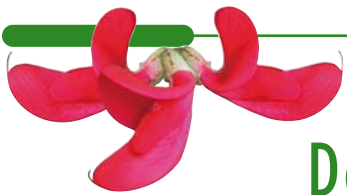


The background of the cover is a composite image. On the right, a tall waterfall cascades down a rocky cliff. In the bottom left corner, a large, colorful parrot with blue, green, and red feathers is perched. In the bottom center, two young children are standing on a rocky path. In the top left corner, a group of children in yellow school uniforms is visible. The overall scene is lush and green, representing the biodiversity of the region.

Commonwealth of Dominica

Biodiversity Strategy and Action Plan

2001 - 2005



Dominica's Biodiversity Strategy and Action Plan

TABLE OF CONTENTS

FOREWORD	i
ACKNOWLEDGEMENTS	iii
EXECUTIVE SUMMARY	1
1.0 INTRODUCTION	3
2.0 COUNTRY OVERVIEW	5
3.0 VISION	8
4.0 GOALS AND OBJECTIVES	9
5.0 GUIDING PRINCIPLES	10
6.0 TERRESTRIAL RESOURCES OF DOMINICA	11
7.0 COASTAL AND MARINE RESOURCES OF DOMINICA	20
8.0 AGRICULTURE AND BIODIVERSITY	30
9.0 HUMAN SETTLEMENT, DEVELOPMENT, AND BIODIVERSITY	40
10.0 BIODIVERSITY AND TRADITIONAL KNOWLEDGE/CULTURE	50
11.0 BIODIVERSITY AND CLIMATE CHANGE	52
12.0 BIOTECHNOLOGY AND BIOSAFETY	55
13.0 ACTION PLAN	59
14.0 IMPLEMENTATION	65
15.0 MONITORING AND REVIEW	66
ANNEX 1	67
ANNEX 2	68
ANNEX 3	69
ANNEX 4	70

FOREWORD



Honorable Pierre Charles
Prime Minister

The Convention on Biological Diversity, signed by the Commonwealth of Dominica on the 5th July 1994 represents a shared commitment to the conservation of biological diversity, the sustainable use of biological resources, and the fair and equitable sharing of the benefits arising out of the use of genetic resources. Dominica's Biodiversity Strategy and Action Plan is intended to implement the country's obligations under the Convention.

For us in Dominica the conservation and protection of our natural ecosystems and species is deeply entrenched in the national values of our people. Indeed, the country has accepted our rich biodiversity as the basis for sustainable national development. In recognition of the need to conserve and protect these vulnerable resources we have established from 1975 a system of national parks and protected areas

that presently cover in excess of 20% of our land area. Dominica's system of national parks includes two marine protected areas and the Morne Trois Piton National Park, which in 2000 was declared a World Heritage Site by UNESCO.

The Government and people of Dominica are pleased to pledge our support to the implementation of Dominica's Biodiversity Strategy and Action Plan. This Strategy and Action Plan establishes for the first time a strategic framework to guide the continued conservation and protection of Dominica's vulnerable natural resources. It also outlines strategies and actions to address newly emerging concerns relating to the control of biotechnology, the impacts of climate change on biodiversity, and the protection and enhancement of traditional knowledge, values and culture.

Dominica's Biodiversity Strategy and Action Plan presents a challenge that must be faced at all levels. It will be a challenge, within our government and the public sector, to ensure that adequate resources are provided to implement this strategy. It will be a challenge for our international relations, both bilateral and multi-lateral; to ensure that financing for biodiversity conservation is secured and mobilized in a responsible way and on terms that are sustainable. And finally, it will be a challenge to all the peoples of Dominica. We must become more aware of how our actions, individually and collectively, affect our environment, our economy, and our nation. We must encourage and continue to foster a responsible and caring attitude towards our truly unique island and the surrounding marine resources, upon which our on-going development as a nation, and indeed our survival, depend.

Dominica's Biodiversity Strategy and Action Plan represents the commitment by our present generations to put our country firmly on a path to sustainable development in order to secure the future for our young people and for future generations.

A handwritten signature in black ink, appearing to read 'Charles'.

.....
HONORABLE PIERRE CHARLES
PRIME MINISTER



ACKNOWLEDGEMENTS

The Ministry of Agriculture and the Environment wishes to acknowledge persons and organizations for their efforts towards the completion of the Dominica National Biodiversity Strategy and Action Plan.

- I. The Steering Committee**
 - Mr. Errol Harris, Chairperson
 - Mr. David Lang
 - Dr. Vivian Moise
 - Mr. Harold Guiste
 - Mr. Arlington James
 - Mr. Oliver Grell
 - Mr. Henry Shillingford
 - Mr. Alvin Bernard
- 2. Project Team**
 - Mr. Mark John, Head of the Environmental Coordination Unit
 - Mrs. Kongit H. Gabriel, National Biodiversity Coordinator
 - Mr. George H. de Berdt Romilly, International Consultant
 - Mr. Oliver Grell - Consultant, Agro-Biodiversity
 - Mr. David Williams – Consultant, Terrestrial Biodiversity
 - Mr. Harold Guiste – Consultant, Marine Biodiversity
 - Ms. Marie-Jose Edwards – Consultant, Tourism & Manufacturing
 - Mr. Charles Pierre – Consultant, Biosafety
 - Mrs. Annie Edwards – Consultant, Geographic Information
 - Mr. Henry Shillingford – Consultant, Legal System
 - Mr. Ronald Charles – Consultant Public Awareness
3. Permanent Secretary and staff of the Ministry of Agriculture & The Environment
4. All stakeholders and the Media who participated in the consultations and made valuable contributions towards the development of Dominica National Biodiversity Strategy Action Plan
5. The UNDP/GEF for providing the funding and the guidelines for the Project



EXECUTIVE SUMMARY

Dominica is a small volcanic Island state with one of the lowest population densities and the most intact forest cover in the Caribbean. This Nature Island of the Caribbean with eight active volcanoes and the only boiling lake in the Western Hemisphere, possesses tremendous terrestrial and marine biodiversity and exhibits a high level of endemism.

Dominica's biodiversity is under threat largely from the impact of human activity and natural disasters. Major threats are presented by:

- Deforestation;
- Over-exploitation of wildlife;
- Encroachment;
- Unregulated development;
- Introduction of foreign species;
- Loss of agro-biodiversity;
- Impacts from climate change;
- Uncontrolled use of biotechnology;
- Pollution;
- Natural disasters;
- Loss of traditional knowledge;
- Inappropriate legal/institutional frameworks.

In 2000 the Government of Dominica embarked upon the preparation of its Biological Diversity Strategy and Action Plan in fulfilment of its obligations under the Convention on Biological Diversity and as part of the Government's commitment to the sustainable management of the country's natural resources. This Strategy and Action Plan is based on a series of sectoral studies and seven stakeholder consultations (five local and two national workshops). Dominica's Biodiversity Strategy and Action Plan highlights the vision, goals and objectives, and guiding principles that are to direct the implementation of specific strategies and actions for the conservation of the country's biodiversity.

With the high retention of in-situ biodiversity in Dominica and its clear importance to economic development, the implementation of Dominica's Biodiversity Strategy and Action Plan is an urgent national imperative. This Strategy and Action Plan is a five-year program of action aimed at establishing the mechanisms to provide for the conserva-

tion and sustainable management of Dominica's terrestrial and marine biodiversity to facilitate intra- and inter-generational equity.

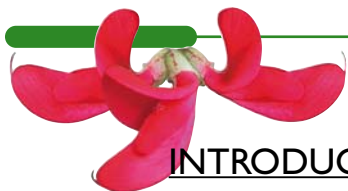
Key elements of Dominica's Biodiversity Strategy and Action Plan include:

- Inventory of biological resources;
- Improved and expanded measures for the conservation and protection of threatened marine and terrestrial ecosystems and species;
- The implementation of a comprehensive public education and awareness campaign on biodiversity conservation so as to reduce the impact of human development;
- The development of comprehensive legislative and institutional regimes for environmental management, biodiversity conservation, and natural resource management;
- The establishment of a comprehensive framework for the management of all natural resources to achieve equitable sharing of the benefits derived;
- The protection, enhancement and encouragement of traditional knowledge, culture and values;
- Adapting to the impacts of climate change on biodiversity and the resilience of natural systems; and
- The regulation of biotechnology.

Dominica's Biodiversity Strategy and Action Plan is to be implemented through a collaborative effort involving the public and private sectors and civil society. It will be monitored by the Ministry of Agriculture and the Environment, in collaboration with the National Biodiversity Committee and will be reviewed in five years to evaluate whether intended goals and objectives have been achieved.

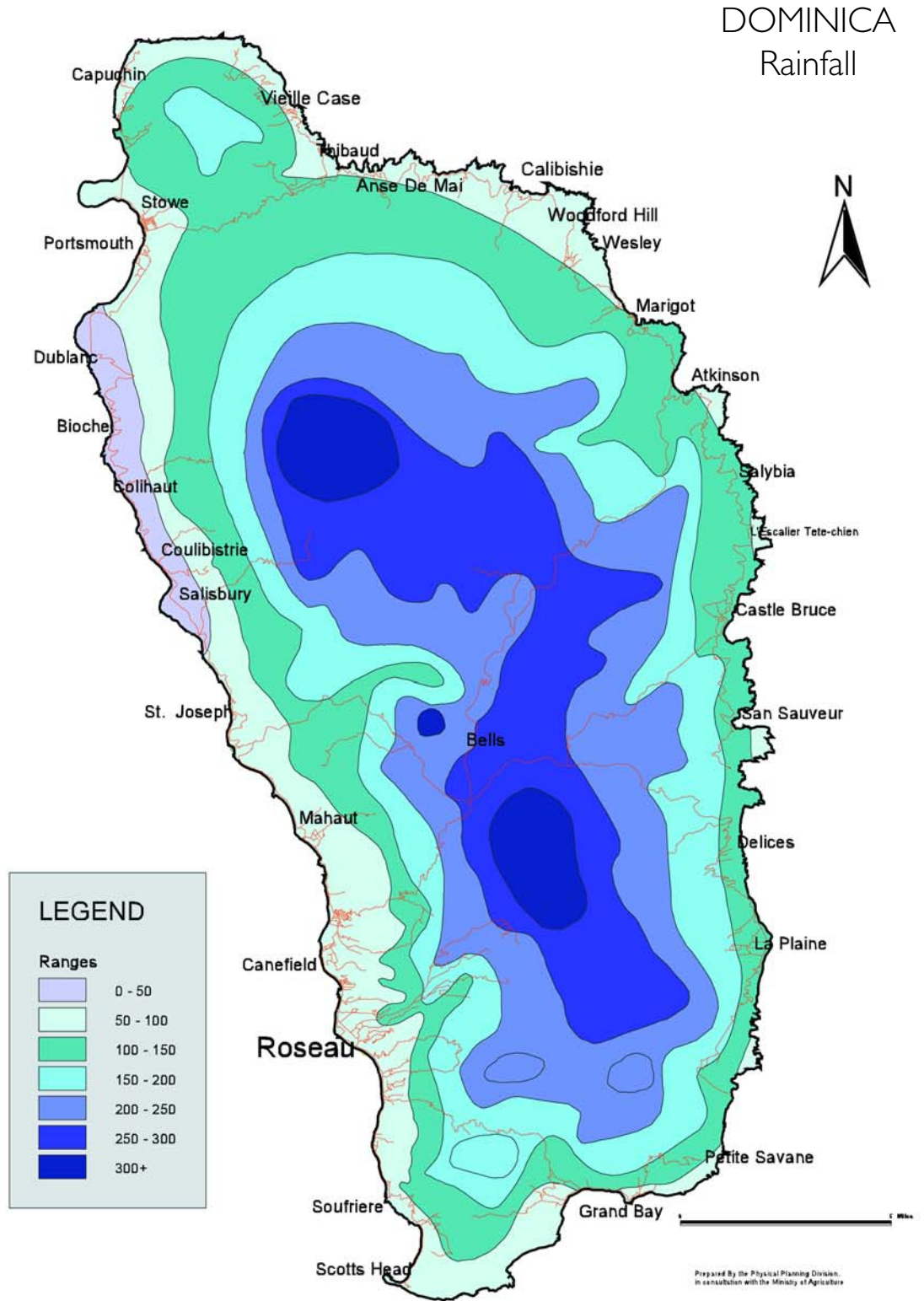


Trafalgar Falls



INTRODUCTION

1. Awareness of the Earth's dwindling biotic wealth during the years leading up to the 1992 Earth Summit in Rio de Janeiro resulted in the conclusion, at this global conference, of the *Convention on Biological Diversity*. The shared sense of urgency led 156 nations and the European Union to sign the legally binding Convention before the conclusion of conference proceedings.
2. Currently, a total of 168 nations have signed the Convention on Biological Diversity. In ratifying the Conventions, nations accept responsibility to safeguard the profusion of species, genetic materials, habitats and ecosystems that make up the natural world. Signatory nations also agree to foster development that use biological resources in a sustainable manner, and agree to recognize each other's sovereignty over the biodiversity found in respective territories. Additionally, member nations commit themselves to finding equitable ways to share biodiversity's monetary and non-monetary values, to spur technical cooperation, and to establish mechanisms to finance investments in maintaining the diversity of life on Earth.
3. In July 1994, the Government of Dominica signed the Convention on Biological Diversity, thereby agreeing to support the following three basic objectives of the Convention:
 - (a) The conservation of biological diversity;
 - (b) The sustainable use of all biological resources; and
 - (c) The fair and equitable sharing of the benefits arising out of the use of genetic resources.
4. As a means of achieving these objectives, Article 6 of the Conventions requires that: Each Contracting Party shall, in accordance with its particular conditions and capabilities:
 - (a) *Develop national strategies, plans or programs for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programs which shall reflect, inter alia, the measures set out in this Convention relevant to the Contracting Party concerned; and*
 - (b) *Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-cutting sectoral plans, programs and policies.*
5. Article 26 of the Convention requires Contracting Parties to submit National Reports to the Conference of the Parties. At its second meeting (Jakarta, November 1995) the Conference of the Parties decided that the first national reports should focus in so far as possible, on the measures taken for the implementation of Article 6 of the Convention, as well as the information available in national country studies on biological diversity.
6. In April 1998, the Government of Dominica secured financial support from the United Nations Development Programme (UNDP) to assist with the development of the country's *Biodiversity Strategy and Action Plan*, and First National Report to the Conference of Parties of the Convention on Biodiversity.
7. As a first step in the process to develop *Dominica's Biodiversity Strategy and Action Plan*, the National Biodiversity Coordinator was appointed in September 2000. A National Steering Committee was established in October 2000 to guide and implement the development of *Dominica's Biodiversity Strategy and Action Plan*.
8. As a next step a series of studies were undertaken on the state of Dominica's biodiversity. These studies are consolidated into a "Country Assessment" which constitutes the technical basis upon which the Strategy and Action Plan has been developed.
9. *Dominica's Biodiversity Strategy and Action Plan* has been developed through an extensive consultation process. In order to facilitate the preparation of *Dominica's Biodiversity Strategy and Action Plan*, a series of workshops and consultative meetings took place between March to August) 2001. A list of the organizations and persons consulted in the development of *Dominica's Biodiversity Strategy and Action Plan* is contained in Annex 1 and Annex 2. This process was complemented with an extensive public education and awareness campaign.
10. *Dominica's Biodiversity Strategy and Action Plan* has been reviewed by the Cabinet of Ministers and was approved on January 15th, 2002.





SECTION 2

DOMINICA – AN OVERVIEW

2.1. Location

The Commonwealth of Dominica is situated between Guadeloupe to the north and Martinique, to the south, at 15° 30' North Latitude and 61° 25' West Longitude, making the island the most northerly of the sub-regional Windward Islands grouping. Located in the middle of the Lesser Antilles, with a total land area of 750.6 km² (290 sq. miles), Dominica is the also the largest Windward Island. In 2000, the population was estimated to be 71,242 with a growth rate of approximately 1.3% per annum. With a population density of 94.8 persons

per km², Dominica is the least populated of the Windward Islands.

2.2. Vegetation, Climate and Geology

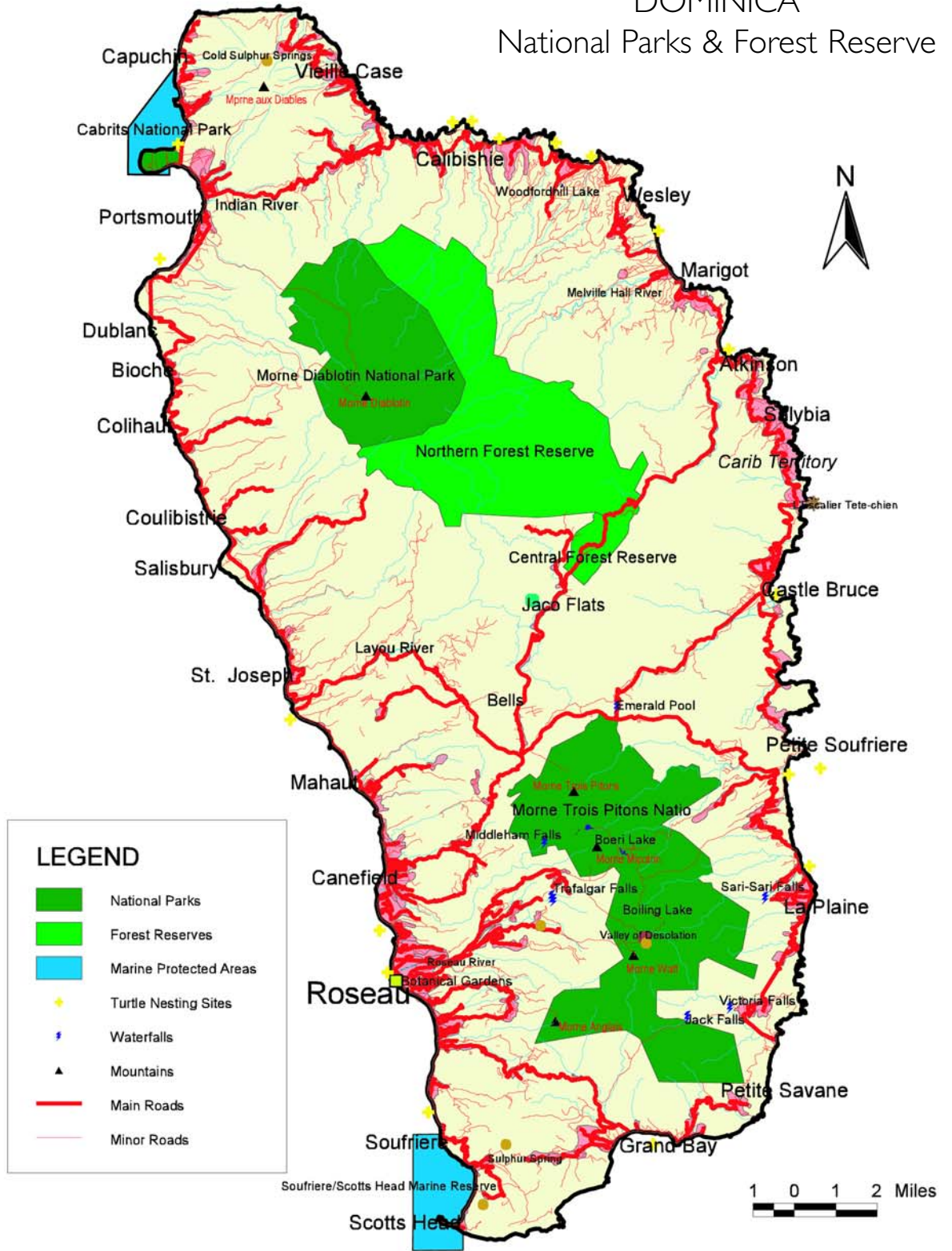
Sixty-five percent (65%) of Dominica's land area is covered by natural vegetation ranging from dry scrub woodland on the west coast to lush, tropical rain forest in the interior and a wide variety of flora. The interior is interspersed with rivers, waterfalls and lakes, and these attributes have earned Dominica the name "The Nature Island of the Caribbean".

Dominica's climate is classified as humid tropical marine, with average temperatures of 27°C (80°F). Because of the island's rugged topography micro-climatic variability exist within very short distances, influenced by the high moisture content of the air masses that enter the region from the Atlantic Ocean. This makes Dominica a very high rainfall country, with an average rainfall of 175 inches per year; most of that amount falls during the wet season. Rainfall increases from the leeward side eastward towards the central parts of the island where it reaches approximately 400 inches annually. The high rainfall makes the country susceptible to landslides, particularly in the more mountainous regions.

Dominica is affected by hurricanes, and as a small island developing State is vulnerable to impacts from climate change. Within the last decade the social and economic infrastructure of the country was severely affected by a number of hurricanes. It should also be noted that besides the impacts on social and economic infrastructure, tropical weather systems also affect biodiversity (e.g. they may introduce new species, or even decimate populations of indigenous species).



DOMINICA National Parks & Forest Reserve



A volcanic island with a series of complex mountain ranges, Dominica is characterised by very rugged and steep terrain. This mountainous topography has made it difficult to clear the lush vegetation and has contributed greatly to the island's dramatic beauty and the conservation of its natural resources. Forests and arable land estimated at 22.6% and 27.8% respectively of total land area, along with an extensive network of surface and underground water, make up the majority of the natural resource base. Dominica possesses hydroelectric energy sources, and extensive marine resources including impressive coral reefs. Since the last decade increasing attention has been placed on the sustainable use of these natural resources.

Dominica's rugged topography, rural ambience, and limited urbanization make it an ideal nature destination. Dominica has coined the title "Nature Island of the Caribbean" as its logo for eco-tourism promotion and offers services such as adventure excursions, habitat research, hiking, river bathing, sightseeing, whale watching, and scuba diving.

SECTOR	1995	1996	1997	1998	1999
Agriculture	-8.1	5.5	1.5	-2.0	-0.5
Manufacturing	2.3	6.0	2.5	16.8	-19.0
Tourism	2.6	-5.4	2.0	-4.0	4.3
Government Services	-1.3	1.5	2.9	5.5	0.23
Total	1.6	3.1	2.0	2.4	0.9

Source: CSO/ECCB

Table 2.1 - Rate of Growth of GDP by Economic Activity at Factor Cost (1990 prices)

ECONOMIC INDICATORS	1995	1996	1997	1998	1999
EC\$-US\$ Exchange Rate	2.7	2.7	2.7	2.7	2.7
Inflation Rate (%) GDP at Factor Cost (1990prices)	1.3	1.7	2.4	1.0	1.2
% Contribution of:	410.3	422.9	431.3	441.8	445.8
Agriculture	20.0	20.8	20.0	19.2	18.9
Manufacturing	6.8	7.0	7.0	8.0	6.4
Tourism	2.8	2.6	2.6	2.4	2.5
Government Services	17.3	17.1	17.2	17.7	17.6

Table 2.2 - Dominica's Key Economic indicators (Source: Central Statistical Office)

2.3. Economic Development

Dominica's economy has always been based on the utilization of its land resources and on the productive initiatives of an educated and healthy labour force of approximately 40,000. The small domestic market makes economic growth highly dependent on exports. Over the five-year period 1995 - 1999 real growth averaged 2.0% per annum. Growth is estimated at less than 1% for the year 1999. Decline and stagnation characterised the major productive sectors, viz., agriculture and manufacturing and tourism during the period 1995 - 1999. Government services contribution, the second largest sub-sector of the economy, has been variable against the background of world-wide reduction in aid flows (Table 2.1).

The difficulties experienced in the banana industry and fluctuation in non-banana exports contributed to the deterioration in the visible trade balance for the period, moving from minus EC\$142.3M in 1995 to minus EC\$185.6M in 1999. However, the inflation rate has been moderate, averaging less than 2% over the last four years, and the exchange rate has been stable (Table 2.2).



SECTION 3

VISION

We the people of Waitukubuli recognise Dominica's unique and fragile ecosystems as the basis for the development and advancement of our people and nation. As custodians of nature's biodiversity, we aspire to integrate the endowed gifts of our biotic wealth, with our cultural knowledge, to ensure economic, cultural and ecological integrity for the well being of present and future generations.



The Carib name for Dominica, Waitukubuli, means "tall is her body" in reference to the island steep mountainous terrain.



SECTION 4

GOALS AND OBJECTIVES

GOALS

1. The conservation and sustainable management of Dominica's terrestrial and marine biodiversity to ensure intra- and inter-generational equity.
2. The promotion of sound and sustainable agricultural practices and technology within existing agricultural human capital so as to minimise the loss of agro-biodiversity, and reduce vulnerability to desertification, soil loss, and the contamination of water resources.
3. To ensure that biotechnology knowledge and concerns are widely distributed so that all life is guaranteed and benefits derived are equitably shared.

OBJECTIVES

1. To secure a biologically rich and diverse Dominica which:
 - maintains optimum systems resilience;
 - maintains resistance to invasive alien species;

- maintains ecosystem structure and function;
 - maximizes ecological integrity by reducing negative environmental impact of human influences; and
 - is populated by a diversity of peoples who promote and undertake the wise and sustainable use of natural resources.
2. To reduce or eliminate the potential risks from the use of biotechnology and its by-products while at the same time exploiting opportunities presented that are in keeping with Dominica's sustainable development agenda.
 3. To reduce and/or minimise the loss of terrestrial and marine biodiversity.
 4. To ensure that the basis for development is through the sustainable use of terrestrial and marine biological resources.
 5. To ensure the equitable and sustainable distribution of social and economic benefits from the use of terrestrial and marine biological resources.



SECTION 5

GUIDING PRINCIPLES

- Dominica as a Small Island State rich in biodiversity recognises its ecological, economic, social, cultural and intrinsic values of these biological resources, and therefore all development decisions must reflect their optimal utilisation.

- All living things including humans are ultimately connected and dependent on each other for their existence.

- Dominicans depend on biodiversity and have a responsibility to understand, appreciate and contribute to its conservation.

- All Dominicans should be empowered through inclusion in the decision-making process to sustainably use their biological resources and equitably share the benefits derived from such use.

- The knowledge, innovations and practices of indigenous and local communities should be respected and mediated by the best knowledge available and approaches refined as new knowledge is gained.

- The conservation, management, and sustainable use of biological resources should be based on an ecosystem approach, mediated by the best knowledge available and refined as new knowledge is gained

- Dominica seeks to co-operate with all other territories and regional and international institutions in the conservation of biodiversity and expects reciprocity from the said territories and regional and international institutions.

Objectives of the Convention on Biological Diversity:

- (a) The conservation of biological diversity;
- (b) The sustainable use of all biological resources; and
- (c) The fair and equitable sharing of the benefits arising out of the use of genetic resources.



SECTION 6

TERRESTRIAL BIOLOGICAL RESOURCES OF DOMINICA

6.1 Terrestrial Flora

The island of Dominica was originally covered with dense primary oceanic forest sustained by high annual rainfall ranging from 10,000mm (400 in.) in the central zone to 1,200mm (50 ins.) on the leeward coast. Numerous plant taxonomists have been attracted to the impressive natural rain forest, which is relatively pristine in many regions of the island. Documentation of the flora of Dominica is very comprehensive.

6.2 Diversity of Flora

Dominica boasts a phenomenal plant diversity of approximately 155 families, 672 genera and 1226

species of vascular plants. The number of indigenous species includes *Pteridophytes* (194), *Gymnosperms* (1), *Monocotyledons* (518) and *Dicotyledons* (1,445). Dominica has several plant species which are recorded as endemic to the island, e.g. *Sabinea carinalis* (Bwa Kwaib) the National Flower of Dominica.

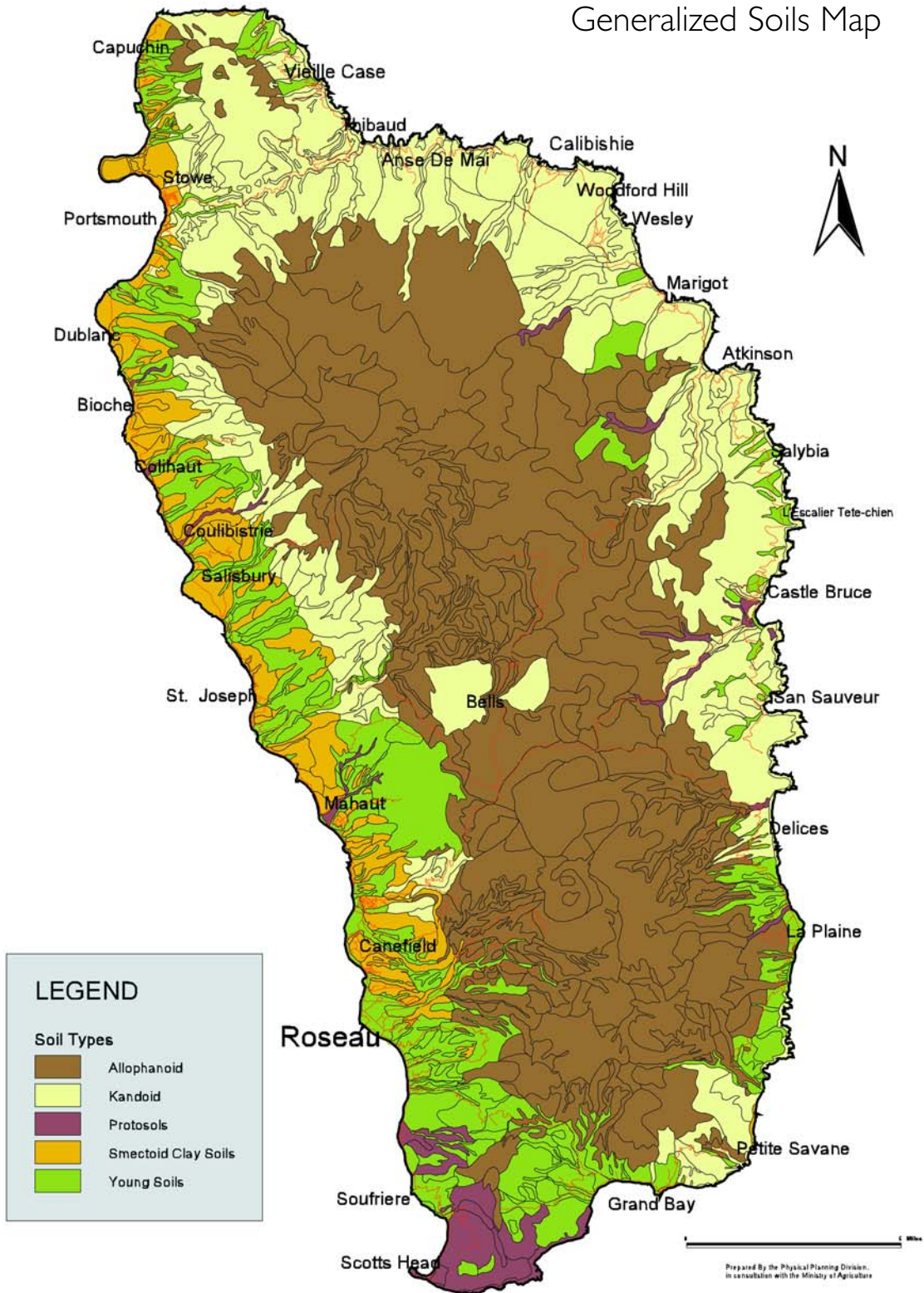
6.3 Vegetation Communities

The natural vegetation is delineated into 7 communities, namely: Coastal Swamp, Littoral Woodland, Dry Scrub Woodland, Deciduous/Semi-evergreen Forest (including Grassland and savannah sub-types), Rain Forest, Montane Rain Forest, and Elfin Woodland. Fumarole vegetation associated with geothermal areas is also present.

Family	Scientific Name
Fabaceae	<i>Sabinea carinalis</i>
Fabaceae	<i>Inga dominicensis</i>
Euphorbiaceae	<i>Phyllanthus megapodus</i>
Melastomataceae	<i>Charianthus purpureus var.</i>
Melastomataceae	<i>Rugosus Miconia mornicola</i>
Melastomataceae	<i>Miconia ernstii</i>
Myrtaceae	<i>Eugenia hodgei</i>
Asteraceae	<i>Chromolaena impetolaris</i>
Asteraceae	<i>Chromolaena macrodon</i>
Gesneriaceae	<i>Besleria petiolaris</i>
Bromeliaceae	<i>Pitcairnia micotrinensis</i>

Table 6.1 – List of Endemic Plant Species in Dominica

DOMINICA Generalized Soils Map



Vegetation Type	Area (ac)	% of Landmass
Coastal Swamp	74.13	0.1
Littoral woodland	345.94	0.2
Dry scrub woodland	15,419.04	7.9
Deciduous/Semi-evergreen forest	17,717.07	9.1
Rain forest	82,931.18	42.5
Montane Rain Forest	10,971.24	5.6
Elfin woodland	420.07	0.3
TOTAL	127,878.67	65.7
Source: Prins (1987) State - 51,169 (40%) Private - 76,754 (60%)		

Table 6.2 - Vegetation Types Found on Dominica

6.4 Terrestrial Fauna

Dominica is host to the most diverse assemblage of wildlife species remaining in the Eastern Caribbean. All the faunal groups are well represented. It is the great diversity of habitats encompassed within this island of only 750 square kilometers (290 sq. mile) that gives rise to this rich diversity of animals and faunal communities. The greatest diversity of animal life occurs in the rain forest with birds and bats particularly well represented.

birds include two single-island endemics and nine regional endemic species.

Dominica's two endemic parrot species - the imperial parrot or "Sisserou" (*Amazona imperialis*) and the red-necked parrot or "Jaco" (*Amazona arausiaca*) are both considered threatened (IUCN Red Data List) and are "specially protected" birds under Dominican law. The most recent (1999) population estimate put the parrot populations at approximately 200 *A. imperialis*, and 1,500 *A. arausiaca*. Although *A. imperialis* may never have been abundant in Dominica, it is now considered to be the world's most critically endangered Amazon parrot. Both species have been negatively impacted by the combined effects of forest clearance for agriculture and the damage to the forests caused by hurricanes. The populations of these two endangered parrots reached critical levels, as low as 60 *A. imperialis* and 200 *A. arausiaca*, following Hurricane David in 1979.

6.4.1 Birds

Dominica has the most diverse avifauna of the Lesser Antilles despite its geographic location within the center of the island chain. Numerous studies on species diversity have been conducted, and to date one hundred and seventy-five species of bird have been recorded for Dominica. Many of the birds are migratory, while sixty species breed on the island. Dominica's resident



Sisserou Parrot

The nine regionally endemic bird species found in Dominica are the Blue-headed Hummingbird (*Cyanophaea bicolor*), Plumbeous Warbler (*Dendroica plumbea*), Forest Thrush (*Cichlherminia lherminieri*), Scaly-breasted Thrasher (*Margarops fuscus*), Brown Trembler (*Cinclocerthia ruficauda*), Lesser Antillean Pewee (*Contopus latirostris*), Lesser Antillean Swift (*Chaetura martinica*), Lesser Antillean Flycatcher (*Myiarchus oberi*), and the Lesser Antillean Bullfinch (*Loxigilla noctis*).

Dominica is also important for seabirds and the most common breeding species are the White-tailed Tropicbird (*Phaethon lepturus*); Red-billed Tropicbird (*Phaethon aethereus*); Common Tern (*Sterna hirundo*); Roseate Tern (*Sterna dougallii*); Bridled Tern (*Sterna anaethetus*); Sooty Tern (*Sterna fuscata*); and Brown Noddy (*Anous stolidus*). The Magnificent Frigatebird (*Fregata magnificens*) is a non-breeding resident species. Breeding colonies of most of the seabird species are small and concentrated on relatively inaccessible coastal cliffs and islets where predation pressures are lower. One of the seabird species of regional interest is the Black-capped Petrel or "Diablotin" (*Pterodroma hasitata*) recorded on Dominica up to the latter half of the 1800s. For several years the Diablotin was considered to be extinct on Dominica. However, a sighting in 1984 could be an indication that the species may be breeding on remote inaccessible coastal cliffs on the island.

6.4.2. Mammals

Eighteen species of wild terrestrial mammals have been recorded for Dominica. These include twelve native species of bats, one species of opossum, one species of feral pig, and four species of rodents including the agouti.

Dominica has no single-island endemic species of mammal. Of the twelve bat species recorded on the island four are regionally endemic viz. *Monophyllus plethodon*, *Ardops nicholsi*, *Myotis dominicensis*, and *Bracyphylla cavernum*. Diversity and density of bats are highest in and around rain forests. The impacts of

agricultural cultivation and hurricanes have reduced bat species populations and diversity on the island.

The other six wild terrestrial mammalian species found in Dominica were all introduced. The Agouti (*Dasyprocta leporinus*) was introduced from South America possibly by the pre-Columbian Arawak and Carib Indians. The Opossum (*Didelphys marsupialis insularis*), the Wild Pig (*Sus scrota*), two species of rats, viz. the Brown Rat (*Rattus norvegicus*) and the Black Rat (*Rattus rattus*) and one species of mouse - the House Mouse (*Mus musculus*) were all introduced on the island by Europeans, and have become naturalised.

6.4.3. Reptiles

Nineteen species of reptiles have been recorded for Dominica consisting of fifteen terrestrial species and four marine species. The fifteen terrestrial reptiles include ten lizard species, four sub-species of snake and one tortoise species. Of the ten species of lizards, the Ground Lizard (*Ameiva fuscata*) and the Tree Lizard (*Anolis oculatus*) are endemic. The Lesser Antillean Iguana (*Iguana delicatissima*) is endemic to a few islands of the Eastern Caribbean, from Anguilla to Martinique (Schwartz and Henderson, 1991). Three species of litter lizards have been recorded on Dominica, viz. *Sphaerodactylus fantasticus*, *S. vincenti*, and *S. microlepis*.



Greater Bulldog or Fishing Bat

Of the four species of snakes, *Typhlops dominicana* is endemic to Dominica, while *Alsophis antillensis* and *Liophis juliae* are endemic to the Lesser Antilles. The Boa constrictor (*Constrictor constrictor nebulosa*), which is the largest snake on the island, is widely distributed throughout Dominica.

The Tortoise (*Geochelone carbonaria*) is considered an introduction to Dominica.

6.4.4. Amphibians

The amphibian fauna in Dominica consists of four species of frogs, one of which is endemic to the island. The most prominent is *Leptodactylus fallax*, a large frog commonly referred to as the Crapaud or Mountain Chicken, which is endemic to Dominica and Montserrat. The other amphibian species are three species of small (tree) frogs consisting of one single-island endemic species *Eleutherodactylus amplinympha* - that is restricted to higher elevations on Dominica, and two regionally endemic species, viz. the Tink Frog (*Eleutherodactylus martinicensis*) and Johnstone's Whistling Frog (*E. Johnstonei*) which was first recorded in Dominica following Hurricane David in 1979.

6.4.5. Fish

Although the freshwater fish of Dominica have not been thoroughly studied, at least some species have been identified. This includes the American eel, gobies - which are locally called "lòsh" (*Sicydium spp.* and *Eleoris Pisonis*) and "Titiwi" in the post-larval stage - the mountain mullet (*Agonostomus monticola*), and the striped mullet or "Mèy", among several other species. The majority of freshwater fish species on Dominica migrate between freshwater and salt water, while some spawn at sea. Introduced Tilapia (*Tilapia mossambica*) occurs in the Freshwater Lake while *Tilapia nilotica* and *T. aurea* are reared in ponds and on aquaculture farms.

6.4.6. Invertebrates

Invertebrates as a group are well represented on Dominica. However, further scientific studies and ecological surveys are required to determine the true status of various invertebrate species on the island.



Dominica's endemic tree frog

6.4.6.1. Crustaceans

The terrestrial and freshwater decapod crustaceans in Dominica include eleven species of freshwater shrimps and twenty species of freshwater/terrestrial/semi-terrestrial crabs. None of the crustaceans are endemic to the island and most are widely distributed in the Caribbean. The twenty crab species occur in ecologically diverse habitats but most occur in coastal habitats.

Shrimps are common in Dominican streams with a distribution ranging from cascading mountain streams to slow flowing river mouths. Shrimps from the following genera have been recorded on Dominica: *Atya*, *Jonga*, *Micratya*, *Potimimirus*, *Xiphocaris*, and *Macrobrachium*. Several of the larger species are used as food on the island.

6.4.6.2. Insects

The class Insecta has not been fully surveyed on the island and as a result the species list is incomplete. Species from the following Orders are present: *Hymenoptera*, *Hemiptera*, *Diptera*, *Coleoptera*, *Lepidoptera*, and *Tricoptera*. The population status of most of these species is not known.

Fifty-five species of butterflies have been recorded in Dominica. Two species are endemic to the island and seven are endemic to the Lesser Antilles and are confined to montane areas in Dominica and Guadeloupe.

Eleven species of *Phasmids* (stick insects) have been recorded for Dominica. One species (*Diapheromera saussurei*) is a confirmed endemic for the island, while two others (*Diapherodes gigantea dominica* and *Lamponius dominicae*) are supposed to be endemic but need further investigation.

The Hercules Beetle (*Dynastes hercules hercules*), which occurs on montane areas in Dominica, is also found in Guadeloupe. It is one of eight recognized races of this beetle whose distribution extends south from Guadeloupe into much of South America.

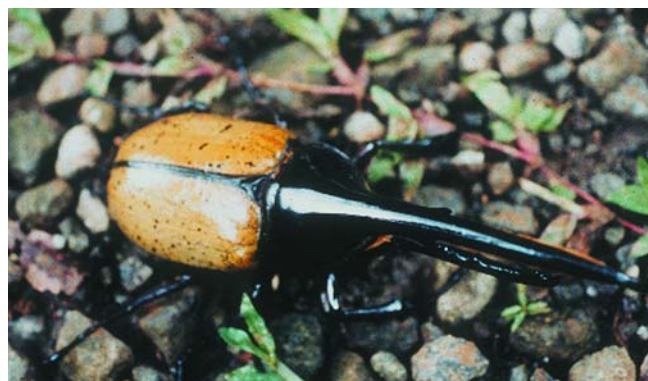
The root causes of loss of terrestrial biodiversity in Dominica are attributed to the following factors:

6.5.1. Deforestation

Deforestation is considered to be the main contributor to biodiversity loss in Dominica. Agricultural expansion and to a lesser extent timber harvesting have resulted in the rapid removal of natural vegetation on both private and public lands. Forests on unallocated State lands are being sold as a means to relieve agricultural land hunger without adequate controls to protect against soil erosion and other forms of land degradation. Rain forests and other vegetation zones, particularly in coastal regions where littoral forests and dry scrub woodland may be found, have been considerably reduced in the past forty years.

The conversion of natural forest to agriculture and for urban expansion has resulted in the fragmentation of natural vegetation types, reduction in the percentage of natural forests particularly rain forest, adverse effects on wildlife habitats, and adverse effects on water quality and quantity, with negative impacts on biodiversity particularly aquatic organisms.

6.5. Loss of Terrestrial Biodiversity



Male Hercules Beetle

6.5.2. Agrochemical Pollution

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 (Rainey et al, 1987). 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.

6.5.3. Natural Disasters

Many natural hazards periodically affect or threaten Dominica, among them are hurricanes, earthquakes, volcanic eruptions, storm surges, and landslides. These natural disasters, particularly hurricanes, can be attributed as one of the root causes of biodiversity loss in Dominica. Hurricane David in 1979 did significant damage to the forest resource 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.

6.5.4. Hunting and Capture of Wildlife

The *Forestry and Wildlife Act (1976)* makes provision for wildlife management and protection in Dominica. The Act also provides for hunting and fishing seasons, both of which usually last six months. Such hunting and fishing activities pose major threats to the wildlife and freshwater fish resources respectively. Legislation is inadequate and fines and fees are low. The resources are not managed on a scientific basis and

little is known about the extent of the resource or sustainable exploitation levels. This situation has been exacerbated by the current socio-economic situation which has resulted in increased exploitation of wildlife resources.



Matthieu dam and reservoir; 1997

6.5.5. Impact of Squatters

Squatting or the practice of shifting cultivation is not considered a major problem in Dominica. There have been isolated reports of trespassing and deforestation in Forest Reserves, National Parks and on unallocated State lands. Illegal tree cutting and charcoal production is a minor problem. However, they pose a continuing problem as these activities are species selective on forest resources. State lands affected by illegal encroachment and intensive cultivation include lands in the Brandy area and an area along the southern boundary of the Morne Trois Pitons National 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 proven to cause serious negative environmental impacts on wildlife habitat.

6.6 Strategic Directions

- Strategy 1 - Develop a comprehensive national land use plan / legislation with the involvement of all key stakeholders.
- Strategy 2 - Review / amend existing legislation, and as appropriate develop new legislation with respect to:
- Conservation and management of terrestrial biodiversity;
 - Regulation of the introduction of alien species;
 - Protection of indigenous species/ ecosystems;
 - Protection of watersheds, stream bank reserves, and riparian ecosystems;
 - The implementation and enforcement of the Convention on the International Trade in Endangered Species of Flora and Fauna (CITES);
 - Forestry / wildlife and national parks management;
 - Management of solid and liquid waste (industrial, agriculture, urban);
 - Conservation and protection of agro-biodiversity.
- Enforcement of existing and proposed legislation through empowerment of all relevant agencies and community groups.
- Strategy 3 - Develop and implement a comprehensive public education, awareness and training programme on issues of environmental protection and conservation of terrestrial natural resources/biodiversity.
- Strategy 4 - Identification and protection of sensitive / fragile / threatened ecosystems with priority given to the Indian River wetland among others, and Dry Scrub Woodland, and the identification and protection of buffer areas required to protect and conserve threatened flora/fauna and ecosystems.
- Strategy 5 - Research to develop wildlife farming technology to reduce stress on wild populations.
- Strategy 6 - Research, inventory and monitoring to develop a comprehensive database and meta-data on:
- Terrestrial/ Aquatic fauna and flora;
 - Species and ecosystem distribution description;
 - Medicinal Plants.
- Strategy 7 - Develop a national policy on water use, conservation and extraction.



Boa constrictor



Crayfish



SECTION 7

MARINE AND COASTAL RESOURCES

7.1. Coastal and Marine Areas of Dominica

The coastal waters of Dominica are richly endowed with an abundance and very diverse array of aquatic flora and fauna. The island's shores are washed by the Caribbean Sea on the western side and by the Atlantic Ocean on the East. The sub-marine topography is similar to that of the land, rugged and mountainous with very deep valleys. There is a very narrow continental shelf around the island and as a result the water plummets to depths in excess of 200 feet very close to shore. There is also a wide range of estuarine habitats resulting from the many rivers found on the island.



Indian River Wetland

7.2. Marine and Coastal Habitats

The topography as well as the geological features, rainfall and climate of the east coast and west coast are different and hence provide differing habitats.

7.2.1. Beaches

The beaches of Dominica are predominantly dark in colour due to their volcanic origin. However, the beaches on the east and north-eastern coast, which is washed by the turbulent Atlantic Ocean, are lighter in colour indicating their coral limestone origin. The beaches along the west coast of Dominica undergo dramatic changes at various times of the year, varying from sandy to stony. Some east coast beaches are made of large boulders whilst in other cases cliff faces drop sharply into the sea. These dramatic variations of topography, accessibility, wave action and human activity have a profound effect on marine and coastal biodiversity.

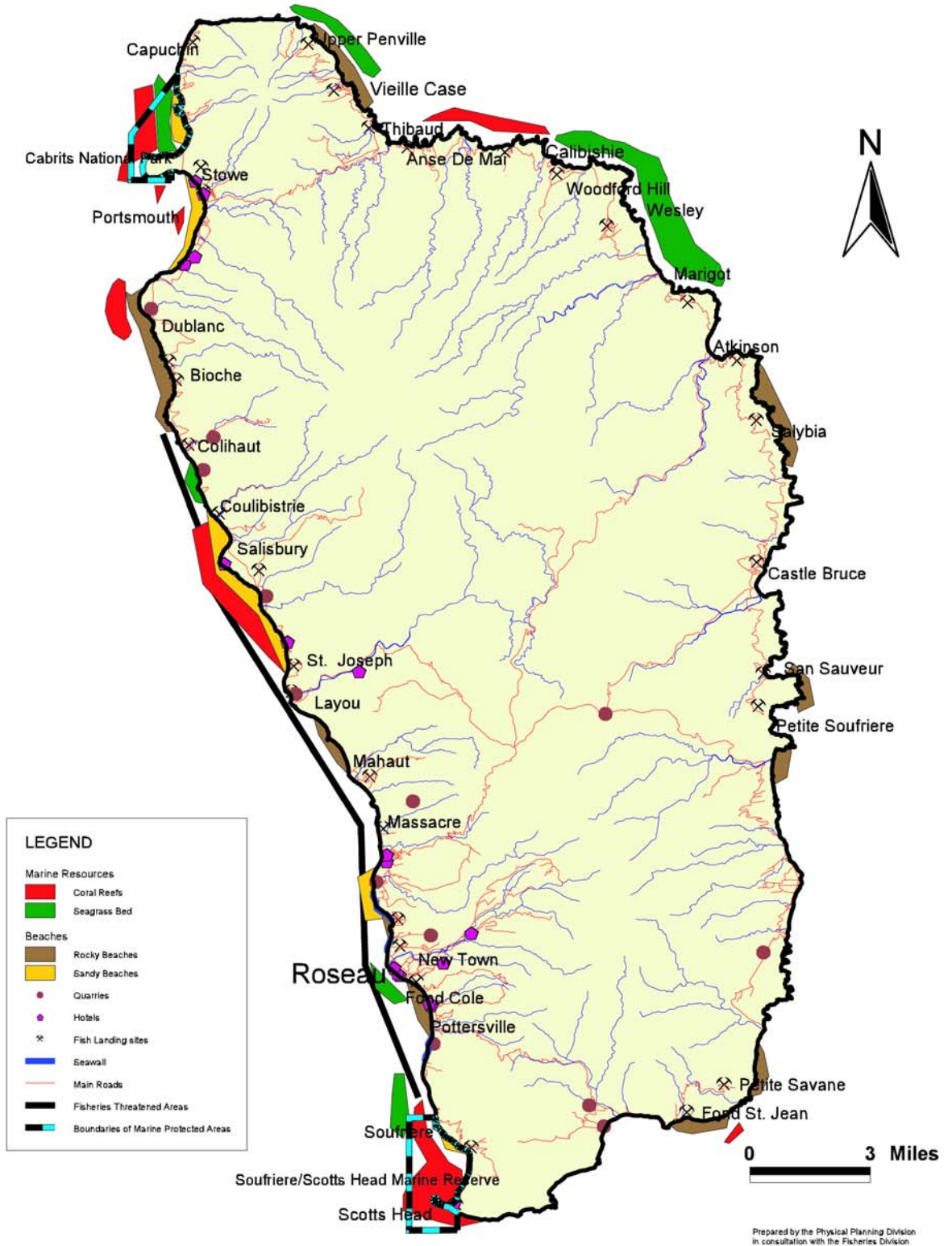
7.2.2. River Estuaries and Wetland Areas

Dominica is blessed with numerous rivers and streams, which flow from the rugged mountains into the Caribbean Sea on the west coast and into the Atlantic Ocean on the east coast of the island. The interface between sea and river varies depending on the size of the river and the gradient of the land as it approaches the sea.

In some cases the sea enters the river for some significant distance inland forming a large pool of brackish water. In other cases the river is slightly elevated above the level of the surf and the river water falls into the sea. This condition enhances the biodiversity of the island by providing a habitat and nursery for many organisms which thrive in brackish water or waters of varying salinities. This habitat also provides a haven for anadromous fish and some crustaceans, which live most of their adult life in the rivers, but whose larval and part of the juvenile stages are spent in the sea. Juvenile marine shrimp also spend some time in the river estuaries.

DOMINICA

Coastal & Marine Resources



7.2.3. Coral Reefs

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 reefs on the west coast of the island (see map). A total of 32 species of hard corals and 16 species of soft corals have been identified, including 28 species of hard coral and 10 species of soft coral in the Scotts Head/Soufriere Marine Reserve alone (Evans, 1990). The majority of corals are in a healthy state. There are marked differences between the species found on the west and east coasts, although some species of coral occur on both coasts. In this regard, many more studies have been done on the western coast owing to the calm nature of the Caribbean Sea, and these studies have indicated that the coral diversity on the west coast of the island is greater than on the east coast.

The Scotts Head / Soufriere area in the south of the island possesses some of the most pristine coral reefs with tremendous diversity. Owing to the rugged nature of the sea bed there exists coral growing on submarine cliff surfaces that provides for very

good wall diving. Corals are also found growing on granite rock, and in cave formations in very deep water. Further north to Anse Bateau are unique fringing coral reefs that withstand the very warm waters produced from hot volcanic vents found on the seabed, which are locally called "champagne bubbles".

The most highly stressed areas of coral reef on Dominica occur along the west coast of the island, in an area stretch-

ing from Point Michel to Colihaut. The greatest factor contributing to the stress of these corals is sedimentation from quarrying operations along the west coast where the majority of these facilities are located. Corals occurring in deeper waters and on the east coast are in a much healthier state. A 1994 study describing the status of the coral reefs of Dominica found that 75% of the coral reefs were in a healthy state.

7.3. Species Diversity

The marine and coastal habitats of Dominica support a wide diversity of species.

7.3.1. Fish

The coastal waters of Dominica provide different types of habitat for many different species of fish. The coral reefs around the island, which are located at depths between 10m and 60m, are endowed with a very wide diversity of species. No documented list of species has ever been compiled for Dominica. Some of the most common species identified in the fish landings of Dominica are lobster, many species of groupers and snappers, squirrel fish, black bar soldier fish, shrimp, goatfish, grunts, many species of wrasse, parrotfish, and file fish.

Further offshore in waters of about 200m to 300m in depth, very large groupers and snappers abound. These are called deep slope species and are relatively under-exploited in Dominica. The main species caught is *Etellis oculatus* (Valenciennes, 1828) the queen snapper. A considerable amount of study is required to determine the potential and diversity of this resource.

Coastal pelagics are found in the water column above the reef ecosystem. These include ballyhoo, sardines, jacks, scads, sprats, skipjack tuna and black-fin tuna. Further offshore migratory pelagics occur, including dolphin fish, wahoo, flyingfish, yellow-fin tuna, skipjack, black-fin tuna and other tunas and tuna-like species (e.g. mackerel).



Tube Sponge

Fisheries Groups	Exploitation level (tons)	Trends	Potential	Constraints
Reef Fisheries	145.9	Declining both in terms of catches and size of individual fish	Fisheries can be sustainable if managed properly	In addition to heavy fishing pressure, there are negative impacts on habitat from land based sources of pollution & development activities.
Deep Slope Fisheries	67.3	Production has remained relatively steady over the years at a low level of exploitation	Has great potential for increase in production	<ul style="list-style-type: none"> • Lack of line haulers and other tackle. • Small and unstable fishing platforms for use on the Atlantic Ocean. • Bottom long lines and palangue very expensive to maintain.
Coastal pelagic Fishery	470.8	Shows an increasing trend	Shows great potential for development as it is caught in large quantities	<ul style="list-style-type: none"> • Habitat affected by land based sources of pollution. • Some species are under-utilized
Migratory Pelagics	437	Increasing trend	Has greatest potential for development	<ul style="list-style-type: none"> • Small size of boats • Lack of use of navigational aids • Fishing fleet presently operates within a 12 mile radius of the island

Table 7.1 - Status of Major Fisheries (1999)

7.3.2. Turtles

There are four species of turtle found in Dominican waters. The hawksbill (*Eretmochelys imbricata*) (Linnaeus, 1766) is the most common and nests on Dominica. The leatherback turtle (*Dermochelys coriacea*) is the next most commonly observed turtle nesting on Dominica, and usually nests on beaches on the east coast of the island. The green turtle

(*Chelonia mydas mydas*) (Linnaeus, 1758) and the loggerhead turtle (*Caretta caretta*) are also found in the waters around Dominica. There are reports of the loggerhead turtle being caught in Dominican waters but no evidence of nesting. There has been some evidence of nesting behaviour of the green turtle on the island. However much is not known of this species' distribution in terms of nesting areas.

7.3.3. Marine Mammals

The coastal waters of Dominica present a haven for many marine mammals. Several species of whales and dolphins have been observed during studies conducted by the Fisheries Department and undertaken in collaboration with Woodshole Oceanographic Institute, including:

- Sperm Whale (*Physeter catodon*)
- Bryde's Whale (*Balaenoptera edeni*)
- Short-finned Pilot Whale (*Globicephala macrorhynchus*)
- Cuvier's Beaked Whale (*Ziphius cavirostris*)
- Pygmy Sperm Whale (*Kogia breviceps*)
- Humpback Whale (*Megaptera novaenglia*)
- Whale Shark (*Rhincodon typus*)
- Spinner Dolphin (*Stenella clymene*)
- Spotted Dolphin (*Stenella sp*)
- Frasers Dolphin (*Lagenodelphis hosei*)
- Bottlenose Dolphin (*Tursiops truncatus*)

Dominica has developed a growing whale-watching industry where day trips are organised for visitors and locals alike. The whales are located from about 0.5 miles to 4 miles from the coastline. In some cases land-based whale-watching can also be done.

Dominica is a breeding ground for the Sperm Whale which is the most commonly observed marine mammal around Dominica, and a resident population is observed all year round off the west coast. Mating behaviour has been observed on many occasions, and adult Sperm Whales, with newly born calves with the umbilical cord still attached, have also been seen.

7.3.4. Invertebrates

A very wide diversity of marine invertebrates exists in the waters off Dominica. Limited studies have been conducted in Dominica, although studies done on invertebrates in the wider Caribbean region also apply to species found in Dominica.

7.3.4.1. Cnidarians

The growing dive tourism industry in Dominica is heavily dependent on the quality and diversity of coral reefs present in the waters around the island. A comprehensive list of the coral species of Dominica has not yet been compiled. However, species identification undertaken in the wider Caribbean region appears to apply.

7.3.4.2. Crustaceans

Dominica possesses an abundance and diversity of crustaceans. These include land crabs, which spend their larval and juvenile stages in the sea, many species of marine crabs, and white brackish water mud crabs. There are also marine shrimp and many fresh water prawn species which inhabit the estuarine conditions of the many rivers found on the island. The mantis shrimp and four species of lobster are also found in Dominica's waters.



Sperm Whale

7.3.4.3. Lobster

The main species of lobster found in Dominica are the spiny lobster (*Panulirus argus*) and *Panulirus guttatus* which are mainly found throughout the island's deeper coastal waters. Both species are relatively abundant, having been protected from over-exploitation by a closed season and the fact that they are generally to be found in deeper waters. Additionally, Dominica has prohibited the capture of lobster with SCUBA gear.

7.3.4.4. Porifera

Many species of sponges are found in the waters of Dominica. They inhabit the same habitat as corals and experience the same adverse effects from anthropogenic sources of pollution.

7.3.4.5. Echinoderms



White Sea Urchin

A fairly diverse range of species of this group are found in Dominican waters. At least two species of sea cucumbers and the brittle star exist, and two main species of sea urchins, the long-spine black sea urchin (*Diadema antillarum*) and the white sea urchin (*Tripneustes ventricosus*) commonly referred to as the "sea egg".

The white sea urchin (*T. ventricosus*), which is found mainly on the east and south-east coast of Dominica, used to occur in great abundance. In recent years there has been a noticeable decline in the population. The reason for this decline is not well understood. There has never been a fishery for white sea urchins in Dominica, and therefore the decline cannot be attributed to over fishing. This variety of sea urchin inhabits very shallow water and uses dead leaves and debris for camouflage. The cause of the decline needs to be investigated.

The long-spine black sea urchin is the most common

and well known, and is found on coral reefs in waters all around Dominica. In 1983 and for a few years thereafter, the population was decimated. This was due to a disease that affected the whole Caribbean region. This situation caused an imbalance in the reef ecosystem that resulted in a profuse growth of marine algae and death of coral reefs in some areas. Over the past five years there has been some recovery and the urchin population has taken an upward turn.

7.3.4.6. Molluscs

The molluscs found in Dominica include whelks, nudibranchs, oysters, octopus, squid, chitons and conch species including the queen conch (*Strombus gigas*).

7.3.4.7. Conch

The conch fishery in Dominica suffered a significant decline in the population in the 1970s, and necessitated the imposition of a ban on harvesting. The ban is still in effect although the conch population has now increased to sustainable levels. There is no significant conch fishery in Dominica, and that is due in part to the very deep waters at which they occur. No export of the conch occurs.

7.3.4.8. Welks

The welk (*Cittarium pica*) is usually found in rocky areas, stony beaches attached to rocks in the surf, and in very shallow waters. This species is prevalent along the entire east coast and on the south east coast of the island. The welks are not present throughout the year. It is not certain where they disappear to but it is thought that at breeding time they burrow into the sand. Since no studies of the life cycle of this species have been done locally, the behaviour of the welk still is not well understood. However, the absence of the welks for at least 8 months of the year serves as a self-control measure and helps to prevent over fishing. A limited number of welks are harvested by skin divers.

7.3.4.9. Marine Algae

Many species of algae occur in the waters of Dominica, ranging from green to brown algae. Although no comprehensive study of marine algae has been done in Dominica a few species which are used commercially have been identified. *Gracilaria sinensis* is the most common alga used in the sea moss industry. Other species identified include *Gelidiella acerosa*, *Ulva fasciata*, *Dilohus guineensis* and *Hypnea musciformis*.

The *Gracilaria sp.* is processed locally and bottled for local consumption and export. However, most of the raw material is imported from neighbouring islands of the Caribbean. Large quantities of the wild stock of sea moss continue to be removed using harmful harvesting practices which pose a threat to the sustainability of this small but growing industry. Commercial farming may be a solution to this particular problem.

7.4. Loss of Coastal and Marine Biodiversity

Although it has not been scientifically proven that coastal and marine species of Dominica are actually threatened with extinction, there have been clear signs of decline in the populations of some species over the years.

The loss of biodiversity is most evident in areas of high concentrations of human activity, especially near estuaries and in near-shore areas. With very tall and rugged mountains occupying Dominica's interior; human settlement developed and continues to expand along the narrow coastal belt and close to rivers. The principal causes for the loss of coastal and marine biodiversity are the following:

Species	Status	Cause
White Sea Urchin	Endangered	Exact cause is not known. There is no fishery for this resource - some environmental factors such as poor water quality are suspected
Marine Turtles	Threatened	Illegal harvesting, loss of habitat and nesting grounds
Corals	Severely Threatened	Siltation due to erosion from poor land management practices, anchor damage, scuba diving, collection of coral for export, poor fishing practices, natural disasters.
Sea grass	Threatened	Siltation is the main cause of death of this species
Reef Fish and coastal pelagics	Threatened	Habitat destruction, poor water quality poor fishing practices along west coast of Dominica.

Table 7.2 - Threatened Coastal and Marine Species

7.4.1. Human Threats

Generally, negative impacts on marine biodiversity caused by human activity can be categorized into five main areas; physical alteration, marine pollution, unsustainable exploitation, introduction of foreign species and climate change.

7.4.1.1 Physical Alteration

The development of shoreline and sea defense structures contributes significantly to loss of biodiversity in Dominica. These structures replace valuable habitat and in addition alter the pattern of sediment and nutrient transport. The erection of jetties, breakwaters and submerged groins prevent re-nourishment



Colihaut Quarry

by currents in some areas along the coast thereby causing beach erosion and loss. The development of hotels on the beach also poses problems in addition to the erection of structures for the protection of frontline property. The above alterations impede the transplanting of sea grass to other locations

by current activity and have significantly affected the land crab population in the south of Dominica and has totally destroyed turtle nesting grounds in some areas, for example, Pottersville and Mero.

Illegal sand mining activities alter the nature of the coastal areas, and predisposes the coastline to erosion from wave action thereby resulting in sedimentation of coral reefs. These illegal activities also destroy turtle nesting habitat.

Some of the greatest causes of coastal alteration, degradation and loss of biodiversity in Dominica are uncontrolled and unregulated quarry operations. These operations are located along the coast and discharge thousands of tons of mud and silt into the marine environment causing death of coral reef and other marine organisms.

7.4.1.2 Marine Pollution

The single greatest source of marine pollution in Dominica is due to improper treatment and disposal of sewerage. The discharge of untreated sewerage and other liquid waste directly into the coastal and marine habitats has severe negative impact on biodiversity. The turbidity caused by such suspended solids results in death of sea grass beds, marine algae and other dependent organisms. A sewerage collection system is being established in Roseau to gather the city's sewerage outfalls that will be redirected out to sea through one outfall that terminates 300 feet offshore. Although it is intended that this system reduce levels of pollution occurring very close inshore, it is uncertain as to whether it will have any positive impact upon marine ecosystems and species.

Household detergent/chemical disposal, discharge of spent engine oil into drains and waterways, inadequate disposal of solid waste and effluent from factories remain some of the main causes of habitat degradation and loss of marine and aquatic biodiversity. Poor land management and agricultural practices coupled with the very steep slopes of Dominica causes soil erosion and eventual sedimentation of the marine environment. Although no studies have been done to determine pesticide levels reaching the marine environment, very significant quantities of pesticides are used in the agricultural sector and the banana industry in particular, eventually reaching the marine environment.

Easy access to beaches with no waste disposal facilities results in littering of beaches and immediate marine space with plastic and other debris. Ship borne waste particularly disposal of waste from smaller and older ships, poses a threat to marine biodiversity in Dominica. Inadequate facilities exist for the disposal of ship waste, and therefore ships discharge both solid and liquid waste in the coastal waters of Dominica. This issue is difficult to address due to a lack of surveillance capability on the island.

7.4.1.3 Overexploitation

Unsustainable use of coastal and marine resources is a prime cause of loss of biodiversity. Dominica has attempted over the years to take precautionary measures to address this problem.

The artisanal commercial fishing fleet of Dominica is characterized by low technology and the use of small boats. By its mere nature fishing has been sustainable in most of the commercial fisheries exploited by local fishermen. However, in the immediate near shore reef areas, which are very limited in Dominica, signs of decline in many reef species have been noticed both in terms of quantity and size of fish. The catch composition of the fishermen has changed slightly in some fishing grounds along the west coast of the island.

Although it is thought that fishing pressure on these resources may have been responsible for some of the decline, it is also very obvious that some forms of land based sources of pollution have played a part. In some areas there are obvious signs of coral and reef fish habitat degradation due to causes other than fishing (e.g. anchor damage from yachts, coral reef bleaching and damage from hurricanes).

The status of the lobster and conch fishery of Dominica is not well known mainly because of the deep waters immediately surrounding the island. Some limited lobster fishing is done on the east coast of the island where 95% of the lobster and conch landed are adult size. There is no significant lobster fishery on the west coast. A moratorium has been declared for the conch fishery and for turtles but some illegal fishing for turtle is still observed. However, no significant illegal activity is noticed for conch.

Dominica adheres to the management regimes put in place by the International Commission for the Conservation of Atlantic Tunas (ICCAT) as far as the management of large migratory pelagics are concerned. However, studies indicate a general decline in

the population of these species.

Illegal Unregulated and Unreported (IUU) fishing by foreign fishing vessels and companies pose a very serious threat to biodiversity of migratory pelagic species. Illegal fishing in marine reserves, collection of coral for sale and export, sand mining and use of illegal fishing methods results in habitat degradation and loss of biodiversity in coastal areas. Marine mammals are threatened by movement of ships and heavy nautical traffic. From time to time whales die from huge infected cuts from boat propellers. Whales are not hunted in Dominica either commercially or for local use. However, Pilot Whales are sometimes landed as an "incidental catch".

7.4.1.4 Transboundary Movement of Marine Species

Introduction of foreign species into Dominica can result in adverse and unexpected biological problems. There is little research in this area and subsequently a limited amount known about the impacts created by foreign introduced species. Local species are being smuggled out of the country from time to time. This results in the loss of genetic material from the country. On a number of occasions the Fisheries Department has intercepted persons leaving the country with species of coral, sponges, marine algae, and reef fish. The implementation and enforcement of the *Convention on the International Trade in Endangered Species of Flora and Fauna* (CITES) has been hampered by the absence of an enforceable regulatory framework.



Stone Beach - Petite Savanne

7.5. Strategic Directions

Strategy 8 - Develop and implement a comprehensive public education, awareness and training programme on issues of environmental protection and conservation of coastal and marine resources/biodiversity.

Strategy 9 - Review/amend existing legislation, and as appropriate develop new legislation with respect to:

- Conservation and management of coastal and marine biodiversity
- Protection of vulnerable/fragile/indigenous marine species and ecosystems
- Coastal zone management
- Coastal and marine parks and protected areas
- The implementation and enforcement of the Convention on the International Trade in Endangered Species of Flora and Fauna (CITES)
- Local and community participation in coastal and marine conservation/management
- Management of solid and liquid waste (industrial, agriculture, urban).

Enforcement of existing and proposed legislation through empowerment and strengthening of all relevant agencies and community groups.

Strategy 10 - Identification and protection of sensitive/fragile/threatened coastal and marine ecosystems and establishment of coastal and marine protected areas and restocking of endangered species where necessary.

Strategy 11 - Involve community participation in coastal and marine management and to provide alternatives to unsustainable exploitation of resources (coastal and marine).

Strategy 12 - Research, inventory, mapping and monitoring to develop a comprehensive database and meta-data on:

- Coastal and marine species and ecosystems
- Species and ecosystem distribution description
- Marine and coastal medicinal species



SECTION 8

AGRICULTURE AND BIODIVERSITY

8.1. Agriculture in Dominica

The agricultural sector plays a major role in economic and rural development in the country. Throughout the decade of the 1990s Dominica's economy continued to be led by output from the agricultural sector. Gross agricultural output averaged 19.8% per annum of GDP between 1995 and 1999, peaking at 20.8% in 1996. Over the same period contributions from the other output sectors, manufacturing and tourism, remained well below that of agriculture, with averages of 7.0% and 2.6% respectively. In spite of government policies providing incentives and investment opportunities in the tourism and manufacturing sub-sectors, the productive capacity of these have not been developed in any appreciable amount to complement and/or match agriculture's contribution.



Typical diversified farm

Within the agricultural sector, crop production is of greatest economic importance as it is the primary foreign exchange earner in the sector, accounting for 78.5% of all agricultural production. Although banana production has decreased by 50% over the last ten years, banana still accounts for 30% of total crop pro-

duction, employing approximately 2,500 farmers - approximately 30% of the agricultural labour force. The livestock, fisheries and forestry sub-sectors contribute very little to foreign exchange earnings, their economic significance being in their contribution made to food security, employment in rural communities, and in the case of fisheries and livestock, a vital source of meat for home consumption.

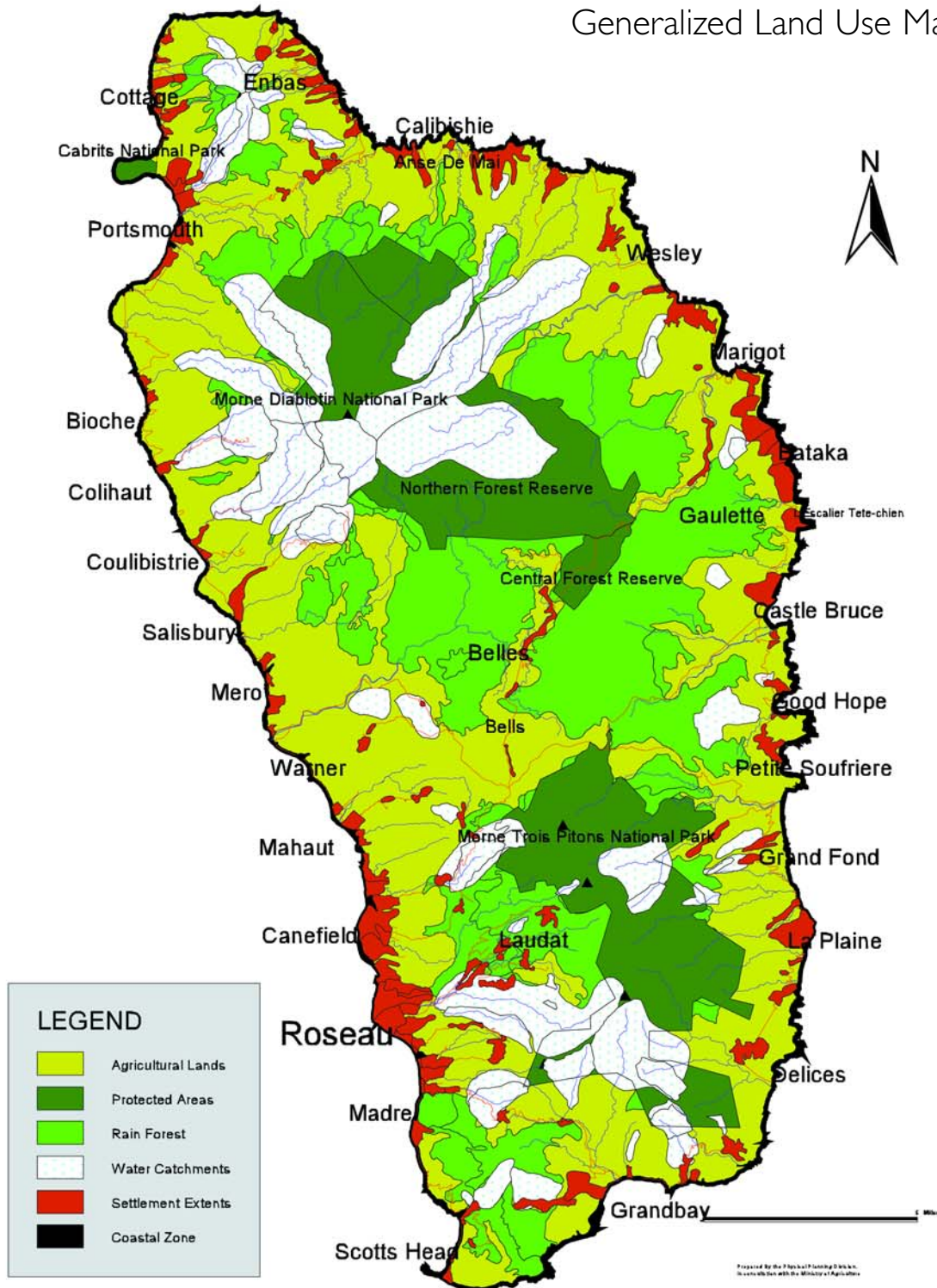
8.2. Crop Production and Biodiversity

A wide variety of crops are grown on integrated farms in Dominica. These include bananas, citrus, oil-based crops, coffee and cocoa, a number of food crops and non-traditional fruits, vegetables and flowers. Because of the rugged topography it is not uncommon to see a three-tiered system of farming on the island, with tree crops on the steeper slopes, bananas or food crops interplanted with tree crops on less steep slopes, and bananas or vegetables on the flatter areas.

8.3. Agricultural Diversification

Since the early 1950s, banana production has been the main economic activity on the island. Although the banana industry is still a leading contributor to the economy, banana production has been decreasing since the early 1990s. To offset this decline, programmes aimed at diversifying the production base and seeking alternative markets were intensified. These agricultural diversification programmes were designed to support policy objectives of increased foreign exchange earnings, income and employment generation, food security, and agro-biodiversity conservation and environmental preservation. Over the past seven years millions of dollars have been spent on the diversification effort.

DOMINICA Generalized Land Use Map



Prepared by the Physical Planning Division,
in consultation with the Minister of Agriculture

8.4. Food Crops

Food crops, including plantains and root crops (dasheen, tannia, yam, sweet potato and to a lesser extent white potato) are important contributors to domestic food production, income and crop diversity. Plantain and dasheen are more extensively planted and traded.

8.5. Livestock and Biodiversity

Over the last few years the contribution of livestock production to overall agricultural production has increased slightly from 6.5% in 1991 to 7.4% in 1999 (CSO, 2000). Based on data from the 1995 Agricultural Census, local production is estimated at approximately 1,209,970lbs of meat annually, approximately 15% of the total meats consumed. Pork, fresh whole chicken and chevron account for 48%, 11% and 8% of local production respectively.



Penned goats

Livestock is produced mainly by many small farmers using traditional systems of production, which are part of the wider integrated farming systems practiced island-wide. Pigs (*Porcine spp.*), goats (*Caprine spp.*), sheep (*Ovine spp.*) and poultry (*Avian spp.*) are the major domesticated species reared commercial-

ly for meat. Other domesticated species include cattle (*Bovine spp.*), rabbit (*Laprine spp.*), dogs (*Canine spp.*), cats (*Feline spp.*), horses (*Equine spp.*) and donkeys.

Dominica has a comparative advantage in the production of mutton, chevron and rabbit meat. These small stock are effectively integrated into our small farming systems, and their high rates of multiplication, utilisation of local farm by-products and intensively grown fodder enables them to make significant contributions to farm incomes. They are also ready sources of disposable income. The technologies introduced over the years (shelters, anthelmintic treatment, cut & carry systems and strategic feed supplementation) are relatively simple and therefore have been easily adopted by farmers.

8.6. Agriculture and Biodiversity

Dominica's landscape and rugged topography is characterized by micro-climates that support indigenous plants in particular conditions that support their cultivation. Over 30 percent of the island is covered by forest. However, over the years, deforestation for agricultural purposes has been the greatest contributor to the loss of natural biodiversity.

The agricultural diversification program has been very successful in contributing to biodiversity conservation. Present agro-biodiversity knowledge originated from a combination of knowledge from slaves brought in from Africa and the indigenous people of Dominica, the Caribs, as they made use of diverse plants, livestock, and agro-ecosystems. Over the centuries, local farmers have employed numerous practices to use, enhance, and conserve agro-biodiversity within their traditional integrated/mixed farming systems.

For example, the use of diverse species in these systems has lessened the risks associated with pests' outbreaks. The integration of different types of fruit trees and the maintenance of windbreaks have enhanced this diversity.

Detailed knowledge about biodiversity has allowed agriculture to evolve over thousands of years. Although sometimes perceived as an enemy to biodiversity conservation, agricultural production is very dependent on the combined use of a number of natural resources, including richly diverse biological resources, land, and water resources. The many types of biological resources tied to agriculture include:

- Genetic resources, which consist of large quantities of genetic information in plants and animals that, are essential for the continued survival of life on earth;
- Edible plants and crops including traditional varieties, cultivars, hybrids and genetically modified plants;
- Livestock and freshwater fish and other animals;
- Soil organisms that are essential for soil fertility, structure, quality and soil health;
- Naturally occurring insects, bacteria, fungi that control insect pests and diseases of domesticated plants and animals;
- Ecosystems that provide environmental services required for nutrient cycling, stability and productivity that are so essential for agricultural production.

8.7. Impact of Agriculture on Biodiversity

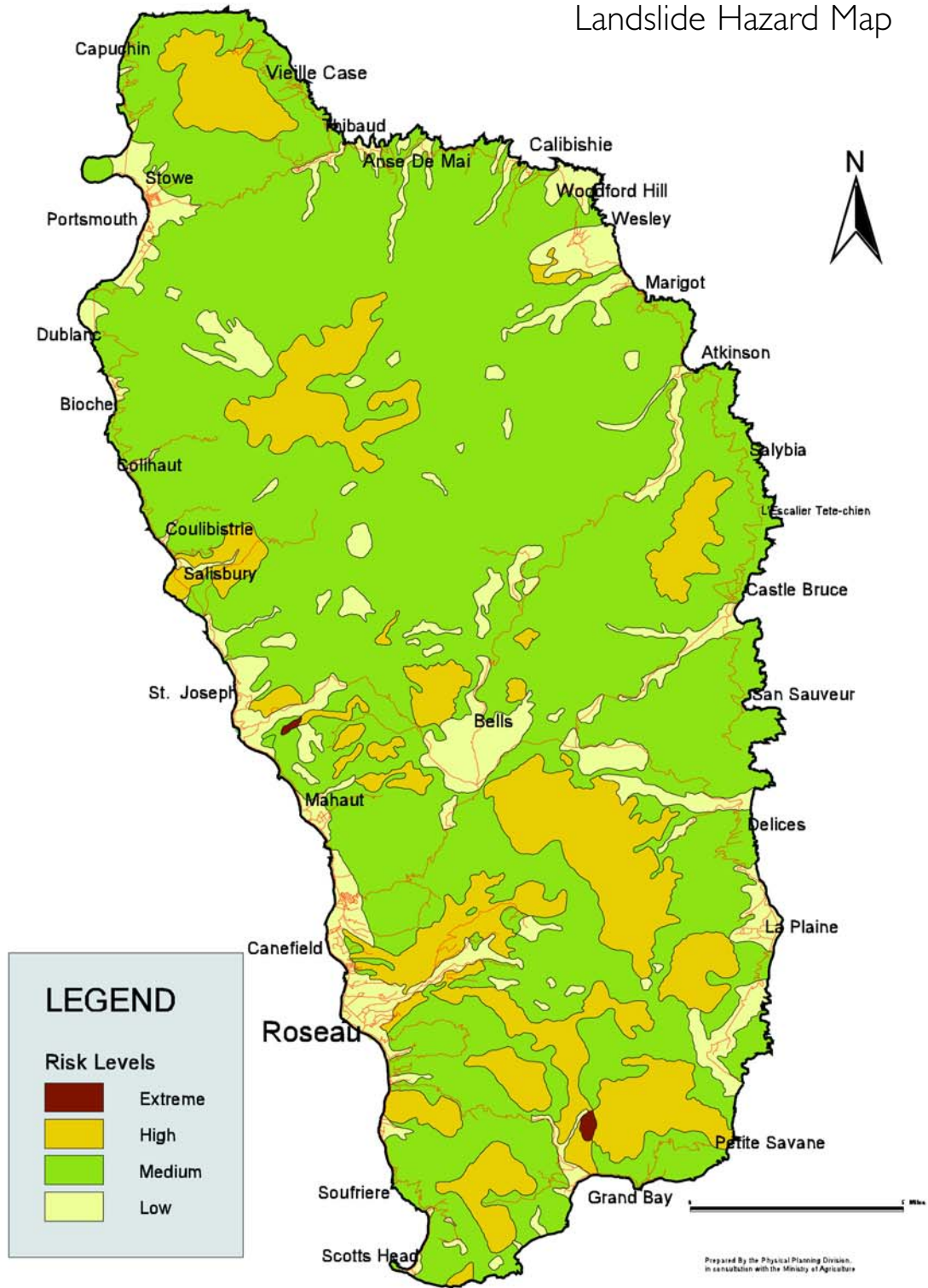
Loss of Dominica's biodiversity is caused primarily by conversion of natural land areas into agricultural and residential development areas. This occurs because farmers generally consider that the rate of return from development of the land is greater than that of conservation. The benefits accrued from development of the land will be greater than the cost because the farmer (or any individual land owner) has a positive rate of time preference, therefore making it more profitable to develop the land than to

conserve it. Most of the benefits of conservation are intangible, with no markets existing for them.

8.7.1. Land Use

Data collected in the agricultural census conducted by the Ministry of Agriculture in 1995, indicate that only 52,256 acres (27%) of total land area is in farms. Of this 31,631 acres (60.5%) is cropped and 14,803 acres (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. This is due mainly to the removal of lands from agriculture into other sectors such as housing, tourism and other infrastructural and commercial development. In many of these cases the flat or gently sloping more productive land has been removed, leaving the steeper lands more prone to soil degradation for agricultural production. 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.

DOMINICA Landslide Hazard Map



- Approximately 37% of Dominica's total land area is classified as land with high erosion risk.
- 20% of the total land area is classified as land with moderately high erosion risk, found mainly in the Northern Forest Reserve and the south of the country.
- 13% of the total land area is classified as poor agricultural land, found mainly on the southern edge of the Central Forest Reserve and northwest of the Morne Trois Pitons National Park.

With increasing settlement on the scarce agricultural lands, steeper lands under forest are being cleared for conversion into agriculture. This has had serious effects, the most visible being soil erosion and landslides leading to loss of soil fertility. Some farmers also practice slash-and-burn during the dry season, mainly along the coastal regions. Many of these fires get out of control and cause destruction of natural habitat, loss of biological resources and landslides. The situation is aggravated when bananas are planted in inappropriate areas and little attention is given to good husbandry practices.

8.7.2. Land Distribution

Through land distribution programmes, the Integrated Rural Development Project and other land reform projects, crown lands and several estates were divided into small parcels, usually in plots of approximately five acres and distributed/sold to farmers. Despite these land distribution efforts, farmers continue to demand land for agricultural production. In the late 1980s and early 1990s, Dominica's natural vegetation was cleared at an increasing rate as farmers cleared land for agriculture, primarily for bananas. Much of this land, however, was unsuitable for banana cultivation, and at the same time suitable lands were being under-utilised. Farming on these steep slopes and the clearance of river buffer belts and natural windbreaks have caused soil erosion and nutrient loss through run-off during heavy rains.

The expansion into forested lands, the continued conversion of former agricultural lands into other

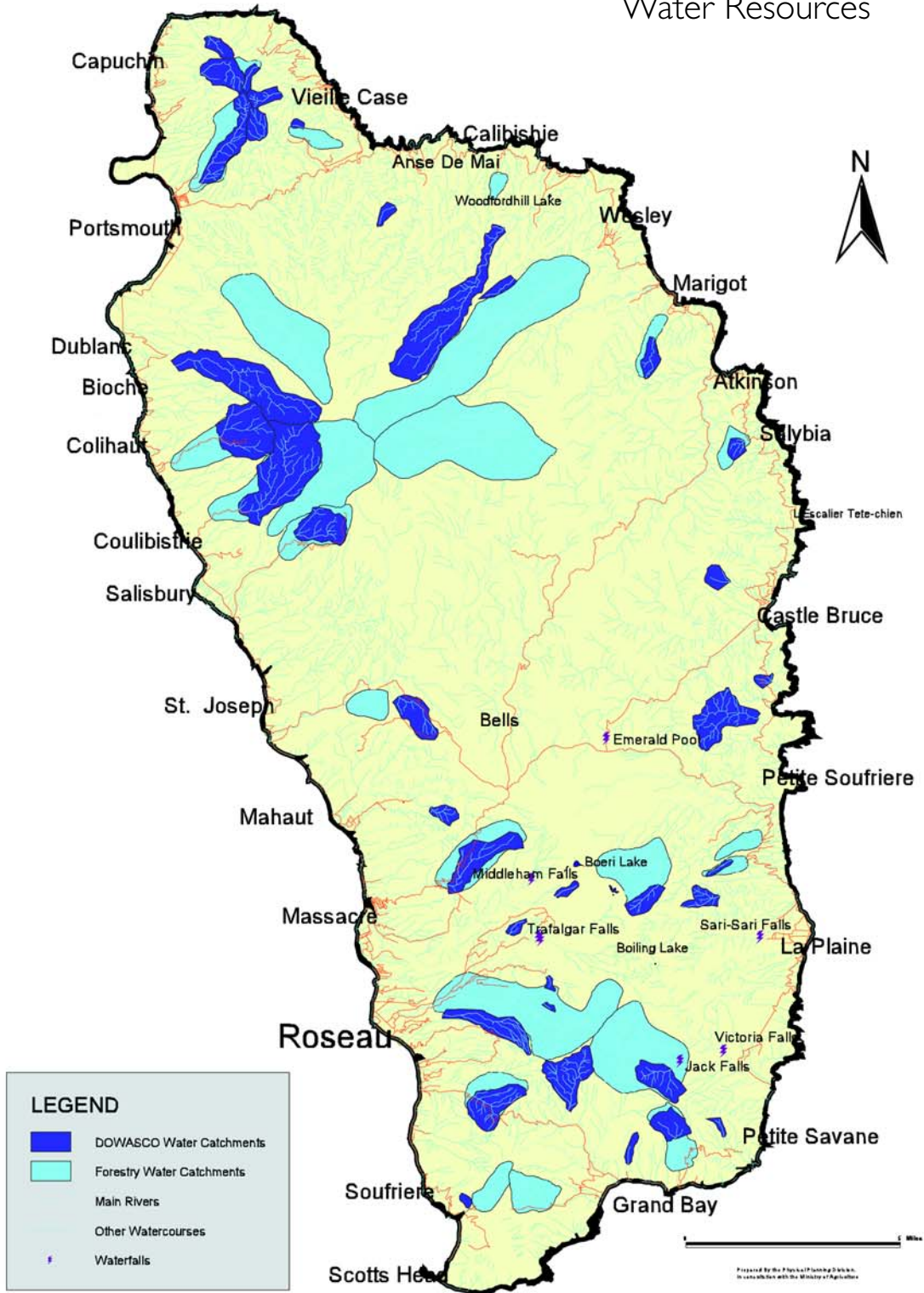
uses and the monoculture of banana production have served to reduce the size and diversity of natural habitats, eroding the biodiversity of existing flora and fauna.

8.7.3. Land Tenure

In the past, a few individuals owned large portions of land on Dominica. In a census carried out in 1961, the wealthier 1.4% of farmers occupied 56.4% of the land. However, by 1995, through the re-distribution of land, 8,434 farmers held all the farmlands, providing an average farm size of a mere 6.2 acres. Sixty-five percent (65%) of the 8,434 farmers own their farms, 11% farm family-owned farms, 5.5% farm on rented lands, and 10% have not stated land ownership status.

The division of family land among children into smaller farms or parcels has also encouraged the fragmentation of land. This land tenure system also encompasses a number of other issues such as unclear land ownership or title and non-payment of rentals for leased lands. Generally family members or farmers without secure title for land are unwilling to make improvements and undertake investments on their farms, thereby impacting adversely on the conservation of agro-biodiversity. In addition farmers leasing land and squatters place much stronger emphasis on short-term crops and without legal ownership do not adopt any appreciable level of stewardship towards the natural resources of those lands.

DOMINICA Water Resources



8.7.4. Water Resources

Dominica has seven major watersheds found mainly in the central region of the island on both the windward and leeward sides. There are also three smaller watersheds located in the north of the island. Water is provided for domestic consumption, export to other Caribbean countries, and for generating hydro-electric power. Water from the rivers and streams is also used for fishing, laundering, bathing, swimming, boating and other activities. This abundant supply of fresh water has prevented the early development of irrigation systems for agricultural production.

Almost all the forty-three (43) water-catchment areas in Dominica are located on privately owned lands where there are no effective controls on land use activities. Most of these catchment areas are under cultivation, and in some cases inappropriate land use activities such as deforestation and banana cultivation on steep slopes have caused soil erosion and landslides. This has resulted in changes to the landscapes of the ecosystems (e.g. steeper slopes and silting of rivers and streams), but because of the fast growth of ground cover, the impact has been considerably lessened.

8.7.5. Loss of Agro-Biodiversity

The diversity of crop species and the diversity of varieties within species have traditionally strengthened the resilience of agriculture. With the introduction of new commercial farming practices and as the number of crop species declines, local nitrogen-fixing bacteria, mycorrhizae, predators, pollinators, seed dispersers, and other species that co-evolve over centuries with traditional agricultural systems die-out. While there has been little research conducted into the resilience of domestic varieties, or their evolving adaptation to changing local circumstances, it is apparent that Dominica's agro-biodiversity is under threat.

An important factor contributing to loss of agro-biodiversity is the demise of the tradition of passing on,

from generation to generation, information and knowledge of traditional agricultural practices and animal husbandry, and the use of native plants (including medicinal plants), their properties and uses. Dominica's agro-biodiversity has been affected by invasive vegetation, and periodic outbreaks of pests and diseases. Historically, with few mechanisms in place to control the importation of foreign varieties/organisms/species and prevent unintended harm to the agricultural sector, there have been incidents where a foreign introduced species/organism/variety has resulted in an unintended impact on domestic agro-biodiversity. Additionally, storms and hurricanes have promoted the use of storm-resistant species by farmers, thereby reducing the variety of crops that are grown.

The introduction of high-yielding planting material and varieties adapted for intensive management regimes have 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 animals 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 agro-biodiversity requires that immediate attention be given to harnessing all available information that will guide sector/sub sector strategy formulation and future agricultural development.

There are a number of measures that can be taken to encourage agro-biodiversity and sustainable agriculture. These include:

- develop all-inclusive inventories or "indicators" of agricultural diversity (e.g. number of varieties/breeds/species, location, distribution), and establish a monitoring program to document any changes;
- eliminate agricultural policies that promote excessive uniformity of crops and crop varieties, or that encourage the overuse of chemical fertilizers and pesticides;
- establish a gene bank to preserve valuable agricultural genetic material;
- institute "genetic diversity checks" for major crop varieties to minimize the risk of crop failure, and undertake tests to evaluate threats posed by "genetic uniformity" in Dominica's major crops/livestock;
- preserve traditional knowledge of agricultural practices and animal husbandry, and the use of native plants (including medicinal plants), their properties and uses;
- create a greater appreciation for the soil as a living entity important for sustained production;
- grow different types of fruit trees and maintain windbreaks for enhancing agro-biodiversity.
- regulate land use practices and changes that influence agricultural practices such as shifting from mono-cropping patterns, agro-forestry and tree crop plantations, especially in degraded lands and on steep slopes.
- encourage sound water and land management practices such as -
 - i. Establishing and maintaining buffer zones along riversides and windbreaks; and
 - ii. Conserving tillage and mulching practices that influence the biological processing of decomposition and mineralisation;
- promote investment in technology development and research aimed at evaluating and improving various soil conservation/land management practices under different agro-eco-

logical zones and especially in degraded land areas;

- monitor changes in soil quality under each land use/management practice and channeling information to the farmers through on-farm technical assistance and extension education.

Priority should be given to the use of biological agents as the preferred method of pest and disease control. The trend towards organic crop production and marketing should be enhanced and strongly supported. Attempts at converting lands from conventional to organic production are to be given priority in implementation.

8.8. Strategic Directions

- Strategy 13 – Develop a comprehensive national land use plan/legislation with the involvement of all key stakeholder.
- Strategy 14 - Develop germplasm/gene banks.
- Strategy 15 - Increase agricultural productivity and "value added" through the maximization of the use of appropriate technology.
- Strategy 16 - Conserve and improve Agriculture Land Base through sound agricultural/conservation practices.
- Strategy 17 - Research, inventory and monitoring to develop a comprehensive database and meta-data on:
- Agro-Biodiversity;
 - Species distribution description (crops and livestock);
 - Medicinal Plants;
 - Traditional agricultural practices.
- Strategy 18 - Develop and implement a comprehensive public education, awareness and training programme on issues of environmental protection and conservation of agro-diversity.

SECTION 9

HUMAN SETTLEMENT, DEVELOPMENT AND BIODIVERSITY

9.1. Human Settlement and Development

9.1.1. Natural Ecosystems and Agro-Ecosystems to Mid-Twentieth Century

The immediate pre-Columbian Afootprint comprised Carib small villages with family lands where biodegradable houses were constructed and regular gardening done using a wide variety of well understood crops with many purposes. Further inland, in small short-lived clearings in rain forest or dry forest were other Carib family gardens, which shifted as necessitated by diminishing returns. During this time trails were of little impact on the natural ecosystems but the Carib agro-ecosystem introduced a few crops, perhaps including the highly important cassava, and some animals. Extraction from the natural forest was selective, with Gommier (*Dacryodes excelsa*) and Larouman reed (*Ischnosiphon arouma*) harvested for canoes and baskets, respectively. The whole lasting impact was relatively small.

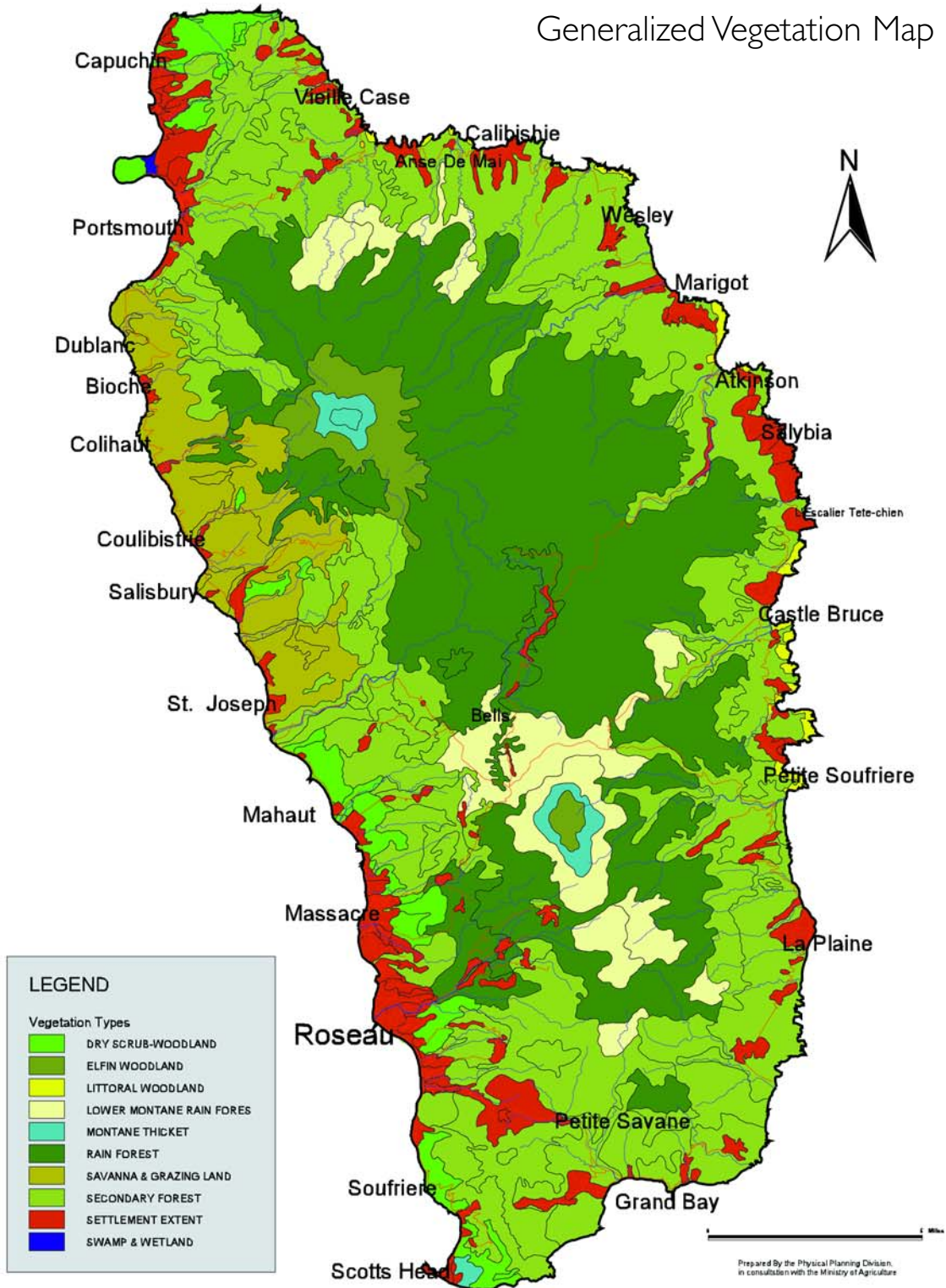
With the arrival of Columbus and the subsequent introduction of European plantations, the country witnessed widespread clearing, on a more extensive scale than previously, especially in valleys near the coast. The development of coffee and then sugar estates, particularly in the dry forest areas, resulted in severe erosion in many places (Atwood, 1791). Smaller proprietors occupied steeper land on ridges and the mainly black peasantry occupied even more marginal land. Permanent structures were built of stone and compartmentalisation of ecosystems by roads began. In some areas land modification by terracing further affected the natural landscape, the hydrology and the ecology.

New crops and new cultivars were introduced from an early stage and some, like the root crops from several sources (Pacific, Africa, Asia) expanded the range of food crops or (e.g. Pandanus), substituted local industrial materials. Successive waves of crop

failure and development of a new crop after a period of low husbandry affected the pattern of terrestrial ecosystem regeneration. The persistence of some crops in long abandoned estates has contributed to the mixed secondary vegetation of some areas, but information on the old cultivars and their relative persistence is scarce. The development of windbreaks of a single species (Galba, Gliricidia etc.) which persisted, further diversified secondary regrowth. The secondary forest of later years is varied and reflects the different uses and abuses of various systems and the extent to which the extensive ecosystems have been replaced by parcels of differing nature.

Emancipation saw the spread of coastal villages both at the sea (e.g. fishing villages such as Mero - and on ridge tops (e.g. Morne Jaune) - and use of the ridges and side slopes increased with more shifting cultivation and differential impact on native species. The demise of plantations commencing soon after the Great War of 1914 - 1918 saw the increasing peasant population squatting on abandoned estates and moving inland to extend the areas of modified forest using shifting cultivation.

DOMINICA Generalized Vegetation Map



9.1.2. Developments after 1950

Economic development in general, including some agro-processing, attempts at forest exploitation, the development of services such as water supply, the development of banana cultivation, government changes, and the sale of Crown Lands saw the rate of modification increase rapidly. Works of soil conservation introduced long-lasting vetiver lines and short-lived contour drains, then the banana monoculture, avoiding the use of ground cover first by mechanical and later by chemical means, produced major soil modification and erosion over large areas where it had previously been rare and selectively reduced some weeds while encouraging others. Other Anew crops were of less significance, and some government subsidized tree crop plantings have become part of secondary forest.

The introduced fire-resistant lemon grass crop began to take over dry forest and is now established along roads and even in a few rain forest areas. Brush fires, especially during the dry season, have resulted in widespread destruction of the dry forest lands on the leeward side of the island and their replacement by invasive lemongrass. Roads constructed to facilitate farming and general movement encouraged landslides, further divided the landscape, and resulted in the loss of ecosystem diversity. The use of bulldozers made the cutting of roads easier and badly aligned roads, access roads to farms and construction sites in particular, have greatly increased erosion - the classic examples being where successions of landslides have persisted for over 40 years. The bulldozer also suddenly made the complete clearing of large areas cheaper and easier, but in doing so it rearranged the soil, reduced fertility and modified local hydrology through soil compaction and reduction of the capacity of the soil to absorb and hold water, especially on the fragile low bulk density soils of most of the interior. In doing this it replaced the traditional "underbrushing" (cutlassing and burning in place with the larger trees left standing) form of land clearing.

Blue Mahoe and Mahogany were planted in areas which had been selectively cut during attempts to exploit the major timber trees of the rain forest. Popular trees such as Gommier, Garapite, Cedar, and others - continue to be selectively felled with or without license, and the harvested land has not been restored to its former state.

9.1.3. Urban Systems

The initial pre-Columbian settlements were small and biodegradable. The peasant villages, which gradually covered many coastal sites, were similarly ephemeral in nature. Plantations introduced small areas of stone buildings and yards which were long-lived but could be gradually overtaken by natural forces.

In the last 50 years of urbanization, large areas of formerly agricultural land have been covered by concrete houses, shaven lawns, non-native plants, and paved yards, with attendant modified drainage systems and roads which further compartmentalize the land. These have extended so far inland that, apart from the national parks and forest reserves, there are no longer continuous areas of natural forest or secondary forest of any size. While many of these urban developments exist as isolated "islands" of differing ecology, particularly in their chemistry, urban spread along roads is inexorable and change to the remaining secondary forest and some natural forest is also likely. The roads, which were formerly longer narrow strips between high forest, have been widened with the use of new technologies and equipment. The erection of telephone, cable and power lines, and construction of storm drains along roads have created ecological barriers and increasing vehicle use have affected the ecology near roadsides.

Concomitant with the construction of the new urban areas, largely centred on very resistant and less biodegradable concrete buildings, is the large scale quarrying of stone and tarrish, producing large bare rock surfaces, and new breaks in the continuity of ecosystems.

The removal of wood from forest land for charcoal production and for construction purposes has further contributed to loss of forest cover.

With increased urbanisation and modernisation, Dominica has witnessed a change in composition and volume of solid and liquid wastes, with negative impacts on the natural environment. Traditional disposal practices for largely biodegradable wastes are no longer able to deal with the increased volume and complexity of modern human waste. Modern waste

collection, treatment and disposal systems are being established, but are not yet able to significantly reduce the impact of human waste on the natural environment.

The ever-increasing demand for portable water continues to place pressure on the country's limited fresh water supplies. The modifications necessary to provide water supplies also affect the hydrology and thereby the ecology well beyond the limits of actual urban sites.

9.2. Tourism in Dominica

Dominica's economy has been dependent on agriculture with bananas contributing up to 70% of

export earnings. This has declined considerably over the last eight years. As a result, emphasis is being placed on tourism development as a means of diversifying and boosting the economy. 1999 figures showed that agriculture's contribution to GDP was

19.1%, and tourism (hotels & restaurants) contributing 2.6%. Tourism development is at an infancy stage in Dominica. Total (stay-over) tourism arrivals in 1999 amounted to 73,506. Cruise tourism has developed at a phenomenal rate. There has been an almost three hundred-fold percent increase over the last eight years to 244,603 passengers. This expansion poses potential real threats to the island's biodiversity and, as such, a management plan embracing carrying capacity issues is an imperative.

9.3. Dominica's Tourism Product

The primary tourism resource base in Dominica is its pristine natural environment. The volcanic landscape with its lush rain forests supports a rich diversity of flora and fauna are of great interest. Tourism in Dominica

Dominica's marine environment supports major tourism activities such as diving, snorkeling, whale and dolphin watching, kayaking and to a lesser extent, sports fishing and windsurfing. Approximately 30% of total tourist arrivals are divers. At present, there are six dive operations in Dominica four of which offer whale and dolphin watching tours. While Dominica is still considered to be largely unspoiled by either development or pollution, there are indicators and in fact examples of the negative impact of tourism at two levels - the development of tourism infrastructure and services and the utilization of tourism attractions and amenities.

The Tourism Policy of 1988 speaks to the conservation of animal and plant life within the general and specific objectives outlined. Within the general objectives, it states that one of the benefits to be derived from the development of the tourism sector is as follows:

"The conservation of the physical resources of the country" and "earning of finance for conservation and development of Dominica's renewable natural resources i.e. plant life and wildlife and the protection of their environment".

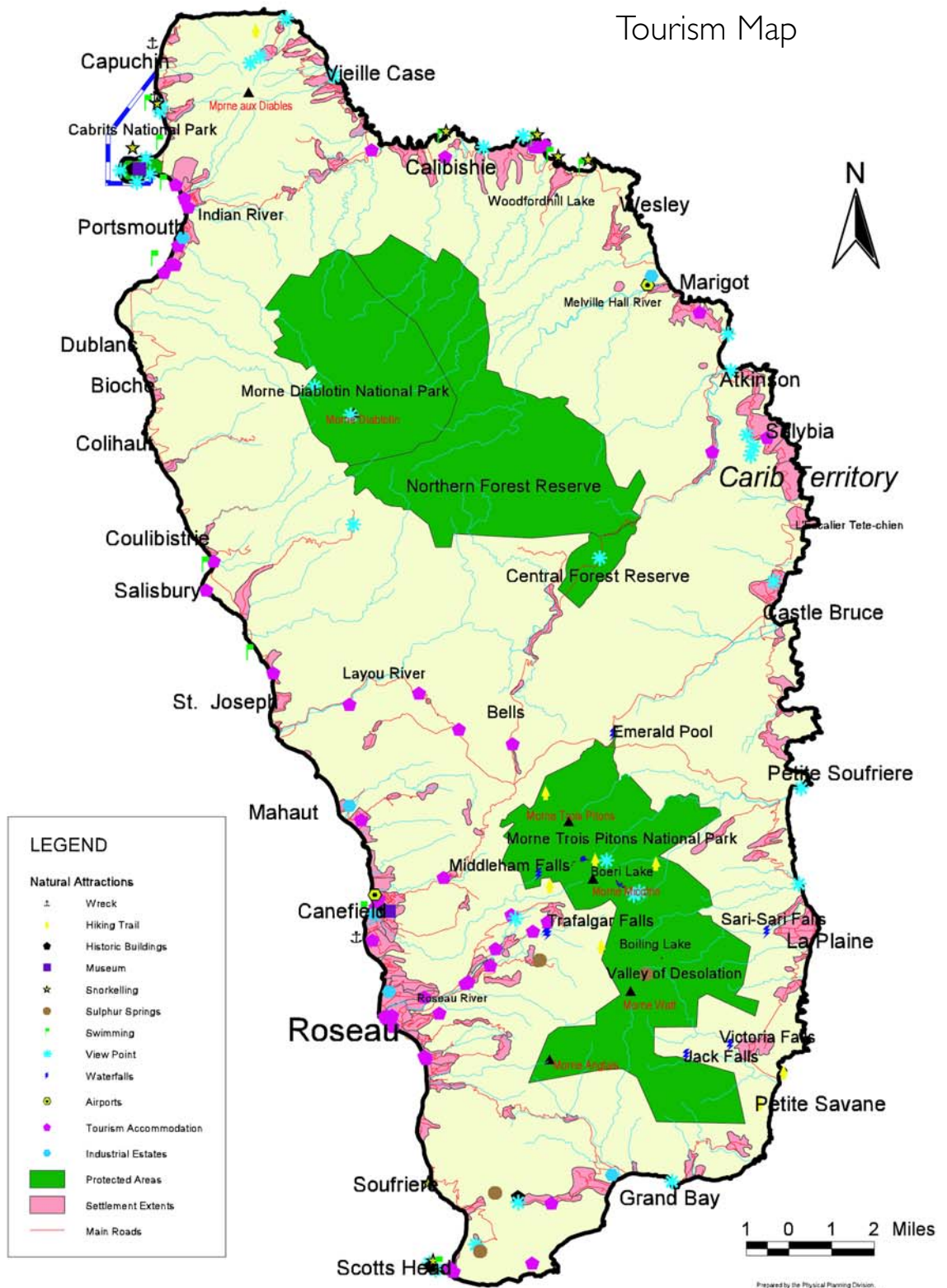
Total visitor arrivals to Dominica including cruise visitors, amounted to 396,221 in 1997.

The number of hotel rooms increased from 567 in 1991 to 867 in 1999 an average of 37.5 rooms a year.

Contributions to foreign exchange earnings increasing from U.S.\$ 28.1 million in 1991 to U.S.\$47.9 million in 1999, representing an average annual increase of 8.8 % over the last eight years.

Revenue from tourist visits to national parks amounts to EC\$4.5 million since the national parks user fee was established in 1997.

DOMINICA Tourism Map



9.4. Impact of Tourism on Dominica's Biodiversity

There are several impacts of tourism development with negative implications for the marine and terrestrial environment. These are as follows:

9.4.1. Inappropriate Land Use

The lack of zoning for tourism development has allowed development of tourism structures and facilities to take place in areas that are not suitable for this type of development, and in direct conflict with traditional uses of the resource base. This has been exacerbated by the fact that traditionally, planning for tourism has been oriented towards the needs of the developers and the tourism industry itself and has not taken into account the impact on biological resources.

9.4.2. Disruption of Biological Resources

Disturbance of wildlife habitat as a result of developing trade in endangered species, and high visitation rates in areas of attraction are some activities with negative impacts on the ecology of the areas. Other serious impacts are increased soil erosion and destruction of flora and fauna.

9.4.3. Marine Pollution

The principal causes of marine pollution from tourism related activities include:

- Construction, dredging and sand mining;
- Solid waste disposal;
- Liquid waste disposal;
- Chemical pollution; and
- Uncontrolled multiple use of marine resources.

Most of the major hotels are located along coastal strips south of Roseau, along the west coast, and in the Picard area. The majority of hotels have no sewage treatment plants except for primary treatment with final discharge into the marine environment. In addition to this, wastewater from kitchens,

bathrooms and laundry areas of hotel establishments are usually discharged directly to the sea. As such, there tends to be some level of marine and coastal pollution in these areas.



Visitors at Indian River

9.4.4. Destruction of Coral Reefs, Wetlands and Beaches

Tourism related activities have resulted in the destruction of coastal ecosystems through;

- Untreated effluent, silting and boat anchors;
- Dredging and filling of mangrove wetlands for hotel development, cruise ship berths or for beach nourishment;
- Beach degradation from sand mining, dredging or violation of shore line Building Codes and set-back requirements;
- Solid waste disposal.

9.4.5. Destruction of the Landscape

Fundamental change in the landscape as a result of construction of buildings, urbanisation and road construction leading to deterioration of aesthetic values important in the built environment. Some wetland areas have been disturbed as a result of hotel development. The Cabrits Freshwater wetland fell prey to the development of a hotel in the area. The wetland was drained and this changed the ecology of the area. Some wetland areas have been disturbed as a result of hotel development. The Cabrits Freshwater wetland fell prey to the development of a hotel in the area.

9.4.6. Destruction of Flora

While this is not a very serious problem, certain tree species such as "Bois bandé" (*Richeria grandis*) have suffered from being debarked to the extent of being killed through infestations. Others such as orchids and some species of ferns tend to be pilfered.

9.4.7. Destruction of Fauna

The two endemic species of parrots, *Amazona imperialis* and *Amazona arausiaca*, have been threatened as a result of increased tourism and black market trade in endangered species. These parrots are very sensitive to increased human activity within their

range. As such, increased tourism activity could contribute to their decelerating population.



Visitors on Trafalger Falls Trail

9.4.8. Soil Compaction and Erosion

In areas like the Emerald Pool and to a lesser extent, the Trafalgar Falls, large volumes of visitors over a short period of time tend to compact and erode the soil. Use of outboard motors for boating on the Indian River has increased erosion of the river bank and toppling of river bank species like *Pterocarpus officinalis*, "Bwa Mang" a tree species important for the stability of the bank. These conditions bring to the fore the need for carrying capacity consideration.

9.4.9. Impact on Whales

The impact of regulated whale and dolphin watching activities on these creatures of the sea may disturb their reproductive processes and parenting activities.

9.4.10. Tourism Infrastructure

The development of tourism-related infrastructure – hotels, cruise ship berths, airports, roads- has had the greatest negative impact on Dominica's coastal and marine resources. There are five major ports of entry for sea and air passenger-three shipping ports and two airports. Both the Canefield and Melville Hall Airports had major impact on the natural courses of the rivers adjacent to them, the Canefield River and the Melville Hall River. In the case of the Melville Hall River, there was a diversion and the airport structure, in fact, was built on the bed of the River. The Canefield airstrip is built over two rivers. The expansion of the Woodbridge Bay Port modified the beach structure and wave pattern in the area.

9.5. Manufacturing and Quarrying

Manufacturing activities in Dominica are very diverse, ranging from agro-processing, to the production of soap, soap products, toothpaste, paints and varnishes, plastic products, solar water heaters, alcoholic and non-alcoholic beverages. Mining operations, construction and furniture operations all form part of the manufacturing industry. Most manufacturing enterprises are located in close proximity to coastal

areas.

There are approximately eight quarries in Dominica, five along the west coast, one located in Canefield and another adjacent to the Emerald Pool area and one along the southern coast.

9.5.1. Impact of the Manufacturing Sector on Dominica's Biodiversity

Activities of the manufacturing sector cause the following impacts upon Dominica's natural resources and biodiversity:

9.5.1.1. Wastewater

Agro-industries generate large volumes of wastewater that are discharged into rivers which eventually find its way into the sea. A large quantity of wastewater used for cleaning or sanitising equipment find its way to rivers and streams and the sea through the sewage or drainage systems. These pollutants affect Dominica's sensitive aquatic and coastal ecosystems.

9.5.1.2. Solid Waste

Solid waste generated by the manufacturing sector consists primarily of plastics, cardboard and carton boxes, broken wooden palettes, pepper, grapefruit and lime residues, metal, plastic drums, broken glass, scrap aluminium, stainless steel, copper, galvanised metal and fibre glass. A small amount of stainless steel and copper is collected for recycling. Grapefruit and lime residues are utilised for animal feed and for other agro-products. All other materials are disposed of at the two landfills or at the Jimmit dumpsite where steel and galvanised metal are disposed. Contamination of rivers from the disposal of solid wastes has resulted in damage to Dominica's sensitive aquatic and coastal ecosystems.

9.5.1.3. Heat

Heated effluent from some manufacturing entities that drain directly into rivers and streams, has increased the temperature of the receiving areas and has adversely affected the ecology of the streams. Reports from the Forestry Division indicate that the Loubiere River had experienced dead crayfish in 1998 as a result of such discharges. Increased temperature and chemical outflow has virtually destroyed the fish life of the Belfast River.

9.5.1.4. Pumice and Silt from Quarries

There are eight quarries located near the west and southern coasts of Dominica. The quarrying operations themselves negatively impact flora and fauna which are destroyed in the process of excavation. Another major impact of quarries on biodiversity is on the marine and freshwater environment through silting of adjacent rivers and the marine environment. Coral reefs on the west coast are very vulnerable to the impacts of increased sedimentation, which in extreme cases, can result in coral deaths and serious impacts on the marine ecosystems.



1st draft workshop of NBSAP

9.6. Strategic Directions

- Strategy 19 – Develop and implement a comprehensive and integrated framework (i.e. legislation, institutional structures, etc.) for natural resource management and physical planning.
- Strategy 20 - Develop and implement a comprehensive public education, awareness and training programme on issues of environmental protection and conservation of natural resources.
- Strategy 21 - Review/amend existing legislation, and as appropriate develop new legislation with respect to:
- Integrated natural resource management and physical planning;
 - Environmental management and protection;
 - Environmental impact assessments (EIAs);
 - Environmental assessment, monitoring and auditing;
 - Local and community participation in environmental and natural resource management, and physical planning;
 - Pollution control and the management of solid and liquid waste (industrial, agriculture, urban);
 - Environmental quality standards, certification and licensing programs;
 - Engineering and architectural standards to reduce impact on natural resources.
- Enforcement of existing and proposed legislation through empowerment and strengthening of all relevant agencies and community groups.
- Strategy 22 - Protect, develop and encourage cultural traditions and traditional knowledge.
- Strategy 23 - Develop inter-agency and inter-sectoral communication and information exchange programmes in support of improved environmental protection and integrated resource management.
- Strategy 24 - Provide incentives in support of improved environmental protection and integrated resource management.



SECTION 10

BIODIVERSITY AND TRADITIONAL KNOWLEDGE/CULTURE

10.1. Traditional Knowledge

Indigenous cultures, such as the Caribs of Dominica, are a part of the ecological landscape. These original residents of Dominica possess considerable knowledge about natural resources, and have important information about how the natural landscape and land uses have changed over long periods of time. The ecological knowledge of indigenous people is most evident in their agricultural systems, which contain many different varieties of a single crop, and contribute tremendously to the conservation of local biological diversity. Attempts to harness this knowledge about medicinal plants have been made in Dominica by non-government organizations such as the Movement for Cultural Awareness (MCA) and the Small Projects Assistance Team (SPAT).

In Dominica, knowledge of medicinal plants and their uses originated with the slaves from Africa and the Caribs. This knowledge base, influenced by colonialism, was passed down from generation to generation and adapted as new uses were discovered. To date, a total of sixty-two (62) plants found in Dominica have been identified as a source of traditional medicines.

The potential income which could be derived from biodiversity prospecting - the exploration of biodiversity for commercial value of genetic and biochemical resource - provides compelling reasons for the identification and preservation of the world's most species-rich ecosystems in the tropics. Plant species are also very valuable for the medicines they provide locally. It is therefore important that traditional practices, culture and knowledge of the peoples of Dominica be preserved and conserved before this valuable resource is lost.

10.2. Loss of Traditional Knowledge and Culture

The loss of traditional knowledge and culture in Dominica has accelerated in the past twenty years.

This is due to a number of factors that by and large revolve around the globalization of international culture and its associated lowering of the value of traditional knowledge and culture.

The specific elements that have contributed to the process are the lack of documentation on traditional practices and the disuse or breakdown in mechanisms that have historically been utilized for transmitting such knowledge throughout the community and to the young. Modern education systems have discouraged and in some instances dismissed the value of traditional knowledge, practices and culture, while rural and regional migration has contributed to the further loss of such knowledge at the community and local levels. Compared to other countries in the Caribbean region, Dominica still retains much of its traditional culture and knowledge – which largely vests with the Carib peoples who are recognized as a distinct culture that is afforded some protection through the establishment of the Carib Territory and the Carib Council. However, easier access to modern technology combined with the lack of appreciation of traditional values and the associated breakdown of the traditional family and village unit have combined to create a situation whereby access to traditional practices, cultures and knowledge will shortly be forever lost to future generations unless immediate action to redress the situation is initiated.



Carib Basket Weaver

10.3. Strategic Directions

Strategy 25 - Develop inventory of biomaterials and their traditional uses.

Strategy 26 - Ministry of Community Development shall develop (through broad consultation) and implement a policy and strategy for the protection, encouragement, enhancement, and conservation of traditional knowledge, culture and values.

Strategy 27 - Formulate and implement a Development Plan for the Carib people that shall be fully integrated into the national development planning process.



SECTION II

BIODIVERSITY AND CLIMATE CHANGE

II.1. Background

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.

There is growing concern that increased levels of atmospheric pollutants from the burning of fossil fuels and the emission of other "greenhouse gases" is causing significant changes to global climate patterns. The recently completed Third Assessment Report of Intergovernmental Panel on Climate Change (IPCC) has confirmed that global warming is already taking place, and that significant changes to global climate patterns are likely to occur in the future.

International concern has led to the development of the *United Nations Framework Convention on Climate Change* that establishes a framework to reduce global greenhouse gas emissions, and to address the actual and anticipated impacts of climate change. Dominica signed the Convention in 1993, and is currently in the process of developing appropriate strategies to reduce the country's vulnerability to the impacts of climate change, and to establish appropriate adaptation options.

II.2. Climate Change and Biodiversity

Global warming will result in climate change that may be manifested by:

- Sea level rise;
- Changes in local and regional temperatures;
- Changes in rainfall patterns;

- An increase in the intensity and frequency of severe weather events (droughts, floods, hurricanes); and
- Changes to ultra-violet penetration levels.

Currently, limited research has been undertaken on the impacts of climate change on global biodiversity. However, scientist have indicated that project ed climate changes for the next century will result in major impacts on forests, biological diversity, water resources, sea level, marine and aquatic ecosystems, and agriculture. Changes in global climate are likely to present the following threats to global biodiversity:

- Impacts as a result of warming that exceeds the migrational capacity of species;
- Losses of habitat during progressive shifts in climatic conditions;
- Reductions in species diversity through reductions or loss of habitat.

Significant impacts are already being witnessed as in the case of the Seychelles islands in the Indian Ocean where extensive coral loss has been witnessed in recent years as a result of a rise in coastal water temperatures. Changing seasonal patterns have also been observed, with a resultant impact on migratory species.



Erosion

11.3. Climate Change Impacts on Dominica's Biodiversity

Global warming, climate change and sea level rise are issues which can affect coastal areas of Dominica. Hurricane Lenny in November 1999 caused severe damage to the coastline of Dominica. The storm caused transformation of the seabed and coastline in some areas resulting in total destruction of habitat and consequent loss of biodiversity.

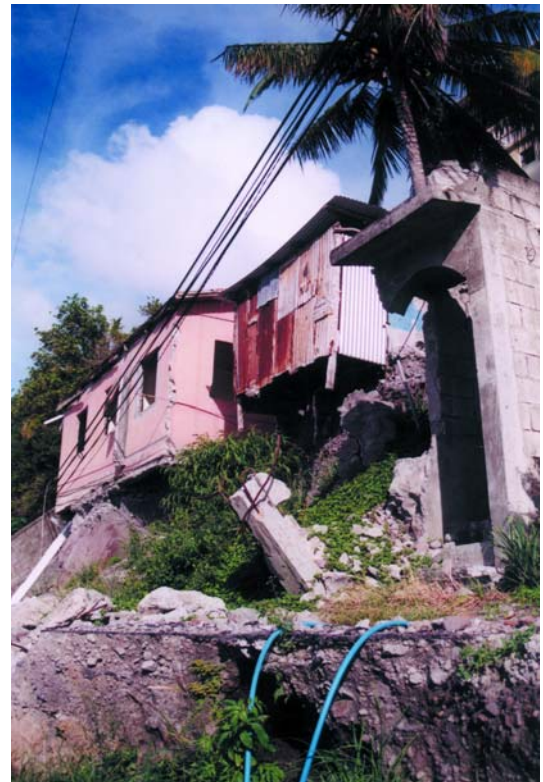
Hurricane Lenny, which was characterised by extremely high impact waves in excess of 60ft high, took a toll on the inshore coral reefs of Dominica. Huge pieces of reef were ripped from the seabed and tossed onto the beach causing severe loss of habitat to coastal pelagic and reef fishes. A sizeable amount of coral was washed up on the beaches and areas where there was a rocky shoreline were turned into sandy beaches and vice versa. It is anticipated that global warming and climate change will bring about an increase in the intensity and frequency of such severe weather events in the Caribbean region.

It is anticipated that climate change will have a significant impact on Dominica's biodiversity in the following ways:

- Intensification of storms as a result will increase erosion and sedimentation in coastal waters, thereby affecting the resilience of natural systems
- High energy waves will result in increased coastal erosion allowing the sea to encroach further inland and also causing severe loss of biodiversity
- Increase in temperature and increase in intensity of ultra-violet radiation will affect sensitive species
- Sea level rise will affect low-lying towns and villages and result in extensive economic loss, and greater development pressure on natural systems
- Change in seasonal weather patterns are likely to impact traditional farming practices, and affect the growing cycle of plants:

- Changes in the composition of natural vegetation are likely to result from changing climatic and hydrological conditions.

Climate change is also likely to impact ecological interactions between animal species within and without these systems. Increased incidents of flooding will increase erosion, and affect soil fertility. Sea level rise will result in the inundation of coral reefs, sea-grass beds and mangrove areas. Fish kills and coral bleaching are likely to result from increased sea water temperatures. An increase in pests and diseases is likely to result from changes in seasonal climate patterns. Increased sedimentation from severe weather events will affect fragile aquatic ecosystems.



Wind and hurricane damage

11.4. Strategic Directions

Strategy 28 - Adopt and implement *Dominica's Climate Change Adaptation Policy and Action Plan* that will, amongst other matters, establish programs for:

- Monitoring and research on the potential effects of climate change on biological diversity;
- Implementation of both *in situ* and *ex situ* measures to conserve species likely to be affected by climate change;
- Implementation of measures to maintain the maximum possible biological diversity;
- Implementation of measures to conserve sufficient natural habitats to enable natural adaptive mechanisms to function;
- Establishment of measures (e.g. pollution control) to enhance the resilience of natural systems.



SECTION 12

BIOTECHNOLOGY AND BIOSAFETY

12.1. Background

The Conference of the Parties to the *Convention on Biological Diversity* adopted a supplementary agreement to the Convention known as the *Cartagena Protocol on Biosafety* on 29 January 2000. The Protocol has been signed by 104 governments and as of July 2001, five countries (Bulgaria, Fiji, Norway, St. Kitts and Nevis, and Trinidad and Tobago) have now deposited instruments of ratification. It will enter into force and become legally binding after 50 governments have ratified the agreement. The Protocol seeks to protect biological diversity from the potential risks posed by living modified organisms resulting from modern biotechnology. It establishes an advanced informed agreement (AIA) procedure for ensuring that countries are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into their territory.

12.2. Potential Benefits of Biotechnology

Genetic engineering (GE) promises remarkable advances in medicine, agriculture, and other fields (such as new medical treatments and vaccines, new industrial products, and improved fibres and fuels). Proponents of the technology argue that biotechnology has the potential to lead to increases in food security, decreased pressure on land use, sustainable yield increase in marginal lands or inhospitable environments and reduced use of water and agro-chemicals in agriculture.

12.3. Problems with Biotechnology

There are a number of problems, which have manifested themselves internationally since the introduction of GMOs into the environment. Biotechnology is a very new field, and much about the interaction of GMOs with various ecosystems is not yet known. Some of the concerns about the new technologies include its potential adverse effects on biological

diversity, and potential risks to human health.

Potential areas of concern might be unintended changes in the competitiveness, virulence, or other characteristics of the target species; the possibility of adverse impacts on non-target species (such as beneficial insects) and ecosystems; the potential for "weediness" in genetically modified crops (where a plant becomes more invasive than the original, perhaps by transferring its genes to wild relatives); and the stability of inserted genes (the possibilities that a gene will lose its effectiveness or will be re-transferred to another host). Consumer groups, environmentalists, and scientists have pointed out several serious problems such genetic tinkering may cause.

1. Crops engineered to resist pesticides and herbicides promote reliance on specific chemicals, generally non-organic pest control chemicals, by forcing farmers to buy the type of pesticide or herbicide to which the crops are designed to be resistant.
2. Critics warn that crops engineered to resist pesticides and herbicides could pass those traits on to weeds, resulting in herbicide and pesticide-tolerant "superweeds". Development of such "superweeds" would force farmers to use more and more herbicides to control plant pests, with unknown effects on the environment and potential risks to food and worker safety.
3. Critics note that GMOs may upset biological diversity. According to a report written for the British government, if GMOs eradicate weeds and insects, species that depend on them for food or habitat, including such birds as the corn bunting, partridge, and skylark, will suffer. Researchers funded by the British government found that plants genetically engineered to resist aphids had serious effects on the fertility and lifespan of ladybirds, which feed on aphids.

Furthermore, crops engineered to resist insect pests may also be toxic to harmless or beneficial insects, such as the Monarch butterflies, green lacewings and springtails, thereby reducing insect diversity.

4. Genetically modified foods can pose serious threats to consumers with allergies and specific dietary requirements because of ethical, religious, or cultural beliefs. For example, people allergic to shellfish could have a reaction to strawberries with transplanted shrimp genes used to enhance their colour. Scientists have warned that the altered corn could trigger dangerous allergies in some, with children at the greatest risk.
5. GMO's might pose human health risks. Scientists found that rats fed on the altered potatoes suffered stunted internal organ growth and weakened immune systems. The Novartis-maize carries a resistance gene against a group of antibiotics, which are used in human medicine, like Ampicillin, Amoxicillin and various Penicillin-type antibiotics. These can be transferred to bacteria in the field or in the digestive tract of humans and animals with a result that dangerous bacteria could no longer be effectively fought with conventional antibiotics.
6. It has been reported that the contamination cases in Europe and North America during 2000 exemplify that genetically engineered organisms cannot be controlled once released into the environment. Through pollen flow, unavoidable grain residues in farm machinery, trucks or elevators, or through bagging and handling errors, genetically engineered seeds will eventually show up everywhere in the production chain.

Due to increase public concern about the environmental and health risks associated with GE crops major food companies around the world have been rejecting the use of GE foods.

12.4. Biosafety

The rapid pace of advancement in biotechnology and the commercialisation of Organisms with Novel Traits (ONT's)/Genetically Modified Organisms (GMO's) have prompted an international movement to create regulatory oversight for biotechnology safety (biosafety). To date, biosafety regulation has focused on the movement of GMOs across national borders and their potential harm to ecosystem conservation and the sustainability of biological diversity.

Biosafety is a term used to describe efforts to reduce and eliminate the potential risks resulting from biotechnology and its products. It refers to the safe transfer, handling and use of living modified organism possessing a novel combination of genetic material obtained through the use of modern biotechnology.

12.5. Biosafety in Dominica

New initiatives in biotechnology have made it necessary for countries such as Dominica to protect human, animal, and plant life and the environment. The products of Biotechnology, generally referred to as "Genetically Engineered Organisms" (GEO's), "Genetically Modified Organisms" (GMO's), or "Living Modified Organisms" (LMO's), are created through genetic engineering. Scientists transplant the genes of one species into another species to try to transfer "desirable" characteristics. It has been argued that these genetic changes improve resistance to disease, pesticides, and herbicides, enhance nutritional value, and increase yield. Genetically Modified (GM) crops already have been planted in the U.S.A. for harvest and for test purposes without containment measures to prevent exposure to the broader environment.

A number of organizations in Dominica are involved in biotechnology research, development and commercial application. However, there is little information available regarding the use, importation or distribution of GMO's and GMO products. Based on the nature of trade with the Western World, it is highly likely that genetically modified foods have been inadvertently introduced into the Dominican environment.

12.6. Biotechnology

Biotechnology has great potential economic benefits as well as health concerns. These two issues demand that these areas be of critical concern, especially to the legal and institutional requirements. The development of legal controls in the importation of GM material and in legislation that protects our biogenetic pool, as well as, an intellectual property regime that ensures equitable benefits is a priority.

12.7. Strategic Directions

- Strategy 29 – Sign and ratify the *Cartagena Protocol on Biosafety*.
- Strategy 30 - Develop comprehensive national biotechnology legislative regime to guide the implementation of bio-safety measures and to ensure protection and use of cultural knowledge that can yield optimal benefit to Dominica. This legislation must seek to compliment the international conventions to which Dominica is signatory.
- Strategy 31 - Establish technical committee to:
- co-ordinate national biosafety program;
 - foster greater alliance and cooperation with regional and international institution;
 - work with government, Non Governmental Organization's (NGO's), other agencies and institutions to foster a national culture of awareness on biosafety;
 - co-ordinate the development and implementation of public education, awareness and training programmes at all levels on issues of biotechnology and biosafety.
 - Develop and implement a national policy on biotechnology.
- Strategy 32 - Develop *Regional Biosafety Strategy* to regulate biotechnology in the CARICOM region, through amongst other things, the establishment of a regional centre to establish the basis for the introduction of standards for inspection, monitoring and use of biotechnology, to facilitate and co-ordinate the establishment of a "clearing-house" mechanisms to track the importation of biotechnology and GMO's, and to foster greater alliance and co-operation with regional and international institution.



SECTION 13

INDICATIVE ACTION PLAN

PROJECT	ACTIVITIES	AGENCIES	TIME	RESOURCES
<p>1. Inventory of Biodiversity Resources (Strategy No. 6, 12, 17, and 25).</p>	<ul style="list-style-type: none"> Identify ecosystems / species for inventory Design appropriate inventory parameters - number of varieties/breeds/species, location, distribution, etc. Undertake all-inclusive inventories of: <ul style="list-style-type: none"> Agricultural diversity Terrestrial diversity Aquatic diversity Marine diversity Traditional plants and medicines Develop and establish database Record on database (see Project No. 9). Establish a monitoring program to document any changes in biodiversity 	<ul style="list-style-type: none"> Department of Fisheries Department of Forestry and National Parks ECU Department of Agriculture National Youth Council Carib Council Ministry of Community Development CBOs Relevant NGOs Land owners Dive operators 	<p>6 months to Launch</p> <p>4 year program</p>	<ul style="list-style-type: none"> Equipment Training for personnel Consultants on biodiversity inventories Funding – US\$750,000 (approx.)
<p>2. Public Information, Awareness, and Education Program (Strategy No. 3, 8, 18, 20, and 31)</p>	<ul style="list-style-type: none"> Consultations and workshops Develop and implement a system for continuous sensitisation of policy decision-makers (public and private) Development of school curriculum Inclusion in schools curriculum Promotional material-visual aids Broadcast media, village meeting, posters, use of field officers Massive Media campaign Web Page Public data base 	<ul style="list-style-type: none"> Teachers Field officers ECU Environmental Health Media Forestry and National Parks Fisheries Coastguard Dive operators Tourism operators Private sector National Youth Council CBOs Relevant NGOs SPAT CCA 	<p>6 months to Launch</p> <p>4 year program</p>	<ul style="list-style-type: none"> Radio/TV inserts News Paper Videos Books Teachers Guide Curriculum Web page Funding – US\$250,000 EU CREP Program

PROJECT	ACTIVITIES	AGENCIES	TIME	RESOURCES
3. Development of Legislative Framework (Strategy No. 2, 7, 9, 19, 21, 24, 29, and 30)	<ul style="list-style-type: none"> • Compile and undertake a comprehensive review and evaluation of relevant legislation and Conventions • Identify gaps and inconsistencies • Amend legislation and develop new laws as necessary • Incorporate nationally ratified international conventions into national laws • Ensure co-ordination • Lobby for passage • Upgrade and improve enforcement capacities <p>Establish multi-disciplinary mechanism to facilitate the negotiation, signing, and implementation of international conventions</p>	<ul style="list-style-type: none"> • ECU • Legal Affairs • National Biodiversity Committee • Relevant NGOs • Foreign Affairs • Ministry of Finance 	<p>6 months to launch</p> <p>24 month program</p>	<ul style="list-style-type: none"> • Legal Personnel • Funding – US\$400,000
4. Integrated Land (Resource) Use Planning and Management (Strategy No.1, 4, 13 and 19.)	<p>Establish/Strengthen Land Management Unit</p> <ul style="list-style-type: none"> • Undertake Resource inventory – terrestrial and coastal • Development of comprehensive resource (coastal and terrestrial) use plan • Development of appropriate legal and institutional structure (guidelines, zoning, set-backs, green belts, etc.) • Integration into IDP process • Institutional strengthening 	<ul style="list-style-type: none"> • Physical Planning Unit • ECU. • NDC • Ministry of Agriculture and the Environment • Relevant NGO's • Local Authorities • Lands and Survey Division 	<p>9 months to Launch</p> <p>3 year program</p>	<ul style="list-style-type: none"> • Equipment • Training for personnel • Consultants on Resource (Land) Use Planning and Management • Funding – US\$1.5 million (approx.)
5. Capacity Building and institutional Strengthening for Environmental Management (Strategy No.1, 4, 13 and 19.)	<ul style="list-style-type: none"> • Perform needs assessments • Establish/strengthen regulating agencies • Establish links with regional/international bodies • Develop a data base of available skills and expertise • Establish environmental information system • Establish public sector audit and review mechanism • Identify training needs and send persons for training • Identify required technologies write projects proposal to acquire resources 	<ul style="list-style-type: none"> • Physical Planning Unit • ECU • SPAT • NDC • Ministry of Education • Ministry of Agriculture • Other relevant NGO's • Local Authorities • Manufacturing • Tourism business • Pesticides Control Board • Private sector importers • National Youth Council • Youth Development Division 	<p>8 months to launch</p> <p>18 months program</p>	<ul style="list-style-type: none"> • Equipment • Consultants in environmental management • Funding – US\$650,000

PROJECT	ACTIVITIES	AGENCIES	TIME	RESOURCES
6. Implement a System of Environmental Standards & guidelines (Tourism and manufacturing) (Strategy No. 21).	<ul style="list-style-type: none"> Establish carrying capacity of terrestrial/marine ecosystems Consultation with business Situation assessment of facilities Adopt best practices system Draft standards and guidelines Implement building codes and engineering/building standards that are sensitive to natural ecosystems Develop monitoring, evaluating and reporting systems 	<ul style="list-style-type: none"> ECU and Regulating Agencies Ministry of Tourism Ministry of Agriculture AIC NGOs Bureau of Standards Private sector 	<p>6 months to launch</p> <p>24 months program</p>	<ul style="list-style-type: none"> Technical Expertise in the area of environmental standards in other countries Green Globe CTO, CAREC ISO standards Funding – US\$100,000 (Part funded by private sector)
7. Develop Comprehensive Water Resource Management Plan. (Strategy No. 7).	<ul style="list-style-type: none"> Establish National Water Board to regulate extraction and use Inventory/mapping of water resources (surface/ underground) Valuation of water as a national natural resource Document water use/ distribution Develop water resource management legislation, policy and plan Establish Water Resource laws 	<ul style="list-style-type: none"> DOWASCO DOMLEC Forestry Division Agriculture Division Environmental Health ECU Communication and Works Public and private land owners 	<p>Start in 6 months</p> <p>24 months program</p>	<ul style="list-style-type: none"> Equipment/GIS system Consultants in water resource management Funding – US\$750,000 (Part funded by water utility)
8. Develop a program that captures and shares traditional knowledge and encourage practice of self reliance (Strategy No. 11 and 22, 25).	<ul style="list-style-type: none"> Develop a data base of traditional farming, construction, medicinal, subsistence and other practices Programs to encourage traditional farming practices Provide technical assistance for development of traditional practices through community base organisations Incorporate into public awareness programmes. 	<ul style="list-style-type: none"> Community leaders YES Corp. Youth Organisations Local Authorities ECU community development Adult Education COMPACT National Youth Council Youth Development Division. 	<p>Start 3 months</p> <p>24 month program</p>	<ul style="list-style-type: none"> Personnel Information system SPAT NDFD Funding – US\$120,000

PROJECT	ACTIVITIES	AGENCIES	TIME	RESOURCES
9. Develop a database and information system on terrestrial and marine biodiversity (Strategy No. 11 and 22, 25).	<ul style="list-style-type: none"> Identify data and information needs Design information management system Develop and deploy mapping and information management system Establish a monitoring and reporting system. 	<ul style="list-style-type: none"> ECU Physical Planning Ministry of Tourism Forestry Division Agriculture Division Academic Institutions Fisheries Division Youth Development Division 	<p>Start 3 months</p> <p>12 month program</p>	<ul style="list-style-type: none"> Equipment/GIS Training for personnel Consultancy on information systems design and management Funding – US\$340,000
10. Identification and Protection of Threatened Ecosystems and Species (Strategy No. 4, 5 and 10).	<ul style="list-style-type: none"> Identification of threatened ecosystems/species (terrestrial and marine) Survey and demarcate proposed protected areas Negotiate with land owners Legally designate Develop research/management programs (e.g. wildlife farming) for conservation of threatened species Establish management program 		<p>Start 3 months</p> <p>18 month program</p>	<ul style="list-style-type: none"> * Resources to undertake survey and demarcation * Equipment for GIS. <p>Funding – US\$650,000</p>
11. Conservation of Agro-Biodiversity (Strategy No. 14, 15, and 16).	<ul style="list-style-type: none"> Inventory of biodiversity resources Establish germplasm/gene bank Establish Incentive Program for Conservation of the Agricultural Gene Pool (Livestock and Plants) Promote sound conservation practices/technology Agro-ecological zoning 	<ul style="list-style-type: none"> Department of Agriculture Agricultural community Private sector CARDI FAO IICA 	<p>Start 3 months</p> <p>5 year program</p>	<ul style="list-style-type: none"> Gene bank Training for personnel Consultants Funding – US\$450,000
12. Community Participation in Terrestrial and Marine Conservation (Strategy No. 4 and 11).	<ul style="list-style-type: none"> Identify interest groups Develop community ownership Training Empower communities Provide incentives Develop management plans Generate financial resources to sustain conservation programs 	<ul style="list-style-type: none"> Department of Fisheries Department of Forestry and National Parks ECU Department of Agriculture National Youth Council Youth Development Division Community Groups Land owners 	<p>Start 12 months</p> <p>3 years program</p>	<ul style="list-style-type: none"> Training for personnel Consultants on community conservation initiatives and legislation Funding – US\$150,000

PROJECT	ACTIVITIES	AGENCIES	TIME	RESOURCES
<p>13. Develop institutional capacity for regulating biotechnology (Strategy No. 6, 25, 29, 30, 31 and 32).</p>	<ul style="list-style-type: none"> • Establish technical committee • Develop database • Inventory of biomaterials and their traditional uses. • Capacity building • Web page and clearing house mechanism • Train Biosafety Officer • Manage database • Co-ordinate drafting of legislation • Develop Regional Biosafety Strategy (including inspection protocols, standards for labelling, monitoring, etc.) • Establish Regional Centre and clearing-house mechanism • Regulation of Biodiversity Prospecting 	<ul style="list-style-type: none"> • ECU • Ministry of Agriculture • Ministry of Health • Customs • CARICOM and OECS (for Regional Strategy and Centre) • Bureau of Standards • Co-ordinating Group of Pesticide Control Boards of the Caribbean • PAHO 	<p>6 months to launch</p> <p>18 month program for national activities</p> <p>5 year program for Regional Strategy</p>	<ul style="list-style-type: none"> • Equipment • Software • Technical support for committee • Web page • Legal expertise • Infrastructure for Clearing house mechanism • Funding – US\$150,000 (national program) <p>US\$10 million (Regional Strategy/Centre)</p> <p>EU CARIFORUM Project on Biotechnology</p>
<p>14. Program for the Conservation of Traditional Knowledge, Culture and Values (Strategy No. 26)</p>	<ul style="list-style-type: none"> • Consultation • Identification of issues • Development of Policy and Strategy • Implementation of Strategy • Pilot projects • Cultural awareness • Training • Institutional strengthening 	<ul style="list-style-type: none"> • Ministry of Community Development • CBOs • Carib Council • Village Councils • Relevant NGOs • Ministry of Education • Ministry of Agriculture • Academic Institutions • Documentation Centre • National Youth Council 	<p>Start in 6 months</p> <p>5 year program</p>	<ul style="list-style-type: none"> • Technical Assistance • Equipment and materials • Education and training material • Database • Funding - US\$250,000

PROJECT	ACTIVITIES	AGENCIES	TIME	RESOURCES
15. Development Plan for Indigenous Carib Peoples (Strategy No. 27)	<ul style="list-style-type: none"> • Consultation • Identify indigenous issues • Formulate Indigenous Peoples Development Plan/Strategy • Development of mechanisms to integrate Indigenous Peoples Development Plan into national development planning process • Integration into IDP process • Implementation of Strategy • Pilot projects • Institutional strengthening 	<ul style="list-style-type: none"> • Ministry of Finance and Planning • Carib Council • Carib Affairs in Prime Ministers Office • National Youth Council • Youth Development Division • Relevant NGOs • CBOs 	<p>Start in 6 months</p> <p>5 year program</p>	<ul style="list-style-type: none"> • Technical Assistance • Equipment and materials • Education and training material • Database • Funding - IDP project
16. Biodiversity and Climate Change Adaptation Program (Strategy No. 28)	<ul style="list-style-type: none"> • Adopt/implement relevant elements of Dominica's Climate Change Adaptation Policy and Action Plan • Monitor/research impacts of climate change on biodiversity • Implement conservation measures • Establish measures to enhance resilience of natural systems. 	<ul style="list-style-type: none"> • ECU • Forestry Division • Agriculture Division • Fisheries Division • Relevant NGOs • National Youth Council • Youth Development Division 	<p>Start in 6 months</p> <p>5 year program</p>	<ul style="list-style-type: none"> • Technical Assistance • Equipment and materials • Education and training material • Database • Funding - US\$400,000
17. Implement a fiscal incentive program to encourage commercial ventures to make sustainable use of biodiversity (Strategy No. 24).	<ul style="list-style-type: none"> • Study fiscal incentives in other Countries • Develop valuation system for biological resources/ ecosystems. • Establish economic instruments • Develop promotional campaign • Develop policies/regulations to target specific areas 	<ul style="list-style-type: none"> • NDC • Financial institutions • Legal Affairs • Ministry of Finance • Ministry of Tourism 	<p>Start 18 months</p> <p>12 month program</p>	<ul style="list-style-type: none"> • Technical guidelines • Funding – US\$50,000



SECTION 14

IMPLEMENTATION

The successful implementation of *Dominica's Biodiversity Strategy and Action Plan* will require the following:

- Public awareness concerning the importance of the Strategy and Action Plan, and the generation of broad public support.
- Endorsement of the Strategy and Action Plan by the Cabinet of Ministers.
- Public participation and involvement in the implementation of the Strategy and Action Plan.
- The formal establishment of the National Biodiversity Committee and National Biodiversity Co-ordinator within three months of the approval of this Strategy and Action Plan by Cabinet.
- The provision of adequate resources (financial, technical, human) from Government, International Agencies, Non-Governmental Organisations (NGOs) and Civil Societies.
- The strengthening of lead agencies involved in the implementation of the Strategy and Action Plan, including project development and management skills.
- The integration of the Strategy and Action Plan into national and sectoral planning activities.
- The establishment of out-reach programs and incentives.

It will be the responsibility of the Ministry of Agriculture and the Environment in collaboration with the National Biodiversity Committee and National Biodiversity Co-ordinator to co-ordinate and direct the implementation of *Dominica's Biodiversity Strategy and Action Plan*, with support from Government, International Agencies, Non-Governmental Organisations (NGOs) and Civil Society. The Environmental Co-ordinating Unit of the Ministry of Agriculture and Environment shall provide administrative support to the National Biodiversity Committee and National Biodiversity Co-ordinator in undertaking their mandate.



SECTION 15

MONITORING AND REVIEW

A system of periodic and regular monitoring and review shall be established to verify that *Dominica's Biodiversity Strategy and Action Plan* is being implemented and achieves intended goals and objectives. Every year, on the anniversary of the date of signing of this Strategy and Action Plan by Cabinet, the Environmental Coordinating Unit in collaboration with the National Biodiversity Committee shall submit to Cabinet a report that will:

- (a) Document activities that have been undertaken to implement the Strategy and Action Plan;
- (b) Identify constraints and limitations that have prevented the implementation of any aspect of the Strategy and Action Plan;
- (c) Indicate activities that shall be undertaken to address any constraints or limitations that have prevented the implementation of any aspect of the Strategy and Action Plan;
- (d) Provide an overview of progress made in achieving the goals and objectives of the Strategy and Action Plan.

To facilitate the preparation of this Report, every government department and agency shall submit to the Environmental Coordinating Unit through the committee, on an annual basis, a report that documents:

- (i) Activities that have been undertaken by the department or agency to implement the Strategy and Action Plan;
- (ii) Constraints and limitations experienced by the department or agency that have prevented the implementation of any aspect of the Strategy and Action Plan;
- (iii) Activities that shall be undertaken in the coming year by the department or agency to address any constraints or limitations that have prevented the implementation of any aspect of the Strategy and Action Plan.

Additionally, any Non-Governmental Organisation

(NGO) that is undertaking any initiative in support of the Strategy or Action Plan, shall periodically report to the Environmental Co-ordinating Unit through the committee on such activities. Upon receiving the reports from the government departments, agencies and from Non-Governmental Organisations, the Environmental Coordinating Unit shall, prior to the preparation of Government's annual budgets, confer with the Ministry of Finance and Planning to determine what measures shall be established to ensure that *Dominica's Biodiversity Strategy and Action Plan* is fully integrated into the national planning process.

Upon reviewing the Report that has been received from the Environmental Coordinating Unit and the National Biodiversity Committee, Cabinet shall make the Report available to the public. A notice to the effect that the Report is available for public scrutiny shall be published in the local newspapers.

No later than five years after the date of signing of this Strategy and Action Plan by Cabinet, the Environmental Coordinating Unit in collaboration with the National Biodiversity Committee shall facilitate and co-ordinate a broad-based public review of the Strategy and Action Plan with a view to determining whether intended goals and objectives have been achieved.

The Environmental Co-ordinating Unit shall prepare, on a periodic basis, a *State of the Environment Report*, that will, amongst other matters:

- (1) Document the state of Dominica's terrestrial and marine biodiversity;
- (2) Document the state of Dominica's agro-biodiversity;
- (3) Document conservation and management activities that are undertaken to protect or conserve fragile/vulnerable/threatened species or ecosystems;
- (4) Identify threats to Dominica's terrestrial and marine biodiversity and agro-biodiversity.



ANNEX I

List of Organisations Consulted

1. AID Bank
2. Barclays Bank
3. Bureau of Standards
4. Canefield Urban Council
5. Carib Affairs
6. Carib Council
7. Colgate Palmolive Co., Ltd.
8. COMPACT Project
9. Curriculum Unit, Ministry of Education
10. Dominica Export Import Agency (DEXIA)
11. Division of Agriculture
12. Dominica Banana Marketing Corporation (DBMC)
13. Dominica Broadcasting Service - Creole Desk
14. Dominica Broadcasting Service – News Desk
15. Dominica Conservation Association (DCA)
16. Dominica Rural Enterprise Project (DREP)
17. Dominica Social Security
18. Dominica Solid Waste Management Corporation
19. Environmental Health department
20. ESPWA
21. Farmer Groups
22. Fisheries Division
23. Fishermen Co-operatives
24. Forestry, Wildlife & Parks Division
25. Government Information Service
26. KFC Corporation
27. Local Area Management Authority (LAMA)
28. Marigot Cooperative Credit Union
29. Marpin Telecom & Broadcasting
30. Ministry of Agriculture, Fisheries and the Environment
31. Ministry of Communication and Works
32. Ministry of Finance and Planning
33. Ministry of Sports and Youth Affairs
34. Ministry of Tourism
35. Ministry of Trade, Industry & Marketing
36. National Association for Local Authorities
37. National Association for Non-Governmental Organisations (NANGO)
38. National Development Corporation
39. National Parks Unit
40. O. D. Brisbane & Sons Limited.
41. Physical Planning Division
42. Youth Environmental Services (YES) Corps



ANNEX 2

1. G. Allport
2. Jacqueline André
3. Axel Auguiste
4. Kent Auguiste
5. Reny Auguiste
6. Raymond Austrie
7. Albert Bellot
8. Camella Bellot
9. Alvin Bernard
10. Ashton Bertrand
11. Moses Brumant
12. Myrtle Bruno
13. Elude Burton
14. Porshia Burton
15. Durand Carbon
16. Adolphus Christian
17. Kent Copel
18. Delia Cuffy
19. Petra Cuffy
20. Leafrose Darroux
21. John Davis
22. George de Berdt Romilly
23. Julien Defoe
24. Melvyn Didier
25. Eisenhower Douglas
26. Anthony Drigo
27. Annie Edwards
28. Marie-José Edwards
29. Rebecca Edwards
30. Reginald Eli
31. Doreen Ettiene
32. Jean Ettiene
33. Franklyn Fabien
34. Carla Fontaine
35. Kaywana Fontaine
36. Lujah Fontaine
37. Doreen Francis
38. Paulette Francis
39. Kongit Gabriel
40. Albert Gallion
41. Lyn Giraud
42. Kelly Graneau
43. Oliver Grell
44. Harold Guiste
45. Errol Harris
46. Jones Harry
47. Audrey Henik
48. James Henry
49. Gerard Hill
50. Lennox Honychurch
51. Arlington James
52. Janie Jean Jacques
53. Luke Jno. Baptiste
54. Cyrille John
55. Mark John
56. Anne Marie Joseph
57. Regina Joseph
58. Doreen Joseph
59. Elivian Jules
60. Emile B. Lancelot
61. Elias Lander
62. David Lang
63. G. Langlais
64. Eden Larocque
65. Ivon Larocque
66. Gerard Langlais
67. Lisa Laurent
68. Miguel Lawrence
69. Rawle Leslie
70. Felix Lester
71. Cynthia Lewis
72. Dave Lloyd
73. Ann-Marie Mason
74. Cheryl Mason
75. Phillip Matthew
76. John C. McIntyre
77. John Moise
78. Julie Morancie
79. Clarence Olivance
80. Henie E. F. Parillon
81. Allan E. Paul
82. Cedric Peter
83. Gilbatsen Peter
84. Algernon Philbert
85. Melbour Phillip
86. Charles Pierre
87. Julie Pierre
88. Lilian Polydore
89. Luanna Prevost
90. Chaminda Rajapakse
91. Isaiah Richards
92. Anthony Roccditts
93. Lucia Sandy
94. Peter Sanford
95. Eud Scotland
96. Kerr B. Serrant
97. Esther Shillingford
98. Henry Shillingford
99. McPherson St. Luce
100. Marcus Thomas
101. Derrick Theophille
102. Alleyne Thomas
103. Anaclete Thomas
104. Joseph Thomas
105. Patsy Thomas
106. Kim Thurlow
107. Damien Valmond
108. Alexis Valmond
109. Olice Valmond
110. Rammanuel Victorine
111. Maximea Vigilant
112. Charles Williams
113. David Williams
114. Jean Williams



ANNEX 3

ACRONYMS ORGANISATIONS

CARDI	Caribbean Agricultural Research and Development Institute	NANGO	National Association of Non-Governmental Authority
CREP	Caribbean Regional Environmental Program	NBSAP	National Biodiversity Strategy & Action Plan
CARICOM	Caribbean Community	NDC	National Development Corporation
CARIFORUM		NDFD	National Development Foundation of Dominica
CBD	Convention on Biological Diversity	NGO	Non-Governmental Organization
CBO	Community Based Organizations	OECS	Organization of American States
CITES	Convention on the International Trade in Endangered Species of Flora & Fauna	PAHO	Pan American Health Organisation
COMPACT	Community Management of Protected Area Conservation Project	SSMR	Soufriere / Scotts Head Marine Reserve
CTO	Caribbean Tourism Organisation	SPAT	Small Projects Assistance Team
DEXIA	Dominica Export Import Agency	UNDP	United Nation Development Program
DOMLEC	Dominica Electricity Company	UNESCO	United Nations Education, Scientific and Cultural Organisation
DOWASCO	Dominica Water and Sewerage Company	YESCORPS	Youth Environment Service Corps
DREP	Dominica Rural Enterprise Project		
EC	Eastern Caribbean		
ECU	Environmental Coordinating Unit		
ECCB	East Caribbean Central Bank		
EIA	Environmental Impact Assessment		
ESPWA	Environmental Services Project Waitikubuli		
EUCREP	European Union CREP (as above)		
FAO	Food and Agriculture Organization		
FDD	Fisheries Development Division		
GDP	Gross Domestic Product		
GIS	Global Information System		
GIS	Government Information Service		
IICA	Inter-American Institute for Co-operation on Agriculture		
IDP	Integrated Development Project		
IPCC	Intergovernmental Panel on Climate Change		
ISO	International Standard Organisation		
IUCN	International Union for the Conservation of Nature		
LAMA	Local Area Management Authority		
LMO	Living Modified Organisms		
MCA	Movement for Cultural Awareness		
MOA	Ministry of Agriculture		



ANNEX 4

REFERENCE 1

Trade and Tourism Sector Plan, December 1990 Percival Marie

Environmental Laws of the Commonwealth Caribbean, Caribbean Law Institute, 1991

Dominica Investment Information Checklist, NDC, 1999

Dominica Environmental Profile, CCA, Govt. of Dominica, USAID, 1991

Central Statistical Office Travel Report, 1999

Earth Summit '92-The United Nations Conference on Environment and Development-Rio de Janeiro, 1992

Ecotourism Development Programme- Project Appraisal, CHL Consulting Group, April 1999.

Dominica Import Export Agency, DEXIA

Dominica Association of Industry & Commerce, DAIC

Central Statistical Office, Ministry of Finance.

REFERENCE 2

CCA, 1991. Dominica Country Environmental Profile. U.S. Agency for International Development, Bridgetown, Barbados.

Evans, P.G.H., 1986. Dominica Multiple Land Use Project. *Ambio* Vol. 15 No. 2, pp 82-89.

GOCD, 1994. Dominica National Environmental Action Plan. Government of the Commonwealth of Dominica.

ICPGR, 1995. International Conference and Program for Plant Genetic Resources. Dominica Country Report. Ed Charles James.

James, A. and Gallion, A., 1990. The Utilization of Non-Wood Forest Products in Dominica. *Caribbean Journal of Agriculture and Natural Resources*, Vol. 1, No. 2, pp 4-12.

FAO, 1998. Forestry Policies in the Caribbean. Volume 2: Reports of 28 selected countries and territories. FAO Forestry Paper 137/2.

Beard, J. S., 1949. *The Natural Vegetation of the Windward and Leeward Islands*. Clarendon Press, Oxford, UK.

Clarke, P., 1994. Conservation Status of the Flora and Fauna of Dominica. Island Resources Foundation (IRF).

James, A., 1990. *Freshwater Swamps and Mangrove Species (Revised Edition)*, Forestry and Wildlife Division, Ministry of Agriculture. Dominica.

OAS/OECS, 1998. Institutional Analysis in the area of Natural Resource Management. The Case of Dominica.

Pollard, Duke E.E. et al., 1991. Environmental Laws of the Commonwealth Caribbean – Analysis and Needs Assessment. Commercial Law Monograph Series No. 1 Caribbean Law Institute, University of the West Indies, (UWI) Barbados.

- Chace, F. and Hobbs, H., 1969. The Freshwater and terrestrial decapod crustaceans of the West Indies with special reference to Dominica. Smithsonian Inst. Bull. 292, Washington, DC.
- Hodge, W., 1954. Flora of Dominica. Lloydia 17 (1, 2 and 3).
- Johnson, T., 1988. Biodiversity and Conservation in the Caribbean: profiles of selected islands International Council for Bird Preservation (ICBP), Monograph No. 1, Cambridge, UK.
- Nicolson, D.H., 1991. Flora of Dominica Part 2: Dicotyledonae. Smithsonian Institution Press, Washington D.C. U.S.A.
- Varty, N. et al., 1992. Proposed Morne Diablotin National Park – Draft Management and Development Plan (1993-2003) International Council for Bird Preservation (ICBP).
- Schwartz, A. and Henderson, R. W., 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions and Natural History. University of Florida, Press, Gainesville, USA.
- Maholtra, A. and Thorpe, R. S., 2000. Reptiles and Amphibians of the Eastern Caribbean. MacMillan Education Ltd. London, Oxford, UK.
- Zamore, M. P., 2000. The Wildlife of Dominica (Revised Edition), Forestry and Wildlife Ministry of Agriculture, Division, Roseau, Dominica.
- Swank, W. and Julien C., 1975. Distribution and Status of Wildlife on Dominica. Food and Agriculture Organization of the United Nations, Rome.
- James, A., 1995. Flora and Fauna of the Cabrits Peninsula. Forestry and Wildlife Division, Ministry of Agriculture, Roseau, Dominica.
- Evans, P.G.H., 1991. Birds of the Eastern Caribbean MacMillan Caribbean, London and Basingstoke, UK.
- Evans, P.G.H. and James, A., 1997. Wildlife Checklists: Dominica Nature Island of the Caribbean, Faygate Printing, Sussex, UK.
- GOCD, 2000. Forestry, Wildlife and Parks Division, Corporate Plan 2001-2002, Ministry of Agriculture and the Environment, Roseau, Dominica.
- Faaborg, J. and Arendt, W., 1995. Wildlife Assessments in the Caribbean, USDA Forest Service, Rio Piedras, Puerto Rico.
- Prins, P., 1987. Forestry Policy and Administration 1987-1997 Natural Resources and Rural Development Project. Commonwealth of Dominica. Dept. Reg. Dev., OAS, Washington, DC.
- DeMilde, R., 1987. Inventory of the Exploitable Forests of Dominica. FAO, Rome.
- Lausche, B., 1986. Dominica National Legislation related to Natural Resource Management. Country Legal Report No. 1. OECS-NRMU, Castries, St. Lucia.
- Rainy, W., et al., 1987. Dominica (West Indies) Banana Industry Rehabilitation: A Pesticide Assessment Island Resources Foundation (IRF), St. Thomas, VI.

