Environmental Profile of

St. Martin's Island


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Coastal and Wetlands Biodiversity Management Project
A Partnership between Department of Environment
Ministry of Environment and Forest
and UNDP-Bangladesh

2010

UNDP Bangladesh

GEF

RESPONSIBLE VISITS TO ST. MARTIN'S ISLAND

In the interests of conservation within the Ecologically Critical Area please follow these simple rules.

DO'S

- Do observe and photograph birds and other wildlife
- Do walk along the shoreline and admire the views and sealife
- Do make use of locally run restaurants
- Follow the rules of ECA which are available now in brochures, signs and posters in the island and can be obtained from DoE.

DON'TS

- No fishing in the designated sanctuary areas
- No hunting or disturbance of birds and wildlife
- No collection of wild plants
- No grazing except in designated areas
- No discharge of chemicals or pollution
- No loud noises or fires
- No littering – please take any waste packaging or materials that you bring back to the mainland when you leave
- No collection or purchase of corals (alive or dead), shells or sea urchins

The views expressed herein are those of the authors and do not necessarily reflect the views of the UNDP

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Sunset at St. Martin's Island
M A Mohit

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Front and back cover: *Quazi Hamidul Haque, M A Mohit, Abu Sayeed Mohammad Sharif, Majeda Haq*, and CWBMP

FOREWORD

The unique island of St. Martin, the only place in Bangladesh where coral colonies are found, is a natural treasure of Bangladesh that attracts thousands of tourists. The Island also has an important ecological value as one of the few remaining nesting places in the region for several species of globally threatened marine turtles, as well as being a flyway and wintering site for migratory birds of the East Asian and Australasian region.

St. Martin's Island is not only significant for its biodiversity value, but also important for Bangladesh in defining its Exclusive Economic Zone and delineating its sea boundary in accordance with the United Nations Convention on the Law of the Sea.

Unfortunately, unregulated tourism has become detrimental for the health of this unique ecosystem. Unless tourists visiting St. Martin's Island quickly adopt ecologically responsible behavior, the unique flora and fauna of the Island that has experienced tragic changes over the last two decades will continue to be degraded.

While the Coastal and Wetland Biodiversity Management Project (CWBMP) under the partnership of Department of Environment and UNDP has achieved considerable results in terms of activating community based conservation and linking it with the local governance structure, conservation management plans and also raising local and national awareness, these achievements seem to be inadequate to address the huge crisis. In addition, enabling polices and legislation, local government leadership and private sector cooperation are a pre-requisite for the sustainability of this unique ecosystem.

Since time is quickly running out, it would be of utmost importance to develop a master plan for the island systems. This has to be based on a comprehensive knowledge base. Although, CWBMP generated several databases for the Island, the existing data and information need to be supplemented by primary studies and scientific investigations. These include information on area of extent of marine eco-systems, bio-physical uniqueness of the island and taxonomic characteristics of the flora and fauna of the eco-systems. In the absence of this much of the information in this document is based on secondary data.

Against this backdrop, this document provides key information including on biodiversity, problems and conservation challenges. It also portrays the necessity of enabling policies and programming actions. It is our sincere hope that this document will raise awareness about this unique island and its formidable challenges in order to generate the necessary policy debates and actions in support of sustainable solutions.

I take this opportunity to acknowledge the contributions of the following: Mamunul Hoque Khan, M. Aminul Islam, Mahbubur Rahman, Mohammad Shaker Hebara, Olga Denyshchyk, Rafiqul Islam, and Samia Saif, each of whom drafted different sections of the text. Information from studies and reports prepared for the Coastal and Wetland Biodiversity Management Project has been incorporated and updated where appropriate, and by highlighting gaps in knowledge we hope that this small book will encourage further scientific study on the Island.

We also thank all of the photographers credited for permission to include their images revealing the beauty and challenges of St. Martin's Island. The many other photographs not credited

in the text have been provided by the Coastal and Wetland Biodiversity Management Project to whose staff we are most grateful. We also thank Mohammad Inamul Shahriar for his willing development and revision of the design and layout of various stages of the book.

Last but not the least, we thank Dr Paul Thompson and Prof. Anwarul Islam for their tireless efforts in improving the drafts and technical editing.

Stefan Priesner
Country Director
UNDP Bangladesh

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ABBREVIATIONS AND ACRONYMS

BIWTA	Bangladesh Inland Water Transport Authority
°C	Temperature in degrees Celsius
cfu	Colony forming units (of faecal coliform bacteria)
cm	centimetre
CO_2	carbon dioxide
CWBMP	Coastal and Wetland Biodiversity Management Project
DO	Dissolved Oxygen
DoE	Department of Environment
E	East
ECA	Ecologically Critical Area
GEF	Global Environmental Facility
ha	hectare
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
km	kilometre
L	Litre
m	metre
mg	milligram
ml	millilitre
mm	millimetre
MoEF	Ministry of Environment and Forest
MSL	Mean Sea Level
N	North
NCS	National Conservation Strategy
NGO	Non Governmental Organisation
ppt	parts per thousand
sp.	species (singular)
spp.	species (plural)
sq	square
St.	Saint
SMBCP	"St. Martin's Biodiversity Conservation Project", correct full title: Conservation of Biodiversity, Marine Park Establishment and Ecotourism Development Project at St. Martin's Island
UNDP	United Nations Development Programme
USA	United States of America

CHAPTER 1

CONTEXT

Eastern shoreline of St. Martin's Island
Quazi Hamidul Haque

In recent years St. Martin's Island has become one of the most popular tourist destinations in Bangladesh, despite its location as the most south-easterly spot in Bangladesh. The Island annually attracts thousands of tourists because of its beautiful landscapes, clear sea water, and, of course, colonies of corals. Due to its favourable and unique environmental conditions, it is the only place in Bangladesh where coral colonies are found. Note that this book uses the name "St. Martin's Island" for an interconnected cluster of three islands, the largest of which is often known by its local name of "Narikel Jinjira" which means Island of Coconut.

At the same time St. Martin's Island also has an important ecological value as one of the few remaining nesting places in the region for several species of globally threatened marine turtles, as well as being a wintering site for migratory birds.

However, the unique flora and fauna of the Island have experienced tragic changes over the last two decades. The small mangrove forest and other natural vegetation have been cleared to construct hotels; over half the coral colonies have been depleted to be sold to tourists; out of three species of marine turtle formerly nesting here, only one species remains because of disturbance of beach areas; and the number of wintering shorebirds on the Island has dramatically fallen. Most probably, if there are no significant changes

Coral of *Favia* sp.
Raquib Ahmed

Sand dune plants
Md Anisuzzaman Chowdhury

made immediately to conserve the ecological resources of St. Martin's Island and its wildlife, the natural beauty and associated ecological values of the Island will be lost.

Administratively St. Martin's Island is part of Teknaf Upazila in Cox's Bazar District, and all of the land is privately owned, the islander families having settled here during the late 19th century. This makes formal protection complex and dependent on the active participation of local communities.

No wonder the Government of Bangladesh, represented by the Department of Environment, has declared the island as an Ecologically Critical Area, to draw national and international attention to the island in an attempt to protect its unique ecosystem. Since 2002 the Department of Environment, with financial support from the Global Environmental Facility, has initiated a project piloting a model for sustainable management of the Island along with three other Ecologically Critical Areas.

Olive Ridley Turtle

CHAPTER 2

LOCATION

St. Martin's Island is located in the northeast of the Bay of Bengal, about 9 km south of the Cox's Bazar-Teknaf peninsular tip and about 8 km west of the northwest coast of Myanmar at the mouth of the Naf River.

Being the south-eastern-most point of Bangladesh, the Island lies between latitude 20°34′ and 20°39′N, and longitude 92°18′ and 92°21′E.

The area of the Island itself is about 5.9 km^2 and with the rocky platforms extending into the sea the total area of the island is about 12 km^2.

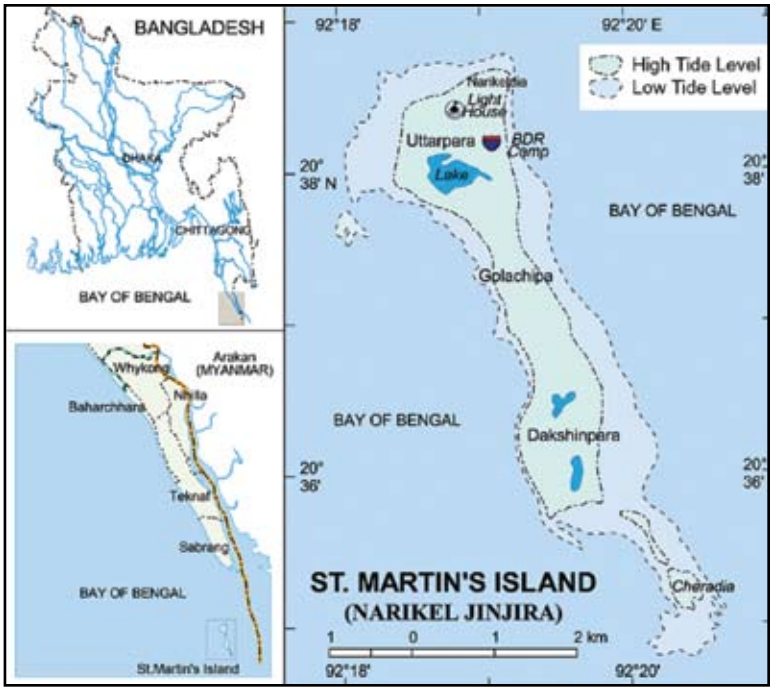
There are five distinct physiographic areas within the Island:

Uttar Para is the northern part of the Island with a maximum length, along the north-south axis, of 2,134 m, and a maximum width (along the east-west axis) of 1,402 m.

Golachipa is a narrow neck of land connecting Uttar Para with Madhya Para.

Madhya Para, directly south of Golachipa is 1,524m long and 518m wide at its maximum.

One of the impressive sunsets seen in the Island



Dakhin Para, lies next to the south and is 1,929 m long, with an additional narrow tail of 1,890 m towards the southeast, and at its maximum is 975 m wide.

Cheradia, the southernmost tip of the Island and extending south-south-east from Dakhin Para is a rocky reef that is about 1.8 km long and between 50 and 300 m wide. It is separated from Dakhin Para during high tide, and located on this inter-tidal reef are three small vegetated islands known as Cheradia, of which the middle one is the largest.

Satellite image of St. Martin's Island
Source: Google Earth, 2009

CHAPTER 3

CLIMATE


Calm sea during low tide

Although it lies within the tropical belt, the climate of the Island is heavily influenced by the subtropical monsoonal climate that prevails over Bangladesh.

From October to February the weather is mild with low rainfall. The hot season extends from March to May, and the monsoon during which most rains are concentrated extends from June to September.

According to MoEF (2001b), annual rainfall for Cox's Bazar varies between 2,867 mm and 4,684 mm. The temperature remains high year-round with small seasonal differences – the mean annual maximum and minimum temperatures recorded at Cox's Bazar falls within the ranges 30.3°C - 33.0°C and 19.3°C - 22.4°C respectively. However, because it is surrounded by sea and further south than Cox's Bazar, St. Martin's Island is believed to experience higher minimum temperatures and lower maximum temperatures than does Cox's Bazar (Tomascik, 1997). Humidity remains relatively high throughout the year - it averages 79.7% at Cox's Bazar (MoEF, 2001b).

From November to February the prevailing winds are from the north-west, from March to May they are from the south-west, and from June to September they are from the south-east. Access to the Island is quite limited during the rainy season due to very rough seas and this is an important consideration for management planning. But from November to March the island usually experiences pleasant weather and calm seas, making this the peak tourism season.

Cyclonic storms in this region are frequent and are usually associated with storm surges. Cyclonic storms develop in the Bay of Bengal, generally in April-May and October-November, and those that make landfall cause severe damage to human settlements and vegetation. Since 1970, 14 severe cyclones affected the Cox's Bazar area, with four major cyclones occurring since 1991 (Disaster Management Bureau, 2008). Moreover, climate change is expected to result in sea level rises of up to 43 cm by 2050, and more frequent and extensive cyclones and storm surges are also expected (Alam, 2003).

CHAPTER 4

PHYSICAL FEATURES

St. Martin's Island is a dumb-bell-shaped sedimentary continental island located on the eastern flank of an anticline, which like Chittagong may be part of the Arakan Yoma-Naga folded system (Warrick et. al., 1993). The surface area of the Island is about 8 km^2 depending on the tidal level. The Island is almost flat with an average height of 2.5m above mean sea level (MSL), rising to a maximum of 6.5m high cliffs along the eastern coast of Dakhin Para (Kabir, 2006).

Rocky beach of St. Martin's Island | *Quazi Hamidul Haque*

4.1 Geology

A sequence of marine sedimentary rocks is exposed on the Island, ranging in age from Late Miocene (around 11.6 to 5.3 million years before present) to Recent. The base rock is grey to bluish-grey Girujan Clay Shale (Pliocene - 5.3 to 2.6 million years before present) inter-bedded with subordinate sandstone. Above this is a layer of St. Martin Limestone (Pleistocene - 2.6 million to 12,000 years before present), which is coquinoid[1], dirty white, coarse grained, bedded and partly consolidated along with cream coloured coral clusters, and includes the fossil bearing Dakhin Para formation. This is overlain by the Holocene (from 12,000 years before present till today) coquina bed, which is continuation of the St. Martin Limestone formation.

[1] A limestone consisting of coarse, unsorted, and often unbroken shelly materials that have accumulated in place without subsequent transportation or agitation, and generally having a fine-grained matrix.

The surface deposits (Holocene) of beach sand, which is medium to coarse grained, and light grey to grey with recent shell fragments, lie above the limestone Banglapedia (2008).

With the gradual relative increase in sea level, dead shell fragments were thrust toward the shore of the Island by wave action and finally heaped up as a narrow ridge forming the coquina horizon along the present southeast border of the island. Coquina is also known as shelly limestone, and it is best exposed in a 6.5 m high cliff of 166 m length along the eastern coast of Dakhin Para. It is composed entirely of broken and crushed shells of molluscs, small crustaceans (Ostracoda), Foraminifera[2], and corals held together by a calcareous cement. Within this rock tiny shells are often found unbroken, while the rock overall is brown with a grey weathered surface, and is cross-bedded, loose and friable. Many of the shells within the rocks are similar to those currently found strewn over the beach. Micro-palaeontological investigation of samples of coquina has revealed the presence of Foraminifera including: *Elphidium crispum*, and *Amphistegina radiate*.

Radiocarbon dating of a 3 m notch of the coquina limestone cliff located in the central coast of Dakhin Para indicates an age of about 450 years at the base and 292 years at the top. From this coquina cliff the present mean rate of uplift of the island can be calculated as 19 mm/year.

4.2 Geomorphology

The main shoreline features are sandy beaches and dunes, where the main sediments are alluvial sands. The beaches and dunes of the southern part of the Island have a higher carbonate content compared to the northern Uttar Para beaches. Most carbonates comprise mollusc shell fragments. The sandy beach in the north and north-east stretches 300-400 m into the sea. The western beach is sandy but the sub-tidal area consists of a bed of boulders.

Coastal dunes are widespread immediately above the beach and along the shorelines. This dune system is particularly well developed around the middle part of the island. The dunes of St. Martin's are of two types: high and low dunes. High

[2] Tiny amoeboid protests, most smaller than 1 mm, which make a shell or "test" of limestone.

dunes are up to 6 m in height and are mostly found on the western side of Golachipa. Dunes along the north-west and south-west corners of the island are low, undulating and broadly extended. These dune systems act as a natural defence against storms and tidal surges, when they help to save lives and properties.

The topsoil of the main three parts of the Island (Uttar Para, Madhya Para and Dakhin Para) consists of alluvial sands mixed with marine calcareous (primarily molluscan in origin) deposits. Scattered throughout the area are small clumps of coral colonies, many still in growth position. A large shallow lagoon is located in the middle of Uttar Para. The lagoon has been largely converted into agricultural fields, and is connected to the sea at high tide by a narrow tidal channel on the west coast. The remaining flooded part of the lagoon has an area of about 0.4 km^2 with a depth of 1 m or less.

Uttar Para is separated from Madhya Para and Dakhin Para by a narrow neck of land known as Galachipa. Galachipa is a beach and dune environment. Similarly the surface deposits on Cheradia have a high content of molluscan shells compared to the northern parts of the island.

Rocks of fanciful forms can be found on the beach
Majeda Haq

One of the significant geomorphologic features of St. Martin's Island is the development of a spit bar at its southern end. This typical spit bar landform is about 2 km long and less than 100 m wide. This bar has been formed due to deposition and movement of fine to medium grained sand materials (consisting of alluvial sand and littoral carbonates) by wave and tidal currents. It connects Dakhin Para with the only smaller islands that form part of St. Martin's Island: three small islands of which the middle one is the largest, and which collectively are known as Cheradia. The peaks of these islands are less than 3 m above MSL and become disconnected from Dakhin Para by nearly 1 m deep water at high tide. These small islands are composed of relatively coarser sand particles with frequent shale fragments, broken coral debris and foraminifera, and are overlaid on nearly all sides by stony corals and boulders. The middle one of the three small islands has an undulating surface with a sub-basin on its top which is slightly submerged during extreme high tides. These three islands can be classified as "vegetated sand islands", since they have developed from the accumulation of both alluvial sands and calcareous littoral deposits. During low tide, they are connected with Dakhin Para by the spit bar which has accumulated on the top of a rocky inter-tidal reef.

Rocky Beach
Md Mahbubur Rahman

A number of non-vegetated rocky outcrops are found on the north-west coast of Uttar Para. These supra-tidal outcrops are the seaward continuations of the rocky inter-tidal zone.

Almost the entire coastline of St. Martin's Island is fringed by a rocky inter-tidal zone unique in Bangladesh. The width of the rocky inter-tidal at spring low tides varies from 100 to 400 m. The rocky inter-tidal is formed by small and large boulders, which according to Alam and Hassan (1998) have a close affinity with the bed rocks of the Island. In addition, many of the spherical boulders are calcareous concretions. Coral boulders are also present, but these are relatively rare and in no place do they form a coherent feature that can be called a coral reef. The presence of relatively well preserved dead coral colonies in the upper and middle inter-tidal suggests that the island has been uplifted in relatively recent times.

The recent uplift of St. Martin's is evident from the presence of large Porites micro-atolls, which are found in the lower inter-tidal on the north-west coast of Uttar Para. The morphology of these micro-atolls suggests that the relative sea level has dropped by about 15 cm during the last 150 years or so. This rough estimate is based on the size and average growth rates of the micro-atolls. Clearly this is an exciting area for new research, as it along with the dating of the cliff sediments, contradicts recent global trends for rising mean sea levels.

The sedimentary boulders, calcareous concretions, sandstone and shale found in the inter-tidal area extend into the sub-tidal zone. Most of the inshore area around the Island comprises of a shelf, this is covered by a layer of sedimentary boulders that vary greatly in size. While they provide a very suitable substrate for the settlement of coral larvae, as is evident from relatively high recruitment rates of juvenile corals, the boulders are very susceptible to overturning and shifting by the heavy seas that are frequently generated by cyclonic storms and tidal surges. The growing corals on the boulders are thus damaged or destroyed when the substrate boulders move. This rocky sub-tidal zone is much wider along the west coast than along the east coast. A number of offshore rocky reefs along the west coast become exposed during low spring tides.

Transparent sea water of St. Martin's
Md Mahbubur Rahman

4.3 Sea water

Surface circulation in the Bay of Bengal is determined by the monsoon winds and to some extent by the hydrological characteristics of the open part of the Indian Ocean. The prevailing winds reverse twice during the year. They blow from the south-west during May-September and from the north-east during November-January with the transition taking place during the months in between. Forced by these winds, circulation in the Indian Ocean has a general eastward direction during summer and westward during winter. The inflow of freshwater from the Ganges-Brahmaputra Delta into the Bay of Bengal has a significant impact: these reversing currents carry low salinity Bay of Bengal water into more saline Arabian Sea water and vice versa playing a crucial role in maintaining the freshwater - saltwater balance of the North Indian Ocean (Vinayachandran and Kurian, 2008).

The massive inflow of freshwater and sediment from the Ganges and Brahmaputra Rivers, and locally from the Naf River, is also an important factor influencing the flora and fauna of the Island. Thus, coral reef development is inhibited due to low water salinity, high turbidity and the soft substrates present.

Tides

The Island experiences normal semi-diurnal tides, i.e. two high and two low tides during a period of 24 hours

and 52 minutes (Banglapedia, 2008). The mean tidal range at Shahpuri Island (about 9 km north-east of St. Martin's Island) in the Naf estuary is 1.87 m. It is expected that somewhat similar, probably lower, tidal ranges occur at St. Martin's Island.

Temperature

The mean annual temperature of the surface water of the Bay of Bengal is about 28°C. The maximum temperature is observed in May (30°C) and the minimum (25°C) occurs in January-February (Banglapedia, 2008; Vinayachandran and Kurian, 2008).

Salinity

The surface salinity in the coastal parts of the Bay of Bengal oscillates from 10 to 25 ppt (parts per thousand, ie grams per kilogram of sea water). Coastal seawater is significantly diluted with freshwater throughout the year, although the inflow of river water is greatly reduced during winter. The coastal water salinity of St. Martin's Island, as measured during the dry season (Tomasick, 1997), fluctuates between 26 and 35 ppt. It is expected that the salinity level drops below this level due to increased freshwater discharge from the Naf River during the rainy season (July-October).

Transparency

Water transparency measured in December fluctuated from 0.62 m near St. Martin's Bazar, where the water is heavily affected by human pressure, to 3.9 m at Galachipa (Hossain et al., 2006). This low light penetration is the consequence of many factors. In addition to silt discharged by the Naf, the combined action of wind generated waves, ocean swell and high velocity tidal currents cause re-suspension of bottom sediments (fine sand; silts and mud). A Secchi depth[3] of over 7 m is required for optimal growth of reef-building corals. Since corals are light-sensitive organisms, the turbid coastal waters of St. Martin's Island are a key environmental factor limiting the development of coral reefs.

Dissolved oxygen (DO) concentration in the surface waters around St. Martin's Island ranges from 4.56 to 6.24 mg/L in December. The highest value of 6.24 mg/L of DO was found at Badam Bunia , whereas the lowest value was recorded at St.

[3] A measure of water transparency based on the maximum depth at which a standardised disk is just visible from the surface.

Martin's Bazar (Hossain et al., 2006).

The effects of aquatic pollution on coral communities are not well understood, however, there is evidence that pollution and other human activities have degraded the quality of water surrounding St. Martin's Island and have adverse impacts on the health, development and survival of corals and associated biodiversity (Hossain et al., 2006).

4.4 Freshwater

Being very porous and permeable, the shelly limestones of the Island provide an excellent aquifer wherever they occur beneath the alluvium. The shelly limestone and recent marine sand are the chief sources of fresh water. The rocks underlying these two formations are mostly impervious Tertiary shale and calcareous sandstone.

As rain water cannot flow downward through these rocks, it accumulates either in the shelly limestone or in the marine sand. The shelly limestone that underlies the village of Jinjira averages 1.2 m (four feet) thick and is overlain by 0.6-1.2 m (2-4 feet) of soil. Drinking and irrigation water is obtained by sinking shallow wells 1.5-3 m (5-10

Freshwater resources of the Island are limited.

feet) to the level of the Tertiary rocks.

However, there is now a scarcity of drinking water on the island. Only a few ponds and several tube wells supply water for drinking as well as for cultivation. Deforestation and large scale expansion of agriculture have adversely impacted the ground water lens of the island. The shallow wells used for crop irrigation may reduce availability of potable water. Increasing salinity in some tube wells has been reported.

Throughout the wet season until January, the water table in St. Martin's Island is within the range of 0.3- 2.1 m (1-7 feet) below the surface. However, in March and April most of the wells go dry and ground water is confined to the areas where the shelly limestone is more than 1.8 m (6 feet) thick.

The needs of the local population and the large annual influx of tourists during the dry season have created a great demand for freshwater, leading to a drop in the water table. This demand will only increase in the near future. Already there is a shortage of water for two or three months before the wells are replenished by summer rains in May and June.

Rocks act as natural protection of the beaches from erosion

CHAPTER 5

ECOSYSTEM

5.1 Ecosystem diversity

A cross-section of the different habitats and eco-systems that make up St. Martin's Island would show a transition from terrestrial to marine habitats. In addition to the dry land of the Island, the key habitats are shallow water marine habitats, including rocky and sandy inter-tidal

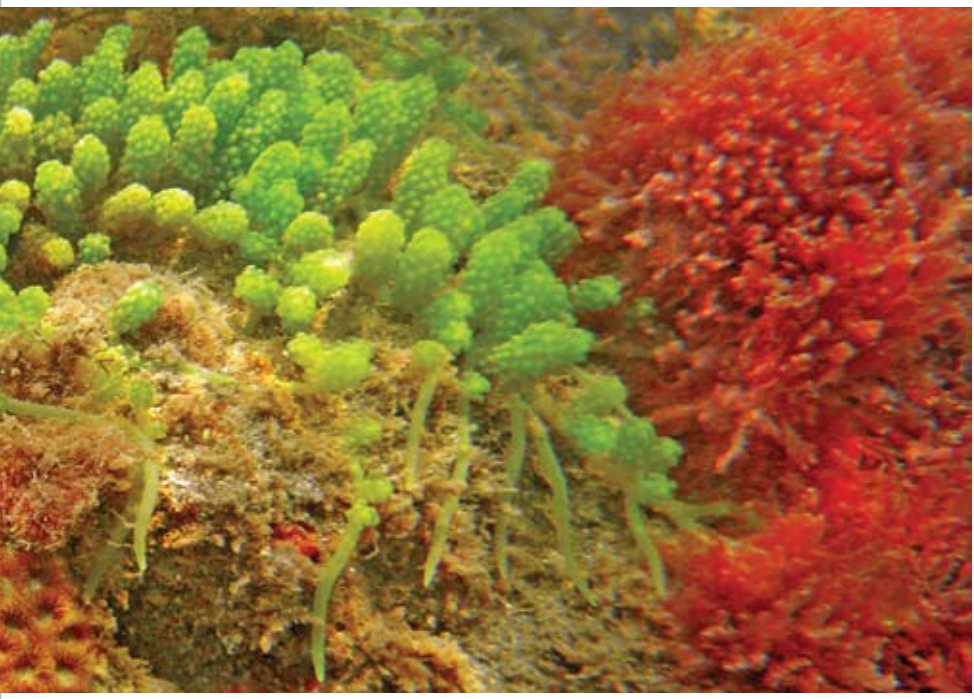
Underwater scene | *Quazi Hamidul Haque*

habitats, offshore lagoons, rocky sub-tidal habitats, coral aggregations, sea grass beds, soft coral habitats and offshore soft-bottom habitats.

5.1.1 Rocky Habitat

The whole terrestrial part of the Island was once a rocky habitat but this has gradually been altered through the removal of rocks and boulders for agriculture. Now much of the land is cultivated and of very limited ecological and bio-diversity interest.

However, a small area of rocky land remains at Shil Bania, south of Dakhin Para Morong (lake), and west of the Coast Guard base. The



Plants found in the rocky areas are well-habituated to this habitat

majority of this area is covered with giant boulders similar to those of the inter-tidal zone, with some lowland pools. This rocky land is the last remaining habitat for reptile species that are rare on the Island such as garden lizards *Calotes* spp., Two-banded Monitor *Varanus salvator*, Monocellate or Bengal cobra *Naja kaouthia*; birds of scrubby habitat; and native herbs, shrubs and climbers. The rocky ground and shallow pools provide an excellent terrestrial microhabitat, especially during winter.

This 100 ha area is the last remaining rocky area on the Island and has not yet been cleared, probably as the boulders are large and difficult to remove. However, local people are actively removing these rocks to improve the land for cultivation.

5.1.2 Sand dunes and beach

The sand dunes on the Island were much better developed and higher during the 1980s. The dunes are in an increasingly degraded state, with those of the north western part of the Island at Kona Para and Golachera, now severely eroded. This degradation has also resulted in a loss of associated dune flora (the dominant species are *Pandanus fascicularis* (previously *P. odoratissimus*), *Ipomea pes-caprae*, grasses *Panicum repens* and *Paspalum vaginatum*, and sedges *Cyperus* spp. and *Fimbristylis* spp.).

The dunes and especially the beach are a vital part of the

Natural patterns "designed" by crabs on the beach

Md Abdul Maleque

natural character of the Island. The continued health of the sand dunes and beach is very important for the protection of local people from predicted sea level rises (which are likely to have a major impact on the Island). The beach is the breeding habitat for globally threatened turtles, and a wintering habitat for shorebirds. The dunes act as a filter for rainwater as it recharges the groundwater. They also prevent sand being blown inland by winds. Winter winds and tidal forces accelerate the erosion of dunes that have had vegetation removed. Natural regeneration is possible if current factors affecting the health of the dunes are controlled, including infrastructure development, the clearing of dunes and dune vegetation adjacent to hotel areas, the collection of dune vegetation for fuelwood and pedestrian traffic (Molony et al, 2006).

5.1.3 Lagoons and wetlands

Several lagoons and wetlands associated with mangrove and floodplain areas occur on the Island, and once probably provided important habitats for birds.

There are three lagoons on the Island. The lagoons on Uttar Para and Dakhin Para have now become muddy swamps with shallow water and are only connected to the sea at high tide through shallow creeks. But the 40 ha lagoon that lies between the southern end of Dakhin Para and the three small islands comprising Cheradia retains

shallow water and is protected by widespread boulders and stone corals. The lagoons in the north are older in origin and show a longer sequence of evolution, while the lagoon in the south is much younger and is under active marine influence (Kabir, 2006).

Since the 1960s the two northern lagoons have been gradually converted into paddy fields, and this process is still ongoing. This conversion has eliminated most of the original wildlife found in these lagoons. The areas of some smaller wetlands located in the southern part of the island have also been reduced.

5.1.4 Mangrove habitat

At one time the Island probably had a significant area of mangrove vegetation, but most of this has been degraded (Tomascik, 1997). In 1996, mangrove forests covered only 2.4 ha (6.1 acres) (MoEF, 2001a). The top canopy was dominated by *Lumnitzera racemosa*, but a total of 29 mangrove species were recorded of which nine were

Wetlands of the southern part of the Island

common. Since then, the mangrove forest has been cleared almost solely to assert land rights and to facilitate the recognition of land ownership. Currently there is only a very small remaining mangrove patch in Dakhin Para consisting mostly of *Sonneratia apetala* mixed with Sea Holly *Acanthus ilicifolius*, Grey Mangrove *Avicennia marina* and *Hibiscus tiliceous*. The potential for this residual mangrove patch to restore and regenerate is unclear (Molony, 2006), even though in principle it is protected having been identified as a core zone of the St. Martin's Island Environmentally Critical Area.

5.1.5 Mudflats

Within the inter-tidal zone there is a small mudflat area (known as Gaitta Banya) located at the southern end of the western beach. The marine invertebrates found here make it an important foraging area for shorebirds. High levels of human activity in the preferred roosting areas for shorebirds in the north of the Island, have made the mudflat area increasingly important for birds.

The only mangroves left are this small patch in the south of the Island

The mudflat is also the only habitat on the Island for the Yellow-lipped Sea Krait or Colubrine Amphibious Sea Snake *Laticauda colubrina* and also supports mud crabs and a large population of fiddler crabs (Molony et al, 2006).

While there are currently no factors adversely affecting this mudflat area, it faces the threat of alteration in the future, for example for hotel construction.

5.1.6 Other inter-tidal habitats

A generalized zonation of east coast benthic communities along an inshore-to-offshore gradient starting from the lower inter-tidal is shown in the following diagram (Figure 1).

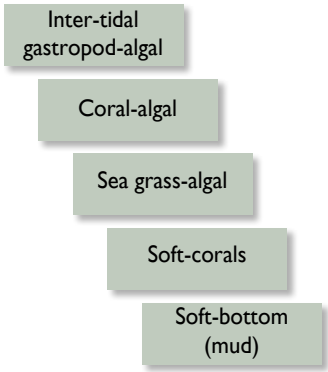


Figure 1. Generalized zonation of east coast benthic communities

The zonation of benthic communities on the west coast is shown in Figure 2.

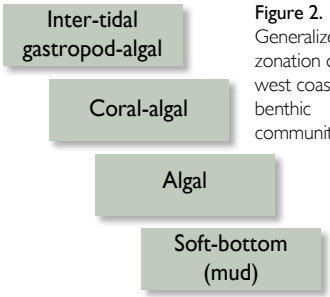


Figure 2. Generalized zonation of west coast benthic communities

With the exception of the north eastern corner, the Island's entire inter-tidal zone is fringed with numerous boulders that extend for anything from a few meters to a few hundred meters into the sub-tidal zone. These boulders, of all shapes and sizes, originate from the bedrock and provide a diverse microhabitat for numerous marine species sheltering from tidal influences. The upper portion of the rocky habitat is mostly dry during low tide and contains dead coral colonies.

The lower inter-tidal area hosts a wide diversity of marine life, including corals, molluscs, echinoderms[4], barnacles, crabs, and algae. It also

[4] Starfish, sea urchins, sea cucumbers, etc

Dead Coral Colony, St. Martin's Island

provides a huge number of rock pools of various sizes where small reef fish forage for the duration of the ebb tide. Inter-tidal zone rocky habitat covers 150-250 ha.

5.1.7 Marine habitats

The rocky sub-tidal habitat from the seaward margin of the inter-tidal zone to about 1,000 m offshore supports a diverse coral community which can be classified as a veneering coral community. Out of the 15 reef-building scleractinian (stony or hard) coral families, 10 are present on the Island, represented by approximately 22 genera and 66 species. Of these, 39 species have been identified alive around the Island. In addition 14 species of soft coral have been recorded, growing in water up to a depth of 7 m.

Sea grass meadows and algal flora associated with extensive coral reefs were discovered in 1997 by Tomascik (MoEF, 2001a).

Thus, beyond the inter-tidal zone, the habitats, ecosystems and life-forms that surround the Island are relatively poorly known. Other than observation of fish catches landed on St. Martin's Island there has been little study and little published on the areas one or more kilometres beyond the shore. It is possible that these areas could host marine life of high biodiversity significance, such as deeper water corals. Surveys of this marine zone are a research priority.

5.2 Flora

5.2.1 Terrestrial vegetation

Since St. Martin's Island is by origin a sedimentary continental island, which was connected to the mainland of the Teknaf peninsula as recently as 6,000-7,000 years ago, the flora of the Island is similar to that of the mainland. However, it has been significantly changed due to human interventions since the island was first settled in the 1880s. At that time the Island most probably was covered with evergreen forest reportedly with an abundance of teak trees (Tomascik, 1997). Following loss of the original forest, continuing intensive agriculture, and the recent increased number of tourists have further changed the vegetation and landforms of the island resulting in the loss of many of the flora and fauna species that once were abundant on the Island.

St. Martin's Island still has quite diverse vegetation because the remaining native species have been supplemented by a considerable number of cultivated and introduced species. Recent floral surveys recorded 260 plant

species including 150 herbs, 32 climbers, 25 shrubs and 53 trees, belonging to 58 families (Zaman, 2006). Aquatic vegetation has been less well studied, but recent surveys identified 151 species of benthic and drifted algae including a number of marine red algae (Aziz et al., 2008), and 18 species of bryophytes.

5.2.1.1 Trees

Among the naturally occurring trees, two species of *Pandanus* (locally called *keya*) and one species of *Streblus* dominate (Zaman, 2006). A number of trees such as coconut palms have been introduced and planted by the local inhabitants to obtain food, fibre, fuel, and construction materials for houses and boats. As noted earlier the small strips of mangroves on Dakhin Para at Cheradia and Gola Chipa hold a very small mangrove formation mostly of *Sonneratia apetala* and *Lumnitzera racemosa*.

Palm Trees

Coconut Palm *Cocos nucifera* (locally called *Narikel*) is abundantly cultivated on the Island and has given the Bangla name of St. Martin's – Narikel Jhinjira. Despite this name,

Palm tree, plantation
Quazi Hamidul Haque

the coconut palm is an exotic (non-native) species which is planted by local people for fruits, fibre and fuel. During a survey conducted in 2006, researchers found more 15,000 coconut palms on the Island (Zaman, 2006).

Three other species of Palmae occur on the island, namely: Areca Nut Palm *Areca catechu* (locally called *supari*), Asian Palmyra Palm *Borassus flabellifer* (locally called *taal*), and Silver Date Palm *Phoenix sylvestris* (locally called *khejur*). All were brought from the mainland and are cultivated by local people for various purposes, including use by local people as astringents, stimulants, and laxatives (Zaman, 2006).

Moraceae

Streblus asper (locally called *shaora*) is considered to be the most abundant tree on the Island, and is known by several common English names, including Siamese Rough Bush, Khoi, and Toothbrush Tree. The leaves are 5-10 cm (2-4 inches) long, rigid, oval-shaped, irregularly toothed, and borne on small slender stems (petioles). The tree has a number

Shimul *Bombax ceiba* blooms light up the Island in February
Olga Denyshchyk

of uses. It has been important in papermaking in some countries of South Asia for 700 years and is used by local people to treat fever and diarrhoea (Zaman, 2006).

Mangrove species

In the remnant patch of mangrove forest are found the following mangrove associated species: *Acanthus ilicifolius*, *Hibiscus tiliceous*, *Excoecaria agallocha*, *Avicennia marina* and *Clerodendrum inerme*. *Aegialitis rotundifolia*, an early coloniser, has disappeared from the Island (MoEF, 2001a). *Streblus asper* and *Vitex trifoliata* are also found among the crevices formed by rocks, adjacent to a swamp supporting the young mangrove formation.

Coconut gardens can be found all over the Island

Mangrove trees during high tide | *Md Mahbubur Rahman*

Local people use screw pines as windbreaks.
Md Abdul Maleque

Shrub of screw pine with unripe fruit

5.2.1.2 Shrubs and herbs

Shrubs

Areas of shrubs are dominated by the abundant *Vitex trifolea* (locally known as *nil nishinda*) and *Vitex negundo*, both belonging to the Amiacea family, and by some species of Leguminosae.

Vitex trifolia is a large coastal shrub reaching up to 5 m in height. The stems are covered by soft hairs (tomentose). The individual flowers have purple to violet two-lipped corollas that are approximately 5 mm long. The fleshy fruits are about 6 mm in diameter and contain four small black seeds. This plant occurs naturally along coastlines from tropical East Africa as far east as French Polynesia.

The Five-leaved Chaste-Tree *Vitex negundo* is a large, aromatic shrub, the stems have a square cross-section and are covered in dense soft whitish hairs (quadrangular and tomentose). This plant has anti-inflammatory, antibacterial, antifungal and analgesic properties, and both plants are used by local people to treat rheumatic fever (Zaman, 2006).

The rattan *Calamus guruba* (locally called *jali bet*) also occurs naturally on the Island.

Screw Pines

One of two dominant tree genera, Pandanaceae, is represented by two species, namely the screw pines *Pandanus fascicularis* (formerly *P. odoratissimus*) locally called *keya* and *Pandanus foetidus* (locally known as *keyawata*). Both species occur

Aerial roots of screw pine.
Md. Mahbubur Rahman

Unripe fruit of screw pine

in mangrove forests but are now cultivated on the sand dunes along the shore line. Pandanus functions virtually as a fence around the Island, protecting inland areas from the elements of wind, water and sand. Pandanus is important for sand dune formation, maintaining dune structure and protecting the shoreline from wind and water erosion. Local people use both species for medicinal purposes, to treat asthma (*keyawata*) and skin disease (*keya*).

Natural entrance formed by screw pines

Sandy beach vegetation.
Abu Sayeed Mohammad Sharif

Beach morning glory – natural decoration of sandy beaches.
Abu Sayeed Mohammad Sharif

Pandanus trees have been planted extensively along the coastline, particularly near homesteads as fences and windbreaks, but they are also collected or cut for fuelwood, and cleared for infrastructure development and dwellings. The mature fruits are collected to sell to tourists as curios, and are also dried for fuelwood, and the dried seeds are eaten by children.

Pandanus are declining because of cutting, and the removal of the whole plant is a serious problem as its root system stabilises beach and dune sediments. As the plants propagate both vegetatively and via seed, the collection of fruits may not seriously affect the natural regeneration of the plants (Molony *et al*., 2006).

Herbs

The main herb of note is the Beach Morning Glory or Goat's Foot *Ipomoea pes-caprae* (locally called *Shagor lota*). This is an abundant creeping vine belonging to the Convolvulaceae family. It grows on the upper parts of beaches and endures salt spray. This common salt tolerant plant has seeds that float and are unaffected by salt water, and can be found along sandy shores throughout the tropical Atlantic, Pacific and Indian Oceans.

Indigenous onion

A small-bulbed variety of onion *Allium* sp. (Family Alliaceae) is indigenous to the Island and is cultivated nowhere else in Bangladesh. Its yield performance, relative cost and the non-availability of quality seed

Sandy beach vegetation.
Abu Sayeed Mohammad Sharif

Green algae cover rocks on the beach

makes it susceptible to replacement by non-indigenous varieties.

While the onion is already a reasonably popular purchase item among tourists, its promotion as indigenous would probably improve sales. The onion represents one aspect of the cultural heritage of the Island (Molony et al, 2006).

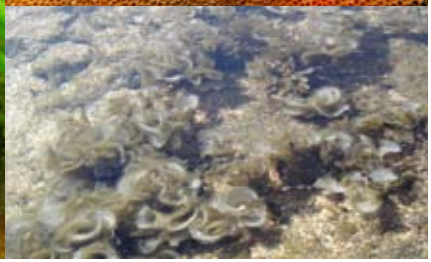
So far 154 species of marine algae have been identified, mainly from the Island's inter-tidal and littoral zone. Marine algae form an important source of nutrients for

Indigenous onions and onion bulbs ready for sale

A wide diversity of marine algae, better known as seaweeds, can be found in the waters around and washed ashore on the beaches of the Island.
All photos: Quazi Hamidul Haque

the myriads of animal life in the sea which feed directly on them or prey on animals that eat algae. Besides the larger species of algae, microscopic organisms such as diatoms, occurring as thick plankton, are the chief source of food for many molluscs, crustaceans, tunicates, and fish (Chowdhury, 2006). The larger species, commonly known as seaweed, play an important role in protecting soil from erosion and in enhancing sedimentation by holding the organic and inorganic components of brackish water during the monsoon. Seaweed is thus very important for improving and protecting beach structure (Molony *et al*, 2006).

While marine algae grow luxuriously on the undisturbed boulders, they



are threatened by harvesting, the indiscriminate removal of boulders, the use of seine nets, and possibly shore pollution. Seaweed is harvested in large quantities by the local community for trading to Myanmar. It is normally collected from the beach between February and April and is traded in its dry form, measured by weight. In 2001, 20 boatloads of 2-3 metric tons each were traded (Islam, 2001).

5.3 Fauna

5.3.1 Echinoderms (sea stars, sea urchins, sea cucumbers)

A total of only nine species belonging to eight genera in four classes of the phylum Echinodermata have been identified to species level from the Island, these comprise four species of sea urchin, one species of sea star, three species of nudibranchs, and one species of sea cucumber.

Sea Cucumbers are over exploited
Abdullah Zahimuddin Ahmad

There are also a number of species of brittle stars present, but these are cryptic and no collection or attempt to identify the species present has been made (Tomascik, 2007).

5.3.2 Cnidaria (jellyfishes, corals, sea anemones)

The coral communities of the Island are highly significant as there are only a few examples worldwide where coral communities dominate rock reefs as they do at St. Martin's. The coral colonies are affected by many factors, both natural and anthropogenic.

Sea urchins
Md. Mahbubur Rahman

Only four species of sea urchins, namely *Echinotrix diadema, Echinotrix calamaris, Echinometra mathaei* and *Echinostrephus aciculatus*, are found in the rocky subtidal habitats of St. Martin's Island (Tomascik, 1997).

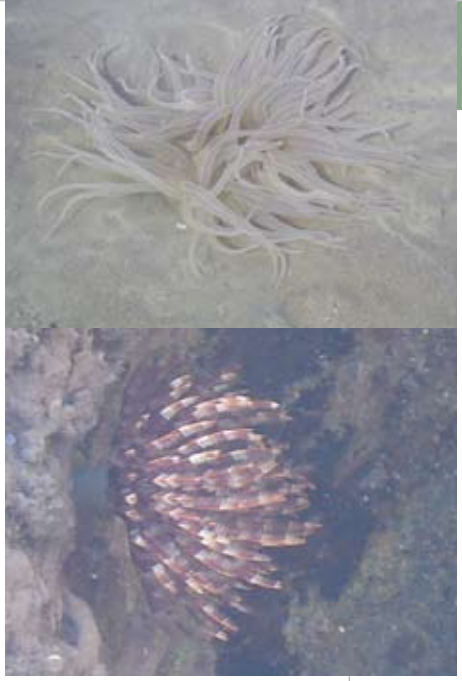
Four species of colorful nudibranchs have been recorded in the shallow subtidal rocky reefs: *Joruna funebris, Glossodoris atromargina*, a *Chromodoris sp*. and an unidentified species (Tomascik, 1997)..

The sea cucumber *Holothuria atra* occurs in very low numbers due to over-exploitation (Islam, 2001).

Jellyfish, are sometimes washed up on the beaches

According to Tomascik (1997), the natural environmental conditions around the Island are marginal for the development and survival of

coral communities, which places even more importance on the management of factors affecting coral that are within our control. Natural constraining factors include low salinity, high turbidity (affecting light availability), substrate disturbance as a result of heavy seas, high nutrient concentrations, the effects of water circulation and tides, cyclonic storms, the possible effect of earthquakes on the unstable (boulder) substrate of the site, and relative sea level changes (as a result of ongoing uplift) (Molony *et al*, 2006).



Sea anemones are animals not plants

Coral communities extend to about 200 m offshore of St. Martin's Island. Corals are found around most of the Island, but their abundance and cover is generally low. Based on limited quantitative data from quadrate surveys of the south-east around Cheradia, where corals are more abundant than in other areas, the density estimate of corals is 1.3 colonies/m^2. In this area, corals cover 7.6% of the rocky substrate. The diversity of the coral community on St. Martin's Island can be classified as low with low species dominance, meaning that no species dominates.

So far 66 coral species of 22 genera have been recorded. The genera *Porites, Favites, Goniopora, Cyphastrea*, and *Goniastrea* are the most abundant. In terms of coral coverage, *Porites* is by far the most important genus. In relative terms, almost all other coral genera, perhaps with the exception of *Acropora*, can be viewed as rare (Tomascik, 1997).

The soft coral community off the east coast of St. Martin's Island is a unique feature of the subtidal zone. Soft corals belong to the subclass Octocoralia, and are represented by three orders: Helioporacea, Alcyonacea, and Pennatulacea. The dominant families of soft corals around the Island are: gorgonian sea

fans (Plexauridae, Acanthogorgidae, Subergorgiidae and Malithaeidae); small sea fans (Anthothelidae); and sea whips (Ellisellidae).

Many of the sea fans and sea whips have attached crynoids (Crynoidea), or feather stars, on them. The most abundant crynoids are *Cenometra bella* (which at St. Martin's is always attached to soft corals) and *Tropiometra afra* (which is also found attached to rocks).

Tomascik (page 50, 1997) also reported that "Another important group of anthozoans (Anthozoa) in the lower inter-tidal and shallow subtidal are the zoanthids (Zoanthidae). The genus Palythoa dominates and covers many large boulders. Other anthozoans observed in the subtidal are *Nemanthus* sp. (Nemanthidae), *Telemactis* sp. (Isophellidae), and *Discosoma* spp. (Discomatidae)."

Some of the diverse corals of St. Martin's Island

From top to bottom:
Quazi Hamidul Haque
Raquib Ahmed
Raquib Ahmed
Abdullah Z. Ahmed

5.3.3 Molluscs

Marine molluscs are the most abundant large invertebrates found on the Island, however, they are declining due to unregulated harvesting. A total of 187 species of molluscs have been recorded from the Island (MoEF, 2001b).

Of these, 44 species are gastropods and the rest are bivalves. Numerically, the most abundant among the gastropod molluscs are Littorinidae (periwinkles), Neritidae (nerites), Trochidae (top shells), Cypraeidae (cowries), Muricidae (murex) and Conidae (cone shells). Tomascik, (1997) reported the presence of some economically important gastropods which at that time were abundant, e.g. *Conus striatus*, *Conus textile* and *Conus geogrphes*, and also two economically important gastropods that are heavily depleted worldwide - *Trochus niloticus* and *Turbo marmoratus*.

Some of the diverse corals of St. Martin's Island

From top to bottom:
Quazi Hamidul Haque
Raquib Ahmed
Raquib Ahmed
Abdullah Z. Ahmed

Some of the diverse crabs that wander the beaches of the Island
Abu Sayeed Mohammad Sharif

5.3.4 Crustaceans (lobsters, crabs, shrimps)

Over 12 species of crab have been recorded from the Island, including commercially important crab species such as the mangrove crab *Scylla olivacea*, which is widely distributed in the Bay of Bengal (Islam, 2006). Some of the other crab species recorded are: Red Egg Crab *Atergatis integerrimus,* Moon Crab *Matuta lunaris*, Flower Moon Crab *Matuta planipes*, Crucifix Crab *Charybdis feriatus*, Flower Crab *Portunus pelagicus*, Three-spot Swimming Crab *Portunus sanguinolentus*, Giant Mud Crab *Scylla serrata*, Crenate Swimming Crab *Thalamita crenata*, Soldier Crab *Dotilla myctiroides*, Horned Ghost Crab Ocypode ceratophthalma, and Horseshoe Crab *Carcinoscorpius rotundicanda*. Crabs of the genus *Scylla* are strongly associated with mangrove areas throughout the Indian Ocean and form the basis of substantial fishery and aquaculture operations elsewhere, but not at St. Martin's Island.

Molluscs

Underwater both lobsters and shrimps can be found
Abu Sayeed Mohammad Sharif

In addition two species of fiddler crab are found around the Island:

1. Marsh or Mud Fiddler Crab Uca pugnax, this species prefers muddy habitats, and digs its burrow above the high-tide line, then creates a mud ledge to shade the entrance to its burrow. It is the smallest fiddler crab of the Bay of Bengal; its body is less that an inch (2.5 cm) wide.

2. Sand Fiddler Crab Uca pugilator, this is a fairly small species that prefers sandy habitats and does not generally survive in silty mud. Sand Fiddlers are lighter-coloured than the other species.

Hermit crabs, which comprise of several species, can be found on or just off the coasts of St. Martin's Island in bushy areas. Hermit crabs insert their abdomens into abandoned gastropod mollusc shells that they carry about with them to protect their soft bodies. The hermit crabs that live in the coastal waters and along the shores of St. Martin's Island belong to the family Paguridae. They are omnivorous and consume plant and animal detritus as well as live benthic organisms. They are most abundant along Golachipa, Cheradia and Uttar Para beaches where enormous numbers of gastropod shells are washed up. Local people report that hermit crabs are most often seen at night-time under keya trees.

Horseshoe Crab

Horseshoe crabs are benthic or bottom-dwelling organisms found in both estuarine and continental shelf habitats, often among seaweed beds across much of the world's oceans. Horseshoe crabs are not true crabs, and actually are closer in form to spiders and scorpions. They are one of the oldest classes of marine arthropods and have not changed much in the last 350 to 400 million years. They are often called a "living fossil" and are related to extinct water scorpions. Scientists believe that horseshoe crabs were among the dominant creatures some 300 million years ago.

Adult horseshoe crabs feed primarily on marine worms and shellfish, including rexor clams and soft-shelled clams. Horseshoe crabs play an important ecological role in the food web. Adults are an important component in the diet of juvenile turtles. The mass spawning of horseshoe crabs at high spring tides in North America produces vast quantities of eggs that provide a seasonal abundance of food for several fish and bird species. For example, in Delaware Bay in the USA millions of migratory shorebirds, particularly Red Knot, refuel on horseshoe crab eggs and are now in decline due to over harvesting of the crabs.

Human use of the horseshoe crab began thousands of years ago and continues to the present day. Of all its uses, the horseshoe crab is most important to us in medicine, where it has helped us make great strides in eye research, in ensuring that our medicines are free of dangerous bacteria, in the development of wound healing bandages. Any drug produced by a pharmaceutical company must pass a test using a component obtained from the blue coloured blood of horseshoe crabs.

5.3.5 Fish

A total of 234 species of fish have been identified from the waters around the Island, 89 of which are coral associated species, and only 16 of which are freshwater fish. Though coral reefs have not developed, the coral community supports fish fauna characteristic of coral reef environments. The most abundant coral or reef-associated herbivores are the damsel fish (Pomacentridae), parrot fish (Scaridae) and surgeon fish (Acanthuridae). Important coral or reef associated predators found here are Serranidae (groupers), Lutjanidae (snappers) and Lethrinidae (emperors).

Five species of butterfly fish (Chaetodontidae) have been recorded from the Island, as has one species of angel fish *Pomacanthus annularis* (Pomocanthidae). Croakers (Sciaenidae) are also present.

The diversity of fish found in St. Martin's waters includes 234 species

Nesting marine turtles – one the main biodiversity treasures of the Island

Other notable species that have been landed from deeper water by fishing boats operating from the Island include the world's largest fish the Whale Shark *Rhincodon* typus a filter-feeder on plankton that is considered to be globally vulnerable to extinction, and Hammerhead Shark *Sphyrna* sp. with its bizarre shaped head.

5.3.6 Reptiles and amphibians

A total of 27 reptile species from 11 families of 3 orders have been recorded from the Island; of them 11 species are locally threatened. All five species of marine turtle known to occur in Bangladesh have been reported in the area, and all five species are globally threatened. The turtles comprise: Olive Ridley Turtle *Lepidochelys olivacea* (endangered), Hawksbill Turtle *Eretmochelys imbricate* (critically endangered), Green Turtle *Chelonia mydas* (endangered), Loggerhead Turtle *Caretta caretta* (endangered) and Leatherback Turtle *Dermochelys coriacea* (critically endangered). Three species – the Olive Ridley, Hawksbill and Green Turtles – are known to nest on the Island.

Nesting populations of marine turtles on the Island were high several decades ago but have declined significantly. Green Turtles were once the most common species to

nest here, but this no longer seems the case; the local community and fishers report a decline in the number of nesting females of 70-80% over the last 30 years (Rashid and Islam, 2005). Observations of natural hatchling emergence, which were once common, are now reduced to zero, with any hatching dependent on protection by NGOs. Islam (2001) recorded the emergence of 144 adult Olive Ridley Turtles and 21 Green Turtles between January 2000 and June 2001, of which those successful in nesting numbered 141 and three respectively. No Hawksbill Turtles were recorded during this period – the last recorded observation of a Hawksbill Turtle was in 1998 (M.Z. Islam, pers. comm., 11 July 2006).

The main nesting beach for the Olive Ridley Turtle is Shil Banyar Gula at the western beach – 80-90% of the Olive Ridley nests recorded in 2000-01 occurred on this 1,000 m beach stretch (Islam, 2001); while the main nesting beach for the Green Turtle is Badam Gonya, a small (100 m) stretch of sand at the southern end of the western beach.

In addition to NGO initiatives, in 2007 the Department of Environment, through the Coastal and Wetland Biodiversity Management Project, recruited local people as environmental guards to protect marine turtles. This has significantly increased turtle nestling and numbers of hatchlings, has improved public awareness, and generated some income for local people. However the long-term future of this initiative is uncertain. The continued protection of turtle breeding and foraging habitat on and around the Island, and other protective measures such as avoiding turtle catch by boats operating from or around the Island, are important for the conservation of the species both locally and globally.

Olive Ridley Turtle

Olive Ridley Turtle

The Olive Ridley is one the two smallest sea turtle species in the world, weighing up to 100 pounds (45 kilograms) and reaching only about 2 feet (65 centimetres) in shell length. These turtles are solitary, preferring the open ocean. They migrate hundreds or even thousands of miles (kilometres) every year, and come together as a group only once a year for the "arribada", when females return to the beaches where they hatched and lumber onshore to nest.

During nesting, they use the wind and the tide to help them reach the beach. Females lay about 100 eggs in one nest, but may nest up to three times a year.

The Olive Ridley is mostly carnivorous, feeding on such creatures as jellyfish, snails, crabs, and shrimp. They will occasionally eat algae and seaweed as well.

Though the Olive Ridley is widely considered the most abundant of the marine turtles, by all estimates, it is in trouble. Rough estimates put the worldwide population of nesting females at about 800,000, but its numbers have declined precipitously. Many governments have passed legislation to protect Olive Ridleys, but still eggs are taken and nesting females are slaughtered for their meat and shells. Fishing nets also take a large toll, frequently snagging and drowning these turtles despite pressure for use of turtle exclusion devices on trawl nets (National Geographic).

The beach and sand dune nesting habitat of marine turtles at the site is increasingly degraded. The main problem is the construction of a coastal embankment by the piling of loose boulders along a considerable length of the east and west coasts. Degradation of sand dunes and development and increased human activity along the shoreline is also affecting nesting habitat. The construction of boulder embankments has severely reduced access to nesting sites above the high tide mark and has led to turtles either being unable to nest, or nesting within the tidal area where the eggs are washed out by the tide. Prior to construction of the embankment, nesting was widespread throughout the west of the Island (Islam, 2001); now the turtles either turn back or start digging their nests then find boulders hidden beneath the sandy surface and reattempt to nest elsewhere.

The maintenance of rock free areas is required for the continued nesting of marine turtles at the site. Sand dune degradation due to both natural and man made causes needs to be arrested in order to maintain this important nesting habitat. Human movement in nesting areas also needs to be controlled (Molony *et al,* 2006).

Other reptiles include, among others, Two-banded Monitor *Varanus salvator*, six species of terrestrial and freshwater snakes (including Monocellate Cobra *Naja kaouthia*, and Dog-faced Water Snake *Cerberus rynchops*), four species of sea snakes, several lizards and four species of freshwater turtle. Information on the sea snakes of St. Martin's Island is scanty, so far the following species have been reported: Narrow-headed or Slender Sea Snake *Microcephalophis gracilis*, Black-banded or Blue-lipped Sea Krait *Laticauda laticaudata*, Yellow-lipped Sea Krait *Laticauda colubrine*, and Hook-nosed Sea Snake *Enhydrina schistosa*.

The Island supports four amphibian species: the Common Asian Toad *Bufo melanostictus*, and three frog species – Skipper Frog *Euphlyctis cyanophlyctis* (formerly *Rana cyanophylctis*), Indian Bull Frog *Hoplobatrachus tigerinus* (formerly *Rana tigerina*) and Spotted Tree Frog *Polypedates maculatus* (formerly *Rhacophorus maculatus*).

Brown-headed Gulls, the number of wintering birds has decreased significantly due to disturbance by tourists

5.3.7 Birds

St. Martin's Island lies on the boundary or overlap zone of the East Asia-Australasian Flyway and the Central Asian Flyway and provides a stepping stone for a number of migratory wader or shorebird species.

A total of 85 species of birds have been confirmed from the Island (35 resident species and 50 migratory species) (Annex 6). Although 107

Lesser Sand Plover

species were claimed during a survey in 2000-01 (Islam, 2001).

The mid-winter surveys conducted as part of the Asian Waterbird Census in 2008 and 2009 and other recent visits have recorded 43 waterbird species, of these Swift or Greater Crested Tern *Sterna bergii* and *Lesser Crested* Tern *Sterna bengalensis* are scarce in Bangladesh, and Pacific Reef Heron *Egretta sacra* is a rare vagrant, but the other species occur in other

Purple-rumped Sunbirds nest around villages *Quazi Hamidul Haque*

Pacific Golden Plovers at St. Martin's Island *Samiul Mohsanin*

coastal areas of Bangladesh. Species recorded include, for example: Ruddy Shelduck *Tadorna ferruginea*, Whimbrel *Numenius phaeopus*, Eurasian Curlew *Numenius arquata*, Common Sandpiper *Actitis hypoleucos*, Pacific Golden Plover *Pluvialis fulva*, Kentish Plover *Charadrius alexandrinus*, Lesser Sand Plover *Charadrius mongolus*, Brown-headed Gull *Larus brunnicephalus*, Great Egret *Casmerodius albus*, Little Egret *Egretta garzetta*, Yellow-billed or Intermediate Egret *Egretta intermedia*, and Indian Pond Heron *Ardeola grayii*. A survey in 2000-01 (Islam, 2001) recorded the near-threatened (BirdLife International, 2008) Black-bellied Tern *Sterna acuticauda*.

Shore bird surveys conducted over the eight years 1997-2004 for two to three days in each winter revealed a decline in both bird species diversity and abundance (M.Z. Islam, pers. comm., 5 August 2006). A count of 3,062 individuals in 1997 declined dramatically to only 356 individuals in 2004, a decrease of 88%. The mean number of species recorded for the period was 19.6, with a minimum of 17 and a maximum of 23, of which only one species showed an increase in abundance over the period and all others showed a decrease in abundance. The decline in wintering waterbirds including shorebirds can be attributed to the loss of wilderness and expansion of agriculture and human habitation. Also the main season for wintering birds coincides with the peak tourist season on the Island, during which time large areas of preferred shoreline habitat are inundated with tourists (Molony *et al.,* 2006).

Indian Pond Heron
CM Reza

On the other hand, the populations of some terrestrial birds associated with human habitation have increased, including: Feral/Rock Pigeon *Columba liva* and Black Drongo *Dicrurus macrocercus* and it is likely that other species commonly found in towns and buildings may invade the Island as the human population and visitor numbers increase.

5.3.8 Mammals

A total of 19 species of mammals were reported from the Island during a survey in 1995-1996, of which none of the land-based mammals are carnivorous. However, four of the marine mammals reported there have not been confirmed in Bangladesh waters (Ahmad *et al*., 2009) and so are treated as unconfirmed here (Blue Whale *Balaenoptera musculus*, Humpback Whale *Megaptera novaeangliae*, Common Dolphin *Delphinus delphis*, and Melon-headed Dolphin *Peponocephala electra*). Four marine mammals from the area surrounding the Island are listed in the 2006 IUCN Red Data Book of Threatened Species.

The waters around St. Martin's Island are considered likely to be visited by six species of marine mammals or cetaceans: Indo-Pacific Humpbacked Dolphin *Sousa chinensis* (listed as Data Deficient by IUCN), Indian Ocean Finless Porpoise *Neophocaena phocaenoides*, Irrawaddy Dolphin *Orcaella brevirostris*, Indo-Pacific Bottlenose Dolphin *Tursiops aduncus*, Pantropical Spotted Dolphin *Stenella attenuate* and Spinner Dolphin *Stenella longirostris*. Smith *et al.* (2008) observed Indo-Pacific Bottlenose Dolphin (listed as Data Deficient by IUCN) and Pantropical Spotted Dolphin; while Molony *et al.* (2006) reported Irrawaddy Dolphin (listed as Data Deficient by IUCN, but as critically endangered within Bangladesh), Indian Ocean Finless Porpoise (listed as Data Deficient by IUCN), and Spinner Dolphin. However, the diversity and abundance of cetacean species is still unclear.

Bottlenose dolphins

These sleek swimming mammals can reach speeds of over 18 miles (30 kilometers) an hour. They surface often to breathe, doing so two or three times a minute. Bottlenose dolphins travel in social groups known as schools, and communicate with each other by a complex system of squeaks and whistles. Schools have been known to come to the aid of an injured dolphin and help it to the surface.

Bottlenose dolphins track their prey through the expert use of echolocation. They can make up to 1,000 clicking noises per second. These sounds travel underwater until they encounter objects, the sound then bounces back to their dolphin senders, revealing the location, size, and shape of their target.

When dolphins are feeding, that target is often a bottom-dwelling fish, though they also eat shrimp and squid. These clever animals are also sometimes spotted following fishing boats in the hope of dining on leftovers.

Bottlenose dolphins are found in tropical oceans and other warm waters around the globe. They were once widely hunted for meat and oil (used for lamps and cooking), but today only limited dolphin fishing occurs. However, dolphins are threatened by commercial fishing for other species, such as tuna, and can become mortally entangled in nets and other fishing equipment.

All the marine mammal species found around St. Martin's Island are under severe anthropogenic pressure. Some species are affected by loss of habitats. For example, the distribution of the Pantropical Spotted Dolphin is reported to be closely correlated with mangrove ecosystems, therefore, after the clearing the mangrove forests in St. Martin's Island, the probability of appearance of Pantropical Spotted Dolphin is low.

However, the major factor affecting cetaceans here is the intensity and type of fishing activity in cetacean habitat. Fishing by-catch is the major problem for small cetacean species, particularly from the use of gill nets, set bag nets, seine nets, trawl nets and long lines. The widely-used low-cost drifting gill net used for commercial fishing is responsible for a high proportion of cetacean by-catch and may be the single greatest threat to cetaceans worldwide. The small cetaceans generally are not strong enough to break free from the nets which prevent them from coming to the surface for air, and so they drown. Despite having a special sympathy for cetaceans, the fishers of St. Martin's Island admit that it is impossible to avoid cetacean by-catch when using strong filament nets to catch their target species. Cetacean mortality as a result of by-catch and entanglement apparently occurs in Bangladesh on a scale unheard of in the scientific community (Molony et al, 2006).

5.3.9 Some species of conservation significance

All the native species of flora and fauna of St. Martin's Island are under significant anthropogenic impact. Thus all the species of marine algae are treated as nationally threatened species. Similarly the echinoderms, cnidaria, molluscs and crustaceans have become of national conservation concern due to overexploitation.

All of the marine turtle species occurring on and around the Island are globally threatened with extinction.

Although the Island does not host significant numbers of threatened bird species, the numbers of wintering migrant water birds have declined considerably, and this is thought to be a direct result of increasing human use of the shoreline.

Olive Ridley Turtle *Lepidochelys olivacea* (Endangered)

M Monirul H Khan

This is one of the smallest sea turtles with a dark olive-green shell with a high dome, and is widely distributed in tropical seas. It usually grows up to 100 lbs (50 kg) and 30 inches (0.8 m) long, and is an omnivore feeding on crabs, shrimps, sea grasses algae, fish, and molluscs. It has declined mainly due to being caught and drowned in trawl nets. This species still commonly nests around the Bay of Bengal including small numbers on the Island.

Hawksbill Turtle *Eretmochelys imbricata* (Critically Endangered)

This sea turtle with a sharp curved beak and a serrated edge to its shell is widely distributed in tropical seas. It reportedly grows up to 3.3 feet (1 m) long and a weight of around 176 lbs (80 kg), and is usually found in shallow waters near corals where it feeds on invertebrates especially sea sponges which are toxic to other animals. Its population has declined because it has been caught for its shell which is the main source of tortoise shell, and its nesting beaches are disturbed. This species used to nest on the Island but was last seen here in 1998.

Green Turtle *Chelonia mydas* (Endangered)

This sea turtle with an olive-brown to black shell and without a hook on its beak is widely distributed in tropical and temperate seas. It reportedly grows up to 700 lbs (315 kg) and 5 feet (1.5 m) long, and is a herbivore feeding only on sea grasses and seaweeds. It was once intensively hunted for its meat for making turtle soup and also suffers loss in fishing nets. This species still nests in small numbers on the Island.

Loggerhead Turtle *Caretta caretta* (Endangered)

This sea turtle with a reddish-brown shell and a large head is widely distributed in tropical and temperate seas. It reportedly grows up to 800 lbs (364 kg) and 3.5 feet (1.1 m) long, and feeds on molluscs, crustaceans, fish, jellyfish, crabs, and shrimps. It was once intensively hunted for its meat and eggs, but this species is also killed for its shells, which are used to make items such as combs. As a result, both subspecies are now internationally protected.

Leatherback Turtle *Dermochelys coriacea* (Critically endangered)

This is the largest sea turtle in the world and instead of a scaly shell its back is covered in thick leathery grey to black skin with long ridges running down its back. It is widely distributed in most of the world's oceans, although it nests in the tropics, and is better able to cope with cold than other turtles, having been recorded diving to 1,200 m depth. It normally grows to 2 m long and 250-700 kg in weight, although the largest recorded was 3 m long and over 900 kg. It specialises in eating jellyfish. It has declined mainly from harvesting of its eggs and by being caught and drowned in the nets of ocean going fishing vessels.

Irrawaddy Dolphin *Orcaella brevirostris* (Vulnerable)

Elisabeth and Rubaiyat Mansur/BCDP/WCS

This dolphin has a rounded head without a beak, and is grey with a paler belly, and has a small dorsal fin. It grows to just over 2 m long and about 115-130 kg in weight. It usually lives in small groups of up to six animals and eats fish, crustaceans and squid. It lives mostly in shallow, brackish and fresh

turbid waters at the mouths of rivers in south-eastern Asia and Australasia. This includes the coast of Bangladesh where recent studies have found an important population. Unfortunately this mammal is sometimes caught and drowned or killed in fishing nets in Bangladesh waters.

Finless Porpoise *Neophocaena phocaenoides* (Vulnerable)

Elisabeth and Rubaiyat Mansur/BCDP/WCS

This small grey cetacean has a rounded head with no beak, and has no dorsal fin just a thin ridge down its back. It normally grows to 1.7 m long and a weight of 70 kg. It lives in coastal waters, including fresh water, around the Indian and Pacific Oceans from the Persian Gulf to Japan.

Bird Migration

It is quite a lengthy journey for human visitors to St. Martin's Island, not only involving a boat from Teknaf, but also a long road journey from the cities of Bangladesh or abroad. But many of the birds you can see here have flown much further - thousands of kilometers across continents, forests, deserts and mountains to be here.

To rest and refuel on the way, these birds use the wetlands in different countries. Water birds concentrate in flocks in a few sites in winter and are especially at risk from hunting and disturbance on the Island. They depend on our remaining wetlands, such as St Martin's Island, just as much as the lands they visit in the breeding season. We have a global responsibility to protect migratory birds and the wetlands they depend on.

Enam Ul Haque

Ruddy Shelduck *Tadorna ferruginea*
This large (63-66 cm) duck breeds in brackish lakes in the deserts of central Asia and Tibet and flies over the Himalayas to spend the winter along our rivers and coast.

Reza Khan

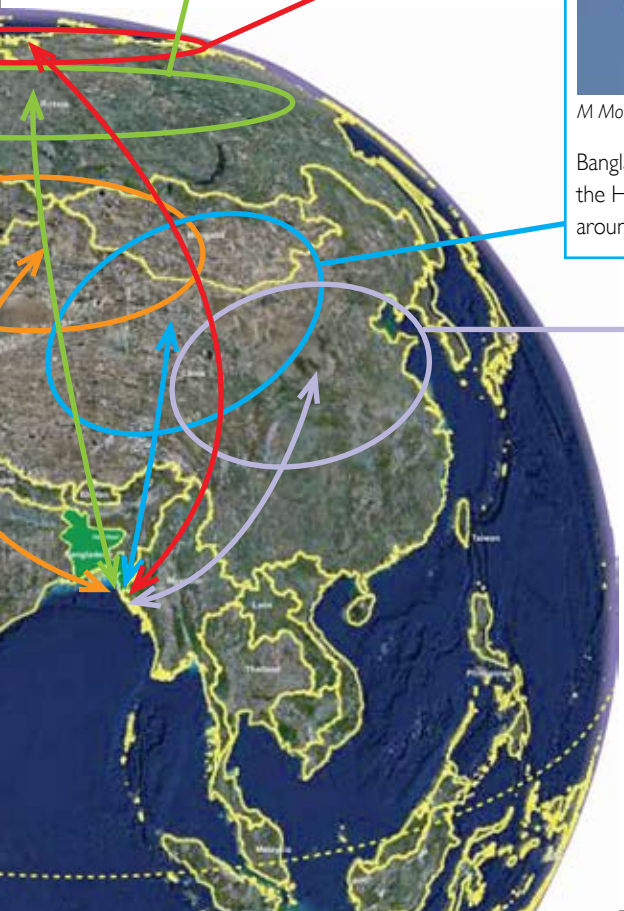
Whimbrel *Numenius phaeopus* (40-46 cm) This long-legged shorebird with a down-curved bill breeds in the northern marshes that extend across Europe, Siberia and Canada. Some of the birds that breed in Siberia spend the winter on the Island.

Enam Ul Haque

Ruddy Turnstone *Arenaria interpres* (23 cm) This small shorebird with a short bill and bright harlequin plumage of black, white and chestnut breeds in the tundra north of the arctic circle. It gets its name from its habit of turning over stones and flotsam along the shoreline in search of small invertebrates.

M Monirul H Khan

Brown-headed Gull *Larus brunnicephalus* (42 cm) This gull spends the winter in wetlands of northern India and Bangladesh. They fly across the high peaks of the Himalayas to reach their breeding grounds around lakes in Tibet and Mongolia.



Enam Ul Haque

Barn Swallow *Hirundo rustica* This small (18 cm) bird breeds throughout the northern hemisphere. Our birds breed in China and southern Siberia, and catch insects in flight while migrating during the daytime.

CHAPTER 6

PEOPLE

Human settlement started on the Island in the 1880s when several families migrated from what is now Myanmar to live on the Island permanently. In the 1920s the hardwood trees of the Island, reportedly mostly teak, were cut and sold to Myanmar (then Burma). From the 1940s onwards it is reported that land was gradually

converted to paddy cultivation, and from the 1960s onwards this involved converting the main lagoon to cultivation.

In 1996 there was a population of around 3,700 people belonging to 535 families (Paiker, 1996 in MoEF, 2001b); in 2000 the population was 4,766 from 791 households (Islam, 2001) and in 2005 the population was 5,726 from 818 households (POUSH, 2006a). Most of the inhabitants are ethnically Bangali and Muslims. This means that the population density is likely by the late 2000s to be about 700 persons per km^2

By 2008 the Island had the following

Local boys enoying football in the sandy beach at St. Martin's *Enam Ul Haque*

significant and public buildings: 17 hotels, 12 restaurants, a government office, two mosques, three primary schools (including one that doubles as a cyclone shelter), one high school, a second cyclone shelter, a large new hospital, a lighthouse, a naval base and two village resource centres.

6.1 Land Tenure

All the land of the Island is privately-owned, with the exception of 18.7 hectares at Cheradia which was recently purchased by Ministry of Environment and Forest, and some small areas on which public buildings have been constructed.

6.2 Livelihood

Fishing (including shrimp fry collection), fish drying, the sale of coconuts, and agriculture are the most common sources of livelihood. A small number of people are engaged in rickshaw van pulling (mainly for tourists). In 2005

A typical local house

Local girl, *Enam Ul Haque*

Local boys enjoy the beach, *Majeda Haq*

a survey of occupations of 728 households showed that 28% were engaged in fishing, 22% in business, 11% in farming, 10% in service and 9% in labour (POUSH, 2006b).

6.2.1 Fishing

Fishing has a long history at the Island and is the main activity of the inhabitants, with about 600 professional fishers and 170 fishing boats recorded on the Island in 2000-01 (Islam, 2001). The main fishing season is September to April, during this period each boat averages a total catch of about 11 metric tons (MoEF, 2001b).

The main fishing gears are drift, fixed and plain gill nets, and seine nets. Fish are caught offshore as well as from the coral beds. Fishing in inshore waters over boulder

Fishing has traditionally been the main economic activity on the Island

Before the "tourist era", fishing used to be the main source of income for local people

reefs is done with rock-weighted gill nets which has an adverse impact on coral.

Most of the fish are sun-dried locally at five large fish drying farms on the Island and in the homesteads of individual households. The dried fish are then supplied to merchants in Cox's Bazar and Chittagong.

Shrimp fry collection is also undertaken on the Island and the fry are sold to suppliers serving the Cox's Bazar shrimp farms. Of 332 family heads engaged in natural resource exploitation in 2000, almost 50% were shrimp fry collectors (Islam, 2001). Shrimp fry collection causes the large-scale loss of many other aquatic organisms

Beach seine nets are still commonly used on the Island

Near-shore fishing by boat lands fish from the coral beds

(Molony *et al.* 2006) because fry and eggs of non-target species are caught in the fine mesh nets and killed. Although shrimp fry collection from the wild has been banned nationally this is difficult to enforce as the activity is dispersed and many poor people depend on it for their livelihoods. In recent years there have been government initiatives to create alternative sources of income for Islanders involved in this activity and joint campaigns of governmental authorities to reduce this illegal activity.

6.2.2 Agriculture

About 116 ha of land on the Island are cultivated, with homestead

May of the fish caught are dried on the Island

Grazing on the Island is limited

gardens occupying a further 7.4 ha, representing in total 37% of land use (POUSH, 2006a). Farming mainly occurs in the north of the Island (Uttar Para) with the main crops being chilli and watermelon. An indigenous small bulb onion variety is also cultivated and a small amount of maize is intercropped with chilli. A small amount of transplanted Aman rice is cultivated in the rainy season.

Planted trees, particularly coconut, have replaced much of the original vegetation. Thus in 2006, 15,000 Coconut Palms were recorded on the Island. Homestead coconut gardening is an important source of income.

Agriculture is causing the ongoing destruction of habitats, especially the clearing of rocky land for cultivation and the filling in of lagoons. Additional problems are the cultivation of exotic and hybrid plants and the use of chemical pesticides and fertilisers.

New plantation to stabilise sand

6.2.3 Tourism

The Island has been a tourist destination for many years, but with recent developments in tourism infrastructure it has become one of Bangladesh's most popular tourist destinations. Tourism has increased steadily since it first began on the Island. Official statistics on the number of tourists visiting the Island are not available as there has been no systematic monitoring of visitor numbers. During a 45-day period in December 1996 - January 1997 between 150 to 200 visitors visited the Island daily (Tomascik, 1997). According to the St. Martin's Island Project, the number of visitors for the whole tourist season for 2002-03, 2003-04 and 2005-06 (2004-05 figures are not available) was 62,520, 103,488 and 156,736 visitors respectively. The 2005-06 figures imply an average of about 750 persons per day over a seven month tourism season, but the numbers of visitors on some days

Beaches are rapidly being developed for tourism

St. Martin's Island is now one of the most popular tourist destinations in Bangladesh

A tourist resort has been built at the end of this long beach

in the peak season must be much higher.

Tourism is concentrated in the winter, particularly December and January, when the Island is most accessible, while the remainder of the year sees hardly any tourists.

A major problem resulting from tourism is uncontrolled and inadequate waste management. Untreated sewage is piped directly into the sea, or stored in open ponds, adversely affecting marine and ground water quality.

Thus the existing pattern of tourism in the peak season is considered to be unsustainable and far beyond the carrying capacity of the Island. The Island has a good potential for

All kinds of fish are offered in local restaurants

Recent hotel construction has damaged natural habitat and negatively impacts threatened wildlife of the Island

responsible ecotourism, but there is currently only mass tourism. This marginalizes local people as very little, if any, money generated from tourism remains in the Island, because all the tourism investors are outsiders. Hence the growth of tourism on the Island since the 1990s hardly contributes to economic development on the Island but it seriously damages natural resources.

Thousand of tourists come daily during the December–January peak season

CHAPTER 7

CLIMATE CHANGE AND OTHER ENVIRONMENTAL THREATS

7.1 Climate change implications

The effects of climate change, particularly sea level rise, pose significant threats to the whole region of South Asian Seas. As a result of global warming, the penetration of heat into the ocean leads to the thermal expansion of the water; this effect, coupled with the melting of glaciers and ice sheets, results in a rise in sea level. Sea level rise will not be uniform globally but will vary with factors such as currents, winds, and tides; as well as with different rates of warming, the efficiency of ocean circulation, and regional and local atmospheric (e.g., tectonic and pressure) effects. It is estimated that sea level would rise, on average, about 5 mm/yr, within a range of uncertainty of 2–9 mm/yr (IPCC 2004).

Recent global increases in reef ecosystem degradation and mortality (the "coral reef crisis") appear to be sending a clear message that the rate and nature of recent environmental changes frequently exceeds the adaptive capacity of coral organisms and communities. The coral crisis is almost certainly the result of complex and synergistic interactions among local-scale human-imposed stresses and global-scale climatic stresses. Documented human stresses include increased nutrient and sediment loading, direct destruction, coastal habitat modification, contamination, and the very important chronic indirect effects of over fishing.

The major climate change factor that is becoming increasingly important for coral communities is rising ocean temperatures, which have been implicated in chronic stress and disease epidemics among corals, as well as in the occurrence of increasing numbers of mass coral bleaching episodes. High water temperatures stress corals leading to "bleaching" — the expulsion of colourful, symbiotic algae that corals need for survival, growth, and reproduction.

Also of concern are increases in atmospheric concentrations of carbon dioxide (CO_2) from fossil fuel combustion that will drive changes in surface ocean chemistry. The higher the concentration of CO_2 in the atmosphere, the greater the amount of CO_2 dissolved in the surface ocean. Higher dissolved CO_2 increases ocean acidity and lowers the concentration of carbonate which corals and other marine organisms use, in the form of calcium carbonate, to build their skeletons. Thus, continued growth in human emissions of CO_2 will further

limit the ability of corals to deposit the calcium carbonate minerals that are the structural building materials of coral reefs, and they will fail to recover from bleaching events or other forms of stress.

7.2 Overexploitation of natural resources

The large scale removal of keystone species and other marine resources (e.g. seaweeds, molluscs, lobsters) for food or as ornamental souvenirs is an on-going threat to the biodiversity of the inter-tidal, sub-tidal and coastal habitats of St. Martin's Island and its adjacent coastal waters.

7.2.1 Seaweeds

As noted earlier, one species of seaweed is reported to be harvested in large quantities by

A typical beach on the Island

the local community and traded to Myanmar, with numerous boatloads amounting to up to 60 metric tons of dried seaweed exported in 2001 (Islam, 2001).

The continuous disturbance of inter-tidal rocks, particularly for construction and household use, is also an impediment to growth of marine algae. Thus, the present day populations of marine algal flora are very different from what they were in the 1960s and even the 1980s, and this degradation may be ascribed to habitat disturbance (MoEF, 2001a).

The dragging of seine nets across the inter-tidal zone also adversely affects algae. Use of seine nets in these areas needs to be limited. Pollution is also an issue: in the north of the Island fish catches are landed and dressed/washed on the beach where the waste subsequently enters coastal waters, and this may affect marine algae growth.

7.2.2 Crustaceans

While there is no data on which to base an assessment of the conservation status of the crabs and lobsters of St. Martin's Island, it is known that several species are harvested deliberately or caught as by-catch. While Muslims in general do not eat crabs, crabs and lobsters are harvested for their high market value and are sent on ice for sale in mainland markets where they are ultimately consumed locally or exported. The Island provides the only habitat in the country for spiny lobsters. The main threats to lobsters are the

Dried seaweed – source of income for local communities
Majeda Haq

Local people collecting seaweed
Majeda Haq

Even crabs are collected and offered to tourists

accidental collection of juveniles in small-mesh monofilament gill nets and bottom-set gill nets, and coral habitat destruction. The collection of juveniles is particularly dangerous given the long life cycle of lobsters.

7.2.3 Corals

Commercial coral collection began in the 1960s and is now the professional activity of a few families. Of 332 family heads engaged in natural resource exploitation in 2000, almost 20% were coral collectors (Islam, 2001).

The main threat to future viability of coral communities comes from direct extraction of coral colonies. Until recently, Acropora was the main group exploited for the curio trade. Most of the corals collected were sold in Cox's Bazar.

The most recent data on the corals of St. Martin's Island is from a 1997 survey, which estimated that 30,000 coral colonies are removed annually, representing 24% of the existing population then. Coral removal has continued unabated since so we can reasonably assume that the current status of coral at the site is

Coral collected for sale at St. Martin's Island

Collecting shells helps the poor earn some income but affects beach ecology
Majeda Haq

very poor, and surveys of corals are an urgent priority.

7.2.4 Molluscs and echinoderms

Shells are extracted from the beach and lower inter-tidal zone for sale as curios. Earlier only larger shells were collected but now small shell species are also collected. As the shell resource has become overexploited, live molluscs are now being collected. Sea cucumber is also heavily exploited. For example, the sea cucumber Holothuria atra occurs in very low numbers due to over-exploitation and sea urchins are collected for sale to curio traders and tourists and are also collected by tourists themselves (Islam, 2001).

7.2.5 Fisheries

Fishers reported in 2001 that the catch per unit of effort from fishing around the Island had declined compared to a decade before (Islam, 2001), which is likely to be a result of a 50-60% increase in the number of fishing boats reported during the same period. However, in 2001 coral-associated fishes were not well represented in the daily catches and it was thought that these fish species were not overexploited (Molony, 2006).

7.2.6 Groundwater extraction

Deforestation and large scale expansion of agriculture has

Collecting drinking water is a daily chore

impacted on the ground water lens of the Island (Tomascik, 1997). Even during Tomascik's 1996 survey, one well went dry and some became saline. Freshwater on the Island is available at shallow depths (3 m, 10 feet) (Islam, 2001) but the needs of the local population and the large annual influx of tourists corresponding with the dry season has created a great demand for freshwater, leading to a drop in the

Underground sources can not fulfil the growing demand for freshwater

water table. This demand is only going to increase in the near future. Motorised pumps are now used by the tourism industry during the peak tourist season to cope with the demand, further reducing the water table level to the extent that local people have trouble accessing water via tube wells.

7.2.7 Boat anchoring, operation and maintenance

Boat operators are continually scooping and throwing overboard oily water that accumulates in the holds of poorly maintained boats. Marine water quality is very important for the ongoing health of marine biodiversity, particularly the coral communities, thus measures to prevent oil spillage, solid waste and sewerage disposal into the marine environment are necessary (Molony et al, 2006).

Boat groundings at low tide cause direct physical damage to the boulder reef substrate as well as

In the peak season visitor numbers exceed the Island's capacity | *Quazi Hamidul Haque*

direct kills of corals. The increased rubble and fine sediments become available for re-suspension and this further affects water clarity, coral recolonization, and coral health in general (Tomascik, 1997).

7.2.8 Deforestation

The use of wood for cooking and timber for constructing houses have been the main factors resulting in the deforestation of the Island. The daily requirement of fuelwood for a dense population of around 5,700 people (POUSH, 2006a) is large. While many purchase wood imported from Teknaf (contributing to on-going deforestation of protected areas of tropical forest there), poorer families cannot afford to do so. Another major cause of recent deforestation is the clearing of vegetation including mangroves to make claims on land. Deforestation has led to increased water turbidity and sedimentation, both of which affect coral development.

The poor of the island cut natural vegetation for fuel

Erosion affects beaches and vegetation

The main threat to the natural flora of the Island lies in construction. In particular substantial tourist resorts have recently been constructed by clearing natural vegetation.

7.2.9 Erosion

Shoreline erosion has been raised in a number of reports as an environmental problem. What seems not to be recognised is that coastal erosion is a natural cyclic process, part of the Island's evolution. Failure to recognise this important process as a natural phenomenon has resulted in a massive and ill-informed coastal works project that started in 1993. Huge quantities of inter-tidal boulders were removed from their original places and a rock wall was built along long stretches of the coastline. This has not only resulted in the destruction of important turtle nesting beaches, but has accelerated erosion processes in other nearby stretches of coast, a phenomenon by now well recognized in other countries. Inter-tidal boulders have also been removed for use in road and house construction. The inter-tidal boulder reef is a natural barrier that protects the coastline from wave action and storm surges. Beach erosion is now evident in all stretches of coast where large numbers of boulders were removed. In addition, continual cutting of Pandanus beach vegetation for fuelwood by a number of poor families is a serious problem resulting in soil and beach erosion.

7.2.10 Water contamination

Floods and heavy runoff during the rainy season introduce high quantities of sediments, nutrients and pesticides from poorly managed agricultural lands to inshore waters, and this has a negative impact on coastal ecosystems. Thus herbicides even in low concentrations

Even sand dunes are occupied by tourist development

Construction activities at St. Martin's Island

interfere with basic food chain by damaging zooxanthellae in corals, and other primary producers - benthic or pelagic. Pesticide can selectively destroy zooplankton communities and larval stages of corals, while insecticides accumulate in animal tissues and interfere with physiological processes (Tomascik, 1997).

According to Hossain et al. (2006), water samples from the inshore zone of St. Martin's Island were contaminated with fecal coliform bacteria up to 6 cfu/100 ml, although this is below the intermediate risk level set by the World Health Organisation, it still is an indicator of sewage contamination, due to the presence in human and animal faeces. Significantly the water was also contained with *Vibrio cholerae*, the cause of cholera, posing a health threat to local people and tourists (Hossain *et al.*, 2006).

7.2.11 Construction activities

Construction of buildings and infrastructure causes direct physical damage to sub-tidal habitats and the adjacent coastline, it increases the influx of sediments from land based and marine operations, introduces toxic chemicals, and has immediate physical impacts through extraction and trampling. Coastal current patterns have been altered as a result of jetty, breakwater and marina construction. Fragile shoreline habitat is also physically destroyed through recreational activities such as inter-tidal walking and boat anchoring.

Natural vegetation is cleared to start construction

CHAPTER 8

SUSTAINABLE MANAGEMENT STRATEGIES

Traditional fishing boats remain after the day-tourists have left | *Quazi Hamidul Haque*

8.1 Policy issues relevant to St. Martin's Island

The depletion of biodiversity resources in Bangladesh is an indicator of other larger underlying problems, two of which are 'over population' and 'poverty'. A population management strategy is a pre-requisite for any development to be sustainable. The rapidly increasing population of the Island creates a growing pressure on land and resources due to the expanding need for housing, food and incomes. While a degraded environment can cause poverty; poverty can also result in serious degradation of environment and natural resources. Any initiative in Bangladesh to conserve biodiversity resources must address both population pressure and poverty. If these issues are not considered priorities locally as well as

Terns and humans both depend on dwindling fish stocks
Majeda Haq

nationally, any initiative to conserve biodiversity resources, however well intentioned, may provide only partial and temporary results.

Along with the above two generic strategic issues, the following specific strategic interventions (Khan, 2008) would assist in conserving biodiversity in Bangladesh in general and in St. Martin's Island:

1. **Policy harmonization and enhancement**. Jurisdictional overlaps and inconsistencies among policies and institutional mandates heighten the challenge of ensuring wise use of biodiversity. Policies and institutional mandates need to be updated for effective collaborative management that is pro-environment and pro-poor. Policy provisions are needed in favour of community rights to participate in the management of biodiversity resources. This could be done by revising the Environmental Conservation Act and associated Environmental Conservation rules in favour of: (i) mandatory public consultation in the planning phase of any development initiative; (ii) community access to information; and (iii) participatory monitoring and evaluation involving the local community. Promoting ecologically sound land use would be a key strategy in this regard. The Bangladesh Land Use Policy has neither been

updated to reflect current priorities nor implemented effectively. Enforcement of policies and rules is difficult, particularly in a location such as St. Martin's Island, so local buy-in and actions to encourage compliance are essential. An appropriate plan of land use zones for the whole Island (areas above high tide, inter-tidal areas and sub-tidal/marine areas) has to be formulated with, and its compliance ensured through, active participation of the community. Moreover public funds need to be allocated for management of this (and other) protected areas.

2. **Awareness.** There is no alternative to raising awareness locally and more widely about the significance of the biodiversity of St. Martin's Island and surrounding areas and how they are being adversely affected.

3. **Knowledge management, monitoring and evaluation**. Data on biodiversity in terms both of sites and species is patchy, dispersed, and often out of date in Bangladesh. A comprehensive inventory on the biodiversity resources in and around St. Martin's Island should be created. For this applied research, monitoring and evaluation of key indicators should be funded as part of the strategy for knowledge based wise use of the Island's biodiversity, including designation of marine protected areas.

4. **Natural resources accounting**. Full accounting of the values of marine wetland systems, including habitats and biological diversity, would be a strategic way to raise awareness and to encourage stakeholders to conserve the biodiversity resources around the Island.

5. **Leveraging national and international partnerships**. Synergies between government and civil society are a vital factor to enable biodiversity conservation. International networking and collaboration can significantly contribute in this. Multilateral Environmental Agreements to which Bangladesh is a signatory, such as the Ramsar Convention, Convention on Biological Diversity, Convention on Migratory Species, and

Scenes of tranquil isolation can still be found on the Island *Quazi Hamidul Haque*

Convention on International Trade in Endangered Species, provide a framework for accessing international collaboration. Along with Community-Public-Private partnership, there is great potential to benefit from South-South and North-South partnerships and networking in conservation efforts, particularly in the context of the additional challenge posed by climate change.

6. **Activating a marine protected area system**. Although a number of protected areas have been declared under the provisions of the Wildlife Act and the Environmental Conservation Act, an effective management system for these areas is not yet in place, and wetlands and marine habitats are poorly represented. A number of project initiatives are attempting to demonstrate viable approaches to manage protected areas of the country. However, all the country's protected areas together cover less than 2% of the total area of Bangladesh, which is much less than the global target of 10%. Steps should be taken immediately to identify and declare a marine protected area network for Bangladesh along with effective management systems for these areas.

7. **Enhancing institutional capacity**. Development of a strong collaborative conservation constituency with fully trained and motivated staff is a condition for facilitating

effective implementation of the relevant updated policies. This should also develop research and monitoring capacity as an input to relevant policy advice and support to facilitate wise use of wetlands.

Making these strategic interventions and achieving a combination of sustainable use and restoration of eco-systems on and around St. Martin's Island are of obvious value for Bangladesh in terms of biodiversity. But there are greater strategic issues – geo-political and geo-physical – for which the Island is increasingly important.

St. Martin's Island is the far south-easternmost point of Bangladesh land, and as such it helps to define a substantial area of national territorial waters (within 12 nautical miles of the baseline) and the Bangladesh exclusive economic zone (within 200 nautical miles of the baseline) under the United Nations Convention on the Law of the Sea. If through unsustainable exploitation it were to lose its population, then there would be a significant loss of territorial waters of significance as a fishery and potentially for other off-shore resources such as natural gas. Moreover, the geomorphology of the lower Meghna delta is complex, there are signs of increasing turbidity but patterns of siltation and accretion frequently change, and may also in future be affected by climatic changes. The implications for the physical condition of the Island are equally uncertain. In this context it is vital to develop and follow an adaptive management approach that emphasises ensuring the resilience of the Island and

To conserve marine turtles Coastal and Wetland Biodiversity Management Project has established turtle hatcheries

Placing of the sea turtle eggs into the hatchery. *Md. Mahbubur Rahman*

associated marine ecosystems and the resilience and sustainability of human settlement on the Island.

8.2 International cooperation

Internationally the Indian Ocean-South East Asian Marine Turtle Memorandum of Understanding, to which Bangladesh is a signatory, puts in place a framework through which States of the Indian Ocean and South-East Asia region, as well as other concerned States, can work together to conserve and replenish depleted marine turtle populations for which they share responsibility. The Conservation and Management Plan, containing 24 programmes and 105 specific activities, focuses on reducing threats, conserving critical habitats, exchanging scientific data, increasing public awareness and participation, promoting regional cooperation, and seeking resources for implementation.

Bangladesh is also a signatory to the Ramsar Convention which places an obligation to ensure wise use of all wetlands, including coastal and marine wetlands. However, only two of our wetlands have so far been listed as wetlands of international significance. There are other opportunities for international collaboration in biodiversity conservation relevant to St. Martin's that Bangladesh has yet to take up, for example Bangladesh is not yet a member of the Partnership for the East Asian – Australasian Flyway, which seeks to coordinate protection of a network of sites used by migratory water birds through east Asia and Australasia (including Bangladesh).

Collecting litter from the beach

Coastal and Wetland Biodiversity Management Project Keya plantation

8.3 Government interventions on St. Martin's Island

In the past there was little government involvement in development changes on the Island. In 1995 the Government of Bangladesh declared St. Martin's Island as an Ecologically Critical Area (ECA). The management of ECAs falls under the jurisdiction of the Ministry of Environment and Forest (MoEF). Under the jurisdiction and supervision of the MoEF are the Forest Department, the Department of Environment (DoE) and several other agencies, with the management of ECAs mandated to DoE.

The MoEF initiated two projects that were expected to make the ECA effective and facilitate conservation of biodiversity. They are:

- "Conservation of Biodiversity, Marine Park Establishment and Ecotourism Development Project at St. Martin's Island" often abbreviated to St. Martin's Biodiversity Conservation Project (SMBCP).
- Coastal and Wetland Biodiversity Management Project (CWBMP)

Moreover, many NGOs have undertaken turtle conservation programmes on the Island. In order to conserve the rich fish biodiversity around St. Martin's Island, the Department of Fisheries has recently proposed to establish a fish sanctuary.

Since 1993 the Ministry of Environment and Forest has been executing the SMBCP through the National Conservation Strategy Implementation Project 1, for which

IUCN Bangladesh provides technical assistance. Baseline information for resource inventories was collected through surveys of fauna and flora, and preparation of base maps, through a programme that involved various universities and research institutes of the country. A coral reef management specialist also helped develop a Management Action Plan for the sustainable management of coral resources.

Concerns regarding the St. Martin's coral resources first came as one of the National Conservation Strategy (NCS) recommendations. The NCS recommendation for St. Martin's Island is as follows: "Declaration of St. Martin's Island and the Jinjira coral reef a Protected Area and development of a management plan". Thus for the conservation and sustainable use of coastal resources, including coral resources, of St. Martin's Island the establishment of a Marine Park has been proposed, but the implications for the inhabitants of the Island and feasibility of this are not clear.

The DoE is currently managing St. Martin's Island ECA through support of the Government of Bangladesh/ United Nations Development Programme/Global Environmental Facility funded Coastal and Wetland Biodiversity Management Project (CWBMP). The project, which started in 2002 and ends in 2010, has as its overall objective the establishment of an innovative system for the management of ECAs in Bangladesh that will have a significant and positive impact on the long term viability of the country's important biodiversity resources. As such there is currently only a temporary management structure in place for the Island through CWBMP, however one of the project's objectives is to support DoE efforts to institutionalise the management of ECAs.

Despite the ecological significance of the Island and these two projects, the government has failed to establish an effective protected area here. Unfortunately, the government has taken a single sector approach to St. Martin's Island, and this has contributed to particularly troublesome developments, for example it has left unregulated the rapid growth of tourism in terms both of visits and infrastructure. It is imperative that a management plan is formulated based on inter-government co-ordination and co-operation.

Participatory approach is an important part of any conservation activity

Meeting of Village Conservation Group

8.4 Potential approaches to environmental management

8.4.1 Co-management

Co-management or collaborative governance can be defined as "a situation in which two or more social actors negotiate, define and guarantee amongst themselves a fair sharing of the management functions, entitlements and responsibilities for a given territory, area or set of natural resources." (Borrini-Feyerabund et al., 2000). This approach to managing natural resources and conservation of biodiversity has become widespread internationally. In Bangladesh there is already considerable experience of "community based co-management" in freshwater fisheries and wetlands whereby local user communities have been strengthened and empowered by government with rights and responsibilities for managing specific areas within a framework of shared responsibilities and coordination with government (Thompson et al. 2003; Halder and Thompson, 2007). Coordination and cooperation among relevant authorities, organizations and agencies along with other stakeholders from private sector and local community is even more important if there is to be biodiversity conservation and sustainable development on St. Martin's Island. Here the role and reach of government is limited, for example land is a sensitive issue and considered to all be private, while government authority over the inter-tidal zone is unclear. The key management issue is to achieve a balance between development, tourism in particular, and natural resources conservation, taking into account the environmental costs and benefits.

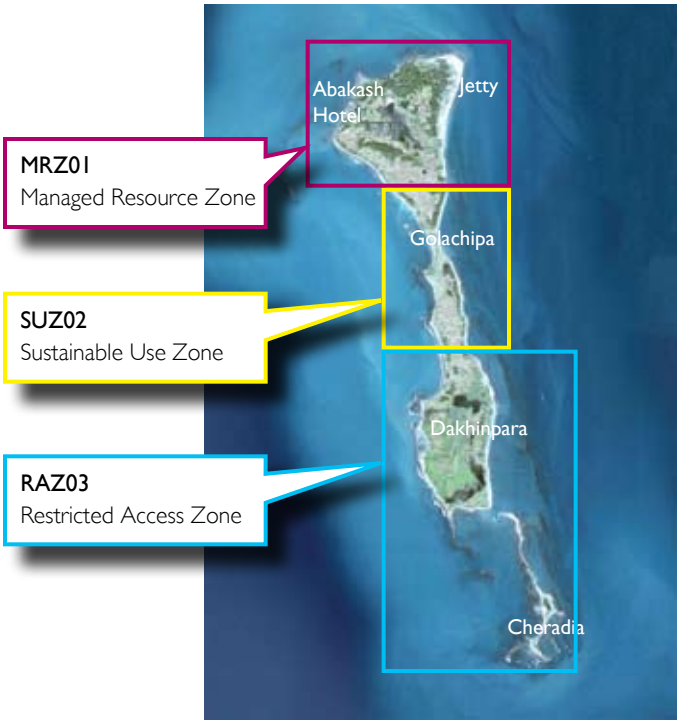
A strong and effective mechanism and forum for cooperation between all stakeholders in development and conservation is needed on the Island and at higher levels. This would most likely be in the form of a management committee, under the ECA framework/strategy being pursued through the CWBMP. This committee should have a clear objective of sustainable development that maintains and restores the biodiversity and ecology of the Island and has sufficient responsibility and authority to take relevant decisions in order to accomplish this objective.

Experience elsewhere in Bangladesh highlights the need for visible interventions and a meeting place/community centre for community participation in wetland management and conservation to be effective. On St. Martin's Island the office building constructed for the SMBCP now lies vacant, but it could easily be converted to serve multiple uses: as a collaborative management centre for regular community meetings, as well as acting as an interpretive centre for visitors and as a facility for visiting researchers.

8.4.2 Zoning

CWBMP has developed proposal for zoning of St. Martin's Island. The term "zoning" means dividing the Island (Ecologically Critical Area) into logical units for management and conservation purposes, with the aim of defining and limiting uses and acceptable development in each zone. The purpose of developing a zoning system for conservation is to create balance between biodiversity protection and economic development. The designation of a zoning system must reflect the natural and cultural values of the area as well as the current pattern of land use on the ground and the essential needs of local communities (Hebara, 2008).

A set of conservation zones has been developed by a Protected Areas Specialist through the CWBMP in direct consultation with local people and respecting both current land use patterns and conservation needs. The zoning plan was simplified to the maximum possible level to make it pragmatic for implementation. This zoning plan is in the process of being endorsed by government. It will then become the strategy of DoE in management of the Island ECA. It is an important



management tool developed by the competent authority to protect the core environmental values of the Island in a pragmatic manner while providing scope for sustainable development and alternative livelihood development for the Island community. It is expected to provide a "win-win" strategy between conservation and development, as it divides the island into two zones: 50% will be dedicated for conservation and 50% will be designated for sustainable development.

Some common conditions are to be set covering the whole Island ECA:

- An Environmental Clearance Certificate based upon an Environmental Impact Assessment will be required for any development project in the

Enforcing the zoning system will ensure conservation of biodiversity resources of St.Martin's Island

ECA. The approval of the ECA authority is mandatory for issuing an Environmental Clearance Certificate for any project located within the ECA boundaries.

- Any activity that could result in deterioration of the natural conditions of any zone of the ECA is strictly forbidden.

- Fishing activity should abide by the environmental rules; for instance, fishing with poisons or chemicals is strictly forbidden.

Managed Resource Zone

This zone covers the northern part of the Island (ECA) south to Golachipa and represents almost 25% of the total area of the ECA. It will function as a multiple-use zone where sustainable development is encouraged to ensure a sustainable flow of natural products and services for the local community without impinging upon the overall objective of the ECA. The key rules of this zone are:

- It will be open for sustainable economic activities with particular emphasis on organic farming, traditional uses, ecotourism, cultural activities and art-crafts production.

- Agricultural production and planting of native species should enjoy priority over exotic species (such as eucalyptus).

Sustainable Use Zone

This zone covers the middle part of St. Martin's Island and represents 25% of the total area of the Island.

Tourists should not have access to some areas of the Island of high importance to wildlife
Md. Mahbubur Rahman

It starts from the southern border of the managed resource zone and continues southward to end approximately 400 m north of the lagoon of Dakhinpara. This zone will form a buffer for the sensitive core zone in the southern part of the Island and will also serve the community by providing a sustainable flow of natural services and products through environmentally friendly projects such as organic farming, handcrafts production and ecotourism. It also provides opportunities for public enjoyment through recreation and environmental tourism within strict environmental regulations and carrying capacity. The western beach will be protected as a nesting area for marine turtles. The key regulations for this zone are:

- No more expansion of human settlements, development or infrastructure is allowed within this zone unless given special approval by the ECA authorities after due process through an Environmental Clearance Certificate.
- Non-destructive marine sports, such as snorkelling, are allowed in this area.
- Only native plants may be planted here as part of carefully planned ecosystem restoration.
- Alteration of natural features and landscape by collection of natural components is strictly prohibited.
- Any activity that could change the natural process of terrestrial or marine life is prohibited.

Fishing activities within 500m from the shore should be banned in the Southern part of the Island. *Md. Mahbubur Rahman*

- Educational and public awareness activities are permitted provided they meet conditions in the management plan.
- Low-profile ecotourism is encouraged in this zone within the carrying capacity set by an integrated plan.

Restricted Access Zone

This zone covers the southern part of the Island, known as Cheradia, and represents almost 50% of the total area of the Island. This zone possesses the ecological critical features for which the ECA was declared - coral-algal communities and coral associated biodiversity - and thus deserves strict protection. Within this zone are also patches of mangrove and other natural vegetation including seaweeds. The sandy beaches are important nesting grounds for marine turtles, and the zone also contains spawning and nursery grounds for marine fishes and shrimps. A range of crabs, molluscs and echinoderms such as sea stars and sea anemones also occur here. There is little development in this area yet but change threatens these fragile ecosystems. Hence it is expected to form a "Strict Nature Reserve" or category I protected area under IUCN's classification, dedicated for conservation and scientific research. The management strategy for this zone is to protect biodiversity and associated habitats, natural features and ecological processes in pristine conditions. The key additional regulations for this zone are;

- Human settlements and associated infrastructure and practices are not allowed.

Fishing boats can be converted to take tourists to see sealife *Quazi Hamidul Haque*

- Alteration of natural features and landscape is strictly prohibited, including collection of natural components,
- Cutting of mangrove trees is strictly forbidden
- Disposal of any pollutants, including solid wastes and oil, onto land, marine or estuarine water is strictly prohibited.
- Any activity that could change the natural process of terrestrial or marine life is prohibited.
- Hunting or disturbing wildlife in any form is strictly prohibited.
- A no fishing zone extends for 500 m from the shore.

Diving is a specialist tourist activity that is eco-friendly *Quazi Hamidul Haque*

The future of the next generation of the Island and their environment depend on implementing a sustainable development plan now
Quazi Hamidul Haque

8.5 Changing the pattern of unsustainable practices

8.5.1 Development of ecotourism

IUCN (Ceballos-Lascurain, 1996) defines ecotourism as "environmentally responsible travel and visitation to relatively undisturbed natural areas, in order to enjoy and appreciate nature (and any accompanying cultural features - both past and present) that promotes conservation, has low negative visitor impact, and provides for beneficially active socio-economic involvement of local populations." The International Ecotourism Society puts it simply as "responsible travel to natural areas that conserves the environment and sustains the well-being of local people". The attraction is nature, and often ecotourism promotes learning (about nature and local society and culture) as well as contributing to local development.

There is great scope for using ecotourism as a strategy for enhancing biodiversity conservation on St. Martin's Island and enhancing the livelihoods of local people by bringing tangible benefits to poor people who will thereby value and appreciate more this biodiversity. On the other hand tourism in its present form poses a great threat to this same biodiversity and is likely to destroy the longer term sustainability of local livelihoods for short term benefits to a few tourism businesses.

Any vision for sustainable tourism should consider the uniqueness and key features of the specific area. The aim for ecotourism in St. Martin's Island is to develop sustainable tourism that reflects local culture as well as the Bangladesh identity and respects local and national priorities and realities, taking into account the principles of nature conservation. It must be based on multi-sector cooperation and community involvement, while reflecting appropriate national development strategies and policies for economic and social development.

The actual carrying capacity of the Island for visitors is unknown. Tomascik (1997) estimated the real carrying capacity, i.e. physical carrying capacity corrected for the constraints of weather and sea conditions to be about 860 visits per day. The effective carrying capacity, i.e. the maximum number of visits that can be managed by the level of infrastructure such as lodgings, potable water, sanitary toilets, and garbage facilities could not be estimated. Most of these facilities did not exist then, and those that now exist are not well coordinated or regulated, so the effective carrying capacity is lower than 860 visits per day. According to Tomascik (1997) the local community tolerated 150-200 visits per day at that time. It is impossible to estimate the daily tourist visits from data available with the St. Martin's Island Project as these are whole-season figures and visits are not distributed evenly throughout the season. Based on the estimates for tourist visits to the Island in December 2005 and January 2006, there were around 500-833 visits to the Island daily. However, the local hotel owners association estimate over 60,000 visitors in 2007 and there are reports of in excess of 1,000 visitors regularly being present in the peak season. The current level of visitation is having an adverse impact on biodiversity, due to a lack of regulation of the activities of those that visit the site.

To maximise the benefits of tourism for biodiversity conservation there needs to be a greening of current conventional tourism on the Island, including the management of tourism within the carrying capacity of the site, and the development of ecotourism activities related directly to biodiversity conservation. The main management actions required for tourism include the development of a policy for tourism, regulation of tourists to minimise tourism's

adverse effects, certification and regulation of the tourism industry (hotels, restaurants, boats, guides) to clean up these enterprises and improve the experience of visitors, and the development of ecotourism opportunities including associated small-scale facilities.

Developing ecotourism on the Island requires a collaborative effort between the community, relevant government agencies and the private tourism sector. Ecotourism typically involves local communities in operating, owning or sharing in tourism enterprises. This may require facilitation and linkages with outside tourism businesses and experts to provide advice and inputs. The capacity of the local community to participate in tourism development and management needs to be built (for example training in the quality requirements for accommodation and food). Education to make local people and visitors aware of the ecological values that make the Island special will be essential, as will respect for the cultural norms of local people. Partnerships between the local community and other stakeholders need to be developed for joint enterprises in ecotourism. A plan for ecotourism development needs to be developed with the local community and other stakeholders. All opinions should be

Snorkelling should be popularized as an eco-friendly activity and source of alternative income for local people

considered, but the main principles of ecotourism development on the Island should be that it is community-based and must employ local community members.

Awareness raising among tourism providers regarding the impact tourism is currently having on the Island and its biodiversity values is the first step in greening the current conventional tourism. Tourism service providers in an ECA should be required to provide an environmentally-friendly service for tourists to enjoy. While directly raising environmental awareness of tourists is important, it is tourist service providers that can lead by example and provide the scope for tourists to have a limited impact on the site. Ecotourism best-practice standards for tourist service providers need to be developed and implemented. Service providers should be certified against these standards, with those not meeting the standards being removed from the Island.

8.5.2 Alternative livelihoods

Realistically, the local community cannot reduce their dependence on natural resources without alternatives, but fortunately there is sufficient scope for that in the ecotourism sector.

Involving local people in management can be done either

To protect the beauty of the only island of Bangladesh with coral communities, government should enforce environmental legislation

Responsible visits to St. Martin's Island will depend on limiting visitors number

by creating tourism rights at the community level or by ensuring that government planning processes are participatory and responsive to local needs. Given the limited present understanding and capacity of local people in conservation and ecotourism, the present priority is participatory planning.

Recent research shows that growing numbers of tourists would like more meaningful contact with local communities, including informative interactions. Diversifying tourism to meet this demand could provide low-cost economic opportunities for local people.

Ecotourism is a good catalyst for substantial involvement of local communities. There are many techniques to do this. The local community needs to come to value the natural environment and biodiversity of St. Martin's Island and subscribe to the implications of its designation as an ECA. Management and stewardship by the local community over natural resources has a vital role in the long-term survival of these resources. In many rural areas around the world, local inhabitants have shifted from being hunters and gatherers to working as ecotourism guides and this has raised their pride in their natural heritage.

8.5.3 Co-management and ecotourism guidelines

The following suggested guidelines would help to strengthen understanding and achieve better informed co-management between conservation authorities and the local community based on conservation, sustainable use and eco-tourism:

- Increase investment in capacity building and empowerment for local people and develop

educational and environmental awareness campaigns and training programs among the local community.

- Create an enabling environment that gives priority for locals over all development activities, provided these are consistent with sustaining biodiversity, for example encourage local employment through policies and incentives.

- Regulate tourism businesses to bring greater benefits to local people – for example by requiring that the majority of employees be local people (islanders).

- Facilitate greater local employment in tourism by providing training to prospective local workers and entrepreneurs in both hospitality skills and sustainability/ biodiversity.

- Minimize negative impacts of tourism on local culture by providing visitors with appropriate literature, briefings, leading by example, and taking corrective actions.

- Give opportunities to the local people to communicate with tourists, explaining their traditional perception of their environment.

- Carry out training programs for tour operators who work with the local community in order to minimize cultural shock and negative impacts.

- Diversify tourism experiences, for example consider ethnic tourism and agro-tourism activities as excellent complements of

ecotourism, and minimise conventional tourism.

- Encourage both direct and indirect benefits from tourism reaching local people, for example selling environmental handicrafts, and providing services and goods such as boat rides.

- Encourage and facilitate financial support, especially micro-credit schemes to community groups and individuals, and simplify forms and procedures for obtaining capital to start small appropriate tourism related enterprises.

- Ensure that independent and financially sustainable community businesses are enabled and not penalized by government.

- Develop with local co-managers simple participatory monitoring of trends in natural resource use and visitation.

- Encourage research on understudied faunal groups and zones of the Island.

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ANNEX I

Angiospermic plant species recorded at St Martin's Island (according to Molony *et al.*, 2006)

Sl. No.	Species Name	Local Name(s)	Family Name
1	*Abelmoschus moschatus*	Kalokasturi	Malvaceae
2	*Abrus precatorius*	Kunch	Leguminosae
3	*Acacia tamesiana*	Bilati babul	Leguminosae
4	*Achyranthes aspera*	Apang	Amaranthaceae
5	*Adenosma indianum*	Borokesuti	Scrophulariaceae
6	*Aegiceras corniculatum*	Halse	Myrsinaceae
7	*Ageratum conyzoides*	Fulkcuri	Compositae
8	*Altemanthera paronychiodes*		Amaranthaceae
9	*Altemanthera sessilis*	Chanchi	Amaranthaceae
10	*Alysicarpus vaginalis*	Pannata	Papilionaceae
11	*Amaranthus gangeticus*		Amaranthaceae
12	*Amaranthus spinosus*	Kantanotey	Amaranthaceae
13	*Amaranthus viridis*	Noteyshk	Amaranthaceae
14	*Amiscophcellus axillaris*		Commelinaceae
15	*Ammania baccifera*	Dadmari	Lythraceae
16	*Anisomeles indica*	Gobura	Ladiatae
17	*Atylosia scarabaeoides*	Banukalai	Leguminosae
18	*Bacopa monniera*	Brahmi shak	Scrophulariaceae
19	*Bergia ammannioides*		Elatinaceae
20	*Bergia capensis*	lalkesuria	Elatinaceae
21	*Blumea aurita*		Compositae
22	*Blumea laciniata*		Compositae
23	*Boetraavia repens*	*Punarnava*	*Nyctaginacae*

Sl. No.	Species Name	Local Name(s)	Family Name
24	*Brachiaria distachya*		Gramineae
25	*Caesalpinia crista*	Letkanta	Caesalpinoideas
26	*Calotropis gigantea*		Asclepiadaceae
27	*Calycopteris floribunda*	Akanda	Asclepiadaceae
28	*Canna indica*	Goache lata	Combretaceae
29	*Canscora diffusa*	kalabati	Cannaceae
30	*Carissa carandas*	kanrancha	Gentianaceae
31	*Cassia occidentalis*	Borokalkesunda	Laguminosae
32	*Cassia tora*	Toraj	Laguminosae
33	*Cassytha filiformis*	Akashbel	Cassythaceae
34	*Cassia occidentalis*	Borokalkesunda	Laguminosae
35	*Cyperus compressus*	chancha	Cyperaceae
36	*Cyperus iria*	Bara chancha	Cyperaceae
37	*Cyperus kyllinga*	Nirbishi	Cyperaceae
38	*Cyperus sp.*		Cyperaceae
39	*Cyperus substramineus*		Cyperaceae
40	*Cyperus tenuispica*		Cyperaceae
41	*Cyrtococcum accrescens*		Gramineae
42	*Dactyloctenium aegyptiacum*	Makra	Gramineae
43	*Datura metel*	Duttara	Solanaceae
44	*Dentella repens*	Bhuopat	Rubiaceae
45	*Derris sp.*		Legumosae
46	*Desmodium triflorum*	Kulaliya	Legumosae
47	*Desmodium umbellatum*		Legumosae
48	*Digitaria longiflora*		Gramineae
49	*Dimeria ornithopoda*		Gramineae
50	*Echinochloa colounm*	Shymaghas	Gramineae
51	*Echinochloa colonum*	*Kalokeshi*	*Compositae*

Sl. No.	Species Name	Local Name(s)	Family Name
52	*Eleocharis congesta*	*Baro keruti*	*Cyperaceae*
53	*Eleusine indica*	*Malangakuri*	*Gramineae*
54	*Eragrostis coarctata*		*Gramineae*
55	*Eragrostis pooides*		*Gramineae*
56	*Eragrostis tenella*	*koni*	*Gramineae*
57	*Eriocaulon luzulaefolium*		*Eriocaulaceae*
58	*Eriocaulon sp.*		*Eriocaulaceae*
59	*Eriochloa procera*	*Nalghas*	*Gramineae*
60	*Euphorbia hirta*	*Ghaspata*	*Euphorbiaceae*
61	*Euphorbia thymifolia*	*Dudhia*	*Euphorbiaceae*
62	*Ficus sp.*		*Moraceae*
63	*Fimbristylis acuminata*		*Cyperaceae*
64	*Fimbristylis miliacea*	*Bara jabani*	*Cyperaceae*
65	*Flagellaria indica*	*Banschand*	*Flagellariaceae*
66	*Glycine max*	*Soabean*	*Leguminosae*
67	*Grangea herbaceum*	*Karpas*	*Malvaceae*
68	*Grangea madaraspatana*	*Nagphul*	*Compositae*
69	*Grewia sp.*		*Tiliaceae*
70	*Hedyotis corymbosa*	*Khet papra*	*Rubiaceae*
71	*Hiliotropium indicum*	*Hatishur*	*Boraginaceae*
72	*Hibiscus tiliaceus*	*Bola*	*Malvaceae*
73	*Hydrocotyle sibthorpioides*		*Umbrelliferae*
74	*Hygrophila phlomoides*		*Acanthaceae*
75	*Hygrophila polysperma*		*Acanthaceae*
76	*Hygrophila quadrivalvis*		*Acanthaceae*
77	*Hyptis suaveolens*		*Labiatae*
78	*Ichnocarpus frutescens*		*Apocynaceae*
79	*Ipomaea mexicana*	*Dudlata*	*Convolvulaceae*

Sl. No.	Species Name	Local Name(s)	Family Name
80	*Ipomaea pes-caprae*		*Convolvulaceae*
81	*Ischacmun indicum*		*Gramineae*
82	*Jatropha curcas*		*Euphorbiaceae*
83	*Justicia genderussa*		*Acanthaceae*
84	*Lantana camara*		*Verbebnaceae*
85	*Launaea pinnaifida*		*Compositae*
86	*Leucas zeylanica*		*Labiatae*
87	*Limnophila repens*	*Dondokalas*	*Scrophulariaceae*
88	*Lindernia antipoda*		*Scrophulariaceae*
89	*Lindernia rotundifolia*		*Scrophulariaceae*
90	*Lindernia sp.*		*Scrophulariaceae*
91	*Linum usitatissimum*		*Linaceae*
92	*Ludwigia hyssopifolia*		*Onagraceae*
93	*Luffa cylindrica*		*Cucurbitaceae*
94	*Lumnitzera racemosa*		*Combretaceae*
95	*Merremia umbellata*		*Convolvulaceae*
96	*Murdannia nudiflora*		*Commelinaceae*
97	*Najas graminea*		*Najadaceae*
98	*Operculina turpethum*		*Convolvulaceae*
99	*Oroxylum indicum*		*Bignoniaceae*
100	*Pandanus foetidus*		*Pandanaceae*
101	*Pandanus odoratissimus*		*Pandanaceae*
102	*Paspalum vaginatum*		*Gramineae*
103	*Phaulopsis dorsiflorus*		*Acanthaceae*
104	*Phragmites karka*		*Gramineae*
105	*Phyla nodiflora*		*Verbebnaceae*
106	*Phyllanthus distichus*		*Euphorbiaceae*
107	*Phyllanthus reticulatus*		*Euphorbiaceae*

Sl. No.	Species Name	Local Name(s)	Family Name
108	*Physalis minima*		*Solanaceae*
109	*Pongamia pinnata*		*Leguminosae*
110	*Portulaca oleracea*		*Portulacaceae*
111	*Pouzolzia indica*		*Urticaceae*
112	*Psophocarpus tetragonolobus*		*Leguminosae*
113	*Ricinus communis*		*Euphorbiaceae*
114	*Rotala beccifera*		*Lythraceae*
115	*Rotala indica*		*Lythraceae*
116	*Rungia pectinata*		*Acanthaceae*
117	*Saccharum arundinaceum*		*Gramineae*
118	*Scirpus erectus*		*Cyperaceae*
119	*Scirpus supinus*		*Cyperaceae*
120	*Scirpus triqueter*		*Cyperaceae*
121	*Scoparia dulcis*		*Scrophulariaceae*
122	*Sesuvium protulacastrum*		*Aizoaceae*
123	*Side acuta*		*Malvaceae*
124	*Sida cordifolia*		*Malvaceae*
125	*Sida cordata*		*Malvaceae*
126	*Solanum torvum*		*Solanaceae*
127	*Sporobolus tremulus*		*Gramineae*
128	*Stictocardia tiliaefolia*		*Convolvulaceae*
129	*Streblus asper*		*Urticaceae*
130	*Tephrosia purpurea*		*Leguminosae*
131	*Tetrastigma bracteolatum*	*Bon nil*	*Vitaceae*
132	*Thespesia populnea*		*Malvaceae*
133	*Tinospora cordifolia*		*Menispermaceae*
134	*Triumfetta bracteata*		*Tiliaceae*
135	*Urena lobata*		*Malvaceae*

Sl. No.	Species Name	Local Name(s)	Family Name
136	*Vemonia patula*	*Kuksin*	*Compositae*
137	*Vitex negundo*		*Verbenaceae*
138	*Vitex trifolia*		*Verbenaceae*
139	*Vitex negundo*	*Nishinda*	*Vitaceae*
140	*Wahlenbergia gracilis*		*Companulaceae*
141	*Wahlenbergia marginata*		*Companulaceae*
142	*Woodfordia fruticosa*		*Lythraceae*
143	*Xanthium indicum*	*Dhai phul*	*Compositae*
144	*Zizphus mauitiana*	*Kulaiya*	*Rhamnaceae*

ANNEX 2

Marine algae recorded at St Martin's Island (according to Molony *et al.*, 2006)

Sl. No.	Species Name	Family Name	Status
1	*Acrochaetium bengalicum*	Rhodophyceae	VU
2	*Acrochaetium crassipes*	Rhodophyceae	VU
3	*Goniotrichum alsidii*	Rhodophyceae	VU
4	*Erythrocladia subintegra*	Rhodophyceae	VU
5	*Erythrotrichia carnea*	Rhodophyceae	VU
6	*Liagora ceranoides*	Rhodophyceae	VU
7	*Actinotrichia fragilis*	Rhodophyceae	VU
8	*Scinaia complanate*	Rhodophyceae	VU
9	*Galaxaura fastigiata*	Rhodophyceae	VU
10	*Gelidiella tenuissima*	Rhodophyceae	VU
11	*Gelidium pusillum*	Rhodophyceae	VU
12	*Jania adhaerens*	Rhodophyceae	VU
13	*Jania ungulata*	Rhodophyceae	VU
14	*Amphiroa fragilissima*	Rhodophyceae	VU
15	*Melobesia confervicola*	Rhodophyceae	VU
16	*Hypnea musciformis*	Rhodophyceae	VU
17	*Hypnea pannosa*	Rhodophyceae	VU
18	*Sarconema jurcellatum*	Rhodophyceae	VU
19	*Catenella impudica*	Rhodophyceae	VU
20	*Champia parvula*	Rhodophyceae	VU
21	*Chrysymenia okamuri*	Rhodophyceae	VU
22	*Halymania duchassaignii*	Rhodophyceae	VU
23	*Asparagopsis taxiformis*	Rhodophyceae	VU

Sl. No.	Species Name	Family Name	Status
24	*Antithamnion sp.*	Rhodophyceae	VU
25	*Callithamnion sp.*	Rhodophyceae	VU
26	*Centroceras clavulatum*	Rhodophyceae	VU
27	*Ceramium fastigiatum*	Rhodophyceae	VU
28	*C. gracillimum*	Rhodophyceae	VU
29	*C. tenerrimum + other spp.*	Rhodophyceae	VU
30	*Dasya pedicillata*	Rhodophyceae	VU
31	*Calliblepharis sp.*	Rhodophyceae	VU
32	*Heterosiphonia sp.*	Rhodophyceae	VU
33	*Caloglossa leprieuri*	Rhodophyceae	VU
34	*Vanvoorstia coccinea*	Rhodophyceae	VU
35	*Cottoniella filamentosa*	Rhodophyceae	VU
36	*Polysiphonia denudata*	Rhodophyceae	VU
37	*Polysiphonia mollis*	Rhodophyceae	VU
38	*Tolypiocladia glomerulata*	Rhodophyceae	VU
39	*Acanthophora specifera*	Rhodophyceae	VU
40	*Bos trychia radicans*	Rhodophyceae	VU
41	*Bostrychia tenella*	Rhodophyceae	VU
42	*Herposiphonia dendroidea var.*	Rhodophyceae	VU
43	*Herposiphonia tenella fa. Secumda*	Rhodophyceae	VU
44	*Laurencia obtusa + other spp.*	Rhodophyceae	VU
45	*Lithothamnion sp.*	Rhodophyceae	VU
46	*Crouania attenuata*	Rhodophyceae	VU
47	*Lophocladia trichociados*	Rhodophyceae	VU
48	*Ectocarpus breviarticulatus*	Phaeophyceae	VU
49	*E. rhodochortonoides + other sp.*	Phaeophyceae	VU

Sl. No.	Species Name	Family Name	Status
50	*Giffordia irregularis*	Phaeophyceae	VU
51	*Giffordia mitchellae*	*Phaeophyceae*	VU
52	*Giffordia rallsae*	*Phaeophyceae*	VU
53	*Giffordia thyrsoideus*	*Phaeophyceae*	VU
54	*Feldmannia columellaris*	Phaeophyceae	VU
55	*Feldmannia elachistaeformis*	Phaeophyceae	VU
56	*Feldmannia indica*	*Phaeophyceae*	VU
57	*Feldmannia vaughani*	Phaeophyceae	VU
58	*Sphacelaria tribuloides*	Phaeophyceae	VU
59	*S.novae-hollandiae fa.*	*Phaeophyceae*	VU
60	*Dectyota bratayresii*	*Phaeophyceae*	VU
61	*Dectyota dechotoma*	*Phaeophyceae*	VU
62	*Dectyota divaricata*	Phaeophyceae	VU
63	*Dectyota friabilis*	Phaeophyceae	VU
64	*Dectyota patens*	*Phaeophyceae*	VU
65	*Dictyopteris australis*	*Phaeophyceae*	VU
66	*Dictyopteris sp.*	*Phaeophyceae*	VU
67	*Lobophora variegata*	*Phaeophyceae*	VU
68	*Padina australis*	*Phaeophyceae*	VU
69	*Padina tenuis*	Phaeophyceae	VU
70	*Padina gymnospora*	*Phaeophyceae*	VU
71	*Padina pavonica*	*Phaeophyceae*	VU
72	*Padina sanctae-crucis*	*Phaeophyceae*	VU
73	*Padina tetrastromatica*	Phaeophyceae	VU
74	*Padina vickersiae*	Phaeophyceae	VU
75	*Myriactula aravica*	Phaeophyceae	VU
76	*Chnoospora implexa*	Phaeophyceae	VU
77	*Colpomenia sinuosa*	Phaeophyceae	VU

Sl. No.	Species Name	Family Name	Status
78	*Hydroclathrus clathratus*	Phaeophyceae	VU
79	*Rosenvingea intricata*	*Phaeophyceae*	VU
80	*Rosenvingea orientalis*	Phaeophyceae	VU
81	*Rosenvingea sanctae-crucis*	Phaeophyceae	VU
82	*Sargassum caryophyllum*	Phaeophyceae	VU
83	*Sargassum flavicans*	Phaeophyceae	VU
84	*Sargassum ilicifolium*	Phaeophyceae	VU
85	*Sargassum piluliferum*	Phaeophyceae	VU
86	*Sargassum vulgare*	Phaeophyceae	VU
87	*Sargassum wightii*	*Phaeophyceae*	VU
88	*S. spp. (unidentified)*	Phaeophyceae	VU
89	*Enteromorpha clathrata*	Chlorophyceae	VU
90	*Enteromorpha compressa*	Chlorophyceae	VU
91	*Enteromorpha intestinalis*	Chlorophyceae	VU
92	*Enteromorpha prolifera*	Chlorophyceae	VU
93	*Ulva lactuca*	Chlorophyceae	VU
94	*Chaetomorpha aerea*	Chlorophyceae	VU
95	*Chaetomorpha brachygona*	Chlorophyceae	VU
96	*Chaetomorpha gracilis*	Chlorophyceae	VU
97	*Chaetomorpha linum*	Chlorophyceae	VU
98	*Lola capillaris*	Chlorophyceae	VU
99	*Lola implexa*	Chlorophyceae	VU
100	*Lola tortuosa*	Chlorophyceae	VU
101	*Rhizoclonium grandae*	Chlorophyceae	VU
102	*Rhizoclonium hookeri*	Chlorophyceae	VU
103	*Rhizoclonium kerneri*	Chlorophyceae	VU
104	*Rhizoclonium riparium*	Chlorophyceae	VU
105	*Cladophora echinus*	Chlorophyceae	VU

Sl. No.	Species Name	Family Name	Status
106	*Cladophora patentiramea*	Chlorophyceae	VU
107	*Dictyosphaeria cavernosa*	Chlorophyceae	VU
108	*Boodlea composita*	Chlorophyceae	VU
109	*Bryopsis indica*	Chlorophyceae	VU
110	*Caulerpa cactoides*	Chlorophyceae	VU
111	*Caulerpa peltata*	Chlorophyceae	VU
112	*Caulerpa racemosa var. clavifera*	Chlorophyceae	VU
113	*Caulerpa racemosa var. occidentalis*	Chlorophyceae	VU
114	*Caulerpa racemosa var. turbinata*	Chlorophyceae	VU
115	*Caulerpa racemosa var. turbinata uvifera*	Chlorophyceae	VU
116	*Caulerpa sealpelliformis*	Chlorophyceae	VU
117	*Caulerpa sertularioides*	Chlorophyceae	VU
118	*Caulerpa sertularioides fa. Brevipes*	Chlorophyceae	VU
119	*Caulerpa taxifolia*	Chlorophyceae	VU
120	*Halimeda discoidea*	Chlorophyceae	VU
121	*Halimeda opuntia*	Chlorophyceae	VU
122	*Acetabularia calyculus*	Chlorophyceae	VU
123	*Codium geppei*	Chlorophyceae	VU
124	*Xenococcus chaetomorphae*	Chlorophyceae	VU
125	*Xenococcus cladophorae*	Chlorophyceae	VU
126	*Aphanothece castagnei & A. pallida.*	Chlorophyceae	VU
127	*Merismopedia glauca*	Chlorophyceae	VU
128	*Ocillatoria amoena*	Chlorophyceae	VU

Sl. No.	Species Name	Family Name	Status
129	*Ocillatoria margaretifera*	Chlorophyceae	VU
130	*Ocillatoria martini*	Chlorophyceae	VU
131	*Ocillatoria subbrevis*	Chlorophyceae	VU
132	*Ocillatoria tenuis*	Chlorophyceae	VU
133	*Lyngbya allorgei*	Chlorophyceae	VU
134	*L. confervoides & L. contorta*	Chlorophyceae	VU
135	*L. hieronymusii*	Chlorophyceae	VU
136	*L. hlutea*	Chlorophyceae	VU
137	*L. magnifica*	Chlorophyceae	VU
138	*Hydrocoleum cantharidosum*	Chlorophyceae	VU
139	*Microcoleus chthonoplastes*	Chlorophyceae	VU
140	*Plectonema wollei*	Chlorophyceae	VU
141	*Anabaena variabilis*	Chlorophyceae	VU
142	*Nostoc commune (?)*	Chlorophyceae	VU
143	*Scytonema siculum*	Chlorophyceae	VU
144	*Scytonema saleyeriense*	Chlorophyceae	VU
145	*Calothrix confervicola*	Chlorophyceae	VU
146	*Calothrix parasitica*	Chlorophyceae	VU
147	*Calothrix crustacea*	Chlorophyceae	VU
148	*Calothrix scopulorum*	Chlorophyceae	VU
149	*Calothrix rarietina*	Chlorophyceae	VU
150	*Halophila decipiens*	Hydrocharitaceae	VU
151	*Halodule pinifolia*	Cymodoceaceae	VU
152	*Halodule uninervis*	Cymodoceaceae	VU

ANNEX 3

Some of the marine invertebrates recorded from St. Martin's Island

ECHINODERMS (Crinoids, Stars, Sea Urchins and Sea Cucumbers)

Class (Sub Class)	Order (suborder)	Family (subfamily)	Species Name	Common name
(Subphylum: Crinozoa) Crinoida	Comatulida	Colobometridae	1. *Cenometra bella*	Feather stars
		Mariametridae	2. *Stephanometra indica*	Feather stars
		Tropiometridae	3. *Tropiometra afra*	Feather stars
(Subphylum: Asterozoa) Stellaroida	Valvatida	Oreasteridae	*4. Protoreaster sp.*	Horned sea star
(Subphylum: Echinozoa) Echinoidea	Echinoida	Echinometridae	*5. Echinometra mathaei*	Matha's Sea Urchin
			6. Echinostrephus aciculatus	Needle Spined Sea Urchin
		Diadematidae	*7. Echinortrix calamaris*	Banded Sea Urchin
Holothuroidea	Aspidochirotida	Holothuriidae	*8. Holothuria atra*	Sea cucumber

CRABS (Class: Crustacea)

Order (Suborder)	Family (Subfamily)	Species Name (Synonym)	Common Name
Decapoda (Infraorder: Brachyura)	Xanthidae	*1. Atergatis integerrimus*	Red Egg Crab
	Calappidae	*2. Matuta lunaris*	Moon Crab
		3. Matuta planipes	Flower Moon Crab
	Portunidae	*4. Charybdis feriatus*	Crucifix Crab
		5. Portunus pelagicus	Flower Crab
		6. Portunus sanguinolentus	Three-spot Swimming Crab
		7. Scylla serrata	Giant Mud Crab
		8. Thalamita crenata	Crenate Swimming Crab
	Ocypodidae	*9. Dotilla myctiroides*	Soldier Crab
		10. Ocypode ceratophthalma	Horned Ghost Crab

ANNEX 4

Reptiles recorded at St. Martin's Island (according to Molony *et al*., 2006)

Sl. No.	Scientific name	Common name	Local name
ORDER: TESTUDINES; family: Geoemydidae			
1	*Pangshura tecta*	Indian Roofed Turtle	*Kaitta*
ORDER: TESTUDINES; family: Trionychidae			
2	*Lissemys punctata*	Spotted Flapshell Turtle	*Sundi kachim*
ORDER: TESTUDINES; family: Cheloniidae			
3	*Caretta caretta*	Loggerhead Turtle	*Sagar kachim*
4	*Chelonia mydas*	Green Turtle	*Sagar kachim*
5	*Eretmochelys imbricata*	Hawksbill Turtle	*Sagar kachim*
6	*Lepidochelys olivacea*	Olive Ridley Turtle	*Sagar kachim*
ORDER: TESTUDINES; family: Dermochelyidae			
7	*Dermochelys coriacea*	Leatherback Turtle	*Sagar kachim*
ORDER: SQUAMATA; family: Agamidae			
8	*Calotes versicolor*	*Common Garden Lizard*	*Rokto chosha*
ORDER: SQUAMATA; family: Gekkonidae			
9	*Hemidactylus brookii*	*Spotted House Lizard*	*Tiktiki*
ORDER: SQUAMATA; family: Scincidae			
10	*Eutropis carinatus*	Common or Brahmany Skink	Anjon
11	*Mabuya dissimilis*	Striped Skink	Anjon
ORDER: SQUAMATA; family: Varanidae			
12	*Varanus bengalensis*	Bengal Monitor	Kalo godi
13	*Varanus salvator*	Ring Lizard or Water Monitor	Guishap

Sl. No.	Scientific name	Common name	Local name
ORDER: SQUAMATA; family: Colubridae			
14	*Amphiesma stolata*	Striped Keelback	Dhora shap, Jal bora
15	*Cerberus rynchops*	Dog-faced Water Snake	Kukur mukhi
16	*Coelognathus radiatus*	Copper-headed Trinket Snake	Arbeki
17	*Dendrelaphis pictus*	Painted Bronzeback Tree Snake	Sutanoli
18	*Enhydris enhydris*	Common Smooth Water Snake	Pani shap
19	*Ptyas mucosa*	Indian Rat Snake	Darash
20	*Xenocrophis piscator*	Checkered Keelback	Dhora
ORDER: SQUAMATA; family: Elapidae			
21	*Bungarus fasciatus*	Banded Krait	Shankhini
22	*Naja kaouthia*	Monocellate Cobra	Kahya gokhra
23	*Naja naja*	Common or Binocellate Cobra	Padma gokhra
ORDER: SQUAMATA; family: Hydrophidae			
24	*Disteira nigrocinctas*	Daudin's Sea Snake	Samudra sap
25	*Enhydrina schistosa*	Hook-nosed Sea Snake	Samudra sap
26	*Hydrophis cyanocinctus*	Annulated Sea Snake	Samudra sap
27	*Hydrophis fasciatus*	Striped or Banded Sea Snake	Samudra sap
28	*Microcephalophis gracilis*	Narrow-headed Sea Snake	Rangila samudra sap

Species list has been reordered following the scientific order and species names used in Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A. and Khondker, M. (eds.) (2009) *Encyclopedia of flora and fauna of Bangladesh. Vol. 25 Amphibians and Reptiles.* Dhaka: Asiatic Society of Bangladesh.

ANNEX 5

Fish recorded at St. Martin's Island (Accoording to Molony *et al.*, 2006)

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
Orectolobiformes (Lamniformes)			
1. Orectolobidae	*1. Stegostoma fasciatum*	Tiger Shark	Bagha hangor
2. Rhincodontidae	*2. Rhincodon typus*	Whale Shark	Timi hangor
Carcharhiniformes			
3. Carcharhinidae	*3. Hemipristis elongata (Carcharhinus ellioti)*	Snaggletooth shark	Hangor
	4. Rhizoprionodon acutus (Scoliodon walbeehmii)	Milk shark	Nak-chokha hangor
	5. Scoliodon laticaudus (Scoliodon sorrakowah)	Spadenose shark	Thutee hangor
4. Sphyrnidae	*6. Eusphyra blochii (Sphyrna blochii)*	Hammerheaded shark	Haturimatha hangor
Rhinobatiformes			
5. Rhinobatidae	*7. Rhinobatos granulatus*	Shovelnose ray	Pitambori
Torpediniformes			
6. Torpedinidae	*8. Narcine brunnea*	Brown electric fish	Badami biddut machh

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
Rajiformes			
7. Dasyatidae	*9. Dasyatis (Himantura) uarnak*	Coach whip ray	Dora-leja housh
	10. Dasyatis (Himantura) walga	Housh pata	Sapla pata
	11. Taeniura lymma	Blue spotted ray	Padmamani
	12. Gymnura micrura	Short-tail butterfly	
Myliobatiformes			
8. Myliobatidae	*13. Aetobatus narinari*	Spotted eagle ray	Chil mach
9. Rhinopteridae	*14. Rhinoptera neglecta**	Australian cownose ray	Chil mach
10. Mobulidae	*15. Manta birostris*	Manta ray	Deo mach
Anguilliformes			
11. Muraenidae	*16. Gymnothorax puntatus*	White spotted moray	Bamosh
	17. Gymnothorax sp.	Black spotted moray	Bamosh
12. Congridae	*18. Congresox telabonoides*	Indian pike-conger	Kamilla mach
Clupeiformes			
13. Engraulidae	*19. Stolephorus commersoni*	Commerson's anchovy	Hitchiri
	20. Stolephorus indicus	Indian anchovy	Hitchiri
	21. Thryssa dussumieri	Dussumier's thryssa	Pati phaissa

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
	22. Thryssa hamiltoni	Hamilton's thryssa	Ram phaissa
	23. Thryssa setirostris	Longjaw thryssa	Datne phasya
	24. Coilia dussumieri	Gold-spotted anchovy	Alua
	25. Coilia neglecta	Neglected grenadier anchovy	Alua
	26. Coilia ramcarati	Ramcarat grenadier anchovy	Alua
14. Pristigasteridae	*27. Ilisha elongata*	Elongate ilisha	Choikka
	28. Ilisha megaloptera	Bigeye ilisha	Choikka
	29. Ilisha melastoma	Indian ilisha	Choikka
	30. Pellona ditchela	Indian pellona	Choikka
	31. Raconda russeliana	Raconda	Fatra phaissa
15. Chirocentridae	*32. Chirocentrus dorab*	Dorab wolf herring	Korati chella
	33. Chirocentrus nudus	Whitefin wolf-herring	Korati chella
16. Cluipeidae	*34. Dussumieria acuta*	Rainbow sardine	Naillah
	35. Sardinella fimbriata	Fringescale sardinella	Chanda
	36. Tenualosa ilisha	Hilsa shad	Ilish
Siluriformes			
17. Bagridae	*37. Mystus gulio*	Catfish	Guilla

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
18. Ariidae	*38. Arius arius*	Threadfin sea catfish	Kata mach
	39. Arius dussumeiri	Blacktip sea catfish	Mos mach
	40. Arius gagora	Gagora catfish	Guizza
	41. Arius nenga	Catfish	Kata gagot
	42. Arius thalassinus	Giant sea catfish	Guizza
	43. Arius thunbergi (Arius maculatus)	Spotted catfish	Mos mach
	44. Arius parvipinnis	Catfish	Kata pini
19. Plotosidae	*45. Plotosus canius*	Grey eel-catfish	Kaun mach
Aulopiformes			
20. Synodontidae	*46. Saurida tumbil*	Greater lizardfish	Achila mach
	47. Trachinocephalus myops	Snakefish	Bele
	48. Harpadon nehereus	Bombay duck	Loitta
Mugiliformes			
21. Mugilidae	*49. Liza parsia*	Gold-spot mullet	Bata
	50. Mugil cephalus	Flathead mullet	Kharul bata
	51. Rhinomugil corsula	Corsula mullet	Khorsula
	52. Sicamugil cascasia	Yellowtail mullet	Bata
Beloniformes			
22. Hemiramphidae	*53. Rhynchorhamphus georgii (Hemiramphus georgii)*	Halfbeak	Ek thuitta

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
23. Exocoetidae	54. Exocoetus volitans	Tropical two-wing flyingfish	Ural mach
24. Belonidae	*55. Ablennes hians*	Flat needlefish	Thuitta mach
	56. Tylosurus crocodilus	Hound needlefish	Thuitta mach
	57. Strongylura strongylura (Tylosurus strongylurus)	Spottail needlefish	Thuitta mach
Cyprinodontiformes			
25. Aplocheilidae	*58. Aplocheilus panchax*	Blue panchax	Techoukka
Atheriniformes			
26. Atherinidae	*59. Atherinomorus lacunosus (Allanetta forskali)*	Hardyhead silverside	
27. Holocentridae	*60. Myripristis vittata*	Whitetip soldierfish	
	61. Sargocentron sp.	Squirrel fish	
Syngnathiformes			
28. Syngnathidae	*62. Hippocampus kuda*	Spotted seahorse	Ghora mach
Scorpaeniformes			
29. Scorpaenidae	*63. Pterois russelii*	Plaintail turkeyfish	Rongila
30. Tetrarogidae	*64. Tetraroge niger (Apistus niger)*		
31. Synanceiidae	*65. Minous monodactylus*	Grey stingfish	Butar mach
32. Platycephalidae	*66. Grammoplites scaber*	Rough flathead	Mur baila

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
Perciformes (Percoidei)			
33. Latidae	*67. Lates calcarifer*	Barramundi	Koral mach
34. Serranidae	*68. Cephalopholis boenak*	Chocolate hind	Chitra bole
35. (Epinephelinae)	*69. Epinephelus hexagonatus*	Starspotted grouper	
	70. Epinephelus lanceolatus	Giant grouper	Koral bole
	71. Epinephelus quoyanus (Epinephelus megachir)*	Longfin grouper	
	72. Epinephelus polyphekadion	Camouflage grouper	
	*73. Plectropomus leopardus**	Leopard coralgrouper	
36. Priancanthidae	*74. Priacanthus tayenus*	Purple-spotted bigeye	
37. Apogonidae (Apogoninae)	*75. Apogon novemfasciatus*	Sevenstriped cardinalfish	
	76. Apogon septemstriatus	Cardinalfish	Gogla
	77. Apogon sp.1	Cardinalfish	
	78. Apogon sp.2	Cardinalfish	
38.Sillaginidae	*79. Sillaginopsis panijus (Sillago domina)*	Flathead sillago	Tulardandi
	80. Sillago sihama	Silver sillago	Hundra
39. Malacanthidae	*81. Malacanthus sp.*	*Quakerfish*	

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
40. Lactaridae	82. Lactarius lactarius	False trevally	Sada mach
41. Echeneididae	83. Echeneis naucrates	Live sharksucker	Hangor chat
42. Rachycentridae	84. Rachycentron canadum	Cobia	Samudra gojar
43. Carangidae	*85. Alepes melanoptera*	Blackfin scad	Doramouri
	86. Alectis indicus	Indian threadfish	Fakir mach
	87. Carangoides malabaricus	Malabar trevally	Malabar mouri
	88. Caranx ignobilis	Giant trevally	Boro mouri
	89. Caranx melampygus	Bluefin trevally	Boga mouri
	90. Megalaspis cordyla	Torpedo scad	Kawa mouri
	91. Parastromateus niger	Black pomfret	Kala chanda
	92. Scomberoides commersonnianus	Talang queenfish	Futi chapa
	93. Selar boops	Oxeye scad	Sonali mouri
	94. Selar crumenophthalmus (Caranx crumenophthalmus)	Bigeye scad	Choukka mouri
	95. Seriolina nigrofasciata (Zonichthys nigrofasciata)	Blackbanded trevally	Bedo mach
44. Menidae	96. Mene maculata	Moonfish	Chan chanda

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
45. Leiognathidae	*97. Gazza minuta*	Toothed ponyfish	Deto chanda
	98. Leiognathus bindus	Orangefin ponyfish	Kamala chanda
	99. Leiognathus fasciatus	Striped ponyfish	Tek chanda
46. Lutjanidae	*100. Lutjanus fulviflammus*	Dory snapper	
	101. Lutjanus johnii	John's snapper	Ranga koi
	102. Lutjanus malabaricus	Malabar blood snapper	Ranga koi
	103. Lutjanus sanguineus	Humphead snapper	Ranga koi
	104. Lutjanus vitta	Brownstripe red snapper	
	105. Lutjanus sp. 1	(One spot snapper)	
	106. Lutjanus sp. 2	(Yellow belly snapper)	
47. Caesionidae	*107. Caesio xanthonota*	Yellowback fusilier	
48. Lobotidae	108. Lobotes surinamensis	Tripletail	Sagor koi
49. Gerreidae	*109. Gerres argyreus*	Common mojarra	Dome mach
	110. Gerres filamentosus	Whipfin silverbiddy	Dome mach
50. Haemulidae	*111. Plectorhinchu sp.1*	Sweetlips	

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
	112. Plectorhinchu sp.2	Sweetlips	
	113. Pomadasys argenteus (Pomadasys hasta)	Silver grunt	Nak koral
	114. Pomadasys maculatus	Saddle grunt	Guti datina
51. Sparidae	*115. Argyrops spinifer*	King soldierbream	Lal datina
52. Lethrinidae	*116. Lethrinus erythracanthus*	Orange-spotted emperor	
	117. Lethrinus olivaceus	Longface emperor	
	118. Lethrinus ornatus	Ornate emperor	Lal mach
53. Nemipteridae	*119. Nemipterus japonicus*	Japanese threadfin bream	Rupban
	120. Scolopsis osmeri	Whitecheek monocle bream	Tolin mach
	121. Scolopsis sp.	Monocle bream	Tolin mach
54. Polynemidae	*122. Eleutheronema tetradactylum*	Fourfinger threadfin	Tailla
	123. Leptomelanosoma indicum	Indian threadfin	Lakhua
	124. Polydactylus plebeius	Striped threadfin	Choto lakhua
55. Sciaenidae	*125. Johnius argentatus***	Silver croaker	Lal poa
	126. Johnius belangerii	Belanger's croaker	Rupali poa

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
	127. Johnius amblycephalus (Johnius dussumieri)	Bearded croaker	Poa
	128. Otolithoides pama (Pama pama)	Pama croaker	Poa
	129. Panna microdon	Panna croaker	Lambu poa
	130. Protonibea diacanthus	Blackspotted croaker	Tila poa
	131. Pterotolithus maculatus	Blotched tiger-toothed croaker	Bilai poa
56. Mullidae	*132. Upeneus sulphureus*	Sulphur goatfish	Sonali bata
	133. Parupeneus sp. 1	Goatfish	
	134. Parupeneus sp. 2	Goatfish	
57. Monodactylidae	135. Monodactylus argenteus	Silver moony	Polish chanda
58. Drepanidae	136. Drepane punctata	Spotted sicklefish	Pan mach
59. Chaetodontidae	*137. Chaetodon collare (Chaetodon collaris)*	Redtail butterflyfish	
	138. Chaetodon decussatus	Indian vagabond butterflyfish	
	139. Chaetodon octofasciatus	Eightbanded butterflyfish	
	140. Chaetodon vagabundus	Vagabond butterflyfish	
	141. Heniochus acuminatus	Longfin bannerfish	
	142. Heniochus singularis	Singular bannerfish	

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
60. Pomacanthidae	*143. Pomacanthus annularis*	Blueringed angelfish	
61. Kyphosidae	*144. Kyphosus cinerascens*	Blue seachub	
	145. Kyphosus vaigiensis	Brassy chub	
62.Terapontidae	*146. Terapon jarbua*	Jarbus terapon	Gogo
	147. Terapon theraps	Largescaled terapon	Xirpai
	148. Terapon sp.		
63. Cirrhitidae	*149. Cirrhitichthys sp.*	Hawkfish	
Perciformes (Labroidei)			
64. Cichlidae	*150. Oreochromis mossambicus*	Mozambique tilapia	Tilapia
	151. Oreochromis niloticus	Nile tilapia	Tilapia
65. Pomacentridae	*152. Abudefduf bengalensis*	Bengal sergeant	
	153. Abudefduf sexfasciatus	Scissortail sergeant	
	154. Abudefduf sordidus	Blackspot sergeant	
	155. Chrysiptera brownriggii (Chrysiptera leucompa)	Surge damselfish	
	156. Chrysiptera unimaculata	Onespot demoiselle	

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
	157. Dascyllus sp.	Dascyllus	
	158. Neopomacentrus azysron	Yellow-tail demoiselle	
	159. Pomacentrus caeruleus	Caerulean damsel	
	160. Pomacentrus coelestis	Neon damselfish	
	161. Neopomacentrus cyanomos (Pomacentrus cyanomos)	Regal demoiselle	
	162. Pomacentrus vaiuli	Ocellate damselfish	
	163. Stegastes fasciolatus	Pacific gregory	
66. Labridae	*164. Bodianus sp.1*	Hogfish	
	165. Bodianus sp.2	Hogfish	
	166. Cheilinus sp.	Wrasse	
	167. Coris gaimard	Yellowtail coris	
	168. Coris sp.	Coris	
	169. Halichoeres sp. 1	Wrasse	
	170. Halichoeres sp. 2	Wrasse	
	171. Labroidis dimidiatus	Bluestreak cleaner wrasse	
	172. Thalassoma lunare	Moon wrasse	
	173. Thalassoma sp. 1	Wrasse	

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
	174. Thalassoma sp. 2	Wrasse	
67. Scaridae	*175. Bolbometopon muricatum*	Green humphead parrotfish	
	176. Callydon sperullum	Sundari mach	
	177. Scarus sp. 1	Parrotfish	
	178. Scarus sp. 2	Parrotfish	
	179. Scarus sp. 3	Parrotfish	
Perciformes (Blennioidei)			
68. Tripterygiidae	*180. Helcogramma sp.*	Triplefin	
	181. Cirripectes castaneus (Cirripectes astaneus)	Chestnut eyelashblenny	
	182. Ecsenius bicolor	Bicolor blenny	
69. Blennidae	*183. Salaries fasciatus*	Jewelled blenny	
Perciformes (Gobioidei)			
70. Eleotridae	*184. Eleotris fusca*	Dusky sleeper	
71. Gobidae: (Amblyopinae)	*185. Trypauchen vagina*	Burrowing goby	Lal chewa
	186. Odontam blyopus rubicundus	Eel goby	Lal chewa
72. Gobidae: (Gobiinae)	*187. Acentrogobius viridipunctatus*	Green-spotted goby	Fool baila
	188. Amblyeleotris sp.		
	189. Amblyeleotris steinitzi	Steinitz' prawn-goby	

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
	190. Cryptocentrus cinctus	Yellow-prawn goby	
	191. Glossogobius giuris	Tank goby Baila	
73. Gobidae: (Oxudercinae)	*192. Apocryptes bato*	Chiring	
	193. Pseudapocryptes elongates (Pseudapocryptes lanceolatus)	Sada chewa	
74. Gobidae: (Gobionellinae)	194. Awaous grammepomus	Scribbled goby	
	195. Awaous guamensis (Awaous stamineus)		
Perciformes (Kurtoidei)			
75. Kurtidae	196. Kurtus indicus	Indian hump head	
Perciformes (Acanthuroidei)			
76. Ephippidae	*197. Ephippus orbis*	Spadefish	Hatirkan
	198. Platax teira	Spotbelly batfish	
77. Scatophagidae	199. Scatophagus argus	Spotted scat	Bishtara
78. Siganidae	200. Siganus stellatus	Brownspotted spinefoot	Bishkatali
79. Acanthuridae	*201. Acanthurus lineatus*	Lined surgeonfish	
	202. Acanthurus xanthopterus	Yellowfin surgeonfish	

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
Perciformes (Scombroidei)			
80. Sphyraenidae	*203. Sphyraena forsteri*	Bigeye barracuda	Darkoral
	204. Sphyraena qenie (Sphyraena genie)	Blackfin barracuda	
	205. Sphyraena obtusata	Obtuse barracuda	
81. Trichiuridae	*206. Lepturacanthus savala*	Savalani hairtail	Churi mach
	207. Trichurus lepturus	Largehead hairtail	Churi mach
82. Scombridae	*208. Rastrelliger kanagurta*	Indian mackerel	Champa
	209. Scomberomorus guttatus (Scomberomorus kuhlii)	Indo-Pacific king mackerel	Maitta
Perciformes: (Stromateoidei)			
83. Stromateidae	*210. Pampus argenteus*	Silver pomfret	Folichanda
	211. Pampus chinensis	Chinese silver pomfret	Rupchanda
84. Psettodidae	212. Psettodes erumei	Indian spiny turbot	Pata mach
Pleuronectiformes			
85. Bothidae	213. Pseudorhombus malayanus	Malayan flounder	Gola lool

Family (Subfamily)	Genus & Species (Synonym)	Common Name (FAO Name)	Local Name
86. Cynoglossidae	*214. Cynoglossus bilineatus*	Fourlined tonguesole	Bilini shol
	215. Cynoglossus cynoglossus	Bengal tonguesole	Kukurjib
	216. Cynoglossus lingua	Long tongue sole	Lamba pata
	217. Cynoglossus kopsii (Cynoglossus versicolor)	Shortheaded tonguesole	Badami soli
87. Soleidae	*218. Aesopia cornuta*	Unicorn sole	Pata mach
	219. Brachirus orientalis	Oriental sole	Pata mach
	220. Zebrias altipinnis		Dora soli
Tetraodontiformes			
88. Tetraodontidae	*221. Arothron stellatus*		
	222. Chelonodon patoca (Tetraodon patoca)	Milkspotted puffer	Potka
	223. Lagocephalus lunaris (Gastrophysus lunaris)	Green rough-backed puffer	Rupali potka
	224. Takifugu oblongus (Torquigener oblongus)	Lattice blaasop	Dora potka
89. Diodontidae	225. Diodon histrix	Spot-fin porcupinefish	Sajaru mach

Notes

* Distribution of these species in Bangladesh coastal water is questionable; probably they are misidentifications: *Rhinoptera neglecta* (Rhinopteridae) may be misidentification for the species *Rhinoptera javanica* or *Rhinoptera adspersa*; *Epinephelus quoyanus*/*Epinephelus megachir* (Serranidae) may be misidentification for *Epinephelus hexagonatus* or *Epinephelus coioides*.

** Name not existing in Fishbase (www.fishbase.org).

NCSIP (2001) in cludes the following freshwater fishes in St. Martin's Island: *Mystus cavasius*, *Mystus tengara*, *Mystus vittatus*, *Clarius batrachus* and *Anabas testudineus*.

ANNEX 6

Birds recorded at St. Martin's Island

Records have been compiled by Paul Thompson on behalf of the Bangladesh bird club with particular thanks to Enam Ul Haque, M. Monirul Khan, Samiul Mohsin, S.M.A. Rashid and Majeda Huq for providing their observations. Note that claims of other species for the Island have been listed in some sources but are not included here as supporting descriptions or evidence were not available.

Species order follows Inskipp, T., Lindsey, N. and Duckworth, W. (1996) *An Annotated Checklist of the Birds of the Oriental Region.* Oriental Bird Club, Sandy, UK. Names are adjusted with, and local names taken from: Siddiqui, K.U., Islam, M.A., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A. Khondker, M., & Rahman, M.M. (eds.) (2008) *Encyclopedia of flora and fauna of Bangladesh. Vol. 26 Birds.* Dhaka: Asiatic Society of Bangladesh.

Sl. No.	English name	Scientific name	Local name
ANATIDAE			
1	Ruddy Shelduck	*Tadorna ferruginea*	Khoira Chokachoki
2	Common Shelduck	*Tadorna tadorna*	Pati Chokachoki
3	Eurasian Wigeon	*Anas penelope*	Eureshio Shithihash
4	Northern Shoveler	*Anas clypeata*	Utturey Khuntehash
PICIDAE			
5	Eurasian Wryneck	*Jynx torquilla*	Eureshio Gharbetha
UPUPIDAE			
6	Eurasian Hoopoe	*Upupa epops*	Pati Hoodhood
DALCELONIDAE			
7	White-throated Kingfisher	*Halcyon smyrnensis*	Dholagola Machranga

Sl. No.	English name	Scientific name	Local name
8	Black-capped Kingfisher	*Halcyon pileata*	Kalatupi Machranga
9	Collared Kingfisher	*Todiramphus chloris*	Dholaghar Machranga
MEROPIDAE			
10	Green Bee-eater	*Merops orientalis*	Shubuj Shuichora
11	Chestnut-headed Bee-eater	*Merops leschenaulti*	Khoiramatha Shuichora
CUCULIDAE			
12	Plaintive Cuckoo	*Cacomantis merulinus*	Koroon Papai
13	Asian Koel	*Eudynamys scolopacea*	Eshio Kokil
CENTROPODIDAE			
14	Greater Coucal	*Centropus sinensis*	Boro Kubo
APODIDAE			
15	Asian Palm Swift	*Cypsiurus balasiensis*	Asho Talbatashi
TYTONIDAE			
16	Barn Owl	*Tyto alba*	Lokkhi Pecha
COLUMBIDAE			
17	Common Pigeon	*Columba livia*	Gola Paira
18	Spotted Dove	*Streptopelia chinensis*	Tila Ghughu
19	Eurasian Collared Dove	*Streptopelia decaocto*	Eurashio Konthighughu
RALLIDAE			
20	Common Moorhen	*Gallinula chloropus*	Pati Panmurgi
SCOLOPACIDAE			
21	Pin-tailed Snipe	*Gallinago stenura*	Lenja Chega
22	Common Snipe	*Gallinago gallinago*	Pati Chega

Sl. No.	English name	Scientific name	Local name
23	Black-tailed Godwit	*Limosa limosa*	Khalalej Jourali
24	Bar-tailed Godwit	*Limosa lapponica*	Dagilej Jourali
25	Whimbrel	*Numenius phaeopus*	Nata Gulinda
26	Eurasian Curlew	*Numenius arquata*	Eureshio Gulinda
27	Spotted Redshank	*Tringa erythropus*	Tila Lalpa
28	Common Redshank	*Tringa totanus*	Pati Lalpa
29	Common Greenshank	*Tringa nebularia*	Pati Shobujpa
30	Wood Sandpiper	*Tringa glareola*	Bon Batan
31	Terek Sandpiper	*Xenus cinereus*	Terek Batan
32	Common Sandpiper	*Actitis hypoleucos*	Pati Batan
33	Ruddy Turnstone	*Arenaria interpres*	Lal Nuribaan
34	Sanderling	*Calidris alba*	Sanderling
35	Broad-billed Sandpiper	*Limicola falcinellus*	Motathuto Batan
CHARADRIIDAE			
36	Pacific Golden Plover	*Pluvialis fulva*	Proshanto Shonajiria
37	Grey Plover	*Pluvialis squatarola*	Metey Jiria
38	Little Ringed Plover	*Charadrius dubius*	Choto Nothjiria
39	Greater Sand Plover	*Charadrius leschenaultii*	Boro Dhuljiria
40	Lesser Sand Plover	*Charadrius mongolus*	Choto Dhuljiria
GLAREOLIDAE			
41	Oriental Pratincole	*Glareola maldivarum*	Udoi Babubatan
LARIDAE			
42	Great Black-headed Gull	*Larus ichthyaetus*	Palasi Gangchil
43	Brown-headed Gull	*Larus brunnicephalus*	Khoiramatha Gangchil

Sl. No.	English name	Scientific name	Local name
44	Common Black-headed Gull	*Larus ridibundus*	Kalamatha Gangchil
45	Gull-billed Tern	*Gelochelidon nilotica*	Kalathot Panchil
46	Caspian Tern	*Sterna caspia*	Kaspian Panchil
47	Lesser Crested Tern	*Sterna bengalensis*	Bangla Tikipanchil
48	Swift Tern (Great Crested)	*Sterna bergii*	Boro Tikipanchil
49	Common Tern	*Sterna hirundo*	Pati Panchil
50	Little Tern	*Sterna albifrons*	Choto Panchil
51	Black-bellied Tern	*Sterna acuticauda*	Kalapet Panchil
52	Whiskered Tern	*Chlidonias hybridus*	Julphi Panchil
ACCIPITRIDAE			
53	Osprey	*Pandion haliaetus*	Machmural
54	Shikra	*Accipiter badius*	Pati Shikrey
FALCONIDAE			
55	Common Kestrel	*Falco tinnunculus*	Pati Kestrel
56	Peregrine Falcon	*Falco peregrinus*	Peregrin Shahin
ARDEIDAE			
57	Great Egret	*Casmerodius albus*	Boro Boga
58	Yellow-billed Egret	*Egretta intermedia*	Majhla Boga
59	Pacific Reef Heron	*Egretta sacra*	Proshanto Shoiloboga
60	Grey Heron	*Ardea cinerea*	Dhupni Bok
61	Indian Pond Heron	*Ardeola grayii*	Deshi Kanibok
62	Striated Heron	*Butorides striata*	Khude Bok
63	Black-crowned Night Heron	*Nycticorax nycticorax*	Kalamatha Nishibok
LANIIDAE			
64	Brown Shrike	*Lanius cristatus*	Khoira Latora
65	Long-tailed Shrike	*Lanius schach*	Lenja Latora

Sl. No.	English name	Scientific name	Local name
CORVIDAE			
66	Large-billed Crow	*Corvus macrorhynchos*	Dar Kak
67	Black-naped Oriole	*Oriolus chinensis*	Kalaghar Benebou
68	Black-hooded Oriole	*Oriolus xanthornus*	Kalamatha Benebou
69	Black Drongo	*Dicrurus macrocercus*	Kala Fingrey
70	Ashy Drongo	*Dicrurus leucophaeus*	Kalche Fingrey
MUSCICAPIDAE			
71	Blue Rock Thrush	*Monticola solitarius*	Neel Shiladama
STURNIDAE			
72	Asian Glossy Starling	*Aplonis panayensis*	Eshio Telshalik
73	Rosy Starling	*Sumus roseus*	Golapi Kathshalik
HIRUNDINIDAE			
74	Barn Swallow	*Hirundo rustica*	Metho Ababil
75	Red-rumped Swallow	*Hirundo daurica*	Lalkomor Ababil
ALAUDIDAE			
76	Oriental Skylark	*Alauda gulgula*	Udoi Ovrobhorot
NECTARINIIDAE			
77	Purple-rumped Sunbird	*Leptocoma zeylonica*	Begunikomor Moutushi
78	Purple Sunbird	*Cinnyris asiaticus*	Beguni Moutushi
PASSERIDAE			
79	White Wagtail	*Motacilla alba*	Dhola Khonjon
80	Citrine Wagtail	*Motacilla citreola*	Sitrin Khonjon
81	Yellow Wagtail	*Motacilla flava*	Holdey Khonjon
82	Grey Wagtail	*Motacilla cinerea*	Metey Khonjon
83	Olive-backed Pipit	*Anthus hodgsoni*	Jolpaipith Tulika
84	Baya Weaver	*Ploceus philippinus*	Deshi Babui
85	Scaly-breasted Munia	*Lonchura punctulata*	Tila Munia

ANNEX 7

Mammals recorded at St. Martin's Island

The following list has been modified from MOEF (2001b) to reflect Bangladesh status and nomenclature in Ahmad, A.T.A., Kabir, S.M.H., Ahmad, M., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A. and Khondker, M. (eds.) (2009) *Encyclopedia of flora and fauna of Bangladesh. Vol. 27 Mammals*. Dhaka: Asiatic Society of Bangladesh. Furthermore field identification of cetaceans (whales and dolphins) requires specialist knowledge, and species recorded in the one recent published study in the Bay of Bengal from waters in the region of St. Martin's Island have been included: Smith, B.D., Ahmed, B., Mowgli, R.M. and Strindberg, S. (2008) Species occurrence and distributional ecology of nearshore cetaceans in the Bay of Bengal, Bangladesh, with abundance estimates for Irrawaddy dolphins *Orcaella brevirostris* and finless porpoises *Neophocaena phocaenoides*. *J. Cetacean Res. Manage*. 10(1):45–58.

Sl. No.	Scientific name	English name	Local name
ORDER: RODENTIA		***FAMILY: Muridae***	
1	*Bandicota bengalensis*	Lesser Bandicoot Rat	Khet-idur
2	*Bandicota indica*	Large Bandicoot Rat	Bara dhari idur
3	*Mus musculus*	House Mouse	Nangti-idur
4	*Rattus norvegicus*	Brown Rat	Demsa-idur
5	*Rattus rattus*	Black Rat	Kala idur
6	*Vandeleuira oleracea*	Indian Long-tailed Tree Mouse	Gecho idur
ORDER: SORICOMORPHA		***FAMILY: Soricidae***	
7	*Suncus murinus*	Asian House Shrew	Chikchiki, Chucho
ORDER: CHIROPTERA		***FAMILY: Pteropodidae***	
8	*Pteropus giganteus*	Indian Flying Fox	Badur

Sl. No.	Scientific name	English name	Local name
9	*Rousettus leschenaulti*	Fulvous Fruit Bat	Kola badur
		FAMILY: Vespertilionidae	
10	*Pipistrellus coromandra*	Indian Pipistrelle	Khudey Chamchika
11	*Pipistrellus mimus*	Least Pipistrelle	Bamon Chamchika
ORDER: CETACEA		***FAMILY: Delphinidae***	
12	*Orcaella brevirostris*	Irrawaddy Dolphin	Shishu, Shushuk
13	*Sausa chinensis*	Indo-Pacific Humpbacked Dolphin	Golapi Dolphin
14	*Stenella attenuata*	Pantropical Spotted Dolphin	
15	*Stenella longirostris*	Spinner Dolphin	
16	*Tursiops aduncus*	Indo-Pacific Bottlenose Dolphin	
17	*Neophocaena phocaenoides*	Indian Ocean Finless Porpoise	Shushuk