CHAPTER 3

STUDY AREA

3.1.1. General Background

The Andaman and Nicobar Islands is an archipelago that lie between 6° 45’N and 13° 45’N latitudes and 92° 15’E and 94° E longitudes, located off the east coast of India in the southern part of Bay of Bengal (Srinivasan, 1986; Fig 3.1). The archipelago consists of 572 islands, islets and rocks extending over 800 km of total geographic area 8249 km² and consists of two groups: the Andaman Islands are north of the Ten Degree Channel from Little Andaman in the south (10°40’ N and 92°45’E) to the North Andaman island (12°95’ N and 92°86’ E) close to Myanmar and the Nicobar Islands lie south. Andaman group consists of about 324 islands of total area 6408 km², of which 10 islands are large (range between 75 km² to1534 km²) and the rest smaller from 0.01 km² to 29 km² (Tikadar and Das, 1985; Anon., 2003).

These islands are rich in biodiversity. Myers (1990) stated that these islands along with Western Ghats and Sri Lanka could be included as one of the major biodiversity ‘hot spots’ of the globe. However, due to deforestation and poor management, the forests have been highly degraded (Saldanha, 1989)

3.1.2. Historical Background

The Andaman and Nicobar Islands were first recorded as ‘Angdaman Islands’ (Islands of good fortune) in the first map of the world drawn by Ptolemy, the second
century Roman geographer. The great traveler Marco Polo called these islands ‘Angamanian’ (Bilham et al., 2005; www.indiannavy.nic.in).

The Andaman and Nicobar Islands were colonized by aboriginals who migrated from Southeast Asia about 60,000 years ago or more (Weber, 2002; Thangaraj et al., 2006). Presently six indigenous tribal populations, of which four belongs to ‘Negritos’ (the Jarawa, Onge, Sentinelese and Great Andamanese) and other two to ‘Asiatic’ (the Nicobarese and Shompens) are the original inhabitants of these islands (Thangaraj et al., 2006).

The first British settlement was in 1789, which was later abandoned in 1796 (Phillimore, 1945; Bilham et al., 2005). The second settlement was basically a penal settlement, started in 1858 followed by establishment of a substantial penal colony near Port Blair by 1869 (www.indiannavy.nic.in; Bilham et al., 2005). During World War II, Japanese forces occupied the Andamans from 1942 to 1945. Later the British recaptured the islands, abolished the penal colony and after independence these islands were under the Indian administration (Bilham et al., 2005; Encyclopedia Britannica, 2009).

3.1.3. Geology

The Andaman and Nicobar islands represent a complex junction at the intersection of two major lithospheric plates-The Indian and the Pacific (Srinivasan, 1986). They form a part of the Sunda-Burmese double chain arc system (inner volcanic arc and outer sedimentary arc), which is the continuation of Indo-Burma ranges (Arakan-Yoma Range of Western Burma) in the north and Indonesian Islands (islands of South and West of Sumatra) in the south (Srinivasan, 1986, Jafri et al., 1990). Tectonically,
Andaman and Nicobar islands are known to be the part of the outer sedimentary arc of the Sunda-Burmese double chain arc system, where the Indian oceanic plate subducted (Jafri et al., 1990).

The Andaman and Nicobar Islands are geologically young and probably had their origin in the Tertiary period (63 mya) and ended about 1 mya when Quaternary period began (Tikadar et al., 1986). These islands are truly oceanic and it is evident from the presence of basalts. Geochemical data suggest that the Andaman basalts are plume-type tholeiites with mild alkaline affinity and have ocean-island-like chemistry. The movement of these Andaman basalts from oceanic environment to Andaman-Nicobar Islands is also supported by the fact that they are deformed and associated with radiolarian chert, tectonised ultramafics and deformed sediments (Jafri et al., 1990).

The archipelago is physically isolated from the adjacent mainland Burma coast on the north by the North Preparis Channel, a depth of more than 225 m (Ripley and Beehler, 1989). These islands were never been connected to mainland in its geological history due to the presence of permanent water barrier as the Pleistocene sea level lowering never exceeded 160 m (Gascoyne et al., 1979).

The main rock types are igneous rocks of the Upper Cretaceous ophiolitic suite, turbidites of Eocene to Oligocene age (Jafri et al., 1990) and chalk and limestones of Archipelago Group of Neogene age (Srinivasan, 1979; Ray et al., 1988). The soil is usually soft and deep sandy loam, varying from fine texture of the alluvial flats to the gravel-strewn soil of the low hills. The higher hills consist of hard clayey soil with micaceous sandstone formations and underlying conglomerates (Padalia et al., 2004).
Fig 3.1: Map of the Andaman and Nicobar Islands and its location in relation to India
3.1.4. Climate and Monsoon

The climate of the archipelago is tropical and oceanic with little seasonal variation in temperature, 23°C to 32°C (Mani, 1974; Ripley and Beehler, 1989). The average annual rainfall from the South West and North East monsoons ranges from 2300 mm in Little Andaman in the south to 3000 mm in Mayabundar near the North Andamans (Fig 3.2). The monsoon starts in May bringing in maximum rainfall and there is a gradual decrease in monthly rainfall from September onwards. There is a dry season for 3 to 4 months from January to April (Fig 3.3).

Fig 3.2: Mean annual rainfall in three stations from 2000 to 2004
3.1.5. Hydrology

Andaman and Nicobar Islands lack major freshwater ecosystems; however there are few exceptions such as Kalpong River in North Andaman, Galathea River in Great Nicobar and lake in Tillanchong Island (Saldanha, 1989; Pande et al., 1991). Instead, there are many perennial and seasonal streams and several water holes present throughout these islands (Pande et al., 1991).

3.1.6. Flora and Fauna

The Andaman and Nicobar Islands harbour diverse flora and fauna that have showed close affinities with Myanmar, the Malay Peninsula and the Indian subcontinent (Balnford, 1901; Rao, 1986). The flora and fauna showed moderate levels of endemism and many species are shared with continental Asia (Thiollay, 1997).
The forest cover of the islands is one of the highest in India with relation to its geographic area. Total forest cover is 84.42 % (6964 km²) of which 42.1 % (3475 km²) very dense forest, 34.2 % (2809 km²) moderate dense forest and 8.2 % (680 km²) open forest (Anon., 1999).

The floristic diversity of Andaman and Nicobar Islands is rich with over 1416 species of flowering plants and 120 pteridophytes. The endemism among flowering plants is quite high with 13 % of total species (Rao, 1986). These island’s environment supports tropical forest vegetation, thus the vegetation broadly fall into several categories such as giant evergreen, Andaman tropical evergreen, southern hilltop evergreen, southern tropical semi-evergreen, Andaman tropical moist deciduous, littoral, mangrove, mangrove scrub and wet bamboo brakes (Parkinson, 1923; Champion and Seth, 1968), lowland swamps (*Padanus* dominated), millul swamps (*Syzygium* dominated) and shrub (Parkinson, 1923).

The faunal diversity of Andaman and Nicobar Islands is high particularly among mammals, birds, butterflies and reptiles (Abdulali, 1965; Ripley and Beehler, 1989; Khatri, 1989; Rao, 1989). However, the amphibians were poorly represented (Rao, 1989). The number of species and endemics in each taxa in both Andaman and Nicobar group is shown in Table 3.1.
Table 3.1: Number of species of some taxa with endemics in the Andaman and Nicobar Islands

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Number of Species</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Andaman</td>
<td>Nicobar</td>
</tr>
<tr>
<td>Plants</td>
<td>1079</td>
<td>770</td>
</tr>
<tr>
<td>Butterflies</td>
<td>150</td>
<td>84</td>
</tr>
<tr>
<td>Amphibians</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Reptiles</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Birds</td>
<td>92</td>
<td>65</td>
</tr>
<tr>
<td>Mammala#</td>
<td>55*</td>
<td>33*</td>
</tr>
</tbody>
</table>

* = includes subspecies
# = includes marine animals

Source: Davidar et al., (1995)

3.1.7. Protected Areas

The protected area network in Andaman and Nicobar Islands includes a total of 105 national parks and wild life sanctuaries covering 18.54 percent of the total protected area network in India (Anon., 1999; Table 3.2). The majority of protected areas are whole islands less than 1 km² in area (Pande et al., 1991).

Table 3.2: Protected area network in Andaman and Nicobar Islands

<table>
<thead>
<tr>
<th>Protected Area/Island Group</th>
<th>Andaman</th>
<th>Nicobar</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Park</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Sanctuary</td>
<td>92</td>
<td>4</td>
</tr>
</tbody>
</table>
3.2. Study Area

To study freshwater fish diversity, five large islands of Andaman group: North Andaman, Middle Andaman, South Andaman, Rutland and Little Andaman were surveyed.

3.2.1. North Andaman

North Andaman is the northernmost island of the Andaman region. The region lies 285 km south of Myanmar and is located between 12°95’ N latitude and 92°86’ E longitude, covering an area of 1458 sq km. Topographically these islands are hilly and have rugged terrain with numerous mountains, peaks, ridges, hill slopes and valleys. Saddle Peak is the highest point, 732 msl (Anon., 2003).

Forest vegetation consists of secondary evergreen, semi-evergreen, moist deciduous, littoral and mangrove forests (Champion and Seth, 1968). Each vegetation type is associated with lianas, climbers, canebrakes and bamboo. Large areas of forest have been destroyed and most of the vegetation is highly degraded.

North Andaman has several large perennial streams which are the source of drinking water. Majority of the streams were characterized by low gradient with pebbles forming the predominant substrate. The cultivation along the stream courses of cleared riparian forest have resulted in the drying up of lower reaches of many of streams during summer months. Most of the study streams were located in the centre of the island with a few towards the north (Fig 3.4).
3.2.2. Middle Andaman

Middle Andaman is the largest island in the archipelago lying between 12°15’ N to 13° N latitude and 92°30’ E to 93° E longitude and with a total area of 1536 sq km. Austin Strait, a creek, separates Middle Andaman from North Andaman in the north and Middle Strait from the Baratang Island in the south (Anon., 2003).

Large mangrove formations are the characteristic feature of Middle Andaman. Apart from these, the major forests types are Andaman evergreen, semi-evergreen and moist deciduous forests. It has the largest area under cultivation, having paddy and vegetables as important crops. Consequently, many large streams have been subjected to continuous habitat alteration and pollution from agricultural run-off. In general, the streams of middle Andamans are characterized by low gradient and pebbles form the main substrate. The study areas were fairly well distributed within the Middle Andamans with many streams in the north and the south being sampled but not much in the centre due to the Jarawa Tribal Reserve (Fig 3.5.)

3.2.3. South Andaman

South Andaman is a densely populated island lying between and 11°55’ N latitude and 92°37’ E longitude with a total geographical area of 1456 sq km. Port Blair is capital in the South Andamans. Topography of this island is hilly with numerous mountains and valleys. The highest point is Mt Harriet at 366 msl (Anon., 2003).

The forest vegetation mainly comprises of Andaman tropical evergreen, southern hill top evergreen, and secondary evergreen, semi-evergreen, moist deciduous forests (Champion and Seth, 1968). Majority of streams were small and medium sized. These
streams were characterized by high gradient, having rock and bed rock as stream substrate. Lower reaches of most of these streams were subjected pollution from solid waste and agricultural run-off. The sampled streams were located in the southern part of the island due to the Jarawa Tribal Reserve where it was not possible to enter (Fig 3.6.).

Fig 3.4: Map showing sampling sites in North Andaman
Fig 3.5: Map showing sampling sites in Middle Andaman
Fig 3.6: Map showing sampling sites in South Andaman
3.2.4. Rutland

Rutland is large sized island located south of South Andaman. This island falls under Reserve forest area. The vegetation is a unique stunted formation of southern hill top evergreen forest dominated by *Dipterocarpus costatus* (with an average height below 10 meters) (Anon., 2003). Apart from this, patches of moist deciduous species, dry deciduous and bamboo stands, comprise the forest vegetation.

There are several seasonal and perennial streams. These streams are relatively small compared to the streams in the other four study sites. Streams are characterized by high gradient, rocky substratum, riffles and waterfalls. Most of the streams are less disturbed and free from anthropogenic activities. The streams sampled covered a large area of Rutland (Fig 3.7.).

3.2.5. Little Andaman

Little Andaman is the southernmost island of Andaman group lying between 10°40’ N latitude and 92°45’E longitude with the total area of 710 sq.km. Topographically the island is flat with maximum altitude at 187 msl (Anon., 2003). Large areas of Red Oil Palm and Areca nut plantation cover this island leaving natural forest to the western fringes of the island which is a tribal Reserve (the Onges). Natural patches of *Casuarina equisetifolia* along the sandy beaches is one of the unique features of the Little Andamans.

There are several perennial streams flowing on either sides of the island. Streams on western side are inaccessible due to terrain and it falls under the protected tribal reserve. On the other hand those streams on eastern side are subjected to high levels of
disturbance such as pollution from agricultural run-off, solid waste etc., and introduced fish species. The streams are low gradient and characterized by wide range of substrate types viz., rocky, pebble and lime stone. The streams sampled were located mostly in the centre and the south of the island (Fig 3.8.).

Fig 3.7: Map showing sampling sites in Rutland
Fig 3.8: Map showing sampling sites in Little Andaman