26,289.00**
• Upgrade the current monitoring programme and instrumentation of the Forestry Division	FWPD		❖					
• Establish an efficient data collection, management and retrieval system in the Forestry Division- purchase necessary hardware and software	FWPD FWPD		❖	❖	❖	❖	❖	

• Install weather stations one in each Park to monitor and assess hydro--meteorological data as a long term strategy								
• Install one rain gauge above each of the forest canopies of the Morne Diablotin and Morne Trois Pitons National Parks to monitor and study the rainfall interception process. • Establish forecasting capability, early warning systems • Train staff responsible for monitoring and collating climate data • Undertake Community involvement/education/awareness in the process • Strengthen the meteorological office to scientifically collate, archive and disseminate information • Establish inter agency coordination with respect to monitoring climate change parameters- at the public and private sector levels and establish a system for communication and information sharing	FWPD Technical assistance request Forestry Refer to public awareness programme Meteorological Office Forestry	Disaster Management Office/CDEMA/ CCCCC MET Office CDEMA/ CCCC Met Office/ Disaster Management Office	❖ ❖ ❖ ❖ ❖	❖ ❖ ❖	❖ ❖	❖	❖	**Technical Assistance request**

2. Update and develop baseline data on physical characteristics and biodiversity of the Parks as a basis for measuring changes								40,000
• Develop baseline data on species and ecosystems	Forestry Division FWPD		❖	❖	❖		❖ .	
• Undertake research and map all endemic species in the Parks.	FWPD		❖	❖	❖	❖	❖	
• Record and monitor any biological invasions (presence of any invasive plant or animal species) and implement mitigation measure to reduce or stop this process	FWPD		❖	❖	❖	❖	❖	
• Establish or adopt indicators for biodiversity and establish a programme to monitor these indicators	FWPD		❖	❖	❖	❖		
• Evaluate and monitor elfin woodland and develop baseline information for assessing the impact of climate change-	Technical Assistance to FWPD FWPD		❖	❖	❖	❖		
• Undertake Vulnerability Assessment of the Parks			❖	❖				
• Develop and implement policies and programmes to protect these critical habitats.								

Increasing the resilience of the Parks To reduce the carbon footprint of the parks • Review legislation and policy of the National Park to allow for restoration of degraded areas of the Park • Establish boundaries and buffer zones to facilitate migration of species • Retrofit all building in the parks to make them energy efficient • Reforest and restore degraded areas of the Park and buffer zones • Provide incentives to land owners with land adjacent to the Parks to reduce impact on the Park • Develop and implement silvicultural techniques to promote forest productivity maintain genetic diversity and promote ecosystem health via restoration • Strengthening the co-operation between Forestry and national parks service, land owners and the private sector • Close down and rehabilitate the quarry in the Park and relocate shooting range in the Park	Forestry Division FWPD /Min of Legal Affairs and Tourism FWPD FWNPD/ Ministry of Tourism & Legal Affairs FWPD FWPD FWPD Forestry, Wildlife & N Park FWPD	Land owners and adjacent communities Land Owners/ communities Land & Surveys Department/ Min of finance Lands & Surveys/ Min of Infrastrucure	❖ ❖ ❖ ❖ ❖	❖ ❖ ❖ ❖	❖ . ❖ ❖ ❖			21,000 budgeted under the Management plan

To undertake ex-situ research to maintain the genome of endemic and indicator species of the Parks	Forestry, Wildlife & Parks Divisions, FWPD / Technical Assistance							150,000 70, 000
• Establish physical infrastructure for housing of seed bank	FWPD	Involve communities in this process		❖				
• Establish seed-gene bank.	❖			❖				30, 000
• Collect and store seeds and plant materials of all endemic and indicator plant species	❖		❖	❖	❖	❖	❖	
• Establish and Maintain a living collection of plants – ex-situ field gene banks	❖		❖	❖	❖	❖	❖	30, 000
• Upgrade existing nurseries and develop new ones	❖			❖	❖	❖		20,000.
• Undertake watershed management techniques	❖	DOWASCO	❖	❖	❖	❖	❖	
• Develop social forestry programmes	❖	Communities	❖	❖	❖	❖	❖	
• To collaborate, co-operate and share best practices and knowledge	❖		❖	❖	❖	❖	❖	

7.2 IMPLEMENTATION AND REVIEW

The implementation period of the plan will be 2011 - 2016

The strategies will be reviewed annually to take into account new changes as a result of ongoing scientific information on climate change.

The following represents the list of stakeholders important in the implementation of the strategy:

PRIMARY STAKEHOLDERS

- Government of Dominica
- Environmental Coordinating Unit
- Forestry Wild Life and Parks Division
- Ministry of Tourism
- Disaster Management Authority
- National Emergency Planning Organization (NEPO)
- Meteorological Office
- Communities in and around the Park and other communities

SECONDARY STAKEHOLDERS

- Discover Dominica
- DOWASCO
- Division of Agriculture
- Physical Planning Division
- Lands and Surveys Department
- DOMLEC
- Local Authorities/Community Groups
- Private Land Owners
- Discover Dominica Authority
- Non-Governmental Organizations (NGOs)
- Tourism Service Providers

7.3 OPTIONS FOR FINANCING

The following agencies and organizations could provide technical assistance and or financing of project with respect to implementing the management Plan:

- UNESCO World Heritage

- The Pilot Program for Climate Resilience (PPCR) a part of the Strategic Climate Fund (SCF), a multi-donor Trust Fund within the Climate Investment Funds (CIFs)
- Conservation International
- Rare Species Conservatory Foundation, RSCF
- World Wildlife Fund/IUCN
- Birdlife International
- World Bank/ Caribbean Community Climate Change Centre (CCCCC)
- Multilateral Agreements Relating to Climate Change
- United Nations Development Programme Global Environment Facility (UNDP/GEF)
- European Union (EU)
- Caribbean Natural Resources Institute (CANARI)
- Food and Agricultural Association (FAO)
- Convention on Biological Diversity (CBD) for Research
- Caribbean Development Bank (CDB)
- Global Water Partnership Caribbean
- World Meteorological Organization (WMO)
- CDEMA, Caribbean Disaster Emergency Management Agency
- University of the West Indies (UWI)/ UWI Centre for Resource Management and Environmental Studies, CERMES
- Caribbean Institute for Meteorology and Hydrology
- The Climate & Development Knowledge Network (CDKN) and the United Kingdom's Department for International Development (DFID) Caribbean.

National Park	Outstanding ecological value	Climate change adaptation measures	Sources of Funding
MTNPWHS	▪ Geological Processes/landforms	Low adaptive capacity	UNESCO World Heritage Foundation
Designations: UNESCO/WHS Other Designations Conservation International-designated Conservation Hotspot WWF/IUCN Centre of Plant Diversity and a BirdLife-Endemic Bird Area, EBA Important Bird Area, IBA	▪ Significant geomorphic/physiographic Features	Low adaptive capacity	
	▪ Significant natural features/biodiversity	**High adaptive capacity** ▪ Research & establishment of indicators ▪ Monitoring ▪ In- situ Conservation ▪ Ex- situ conservation- seed collection, germ plasm, tissue culture ▪ Habitat restoration ▪ Establishment of buffer zones	UNESCO World Heritage Foundation WWF/ IUCN World Bank/ Caribbean Community Climate Change Centre (CCCCC)
	Threatened sp. Of outstanding universal value *Amazona imperialis* *Amazona arausiaca* Forest thrush, *Cichlherminia lherminieri*	In-situ conservation- ongoing for Amazona imperialis Ex-situ conservation	Conservation Int'l Bird Life International
MDNP Important Bird Area, IBA	Biological Diversity	**High adaptive capacity** ▪ Research & establishment of indicators ▪ Monitoring ▪ In- situ Conservation ▪ Ex- situ conservation- seed collection, germ plasm, tissue culture ▪ Habitat restoration Establishment of buffer zones	UNESCO World Heritage Foundation WWF/ IUCN World Bank/ Caribbean Community Climate Change Centre (CCCCC) UNDP/GEF
	Protection of endemic Amazona parrots		Rare Species Conservatory, Foundation RSCF Bird Life International

	Protection of habitat of Amazonas pp.		
	Protection of other endemic species- endemic plants *Chromolaena impetiolaris* and *Chromolaena macrodon*	Research and monitoring In-situ Ex-situ conservation measures	University of the West Indies, UWI
	Other endemic bird species and other wildlife species	Research and monitoring In-situ and Ex-situ conservation measures	Bird Life International Rare Species Conservatory, Foundation RSCF

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LIST OF ACRONYMS

CANARI	Caribbean Natural Resources Institute
CARICOM	Caribbean Community
CBD	Convention on Biological Diversity
CCCCC	Caribbean Community Climate Change Centre
CCD	Convention to Combat Desertification
CDERA	Caribbean Disaster Emergency Response Agency
CEHI	Caribbean Environmental Health Institute
CERMES	Centre for Resource Management and Environmental Studies
Programme	
CIMH	Caribbean Institute of Meteorology and Hydrology
CPACC	Caribbean Planning for Adaptation to Climate Change Project
DOMLEC	Dominica Electricity Services
DOWASCO	Dominica Water and Sewerage Company
ENSO	El Niño Southern Oscillation
IWCAM	Integrating Watershed and Coastal Area Manage
FDD	Fisheries Development Division
FWD	Forestry, Wildlife & Parks Division,
GIS	Geographic Information Systems
GOCD	Government of the Commonwealth of Dominica
GEF	Global Environment Facility
IPCC	Intergovernmental Panel on Climate Change
IWCAM	Integrating Watershed and Coastal Areas Management
IWRM	Integrated Water Resource Management
IUCN	International Union for the Conservation of Nature
MTPNP	Morne Trois Pitons National Park
MDNP	Morne Diablotin National Park
NEPA	National Environment and Planning Agency
NSO	National Statistical Office
OAS	Organization of American States
OECS	Organization of Eastern Caribbean States
UNDP	United Nations Development Programme
UNEP	United Nations Development Programme
UNESCO	United National Educational Social Organization
UNFCC	United Nations Framework Convention on Climate Change
WHS	World Heritage Site

APPENDIX 1- CAPACITY BUILDING REQUIREMENTS AND ONGOING RESEARCH AND DATA COLLECTION IN DOMINICA

CAPACITY BUILDING REQUIREMENTS

- Data collection, storage, retrieval and analysis
- Germplasm management/ tissue
- Seed storage/ Ex situ conservation
- Climate change Vulnerability analysis
- Risk Assessment
- meteorology
- hydrology
- Installing and maintaining recording sensors, data loggers and data transmission systems.
- Electronics
- Computer programming and database management

ONGOING RESEARCH AND DATA COLLECTION IN DOMINICA

Monitoring of Hydrological Data

- Rainfall data collection is being undertaken at the following areas:
  - Emerald Pool and Fresh Water Lake within the National Parks (Other collection points are Cabrits¸Delices, Pond Casse, Glo Gommier, and Caholm).
  - DOWASCO - Within the Morne Trois Pitons National Park
  - MET Office at Canefield and Melville Hall Airports
  - Yale University - automated weather stations, DOMEX Project
  - DOMLEC – Fresh Water Lake – Rainfall measurements
  - Stream Flow Measurements
  - DOMLEC – Fresh Water Lake – Stream Flow Measurements
  - DOWASCO- Stream Flow measurement

Current Research Programs within the National Parks

- Parrots Research at Morne Diablotin (RARE Species Conservatory Contact Mr. Arlington James)
- Research on Forest Dynamics – Forestry Division

- Smithsonian Research on Hummingbirds and University (?) Did not receive further information from the Forestry Division)
- Policy Document for Integrated Water Resource Management
- Monitoring of Mountain Chicken and other Frogs
- Global Water Partnership Agreement (GWPA)
- CREPDZ – Mini Hydro Project
- Feasibility Study on Checkhall River
- Yale University automated weather stations, DOMEX Project:

    - To understand the physics of mountain triggered convection and precipitation in the tropics, using Dominica as a natural laboratory
    - To develop data sets that can be used to test and improve numerical models of convection and precipitation in the tropics
    - To better understand and predict the weather and climate of the Lesser Antilles including Guadeloupe, Dominica and Martinique

Ten recording rainfall stations have been installed at stations at La Plaine, Freshwater Lake, Springfield, Canefield Airport, Rosalie, Botanical Gardens, Pont Cassé, Grand Fond, Laudat Village and Boeri Lake.

The principal investigator of DOMEX is Professor Ronald B. Smith from Yale University, with support from the USA National Science Foundation. Participating institutions include: Dominica Division of Forestry, MeteoFrance DIRAG, University of Reading, University of Wyoming, and the Max Planck Institute.