CHAPTER II

PHYSICAL ENVIRONMENT OF THE ANDAMAN ISLAND ECOSYSTEM
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As ecology is the interrelationship between the organism and environment of an ecosystem, and within it particularly of the ecological niche, it is relevant to understand the physical environment so that ecological interrelationship could be revealed in its all-possible details. Moreover, it is from the biophysical environment a human group identifies, perceives and derives resources for the subsistence and survival. Therefore, in the following lines physical environment of the Andaman Island (that is the habitat of the Jarawa) has been discussed. The discussion not only highlights the natural endowment of the Andaman Islands but also points out its peculiarities to which the Jarawa have adapted and made their niche.

2.1 LOCATION AND EXTENT

The Andaman and Nicobar archipelago comprises as many as 319 islands, spread in the form of more or less an arch for a length of 700 km. The Andaman and Nicobar group of islands cover an area of about 8,293 sq km, and it extends between 6° to 14° North latitudes and 92° to 94° East longitudes in the Bay of Bengal with the Ten Degree Channel separating the Andaman group of islands from the Nicobar group of islands (Fig. 2.1). The Andaman and Nicobar Islands are located in the eastern side of the Bay of Bengal. These Islands are comparatively at more distance from the mainland India then the Myanmar and Malaya Peninsula (Fig. 2.2). The Andaman Islands lie 944 km from the Hooghly mouth, while merely 192 km from Cape Negrais of Myanmar. The land area of the Andaman Islands is 6,340 sq km and that of the Nicobar is 1,953 sq km. Interestingly, only 38 islands are inhabited, of which 26 are in the Andaman group and 12 are in the Nicobar group. In addition,
these islands are habitat of six tribal groups, four of them (including the Jarawa) belong to the Negrito stock, while remaining two belong to the Mongoloid stock.

The Andaman group of Islands lie north of the Nicobar group of Islands (Fig. 2.1). It extends between 10°30' and 13°30' North latitudes and 92°15' and 95°10' East longitudes. The Andaman Islands consist of 204 islands. At the extreme north of the Andaman group of Islands is the Landfall Island followed by the three main islands known as the North Andaman, Middle Andaman and South Andaman, all of them separated by shallow seas. At a distance of 64 km from the South Andaman stands the Little Andaman Island. Besides, there are innumerable small islands, e.g., Ritchie’s Archipelago, Tarmughli, North and South the Sentinel Islands etc. (Table 2.1). The Middle Andaman is the largest of all islands in terms of area (561 sq km).

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Islands</th>
<th>Area (sq km)</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>North Andaman</td>
<td>490.20</td>
</tr>
<tr>
<td>2.</td>
<td>Middle Andaman</td>
<td>561.00</td>
</tr>
<tr>
<td>3.</td>
<td>South Andaman</td>
<td>359.51</td>
</tr>
<tr>
<td>4.</td>
<td>Landfall and 7 other islands in the North Andaman Group</td>
<td>27.92</td>
</tr>
<tr>
<td>5.</td>
<td>Interview and 4 other islands in the Middle Andaman Group</td>
<td>59.00</td>
</tr>
<tr>
<td>6.</td>
<td>Baratang and 4 other islands in the Baratang Group</td>
<td>11.34</td>
</tr>
<tr>
<td>7.</td>
<td>Havelock and 6 other islands in the Ritchie’s Archipelago Group</td>
<td>94.20</td>
</tr>
<tr>
<td>8.</td>
<td>Rutland and 3 other islands in the South Andaman group of islands</td>
<td>73.86</td>
</tr>
<tr>
<td>9.</td>
<td>Tarmughli and 4 other islands in the Labyrinth Island</td>
<td>12.20</td>
</tr>
<tr>
<td>10.</td>
<td>Little Andaman</td>
<td>289.90</td>
</tr>
<tr>
<td></td>
<td>Other islands numbering 166</td>
<td>430.97</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
</tr>
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</table>

Fig. 2.1
LOCATION OF ANDAMAN AND NICOBAR ISLANDS

Fig. 2.2
2.2 PHYSIOGRAPHY

The first attempt to study geology of these islands was made by Helfer and Millheil in 1840 which was published in 1859. However, a systematic geological study could begin only from 1870 and thereafter a number of geological notes were published in the ‘Records and Memoirs of the Geological Survey of India’ and ‘London Geological Magazine’ (cf. Lal, 1976). Since 1958, the Geological Survey of India has been doing detailed study with a view to investigate geology and mineral resources of the Islands. Most of the physiographic information on Andaman Islands, which have mentioned below, have been sourced from Sen (1962) and Lal (1976).

Oldham (1885) has distinguished two sedimentary formations besides serpentine series- Port Blair Series, and Archipelago Series. In the Port Blair series, the rock types are grey sandstones with interbedded shales, frequently consisting nests of coaly matter and occasionally beds of conglomerate and pale grey limestone as subsidiary members. The Archipelago series, as the name implies, is dominant in the islands of the Archipelago group. It consists of soft limestone formed of coral and shell and soft calcareous sandstones and soft white clays with occasional bands of conglomerates. Tipper (1904-05) put these series to Eocene (Lower Lutetian) and Miocene formations, respectively. Altogether five formations have been distinguished in the Andaman Islands. These are Pre-tertiary, Cretaceous, Eocene (Lower Lutetian), Miocene Burdigalian, Miocene and recent and sub-recent formations. Of all the formations, the Eocene rocks are most widely prevalent. They occupy the three main islands i.e., North, Middle and South Andaman Islands. Conglomerate is common in the North Andaman and in some parts of the Middle Andaman, while sandstone is common in the South Andaman.
ANDAMAN ISLANDS
PHYSIOGRAPHIC DIVISIONS

INDEX

- Main Hill Ranges
- Low Lands and Undulating Ground
- Submerged Hill Ranges

Fig. 2.3
Fig. 2.4
Physiography of the Andaman and Nicobar Islands is dominated by the mountain ranges. Andaman Islands consist of three parallel ranges, which are, in fact, continuation of the Arakan Yoma arc - running from the Pataki range in the Northeast India to Sumatra Island in Southeast Asia. These ranges run through the islands from north and northeast to south and south-west in an arcuate shape. Along the east coast, the Saddle range of the North Andaman continues in the Middle Andaman and passes through Baratang Island to form the Harriet Range of the South Andaman (Fig. 2.3). The western range passes through the west coast of Andaman Islands. In the west coast of North Andaman, it forms a series of detached islets as West Islet, Paget Islet, Interview Island, Flat Islet and finally forms the west coast range of South Andaman which continues in the south to form Tarmugli and other small islets. In between the two parallel ranges is Cholunga Range. Cholunga Range and its continuation up to the Rangers Island are one of the highest ranges of the Andaman Islands, attaining maximum height of 434.64 m at Mt. Ford peak in Rutland. It runs through the middle of South Andaman, where on its both sides are longitudinal bays. Further, the range runs along the west coast of the Middle Andaman and merges into the Ranger Island. The series of parallel ranges have given rise to ridge and valley topography in the Islands. In between the mountain ranges lie the longitudinal bays into which a number of very short distances torrential streams flow from both sides.

In general, the hill ranges are low in height never exceeding 762 m and they send out spurs in all directions. The highest peak in the whole of the archipelago is Saddle Peak (732.12 m) in North Andaman. On an average, the east coast ranges are steeper than the west coast ranges. All these ranges are under the deep mantle of forest cover. In between the East West Range of North and Middle Andaman Islands and Harriet Range continuation in the North, lie the Blair Bay, Kalpong Bay, Kalara
Bay, Congo Bay etc., in the North Andaman and Betapur river valley and Bomlungta river valley in the Middle Andaman.

A profile across north Andaman from west to east gives an idea of the nature of terrain of the Andaman Islands. In the west coast up to Kalara Sea Creek, the relief is undulating. Here the topography is dominated by parallel hills of moderate elevations and narrow valleys. To the east of Kalara Creek, the land for some distance rises gently and then steeply to the highest point at the Saddle Peak (732.12 m). To the east of the Saddle Peak, the slope is very steep and the steepness continues even under the sea after a narrow continental shelf.

The relief of Andaman Islands is striking because, nowhere, the elevation is more than 732.12 m, which is the culminating point in the entire Andaman and Nicobar group of islands. This height is attained by Saddle Peak along the east coast of the North Andaman. The general elevations of the hills ranges in the Andaman Islands vary from 76.2 m to 381 m (Fig. 2.4). A number of ridges and spurs project out from these hill ranges that enclose narrow and flat valleys and at places have been cut up by streams and their tributaries. The valleys are usually below 15.24 m in their lower part while in the upper part the valleys pass through areas of difficult terrain. Narrow stretches plain land is available at few places. The hills in most places descend steeply to the water.

A continental shelf that dips steeply seaward bound the seaward edge of the Andaman and Nicobar Islands. The continental shelf is wider on the western side than on the eastern side. The western side has a number of coral banks in the Andaman Islands. The rate of growth of and extent of corals formation are richer on the western
considered as barrier reefs. On the eastern side, the coral reefs are fringing type. The coastline is highly indented and at many places penetrates into the island to make inland bays and deep creeks. Protected harbours are mostly along the east coast of the island. Thus, one observes that a wider continental shelf, indented coast and barrier reef provide a ideal breeding and nesting place for many marine resources which are harvested by the different population groups particularly Jarawa.

2.3 SOIL

The soils of the Andaman Islands have either developed *in situ* on the hill ranges or in the valleys by the materials derived from the hills by erosion and deposited in the valleys or along the seacoast. Following are the three major soil types:

1. *Sandy soils:* This soil type consists chiefly of sand and shingle, mostly calcareous, lumps of old coral and broken shells uplifted by the action of wind and waves just above the reach of high tides. It is extremely porous and the streams coming down the hills disappear here to emerge again at sea level or in the sea. This formation is limited to the seacoast and usually occurs as narrow strips.

2. *Clay and loamy soils:* This soil type occurs in the valleys and in the lower slopes of the ridges up to a height of about 76.2 m from the sea level. It is rarely found beyond 91.44 m. This soil is formed by the disintegration of indurated clays and shales, limestones and conglomerates. The soil varies from clayey loam to a coarse rubbly sandy loam and is very shallow in some places. There is no trace of visible humus. It is rich when it is dry and water is less in the dry season.
3. **Hilly soils**: This consists of stiff clayey soil of dark red loam overlying micaceous sandstones. It is moist throughout the year and numerous perennial springs issue from it.

In general, it can be said that the soils of different parts of Andaman Islands contain high amount of clay, and are of silty clay to loamy in texture. The refugee population has been settled in the valleys where clay and loamy soil are found and thus conducive for agriculture.

2.4 **CLIMATE**

The location of the Andaman Islands between 10°30' and 13°30' North latitudes makes the climate of the islands as of the tropical type which closely approximates to the equatorial one in the south. The insular position of the Islands in the Bay of Bengal in between two landmasses in the east and west, location in the tropical zone along the path of travelling tropical storms and cyclones in specific months, considerable north south extension, broken coastline and peculiar arcuate shape, and the dominant functional control of the southwest and northeast monsoons in the specific months of the year, all together have combined influence on the climate of the Andaman Islands to give it a distinct feature. With the help of the temperature, rainfall and humidity the peculiarity of the climate of the Andaman has been tried to explain in the following lines.

2.4.1 **Temperature**

The mean annual temperature is 26°C. The islands have very little annual variation in temperature. The annual mean maximum temperature varies from 29° to 30.5°C and mean minimum from 23.5°C to 25°C and mean annual temperature from 26°C to 27.5°C. The relative humidity is also very high and the average is 80 per cent
The high temperature coupled with the high relative humidity gives rise to a high sensible temperature. The weather is always warm and very sultry but is ameliorated to some extent by the pleasant sea breezes.

### 2.4.2 Rainfall

The relative humidity varies from 63 per cent to 90 per cent. The highest humidity occurs from May to November i.e., during the southwest monsoon and the beginning of the northeast monsoon. The lowest humidity occurs during December to February when it varies from 72 per cent to 75 per cent. The annual variation is about 15 per cent. (India Meteorology Department, 2003). Comparatively, the humidity in the south is more than in the north.

The Islands experience good rainfall from both the southwest and northeast monsoons. The average annual rainfall is 3400 mm. The highest annual rainfall recorded during the last 60 years is 3810mm and the lowest is 2130mm (India Meteorology Department, 2003). The southwest monsoon brings the maximum amount of rainfall. It begins from third week of May and ends in October. The southwest region experiences the maximum amount of rainfall because it comes first under the direct impact of the southwest monsoon. This greater amount of rainfall helps in the development of dense tropical vegetation in the western coast. The southwest monsoon burst over the South Andaman by about 20\(^{th}\) May accompanied by thunder and rain. The two periods of maximum precipitation are from May to June, and from August to, which correspond to the beginning and the termination of the southwest monsoon. Rainfall from the northeast monsoon begins in the month of October, whereas, the months of January and February are almost rainless in the northern stations.
2.4.3 Seasons

As mentioned earlier that there is not much monthly variation in temperature of the Andaman Islands but there are seasonal variability in rainfall. In spite of the equable nature of the climate round the year, four seasons are experienced in the Islands mainly due to the mechanism of the southwest and northeast monsoons. Moreover, the seasons do govern the availability and distribution of certain prey animal species including their nesting and hatching periods, for example the turtle nest and hatch from November to February, particularly along the western coast. In accordance with seasons, the Jarawa regulate their movement over space to avail the seasonal resources. The four seasons are as follows:

1. Cool season ... From December to February
2. Hot season ... From March to Mid-May
3. Southwest monsoon season ... From Mid-May to Mid-October
4. Post southwest monsoon season... From Mid-October to November

2.5 STREAMS

The Andaman Islands is traversed by innumerable streams. The drainage is influenced by the nature and amount of rainfall, the extent of the catchment area and the character of rocks through which they flow. The copious rainfall in these Islands, hilly terrain and surrounding of sea from all sides, results in short and swift streams capable of vigorous erosion. These streams form a close network of drainage over the whole Islands. The water divide of the Andaman Islands runs in north-south direction separating the drainage systems of the east coast from that of the west coast. From the main water divide, minor divides shoot off and thus dividing the whole region into a number of drainage basins. Because of the seasonal rainfall fall, the water level of the
streams declines in the dry season, hence most of the rivers either do not have any water or have only a trickle of water. Little water in the rivers may also be partly due to the porous nature of the soils and rocks, whereas, perennial streams are mostly confined to the eastern part of the Andaman Islands, thus favouring establishment of more number of human settlements along the eastern coast.

The Middle Andaman Island has only a few small rivers and important among them are the Betapur and Bamlangta rivers. Both of them originate from the hill ranges that are continuation of Mt. Harriet Range and flow through the longitudinal valleys. The Betapur River and its tributaries drain almost the whole of the northeastern part of the Middle Andaman. A noteworthy feature of the drainage system of these islands is that the perennial rivers are very few. For the aboriginal populations, including the Jarawa, both perennial and non-perennial are very important as the water points are one of the deciding factors for the setting of their camps. It means their camps are wet point camps.

2.6 FORESTS

Forests are in abundance in the Andaman Islands except in the areas that have been cleared for settlement and agricultural needs of the settlers. About 77.80 per cent (6682.17 sq km) of the total area of the Andaman Islands is still covered under thick forests. The original forest cover in many areas has been modified in many areas. The growing settlements around Port-Blair, Rangat, Mayabander and Diglipur areas in South, Middle and North Andaman have encroached upon the forest reserve. Of the total area under forest (6353.24 sq km) in the Andaman Islands, 86 per cent is reserved, 1 per cent is protected, 5 per cent is unclassified and 8 per cent is under Jarawa Reserve (Basu, 1993). The following are the administrative divisions of the forest:
1. **Reserved Forests**: These forest cover an area of 5410.74 sq km or 86 per cent of the total area of Andaman Islands.

2. **Protected Forests**: These forests cover 53.35 sq km. The forests of south Andaman have been declared as ‘protected forests’ by the government.

3. **Unclassified Forests**: These forests cover 355.35 sq km.

4. **Jarawa Tribal Reserve**: About 765 sq km of forests have been reserved for Jarawa in south and middle Andaman Islands along the western coast.

The forests of the Andaman Islands can broadly be divided into two categories based on edaphic and climatic factors. On the basis of edaphic factors, three broad forest divisions are: (i) Tidal Forests (Mangrove Forest), (ii) Beach Forests, and (iii) Riverine Forests (Low Level Evergreen Forests). On the basis of climatic factors two major types of forests are: (i) Moist Deciduous Forests, and (ii) Wet Evergreen Forests. Except for the areas cleared for settlements and small Islets which are devoid of natural vegetation, the entire land mass of the Islands is covered with lush green forests - a characteristic of the humid and warm tropics.

### 2.6.1 Forest Types

The standard and most detailed classification of Andaman forests is that of H.G. Champion (1936). Later, Champion and Seth (1968) gave a revised classification of forest types. They distinguished altogether 14 types of natural vegetation. Some of the forests types merge into each other imperceptibly hence difficult to identity, whereas others offer a distinct contrast, and can be discern without any easily. Major forest types as identified by the Department of Forest have been shown in the Figure 2.5, 2.6 and 2.7. Distribution and types of forests are discussed below.
Fig. 2.5
SOUTH ANDAMAN
VEGETATION COVER

INDEX
- Andaman Evergreen Forest
- Southern Tropical Evergreen Forest
- Secondary Evergreen Forest
- Semi-evergreen Forest
- Moist Deciduous Forest
- Littoral Forest
- Mangrove
- Degraded Forest
- Plantation
- Scrub
- Bamboo
- Mud Flat
- Forest Blank
- Agriculture
- Settlement
- Sand
- Jarawa Reserve

Port-Blair

Road
Creek

Fig. 2.6
MIDDLE ANDAMAN
VEGETATION COVER

INDEX
- Andaman Evergreen Forest
- Southern Tropical Evergreen Forest
- Secondary Evergreen Forest
- Semi Evergreen Forest
- Moist Deciduous Forest
- Littoral Forest
- Mangrove
- Degraded Forest
- Plantation
- Scrub
- Bamboo
- Mud Flat
- Forest Blank
- Agriculture
- Settlement
- Barren Land
- Sand
- Jarawa Reserve
- Andaman Trunk Road
- Link Road
- Creek

Fig. 2.7
2.6.1.1 Low mangrove forest and High mangrove forest

These two types of tidal forests occupy marshy alluvium and stiff clays inundated by salt water. They extend as far as the highest reach of the tide along sheltered seacoast and up the creeks as far as the influence of the salt water is felt. The low mangrove forests, which form more or less dense evergreen belts, are characterised by *Rhizophora mucronata* and *Rhizophora congugata* species that extend farthest into the sea and take the full blast of the tidal currents. These forests do not grow more than 7 m of height. Next to the low-level mangrove belt is found belt of high mangrove forests which are spread in the higher reaches of the tidal creeks where influence of the fresh water is also felt. The predominant species of the high-level mangrove forests are *Brugviera gymnorrhiza* and *Brugviera paruiflora*. They grow gregariously and attain height of 13 m to 21.33 m.

2.6.1.2 Beach forest

Beach forests form a narrow belt just above the high tide level in the Andaman Islands. The soil of this belt consists of sands, shingle, shells fragments, etc., and is poorest in mineral contents except lime. This soil is coarse porous and more or less dry at the surface. Beach forests are locally known as *Mohwakhari* and have a fairly high girth and a long clear bole. Main species of beach forests are *Colophyllum inophyllum*, *Terminalia catapa*, etc.

2.6.1.3 Southern tropical moist deciduous riverine forest

This type forms a very small percentage of the forests of these islands being confined to the well-drained alluvium near the banks of the big streams. It grows in the areas characterized by gravelly, sandy and very loose textured soils. The predominant species are Pyinma and Thitkando, etc.
2.6.1.4 Southern tropical semi-evergreen riverine forest

In the Andaman Islands these forests are found typically on alluvial soils along the banks of large fresh water streams which are sufficiently raised above the flood level and are, therefore, fairly well drained having a good subsoil water supply. The soil is clayey and sufficiently old to let vegetation progress to a climatic climax. The principal species in these forests is *Dipterocarpus alatus*, which grows to the largest size amongst Gurjans (*Dipterocarpus spp.*), often reaching a girth of 9.14 m at breast height and a clear bole of about 304.8 m. Other tree species of importance in these forests are *Sterculiacompanulata, S. alata, Terminalia procera, T. biolata*, etc. The trees are found scattered and the ground floor is densely covered by shrubs, bamboos, climbers and cane breakers forming a thick tangle of vegetations.

2.6.1.5 Secondary moist bamboo brakes

This type of forests occurs usually in the upper parts of steep hill slopes particularly on their hotter (sunny) aspects. It is found characteristically in parts of the north Andaman along the higher ridges of Saddle Range. This type of forests consists of a gregarious growth of bamboo brakes with a few scattered trees of *Dipterocarpus turbinatus, Terminalia procera, Sterculia companulata*, etc.

2.6.1.6 Andaman moist deciduous forest

This is the subsidiary edaphic type of moist tropical forests, locally known as the *Padauk* (*Pterocarpus dalbergioides*), which is found on the undulating surface and gentle slopes up to about 91.44 m in height and covers about 45 per cent of the total area of the Andaman. *Padauk* is the most important timber species of these forests and is associated with many other valuable deciduous species such as *Terminalia biolata, T. procera, Canarium euphyllum*, etc., and a number of species valuable to the match, plywood and packing case industries.
2.6.1.7 Cane brakes

They occur in dense shadow and wet hollows where the soil is permanently wet, consisting of fine clay rich in humus. This type is mostly in association with evergreen and semi-evergreen climaxes than the deciduous ones. It forms an impenetrable thicket of long trailing stems with a few erect species also. Some of the important species of cane present in these brakes are Calamus andamanicus, Calamus pheuborivalsis, Calamus palustris, etc. The creeping bamboo is also invariable present.

2.6.1.8 Southern wet bamboo brakes

This type is also connected with the evergreen and semi-evergreen climaxes along sheltered valleys. Dense clumps of Oxylenanthera nigso-ciliata occur with scattered trees of Dipterocarpus incanus, Planchonia andamanica, Pisonia excelsa, etc.

2.6.1.9 Southern moist bamboo brakes

This type occurs on the moist shady and gentle slopes. The species forming such brakes are Oxylenanthera nigsociliata occurs with scattered trees of Dipterocarpus incanus, andamanica, Pisonia excelsa, Hopea odonata, etc.

2.6.1.10 Southern tropical semi-evergreen forest

This type is more or less in transitional pre-climax form, between the tropical evergreen and the moist deciduous forms. It is not as dense as the southern tropical semi-evergreen riverine type, though it resembles very much in its floristic composition. It has a mixture of both the evergreen and deciduous trees, the former predominating.
2.6.1.11 Southern low tropical evergreen forest

This type occurs in steep hill slopes exposed to strong winds and having hard, reddish brown, infertile thin layer of soil. In the region of its occurrence, there is usually heavy rainfall of over 2540 mm and very often, the atmosphere is cloudy and misty. It occurs typically on the steep slopes of Saddle Hill and surrounding peaks in north Andaman, Mt. Ferrington in Middle Andaman, etc. The characteristic feature of this type is the presence of stunted trees which rarely exceed 9.14 m in height and 0.9 m in girth. The floristic composition in the overhead canopy is of *Dipterocarpus costatus, Mesua ferras, Canarium mannii*, etc.

2.6.1.12 Eastern tropical evergreen forest

This type forms the climax vegetation in areas of heavy rainfall having more or less shallow soil overlying serpentine intrusions. It is found on the steeper slopes of the higher ridges, the tree growth being less luxuriant than in the evergreen *Dipterocarpus* type.

2.6.1.13 Evergreen *Dipterocarpus* forest

Andaman forests reach their climax in this type of forests and it constitutes the most luxuriant evergreen forests of the Islands. These forests are found in the high hill slopes and ridges in which outcrops of igneous rocks predominate. The rainfall here is the heaviest being well over 3040.8mm per annum. The soil consists of a deep clayey loam which is always wet, having a thick humus layer. The principal tree species is *Dipterocarpus grandiflorus* which attains maximum height and growth among the trees in the Andaman Island Ecosystem.
2.6.2 Characteristics of Andaman Forests

The dense forests consist of a tangled mass of climbers, lianas, canes, bamboos etc. Mangrove forests are confined to low lying banks of creeks and sheltered portions of the coastline subject to tidal action. On the upper most part of the higher hills and sometimes on steep slopes with poor soils, which are usually exposed to speedy winds, the vegetation is comparatively stunted in growth. Such areas contain mainly bushes, shrubs and stunted trees, which are not presently of commercial importance. In various types of forests excluding mangroves, the trees grow in an intimate mixture of different species, many of which are of commercial importance.

In virgin deciduous forests, fresh regeneration and the younger age classes are practically absent except to a small extent in giant evergreen and Andaman tropical evergreen forests. The reason for this is that in deciduous forests, the top storey trees are deciduous whereas vegetation below the top storey is often evergreen. Without human assistance, the deciduous species would find it difficult to regenerate themselves through this evergreen under storey. In fact, the climax vegetation of the Andaman Islands belongs to the giant evergreen forests.

The lack of gregariousness in Andaman forest is well known. An absolute preponderance of one species or even an assemblage of species rarely marks the floral landscape in these islands. There are several key features of tropical rain forest ecology of the Andaman Islands, some of which are as follows:

1. the tropical rain forests of the Andaman Islands are having one of the most productive terrestrial ecosystems with very high gross and net primary productivity;
2. it is extremely efficient in rapidly cycling most of the nutrients; and
3. it is having a very great biomass.

A notable feature of the resource availability in the tropical rain forest is that the species with edible parts are widely dispersed. It is, therefore, implied that the tropical rain forest environment of the Islands is extremely diverse floristically. The members of a particular species tend to be widely dispersed than clumped together. In addition, there are limited numbers of edible plant species. It, in turn, is reflected in the dietary composition of the Jarawa. The Jarawa, despite inhabiting an ecosystem with diverse biotic environment, rely upon a limited range of edible plants. However, there are enough non-edible plant resources to meet their various requirements.

2.7 FAUNA

In spite of abundance of forests in the Andaman Islands, wild life is peculiarly deficient throughout these islands. The deficiency is more pronounced concerning mammals. There are only 20 identified species of mammals, of which again about 12 are peculiar to these islands. The Andaman species of mammals and birds differ significantly from those of the adjacent islands like Nicobar, Sumatra and Java, etc.

2.7.1 Mammals

The Andaman Islands are endowed with rich floristic composition but they are poor in fauna. The large mammals and monkeys are entirely absent from the Andaman Islands. The largest indigenous wild mammal is only the Andaman Pig (*Sus andamanensis*) which is much smaller than the mainland pig. The other indigenous mammal found in the Islands is Civet Cat (*Paguma larvata tytleri*). Bats and rats constitute nearly three-fourth of the known mammals. A number of deer species were introduced in these islands in the early 1920s. Of these, the spotted deer (*Axis axis*)
has acclimatized well and has spread in almost all the islands. Barking deer \((Muntiacus muntjak)\) has also survived in these Islands, and have been breeding successfully but they are comparatively rare. Hog deer \((Axis porcinus)\) has also been reported in the Islands but they are also rare. Of the introduced mammals, another interesting species is the wild goat in Barren Island. Queerly enough, they have adapted to saline water. Two marine mammals, viz., sea cow \((Dugong dugong)\) and Dolphins \((Dolphinus dolphis)\) are found in the surrounding seawaters. While dolphins could be seen very frequently, but the \textit{dugong} is very rare. All mammals, except deer, are an invaluable source of food for the aborigines.

2.7.2 **Reptiles and Amphibians**

There are a number of lizards and snakes including viper and cobra inhabited in the Island ecosystem. However, cobras are very rare. Salt-water crocodiles \((Crocodiles palustris)\) are widely distributed in almost all the creeks and back waters. Among the reptiles, only monitor lizards are the game animal for the aborigine of Andaman Islands.

2.7.3 **Birds**

The bird fauna though not very rich but consists of a few indigenous species which are rare and quiet interesting. There are few species indigenous to these islands which are rare and quite interesting. Amongst birds, the Andaman green pigeon, hawk, eagle, scarlet minivet, black head bulbul, white head mynah and Indian cuckoo are common. Based on his survey as well as on the basis of the recorded evidences available, Abdulali (1962) has listed 112 species and sub-species of birds. The list also includes several introduced species that have adapted to the environmental setup of the Islands. Birds are occasionally eaten by the aborigines including the Jarawa and therefore are not the part of major edible food items.
2.8 COASTAL ENVIRONMENT

In terms of assemblage of animal species, the Andaman and Nicobar Islands occupy a unique position. They are close to the “Indo-Malayan Region” which is considered to be a ‘faunastic centre’ from which other sub-divisions of the Indo-West Pacific region recruited their fauna (Tikader et al., 1986). Therefore, some of the typical Indo-West Pacific groups of animals are found in these Islands. Some of the animals are giant calms (Tridacnidae) among molluscs and sea moths (Pegasidae), whittings (Silligindae), rabbit fishes (Siganidae) and plesiopdae (Plesiopidae) among fishes. There are many more such marine animals. Although the Islands have a great diversity of marine fauna, many groups are yet to be identified in detail. The Andaman Sea in the tropical belt, with an area of $0.602 \times 10^6$ km$^2$ (average depth of 106 m) and enclosing water of the volume of $0.660 \times 10^8$ km$^3$ (Tikader et al., 1986:14), provides a vast ecosystem for the existence of rich marine life that can be converted into resources for various uses. The intertidal and neritic zones of the Andaman islands, together called as coastal sea, are the happy abodes of almost four-fifth of all the plants and animals. They are abode to a variety of pisces, molluscs, crustacean and reptiles. Around the islands, the littoral and sub-littoral zones are occupied by underwater coral populations, which display the flamboyancy of tropical life. Sea shore of Andaman Islands can be divided into rocky, sandy and muddy shores. It is often interspersed with mangrove vegetation.

2.8.1 Rocky Shore

In several of the Islands, the coasts are rocky. The life forms on the rocky shore are mainly governed by the tides. The sea animal found in the rocky shore zone are limpets, chitons, neritides, top shells, turban shells and certain species of crabs, molluscs and shrimps.
2.8.2 Sandy Shore

The flourishing of life in the sandy shores is not so marked as on rock shore. The fauna of sandy beaches are *polychaetes*, molluscs, amphipods, *sea-anemones*, etc. *Polychaetes* of the phylum *Annelida* are the most characteristic and abundant of the sandy intertidal animals. Among crustaceans, dominance of copepods has been seen. Other important crustaceans are snapping shrimps, fiddler crabs, bivalve shells, cockles, and calms. The turtles prefer to visit the sandy shores during the winter season for laying eggs.

2.8.3 Muddy Shore

The muddy shores have developed where sea currents are slow and weak allowing settling of fine particles on the relatively calm beaches. Such conditions are found in sheltered bays and in mouths of coastal streams. The fauna of muddy shore consists predominantly of pelecypod molluscs, worms, few crustaceans and some fish that spend at least part of their lives in the habitats below the ground.

2.8.4 Mangroves

Two types of forest, namely mangroves or tidal swamps and littoral forests or beach forests influence seashore topography of the Islands. The mangrove ecosystem supports many brackish water and fresh water fishes. Many of the animals of mangroves are common to mud flats. These include different types of crustaceans like fiddler crabs and hermit crabs. Among molluscs gastropods, bivalves and edible oyster are common. It can be said that the paucity of terrestrial fauna is compensated by the abundance and diversity of marine animals. In fact, the coastal zones are the major food gathering zones for the aboriginal people of the Andaman and Nicobar Islands. Interestingly, the Jarawa do not relish the sea cucumbers which are available in abundance near the shore.
2.9 THE PEOPLE

Discussion on the physical environment of the Andaman ecosystem would remain irrelevant if the people whose habitat it has become are not mentioned. Ecological study of the people of the Andaman Islands is rendered extremely interesting by virtue of the great diversity of the people inhabiting the island ecosystem. Andaman Islands have found place in the accounts of sailors, travellers and traders from long past like that of Ptolemy in the Second Century, of Chinese in the Seventh Century, of the Arabs in Ninth Century, and of the Europeans in the Thirteen Century (Mathur, 1968:7). However, a systematic and detailed account about the Islands and its people has been found since 1858 when the British occupied the Islands second time for penal settlement. In post-Independence period, some detailed studies were carried out on the environment and people of the Andaman Islands (Majumdar, 1975; Pandit, 1974, 1976, and 1989; Sarkar, 1985 and 1987; Sarkar, 1987, 1990, 1993 and 1996). In the post 1998 phase, the major works are by Sreenathan (2001) and Mukhopadhaya et al., (2002).

The Andaman and Nicobar Islands are home to six tribal groups namely the the Sentinelese, the Jarawa, the Onge, the Great Andamanese, the Shompen and the Nicobarese. Of the six tribal groups, the first four tribal groups belong to Negrito stock (Plate 1, 2, 3, and 4) while the latter two to Mongoloid stock. Interestingly, the Andman Islands are home to Negrito people while the Nicobar islands to Mongoloid people.

Prior to the colonisation of these Islands by the British, particularly after 1857, The Andman Islands were the exclusive abode of the Negrito aborigines. However, it was only at the end of the 18th Century, with the attempt of the formation of the settlements and latter on, of the penal settlement, that there could began an influx of
the foreign people, mainly from different parts of main land India. Since these people were from different parts of India, their diverse social and cultural traits gave a character of heterogeneity to the human fabric of the Islands. In the post-Independence period, the settlement of the refugees from the erstwhile East Bengal and some of the people from South India took place in the Islands. It was mostly at the displeasure of the aboriginal people. Hence, people of the Andaman Islands could now be divided into two groups, viz., the aboriginal (generally referred to as tribal) and the non-tribal people.

2.9.1 The Aboriginal People

Nothing more deserves a special note in the Islands than the aboriginal population. Because of the insular nature of the Islands, the aboriginal population is considered as one of the purest types. Their way of life may be considered as the living forms of the most ancient and primitive style of life. They are short in stature; their skin is black and their hair frizzy. There are some biological and cultural affinity of these tribes with the Negrito groups of South-East Asia like, Semang of Malaysia Peninsula and the Aeta of Philippines. Thus, it is believed that Andaman Negrito groups migrated to their present habitat from South-East Asia in remote past either by sea or by land route. Nevertheless, evidences to establish this hypothesis are not yet sufficient. Regarding distribution of the four Negrito tribes (aborigines) in three different islands of the Andaman and Nicobar, there are a number of assumptions, but all these have a common proposition that for their nomadic nature either these tribes moved to different islands or some of them were drifted to present habitat by the sea waves, while moving from one place to other in canoes. Their movement further south below Little Andaman was most probably hindered because of the presence of fast flowing turbulent ocean currents at 10° North latitude which is also known as 10° Channel.
Table 2.2 Tribal population in Andaman and Nicobar Islands

<table>
<thead>
<tr>
<th>Tribes</th>
<th>Location</th>
<th>Population</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Andamanese</td>
<td>Strait Island</td>
<td>41</td>
<td>On the verge of extinction</td>
</tr>
<tr>
<td>Onge</td>
<td>Little Andaman</td>
<td>97</td>
<td>78 settled in Dugong Creek and 19 in the South Bay</td>
</tr>
<tr>
<td>Sentinelese</td>
<td>North Sentinel Islands</td>
<td>100 *</td>
<td>No major breakthrough until today in establishing friendly relationship with them, but efforts are on.</td>
</tr>
<tr>
<td>Jarawa</td>
<td>Western Coast of South and Middle Andaman Island</td>
<td>265</td>
<td>Till 1997, a hostile tribe. Efforts to befriend them have been successful.</td>
</tr>
<tr>
<td>Nicobarese</td>
<td>Car Nicobar, Chowra, Teresa, Nancowry, Katchal, Trikant and Great Nicobar</td>
<td>36000</td>
<td>Relatively well advanced.</td>
</tr>
<tr>
<td>Shompen</td>
<td>Great Nicobar</td>
<td>274</td>
<td>A shy tribe living in the interior.</td>
</tr>
</tbody>
</table>

* Approximate population

The intrusion and decades of contacts with the non-aboriginal population have brought about a rapid impoverishment and decline of two of the aboriginal people of the Islands, i.e., the Onges and Great Andamanese. The other aboriginal population i.e., the Jarawa have been experiencing a gradual shrinkage in their total command area because of the gradual expansion of the area of influence of the new settlers. The Jarawa are today confined to the western part of the Middle and South Andaman Islands with a total population of about 265 and the Onges in the Dugong Creek and West Bay areas of the Little Andaman having a population of 96. While the Great Andamanese have been resettled at the Strait Island having a total population of about
41 and the Sentinelese are in the North Sentinel Island with an estimated population of 100 souls only (Table 2.2). The relationship of the aborigines with the outsiders have had one of deep distrust and hostility, which has rightly been explained by Portman (1899) as an outcome of unfriendly attitude of the outsiders. While the Great Andamanese and the Onges were coerced to be friendly with the use of force during the colonial period, the relation with other two Negrito groups continued to be sour even in the post-Independence period. Decades of friendly gesture by the Andaman Administration ultimately succeeded in befriending the Jarawa in 1997, but this is not the case with the Sentinelese. They are still outside the ambit of friendly relations. However, the acceptance of friendliness on the part of the aborigines has proved to be a bane for them as their numbers have drastically decreased after the friendly contacts due to various reasons.

2.9.2 Antiquity of the Negrito People

The antiquity of the Jarawa or for that matter of the Negrito people of the Andaman Islands is still shrouded in the mystery. In this regard, one has to depend on the materials obtained from the excavation of the kitchen midden sites (shell mounds), which are an assemblage of shells, pottery, implements, equipments etc. buried in successive layers at Beehive Island and Chouldhary, and considered to be the earliest sites of human occupancy of the Islands (Man, 1883; Portman, 1899; Holland, 1904; Cipriani, 1966; and Dutta, 1974). Chatterjee excavated one kitchen midden site at Beehive Island of Middle Andaman in 1952, and Cipriani also carried out study of the shell mounds (cf. Dutta 1974: 13-15). In comparison to the Beehive, lithic industry at this site was richer. Here the flakes were predominant (65%) than core (2.03%) and finished tools (32.93%). On the basis of faunal evidences, flakes etc. and comparing them with the blade industry found at different Toalean sites of South-East Asia, Dutta (1974: 35-38) opined that the Andaman Islanders would not have arrived prior
than 300-100 years B. C. The radio carbon dating of these materials put them to be 2,280 years old (Cooper, 1990). The Mesolithic culture of the Andaman Islands was associated with the pottery. When the Andaman findings are compared with those of the South-East Asian ones, it seems improbable that the bearers of this culture existed in Andaman Islands earlier than 300 B.C. It must be noted that pottery could be found in the Upper Toalean layer in Indonesia, allowing some time for the spread and drift of the culture, the Mesolithic culture “possibly arrived in the Andaman Islands sometimes around the beginning of the Christian era” (Dutta, 1974:35). Thus, the archaeological evidences suggest establishment of a cultural link between the Andaman Islands and South-East Asia around that period. Interestingly, the Great Andamanese oral tradition bears memory of a period when they were inhabitants of a large landmass where there were many other people speaking the same language, and large animals used to roam in that land. Then there was a great cataclysm that submerged the large mass of land with man and animals (Portman 1899:8).

2.9.3 The Jarawa

The Jarawa are one of the four Negrito groups of the Andaman Islands. They inhabit the western part of the South and Middle Andaman Islands. The Jarawa territory, also known as ‘Jarawa Reserve’ measuring approximately about 765 sq km (see Fig. 3.1 in Chapter III). The total population of the Jarawa is 265 as per the last survey in 2002. They derive their livelihood through hunting, fishing and gathering. The tools used for the collection of resources are simple, which include bow and arrow, fishing hand net, digging rod, metal knife, iron dao (a kind of chopper), wooden bucket and baskets. The resources are collected from both terrestrial and aquatic ecosystem. There are three territorial groups of the Jarawa viz., Tanmand group, Thidong group and Boiab group (see Fig. 3.1 in Chapter III). The Tanmad group inhabits the southern part of Middle Andaman Island, while Thidong and Boiab
groups inhabit the northern and southern part of the South Andaman Island, respectively. The immediate neighbours of the Jarawa are the non-tribal population, which have also been referred as ‘Non-Jarawa’ in the present discussion.

2.9.4 Non-Tribal Population

Leaving aside the aboriginal people, the Islands are being inhabited by the those who came or were brought to Andaman Islands after the arrival of the British. The convicts of the penal settlements have settled in these areas by bringing their family members from the mainland or by getting married with the convict women. They are now called as ‘local born’. The settlements of these people have grown exclusively in the South Andaman, particularly in Port-Blair and the neighbouring villages. Though having hailed from different parts of India and speaking different languages, they have become an integrated community and the Hindi is their spoken language- a binding force. Such formation of a homogenous community is verily an example of fusion under a given set of geographical setting- isolation of the Islands. Apart from them, a few groups of Bhantus and Mopillas, and a few Burmese and Karens have also settled in these Islands. Except the Karens, who have settled through free enterprise in the northern part of Middle Andaman, all other groups were brought to the Islands to serve the terms of their conviction. After termination of colonial rule, very few of them opted to go back to their native place. However, all these groups have settled quite peacefully in these islands. Initially the agriculture was the basis of economy. Now many of them are engaged in other enterprises also like service, business, transport etc. With a view to attain all-round development of the Andaman Islands, the Government of India initiated a programme to rehabilitate persons displaced from the then East Bengal in the Andaman Islands immediately after Independence. At that time, it was very difficult to get any large patch of suitable land for settling the refugees as the Andaman Islands were covered with dense forests.
However, some lands were identified, acquired and cleared of forest in different parts of the South, Middle and North Andaman Islands for locating settlements of the refugees. Out of approximately 5,000 refugee families, 1,328 families were settled in South and Middle Andaman Islands (Census of India, 1961). Each of the family was given 10 acres of land for agriculture and horticulture.