4.1.1 Marine and Coastal Habitats[36]

Mangroves

With the exception of the harbours at St. George's and Halifax, the west coast consists of a series of shallow bays separated by headlands, as do the north and northeast coasts. The southeast coast, south of Telescope Point and the south coast westerly of Point Salines are deeply indented with many small bays that had previously been backed by mangrove swamps. Mangrove vegetation also existed at Lavera Pond, St. Patrick and at Harvey Vale, Carriacou. Other areas included the Conference/Pearls area and the bays between St. David and Prickly Bay on the south coast off the main island. The main species of mangrove included red mangrove (*Rhizophora mangle*), black mangrove (*Avecennia germinans*), white mangrove (*Laguncularia racemosa*), and button wood (*Conacarpus erectus*). The rest of the coastal area is considered dry woodland and cactus shrub and made up of a mixture of species including *Impomea sp.* In some sandy beaches, sea grape (*Cocoloba uvifera*), coconuts (*Cocos nucifera*), almond (*Terminalia cattapa*) and manchineel (*Hippomane mancinella*).

Sea Grass Beds

Marine plants included sea grass communities which existed in the Telescope area and within the barrier type reef extending from Grenville Bay to (MAP) Prickly Bay in the South; at Carnacou in the L'Esterre Bay and Machineel Bay and within the reef at North Bay, Isle de Rhonde. The main species are turtle grass, *Thalassia testudinum* and mantee grass, *Syringodium filiforme.* Other marine plants include various species of green, blue green, brown and red algae, some of which are locally used as a food. A variety of seaweeds or sea moss (red marine algae) mainly *Gracilria sp.* was harvested at notable sand-mud locations at Calliste, Conference, Pearls and Telescope as well as locations at Carriacou and Isle de Ronde. The sea moss is harvested primarily for local consumption although some of the dried plants are exported to neighboring islands. Sustainable harvesting of the sea moss has been maintained at Calliste, St. George's.

Coral Reefs

Most of the reefs around Grenada and the Grenadines, especially along the East and South East are in varying stages of degradation and recuperation. The islands adjacent to the Lavera Bay have reef systems with Sugar Loaf being in the best state of recovery and dominated by elkhorn coral (*Acropora palmate*) There is one barrier type reef stretching from Telescope Point to Marquis Islands with elkhorn coral, finger coral (*Porites porites*) and some boulder coral including mustard, and brain coral. Small fringing reefs mainly of elkhorn coral exist along the southeast and the south coast of Point Salines. These reefs have shown some signs of recovery but most of them remain covered with algae.

On the north west coast of Grenada, the reef at Red Rock, originally dominated by elkhorn coral has suffered much physical damage from strong storm swells that frequently hit the area. Reefs also exist at Beausejour and Molinere. The reefs at

[36] This section is informed by the Biodiversity Strategy and Action Plan for Grenada. This was prepared in July 2000 and consisted of gathering information on the status of biological resources, benefits, threats to and loss of biodiversity and the causes of these threats and losses.

Mollinere have been steadily degrading as a result of overuse mainly by tourists. The three fathoms reef in Grand Anse is badly degraded; however, the six fathoms reef is still in good shape. Large barrier reefs occur along the east coasts of Carriacou, Petit Martinique and some of the smaller islets of the Grenadines These are strongly dominated by elkhorn corals in the shallower's waters and boulder coral in the fore reef. Saline and White Islands have an excellent reef system and presently have the best species combination in the area.

Forests and Natural Vegetation

Prior to Hurricane Ivan there was very little documentation on the composition and status of Grenada's forests. However, three (3) endemic species of plants were known: the Grand Etang Fern (*Danaea sp.*), the Cabbage Palm (*Oxeodoxa oleracea*) and one endemic tree species (*Maythenus grenadensis*).

Using the Beard classification, there were six (6) major forest communities:

- Cloud Forest (montane thicket, palm break and elfin woodlands). Generally, these forests were located in the inaccessible upper slopes of Grand Etang and on Mt. St. Catherine. They have suffered little degradation and appear to be under no serious threat.
- Rain Forest and Lower Montane Rain Forest. These forests occurred below the cloud cover and where rainfall exceeds 2500mm per annum. The best remnants were found in the Grand Etang Forest Reserve.
- Evergreen and Semi-evergreen forests. These forests occurred where the rainfall is between 2000 and 2500mm per annum. A 40 to 60ha of this forest type was found at Morne Gazo in the south.
- Deciduous Forest and Cactus Scrub. These occurred at lower elevations where the rainfall is between 1000 – 2000mm per annum, usually falling within a five month period. They were found in the north and south of mainland Grenada, and on Carriacou and Petit Martinique.
- Littoral Woodlands. A small patch remained at the edge of Levera woodland in the northeast of Grenada.
- Mangrove woodlands (this has already been described above).

None timber forest products, primarily screw pine (*Pandanus utilis*) and bamboo (*Bambusa vulgaris*) are harvested and utilized for making baskets and other handicraft. Many naturally occurring herbs are also used to produce herbal medicines, especially in the rural areas.

Wildlife

Records on faunal species numbers, distribution and their current status are extremely limited. The terrestrial wildlife[37] is thought to consist of:

- Four amphibian species
- Eight species of lizards

[37] Groome, 1970. The list by Groome may be incomplete, and some of species mentioned may no longer exist.

- Five species of snake
- One hundred and fifty species of birds (18 are thought to be threatened)
- Four native species of terrestrial mammals
- Eleven native species of bats
- One endemic specie of weevil (*Diaprepes sp.*)
- Several species of fresh water shrimps and land crabs

The dry forest in the south and north of the island is considered prime habitat for the Grenada Dove (*Leptotila wellsi*) and the Grenadian Hook-billed kite (*Chondrohierax uncinatus*). Grenada is also home to four bird species that are endemic to the Lesser Antilles[38]. These include the Grenada flycatcher (*Myiarchus nugatory*), the Scaly-breasted thrasher (*Margarops fuscus*), the Lesser Antillian bullfinch (*Loxigilla noctis*), and the Lesser Antillian tanager (*Tangara cucullata*).

Hunting, for recreation and a source of food, was a very popular activity in Grenada. The main animals hunted were: manicou, armadillo, mona monkey, ramier pigeon, and iguana.

Fisheries

The International Centre for Living Aquatic Resource Management (ICLARM) records 233 marine species, 69 marine/brackish water species and 17 species for fresh water.

Records of fish landings classify the range of marine species into pelagic finfish, demersal finfish, crustaceans and shellfish; the unclassified fish are mainly dermesals. The near shore and off shore coral reefs provide the base for dermasal fish such as snappers, groupers, grunts, doctorfish, etc., while the off-shore ocean provides Yellow-fin Tunas, Oceangar, Marlin, Dolphin fish and King fish among others. Beach seines very close to shore harvest jacks and robins when such fish come off the ocean deep on a daily basis. Divers in significant quantities traditionally harvest crustaceans and other shellfish such as lobsters, turtles and conch.

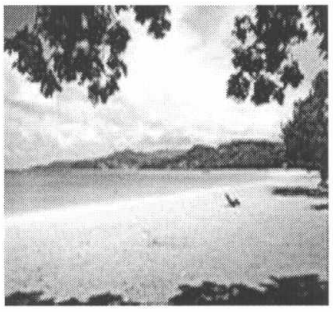
Although a large segment of the national fishery remains semi-subsistence, commercial fisheries has been quite significant. The Yellow-fin Tuna is a highly sough-after species because of its market value; it now accounts for the largest species catch in national landings. Before the hurricane, tuna fishery contributed, on an average, to at least 16% of landed catches.

The environmental profile of each of the parishes in Grenada is presented in Table 20.

[38] CCA/GOG/USAID 1999

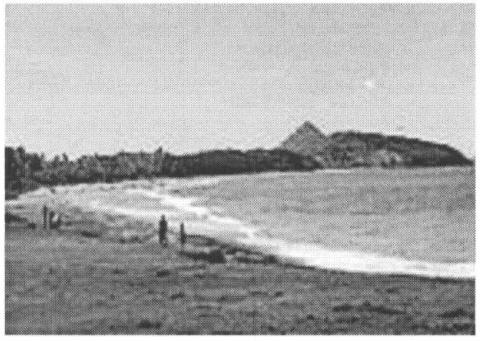
Parish	Population	Natural Resources (Key)
St. George's	31,994	Beaches, coral reef, Grand Etang Rain Forest, rivers, dry scrub forests, waterfalls, lakes, mangrove forests, off shore islands, bays and sheltered harbours
St. John's	8,752	Rivers, waterfalls, beaches, lakes, mangrove forests, bays and sheltered harbours
St. Mark's	3,861	Rain forests, rivers
St. Patrick's	10,118	Forests, rivers, beaches, lakes, mangrove forests, coral reefs, offshore islands, dry scrub forests
St. Andrew's	24,135	Forests, beaches, coral reefs, waterfalls, dry scrub forests, rivers (Great River)
St. David's	11,011	Dry forests, mid-elevation wet forests, beaches, coral reefs, mangrove forests, sheltered bays
Carriacou and Petit Martinique	5,726	Coral reefs and beaches, mangrove forests, oyster beds, sheltered bays, dry scrub forests

Table 33 Environmental Profile for Parishes in Grenada[39]



Grande Anse Beach

Concord Falls



Lavera

Photo 15 Some Environmental Assets before Hurricane Ivan

[39] Jessamy 1999

Figure7 Map showing environmental assets

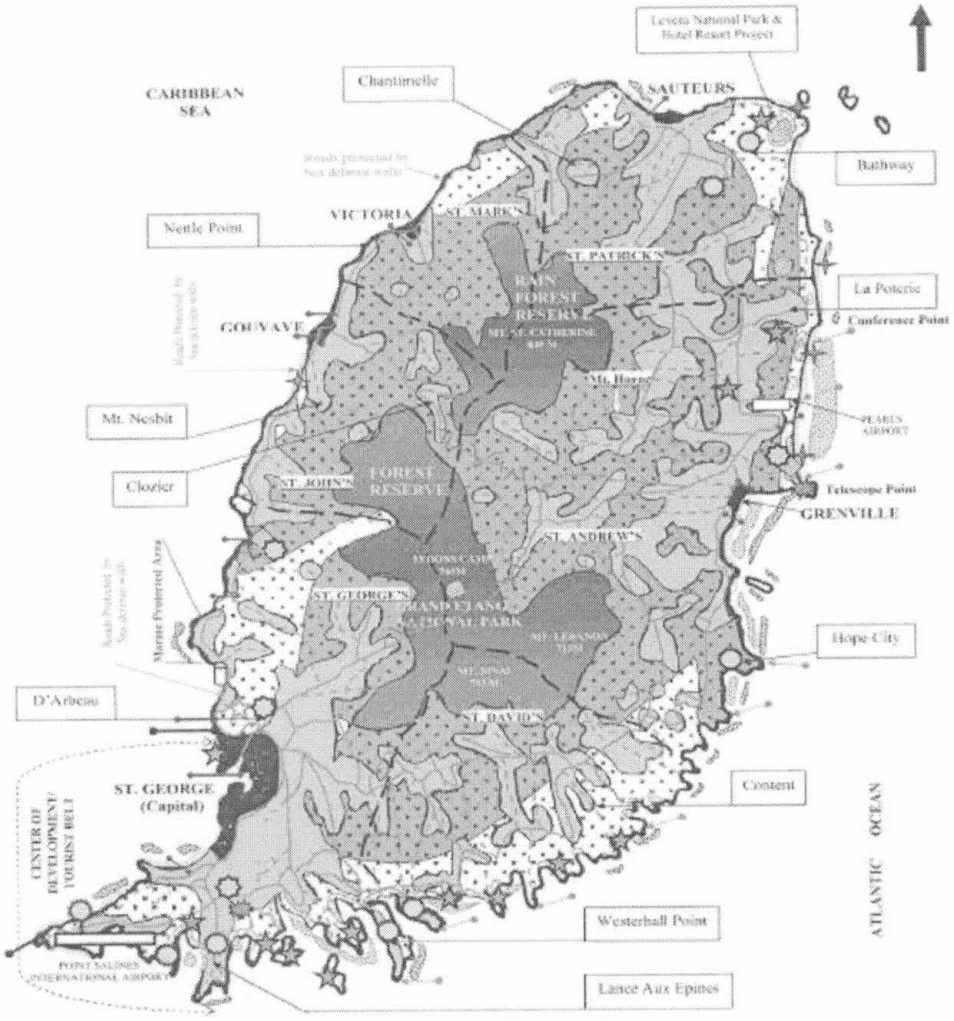


Figure 8. Map of Grenada showing damage to environmental assets

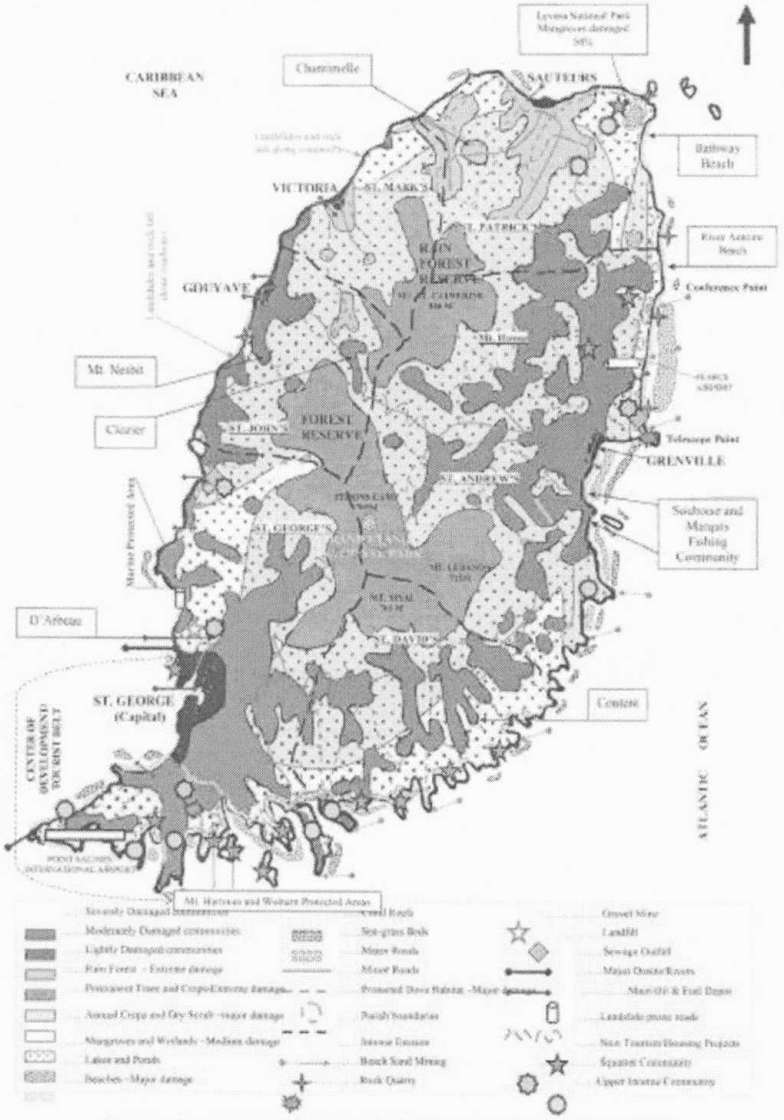


Figure 2 Map of Grenada showing Hurricane Ivan Damage to Environmental Assets

4.2 Description of Environmental Impacts

Environmental Asset	Intensity of Damage	Extent of Damage	Functioning of Asset	Duration of Impact	Recovery of Asset
Mangroves	Medium	70%	Adverse Effect	Short to Medium term	Natural/ requires appropriate environmental protection measures
Sea grass beds	Minor	<10%	No Effect	Short term	Natural
Coral reefs	Minor	<10%	No Effect	Short term	Natural
Beaches	Major	>50%[a]		Short to Medium term	Natural
Forest and natural vegetation	Extreme	100%	Intense impairment of the functioning of the asset	Long term	Irreversible damage. Requires concentrated environmental protection measures.
Wildlife	Extreme	100%	Impairment of the functioning of the asset	Medium to Long term	Requires concentrated environmental protection measures
Fisheries[a]	Minor	<10%	No effect	Potential Medium to long term impact*	Natural

Table 34 Incremental Damage Intensity Rating of Environmental Assets[40]

[a] La Sagesse, River Antoine, Bathway, Pearls

[b] The immediate impact of the hurricane has been minor but there may be a potential medium to long-term impact on the fish stock, particularly near shore and reef fisheries which are dependent on other neighbouring ecosystem such as mangroves and watersheds. Fresh water fisheries will also be impacted seriously in the medium term because of a change in water quality and quantity, resulting in a disturbance in the habitat. The impact on the sector is mainly due to damaged boats and equipment.

Photo 16 Damage to Watersheds and Forests

[40] Source OECS ground truthing

List of Livelihoods	Intensity	Comments
Hunting	Extreme	The wildlife habitats and source of food have been destroyed
Tour-guiding	Extreme	Access routes to the eco-tourism sites are impassable; it is envisaged that the sites have also sustained some damage
Craft-making	Major	Although the bamboo and screw pine have sustained damaged, material can still be obtained from the damaged stock; unfortunately, preservation and storage of the material may prove problematic
Fruit gatherers	Extreme	All the trees and plants have been severely damaged
Charcoal burners		This has a positive impact because of the abundance of wood from the fallen trees

Table 35 Damage to Livelihoods Generated from Ecological Assets[41]

Environmental Assets (Key)	St. George's	St. John's	St. Mark's	St. Patrick's	St. Andrew's	St. David's
Beaches	Minor	Minor	Minor	Major		
Coral reef	Minor	NA	NA	Minor		
Grand Etang Rain Forest	Extreme	Extreme			Extreme	Extreme
Mid-elevation wet forests	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme
Dry scrub forest	Major	-	-	-	-	Major
Watersheds	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme
Waterfalls	Minor	Minor			Minor	
Mangroves	Major			Major		Major
Off shore islands	Minor			Minor		

Table 36 Effects of Hurricane Ivan to Environmental Assets in each Parish[42]

One of the other problems associated with environmental assessment of disasters is the difficulties encountered in calculating the population that suffers loss of well being: ecosystems are assets(natural capital) from which goods and services are derived for the general public. Table 5 has therefore been constructed to show how the hurricane has impacted upon the goods and services that are normally derived from the major ecosystems in Grenada.

[41] Source OECS field interviews

[42] Source OECS ground truthing

Ecosystem	Goods	Services
Forest ecosystems	Timber Fuelwood Drinking water Non-timber products (fruit, plant medicines, wildlife) Genetic resources	Maintain array of watershed functions (infiltration, purification, stabilisation) Remove air pollutants, emit oxygen Cycle nutrients Maintain biodiversity Sequester atmospheric carbon Moderate whether extremes and impacts Generate soil Provide aesthetic enjoyment and recreation
Agro-ecosystems	Food crops Crop genetic resources	Maintain limited watershed functions (infiltration, partial soil protection) Provide habitats for birds, pollinators, soil organisms, etc. important to agriculture Build soil organic matter Sequester atmospheric carbon
Freshwater ecosystems	Drinking and irrigation water Fresh water fisheries Genetic resources	Dilute and carry away waste Cycle nutrients Maintain biodiversity Provide aquatic habitat Provide transportation corridor Provide for aesthetic enjoyment and recreation
Coastal ecosystems	Fisheries Seaweeds (sea moss) Wood for charcoal Genetic resources	Moderate storm impacts (mangroves, barrier reefs) Provide wildlife (marine and terrestrial habitat) Maintain biodiversity Dilute waters Provide for aesthetic enjoyment and recreation
Reef Fisheries	Minor	The habitat for reef fisheries received minor damage There is, however, a reported increase in spear fishing of reef fisheries after the hurricane.

Table 37 Goods and Services Provided by Ecosystems in Grenada[43]

Solid Waste Management

The hurricane has created large volumes of wastes Table 6 below seeks to identify the waste stream, volume of each waste stream and the way in which it is being managed, two weeks after the event.

[43] Adapted from World Resources Institute (2001)

Types of Waste	Estimated volume	Cost of Removal in EC$	How disposed
Fabric and clothing	NA	NA	Burning Disposed as household waste
Zinc Roofing (residential only)	4,000 tonnes	$.6mil	Left on the roadside Dumped in unauthorized locations (national stadium, Tanteen, Westerhall)
Bulky waste (mainly wood from destruction to property)	50,000 m^3	$1.1mil	Left on the roadside Dumped in unauthorized locations
Demolition waste	800,030 m^3	$2.35mil	Left on the roadside Dumped in unauthorized locations
Fallen Trees	130,000m^3	$3mil	Left on the roadside Still lying along river banks

Table 38 Type and Volume of Waste after Hurricane Ivan[44]

The volumes identified above were calculated on the basis of the waste that still remains to be cleared, two weeks after the passage of the hurricane.

Valuing the Damage

The purpose of assessing damage is to identify the magnitude of the impact of the environmental resources and services and on the economy of the country. Damage may be valued in different ways, based on the end use to which the information will be put. The two values are full economic loss and remediation cost. The full economic loss is used to gauge the impact of the event on the national economy.

The simplest method of crudely estimating full economic cost on any environmental asset is to multiply the value of the asset by a factor that represents the extent and intensity of the damage. In Grenada, as is true in the rest of the OECS sub-region, national accounts do not include environmental assets.[45] Consequently, as observed from the tables above,

[44] Volumes provided by Ewald Spitaler of OXFAM (personal communication)

[45] Some of the value of environmental services is, however, included in the statistics of such sectors as agriculture and tourism Some of the value of environmental services is, however, included in the statistics of such sectors as agriculture and tourism

the damage assessment has not been able to quantify the economic loss of the environmental assets and services as a result of Hurricane Ivan.

In the absence of full economic loss, the most appropriate response to assessing damage to environmental assets is to cost the remediation. These values are particularly useful in determining the estimates for financial assistance. However, remediation costs are based on the nature of the remediation work to be undertaken and must be estimated on a case-by-case basis. Some of the remediation costs are also provided under the chapter dealing with agriculture, forestry and fisheries.