Report on ecological and socio-economic conditions at ridge-to-reef project sites (Grenada)

Technical Report · November 2013

CITATION
1

READS
4,807

1 author:

Serge Aucoin
Fisheries and Oceans Canada
23 PUBLICATIONS **52** CITATIONS

SEE PROFILE

Implementing a 'Ridge to Reef' approach to protecting biodiversity and ecosystem functions within and around protected areas in Grenada

Report on ecological and socio-economic conditions at ridge-to-reef project sites

Project Preparation Grant Activity 2.1

Serge Aucoin, MSc.

November 2013

CONTENT

TABLES

MAPS

FIGURES

APPENDICES

1. PROJECT OVERVIEW

Project "*Implementing a 'Ridge to Reef' Approach to Protecting Biodiversity and Ecosystem Functions within and around Protected Areas in Grenada*" (hereafter 'ridge-to-reef project') focuses on 22 documented sites of conservation interest and concern across Grenada and Carriacou (see *Project Identification Form—PIF*). The 22 sites cover a total area of ~16300 ha (163 km^2), comprising ~3400 ha of land (~10 % of all land nationwide—344 km^2) and ~12800 ha of coastal marine environment (bordering >25 % of the national coastline) (see Table 1).

Table 1: Total areal extent of ridge-to-reef project sites by current classification

Current classification[1]	Terrestrial area (ha)	Marine area (ha)	Total area (ha)
Designated protected area	2001	498	2499
Proposed/pending designation	237	752	989
Undesignated protected area	45	-	45
Proposed protected area	1160	11590	12750
Total area of 22 sites	**3443**	**12840**	**16283**

1. See below for description of classification/status

Classification/status of sites are summarized as follows:

Designated protected areas are officially protected sites—legally established with an approved management plan and/or actively managed.

Proposed/pending areas are sites that are currently under active initiatives to becoming established (e.g., within parliamentary process and/or have draft management plans).

Undesignated protected areas are sites where management activities have been put in place and are treated as designated protected areas, but have no true legal establishment (i.e., unofficial/not legislated).

Proposed protected areas are recognized priority areas of conservation interest planned by the ridge-to-reef project, as well as emphasized by seminal country reports *Plan and Policy for a System of National Parks and Protected Areas* (Huber and Vincent 1988) and *Grenada Protected Area System Plan* (Turner 2009).

The following Table 2 profiles the current classification/status at each of the 22 ridge-to-reef project sites and indicates their areal extent. Corresponding maps 1, 2, and 3 identify ridge-to-reef site locations (with their existing borders or projected boundaries) showing land classes and habitat types within and around project sites.

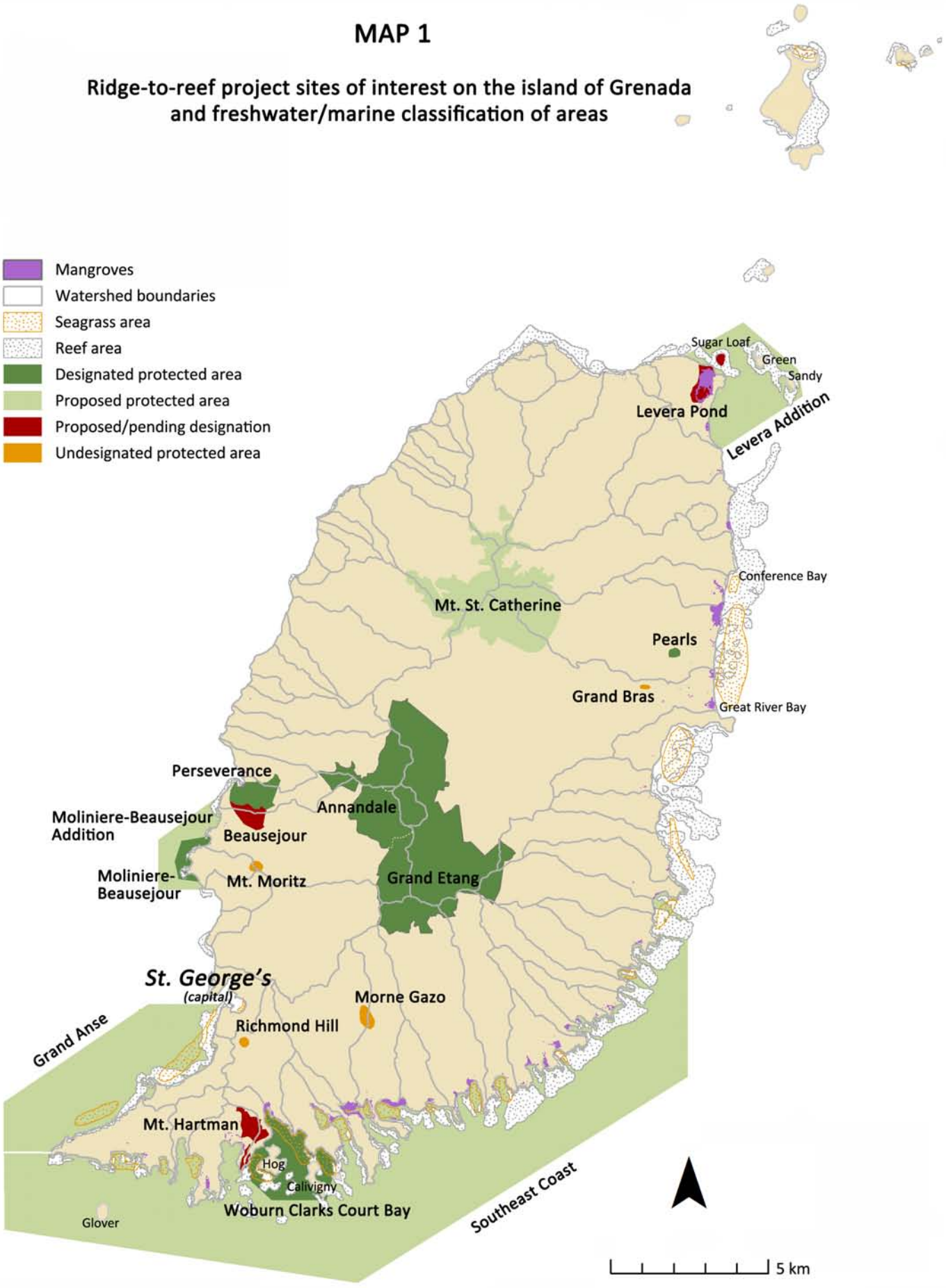
Table 2: Ridge-to-reef project site profiles

Official name / current designation / site status	Land (ha)	Sea (ha)	Total area (ha)	Source
Protected Area legally designated/established, approved management plan, actively managed				
Perseverance Protected Area[1]	113	-	113	Management plan
Grand Etang Forest Reserve	~1600	-	~1600	Management plan
Annandale Forest Reserve	236	-	236	Management plan
High North Forest Reserve	52	-	52	GPASP[2]
Moliniere-Beausejour Marine Protected Area	-	60	60	Management plan
Woburn Clarks Court Bay Marine Protected Area	-	438	438[4]	Management plan
Pearls	-	-	To be determined	GPASP[2]
Proposed/pending designation active initiatives, draft management plan, in parliamentary process				
Beausejour Protected Area	60	-	60	Management Plan
Sandy Island/Oyster Bed Marine Protected Area	50[3]	737	787	Management plan
Mt. Hartman National Park and Protected Area[5]	62	-	62	GPASP[2], PIF[7]
Levera Pond Protected Area	65	15	80[6]	Management Plan
Undesignated protected area existing management activities, but no management plan; lacks legislative designation				
Morne Gazo	25	-	25	GPASP[2],
Richmond Hill	8	-	8	GPASP[2], PIF[7]
Grand Bras	4	-	4	GPASP[2], PIF[7]
Mt. Moritz	8	-	8	GPASP[2], PIF[7]
Proposed protected area priority area of interest established; projected initiatives				
Mt. St. Catherine	1000	-	1000	GPASP[2], PIF[7]
High North addition	-	160	160	GPASP[2]
Levera marine area addition	25[8]	725	750	GPASP[2], PIF[7]
Moliniere-Beausejour marine area addition	-	240	240	PIF[7]
White Island marine area	130[9]	1970	2100	GPASP[2], PIF[7]
Grand Anse marine area	-	1500	1500	GPASP[2], PIF[7]
Southeast Coast marine area	5[10]	6995	7000	GPASP[2], PIF[7]

1. Revised name: Perseverance Protected Area and Dove Sanctuary (unofficial)
2. Grenada Protected Area System Plan (Turner 2009)
3. Includes southeast mainland areas of mangroves, Mabouya and Sandy islands
4. Excludes Hog and Calivigny islands; includes yacht mooring areas
5. Revised name: Mt. Hartman National Park and Dove Sanctuary (unofficial)
6. Includes Sugar Loaf Island and area between Sugar Loaf Island and Levera Beach
7. *Ridge-to-Reef Project Identification Form*
8. Includes Green and Sandy islands
9. Includes White, Saline, Frigate, and Bird islands
10. Glover Island

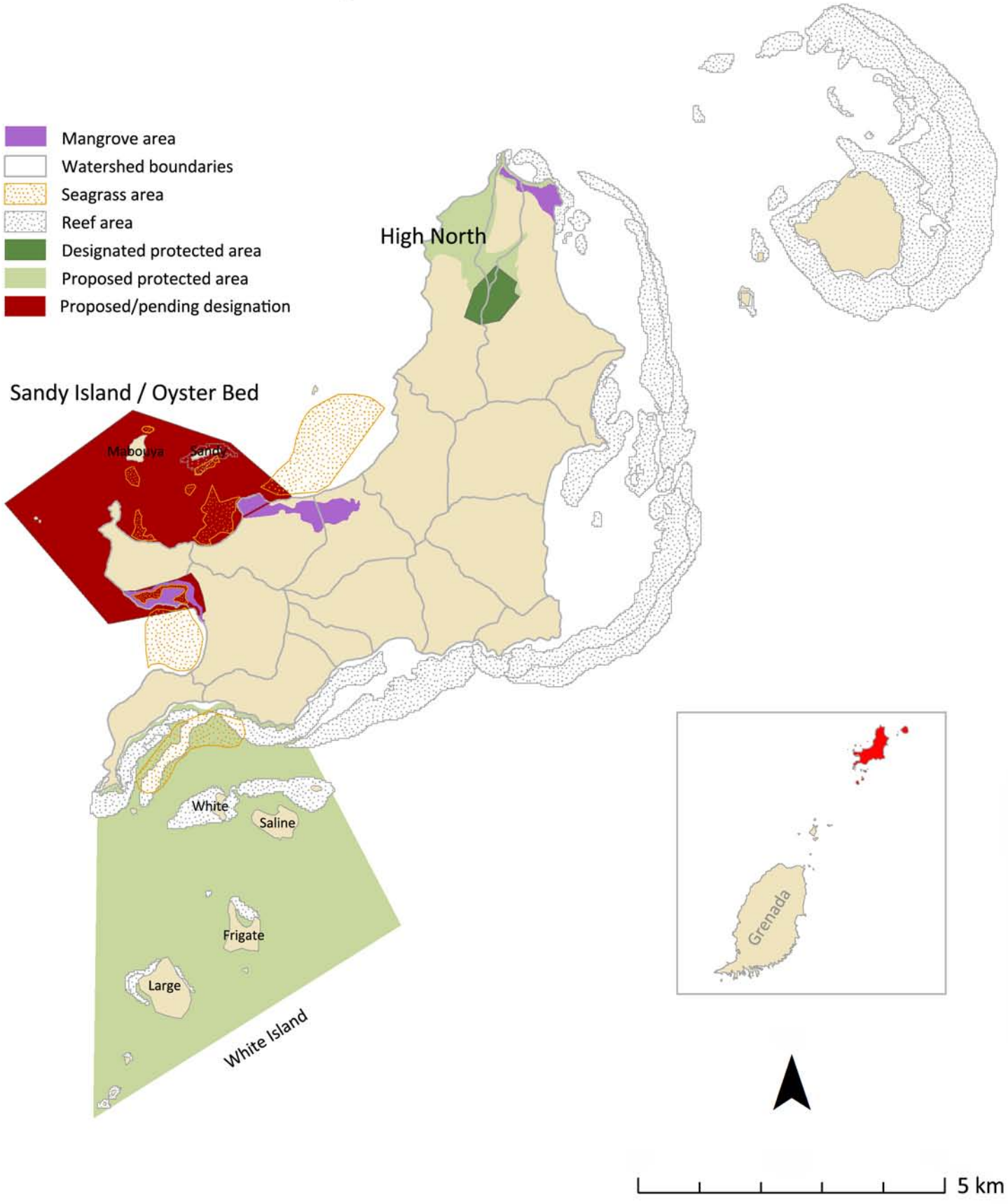
MAP 1

Ridge-to-reef project sites of interest on the island of Grenada and freshwater/marine classification of areas



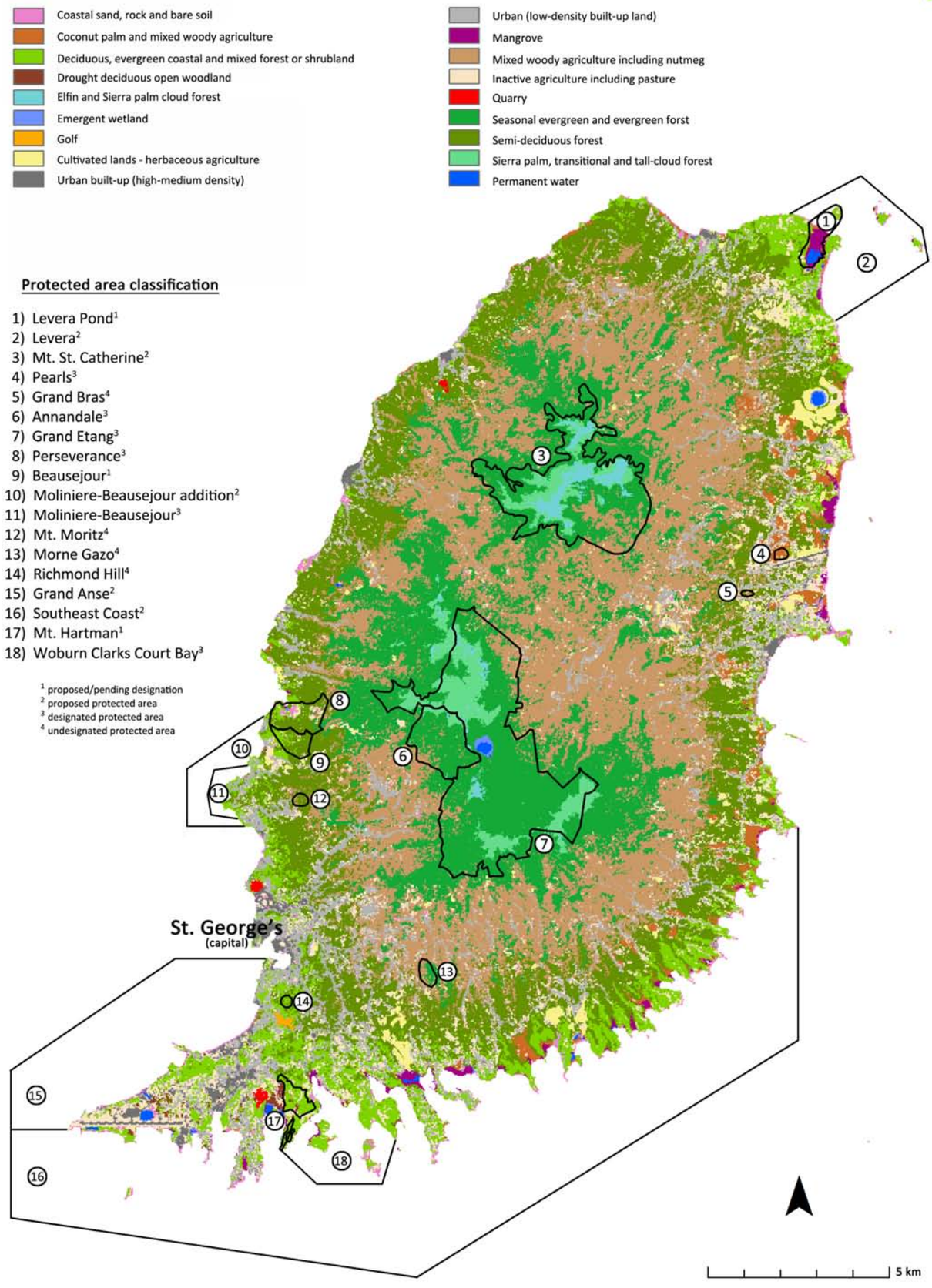
MAP 2

Ridge-to-reef project sites on the island of Carriacou and freshwater/marine classification of areas



MAP 3

Location/boundaries and land classes within ridge-to-reef proposed, proposed/pending, undesignated, and designated protected sites in Grenada



2. MARINE AREAS

Knowledge of the areal extent and distribution of ecosystems is essential in the implementation of 'ridge-to-reef' approaches to conservation (Douvere and Ehler 2009, Baldwin and Mahon 2011). Available information on ecosystems critical for conservation (coral reefs, seagrass beds, mangroves) for marine project sites is summarized in Table 3. Percentage shown indicates the estimated proportion of these ecosystems present at each ridge-to-reef marine project site (i.e., within existing site borders or projected site boundaries) in relation to total nationwide extent (see Maps 1 and 2). In summary, the ~12800 ha of coastal marine environment covered by the ridge-to-reef project (see Table 1, Maps 1 and 2) includes: 34 % of the estimated total coral reef area, 51 % of the estimated seagrass area, and 67 % of the estimated mangrove area nationwide.

Table 3: Areal extent of marine ecosystems critical for conservation in Grenada in relation to ridge-to-reef project sites

	Estimated area from available GIS data					
GRENADA	**Reef Area 3052 ha[1]**	**%**	**Seagrass 894 ha[1]**	**%**	**Mangrove 172 ha[2]**	**%**
Moliniere-Beausejour MPA	7	0.2	0	-	0.1	0.05
Moliniere-Beausejour addition	77	3	0	-	n/a	-
Woburn Clarks Court Bay MPA	77	3	127	14	9	5
Levera Pond & Levera addition	172	6	0	-	37	22
Grand Anse	177	6	134	15	0.4	0.2
Southeast Coast	954	31	226	25	79	46
Project area for Grenada	**1464 ha**	**49 %**	**487 ha**	**54 %**	**126 ha**	**73 %**

CARRIACOU	**Reef Area 2043 ha[1]**	**%**	**Seagrass 407 ha[3]**	**%**	**Mangrove 112 ha[1,4]**	**%**
Sandy Island/Oyster Bed MPA	22	1	80	20	34	30
White Island	268	13	93	23	9	8
High North addition	n/a	n/a	n/a	n/a	21	20
Project area for Carriacou	**290 ha**	**14 %**	**173 ha**	**43 %**	**64 ha[4]**	**58 %**

Grenada + Carriacou	**Reef Area 5095 ha[1]**	**%**	**Seagrass 1301 ha[3]**	**%**	**Mangrove 284 ha[5]**	**%**
Ridge-to-reef project area covered nationwide	**1754 ha**	**34**	**660 ha**	**51**	**190 ha**	**67 %**

n/a: not applicable

1. GIS data from the Land Use Division of the Ministry of Agriculture, Lands, Forestry and Fisheries (Grenada) and crossed referenced with other available sources (e.g., Reefbase 2013)
2. Data from Helmer *et al.* (2008), circa 2001
3. Seagrass data from the Land Use Division of the Ministry of Agriculture, Lands, Forestry and Fisheries (Grenada) and crossed references with other available sources (e.g., UNEP-WCMC 2005) and includes data obtained from the Sandy Island/Oyster Bed Marine Protected Area Management Plan (i.e., from classification maps)
4. Available data on mangrove cover on Carriacou are more than likely overestimations (see Section 2.2.2)
5. Sum of mangrove data for Carriacou (from the Land Use Division of the Ministry of Agriculture, Lands, Forestry and Fisheries) and Grenada (from Helmer *et al.* 2008)

2.1 Coral reefs

2.1.1 Historical and present context

Coral cover across Caribbean reefs has declined by an average of 80 % since the mid-1970s (i.e., a reduction from about 55 % hard-coral cover to less than 10 % during the last 40 years) (Gartner *et al.* 2003, Jackson *et al.* 2012; see Figure 1). Concerted impacts to the marine environment from multiple human activities (Hughes and Connell 1999, Crain *et al.* 2008) along with Caribbean-wide declines in carbonate production threaten future coral reef growth (Perry 2013).

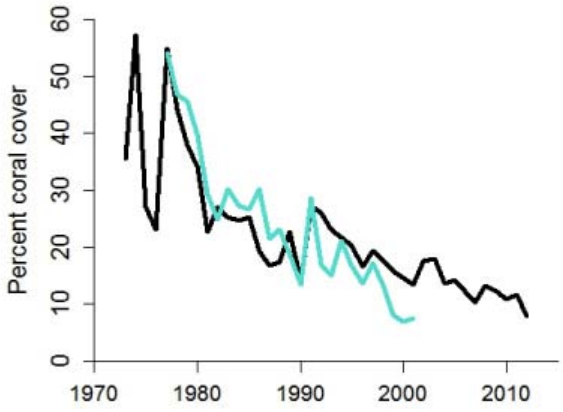


Fig. 1: Decline in percent live coral cover in Caribbean coral reefs from 1973 to present. Black line represents compiled data based on yearly averages weighted by the area surveyed per study; blue line represents data adapted from Gardner *et al.* 2003 (in Jackson *et al.* 2012).

2.1.2 State and extent of coral reefs in Grenada

The Lesser Antilles (including Grenada) has been identified as the global region with the 2nd highest proportion of reefs considered in critical stages (i.e., showing a recent 50-90 % coral decline and with a number of reefs likely to be effectively lost during the next 20 years) (see Wilkinson 2008). Virtually all coral reefs and adjacent marine areas of the Lesser Antilles are classified as being at significant risk from human activities (Bryant *et al*. 1998, Roberts *et al*. 2002, Bouchon *et a*l. 2008), with Grenada placing in the highest risk quartile from current threat analyses conducted on 27 countries and territories considered most vulnerable (Burke *et al.* 2011).

From the assessment by Burke and Maidens (2004), Table 4 shows the *Reefs at Risk Index* for Grenada (i.e., proportional scale of threat across all reefs) in relation to (1) fishing pressure—unsustainable harvesting of fish and invertebrates, (2) coastal development—runoff from coastal construction, sewage discharge, and impacts from unsustainable tourism, (2) watershed-based pollution—erosion and nutrient fertilizer runoff from agriculture delivered by rivers to coastal waters, (4) marine-based pollution and damage—solid waste and contaminants from gas installations or shipping, and physical damage from anchors and ships.

Table 4: Ranked threats to reefs in Grenada showing proportional scale (%) of threats across reefs; *Reef Threat Index* indicating the cumulative rating (%) of reef threats in the country (adapted from Burke and Maidens 2004)

Individual threat	Low	Medium	High
Fishing pressure	0	37	63
Coastal development	15	22	63
Watershed-based pollution	43	27	30
Marine-based pollution and damage	76	14	9

All threats together	Low	Medium	High	Very high
Reef Threat Index[1]	0	20	40	40

1. The index is rated *very high* where three or four of the individual threats are high

Large-scale mapping data and analyses used to produce current reef estimates remain too coarse to measure explicit coral reef structures or coral cover (Palandro *et al.* 2008). Past and current estimates of reef areas for Grenada and Carriacou vary (Table 5) and the available data does not identify the proportion of live coral and/or healthy contiguous reef habitat. Note that indicating *reef area* (as is often done) instead of coral cover can be misleading. For example, many large reef areas indicated for Grenada (notably on the southeast side of the island; see Map 1) do not have any major reef structures (e.g., reef crests), but instead are comprised mostly of fleshy algal pavements or dense stands of algae (e.g., *Sargassum* spp.) that overlie carbonate foundations (presumably from ancient *Acropora* spp. accretion) (Adey and Burke 1976). Taking this general *reef area* characterization into account, 60 % of the estimated *reef area* occurs in Grenada and 40 % in Carriacou.

Table 5: General estimates[1] of coral reef areas nationwide

Total reef area[1] (km^2)	Source
51	UNEP-WCMC, WorldFish Centre, WRI and TNC (2010) IMaRS-USF and IRD (2005) IMaRS-USF and IRD (2005)
160	Burke and Myers 2004
150	Spalding *et al.* 2001

1. Note that estimates do not necessarily differentiate between live/dead corals or rocky bottom substrates (e.g., coral rubble, bedrock)

The actual proportion of live coral cover across reefs in Grenada is largely unknown and higher resolution surveys of reef areas are needed. Spalding *et al.* (2001) indicated that even though there are fringing and patch reefs across all coasts of Grenada also highlighted that "the total area of reef is not great", presumably referring to contiguous reef habitat or live coral cover. The majority of Grenada's shallow reef environment is overgrowing with algae (Anderson *et al.* 2012). Deeper more offshore reefs have been noted as being relatively healthier, with algal growth said to be mostly seasonal (Creary 2008).

Anderson *et al.* (2012) further report that existing coral reef habitat in Grenada's nearshore waters is comprised mostly of low-density stands of branching corals: *Agaricia* spp. and *Porites* spp. (notably in the southwest). There are some relatively significant stands of *Acropora* sp. to the north (despite hurricane damage in the recent past) and large bank barrier reefs off the eastern coast of Carriacou provide relatively better reef habitat than that found off mainland Grenada (GoG 2001, Bouchon *et al.* 2008; pers. comm. 2013, D. Winsborrow—local sport diver).

Systematic reef surveys have only been conducted off the southwest coast of Grenada (Table 6), where the majority of established coral dive sites occur (Bouchon *et al.* 2008). Low values of coral cover in relation to algae are similar to many reported findings from across the Caribbean (see Figure 1).

Table 6: Summary of reef cover surveys across a number of locations in the Grand Anse reef system (southwest Grenada)

Survey year	**2006-2007[1]**	**2007[2]**	**2008[3]**	**2010[3]**
Number of survey locations	9	6	5	5
Live hard coral (%)	24 - 38	10	17	15
Fleshy algae (%)	37 - 53	42	46	53

1. Bouchon *et al.* 2008
2. Creary 2008
3. Anderson *et al.* 2012 (only data from point line transects are shown)

The Fourth National Report of Grenada to the Secretariat on the Convention on Biological Diversity (2009) states that coral reef surrounding Grenada is estimated at 12.5 km^2 (no further information or reference provided). A coral reef area of 12.5 km^2 would result by applying an estimate of 25 % live coral cover to the total reef area estimated for Grenada (i.e., 51 km^2, see Table 5). A 15 % live coral cover (from data in Table 6) applied to the total reef area estimated (51 km^2) would yield an estimate of ~8 km^2 of live coral reef cover nationwide.

2.1.3 Reef biodiversity and species of conservation concern

Caribbean reefs likely contain about 30000 described species (Reaka-Kudla 2005). In an inventory of 5 major taxonomic groups within the Caribbean, 12046 marine species were directly identified, with 1441 species from these groups occurring in the Lesser Antilles (Miloslavich *et al*. 2010). Table 7 summarizes species numbers within these major groups identified for the Lesser Antilles (excluding crustaceans—except amphipods; and excluding fish—see Section 2.1.3.2).

Only hard corals, reef-associated fish and sea turtles are examined in this section. Many other important coastal species of conservation concern (e.g., bottlenose dolphins and other cetaceans) and/or reef-associated species (e.g., Queen conch, spiny lobster, tube sponges, etc.) are not included in this species assessment.

Table 7: Number of species identified in 5 major taxonomic groups in the Lesser Antilles (adapted from Miloslavich *et al.* 2010)

Major taxonomic group	Number of species
Hard corals	71
Sponges	126
Molluscs	1119
Echinoderms	79
Amphipods	46
Total species	1441

2.1.3.1 Coral species

Of the 71 *hard coral* species (order Scleractinia) known to occur in the Lesser Antilles (Miloslavich *et al*. 2010), 54 species from 10 family taxa are identified as occurring in Grenada (see Appendix 1; Anderson *et al.* 2012, Sealifebase 2013, IUCN 2013, UNEP-WCMC 2013). To simplify, only scleractinian corals are addressed in this report as they are considered the basic reef-forming/building corals (Humann and Deloach 2002). Information on *octocorals* (e.g., gorgonian sea fans), *hydrocorals* (e.g. *Millepora* fire corals) and other important reef invertebrate components in Grenada cannot be evaluated in this report because little information is available. Note that hydrocorals were included as hard coral cover in reef surveys identified in Table 6. Almost all of the hard coral species identified as occurring in Grenada have been assessed under the protocol of the IUCN Red List of Threatened Species, and 11 species are currently red-listed (Table 8; IUCN 2013).

Table 8: Conservation status of hard corals (i.e., reef-building) in Grenada

Species	Common name	IUCN status[1]
Acropora cerviconis	Staghorn coral	*Critically Endangered*
Acropora palmata	Elkhorn coral	
Montastraea annularis	Boulder star coral	*Endangered*
Montastraea faveolata	Mountainous star coral	
Porites branneri	Blue Crust Coral	*Near Threatened*
Agaricia lamarcki	Lamarrck's sheet coral	*Vulnerable*
Montastraea franksi	Boulder star coral	
Dichocoenia stokesii	Elliptical star coral	
Dendrogyra cylindrus	Pillar coral	
Mycetophyllia ferox	Rough cactus coral	
Oculina varicosa	Large ivory coral	

1. IUCN Red List of Threatened Species (2013)

2.1.3.2 Reef-associated fish

Appendix 2 shows 317 reef-associated fish from 72 family taxa identified as occurring in Grenada (Fishbase 2013). Of these, 81 fish have been assessed under the protocol of the IUCN Red List of Threatened Species, and 23 species are currently red-listed (Table 9; IUCN 2013). Past annual surveys conducted at five reefs across the southwest coast (i.e., Grand Anse) showed that fish diversity indices were high and similar across sites, but that the density of most major fish groups examined decreased significantly from 2008 to 2010 (Anderson *et al.* 2012). Overfishing of reef fish in Grenada has been documented in the past (Jeffrey 2000) and remains a major threat largely unabated (see Table 4). Increasing exploitation of reef fisheries along with increasing tourism—one of the fastest growing economic sectors in the Eastern Caribbean, is more than likely affecting fish stocks adversely (Jeffrey 2000). Threats to reef fish populations are now compounded by invasive lionfish (*Pterois volitans*—known to significantly reduce recruitment of coral reef fishes; Albins and Hixon 2008). Lionfish were first reported in Grenada circa 2010 (Loughney 2013) and recent eradication projects have captured more than 50 individuals in one day in the Moliniere-Beausejour Marine Protected Area (pers. comm. 2013, P. Phillipson—Scubatech Dive Center, Grenada).

Table 9: Conservation status of reef-associated fish in Grenada

Species	Common name	IUCN status[1]
Epinephelus itajara	Atlantic goliath grouper	*Critically Endangered*
Epinephelus striatus	Nassau grouper	*Endangered*
Albula vulpes	Bonefish	
Carcharhinus acronotus	Blacknose shark	
Carcharhinus falciformis	Silky shark	
Carcharhinus leucas	Bull shark	
Carcharhinus limbatus	Blacktip shark	
Negaprion brevirostris	Lemon shark	
Aetobatus narinari	Spotted eagle ray	*Near Threatened*
Scarus guacamaia	Rainbow parrot fish	
Dermatolepis inermis	Marbled grouper	
Mycteroperca bonaci	Red grouper	
Mycteroperca bonaci	Black grouper	
Mycteroperca venenosa	Yellowfin grouper	
Paralabrax dewegeri	Vieja	
Balistes vetula	Queen triggerfish	
Lachnolaimus maximus	Hogfish	
Lutjanus analis	Mutton snapper	
Lutjanus cyanopterus	Cubera snapper	*Vulnerable*
Megalops atlanticus	Tarpon	
Mycteroperca intestitialis	Yellowmouth grouper	
Hippocampus erectus	Lined seahorse	

1. IUCN Red List of Threatened Species (2013)

2.1.3.3 Reef-associated turtles and turtle nesting

Of the four marine turtles known to frequent waters of Grenada, only hawksbill and green turtles occur in reefs and adjacent foraging habitats (e.g., seagrass beds and mangroves). Loggerhead turtles occur further offshore and leatherback turtles will come inshore during the nesting season (Grazette *et al.* 2007) but only to beaches near deep water and typically away from coral reefs.

Sea turtle nesting occurs intermittently along northeastern beaches of Grenada and generally on most beaches around Carriacou. Beaches at four ridge-to-reef project sites have significant turtle nesting activity documented (Table 10) and appear to include the majority of recent sea turtle nesting sites (SWOT 2013). Nesting turtle populations in Grenada are under significant pressure from illegal harvesting of sea turtle eggs and a legal turtle fishery (Lloyd and King 2006, Grazette *et al.* 2007, Isaac 2010).

Table 10: Conservation status and nesting of sea turtles in Grenada[1]

Species[1]	Common name	IUCN status[2]	Site	Max. annual nesting frequency[3]
Dermochelys coriacea	Leatherback turtle[4]	Critically Endangered	Levera Pond & Levera addition High North additon White Island Sandy Island / Oyster Bed MPA	>1000 <500 <100 <25
Eretmochelys imbricata	Hawksbill turtle	Critically Endangered	High North addition Levera Pond & Levera addition	<100 <25
Chelonia mydas	Green turtle	Endangered	High North addition	<25

1. Note that IUCN red-listed *Endangered* loggerhead turtle (*Caretta caretta*) also occurs in national waters, but further offshore
2. IUCN Red List of Threatened Species (2013)
3. Maximum estimate of binned turtle clutches from data presented from 2006 to 2010 (SWOT 2013)
4. Both marine turtles are also associated with mangrove and seagrass habitats (see Sections 2.2.3 and 2.3.3)

2.2 Mangroves

2.2.1 Historical and present context

Mangroves are disappearing worldwide by 1-2 % per year, a rate greater than or equal to declines in adjacent coral reefs (Duke *et al.* 2007). Large-scale analyses across the Americas (including Grenada) indicate that at least 38 % of mangrove forest area has been lost over recent decades (Valiela 2001). More recent studies using improved spatial analyses now show that worldwide mangrove cover is even less than previously estimated (by at least 12 %; see Giri *et al.* 2011).

Impacts to mangrove forests come from direct human activities (Ellison and Farnsworth 1996, Farnsworth and Ellison 1997, Alongi 2002, Gillman *et al.* 2008) and indirect qualitative degradation, where other coastal vegetation and mangrove associates (e.g., *Acrostichum* spp.) replace typical, valuable, and functional true mangrove species with no change in vegetation cover to the initial mangrove area (see Dahdouh-Guebas *et al*. 2005, Ellison *et al.* 2005). The protection and restoration of mangroves are probably among the most important conservation priorities for Grenada (Helmer *et al.* 2008).

2.2.2 State and extent of mangroves in Grenada

Loss of mangroves in Grenada has occurred primarily because of clearing for construction and land conversion (e.g., the removal of mangroves for marinas and yachting activities; Thomas 2000; Moore 2004), followed by waste disposal (e.g., landfill garbage, asphalt manufacturing effluents; Rusk 2010) and firewood/charcoal production (FAO 2007, Rusk 2009, Spalding *et al.* 2010). Recent estimates of mangrove distribution over time for Grenada indicate an annual mangrove areal decline of 1.2 to 1.3 % occurring from 1980 and projected to 2005 (FAO 2007). However, with large unaccounted mangrove declines due to clearings around Levera Pond (in Grenada; Rusk 2009) and Tyrell Bay (in Carriacou; Moore 2004) the estimated annual mangrove decline over time is likely greater than currently specified.

The most reliable estimate of total mangrove area in Grenada (excluding Carriacou) is currently calculated at 172 ha (see Table 3 and Map 1; Helmer *et al.* 2008). Levera Pond remains the largest stand of mangrove forest and accounts roughly for 20 % of the estimated mangrove area on the island (~33 ha; Spalding *et al.* 1997, FAO 2007). Remaining mangroves in Grenada are located mainly along the northeastern and southwestern coasts spread out in pockets alongside fringing coastal forests. Available GIS data sourced from the Land Use Division of the Ministry of Agriculture, Lands, Forestry and Fisheries (Grenada), Spalding *et al.* (2010), and including mangrove cover estimated on Saline island (gleaned from GoogleEarth), yield a total areal estimate of 112 ha of mangroves for Carriacou (see Table 3 and Map 2). Nevertheless, this areal extent is based on large-scale classification analyses considered very course and does not take recent hurricane damage into account. It is more than likely that mangrove cover on Carriacou is much less than currently estimated (see Moore 2004a, 2004b).

2.2.3 Mangrove biodiversity and species of conservation concern

A total of 10 mangrove tree species from 4 genera are found in Atlantic Latin America and the Caribbean (Lacerda 1993). Five true mangrove tree species are present in the Lesser Antilles (Imbert *et al.* 2000), and all have been identified in the mangal flora of Grenada (Table 11; Tomlinson 1994, FAO 2007, Massó-Alemán *et al*. 2010). These are listed as 'Least Concern' under the protocol of the IUCN Red List of Threatened Species (IUCN 2013); however, it is

important to note that at insular local scales (such as Grenada), these mangrove species and entire mangrove ecosystems are generally considered threatened (see Polidoro *et al*. 2010). Many plant species also occur associated with mangrove forests in the Caribbean, with flora varying from region to region and even from forest to forest in a given region (de Lacerda 1993). No systemic faunal or floral species assessments have been conducted in mangroves across Grenada.

Table 11: The five mangrove tree species identified as occurring in Grenada

Species	Common name	IUCN Status[1]
Avicennia germinans	Black mangrove	Least Concern[2]
Avicennia schaueriana		
Conocarpus erectus	Silver-leaved buttonwood	
Laguncularia racemosa	White mangrove	
Rhizophora mangle	Red mangrove	

1. IUCN Red List of Threatened Species (2013)
2. Pertains to the global distribution range; note that the areal extent of mangroves in Grenada accounts for ~0.5 % of the total land area and ~3 % for Carriacou, thus warranting a greater local conservation concern

Mangrove fauna is large and diversified—hundreds of species of terrestrial and marine invertebrates, along with over 140 bird and 220 fish species identified, create a variety of dynamic and diverse assemblages across mangroves in the Americas (de Lacerda 1993). In nearby Trinidad, over 350 species of invertebrates (e.g., insects, crustaceans) and vertebrates (e.g., birds, reptiles) were recorded in just one mangrove forest (de Lacerda 2002).

Much of the fauna found in mangroves also occurs in other coastal habitats; for example, many typical coral reef fishes have been recorded to occur frequently in mangroves (Alvarez-Leon 1993) and *Critically Endangered* hawksbill turtles and *Endangered* green turtles are also known to feed along mangrove edges (Limpus and Limpus 2000, Guebert-Bartholo *et al.* 2011, Gaos *et al.* 2012).

Many species occupy mangroves during some stage of their life cycle or as part of their daily activities or migrations. Whether resident, transient or vagrant, 106 of the 222 bird species recorded in Grenada (Appendix 3) are known to occur/frequent mangrove forests or mangrove edges (Frost and Messiah 2003, Rusk 2008, BLI 2012, Ridgley *et al.* 2012, Avibase 2013, Cornell 2013; IUCN 2013). Of all the birds identified in Grenada and known to occur/frequent mangrove forests or mangrove edges (see Appendix 3), 3 species are of conservation concern and the scaly-breasted thrasher has a restricted range across the Lesser Antilles (out of 3 birds considered regional endemics known to occur in Grenada) (Table 12). Moore (2004) notes that without mangrove habitats in Carriacou it is unlikely that many waterbirds would remain on the island.

Table 12: The four birds of conservation concern known to occur/frequent mangroves in Grenada and/or mangrove habitat edges.

Species	Common name	IUCN Status[1]
Calidris pussilla	Semipalmated sandpiper	Near Threatened
Fullica caribaea	Caribbean coot	Near Threatened
Dendrocygna arborea	West Indian whistling-duck	Vulnerable
Allenia fusca	Scaly-breasted thrasher	Regional endemic[2]

1. IUCN Red List of Threatened Species (2013)
2. IUCN status *Least Concern*; (i.e., restricted range); formerly known as *Margarops fuscus*

2.3 Seagrass

2.3.1 Historical and present context

Global seagrass cover has been reduced by at least 29 % (by ~51000 km^2) over the past century, with rates of decline increasing nearly 8-fold from before 1940 through to 1990 (Waycott *et al.* 2009). Comparable to rates of decline reported for coral reefs and mangroves, seagrass loss has been estimated at 110 km^2 per year since 1980 (Orth *et al.* 2006, Waycott *et al.* 2009).

Threats to seagrasses worldwide are similar and widespread (Green and Short 2003, Short *et al*. 2011). In tropical regions, the major impacts by human activities responsible for seagrass loss include those affecting water quality or clarity (e.g., eutrophication leading to algal blooms) as a result of nutrient loading (e.g., fertilizers) and increased turbidity (e.g., sedimentation) from agricultural runoff and sewage disposal, upland clearing (e.g., erosion of watersheds due to deforestation), mechanical damage (e.g., dredging and deposition, boating activities), construction and coastal development (e.g., tourism), water pollution (e.g., leaching of pesticides, disposal of toxic wastes) and fisheries (e.g., trawling, aquaculture) (Short and Wyllie-Echeverria 1996, Green and Short 2003, Orth *et al.* 2006, Short *et al*. 2011). Insufficient data is available to provide a comprehensive assessment of Caribbean seagrasses (Green and Short 2003), and much less so for Grenada, but acknowledged general declines in the region have resulted from a combination of these impacts—also related to declines in coral cover (see Table 13; compare to Table 4).

Table 13: Percentage of global seagrass species affected by the top 4 major threat categories (adapted from Short *et al*. 2011).

Major threat category[1]	Percentage of affected species[2]	Percentage of affected species at significant risk[3]
Coastal development	93	21
Water quality	58	26
Mechanical damage	44	9
Fisheries	38	4
Sedimentation/siltation	36	12

1. Threat categories are not mutually exclusive (e.g., water quality can also be affected by coastal development)
2. 72 species assessed worldwide
3. Percent of affected seagrass species classified as either IUCN status *Threatened* or *Near Threatened*

2.3.2 State and extent of seagrass beds in Grenada

Nayer *et al.* (2009) indicate that seagrass beds are predominantly concentrated on the eastern and southeastern coasts of Grenada and around the eastern and southwest coasts of Carriacou, based on sea urchin harvesting sites (typically, shallow seagrass habitats). The lack of urchin harvesting sites on the western and northern coasts suggests that such habitat is not as common in these areas. Based on reports from the early 1980s, the Ramsar Convention on Wetland's country profile for Grenada also notes the presence of extensive seagrass beds off the eastern and southern coasts of Grenada and off western Carriacou (see Scott and Carbonell 1986).

Available estimates of seagrass areas in Grenada and Carriacou have been calculated to total ~1300 ha (see Table 3). Ridge-to-reef marine sites include ~50 % of this estimated area (see Maps 1 and 2). Nevertheless, one needs to take into account that this data, provided by UNEP-WCMC (2005), is best limited to large-scale analyses as it is reported to have substantial inaccuracies, poor spatial representation, and limited spatial resolution (Wabnitz 2008). More reliable and current estimates of seagrass cover are necessary for small island states such as Grenada, especially since seagrass distribution generally changes on the micro-scale level and over very short periods (Short *et al.* 2007). Note that optical remote sensing is now providing detailed high-temporal resolution for mapping seagrass areas with much greater confidence (Pu *et al*. 2010).

Despite few historical reports available that document the permanent loss of seagrass beds in the Caribbean, Green and Short (2003) report on the loss of seagrasses in Carriacou between 1969 and 1994 in their report *World Atlas of Seagrasses* (but provide no further detail). Recently, Moore (2004a) reported that sand mining near the Sandy Island/Oyster Bed Marine Protected Area, as well as land-reclamation activities resulting in cleared mangroves within Tyrell Bay, have created a permanent disturbance to surrounding seagrass beds. Removal of sand from beaches and coastal areas for use in the construction industry is widespread throughout the Caribbean, particular in the smaller island states (Green and Short 2003). Sand mining is now prohibited in Grenada (Singh 2010), but smaller scale removals still occur (Isaac 2010). GIS data obtained from the Land Use Division of the Ministry of Agriculture, Lands, Forestry and Fisheries indicated that sand mining activities occurred predominantly on the northeastern side of the island in the recent past (south of Levera on beaches between Conference Bay and Great River Bay—see Map 1) where extensive seagrass habitat is purported to occur (Nayer *et al.* 2009), significant areas of mangrove forests are found (Helmer *et al.* 2008) and *Critically Endangered* leatherback turtles have been known to nest (Dow and Eckert 2007).

2.3.3 Seagrass biodiversity and species of conservation concern

A total of 12 seagrass species from 5 genera are found in the tropical Altlantic (Short *et al.* 2007). Six of these seagrass species have been identified in nearshore waters of Grenada (Table 14), including the recent discovery of the potentially invasive seagrass *Halophia stipulacea* (Willette and Ambrose 2009).

Table 14: The five seagrass species identified as occurring in Grenada

Species	Common name	IUCN status[4]
Thalassia testudinum	Turtlegrass[1]	
Syringodium filiforme	Manatee grass[1]	
Halodule wrighti	Shoal grass[1]	Least Concern
Halophila decipiens	Paddle grass	
Halophila stipulacea	Halophia seagrass[2]	
Halophila baillonii	Cover grass[3]	Vulnerable

1. Most common and dominant seagrasses
2. Introduced/invasive species, originally from Indian Ocean
3. Restricted range—includes Lesser Antilles, thus most probably occurring in Grenada (Littler and Littler 2000
4. IUCN Red List of Threatened Species (2013)

The majority of seagrasses are listed as 'Least Concern' under the protocol of the IUCN Red List of Threatened Species (IUCN 2013); however, at insular local scales (as highlighted for mangroves—see Section 2.2.3) such ecosystems are generally considered threatened.

Of the 115 species assessed under IUCN protocol that occur in seagrass habitats worldwide, there is currently 31 species of conservation concern (27%); specifically, 9 species—*Critically Endangered*, 7 species—*Endangered*, and 15 species—*Vulnerable* (Short *et al.* 2011). Many other species found in seagrass habitats have not been assessed, and especially so across the Caribbean. It is important to note that both *Critically Engangered* hawksbill turtles and *Endangere*d green turtles will forage in seagrass habitats, with green turtles feeding directly upon seagrasses in Grenada.

Seagrass habitats have consistently shown to have important levels of biodiversity, with comparisons to adjacent coral reefs often showing similar to significantly higher levels of diversity (Hemminga and Duarte 2000). Despite this high diversity and the importance of associated species (e.g., sea turtles), there are few detailed studies of species associated with seagrass beds in the Caribbean (Heck 1977, Weinstein and Heck Jr. 1977, Nagerlkerken *et al.* 2001). Although some species appear to be primarily restricted to seagrass ecosystems (e.g., Queen conch, Stoner *et al*. 1996; various urchins, Valentine and Heck 1999) or dependent on seagrasses for at least part of their life cycle (e.g., spiny lobster, Acosta 1999), still many of the species that have been recorded have also been found in other ecosystems (e.g., coral reefs, mangroves) (Green and Short 2003).

3. LAND AREAS

3.1 Historical and present context

Forests in Grenada are primarily secondary growth as most of the original native forests were cleared during the plantation era. The decline of sugar cane cultivation, the banana industry, and other land-use shifts away from agriculture have caused forest cover in Grenada to increase significantly during the last half century (Table 15, Figure 2) (Helmer *et al*. 2008, FAO 2010a). During 1990-2005, Grenada is said to have gained 12.5 %[1] of its forest and woodland habitat (FAO 2006). Leipzig (1996) and FAO (2006) report that the state owns 69 % (4830 ha) of classified forests and woodlands in Grenada and that 31 % (2170 ha) is privately owned. However, with estimated increases in forested areas from abandoned agriculture and/or fallow land; especially after past hurricanes in the last 10 years, the proportion of privately owned forested areas and woodlands is expected to be much higher. Interestingly, Singh (2010) indicates that over 85 % of the land in Grenada is privately owned.

Table 15: Land-cover change from about 1945 (Beard 1949) to 2001 (Helmer *et al.* 2001).

Land-cover/forest class	1945 (ha)	2001 (ha)	Change[1] (%)
Drought deciduous woodland, inactive agriculture, and all grassy areas[2]	405	2397	+ 491
Drought deciduous or Semi-deciduous forest, and dry shrub woodland	1052	8584	+ 716
Seasonal evergreen, evergreen, and cloud forests[3]	3946	7208	+ 83
Cultivated land[4]	27661	9784	- 65
Urban or built-up land[5]	202	3153	+ 1458

1. Percent change = [value for 1945] – [value for 2001] ÷ [value for 1945] x 100 %
2. Includes savannas and grazing areas
3. Includes rain forest, lower montane rain forest, montane thicket, elfin woodland, palm brake and secondary rain forest
4. Includes herbaceous agriculture, mixed and woody agriculture
5. Includes other uncultivated land (e.g., golf course, sparsely vegetated areas)

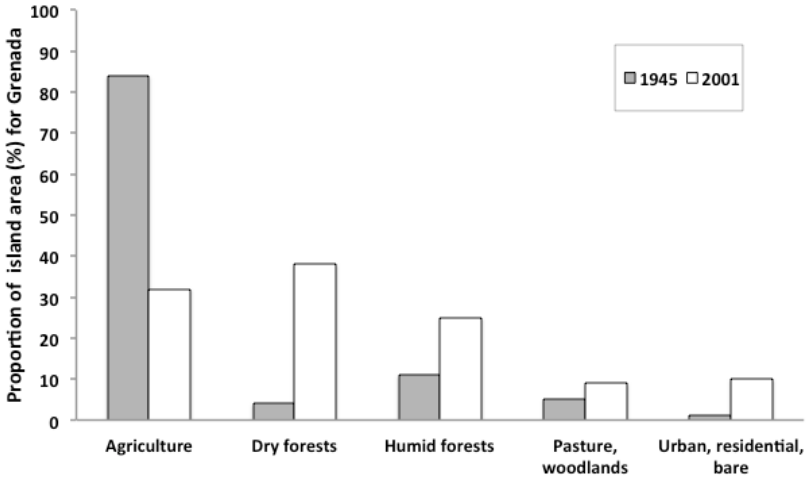


Fig. 2: Land-cover distributions in Grenada between 1945 and 2001 (adapted from Helmer *et al.* 2001)

[1] Defining total rate of habitat conversion as the [change in forest area] + [change in woodland area] – [net plantation expansion]

3.2 State and extent of forest habitats in Grenada

3.2.1 Land cover and forest formations

Available information on land-cover and forest class distributions for all ridge-to-reef terrestrial project sites is summarized in Table 16 (for mangroves—see Table 3). Areal proportions (%) in Table 16 represent the total area for each land class distributed at project sites (see Map 3). Table 17 profiles the different land classes at each project site.

Table 16: Areal extent of forest and land-cover classes for Grenada and Carriacou in relation to the ridge-to-reef project (all sites together).

Land classification for Grenada[1] (ha)	Total area in Grenada (ha)	Total area in project	%
Drought deciduous open woodland	54	4.0	7.3
Deciduous, evergreen coastal, mixed forest or shrubland	2162	96.3	4.5
Semi-deciduous forest (includes semi-evergreen forest)	6422	136.9	2.1
Seasonal evergreen & evergreen forest	6347	1914.7	30.2
Sierra palm, transitional & tall cloud forest	663	563.0	84.9
Elfin & Sierra palm cloud forest	198	185.7	93.8
Nutmeg & mixed-woody agriculture)	8984	280.4	3.1
Coconut palm & mixed-woody agriculture	469	12.1	2.6
Pasture, hay, or inactive agriculture	2343	34.4	1.5
Emergent wetland	43	2.1	4.9
Water (permanent)	63	22.8	36.1
Rivers (length in km)	822 km	124.4 km	15.1
Low-density built-up land (rural/residential)	2439	5.5	0.2

Land classification for Carriacou[2] (ha)	Total area for Carriacou (ha)	Total area for project sites	%
Deciduous forest	295	54.3	18.4
Scrub and cactus	1189	127.3	10.7
Open scrub and cactus	632	1.1	0.2
Pasture and grazing with fruit trees	318	0.5	0.2
Open & controlled grazing	405	8.8	6.2
Rivers (length in km)	83 km	2.0 km	2.3

1. Data from Helmer *et al.* (2008), circa 2001
2. Data from the Land Use Division of the Ministry of Agriculture, Lands, Forestry and Fisheries (Grenada), provided by The Nature Conservancy

Table 17: Areal extent of land-cover and forest class for reef-to-ridge project sites

Land class and area for Grenada[1] (ha)	Perseverance	Beausejour	Mt. Hartman	Grand Etang	Annandale	Mt. St. Catherine	Levera[2]	Richmond Hill	Mt. Morritz	Morne Gazo	Grand Bras	Pearls
Drought deciduous open woodland	-	-	4.0	-	-	-	-	-	-	-	-	-
Deciduous, evergreen coastal, mixed forest or shrubland	14.9	15.6	49.9	-	-	-	11.2	4.2	-	-	-	0.5
Semi-deciduous forest includes semi-evergreen forest	65.2	38.9	3.3	-	-	-	14.0	3.9	8.9	0.5	2.3	-
Seasonal evergreen & evergreen forest	4.5	0.4	-	1174.0	189.5	533.5	-	-	-	12.7	-	0.1
Sierra palm, transitional & tall cloud forest	-	-	-	348.0	23.0	192.2	-	-	-	-	-	-
Elfin & Sierra palm cloud forest	-	-	-	39.5	2.6	143.6	-	-	-	-	-	-
Nutmeg & mixed-woody agriculture	3.4	0.2	3.0	111.6	26.8	121.1	-	-	-	12.4	1.6	0.3
Coconut palm & mixed-woody agriculture	-	-	-	-	-	-	4.5	-	-	-	-	7.6
Pasture, hay, or inactive agriculture	14.6	2.9	7.1	3.5	0.3	1.6	2.4	-	-	0.1	0.5	1.4
Emergent wetland	0.7	-	-	-	-	-	1.4	-	-	-	-	-
Low-density built-up land (rural/residential)	2.2	-	0.2	2.2	-	-	0.1	-	-	-	-	-
Water (permanent)	-	-	-	10.3	-	-	12.4	-	-	-	-	-
Rivers (km)[3]	2.0 km	19.0	-	64.1	8.2	29.3	0.9	-	-	0.4	-	-

Land class and area for Carriacou[3] (ha)	High North	High North additon	Sandy Island/Oyster bed
Deciduous forest	9.3	45	-
Scrub and cactus	42.5	82.4	2.4
Open scrub and cactus	-	0.3	0.9
Pasture and grazing with fruit trees	-	-	0.5
Open & controlled grazing	-	8.8	-
Coconut palm	-	-	-
Rivers (km)[3]	0.1 km	1.9	-

1. Data from Helmer *et al.* (2008), circa 2001
2. Includes both proposed Levera Pond Protected Area and Levera marine area addition (see Map 2)
3. Data from the Land Use Division of the Ministry of Agriculture, Lands, Forestry and Fisheries (Grenada), provided by The Nature Conservancy; note river measurements are in kilometers

Table 18: General areal extent of forest class and land cover for Carriacou

Land class and area for Carriacou[1]	Total areal extent (ha)
Deciduous forest	1869.8
Semi-deciduous forest	580.7
Evergreen and seasonal evergreen forest	19.6
Agriculture – cultivated land	185.3
Agriculture – woody land	18.5

1. Data from FAO (2010a), circa 2001

Table 18 likely provides more reliable land cover data for forest classes in Carriacou than those estimated in Table 17. Note that land classes for Carriacou used in Table 18 are also similar to parameters used for land classes in Grenada (Helmer *et al.* 2008), and thus would facilitate more complete nationwide analyses of forest types. Unfortunately, detailed data was not obtained and respective land cover analyses could not follow (e.g., identifying land-cover proportions and mapping forest types at project sites).

3.2.2 Land use and forestry

FAO (2010a, 2010b) reports a total forest area of ~17000 ha in Grenada, which corresponds with information presented on forest cover for Grenada and Carriacou in Table 16. As reported by FAO (2010a, 2010b), primary designated functions of forests in Grenada are presented in Table 19.

Table 19: Primary designated function of forested areas in the country

Primary designated function of forests	%	Approx. area[1] (ha)
Timber production	1	170 - 210 ha
Protection of soil and water	3	510 - 560 ha
Conservation of biodiversity	14	2320 - 2380 ha
None or unknown	82	13900 - 13940 ha

1. Proportional to the ~17000 ha of forest cover reported for Grenada in FAO (2010a, 2010b).

Outside of land cover reported in Helmer *et al.* (2008), little information on land use in Grenada is available. Timber extraction/production is reported as harvests of 139 m^3 for 1990, 2000, and 2005 FAO (2010a) and no data exists concerning wood-fuel removals (i.e., firewood, charcoal production).

A phasing out of timber production from natural forests is reported to have begun in the 1990s (Leipzig 1996), with reforestation initiatives increasing over the last 10 years (e.g., 15000 seedlings produced in 2009; GoG 2009). Forest extractions for non-timber forest products (e.g., baskets and other handicrafts) have been reported as using primarily screw pine (*Pandanus utilis*) and bamboo (*Bambusa vulgaris*) (GoG 2000), but no further information on these types of increasing forest extractions are available.

The Fourth National Report of Grenada to the Secretariat on the Convention on Biological Diversity (2009) indicates main threats to forest biodiversity in Grenada as the clearing of land for agricultural production, animal grazing, infrastructure, housing settlement and commercial activities, invasive and pest species, and natural disasters (e.g., hurricanes and fire), but provide no further data.

FAO (2010a) provides some information on the above noted threats and reports the following (starting from 2004):

- that hurricanes and tropical storms have impacted ~90 % of forests in Grenada
- a total of 10 forest fires have affected 5 ha of forested land
- mealybug pests have affected 500 ha of forested land (stemming from 38-90 ha of Blue mahoe reportedly destroyed and/or felled after mealy bugs were first recorded in 1994—Kairo *et al.* 2000, Sagarra and Peterkin 1999)
- that invasive bamboo is increasing rapidly in area (but no data is available to quantify the extent)

3.3 Forest biodiversity and species of conservation concern

Ridge-to-reef project sites include much of the critical habitat important for Grenadian wildlife and, most notably include much of the habitat range for all IUCN red-listed species of concern in Grenada. Table 16 and 17 highlight the diverse forest habitats and land areas of the project. The terrestrial ridge-to-reef project sites in Grenada (see Table 17) currently comprise 7 of the 9 areas highlighted nationwide for priority biodiversity conservation within reported Caribbean biodiversity hotspots—defined as areas of high levels of endemism and threat (Anadon-Irizarry 2012).

3.3.1 Flora

Beard (1949) reports a total of over 2000 species of flowering plants and 243 tree species distributed across the Lesser Antilles (cited in Lugo *et al.* 1981). IUCN (1998) reports that 1068 vascular plant species are encountered in Grenada. Excluding mangrove species assessments (see Table 11). There are 4 species currently red-listed (Table 20; IUCN 2013) from a total of 44 plants and trees assessed under the protocol of the IUCN Red List of Threatened Species (see Appendix 4).

Table 20: IUCN red-listed plants in Grenada

Species	Common name	IUCN status[1]
Guaiacum officinale	Commoner Lignum Vitae	Endangered
Melocactus broadwayi *Opuntia triacantha*	Turk's cap Big pine key prickly-pear	Near Threatened
Dedrela odorata	Spanish cedar	Vulnerable

1. IUCN Red List of Threatened Species (2013)

The majority of plants in Grenada have been described in Hawthorne *et al.* (2004). Endemic flora has been recorded (e.g., *Charianthus grenadensis*, *Maytenus grenadensis, Lonchocarpus broadwayi, Rhytidophyllum caribaeum*, *Cyathea elliottii),* but systemic surveys to provide a complete assessment is needed. Huber and Vincent (1988) report that overall floral diversity in Grenada is less than other islands in the Lesser Antilles, but habitat biodiversity indices calculated for Grenada remain one of the highest for the Lesser Antilles (Ricklefs and Lovette 1999, Henderson 2004).

3.3.2 **Mammals** (native and introduced species)

Similar to other islands of the Lesser Antilles, the land mammal fauna of Grenada is typically depauperate (Allen 1911). The land mammal fauna known to be present on the island (i.e., excluding known extinctions/extirpations) is comprised of 21 species of which none are endemic and more than half are bats (Appendix 5) (Nowak 1994, Genoways 1998, MacPhee *et al.* 2000, IUCN 2013). The majority of mammals are listed as 'Least Concern' under the protocol of the IUCN Red List of Threatened Species (IUCN 2013) (see Appendix 5); however, it is important to note that at insular local scales (such as small islands like Grenada), some populations of species are naturally small, thus warrant extended protection.

3.3.3 **Reptiles and Amphibians** (native and introduced species)

The current Grenadian herpetofauna is comprised of 4 amphibian species (1 endemic) and 14-18 reptiles (i.e., 4 species are strongly suspected extirpated, and no true wild population of the red-footed tortoise or Morocoy occurs) (see Appendix 6) (Germano *et al.* 2003, Henderson 2004, Powell and Henderson 2005, Henderson and Berg 2011, Powell and Henderson 2012). Few species of Grenadian herpetofauna have been assessed under the protocol of the IUCN Red List of Threatened Species, but 3 species are currently red-listed (Table 21) (IUCN 2013).

Table 21: IUCN red-listed terrestrial herpetofauna of Grenada (see Table 10 for sea turtles)

Species	Common name	IUCN status[4]
Pristimantis euphronides	Grenada frog[1]	Endangered
Typhlops tasymicris	Grenada bank blindsnake[2]	
Sphaerodactylus kirbyi	Grenadines sphaero gecko[3]	Vulnerable

1. Endemic; species also commonly referred to as *highland piping frog*
2. Suspected as extirpated in Grenada—only recent records from Union Island, St. Vincent and the Grenadines (Rogriguez *et al*. 2011)
3. Native in Carriacou, not expected to occur naturally in Grenada
4. IUCN Red List of Threatened Species (2013)

Important critical habitat for IUCN red-listed herpetofauna of Grenada is provided by Levera (potential presence of the *Endangered* bank blindsnake), High North and H. North addition (*Vulnerable* Grenadines sphaero gecko), and Grand Etang and Mt. St. Catherine provide species-specific habitat for the *Endangered* Grenada frog. Grand Etang and Mt. St. Catherine are of particular importance as they provide sufficient area for the larger of the land mammal species (see Appendix 5) and many IUCN red-listed birds (see Appendix 2) (Huber and Vincent 1988).

3.3.4 **Birds** (natives, migrants and vagrants)

The avifauna of Grenada is known to be primarily West Indian but with still a strong South American influence. A total of 222 species have been recorded nationwide (see Appendix 3; Frost and Messiah 2003, Rusk 2008, BLI 2012, Ridgley *et al.* 2012, Avibase 2013, Cornell 2013; IUCN 2013), with 35 species considered resident landbirds (Rusk 2009). A total of 5 birds are red-listed (Table 22), with the majority of species listed as 'Least Concern' under the protocol of the IUCN Red List of Threatened Species (IUCN 2013).

Table 22: IUCN red-listed birds in Grenada

Species	Common name	IUCN Status[1]
Leptotila wellsi	Grenada dove	Critically Endangered
Calidris pussilla	Semipalmated sandpiper	Near Threatened
Fullica caribaea	Caribbean coot	
Tryngites subruficollis	Buff-breasted sandpiper	
Dendrocygna arborea	West Indian whistling-duck	Vulnerable

1. IUCN Red List of Threatened Species (2013)

Along with regional endemics (see Appendix 3), of particular conservation importance is the national bird and endemic, the Grenada dove (*Leptotila wellsi*)—with a current population between 130-140 individuals (pers. comm. 2013, B. Rusk—Forestry Division). Three of the five identified *Important Birding Areas* (IBA) that provide dry forest habitat and directly support the population of Grenada doves are sites included in the ridge-to-reef project (Perseverance, Beausejour, Mt. Hartman) (Rusk 2009). The largest of all 6 identified IBAs is also included in the ridge to reef project (i.e., the Grand Etang and Annandale Forest Reserves).

3.3.5 Other

Islands in the Lesser Antilles, with the exception of Trinidad and Tobago (see Phillip *et al.* 2013; 66 brackish/freshwater fish reported) typically have few freshwater fish (Briggs 1984). Generally, freshwater fish assemblages of the Lesser Antilles are characterized by semi-marine mountain mullets (Mugiliidae) and gobies (Gobiidae), with the only *true* freshwater fish being the introduced poeciliids or guppies (i.e., *Lebistes reticulatus*, *Poecilia vivipara*) and cichlids (e.g., *Oreochromis* spp.) (Myers 1938). No systemic surveys for freshwater fish species in Grenada have been conducted, and existing data in the literature is mostly misleading and/or inadequately substantiated (e.g., see referenced material for Grenadian freshwater fish in Fishbase 2013).

Several types of aquatic environments are present in Grenada. Steeply flowing watercourses drain from the mountains, with many small streams exhibiting periods of intermittent flow and some larger rivers flowing slowly across narrow coastal lowlands forming marshes (prior to entering the sea). Some marine/brackish fish, such as the rare marbled swamp eel or *tête chien* (*Synbranchus marmoratus*) and common snooks (e.g., *Centropomus* spp.) are known to reside in such coastal aquatic environments in Grenada, but species distribution is not documented.

Freshwater macroinvertebrate faunas of the islands of the Lesser Antilles are also typically sparse (Bass 2003a). A total of 101 species of freshwater macroinvertebrates (including terrestrial species with aquatic life stages) from 12 taxonomic groups have been identified in Grenada (see list in Bass 2004), but still very little information is available and more studies are needed. It is likely that more studies would record many more additional species (Bass 2003b, 2004).

REFERENCES

Acosta CA (1999) Benthic dispersal of Caribbean spiny lobsters among insular habitats: Implications for the conservation of exploited marine species. *Conservation Biology* 13(3): 603-612.

Adey WH and R Burke (1976) Holocene bioherms (algal ridges and bank-barrier reefs) of the eastern Caribbean. *Geological Society of America Bulletin* 87: 95-109.

Albins MA and MA Hixon (2008) Invasive Indo-Pacific lionfish Pterois volitans reduce recruitment of Atlantic coral-reef fishes. *Marine Ecology Progress Series* 367: 233-238.

Allen GM. (1911) Mammals of the West Indies. *Bulletin of the Museum of Comparative Zoology at Harvard University*. 54: 175-263.

Alongi DM (2002) Present state and future of the world's mangrove forests. *Environmental Conservation* 29(3): 331-349.

Alvarez-Leon R (1993) Mangrove ecosystems of Columbia. Pp 75-114. *In:* Conservation and sustainable utilization of mangrove forests in Latin America and Africa Regions. (Ed.) Lacerda LD. Part I: Latin America. International Society for Mangrove Ecosystems and the International Tropical Timber Organization. Society for Mangrove Ecosystems, Okinawa, Japan.

Anadon-Irizarry V, Wege DC, Upgren A, Young R, Boom B, Leon YM, Arias Y, Koenig K, Morales AL, Burke W, Perez-Leroux A, Levy C, Koenig S, Gape L and P Moore (2012) Sites for priority biodiversity conservation in the Caribbean Islands Biodiversity Hotspot. *Journal of Threatened Taxa* 4(8): 2806-2844.

Anderson R, Morral C, Nimrod S, Balza R, Berg C and J Jossart (2012) Benthic and fish population monitoring associated with a marine protected area in the nearshore waters of Grenada, Eastern Caribbean. *Revista de Biologia Tropical* 60(1): 71-87.

Avibase (2013) Bird checklists of the world. Birdlife International. World Wide Web publication. Accessed September 2013. http://avibase.bsc-eoc.org/

Baldwin K and R Mahon (2011) A geospatial framework to support ecosystem based management and marine spatial planning for the transboundary Grenadine Islands. CHC Indies – Coast GIS 2011 Conference. 12 p.

Bass D (2003a) A comparison of freshwater macroinvertebrate communities on small Caribbean islands. *BioScience* 53(11): 1094-1100.

Bass D (2003b) A survey of freshwater macroinvertebrates in Tobago, West Indies. *Living World, Journal of Trinidad and Tobago Field Naturalist's Club*. 2003:64-69.

Bass D (2004) A survey of freshwater macroinvertebrates on Grenada. *Living World, Journal of Trinidad and Tobago Field Naturalist's Club*. 2003:26-31. (Only list viewed: http://www.biology.uco.edu/personalpages/bassweb/Grenda%20List.pdf).

Beard JS (1949) The Natural Vegetation of the Windward & Leeward Islands. Oxford, Clarendon Press, Oxford, London. 192 p.

Briggs JC (1984) Freshwater fishes and biogeography of Central America and the Antilles. *Systemic Zoology* 33(4): 428-435.

Burke L and J Maidens (2004) Reefs at Risk in the Caribbean. World Resources Institute, Washington D.C., USA. 84 p.

Burke L, Reytar K, Spalding M and A Perry (2011) Reefs at Risk Revisted. World Resources Institute, Washington D.C., USA. 114 p.

Bouchon CP, Portillo Y, Bouchon-Navaro M, Loius P, Hoetjes K, De Meyer D, Macrae H, Armstrong V, Datadin S, Harding J, Mallela R, Parkinson J-W, Van Bochove D, Lirman-Herlan J, Baker A, Collado L, and SC Isaac (2008) Status of Coral Reef Resources of the Lesser Antilles: The French West Indies, The Netherlands Antilles, Anguilla, Antigua, Grenada, Trinidad and Tobago. Pp 265-280. *In*: Status of Coral Reefs of the World. (Ed.) C Wilkinson. Global Coral Reef Monitoring Network and Reef and Rainforest Research Center, Townsville, Australia.

Bryant D, Burke L, McManus J and M Spalding (1998) Reefs at Risk: A Map-Based Indicator of Potential Threats to the World's Coral Reefs. World Resources Institute (Washington, DC.), International Center for Living Aquatic Resource Management (Manila), and United Nations Environment Programme. World Conservation Monitoring Centre, Cambridge, UK.

Clark AH (1914) VIII.- Two interesting mammals from the Island of Tobago, West Indies. *Journal of Natural History* 13(73): 68-70.

Cornell (2013) The Cornell Lab of Ornithology—Neotropical Birds. World Wide Web publication. Accessed September 2013. http://neotropical.birds.cornell.edu/

Crain CM, Kroeker K and BS Halpern (2009) Interactive and cumulative effects of multiple human stressors in marine systems. *Human Ecology Letters* 11: 1304–1315.

Creary MC (2008) Coral reef monitoring for the organization of eastern Caribbean states and Tobago. Status of the coral reefs. Caribbean Climate Change Centre. Technical report 5C/MACC-11-08-03. 94 p.

Dahdouh-Guebas F, S. Hettiarachchi, Lo Seen D, Batelaan O, Sooriyarachchi S, Jayatissa LP and N Koedam (2005) Transitions in ancient inland freshwater resource management in Sri Lanka affect biota and human populations in and around coastal lagoons. *Current Biology* 15(6): 579-586.

De Lacerda LD (2002) Mangrove ecosystems: function and management. Environmental Science Series. Springer, London, UK. 292 p.

Dow WE and KL Eckert (2007) Sea turtle nesting habitat - A spatial database for the wider Caribbean region. WIDECAST Technical Report No. 6. Beaufort, North Carolina: Wider Caribbean Sea Turtle Conservation Network and The Nature Conservancy.

Duke NC, Meynecke JO, Dittmann S, Ellison AM, Anger K, Berger U, Cannicci S, Diele K, Ewel KC, Field CD, Koedam N, Lee SY, Marchand C, Nordhaus I and F Dahdouh-Guebas (2007) A world without mangroves? *Science* 317: 41-42.

Ellison AM and EJ Farnsworth (1996) Anthropogenic disturbance of Caribbean mangrove ecosystems: past impacts, present trends, and future predictions. *Biotropica* 28(4a): 549-565.

Ellison AM, Bank MS, Clinton BD, Colburn EA, Elliott K, Ford CR, Foster DR, Kloeppel BD, Knoepp JD, Lovett GM, Mohan J, Orwig DA, Rodenhouse NL, Sobczak WV, Stinson KA, Stone JK, Swan CM, Thompson J, Von Holle B and JR Webster (2005) Loss of Foundation Species: Consequences for the Structure and Dynamics of Forested Ecosystems. Frontiers in Ecology and the Environment 3(9): 479-486.

FAO (2006) Gobal Forest Resources Assessment 2005. Global Forest Resources Assessment 2005 – Progress towards sustainable forest management. FAO Forestry Paper No. 147. Food and Agricultural Organization, Rome, Italy. 320 p.

FAO (2007) Grenada. Pp. 65-68. *In*: Mangroves of North and Central America 1980-2005. FAO Forestry paper 138. Food and Agricultural Organization. Italy, Rome.

FAO (2010a) Gobal Forest Resources Assessment 2010. Country Report – Grenada. Forestry Department, Food and Agriculture Organization of the United Nations. Italy, Rome. 38 p.

FAO (2010b) Gobal Forest Resources Assessment 2010. Global Forest Resources Assessment 2010 – Main Report. FAO Forestry Paper No. 163. Food and Agricultural Organization. Italy, Rome. 329 p.

Farnsworth EJ and AM Ellison (1997) The global conservation status of mangroves. *Ambio* 26(6): 328-334.

Fishbase (2013) Froese R. and D. Pauly (Eds.). FishBase. World Wide Web electronic publication. Vers. 04/2013. Accessed August 2013. http://www.fishbase.org

Fourth National Report of Grenada to the Secretariat on the Convention on Biological Diversity (2009) Convention on Biological Diversity World Wide Web publication. Accessed August 2013. http://www.cbd.int/doc/world/gd/gd-nr-04-en.pdf

Frost MD and EB Massiah (2003) Observations of rare and unusual birds on Grenada. *The Journal of Caribbean Ornithology* 16(1): 63-65.

Gaos AR, Lewison RL, Yanez IL, Wallace BP, Liles MJ, Nichols WJ, Baquero A, Hasbun CR, Ureaga J and JA Seminof (2012) *Shifting the life-history paradigm: discovery of novel habitat use by hawksbill turtles*. *Biology Letters* 8: 54–56.

Genoways HH, Phillips CJ and RJ Baker (1998) Bats of the Antillean island of Grenada: A new zoogeographic perspective. Mammalogy Papers: University of Nebraska State Museum. Paper 98. 28p.

Germano JM, Sander JM, Henderson RW and R Powell (2003) Herpetofaunal communities in Grenada: A comparison of altered sites, with and annotated checklist of Grenadian amphibians and reptiles. *Caribbean Journal of Science* 39(1): 68-76.

Green EP and FT Short (2003) World Atlas of Seagrasses. University of California Press Ltd., Los Angeles, USA. 302 p.

Guebert-Bartholo FM, Barletta M, Costa MF, and ELA Monteiro-Filho (2011) Using gut contents to assess foraging patterns of juvenile green turtles *Chelonia my*das in the Paranagu Estuary, Brazil. *Endangered Species Research* 13: 131–143.

Gilman E, Ellison J, Duke NC and C Field (2008) Threats to mangroves from climate change and adaptation options: a review. *Aquatic Botany* 89(2): 237-250.

Giri C, Ochieng E, Tieszen LL, Singh A, Loveland T, Masek J and N Duke (2011) Status and distribution of mangrove forests of the world using earth observation satellite data. *Global Ecology and Biogeography* 20: 154-159.

Gardner TA, Côté IM, Gill JA, Grant A and JR Watkinson (2003) Long-term region-wide declines in Caribbean corals. *Science* 301: 958–960.

GoG (2001) National Report Grenada. Integrating management of watersheds and coastal areas. Department of Economic Affairs. World Wide Web publication. Accessed September 2013. http://iwlearn.net/iw-projects/1254/reports/Grenada-national-report.pdf

GoG (2000) Biodiversity Strategy & Action Plan. Grenada. Secretariat of the Convention on Biological Diversity, World Wide Web publication. Accessed September 2013. http://www.cbd.int/doc/world/gd/gd-nbsap-01-en.pdf

GoG (2009) Ministry of Agriculture, Forestry and Fisheries. Annual Agriculture Review Grenada W.I. World Wide Web publication. Accessed September 2013: http://www.gov.gd/egov/docs/reports/MOA_annual_review_09.pdf

Grazette S, Horricks JA, Philip PE and CJ Crafton (2007) And assessment of the marine turtle fishery in Grenada, West Indies. *Orxy* 41(3): 1-7.

Hawthorne WD, Jules D and G Marcelle (2004) Caribbean Spice Island Plants: Trees, shrubs and climbers of Grenada, Carriacou and Petit Martinique: a picture gallery with notes on identification, historical and other trivia. Oxford Forestry Institute, University of Oxford. 330 p.

Heck KL (1977) Comparitaive species richness, composition, and abundance of invertebrates in Caribbean seagrass (Thalassia testudinum) meadows (Panama). *Marine Biology* 41: 335-348.

Helmer EH, Kennaway TA, Pedreros DH, Clark ML, Marcano-Vega H, Tieszen LL, Ruzycki TR, Schill SR and CMS Carrington (2008) Land cover and forest formation distributions for St. Kitts, Nevis, St. Eustatius, Grenada and Barbados from decision tree classification of cloud-cleared satellite imagery. *Caribbean Journal of Science* 44(2): 175-198.

Hemminga MA and CM Duarte (2000) Seagrass Ecology. Cambridge University Press, Cambridge. 298 p.

Henderson RW (2004) Lesser Antillean snake faunas: distribution, ecology and conservation concerns. *Oryx* 38(3): 311-320.

Henderson RW and CS Berg (2011) The herpetofauna of Grenada and the Grenada Grenadines: Conservation concerns. Pp. 239-258. Hailey A, Wilson B and J Horrocks (Eds.). *In*: Conservation of Caribbean island hepetofaunas (Volume 2): Regional accounts of the West Indies. Koninklijke Brill, The Neatherlands.

Huber R and G Vincent (1988) Plan and Policy for a System of National Parks and Protected Areas. Grenada. National Parks and Wildlife Unit. General Secretariat of the Organization of American States, Executive Secretariat for Economic and Social Affaires, Dept. of Regional Development. 130 p.

Hughes TP and JH Connell (1999). Multiple stressors on coral reefs: a long-term perspective. *Limnolology and Oceanography* 44: 932–940.

Humann P and E Deloach (2002) Reef Coral Identification. New World Publications Inc., Jacksonville, FL. USA. 291 p.

Imbert D, Rousteau A and P Scherrer (2000) Ecology of mangrove growth and recovery in the Lesser Antilles: State of knowledge and basis for restoration projects. *Restoration Ecology* 8(3): 230-236.

Isaac CF (2010) An evaluation of socio-economic condition and environmental interactions on a section of the east cast of Grenada. Centre for Resource Management and Environmental Studies (CERMES). University of the West Indies, Cave Hill Campus, Barbados. 21 p.

IMaRS-USF and IRD (2005) Millennium Coral Reef Mapping Project (validated maps). UNEP World Conservation Monitoring Centre. Cambridge, UK. Accessed August 2013. http://data.unep-wcmc.org/datasets/13

IMaRS-USF (2005) Millennium Coral Reef Mapping Project (unvalidated maps are unendorsed by IRD, and were further interpreted by UNEP-WCMC). UNEP World Conservation Monitoring Centre. Cambridge, UK. Accessed August 2013. http://data.unep-wcmc.org/datasets/13

IUCN (2013) World Wide Web electronic publication IUCN Red List of Threatened Species. Version 2013.1. Accessed September 2013. http://www.iucnredlist.org

IUCN (1998) Walter KS and HJ Gillett (Eds.) 1997 lUCN Red List ofThreatened Plants. Compiled by the World Conservation Monitoring Centre. lUCN - The World Conservation Union, Gland, Switzerland and Cambridge, UK. 862 p.

Jackson J, Cramer K, Donovan M, Friedlander A, Hooten A and V Lam (2012) Tropical Americas Coral Reef Resilience Workshop Report. 29 April - 5 May, Smithsonian Tropical Research Institute, Panama City, Panama. 26 p.

Jeffrey CFG (2000) Annual, coastal and seasonal variation in Grenadian demersal fisheries (1986-1993) and implications for management. *Bulletin of Marine Science* 66: 305-319.

Kairo TK, Pollard GV, Peterkin DV and VF Lopez (2000) Biological control of the hibiscus mealybug, *Maconellicoccus hirsutus* Green (Hemiptera: Pseudococcidae) in the Caribbean. *Integrated Pest Management Reviews* 5: 241-245.

Lacerda LD, Conde JE, Alarcon C, Alvarez-Leon R, Bacon PR, D'Croz LP, Kjerfve B, Polaina J and M Vannucci (1993) Mangrove Ecosystems of Latin America and the Caribbean: a Summary. Pp. 1-42. Lacerda LD (Ed.) *In:* Conservation and sustainable utilization of mangrove forests in Latin America and Africa Regions.. Part I: Latin America. International Society for Mangrove Ecosystems and the International Tropical Timber Organization. Society for Mangrove Ecosystems, Okinawa, Japan.

Limpus CJ and DJ Limpus (2000) Mangroves in the diet of *Chelonia mydas* in Queensland, Australia. *Marine Turtle Newsletter* 89:13-15.

Littler DS and MS Littler (2000) Caribbean reef plants. Offshore Graphics. Washington. 542 p.

Lloyd C and R King (2006) Community based sea turtle conservation in Grenada, West Indies. Proceedings of the 23rd annual symposium on sea turtle biology and conservation. NOAA Technical Memorandum NMFS-SEFSC-536. 61 p.

Loughney E (2013) Protected area management effectiveness in Grenada: A modified threat reduction assessment of the Moliniere/Beausejour Marine Protected Area. Erasmus Mundus Masters Course in Environmental Sciences, Policy and Management. 113 p. World Wide Web publication. Accessed September 2013. http://www.etd.ceu.hu/2013/loughney_erin.pdf

Lugo A, Schmidt R, and S Brown (1981) Tropical forests in the Caribbean. *Ambio* 10(6): 318-324.

Massó-Alemán S, Bourgeois C, Appeltans W, Vanhoorne B, De Hauwere N, Stoffelen P, Heaghebaert A and F Dahdouh-Guebas (2010) The Mangrove Reference Database and Herbarium. World Wide Web publication. Accessed September 2013. http://www.vliz.be/vmdcdata/mangroves

Moore GE (2004a) Assessment of the mangrove ecosystem of Tyrrel Bay, Carriacou (Grenada) West Indies. Jackson Estuarine Laboratory, University of New Hampshire, New Hampshire, USA. 10 p.

Moore GE (2004b) Response of a strom-damaged mangrove system to restoration planting, Carriacou (Grenada), West Indies. Jackson Estuarine Laboratory, University of New Hampshire, New Hampshire, USA. 14 p.

Myers GS (1938) Annual Report of the Board of Regents of the Smithsonian Institution 92: 339-364.

Nagelkerken I, Kleijnen S, Klop T, van den Brand RACJ, Cocheret de la Moriniere E and G van der Velde (2001) Dependence of Caribbean reef fishes on mangroves and seagrass beds as nursery habitats: a comparison of fish faunas between bays with and without mangroves/seagrass beds. *Marine Ecology Progress Series* 214: 225-235.

Nowak RM (1994) Walker's Bats of the World. John Hopkins University Press. 287 pp.

Orth RJ, Carruthers TJB, Dennison WC, Duarte CM, Fourqurean JW, Heck KL, Hughes AR, Kendrick GA, Kenworthy WJ, Olyarnik S, Short FT, Waycott M and SL Williams (2006) A global crisis for seagrass ecosystems. *BioScience* 56: 987–996.

Palandro DA, Andréfouët S, Hu C, Hallock P, Müller-Karger FE, Dustan P, Callahan MK, Kranenburg C, and CR Beaver (2008) Quantification of two decades of shallow-water coral reef habitat decline in the Florida Keys National Marine Sanctuary using Landsat data (1984–2002). *Remote Sensing of Environment* 112: 8-15.

Perry CT, Murphy GN, Kench PS, Smithers SG, Edinger EN, Steneck RS, and PJ Mumby (2013) Caribbean-wide decline in carbonate production threatens coral reef growth. *Nature Communications* 4(1402): 1-6.

Polidoro BA, Carpenter KE, Collins LC, Duke NC, Ellison AM, Ellison JC, Farnsworth EJ, Fernando ES, Kathiresan K, Koedam NE, Livingstone SR, Miyagi T, Moore GE, Ngoc Nam V, Ong JE, Primavera JH, Salmo SG, Sanciangco JC, Sukardjo S, Wang Y and JW Hong Yong (2010) The loss of species: Mangrove extinction risk and geographic areas of global concern. *PLos ONE* 5(4): 1-10.

Powell R and RW Henderson (2005) Conservation status of Lesser Antillean reptiles. International Reptile Conservation Foundation. *Iguana – conservation, natural history, and husbandry of reptiles* 12(2): 63-78.

Powell R and RW Henderson (2012) Island lists of West Indian amphibians and reptiles. *Florida Museum of Natural History Bulletin* 51(2): 85-166.

Pu R, Bell S, Levy KH and C Meyer (2010) Mapping detailed seagrass habitats using satellite imagery. Geoscience and Remote sensing Symposium (IGARSS), 2010 IEEE International. 4 p.

Reaka-Kudla ML (2005) Biodiversity of Caribbean coral reefs. Pp. 259–276. Miloslavich P. and E. Klein (Eds.). *In*: Caribbean Marine Biodiversity: The Known and the Unknown. DEStech Publications. Lancaster, Pennsylvania, USA.

ReefBase (2013) Reefbase: A Global Information System for Coral Reefs. Wold Wide Web publication. Accessed August 2013. http://www.reefbase.org

Ricklefs R and IJ Lovette (1999) The roles of island area *per se* and habitat diversity in the species-area relationships of four Lesser Antillean faunal groups. *Journal of Animal Ecology* 68: 1143-1160.

Ridgely *et al.* (2012) Digital Distribution Maps of the Birds of the Western Hemisphere, version 5.0 . *In:* BirdLife International and NatureServe (2012) Bird species distribution maps of the world. World Wide Web publication. Accessed September 2013 through http://www.iucnredlist.org

Roberts CM, McClean CJ, Veron JEN, Hawkins JP, Allen GR, McAllister DE, Mittermeier CG, Schueler FW, Spalding M, Wells F, Vynne C and TB Werner (2002) Marine biodiversity hotspots and conservation priorities for tropical reefs. *Science* 295: 1280-1284.

Rusk BL (2008) Waterbirds in Grenada. Report—Waterbird Conservation for the Americas. (Eds.) Anadón-Irizarry V and D Wege. BirdLife International. 11 p

Rusk BL (2009) Grenada. Pp 229 –234. Devenish C, Díaz-Fernández DF, Clay RP, Davidson I and I Yépez Zabala (Eds.). *In:* Important Bird Areas Americas - Priority sites for biodiversity conservation. BirdLife Conservation Series (No. 16), Birdlife International, Quito, Equador.

Rusk BL (2010) Conservation and Management Plan for the Perseverance/Beausejour Area (Draft). 153 p.

Sagarra LA and DD Peterkin (1999) Invasion of the Caribbean by the hibiscus mealy bug, Maconellicoccus hirsutus Green [Homopter: Pseudococcidae]. *Phytoprotection* 90(2): 103-113.

Scott DA and M Carbonell (1986) Grenada. Pp. 523-526. A directory of neotropical wetlands. IUCN Conservation Monitoring Center, Gland and Cambridge.

Sealifebase (2013) Palomares MLD and D Pauly (Eds.) SeaLifeBase World Wide Web electronic publication. Vers. 06/2013. Accessed August 2013. http://www.sealifebase.org

Short FT and S Willie-Echeverria (1996) Natural and human-induced disturbance of seagrasses. *Environmental Conservation* 23(1): 17-27.

Short F, Carruthers T, Dennision W, and Waycott 2007 (2007) Global seagrass distribution and diversity. *Journal of Experimental Marine Biology and Ecology* 350: 3-27.

Short FT, Polidoro B, Livingston SR, Carpenter KE, Bandeira S, Bujang JS, Calumpong HP, Carruthers TJB, Coles RG, Dennison WC, Erftemeijer PLA, Fortes MD, Freeman AS, Jagtap TG, Kamal ABHM, Kendrick GA, Kenworthy WJ, La Nafie YA, Nasution IM, Orth RJ, Prathep A, Sanciangco JC, van Tussenbroek B, Vergara SG, Waycott M and C Zieman (2011) Extinction risk assessment of the world's seagrass species. *Biological Conservation* 144: 1961-1971.

Singh A (2010) National Environmental Summary. Grenada 2010. United Nations Environment Programme. 27 p.

Spalding MD, Blasco E and CD Field (1997) World Mangrove Atlas. The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.

Spalding M, Kainuma M and L Collins (2010) World Atlas of Mangroves. A collaborative project of ITTO, ISME, FAO, UNEP-WCMC, UNESCO-MAB, UNU-INWEH and TNC.Earthscan, London. 319 p.

Spalding MD, Ravilious C, and EP Green (2001) World Atlas of Coral Reefs. UNEP World Conservation Monitoring Centre. University of California Press, Berkeley, USA. 421 p.

SWOT (2013) The state of the world's sea turtles. SWOT World Wide Web database for Grenada (referenced therein) Accessed August 2013. http://seamap.env.duke.edu/swot

Stoner AW, Pitts PA and RA Armstrong (1996) Interaction of physical and biologicial factors in the large-scale distribution of juvenile queen conch in seagrass meadows. *Bulletin of Marine Science* 58(1): 217-233.

Thomas A (2000) Grenada, Carriacou and Petit Martinique—National Report on the implementation of the United Nations convention to combat desertification and/or drought (UNCCD). 43 p.

Tomlinson PB (1994) The botany of mangroves. Cambridge tropical biology series. Cambridge University Press, New York, USA. 419 p.

Turner M (2009) Grenada Protected Area System Plan. OECS Protected Areas and Associated Livelihoods Project (OPAAL). Mel Turner (independent consultant - Parks Canada). 55 p.

UNEP-WCMC (2005) Global distribution of seagrasses. Created from multiple sources. This is an update of the data used in Green and Short (2003). Cambridge (UK): UNEP World Conservation Monitoring Centre. Data accessed September 2013. http://data.unep-wcmc.org/datasets/10 (polygons) and http://data.unep-wcmc.org/datasets/9

UNEP-WCMC, WorldFish Centre, WRI and TNC (2010). Global distribution of warm-water coral reefs, compiled from multiple sources, including the Millennium Coral Reef Mapping Project. See attribute table for details. UNEP World Conservation Monitoring Centre. Cambridge, UK. Data accessed September 2013. http://data.unep-wcmc.org/datasets/13

UNEP-WCMC (2013) Species Database for Grenada. World Wide Web electronic publication. Accessed August 2013. http://www.unep-wcmc.org/unep-wcmc-species-database_549.html

Valiela I, Bowen JL and JK York (2001) Mangrove forests: one of the world's threatened major tropical environments. *Bioscience* 51(10): 807-815.

Valentine JF and Heck KL (1999) Seagrass herbivory: evidence for the continued grazing of marine grasses. *Marine Ecology Progress Series* 176: 291-302.

Waycot M, Duarte CM, Carruthers TJB, Orth RJ, Dennison WC, Olyarnik S, Calladine A, Fourqurean JW, Heck KL, Hughes AR, Kendrick GA, Kenworthy WJ, Short FT and SL Williams (2009) Accelerating loss of seagrass across the globe threatens coastal ecosystems. *Proceedings of the National Academy of Sciences* 106: 12377–12381.

Weinstein MP and KL Heck Jr. (1979) Ichthyofauna of seagrass meadows along the Caribbean coast of Panama and in the Gulf of Mexico: Composition, structure and community ecology. *Marine Biology* 50(2): 97-107.

Wilkinson C (2008) Status of coral reefs of the world. Global Coral Reef Monitoring Network and Reef and Rainforest Research Centre, Townsville, Australia, 296 p.

Willette DA and RF Ambrose (2009) The distribution and expansion of the invasive seagrass Halophila stipulacea in Dominica, West Indies, with a preliminary report from St. Lucia. *Aquatic Botany* 91: 137-142.

Wilson DE and DM Reeder (2005) Mammal Species of the World: A taxonomic and geographic reference. John Hopkins University Press. Baltimore, USA. 2000 p.

4. ECONOMIC VALUATION OF ECOSYSTEMS AND PROTECTED AREAS

The concept of ecosystem services has become an organizing principle in international conservation practice and policy. Recent comprehensive reviews have reported on an increasing number of valuation applications and methods used in assessing the value of ecosystem services and biodiversity (Atkinson *et al.* 2012, Ferraro et *al.* 2012). This can provide economic incentive and ultimately help leverage sustainable financing for protecting critical ecosystems and livelihoods. Outside of one valuation study focusing on past and potential revenue generation in relation to Grenadian protected areas (e.g., implementation of user fee programs projected to generate over US$1400000 yearly) (Sector 2006), no further assessments have been conducted.

It is necessary to highlight that the following valuation data must be taken in circumspect until studies specific to Grenada are conducted. Note that any given site must be assessed in its specific context, and the values presented in this report (including extrapolations by Sector 2006; see Tables 23 and 25) are to be used indicatively, and primarily to facilitate further policy thinking/action on economic valuing of ecosystems in Grenada.

4.1 Marine ecosystems

The value of Caribbean coral reefs, seagrass beds, coastal mangroves and associated habitats in relation to ecosystem processes has long been recognized as providing important goods and services both individually and through functional linkages (e.g., coastal defense, sediment production, primary production, fisheries, the maintenance of high species diversity, etc.) (Moberg and Folke 1999, Moberg and Ronnback 2003, Harborne *et al.* 2006). More recently, their value has been further highlighted in relation to greenhouse emission reductions and CO_2 sequestering in countering climate change (Nellemann *et al.* 2009, McLeod *et al.* 2011) (Table 23).

Table 23: Monetary values in relation to coastal ecosystem services (including provisioning services, regulating services, cultural and social services) and reported values on carbon stocks

Ecosystem	Estimated monetary value ($US/ha/year)[1]	Source
Coral reefs	$15 – $1195500 $1100	TEEB 2013 Sector 2006
Mangroves & salt marshes	$1995 – $215350 $5590[2]	TEEB 2013 Sector 2006
Seagrasses	no monetary estimates available	-
Other coastal systems (e.g., shallows, rocky shores, estuaries)	$250 – $79600	TEEB 2013

Carbon stock	Below-ground C values (tonnes of C/ha/year)[3]	Above-ground C values (tonnes of C/ha)[4]
Mangroves	0.20 – 9.5	145.3 (average)
Salt marshes	0.18 – 17.3	0.6 – 8.1
Seagrasses	0.45 – 1.9	0.000001 – 0.0055

1. Provisioning, regulating, cultural and social services provided by ecosystems—see de Groot *et al.* (2002) for classifications, descriptions and valuation of ecosystem functions, goods, and services
2. Does not include values for salt marshes
3. Data from McLeod *et al.* 2011
4. Data from Hutchison *et al.* 2013 (mangroves), Chmura 2013 (salt marshes), Fourqurean *et al.* 2012 (seagrasses)

The purpose of valuation is to make the value of each ecosystem explicit, rather than to put a monetary value on nature. Despite the fact that seagrass beds provide a wide range of ecosystem services, including coastal protection, erosion control, maintenance of fisheries, water purification, and carbon sequestration among others, no estimates of monetary values for most of these services are available (see Barbier *et al.* 2011) (Table 23). Nevertheless, in terms of fisheries valuation and economic contribution, ~12700 ha of seagrass degradation has been equated with fishery production losses valued over US$220000 (in Australia; McArthur and Boland 2006). Queen conch, spiny lobster, sea urchin, as well as sea turtle yields are directly linked to seagrass beds (see Section 2.3.3) and represent important sectors in the Grenadian fishery (total fish exports ~US$3900000 reported for 2009; GoP 2011). In 2004, yields of conch, lobster and turtles generated US$262000 (referenced in Sector 2006) and limited sets of catch statistics indicate a significant seagrass urchin fishery ongoing today (Pena *et al.* 2009). In terms of valuing coastal protection, even low-canopy and low-biomass seagrass beds coastal provide significant protection from coastal erosion (Christianen *et al.* 2013). Coastal erosion in Grenada has been reported as high as 3.6 m/year[1] in the past (specifically, Grand Anse and Levera; Gajraj 1988), thus further highlighting the importance of seagrass ecosystem services in Grenada.

4.2 Forest ecosystems

Among timber production, general agroforestry and non-timber forest products (i.e., direct use values), some of the other benefits delivered by forests via ecological function (i.e., indirect use values/regulating services) provide carbon storage, safeguard watersheds and soils, enable water and nutrient cycling, increase soil fertility and other associated benefits such as the enhancement of agricultural productivity (Cavatassi 2004, Ferraro *et al.* 2012). Valuation studies that quantify ecosystem services for tropical forests are few (Cavendish 2002, Bernard *et al.* 2009, Ferraro *et al.* 2012). No monetary estimations in relation to forest ecosystem services could be provided as for coastal ecosystems—see Table 23. Nevertheless, the relative importance of direct-use and indirect-use value components for tropical forests (typical of Grenada) is summarized in Table 24.

4.2.1 Forests and watersheds

The safeguarding of watersheds is a major priority for Grenada (Geoghegan *et al.* 2003, CEHI 2007, Peters 2010). Forest ecosystems provide a range of watershed services, including hydrological regulation, flood control, groundwater recharge, water quality enhancement, and soil conservation (Sharachandra 2009), which is of particularly importance for Grenada because rainfall is highly seasonal, locally limited (e.g., Carriacou), and important agrarian landscapes downstream (e.g., nutmeg, cocao) are affected by soil-hydrological processes from upstream forests (see Bonell and Bruijnzeel 2004). No current data is available in relation to watershed processes in Grenada (e.g., peak and low-flow levels, groundwater recharge rates, water quality, erosion rates) (but see Ternan *et al*. 1987, 1989), hence no estimates of monetary values for the aforementioned ecosystem services are currently possible. Further, few studies with sufficient original data are available, presenting a major technical challenge for valuation studies or payment for these types of ecosystem services (Ternan *et al.* 1989, Locatelli and Vignola 2009). However, in terms of broader economic valuation, water supply revenue in Grenada was over US$3880000 (1 % of GDP) (in 2004; from Sector 2006).

[1] Gajraj (1988) does not provide further detail on purported erosion rate

Table 24: Ranked economic values by forest type (adapted from SCBD 2001)

Direct-use value	Mangrove	Montane[1]	Moist broadleaf[2]	Semi-deciduous
Timber	✗	✗	✓✓	✓✓
Fuelwood/charcoal	✓	✗	✗	✓
NTFPs[2]	✓	✗	✓	✓
Genetic information	✗	✓	✓	✓
Recreation/tourism	✗	✓	✓	✓
Research/education	✓	✓	✓	✓
Cultural	✗	✓	✓	✓
Indirect-use value				
Watershed services				
• Soil conservation	✓	✓✓	✓✓	✓
• Water supply	✓	✓	✓	✓
• Water quality	✓	✓	✓	✓
• Flood/storm protection	✓	✗	✗	✗
• Fisheries protection	✓	✓	✓	✓
Global climate				
• Carbon storage	✓	✓	✓	✓
• Carbon fixing	✓	✗	✗	✗
Biodiversity	✓	✓✓	✓✓	✓

✓ benefit, ✗ no effect

1. Associated to *Sierra palm, transitional & tall cloud forest* and *Elfin & Sierra palm cloud forest*—see Table 16
2. Associated to *Seasonal evergreen & evergreen forests*
3. Non-timber forest products

The main focus for watershed management activity in Grenada is within the interior mountain range, and especially at the Grand Etang/Annandale Forest Reserve and Mount St. Catherine project sites (see Map 1) (Geoghegan e*t al.* 2003). Surface water (e.g., watershed catchment basins) provides the majority of the island's potable water (~90 %), with groundwater use increasing during the dry season (Geoghegan *et al.* 2003). The largest of all watersheds is by far Great River (Ternan 1989—Watershed 29), which feeds the island's major natural water storage reservoir at Grand Etang. Grand Etang and Annadale supply potable water to the capital city of St. George's and the surrounding area (where the majority of the island's population is established) and provide the estimated 85 % of all non-domestic water, which is consumed in St. George Parish (Geoghegan e*t al.* 2003, Sector 2006).

Severe watershed soil erosion has not appeared to be an island-wide issue in the past, particularly because much of the agriculture in Grenada is based on tree crops (Ahmad 1977, GoG 2009). However, high-suspended sediment concentrations in excess of 1000 mg/L have been recorded in rivers of the Beausejour watershed during rainstorms (ridge-to-reef project watershed focal area) (see Ternan 1989—Watershed 11). Under such circumstances, this translates to an estimated rainstorm discharge that includes 150 kg of soil leaving the watershed every minute (Ternan *et al.* 1989). While 1000 mg/L suspended sediment concentration may not be an absolute indicator of accelerated erosion in Grenada, high sediment concentrations discharged into the sea following rainstorms markedly affect water clarity. Coral reefs south of St. George's are degrading due in part to this reduced water clarity and sediment deposition (Ternan et al. 1989, pers. comm. 2013, R. Baldeo—Fisheries Division).

4.2.1 Forest carbon storage

Evaluating contributions of forest ecosystems to climate change mitigation requires well-calibrated models with quantified baseline carbon stocks, which is not currently accessible for many countries including Grenada (see Keith *et al.* 2010). However, biome-average approaches are often used in the tropics to estimate national-level forest carbon stocks and are still widely accepted (Gibbes *et al.* 2007). This approach is fairly generalized (i.e., with a high degree of uncertainty), but nonetheless is noted to work better for smaller areas than larger ones (and thus reasonably suited for Grenada within the current scope of the ridge-to-reef project).

Carbon stock estimates (including above- and below-ground carbon stores) calculated for ridge-to-reef project sites are presented in Table 25, and correspond to carbon stores indicated in the project identification form (PIF—see component 1).

Table 25: Forest carbon stocks for ridge-to-reef project sites in Grenada and Carriacou (all sites together)

GRENADA[1]

Biome classification	Biome estimates of carbon stock[2] (tonnes of C/ha)	Forest area at project sites (ha)	Carbon stock estimates[3] at project sites (tonnes of C/ha)
Tropical dry forest	47 – 126	237.2[4]	15900 – 42626
Tropical equatorial forest	193 – 200	748.7[5]	144499 – 149740
Tropical seasonal forest	128 – 140	2195.1[6]	280972 – 307314
Mangrove forest	145[7]	126[8]	18270
Total estimated tonnes of C at project sites in Grenada			**459641 – 517950**

CARRIACOU[9]

Tropical dry forest[8]	193 – 200	182[10]	35126 – 36400
Mangrove forest	145[7]	64[11]	9280
Total estimated tonnes of C at project sites in Carriacou			**44406 – 45680**

1. Land-classification data from Helmer *et al*. (2008), circa 2001
2. Biome-average forest biomass carbon stock estimates from review by Gibbs *et al.* (2007), and includes estimates from guidelines by the *Intergovernmental Panel on Climate Change* (IPCC 2006)
3. Includes estimates of *above-* and *below-ground* carbon stocks
4. From Table 16: *Drought deciduous open* woodland (4.0 ha) + *Deciduous, evergreen coastal, mixed forest/shubland* (197.4 ha) + *Semi-deciduous forest* (136.9 ha)
5. *Sierra palm, transitional & tall cloud forest* (563 ha) + *Elfin & Sierra palm cloud forest* (185.7 ha)
6. *Seasonal evergreen & evergreen forest (1914.7 ha) + Nutmeg & mixed-woody agriculture* (280.4 ha)
7. From Table 23: average value for mangrove carbon; only includes above-ground carbon stock
8. Includes mangroves within and bordering marine project sites
9. GIS land-classification data from the Land Use Division of the Ministry of Agriculture, Lands, Forestry and Fisheries
10. From Table 16: *Deciduous forest* (54.3 ha) + *scrub and cactus* (127.3 ha)
11. Available data on mangrove cover on Carriacou are more than likely overestimations (see Section 2.2.2)

REFERENCES

Atkinson G, Bateman I and S Mourato (2012) Recent advances in the valuation of ecosystem of ecosystem services and biodiversity. *Oxford Review of Economic Policy* 28(1): 22-47.

Barbier EB, Hacker SD, Kennedy C, Koch EV, Stier AC and BR Silliman (2011) The value of estuarine and coastal ecosystem services. *Ecological Monographs* 81(2): 169-193.

Bernard F, de Groot RS and JJ Campos (2009) Valuation of tropical forest services and mechanisms to finance their conservation and sustainable use: A case study of Tapanti National Park, Costa Rica. *Forest Policy and Economics* 11: 174-183.

Locatelli B and R Vignola (2009) Managing watershed services of tropical forests and plantations: Can meta-analyses help? *Forest Ecology and Management* 258: 1864-1870.

Bonell MJ and LA Bruijnzeel (2004) Forests, water and people in the humid tropics: Past, present, and future hydrological research for integrated land and water management. Cambridge University Press, UK. 994 p.

Cavatassi R (2004) Valuation methods for environmental benefits in forestry and watershed investment projects. Food and Agriculture Organization of the United Nations. Agricultural and Development Economics Division. FAO ESA Working Paper No. 04-01, Italy. 52 p.

Cavendish W (2002) Quantitative methods for estimating the economic value of resource use to rural households. Pp. 17–65. *In*: Uncovering the hidden harvest: valuation methods for woodland and forest resources. Campbell BM and MK Luckert (Eds.). Earthscan Publications Ltd. UK. 262 p.

CEHI (2007) Road map towards integrated water resources management planning for Grenada. Caribbean Environmental Health Institute (CEHI). United Nations Environment Programme Collaborating Centre for Water and Environment. 111 p.

Chmura GL (2013) What do we need to assess the sustainability of the tidal salt marsh carbon sink? *Ocean and Coastal Management* 83: 25-31.

Christianen MJA, van Belzen J, Herman PMJ, van Katwijk MM, Lamers LPM, van Leent JM and TJ Bouma (2013) Low-canopy seagrass beds still provide important coastal protection services. *PLoS ONE* 8(5) (*in print*).

Feraro PJ, Lawlor K, Mullan KL and SK Pattanayak (2012) Forest Figures: Ecosystem services valuation and policy evaluation in developing countries. *Review of Environmental Economics and Policy* 6(1): 20-44.

Fourqurean JW, Duarte CM, Kennedy H, Marba N, Holmer M, Mateo MA, Apostolaki ET, Kendrick GA, Krause-Jensen D, McGlathery KJ and O Serrano (2012) Seagrass ecosystems as a globally significant carbon stock. *Nature Geoscience* 5: 505-509.

Gajraj AM (1988) The environmental impact of development in the Caribbean Islands from 1660 to the present. Pp. 171–179. *In:* Proceedings of the ROPME workshop on coastal area development. United Nations Environment Programme Regional Seas Reports and Studies No. 90. ROPME Publication No. GC-5/006. UNEP, France.

Geoghegan T, Krishnarayan V, Pantin D and S Bass (2003) Incentives for watershed management in the Caribbean: diagnostic studies in Grenada, Jamaica, St. Lucia and Trinidad. The Caribbean Natural Resources Institute, Laventille, Trinidad and International Institute for Environment and Development, London. 59 p.

Gibbs HK, Brown S, O'Niles J and JA Foley (2007) Monitoring and estimating tropical forest carbon stocks: making REDD a reality. *Environmental Research Letters* 2: 1-13.

GoG (2011) Annual Agriculture Review – Grenada W.I., Ministry of Agriculture, Forestery and Fisheries. 41 p.

de Groot RS, Wilson MA and RMJ Boumans (2002) A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics* 41: 393-408.

Harborne AR, Mumby PJ, Micheli F, Perry CT, Dahlgren CP, Holmes KE, and DR Brumbaugh (2006) The functional value of Caribbean coral reef, seagrass and mangrove habitats to ecosystem process. *Advances in Marine Biology* 50: 57-190.

Helmer EH, Kennaway TA, Pedreros DH, Clark ML, Marcano-Vega H, Tieszen LL, Ruzycki TR, Schill SR and CMS Carrington (2008) Land cover and forest formation distributions for St. Kitts, Nevis, St. Eustatius, Grenada and Barbados from decision tree classification of cloud-cleared satellite imagery. *Caribbean Journal of Science* 44(2): 175-198.

Hutchison J, Manica A, Swetnam R, Balmford A and M Spalding (2013) Predicting global patterns in mangrove biomass. *Conservation Letters* (*in print*).

Keith H, Mackay B, Berry S, Lindenmayer D and P Gibbon (2010) Estimating carbon carrying capacity in natural ecosystems across heterogeneous landscapes: addressing sources of error. Global Change Biology 16: 2971 – 2989.

Locatelli B and R Vignola (2009) Managing watershed services of tropical forests and plantations: Can meta-analyses help? *Forest Ecology and Management* 258(9): 1864-1870.

McArthur LC and JW Boland (2006) The economic contribution of seagrass to secondary production in South Australia. *Ecological Modeling* 196: 163-172.

McLeod E, Chmura GL, Bouillon S, Salm R, Bjork M, Duarte CM, Lovelock CE, Schlesinger WH and BR Silliman (2011) A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO_2. *Frontiers in Ecology and the Environment* 9(10): 552-560.

Moberg F and C Folke (1999) Ecological goods and services of coral reef ecosystems. *Ecological Economics* 29: 215-233.

Moberg F and P Ronback (2003) Ecosystem services of the tropical seascape: Interactions, substitutions and restoration. *Ocean & Coastal Management* 46: 27-46.

Nellemann C, E Corcoran, Duarte CM, Valdes L, De Young C and C Grimsditch (2009) Blue Carbon. The role of healthy oceans in binding carbon. A rapid response assessment. United Nations Environment Programme, GRID-Arendal, Norway. 80 p.

Pena M, Parker C, Oxenford HA and A Johnson (2009) Synthesis of the biology, fisheries and management of the white sea urchin, *Tripneustes ventricosus*, in the Caribbean. Proceedings of the 61st Gulf and Caribbean Fisheries Institute. Nov. 10-14. Guadeloupe. *GCFI* 61: 471-481.

Peters EJ (2010) Impact of hurricane Ivan on Grenada water supply. Proceedings of the Institution of Civil Engineers. *Water Management* 163: 57-64.

Sharachchandra L (2009) Watershed services of tropical forests: from hydrology to economic valuation to integrated analysis. *Current Opinion in Environmental Sustainability* 1: 148-155.

SCBD (2001) The value of forest ecosystems. Secretariat of the Convention on Biological Diversity. CBD Technical Series No. 4. Canada. 67 p.

Sector A (2006) Sustainable finance plan for Grenada's protected areas system. Ministry of Agriculture, Land, Fisheries, and Forestry; Ministry of Tourism; USAIDE; The Nature Conservancy. 55 p.

TEEB (2013) The Economics of Ecosystems and Biodiversity for Water and Wetlands. Russi D, ten Brink P, Farmer A, Badura T, Coates D, Förster J, Kumar R and N Davidson N (Eds.). IEEP, London and Brussels; Ramsar Secretariat, Gland. 77 p.

Ternan JL, Williams AG, and K Solman (1987) A pre-liminary assessment of soil hydraulic properties and their implications for agroforestry management in Grenada, West Indies. Forest *Hydrology and Watershed Management*. Proceedings of the Van- couver Symposium. I.A.H.S. Publication 167.

Ternan JL, Williams AG and C Francis (1989) Land capability classification in Grenada, West Indies. *Mountain Research and Development* 9(1): 71-82.

Turner M (2009) Grenada Protected Area System Plan. OECS Protected Areas and Associated Livelihoods Project (OPAAL). Mel Turner (independent consultant - Parks Canada). 55 p.

5. SUMMARY INFORMATION ON SOCIO-ECONOMIC CONDITIONS

5.1 Background

In 2008[1], Grenada had one of the highest unemployment rates in the Caribbean (25 %), where citizens in the 15-24 year-class accounted for almost half of all unemployed, and female unemployment was nearly twice that of male unemployment (CPA 2010). Further, an estimated 37.7 % of the population resided below the poverty line (<US$2205/year, CPA 2010; GDP per capita 2008—US$8094, 2013—US$8586, Bisset and Francis 2012) and the majority of citizens in rural areas were living in poverty (IFAD 2013) (Table 26).

Table 26: Summary of socio-economic data[1] and available indicators (for 2008—unless otherwise noted; focus on poverty) (adapted from CPA 2010)

		Population distribution	Percent distribution (%)	Registered employers[2]	Employability ranking[3]	Population distribution living in poverty	Percent distribution living in poverty (%)	Parishioners living in poverty (%)
Grenada (parish)	St. George	36289	33.1	392	2	11893	10.8	32.8
	St. Andrew	29413	26.8	204	5	13195	12.0	44.9
	St. David	12334	11.2	68	7	3637	3.3	29.5
	St. Patrick	11280	10.3	76	6	6392	5.8	56.7
	St. John	9486	8.6	72	4	3478	3.2	36.7
	St. Mark	4310	3.9	35	3	2347	2.1	54.5
	Carriacou	6650	6.1	88	1	437	0.4	6.6
Total population		**109762**	-	-	-	**41379**	**37.7**	-

1. Poverty line in 2008: <US$2205/year (CPA 2010)
2. Data for 2011 (pers. comm. 2013, R. Jacobs—Statistical Division, Grenada)
3. Data for 2011; Ranking produced with a rudimentary index calculation of employability: [registered employers] ÷ [population] and does not include any other variable (e.g., education level)

Table 27 shows the percent distribution of employed citizens by employment sector. Analyses of consumption quintiles (see CPA 2010) indicate that lower incomes are strongly correlated with the *Agriculture & Fishing* and *Construction* sectors, whereas higher incomes are correlated with the Education/Social Security sector (CPA 2010). No other clear correlations were apparent between levels of income and other employment sectors.

[1] The National Census Report for Grenada (compendium for 2011) is pending and available information is currently limited

Table 27: Population frequency distribution by employment sector in 2008 (focus on poverty) (adapted from CPA 2010)

Employed (pop. %)	Agriculture & Fishing	Manufacturing	Construction	Wholesale & Retail	Hotel & Restaurant	Transportation	Services	Admin./Social Security	Education/Social Work	Unknown
Living below the poverty line (%)	11.9	0.7	23.5	2.4	3.2	3.5	30.0	0.7	4.3	19.9
Living above the poverty line[1] (%)	7.5	3.2	18.2	6.1	2.7	3.1	35.1	0.9	8.4	14.5

1. Population frequency distribution by consumption quintile in CPA (2010)

Table 28: Demographics and poverty index of local communities at project sites in 2011 (Grenada only) (adapted from data provided by the Statistical Division, Grenada)

Project site[1]	No. of villages in the vicinity of project site	Total population	Male:female	Poverty index[2]
Grand Anse	8	5355	0.97	31
Grand Bras	5	4544	1.05	43
Grand Etang & Annandale	30	8151	1.01	34
Levera Pond & addition	4	1703	1.07	60
Moliniere-Beausejour & addition	6	3469	0.97	27
Morne Gazo	5	765	0.88	27
Mt. Hartman	1	422	0.71	33
Mt. Moritz	3	1750	1.09	29
Mt. St. Catherine	14	4458	1.00	55
Pearls	4	2695	1.13	50
Perseverance & Beausejour	3	532	0.95	33
Richmond Hill	4	771	1.05	15
Southeast Coast	15	5512	0.98	29
Woburn Clarks Court Bay	5	1969	0.97	18

1. Note that information is site specific as some of the same villages are repeated at different project sites due to proximity (see Appendix 7); any multiplicity of data is removed in tallied totals (Section 5.2, Appendix 7)
2. As poor citizens of Grenada are more likely to use wood-based materials than any other type of material in home construction (from CPA 2010), available data on the use of *wood*, *plywood*, and *makeshift* materials of homes (from 2011) were used as a proxy to calculate a basic poverty index for each project site: [no. of homes made of wood + plywood + makeshift materials] ÷ [total no. of homes] x 100 %

5.2 Socio-economic conditions of local communities at project sites

A total of 96 local communities (pop. 38643) are found in the vicinity of project sites (Grenada sites only) (Table 28). Few data on socio-economic conditions or information on key demographics of local communities at project sites are currently available (Isaac 2010, Blackman 2013). Some data provided by the Statistical Division is presented in Appendix 7. This data is from the pending National Census Report for Grenada (compendium for 2011), which will provide more complete information upon publication.

No information on local community livelihoods at project sites could be assessed since relevant census information was being compiled at the writing of this report (pers. comm. 2013, R. Jacobs—Statistical Division, Grenada). Nonetheless, some accessible data provided preliminary information on the degree of poverty at the local communities around project sites (Table 28) and background information presented (Section 5.1) can provide some insight on general socio-economic conditions.

REFERENCES

Bissett KA and RA Francis (2012) Standard & Poor's Rating Services. Grenada. McGraw-Hill, New York. 22 p.

Blackman K (2013) Comparison of socio-economic conditions and environmental awareness in the Grenadine islands between 2005 and 2010. Centre for Resource Management and Environmental Studies (CERMES). University of the West Indies, Cave Hill Campus, Barbados. 35 p.

CPA (2010) Country Poverty Assessment: Grenada, Carriacou and Petit Martinique 2007/2008. Kairi Consultants Limited, Trinidad and Tobago. Vol. 1. 191 p.

Isaac CF (2010) An evaluation of socio-economic condition and environmental interactions on a section of the east cast of Grenada. Centre for Resource Management and Environmental Studies (CERMES). University of the West Indies, Cave Hill Campus, Barbados. 21 p.

IFAD (2013) International Fund for Agriculture. Rural poverty in Grenada. World Wide Web publication. Accessed November 2013. http://www.ruralpovertyportal.org/country/home/tags/grenada

TE (2013) Trading Economics. World Bank Indicators for Grenada. World Wide Web publication. Accessed Nov. 2013. http://www.tradingeconomics.com/grenada/population-total-wb-data.html

APPENDIX 1: Hard corals (Scleractinia) identified as occurring in Grenada

Family	Scientific name	Common name	IUCN Status
Acroporidae	*Acropora cerviconis*	Staghorn coral	**Critically Endangered**
	A. palmata	Elkhorn coral	
Agariciidae	Agaricia agaricites	Lettuce coral	Least Concern
	A. fragilis	Fragile saucer coral	Data Deficient
	A. grahamae	Graham's sheet coral	Least Concern
	A. humilis	Lowrelief lettuce coral	Least Concern
	A. lamarcki	Lamarrck's sheet coral	**Vulnerable**
	Helioseris cucullata	Sunray lettuce coral	Least Concern
	Leptoseris cailleti	-	Least Concern
Astrocoeniidae	*Madracis auretenra*	Yellow pencil coral	Least Concern
	M. decactis	Ten-ray star coral	Least Concern
	M. formosa	Eight-ray finger coral	Least Concern
	M. mirabilis	Yellow pencil coral	n/a
	M. pharensis	Star coral	Least Concern
	M. senaria	Six-ray star coral	Least Concern
	Stephanocoenia intersepta	Blushing star coral	Least Concern
Faviidae	*Cladocora arbuscula*	Tube Coral	Least Concern
	Colpophyllia natans	Boulder brain coral	Least Concern
	Diploria clivosa	Knobby brain coral	Least Concern
	D. labyrinthiformis	Grooved brain coral	Least Concern
	D. strigosa	Symmetrical brain coral	Least Concern
	Favia fragum	Golfball coral	Least Concern
	Manicina areolata	Rose coral	Least Concern
	Montastraea annularis	Boulder star coral	**Endangered**
	M. cavernosa	Great star coral	Least Concern
	M. faveolata	Mountainous star coral	**Endangered**
	M. franksi	Boulder star coral	**Vulnerable**
	Solenastrea bournoni	Smooth star coral	Least Concern
Meandrinidae	*Dendrogyra cylindrus*	Pillar coral	**Vulnerable**
	Dichocoenia stellaris	-	Data Deficient
	D. stokesii	Elliptical star coral	**Vulnerable**
	Eusmilia fastigiata	Smooth flower coral	Least Concern
	Meandrina danae	-	Least Concern
	M. meandrites	Maze coral	Least Concern
Mussidae	*Isophyllastrea rigida*	Rough star coral	Least Concern
	Isophyllia sinuosa	Sinuous cactus coral	Least Concern
	Mussa angulosa	Spiny floer coral	Least Concern
	Mycetophyllia aliciae	Knobby cactus coral	Least Concern
	M. danaana	Lowridge cactus coral	Least Concern
	M. ferox	Rough cactus coral	**Vulnerable**
	M. lamarckiana	Ridged cactus coral	Least Concern
	M. reesi	Ridgeless cactus coral	Data Defficient
	Scolymia cubensis	Artichoke coral	Least Concern
	S. lacera	Atlantic mushroom coral	Least Concern
Oculinidae	*Oculina diffusa*	Diffuse ivory bush coral	Least concern
	O. varicosa	-	**Vulnerable**
Poritidae	*Porites astreoides*	Mustard Hill Coral	Least Concern
	P. branneri	Blue Crust Coral	**Near Threatened**
	P. divaricata	Thin Finger Coral	Least Concern
	P. furcata	Branched Finger Coral	Least Concern
	P. porites	Finger coral	Least Concern
Siderastreidae	*Siderastrea radians*	Lesser starlet coral	Least Concern
	S. siderea	Massive starlet coral	Least Concern
	S. stellata	-	Data Deficient

n/a: not assessed

APPENDIX 2: Reef-associated fish identified as occurring in Grenada

PART 1/2

Family	Species	Common name	IUCN status
Acanthuridae	*Acanthurus bahianus*	Ocean surgeon	Least Concern
	A. chirurgus	Doctorfish	Least Concern
	A. coeruleus	Blue tang surgeonfish	Least Concern
Albulidae	*Albula vulpes*	Bonefish	**Near Threatened**
Antennariidae	*Antennarius multiocellatus*	Longlure frogfish	n/a
	A. striatus	Striated frogfish	n/a
Apogonidae	*Apogon binotatus*	Barred cardinalfish	n/a
	A. lachneri	Whitestar cardinalfish	n/a
Apogonidae	*A. maculatus*	Flamefish	n/a
	A. planifrons	Pale cardinalfish	n/a
	A. quadrisquamatus	Sawcheek cardinalfish	n/a
	A. townsendi	Belted cardinalfish	n/a
	Astrapogon puncticulatus	Blackfin cardinalfish	n/a
	A. stellatus	Conchfish	n/a
	Phaeoptyx conklini	Freckled cardinalfish	n/a
	P. pigmentaria	Dusky cardinalfish	n/a
Atherinidae	*Hypoatherina harringtonensis*	Reef silverside	n/a
Aulostomidae	*Aulostomus maculatus*	Trumpetfish	n/a
Balistidae	*Balistes capriscus*	Grey triggerfish	n/a
	B. vetula	Queen triggerfish	**Vulnerable**
	Canthidermis sufflamen	Ocean triggerfish	n/a
	Melichthys niger	Black triggerfish	n/a
	Xanthichthys ringens	Sargassum triggerfish	n/a
Belonidae	*Ablennes hians*	Flat needlefish	n/a
	Tylosurus crocodilus crocodilus	Hound needlefish	n/a
Blenniidae	*Entomacrodus nigricans*	Pearl blenny	n/a
	Hypleurochilus aequipinnis	Oyster blenny	n/a
	H. springeri	Orangespotted blenny	n/a
	Ophioblennius atlanticus	Combtooth blenny	n/a
	Parablennius marmoreus	Seaweed blenny	n/a
	Scartella cristata	Molly miller	n/a
Bothidae	*Bothus lunatus*	Plate fish	n/a
	B. ocellatus	Eyed flounder	n/a
Bythitidae	*Calamopteryx goslinei*	Longarm brotula	n/a
	Ogilbia cayorum	Key brotula	n/a
Callionymidae	*Callionymus bairdi*	Lancer dragonet	n/a
Carangidae	*Alectis ciliaris*	African pompano	Least Concern
	Carangoides bartholomaei	Yellow jack	n/a
	Caranx crysos	Blue runner	Least Concern
	C. latus	Horse-eye jack	n/a
	C. ruber	Bar jack	n/a
	Decapterus punctatus	Round scad	n/a
	Elagatis bipinnulata	Rainbow runner	n/a
	Naucrates ductor	Pilotfish	n/a
	Oligoplites saurus	Leatherjacket	n/a
	Selar crumenophthalmus	Bigeye scad	n/a
	Seriola dumerili	Greater amberjack	n/a
	S. rivoliana	Longfin yellowtail	n/a
	Trachinotus falcatus	Permit	n/a
	T. goodei	Great pompano	Least Concern
	Trachurus lathami	Rough scad	n/a
Carcharhinidae	*Carcharhinus acronotus*	Blacknose shark	**Near Threatened**
	C. falciformis	Silky shark	**Near Threatened**
	C. leucas	Bull shark	**Near Threatened**
	C. limbatus	Blacktip shark	**Near Threatened**
	C. perezii	Caribbean reef shark	n/a
	Negaprion brevirostris	Lemon shark	**Near Threatened**
	Rhizoprionodon porosus	Caribbean sharpnose shark	Least Concern
Centropomidae	*Centropomus undecimalis*	Common snook	n/a

Family	Species	Common name	IUCN status
Chaenopsidae	*Acanthemblemaria aspera*	Roughhead blenny	n/a
	A. maria	Secretary blenny	n/a
	A. medusa	Medusa blenny	n/a
	A. spinosa	Spinyhead blenny	n/a
	Chaenopsis ocellata	Bluethroat pikeblenny	n/a
	Emblemaria pandionis	Sailfin blenny	n/a
	Emblemariopsis bahamensis	Blackhead blenny	n/a
	E. signifer	Flagfin blennhy	Least Concern
	Lucayablennius zingaro	Arrow blenny	n/a
Chaetodontidae	*Chaetodon ocellatus*	Spotfin butterflyfish	Least Concern
	C. sedentarius	Reef butterflyfish	Least Concern
	C. striatus	Banded butterflyfish	Least Concern
	Prognathodes aculeatus	Longsnout butterflyfish	Least Concern
Chlopsidae	*Kaupichthys nuchalis*	Collared eel	n/a
Cirrhitidae	*Amblycirrhitus pinos*	Redspotted hawkfish	n/a
Clupeidae	*Harengula clupeola*	False herring	n/a
	H. humeralis	Redear herring	n/a
	H. jaguana	Scaled herring	n/a
	Jenkinsia lamprotaenia	Dwarf round herring	Least Concern
	Opisthonema oglinum	Atlantic thread herring	n/a
	Sardinella aurita	Round sardinella	n/a
Congridae	*Conger triporiceps*	Manytooth conger	n/a
	Heteroconger longissimus	Brown garden eel	n/a
Cynoglossidae	*Symphurus arawak*	Caribbean tonguefish	n/a
	S. diomedeanus	Spottedfin tonguefish	n/a
Dactylopteridae	*Dactylopterus volitans*	Flying gurnard	n/a
Dactyloscopidae	*D. tridigitatus*	Sand stargazer	n/a
	Gillellus greyae	Arrow stargazer	n/a
	Platygillellus rubrocinctus	Saddle stargazer	n/a
Dasyatidae	*Dasyatis americana*	Southern stingray	Data Deficient
Diodontidae	*Chilomycterus antennatus*	Bridled burrfish	n/a
	C. antillarum	Web burrfish	n/a
	Diodon hystrix	Spot-fin porcupinefish	n/a
Echeneidae	*Echeneis naucrates*	Live sharksucker	n/a
	Remora remora	Shark sucker	n/a
Engraulidae	*Anchoa lyolepis*	Shortfinger anchovy	n/a
Ephippidae	*Chaetodipterus faber*	Atlantic spadefish	n/a
Fistulariidae	*Fistularia tabacaria*	Cornetfish	n/a
Gerreidae	*Eucinostomus argenteus*	Silver mojarra	n/a
	E. gula	Jenny mojarra	n/a
	Gerres cinereus	Yellow fin mojarra	n/a
Ginglymostomatidae	*Ginglymostoma cirratum*	Nurse shark	Data Deficient
Gobiesocidae	*Acyrtops beryllinus*	Emerald clingfish	n/a
Gobiidae	*Coryphopterus dicrus*	Colon goby	n/a
	C. glaucofraenum	Bridled goby	n/a
	C. lipernes	Peppermint goby	n/a
	C. personatus	Masked goby	n/a
	Elacatinus chancei	Shortstripe goby	n/a
	E. evelynae	Sharknose goby	n/a
	E. multifasciatus	Greenbanded goby	n/a
	E. randalli	Yellownose goby	n/a
	Ginsburgellus novemlineatus	Nineline goby	n/a
	Gnatholepis thompsoni	Goldspot goby	n/a
	Microgobius carri	Seminole goby	n/a
	Nes longus	Orangespotted goby	n/a
	Priolepis hipoliti	Rusty goby	n/a
	Risor ruber	Tusked goby	n/a
Grammatidae	*Gramma loreto*	Royal gramma	n/a

Family	Species	Common name	IUCN status
Haemulidae	*Anisotremus surinamensis*	Black margate	n/a
	A. virginicus	Porkfish	n/a
	Haemulon album	White margate	n/a
	H. aurolineatum	Tomtate grunt	Data Deficient
	H. bonariense	Black grunt	n/a
	H. boschmae	Bronzestripe grunt	n/a
	H. carbonarium	Caesar grunt	n/a
	H. chrysargyreum	Smallmouth grunt	n/a
	H. flavolineatum	French grunt	n/a
	H. macrostomum	Spanish grunt	n/a
	H. melanurum	Cottonwick grunt	n/a
	H. parra	Sailor's grunt	n/a
	H. plumierii	White grunt	n/a
	H. sciurus	Bluestriped grunt	n/a
	H. striatum	Striped grunt	Data Deficient
	H. vittatum	Boga	n/a
Hemiramphidae	*Hemiramphus balao*	Balao halfbeak	n/a
	H. brasiliensis	Ballyhoo halfbeak	n/a
	Hyporhamphus unifasciatus	Common halfbeak	n/a
Holocentridae	*Holocentrus adscensionis*	Squirrelfish	n/a
	H. rufus	Longspine squirrelfish	n/a
	Myripristis jacobus	Blackbar soldierfish	n/a
	Neoniphon marianus	Longjaw squirrelfish	n/a
	Plectrypops retrospinis	Cardinal soldierfish	n/a
	Sargocentron coruscum	Reef squirrelfish	n/a
	S. vexillarium	Dusky squirrelfish	n/a
Kyphosidae	*Kyphosus incisor*	Yellow sea chub	n/a
	K. sectatrix	Bermuda sea chub	n/a
Labridae	*Bodianus pulchellus*	Spotfin hogfish	n/a
	B. rufus	Spanish hogfish	n/a
	Clepticus parrae	Creole wrasse	Least Concern
	Decodon puellaris	Red hogfish	Data Deficient
	Doratonotus megalepis	Dwarf wrasse	Least Concern
	Halichoeres bivittatus	Slippery dick	Least Concern
	H. cyanocephalus	Yellowcheek wrasse	Least Concern
	H. garnoti	Yellowhead wrasse	Least Concern
	H. maculipinna	Clown wrasse	Least Concern
	H. pictus	Rainbow wrasse	Least Concern
	H. poeyi	Blackear wrasse	Least Concern
	H. radiatus	Puddingwife wrasse	Least Concern
	Lachnolaimus maximus	Hogfish	**Vulnerable**
	Thalassoma bifasciatum	Bluehead	Least Concern
	Xyrichtys novacula	Pearly razorfish	Least Concern
Labrisomidae	*Labrisomus bucciferus*	Puffcheek blenny	n/a
	L. gobio	Palehead blenny	n/a
	L. guppyi	Mimic blenny	n/a
	L. nigricinctus	Spotcheek blenny	n/a
	L. nuchipinnis	Hairy blenny	n/a
	Malacoctenus aurolineatus	Goldline blenny	n/a
	M. erdmani	Imitator blenny	n/a
	M. gilli	Dusky blenny	n/a
	M. macropus	Rosy blenny	Least Concern
	M. triangulatus	Saddled blenny	n/a
	M. versicolor	Barfin blenny	n/a
	Paraclinus fasciatus	Banded blenny	n/a
	P. grandicomis	Horned blenny	n/a
	P. nigripinnis	Blackfin blenny	n/a

n/a: not assessed

APPENDIX 2: Reef-associated fish identified as occurring in Grenada

PART 2/2

Family	Species	Common name	IUCN status
Lutjanidae	*Apsilus dentatus*	Black snapper	Least Concern
	Lutjanus analis	Mutton snapper	**Vulnerable**
	L. apodus	Schoolmaster snapper	n/a
	L. buccanella	Blackfin snapper	n/a
	L. cyanopterus	Cubera snapper	**Vulnerable**
	L. griseus	Grey snapper	n/a
	L. jocu	Dog snapper	n/a
	L. mahogoni	Mahogany snapper	n/a
	L. synagris	Lane snapper	n/a
	L. vivanus	Silk snapper	n/a
	Ocyurus chrysurus	Yellowtail snapper	n/a
Malacanthidae	*Malacanthus plumieri*	Sand tilefish	n/a
Megalopidae	*Megalops atlanticus*	Tarpon	**Vulnerable**
Microdesmidae	*Cerdale floridana*	Pugjaw wormfish	n/a
Monacanthidae	*Aluterus schoepfii*	Orange filefish	n/a
	A. scriptus	Scribbled leatherjacket filefish	n/a
	Cantherhines macrocerus	American whitespotted filefish	n/a
	C. pullus	Orangespotted filefish	n/a
	Monacanthus ciliatus	Fringed filefish	n/a
	M. tuckeri	Slender filefish	n/a
	Stephanolepis hispidus	Planehead filefish	n/a
	S. setifer	Pygmy filefish	n/a
Mugilidae	*Mugil curema*	White mullet	n/a
Mullidae	*Mulloidichthys martinicus*	Yellow goatfish	n/a
	Pseudupeneus maculatus	Spotted goatfish	n/a
Muraenidae	*Channomuraena vittata*	Broadbanded moray	n/a
	Echidna catenata	Chain moray	n/a
	Enchelycore nigricans	Mulatto conger	n/a
	Gymnothorax funebris	Green moray	n/a
	G. miliaris	Goldentail moray	n/a
	G. moringa	Spotted moray	n/a
	G. ocellatus	Caribbean ocellated moray	n/a
	G. vicinus	Purplemouth moray	n/a
Myliobatidae	*Aetobatus narinari*	Spotted eagle ray	**Near Threatened**
Ogcocephalidae	*Ogcocephalus nasutus*	Shortnose batfish	n/a
Ophichthidae	*Myrichthys ocellatus*	Goldspotted eel	n/a
	Quassiremus ascensionis	Blackspotted snake eel	n/a
Opistognathidae	*Opistognathus aurifrons*	Yellowhead jawfish	n/a
	O. macrognathus	Banded jawfish	n/a
Ostraciidae	*Acanthostracion polygonius*	Honeycomb cowfish	n/a
	A. quadricornis	Scrawled cowfish	n/a
	Lactophrys bicaudalis	Spotted trunkfish	n/a
	L. trigonus	Buffalo trunkfish	n/a
	Rhinesomus triqueter	Smooth trunkfish	n/a
Paralichthyidae	*Syacium gunteri*	Shoal flounder	n/a
Pempheridae	*Pempheris schomburgkii*	Glassy sweeper	n/a

Family	Species	Common name	IUCN status
Pomacanthidae	*Centropyge argi*	Cherubfish	Least Concern
	Holacanthus ciliaris	Queen angelfish	Least Concern
	H. tricolor	Rock beauty	Least Concern
	Pomacanthus arcuatus	Gray angelfish	Least Concern
	P. paru	French angelfish	Least Concern
	Abudefduf saxatilis	Sergeant-major	n/a
	A. taurus	Night sergeant	n/a
	Chromis cyanea	Blue chromis	Least Concern
	C. enchrysura	Yellowtail reeffish	n/a
	C. multilineata	Brown chromis	n/a
	Microspathodon chrysurus	Yellowtail damselfish	n/a
	Stegastes adustus	Dusky damselfish	n/a
	S. diencaeus	Longfin damselfish	n/a
	S. leucostictus	Beaugregory	n/a
	S. partitus	Bicolor damselfish	n/a
	S. planifrons	Threespot damselfish	n/a
	S. variabilis	Cocoa damselfish	n/a
Priacanthidae	*Heteropriacanthus cruentatus*	Glasseye	n/a
	Priacanthus arenatus	Atlantic bigeye	n/a
	Pristigenys alta	Short bigeye	n/a
Ptereleotridae	*Ptereleotris helenae*	Hovering goby	n/a
Rachycentridae	*Rachycentron canadum*	Cobia	n/a
Scaridae	*Cryptotomus roseus*	Bluelip parrotfish	Least Concern
	Scarus coelestinus	Midnight parrotfish	Data Deficient
	S. coeruleus	Blue parrotfish	Least Concern
	S. guacamaia	Rainbow parrotfish	**Near Threatened**
	S. iseri	Striped parrotfish	Least Concern
	S. taeniopterus	Princess parrotfish	Least Concern
	S. vetula	Queen parrotfish	Least Concern
	Sparisoma aurofrenatum	Redband parrotfish	Least Concern
	S. chrysopterum	Redtail parrotfish	Least Concern
	S. radians	Bucktooth parrotfish	Least Concern
	S. rubripinne	Redfin parrotfish	Least Concern
	S. viride	Stoplight parrotfish	Least Concern
Sciaenidae	*Corvula batabana*	Blue croaker	n/a
	Equetus lanceolatus	Jack-knifefish	n/a
	E. punctatus	Spotted drum	n/a
	Odontoscion dentex	Reef croaker	n/a
Scombridae	*Euthynnus alletteratus*	Little tunny	n/a
	Scomberomorus cavalla	King mackerel	Least Concern
	S. regalis	Cero	Least Concern
Scorpaenidae	Pterois volitans	Red lionfish	n/a
	Scorpaena albifimbria	Coral scorpionfish	n/a
	S. brasiliensis	Barbfish	n/a
	S. elachys	Dwarf scorpionfish	n/a
	S. inermis	Mushroom scorpionfish	n/a
	S. plumieri	Spotted scorpionfish	n/a
	S. caribbaeus	Reef scorpionfish	n/a

Family	Species	Common name	IUCN status
Serranidae	*Alphestes afer*	Mutton hamlet	Least Concern
	Cephalopholis cruentata	Graysby	Least Concern
	C. fulva	Coney	Least Concern
	Dermatolepis inermis	Marbled grouper	**Near Threatened**
	Diplectrum formosum	Sand perch	n/a
	Epinephelus guttatus	Red hind	Least Concern
	E. itajara	Atlantic goliath grouper	**Critically Endangered**
	E. morio	Red grouper	**Near Threatened**
	E. striatus	Nassau grouper	**Endangered**
	Hypoplectrus chlorurus	Yellowtail hamlet	n/a
	H. guttavarius	Shy hamlet	n/a
	H. nigricans	Black hamlet	n/a
	H. puella	Barred hamlet	n/a
	H. unicolor	Butter hamlet	n/a
	Liopropoma rubre	Peppermint bass	n/a
	Mycteroperca bonaci	Black grouper	**Near Threatened**
	M. interstitialis	Yellowmouth grouper	**Vulnerable**
	M. tigris	Tiger grouper	Least Concern
	M. venenosa	Yellowfin grouper	**Near Threatened**
	Paralabrax dewegeri	Vieja	**Near Threatened**
	Paranthias furcifer	Creole-fish	Least Concern
	Pseudogramma gregoryi	Reef bass	n/a
	Rypticus saponaceus	Greater soapfish	n/a
	R. subbifrenatus	Spotted soapfish	n/a
	Serranus tabacarius	Tobaccofish	n/a
	S. tigrinus	Harlequin bass	Least Concern
	S. tortugarum	Chalk bass	n/a
Sparidae	*Archosargus probatocephalus*	Sheepshead	n/a
	A. rhomboidalis	Western Atlantic seabream	n/a
	Calamus bajonado	Jolthead porgy	n/a
	C. calamus	Saucereye porgy	n/a
	C. penna	Sheepshead porgy	n/a
	C. pennatula	Pluma porgy	n/a
	Diplodus argenteus argenteus	South American silver porgy	n/a
	D. argenteus caudimacula	Silver porgy	n/a
Sphyraenidae	*Sphyraena barracuda*	Great barracuda	n/a
	S. picudilla	Southern sennet	n/a
Syngnathidae	*Cosmocampus albirostris*	Whitenose pipefish	n/a
	Hippocampus erectus	Lined seahorse	**Vulnerable**
	H. reidi	Longsnout seahorse	Data Deficient
	Micrognathus crinitus	Banded pipefish	n/a
Synodontidae	*Synodus intermedius*	Sand diver	n/a
	S. synodus	Diamond lizardfish	n/a
	Trachinocephalus myops	Snakefish	n/a
Tetraodontidae	*Canthigaster rostrata*	Caribbean sharpnose-puffer	n/a
	Sphoeroides nephelus	Southern puffer	n/a
	S. spengleri	Bandtail puffer	n/a
	S. testudineus	Checkered puffer	n/a
Urotrygonidae	*Urobatis jamaicensis*	Yellow stingray	Least Concern

n/a: not assesed

APPENDIX 3: Birds identified as occurring in Grenada (residents, migrants, vagrants)

PART 1/2

Family	Species	Common Name	Distribution	IUCN Status
Accipitridae	*Circus cyaneus*	Northern harrier[1]	Native	Least Concern
	Chondrohierax uncinatus	Hook-billed kite[1]	Native	Least Concern
	Buteogallus anthracinus	Common black-hawk[1]	Native	Least Concern
	Buteo platypterus	Broad-winged hawk	Native	Least Concern
Alcedinidae	*Megaceryle alcyon*	Belted kingfisher[1]	Native	Least Concern
	M. torquata	Ringed kingfisher[1]	Vagrant	Least Concern
Anatidae	*Anas acuta*	Northern pintail[1]	n/a	Least Concern
	A. americana	American wigeon[1]	n/a	Least Concern
	A. bahamensis	White-cheeked pintail[1]	n/a	Least Concern
	A. clypeata	Northernshoveler[1]	n/a	Least Concern
	A. crecca	Green-winged teal[1]	Vagrant	Least Concern
	A. discors	Blue-winged teal[1]	Native	Least Concern
	Aythya affinis	Lesser scaup[1]	n/a	Least Concern
	A. collaris	Ring-necked duck[1]	Native	Least Concern
	Dendrocygna arborea	West Indian whistling-duck[1]	Vagrant	**Vulnerable**
	D. autumnalis	Black-bellied whistling-duck[1]	Vagrant	Least Concern
	D. bicolor	Fulvous whistling-duck[1]	Vagrant	Least Concern
	Nomonyx dominicus	Masked duck[1]	n/a	Least Concern
	Oxyura jamaicensis	Ruddy duck[1]	Native	Least Concern
Anhingidae	*Anhinga anhinga*	Anhinga[1]	Vagrant	Least Concern
Apodidae	*Aramus guarauna*	Limpkin[1]	n/a	Least Concern
	Ardea alba	Great egret[1]	Native	Least Concern
	A.herodias	Great blue heron[1]	Native	Least Concern
	Bubulcus ibis	Cattle egret[1]	Native	Least Concern
	Butorides striata	Striated heron[1]	n/a	Least Concern
	B.virescens	Green heron[1]	Native	Least Concern
	Chaetura brachyura	Short-tailed swift	Native	Least Concern
	C. cinereiventris	Gray-rumped swift	Native	Least Concern
	Cypseloides niger	Black swift	Native	Least Concern
	Egretta caerulea	Little blue heron[1]	Native	Least Concern
	E. garzetta	Little egret[1]	n/a	Least Concern
	E.thula	Snowy egret[1]	Native	Least Concern
	E. tricolor	Tricolored heron[1]	n/a	Least Concern
	Nyctanassa violacea	Yellow-crowned night-heron[1]	Native	Least Concern
	Nycticorax nycticorax	Black-crowned night-heron[1]	Native	Least Concern
	Streptoprocne zonaris	White-collared swift	Native	Least Concern
Cardinalidae	*Charadrius collaris*	Collared plover[1]	Native	Least Concern
	C. semipalmatus	Semipalmated plover[1]	Native	Least Concern
	C.vociferus	Killdeer	Native	Least Concern
	C.wilsonia	Wilson's plover[1]	Native	Least Concern
	C.atratus	Black vulture[1]	Vagrant	Least Concern
	Pheucticus ludovicianus	Rose-breasted grosbeak	Native	Least Concern
	Piranga olivacea	Scarlet tanager	n/a	Least Concern
	P. rubra	Summer tanager	n/a	Least Concern
	Pluvialis dominica	American golden-plover[1]	Native	Least Concern
	P. squatarola	Black-bellied plover[1]	Native	Least Concern
Ciconiidae	*Jabiru mycteria*	Jabiru[1]	Native	Least Concern
Columbidae	*Columba livia*	Rock pigeon	**Introduced**	Least Concern
	C. passerina	Common ground-dove[1]	Native	Least Concern
	Geotrygon montana	Ruddy quail-dove	Native	Least Concern
	Leptotila wellsi	Grenada dove	**Endemic**	**Critically Endangered**
	Patagioenas squamosa	Scaly-naped pigeon	Native	Least Concern
	Zenaida auriculata	Eared dove[1]	Native	Least Concern
	Z. aurita	Zenaida dove[1]	Native	Least Concern
Cracidae	*Ortalis ruficauda*	Rufous-vented chachalaca	Native	Least Concern

Family	Species	Common Name	Distribution	IUCN Status
Cuculidae	*Coccyzus melacoryphus*	Dark-billed cuckoo[1]	n/a	Least Concern
	C.minor	Mangrovecuckoo[1]	Native	Least Concern
	Crotophaga ani	Smooth-billed ani[1]	Native	Least Concern
Falconidae	*Falco columbarius*	Merlin[1]	Native	Least Concern
	F. peregrinus	Peregrine falcon[1]	Native	Least Concern
	F. sparverius	American kestrel[1]	Native	Least Concern
Fregatidae	*Fregata magnificens*	Magnificentfrigatebird	Native	Least Concern
Fringillidae	*Euphonia musica*	Antillean euphonia	Native	Least Concern
Hirundinidae	*Hirundo rustica*	Barn swallow	Native	Least Concern
	Petrochelidon pyrrhonota	Cliff swallow	n/a	Least Concern
	Progne dominicensis	Caribbean martin	Native	Least Concern
	Riparia riparia	Bank swallow	n/a	Least Concern
	Tachycineta albiventer	White-winged swallow[1]	n/a	Least Concern
Hydrobatidae	*Oceanites oceanicus*	Wilson'sstorm-petrel	Native	Least Concern
Icteridae	*Anous stolidus*	Brown noddy	Native	Least Concern
	Chlidonias niger	Black tern	Vagrant	Least Concern
	Chroicocephalus ridibundus	Black-headed gull	Vagrant	Least Concern
	Dolichonyx oryzivorus	Bobolink	n/a	Least Concern
	Icterus galbula	Baltimore oriole	Vagrant	Least Concern
	I. icterus	Venezuelan troupial	n/a	Least Concern
	Larus argentatus	Herring gull	n/a	Least Concern
	Leucophaeus atricilla	Laughing gull	Native	Least Concern
	Molothrus bonariensis	Shiny cowbird[1]	Native	Least Concern
	Onychoprion anaethetus	Bridledtern	Native	Least Concern
	O. fuscatus	Sooty tern	Native	Least Concern
	Quiscalus lugubris	Carib grackle[1]	Native	Least Concern
	Rynchops niger	Black skimmer	Vagrant	Least Concern
	Sterna dougallii	Roseate tern	Native	Least Concern
	S. hirundo	Common tern	Native	Least Concern
	S. antillarum	Least tern	Vagrant	Least Concern
	Thalasseus maximus	Royaltern	Native	Least Concern
	T. sandvicensis	Sandwich tern	Native	Least Concern
Mimidae	*Allenia fusca*	Scaly-breasted thrasher[1]	**Regional endemic**	Least Concern
	Cinclocerthia ruficauda	Brown trembler	Native	Least Concern
	Margarops fuscatus	Pearly-eyed thrasher[1]	n/a	Least Concern
	Mimus gilvus	Tropical mockingbird	Native	Least Concern
Pandionidae	*Pandion haliaetus*	Osprey[1]	Native	Least Concern
Parulidae	*Mniotilta varia*	Black-and-white warbler[1]	n/a	Least Concern
	Parkesia motacilla	Louisiana waterthrush[1]	n/a	Least Concern
	P. noveboracensis	Northern waterthrush[1]	Native	Least Concern
	Protonotaria citrea	Prothonotary warbler[1]	Native	Least Concern
	Setophaga americana	Northern parula	Native	Least Concern
	S. discolor	Prairie warbler[1]	Vagrant	Least Concern
	S. fusca	Blackburnian warbler	Vagrant	Least Concern
	S. petechia	Yellow warbler[1]	Native	Least Concern
	S. ruticilla	American redstart[1]	Native	Least Concern
	S. striata	Blackpoll warbler[1]	Native	Least Concern
	S.a tigrina	Cape May warbler[1]	Vagrant	Least Concern
Pelecanidae	*Pelecanus occidentalis*	Brown pelican[1]	Native	Least Concern
Phaethontidae	*Phaethon aethereus*	Red-billed tropicbird	Native	Least Concern
	P. lepturus	White-tailed tropicbird	Native	Least Concern
Podicipedidae	*Podilymbus podiceps*	Pied-billed grebe[1]	Vagrant	Least Concern
Procellariidae	*Puffinus lherminieri*	Audubon's shearwater	Native	Least Concern
Psittacidae	*Amazona* sp.	Amazona parrot	Vagrant	n/a

1. Known to frequent mangroves and/or mangrove habitat edges
n/a: not assessed

APPENDIX 3: Birds identified as occurring in Grenada (residents, migrants, vagrants)

PART 2/2

Family	Species	Common Name	Distribution	IUCN Status
Rallidae	*Fulica americana*	American coot[1]	Vagrant	Least Concern
	F. caribaea	Caribbean coot[1]	Vagrant	**Near Threatened**
	Gallinula chloropus	Common moorhen[1]	Native	Least Concern
	Gallinula galeata	Common gallinule[1]	n/a	n/a
	Porphyrio martinicus	Purple gallinule[1]	n/a	Least Concern
	Porzana carolina	Sora[1]	Native	Least Concern
Ramphastidae	*Ramphastos vitellinus*	Channel-billed toucan	Vagrant	Least Concern
Recurvirostridae	*Himantopus mexicanus*	Black-neckedstilt[1]	Native	Least Concern
Scolopacidae	*Actitis macularius*	Spotted sandpiper[1]	Native	Least Concern
	Arenaria interpres	Ruddy turnstone[1]	Native	Least Concern
	Bartramia longicauda	Uplandsandpiper	Vagrant	Least Concern
	Calidris alba	Sanderling[1]	Native	Least Concern
	C. canutus	Red knot[1]	Native	Least Concern
	C. ferruginea	Curlew sandpiper[1]	Vagrant	Least Concern
	C. fuscicollis	White-rumpedsandpiper[1]	n/a	Least Concern
	C. himantopus	Stilt sandpiper[1]	Native	Least Concern
	C. mauri	Western sandpiper[1]	Native	Least Concern
	C. melanotos	Pectoral sandpiper[1]	Native	Least Concern
	C. minutilla	Least sandpiper[1]	Native	Least Concern
	C. pusilla	Semipalmated sandpiper[1]	Native	**Near Threatened**
	Gallinago delicata	Wilson's snipe	n/a	Least Concern
	G. gallinago	Common snipe[1]	Native	Least Concern
	Limnodromus griseus	Short-billed dowitcher[1]	Native	Least Concern
	Limosa fedoa	Marbled godwit[1]	Vagrant	Least Concern
	Numenius phaeopus	Whimbrel[1]	Vagrant	Least Concern
	Phalaropus tricolor	Wilson's phalarope[1]	Vagrant	Least Concern
	Philomachus pugnax	Ruff[2]	Native	Least Concern
	Tringa flavipes	Lesser yellowlegs[1]	Native	Least Concern
	T. melanoleuca	Greater yellowlegs[1]	Native	Least Concern
	T.semipalmata	Willet[1]	Native	Least Concern
	T. solitaria	Solitary sandpiper[1]	Native	Least Concern
	Tryngites subruficollis	Buff-breasted sandpiper	Native	**Near Threatened**
Stercorariidae	*Stercorarius parasiticus*	Parasitic jaeger	Vagrant	Least Concern
Sulidae	*Sula dactylatra*	Masked booby	Vagrant	Least Concern
	S. leucogaster	Brown booby	Native	Least Concern
	S.sula	Red-footed booby	Native	Least Concern
Thraupidae	*Coereba flaveola*	Bananaquit	Native	Least Concern
	Loxigilla noctis	Lesser Antillean bullfinch[1]	Native	Least Concern
	Sicalis luteola	Grassland yellow-finch	n/a	Least Concern
	Sporophila nigricollis	Yellow-bellied seedeater	Native	Least Concern
	Tangara cucullata	Lesser Antillean tanager	**Regional endemic**	Least Concern
	Tiaris bicolor	Black-faced grassquit	Native	Least Concern
	Volatinia jacarina	Blue-black grassquit	Native	Least Concern
Threskiornithidae	*Eudocimus ruber*	Scarlet ibis[1]	Vagrant	Least Concern
	Platalea ajaja	Roseate spoonbill[1]	Vagrant	Least Concern
	Plegadis falcinellus	Glossy ibis[1]	n/a	Least Concern

Family	Species	Common Name	Distribution	IUCN Status
Trochilidae	*Amazilia brevirostris*	White-chested emerald[1]	Native	Least Concern
	A. tobaci	Copper-rumped hummingbird	Native	Least Concern
	Anthracothorax viridigula	Green-throated mango[1]	Native	Least Concern
	Chrysolampis mosquitus	Ruby-topaz hummingbird	Vagrant	Least Concern
	Eulampis holosericeus	Green-throated carib[1]	Native	Least Concern
	E. jugularis	Purple-throated carib[1]	Vagrant	Least Concern
	Florisuga mellivora	White-necked jacobin	Vagrant	Least Concern
	Glaucis hirsutus	Rufous-breasted hermit	Native	Least Concern
	Orthorhyncus cristatus	Antillean Crested hummingbird	Native	Least Concern
Troglodytidae	*Troglodytes aedon*	House wren	Native	Least Concern
Turdidae	*Catharus minimus*	Gray-cheeked thrush	n/a	Least Concern
	Turdus fumigatus	Cocoa thrush[1]	Native	Least Concern
	T. nudigenis	Spectacled thrush	Native	Least Concern
Tyrannidae	*Elaenia flavogaster*	Yellow-bellied elaenia	Native	Least Concern
	E. martinica	Caribbean elaenia[1]	Native	Least Concern
	Myiarchus nugator	Grenada flycatcher	**Regional endemic**	Least Concern
	Tyrannus dominicensis	Gray kingbird[1]	Native	Least Concern
	T. melancholicus	Tropical kingbird	Native	Least Concern
	T. savana	Fork-tailed flycatcher	Vagrant	Least Concern
Tytonidae	*Tyto alba*	Barn owl[1]	n/a	Least Concern
	Lathrotriccus euleri flaviventris	Grenadian Euler's flycatcher[2]	n/a	**Extinct**
Vireonidae	*Vireo altiloquus*	Black-whiskered vireo[1]	Native	Least Concern
	V. flavifrons	Yellow-throated vireo	Vagrant	Least Concern

1. Known to frequent mangroves and/or mangrove habitat edges

2. Subspecies of Euler's flycatcher; last recorded in the early 1950s

n/a: not assessed

APPDENDIX 4: Plants and trees in Grenada assessed by IUCN

Family	Species	Common name	IUCN Status
Cactaceae	*Cereus repandus*	Apple cactus	Least Concern
	Consolea rubescens	-	Least Concern
	Hylocereus undatus	Dragonfruit	Least Concern
	Mammillaria mammillaris	-	Least Concern
	Melocactus broadwayi	Turk's cap	Least Concern
	M. intortus	Turk's head	Least Concern
	Opuntia triacantha	Spanish lady	**Near Threatened**
	Pilosocereus royenii	Royen's tree cactus	Least Concern
	Rhipsalis baccifera	Mistletoe cactus	Least Concern
Ceratophyllaceae	*Ceratophyllum demersum*	Rigid hornwort	Least Concern
Commelinaceae	*Commelina erecta*	Slender dayflower	Least Concern
Cyperaceae	*Fimbristylis cymosa*	-	Least Concern
	F. dichotoma	-	Least Concern
	Fuirena umbellata	Yefen	Least Concern
	Pycreus flavescens	Yellow souchet	Least Concern
Gramineae	*Isachne disperma*	-	Least Concern
	Phragmites australis	Common reed	Least Concern
Leguminosae	Acacia riparia	-	Least Concern
	Bauhinia variegata	-	Least Concern
	Chaetocalyx scandens	-	Least Concern
	Chamaecrista absus	Tropical sensitive pea	Least Concern
	C. glandulosa	-	Least Concern
	Erythrina variegata	Indian coral tree	Least Concern
	Hymenaea courbaril	-	Least Concern
	Rhynchosia minima	-	Least Concern
	Senna bicapsularis	Chirstmas bush	Least Concern
Lemnaceae	*Lemna minor*	Common duckweed	Least Concern
Lythraceae	*Ammannia baccifera*	Blistering ammania	Least Concern
Meliaceae	*Cedrela odorata*	Spanish cedar	**Vulnerable**
	Swietenia mahagoni	West Indian mahogany	Endangered
Onagraceae	*Ludwigia hyssopifolia*	Seed box	Least Concern
	L. octovalvis	-	Least Concern
Orchidaceae	*Habenaria monorrhiza*	-	Least Concern
	Oeceoclades maculata	Monk orchid	Least Concern
	Scaphyglottis sickii	Sicks Scaphyglottis	Least Concern
Pteridaceae	*Acrostichum aureum*	Golden-leather fern	Least Concern
	A. danaeifolium	-	Least Concern
	Pteris vittata	-	Least Concern
Scrophulariaceae	*Bacopa monnieri*	Water hyssop	Least Concern
Zygophyllaceae	*Guaiacum officinale*	Guaiac tree	**Endangered**

APPENDIX 5: Land mammals identified as occurring in Grenada

Family	Species	Common name	IUCN Status
Emballonuridae	*Peropteryx trinitatis*	Trinidad dog-like bat	Least Concern
Viveridae	*Herpestes auropunctatus*	Asian mongoose	Least Concern
Vespertilionidae	*Myotis Nigricans*	Black Myotis	Least Concern
Phyllostomidae	*Micronycteris megalotis*	Little big-eared bat	Least Concern
	Glossophaga longirostris	Miller's long-tongued bat	Data Deficient
	Glossophaga soricina	Pallas's long-tongued bat	Least Concern
	Artibeus glaucus	Silvery fruit-eating bat	Least Concern
	Artibeus jamaicensis	Jamaican fruit-eating bat	Least Concern
	Artibeus lituratus	Great fruit-eating bat	Least Concern
	Anoura geoffroyi	Geoffroy's tailless bat	Least Concern
	Sturnira lilium	Little yellow-shouldered bat	Least Concern
Noctilionidae	*Noctilio leporinus*	Greater bulldog bat	Least Concern
Murinae	*Rattus rattus*	House rat	Least Concern
	Mus musculus	House mouse	Least Concern
Mormoopidae	*Pteronotus davyi*	Davy's naked-backed bat	Least Concern
Molossidae	*Molossus molossus*	Pallas's mastiff bat	Least Concern
	Tadarida brasiliensis	Brazilian free-tailed bat	Least Concern
Didelphidae	*Marmosa robinsoni*	Robinson's mouse opossum	Least Concern
	Didelphis marsupialis	Common oppossum (Manicou)	Least Concern
Dasypodidae	*Dasypus novemcinctus*	Nine-banded armadillo (Tatu)	n/a
Cercopithecidae	*Cercopithecus mona*	Mona monkey	Least Concern

n/a: not assessed

APPENDIX 6: Reptiles and amphibians identified as occurring in Grenada

Family	Species	Common name	IUCN status
Boidae	*Corallus grenadensis*	Tree boa	n/a
Bufonidae	*Rhinella marina*	(Crapaud) Cane toad	Least Concern
Colubridae	*Mastigodryas bruesi*	Boddaerts's tree snake	n/a
	Tantilla melanocephala	Black-headed snake	n/a
Craugastoridae	*Pristimantis euphronides*	(Grenada frog) Highland piping frog	**Endangered / Endemic**
Dipsadidae	*Clelia clelia*	Cribo	**likely extirpated**
Eleutherodactylidae	*Eleutherodactylus johnstonei*	Lesser Antillean whistling frog	Least Concern
Gekkonidae	*Hemidactylus mabouia*	Tropical house gecko	n/a
	Thecadactylus rapicauda	Turnip-tailed gecko	n/a
Gymnophtalmidae	*Bachia heteropus*	Alien's ground lizard	n/a
	Gymnophthalmus underwoodi	Underwood's spectacled tegu	Least Concern
Iguanidae	*Anolis aeneus*	Zandoli (bronze anole)	n/a
	A. richardii	Grenada tree anole	n/a
	Iguana iguana	Green iguana	n/a
Leptodactylidae	*Leptodactylus validus*	(Tadpole) Garman's woodland frog	Least Concern
Mabuyidae	*Copeoglossum aurae*	Greater windward skink	**likely extirpated**
	Marisora aurulae	Lesser windward skink	**likely extirpated**
Polychrotidae	*Anolis sagrei*	Brown anole	n/a
Sphaerodactylidae	*Sphaerodactylus kirbyi*	Grenadines sphaero[1]	**Vulnerable**
Teiidae	*Ameiva ameiva*	Giant ameiva	n/a
Testudinidae	*Chelonoidis carbonaria*	(Morocoy) red-footed tortoise	**no breeding population**
Typhlopidae	*Typhlops tasymicris*	Grenada bank blindsnake	**Endangered / likely extirpated**

1. only occurs in Carriacou

n/a: not assessed

Part 1/2

			2011 Census				House construction (2011)									Land tenure (2011)						
Project Site	Parish	Local community	Male	Female	Total population	Total Homes	Wood	Plywood	Makeshift	Plywood & concrete	Concrete/ Blocks	Wood & concrete	Stone	Brick	Other	Owned/ Freehold	Leasehold	Rented	Squatted	Other/Unknown	Permission to work land	Share cropping
Grand Anse	St. George	Belmont	2	5	7	353	88	7	2	7	222	27	0	0	0	211	10	26	3	103	0	0
		Calliste	238	261	499	158	20	8	0	4	120	5	0	0	1	121	5	9	4	19	0	0
		Golflands	236	218	454	189	34	8	0	2	126	18	0	0	1	-	-	-	-	-	-	-
		Grand Anse	841	872	1713	447	78	39	0	21	262	46	0	1	0	254	12	128	8	45	0	0
		Grand Anse Valley	535	510	1045	340	110	52	1	12	135	29	0	0	1	95	5	34	135	69	1	1
		Ka-Fe Beau	46	56	102	31	10	5	1	1	8	6	0	0	0	11	2	13	1	4	0	0
		Mont Toute	561	570	1131	266	73	31	0	0	129	33	0	0	0	146	0	34	11	43	2	30
		The Limes	181	223	404	89	20	0	0	1	58	10	0	0	0	59	1	9	0	20	0	0
		Total	**2640**	**2715**	**5355**	**1873**	**433**	**150**	**4**	**48**	**1060**	**174**	**0**	**1**	**3**	**897**	**35**	**253**	**162**	**303**	**3**	**31**
Grand Bras	St Andrew	Dunfermline[3]	381	338	719	217	77	15	0	1	107	17	0	0	0	106	3	58	1	49	0	0
		Ford	77	78	155	59	20	3	0	0	21	15	0	0	0	44	0	12	0	2	0	1
		Grand Bras	459	457	916	298	57	6	0	2	170	63	0	0	0	225	1	53	0	19	0	0
		Paradise	524	526	1050	343	142	43	0	2	115	40	1	0	0	174	4	122	0	43	0	0
		Telescope	886	818	1704	550	175	92	3	8	189	82	0	0	1	304	2	64	60	91	18	11
		Total	**2327**	**2217**	**4544**	**1467**	**471**	**159**	**3**	**13**	**602**	**217**	**1**	**0**	**1**	**853**	**10**	**309**	**61**	**204**	**18**	**12**
Grand Etang & Annandale	St Andrew	Adelphi	104	121	225	66	13	1	0	0	34	18	0	0	0	56	1	2	0	7	0	0
		Balthazar	208	198	406	120	36	6	0	0	57	20	0	0	1	60	3	10	0	45	2	0
		Beauregard	59	51	110	31	5	3	0	1	13	9	0	0	0	27	0	0	0	4	0	0
		Grand Etang	5	4	9	2	1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0
		Morne Longue	161	109	270	70	33	13	0	0	15	9	0	0	0	58	3	3	0	3	3	0
		Spring Garden	24	21	45	17	6	1	0	0	9	1	0	0	0	8	0	1	0	7	1	0
	St. David	Champs Fleurs	33	50	83	17	3	0	0	0	12	2	0	0	0	12	0	3	0	2	0	0
		Minorca	9	23	32	12	1	0	0	0	10	1	0	0	0	8	0	1	0	3	0	0
		Mt. Agnes	19	19	38	12	5	0	0	0	6	0	0	1	0	6	0	2	0	4	0	0
		Mt. Tranquil	47	49	96	25	11	1	4	1	7	1	0	0	0	9	2	4	0	9	1	0
		Mt. William	67	62	129	38	17	0	0	0	4	17	0	0	0	26	1	8	0	3	0	0
		Retreat	50	38	88	29	13	0	9	0	6	1	0	0	0	21	0	6	0	1	0	1
		Vine yard	18	19	37	11	1	0	0	0	10	0	0	0	0	8	0	0	0	2	0	1
		Windsor Forest	226	273	499	147	41	3	4	0	85	14	0	0	0	111	3	8	0	22	2	1
	St. George	Annadale	130	157	287	73	21	3	0	0	42	7	0	0	0	59	0	13	0	1	0	0
		Beausejour[1]	279	272	551	154	38	17	2	15	72	10	0	0	0	110	0	5	24	15	0	0
		Granton	67	61	128	40	7	7	2	2	20	2	0	0	0	32	1	7	0	0	0	0
		Grenville Vale Estate	51	59	110	35	5	6	0	0	24	0	0	0	0	26	0	1	5	2	1	0
		Happy Hill[4]	412	389	801	205	49	7	0	0	132	17	0	0	0	138	0	11	0	53	3	0
		Mango	45	41	86	31	9	5	0	1	12	4	0	0	0	23	0	7	1	0	0	0
		Morne Jaloux	439	491	930	287	29	4	0	1	227	26	0	0	0	200	1	45	0	41	0	0
		New Hampshire	457	444	901	252	86	31	0	2	122	10	0	0	1	190	4	35	5	18	0	0
		Spring Garden	21	19	40	12	5	3	0	0	4	0	0	0	0	6	0	0	0	6	0	0
		Vendome	265	274	539	147	34	2	0	2	80	27	0	0	2	129	0	9	0	8	0	1
		Willis	121	108	229	78	29	7	0	0	35	7	0	0	0	63	2	2	2	8	1	0
	St. John	Clozier	214	166	380	123	57	0	2	1	49	14	0	0	0	65	0	46	1	8	3	0
		Concord	230	198	428	141	35	7	11	1	64	23	0	0	0	79	4	46	0	11	0	1
		Mt. Granby	161	167	328	82	19	2	1	0	54	6	0	0	0	61	0	5	2	14	0	0
		Mt. Nesbit	81	85	166	59	10	0	2	1	46	0	0	0	0	45	0	10	1	3	0	0
		Mt. Plaiser	97	83	180	67	25	0	1	0	33	8	0	0	0	41	2	18	2	4	0	0
		Total	**4100**	**4051**	**8151**	**2383**	**644**	**129**	**38**	**28**	**1285**	**254**	**0**	**1**	**4**	**1678**	**28**	**308**	**43**	**304**	**17**	**5**
Levera	St. Patrick	Chambord Estate	2	2	4	2	1	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0
		Levera	39	22	61	23	5	4	1	0	8	3	0	0	2	19	0	2	0	2	0	0
		River Sallee	551	534	1085	312	163	23	1	3	84	36	0	1	1	192	1	66	2	51	0	0
		Rose Hill	289	264	553	123	78	0	1	0	34	10	0	0	0	62	3	45	2	9	0	2
		Total	**881**	**822**	**1703**	**460**	**247**	**27**	**4**	**3**	**126**	**49**	**0**	**1**	**3**	**273**	**4**	**114**	**4**	**63**	**0**	**2**
Moliniere-Beausejour	St. George	Beausejour[1]	279	272	551	154	38	17	2	15	72	10	0	0	0	110	0	5	24	15	0	0
		Brizan[2]	155	172	327	90	21	7	1	1	49	11	0	0	0	56	0	25	3	6	0	0
		Fontenoy	319	349	668	176	58	10	0	6	83	18	1	0	0	-	-	-	-	-	-	-
		Grand Mal	232	257	489	136	26	11	0	0	93	6	0	0	0	103	1	14	6	12	0	0
		Happy Hill[4]	412	389	801	205	49	7	0	0	132	17	0	0	0	138	0	11	0	53	3	0
		Mt. Moritz[6]	311	322	633	207	13	2	0	0	188	4	0	0	0	147	1	25	0	33	1	0
		Total	**1708**	**1761**	**3469**	**968**	**205**	**54**	**3**	**22**	**617**	**66**	**1**	**0**	**0**	**554**	**2**	**80**	**33**	**119**	**4**	**0**
Morne Gazo	St. David	Charlotte Vale	27	26	53	16	2	0	0	0	10	4	0	0	0	7	0	8	0	1	0	0
		Epping Forest	16	25	41	17	4	0	0	0	10	3	0	0	0	6	0	10	0	1	0	0
		La Femme	122	129	251	76	40	0	0	0	22	14	0	0	0	32	2	40	0	2	0	0
	St. George	Corbeau Town	56	71	127	33	2	2	0	2	26	1	0	0	0	20	0	3	0	10	0	0
		Mt. Airy	138	155	293	89	8	4	0	0	72	4	0	0	1	53	1	4	1	30	0	0
		Total	**359**	**406**	**765**	**231**	**56**	**6**	**0**	**2**	**140**	**26**	**0**	**0**	**1**	**118**	**3**	**65**	**1**	**44**	**0**	**0**
Mt Hartman	St. George	Mt. Hartman[5]	206	219	425	140	26	20	0	2	91	1	0	0	0	64	0	39	13	24	0	0

Part2/2

			2011 Census				House construction (2011)									Land tenure (2011)						
Project Site	Parish	Local community	Male	Female	Total population	Total Homes	Wood	Plywood	Makeshift	Plywood & concrete	Concrete/ Blocks	Wood & concrete	Stone	Brick	Other	Owned/ Freehold	Leasehold	Rented	Squatted	Other/Unknown	Permission to work land	Share cropping
Mt. Morritz	St. George	Beaulieu	518	429	947	295	110	22	1	2	142	18	0	0	0	185	18	56	2	34	0	0
		Mt. Moritz[6]	311	322	633	207	13	2	0	0	188	4	0	0	0	147	1	25	0	33	1	0
		Snug Corner	85	85	170	53	14	0	0	0	36	3	0	0	0	38	1	4	1	9	0	0
		Total	**914**	**836**	**1750**	**555**	**137**	**24**	**1**	**2**	**366**	**25**	**0**	**0**	**0**	**370**	**20**	**85**	**3**	**76**	**1**	**0**
Mt. St. Catherine	St Andrew	Belair	81	77	158	51	24	3	1	0	11	11	0	0	1	35	0	15	0	1	0	0
		Belmont	551	632	1183	14	9	0	0	0	4	1	0	0	0	10	0	0	0	2	2	0
		Blaize	67	43	110	30	14	7	0	0	3	6	0	0	0	27	0	2	0	1	0	0
		Bylands	400	434	834	102	57	5	0	0	16	24	0	0	0	72	0	26	0	3	1	0
		Felix Park	116	109	225	71	24	0	0	0	35	11	0	0	1	57	1	10	0	3	0	0
		Mt. Castle	1	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Mt. Horne estate	28	11	39	244	95	48	4	1	49	46	0	1	0	179	0	44	0	19	2	0
		Mt. Horne	507	449	956	9	4	0	0	0	3	2	0	0	0	7	0	1	0	1	0	0
		Paraclete	268	293	561	159	54	22	0	1	67	15	0	0	0	120	2	32	0	4	1	0
		Plaisance	35	42	77	25	19	0	0	0	6	0	0	0	0	18	0	7	0	0	0	0
		Pyrenees	3	0	3	2	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0
		Windsor	2	1	3	3	2	0	0	0	0	1	0	0	0	3	0	0	0	0	0	0
	St. John's	Florida	136	119	255	86	46	0	0	0	21	17	0	2	0	68	0	12	4	1	0	1
	St. Patrick's	Belmont	30	23	53	4	1	0	0	0	3	0		0	0	2	0	1	0	1	0	0
		Total	**2225**	**2233**	**4458**	**801**	**351**	**85**	**5**	**2**	**219**	**134**	**0**	**3**	**2**	**600**	**3**	**150**	**4**	**37**	**6**	**1**
Pearls	St Andrew	Dunfermline[3]	381	338	719	217	77	15	0	1	107	17	0	0	0	106	3	58	1	49	0	0
		Pearls	547	480	1027	281	132	30	3	1	83	32	0	0	0	190	1	41	4	44	1	0
		Simon	401	379	780	239	107	0	0	0	97	35	0	0	0	146	5	11	22	55	0	0
		Upper Pearls	98	71	169	44	6	17	0	11	6	4	0	0	0	39	0	1	0	4	0	0
		Total	**1427**	**1268**	**2695**	**781**	**322**	**62**	**3**	**13**	**293**	**88**	**0**	**0**	**0**	**481**	**9**	**111**	**27**	**152**	**1**	**0**
Perseverance & Beausejour	St. George	Brizan[2]	155	172	327	90	21	7	1	1	49	11	0	0	0	56	0	25	3	6	0	0
		Perseverance Estate	15	6	21	10	6	1	0	1	1	1	0	0	0	5	0	0	5	0	0	0
	St. John	Woodford	89	95	184	59	15	0	1	0	34	9	0	0	0	43	1	10	0	5	0	0
		Total	**259**	**273**	**532**	**159**	**42**	**8**	**2**	**2**	**84**	**21**	**0**	**0**	**0**	**104**	**1**	**35**	**8**	**11**	**0**	**0**
Richmond Hill	St. George	Paddock	103	102	205	71	10	1	0	0	45	15	0	0	0	45	1	16	1	8	0	0
		Parade	20	16	36	15	1	0	0	0	13	1	0	0	0	7	0	3	0	4	1	0
		Richmond Hill	120	113	233	82	8	1	0	0	61	12	0	0	0	57	1	9	1	13	1	0
		The Bocas	151	146	297	82	13	4	0	0	57	8	0	0	0	51	0	10	0	20	1	0
		Total	**394**	**377**	**771**	**250**	**32**	**6**	**0**	**0**	**176**	**36**	**0**	**0**	**0**	**160**	**2**	**38**	**2**	**45**	**3**	**0**
Southeast Coast	St Andrew	Crochu	106	131	237	71	12	0	0	0	53	6	0	0	0	63	0	4	0	3	1	0
		Grand Bacolet	300	253	553	155	45	0	0	0	94	16	0	0	0	116	1	5	0	24	4	5
		Hope Estate	293	319	612	195	59	5	0	0	124	7	0	0	0	136	1	26	2	27	2	1
		Mahot	46	43	89	21	14	0	0	0	6	1	0	0	0	16	0	0	2	1	2	0
	St. David	Bailles Bacolet	165	178	343	137	18	0	1	0	103	15	0	0	0	88	2	27	0	18	2	0
		Belle Isle	112	129	241	86	30	3	12	0	37	4	0	0	0	28	0	42	0	16	0	0
		Content	92	77	169	57	19	0	10	0	28	0	0	0	0	40	0	8	0	9	0	0
		La Sagesse	397	379	776	236	69	11	30	0	96	30	0	0	0	120	6	63	4	43	0	0
		Lower La Tante	179	188	367	115	48	0	3	0	58	6	0	0	0	75	1	30	2	7	0	0
		Petit Bacaye	36	40	76	34	2	0	0	0	31	1	0	0	0	24	0	6	0	4	0	0
		Requin	209	188	397	122	48	0	0	0	68	4	0	2	0	72	4	10	0	6	0	30
		Westerhall	362	397	759	294	51	0	2	6	215	20	0	0	0	194	2	49	0	49	0	0
		Westerhall Point	82	102	184	68	4	0	0	0	59	5	0	0	0	41	0	3	0	24	0	0
	St. George	Calivigny	266	253	519	180	31	4	0	1	136	8	0	0	0	131	4	4	0	41	0	0
		Fort Jeudy	86	104	190	68	0	0	0	0	63	2	1	2	0	-	-	-	-	-	-	-
		Total	**2731**	**2781**	**5512**	**1839**	**450**	**23**	**58**	**7**	**1171**	**125**	**1**	**4**	**0**	**1144**	**21**	**277**	**10**	**272**	**11**	**36**
Woburn Clark Court's Bay	St. George	Egmont	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Lance Aux Espine	284	276	560	204	4	0	0	0	189	9	2	0	0	146	0	25	0	33	0	0
		Mt. Hartman[5]	206	219	425	140	26	20	0	2	91	1	0	0	0	64	0	39	13	24	0	0
		Petite Caliviginy	6	2	8	2	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0
		Woburn	476	500	976	306	61	4	0	1	223	15	2	0	0	217	1	29	0	49	10	0
		Total	**972**	**997**	**1969**	**652**	**91**	**24**	**0**	**3**	**505**	**25**	**4**	**0**	**0**	**429**	**1**	**93**	**13**	**106**	**10**	**0**
All project sites (multiple village listings removed in final totals--see footnotes)			**19399**	**19244**	**38643**	**11546**	**3283**	**709**	**118**	**128**	**6096**	**1181**	**7**	**10**	**14**	**7104**	**135**	**1794**	**343**	**1580**	**70**	**87**

1. Beausejour village listed twice: Grand Etant & Annandale and for Moliniere-Beausejour
2. Brizan village listed twice: Perseverance & Beausejour and for Moliniere-Beausejour
3. Dunfermline listed twice: Grand Bras and for Pearls
4. Happy Hill village listed twice: Grand Etang & Annandale and for Moliniere-Beausejour
5. Mt. Harman village listed twice: Mt. Hartman and for Woburn Clarks Court Bay
6. Mt. Moritz village listed twice: Mt. Moritz and Moliniere-Beausejour