



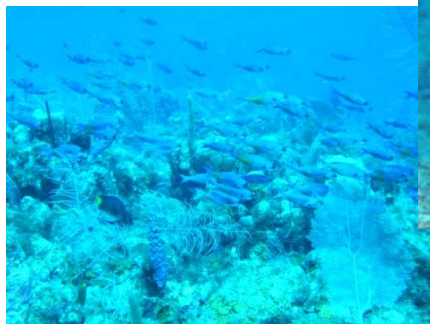
Organization of  
American States



## ReefFix: An Integrated Coastal Zone Management (ICZM) Ecosystem Services Valuation and Capacity Building Project for the Caribbean



### ST. KITTS AND NEVIS FIRST DRAFT REPORT JUNE 2013



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## **GLOSSARY OF TERMS**

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**Biodiversity:** the variability among living organisms from all sources including *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

**Beach:** The sloping area of unconsolidated material, typically sand, that extends landward from the mean high water mark to the area where there is a marked change in material or natural physiographic form or when there is no such marked change in the material or natural physiographic form, the beach shall be deemed to extend to a distance of twenty metres landward from the high water mark or such lesser area as may be determined by the Minister in consultation with the National Conservation Commission and in all cases shall include the primary sand dune.

**Coastal management:** the development of a strategic, long-term and sustainable coastal use policy.

**Coastline:** commonly, the line that forms the boundary between land and the water.

**Coastal Environmentally Sensitive Area:** An area, which because of its inherent environmental characteristics, is susceptible to destruction by development activity and which may be earmarked for preservation or conservation including coastal aquifers, beaches, mangroves, coral reefs and primary sand dunes.

**Coastal zone:** Any area having an elevation less than 15 metres above sea level within a limit of one hundred metres of the mean high water mark and a limit of two kilometres seaward of the mean low water mark and shall include the foreshore and the floor of the sea.

**Conservation:** maintenance of a favourable balance in the use of resources by careful control and management, especially for the benefit of posterity.

**Development:** includes the carrying out of building, engineering, mining or other operations in, on, over or under any land, the making of any material change in the use of any building or other land, or the subdivision of any land.

**Disaster:** A serious disruption of the functioning of a society causing widespread human, material or environmental losses which exceed the ability of the affected society to cope using only its own resources. Disasters may be classified according to the speed of onset (sudden or slow) or according to their cause (natural or man-made, or perhaps a combination of both). The disruption caused to people's lives can be in the form of personal injury, malnutrition, the loss of property or livelihood, or in extreme cases, the loss of life.

**Disaster management:** The process by which we plan for, respond to and recovery from a disaster.

**Ecology:** the study of the relations of living organisms to one another, their surroundings, their habitats and modes of life.

**Ecosystems:** a dynamic complex of plant, animal and micro-organism, communities and their non-living environment interacting as a functional unit.

**Endemic:** native to a specific geographic area.

**Environment:** the sum of all external conditions (including layers of the atmosphere; organic and inorganic matter and living organisms) and the interacting systems that affect the life, development and survival of an organism within the boundaries of a country.

**Fauna:** The animal life of any region, geological formation or period.

**Flora:** The plant-life of any region, formation or period.

**Fishers:** a person or ship engaged in fishing.

**Habitat:** a place where a particular plant or animal lives: Generally refers to a smaller area than environment.

**Marine Management Area (MMA):** A named, discrete geographic marine area along the St. Kitts and Nevis coast designated by law or administrative action, and intended to protect, conserve, or otherwise manage a variety of resources and their uses. The resources and uses include, but are not limited to, living marine resources and their habitats, scenic views, water quality, recreational values, and cultural or geological resources. General areas that are administratively established for recreational or commercial fishing restrictions, such as seasonal or geographic closures or size limits, are not included in this definition.

**Marine Protected Area (MPA):** Any area of the marine environment that has been reserved to provide lasting protection for part or all of the natural and cultural resources therein.

**Marine reserve:** An area where some or all fishing is prohibited for a lengthy period of time as provided in Section 23 of the Fisheries Act, 1984.

**National park:** An area consisting of a relatively large land or marine area or some combination of land or sea, containing natural and cultural features or scenery of national or international significance and managed in a manner to protect such resources and sustain scientific, recreational and educational activities on a controlled basis.

**Natural area:** An area that remains largely uninfluenced by human intervention and which still reflects the natural processes, geological foundation and the wildlife associated with the area.

**Natural resources:** The non-produced factors of production which occur naturally in an area. They may be renewable – can be used repeatedly without depleting what is available for future use. Non-renewable resources can only be used once and cannot be replaced once they are used.



**Pollutant:** any dredged spoil, solid waste, incinerator residue, sewage, garbage, chemical waste, heat, industrial, domestic, municipal or agriculture waste discharged into the environment.

**Pollution:** the direct or indirect alteration of the physical, chemical, thermal, biological or radioactive properties of any part of the environment in such a way as to create a hazard or potential hazard to the health, safety or welfare of living species.

**Reef:** a ridge of rock or other material lying just below the surface of the sea.

**Sea grass:** members of marine seed plants that grow chiefly on sand or sand-mud bottom. They are most abundant in water less than 9 m deep.

**Sewer:** A pipe or conduit, generally closed, for carrying sewage and other waste in liquid form.

**Sewer System:** Any plant, system, facility or property used or useful or having the present capacity for future use in connection with the collection, treatment, purification or disposal of sewage and sewage effluent and residue from more than one dwelling or from any commercial or industrial establishment, and without limiting the generality of the foregoing definition, embraces treatment plants, pumping stations, intercepting sewers, pressure lines, mains, laterals and all necessary appurtenances and equipment and shall include all property, rights, easements and franchises relating to any such system and deemed necessary or convenient for the operation thereof.

**Sustainable development:** Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

**Sustainable use:** The use of natural resources in a way and at a rate that does not lead to the long-term decline of that resource, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

## ACRONYMS

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<b>CARICOM</b>	Caribbean Community
<b>CBD</b>	United Nations Convention on Biological Diversity
<b>CEP</b>	Country Environmental Profile
<b>CITES</b>	Convention on International Trade in Endangered Species
<b>COP</b>	Conference of the Parties
<b>CRFM</b>	CARICOM Regional Fisheries Management
<b>CZMP</b>	Coastal Zone Management Plan
<b>DCPA</b>	Development Control and Planning Act, 2000
<b>DCPB</b>	Development Control and Planning Board
<b>DLS</b>	Department of Lands and Surveys
<b>DOA</b>	Department of Agriculture
<b>DOH</b>	Department of Health
<b>DMR</b>	Department of Marine Resources
<b>DPPE</b>	Department of Physical Planning and the Environment
<b>EC\$</b>	Eastern Caribbean dollars
<b>EEZ</b>	Exclusive Economic Zone
<b>FAO</b>	United Nations Food and Agricultural Organisation
<b>GDP</b>	Gross Domestic Product
<b>GIS</b>	Government Information Service
<b>GOSKN</b>	Government of St. Kitts and Nevis
<b>ICZMP</b>	Integrated Coastal Zone Management Plan
<b>LME</b>	Large Management Area
<b>MOF</b>	Ministry of Finance
<b>MOT</b>	Ministry of Tourism
<b>MMA</b>	Marine Management Area
<b>MPA</b>	Marine Protected Area
<b>MSD</b>	Ministry of Sustainable Development
<b>MTESP</b>	Medium-term Economic Strategy Paper
<b>NABSAP</b>	National Biodiversity Strategy and Action Plan
<b>NCC</b>	National Conservation Commission
<b>NCEPA</b>	National Conservation and Environmental Protection Act, 1987
<b>NCHS</b>	Nevis Historical and Conservation Society
<b>NEMS</b>	National Environmental Management Strategy and Action Plan
<b>NGO</b>	Non-Government Organization
<b>NPDP</b>	National Physical Development Plan
<b>OECS</b>	Organisation of Eastern Caribbean States
<b>PSIP</b>	Public Sector Investment Programme
<b>PWD</b>	Public Works Department
<b>SCASPA</b>	St. Christopher Air and Sea Ports Authority
<b>SCNT</b>	St. Christopher National Trust
<b>SEP</b>	South-east Peninsula
<b>SGD</b>	St. Georges Declaration, 2000
<b>SIDS</b>	Small Island Developing States

<b>SKN</b>	St. Kitts and Nevis
<b>SWMA</b>	Solid Waste Management Authority
<b>TEK</b>	Traditional Ecological Knowledge
<b>UK</b>	United Kingdom
<b>UNCHS</b>	United Nations Commission for Human Settlements
<b>UNCLOS</b>	United Nations Convention on the Law of the Sea
<b>UNDP</b>	United Nations Development Programme
<b>UNEP</b>	United Nations Environment Programme
<b>US</b>	United States
<b>USAID</b>	United States Agency for International Development
<b>WHO</b>	World Health Organisation
<b>WSD</b>	Water Services Department

## EXECUTIVE SUMMARY

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The major objective of this paper is to demonstrate the application of ReefFix’s “direct value transfer” method of economic valuation techniques in St. Kitts and Nevis. Data were gathered through information received from the Department of Marine Resources (DMR), the Department of Physical Planning and Environment (DPPE), the St. Kitts Tourism Authority, the St. Kitts and Nevis Hotel and Tourism Association and the Chamber of Industry and Commerce.

The “direct valued transfer” methodology utilises a “benefits transfer” technique that uses calculated values from “heavily-studied” reefs in other areas and applying them to similar sites (ReefFix 2009). For the purposes of this study, categories of land cover types include coral reef environs, seagrass beds, mangroves (including salt ponds) and beaches.

The Federation’s surrounding exclusive economic zone (EEZ) waters extend out to adjacent territorial waters and cover 20,400 square kilometers (7,876.5 sq. miles) in area with a shelf area of 845 square kilometres (326.3 square miles). The small shelf area and relatively stable annual water temperature limits the marine biological diversity. Additionally, the minimal areas of upwelling restrict nutrient supply and subsequently the offshore fisheries. Coastal fisheries have declined sharply in recent years, and storms and anchoring have heavily damaged the reefs. Anecdotally, fishers have reported smaller catches of conch, lobster, and large pelagic and demersal fishes. Major threats to the marine ecology of the islands include coastal development, unsustainable fisheries practices, land-based sources of pollution, rising ocean temperatures, and the increasing intensity of hurricanes.

The coastal areas of St. Kitts are an invaluable asset and a vital part of the island’s tourism and fishing infrastructure. The beaches and reefs must be preserved if their contribution to tourism is to continue. They are, however, being threatened both by continual development in land and by the ravages of storms – particularly in the last decade.

Coral reefs, sea grass beds and other endangered species in the nearshore waters of St. Kitts are in need of protective measures. It was in recognition of this fact that the Department of Marine Resources has recently proposed the designation of a Marine Management Area (MMA) to encircle the entire coastline of St. Kitts and Nevis. The aim is to take the pressure off inshore fishing grounds which in recent years have been over-fished. The proposed boundary is to extend “from high tide and seaward out to the 30m (100 ft.) depth contour or two miles maximum around the entire coastline of the Federation whichever comes first.” This boundary will allow GOSKN to manage and control the use of SKN waters containing most of the productive seagrass beds, coral reef systems and fisheries resources of the offshore waters of the Federation.

Nestled within the proposed Marine Management Area are a number of proposed Marine Protected Areas (MPAs). Proposed MPA areas include:

- Sandy Point area – Shoal (Paradise) Reef, Anchors Away and Red Drum;

- South East Peninsula Area – Monkey Shoals, the Ledge, Green Point;
- Basseterre area – Brimstone Shallows. Coconut Tree Reef, Rivertaw Wreck, Talata Wreck, Black Coral Reef, Ponds Bar, Tug Boat, Friars Deep, Camps Reef, Dance Hall and Turtle Bar; and,
- Old Road area – Old Road, Ross Reef and Lobster Reef.

In order to determine the value of economic and environmental services provided by marine resources, terrestrial area values were derived from IKONOS and Quickbird satellite imagery (2010) where the desired land cover types were outlined and exported into ArcGIS in order to calculate surface areas.

Select marine data were derived from the TNC’s Marine Zoning Plan (MZP) GIS database project (2010). The MZP project sought to aid marine space use planning and management in St. Kitts and Nevis by gathering information on marine space use such as critical habitats, representative marine ecosystems, areas of high aesthetic value and cultural importance, fishing grounds and marine-based tourism, areas of highest human threat and space use conflict (see Table 1).

**Table 1: Total area of seabed habitat types and coverage in coastal waters (less than 30 meters deep) around St. Kitts and Nevis**

Benthic Class	Size	
	Hectares	Acres
Sand	16,351	40,402.2
Dense seagrass	3,098	7,655.3
Flat gorgonian hardgrounds	2,854	7,052.4
Dense macroalgae on hardground	2,774	6,854.7
Semi-consolidated rubble	2,595	6,412.4
Unconsolidated sand with algae	1,929	4,766.7
Hardcoral framework	1,578	3,899.3
<i>Acropora palmata</i> stumps	574	1,418.4
Sparse seagrass	370	914.3
Rugose gorgonian slope	258	637.5
Lagoonal mud	165	407.7
Algal reef flat	61	150.7

Source: Adapted from Agostini et. al. (2010)

Table 2 below shows the value of marine habitats in the coastal waters surrounding St. Kitts and Nevis. The results indicate that the marine ecosystems in St. Kitts and Nevis could be contributing about US \$388,196,434 to the economy each year.

Coral reefs appear to be the major contributor to the economic value of the marine resources of St. Kitts, accounting for 55% of the overall value. The 203.8 hectares of wetlands (including salt ponds and mangroves) is the next most valuable resource (29%). The 3,098 hectares of seagrass

beds is third with respect to their economic contribution and ecosystem services (13%). The small beaches that are scattered throughout the island also make a notable contribution of around US\$ 10,461,700 to the economy each year.

**Table 2: Ecosystem Service Values by Cover Type for St. Kitts and Nevis marine habitats**

<b>Ecosystem Type</b>	<b>\$/ha/yr.</b>	<b>Total hectares</b>	<b>Total contribution (US \$)</b>
Beach	88,000	54.4	4,787,200
Beach near dwelling	117,000	48.5	5,674,500
Wetlands (including salt ponds and mangroves)	550,000	203.8	112,090,000
Nearshore aquatic habitat (seagrass beds)	16,283	3,098	50,444,734
Coral reef environ	100,000	2,152	215,200,000
<b>Total Ecosystem Service Value</b>			<b>388,196,434</b>

## CONCLUSIONS

ReefFix’s “Ecosystem Value Transfer (EVT)/Benefit Transfer Method (BTM)” was used for this activity in which values which have already been estimated for similar ecosystems are extrapolated to the coastal/marine ecosystems of St. Kitts. In St. Kitts, marine ecosystems are heavily used areas and provide income for many stakeholders such as fishers and dive boat operators. However, the current degradation of coastal habitats is threatening not only their livelihoods but the local economy. Interventions are even more urgent now as the threat of climate change, land-based sources of pollution and inappropriate coastal development presents new challenges for management. For resource managers, it is hoped that this exercise will spur an interest in the application of valuation methodologies in the future management of the island’s coasts. The ReefFix methodology communicates the benefits of marine ecosystems to policy makers that relate more readily to economic figures than to conservation theory and data. Technocrats and decision-makers can use this cost-effective technique to analyse and create economic output that can be presented both numerically and graphically, building a bridge between scientific research and policy making. However users should always be aware of its limitations and proceed cautiously recognising the lack of precision that is often encountered in the field of environmental economics.

# PART 1: SITUATIONAL ANALYSIS

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## 1.1 INTRODUCTION

Like other Caribbean SIDS, the Federation of St. Kitts and Nevis has traditionally used its coastal environment for trans-oceanic and inter-island trade and fishing. Today, we must add the strong demands for clean, clear coastal sea water for swimming, pleasure boating, recreational fishing, wildlife photography and sea-life watching. St. Kitts and Nevis is finding it particularly difficult to meet diverse demands from growing coastal populations because human-induced impacts are reducing the capacity of coastal ecosystems to perpetuate themselves. The effects of some activities from certain sources have, in many cases, been slow in materializing, but where the combined effects of noxious chemicals, sedimentation, dredging, harbour and marina operations, poorly executed beach-front housing and coastal land reclamation have occurred, the effects have been startling. The end result is a sterilizing of the productive capacity of large near shore coastal areas. As a result, the Government of St. Kitts and Nevis (GOSKN) have become aware of the need to effect environmentally sound planning and have been prompted to establish marine and coastal protected areas within its jurisdiction.

The coastal zone of St. Kitts and Nevis constitutes a rich and unique habitat. The islands abound in shore and marine natural resources including coral reefs, mangroves, saltwater lagoons, sea-grass beds and coral and volcanic beaches. Biodiversity is particularly rich in the marine and coastal areas and includes a number of endemic and threatened/endangered species such as sea turtles. These coastal resources provide the basis for a range of economic and social activity including the important tourism and fishing industries. There are also strong cultural attachments to coastal resources and their uses.

A variety of factors are presently stressing marine ecosystems globally. The marine resources of the Federation of St. Kitts and Nevis are no exception and have generally degraded over the last decade. It is for this reason that it is critical that the nation's marine ecosystems be protected. Yet, protection through designation alone remains an inadequate tool. To be effective, designation must be accompanied by a management system and enforcement that focuses on quantifiable social and bio-physical goals. It is against this backdrop that this project provides support for the valuation of critical coastal resources such as coral reefs leading to the development of strategies that will contribute to the judicious use of coastal and marine resources.

The Organization of American States (OAS) and the Government of Mexico are jointly implementing a project aimed at improving the capacity of Caribbean countries to value and measure ecosystem services of coral reefs and to strengthen coastal zone management systems. Titled “**ReefFix: An Integrated Coastal Zone Management (ICZM) Ecosystem Services Valuation and Capacity Building Project for the Caribbean**”, the project builds on a prior project supported by the Government of Chile to enhance the technical capacity of Caribbean nations to collect and manage data on their Marine Protected Areas (MPAs).

ReefFix also seeks to complement existing initiatives to protect the Mesoamerican Barrier Reef System (MBRS) off the shores of Belize, Guatemala, Honduras and Mexico.

The project has three principal components: (a) generating data on the value of ecosystem services of selected reefs; )b) training civil society, stakeholders in coastal communities, and government officials in ecosystem valuation methodologies and MPA management; and, (c) disseminating lessons learned to the rest of the Americas.

## **1.2 PHYSICAL ATTRIBUTES**

### **1.2.1 Location**

St. Kitts is located at latitude 17° 15' north and longitude 62° 45' west and Nevis is located two miles (3 km) to the south-east, at 17° 10' north and longitude 62° 35' west.

### **1.2.2 Area**

The Federation of St. Kitts and Nevis has a land area of 269 sq. km. (104 sq. miles). The larger of the two islands, St. Kitts is 176 sq. km. (68 sq. mi.) in area. It is approximately 36.8 km (23 mi) long and is roughly oval in shape with a narrow neck of land extending like a handle from the southeastern end. Nevis has an area of 93 sq. km. (36 sq. mi), with a length of 12.3 km (7.64 mi) and a width of 9.6 km (5.96 mi) at its widest point.

### **1.2.3 Physical landscape**

#### ***St. Kitts***

The physical landscape of St. Kitts is characterised by three volcanic centres: (1) The central northwest range, dominated by Mt. Liamuiga, rises with a pronounced crater to 1,156 meters (3,792 ft) and is the Federation's highest peak. (2) The middle range, which consists of a number of irregular related peaks dominated by Verchild's Mountain at a height of 975 meters (3,200 ft), with steeper and shorter slopes towards the leeward coast. (3) The southeast range, which consists of a number of irregular peaks, with the highest being 900 meters (2,953 feet) above mean sea level. Like the middle range, the slopes here are steeper and shorter on the leeward side.

Most flat or moderately sloped land occurs near the coast, and as a result, most urban and agricultural developments have are located there. The island's coastline largely consists of cliffs, some 15 to 30 meters (50 to 100 feet) high. Beaches at the foot of these cliffs are narrow and the sand is coarse and black, with many pebbles and boulders. Exceptions are in the northwest, where the cliffs are lower and some beaches have yellow sand and are wider. In Basseterre where there are cliffs, there is a narrow beach of grey sand. From Conaree, on to the southeast of the island, there are long stretches of yellow sand beaches.

#### ***Nevis***

Topographically, Nevis is approximately circular and dominated by the central Nevis Peak, 985 m (3,232 ft.) high. Windy Hill (309m) and Saddle Hill (381m) at the head and tail of the island,



respectively, align with Nevis Peak to form a north-northwest/south-south-east trending spine comparable to the more pronounced spine of St. Kitts. To the east, the spine is thickened by the bulge of Butlers Mountain (478m). Slopes vary from almost zero near the sea, to over 40 percent in the vicinity of Saddle Hill, Butlers Mountain, Nevis Peak and Windy Hill.

**Fig. 1: Map of Caribbean showing location of St. Kitts and Nevis**



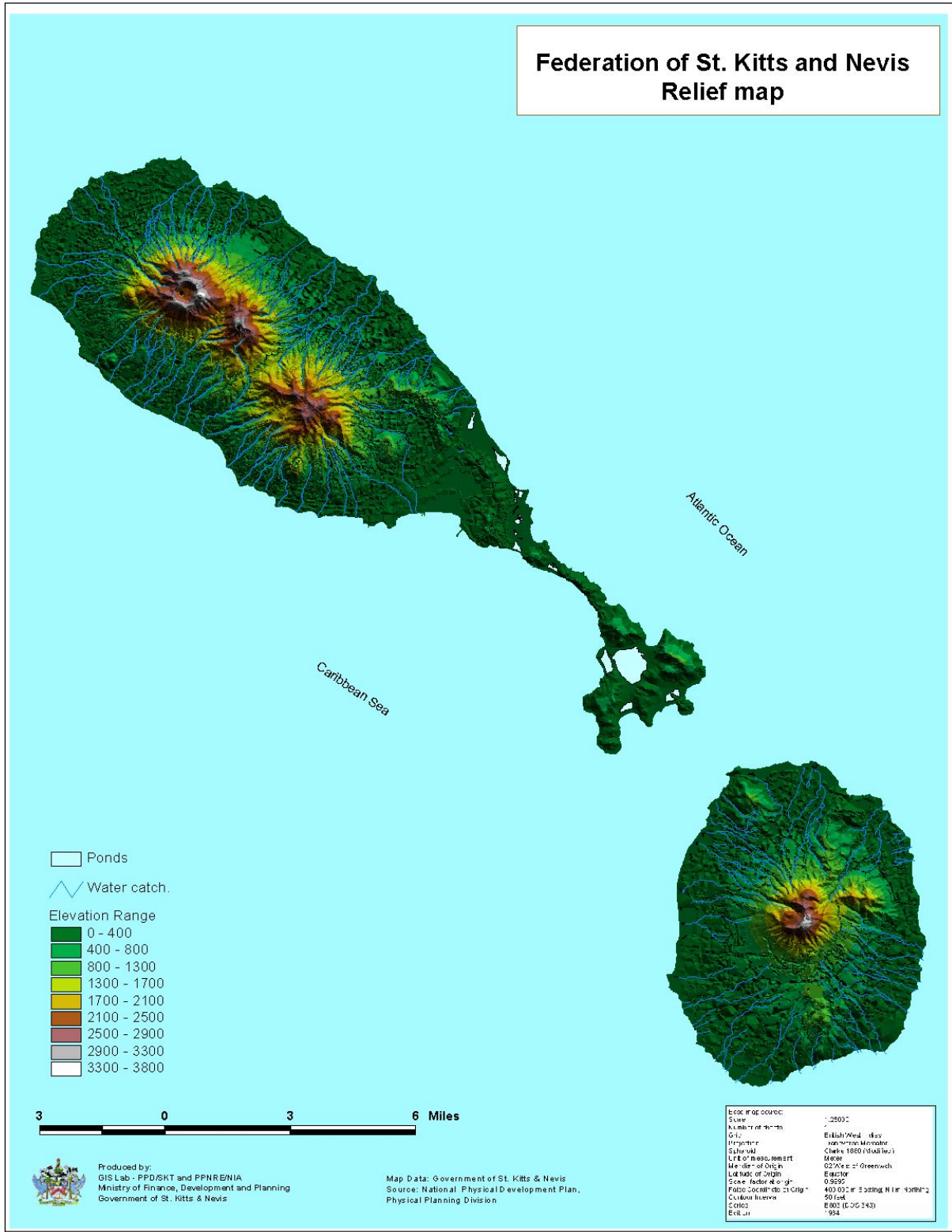
*Source: First St. Kitts and Nevis Digital Data Atlas (2002)*

#### 1.2.4 Coastal zone management

The coastal areas of St. Kitts are an invaluable asset and a vital part of the island's tourism infrastructure. The beaches and reefs must be preserved if their contribution to tourism is to continue. They are, however, being threatened both by continual development in land and by the ravages of storms - especially in the last decade. Hotel development has mushroomed at the same time that the islands have been visited by several severe hurricanes - most notably Hurricane George in 1998 and Hurricane Lenny in 1999.

Coral reefs, sea grass beds and other endangered species in the nearshore waters of St. Kitts are in need of protective measures. Prohibitions against the taking of undersized or egg laying shellfish are largely ignored. As a result, the near-shore waters of St. Kitts are being depleted of both spiny lobster and conch. Regulations against the hunting of turtles and of turtle eggs are also ignored.

**Figure 2: Relief map of St. Kitts and Nevis**



Beaches are dynamic fast-changing systems which are vitally important to the tourism-oriented economy of St. Kitts. The 2006 NPDP adheres to the principle that the prudent use of coastal development setbacks provides for beach preservation, reduction of erosion and improved access. For cliffed coasts, the proposed setback is 15 m (50 feet ) from the cliff edge. On low rocky shores, the proposed setback is 30 m (100 feet) from the natural vegetation line. Setbacks for individual beaches have been determined based on historical changes over the last thirty years, predicted impacts of major hurricanes, predicted change due to sea-level rise and other factors such as coastal form, human impacts and general planning considerations. Setbacks from beaches are measured from the line of permanent vegetation (the tree line or scrub line).

Most flat or moderately sloped land occurs near the coast, and as a result, most urban and agricultural developments have are located there. The island's coastline largely consists of cliffs, some 15 to 30 meters (50 to 100 feet) high. Beaches at the foot of these cliffs are narrow and the sand is coarse and black, with many pebbles and boulders. Exceptions are in the northwest, where the cliffs are lower and some beaches have yellow sand and are wider. In Basseterre where there are cliffs, there is a narrow beach of grey sand. From Conaree, on to the southeast of the island, there are long stretches of yellow sand beaches.

### **1.2.5 Vulnerability of coastal transportation system**

The main island road on St. Kitts is a coastal road circumnavigating the island. At many points the road runs along the coastline and at several points has been subjected to coastal erosion. Recent programmes in 1996 and in 2004/2005 have provided coastal erosion protection by the provision of rock armouring, particularly at the Newtown Boulevard in east Basseterre and at several other points on the Leeward Highway. These have been very successful, withstanding the strong storm surges of Hurricane Luis, Marilyn, Georges and, particularly, Lenny in 1999. There remain, however, several vulnerable sites, namely those at Conyers, Parsons, Frigate Bay, Irish Town Bay Road and Fortlands which require coastal protection works.

### **1.2.6 Climate**

The climate of the Federation of St. Kitts and Nevis is classified as tropical marine. Generally, it is influenced by steady northeast trade winds and tropical oceanic and cyclonic movements. Temperatures average approximately 27°C. Seasonal and diurnal variations in temperature are small. The relative humidity is fairly high all year round; lower in the dry season and higher in the wet season. The mean value is 76%, but it ranges from 70% in March, to 78% in September, October and November.

Rainfall is mainly cyclonic and orographic in origin, and increases in amount and frequency with altitude. Mean annual rainfall ranges from about 890 – 1,000 mm in the coastal areas, to about 2,500 – 3,800 mm in the central mountain ranges. The rainfall is unevenly distributed between years and between months, but there is a reliable wet period from August to September and a dry period from January – April.

## 1.3 SOCIO-ECONOMIC CONTEXT

### 1.3.1 Population

The Federation has a population of 46,111, with 75.6% of the population residing on St. Kitts and the remaining 24.4% on Nevis. The majority of the population resides in the main towns; Basseterre and environs on St. Kitts, and Charlestown on Nevis. The Human Development Index (UNDP) of St. Kitts & Nevis was ranked at 49 in 2005.

Demographic features of the population of SKN include the following:

- The population of St. Kitts increased at about 0.93% per annum over the period 1991 - 2001. The population of St. Kitts is projected to grow from its 2001 figure of 35,217 to a total population of 33,836 by the year 2021 (an increase of 6.3% in 15 years).
- The total number of households is increasing as average household size has been declining. The trend for smaller but more numerous households will greatly influence the demand for land and housing.
- A significant proportion of households (approximately 43.0% in 2001) in SKN are headed by women. Thus, social and housing policies need to target interventions to suit the needs of this group, and enhance their access to opportunities.
- SKN, like many islands in the Caribbean, has a very young population. In the year 2001, 29.6% of the population was under 15 years of age;
- SKN has maintained remarkable stability in the crude birth rate since the 1970's. In 1970, the crude birth rate was 25.9 live births per 1000 population, by 1980 it was 29.8 live births per 1000 population and by 2000 it had fallen to 20.47.
- The crude death rate for SKN in 1970 was 11.1 deaths per 1000 population per annum, and has declined to 7.98 in 2000 largely due to improvements in the delivery of primary health care. The infant mortality rate (per 1000) children of one year and below, decreased from 48.4 in 1970 to 19.67 in 1990 and 14.32 in 2000. In 1986, the total number of infant death was 40 and by 1995 it had decreased to 18. This change indicates an improvement in child health care on the island.
- The main feature of the distribution pattern in 2001 was the marked concentration of population in Basseterre city with 37.9% of the population of St. Kitts. Other major population centers include Sandy Point in the west (9%), Cayon in the northeast (10%), St. Peters north of Basseterre (10%), St. Pauls in the west (7%) and Old Road in the southwest.
- The gross population density of the island of St. Kitts is 202 persons/sq. km. (525 persons/sq. ml.). There is a great deal of variability in the population densities of the parishes, which range from just over 99 persons/sq. km. in St. Thomas to nearly 462 in St. George, which

includes the Capital, Basseterre. In addition, the parishes of St. Anne and St. Mary have considerable higher densities of 248 and 227 persons/sq. km., respectively.

### **1.3.2 General economy**

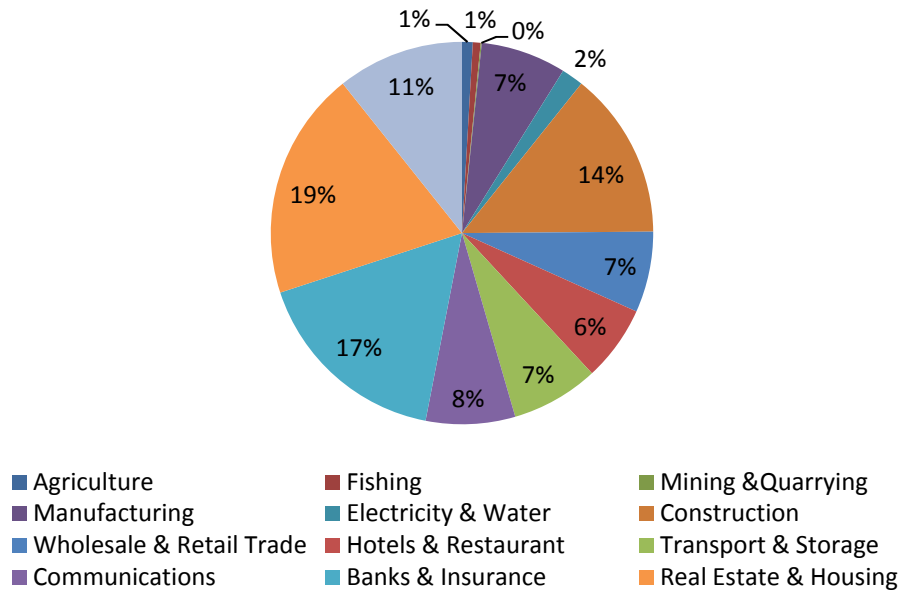
Traditionally, the SKN economy was dominated by sugar production, but it has been undergoing a process of gradual transformation into a more diversified modern economy in which the other key sectors are tourism, financial services, construction and manufacturing.

In 2013, preliminary estimates provided by the *Eastern Caribbean Central Bank* (ECCB), the *International Monetary Fund* (IMF) and the MSD's Department of Statistics indicated that the SKN economy contracted by -0.91% in 2012 compared with -4.22% in 2009, 0.05% in 2010 and -1.85% in 2011. This was largely attributable to the ravages of the global financial and economic crisis. Positive sectoral growth was recorded in manufacturing (7.95%), tourism (0.46%), communications (2.2%) and financial institutions (3.14%). Important sectors, such as construction (-6.79%), agriculture (-13.4%) and transport (-5.92%), exhibited negative growth during 2012.

Real GDP growth is expected to recover to 1.8% in 2013, as it is predicted that *foreign direct investment* (FDI) will gain momentum. It is projected that the additional growth impetus will originate from several sectors: construction, retail and tourism (on the basis of the momentum following the relatively strong outturn in 2012). Eighty-five (85) rooms at a boutique cottage hotel and an 18-hole golf course is nearing completion at the Kittitian Hill project. Additionally, the Kittitian Hill's Terrace Complex which includes a lobby, lounge, bar, all day dining and fitness centre, and main swimming pool is expected to open for the 2013 – 2014 tourist season under the management of Sedona Resorts. The Christophe Harbour Development also continues to make progress on the construction of the mega-yacht marina, the 'Harbour Side' homes and 'Windswept' villas. At the Silver Reef Resort Development seventy-two (72) apartments have been completed and two additional buildings are to be constructed as part of the Phase 3 activities of this project. Other development projects include the Koi Resort and Residences, the US \$10 million 86-room Imperial Bay Beach and Golf Residences in Half Moon Bay, the ultra-luxury five-star 200 room Parks Hyatt Hotel on the South-east Peninsula, the EC \$84 million expansion to Ross University and the US \$115 million 258-room Pelican Bay condominium and hotel project in Potato Bay. Real GDP growth is envisaged to reach 4% by 2016.

Clearly, SKN needs further economic diversification in order to lessen the economic vulnerability represented by the high dependence on tourism and given the challenges imposed by developments in the regional and international economies, especially the realities of globalization, trade liberalization and its obligations under the WTO, the dismantling of trade preferences, the CSME, increasing fuel prices and the fear of possible increase in global inflation that could exert upward pressure on interest rates. The economy needs to generate the financial resources for servicing the national debt and to redress the foreign exchange imbalance also partly due to the importation of fuel, food and other goods and services.

**Fig. 3: GDP by Economic Activity at Basic Price  
In Constant (2006) Prices (E.C. \$ Million)**



### 1.3.3 Poverty

The Poverty Assessment Report (2001) reported that 30.5%, or a little less than 1 in 3 individuals in St. Kitts are poor. This suggests that their monthly expenditure is less than the cost of meeting their minimal food and other basic requirements – the poverty line was estimated at EC \$280.05 (US\$103.72) per month for an individual. Eleven percent (11%), or slightly more than 1 in 10 individuals in the country, were found to be extremely poor or indigent – the indigence line was EC \$177.94 (US\$65.90) per month. More than two-thirds of the poor (67.8%) are under 25 years of age. Males were 44 percent of the poor and women 56 percent. Twenty-nine percent of males are poor and 32 percent of women are poor.

Similarly in Nevis, 32% or a little less than 1 in 3 individuals are poor. This suggests that their monthly expenditure is less than the cost of meeting minimal food and other basic requirements or less than E.C. \$328.40 (US\$121.63). Seventeen percent of all individual are extremely poor or indigent, and do not have the E.C. \$204.40 (US\$75.70) necessary to meet their dietary needs. Fifty-eight percent of the poor are under the age of 25. Males make up 37 percent of the poor and females 63 percent. Twenty-six percent of males are poor and females account for 36 percent of the poor.

GOSKN's policy position is that vulnerable groups in the society must not be forgotten during the economic adjustment process following the closure of the sugar industry. It will be necessary to cushion the effects of adjustment on the most adversely affected groups. Special safety net provisions have been made for the poor and for selected former workers of the sugar industry. The extent to which these will be needed throughout the adjustment period will depend on how well they are combined with programmes to retrain and resettle displaced workers and the unemployed into meaningful jobs that are needed in the economy.

#### **1.4 POLICY FRAMEWORKS OF RELEVANCE TO MARINE RESOURCE PROTECTION AND MANAGEMENT IN ST. KITTS**

The following are some of the domestic policies related to coastal zone management and the protection and conservation of coastal and marine resources:

##### **1.4.1 National Environmental Action Plan (1994)**

The 1994 *National Environmental Action Plan* (NEAP) was prepared by GOSKN as a result of its participation in UNCED. The NEAP identifies the major environmental problems of the country and recommends appropriate policies and actions to address these problems. Over the years, GOSKN has used the recommendations and findings in the overall planning process to ensure that economic development does not proceed at the expense of the environment in an attempt to assure a balance between economic development and environmental conservation. Also, the NEAP was intended to ensure that the country's involvement in regional and international projects related to sustainable development, assisted with the enhancement of environmental legislation, the review of development policies and the upgrade of existing institutions to address environmental concerns.

##### **1.4.2 National Physical Development Plan (2006)**

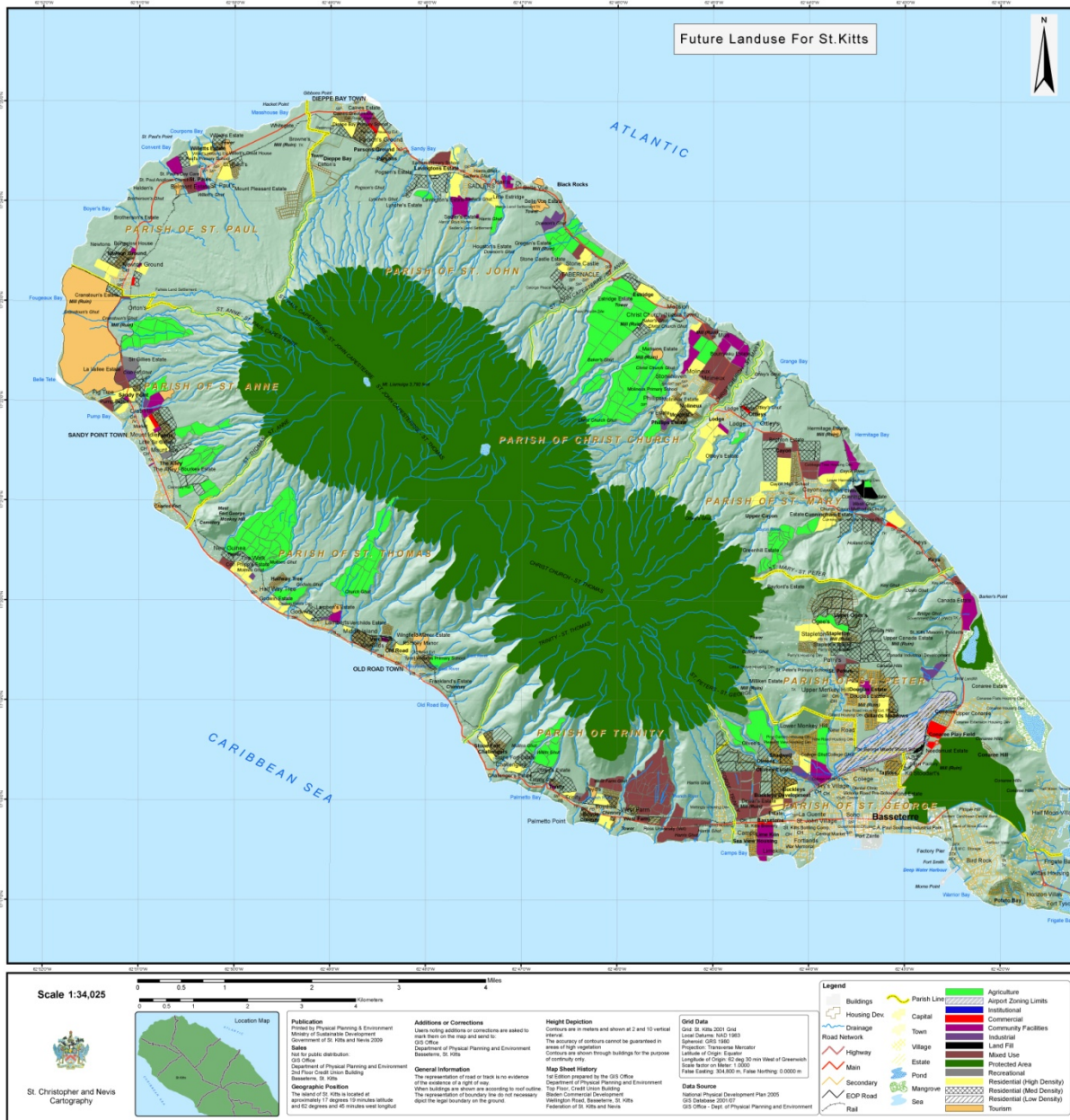
To ensure the sustainability of the island's resources through the regulation of land-use, the *Development Control and Planning Board* (DCPB) developed a 15-year *National Physical Development Plan* (NPDP) in 2006. The plan includes policies and guidelines for sustainable development and seeks to guide location of housing, industry, parks/conservation areas, hotel and tourism development with regards to land suitability and other physical and environmental attributes. The NPDP will be used to direct growth on the island when considering future land use, re-zonings, natural and heritage conservation, the provision of public infrastructure and aiding decisions for private sector investment. The NPDP promulgates policies intended to reduce the negative environmental, economic and social impacts of development projects.

##### **1.4.3 National Environmental Management Strategy (NEMS)**

The *National Environmental Management Strategy* (NEMS) defines the specific directions and mechanisms for more effective environmental policy implementation and includes specific actions necessary and results expected to realize the policy objectives of the government. It articulates the key strategies and priority actions for environmental management in the context of

sustainable development. With specific reference to resource management, the NEMS proposes measures to restore environmentally degraded coastal and marine areas and to ensure the sustainable use of natural resources in a manner which recognizes the intricate linkages between ecological systems in SKN. Key activities under the NEMS include: (a) formulation of criteria for and identification of environmentally degraded areas; and, (b) identification of critical areas for the conservation of terrestrial and marine biodiversity.

**Fig. 4: Future Land Use Management Plan, St. Kitts (2006)**







With specific reference to coastal zone management, the NEMS proposed measures to restore environmentally degraded coastal and marine areas and to ensure the sustainable use of natural resources in a manner which recognizes the intricate linkages between ecological systems in small island states, and between these systems and human activity, and which reflect the principles of island systems management. Key activities are: (a) formulation of criteria for and identification of environmentally degraded areas; and, (b) identification of critical areas for the conservation of terrestrial and marine biodiversity (*see Box 1*).

### **Box 1: Relevant Excerpts from St. Kitts and Nevis NEMS**

#### **PRINCIPLE 11: Ensure the Sustainable Use of Natural Resources**

Strategy 32: Manage terrestrial, marine and atmospheric resources, organisms and eco-systems in an appropriate manner to obtain the optimum sustainable productivity, while maintaining the integrity of natural and ecological processes and inter-relationships between such systems and processes.

##### Activities:

- i. Assess threats to sustainable use of natural resources; quantify rates of decline of resources; devise recommendations to counteract rates of decline.
- ii. Develop and implement management plans for marine and terrestrial protected areas.

#### **PRINCIPLE 13: Protect and Conserve Biological Diversity**

Strategy 39: Pursue appropriate measures to manage biological resources and, where necessary, restore biological diversity, including species diversity, genetic diversity within species and ecosystem diversity.

##### Activities:

- i. Implement the measures contained in the National Biodiversity Strategy and Action Plan (NBSAP) for St Kitts and Nevis.
- ii. Ensure that the workplans of all relevant Ministries contain elements of the NBSAP appropriate to their jurisdiction.
- iii. Establish the legal and institutional structure to control and license the prospecting for, or harvesting and export of cultural and ecological resources.

### **1.4.4 National Biodiversity Strategy and Action Plan (NABSAP)**

The *National Biodiversity Strategy and Action Plan* (NABSAP) was completed and ratified by Government in 2006. In accordance with the *United Nations Convention on Biological Diversity* (UNCBD), the NABSAP identifies the factors contributing to land and marine degradation and promotes measures required to protect and conserve natural ecosystems as well as mitigate the effects of development.

### **1.4.5 Medium Term Economic Strategy Paper (MTESP)**

The Medium Term Economic Strategy (MTESP) sets out the sectoral priority policies of the GOSKN. While traditionally the MTESP has focused primarily on the economic sectors, there is

now increased recognition of the need to include environmental considerations. The 2005-2007 MTESP identified the following objectives as the Government's priority for the environment over the medium term:

- To reduce current and potential environmental degradation;
- To reduce the adverse environmental effects of current and future economic development;
- To educate and raise awareness on current and potential environmental issues; and,
- To raise the profiles of the available alternative sources of energy.

## **1.5 LEGISLATIVE INSTRUMENTS OF RELEVANCE TO MARINE RESOURCE PROTECTION AND MANAGEMENT IN ST. KITTS**

There are several legislative instruments of relevance to coastal zone management in the Federation. These are identified in *Table 1* along with the responsible agency and the key legislative provisions.

### **1.5.1 The Development Control and Planning Act (DCPA), 2000**

Under the *Development Control and Planning Act*, the DCPB is empowered to issue permits to persons undertaking any new development, construction or enterprise, anywhere on the island of St. Kitts, as well as permits for the construction or modification of any work causing the discharge of trade or sewage effluent into the environment. The DPPE monitors construction to ensure that development restrictions and requirements are adhered to. It also deals with issues such as fencing and appropriate signage around the island. The DPPE requires that any proposal for the subdivision of land and the construction of houses thereon be accompanied by a plan of the area inclusive of, but not restricted to, the following:

- The manner in which it is intended that the area shall be laid out, in particular, the land intended to be used for the provision respectively of houses, roads and open spaces for public and commercial uses;
- the approximate area of the land;
- the approximate number and nature of the houses and other buildings to be provided;
- the average number of houses to be constructed per acre; and,
- Particulars relating to water supply drainage and sewage disposal.

### **1.5.2 National Conservation and Environmental Protection Act (NCEPA), 1987**

The *National Conservation and Environmental Protection Act* (NCEPA) is a synopsis of various matters related to conservation, environmental protection and management and the preservation of historic sites. It empowers the Minister responsible for managing the environment to designate certain land or marine sites as "protected areas". Areas that may be designated as such include national parks, nature reserves, botanical gardens, marine reserves, historic sites, scenic sites, or areas of special interest. The purpose of this Act is to preserve biological diversity of flora and fauna species that may be endemic or threatened by extinction and their habitat, land

and marine biological communities, areas that are important for the maintenance of life-support systems such as water and air, and basic ecological processes such as water recharge and soil regeneration. It is also intended to protect scenic sites, or sites of scientific, ecological, historic or archaeological interest.

**Table 1: Summary of legislation of relevance to marine resource protection and management in St. Kitts and Nevis**

<b>Legislation</b>	<b>Summary of content or purpose</b>
Fisheries Act (1984) and Regulations (1995)	Regulates seine nets, fish traps, trammel and other entangling nets, lobsters, marine turtles, sea eggs, pelagic, aquaculture and corals. Sets fees for registration, inspection, licenses and other services. Imposes an open and closed season for the harvesting of sea turtles and prohibits removal of coral from the sea.
Marine Pollution Management Act (2002)	Prevention, reduction and control of marine pollution.
Merchant Shipping Act (2002)	Registration and inspection of large vessels.
Development Control and Planning Act (2000)	Coastal resources management and planning.
National Conservation and Environmental Protection Act (1987)	Coastal and marine resources management. Provides for the entry into force of various international agreements and conventions.
Maritime Areas Act (1984)	Defines waters of EEZ and important in ongoing boundary delimitation negotiations with Saint Eustatius and Antigua and Barbuda.
St. Christopher Air and Sea Ports Authority Act (1993)	Provides for the creation of a St. Christopher Air and Sea Ports Authority which controls all activity within the limits of all sea ports.
Water Courses and Water Act (1956)	Control potable water supply and management
Public Health Act (1969)	Maintenance of environmental health
Pesticides Act (1973)	Control the use of pesticides, including labeling and storage
Litter Act 1989	Restrict the deposit of litter in public and private places.
Solid Waste Management Act (1996)	Provisions for establishment of management authorities and orderly and safe collection and disposal of solid waste.

### **1.5.3 Public Health Act (1969)**

Despite being chronically outdated, the Public Health Act remains the main legislative instrument for addressing environmental health issues in SKN. Initially, the Act did not address important issues of wastewater management including the discharge of untreated sewage, waste reduction, collection, storage transport, recycling or any of the present day concepts regarding waste management. As such, the scope of the legislative framework for environmental health revolved mainly around the maintenance of general sanitary conditions and cleanliness. However, the introduction of the Solid Waste Management Corporation Act in 1996 provided a legal framework to undertake waste management.

Public health and environmental protection is a multi-faceted issue. There is a need to further revise the Public Health Act and/or consolidate the environmental management provisions of other legislations toward establishing more appropriate institutional arrangements to support, coordinate and direct relevant environmental health activities.

#### **1.5.4 Solid Waste Management Corporation Act (1996)**

The Solid Waste Management Corporation Act for SKN was introduced in 1996 to provide for the management of solid waste in conformity with the best environmental practices. The Act provides the legislative framework for the storage, treatment and disposal of solid waste, so as to avoid environmental degradation. Section 28 (1a) of the Act, requires that no individual shall not deposit or knowingly cause to be deposited solid waste in or on land, beach, foreshore, marine waters or river banks.

Since the closure of the sugar industry the incidence of illegal solid waste disposal has been on the increase. While the Act makes no specific reference to SLM, it can be well appreciated that its effective implementation can assist in realizing the objectives of the SLMP. The Solid Waste Management Corporations on St. Kitts and Nevis have oversight for the waste management. The Ministries of Health on both islands are the parent ministries of the SWMC.

#### **1.5.5 Water Courses and Water Works Ordinance (Cap 185 of 1956)**

The principal water legislation is the *Watercourses and Waterworks Ordinance* (Cap 185 of 1956) and the *Watercourses and Waterworks Regulations*. This Ordinance establishes legislative and regulatory powers for the WSD on both islands to, among other things, regulate the supply of water to consumers, prevent waste, misuse and pollution of water and control sanitation of watersheds. Substantively, it addresses issues of water supply and protection of watercourses. “Watercourses” is defined to mean any pond, spring, stream or part thereof vested in the Crown or declared subject to the Ordinance.

Under this legislation it is an offence to put any rubbish or offensive solid or liquid matter into a watercourse, or to pollute water flowing into or out of a watercourse. Regulations provide details on water supply, water meters and the control of standpipes.

Public health inspectors also discharge responsibilities in respect of maintaining drinking water quality. Under the Public Health Act the Minister having responsibility for health 5 is authorized to make regulations for the protection of water from contamination and pollution including the:

- inspection and approval of sources of supply, and the conditions, if any, on which such approval is granted;
- testing and analysis of water;
- construction, alteration, maintenance and purification of water supplies and water distribution systems;
- supervision and control of any river, spring or part thereof contributing to a public water supply;

- regulation of persons bathing, washing clothes, cleaning vehicles, utensils or animals at or in any river, stream or spring or part thereof contributing to a public water supply; and
- prescribing the limit or purpose for which water may be used and distributed.

### **1.5.6 Maritime Areas Act (1984)**

The Maritime Areas Act (1984) defines maritime areas of St. Kitts and Nevis: the inland waters, territorial sea, contiguous zone, and EEZ. Echoing the provisions of UNCLOS, it sets out the various rights and responsibilities of the government with respect to these areas. Under the Act, GOSKN enjoys sovereign rights in the territorial sea and the sovereign right to conserve and manage resources in the EEZ. GOSKN also has jurisdiction to protect and preserve the marine environment within the EEZ. The Act authorizes the Minister of Maritime Affairs to enact regulations for the protection and preservation of the marine environment of both the territorial sea and the EEZ, and for the exploration and exploitation of the EEZ for economic purposes.

### **1.5.7 Marine Pollution Management Act (2002)**

This Act seeks to: (a) provide for the protection of ecologically sensitive marine resources; (b) enhance environmental quality of territorial waters and adjacent international waters; (c) give effect to certain international conventions relating to pollution of the sea; (d) implement port-state control to improve management of ship-generated wastes and prevent harm to safety, health and the marine environment from shipping activities; and, (e) encourages good environmental operating practices in commercial, cruise liner and leisure shipping and in ports, marinas and harbours.

Thus the Act provides for the monitoring and control of all marine pollution in waters of SKN and marine pollution caused by a vessel or marine structure of SKN outside of the territorial sea of SKN. The kinds of marine pollution to which particular attention is given in this Act are the dumping of hazardous waste in marine areas and marine pollution caused by vessels and land-based sources.

### **1.5.8 Fisheries Act (1984)**

This legislation seeks to: (a) provide for the licensing of local and foreign fishing vessels; (b) confer upon the Minister of Marine Resources the power to enter into arrangements or agreements dealing with access or otherwise in regard to fishery matters; and, (c) provide an institutional framework for the management, planning, development and conservation of fishery resources in SKN.

Provisions of the Act apply to the EEZ, the territorial sea and internal waters of SKN. The Act is divided into 5 Parts: Preliminary (I); Fisheries Management and Development (II); Marine reserves and conservation (III); Enforcement (IV); General (V). Part II contains, inter alia, sections on management and development plans, a Fisheries Advisory Committee, regional cooperation, licences for foreign and local vessels, fish processing establishments and local fisheries management areas. Part III contains sections on fishing priority areas, leasing of land for aquaculture, marine reserves and prohibited fishing methods.

The Act allows for and anticipates regional cooperation in the regulation of fisheries, e.g. the Caribbean Regional Fisheries Mechanism. As such, it allows the responsible Minister to enter into agreements with other countries in the region and any such regional organizations to create a uniform licensing system for foreign fishing licenses, enforcement, creation of a joint fisheries management body, and “any other cooperative measures as appropriate.” Any agreement entered into should be published as an order in the Gazette, and then approved by Parliament.

Section 22 permits the leasing of land for the purposes of aquaculture. Section 25 lists prohibited fishing methods. Section 40 authorizes the Minister to make regulations generally for the management and development of fisheries. Regulations can prescribe management and conservation measures.

The Act also lists offenses, including prohibited fishing methods, and associated punishments. In order to enforce the provisions of the Act, the Minister can designate any persons “he deems fit,” via notice in the Gazette, to enforce the Act. This can include “members of the enforcement authority of any country or of any regional or sub-regional marine enforcement entity.”

### **1.5.9 Fisheries Regulations (1995)**

The 39 regulations are divided into 7 Parts: Preliminary (I); Safety Equipment (II); Foreign Fishing Licences (III); Local Fishing Licence and Boat Registration (IV); Fish Processing Establishment Licence (V); Fishery Conservation Measures (VI); Miscellaneous Provision (VII). Part VII contains provision on interfering with, or disturbing of fishing, protection of fish in fishing priority areas and pollution. The Minister may establish a Fishery Advisory Committee for the purposes of the Fisheries Act.

The Regulations contain conservation measures for lobster, turtles, conch, coral, sponges, marine algae, sea stars, and aquarium fish. The regulations also affirm that in fishery waters, no person or company may introduce pollutants, poisons, or other harmful substances. (38).

### **1.5.10 Saint Christopher Air and Sea Ports Authority Act (No.9 of 1993)**

The Saint Christopher Air and Sea Ports Authority Act establishes the *Saint Christopher Air and Sea Port Authority* (SCASPA), which is responsible for creating an integrated system of lighthouses, ports, and port services. SCASPA may also regulate navigation to the ports. SCASPA, with the approval of the Minister of Finance, (a) controls and prohibits all activity within the limits of any air or sea port; (b) regulates, restricts and controls the depositing of any substance, solid matter or pollutant likely to cause pollution of the waters of any port; and, (c) regulates the traffic and navigation of ships within the limits and approaches to any port on the island of St. Kitts. The Nevis Air and Sea Ports Authority performs the same functions for the island of Nevis.

### **1.5.11 Merchant Shipping Act (2002)**

This Act makes provision for the registration of ships, proprietary interests in ships and the control of navigation and related matters such as survey, marking, the prevention of pollution

and liability for and compensation of oil pollution. Selected provisions of this Act apply to fishing vessels. The Minister may make Orders for implementation of the Law of the Sea Convention in relation with protection of the marine environment. The Chapters on oil pollution damage concern, among other things, compulsory insurance, contributions to the International Oil Compensation Fund and compensation for oil pollution damage.

#### **1.5.12 Merchant Shipping Amendment Act (2009)**

This Act amends the Merchant Shipping Act, 2002 by deleting section 461. This section stipulates that Regulations made by the Minister under this Act shall be subject to negative resolution of the National Assembly.

#### **1.5.13 International Trade in Wild Flora and Fauna Act (2009)**

This Act aims at compliance of SKN with the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) and in particular international trade of specimen listed in Appendix I, Appendix II and Appendix III of the Convention. The Act, among other things: (a) provides for the designation by the Minister of a Management Authority and a Scientific Authority; (b) grants power to the Minister to establish a Conservation Fund; (c) places restrictions on trade in and possession of listed fauna and flora and captive breeding of listed animals and artificial propagation of listed plants; (d) provides for a system of registration, certification and authorization; (e) provides for a control mechanism for the international trade of listed specimens; and, (f) defines various exemptions; and provides for measures of enforcement for purposes of this Act. A person wishing to carry out international trade, captive breeding or artificial propagation of CITES specimens shall apply to the Management Authority for registration and for a permit or certificate from the Management Authority.

#### **1.5.14 St. Christopher and Nevis National Trust Act (2009)**

This Act provides for the establishment of a National Trust for the purpose of administering and preserving sites, buildings and objects of historical, archaeological, architectural, environmental and artistic importance to the island of St. Kitts. The Act establishes a National Trust for St. Kitts as a body corporate. The Trust shall principally engage in the protection, conservation, restoration and maintenance of monuments and the natural environment, including plant and animal life. The Trust shall be responsible for the management of properties or sites set out in the Schedule to this Act. It shall be governed by a Board, which shall have the power to make rules for purposes of the objects of the Trust. The Act also grants regulation-making powers on the Minister.

### **1.6 INSTITUTIONAL ARRANGEMENTS FOR MARINE RESOURCE PROTECTION AND MANAGEMENT**

Most of the responsibility for marine protection and management can be found within the Department of Physical Planning and Environment of the Ministry of Sustainable Development.



However, some responsibility is also shared with the Department of Marine Resources and the Department of Maritime Affairs. These institutions are discussed briefly below:

### **1.6.1 Ministry of Sustainable Development (MSD)**

The departmental components of the MSD include:

1. Administration;
2. Economic Affairs and PSIP;
3. Physical Planning and Environment;
4. Lands and Surveys; and,
5. Statistics.

#### ***Department of Physical Planning and Environment (DPPE)***

The multiple-agency *Development Control and Planning Board* (DCPB) is responsible for land and coastal administration on the island of St. Kitts. The DPPE serves as Secretariat to the Board. Under the aegis of the DCPA (2000), the DCPB has the responsibility to implement the NPDP for the island of St. Kitts and to grant permits for development.

The DPPE is responsible for the preparation of long range and local area plans. Activities also include the design and conduct of surveys, policy review, preparation of development project proposals, review of EIAs and review of development applications. The DPPE also manages development control activities. The range of activities included within the DPPE portfolio include: (a) receipt, review and approval of building applications; (b) building inspection; (c) evaluation of applications for duty free concessions on construction projects; and, (d) monitoring and enforcement of development standards.

With respect to environmental management and the achievement of sustainable development goals, the DPPE is responsible for the administration of the NCEPA. The preparation of national project documents including country position papers and national communications as required by multi-lateral environmental agreements are also the responsibility of the DPPE. Other activities that fall within the day-to-day functions of the DPPE are preparation of project proposals for funding and implementation and review of development applications.

#### ***Department of Lands and Surveys***

The *Department of Lands and Surveys* (DLS) assists the MSD in the fair and equitable distribution of Crown Lands and provides for proper land management policies in order to enhance the well-being of the citizens of SKN. The department is the first point of contact in the processing of all land issues. Key responsibilities include:

- the design, survey and implementation of residential land subdivision schemes;
- the provision of land management services such as surveying, mapping and land valuation for the GOSKN;

- the establishment of a fixed boundary coordinated cadastral system after a systematic resurvey
- the identification of residential, commercial and industrial lots for sale in order to generate revenue and meet the demand for new developments and expansion in the business sector;
- the provision of valuation services for the GOSKN;
- the provision of technical support to the National Housing Corporation;
- the management of the Special Land Distribution Initiative; and,
- the complete development of a Land Information System that would fully support the survey, registration, valuation and management of land.

With representation on the DCPB, the DLS works closely with the DPPE and other key public sector institutions to rationalize land use and land development decisions.

### ***Department of Economic Affairs and Public Sector Investment Planning***

This Department serves as the coordinating unit for several regional and international donor agencies that embark on a range of capital initiatives with the GOSKN such as the *Caribbean Development Bank* (CDB), *Organization of American States* (OAS), UNDP, *United Nations Environment Programme* (UNEP); the GEF, World Bank, and the European Union (EU). It facilitates the coordination of requests for technical assistance, grant funding and loan funding between various government ministries and non-governmental institutions and external donor agencies, in an effort to augment the existing resource base available for in country project implementation.

It prepares and manages the Public Sector Investment Programme (PSIP) through close collaboration with line ministries and statutory corporations. The PSIP is a ministry-wide project management database which captures relevant project information on a timely and consistent basis to aid in decision making. The PSIP also informs the budgeting process and assists in ensuring integration and complementarities in inter-ministerial and inter-departmental programming, so as to reduce duplication and maximize resources.

#### **1.6.2 Water Services Department**

The *Water Services Department* (WSD) is responsible for the identification, upkeep and protection of water supply sources on St. Kitts. The Watercourses and Waterworks Ordinance (1956) makes provision for the declaration of watersheds to protect waterworks and water sources. Watershed management is critical to maintaining both surface and groundwater sources, but the Water Services Department does not consider itself a watershed management institution, and would prefer to leave that function to a competent institution. Notwithstanding the WSD, working in close collaboration with the DPPE, has spearheaded the implementation of the first phase of the IWCAM project which seeks to rehabilitate the lower coastal section of the Basseterre. Additionally, the WSD for many years has been playing a lead role in the management of the Wingfield Watershed.

### **1.6.3 Department of Agriculture (DOA)**

In SKN, agricultural development policies and programmes are developed and managed by the *Department of Agriculture* (DOA). While the DOA on both departments have separate organizational structures and reporting systems, there is strong partnership and collaboration at the national level. Traditionally, the DOA has focused on agricultural extension services, focusing primarily on methods of cultivation and overall crop production. Generally, the DOA is responsible for a range of services related to agriculture and rural development in both SKN. Some of these include:

- Soil sampling and analysis;
- Soil conservation;
- Forestry;
- Water conservation;
- Integrated pest management;
- Animal and plant health;
- Food safety and nutrition;
- Food security;
- Marketing; and,
- Natural resources management.

### **1.6.4 Public Works Department (PWD)**

The *Public Works Department* (PWD) is responsible for overseeing the design of new and maintenance of existing public infrastructure, including roads, drainage, bridges, and culverts. It is responsible also for overseeing the design, construction and repair of public buildings. As a member of the DCPB, the PWD provides technical support to the land development and building application review processes. The PWD is a member of the existing PSIP framework that is managed by the Ministry of Sustainable Development.

### **1.6.5 Solid Waste Management Corporation (SWMC)**

Statutory authority for the *Solid Waste Management Corporation* (SWMC) on St. Kitts and on Nevis is provided by the Solid Waste Management Corporation Act. The SWMC is charged with the responsibility of developing solid waste management facilities for storage, collection, treatment and disposal of solid waste. While there are two private companies on St. Kitts involved in solid waste collection and disposal, the SWMC remains the primary collector and transporter of waste throughout the Federation.

### **1.6.6 Department of Marine Resources**

The Department of Marine Resources (DMR) of the Ministry of Agriculture has primary responsibility for fisheries in St. Kitts and Nevis. Its purposed is to ensure the optimum utilisation of fisheries resources in the waters of St. Kitts and Nevis for the benefit of the people and economy of St. Kitts and Nevis through management and development. The DMR is responsible by law for fisheries management including conservation of resources and

development of the fisheries. The Fisheries Act (1984) and the Fisheries Regulations (1995) provides the legal authority for management and development of fisheries in St. Kitts and Nevis. The DMR performs research and data collection towards assessing the state of the various fisheries and marine ecosystems, and suggests conservation and development methods. The DMR compiles fisheries related statistics which are integrated into national economic development planning by the MSD and, therefore, plays a role in the project cycle including reporting on major capital projects for fisheries management. It also conducts fisheries-related surveys and deals with some matters of fisheries economics and trade. The DMR assists in the implementation of local and foreign-funded capital projects such as improvements to landing site infrastructure. It is also responsible for the registration of fisherfolk and vessels and performs inspection of fishing vessels in accordance with local and international standards. The DMR manages all primary and secondary landing sites.

### **1.6.7 Other agencies**

Other agencies with some role in marine resource protection and management either as a beneficiary or resource custodian, include the St. Christopher National Trust, the Ministry of Tourism and the Ministry of Finance.

## **1.7 REGIONAL AND INTERNATIONAL OBLIGATIONS**

The Federation's accession to international treaties and its membership in regional institutions such as the *Caribbean Community* (CARICOM) and the OECS has given rise to obligations in various sectors of importance to marine conservation, including pollution control, fisheries management and conservation, and protection of endangered species and their habitats.

### **1.7.1 CARICOM**

***Caribbean Regional Fisheries Mechanism (CRFM):*** Member countries signed the Agreement Establishing the CRFM on February 4, 2002 to promote and facilitate “the responsible utilization of the region's fisheries and other aquatic resources for the economic and social benefits of the current and future population of the region”. Conservation and protection of fish stocks and ecosystems is a priority objective of the CRFM. Strategic, medium-term, and annual work plans guide activities of participating countries. These targets could inform the goals of a zoning system.

### **1.7.2 OECS**

***St. George's Declaration (SGD):*** The 2000 (SGD is the benchmark environmental management framework in the OECS region. It is structured around twenty one principles. The SGD is implemented at the national level by the *National Environmental Management Strategy* (NEMS).

### **1.7.3 United Nations Convention on Law of the Sea (UNCLOS)**

Under the UNCLOS, coastal states have obligations to conserve marine living resources and protect and preserve the marine environment. The Convention does not qualify this obligation but it requires coastal states to take all measures necessary to prevent, reduce and control pollution from any source; and to protect and preserve rare or fragile ecosystems, the habitats of depleted, threatened or endangered species, and other forms of marine life. The obligation to conserve marine living resources applies within each coastal state's territorial sea, its exclusive economic zone (EEZ), and on the high seas. On the high seas, all states must cooperate in conserving and managing living resources.

### **1.7.4 Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention, 1983)**

The Convention is a comprehensive, umbrella agreement for the protection and development of the marine environment. It provides the legal framework for cooperative regional and national actions in the wider Caribbean region. The Convention requires the adoption of measures aimed at preventing and controlling pollution from ships, and seabed activities. It also requires parties to take appropriate measures to protect and preserve fragile ecosystems. The Cartagena Convention consists of three protocols: (a) the **Protocol concerning Pollution from Land-based Sources of Pollution (LBS Protocol)**; (b) the **Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region**; and, (d) the **Protocol Concerning Specially Protect Areas and Wildlife (SPA) in the Wider Caribbean**. All three protocols are of direct relevance to marine protection and management in St. Kitts and Nevis. The GOSKN has not yet acceded to the LBS Protocol although there are ongoing activities consistent with its obligations such as the management of solid and liquid waste, the management of pesticide use and water quality testing.

### **1.7.5 Jakarta Mandate on Marine and Coastal Biological Diversity (under the Convention on Biodiversity)**

The mandate was adopted in Jakarta in November 1995 by the *Conference of the Parties (COP)* of the *UN Convention of Biodiversity (CBD)* at its second meeting. It is an agreement on a plan of action for implementing the CBD. It has five principal themes: (a) integrated marine and coastal area management; (b) marine and coastal living resources; (c) marine and coastal protected areas; (d) mariculture; and, (e) alien species. At the fourth meeting of the COP in 1998, the multi-year program of work for the Mandate was adopted, and is included in the annex to decision IV/5 of the meeting.

## **1.8 RELEVANT REGIONAL PROJECT INITIATIVES**

### **1.8.1 Reducing Risks to Human and Natural Assets Resulting from Climate Change (RRACC) project**

The RRACC project is funded by the United States Agency for International Development (USAID) with a total budget of US\$2.5 million. Under the RRACC, St. Kitts has proposed a water audit and conservation project. The main objectives of the project are: (1) capacity building and training of a cadre of persons in water auditing including implementation of water conservation practices; (2) pilot water audit projects targeting the tourism and agricultural sectors; and, (3) demonstration of water conservation technologies such as rainwater harvesting for irrigation of schoolyard and backyard gardens and installation of water saving devices in hotels. The water audit is estimated to cost US\$110,000.00. Under the RRACC, Nevis has proposed a drainage system demonstration project. The project has the following objectives: (a) to develop a drainage master plan; and, (b) to develop and implement a hydrological data collection and monitoring system for the Charlestown area

### **1.8.2 Global Climate Change Alliance (GCCA) Project**

The GCCA project is an initiative of the European Union (EU) to strengthen dialogue and cooperation on climate change with developing countries most vulnerable to climate change. The overall objective is to support sustainable development in the Caribbean region and preserve the progress of the countries towards achieving the Millennium Development Goals (MDGs). The support to the GCCA Project is being implemented by the Caribbean Community Climate Change Centre (CCCCC) over a period of 42 months in 16 Caribbean Forum (CARIFORUM) countries. This initiative has a total budget of €8 million Euros (roughly US\$10 million or EC\$27million). The Support to the GCCA Project has been endorsed by the MoSD and the letter has been sent to GCCA for further action. The Senior Environmental Officer/Climate Change Focal Point will be following up on this project.

### **1.8.3 Caribbean Large Marine Environment (CLME) Project**

The CLME project will assist participating countries from the wider Caribbean Region to improve the management of their shared Living Marine Resources – most of which are considered to be fully or overexploited—through an Ecosystem-Based Management (EBM) approach. A preliminary Transboundary Diagnostic Analysis (TDA) identified three priority transboundary problems that affect the Caribbean Large Marine Ecosystem (CLME) and Adjacent Regions: (1) Unsustainable exploitation of fish and other living marine resources, (2) Habitat degradation and community modification and (3) Pollution. The Global Environment Facility (GEF) provides the funding for the CLME project along with co-financing from countries and other international partners with a total budget of US\$7.01 million.

#### **1.8.4 Adaptation Activities to Increase Resilience and Reduce Vulnerability to Climate Change Impacts in the Eastern Caribbean Fisheries Sector (ARCCIF) Project**

The ARCCIF project respond to the expressed needs of the countries targeted namely: Trinidad and Tobago, Barbados, Grenada, St Vincent and the Grenadines, St Lucia, Dominica, Antigua and Barbuda and St. Kitts and Nevis. The project involves a number of win-win adaptation strategies that include; (1) the development and introduction of practical adaptive fisheries management tools, (2) strengthening the capacity of fisherfolk organizations and their access to critical safety equipment such as VHF and GPS, (3) the development of innovative information communication technologies (ICTs) for information sharing between fishers, scientists and policy-makers, (4) pilot and demonstrations activities, (5) knowledge networks and (6) policy adjustments.

#### **1.9 DATA COLLECTION AND ANALYSIS**

Use of Geographic Information Systems (GIS) has continued to increase in St. Kitts over the past years. It is anticipated that the DPPE will be managing a large amount of data, both tabular and geographical in nature. The DPPE's GIS will be used to store, map and analyze data, both spatial and non-spatial data, of the CZMP.

#### **1.10 CONCLUSION**

The island of St. Kitts needs an active integrated coastal zone management programme to conserve its diverse marine resources. The Ministry of Sustainable Development's CZMP will be implemented with the intention of assisting in this management effort through the provision of additional ecological information.

Data collected from the CZMP will then be used to provide status reports on the region after natural events such as hurricanes or human cause disasters. Collected data could also assist the ministry in making well-informed policy recommendations to various governmental departments, cooperatives and agencies on issues such as land use, industrial and domestic pollution.

## PART 2: IDENTIFICATION OF CRITICAL MARINE HABITATS

### 2.1 VALUABLE MARINE ECOSYSTEMS WITHIN THE EEZ

As discussed earlier in Part 1, the Federation of St. Kitts and Nevis is a two-island nation located in the eastern Caribbean. *Fig. 5* shows that the Federation’s surrounding exclusive economic zone (EEZ) waters extend out to adjacent territorial waters and cover 20,400 square kilometers (7,876.5 sq. miles) in area with a shelf area of 845 square kilometres (326.3 square miles).

In 2010, the Nature Conservancy completed a “Marine Zoning Plan” for St. Kitts and Nevis. The resultant baseline data shows that St. Kitts and Nevis has a relatively small ocean shelf area that surrounds both islands. On the western side of St. Kitts, the ocean shelf drops off steeply after reaching the depth of 30 meters. The shelf is covered primarily with bare carbonate sand, while healthy reefs and other coral structures cover a small percentage of the area (*see Table 2 and Figure 7*). The distribution of all classes showed in *Table 2* is depicted in *Figure 8*.

The small shelf area and relatively stable annual water temperature limits the marine biological diversity. Additionally, the minimal areas of upwelling restrict nutrient supply and subsequently the offshore fisheries. Coastal fisheries have declined sharply in recent years, and storms and anchoring have heavily damaged the reefs. Anecdotally, fishers have reported smaller catches of conch, lobster, and large pelagic and demersal fishes. Major threats to the marine ecology of the islands include coastal development, unsustainable fisheries practices, land-based sources of pollution, rising ocean temperatures, and the increasing intensity of hurricanes and other storm events.

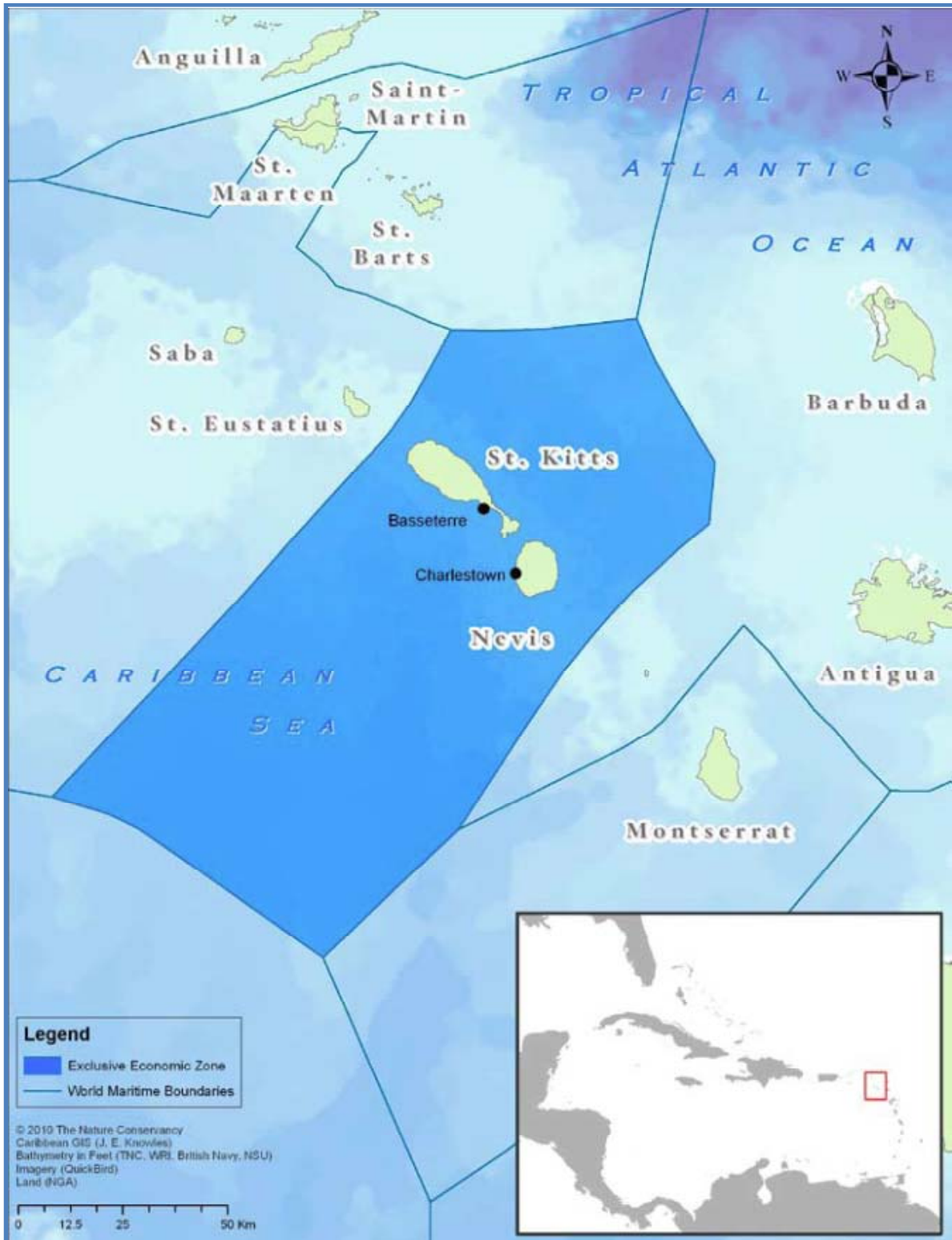
**Table 2: Total area of seabed habitat types and coverage in coastal waters (less than 30 meters deep) around St. Kitts and Nevis**

Benthic Class	Size	
	Hectares	Acres
Sand	16,351	40,402.2
Dense seagrass	3,098	7,655.3
Flat gorgonian hardgrounds	2,854	7,052.4
Dense macroalgae on hardground	2,774	6,854.7
Semi-consolidated rubble	2,595	6,412.4
Unconsolidated sand with algae	1,929	4,766.7
Hardcoral framework	1,578	3,899.3
<i>Acropora palmata</i> stumps	574	1,418.4
Sparse seagrass	370	914.3
Rugose gorgonian slope	258	637.5
Lagoonal mud	165	407.7
Algal reef flat	61	150.7

*Source: Adapted from Agostini et. al. (2010)*

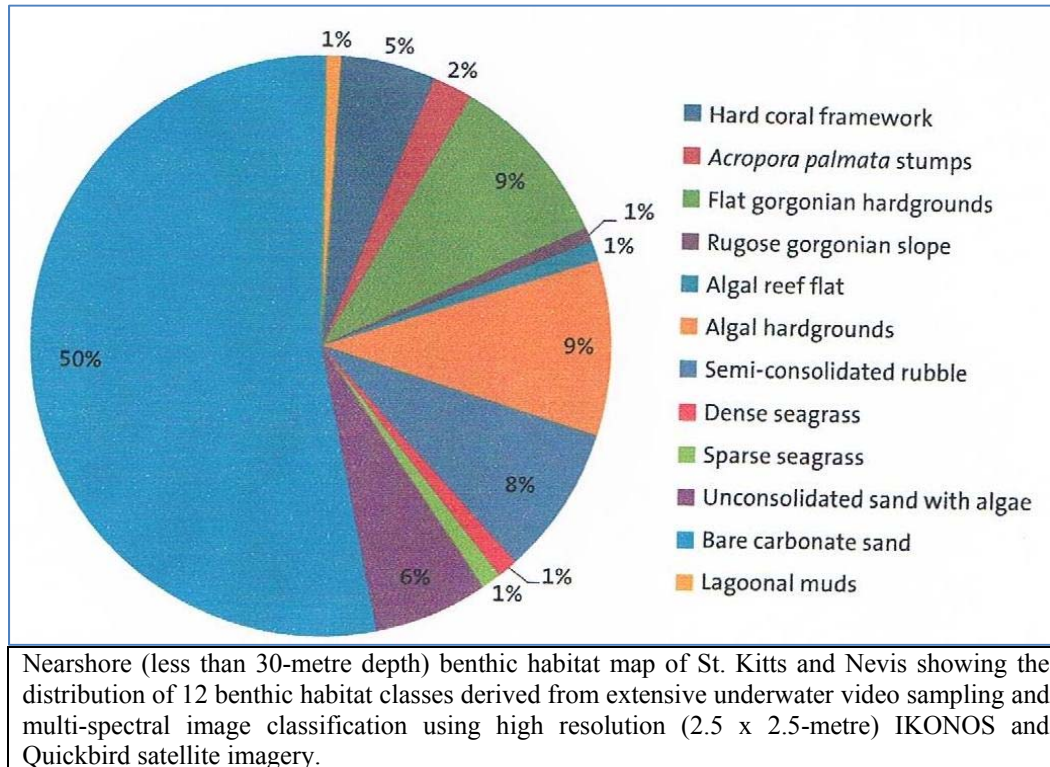


Fig. 6: Map showing EEZ of St. Kitts and Nevis



Source: Agostini et al. (2010)

**Fig. 7: Benthic habitat classification**



Source: Agostini et. al. (2010)

## 2.2 COASTAL RESOURCES OF ST. KITTS

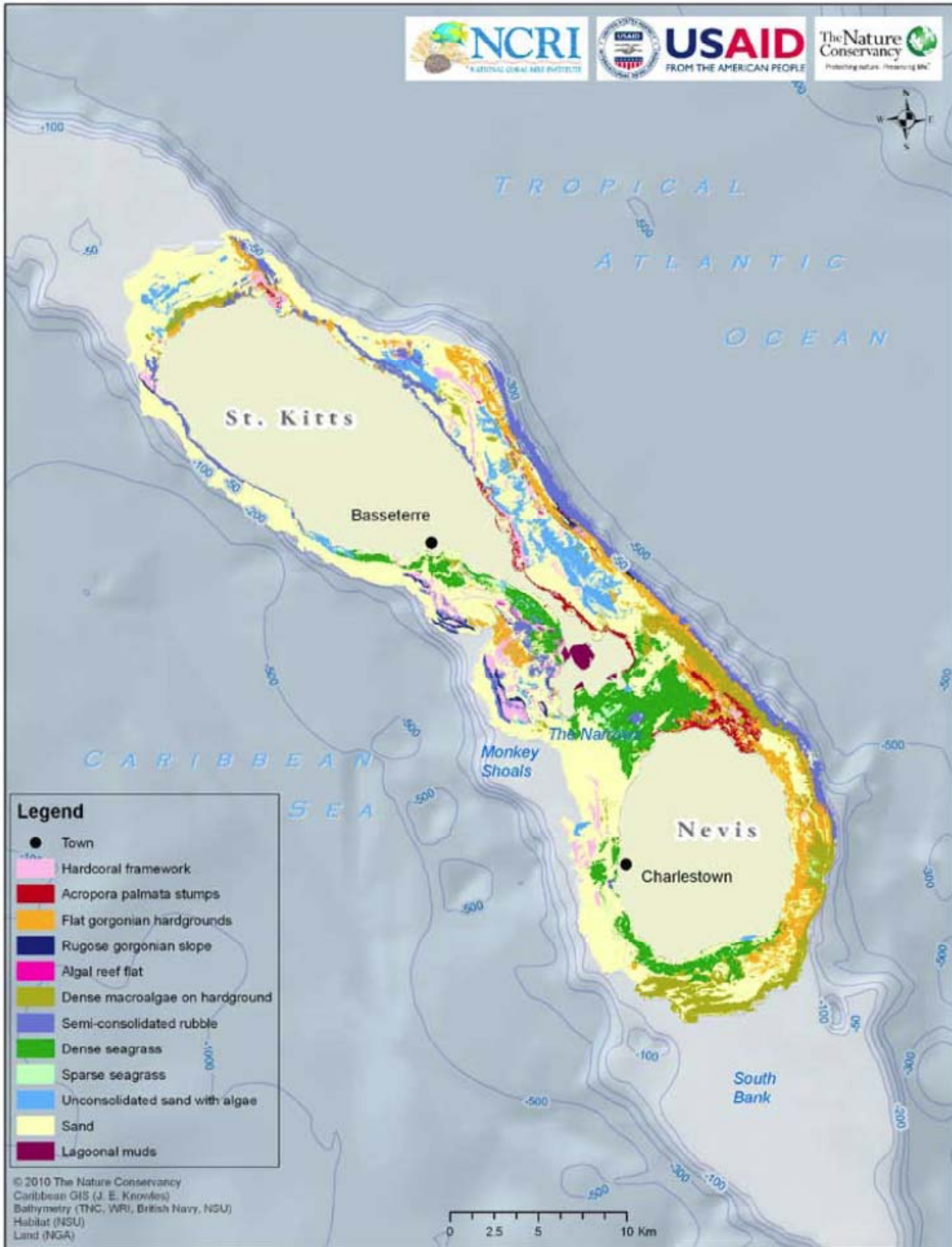
Despite its small shelf area, St. Kitts and Nevis boasts a representative cross-section of Caribbean marine life, including endangered corals, marine mammals, fish species, and sea turtles (see Figure 8).

### 2.2.1 Coral reefs and seagrass beds

The diversity of corals ranges from species categorized as critically endangered by the International Union for Conservation of Nature (IUCN), such as staghorn (*Acropora cervicornis*) and elkhorn (*Acropora palmate*), to the more common finger coral (*Porites divaricata*).

Complementing the hard coral varieties are an array of sponges and soft corals. Additionally, there are several large seagrass beds, most notably in the area between the two islands known as “the Narrows”. These seagrass communities are typically co-dominated by turtle grass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*) and serve as vital breeding grounds for fishes and conch, including queen conch (*Strombus gigas*), which is regulated by the Convention on International Trade in Endangered Species (CITES).

**Fig. 8: Benthic coverage map of St. Kitts and Nevis**



*Source: Agostini et al. (2010)*

Figures 9 and 10 show that in St. Kitts and Nevis, coral reefs and seagrass beds occur primarily along the Southwest coast between Nag’s Head and the southern end of Basseterre Bay, the Northwest coast between Sandy Point and Dieppe Bay, the East coast between Conaree and Friar’s Bay, the Southeast coast adjacent to the Narrows, the island of Nevis (reasonable balance of coral reefs surrounding the island), and the Northwestern and southern coasts of Nevis. Table 3 lists some of the corals found within the coastal waters of St. Kitts and Nevis. A more complete list can be found in Annex IV.

**Table 3: Sponges and corals found within the coastal waters of St. Kitts and Nevis**

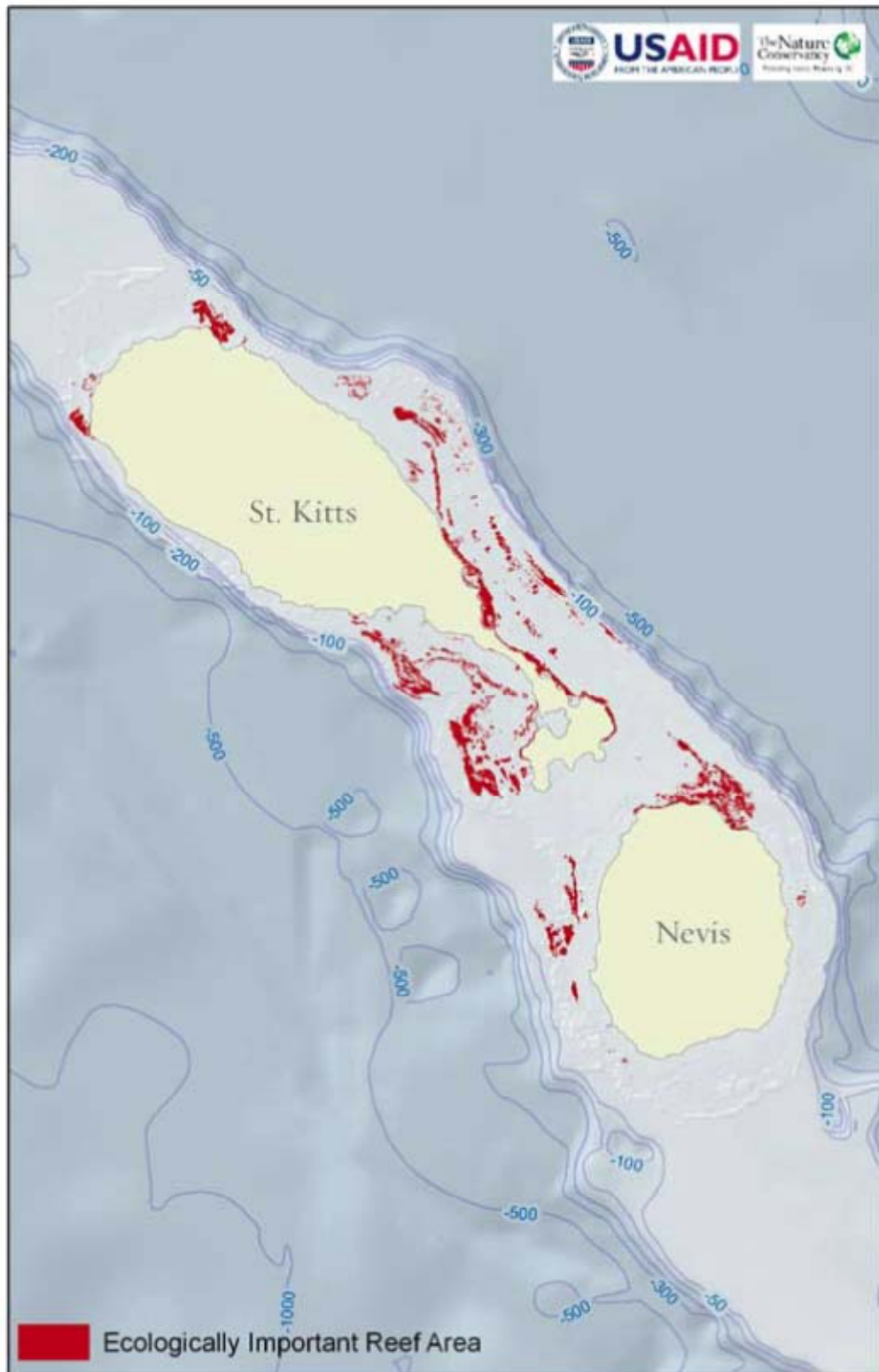
<b>Sponges</b>	
Encrusting sponges	<i>Demospongia sp., Ulosa hispida</i>
Burrowing sponge	<i>Adocia carbonaria, Cliona sp.</i>
Trumpet sponges	<i>Agelus sp.</i>
Fluorescent sponge	<i>Callyspongia plicifera</i>
Barrel sponge	<i>Xestospongia muta</i>
Stinker sponge	<i>Ircinia faciculata</i>
Candle sponge	<i>Verongia fistularis, V. longisima, V. gigantean</i>
<b>Soft corals</b>	
Encrusting corals	<i>Mandraxis decactus, M. mirabilis, Siderastrea sidereal</i>
Star corals	<i>Montastra annularis, M. cavernosa</i>
Plate corals	<i>Mycetophyllia sp.</i>
Lettuce corals	<i>Agaricia agaricites, A. fragile</i>
Finger corals	<i>Porites porites. P. asteroides</i>
Pillar coral	<i>Dendrogyra cylindricus</i>
Flower coral	<i>Eusmilia fastigiata</i>
Brain corals	<i>Diploria sp.</i>
Black coral (Cnidarian)	<i>Antipathes sp.</i>
Fire coral (Hydrozoan)	<i>Millepora sp.</i>
Sea fans	<i>Gorgonia sp.</i>
Ascadians (sea squirts)	<i>Clavelina sp.</i>

Source: NABSAP, 2004

Both coral reef and sea grass communities contribute to the following environmental processes:

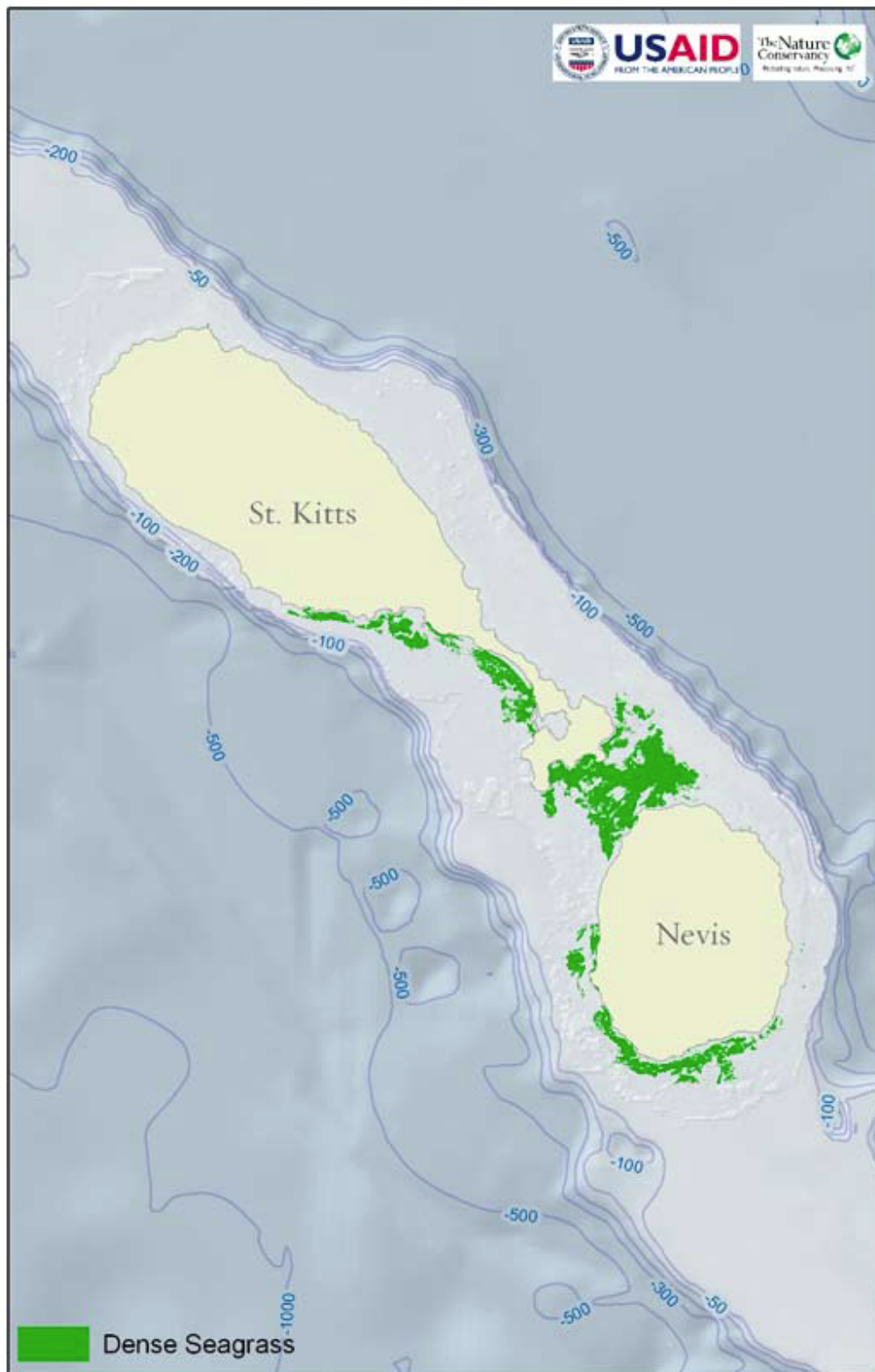
- Provide habitat for commercially important fish species, spiny lobster and queen conch;
- Produce nutrients which are important in sustaining the life of fish species and other organisms;
- Act as barriers during periods of heavy wave attack; and,
- Contribute to the development of white sand beaches – an important tourism asset.

**Fig. 9: Map showing ecologically important reef areas of St. Kitts and Nevis**



*Source: Agostini et. al. (2010)*

**Fig. 10: Map showing dense sea grasses in the coastal waters of St. Kitts and Nevis**



*Source: Agostini et. al. (2010)*

### 2.2.2 Mangroves

Mangroves are found principally on the margins of salt ponds in St. Kitts and Nevis (*see Fig. 11*). Typical species include black mangrove (*Avicennia germinans*), buttonwood (*Conocarpus erectus*), white mangrove (*Laguncularia racemosa*); and, red mangrove (*Rhizophora mangle*). Mangroves: (1) protect and stabilize low-lying coastal lands; and, (2) provide protection and food sources for coastal fishery food chains. Mangroves serve as feeding, breeding, and nursery grounds for a variety of fish, shellfish, birds, and other wildlife. In St. Kitts and Nevis, there is a large number of resident and migratory birds that depend on the mangrove and pond communities for feeding and nesting.

On the island of St. Kitts, mangroves are found principally on the margins of the salt ponds. Typical species include red, black and white mangroves. Where there is high salinity, red mangroves are rare. Red mangroves dominate the pond margins of Friars Bay, with white and black mangrove occupying the more landward margins of the pond. The Friar's Bay Salt Pond is a brackish pond that supports a large migratory population of ducks and assorted other wading birds. The remaining ponds are hypersaline (ranging in salinity from 115 to 180 parts per thousand) supporting a variety of both resident and migratory wading birds. A very important aspect of the salt ponds is the area of exposed mudflats along the periphery that accumulates large concentrations of shore and wading birds.

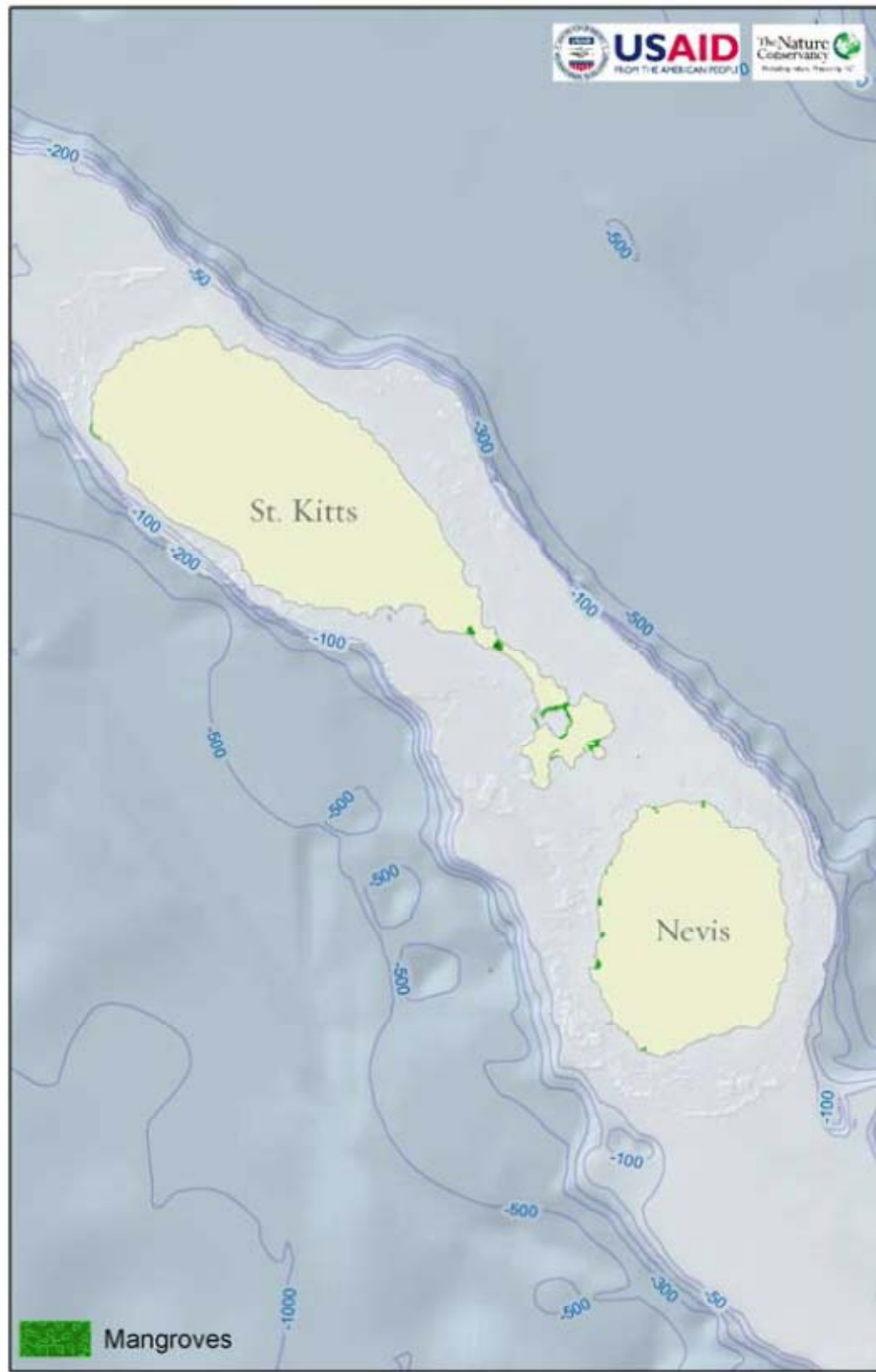
Mangrove communities are important roosting and nesting sites for numerous resident and migratory avian species. They are rare on St. Kitts occupying the fringes of the salt ponds at Friars Bay, Mosquito Bay, Cockleshell Bay, Majors Bay, Frigate Bay, Half Moon Bay and Great Heeds Pond. There are some stands of white and black mangroves on the fringes of the Great and Little Salt Ponds.

*Figure 11* shows that, generally, the mangroves are not abundant on the island of St. Kitts. The most extensive mangrove systems occur on the Southeast Peninsula. On the island of Nevis, red and black mangroves no longer occur naturally in any of the mangrove systems. Stands of white mangroves are dominant on the island, accompanied by fewer buttonwood species. These mangrove systems can be found at Bath Bogs/Bath Stream, Parris Pond, Pinneys Pond, Jessups Bogs/Bowrin Pond, Fort Ashby Lagoon, Mariners Pub Lagoon/Lawrence's Pond, Cades Bay, Jones Bay, Oualie Beach, Newcastle, Nisbet's, Long Haul Bay and at Indian Castle/White Bay.

### 2.2.3 Salt water ponds and freshwater lagoons

On the island of St. Kitts, there are a number of saltwater ponds located on the Southeast Peninsula (*see Figure 12*). Nevis has a system of freshwater lagoons located throughout the island, some of which are along the coast and are therefore subject to saltwater intrusion. Two small ponds located northeast of Basseterre are the only freshwater ponds on the island of St. Kitts. These ponds provide habitats for many migratory seabirds and shorebirds in the fall and spring

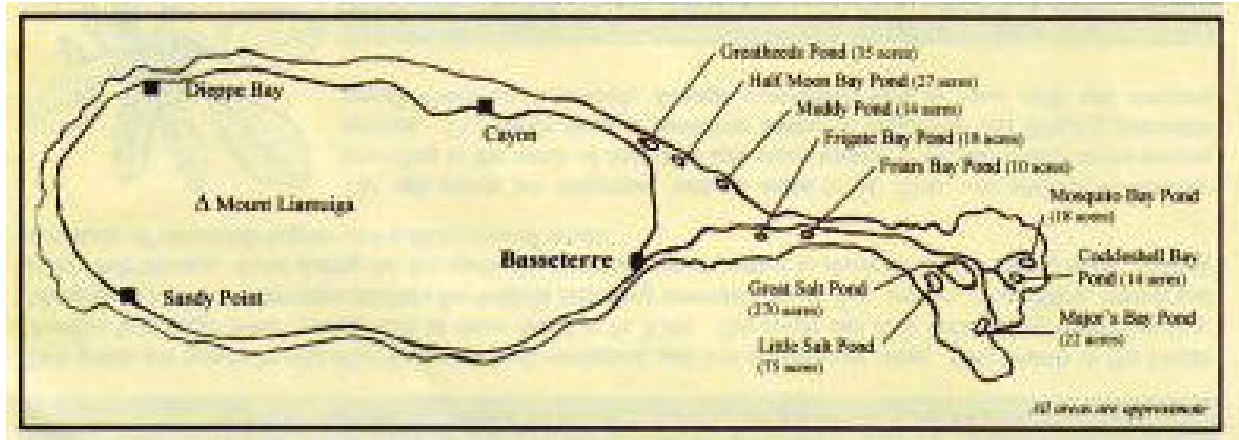
**Fig. 11: Map showing coastal mangroves in St. Kitts and Nevis**



*Source: Agostini et. al. (2010)*



**Figure 12: Distribution of salt ponds in St. Kitts**



### 2.2.4 Marine fishes

The diversity of fish within the marine environment of St. Kitts and Nevis is similar to almost any tropical marine environment. There are 462 species of marine fish tabulated for St. Kitts and Nevis of which 16 species are deemed threatened. *Table 4* lists major species fished within the territorial waters of the Federation.

**Table 4: Major fish species caught by trap and handline in St. Kitts and Nevis**

Doctor Fish	<i>Acanthuridae</i>
Trigger Fish	<i>Balistidae</i>
Grunt	<i>Pomadasyida</i>
Squirrel Fish	<i>Holocentridae</i>
Goat Fish	<i>Mullidae</i>
Snapper	<i>Lutjanidae</i>
Parrot Fish	<i>Scaridae</i>
Grouper	<i>Serranidae</i>
Lobster	<i>Panulinus</i>
Gar	<i>Belonidae</i>
Ballahoo	<i>Exocoetidae</i>
Jacks	<i>Selar crumenophthalmus</i>
Dolphin	<i>Coryphaena hippurus</i>
Tuna/mackerel	<i>Thunnus scombridae</i>
Conch	<i>Strombus gigas</i>

*Source: NABSAP, 2004*

### 2.2.5 Marine Turtles

Three species of sea turtles, all internationally classified as endangered, are known to nest in St. Kitts. These include the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*) and leatherback turtle (*Dermochelys coriacea*). Generally, turtles have been indiscriminately hunted for eggs, meat and shell. The reptiles tend to nest at discrete sites which include Belle Tete, Conaree and the SEP. Existing regulations provide for a closed season effective February 28th 1st through October 1<sup>st</sup> annually. Generally, catch restrictions state 350 lbs. pounds, 180 lbs. and 160 lbs. as the lower limit for the Leatherback turtle, Green turtle and Hawksbill turtle respectively, and no product can be marketed during the closed season.

### 2.2.6 Seabirds and shorebirds

Norton (1989) concluded that the pond systems of St. Kitts are extremely important to shorebirds. He counted 25 species of 2,300 shorebirds in one day. Shorebirds are particularly concentrated at Half Moon Pond, Little Salt Pond, Friars Bay Pond, and Majors Bay Pond. Many of these shorebirds are winter residents or birds arriving in July/August and remaining until April/May before leaving for breeding grounds further north and include the great blue heron (*Ardea herodias*) and the western sandpiper (*Calidris mauri*). Three local nesting shorebirds have been documented for St. Kitts – black necked stilt (*Himantopus mexicanus*), wilson's plover (*Charadrius wilsonia*) and snowy plover (*Charadrius alexandrinus*). Another group of water birds (ducks and coots) use Mosquito Bay, Friars Bay and the eastern shore of Great Salt Pond as wintering habitats. These include American coots (*Fulica Americana*), Caribbean coots (*Fulica caribaea*), and the blue-winged teal (*Anors discors*).

The following eight species of seabirds are known to nest on the island of St. Kitts: brown pelican (*Pelecanus occidentalis*), magnificent frigate bird (*Fregata magnificens*), least tern (*Sterna albifrons*), sooty tern (*Sterna fuscata*), bridled tern (*Sterna anaethetus*), laughing gull (*Larus atricilla*), brown noddy (*Anous stolidus*) and roseate tern (*Sterna dougallii*). The most important seabird nesting sites for St. Kitts are Booby Island and the area between Green Point and Nags Head on the South-east Peninsula.

### 2.2.7 Beaches

The island's coastline largely consists of cliffs, some 50 to 100 feet high. Beaches at the foot of these cliffs are narrow and the sand is coarse and black, with many pebbles and boulders. Exceptions are in the south-east, where the cliffs are lower and some beaches have yellow sand and are wider. In Basseterre where there are cliffs, there is a narrow beach of grey sand. From Conaree on to the south-east of the island, there are long stretches of fine yellow sand beaches.

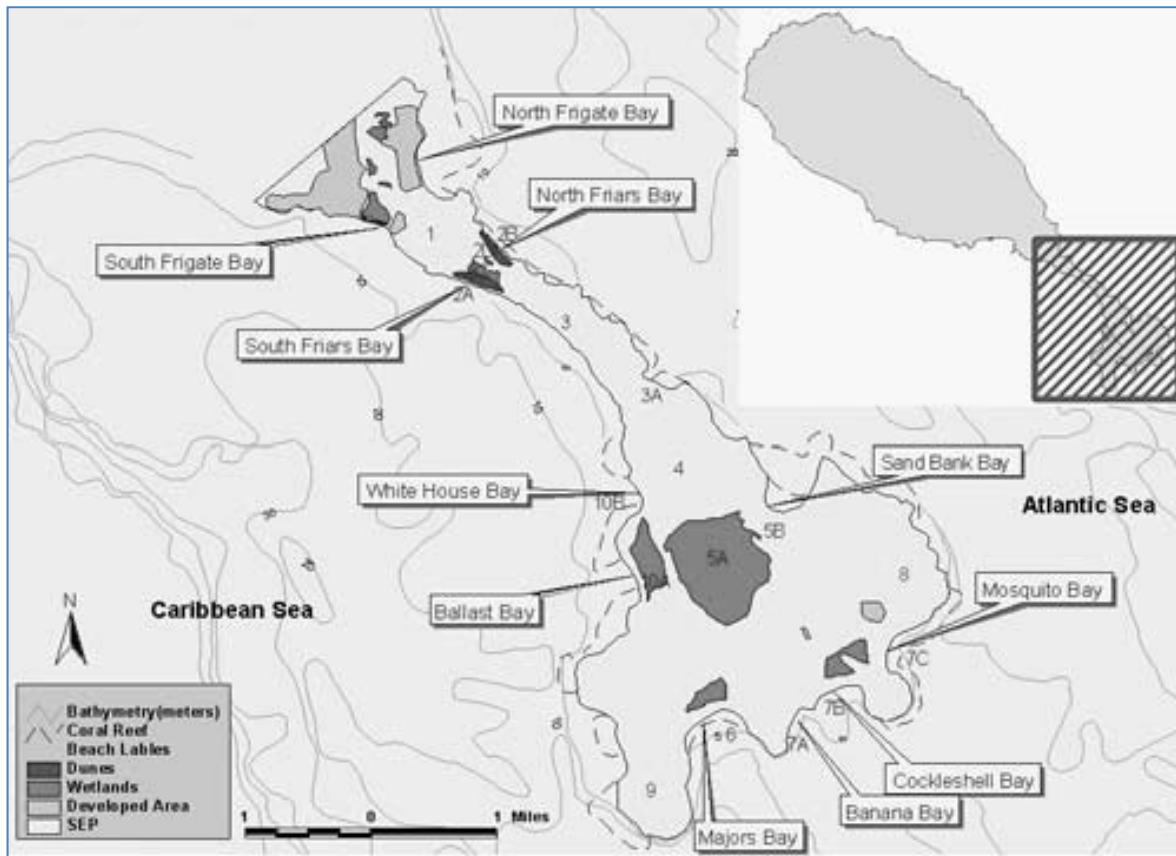
As an island territory, St. Kitts has a fragile 78.1 km long coastline in need of special protective measures for ecological, environmental and economic reasons. It consists of 34.7km cliff (rocks), 10.8 km cobble, 6.3 km boulders and rocks, 13.1 km black volcanic sand, and 13.2 km golden sand (*see Table 5 and Figure 13*).

**Table 5: Coastal materials and their various lengths (km), St. Kitts (1997)**

Category	Length (km)	Percent
Cliff/Rocks	34.7	44.4
Cobble	10.8	13.8
Boulders/Rocks	6.3	8.1
Black Sand	13.1	16.8
Golden Sand	13.2	16.9
<b>TOTAL</b>	<b>78.1</b>	<b>100.0</b>

*Source: Physical Survey (April 1997)*

**Figure 13: Economically important beaches on south-eastern end of St. Kitts**



Nevis also has sandy beaches, rocky shores and massive sea cliffs. The most prominent sandy beach is a 4 km stretch of coastline north from Charlestown to Cades Bay, called Pinneys Beach.

### **2.2.8 Migrant mammals**

Migrant mammals, including humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), common bottlenose dolphin (*Tursiops truncatus*), rough-toothed dolphin (*Steno bredanensis*), and spinner dolphin (*Stenella longirostris*) are consistently present on an annual basis.

### **2.2.9 Invasive species**

Eighteen invasive species have been identified for St. Kitts and Nevis on the Global Invasive Species Database. To date, the most critical invasive species attacking healthy reef systems in St. Kitts and Nevis is the Pacific lion fish (*Pterios miles* and *Pterios volitans*).

## **2.3 USERS OF MARINE RESOURCES**

Users of marine resources identified in *Figures 8 – 11* above include scuba divers, snorkelers and swimmers. *Figure 14* shows the areas mostly used by scuba divers. Additionally, a large community of full- and part-time fishers earns their livelihood from marine resources. *Figure 15* shows that there are four core fishing areas in St. Kitts and Nevis, as follows:

- 1) northern bank (north of St. Kitts),
- 2) northeastern Atlantic side of St. Kitts,
- 3) southeastern Atlantic side near The Narrows, and
- 4) southern bank (south of Nevis).

## **2.4 CAUSES OF MARINE RESOURCE DEPLETION**

### **2.4.1 Natural stresses on coastal resources**

Like other tropical small island developing states, the coastal and marine resources of the Federation of St. Kitts are experiencing degradation. In some cases, natural changes in oceanographic features are altering marine habitats such as coral reefs, sea grass beds and mangroves. Already there is evidence of coral bleaching, largely believed to be a consequence of global warming. This has led to some discontinuities in the oceanic food web. Natural environmental changes also lead to different advantages for predator and prey species. Strong winds and currents sometimes lead to more mixing of water layers. Prey that can stratify at a certain depth may become more dispersed when there is mixing and less available to predators. Their abundance may increase while that of the predators may decrease. Increased storminess, that may come with climate change, affects coastal systems in several ways. For example, increases in water runoff from more intense precipitation can reduce salinity along the coast, bring more nutrients in the runoff and increase sediments in the water. The changes can lead to changes in production and distribution of species, including changes in migratory paths. When combined with the expected warming of coastal waters, there may be considerably ecological changes. In the coastal waters of St. Kitts and Nevis there are many such interactions and

complexities.

Sediments entering ghauts is a natural process, but in excessive quantities from urban development activities, agriculture, road construction, housing developments and industrial and wastewater discharges, it can cause problems. Increased sedimentation can reduce the availability of coastal habitats and affect the breeding and feeding habits of native fish as well as aquatic invertebrates. Sediments suspended in the water column turn the water turbid (muddy). This reduces the amount of sunlight entering the water, which inhibits plant and coral growth and makes it difficult for predators such as fish and birds to hunt. Suspended sediments in the water column also interfere with the uptake of oxygen by fish and invertebrates. Sediments also enter the marine environment through ghauts, again emphasizing that what we do in our catchments affects our coast. Excessive sediments can kill marine plants and animals by smothering them or cutting off access to light. Sedimentation is one of the factors causing the large decline in seagrasses seen in recent years.

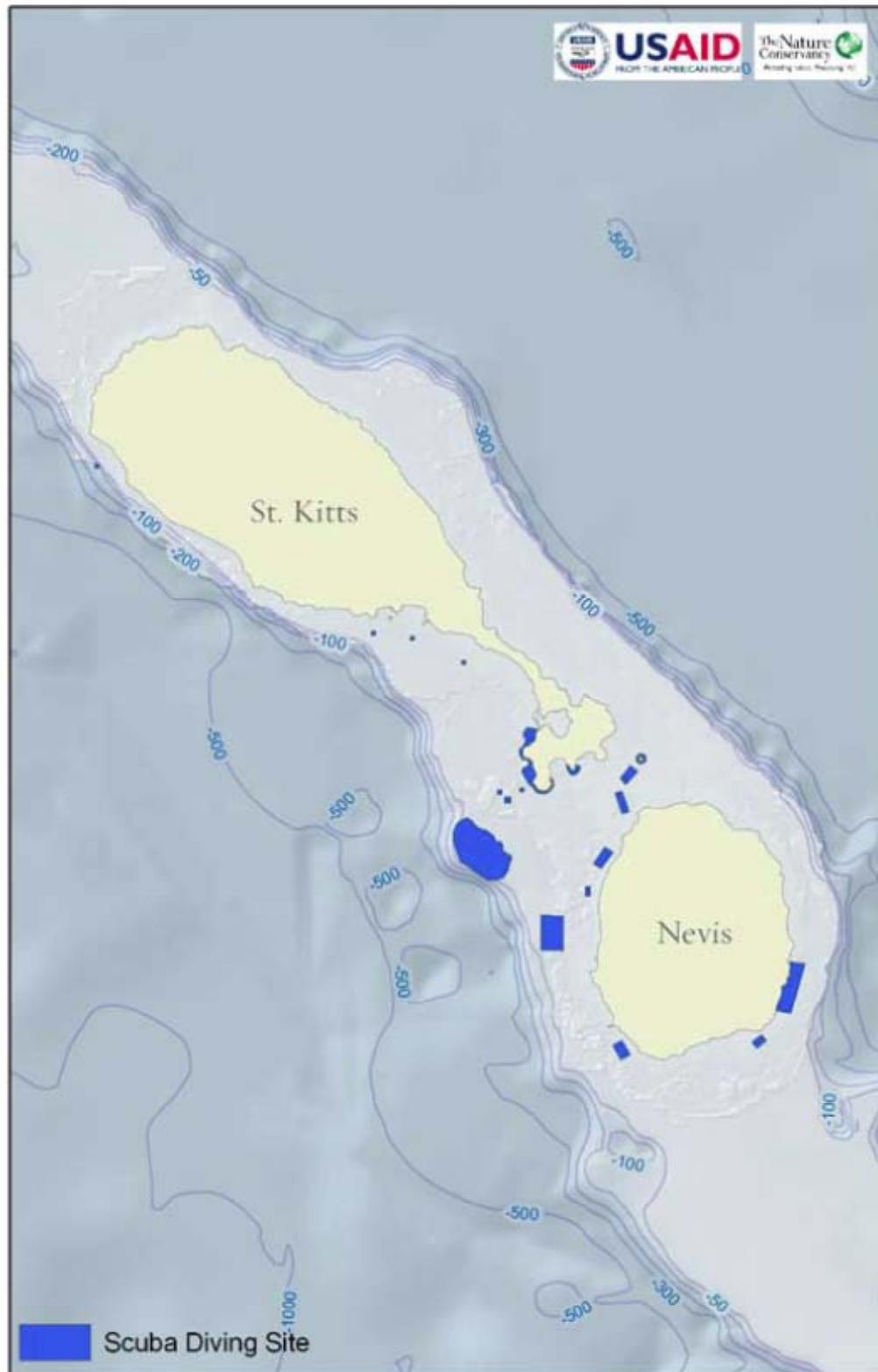
### **2.4.2 Human Impacts**

The impact of human activities coupled with land-based processes such as shore development, farming, mining, quarrying, sewage disposal and dredge-and-fill is placing a tremendous stress on the ecological balance of coral reefs, seagrass beds and mangroves causing an unusually rapid decline of marine ecosystems' overall health and ability to function. Some direct impacts are the result of:

- Boat groundings and anchor- and propeller- damaged corals, seagrasses and injury to sea turtles;
- Placement and recovery of lobster traps;
- Flipping of coral heads by sport divers while capturing lobster;
- Divers and snorkelers grabbing, stepping and standing on and kicking corals with fins and/or dragging their gear;
- Hook and line fishing – dragging, loss and discarded used line;
- Commercial fishery – trap and gear loss (nets, lines, etc.);
- Coral reef fauna collection;
- Shore development – marinas, land filling, sea wall construction – leads to marine resource destruction;
- Spear fishing removes large predatory species (tipping the balance); and,
- Over-fishing can lead to the extinction of species (e.g., queen conch and the Jewfish).

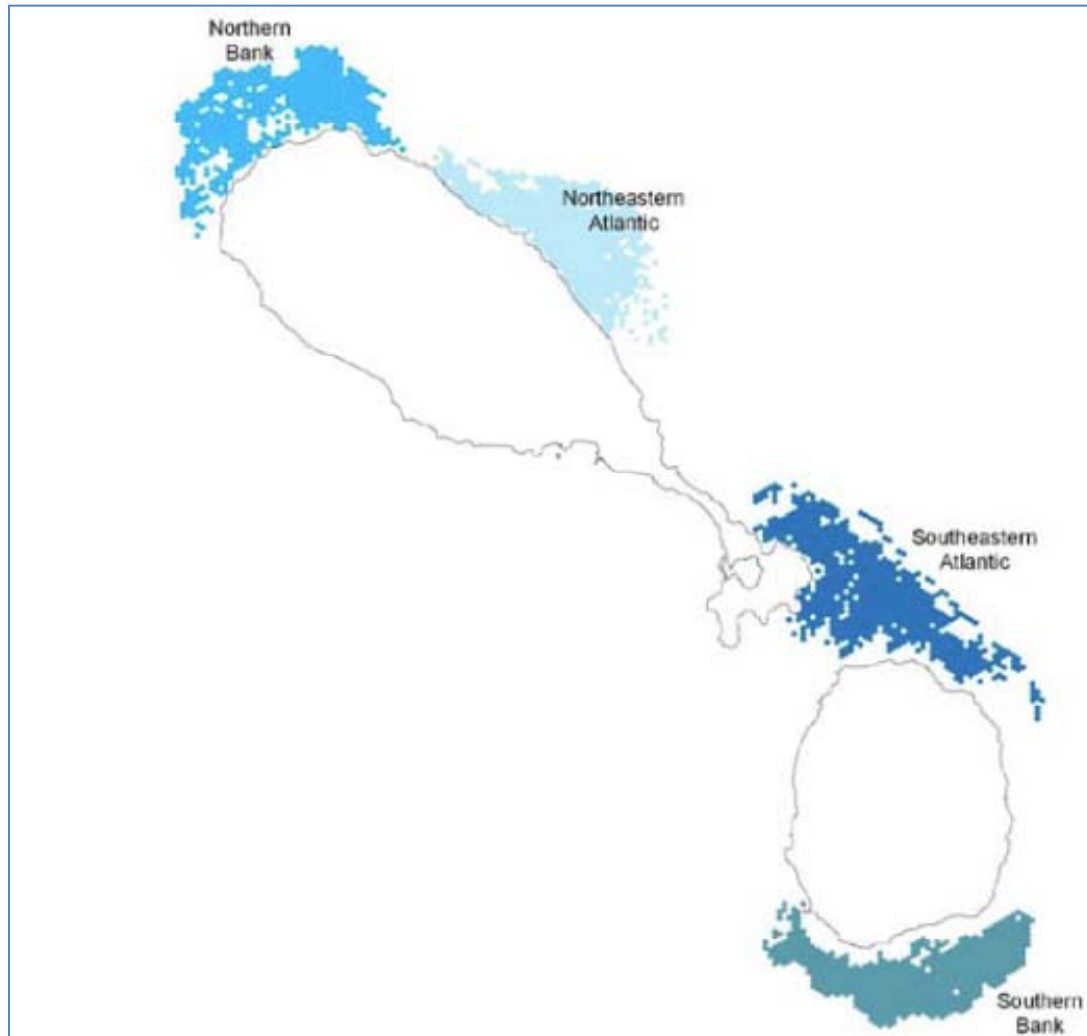
In St. Kitts and Nevis, elevated nutrient levels in the coastal zone is caused by wastewater and desalination treatment plant discharges, urban stormwater run-off, agricultural run-off, intensive industrial operations and soil erosion. Nutrients generally enter the marine environment through the many ghauts around the islands. Excessive nutrient inputs from catchments to the coast can lead to imbalances to marine ecosystems.

**Fig. 14: Map showing scuba diving sites in St. Kitts and Nevis**



*Source: Agostini et. al. (2010)*

**Fig. 15: Major fishing banks in St. Kitts and Nevis**



*Source: Agostini et. al. (2010)*

All plants and animals need nutrients to grow. However, when excessive amounts of nutrients are present, algal blooms and nuisance plant growths can occur in waterways. This can lead to (1) reduction in habitat and light availability for plants and animals; (2) decreases in the available oxygen in the water; (3) obstruction of waterways, affecting recreational use and fish migration; (4) odours and unsightly appearance; and (5) the production of toxins which threaten aquatic ecosystems and human uses of water.

Herbicides and pesticides may interfere with basic food chain processes by destroying or damaging zooxanthellae in coral, free living phytoplankton, planktonic larvae, algal or seagrass plant communities. These may also accumulate in animal tissues and affect physiological processes.

Salinity is a key factor in the distribution and physiological performance of many reef organisms.

Hypersaline and heated waste water from desalination plants can change local ecological conditions.

There is also a threat posed by the accidental spilling of petroleum products as they are being transferred from tanker to land based storage tanks. At risk are our coral reefs, seagrass beds, benthic habitats and wetlands. The effects of an oil spill on marine life have negative consequences for our fisheries, food chain, ecosystem balance, health and enjoyment of the diversity of nature. Fisheries can be expected to close down in the event of an oil spill. Fish can be negatively impacted by chemical toxicity, physical irritations and damage to gills by mud particles. Additionally, the local tourism economy would be undermined and a reputation as being environmentally unfriendly.

The use of new fishing technologies have reduced fish stocks in the coastal waters of St. Kitts and Nevis (e.g., lobsters and conch) below an acceptable level. Overfishing can do more than endanger our food supply. It also causes widespread changes in ocean ecology leading to the degradation of reefs, destruction of bottom grasses and increased eutrophication of our bays. If overfishing is controlled these ecosystems often recover. Notwithstanding, the over-exploitation of our fishery resources has already led to some spectacular fisheries collapses (e.g., the lobster and conch fishery).

Unsustainable fishing practices assist in the depletion of fish stocks, degrade nursery areas and produce the unintentional removal of non-targeted species during fishing operations (by-catch).

### **2.4.3 Stress-related Signs**

Evidence of stress on the nearshore water environment is manifested in the following signs:

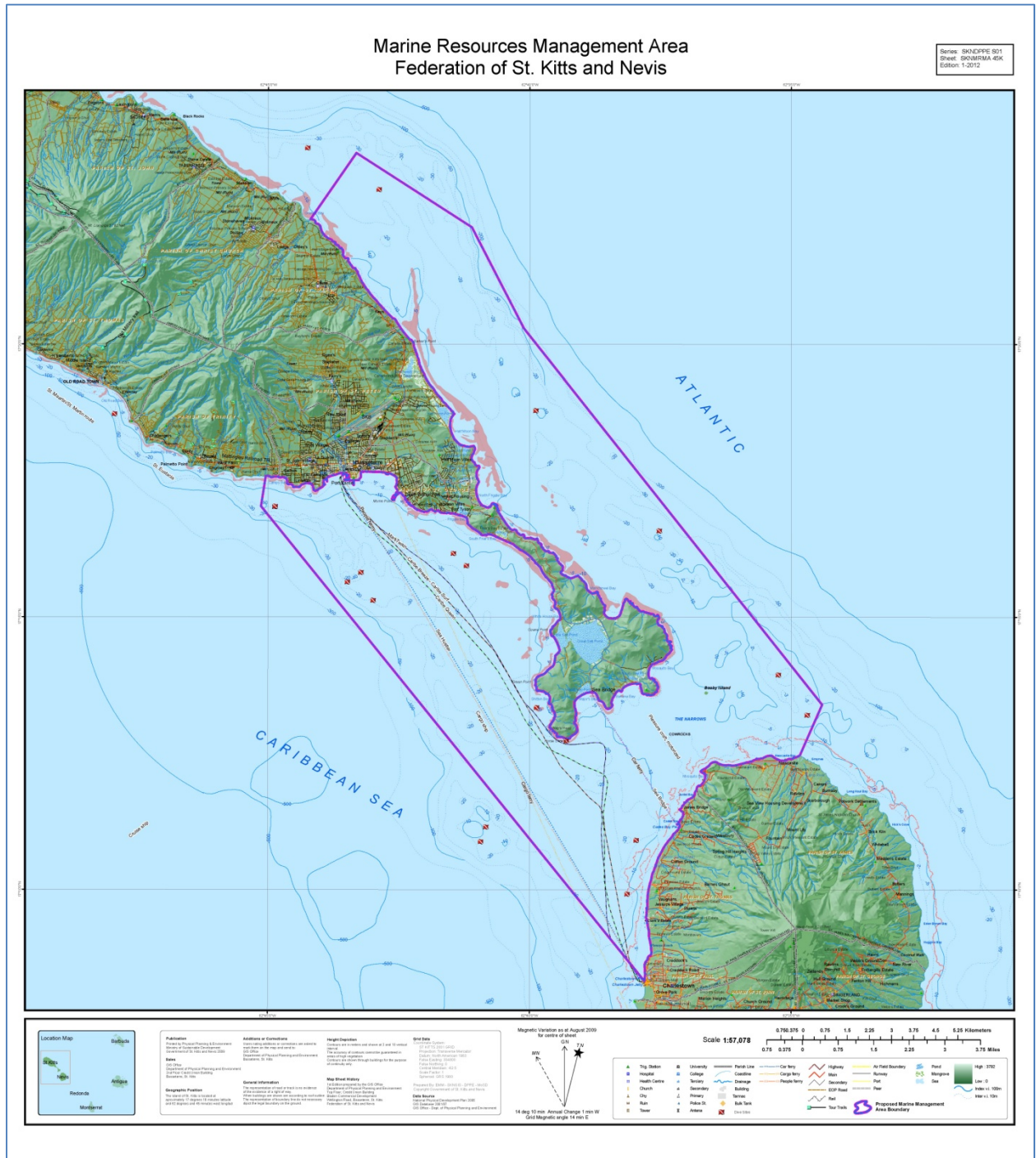
- Deterioration of water quality;
- Accelerated coastal and beach erosion;
- Depleted fish stocks;
- Coral bleaching affecting star coral, fire coral, elkhorn coral, soft coral and anemones; and,
- Blackband disease affecting brain and star coral, sea plumes and sea fans.

## **2.5 MARINE MANAGEMENT AREAS PROPOSED FOR ST. KITTS AND NEVIS**

The Department of Marine Resources has recently proposed the designation of a Marine Management Area (MMA) to encircle the entire coastline of St. Kitts and Nevis. The aim is to take the pressure off inshore fishing grounds which in recent years have been over-fished. The proposed boundary is to extend “from high tide and seaward out to the 30m (100 ft.) depth contour or two miles maximum around the entire coastline of the Federation whichever comes first.” This boundary will allow GOSKN to manage and control the use of SKN waters containing most of the productive seagrass beds, coral reef systems & fisheries resources of the offshore waters of the Federation (*see Fig. 15*).



**Fig. 16: Proposed Marine Management Area for St. Kitts and Nevis**



Source: GIS Section, DPPE (2013)

Nestled within the proposed Marine Management Area are a number of proposed Marine Protected Areas (MPA) identified in 1998 by the former Fisheries Management Unit. The main objectives of the proposed Marine Protected Area network are to achieve ecological

sustainability and environmental quality, to bring economic benefits to St Kitts, to manage proposed MPAs in a socially acceptable manner and to provide an international site for learning about marine biology and management, using the MPAs as a model.

Initially, two general areas in St. Kitts were originally considered suitable for the development of MPAs: (a) the South-East Peninsula (SEP); and, (b) Shoal Reef (identified as Paradise Reef in tourism literature) at Sandy Point. The SEP is approximately one tenth (1/10) of the total area of St. Kitts yet it has one quarter (¼) of the island's coastline (16.325 mi or 26.2 km). There is a predominance of seagrass and calcareous algae in the near shore reaches of the channel and leeward coast. These support the productivity of very important local fisheries such as finfish, conch and lobster.

Shoal Reef is on the northwest corner and leeward side of the island and is about 10 miles from the capital, Basseterre in the vicinity of Sandy Point, which is the second largest town in St. Kitts. It consists of an extensive and diverse coral reef system that is spotted with many large barrel sponges and a large variety of fish and invertebrates is situated in the Sandy Point harbour. It starts at about 300 metres from the shore at a depth of 50 feet and descends to 100 feet. This area attracts fishermen, scuba divers, swimmers and snorkelers.

The famous Brimstone Hill Fortress, as well as a 17th century Fort are located nearby and there is evidence of shipwrecks from that era on the Sandy Point reef. Many of these wrecks are there due to battles from that era. As this reef is important to our culture, history, tradition and economy it is considered an area to be part of the Marine Protected Areas System.

However, following intense consultations with stakeholders, it was later recognized that the MPAS should be broadened to include other areas. In so doing, certain categories were included, as follows:

**(a) Marine reserves (as defined in the Fisheries Act No.4, 1984)**

The primary purpose is the protection of the biodiversity. Some of these areas are considered fish nurseries and have to be protected as well. Nurseries are located on the South East Peninsula, particularly in Cockleshell Bay, Banana Bay, Mosquito Bay and Major's Bay. Here, just snorkelling will be allowed. Scuba diving will be allowed in all other parts of the Marine Reserve.

Seven areas were designated to be part of the Marine Reserve: Sandy Point, Cockleshell and Banana Bay, Mosquito Bay Major's Bay, Basseterre and Old Road (*see Figures 17 to 21*).

**(b) Fishing priority Areas (as defined in the Fisheries Act No. 4, 1984)**

Fishing activity will be given priority outside Marine reserves, Yacht Mooring areas and day charter boats areas (*see Figure 20*).

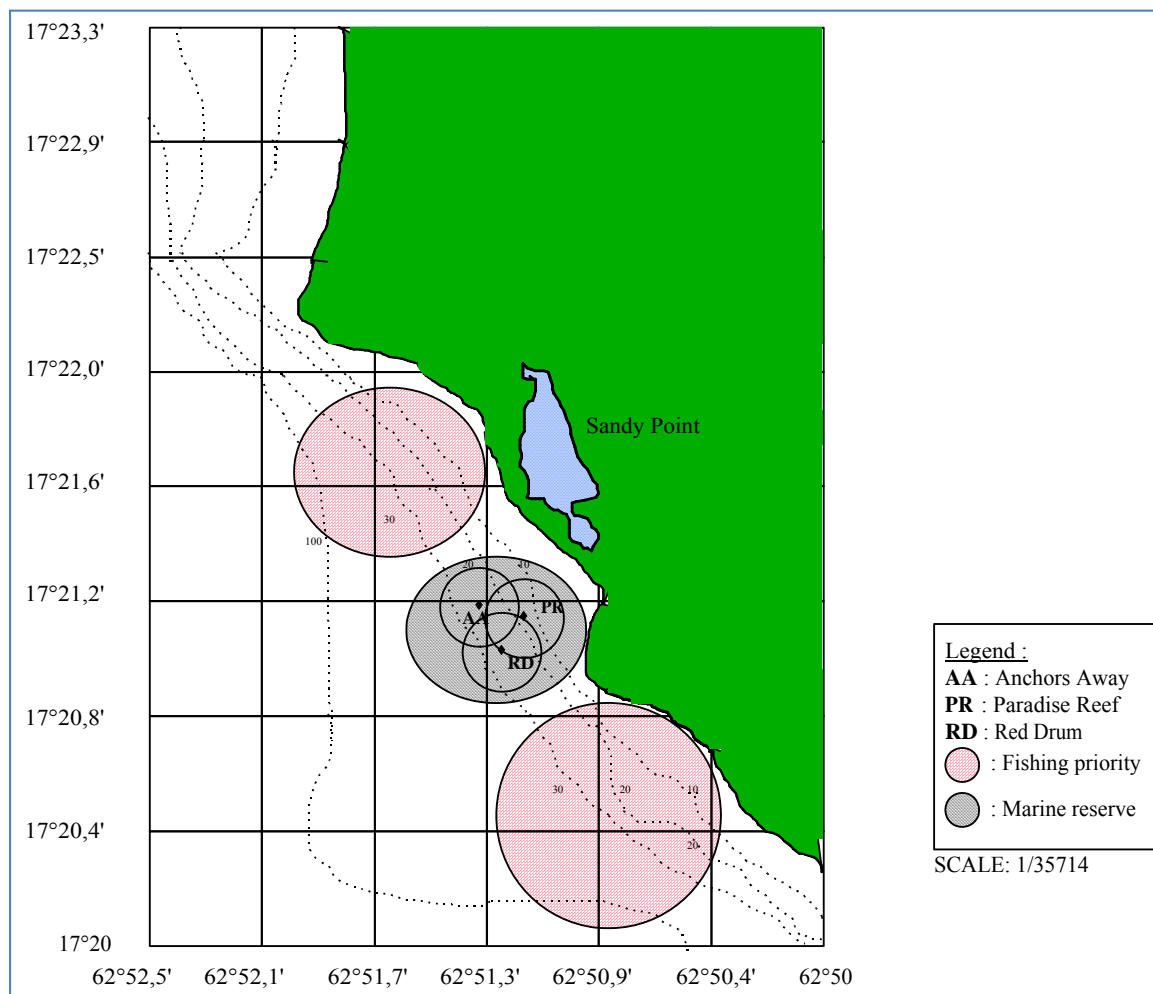
### (c) Yacht mooring areas

Some areas have to be reserved for yacht mooring, in order for them to stay in specified areas. Mooring of yachts are designated to these areas: Shitten Bay & Whitehouse Bay (see Fig. 20).

Figures 17 to 21 show the location of important dive sites within the MPAS as follows:

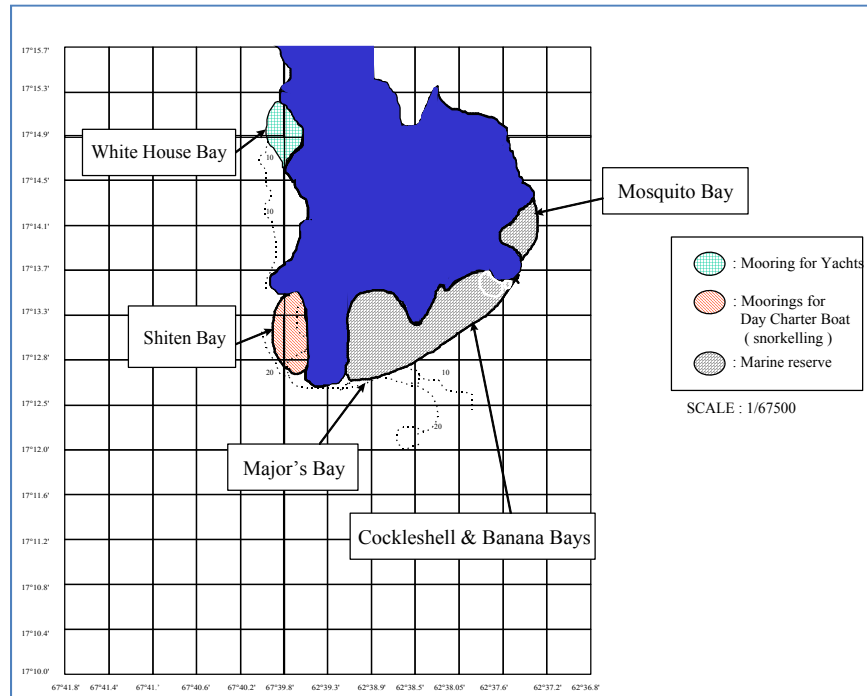
- *Figure 17*: Sandy Point area – Shoal (Paradise) Reef, Anchors Away and Red Drum;
- *Figures 18 and 19*: South East Peninsula Area – Monkey Shoals, the Ledge, Green Point;
- *Figure 20*: Basseterre area – Brimstone Shallows. Coconut Tree Reef, Rivertaw Wreck, Talata Wreck, Black Coral Reef, Ponds Bar, Tug Boat, Friars Deep, Camps Reef, Dance Hall and Turtle Bar; and,
- *Figure 21*: Old Road area – Old Road, Ross Reef and Lobster Reef

**Fig. 17: Shoal Reef, Sandy Point**



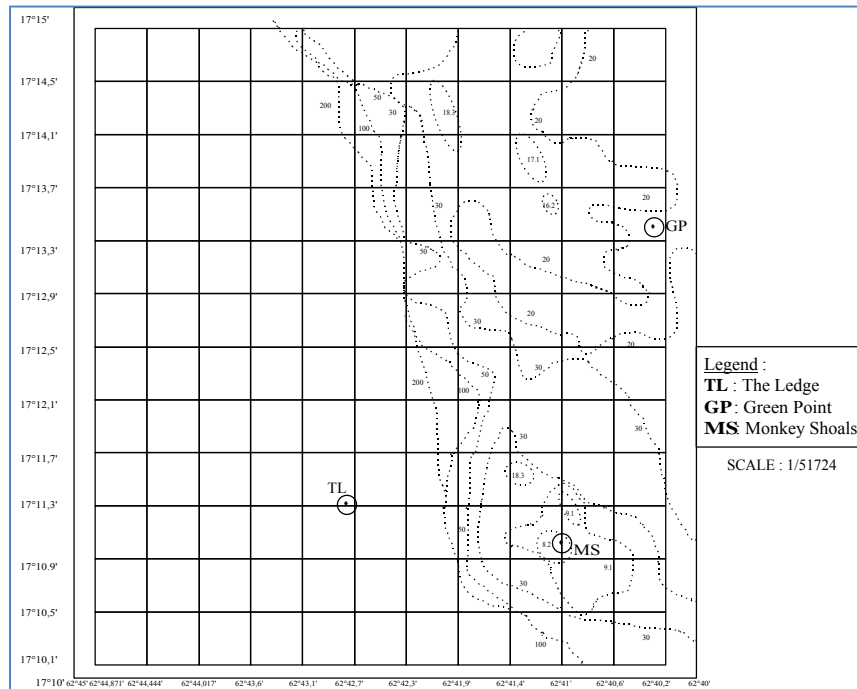
Source: Fisheries Management Unit (1998)

**Fig. 18: South-east Peninsula**



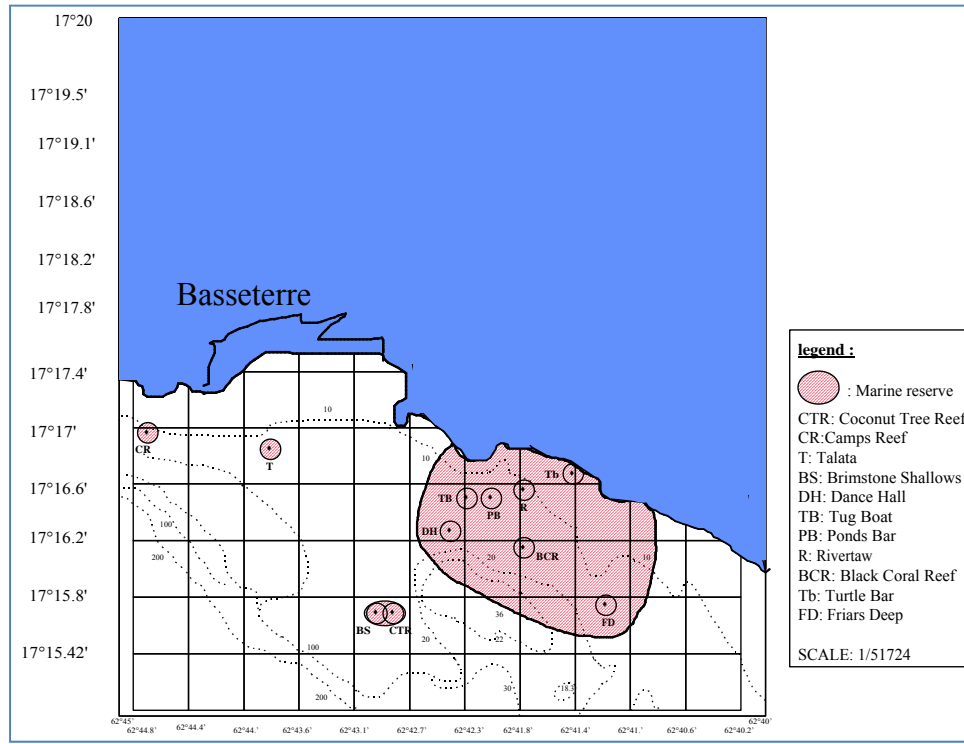
Source: Fisheries Management Unit (1998)

**Fig. 19: Dive sites, South-east Peninsula area**



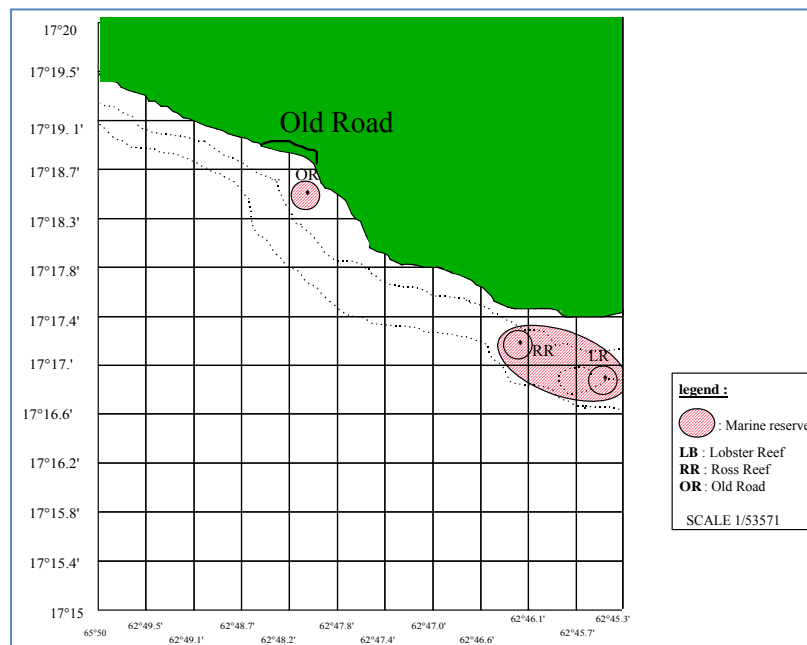
Source: Fisheries Management Unit (1998)

**Fig. 20: Dive sites, Basseterre area**



*Source: Fisheries Management Unit (1998)*

**Fig. 21: Old Road dive sites**

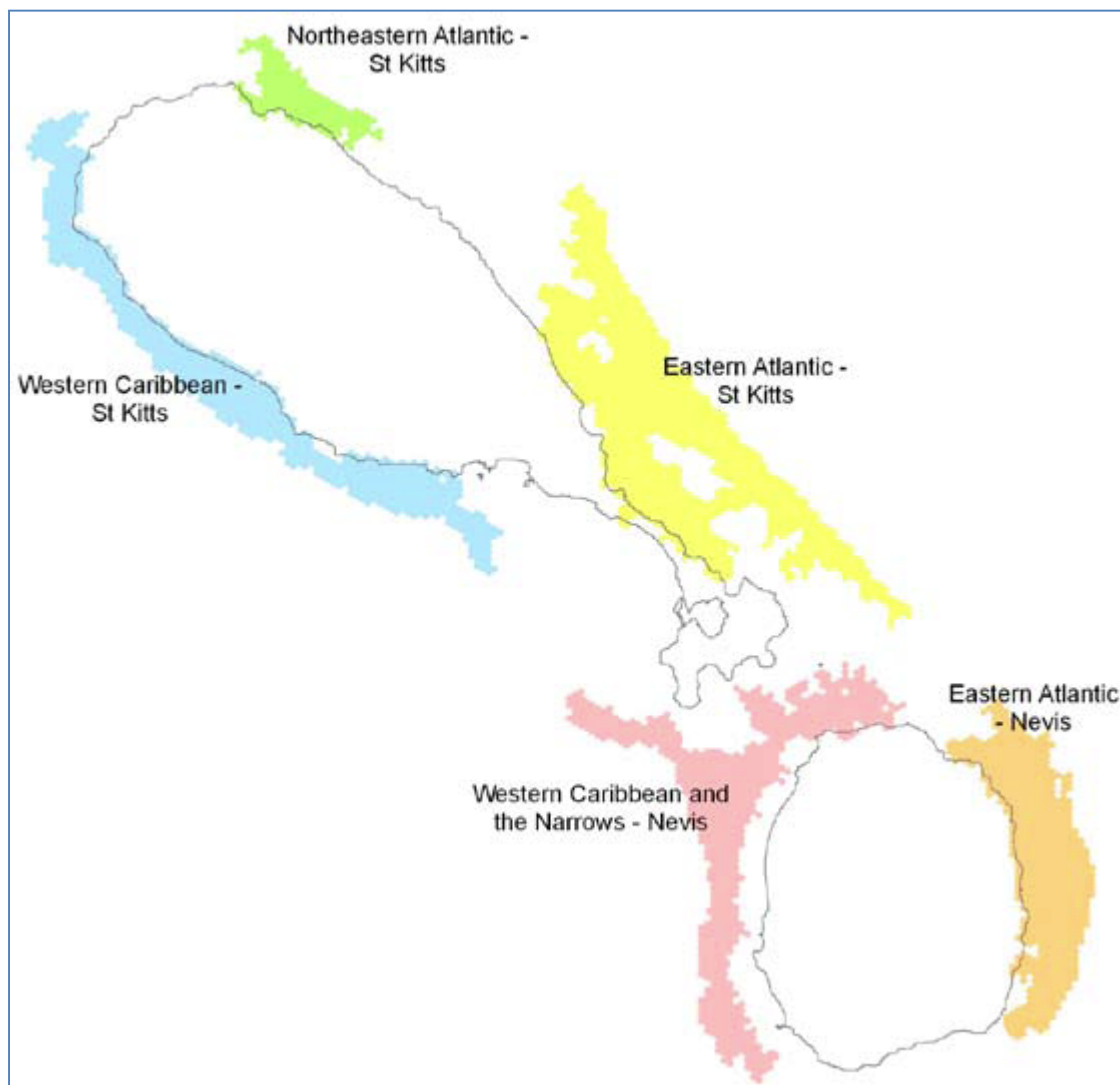


*Source: Fisheries Management Unit (1998)*

In conclusion, the review of existing literature generally identifies five core conservation areas in St. Kitts and Nevis (*see Figure 22*), as follows:

- 1) western Caribbean side of St. Kitts,
- 2) northeastern Atlantic side of St. Kitts (off and to the north of Black Rocks),
- 3) eastern Atlantic side of St. Kitts,
- 4) eastern Atlantic side of Nevis, and,
- 5) western Caribbean side of Nevis and the Narrows.

**Fig. 22: Areas identified for coastal and marine conservation in St. Kitts and Nevis**



*Source: Agostini et. al. (2010)*

## **PART 3: VALUATION OF MARINE ECOSYSTEMS**

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### **3.1 ECONOMIC AND ENVIRONMENTAL SERVICES OF MARINE ECOSYSTEMS**

Tropical marine and coral reef ecosystems, including mangroves and seagrasses, are vulnerable environmental resources that provide significant economic goods and services and contribute to the livelihoods, food security and safety of millions of people around the world. The health of these resources is critical to human well-being. By accounting for coastal marine and coral reef ecosystem values in management decisions, we can sustain their flow of goods and services in the interest of current and future generations.

The World Meteorological Organization says that tropical coral reefs yield more than US \$39 billion annually in global goods and services, such as coastline protection, tourism and food. The US agency, NOAA (the National Oceanic and Atmospheric Administration) puts the economic value even higher and says that coral reefs provide economic services – jobs, food and tourism – estimated to be worth as much as \$375 billion each year.

The Evolutionary Distinct and Globally Endangered (EDGE) organisation estimates that half a billion people, that's 8% of the world's population, are heavily dependent on reefs for their goods and services which include food, coastal protection, building materials and income from tourism, and 30 million are entirely dependent on reefs. EDGE further postulates that coral reefs supply about 10% of the marine fisheries landings and are a critical area for breeding, spawning and the early life stages and feeding of many marine species. This rich complex system is also a fertile source of pharmaceutical products which as yet is largely untapped. EDGE estimates that reefs are worth US\$172 – 375 billion per annum and this is probably underestimated as many benefits of coral reefs pass through non-market economies, such as cycling of nitrogen and carbon, and creation of favourable conditions for other ecosystems such as seagrasses.

The economic worth of coral reefs is not the only value that should be considered. The cultural significance of coral reefs to coastal communities across the world is also hugely important. While the demise of coral reefs will have knock-on effects to other reef-associated ecosystems and species such as sea grass beds, mangroves, marine reptiles, seabirds, pelagic ecosystems, and estuarine habitats. The extinction of coral reefs would mean the loss of a large part of the Earth's total biodiversity.

In the past few years, however, global threats to coral reefs have been increasing and in the context of the wider environment, the value of coral reefs may be even greater. All around the world, much of the world's marine biodiversity face threats from activities and events such as:

- Coastal development;
- Overfishing.
- Inland pollution;
- Global climate change; and,
- Ocean acidification caused by some of the excess carbon dioxide emissions being absorbed by the world's oceans.

### 3.2 METHODOLOGY TO DETERMINE THE ECONOMIC VALUATION OF GOODS AND SERVICES DERIVED FROM MARINE ECOSYSTEMS IN ST. KITTS AND NEVIS

The major objective of this paper is to demonstrate the application of ReefFix’s “direct value transfer” method of economic valuation techniques in St. Kitts and Nevis. Data were gathered through information received from the DMR, the DPPE, the St. Kitts Tourism Authority, the St. Kitts and Nevis Hotel and Tourism Association and the Chamber of Industry and Commerce.

The “direct valued transfer” methodology utilises a “benefits transfer” technique that uses calculated values from “heavily-studied” reefs in other areas and applying them to similar sites (ReefFix 2009). For the purposes of this study, categories of land cover types include coral reef environs, mangroves, beaches, coastal wetlands and coastal forests (*see Table 8*).

Terrestrial area values were derived from IKONOS and Quickbird satellite imagery (2010) where the desired land cover types were outlined and exported into ArcGIS in order to calculate surface areas. Select marine data were derived from the TNC’s Marine Zoning Plan (MZP) GIS database project (2010). The MZP project sought to aid marine space use planning and management in St. Kitts and Nevis by gathering information on marine space use such as critical habitats, representative marine ecosystems, areas of high aesthetic value and cultural importance, fishing grounds and marine-based tourism, areas of highest human threat and space use conflict (Agostini et. al., 2010). The MZP surface area values were identified through site surveys of the bottom habitats and include deeper reefs that cannot be correctly defined by IKONOS and QuickBird satellite photographs.

ArcGIS analysis revealed that the total area of salt ponds on the island of St. Kitts was 203.8 hectares (*see Table 6*). Additionally, data assessed from the UNESCO COSALC beach monitoring project conducted in St. Kitts from 1991 to 1999 was used to determine the area of coastal beaches (*see Table 7*).

**Table 6: List of salt ponds on St. Kitts**

<b>Name of salt pond</b>	<b>Area (ha)</b>
Greatheeds Pond	14.2
Halfmoon Bay Pone	11.0
Muddy Pond	5.7
Frigate Bay Pond	7.3
Friars Bay Poind	4.0
Little Salt Pond	30.4
Great Salt Pond	109.3
Majors Bay Salt Pond	8.9
Cockleshell Bay Salt Pond	5.7
Mosquito Bay Salt Pond	7.3
<b>TOTAL</b>	<b>203.8</b>



**Table 7: Beach Data – St. Kitts**

<b>Beach Name</b>	<b>Average beach width, 1991 – 1999 (m)</b>	<b>Beach Length (m)</b>	<b>Area (ha)</b>	<b>Erosion Hazard Ranking</b>
<b>Black sand beaches on mainland</b>				
Sandy Bay	19.24	429	0.8	Very high
Belle Tete	50.42	5,395	27.2	Very low
<b>TOTAL</b>			<b>28.0</b>	
<b>Economically important black sand beaches on mainland of St. Kitts</b>				
<b>Beach near dwellings</b>				
Dieppe Bay	31.38	645	2.0	High
Pump Bay	23.14	2,689	5.7	Low
Basseterre	24.9	3,057	0.7	Low
New Guinea	8.13	485	0.3	Low
<b>TOTAL</b>			<b>8.7</b>	
<b>Economically important yellow sand beaches on south-eastern end of the island</b>				
<b>Beach near dwellings</b>				
Conaree	29.98	1,954	5.8	Low
Half Moon Bay	53.67	626	3.4	Very high
North Frigate Bay	28.75	2,708	7.8	Very low
Sand Bank Bay	42.36	3,096	13.1	Very high
Mosquito Bay	18.59	1,667	3.0	Moderate
South Frigate Bay	24.81	2,710	6.7	Moderate
<b>TOTAL</b>			<b>39.8</b>	
<b>Without dwellings</b>				
North Friars Bay	54.67	2,133	11.6	High
Cockleshell Bay	17.04	2,118	3.6	Low
Banana Bay	19.56	1,383	2.7	Moderate
Majors Bay	12.26	1,597	1.9	Moderate
Whitehouse Bay	14.35	525	0.7	Very low
South Friars Bay	27.90	2,115	5.9	High
<b>TOTAL</b>			<b>26.4</b>	

### 3.3 ECONOMIC VALUATION RESULTS

Table 8 below shows the value of marine habitats in the coastal waters surrounding St. Kitts and Nevis. The results indicate that the marine ecosystems in St. Kitts and Nevis could be contributing about US \$388,196,434 to the economy each year.

**Table 8: Ecosystem Service Values by Cover Type for St. Kitts and Nevis marine habitats**

<b>Ecosystem Type</b>	<b>\$/ha/yr.</b>	<b>Total hectares</b>	<b>Total contribution (US \$)</b>
Beach	88,000	54.4	4,787,200
Beach near dwelling	117,000	48.5	5,674,500
Wetlands (including salt ponds and mangroves)	550,000	203.8	112,090,000
Nearshore aquatic habitat (seagrass beds)	16,283	3,098	50,444,734
Coral reef environ	100,000	2,152	215,200,000
<b>Total Ecosystem Service Value</b>			<b>388,196,434</b>

Coral reefs appear to be the major contributor to the economic value of the marine resources of St. Kitts, accounting for 55% of the overall value. The 203.8 hectares of wetlands (including salt ponds and mangroves) is the next most valuable resource (29%). The 3,098 hectares of seagrass beds is third with respect to their economic contribution and ecosystem services (13%). The small beaches that are scattered throughout the island also make a notable contribution of around US\$ 10,461,700 to the economy each year.

### 3.4 CONCLUSIONS

ReefFix’s “Ecosystem Value Transfer (EVT)/Benefit Transfer Method (BTM)” was used for this activity in which values which have already been estimated for similar ecosystems are extrapolated to the coastal/marine ecosystems of St. Kitts. Maps and tools from IKONOS and Quickbird satellite images as well as ArcGIS were used to estimate ecosystem areas.

In St. Kitts, marine ecosystems are heavily used areas and provide income for many stakeholders such as fishers and dive boat operators. However, the current degradation of coastal habitats is threatening not only their livelihoods but the local economy. Interventions are even more urgent now as the threat of climate change, land-based sources of pollution and inappropriate coastal development presents new challenges for management. For resource managers, it is hoped that this exercise will spur an interest in the application of valuation methodologies in the future management of the island’s coasts. The ReefFix methodology communicates the benefits of marine ecosystems to policy makers that relate more readily to economic figures than to conservation theory and data. Technocrats and decision-makers can use this cost-effective technique to analyse and create economic output that can be presented both numerically and graphically, building a bridge between scientific research and policy making. However users should always be aware of its limitations and proceed cautiously recognising the lack of precision that is often encountered in the field of environmental economics.

Whilst the ReefFix tool provides a cost-effective methodology to analyse and create economic output on marine resources that can be presented both numerically and graphically, users and

decision-makers should always be aware of the limitations and proceed cautiously recognising the lack of precision that is often encountered in the advancing field of environmental economics.

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## ANNEXES

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### ANNEX I: COMMON FISH SPECIES FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS

Family	Species	Common Name
Acanthuridae	<i>Acanthurus coeruleus</i>	Blue tang
Acanthuridae	<i>Acanthurus bahianus</i>	Ocean surgeonfish
Acanthuridae	<i>Acanthurus chirurgus</i>	Doctorfish
Albulidae	<i>Albula vulpes</i>	Bonefish
Apogonidae	<i>Apogon binotatus</i>	Barred cardinalfish
Apogonidae	<i>Apogon townsendi</i>	Belted cardinalfish
Apogonidae	<i>Phaeoptyx pigmentaria</i>	Dusky cardinalfish
Apogonidae	<i>Apogon maculatus</i>	Flamefish
Apogonidae	<i>Apogon pseudomaculatus</i>	Twospot cardinalfish
Apogonidae	<i>Apogon lachneri</i>	Whitestar cardinalfish
Aulostomidae	<i>Aulostomus maculatus</i>	Trumpetfish
Balistidae	<i>Canthidermis sufflamen</i>	Ocean triggerfish
Balistidae	<i>Aluterus schoepfi</i>	Orange filefish
Balistidae	<i>Cantherhines pullus</i>	Orange spotted filefish
Balistidae	<i>Balistes vetula</i>	Queen triggerfish
Balistidae	<i>Balistes capriscus</i>	Gray triggerfish
Balistidae	<i>Melichthys niger</i>	Black durgon
Balistidae	<i>Cantherhines macrocerus</i>	White spotted filefish
Balistidae	<i>Monacanthus tuckeri</i>	Slender filefish
Belonidae	<i>Platybelone argalus</i>	Garfish
Belonidae	<i>Tylosurus crocodiles</i>	Houndfish
Blennidae	<i>Lucayablennius zingaro</i>	Arrow blenny
Blennidae	<i>Malacoctenus boehlkei</i>	Diamond blenny
Blennidae	<i>Scartella cristata</i>	Molly miller
Blennidae	<i>Ophioblennius atlanticus</i>	Redlip blenny
Bothidae	<i>Bothus lunatus</i>	Peacock flounder
Bothidae	<i>Bothus ocellatus</i>	Eyed flounder
Carangidae	<i>Caranx crysos</i>	Blue runner
Carangidae	<i>Caranx bartholomaei</i>	Yellow jack
Carangidae	<i>Selar crumenophthalmus</i>	Bigeye scad
Carangidae	<i>Seriola dumerili</i>	Greater amberjack
Carangidae	<i>Trachinotus goodie</i>	Palmoeta
Carangidae	<i>Caranx hippos</i>	Crevalle jack
Carangidae	<i>Caranx lugubris</i>	Black jack
Carangidae	<i>Decapterus punctatus</i>	Round scad
Carangidae	<i>Decapterus macarellus</i>	Mackerel scad
Carangidae	<i>Uraspis secunda</i>	Cottonmouth jack
Carangidae	<i>Trachinotus falcatus</i>	Permit
Carangidae	<i>Caranx rubber</i>	Bar jack

Carangidae	<i>Caranx latus</i>	Horse eye jack
Carangidae	<i>Elagatis bipinnulata</i>	Rainbow runner
Centropomidae	<i>Centropomus undecimalis</i>	Common snook
Chaetodontidae	<i>Chaetodon ocellatus</i>	Spotfin butterflyfish
Chaetodontidae	<i>Chaetodon aculeatus</i>	Longsnout butterflyfish
Chaetodontidae	<i>Chaetodon striatus</i>	Banded butterflyfish
Chaetodontidae	<i>Chaetodon capistratus</i>	Foureye butterflyfish
Chaetodontidae	<i>Coryphopterus lipernes</i>	Peppermint goby
Chaetodontidae	<i>Chaetodon sedentarius</i>	Reef butterflyfish
Cirrhitidae	<i>Amblycirrhitus pinos</i>	Redspotted hawkfish
Clupeidae	<i>Sardinella sp.</i>	Silversides, herrings, anchovies
Congridae	<i>Heteroconger halis</i>	Brown garden eel
Coryphaenidae	<i>Coryphaena hippurus</i>	Dolphinfish
Dactylopteridae	<i>Dactylopterus volitans</i>	Flying gurnard
Echeneida	<i>Echeneis naucrates</i>	Sharksucker
Ephippidae	<i>Chaetodipterus faber</i>	Atlantic spadefish
Exocoetidae	<i>Hirundichtys affinis</i>	Fourwing flyingfish
Gerreidae	<i>Eucinostomus lefroyi</i>	Mottled mojarra
Gerreida	<i>Gerres cinereus</i>	Yellowfin mojarra
Gobiidae	<i>Ioglossus calliuris</i>	Blue goby
Gobiidae	<i>Coryphopterus glaucofraenum</i>	Bridled goby
Gobiidae	<i>Coryphopterus personatus/hyalinus</i>	Masked/Glass goby
Gobiidae	<i>Gobiosoma oceanops</i>	Neon goby
Gobiidae	<i>Coryphopterus eidolon</i>	Pallid goby
Gobiidae	<i>Xanthichthys ringens</i>	Sargassum triggerfish
Gobiidae	<i>Gobiosoma evelynae</i>	Sharknose goby
Gobiidae	<i>Gobiosoma chancei</i>	Shortstripe goby
Gobiidae	<i>Gnatholepis thompsoni</i>	Goldspot goby
Gobiidae	<i>Coryphopterus dicrus</i>	Colon goby
Gobiidae	<i>Gobiosoma genie</i>	Cleaning goby
Gobiidae	<i>Gobiosoma randalli</i>	Yellownose goby
Gobiidae	<i>Gobiosoma sp.</i>	Goby
Grammatidae	<i>Gramma melacara</i>	Blackcap basslet
Grammatidae	<i>Gramma loreto</i>	Fairy basslet
Grammatidae	<i>Gramma melacara</i>	Blackcap basslet
Grammistinae	<i>Rypticus saponaceus</i>	Greater soapfish
Haemulidae	<i>Haemulon album</i>	White margate
Haemulidae	<i>Anisotremus surnamensis</i>	Black margate
Haemulidae	<i>Haemulon parra</i>	Sailor's choice
Haemulidae	<i>Haemulon carbonarium</i>	Caesar grunt
Haemulidae	<i>Haemulon melanurum</i>	Cottonwick
Haemulidae	<i>Haemulon flavolineatum</i>	French Grunt
Haemulidae	<i>Anisotremus virginicus</i>	Porkfish
Haemulidae	<i>Haemulon chrysargyreum</i>	Smallmouth grunt
Haemulidae	<i>Haemulon aurolineatum</i>	Tomtate



Haemulidae	<i>Haemulon sciurus</i>	Blue striped grunt
Haemulidae	<i>Haemulon striatum</i>	Striped grunt
Haemulidae	<i>Haemulon macrostomum</i>	Spanish grunt
Hemiramphidae	<i>Hemiramphus brasiliensis</i>	Ballyhoo
Holocentridae	<i>Plectrypops retrospinis</i>	Cardinal soldierfish
Holocentridae	<i>Myripristis jacobus</i>	Blackbar soldierfish
Holocentridae	<i>Holocentrus rufus</i>	Longspine squirrelfish
Holocentridae	<i>Holocentrus adscensionis</i>	Squirrelfish
<i>Holocentridae</i>	<i>Holocentrus vexillarius</i>	Dusky squirrelfish
Holocentridae	<i>Holocentrus coruscum</i>	Reef squirrelfish
Holocentridae	<i>Holocentrus marianus</i>	Longjaw squirrelfish
Intermiidae	<i>Inermia vittata</i>	Boga
Istiophoridae	<i>Makaira nigricans</i>	Blue marlin
Kyphosidae	<i>Caranx lugubris</i>	Blackjack
Kyphosidae	<i>Kyphosus sectatrix</i>	Bermuda Chub
Labrisomidae	<i>Malacoctenus macropus</i>	Rosy blenny
Labrisomidae	<i>Malacoctenus triangulates</i>	Saddle blenny
Labridae	<i>Halichoeres garnoti</i>	Yellowhead wrasse
Labridae	<i>Clepticus parrae</i>	Creole wrasse
Labridae	<i>Thalassoma biruasciatum</i>	Bluehead wrasse
Labridae	<i>Halichoeres pictus</i>	Rainbow wrasse
Labridae	<i>Halichoeres maculipinna</i>	Clown wrasse
Labridae	<i>Halichoeres poeyi</i>	Blackear wrasse
Labridae	<i>Halichoeres bivittatus</i>	Slippery dick
Labridae	<i>Bodianus rufus</i>	Spanish hogfish
Labridae	<i>Halichoeres radiatus</i>	Pudding wife
Lutjanidae	<i>Lutjanus buccanella</i>	Blackfin snapper
Lutjanidae	<i>Lutjanus campechanus</i>	Red snapper
Lutjanidae	<i>Etelis oculatus</i>	Queen snapper
Lutjanidae	<i>Lutjanus vivanus</i>	Silk snapper
Lutjanidae	<i>Ocyurus chrysurus</i>	Yellowtail snapper
Lutjanidae	<i>Lutjanus mahogoni</i>	Mahogany snapper
Lutjanidae	<i>Lutjanus apodus</i>	School master
Lutjanidae	<i>Lutjanus jocu</i>	Dog snapper
Lutjanidae	<i>Lutjanus griseus</i>	Gray snapper
Lutjanidae	<i>Lutjanus synagris</i>	Lane snapper
Lutjanidae	<i>Lutjanus analis</i>	Mutton snapper
Malacanthidae	<i>Malacanthus plumieri</i>	Sand tilefish
Mugilidae	<i>Mugil cephalus</i>	Striped mullet
Mugilidae	<i>Mugil curema</i>	White mullet
Mullidae	<i>Mulloidichthys martinicus</i>	Yellow goatfish
Mullidae	<i>Pseudupeneus maculatus</i>	Spotted goatfish
Muraenidae	<i>Gymnothorax miliaris</i>	Goldentail moray
Muraenidae	<i>Echidna catenata</i>	Chain moray
Muraenidae	<i>Enchelycore nigricans</i>	Viper moray
Muraenidae	<i>Gymnothorax moringa</i>	Spotted moray

Muraenidae	<i>Myrichthys breviceps</i>	Sharptail moray
Muraenidae	<i>Gymnothorax miliaris</i>	Goldtail moray
Muraenidae	<i>Channomuraena vittata</i>	Broadbanded moray
Octopodidae	<i>Octopus briareus</i>	Caribbean reef octopus
Ophichthidae	<i>Myrichthys ocellatus</i>	Goldspotted eel
Ostraciidae	<i>Lactophrys trigonus</i>	Trunkfish
Ostraciidae	<i>Lactophrys bicaudalis</i>	Spotted trunkfish
Ostraciidae	<i>Lactophrys triqueter</i>	Smooth trunkfish
Ostraciidae	<i>Lactophrys polygona</i>	Honeycomb cowfish
Ostraciidae	<i>Lactophrys quadricornis</i>	Scrawled cowfish
Pempheridae	<i>Pempheris schomburgki</i>	Glassy sweeper
Pomacanthidae	<i>Holacanthus tricolor</i>	Rock beauty
Pomacanthidae	<i>Pomacanthus paru</i>	French angel
Pomacanthidae	<i>Centropyge aurantonotus</i>	Flameback angelfish
Pomacanthidae	<i>Holacanthus ciliaris</i>	Queen angelfish
Pomacentridae	<i>Chromis cyanea</i>	Blue chromis
Pomacentridae	<i>Chromis multilineata</i>	Brown chromis
Pomacentridae	<i>Stegastes paritus</i>	Bicolor damselfish
Pomacentridae	<i>Microspathodon chrysurus</i>	Yellowtail damselfish
Pomacentridae	<i>Abudefduf saxatilis</i>	Sergeant major
Pomacentridae	<i>Stegastes dienaecus</i>	Longfin damselfish
Pomacentridae	<i>Stegastes fuscus</i>	Dusky damselfish
Pomacentridae	<i>Centropyge argi</i>	Cherubfish
Pomacentridae	<i>Stegastes variabilis</i>	Cocoa damselfish
Pomacentridae	<i>Stegastes leucosticus</i>	Beaugregory
Pomacentridae	<i>Stegastes planifrons</i>	Three spotted damselfish
Pomacentridae	<i>Chromis insolata</i>	Sunshine fish
Priacanthidae	<i>Priacanthus arenatus</i>	Big eye
Priacanthidae	<i>Priacanthus cruentatus</i>	Glasseye snapper
Scaridae	<i>Scarus coeruleus</i>	Blue parrotfish
Scaridae	<i>Cryptotomus roseus</i>	Bluelip parrotfish
Scaridae	<i>Sparisoma radians</i>	Bucktooth parrotfish
Scaridae	<i>Scarus coelestinus</i>	Midnight parrotfish
Scaridae	<i>Scarus taeniopterus</i>	Princess parrotfish
Scaridae	<i>Sparisoma viride</i>	Stoplight parrotfish
Scaridae	<i>Scarus iserti</i>	Striped parrotfish
Scaridae	<i>Sparisoma aurofrenatum</i>	Redband parrotfish
Scaridae	<i>Sparisoma rubripinne</i>	Redfin parrotfish
Scaridae	<i>Sparisoma atomarium</i>	Greenblotch parrotfish
Scaridae	<i>Scarus vetula</i>	Queen parrotfish
Scaridae	<i>Sparisoma chrysopterus</i>	Redtail parrotfish
Scaridae	<i>Scarus guacamaia</i>	Rainbow parrotfish
Sciaenidae	<i>Equetus punctatus</i>	Spotted drum
Sciaenidae	<i>Equetus acuminatus</i>	Highhat
Sciaenidae	<i>Equetus lanceolatus</i>	Jackknife fish
Scombridae	<i>Menticirrhus littoralis</i>	Gulf kingfish

Scombridae	<i>Tunnus albacares</i>	Yellowfin tuna
Scombridae	<i>Euthynnus alletteratus</i>	Little tunny
Scombridae	<i>Thunnus atlanticus</i>	Blackfin tuna
Scombridae	<i>Thunnus obesus</i>	Bigeye tuna
Scombridae	<i>Katsuwonus pelamis</i>	Skipjack tuna
Scombridae	<i>Acanthocybium solandri</i>	Wahoo
Scombridae	<i>Thunnus alalunga</i>	Albacore tuna
Scombridae	<i>Sarda sarda</i>	Atlantic bonito
Scombridae	<i>Scomberomorus regalis</i>	Cero
Scombridae	<i>Scomberomorus cavalla</i>	King mackerel
Scombridae	<i>Scomberomorus macula</i>	Spanish mackerel
Scorpaenidae	<i>Scorpaenodes caribbaeus</i>	Reef scorpionfish
Scorpaenidae	<i>Scorpaena plumieri</i>	Spotted scorpionfish
Serranidae	<i>Epinephelus striatus</i>	Nassau grouper
Serranidae	<i>Epinephelus itajara</i>	Jewfish
Serranidae	<i>Mycteroperca tigris</i>	Tiger grouper
Serranidae	<i>Mycteroperca bonaci</i>	Black grouper
Serranidae	<i>Mycteroperca venenosa</i>	Yellowfin grouper
Serranidae	<i>Mycteroperca interstitialis</i>	Yellowmouth grouper
Serranidae	<i>Alphestes multiguttatus</i>	Mutton hamlet
Serranidae	<i>Hypoplectrus puella</i>	Barred hamlet
Serranidae	<i>Serranus tigrinus</i>	Harlequin bass
Serranidae	<i>Serranus tabacarius</i>	Tobacco fish
Serranidae	<i>Epinephelus adscensionis</i>	Rock hind
Serranidae	<i>Epinephelus cruentatus</i>	Grasby
Serranidae	<i>Epinephelus guttatus</i>	Red hind
Serranidae	<i>Rypticus saponaceus</i>	Greater soapfish
Serranidae	<i>Epinephelus fulvus</i>	Coney
Serranidae	<i>Hypoplectrus chlorurus</i>	Yellowtail hamlet
Serranidae	<i>Liopropoma rubre</i>	Peppermint bass
Serranidae	<i>Hypoplectrus guttavarius</i>	Shy hamlet
Serranidae	<i>Hypoplectrus aberrans</i>	Yellowbelly hamlet
Serranidae	<i>Serranus tortugarum</i>	Chalk bass
Serranidae	<i>Serranus baldwini</i>	Lantern bass
Serranidae	<i>Hypoplectrus nigricans</i>	Black hamlet
Serranidae	<i>Hypoplectrus indigo</i>	Indigo hamlet
Serranidae	<i>Hypoplectrus sp.</i>	Tan hamlet
Serranidae	<i>Diplectrum formosum</i>	Sand perch
Sparidae	<i>Calamus bajonado</i>	Jolthead porgy
Sparidae	<i>Calamus pennatula</i>	Pluma
Sparidae	<i>Calamus calamus</i>	Saucereye porgy
Sparidae	<i>Calamus penna</i>	Sheepshead porgy
Sphyraenidae	<i>Sphyraena barracuda</i>	Great barracuda
Sphyraenidae	<i>Sphyraena picudilla</i>	Southern sennet
Synodontidae	<i>Synodus intermedius</i>	Sand diver
Tetraodontidae	<i>Chilomycterus antillarum</i>	Web burrfish

Tetraodontidae	<i>Canthigaster rostrata</i>	Sharpnose puffer
Tetraodontidae	<i>Diodon hystrix</i>	Porcupine fish
Tetraodontidae	<i>Diodon holocanthus</i>	Balloonfish
Tetraodontidae	<i>Sphoeroides spengleri</i>	Bandtail puffer

## ANNEX II: SPECIES OF ALGAE FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS

Phylum	Species	Common Name
Chlorophyta	<i>Halimeda discoidea</i>	Large leaf watercress algae
Chlorophyta	<i>Halimeda lacrimosa</i>	Bulbous lettuce leaf alga
Chlorophyta	<i>Caulerpa racemosa</i>	Green grape alga
Chlorophyta	<i>Udotea cyathiformis</i>	Mermaid's teacup
Chlorophyta	<i>Ventricaria ventricosa</i>	Sea pearl
Cyanophyta	Not identified	Fuzz ball algae
Phaeophyta	<i>Dictyota sp.</i>	Y Branched algae
Phaeophyta	<i>Hydroclathrus clathratus</i>	Swiss cheese algae
Phaeophyta	<i>Lobophora variegata</i>	Encrusting fan-leaf alga
Rhodophyta	Not identified	Crustose coralline algae
Rhodophyta	<i>Galaxaura sp.</i>	Tubular thicket algae

## ANNEX III: SPECIES OF CNIDARIA (EXCLUDING CORALS) FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS

Family	Species	Common Name
Actinaria	* <i>lucida</i>	Knobby anemone
Actinaria	<i>Lebrunia coralligens</i>	Hidden anemone
Actinaria	<i>Lebrunia danae</i>	Branching anemone
Ceriantharia	<i>Arachnanthus nocturnus</i>	Banded tube-dwelling anemone
Hydroida	<i>Macrorhynchia robusta</i>	Stinging bush hydroid
Hydroida	<i>Gymnangium sp.</i>	Feather hydroid
Hydroida	<i>Halopteris carinata</i>	Thread hydroid
Zoanthidea	<i>Zoanthus pulchellus</i>	Mat zoanthid
Zoanthidea	<i>Palythoa caribaeorum</i>	White encrusting zoanthid
Zoanthidea	<i>Palythoa grandis</i>	Sun zoanthid

\*Genera for this species was recently reclassified and is not available

**ANNEX IV: SPECIES OF CORALS FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS**

<b>Family</b>	<b>Species</b>	<b>Common Name</b>
Acroporidae	<i>Acropora palmata</i>	Elkhorn coral
Agariciidae	<i>Agaricia humilis</i>	Low relief lettuce coral
Agariciidae	<i>Agaricia agaricites</i>	Lettuce coral
Agariciidae	<i>Agaricia lamarcki</i>	Sheet coral
Anthothelidae	<i>Iciligorgia schrammi</i>	Deep water sea fan
Anthothelidae	<i>Erythropodium caribaeorum</i>	Encrusting gorgonian
Antipathidae	<i>Antipathes lenta.</i>	Hairnet black coral
Antipathidae	<i>Antipathes sp.</i>	Black coral
Astrocoeniinae	<i>Stephanocoenia michilini</i>	Blushing star coral
Briareidae	<i>Briareum asbestinum</i>	Corky sea finger
Caryophyllidae	<i>Catalaphyllia jardinei</i>	Elegant coral
Caryophyllidae	<i>Eusmilia fastigiata</i>	Smooth flower coral
Ellisellidae	<i>Ellisella barbadensis</i>	Devil's sea whip
Faviidae	<i>Favia fragum</i>	Golf ball coral
Faviidae	<i>Montastrea annularis</i>	Boulder star coral
Faviidae	<i>Cladocora arbuscula</i>	Tube coral
Faviidae	<i>Montastrea cavernosa</i>	Great star coral
Faviidae	<i>Diplora strigosa</i>	Symmetrical brain coral
Faviidae	<i>Diplora clivosa</i>	Knobby brain coral
Faviidae	<i>Diplora labyrinthiformis</i>	Grooved brain coral
Faviidae	<i>Manicina areolata</i>	Rose coral
Faviidae	<i>Colpophyllia natans</i>	Boulder brain coral
Faviidae	<i>Meandrina brasiliensis</i>	Rose coral
Gorgoniidae	<i>Pterogorgia citrina.</i>	Yellow sea whip
Gorgoniidae	<i>Pseudopterogorgia sp.</i>	Sea plume
Gorgoniidae	<i>Gorgonia mariae</i>	Wide-mesh sea fan
Gorgoniidae	<i>Gorgonia ventalina</i>	Sea fan
Meandrinidae	<i>Dendrogyra cylindrus</i>	Pillar coral
Meandrinidae	<i>Meandrina meandrites</i>	Maze coral
Meandrinidae	<i>Dichocoenia stokesii</i>	Elliptical star coral
Milliporidae	<i>Millepora alcicornis</i>	Branching fire coral
Milliporidae	<i>Millepora squarrosa</i>	Box fire coral
Mussidae	<i>Mussa angulosa</i>	Spiny flower coral
Mussidae	<i>Isophyllastrea rigida</i>	Rough star coral
Mussidae	<i>Mycetophyllia danaana</i>	Low ridge cactus coral
Mussidae	<i>Scolymia sp.</i>	Disk coral
Oculinidae	<i>Oculina diffusa</i>	Diffuse Ivory bush coral
Plexauridae	<i>Eunicea sp.</i>	Sea rod
Plexauridae	<i>Plexaura flexuosa</i>	Bent sea rod
Plexauridae	<i>Pseudoplexaura sp.</i>	Porous sea rod
Plexauridae	<i>Plexaurella sp.</i>	Slit pore sea rod
Pocilloporidae	<i>Madracis mirabilis</i>	Yellow pencil coral

Pocilloporidae	<i>Madracis decactis</i>	Ten ray star coral
Poritidae	<i>Porites colonensis</i>	Honey comb plate coral
Poritidae	<i>Porites asteroidis</i>	Mustard hill coral
Poritidae	<i>Porites porites</i>	Finger coral
Poritidae	<i>Porites divaricata</i>	Finger coral
Seriatoporidae	<i>Madracis pharensis</i>	Encrusting star coral
Siderastreidae	<i>Siderastrea radians</i>	Lesser starlet coral
Siderastreidae	<i>Siderastrea sidereal</i>	Massive starlet coral

#### ANNEX V: SPECIES OF MOLLUSKS FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS

Family	Species	Common Name
Amphineura (class)	<i>Acanthopleura granulate</i>	Fuzzy chiton
Limidae	<i>Lima scabra</i>	Rough file clam
Loliginidae	<i>Sepioteuthis sepioidea</i>	Caribbean reef squid
Octopodidae	<i>Octopus briareus</i>	Caribbean reef octopus
Strombidae	<i>Strombus gigas</i>	Queen conch
Strombidae	<i>Strombus ranius</i>	Hawkwing conch
Cypraeidae	<i>Cypraea cinerea</i>	Atlantic gray cowrie
Ovulidae	<i>Cyphoma gibbosum</i>	Flamingo tongue

#### ANNEX VI: SPECIES OF PORIFERA FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS

Family	Species	Common Name
Demospongia	<i>Pseudoceratina crassa</i>	Branching tube sponge
Demospongia	<i>Aplysina fistularis</i>	Yellow tube sponge
Demospongia	<i>Ages conifera</i>	Brown tube sponge
Demospongia	<i>Callyspongia vaginalis</i>	Branching vase sponge
Demospongia	<i>Callyspongia plicifera</i>	Azure vase sponge
Demospongia	<i>Xestospongia muta</i>	Giant barrel sponge
Demospongia	<i>Spheciospongia vesparium</i>	Loggerhead sponge
Demospongia	<i>Iotrochota birotulata</i>	Green finger sponge
Demospongia	<i>Halisarca sp.</i>	Blue encrusting sponge
Demospongia	<i>Amphimedon compressa</i>	Erect rope sponge
Demospongia	<i>Siphonodictyon coralliphagum</i>	Boring sponge
Demospongia	<i>Ectoplasie ferox</i>	Brown encrusting octopus sponge
Demospongia	<i>Siphonodictyon coralliphagum</i>	Variable boring sponge
Demospongia	<i>Niphates digitalis</i>	Pink vase sponge

**ANNEX VII: SPECIES OF ECHINODERMS FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS**

<b>Family</b>	<b>Species</b>	<b>Common Name</b>
Asteriidae	<i>Asterias rubens</i>	Common starfish
Crinoidea	<i>Davidaster rubiginosa</i>	Golden crinoid
Crinoidea	<i>Analcidometra armata</i>	Swimming crinoid
Echinoidea	<i>Diadema antillarum</i>	Long-spined sea urchin
Echinoidea	<i>Tripneustes ventricosus</i>	West Indian sea egg
Echinoidea	<i>Meoma ventricosa</i>	Red heart urchin
Echinoidea	<i>Echinometra viridis</i>	Reef urchin
Echinoidea	<i>Euclidaris tribuloides</i>	Slate-pencil sea urchin
Holothuroidea	<i>Holothuria mexicans</i>	Donkey dung sea cucumber
Ophiuroidea	<i>Schizostella bifurcate</i>	Sea rod basket star
Ophiuroidea	<i>Astrophyton muricatum</i>	Giant basket star
Ophiuroidea	<i>Ophiothrix suensonii</i>	Sponge brittle star
Ophiuroidea	<i>Ophionereis reticulate</i>	Reticulated brittle star

**ANNEX VIII: SPECIES OF ANNELIDS FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS**

<b>Family</b>	<b>Species</b>	<b>Common Name</b>
Amphinomidae	<i>Hermodice carunculata</i>	Bearded fireworm
Sabellidae	<i>Bispira brunnea</i>	Social feather duster
Sabellidae	<i>Bispira variegata</i>	Variegated feather duster
Sabellidae	<i>Anomobaea orstedii</i>	Split-crown feather duster
Sabellidae	<i>Sabellastarte magnifica</i>	Magnificent feather duster
Serpulidae	<i>Spirobranchis giganteus</i>	Christmas tree worm
Serpulidae	<i>Vermiliopsis sp.</i>	Blushing star coral fanworm
Terebellidae	<i>Eupolymnia crassicornis</i>	Spaghetti worm

**ANNEX IX: SPECIES OF SEA TURTLES FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS**

<b>Family</b>	<b>Species</b>	<b>Common Name</b>
Chelonidae	<i>Chelonia mydas</i>	Green turtle
Chelonidae	<i>Eretmochelys imbricata</i>	Hawksbill turtle
Dermochelyidae	<i>Dermochelys coriacea</i>	Leatherback turtle

**ANNEX X: SPECIES OF SHARKS FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS**

<b>Family</b>	<b>Species</b>	<b>Common Name</b>
Carcharhinidae	<i>Carchathinus perez</i>	Caribbean reef shark
Carcharhinidae	<i>Carcharinus limbatus</i>	Blacktip reef shark
Carcharhinidae	<i>Galeocerdo cuvieri</i>	Tiger shark
Ginglymostomatidae	<i>Ginglynostoma cirratum</i>	Nurse shark
Sphyrnidae	<i>Sphyrna mokarran</i>	Great Hammerhead shark

**ANNEX XI: SPECIES OF RAYS FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS**

<b>Family</b>	<b>Species</b>	<b>Common Name</b>
Dasyatidae	<i>Dasyatis guttata</i>	Longnose stingray
Dasyatidae	<i>Dasyatis Americana</i>	Southern stingray
Dasyatidae	<i>Pteroplatytrygon violacea</i>	Blue stingray
Myliobatidae	<i>Aetobatus narinari</i>	Spotted Eagle Ray
Mobulidae	<i>Manta birostris</i>	Giant manta ray
Mobulidae	<i>Mobula hypostoma</i>	Devil ray

**ANNEX XII: SPECIES OF MARINE MAMMALS FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS**

<b>Family</b>	<b>Species</b>	<b>Common Name</b>
Balaenopteridae	<i>Balaenoptera acutorostrata</i>	Minke whale
Balaenopteridae	<i>Balaenoptera edeni</i>	Bryde's whale
Balaenopteridae	<i>Balaenoptera borealis</i>	Sei whale
Balaenopteridae	<i>Balaenoptera musculus</i>	Blue whale
Balaenopteridae	<i>Balaenoptera physalus</i>	Fin whale
Balaenopteridae	<i>Megaptera novaeangliae</i>	Humpback whale
Odontoceti	<i>Physeter catodon</i>	Sperm whale
Delphinidae	<i>Delphinus delphis</i>	Shortbeaked common dolphin
Delphinidae	<i>Feresa attenuata</i>	Pygmy killer whale
Delphinidae	<i>Globicephala macrorhynchus</i>	Shortfinned pilot whale
Delphinidae	<i>Orcinus orca</i>	Killer whale
Delphinidae	<i>Stenella coeruleoalba</i>	Striped dolphin
Delphinidae	<i>Stenella longirostris</i>	Spinner dolphin
Delphinidae	<i>Tursiops truncatus</i>	Bottlenose dolphin



**Annex XIII: Species of lobsters found in coastal waters of St. Kitts and Nevis**

<b>Family</b>	<b>Species</b>	<b>Common Name</b>
Nephrodidae	<i>Acanthacaris caeca</i>	Atlantic deep sea lobster
Palinuridae	<i>Panulirus augus</i>	Caribbean spiny lobster
Palinuridae	<i>Panulirus guttatus</i>	Spotted spiny lobster
Palinuridae	<i>Justitia longimanus</i>	Red band lobster
Scyllaridae	<i>Scyllarides sp.</i>	Slipper lobster

**ANNEX XIV: SPECIES OF SHRIMPS FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS**

<b>Family</b>	<b>Species</b>	<b>Common Name</b>
Aristeidae	<i>Aristaeopsis edwardsiana</i>	Scarlet shrimp
Hippolytidae	<i>Lysmata wurdemanni</i>	Caribbean cleaner shrimp
Penaeidae	<i>Farfantepenaeus brasiliensis</i>	Red spotted shrimp
Penaeidae	<i>Farfantepenaeus subtilis</i>	Southern brown shrimp
Penaeidae	<i>Litopenaeus schmitti</i>	Southern white shrimp
Rhynchocinetidae	<i>Rhynchocinetes rigens</i>	Red night shrimp
Stenopodidea	<i>Stenopus hispidus</i>	Banded coral shrimp

**ANNEX XV: SPECIES OF CRABS FOUND IN COASTAL WATERS OF ST. KITTS AND NEVIS**

<b>Family</b>	<b>Species</b>	<b>Common Name</b>
Diogenidae	<i>Paguristes punticeps</i>	White speckled hermit
Diogenidae	<i>Paguristes cadentia</i>	Red reef hermit
Graspidae	<i>Graspidae sp.</i>	Rock runners/spray crabs
Majidae	<i>Stenorhynchus seticornis</i>	Yellowline arrow crab
Majidae	<i>Mithrax pilosus</i>	Hairy clinging crab
Ocypodidae	<i>Ucides cordatus</i>	Ghost crab
Portunidae	<i>Potunus sebae</i>	Ocellate swimming crab

**ANNEX XVI: BENEFITS TRANSFER MATRIX – ECOSYSTEM SERVICES VALUES BY COVER TYPE FOR MARINE PARKS AND ENVIRONS IN THE CARIBBEAN**

Land Cover	Ave.\$/ha/yr	Lower Bound	Upper Bound	Area (ha)	Total ESV Flow
<b>Disturbed and Urban Beach</b>	88,000			4.83	425,040
<b>Beach</b>	88,000	77,000	99,000	1.615	142,120
<b>Beach near dwelling</b>	117,000	140,000	94,000	Included in disturbed	
<b>Coastal &amp; Riparian Forest</b>	9,271	5,542	13,000	125.13	1,160,080.23
<b>Freshwater Stream</b>	1,595	1,231	939	Hard to get area represented as a line	
<b>Freshwater Herbaceous Swamp</b>	64,000	32,000	96,000	None apparent	
<b>Grassland/pasture</b>	118	118	118	10.0	1,180
<b>Near shore aquatic habitat</b>	16,283	4,630	27,935	None apparent	
<b>Coral Reef environ</b>	100,000			140.08	14,008,000
<b>Mangrove</b>	37,500			None apparent	
<b>Mangrove</b>	550,000	200,000	900,000		
<b>Mangrove restoration</b>		225	216,000		
<b>Total</b>					<b>15,594,300.23</b>

Other background data and studies: Caribbean tourism reefs are estimated to be worth US\$1 million per square kilometer, based on the cost of maintaining sandy beaches and the value of attracting snorkelers and scuba divers.

The annual economic values of mangroves, estimated by the cost of the products and services they provide, have been estimated to be between USD 200,000 -- 900,000 per ha. The range of reported costs for mangrove restoration is USD 225 -- 216,000 per ha.

Caribbean tourism reefs are estimated to be worth US\$1 million per square kilometer, based on the cost of maintaining sandy beaches and the value of attracting snorkelers and scuba divers.

This paper presents a meta-analysis of the economic valuation literature on ecosystem services provided by wetlands in agricultural landscapes. We focus on the value of three regulating services, namely flood control, water supply and nutrient recycling. We construct a database containing 66 value estimates, mainly for wetlands in the US and Europe but also a substantial number in developing countries. Values are standardised to USD per hectare per year. The mean (median) values are found to be 6923 (427) USD/ha/yr for flood control; 3389 (57) USD/ha/yr for water supply; and 5788 (243) USD/ha/yr for nutrient recycling.

The values of these services are highly variable across individual wetland sites due to, amongst other factors, differences in wetland type, size, the scarcity or abundance of other wetlands in the surrounding landscape, and the socio-economic characteristics of the beneficiaries of these services. We include explanatory variables in the meta-analysis to account for these influences on estimated wetland values. GIS is used to quantify potentially important spatial variables. The meta-regression is used to produce a value function for wetland regulating services, which can be used to transfer values to other wetland sites while controlling for site and context specific characteristics. An illustrative value transfer exercise is conducted to estimate global values for wetland regulating services in agricultural landscapes.

### **What is the medical value of marine biodiversity?**

Undiscovered cancer treatments from marine organisms could be worth between US\$563 billion (€428.5 billion) and US \$5.69 trillion (€4.33 trillion), according to a recent study. The researchers estimate that there may be as many as 594,232 novel compounds waiting to be discovered in unstudied marine species, and that these could lead to between 55 and 214 new anti-cancer drugs. The study only accounted for anti-cancer drug revenues. In reality, these chemicals from the sea can have numerous other biomedical applications including antibacterial, antifungal, antiviral and anti-inflammatory uses.

The annual economic values of mangroves, estimated by the cost of the products and services they provide, have been estimated to be between USD 200,000 -- 900,000 per ha. The range of reported costs for mangrove restoration is USD 225 -- 216,000 per ha.

The Value of Coastal Wetlands for Hurricane Protection. Robert Costanza, Octavio Pérez-Maqueo, M. Luisa Martinez, Paul Sutton, Sharolyn J. Anderson, and Kenneth Mulder.

Coastal wetlands reduce the damaging effects of hurricanes on coastal communities. A regression model using 34 major US hurricanes since 1980 with the natural log of damage per unit gross domestic product in the hurricane swath as the dependent variable and the natural logs of wind speed and wetland area in the swath as the independent variables was highly significant and explained 60% of the variation in relative damages. A loss of 1 ha of wetland in the model corresponded to an average USD 33 000 (median = USD 5000) increase in storm damage from specific storms. Using this relationship, and taking into account the annual probability of hits by hurricanes of varying intensities, we mapped the annual value of coastal wetlands by 1km × 1km pixel and by state. The annual value ranged from USD 250 to USD 51 000 ha<sup>-1</sup> yr<sup>-1</sup>, with a mean of USD 8240 ha<sup>-1</sup> yr<sup>-1</sup> (median = USD 3230 ha<sup>-1</sup> yr<sup>-1</sup>) significantly larger than previous estimates. Coastal wetlands in the US were estimated to currently provide USD 23.2 billion yr<sup>-1</sup> in storm protection services. Coastal wetlands function as valuable, self maintaining “horizontal levees” for storm protection, and also provide a host of other ecosystem services that vertical levees do not. Their restoration and preservation is an extremely cost-effective strategy for society.