

**Special Program for Adaptation to Climate Change (SPACC) Project
Commonwealth of Dominica**

Situation Analysis

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I. Introduction to SPACC, forum, and scope of situation analysis

The Commonwealth of Dominica together with St. Lucia and St. Vincent and the Grenadines have been selected as beneficiary countries under the GEF-World Bank **Special Programme for Adaptation to Climate Change (SPACC) project** whose overall objective as stated in the approved Project Appraisal Document (PAD) is *“to implement specific (integrated) pilot adaptation measures addressing primarily, the impacts of climate change on their natural resource base, focused on biodiversity and land degradation along coastal and near-coastal areas. This will be achieved through: (i) the detailed design of pilot adaptation measures to reduce expected negative impacts of climate change on marine and terrestrial biodiversity and land degradation; and (ii) the implementation of pilot adaptation measures”*.

The project also seeks to *“produce knowledge of global value on how to implement adaptation measures in small island states that can be applied in other countries in the region”*.

In Dominica the two sites identified for the detailed design and implementation of adaptation measures are: (a) the Morne Diablotin National Park (MDNP) and its neighboring communities of Colihaut, Dublanc and Bioche (CDB) communities; and (b) the Morne Trois Pitons National Parks.

The project supports the following activities in Dominica:

- (a) Component 1 – Identification, Evaluation, Selection and Design of Priority Adaptation Measures to address impacts of climate change on biodiversity and land degradation;
- (b) Component 2 Sub-component 2 – Implementation of adaptation measures in the biodiverse Morne Diablotin National Park and its Neighboring Communities identified in Component 1; and
- (c) Component 2 Sub-component 3 – Morne Trois Pitons National Park Integrated Ecosystem Management.

Key performance indicators in relation to the activities to be undertaken in Dominica are to maintain the ecosystem functioning in Morne Diablotin and Morne Trois Pitons Parks (World Heritage Site) in Dominica.

Research has not been conducted on the effects of climate change on the resources of the Morne Diablotin National Park and Morne Trois Pitons National Park specifically. Therefore, before any adaptation measures can be implemented under Sub-component 2, it will be necessary to undertake a detailed and scientifically defensible analysis of climate change impacts on the ecosystem and biodiversity of the two National Parks as provided under Component 1. The detailed analysis should identify, evaluate, select, and design priority adaptation measures to address impacts of climate change on biodiversity and land degradation in the Morne Diablotin National Park and Morne Trois Pitons National Park. However, the absence of data on the status and trends on ecosystems and climatic variables will be a significant constraint.

The analysis will include the following:

- i) synopsis of the current ecosystems and physical conditions and threats (natural and anthropogenic) in the two National Parks and adjoining areas;
- ii) synopsis of anthropogenic activities that impact or may threaten the viability and integrity of the two National Parks;
- iii) overview of past, current and future temperature and rainfall patterns in the two National Parks and adjoining areas;
- iv) identification of climate change impacts, primarily concerning biodiversity of global significance and climate change impacts on key “values” for which the National Parks were established
- v) identification and evaluation of possible adaptation responses (natural and anthropogenic) to address climate change and associated threats;
- vi) feasibility analysis of possible anthropogenic adaptation measures to address climate change and associated risks;
- vii) prioritization of feasible anthropogenic adaptation options to support or compliment natural adaptation responses;
- viii) design of priority anthropogenic adaptation measures to support or compliment natural adaptation responses.

In view of the wide range of scientific disciplines and knowledge (international and national) required to undertake such a vulnerability assessment and the limited budget available under the SPACC project for undertaking such an assessment, the Government of Dominica will convene a Forum over a one-week period that would include the presentation of papers by technical experts, panel discussions amongst ecosystem experts (parrots, rainforest, aquatic volcanism, etc), site visits, and community consultation. Plenary meetings by technical experts will focus on developing a scientifically defensible consensus document.

Once refined through this peer review process, the consensus document will constitute the implementation plan for Component 2 of the SPACC project. It is anticipated that the adaptation plan developed through this process will constitute a technical annex to the Management Plans of the Morne Diablotin National Park and Morne Trois Piton National Park. Priority adaptation measures identified in the consensus document will be implemented under Component 2 of the SPACC project, in coordination and collaboration with other ongoing GEF-funded projects currently being implemented in Dominica.

Situation analysis

The chapters herein comprise the situation analysis, which primarily addresses items (i)-(iv) outlined above. The purpose of this analysis is to assist the deliberations and evaluation to be undertaken by the Forum. Prepared with the assistance of local experts, this analysis draws from the management plans of the two National Parks and recent studies. The purpose of the situational analysis is to compile and synthesize the most pertinent information on the National Parks, adjoining communities, and climate change, thereby providing a sound foundation from which to propose the highest priority adaptation measures.

The analysis represents a synthesis of relevant information from primary body of documentation available. The reports from which the analysis has drawn includes:

- The Morne Diablotin National Park Management Plan 2009-2014 – Dominica National Park Service
- The Commonwealth of Dominica – Biodiversity Strategy and Action Plan 2001-2005
- Caribbean Planning for Adaptation to Climate Change (CPACC) Policy Framework for Integrated Adaptation Planning and Management in Dominica – 2002
- Pont Casse and Environs Development Plan 2008, Baptiste & Associates
- Initial National Communication to the UNFCCC, ECU – 2001
- Second National Communication to the UNFCCC, ECU (draft)- 2010
- Final Report: Development of Landslide Hazard Map and Multi-Hazard Assessment for Dominica, West Indies - USAID, Caribbean Open Trade Support (COTS) – Oct 2006
- Coastal Vulnerability Assessment for Dominica – USAID – Feb 2007
- Steiner, SCC (2008) Marine Habitats of Dominica (<http://www.itme.org/marinehabitats>)
- Smith R, et. al (2008). Orthographic precipitation in the tropics: Experiments in Dominica. *Journal of the Atmospheric Sciences*. 66 (1698-1716).
- Day. O. 2009. The impacts of climate change on biodiversity in Caribbean islands: what we know, what we need to know, and building capacity for effective adaptation. CANARI Technical Report No.386: 28pp
- Cox, C. 2005. An Impact Assessment of Potential Residential Development in the Vicinity of the Morne Trois Pitons National Park – Final Report. Made at the instance of the Waitukubuli Ecological Foundation, financed by the Government of Australia.
- Caribbean Natural Resources Institute (CANARI) and FAO National Forest Program Facility - Participatory Forest Management Project: Improving Policy and Institutional Capacity for Development
- St. Louis, A, et. al. 2009. Socioeconomic Monitoring Assessment of Coastal Management in the Colihaut, Dublanc, and Bioche Villages of Dominica. Funded by Cermes
- GIS Maps created for Land Use, Water Catchments, Watersheds, Slope steepness, and Soils

Additional documentation available in hard copy includes:

- Morne Trois Pitons National Park Management Plan 2002-2012
- Rapid Assessment of Quarry Impacts on Marine and Freshwater Biodiversity in Dominica – USAID, Caribbean Open Trade Support (COTS) – March 2008
- Rainfall report – Forestry Division – Mr. Arlington James -2007
- Preliminary Findings of the Government-Appointed Crop Depredation Task Force – Minchonton Burton, Chairman of the Task Force & Director of Forestry, Wildlife & Parks, July 2009

Electronic documentation will be made available for download on a website for the forum. Hard copies can be provided upon request.

Acknowledgements

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II. Current ecosystems and physical conditions in the two National Parks and adjoining areas

(Note: unless otherwise indicated, all information in this chapter has been sourced from the management plans of the two National Parks and Cox 2005)

A. Values and principles underlying the establishment of the parks



Figure 1: Map of Dominica and the National Parks (note: MDT is shown along with the Northern Forest Reserve)

The premise behind the proposed projects will be to implement adaptation measures that assist in maintaining the integrity of the National Parks. Designing adaptation responses to climate change in the national parks will invariably necessitate understanding the values and principles that underpin the designation of the areas as protected areas of global significance. Proposed solutions should concentrate on mitigating the impacts of climate change on these key areas.

Morne Diablotin National Park – Officially created in January 2000, the Morne Diablotin National Park is a spectacular wilderness area with many rivers and mountains and impressive primary forest rich in wildlife. Located in the North-west part of Dominica, the National Park is centred on the island’s highest peak (1,447 m) after which it is named. It comprises 3,410 ha of some of the finest and least disturbed rainforest in the insular Caribbean. The majority of the area is very rugged and above 610 m elevation. Several

peaks occur within the Park and a deep ravine, the Picard Gorge, runs through the north-west section. The Park has tremendous value as a protected forest since it includes portions of the watersheds of 12 rivers, four of which provide water to domestic, agricultural and industrial users in the north of the island. It is also host to two species of highly endangered parrots the Sisserou or Imperial Parrot *Amazona imperialis* and the Jaco or red-necked Parrot *Amazona arausiaca*, and to a number of other rare species including the plants *Chromolaena impetiolaris* and *Chromolaena macrodon* which are only found on Morne Diablotin and nowhere else in the world (endemic).

Morne Trois Pitons National Park (World Heritage Site) – spanning an area of 6,875 hectares and centered on the 1,342 meter high volcano after which it was named, the Morne Trois Pitons National Park was inscribed as a World Heritage Site in December 1997 by UNESCO for its diverse flora with endemic species of vascular plants, its volcanoes, rivers and waterfalls, illustrating ongoing geo-morphological processes. The parks has significant value as a protected area, containing the “richest biodiversity in the

Lesser Antilles”, the IUCN Technical Evaluation recommending and supporting the UNESCO listing cites “dramatic examples of active vulcanism”... “including 50 fumaroles and hot springs as well as a “boiling lake” one of the two or three largest in the world”. Other landscape features cited include three freshwater lakes and numerous waterfalls. Experiencing an humid tropical maritime climate with annual rainfall of 7 meters, the park “contains a rich rainforest flora with six communities (Elfin/cloud forest at the summits, montane thicket, montane rainforest, mature rainforest, secondary rainforest, semi-evergreen forest) which vary with elevation.” The majority of 5,000 vascular plants found in Dominica grow in the park, including 21 endemic species.

B. Relevant forest legislation, management, and buffer zones

Forest legislation: There are 5 acts that have guided the management and establishment of the National Parks:

- The National Parks and Protected Areas Act of 1975 established the authority to create and manage special areas within Dominica
- Forest Act and Forest Rules of 1958
- Forestry and Wildlife Act of 1976 provides for the protection, conservation, and management of wild mammals, freshwater fish, amphibians, crustaceans, and reptiles
- Water Catchment Rules. No entity is responsible in general for management of watershed areas. Water in Dominica is distributed to the public by the Dominica Water and Sewage Company (DOWASCO), a state-owned corporation that is overseen by the Ministry of Public Utilities and Public Works. Dominica Electricity Services Ltd. is a privately owned, formerly state-run company that also uses substantial amounts of water to operate its hydroelectricity plant.
- Mines and Minerals Act of 1996 made environmental assessments discretionary rather than mandatory. There is currently a government-managed quarry in the Morne Trois Piton National Park, which was established many years before the designation of the national park.

There are no legislated, enforced buffer zones for either of the two national parks. Management of buffers remains to be codified. Approval from the Division of Physical Planning is required for building but there is no national land use policy or plan, which means that the use of private land is largely unregulated. Therefore, management of the National Parks and the integrity of its boundaries are critical priorities for maintaining the integrity of the national parks.

There are “casual” staff at each eco-tourism site (maintenance, reception) and sent on an ad hoc basis but no officers assigned to each national park exclusively.

Morne Diablotin National Park

The Park is managed by the Forestry and Wildlife Division of the Ministry of Agriculture, Fisheries and Forestry. Visitors are restricted mostly to day use pedestrian activities. A Wilderness zone covers most of the Park, and no infrastructure other than unimproved trails is allowed. Improved trails, overlooks, and rain shelters are permitted in the Extensive Use Zone. Park management is built around 5 management programs: The Resource Protection Program, The Public Use Program, the Research and

Monitoring Program, The Environmental Education and Public Awareness Program, and The Community Outreach Program.

The Syndicate Nature Trail and the Milton Waterfall are important tourism attractions and serve as a source of income for tour operators and individuals in the community. The trail is located in the 83 ha tract of forest that in 1989 was purchased by the government with help from international conservation organizations and local people and declared a Parrot Preserve. Sightings of the Imperial parrot as well as the more abundant Red-necked parrot are common in this portion of the park, especially because the parrots often fly into the adjoining citrus farms to feed. The proposed buffer zone in the Management Plan for the park is 2km outside of the park boundaries.

Morne Trois Pitons National Park (World Heritage Site)

Morne Trois Pitons National Park, managed by the Forestry and Wildlife Division, was the first unit of the Dominica National Parks System to be established. While there is a UNESCO office in Dominica, the committee that provides recommendations on management is currently defunct. It is the most popular tourist destination in Dominica. The Morne Trois Pitons National Park includes numerous attractions such as The Boiling Lake, The Valley of Desolation, Titou Gorge, Boeri Lake, and Middleham Falls.

The National Park is made up of former crown lands and the privately, contributed Middleham Estate. Within its boundaries are a few private-in-holdings. Additionally, the GOCD granted rights of way to DOMLEC, the power utility. DOMLEC's rights of way and the private in-holdings are both situated near the Park's Main entrance at the Fresh Water Lake. Villages in close proximity to the boundaries of the Park contain rather more than 10 percent of the nation's population.

Buffers have been proposed for all lands east of the road running along Corona Estate to the Castle Bruce/La Plaine junction back to the Morne Trois Pitons National Park boundary to protect the transitional Montane Rain Forest, minimize landslide risk, and provide watershed protection downstream. Buffers have also been proposed in the Terre Ferme area.

C. Ecosystem regulatory functions (hydrologic, edaphic)

The in-tact forest cover of both National Parks provides various ecosystem services to the island ranging from watershed regulation to soil conservation. The benefits are most relevant to the communities surrounding the parks.

While the watershed functions of the forests are well documented, inconsistencies in stream flow data preclude us from making definitive conclusions about the volume of water harvested from the watersheds of the national parks.

Morne Diablotin National Park

Morne Diablotin is almost always enveloped by rain or mist. The driest season occurs between February and May NE trade winds blow during most of year, but there is a SE pattern July to September when tropical storms can hit the island.

Morne Trois Pitons National Park (World Heritage Site)

Distribution of vegetation type is strongly related to natural climatic and topographic conditions in a given locality. These microclimatic conditions are greatly influenced by the elevation of the area.

Vegetation cover influences contribute more to erosion mitigation than any other factor through a dual role of soil and water conservation. In this context, vegetation includes all the strata within the ecosystem; the mature overstory, the sub-dominant strata, shrub and ground vegetation and the litter layer. The tree and shrub canopy serves to absorb and diffuse raindrop impact energy, an important function in environments where high-intensity rainfall is commonplace. Surface residues and leaf litter act as physical impediments to retard overland flow where it does occur and trap sediment being transported. The role of tree root networks in the soil profile is paramount in steep environments that are prone to landslides.

Figures 4 and 5 show the 12 watersheds that originate within the park, as well as several water catchments. Declining water quality continues to be a major source of concern, particularly because water is abstracted from surface sources that are vulnerable to conflictive land use.

D. Flora and Fauna (biodiversity)

Morne Diablotin National Park

Hurricanes and rainfall have shaped the composition of flora and fauna in the Park. The main vegetation type in the Park is the rainforest with a dense canopy and rich diversity of lianas. Secondary rainforest occurs on the northern and western boundaries where pioneer and secondary trees that have come in after hurricanes, agricultural clearings, or selective logging. The Montane Thicket vegetation type occurs above 850 m. on thin soils, but not on exposed ridges or summits, and its canopy reaches only 10-15 m. The Elfin Woodland vegetation type occurs above 850 m. on the most exposed ridges and summits; covers only a small portion of the Park and is constantly shrouded in mist and hence is often called "cloud forest". It is characterized by impenetrable growth of small, gnarled trees 3-9 m. high.

Only the higher invertebrates have been documented in the Park. Invertebrates, such as freshwater shrimp and freshwater and terrestrial crabs occur in the Park, but no collections have been made. There are 24 species of butterflies identified in the Park, but fishes have not been studied. Amphibians identified in the Park include 2 species of frogs, while reptiles include 5 species of lizards, and 4 species of snakes. Some 53 species species of bird have been recorded for the Park of which 30 are regular breeders. The Park is also home to the charismatic macrofauna, the endemic and endangered "Sisserou" or Imperial Parrot (*Amazona imperialis*), and "Jaco" (*Amazona arausiaca*) or Red-necked Parrot. The mammals recorded in the Park include 17 species, mostly bats.

Morne Trois Pitons National Park (World Heritage Site)

The high rainfall regime in the central elevations gives rise to five major vegetation types within the park. Elfin/cloud forest is found on the summit of Morne Trois Pitons. The vegetation is characteristically stunted and gnarled due to exposure to persistent winds while the high moisture regime promotes proliferation of a variety of mosses, lichens that covers the vegetation. Montane thicket is dominant on ridges and well-drained slopes at high elevations and forms a continuous band around the slopes of Morne Trois Pitons at elevations between 1,000 and 1,300 m. The Montane Rainforest is characteristic of the steep slopes underlain by shallow soils. The Mature Rainforest occurs at lower elevations upwards from between 200 and 400 m, generally in the deeper soil within the upper valley bottoms. The Secondary Rainforest is dominated by many of the same species as the Mature Rainforest class but is modified due to inclusion of exotic species.

The fauna found in the area is closely associated with the forest species mix. The greatest diversity of macro-fauna is found within the avian community. Of note is the endemic Red-necked Parrot or Jaco (*Amazona arausiaca*) which is commonly seen in the area. Other regional endemics found in the habitat include the Plumbeous Warbler or chik-chik (*Dendroica plumbea*), Blue-headed Hummingbird or fougou tèt blé (*Cyanophaia bicolor*), Lesser Antillean Pewee or gòb mouch (*Contopus latirostris*) and the Forest Thrush or movi or gwiv-a-linèt (*Cichlerminia lherminieri*). The Imperial Parrot or Sisserou (*Amazona imperialis*), the world's largest and among the rarest Amazon parrots, likely inhabited the southern mountain habitats but have not been recently recorded in the area around Morne Trois Pitons. In terms on mammals, greatest diversity is to be found in bat species. Some 12 bat species are recorded from Dominica, of which four are regional endemics. Other notable mammal species include Agouti (*Dasyprocta leporina*), and the Opossum or manicou (*Didelphis marsupialis*). Feral pigs, rats and mice are the other species found in the park. Several reptile species occur within the park and include four lizard species of which two are endemic; the Dominican Tree Lizard or zanndoli (*Anolis oculatus*) and the Dominican Ground Lizard or abòlò (*Ameiva fuscata*), four snake species which include the boa constrictor or tèt chien (*Boa constrictor nebulosa*) and the kouwès nwè (*Alsophis antillensis sibonius*), and two gecko species, (*Sphaerodactylus vincenti*) and the Turnip-tailed gecko or mabouya hazyé (*Thecadactylus rapicauda*) (Maximea et al., 2001 and A. James pers. comm. 2005). The Mountain Chicken or crapaud (*Leptodactylus fallax*) was recently afflicted with a rare fungal disease, chytridiomycosis, and there is doubt as to whether it still can be found in the Park. Other amphibian species that are likely present include the endemic Dominican Piping Frog (*Eleutherodactylus amplinympha*) and *Eleutherodactylus martinicensis*. Some five crab and six shrimp species are known to occur in the Park

E. Available data and relevant monitoring

1. Government sponsored

Scattered, inconsistent, and uncoordinated efforts have been made to monitor the climatic conditions in the parks over time. The Meteorological Office has recorded temperature and rainfall consistently at the two airports, Canefield (3 miles north of Roseau) and Melville Hall, (northeast of the island)_ both of which are not in the

National Parks. The stations record temperature, rainfall, humidity, and cloud cover every hour until 8pm at Melville Hall and 6pm at Canefield. The data is available from 1982 at Melville Hall and 1974 at Canefield. Neither of these stations reflects the conditions in the National Parks precisely because there are significant rainfall gradients and microclimates in Dominica. This data, however, has been used to model climate predictions in Dominica for the Second National Communication to the UNFCCC.

Additional sources of data are available from the Forestry, Wildlife, and Parks Division for various sites in and near Morne Trois Piton National Park. The data is less reliable, however, because rainfall gauges are not consistently checked daily. DOMLEC, Dominica's power utility, also records rainfall data at the freshwater Lake in Morne Trois Piton National Park. A detailed study was conducted in 1967 by DS Lang on the soil composition on the island and recommended land uses. The report remains relevant but has not been updated.

DOWASCO, Dominica's water utility, records stream flow before water intakes. The data, though available, does not allow us to make statistically significant conclusions about stream flow over time because of the inconsistency in measurements taken.

A JICA funded project is currently assessing flood risk on Roseau River to implement an early warning system in light of severe riverbank erosion and recent flooding events.

Discover Dominica (Tourism) has consistent figures on visitors to eco-tourism sites on the island.

2. Scientific research

Dr. Ron Smith of Yale University has established several rain monitoring stations in Dominica as part of a study on orographic precipitation. This data, however, is only available from 2007 onwards. The stations transect the island west to east, also through Morne Trois Piton National Park.

Additional research that has been done on the island includes:

- Dr. Paul Reillo – (Rare Species Conservatory Foundation) – Parrots
- Dr. Andrew Cunningham (Zoology Society of London) and Dr. Jay King (Rare Species Conservatory Foundation) – Amphibians
- Dr. Kalan Ickes (Clemson University) – Forest trees
- Dr. Charles Knapp (San Diego Zoo) - Iguanas/Reptiles
- Dr. Sasha Steiner (Institute for Tropical Marine Ecology – Dominica) – Marine biodiversity, degradation, coral, bleaching, etc
- Dr Leslie Bishop (Earlham College) – Spiders
- Dr. Bob Henderson – Snakes in the Caribbean
- Leo Douglas – Phd student, Jamaica – Crop depredation of citrus by parrots

Several of the reports used to inform this analysis were prepared by consultants who were contracted to undertake studies on hazards and vulnerabilities in Dominica, assess the impact on quarrying on marine ecosystems, and land use in the areas surrounding MTPNP. Therefore, data on landslides and coastal degradation is more widely available.

III. Threats to the Parks: anthropogenic activities & natural phenomena that impact the viability and integrity of the two National Parks

A. Primary land uses

Morne Diablotin National Park



Figure 6: Citrus farms adjacent to Morne Diablotin

While there are no settlements inside the Park, there are 27 communities within 5 miles of the Park that have a population of more than 100 people. The areas to the east and south of the Park are part of the Northern Forest Reserve. Areas to the north comprise large estates (Chilenbain, Maikay and Brandy that are on rugged and inaccessible lands that are mostly covered in forest). Land to the south (En L'ilet and Macatrin Valley) are also very rugged and unpopulated.



Figure 7. Land-use map of area surrounding MDTNP. See next page for legend

The greatest concentration of human use for agriculture and forestry around the Park occurs to the west and north-west on the Syndicate, Dyer and Morne Plaisance Estates.

The lands between the Morne Diablotin National Park and the communities of Dublanc and Bioche contain privately owned farms. These are cultivated with tree crops such as bananas, coconuts, grapefruits oranges,

coffee, ground provisions thus making this area one of the most diversified farmlands in Dominica. The farms average acreage is 4 ha and the total amount of farms is in the region of 100. Figure 7 shows the extent of farms and fallow land on the west boundary of the Park.

Source: The Morne Diablotin National Park Management Plan 2009-2014

Morne Trois Pitons National Park (World Heritage Site)

The lands in the island’s interior were historically owned by the state but were subdivided and sold primarily as agricultural lands in the early 1970s. The program was abandoned given the severe edaphic constraints related to the shallow, excessively leached soils. These soils are described as being high erosion hazards if operated under agriculture or any other intensive land management regime.

The following communities are within the watersheds of MTPNP: Belles, Penrice, Pont Cassé , Layou, Sylvania, Corona, Campbell, Warner, Mahaut, Castle Bruce, Tranto, and Grande Fond. Presently, there are only approximately 125 ha of actively cultivated lands in the area, found mainly at Corona, Soltoun, Penrise and New Foundland. The most commonly grown crops are citrus, bananas, dasheen, and cut flowers.

The area also has about 80 ha of semi-abandoned and abandoned (fallow) lands (Pont Casse, Soltoun and Brantridge Settlements, for example) mainly under citrus. Lands which have been abandoned for an extended period (Brantridge, William and Terre Ferme settlements) are under secondary forest. Figure 8 shows the extent of fallow lands surrounding the park, which are believed to be under threat of development.

Source: Pont Casse and Environs Development Plan 2008

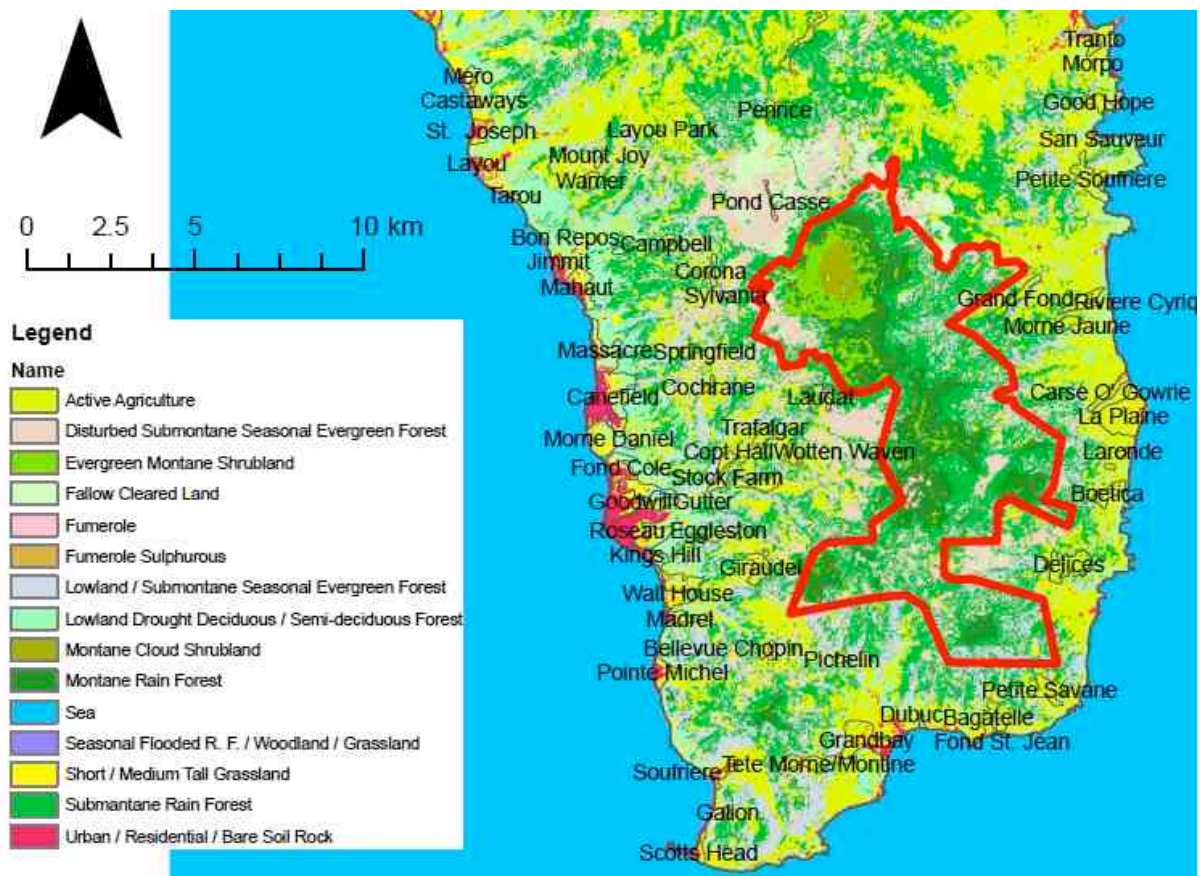


Figure 8. Land use surrounding MTPNP with legend

B. Anthropogenic threats to the parks and drivers

Morne Diablotin National Park

The economic condition of the neighboring communities poses certain threats to the parks. In recent times the communities have seen a decline in fishing yield in coastal areas primarily from near shore fishing. It is possible that rural poverty is leading to problems of deforestation and soil erosion, particularly due to slash and burn cultivation to obtain wood for cooking. Subsistence hunting is threatening the preservation of some species. Additionally, the illegal cultivation of ganja/marijuana is a significant (but not quantified) practice in the parks. The extent of persons utilizing the parks is not known with certainty and needs to be investigated.



Figure 9: Residential development in Pont Casse



Figure 10: Road cut for development in Pont Casse

Morne Trois Pitons National Park (World Heritage Site)

Squatting or the practice of shifting cultivation is not considered a major problem in Dominica. Illegal tree cutting and charcoal production may be a minor problem but the full extent has not been verified. State lands affected by illegal encroachment and intensive cultivation include lands in the Brandy area and an area along the southern boundary of the park near Petite Savanne, an area which was cultivated long before the Park was established. The slash and burn method of cultivation used by subsistence farmers has been said to cause serious negative environmental impacts on wildlife habitat. However, it is not considered to be a problem by forest officers and data to support this qualification was not available at time of writing.

The lands in the island's interior (Pont Casse) were historically owned by the state but were subdivided and sold primarily as agricultural lands in the early 1970s. The Government sold the lands on condition that ownership could not be changed within 10 years following sale. The 10-year period has since elapsed on all transactions and many are now being further sub-divided for housing as evidenced in surrounding areas. The designation of Morne Trois Pitons as a World Heritage Site has been cited as a contributing factor driving the expansion of housing within an aesthetically striking area of the country. A shortage of vacant residential land in the City of Roseau has made this option even more attractive. The increased developments, while not *inside* the National Park, are potential threats because they make the park more accessible to encroachment and illegal exploitation.

Along with poor agricultural practices and waste disposal, development in these areas will surely have wide-ranging effects as sediment and other pollutants will be carried down through the river channels. Also, ongoing road projects have a very negative impact on the watershed and catchment areas due to the dumping of loose material in precipices immediately above these systems. Disruptions to the water supply are frequent during heavy rains when the intake valves are shut off to reduce sediment uptake, or when the infrastructure becomes damaged due to excessive sedimentation.

Source: Pont Casse and Environs Development Plan 2008; Cox, C. 2005

Tourism threats

Unprecedented mass tourism, particularly in Morne Trois Piton National Park at the easily accessible Emerald Pool and Trafalgar Falls (outside the National Park), has resulted from the influx of visitors from cruise ships. Cruise ship season is from November-April, during which 2-3 ships stop 5 days a week. The total number of cruise ship passengers during the peak season is ~300,000, 80% of which disembark. Around 30% of the passengers that disembark go to the Emerald Pool. This amounts to ~500 persons/day. From 2001-2007 Tourism has noticed a 2-3% increase in visitors going to the sites in the National Park.; and in this time there has been a 71% increase in the number of cruise ships coming to Dominica.

If not properly managed and regulated, the increase in mass tourism could compromise these sites through overuse by bringing more vehicles into the park as well as disruption of the fragile ecosystems. A preliminary study by a professor from Clemson University indicated that further research is needed on the carrying capacity of these sites. The researcher recommended staggering visitors to the sites to minimize stress on the sensitive areas.

Waitukubuli National Trail Project

A pioneering effort to provide locals and visitors alike an opportunity to view the vast diversity of ecosystems, historical sites, and landscapes in Dominica. The project includes a trail 115 miles long that winds along the island from the southern-most point Scott's Head, through Morne Trois Piton National Park, along the east coast Carib territory, through Morne Diablotin National Park, up to the north coast, ending at Cabrits National Park. The trail seeks to enhance tourism attractions in Dominica,

provide local communities an opportunity to get involved with maintenance and marketing of the trail, and engender a sense of pride amongst locals for their national heritage. The project rehabilitates many existing trails throughout the island. For areas in which new trails will need to be constructed, the project has arranged for training on management of the forest and the ways in which destruction of habitat can be minimized.

As of now, the trail has only 3 of 14 segments constructed as operational. The primary concern with this project with respect to the National Parks is the potential of increasing access to sensitive areas of the National Parks. The trail is proposed to go through the interior of both parks. Impact assessments have not been conducted but measures have been proposed to encourage community involvement and ensure the construction and maintenance of the trail are environmentally responsible.

C. Natural threats to the parks – including disasters, excessive rainfall, landslides, and erosion

Many natural hazards periodically affect or threaten Dominica, among them are hurricanes, earthquakes, volcanic eruptions, storm surges, and landslides. Being situated in the hurricane belt, hurricanes of varying intensity are reported to occur in

Dominica on average every 15 years. Hurricanes can be attributed as one of the root causes of biodiversity loss in Dominica. Hurricane David in 1979 did significant damage to forest resources by damaging 50% of the trees in the southern half of the island. Hurricanes also cause loss of habitat and food supplies for wildlife species and sometimes result in wildlife mortality. An indirect resultant effect of hurricanes such as “David” is the conversion of wildlife habitat to agriculture. In accessible areas the toppled trees provide an opportunity to more easily clear land for farming, resulting in a further fragmentation of wildlife habitat. This, however, is not a threat within the national parks, where trees are only removed if they obstruct a trail and otherwise not removed, even if dead or fallen.

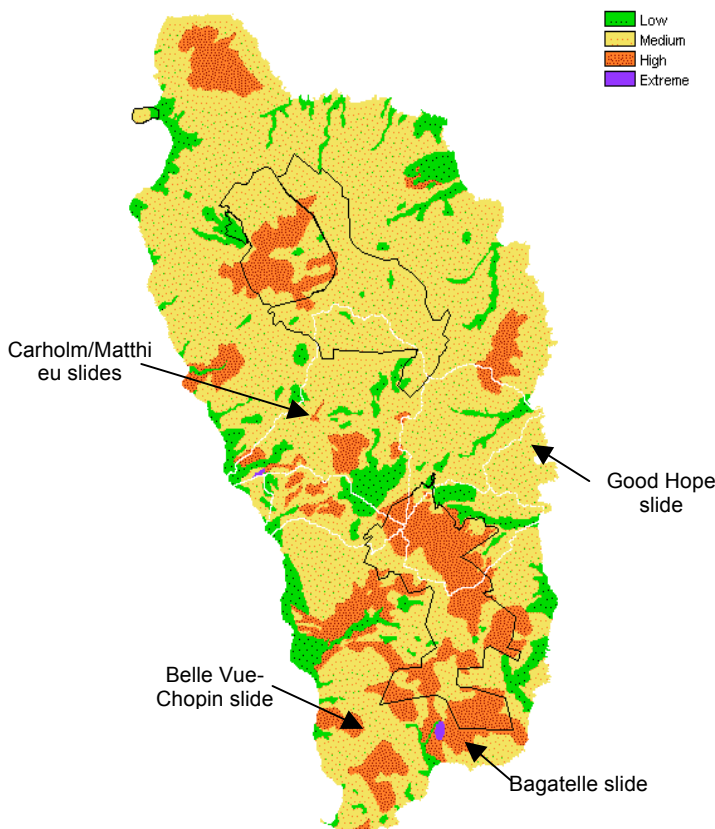


Figure 11: Landslide hazard vulnerability (Cox 2005) with superimposed national park boundaries. Note: the Northern Forest Reserve is also outlined but is not a National Park

Problems of landslides, soil erosion and rapid runoff of storm water damaging major roads in

the area have been of concern for a very long time. These problems were observed to be more pronounced both within the area and downstream of the major rivers receiving surface runoff from the area during the passage of Hurricane Dean in August 2007 and subsequent periods of heavy rains.

In a January 2005 document entitled "Landslides in Dominica" funded by the UK Foreign and Commonwealth Office in Barbados, the authors' analyzed rainfall data from several locations and source on the island to determine the likelihood of rainfall triggered landslides. The study looked at two aspects of rainfall to understand the temporal and spatial distribution of heavy rain events and to develop a landslide triggering rainfall curve for Dominica. The study also identified areas prone to suffer landslides under heavy precipitation and intense rainfall events. While the aforementioned document could not be located, an inventory conducted in 1987, more than 980 landslides were studied for vulnerability (Figure 11). It was found that Dominica has roughly 1.2 landslides per square kilometer (De Graff, 1987).

Additionally, Cox (2003) found a 20-fold differences in magnitude of soil losses from an intensively cultivated agricultural watershed as compared to a forest watershed having similar landform and soils, and subject to similar rainfall events. As such, anthropogenic modification of land exacerbates the effects of intense rainfall such as landslides.

Morne Diablotin National Park

Hurricanes hitting Dominica in recent years have compounded the decline of the parrot populations through the direct deaths of birds and loss of food plants and nesting sites. Studies have shown that after Hurricanes David and Allen in 1979 and 1980, the populations of Imperial Parrots and Red-Necked Parrots fell for several years, dropping as low as 40-60 Imperial Parrots and 200-250 Red-necked parrots in 1985.

The rugged topography causes an uplift of air currents that result in heavy rainfall and a large number of watercourses. There is high risk of landslides over much of Park, especially if the forest is removed.

Source: The Morne Diablotin National Park Management Plan 2009-2014

Morne Trois Pitons National Park (World Heritage Site)

The soils found in the north central, central and south central, and east coast of Dominica represent the most susceptible latosolics soils to landslides. They are the dominant soils in the Pont Casse area (north of MTPNP).

Flooding of rivers and streams is the most common type of flooding in Dominica. River floodplains range from narrow confined steep channels in mountainous areas to wide, flat areas in low-lying coastal areas. Rainfall is also high, ranging between 100 inches (Springfield and New Foundland area) to 300 inches (Pond Casse) annually. Such high rainfall coupled with dominant soil type found in the area increases erosion risks. Surface erosion processes under poor land management regimes tend to be chronic, where, vast quantities of top soil can be lost over time (particularly during large erosive storm events) leading to deterioration of the capacity of the land to support crops or



Figure 12: Landslide in Pont Casse area

sustain ecological needs. Unconsolidated material from landslides in upper watershed areas are significant sediment contributors to runoff for extended periods, causing a myriad of downstream problems.

The geology is another important consideration. The composition of the underlying bedrock when subjected to the climatic regime determines the nature of soil-forming parent material and the relative resilience to man-induced impacts. In the case of Dominica, the range of parent material are fairly

narrow, with pyroclastic and lava flows constituting the majority of the land area. The resultant parent material tends to be deeply weathered. In the high rainfall environment, the geology and resultant landforms and soils present special management challenges.

Observations made in the areas surrounding Morne Trois Piton National Park suggest gully erosion processes already setting in within the drains associated with the road cuts, however observation during storm events will be needed to assess the severity of the problem. The hard-pan associated with the soils within the area will likely present special management concerns on account of the relative shallowness of depth of the hard-pan which will limit deep percolation (Lang, 1967); where the top soil is removed to the depth of the pan, channelized flow may be severe in localized areas.

Source: Pont Casse and Environs Development Plan 2008; Cox, C. 2005

Earthquake and volcanic risk are important issues in Dominica. While large areas of the island are threatened by potential volcanic activity, only small portions of the Morne Trois Piton area are at high risk for volcanic activity within the next 100 years.

Source: Final Report: Hazard Map and Multi-Hazard Assessment for Dominica

1. Data, monitoring, and reports

Rainfall

Rainfall is well-known to be an important variable that strongly influences stream flow, watersheds, flooding, and erosion events. Anecdotally, evidence suggests that stream flow has declined over the last few years.

Long-term rainfall data is scant in Dominica. The Forestry Division’s rainfall stations, however, have fairly reliable data from 1999-2007. Although none of the stations are in Morne Diablotin National Park, the data provides a sense of the yearly differences in rainfall in Dominica, including the significant variations documented from year to year. These variations make it challenging to determine a baseline or trend in yearly rainfall because data is only available for 8 years. Another important comparison could include examining aggregate monthly rainfall data to determine if the driest and wettest month trends in Dominica are changing. The yearly data does not accurately reflect the possible shifts in wet and dry seasons and the intensity of rain events. This data could have implications for flooding events and agriculture, but was not available at the time of analysis.

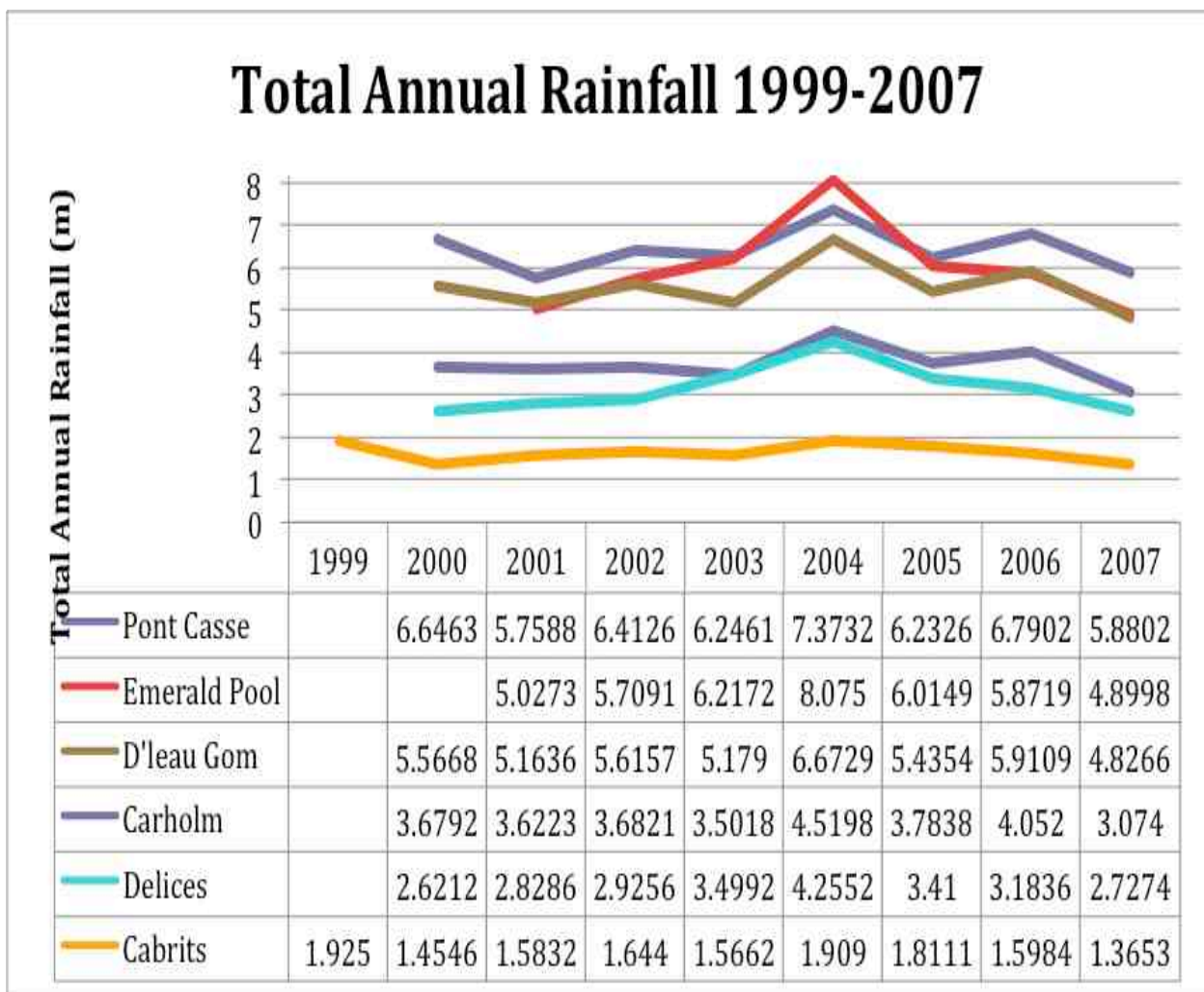


Figure 13 Source: Rainfall report, 2007 – Forestry Division

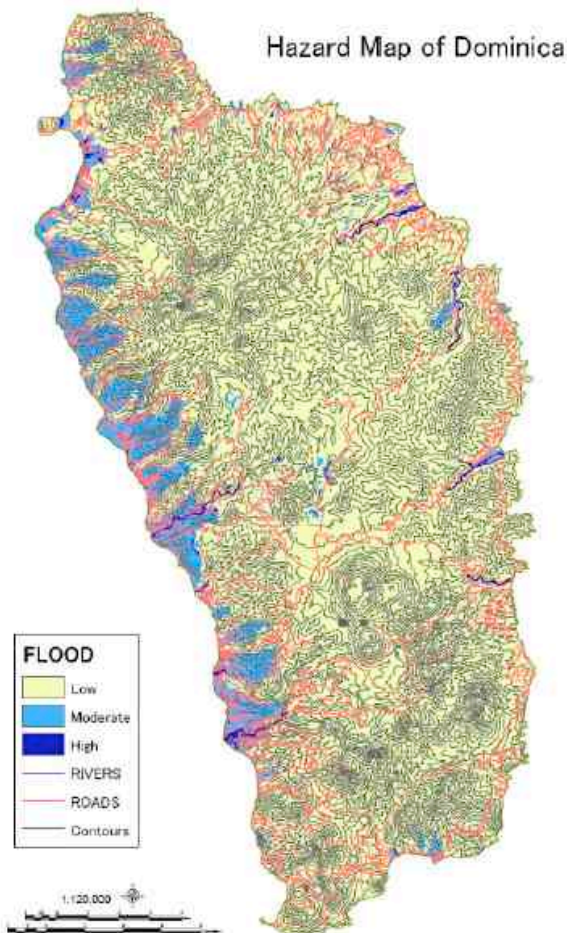


Figure 14. Inland flood vulnerability

Floods

A flood hazard susceptibility mapping model was prepared for Dominica that reflected the varying influences of slope, soils, rainfall, and land use. The output of the model was reclassified into three susceptibility categories: Low, Moderate, and High. The three categories provide an indicator of flood hazard areas in Dominica. While floods do not appear to be a problem within the national parks, it is important to note that many coastal areas with watersheds originating in the national parks are at risk. Refer to Chapter 5 Section B for additional information on the risk of floods due to rainfall events, amplified by climate change.

Source: Final Report: Hazard Map and Multi-Hazard Assessment for Dominica

Erosion

Increased rainfall inevitably results in runoff. The energy of flowing water typically leads to channel erosion, a process of detachment and transport of soil by flowing water within a

defined channel. Over short slopes and distances, erosion due to inter-rill processes is higher, however, as slope steepness and length increases, channel erosion processes become more important as soil detachment and transport within rills and gullies increase. Gullying starts with failure of the gully head and banks, followed by cleanout of the debris by stream flow and further degradation of the channel.

Certain soil types are most susceptible to these types of erosion. Shallow and porous allophane latosol and podzol soils show high water retention in the topsoil and high subsoil permeability. Soil nutrients are concentrated in surface organic matter from the trees themselves. As such, these soils characterize high erosion vulnerability. Figure 17 shows vulnerability based on soil type (Figure 16) and slope steepness (Figure 15). Many areas in both National Parks are therefore vulnerable to erosion, particularly in MTPNP.

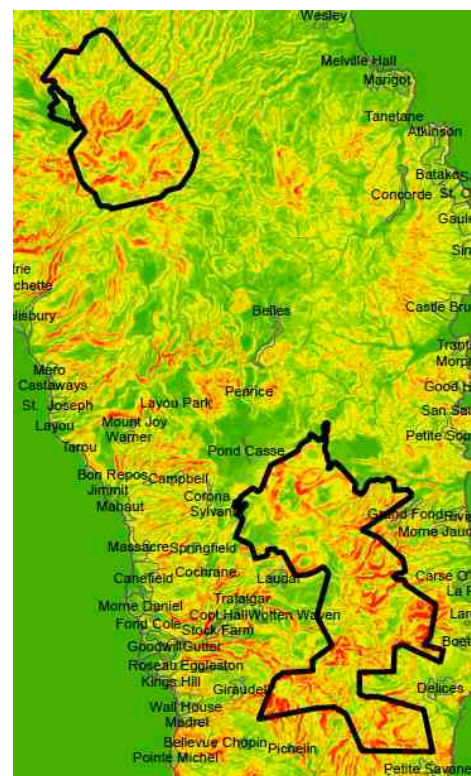


Figure 15. Slope Steepness

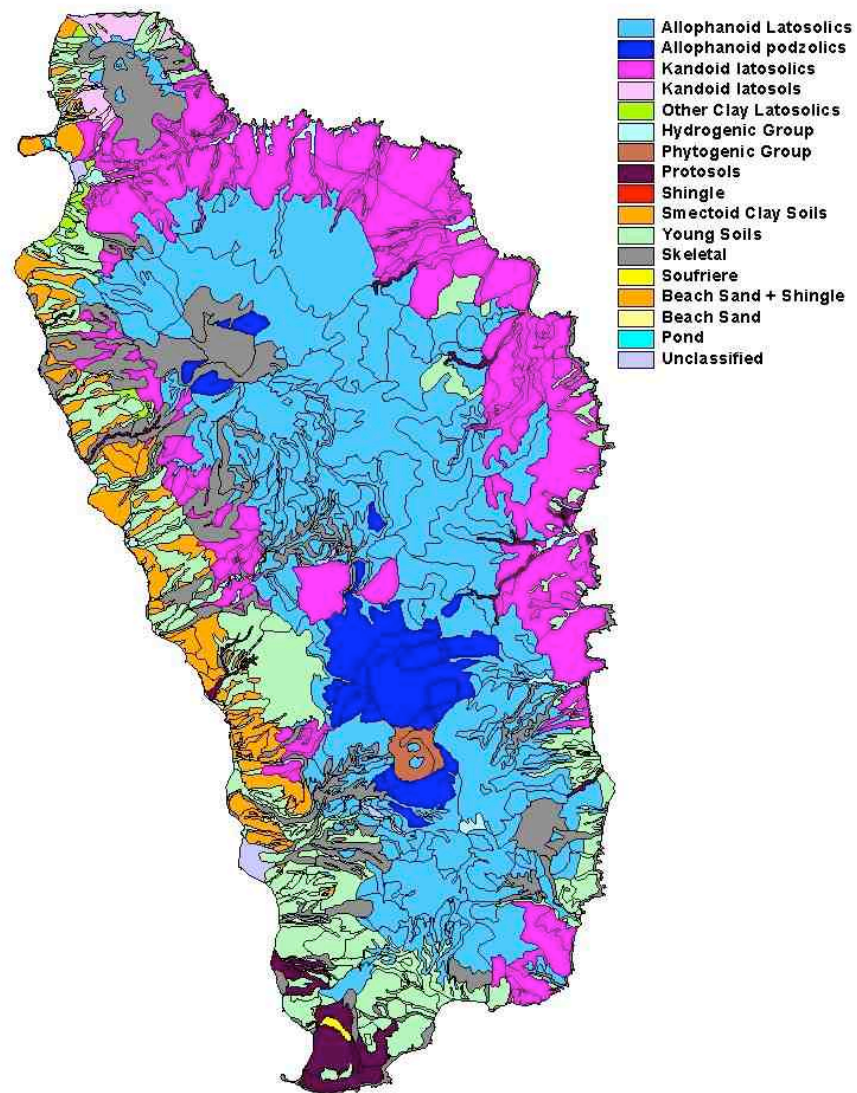


Figure 16. Soil classification (Cox 2005)

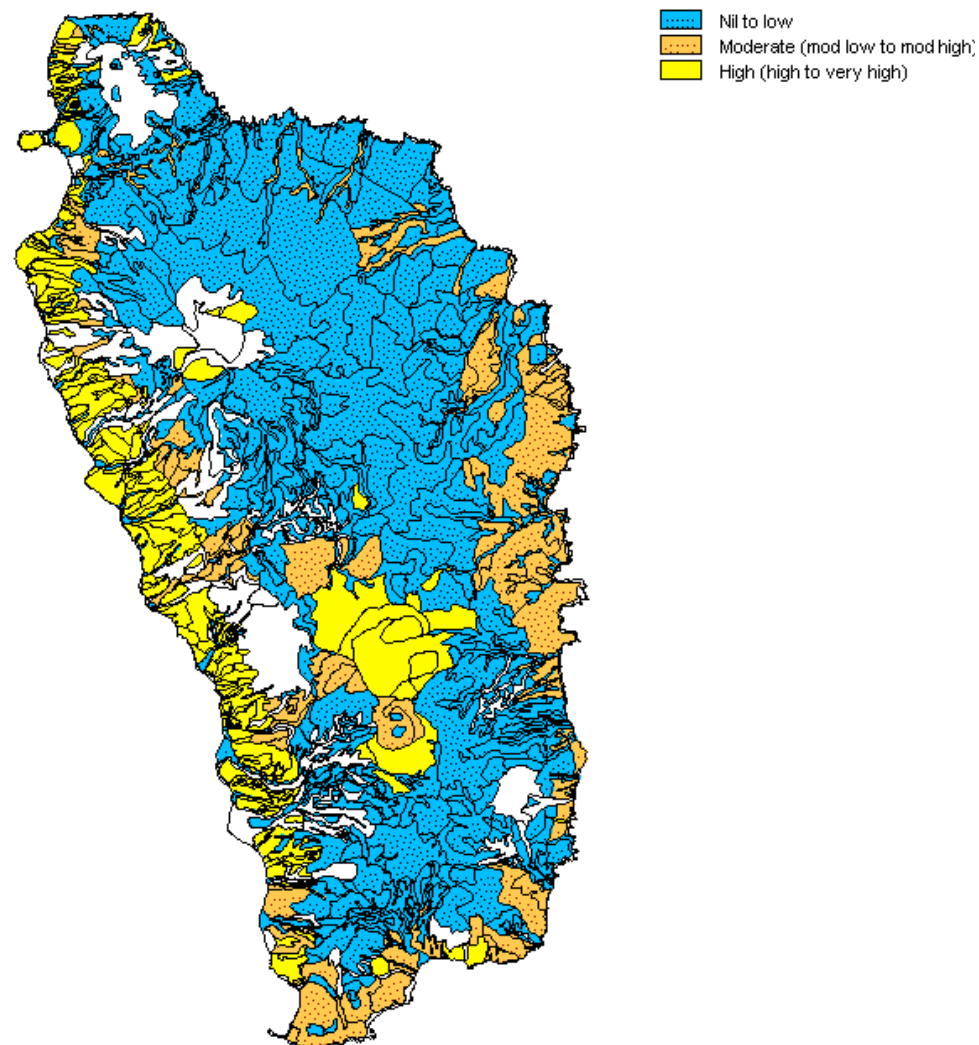


Figure 17. Erosion vulnerability (Cox 2005).

IV. Linkages between the terrestrial and marine ecosystems and concomitant impacts on communities neighboring the Parks

A. Interrelations between geo-morphological processes on land and fishing grounds/coral reefs

The effects of sediment loading in the offshore marine environment are well known in the Caribbean. Sediment runoff from land, a natural process, is exacerbated by activities such as deforestation for agriculture, logging and other activities and purposes. In essence, any activity that decreases the sediment retention (for example via vegetation) of a particular area leads to increased terrestrial runoff. Increased sedimentation due to infrastructural development and sand/gravel quarrying are among the recent sources of this type of disturbance.

Topsoil erosion and subsequent deposition are by far the most obvious impacts of quarries particularly in the wet period or after heavy precipitation. Areas denuded of topsoil and vegetation are prone to erosion and given the topographical characteristics of these sites, the potential for erosion and sediment loss is great. Storage points for processed aggregate are also major sources of sediment entering the coastal system. In addition, depending on the mineral nature of the excavated rocks, considerable quantities of nitrates and phosphate may be leached into the aquatic ecosystem triggering eutrophication.

Additionally, increasing sedimentation within the channels of the lower river reaches is of general concern from a flood risk perspective. Under conditions where eroded material rapidly accumulates in the river channel, its hydraulic capacity is reduced, increasing the likelihood of more frequent overtopping its banks during large flows. This has potentially disastrous implications to communities, croplands and other infrastructure along, and in close proximity to river channels.

Quarries are a major source of sedimentation into the coastal zones, threatening the sustainability of coastal systems and the diverse near shore ecosystems that depend on them. Quarries are also significant sources of pollutants to the coastal, river and marine environment. The negative impacts of sedimentation include the suffocation of marine organisms, weakening of animals allocating excessive energy to rid themselves of sediment, and decreased light levels affecting photosynthetic organisms. The consequences can be seen in the burial and consequent death of coral assemblages (Fond Cole) and sea grass habitats (West Coast).

Source: Steiner, SCC (2008) Marine Habitats of Dominica

B. Documented degradation of marine ecosystems

Dominica has a very narrow continental shelf on the west coast and a fairly large shelf on the east coast. As a result there are not many very large expanses of coral reef on the west coast of the island. The coral diversity on the western side of the island is greater than on the eastern side. Hurricanes and storm surges have caused tremendous damage to reef systems located in shallow waters. Hurricane Lenny, which was characterized by extremely high impact waves in excess of 18m high, took a toll on the inshore coral reefs of Dominica. Huge pieces of reef were ripped from the seabed and tossed unto the beach, causing severe loss of habitat to coastal pelagic and reef fishes.

In Dominica researchers at the Institute for Tropical Marine Ecology have recorded coral bleaching events in Dominica during 2003, 2004, 2005, and 2006. The bleaching event of 2005, the warmest year of sea surface temperatures for the Caribbean, was particularly severe resulting in the bleaching affecting an estimated 90% of Dominica's corals. Bleaching episodes also appear to result in a reduction of the shrinking in size and reduction in diversity of the corals. These disturbances lead to the weakening of species and ecosystems, which, alone, may not kill a species or habitat, but when combined with multiple other local disturbances such as pathogens, individual species or habitats have the potential to destroy ecosystems. Regional disturbances are not easily mitigated by small island nations and this highlights the urgency of immediate action in reducing local disturbances if the island's coral reef resources are to have a chance of being conserved. (Steiner, SCC (2008) Marine Habitats of Dominica).

Nearshore fisheries, already stressed by pollution and over-fishing, will be impacted in a number of areas by warmer seas, intensified hurricane activity changes in oceanic circulation, acidification of the oceans, and sea-level rise. The characteristics and dynamics of the industry have shifted to constitute a greater emphasis on offshore pelagic species of tuna and marlin. Interviews with the Fisheries Division staff and personal communication with fishers have indicated that coastal pelagic catch volumes have been decreasing slowly over the last five years particularly as a result of quarrying on the west coast and overfishing. Figure 18 shows the increase in coastal pelagic yields while reef and coastal pelagic yields have leveled out. It is important to note that in the past (10-15 years ago), coastal pelagic and reef fish yields were higher than coastal pelagic.

At the same time Dominica's migratory and pelagic fisheries, also at risk globally from over fishing and other anthropogenic impacts, have been affected by shifts in currents, impacts on food supply, warmer oceans and other direct and indirect impacts from a changing climate. The seasonality of dolphin and tuna traditionally observed has changed over the past 5 years. Typically, tuna season was Aug-Nov with a peak around October. This occurrence had been observed for decades. The migratory tuna however, now has several peaks in seasonality throughout the year. Further, dolphin season typically occurred in two distinct peaks, Feb-April and July-Sept. However, Figure 19 shows the recent trend of changing seasonality in the two migratory species. Dolphin season has been consistently broadening with 1 large, wide peak, making dolphin catches more available to fishermen for a majority of the year. While this appears to be beneficial to fishermen in the short-term, the long-term sustainability of increased catches

throughout the year has been questioned and will invariably necessitate a sustainable fisheries management plan for dolphin. These changes observed are not a consequence of the pervasive use of Fishing Aggregate Devices, but are driven by the migration patterns of the fish.

Lastly, within the last 5 years, algal blooms have been a common occurrence in Dominica’s coastal waters, significantly reducing visibility. The cause of this phenomenon is unknown.

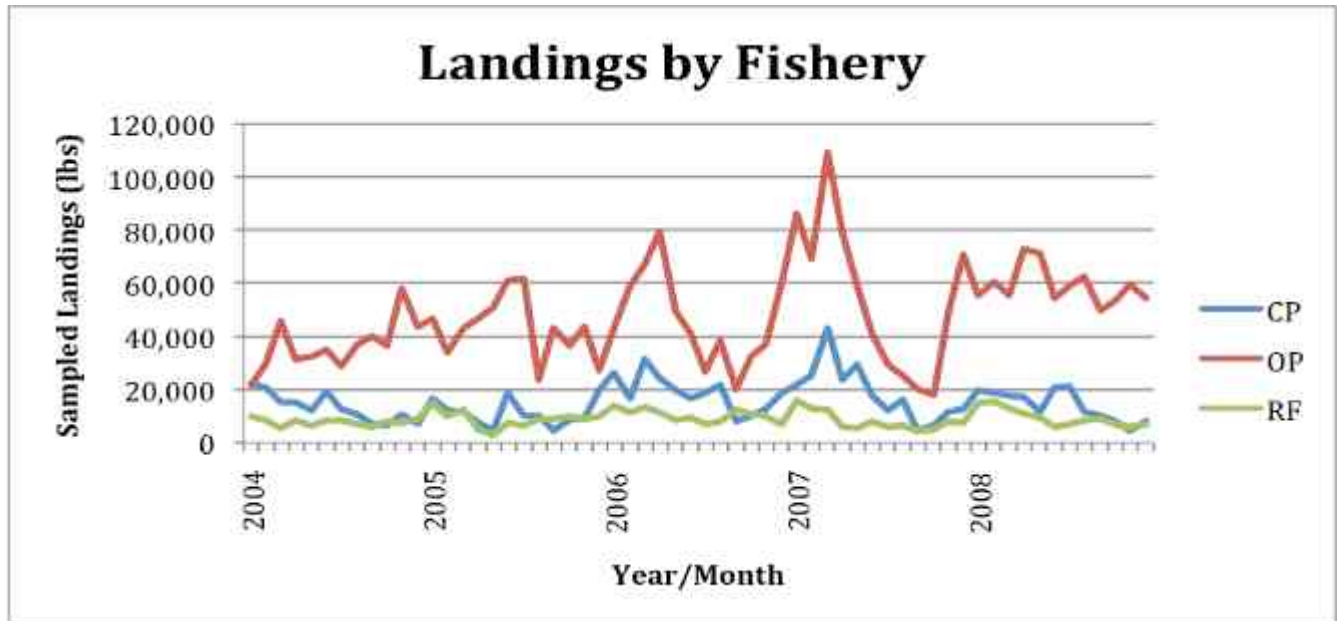


Figure 18. Landings by Fisheries (Fisheries Division, 2009). CP=coastal pelagic, OP=ocean pelagic, RF=reef fisheries

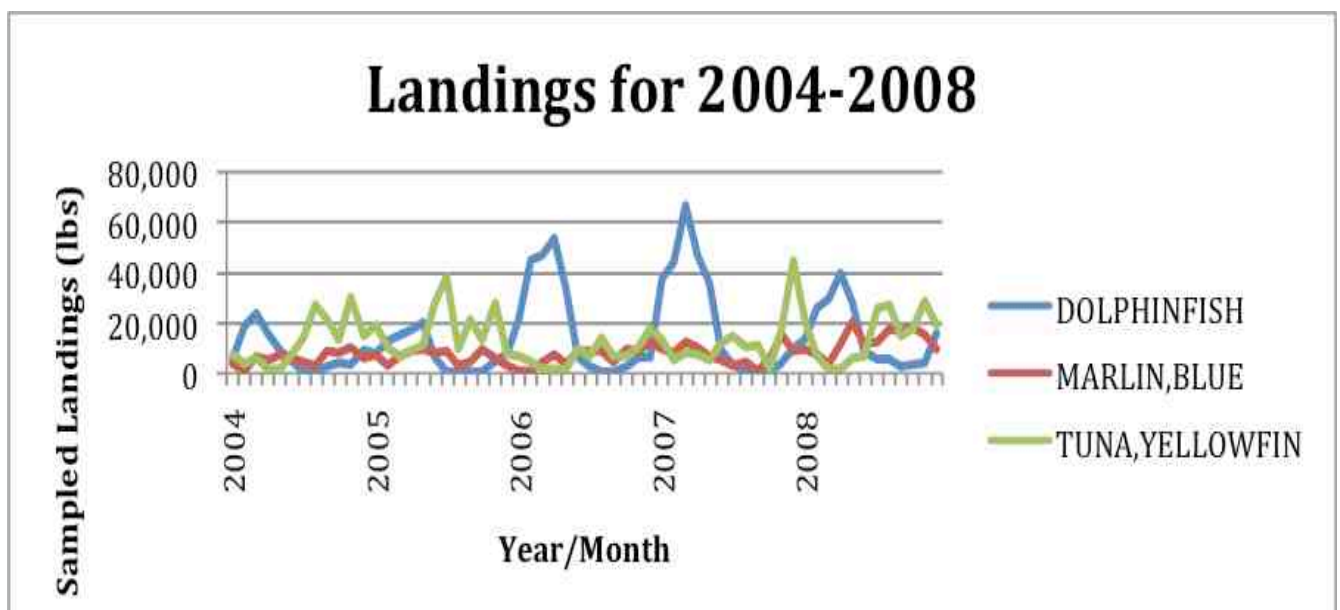


Figure 19 Fisheries Landings for 2004-2008 for 3 key species

C. Impacts on adjoining areas, coastal communities, and fisheries

In Dominica, agriculture is mainly rain fed. Precipitation and water availability influences the type of crops, farming technologies, and the season for cultivating crops. Given Dominica's topographic and climatic conditions as well as the country's principal agricultural products where precipitation is extreme there is also potential for soil loss. Conversely, drought conditions seriously affect crop development and yields. Additionally, Dominica's fisheries sector is relatively small (1.8% of GDP) but is important as a source of protein and food, employment, and has tremendous potential for growth and development. Fisheries remain extremely important to the food security and rural employment in Dominica.



Figure 20: "Dead" river in Bioche

As the pervasive research has shown, climate change has significantly impacted both terrestrial and marine ecosystems. Coastal communities in the vicinity of the National Parks demonstrate the gradients in Dominica whereby the linkages between the terrestrial and marine ecosystems manifest in palpable ways. Thus, policies and programs implemented in the National Parks, also influence the communities surrounding the parks. The impacts of climate change on communities surrounding the national parks cannot be ignored. Communities heavily rely on forested ecosystems for maintaining watershed integrity, mitigating flood and erosion impacts, and sustaining livelihoods. As such, the National Parks cannot be considered independently from the surrounding communities.

These communities are in close vicinity to the National Park and invariably rely on the regulatory function of the nearby forested ecosystems to maintain watersheds and mitigate flood and erosion impacts, particularly in the coastal zones. As previously shown, sedimentation on the coasts has numerous deleterious effects, reducing marine biodiversity and contributing to the reduction in fishing yields. A functioning ecosystem, therefore, benefits these communities directly. A telling example of how coastal communities are impacted by change upstream in the main river in Bioche, which has stopped flowing entirely within the past year (2009). This is a rare and shocking site in Dominica, the land of 365 rivers. The cause of this occurrence is speculated to be climate change but the possible presence of blockages or development upstream has not been investigated.

Component 2 of SPACC includes consideration of the neighboring communities to Morne Diablotin National Park, namely, Colihaut, Bioche, and Dublanc. The villages of



Figure 21: Fish catch in Dublanc, marlin shown

Colihaut, Dublanc, and Bioche are located along the northwest coast of Dominica approximately 14 miles north of the capital in Roseau. These three villages form the Parish of St. Peter. As of the 2001 National Census, St. Peter's Parish had 1,451 residents. With a population of 773 persons, Colihaut is the largest of the three communities and the most southern. Bioche is approximately five miles north from Colihaut with a population of over 250 persons; Dublanc is one mile north of Bioche with over 450 residents. Residents of the St. Peter's Parish earn a living through agriculture, fishing, public sector work, and entrepreneurial endeavors. Although the construction and service sectors are employing increasing numbers of

young persons, fishing is part of the heritage and culture of the Colihaut, Dublanc and Bioche communities. Many fishers choose the occupation because of a desire to fish coupled with a strong family history in fishing. There are approximately 200 registered full-time and part-time fishers in the Colihaut, Dublanc and Bioche area. Their types of fishing include trolling (ocean pelagics), beach seine, hand line (demersals and pelagics), and fish pots. Of the majority of fishers interviewed, only 55% fish full-time.



Figure 22: Fishing boats in Dublanc

However, the communities of Colihaut, Dublanc, and Bioche, have been experiencing drastic reductions in fishing yields. Traditional fishing in these communities includes the practices of fishing near the shore with nets. This practice had been sustainable until around 10 years ago when on-shore fish stocks were severely depleted, the reasons for which include overfishing and increased sedimentation from quarry operations on land. Of those interviewed, the overwhelming majority of fishers (69%) reported a decline in fish catch over the

last fifteen years with fishers noting smaller fish size, change in species caught and farther fishing grounds (St Louis, 2009). Of the remaining 31% who saw an increase or

no change at all in fish catch, some credited the use of Fish Aggregating Devices (FADs) for their stable fish catch. With FAD fishing and the general trend of fishing farther out at sea, there is a greater risk of losing life and equipment to inclement weather, piracy or poor navigation.

As mentioned previously, one possible reason for the reduction in fish yields is quarrying. A recent USAID report assessing the impact of quarrying operations in Dominica concluded that quarrying heavily impacts marine ecosystems, particularly in the Colihaut, Dublanc, and Bioche area. Additionally, the multitude of fishing techniques (line and hook, fish pots, seine nets, and spear fishing) used for the past centuries have depleted reef fish communities in Dominica to a point many species are rarely seen and large reef / near-shore demersal pelagic fishes are an uncommon sight. Anthropogenic debris and lost fishing gear (gill nets, boats, pots, engines) also cause considerable damage to reefs. According to the National Fisheries Census, each fisher owns an average of 18 pots. Considering the limited shelf size available for use of such gear, the great losses of pots which occur annually due to storms and hurricanes, the observed decline in the demersal fishery from catch data and reef habitat degradation being caused by quarry operations and other land based activities, the number of pots deployed in this fishery is cause for concern.

As such, due to reduction in fish yields, fishermen in these communities must either 1) continue fishing in the reef unsustainably or 2) put forth the capital investment to buy a larger boat allowing them to go into the pelagic zone to catch larger fish such as tuna, marlin, and dolphin. In order catch larger fish, however, FADs are essential. These devices cost 4000EC and require additional investment.

Most fishers have another form of income, often from other fishing-related activities. Colihaut is marked by a drastic shift away from traditional livelihoods such as fishing with more and more community members working outside their villages primarily in the construction and service industries (20.3% and 36.2% respectively). In Bioche and Dublanc, fishing is still a dominant source of income. Fishermen's alternate means of livelihood also includes agriculture. Mixed crop agriculture is pervasive in the "buffer zone", particularly citrus.

The issues impacting citrus farms on the periphery of the park are therefore especially relevant because citrus farms provide income security for many fishermen who cannot afford to fish full-time due to reduced yields. A major source of contention remains the fact that the Red-necked Parrots (Jaco) are considered a pest to farmers in the area. Conservation efforts to protect the 2 species of endemic parrots in Dominica have proven to be very successful, with documented increases in populations. Yet, as early as the late 1980's it was noticed that parrots had begun to forage on agricultural production, a practice never before exhibited. Since citrus is widely available in farms adjacent to the park, parrots may have the habit of feeding on citrus pulp and seeds. It is believed that this behavior is a result of deforestation and destruction of food sources for the parrots. This pattern became more prominent in the early 2000 to present. Due to the decline in the banana industry, the destruction of citrus yields by the parrots and the marginal returns from the other crops, a number of these farms are presently idle or under utilized creating a situation where the income and livelihood of these farmers have been declining. Farmers have no means to compensate themselves for the losses resulting from the destruction of citrus in their farms. However, a task force has been

established to identify the drivers of the problem and propose solutions to crop depredation. The task force found that the farms surrounding Morne Diablotin National Park were heavily affected by crop depredation by the Red-necked Parrots but the economic losses to farmers were not quantified. The report cited that farmers successfully mitigated depredation by other birds by planting fruit trees on the periphery of farms as distractions. Parrots appear to receive a majority of the blame for reduction in crop yields but many farms are not maintained, are affected by other wild animals, or are afflicted with fruit disease as well.

Additionally the West Coast Citrus Farmers Association has rallied farmers to set up a micro-juicing program to juice fruits before they are ripe and eaten by birds. The program is ready to be implemented.

Sources: Personal communication; St. Louis, A, et. al. 2009

V. Climate change impacts relevant to the target areas

Climate change is impacting Dominica and its natural resources through a variety of climate processes. These climate changes have important consequences in the natural resource base of the island, and to the ecosystems preserved through the national parks of Morne Diablotin and Morne Trois Pitons.

Based on the scenarios for the Caribbean, climate change will change climatic, hydrologic and edaphic conditions resulting in loss of Dominica's terrestrial biodiversity, change in ecological interactions between animal's species and increase in soil fragility and hence, erosion. The effects of climate change that will have the most impact and exacerbate the identified threats to the two national parks and surrounding communities are sea level rise, changes in local and regional temperatures regimes, changes in rainfall patterns and more severe weather events such as droughts, rainstorms, winter swells and hurricanes.

(Note: unless otherwise indicated, all information in this chapter has been sourced from the draft of Dominica's Second National Communication to the UNFCCC- 2010)

A. Impacts on the regulatory functions of the ecosystem, particularly water

The island's freshwater supply is dependent on rainfall cycles. Some parts of the island experience intermittent shortages due to extended dry season conditions, which reduce volumes and flow rates in rivers. Some river flows have declined according to anecdotal information but this is difficult to ascertain due to the absence of reliable data.

The unequal distribution of precipitation influencing fresh water availability on the island is likely to become more acute as a result of climate change impacts and with the current and proposed developments on the western side of the island. It has been observed that during the peak dry season on the island that there is a greater reduction in flow volumes of river on the west coast as compared to the eastern Atlantic coast.

In 2001 Dominica experienced its worst drought conditions for many years. Scores of fires occurred in lower scrub forest and in the rainforest during April and May of that year and water intakes were severely reduced in all areas. The island's north central coast is the area most susceptible to drought conditions. The bush/forest fires are also a common phenomenon in the dry periods, which are further exacerbated by the windy conditions of April and May.

The impact of natural disasters such as hurricanes and storms affects water quality and availability. For example heavy rains and tree falls during storms results in mudslides that may damage distribution lines. Heavy sedimentation results in increased turbidity. The passage of Hurricane Dean in 2007 left a trail of destruction on the water infrastructure of the island amounting to 3.79 million dollars (Office of Disaster Management, 2007).

B. Impacts on temperature, rainfall, and frequency of extreme events (erosion, landslides, storms, swells)

For many forested ecosystems, increases in the frequency and severity of extreme weather events such as storms and floods will cause some of the most serious impacts. Shifts in seasonal precipitation patterns and weather variability will become critical.

Irrespective of scenario, model or methodology used, there is a projected annual mean temperature increase for Dominica. The climate models for Dominica suggest that the mean annual increase in temperature will be between 0.4°C and 0.5°C by the 2015s, 0.6°C - 0.8°C by the 2030s, 0.9°C - 1.3°C by the 2050's and between 1.5°C (B1 scenario) and 3°C (A2 scenario) by the end of the century (2100). The RCM shows a similar rate of increase with an annual temperature change of 1.8–2.3°C by the 2090s. These projections are consistent with IPCC projections for the Caribbean which show annual mean temperatures increasing by 1.4°C to 3.2°C, with a median increase of 2.0°C by 2100. The increases are however slightly less than the anticipated global average warming. The frequency of very hot days and nights will increase, while the number of very cool days and nights will decrease. The seasonality of Dominica will be largely unchanged. The cooler (with respect to late season temperatures) dry early months and wet hotter late months will still prevail.

While there is less consistency in relation to projections for future rainfall there is an identifiable trend toward drier conditions in the annual mean, with greater consensus toward the end of the century. For the 2015s, the models project changes ranging from -15% to +13% (dependent on scenario and model), with 5 of 9 model runs indicating a decrease in the annual mean rainfall. For the 2030's the range is from -20% to +15% and 6 of 9 runs indicate a drier Dominica. By the 2050's the range is -21% to +10% and 7 of 9 runs indicate drier conditions than the present. The RCM captures the same drying trend but is more drastic. It projects the annual rainfall to be 30%-50% less than present day amounts by the end of the century. This is consistent with the IPCC projections of a drier Caribbean by the century's end. The country is likely to be drier in the mean. Projections are for up to 20% drier by mid century when models show more consensus about the trend, and up to 50% drier by 2100.

Projected increases in temperature will take place against a background of overall drying trends. Some of the possible impacts of temperature change on Dominica's forests and terrestrial ecosystems are likely to be:

- Reduction in flow volumes of streams and river due to longer drier period. This is already a seasonal phenomenon in Dominica in the dry season and will likely be exacerbated by higher seasonal temperatures and increasing drought conditions.
- Increase in the incidence of higher pests and diseases occurrences associated with changing temperate and rainfall patterns could affect many wild species.

The following implications are associated with an increased rainfall scenario:



Figure 23: Flood event of Roseau River during recent rains

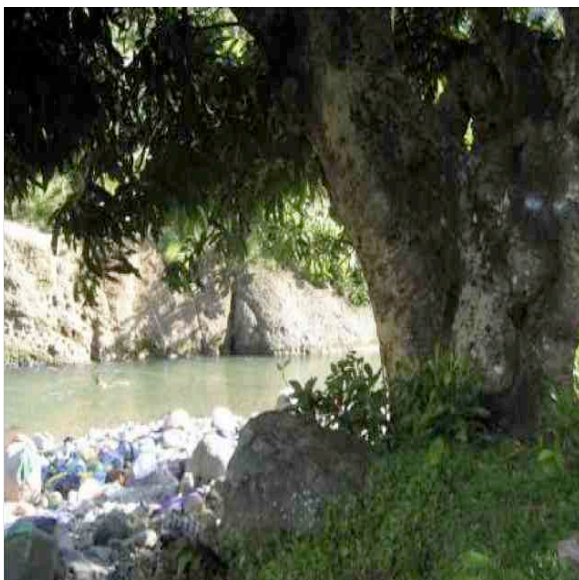


Figure 24: Roseau River with mark on tree indicating flood levels

- Landslides: Some of Dominica's soils are highly erosive. Torrential rainfall frequently causes earth movements in the forms of debris flows, rockslides, land slump and landslides. This could pose a serious challenge to the quality of water resources.
- Flooding: It is anticipated that significant increases in rainfall will cause rapid expansion of rivers leading to increased incidents of flash flooding especially in low-lying areas (such as the Layou-Mathieu valleys). Unprotected riverbanks (vegetation has been removed) may collapse, thus leading to the formation of wider river courses. Figures 23-25 show this impact on Roseau River.
- Coastal salinity changes: Increased freshwater outflows will reduce the salinity of coastal waters in areas such as Layou.
- Water Quality: Unless there are changes in agricultural practices, zoning, stricter regulations to location choices for housing, waste disposal habits, increased

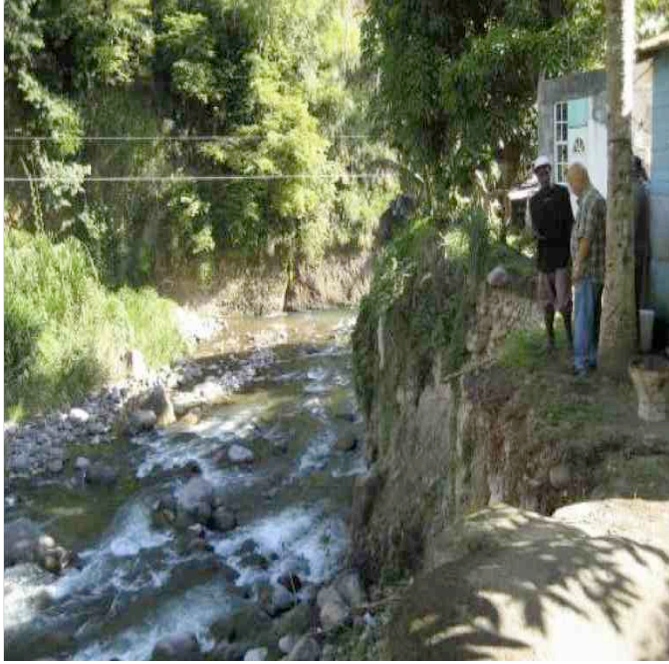


Figure 25: Extreme riverbank erosion putting settlements at risk (Roseau River)

precipitation will undoubtedly result in increased levels of topsoil removal, increased agro-and industrial chemical concentrations and heightened levels of microbes in the surface waters leading to increased incidence of waterborne diseases.

- Water intakes and supply: where episodes of increased precipitation result from storm or other tropical systems there is a greater likelihood of likely to damage to the water infrastructure on the island such as intakes, supply lines, reservoirs.

Hurricanes and storms

From 1910-2007, there were 100 storms in or around Dominica. From 1851-2007, there were 57 Category 1-4 Hurricanes in or near Dominica (NOAA storm data¹). Understanding of the dynamics of hurricanes and tropical storms under scenarios of climate change reflects a wide scope of possibilities. Hurricane intensity is likely to increase (as indicated by stronger peak winds and more rainfall) but not necessarily hurricane frequency. The experience of Hurricane Dean in 2007 provides an indication of many of the adverse impacts on Dominica's associated with hurricane and tropical storm activity. That hurricane, which was accompanied by intense rainfall, resulted in extensive defoliation with fallen or uprooted trees occurring through out the forest all over the island, but in a very scattered way. Landslides and landslips occurred on many slopes. Rivers caused great havoc along adjacent lands, in many instances tearing away at the properties of private owners.

Caribbean sea levels are projected to rise by up to 0.24 m by mid century while sea surface temperatures in the Caribbean are projected to warm, up to approximately 2°C by the end of the century.

Experts are of the view that forest gaps and adjoining forests suffer greater hurricane impact than undisturbed forests. This is believed to have contributed to destruction of some forested lands during Hurricane Luis in 1995 with logging believed to have contributed to heightened vulnerability to storm damage. Research by Dr. Ariel Lugo on the Luquillo Mountains of Puerto Rico has also strongly shown the ways in which

¹ <http://csc-s-maps-q.csc.noaa.gov>

hurricanes affect forests, even more so than ecological and topographic factors because of the frequency of storm events in the Caribbean².

C. Impacts on biodiversity

Those ecosystems that are already stressed by human activities will be more vulnerable to climatic threats and will be among the first to show the effects of climate change. However, the multiple factors affecting these ecosystems will complicate the identification of strictly climatic effects.

Climate plays a primary role in determining both the geographic distribution of organisms and the distribution of the habitats upon which they depend. Climate also plays a significant role in plant growing cycles, and may impact upon the reproductive regimes of some animal species. Dominica's natural systems feature unique microclimates, which are extremely sensitive, and any change in climate will therefore have a profound impact upon individual species of flora and fauna, natural ecosystems and biodiversity in general.

Changes in ecosystem composition as some plant species (slow growers) have difficulty in achieving maturity between extreme weather events (high wind speeds that tear down forest sections of slow growing species.)

Some additional impacts of climate change on terrestrial biodiversity include:

- Alterations in the species diversity of many forested ecosystems. Examples of this already exist with the gradual shift into higher elevations of invasive drought tolerant lemon grass species.
- Species adaptive abilities depend not only on genetic variability but also on dispersal and migration capacity. For Dominica and other small island States, insularity means that such options may not be available. Increasingly ecosystem resilience and genetic variability within populations are being reduced through habitat fragmentation. They will be further pressured by climate change. In some cases opportunistic species may invade new ecosystems.
- Higher pest related problems, droughts, variable rainfall as well as more frequent hurricanes and storms, could lower recovery periods of disturbed ecosystems and food availability for wildlife
- Change in seasonal weather patterns are likely to impact traditional farming practices, and affect the growing cycle of plants

Key species

As mentioned earlier, the Mountain Chicken or **crapaud** (*Leptodactylus fallax*) was recently afflicted with a rare fungal disease, chytridiomycosis,. The fungus was first discovered in 2002 and wiped out a sizeable portion of the population (70% reduction). Forest officers reported sightings of dead crapauds near water sources. The fungus has recently spread to Montserrat (the only other Caribbean island the crapaud can be

² Hurricane Hugo: Damage to a Tropical Rain Forest in Puerto Rico, by Khadga Basnet, Gene E. Likens, F. N. Scatena and Ariel E. Lugo © 1992 Cambridge University Press.

found). Frogs have long been known to be an indicator species of environmental stress, particularly because they drink and breathe through their skin. While there is a hunting ban on crapaud, its numbers continue to decline. Some scientists speculate that climate change is a main driver of the spread of the fungus due to rising temperatures.³

The Imperial Parrot “**Sisserou**” & The Red-necked Parrot “**Jaco**”

Rainfall and storm patterns significantly influence the endangered Sisserou parrots. Hurricanes provide some benefits to parrots, particularly by providing cavities for nests. However, most of the impacts of rainfall and storms on parrots that have been observed recently seem to have caused particular stresses on parrot populations, necessitating marked species adaptations.

Both the Jaco and Sisserou occupy elevations within 275 to 730 m areas with marked seasonal conditions. Climatic shifts may significantly alter these altitudinal zonation which in turn may impact on breeding, habitat selection and food availability. Unseasonal torrential rainfall during the dry season can cause deflowering of fruit bearing species and subsequent food shortages. Parrots have adapted to these impacts by feeding on young shoots. Storms can also cause flooding of nests and hence cause high mortality rates in chicks. Since Jacos build nests and mate for life, this impact affects them more severely. Additionally, sometimes nesting is delayed because of lack of food or wetness of nests. Typically there was 1 prolific flowering and fruiting event per year but within recent times, species have begun to fruit/flower at different times than expected. Table 1 shows the food sources for parrots with the normal observed fruiting season. Species in bold have been observed to show delayed fruiting seasons, sometimes to the benefit of parrots. The cause of these phenological changes is speculated to be climate change. The extent of the deviations and impact on parrots has yet to be thoroughly investigated.

Table 1. Forest food sources for parrots in Dominica. Species in bold have been observed to have changes in seasonality

Plant species	Local name	Plant part eaten	Fruiting season
<i>a) both parrot species</i>			
<i>Dacryodes excelsa</i>	Gommier	Fruits	June-Nov (mainly Jun-Oct)
<i>Licania ternatensis</i>	Bwa Diable	Fruits	Dec-May (mainly Dec-Feb)
<i>Richeria grandis</i>	Bwa Bande	Fruits	All year
<i>Amanoa caribaea</i>	Carapite	Fruits	Dec-May (mainly Feb-Apr)
<i>Simarouba amara</i>	Bwa blanc	Fruits	June-Sept
<i>Symphonia globulifera</i>	Mange blanc	Fruits	Sept-Oct
<i>Chimarrhis cymosa</i>	Bwa riviere	Fruits/Flowers	Aug-Oct
<i>Oxythece pallida</i>	Balate	Fruits	Dec-July (mainly Apr-Jun)
<i>b) Red-necked parrot</i>			
<i>Cordia elliptica</i>	Coco poule	Fruits	Jan-Feb & June-Aug

³ <http://www.guardian.co.uk/environment/2009/apr/21/wildlife-conservation>

<i>Cordia laevigata</i>		Fruits	Dec-May
<i>Pithecellobium</i>	Pistolet	Fruits	June-Sept
<i>Byrsonima martinicensis</i>	Mauricif	Fruits	Oct-Dec
<i>Euterpe dominicana</i>	Palm	Fruits	
<i>Anacardium occidentale</i>	Wild almond	Buds	
<i>Pouteria multiflora</i>	Penipiece	Fruits	July-Sept
<i>Dussia martinicensis</i>	Pommier	Fruits	
<i>Ormosia krugii</i>	Caconier blanc	Fruits	Nov-Dec
<i>Ormosia monosperma</i>	Caconier	Fruits	July-Sept
<i>Buchenavia capitata</i>	Zslivier	Fruits	Aug-Oct
<i>Lonchocarpus sp.</i>	Savonette	Fruits/Buds	Nov-Dec
<i>Ilex macfadonii</i>		Fruits	Dec-May
<i>Anthurium spp.</i>		Fruits	June-Nov
<i>Vine</i>	Cord sec	Fruits	Dec-May
<i>Sloanea caribea</i>	Chataye te fey	Fruits	Jan-June
<i>Sloenia dentate</i>	Chataye Gava fey	Fruits	Jan-June
<i>c) Imperial Parrot</i>			
<i>Tapura antillana</i>	Bwa cote	Fruits	
<i>Euterpe globosa</i>	Palm	Fruits	
<i>Clusia venosa</i>	Kaklin	Fruits	July-Sept

The range of the parrots seems to be increasing as parrots have also been found in coastal zones. Adapting to changes in their natural habitat, it has been observed that the Jacos have acclimated well to cultivated species of fruit (passion fruit, all types of citrus, mangoes, kennips) with their food range increasing steadily (from oranges to grapefruits to limes). As mentioned earlier, since the passage of Hurricane Dean, not only is crop depredation by birds expected, but a marked increase has already been observed. Such instances of crop depredation are likely to increase where hurricane damage occurs to forest habitats. It is unknown if the parrots have just adapted to stresses in the natural habitat or if they have permanently changed their feeding preference, but there have been observations that crop depredation persists while there are natural food sources available in the forest.

The aforementioned Task Force within the Division of Forestry has made several recommendations to reduce negative impacts on farmers. These include improved data collection, practical compensation schemes, insurance schemes, improved harvesting practices, and citrus farm rehabilitation.

D. Impacts on agriculture & livelihoods in adjoining areas

Data collected in the agricultural census conducted by the Ministry of Agriculture in 1995, indicate that only 21,147 ha (27%) of total land area is in farms. Of this 12,800 ha (60.5%) is cropped and 5,990 ha (8.3%) is in forest. These figures indicate that although there has been clearing of more land for agriculture over the years, there has been only

a slight increase in actual percentage of total land area in farms. 70% of Dominica's land resources have been classified as unsuitable for agriculture mainly because of erosion risks, water saturation due to heavy rainfall, or poor soils. Due to the decline in the banana industry a number of the farms are presently idle. From 1992-2005, banana production declined by 80%, from 52,229 M tonnes to 10,894 M tonnes. The number of banana farmers also decreased from 6055 to 880. As such large amounts of banana farms are abandoned and not under production.

Agriculture in Dominica is mainly rain fed. Drought conditions affect productivity, as the plants do not yield their optimum production. The period of December to June is characterized by very low rainfall and intense heat. The introduction of high-yielding planting material and varieties adapted for intensive management regimes has lessened the demand for traditional products on the international market. This has led in some instances to the erosion of the genetic pool of traditional agricultural species. However, it should also be recognized that the introduction of new plant material has been beneficial in increasing the overall genetic base on the island. Agricultural productivity assistance such as modernized farm techniques, irrigation and new crop varieties have all helped farmers cope with marginal lands, and agricultural diversification programs have been very successful in contributing to biodiversity conservation. Dominica does possess, through its wide range of plant and animal species, a pool of genetic material that if properly identified, developed and sustained could be of immense potential to its continued development and prosperity. Continued conservation of Dominica's agrobiodiversity requires that immediate attention be given to harnessing all available information that will guide sector/sub sector strategy formulation and future agricultural development.

In Dominica although to date there is generally an abundance of freshwater, existing problems facing agriculture include minimal storage capacity, small watersheds and uneven distribution. In the drier periods of the year, water shortages hamper agricultural production. If the climate gets drier this will adversely affect crop production. Increased irrigation can militate against this, but irrigation infrastructure is expensive to implement on the small farms that characterize Dominica's agricultural sector.

Organic farming, Non-timber forest products, and Agro-tourism

The significant expansion of agriculture, particularly banana cultivation, with the resultant use of agrochemicals has had negative impacts on the island's biodiversity. Qualitative and quantitative observations in and around banana cultivations revealed no marked declines in terrestrial vertebrates (birds, bats, and amphibians) that might be attributable to pesticide contamination. However, bird mortality linked to agrochemical use has been reported. Also, pesticide runoff in streams has resulted in isolated fish kills and may have negatively impacted other aquatic fauna.

Small-scale efforts in Dominica have promoted organic agriculture through the production of organic inputs through composting. It has been argued that organic agriculture helps to preserve soil fertility and maintain organic matter in soils. The Rainforest Mushroom Project is a farming project that promotes the cultivation of mushrooms organically in the forests surrounding Morne Trois Piton National Park. The

project has been successful and has the potential to be profitable. It is also minimally invasive because no clearing of land is required.⁴

The Rainforest Mushroom project has also shown the potential for synergies with agro-tourism. Agro-tourism provides food and raw materials for arts and crafts that sustain and promote eco-tourism. Tourism has the potential to assist agricultural development by providing farmers with an alternative source of income and greater scope for reinvestment in agriculture.

In terms of non-timber forest production (NTFPs), a report from the Forestry Division notes that farmers depend on forests in a number of ways. Some used sticks as trestles for their young yams and passion fruit, and others use round posts as fencing materials or support for building animal sheds or houses. Lumber is also used for building farm structures, while wildlife is used as meat for food. Additionally, Bois Bande (*Richeria grandis*) is a bark extracted for its aphrodisiac properties.

VI. Key conclusions, caveats, gaps, and the way forward

Conclusions

The pervasive literature on the Morne Diablotin and Morne Trois Piton National Parks has shown tremendous foresight on the part of the Dominican government to set aside these areas as nationally, legally protected areas. For a small island nation, designating 3 national parks has allowed for the branding of Dominica as the Nature Island of the Caribbean with remarkable natural assets within its borders. The 2 national parks discussed in this analysis have both *global and local significance*. Not only does the high forest cover of the parks serve as a carbon sink, several endemic species also reside in the parks. Not found anywhere else in the world, these species enrich the forests of Dominica and demonstrate the global significance of biodiversity. Among these species are the endangered Jaco and Sisserou parrots, quite possibly the most significant charismatic macro-fauna on the island.

Just as, if not more, important are the benefits that these parks provide to communities on the island locally. Most relevant are the various ecosystem services of the forests. As outlined in the situation analysis, the acreage of forest cover in the parks mitigates flood and erosion/sedimentation risk, preserves watersheds and water filtration, contributes to soil preservation, and regulates climate.

Ecosystem services are notoriously difficult to quantify. Valuing ecosystem services requires determining the economic cost of anthropogenically-constructed replacements (such as water filtration systems), in one method. However, economic valuation oftentimes underrepresents the true extent of the importance of ecological functions and benefits. Recreational (such as hiking to a waterfall) or cultural uses of the forest are challenging to quantify in monetary terms. Direct use of the forest also benefits the communities by providing food sources (meat, fruit), wood for charcoal (although not

⁴ <http://www.geocities.com/rainforestmushroomsdominica/mushroomfarm>

allowed in the parks), non-timber forest products, and the cultivation of marijuana (illegal, but known to occur in the parks). As such, the national parks are invaluable assets to the people of Dominica.

Despite the many benefits outlined above, the parks are threatened by particular anthropogenic activities. The increase in banana cultivation in the 1980s drove massive deforestation in Dominica. Although the banana industry has somewhat collapsed in Dominica, many farms can be found adjacent to the Morne Diablotin National Park presently. Economic conditions of farmers in these areas have the potential to increase future encroachment into the park. In Morne Trois Piton, the primary anthropogenic threat to the park is commercial and residential development in the areas surrounding the park. Research has shown that the primary natural threats to both the parks are erosion, landslides, and tropical storms.

While research has not been conducted on the *specific* climate change impacts within the boundaries of the national parks, climate projection models and general studies on impacts on the island suggest that there will be increased rainfall, increased intensity of storms, and extended droughts in Dominica. In light of the natural threats of landslides and erosion, it is clear that climate change therefore will exacerbate climate stresses on the parks. Land use and agricultural practices outside of the parks can amplify the effects of sedimentation and flooding downstream.

An aspect of this project not to be forgotten is the community dimension. Colihaut, Dublanc, and Bioche clearly benefit from Morne Diablotin National Park but are also severely impacted by the degradation of marine ecosystems. The reduction in coastal fish due to quarrying on land and unsustainable fishing practices has affected many fishermen. Additionally, crop depredation has resulted in economic losses to farmers (an unfortunate consequence of the recovery of the endangered parrot's population and subsequent adaptation to loss of natural food sources). The challenges with both fishing and farming *may* perpetuate encroachment into the parks for hunting or charcoal extraction. Further, reduced stream flow (noticed anecdotally throughout the island) threatens to render more rivers stagnant like the Bioche River, compromising potable water resources in many areas. For the Colihaut, Dublanc, and Bioche communities, therefore, the primary issues are sedimentation in the coastal zone, loss in crop yields due to depredation, and loss in fishing yields (although this observation cannot be linked to the national parks). We strongly recommend that these communities be central to adaptation measures under Component 2 Sub-component 2.

Caveats

The situation analysis indicates several areas for which certain assertions cannot be verified by data. While anecdotal evidence is clearly indicative of potential threats or stresses, adaptation solutions can only be proposed such that they address climate change impacts directly. Additionally, if we cannot quantify the problem, specifying the parameters of the solution becomes particularly difficult. Less discussed but equally important is the risk of maladaptation, which is a primary concern. Specific data and information is essential to ensure that projects are not designed upon a flawed or

uncorroborated premise. Utilizing funds in a responsible and efficacious manner requires project designers to identify specifically the vulnerabilities to climate change in both natural and anthropogenic systems.

Clearly, for the SPACC project in Dominica, the main constraint will be lack of data. This analysis has been limited by the lack of data on specific climate change impacts, their effect on communities, and on the parks. While the establishment of a data monitoring service or clearinghouse is not within the purview of this project, we strongly recommend the Government of Dominica implement programs to synchronize data collection of data, standardize methodologies and instrumentation, and invest in monitoring programs. These programs will allow Dominica to benefit from more specifically tailored projects that directly address observed and measured fluxes in climatic, economical, and ecological variables over time.

While much of the information on climate change impacts in the parks is not specific to the National Parks themselves, it doesn't mean projects cannot be designed utilizing the information that is available and presented in this analysis. The key to success in this project will be recognizing the limitations of the lack of data, finding/collecting data that may enhance the analysis in the interim, and identifying projects that satisfy the requirements of data availability.

Gaps

That which has not and could not be addressed in the situation analysis should be discussed and developed before and during the forum.

The following was compiled with the support of the Forum Technical Coordinator and key stakeholders in Dominica. The data that is essential to designing adaptation projects includes.

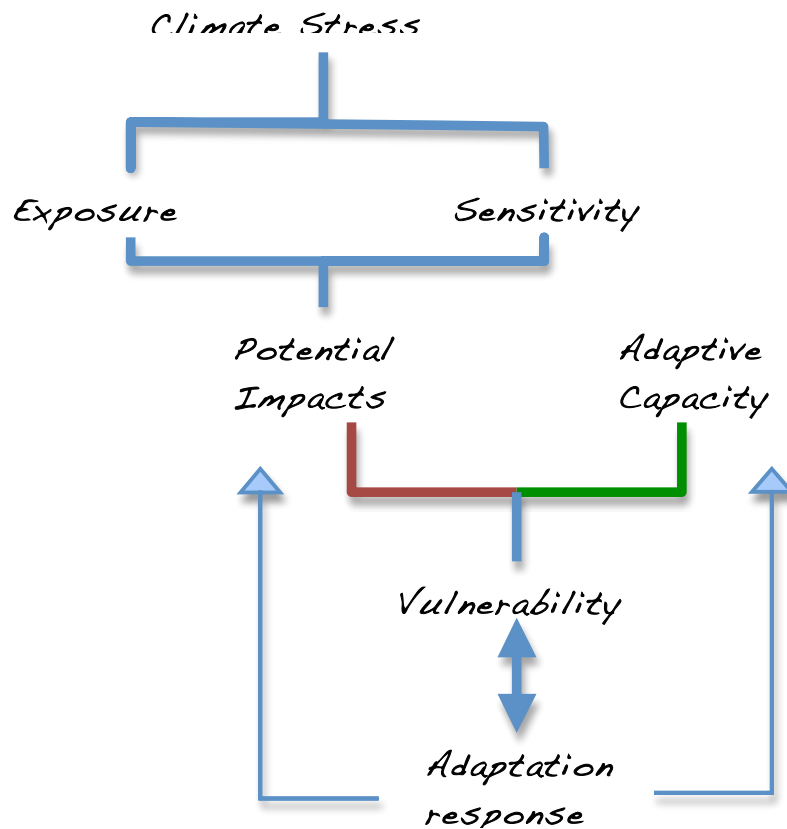
- Rainfall: Morne Diablotin National Park and Morne Trois Piton National Park, key agricultural areas, and target communities.
 - Monthly rainfall data to supplement the yearly data in this analysis
- Stream flow: catchments used for potable water supply and catchments with potential or actual flood hazards to adjacent communities.
 - Consistent measurements and conclusions on volume of water
- Temperature: sea surface temperatures, forested/protected areas, key coastal communities.
- Soil moisture: Morne Diablotin National Park and Morne Trois Piton National Park.
- Species: parrot nesting sites, extent and location of feeding on agricultural crops; inventory of species (quantity, distribution, coverage) in target protected areas; identification of indicator species in the protected areas and monitoring of these species.
- Forest cover: Compare aerial photos over past 30 years to determine forest cover changes in protected areas.
- Encroachment: type, extent, location, frequency and impact of encroachment into the target protected areas.
- Economic: The extent of losses to farmers due to depredation

To the extent possible, these areas should be more thoroughly investigated before the forum. Programs may need to be put in place to enable the Government of Dominica to collect necessary information to implement the projects identified under SPACC.

Being practical about the limitations due to lack of reliable information, the forum should further expand upon the ways in which the vulnerabilities (due to anthropogenic activities and natural impacts) referenced in the analysis can be mitigated.

Ways forwards

Since the crux of the SPACC project is adaptation, it is necessary to consider adaptive management more generally before applying concepts to the particular situation in Dominica. Adaptation includes actions that intend to counteract or reverse the negative impacts of climate change by reducing vulnerability. Vulnerability is generally known to be a function of exposure, sensitivity, and adaptive capacity.



To address vulnerability, therefore, one must look to responding to the impacts of climate change or building adaptive capacity through technology, building institutional mechanisms, etc. Applying the concept of adaptive capacity to Dominica, it is clear that in order to confront climate change, response/adaptive capacity must be built such that the planning mechanisms are put in place to lay the foundation for more directed adaptation actions. Risk must be managed through careful assessments and implementing the associated integrated policies that involve all levels of governance. While building adaptive capacity should be a long-term goal for Dominica, there are palpable ways in which the two legs of vulnerability can be addressed under SPACC.

First, the government of Dominica must decide the ultimate goal of adaptation. Is it to enhance livelihoods negatively impacted by climate change? Is it to put in place measures that dampen the effects of climate change on natural areas (if so, for the benefit of biodiversity and species, or for the preservation of ecosystem services for nearby communities)? The PAD and consultations with key stakeholders in Dominica indicate that both are priorities of adaptation in Dominica – to reduce the vulnerabilities of communities but also preserve the integrity of natural systems. Figure 26 is one understanding of a holistic way to approach adaptation. First, goals of adaptation measures are decided upon. Next, the hindrances or threats to achieving those goals are identified. These would presumably include climate change stresses as well as anthropogenic amplifiers of effects. Lastly, adaptation actions that minimize threats or hindrances are chosen. By framing adaptation solutions in this way, project designers can ensure that proposed interventions directly address the impacts of climate change on the key values meant to be preserved (both ecologically and socially).



Figure 26. Diagram identifying the key goals of SPACC, hindrances or threats identified in this situation analysis, and possible actions that minimize threats

Probing further, a similar methodology can be used to identify specific adaptation solutions by starting with specific climate change impacts, extending to the effects of those impacts, and then proposing solutions mitigating those effects. Specifically

considering the findings of this analysis, the 3 predominant climate change impacts that effect the National Parks and adjoining communities are (i) increased rainfall, (ii) extended drought and increases in temperature, and (iii) increased intensity of storms and changes in phenology. Forum participants should seriously consider this schematic methodology (Figure 27) for identifying and evaluating adaptation solutions in Dominica.

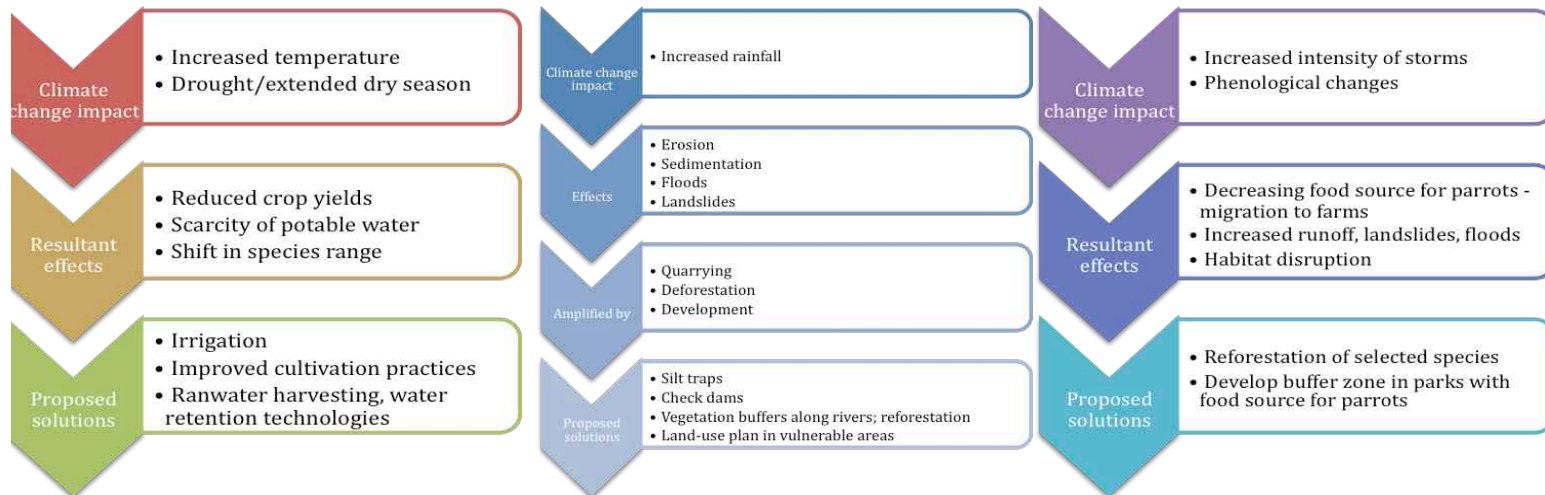


Figure 27. Identification of the key climate change impacts affecting the national parks directly, the resultant effects of the impact, any anthropogenic amplifiers, and proposed adaptation solutions

The exercise of completing the situation analysis has shown that there are considerable constraints in Dominica in relation to data and information availability. This should not be taken to mean, however, that adaptation solutions cannot be implemented. Project designers and implementers should, however, remain aware of how projects may need to be modified or made to include capacity/enabling activities to put in place systems to collect the necessary information. Design and implementation of the SPACC project will invariably necessitate a strong commitment from the Government of Dominica in aforementioned areas to ensure that the project reaches fruition.

Annex

Local Experts

The following are the local experts to be consulted for further information. Contact information can be provided upon request:

Agriculture: Richard Allport

Biodiversity: Kongit Halie Gabriel

CBD Communities: Herbert Sabaroche

Climate change: Lloyd Pascal, Collin Guiste

Environmental law: Henry Shillingford

Environmental NGOs: Bernard Wiltshire

Fisheries: Andrew Magloire

Forest ecology and data collection: Arlington James

Geology: Tessa Deroche

Hydrology: Gomez Drigo (water engineer)

Land degradation: Bradley Guye

Land use: George Butler

Marine science: Dr. Sasha Steiner

Meteorology: Fitzroy Pascal

National parks management: David Williams

Natural disasters: Nathaniel Isaac

Organic farming: Al-Mario Cisimir

Parrots (biology, phenology): Stephen Durrand

Physical planning: Kelvin Rolle, Keith Stephens

Tourism: Monique Jacob-Ducler