SAVING THE ANDAMANS

TOWARDS A STRATEGY FOR SUSTAINABLE DEVELOPMENT OF ISLAND ECOSYSTEMS

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MAN AND THE BIOSPHERE ROGRAMME

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INTRODUCTION

The purpose of this study was to identify the major threats to the ecosystem of the Andaman and Nicobar Islands and to recommend ways in which these threats could be removed, minimised or mitigated. The challenge was to ensure that conservation of ecosystems was done in a manner that did not stop the economic growth and development of the islands and that such growth and development was socially and environmentally sustainable.

The first part of the study describes the islands, especially their history, their geographical and physical features, their social and economic profile and their ecology. The second part of the study identifies and describes the major threats to the ecosystems and the causes and source of such threat. The third part of the study identifies measures that can and need to be taken in order to bring the islands on to a path of sustainable development.

The Andaman and Nicobar Islands (A&N Islands) are among the most ecologically valuable sites in India and, in some ways, in the world. They are perhaps the second richest sites in the world for corals, with over 190 species belonging to 58 genera already identified. They also harbour a large number of endemic species and subspecies of birds, reptiles, amphibians and insects and have among the last untouched stands of tropical evergreen rain forests in India.

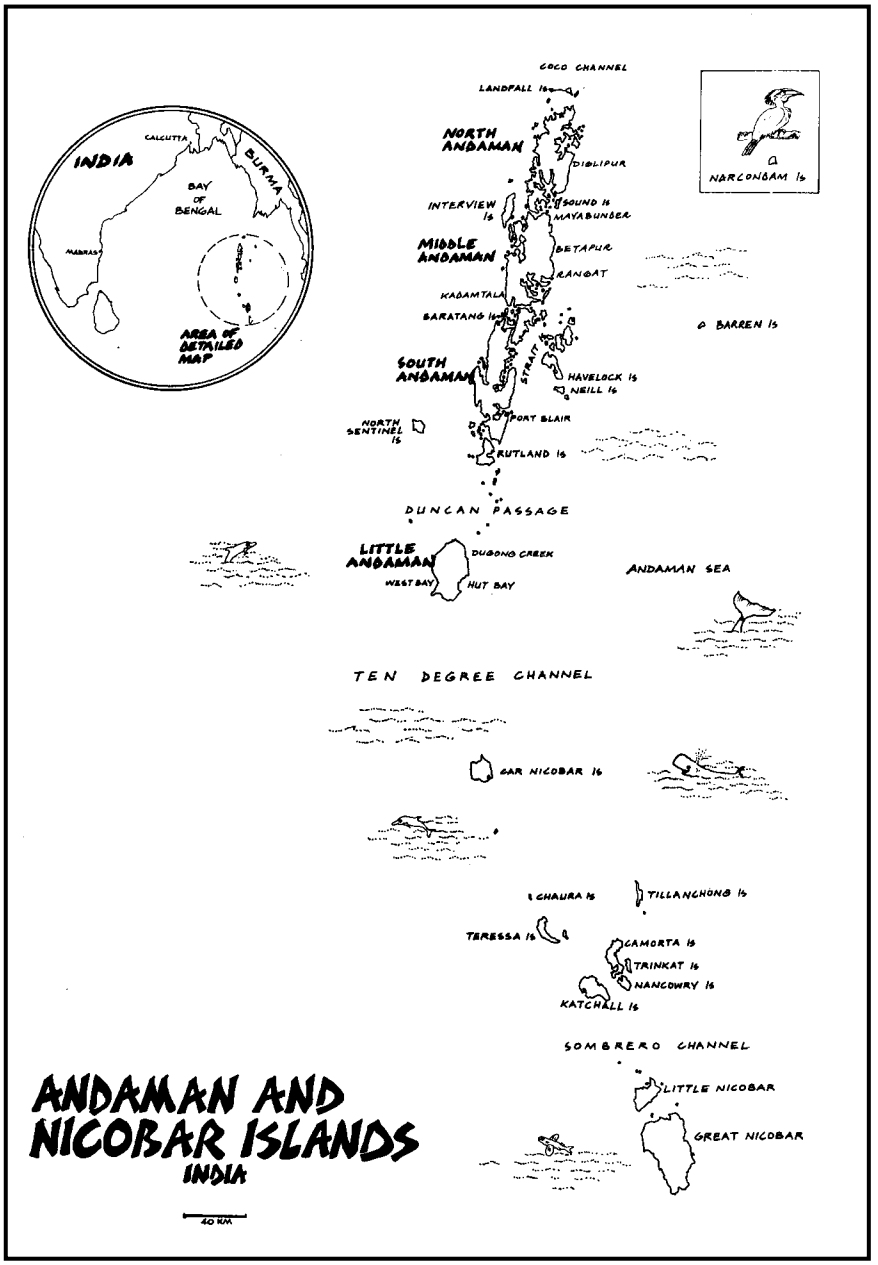
The fact that they have a relatively small human population (estimated to be 350,000 in 2001) and a large number of uninhabited islands, most of which are remote and not easily accessible, make them an ideal candidate for the development and application of sustainable development strategies. However, along with these advantages, there are also significant obstacles, many of them a result of past mistakes or well meaning but inappropriate actions. Also, the imperatives of conservation, especially of biodiversity conservation, are only now being understood and accepted and past policies reflected the priorities that were in vogue then. Some of the major pressures came from inappropriate forest working, rapid expansion of human population, unsuitable construction practices, mismanaged tourism and lack of security and regulation. These and other pressures have been discussed in detail in the report.

Recently, the Supreme Court of India, the apex Indian court, has passed orders on a petition filed by certain NGOs that significantly curtails or totally bans many of these destructive trends. It is too early to judge what the outcome of this order would be but at the moment things look optimistic and, if all goes well, the A&N Islands may become the first aprt of India to adopt a sustainable path of development.

THE ISLANDS AND THE PEOPLE

I. THE ISLANDS

The Andaman and Nicobar group of islands is situated in the Bay of Bengal, between peninsular India and Mayanmar. It is located between 6^0 45" and 13^0 41" North latitudes, and 92^0 12" and 93^0 57" East longitudes. Arranged in an arc from the north to the south, there are 349 islands, which can be distinguished into two groups geographically. Islands located north of 10^0 N Latitude are the Andaman group of islands while the rest belong to the Nicobar group.



The northernmost point (Land-fall island) is about 901 km away from the mouth of Hoogly River and about 190 km from Myanmar. The southernmost island is Great Nicobar, whose southern most tip is only about 150 km away from Sumatra, Indonesia. The Capital of the Andaman and Nicobar Islands is Port Blair, which is 1255 km from Kolkata, 1190 km from Chennai and 1200 kms from Vishakhapatnam. The Union territory has two districts viz. Andaman and Nicobar.

There are 325 islands in the Andaman group while the Nicobar group has 24 islands. Total geographic area of Andaman and Nicobar Islands is 8249 sq. km., of

which, the Andaman group of islands cover 6408 sq. km., while the Nicobar group covers 1841 sq. km. The recorded forest area is 7170.69 sq km (86.93%) and the actual forest cover is 7606 sq km (92.2%).

Out of the total 349 islands only 38 islands are inhabited, 24 in the Andaman group and 12 in the Nicobar group.

Geography and Geology

These islands are the summits of a submerged mountain range lying on the great tectonic suture zone extending from the eastern Himalayas along the Mayanmar border to the Arakan and finally Sumatra and Lesser Sundas.

The physiography of these islands is characterised by undulating topography and intervening valleys. There are, however, some flat islands like Car Nicobar and Trinket.

There are no major perennial fresh water rivers in these islands except Kalpong in North Andaman and Alexendra, Dagmar and Galathea rivers in Great Nicobar. There are several rain fed streams, which dry up during summer. The coastline of these islands forms a large number of bays, lagoons and serpentine creeks, and has a length of about 1962 km. At several places tidal creeks penetrate far inside the land and form outlets for fresh water streams.

Two islands of volcanic origin are found here- the Narcondum and the Barren Islands. The former is now apparently extinct while the latter is still active. [Andaman and Nicobar forest Department Report]

Soil

Soil cover is rather thin, varying from 2m to 5m. It is mostly alluvial on hilltops while diluvial in ridges and valleys. The coastal flats have an admixture of sand, silty clay and diluvial material with fine fragments of coral lime. The soil is, in general, mild to moderately acidic with high humus on top [Andaman and Nicobar forest Department Report]. Details of soil types are given below.

Table 1.1: Suborder wise Soil Series and their distribution in Andaman and Nicobar group of Island

Order	Suborder	Name of Series	Location
Entisols	Fluvents	School Line, Patitiya* Koe*	South Andaman, Middle Andaman, North Andaman, Great Nicobar.
	Orthents	Calicu Garacharma Chegin* Holchu*	South Andaman, Baratang, Middle Andaman, Kamorta, Katachal, Nancowrie, Little Nicobar, Kondul, Great Nicobar.
	Aquents	Dhanikhari	South Andaman, Kamorta, Katchal, Nancowrie, Great Nicobar, South Middle and North Andaman
	Psamments	Rangachang, Nylol*	In all the Islands excepts Middle and North Andaman
Inceptisols	Aquepts	Tushnabad, Kokeon* Pullobakka*	South Andaman, Terressa, Great Nicobar
	Ochrepts	Munda Pahar, Wandoor	South Andaman, Little Nicobar, Great Nicobar, South Andaman, North Andaman, Little Nicobar, Kondul, Great Nicobar.
		Austinabad	South, Middle and North Andaman, Tillachang, Great Nicobar
		Pahargaon	South, Middle and North Andaman
Alfisols	Udalfs	Little Andaman	Little Andaman and North Andaman
	Aqualfs*	Pullobaha* Kosentoth*	Great Nicobar
Ultisols	Udults*		Little Andaman
Mollisols	Udolls *	Locafum*	Great Nicobar, Little Andaman
	Rendolls*	-	Little Andaman

* All India Soil & Land Use Survey, New Delhi
Source: Central Agricultural Research Institute, Port Blair, as quoted in PC 1987

Climate

These islands have a tropical climate, which is warm, moist and equable. The temperature ranges from 18^0 C to 34^0 C. The proximity of the sea and the abundant rainfall prevent extremes of heat. An average of 3000 mm per year is received from southwest and northeast months. Humidity is high varying from 66 to 85%. [Andaman and Nicobar forest Department Report]

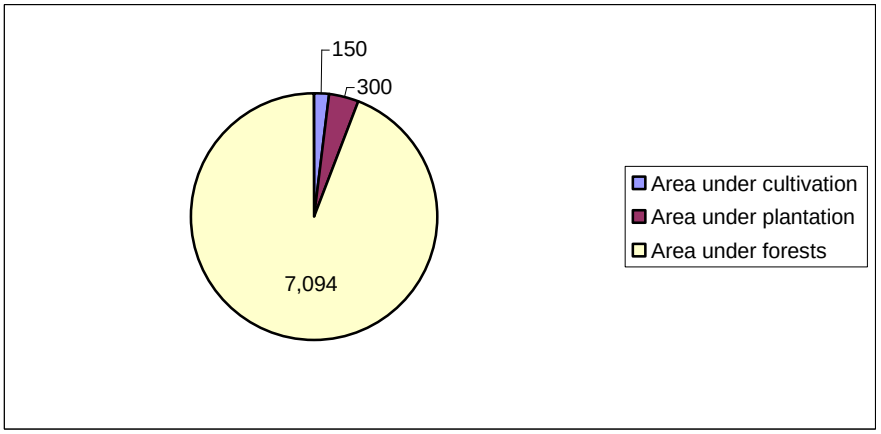
Land Use

Out of the total geographical area of 8,249 km^2, forests occupy 7,606 km^2 or 92.2 % of the area. (5,883 km^2 in the Andaman group of islands and 1,723 km^2 in the Nicobar group). Of the total forest cover, dense forests with a crown density of 40% and above,

constitute 85.6%, open forests with crown density less than 40%, constitute 1.7% and mangroves constitute 12.7% (ANI F&E 2001 and Anon, 1999)

However, the legal forest area is 7170.69 km^2, which constitute 86.93% of the geographic area of these islands. Out of this, 4,242 km^2 are protected forests and 2,929 km^2 are reserved forests (ANI F&E 2001). For further details, please see Table A in appendix.

The remaining 14% of land is revenue land and is used for human settlements, cultivation and other human use activities. Most of the revenue land is along the coast, where people have been settled. "The entire rural/revenue area is under CRZ-IV (Coastal Regulation Zone – Category IV), except a very small area under CRZ-II. No new construction is permissible within 200 metres of High Tide Line in CRZ-IV areas" (ANI F&E 2001). (Refer to Chapter 7.2 for details of Coastal Regulation Zone Notification of 1991). Of the available revenue land, only 21% is under intense cultivation, another 11% is classified as fallow and culturable waste (land that is cultivable, but currently lies fallow). 45% of the revenue land is under plantation crops (Sirur, 1999).



In sq km

Forestry

One of the main economic activities in the islands, along with fisheries, is forestry. Historically, the forests of the islands have been "worked" since the late 1880s and in the middle of the 20th century various wood based industries were set up in the Islands. However, in recent years there has been a closing down of the wood based industry and a decline in forestry activities, especially in the extraction of timber. The recent order of the Supreme Court of India, discussed later, has further restricted forestry activities. More

details of the forestry operations in the islands will be given later while discussing the major threats to the ecosystem.

Industry

For facilitating the growth of industry, the Directorate of Industries was set up in 1978 and the District Industrial Centre also started functioning. The Khadi and Village Industries Advisory Board (small-scale sector) has also been set up. However, \iIndustrial development is handicapped by the fact that all inputs, except perhaps raw material in some cases, have to be procured and transported from the mainland. There is little demand for finished goods in the A&N Islands and these have again to be transported to the mainland (Census of India, 1991).

As per the 1991 census, 970 village and small industries were functioning in the Islands (Census of India, 1991). The industrial sector makes up for 10% of the Gross Domestic Product (GDP) and employs about 6% of the main workers.

The major industry in the A&N Islands is the Timber industry. In the past, forests were leased out to the private industry and, from 1977, to the Forest Corporation, to extract raw material for the timber based industry. Though the practice of leasing forests to the private industry finally stopped in 1990-91, the corporation continues to directly fell forests in Little Andaman and in North Andaman Islands (Singh, 2002).

Fisheries

As in the case of agriculture, the fisheries sector began by bringing fishermen's families from the mainland and settling them on the islands. Fishing operations around the Islands have been reported since 1908. A private fisheries company was floated in the 1940s. It was wound up despite its reporting that the potential was enormous. Another operation started in 1951 also failed. The Department of Fisheries was set up by the A&N administration in 1955. Since the islands did not have a non-tribal population of local fishermen, a “fishermens settlement scheme” was initiated in 1955 and families of fishermen from Kerala and Andhra were brought and settled in the Andamans” (Saldanha, 1989).

The administration also allocated land for housing and provided loans and fishing equipment. In subsequent years, presumably attracted by the vast fisheries potential, many more fisher-folk migrated from the mainland to the islands.

The inland aquaculture sector is also being developed, with inputs from CARI (Central Agricultural Research Institute). There are a few freshwater ponds in the municipal area and the CARI runs a demonstration farm for freshwater fish (Sirur, 1999).

There is no tradition of commercial fishing by the local inhabitants and fishing has mostly been for sustenance. The number of marine fishermen on the islands is very small and most of the Bengali settlers prefer to eat freshwater fish. There are very few mechanized and non-mechanized fishing boats and many of the on-shore areas, with rich fishery potential, are not being exploited.

The islands are also very close to the known tuna fishing grounds and there is considerable potential for catching and exporting tuna. Two species of lobsters, namely *Panilurus cranatus* and *Panilurus polyphagus* are also found in the islands and the fact that the Nicobar Islands lie close to international shipping routes makes the development of international trade in fisheries very plausible (Anon, 1986).

Some efforts have been made by the government to promote the growth of commercial fishing. Besides developing markets and infrastructure, the government has set up the Andaman and Nicobar Islands Integrated Development Corporation (ANIIDCO), which has floated a company called Andaman Fisheries Limited (AFL). AFL is establishing cold storage and processing plants at Wandoor, near Port Blair, at Havelock and at Diglipur. The government has also started a leasing policy for allotment of land to entrepreneurs for prawn farming. The Marine Products Export Development Authority, funded by the Department of Ocean Development, Government of India, is also implementing a demonstration project for prawn farming (Census of India, 1991). However, there is a lack of cooperatives or self help groups among the fishing communities (Sirur, 1999; Workshop, 2001). Though the government has organized primary level cooperatives, they appear to be inactive (Sirur, 1999).

Agriculture

A hilly terrain, with heavy rainfall and a thin and porous covering of soil, characterizes the islands. The land is more suited for plantation crops rather than paddy cultivation (Census of India, 1991).

Initially the government settled refugees in remote locations, giving each family two hectares (five acres) of lowland and two hectares of hilly land. The Bengali settlers

were mainly rice eaters and, as low-lying lands were suitable for rice cultivation, it was hoped that they would become self-sufficient in food (Census of India, 1991). The total flat land on all the islands, suitable for agriculture, was estimated to be 77,500 ha. Of this, the, land brought under agriculture by 1981 was 14,953 ha (Whitaker, 1985).

By the end of 1991-92, the land under high-yielding variety of paddy was 12,000 ha. The cultivation of vegetables, pulses and oil seeds had also been encouraged, as an alternate rice-fallow crop, for utilization of residual soil moisture. Considering the nature of the land, importance was also given to tree (horticultural) crops. Six per cent of the total geographical area has come under agriculture and allied activities, including horticulture crops (Census of India, 1991).

Socio-economic surveys conducted (Ali, 2000 and Singh, 1997) around Mt. Harriet N.P. and Saddle Peak N.P. show that 41% of villagers raise paddy and plantation crops and 54% raise plantation crops alone. Reports and statistics indicate that plantation crops occupy a larger area. Of the land given to settlers, much of the hilly land has not yet been fully utilized.

The Department of Agriculture (DoA) estimates that 53,315 ha of land are under various forms of agricultural production. According to estimates developed by the Food and Agriculture Organization of the UN and allied organisations, the A&N Islands can support three persons/ha at an intermediate level of agriculture and five persons/ha at the level of intensive and technologically advanced agriculture. At the level of production in 1989, which has not significantly increased since then, the islands can support only 1.6 persons/ha. With the current increased population level, it can safely be presumed that the agricultural carrying capacity may well have been surpassed (Sirur,1999). Another alarming factor is that rice yields are dropping both in North and South Andaman (Ali 2000, Singh et al 2001).

Out of the total geographical area, 14 per cent is for agriculture as well as for non-agricultural purposes. Of these only about 47,823 hectares are reported to have been covered under various crops which depend upon the annual rainfall. The agricultural soils comprise of valley lands and slightly undulating to flat lands.

Almost 12,000 ha of land is presently under rice cultivation. There are some hilly lands allotted for agriculture and plantation, which are still to be utilized by the farmers. These hilly lands are utilized for cultivation of coconut, bananas, papaya etc. The local population depends on mainland for most of their food ingredients.

Tropical vegetables are grown on a limited scale all over the territory during rainy season. But in summer, only levelled and irrigated areas with deep soil support vegetable crops.

Other crops grown are sugarcane, oilseeds like mustard (North Andaman), sesamum and groundnut (Little Andaman) and fodder crops like maize and sorghum. There are difficulties in growing tuber crops such as potato, onion on hills as the plots after harvest is prone to heavy erosion. Some tropical fruits like banana, papaya, mango, lemon, orange, pine-apple, and septa are grown in these islands. The tropical heat coupled with heavy rainfall support the growth of a number of commercially important plantation crops. Coconut is by far the major plantation crop of these islands occupying a total of 22,000 hects, with a production of 730 million of nuts per annum. The climatic condition of Nicobar group of islands. Areca nut also grows every well in these, islands even in hill slopes. At present total area under this crop is around, 2,100 ha. producing 3,000 M.T. of nuts per year.

Pepper, clove, cinnamon and nutmeg are some of the major spice crops grown in Andaman and Nicobar islands. On eroded hill slopes cashew nut has been planted.

To meet the acute shortage of edible oils and relieve strain of the foreign exchange for import of palm oil, the idea of cultivating red palm oil in A&N islands has been receiving the attention. First, this was planted over 160 ha. in Little Andaman. Now an additional area of 68,000 hects, has been sanctioned by Government for this plantation. In recent years, rubber was introduced by Agriculture Department on these islands. At present about 614 ha. are under rubber plantation in South Andaman and Katchal Islands. The average production of rubber is about 600-800 kg. per ha.

Dry weather that prevails for four months on Andaman and Nicobar islands retard the growth of coffee plants. Tea plantation is not possible as there is no place at higher altitude. The scope of growing coco was extremely limited owing to the nature of soil.

The tropical hot and humid climate of Andaman and Nicobar islands can support the growth of important medicinal plants like Cinchona, ipecac etc. (CSIR 1987)

Energy

The rainfall data indicates that nearly eight to nine months in a year it rains in Andaman and Nicobar islands and average rainfall in a year is about 300 cm. Considering the climatic conditions and other environmental factors, it is not likely that solar energy could make an impact as a major source of alternate energy. However, application of solar energy in the area of desalination of sea water, street lighting with the application of photovoltaic system could be considered. Considering wind energy, wild velocities during last four year is properly exploited with the help of well designed wind mills, it is likely to contribute to an extent of 10 to 15 per cent of total energy requirement, particularly for agricultural purpose. With this in view, it is essential to design a complimentary system using both solar and wind energies so that both will work as a substitutional energy sources.

The consumption pattern of electricity considering the present generation and consumption rates and likely demand from industrial growth and agriculture is expected to be around 515 million KWH by the year 2000 AD. The present soenario of energy indicates that the entire energy requirement is met out of electricity produced from power generators running on oils. It is also not likely to generate power either from thermal energy or through hydro-electric stations. Alternately, the energy requirements are to be met out of solar wind energy and bio-mass.

Power consumption

To make a pragmatic estimation of energy requirements, rate of power consumptions has been taken as the basis. The major sector that needs power is fisheries. Assuming, fish catch of 1,35,000 tonnes of fish by the year 2000 AD, the power requirement for the cold storage is around 40,150 KWH. Assuming, 100 per cent of requirement for all other sectors together, total power consumption is approximately 4,00,000 KWH.

Power plant Capacity

The power plant capacity has been estimated in proportion with its present oration of consumption and plant capacity. Accordingly, the estimated plant capacity by 2000 AD is about 240 million KWH.

Power generation

It has been observed from the past data, the rate of utilisation of power plants is only 18 per cent, which means a reasonable gap to accommodate any additional power requirement without altering the plant capacities. Hence, no logistic model has been made for power generation.

S&T inputs

1. To prepare a wind energy resources map, which will indicate the wind, flow patterns (velocity, deviations, frequency etc.) and help in selecting suitable sites for installing the windmills for power generation, pumping water for agricultural and other community uses.
2. Use of pig and the human waste for generation of gobar gas.
3. Tapping of strong sea waves for generation of power in the Nicobars.
4. In view of negligible indigenous energy resources, possibility of setting up an oil refinery taking the crude from neighbouring countries should be examined. This refinery could supply petrol and diesel for transport system, power generation and tar for road making etc., in addition to produce many organic chemicals. Due to the volcanic origin of the main islands, it is possible that suitable geothermal sites for fairly large-scale power generations might be available. Possible geothermal sites should be explored.
5. Distribution of smokeless chulhas.
6. Installation of solar thermal energy heating system.
7. Installation of de salination device in tribal islands.
8. Installation of water/air heating system.
9. Development of wood gasification.
10. Development of biogas/ biomass.
11. Development of energy plantation.

(CSIR 1987)

Tourism

The A&N Islands, famous for its pristine ecosystems and primeval beauty, is a natural tourist destination. On the recommendation of the Working Group on Tourism, constituted by the Island Development Authority, tourism was officially declared an industry in 1987. However, despite this, though expenditure on the tourism sector has

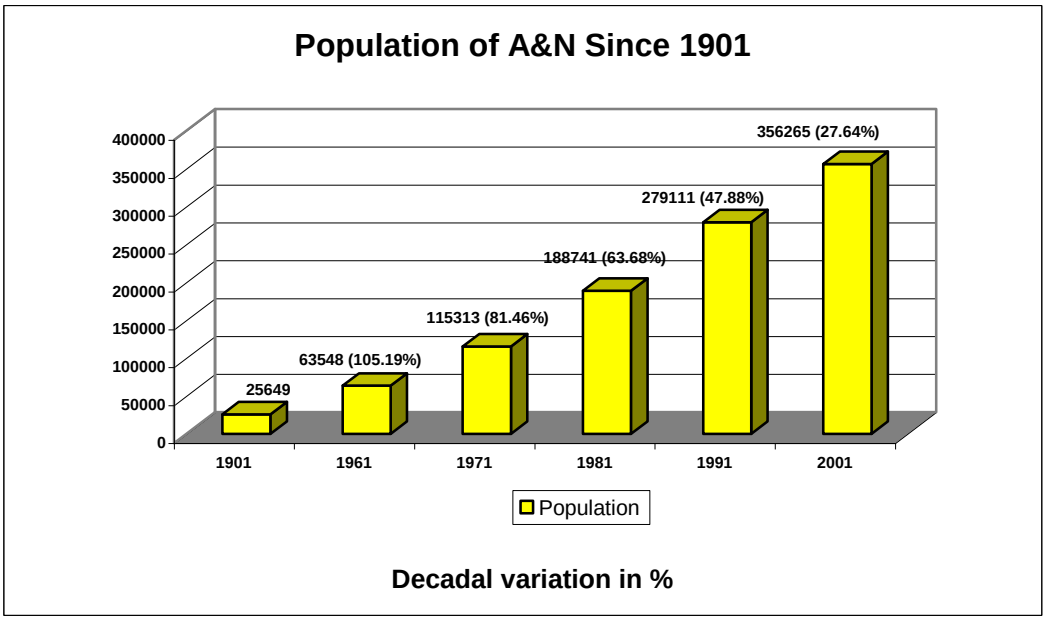
increased from 1993, earnings from tourism have been almost stationary. The Directorate of Tourism has been incurring heavy losses (Sirur, 1999).

There are many problems that affect the tourism sector. the A&N Islands imports much of its processed and some of its unprocessed food. The transportation of food and other items, from the mainland, is heavily subsidised, mainly to control prices for the local population. Travel to the islands, by ship, is also highly subsidised, for the same reason. Consequently, the food and other items used by tourists also have the same levels of subsidy, as it is impossible to have a variable price system. Also, tourists who travel to and from the islands by ship also enjoy the travel subsidy given by the government. As a result, the net earnings from tourism are negligible.

There are also restrictions on infrastructure development, especially because of environmental considerations and the cost of building material. Most of the islands are legally forest land and the diversion of forest land for non-forest activities, like tourism, requires prior permission of the Government of India. There are also constraints because of the Coastal Regulation Zone (CRZ) notification, which restricts construction in coastal areas. Waste disposal is also a problem and increased tourism might well aggravate the problem. There is also a shortage of fresh water and the fragile ecosystem may not be able to cope with a large number of tourists.

II THE PEOPLE

The growth of population in these islands is shown below.



The table above shows the rapid growth of population. Though the rate of growth appears to be less between 1991 and 2001, it is widely believed that the census figures for 2001 are a gross underestimate and that the actual population in 2001 was closer to 450,000. This increase is mainly due to the immigration of people from mainland. The density of population in the A&N Islands is about 43 persons per sq. km (All India: 324). Population is mainly dominated by settlers from mainland. Tribal population constitute only 9.45% of the total population. Main occupations of people include agriculture, animal husbandry, fishing, forestry and plantations, construction, transport, trade and commerce. [Andaman and Nicobar forest Department Report and Census of India 2001]

The population of the islands can be divided into four distinct groups:

- The tribals or indigenous people.
- The former convicts, their families and their descendants.
- The settlers, mainly from the Indian mainland but also from Burma, brought there by the government.
- Recent immigrants, who have come and settled on their own, many on forest land.

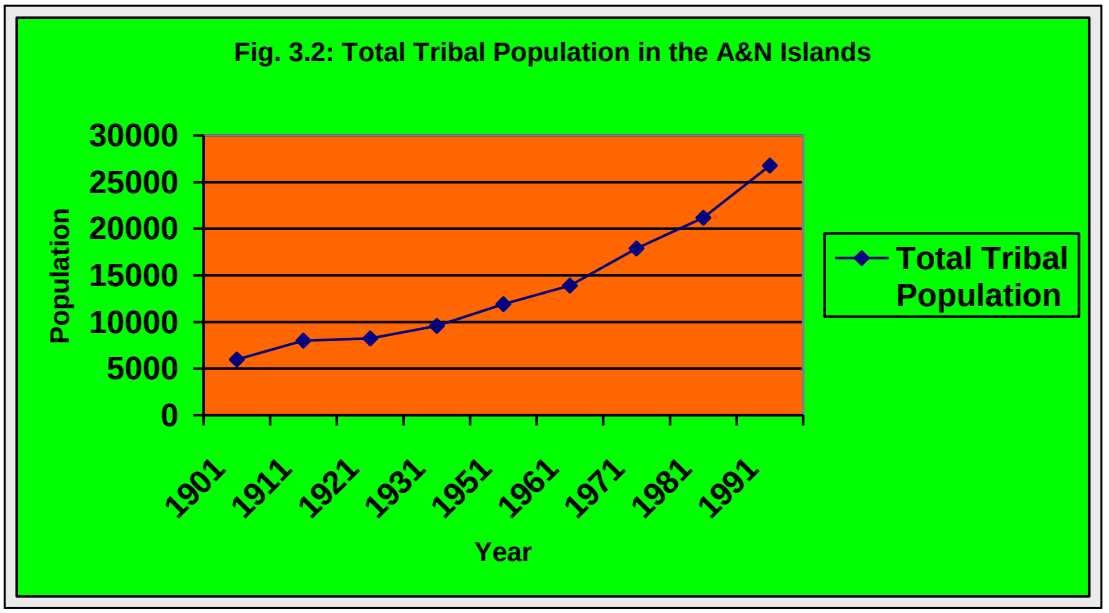
The government has declared areas with predominant tribal populations as tribal reserves, where special regulations are applicable that seek to protect the economy, culture and social organisation of tribals. A list of tribal reserves is given below.

Table 2.1: Island Wise Area Declared as Tribal Reserve in A & N Islands

SL. No.	Name of Island	Name of Tribes	Total Area (in Sq.Km)	Tribal Reserve Area (in sq.Km)
1.	Battimaly	Nicobarese	2.07	2.07
2.	Bampoka	Nicobarese	13.46	13.46
3.	Bluff	Jarawa	1.14	1.14
4.	Car Nicobar	Nicobarese	126.91	126.91
5.	Chowra	Nicobarese	8.28	8.28
6.	Great Nicobar	Shompens Nicobarese	1044.54	853.19
7.	Katchal	Nicobarese	174.30	174.30
8.	Kondul	Nicobarese	4.66	4.66
9.	Kabra	Nicobarese	0.51	0.51
10.	*Camorta	Nicobarese	188.03	188.03
11.	Little Nicobar	Nicobarese	159.02	159.02
12.	Little Andaman	Onge	731.57	403.37
13.	Middle Andaman (Main island)	Jarwa	1535.50	338.69
14.	Meroe	Nicobarese	0.51	0.51
15.	Menchal	Nicobarese	1.29	1.29
16.	North Sentinal	Sentinalese	59.67	59.67
17.	Nancowry	Nicobarese	66.82	66.82
18.	Pillo-Millo		1.29	1.29
19.	Strait Island	Andamanese	6.01	6.01
20.	Spike	Jarawa	11.70	11.70
21.	South Andaman (Main Islands)	Jarawa	1347.97	560.66
22.	Teressa	Nicobarese	101.26	101.26
23.	Tilangchong	Nicobarese	16.83	16.83
24.	Trinket	Nicobarese	36.26	36.26
25.	Trak	Nicobarese	0.25	0.25
26.	Tries	Nicobarese	0.25	0.25
27.	South Sentinal	Nicobarese	1.06	1.60
28.	Brother	Nicobarese	1.99	1.99
29.	Sister	Nicobarese	0.36	0.36
30.	Passage	Nicobarese	0.62	0.62
31.	Cinque	Nicobarese	9.53	9.53
		Total	5645.20	3150.65

The Tribals of the Andamans

The tribal population of the islands can be divided into two distinct groups, those found in the Andaman Islands and those found in the Nicobar Islands.



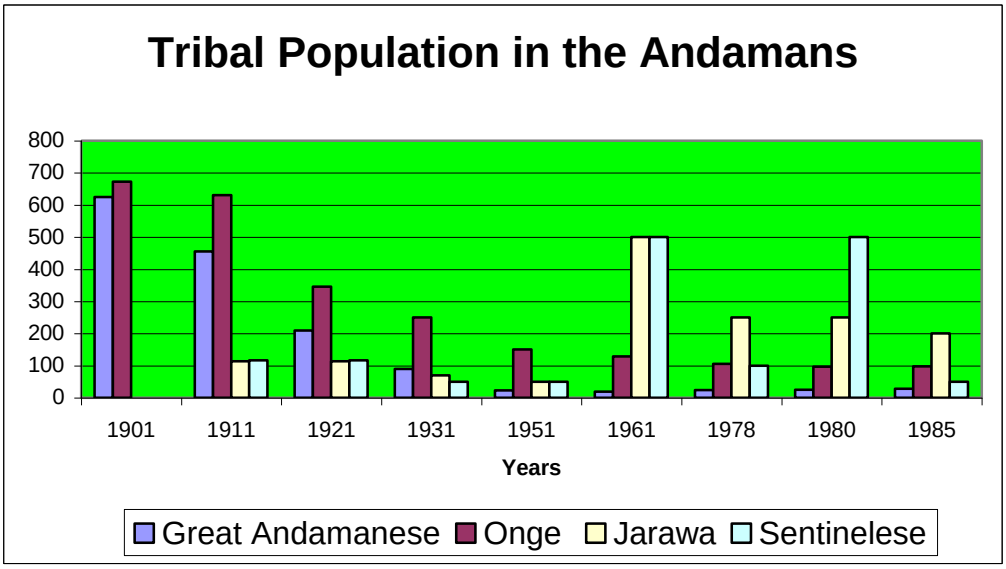
The tribals found in the Andaman Islands are of negrito stock. There are four distinct groups, the Andamanese, the Onges, the Jarawas and the Sentinalese.

Though the overall tribal population in the islands has increased in the last century, the increase is restricted to the nicobarese, who have integrated well with the mainlanders and their life styles. All the other tribal groups show no increase and, infact, some of them show a decline, as will be seen later.

The Andamanese

The (Great) Andamanese are the most threatened of the tribal groups in the islands. From an original estimated population of between 5,000 to 8,000 in the late 1880s, the Andamanese declined to 19 in 1961, and then increased to 24 by 1971 (1971 Census). In 1970, a few individuals of this tribe lived around Port Blair in miserable conditions, but preserving their identity. "Near Memyo village in South Andaman, there were 18 people living in Pipaldera and Nanmaria hamlets. Four individuals were attached as labourers to Burmese families at Memetora hamlet in South Andaman" (Sarkar, 1989).

The population of all the tribal groups in the Andaman Islands has decreased to a point where many of them are threatened with extinction. Details of the population trends are given below.



The table above brings out clearly the decline in the population of the Great Andamanese and the Ongese. In the case of the Jarawas and the Sentinelese, all the population figures are estimates and the wide variations more likely indicate the propensities of the estimator rather than any real cesus data..

Total Tribal population in 1858 was estimated to be 5,000 Great Andamanese and 1,500 Onge – Jarawa – Sentinelese. The Andamanese lived in South Andaman, especially around the Port Blair area, and were the group most seriously impacted by the British settlement. Apart from being killed in skirmishes with British soldiers they also succumbed to various common diseases that they caught from the British and other early settlers, to which they had no immunity. Epidemics such as pneumonia (1868), syphilis (1876), measles (1877) and influenza (1892) reduced their number to 625 at the time of the first census in 1901. By 1931, their number had dwindled to 90 and by 1970, only 20 Great Andamanese survived. These survivors were finally settled in Strait Island (Whitaker, 1985).

The Onges

The Onges live on the island of Little Andaman, south of Port Blair. Originally there were three groups of Ongese, each having their own foraging territory. Each group had its own community huts to which individual bands would retire during the rainy season.

Depending on the season, they would either hunt or fish and erect lean-to type of individual huts, wherever they were engaged in these activities.

The British established contact with the Onges in the 1860s. In 1867, the captain and crew of the ship 'Assam Valley' were killed when they docked in Little Andaman. In retaliation, a punitive expedition was organised by the British, in which 70 Onge men were killed. In another encounter with the British, 30 Onges were killed. However, subsequently, the British were successful in befriending them. A few Onge boys were captured and taken to Port Blair, where they were treated well and sent back with gifts.. This helped in making the Onges friendly towards the British (Sarkar, 1989). Fortunately, due to their being relatively isolated in the Little Andamans, the Onges did not suffer the fate of the Andamanese and have survived till today, though in depleted numbers.

Until recently, the Onges lived on the food collected by hunting, fishing and gathering. The food included meat of wild boar, dugong, turtle and other smaller marine animals, apart from roots, tubers and honey. Awaradi cites various anthropological works which say that they must have originally been dependent entirely on fish, as the Onges started hunting pigs only recently, after they were introduced into Little Andaman by the Nicobarese.

In 1969, the Government started settling refugees on Little Andaman. Nicobarese from Car Nicobar were also brought here and settled in Hut Bay. The Onges' foraging area was consequently restricted and the settlers also started hunting pigs. Meanwhile, the Onge population has declined at an alarming rate, from the initial estimated population of 672 in 1901, it was reduced to 112 in 1971 and to 97 in 1987(Sarkar, 1989).

There were also other adverse impacts on the Onge society. "In 1977, more than two-thirds of the over 700 km^2 of Onge land on Little Andaman was allotted to settlers and to the Forest Development Corporation. Onges are confined to a reserve of 110 km^2" (Whitaker, 1985). The bands have reduced in number and their social customs like exogamous marriages are also under stress because of their reduced population. Many anthropologists and medical missions have studied the problem of dwindling numbers in detail.

The Jarawas

The Jarawas, currently estimated to be around 250 in number, live in the Western part of the South and Middle Andaman. They are semi-nomadic hunter-gatherers and, till recently, were the only truly hostile group of tribals on the Islands.

The Jarawas were reportedly friendly to the Britishers when they first came to the Islands in 1790. Sadly, this soon changed. The British administration in the Andamans started using the friendly Andamanese to track down escaped convicts within Jarawa territory and to make contact with the Jarawas. However, the Jarawas and the Andamanese were traditional enemies and this move backfired. The British also supplied firearms to the Andamanese, which the latter used against the Jarawas. This resulted in the Jarawas becoming hostile, not only to the British, but to all outsiders (Sarkar, 1989). The Jarawas were not only killed by the British but were also killed by the Japanese, when they occupied the islands during the Second World War. This made them even more bitter and hostile and they killed outsiders on sight, often cruelly.

In 1968, three Jarawa boys were captured and brought to Port Blair. They were kept for a month, showered with gifts and then released. However, this did not appear to have changed the attitude of the Jarawas to outsiders. However, in 1974 the Jarawas made their first efforts to come forward to meet the bush police, when they came to drop off the gifts. After this, a formal contact mission was established to go to the Jarawa area with gifts. A doctor and an anthropologist were included and the constitution of the contact party was entrusted to the Deputy Commissioner of Andaman (Anon, undated).

The attempts to study Jarawa ethnography did not succeed for a long time as they were hostile to visitors to their territory. In the last few years, however, more information about their way of life has been available because of the establishment of friendly contacts due to the "contact missions/parties". Anthropologists have located three areas in Middle Andaman where their community huts are found. Besides these community huts, there are a number of smaller shelters where individual families stay when they move out of these huts. Their customs and habits are very similar to the Onges, though the Jarawas do not have canoes like the other Negrito tribes. They are known to fish with small nets and to use small rafts to cross creeks.

The Jarawa habitat has also been affected by the construction of the Andaman Trunk Road (ATR) connecting Port Blair to Diglipur in North Andaman. The rainforest was clear-felled for construction of the road and labour camps were pitched along the road. Though these camps were supposed to be temporary, the labourers were allowed to build their own huts. After the completion of the construction of ATR, many labourers have stayed back and use the forest resources for their livelihood. "The encroachers on this land that rightfully belongs to the Jarawas have actually been rewarded by the administration's decision to legalise illegal occupancy of land belonging to the tribals, who are unable to defend their rights in courts. The administration has legalized all encroachments made up to 1978" (Anon, undated).

The Sentinelese

The Sentinelese live on the North Sentinel Islands, 60 km southwest of Port Blair. The estimated population of the Sentinelese is between 100 and 150. They occupy the entire island, which is estimated to be 60 km^2 (Pande *et al*, 1991) and 20 km^2 according to Reddy and Sudarsen (undated).

The Sentinelese live in complete isolation and spurn all attempts at "friendly contact." In 1967, two different teams landed on North Sentinel Island. The teams spotted the Sentinelese and left presents for them in their huts. It is reported that in one of the later expeditions, a member of the contact party fired in the air and this might have antagonised the tribals. For a long time they were hostile towards outsiders but in January and February 1991 anthropologists were able to establish friendly contacts (Pande *et al*, 1991).

Very little information is available on Sentinelese ethnography. Occasional visits and landings on the Islands have indicated small, lean-to, type of thatched huts, open from the sides, and used as living quarters. Like other Negrito tribes, perhaps they also move in small bands for hunting purposes. They have small dug-out, outriggered canoes which they ply on shallow waters with the help of a long pole. They apparently know the use of iron because they have arrowheads and harpoons. They also seem to use honey, as raw honey was found stored in wooden buckets inside their huts (Sarkar, 1989).

Lately, the Government has started sending out contact teams with gifts to North Sentinel Island. Initially the Sentinelese did not touch the gifts, but during later visits they started picking them up after the visitors had left

Tribals of the Nicobar islands

The Nicobars have two tribal groups, both of Mongoloid race. These are the Nicobaris who inhabit most of the inhabited islands in the Nicobar group, and the Shompens, who are found in Great Nicobar.

The Nicobarese

The Nicobarese are the largest tribal group in the island, with an estimated population of 22,000 in 1988 (Saldanha, 1989). They are found all over the Nicobars, with the greatest concentration in Car Nicobar (population 13,574).

The Nicobarese have a relatively high literacy rate (18%) and have integrated well with the mainland culture.

The Shompens

The Shompens of Great Nicobar live near fresh water sources, like hill streams, where they raise pandanus, betel leaves and, in recent times, citrus fruits and coconuts. They also hunt wild boar and catch fish.

Individual settlements of Shompens have only four to five huts, perhaps, of related families. Sarkar (1989) estimated their population to be 214 in 1981. Awaradi in his Master Plan estimates the population to be 135. He reports that during the year 1985 – 87, an epidemic of dysentery occurred, which could have wiped out many people. "The bacillus causing dysentery invaded the Shompen camps through coastal Nicobarese of Great Nicobar and Kodul." (Awaradi, 1990)

Nicobar did not experience a huge influx of immigrants like the Andaman Islands. Yet there was enough disturbance caused to the Shompens through settling of 303 families of ex-Servicemen along the road constructed from Campbell Bay in the east to Indira Point. "The settlements of these families have come up on the fringe of the Shompen habitats. Another road constructed from north to the south recently has also opened the area to the outsiders. Besides the age-old restriction of movement of the Shompens towards the coastal areas due to the presence of the Nicobarese, the establishment of settlements under rehabilitation programmes and clearing of forests for

other infrastructural development have already affected the free movement of the Shompen for hunting and gathering" (Sarkar, 1989).

Their contact with outsiders has increased because of all these developments. Today some of them visit Campbell Bay and exchange honey and other forest products with the Nicobarese and also collect the ration supplied to them by the Government. In the recent past, a "Shompen Complex" has been developed on the north-south road. Horticultural plants are grown here for demonstration. There is also a Government-appointed doctor. The doctor and a social worker periodically visit Shompen camps and provide medical help. During their visits, they also carry food for distribution (Sarkar, 1989).

The Former Convicts and their Descendants

The first non-tribal settlers in the islands were mainly convicts and ex convicts. The convicts first came in 1858, with the establishment of the penal settlement in Port Blair. The first batch consisted of 733 convicts and 4 officers (Mathur 1968). In 1874, a provision was made to release those life convicts who had completed at least 20-25 years of their sentence and with good conduct (Awaradi 1990). However, these convicts were not allowed to go back to the main land but had to spend the rest of their lives in the Andamans. They were allowed to bring their families from the mainland, if they so desired.

By the 1920s, the Government was attempting to convert the penal settlement into a self-supporting community and, in 1926, out of a total of 7740 convicts, 2105 were working for the government and drawing wages, while another 2272 were supporting themselves and their families through agricultural activities. The transportation of convicts from the Mainland to Andamans came to an end after the penal settlement was abolished in 1945 (Mathur, 1968).

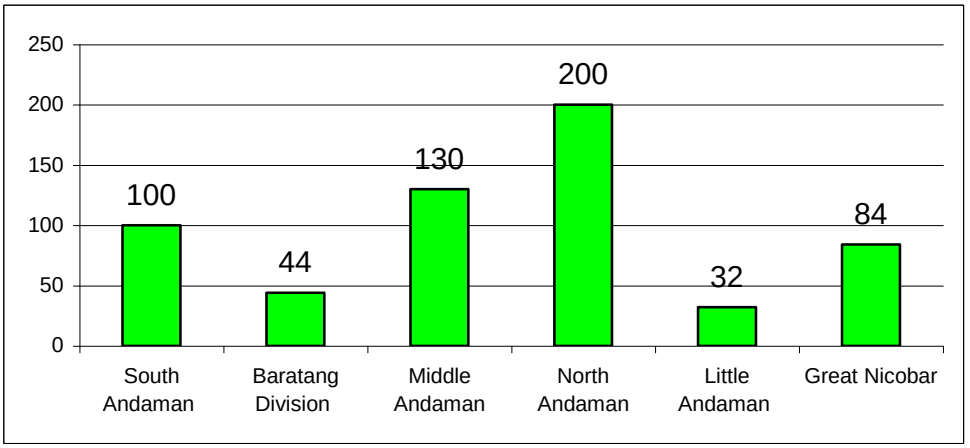
In addition, the Moplahs of Kerala were also deported to the A&N Islands after the Moplah rebellion, and settled here in 1921. The Bhattus, a criminal tribe of UP, were also settled ihere in 1926. All these settlements were in and around the Port Blair town (Awaradi,1990).

The Settlers

The first wave of settlers arrived in the islands in the 1940s, followed by another wave after independence, in the 1950s and 1960s, brought over by the government under what was known as the Colonisation Rehabilitation Schemes. These included ex-service men and their families, who were brought from the Indian mainland and settled in the islands.

The details of the settlements established under this scheme are given below.

Table 2.3: Area Given to Settlers Under Colonisation Rehabilitation Schemes



The Rehabilitation Schemes of Government of India up to 1949 provided for a 1 acre house site, 5 acres of paddy land (flat valley land), and 5 acres of hilly land per family. From 1954, the colonisation scheme of the A & N Administration provided for 5 acres of agriculture land and 5 acres of hilly land per family. The total land thus given to settlers totals nearly 50% of the total revenue (non-forest) land available.

The Refugees

Refugees from Bangladesh (East Pakistan) were settled in the Andaman Islands between 1950 and 1960. Each family was given two hectares of flat land for paddy cultivation, two hectares of hilly land for tree crops and 0.4 hectare of land to build a home. Twelve tons of timber was given for building the houses. Besides this, five tons is given once in five years for repairs, and one ton for making tools or a dinghy (boat). License to extract liberal quantities of firewood, bamboo posts, thatching leaves and canes were also given. These privileges continue, but have been slightly reduced (Saldanha, 1989).

614 families of displaced persons from East Pakistan were also settled in the Little Andamans between 1969 and 1979.

The Mainlanders

The other large groups are from Tamil Nadu, Andhra Pradesh and Kerala and they all work in the service (tertiary) sector. The labour force working in forestry operations, the Public Works Department and harbour works are from Chotanagpur in Bihar. Though some have returned home, many have stayed on the island.

With the establishment of forestry operations in Little Andaman, a number of government officials, labourers and contractors have also settled there.

The first group of ex-Servicemen were settled on the eastern coast of Great Nicobar in 1969. 337 families were settled and forest area of 1,499.65 ha was cleared for this purpose. Each family was given 11 acres of land. Schools and primary health centres were established for their benefit (Saldanha, 1989).

The Karens

The Karens inhabit coastal areas of Middle and North Andaman Islands, especially at Webi, near Mayabundar. They are the descendants of the Burmese Karen (tribes) who were brought to the Andamans as labourers by the British. An American Baptist Mission in Burma sent 45 families in 1925 at the request of the British Government. After Independence these people were settled as agriculturalists in Middle Andaman (Pande *et al*, 1991).

The Karens have now acquired excellent knowledge of the rainforest and the seas. The single keel mechanized Karen boat is very popular in the islands.

The Recent Immigrants

Besides, the refugees settled on the islands by the Government, there has been a steady inflow of immigrants from various parts of the mainland since independence

There is a change in population pattern brought about by large-scale immigration from South India. In the last twenty years, a large number of persons have been brought in from the mainland to work as labourers with the various wood-based industries, with the forest department, the forest corporation, the public works department and other government and private agencies. Many of these labourer families did not go back after the completion of their assignments and stayed on, encroaching on forest and other land.

III THE HISTORY

Early History

The earliest known reference to these islands was in the second century A.D., when Ptolemy published an atlas that showed their location. Since then, there have been references to the islands and the islanders in the writings of various travellers. In fact, "from second century onwards till sixteenth century, all travellers who wrote about the Andaman islands, describe all inhabitants of these islands as cannibals"(Mathur, 1968). It is now thought that the accounts of cannibalism were mainly hearsay, supposedly spread by the Malay pirates to scare away people from these islands, reportedly, the Malay pirates used these islands as hideouts and were keen to keep all others out of them (Mathur, 1968).

The origin of the names Andaman and Nicobar is ambiguous for there is no knowledge of these being used by the tribes any time. However it is considered that the Chinese had fire knowledge of these islands from very early days. The earliest mention of Andamans could be traced to Claudious Ptolemy during the 2nd Century AD where a mention of the islands under the name Good Fortune, much like 'Angdaman'. It is considered the name 'Angdaman' in course of time got transformed through Angamanian, Andaban, Agdaman and Angdaman into Andaman. The Chinese traveler and Buddhist Monk Tsiang during the 7th Century mentions 'Andaban' as the 'land of the naked people'. The accounts of Arab travelers in the 9th century mention these islands as 'Angamanian' where "naked people of black complexion with frizzled hair and frightful eyes eat human flesh quite raw". In the Great Tanjore Inscriptions (11th Century AD) these islands are mentioned as "Timaittivu" (Islands of Impurity) and abode of cannibals. The narrative of Marco Polo (13th Century AD) refers to Andaman as a land where 'people are no better than wild beasts'. Master Caesar Frederike who passed near the Nicobars on his way from Malacca to Goa in 1563 mentions about the Andamanese thus: "These tribes have not nay acquaintance with any other people, neither have they any trade with any, but live only on such fruits as the islands yield". John Francis Gemelli Careri, an Italian doctor and voyager round the World refers to Andamans (1695) as "No man in Europe or Asia can give any certain account of it, because those people have no commerce with any nation in the world".

Colonial History

Trustworthy accounts of the islands began to appear towards the end of the 18th Century when the British East India Company sent a small expedition under Colonel Colebrooke and Captain Blair in 1788 to report on a possibility to establish a settlement. A penal settlement then called Port Cornwallis (now Port Blair) was established in 1789 on Chatham Island. The settlement was shifted to North Andamans in 1792 with its name and the first settlement at Chatham was called Old Harbour. In 1796 the whole settlement was abandoned, the prisoners shifted to Penang and troops to Bengal. The First War of Independence of India (Often referred to as the Mutiny by the English East India Company) in 1857 prompted the English to establish a penal settlement once again in the islands. A Commission headed by Dr. F.J. Mout selected the Old Harbour at Chatham Island and the name Port Blair was given in honour of Captain Blair. In 1858, Captain H. Man (later General) formally re-annexed the islands and DR. J.P. Walker took charge as the Superintendent. The penal settlement started with 776 convicts and need based agriculture started thenceforth. During 1872 both the Groups of Andaman and Nicobar Islands were clubbed under a Commissionership. Towards the end of the 19th century the settlement spread to about 1200 sq. km. The construction of a Cellular Jail was started in 1898 and on completion after 10 year had seven three storied wings having 694 cells.

The narratives on the Nicobar islanders were not morbid as those in the Andamans. The Chinese has records on the Nicobars from very early days. Ancient Arab travelers mention these islands as Lankha Balus and Nagabalus. The narrative of an Arab trader in 851 AD refers, “Nagabalus, which are pretty well peopled; both men and women there go naked, except that the women conceal their private parts with leaves of trees. When shipping is among these islands, the inhabitants come off in embarkations, and bring with them ambergris and coconuts, which they truck for iron, for they want no clothing, being free from the inconveniences of heat and cold”. It is considered that group of islands mentioned by Ptolemy, as ‘Barussae’ is the Lankha Balus of the Arab Navigators. In Prolemy’s days, the Nicobar islanders were reported as tailed men, a statement perhaps due to the long waggling end of the narrow loincloth they wore. The islands referred to, as ‘Naccuvarum’ (the land of the naked people) are included among the conquests of Rajendra Chola II of the 11th Century. Marco Polo and Friar Oderic (14th

Century AD) refers nicobars as 'Nocuverum' and Necoveran' respectively. In the 15th and 16th Centuries these islands were referred to as 'Nacabar' and 'Nicubar' by the Portuguese pioneers who attempted to evangelized the inhabitants by missionaries with their head quarters in the Margui Archipelago.

The history of the Nicobar Islands since the 17th Century is a record of unsuccessful attempts at colonization and evangelization. During 1750s, the Danish East India Company took possession of the islands to colonize and convert the inhabitants into Christianity. As the colony did not flourish they left the islands in 1773. The Austrians tried the same in 1778 and left after three years. During the Nepoleonic War, the islands were in British control being officially annexed in 1807. In 1814 the islands were restored by the Danes, by treaty. In 1831, Denmark again tried to colonize the islands through missionaries under pastor Rosen dwelling at Nancowry and Trinket and after three years returned to Europe. An attempt was also made by Catholic Missionaries from Malacca in 1844 but failed. The Danish expedition by Sten Bille in 1846 and the Austrian frigate Novara in 1858 surveyed the islands and gathered valuable information on the islands. However, attempts to colonize the islands by the Dutch and the Austrians did not turn fruitful and the idea was dropped subsequently.

During those the late 18th and early 19th Centuries the harbors at the Central group of islands, especially Nancowry and Expeditions, got notoriety as head quarter of pirates. For long it was considered that the disasters occurring to ship in the Bay of Bengal were due to cyclones and storms. The frequency of the disasters increased during the 19th Century and it was discovered that that it was the piratical activities around the islands, which captured many ships, by treachery. To stop the piratical activities, the British took formal possession of the islands from the Danes in 1864 and send a punitive expedition in 1867. The British established a harbor and penal settlement at Nancowry in 1869 and the piratical activities were contained since then, this was later abandoned in 1888 due to excessive expenditure and unhealthy conditions of the islands. They kept an agent at Car Nicobar and a subagent at Nancowry just to hoist the Union Jack to proclaim British Authority to the passing ships and the history of the islands became part of the whole archipelago since they were formally affiliated to the Andamans in 1869.

In 1895, V. Solomon, Evangelist to the Nicobar landed at Car Nicobar and established a successful mission in 1896. Till his death in 1909, he made a thorough study of the Nicobari language and habits and played a major role in their development. From mid 19th Century traders from England and other part of the world started visiting the islands frequently for trade on coconuts and these contacts brought in great impacts on the customs and life style of the Nicobarese.

The British established a base on these islands in the late eighteenth century and, since then, there are better accounts of the islands and their people (Awaradi, 1990). In 1789, the (British) East India Company asked Lt. Archibald Blair to survey and establish a port on the Andaman Islands, for ships to dock during the monsoon. One objective was also to secure the islands and to deny them as hideouts to the Malay pirates, who were frequently attacking and plundering ships on the high seas and taking refuge in the natural harbours of these islands.

To secure the islands and provide a natural harbour, Lt. Blair established Port Cornwallis (later named Port Blair), in 1789. However, not long after, the settlement was abandoned due to inhospitable climate and rampant malaria (Awaradi, 1990).

A second attempt at establishing a British colony and setting up a penal settlement, in these islands, was made in 1857. Finally, in March 1858, a penal settlement, administered by a British Superintendent, came into existence around the harbour of the present Port Blair. Subsequently, the post of Superintendent was raised to the level of a Chief Commissioner, in 1872.

Convicts, mainly those convicted for political or capital crimes, were incarcerated in these islands right up to the Second World War. The British constructed a huge prison complex, part of which still survives today, called the Cellular Jail. Initially, convicts were imprisoned in this jail, however, after some years they were allowed to go out and live in the community and even encouraged to bring their families from the mainland. They were not allowed to leave the island and had to settle there for the rest of their lives (Awaradi, 1990).

Early Arabs, Chinese and Portuguese travellers also knew the Nicobar Islands. There were successive attempts by French, Danish and Austrian priests to settle there and convert the indigenous people to Christianity. However, none of them succeeded.

In 1869, the British Government took possession of the Nicobars and established a penal settlement at Nancowry. In 1872, the Andaman and Nicobar Islands were brought under the single administration of the Chief Commissioner. However, the penal settlement at Nancowry was withdrawn in 1888, and only the one in Port Blair continued to function (Awaradi, 1990).

From 1942 to 1945, the Andaman and Nicobar Islands were under Japanese occupation. Much of the British administration was either killed or escaped into the jungles, from where they waged a guerrilla war against the Japanese. The Japanese constructed extensive fortifications and bunker systems in the islands and also operationalised the airfield, which they used to bomb parts of mainland India. They were also credited with introducing a large land snail in the islands. This snail, reportedly a Japanese delicacy, subsequently multiplied and poses a serious threat to the vegetation of some parts of the Islands.

The period of Japanese occupation witnessed many events of which a few were favorable to the people. Release of the convicts, completion of the airstrip started by the British, construction of roads, employment in various fields, increase in income among people and a general feeling of liberation from the British Rule; the beginning was welcomed by the people. Port Blair could get the unique distinction to be the land to hoist the tricolour first, during the period. However, the situation changed towards the end of Second World War. The Economy collapsed, ships carrying foodstuff were either sunk or could not reach Port Blair and the islands were air raided repeatedly by Allied Force. Scarcity of food, war hysteria and the desperation of facing defeat ultimately resulted in the torturous killings of innocent people. In the Nicobar Islands, the islander faced several hardships, many massacred and John Richardson, their undisputed leader, was imprisoned and tortured. Starting on 15th August 1945, once the news of Japanese surrender reached the islands, the Japanese started destroying the official records, mining the sea and some even committed suicide. However they let out the prisoner lodged in the cellular Jail. The British reoccupation forces landed in October 1895 and they too had a different approach after the war. This came noticeable first from their decision to abolish the penal settlement and more than 4000 people left the islands for good.

Contemporary History

India became independent in 1947 and these islands became a part of the Union of India. Initially the British were reluctant to part with the islands because of their strategic location but eventually succumbed to pressure and agreed to the islands becoming a part of India.

The Indian Government used these islands to settle the people displaced due to the partition of India and East Pakistan (now Bangladesh). Many of the refugees from East Pakistan were settled in these islands. Also, nearly a hundred families of ex-military personnel were settled in both the Andaman Islands and in Great Nicobar (Reddy and Sudarsen, undated; Anon, undated).

After independence, the establishment of defence bases in the Andaman and Nicobar Islands closely followed the establishment of civil administration. The Andaman Islands have become an important strategic base with the first combined command headquarters, with the Navy, Air Force and Army under a joint command, located at Port Blair. Port Blair is also the regional headquarters of the Indian Coast Guard.

The History of Biological Explorations

Until the latter half of the 18th Century, nothing was specifically known about the forests and the inhabitants of the Andaman and Nicobar Islands. Till then, only loose and exaggerated statements on the islands existed without assigning any certainty or scientific proof. For example, it was believed that there was a well in these islands, the water of which could convert iron into gold. Ships, principally for the purpose of collecting water and to procure coconuts, turtles and edible swift nests visited the islands, especially the Nicobars, where the islander bartered coconuts for cloth, utensils and knives. Trustworthy accounts on the Andaman islands appear only after the visit of Captain Blair, a hydrographer and Colonel Colebrooke, the then Surveyor General of India in 1789. Prior to this I.G Koenig, a Swedish doctor and student of Linnaeus accompanying Danish missionaries in the ship Bristol on a voyage from India to Siam during 1778 the Danish East India company, visited Car Nicobar Island and collected specimens and made out clear observations and botanical accounts of his visit in his diary (Nair nd).

The earliest documented botanical collection from the Andaman Islands dates back to Colonel Kyd in 1791. The collections enabled him to introduce a few plants to

the Botanical Gardens, Calcutta, which were later described in William Roxburgh's 'Flora Indica'.

Helfer, a Russian Geologist, engaged by the British East India Company visited these islands in 1839 to ascertain the availability of mineral wealth. He made extensive botanical collection but these were unfortunately mixed up with his 'Tenesserim' (Burma) collections after his death at the hands of the aborigines at North Andaman. The specimens were labeled "Tenesserim and Andaman" giving a great deal of confusion and as a consequence, many of his Tenesserim plants were wrongly ascribed to the Flora of Andaman.

In the year 1846 the Danish corvette Galathea, voyaging around the world, led by Commodore Steen Bille, visited the Nicobar islands and surveyed the islands for coal and other minerals. The observations of Mr. Rink on the geology and soils brought out very valuable information. Dr. Diedricshen, Assistant Surgeon on board collected plant specimens and information on the vegetation. These were published by Steen Bille and were later translated by N. Wallich into English. The Team named the principle river in Great Nicobar Island 'Galathea'.

The Austrian frigate 'Novara' during 1858, under Dr. Von Hochstetter undertook careful explorations in the islands and the sea around, charting many unsurveyed parts, collecting ethnographical, geological and biological information's. Dr. Hochstetter correlated the geological characters of the underlying rocks and soils with the representative vegetations. Mr. Jelineck, a member of the expedition collected several plants, which were later described by S. Kurz.

Rev. C.S.P Parish from Moulmein, Chaplain and orchidologist visited the Andaman in 1861 (1863) and made some collections. The endemic orchid Habenaria andamanica was described from his material.

Dr. F.J. Mouat, as the head of the Commission to examine and select a suitable locality in the islands for a penal settlement visited Andamans in 1857. Dr. Mout and his associates Dr. Playfair, Lt. Heathcoate and made independent observations, acquired considerable knowledge with regard to the botany and zoology of the islands. Dr. Mout narrated the experiences in 'Adventures and Research Among the Andaman Islanders' (1863). A brief note on the Zoology of the islands by Edward Blyth, Curator, Museum of

the Asiatic Society was appended. Zoological collection of Dr. G. Von Liebig (1858), Captain T.H. Hodge who commanded the guard ship Sesotris in 1859-60. Lt. Col. Tytler an Official at Port Blair and an experienced Ornithologist which were preserved in the Asiatic Society and notes appeared in the Journal of the Asiatic Society were briefly mentioned in the appendix prepared by Blyth F. Stoliczka (1870) studied Amphibians and Retiles and made interesting observations on zoogeography of the islands.

Among the important old collections and literature on the botany of Andaman and Nicobar Islands, Wilhem Sulpiz Kurz's work is of special merit. A German Botanist and curator of the Herbarium at Calcutta, he was sent by the Government of India in 1866to collect material for a flora of the Andaman Islands and to investigate and evaluate the forest wealth of these islands. The beginning was a little disappointing to him, as there was a disaster when the Burmese convicts assigned to serve him turned against and left him bound in the forests. From the collections he made and from those of Colonel Kyd, Leibig and Playfair, he gave his first report (1870) on the vegetation of the Andaman Islands which contained 669 Phanerograms and 49 Crytogams. He visited the islands again in 1875 and explored many islands in the Nicobars including Kamorat, Katchal and Great Nicobar. He described 17 new plants from Andaman and Nicobar Islands (1875) in the Journal of Botany, London. In addition to these, many Andaman plants were also death with in his Flora of Burma (1877). The first major contribution to the Flora of Nicobar Islands was again by Kurz with his publication of a Sketch on the Vegetation of the Nicobar Islands (1876).

A.O. Hume, accompanied by a group of collector cruised around the islands in 1873, made a careful analysis of the Avifauna and discovered many new species of birds (Stray Feathers 1874). He also made few collections of plants, which were included in the works of K. Kurz. After Hume's Stary Feathers' it was A.L. Butler who made comprehensive ornithological notes in his birds of the Andaman and Nicobars (1899).

David Prain made extensive explorations in the islands during 1889 to 1892 and in a series of article described the vegetation of Cocos (1891), Narcondum Barren Islands (1893), Little Andaman and Car Nicobar Islands (1891). His paper on the no-indigenous species of the Andaman Flora (1891) highlighted the impacts of species introduction at the hands of man.

Sir George King, Superintendent of the Calcutta Botanical Garden made collections form the islands in 1889 and also employed several collectors. In a series of communications, beginning with the year 1889 he published his 'Materials for a flora of the Malayan Peninsula'. This was completed in later years with the collaboration of Gamble, Prain, Clarke, Stapf and other. In this monumental work many Andaman plants were described which included a number of new species.

Heining and Rogers of the India Forest Service, made valuable collections and the results were communicated by Gamble (1903) in the 'Preliminary list of plants of the Andaman Islands'.

On the recommendations of the Board of Forestry at Dehra Dun in 1913, C. E. Parkinson took the major task of compiling a Forest Flora of Andaman Islands. In his Forest Flora of the Andaman Islands (1923) Parkinson described 650 species.

After Parkinson, a number of forest officers who served in the island wrote short accounts on different types of forest vegetation (Chengappa 1944, Bhargava 1958). K.C. Sahni (1953 & 1958) and Srinivasan (1960) made a few studies on the Nicobar Islands.

Excellent contributions to the Botany of the island started appearing with Dr. Thothathri's publications (1960, 1961 & 1962) in the Bulletin of the Botanical Survey of India. With the establishment of a regional office of the Botanical Survey of India at Port Blain (1972), extensive and intensive systematic works started. Unmatched contribution to the Botany of the islands was made by Dr. N.P. Balakrishnan by setting up the Andaman and Nicobar Circle of the Botanical Survey of India and organizing and exploring different parts of the territory. The botany of the islands became better known since then. Collecting Zoological specimens are far more difficult than that of plants. Chances of observation of animals in motion, shooting or trapping and preserving them without proper facilities hindered zoological studies in the earlier period. Principally Masters of the cruising vessels or Doctors or naturalists accompanying them made collections. As mentioned earlier the Galathea and Novara expeditions, principally oriented for oceanographic, geologic and ethnologic studies also made observations on the biota and collected specimens. Dr. G. Von Liebig, a surgeon made valuable contribution to the zoology of the islands (1858) and is considered a pioneer in this field. He also made collections of plants, especially from Barren Island. Captain T.H. Hodge,

who commanded the guard-ship Sesotris (1859-90), collected large number of animals and the specimens were sent to the Museum of the Asiatic Society at Calcutta. Lt. Colonel Tytler, Governor of Port Blair during the 1860s, an amateur naturalist and experienced ornithologist collected various species and described new birds form the islands. He also described (1864) the only palm civet from the islands, Paguma larvata tytleri. The voyage around the island by the Schooner 'Terrapin' for obtaining representative specimens for the national Museum, Washington in 1900-1991 made one of the best collections from the island. Various experts studied the material obtained by Dr. W. L. Abbott, Captain of the schooner and C. Boden Kloss. The narrative of the cruise was published in 1902 by Boden Kloss and is still and the best work on the islands which includes general descriptions on the islands, their inhabitants, history, ethnological details, geological notes, motes on animals, birds and plants. Gerrit S. Miller's paper on the Mammels of Andaman and Nicobar Islands (1902) includes many specimen collected by DR. Abbot. Works of Godwin Austen (1895), Osmaston (1906), Annandale and Hora (1925) and Smith (1930) gave a better understanding on the animal life of the islands.

Major studies on the fauna of the islands were taken up in the later years by the Zoological Survey of India and the Bombay Natural History Society. H. Abdulali , K.K. Tiwari, M.L. Roonwal, A.G.K. Menon, A. Daniel, G.C. Rao, N.V. Subba Rao, R. Whitaker, S.K. Ghosh, B. Nath, S.C. Mshra, S. Biswas, Y. Chaturvedi, K.N. Reddy, B.K. Tikader, and A.K. Das are some of the worker who contributed to the zoology of the Islands. Systematic studies on the fauna of the islands started in an organised way with the setting up a Regional Station in the Islands in 1977.

Though Oceanographic Investigations started with the expedition of Lieutenant Blair in 1788, effective biological investigations of the sea was carried out in 1869 with the visit of Francis Day, a fishery biologist. In 1872, Dr. J. Wood Mason of the Indian Museum visited the islands to explore the marine organisms. The same year the Marine survey of India commenced its work in the Andaman waters. The voyage of HMS Challenger during 1973-75 brought forth very valuable biological data. Biological Investigations were carried out by Investigator I (1881-1905) with Dr. J. Armstrong as Surgeon Naturalist and Investigator II (1908 onwards) and the first report of challenger I was published by A. Alcock. The investigations of the Indian Ocean by the German Ship

‘SMS Gazelle’ during 1874-75 covered the water around the Nicobar Islands. R.V. Dana (1928-30) and R.V Albetross (1947-48) also conducted geophysical and biological studies in these areas. F. Day (1870), Studder (1878), F.J. Bell (1887), W.J. Sollar (1888), P.G. Bridgman (1909), R.V.S. Sewell (1922), H.S. Rao (1937) and N.K. Panikkar (1938) are some of the early scientist who contributed to the biology of the sea.

The International Indian Ocean Expedition during 1960 to 1965, a major venture of its kind, helped to bring in various features of the Andaman Sea including the fauna. Later the National Institute of Oceanography and Zoological Survey of India conducted several investigations. N.V. Subba Rao, A. Daniel, A.H. Parulekar, A.S. Rajagopal, B.B. James, C. Shankrankutty, K. Reddiah, C.P. Gopinathan, Z.A. Ansari, E.G. Silas, D. Sudarsan and other contributed to the marine life around the islands. These studies brought out a wealth of valuable scientific information. (Much of the material for the section on The History of Biological Exploration has been taken from Nair nd)

IV THE ECOLOGY

Island ecosystems across the world are fragile and particularly susceptible to human pressures. The A&N Islands are oceanic, having come closest to the continent during the Pleistocene glaciation, when sea level sometimes receded over 150m. It was probably during this period that there was the maximum dispersal of species to these islands. The fauna and flora of the Andaman and Nicobar Islands are much richer than many other oceanic islands, probably because of their geological history. Geological processes such as the uplifting of the ocean floor in the Tertiary period and climatic variations, which caused the drop in sea levels during the Pleistocene epoch, probably brought these islands very close to the continent. The colonisation of flora and fauna, predominantly from Burma for the Andamans and the Greater Sunda Islands for the Nicobars, was therefore comparatively easy. The flora of the Andamans is predominantly allied with that of Burma, and that of the Nicobars to Sumatra and the Malay Peninsula. For the avifauna, there are indications that the Burmese element was predominant, and that the Nicobars have an impoverished subset of the Andamanese avifauna, rather than a distinct Nicobarese avifauna (Davidar 2001b).

ANDAMAN & NICOBAR ISLANDS BIODIVERSITY AT A GLANCE

- ***Plant diversity:***
  - ***–About 2500 flowering plants described (223 spp.) are endemic- found no where else in the World - and 40% of non-endemics have only extra-Indian distribution***
- ***Animal diversity:***
  - ***–5100 animals described (100 freshwater, 2100 terrestrial and 2900 marine)***
  - ***–Coral reefs richest in India- 179 spp.***
  - ***–Mammals- 52 spp of which 33 are endemic (63%), Birds- 244 spp of which 96 are endemic (39%) and Reptiles –76 spp of which 24 are endemic (32%) (Source: ANI Forest Department Presentation)***

Apart from the inherent vulnerability of Island ecosystems, primarily because of their isolation and the resultant magnification of all disturbances, the A&N Islands also has various types of ecosystems that require special protection.

The Andaman and Nicobar Islands are an internationally acknowledged hot spot for biodiversity. This is despite the fact that there have been very few intensive studies in these Islands and many of the species still remain to be discovered or identified.

However, even the little that is known is enough to establish the very high biodiversity value of these islands.

These islands are rich in endemic species because of their long isolation from the adjoining landmass. The Islands are the third most significant area for biodiversity in India, the first two being the Western Ghats and the Eastern Himalayas. For example, the A&N Islands have 144 species of flowering plants and 75 species of land snails that do not occur anywhere else in the world (Gadgil 1997). The giant robber crab *Birgus latro,* which occurs only in the Southern Nicobar Group, southwestern part of Little Andaman, and South Sentinel Islands, is a flagship species of the inland invertebrates. There is a remarkable diversity among insects, of which several species are rare and threatened.

Fauna

Nature has endowed these islands with a unique and varied animal life both on land as well as in sea. Faunal distribution in these islands is influenced by fauna of both Indo-Chinese and Indo-Malayan regions. Large mammals are absent in both Andaman and Nicobar Islands. Geographic Isolation of these islands has resulted in high degree of endemism. The surrounding seas are equally rich in marine biodiversity. Endemism is more pronounced in land animals.

Table 8.1: Faunal Diversity and Endemism in the A&N Islands[1]

Animal Group	No. of special Subspecies	No. of Endemics	% Endemism
Terrestrial Fauna			
Mammalia	55	32	61.5
Aves	246	99	40.2
Reptilia	76	24	31.6
Amphibia	18	3	16.7
Mollusca	110	77	70.0
Arachnida	94	38	40.4
Hemiptera	146	22	15.0
Diptera	214	24	11.2
Coleiotera	878	92	10.5
Lepidoptera	426	52	12.2
Isoptera	40	19	47.5
Odonata	36	4	11.1
Annelida	30	9	30.0
Total	**2,366**	**495**	**20.9**
Marine Fauna			

[1] Das (1999) gives different figures for amphibians and reptiles, listing 12 amphibian species (with 7 endemics) and 45 reptile species (with 15 endemics) for the Andamans. He lists 11 amphibian species (with 2 endemics) and 43 reptile species (with 14 endemics) for the Nicobars. However, there are overlaps in the two lists.

Mammalia	7	0	0
Reptilia	12	0	0
Pisces	1,200	2	0.2
Echinodermata	350	4	0.4
Mollusca	1,000	18	1.9
Crustacea	600	6	1.0
Polychaeta	184	4	2.2
Anthozoa	326	2	0.6
Porifera	72	-	-
Meiofauna	490	102	21.0
Total	**4,241**	**138**	**0.11**

(Source: ANI F&E 2001)

Mammals

Out of 55 terrestrial and 7 marine mammal species reported so far, **32 species are endemic.** Common mammals found here are Andaman Wild Pig, Crab eating macaque, Andaman masked palm civet, Dugong, Dolphin, Whale, Spotted deer, Andaman spiny shrew, Nicobar tree shrew, Andaman horse-shoe bat, Lesser short nosed bat, elephant etc.

The main terrestrial mammals are crab-eating macaque (only in the Nicobars), wild boar, civets, several species of bats, rats and shrews. "The inland mammals are more interesting, particularly to zoologists, as the islands have been treated as 'evolutionary laboratories' since the Darwin-Wallace era. From the faunistic point of view, the most interesting feature is the absence of large mammals and the presence of a considerable number of endemics among the inland vertebrates" (Ellis *et al*. 2000).

The Andaman horseshoe bat *Rhinolophus cognatus* and Car Nicobar flying fox *Pteropus faunulus*, rats such as *Rattus burrulus, Rattus palmarum*, and *Rattus pulliventer* and shrews such as the Andaman Island spiny shrew *Crocidura hispida* and Nicobar tree shrew *Tupaia nicobarica* are among the endemic mammalian species found here. Endemic subspecies include two subspecies of the wild boar: the Andaman wild pig *Sus scrofa andamanensis* and the Nicobar wild pig *Sus scrofa nicobarensis*. The only other species of large land mammals, spotted deer *Axis axis* and a population of elephants *Elephas maximus*, were introduced into the region. The spotted deer have proliferated and are now widespread. The elephants, abandoned after the discontinuation of logging operations, have now become feral. The effects of browsing by spotted deer and elephants on the ecosystem have been discussed by Ali (2000), Aul and Ali (2001) and Aul (2002).

Sea Weed Resources

These are found primarily in intertidal zone on the rocky coasts. 55 species of Sea Weeds were collected in Andaman & Nicobar Islands (16 species of Chlophyceao, 17species of Phaeophycese & 22 species of Rhodophyceae. The distribution of some species are as under:

Place	-	**Genera / Species**
Diglipur	-	*Turbinaria, Sargassum*
Mayabandar	-	*Padania, Turbinaria, Sargassun Dictyota, Hormophysa*
Little Andaman	-	*Laurencia, Gracillaria, Halimeda*
Car Nicobar	-	*Dictyota, Turbivaria, Hormophysa, Gracilaria*
Kalchall	-	*Amphiroa, Galaxuara, Turbivaria, Sargassun*
Camorta	-	*Ulva, Halimeda, Laurencia, Gracilaria*
Nan Cowry	-	*Sargassun, Turbinaria, Padina*
Trinkat	-	*Gracilaria, Turbinaria*
Great Nicobar (Campbell bay)	-	*Turbinaria, Gracilaria, Ulva*

(Source: Chaudhury 1987)

Birds

The rich avi-faunal diversity has always attracted ornithologists and bird watchers to these islands. As many as 246 species and sub species of birds are reported to inhabit these islands and of these **99 species and sub-species are endemic**. Some important species are Andaman Teal, Megapode, Narcondum hornbill, Nicobar pigeon, Green Imperial Pigeon, Nicobar Parakeet, Crested serpent eagle, White-bellied sea eagle, Edible-nest swiftlet, Emerald dove etc.

With a total number of 270 bird species and subspecies (Sankaran & Vijayan 1993) the bird diversity of the A&N Islands is remarkable. Of these, 126 are exclusive to the Andamans and 56 to the Nicobars. BirdLife International (Stattersfield *et al*. 1998) has separately designated the Andaman Islands and the Nicobar Islands as two of the 221 major 'Endemic Bird Areas' of the world. Among the well-known flagship species are the Nicobar scrubfowl or megapode, the Narcondam hornbill and the Nicobar serpent-eagle. The Andaman serpent-eagle, brown coucal (or Andaman crow-pheasant), and the Andaman tree-pie are some of the other endemic species in the Andaman group. The Nicobar sparrowhawk, Blyth's parakeet and Nicobar bulbul (see Table 2.4a for fuller details and scientific names) are among the endemics in the Nicobar group. The endemic subspecies include the Andaman flowerpecker *Dicaeum concolor virescens*, large Andaman parakeet *Psittacula eupatria magnirostris*, Andaman glossy starling *Aplonis panayensis tytleri*, Nicobar ground thrush *Zoothera citrina albogularis*, Andaman teal

Anas gibberifrons albogularis etc. The Andaman grey-rumped swiftlet *Collocalia fuciphaga inexpectata* belongs to the 'white nest swiftlet' group, whose nests are made entirely of agglutinated saliva and are of very high commercial value in the international market (Sankaran 1995). Over-collection of nests has led to a considerable depletion of its population.

Table 2.4a: Distribution of threatened and endemic bird species

ENGLISH COMMON NAME	SCIENTIFIC NAME	IUCN THREAT CATEGORY	DISTRIBUTION	
			ANDAMANS	NICOBARS
Narcondam Hornbill	*Aceros narcondami*	Vu (D1; D2)	Narcondam	
Nicobar Scrubfowl	*Megapodius nicobariensis*	Vu (C1)		All islands except Car Nicobar, Pilo Milo & Chaura
Nicobar Bulbul	*Hypsipetes nicobariensis*	Vu (C1)		Nancowry island group: Camorta, Trinkat, Nacowry, Katchall, Teressa, Bompoka & Tillanchong
Brown-chested Jungle Flycatcher	*Rhinomyias brunneata*	Vu (C1)	Andamans?	Nicobars?
Nicobar Serpent-eagle	*Spilornis minimus*	LR / nt		Little Nicobar, Camorta, Nancowry, Teressa, Menchal, Katchall & Trinkat
Andaman Serpent-eagle	*Spilornis elgini*	LR / nt	Andamans	
Nicobar Sparrowhawk	*Accipiter butleri*	LR / nt		Great Nicobar, Little Nicobar, Nancowry islands, Camorta & Car Nicobar
Beach Thick-knee	*Esacus magnirostris*	LR / nt	Andamans	
Andaman Wood-pigeon	*Columba palumboides*	LR / nt	Andamans	Great Nicobar, Nancowry islands, Car Nicobar & Battimalv
Andaman Cuckoo-dove	*Macropygia rufipennis*	LR/ nt	Andamans	Great Nicobar & Nancowry islands
Nicobar Pigeon	*Caloenas nicobarica*	LR / nt	Andamans	Nicobar Islands
Nicobar Parakeet	*Psittacula caniceps*	LR / nt		Great Nicobar, Little Nicobar, Menschal & Kondul
Long-tailed Parakeet	*Psittacula longicauda*	LR / nt	Andamans	Nicobars
Andaman Scops-owl	*Otus balli*	LR / nt	Andamans	
Andaman Hawk-owl	*Ninox affinis*	LR / nt	Andamans	Nicobars
Andaman Woodpecker	*Dryocopus hodgei*	LR / nt	Andamans	
Andaman Treepie	*Dendrocitta baylei*	LR / nt	Andamans	
Andaman Drongo	*Dicrurus andamensis*	LR / nt	Andamans (and Coco Islands, Burma)	
Andaman Crake	*Rallina canningi*	DD	North, Middle &	

ENGLISH COMMON NAME	SCIENTIFIC NAME	IUCN THREAT CATEGORY	DISTRIBUTION	
			ANDAMANS	NICOBARS
			South Andaman	
Nicobar Scops-owl	*Otus alius*	DD		Great Nicobar
Brown Coucal	*Centropus andamensis*	-	Little, South, Middle & North Andaman, Table and Coco Islands (both Burma)	
White-headed Starling	*Sturnus erythropygius*	-	Andamans	

Source: IUCN (2000), BirdLife International (2000).

Note: Of the 22 species in this table, 20 are threatened. Four species, namely the Brown-chested Jungle Flycatcher, Beach Thick-knee, Nicobar Pigeon and Long-tailed Parakeet, are not endemic, being found also in mainland SE Asia: all the remaining 18 are restricted range species *sensu* BirdLife International (Stattersfield *et al*.1998). Of these 18, 16 species are endemic to India (7 to the Andamans, 6 to the Nicobars and 3 to both), and 2 are near-endemic (being also found just to the north of the Andamans on the Table and Coco Islands which belong to Burma). The Brown-chested Jungle Flycatcher breeds in South-east China and winters in Thailand and Peninsular Malaysia. Its status on the Andaman and Nicobar Islands is unclear, and it is not listed as an Indian threatened species by BirdLife International / IUCN. Key to threat categories: VU = Vulnerable, LR = Lower Risk, NT = Near Threatened, DD = Data Deficient.

Table 2.4b: Distribution of Endemic Bird Taxa

Island Group	Island	No. of endemic bird taxa (includes species and subspecies)
Andamans	North Andaman	40
	Middle Andaman	48
	South Andaman	53
	Little Andaman	34
Nicobars	Teressa	26
	Camorta	31
	Trinkat	28
	Katchall	27
	Little Nicobar	26
	Great Nicobar	31

Source: (Gandhi 2000). NOTE: This table is based on information compiled from several literature sources.

Reptiles

Sandy Beaches of these islands are famous for turtle nesting. There are 76 terrestrial reptiles. **Of these 24 species are endemic**. Also found is the Salt-water crocodile, Water monitor lizard, Reticulate Python, sea snakes and many other varieties of snakes including King Cobra.

The reptiles include a number of species of snakes. Geckos and lizards are also found along with several threatened species like the Andaman water monitor *Varanus salvator andamanensis*, the saltwater crocodile *Crocodylus porosus* and four species of marine turtles, viz. the endangered olive ridley *Lepidochelys olivacea* and green turtle *Chelonia mydas*, and the critically endangered hawksbill *Eretmochelys imbricata* and leatherback *Dermochelys coriacea* (Bhaskar 1993, Andrews 2000c & 2001, Andrews *et al.* 2001). All of these are known to breed in the islands. One of the most data deficient groups on the islands are the Amphibians, though some work on them has been done in the Andamans and on Great Nicobar Island (Daniels 1997; Das 1994, 1997a & 1999).

Sea Turtles

Sea turtle resources – of the seven species of sea turtles found in the oceans of the world, four species Viz., Olive Rodley Turtle (*Lipidochelys olivacea*) Green turtle (*Chelonia mydas*), Hawkbill turtle (*Eremochelys imbricata*) and Leather back turtle (*Dermochelys coriacea*) occur in Andaman islands.

Sea turtle meat and eggs constitute an important food source in many countries. Turtle soup prepared from cartilaginous tissue called "calipee" is widely relished. The horny laminate on the shell of the Hawkbill turtle are made into high valued curios. Carefully supervised "Turtle watching night" to observe the turtle behaviour, nest formation etc. has become popular to tourists in Australia and Malaysia.

Turtle nesting beaches have been destroyed by construction of structures on the Betapur Coast in Middle Andaman.

On a Survey it has been found that Leatherback turtle occurs in greater abundance in little Andaman (in West Bay and South Bay) than the other three species.

At one time Wandoor become the largest turtle depot and butchering centre in South Andaman.

Turtles occur in Landfall island, Table islands, Turtle islands, South islands, Long island, Strail island, Betapur shore, Ross island, Burmanaka, Chiriyatapur, Wandoor, Cinque island, Hutbay, Butter bay, South bay, Bompoka island, Katchall island & elsewhere. (Chaudhury 1987)

Marine Life

Due to its long coastal stretch, these islands have a very rich marine biodiversity. They harbour more than 1200 species of fish, 350 species of echinoderms, 1000 species of molluscs and many lower forms of life. Among vertebrates, dugongs, dolphins, whales, salt-water crocodiles, sea turtles, sea snakes etc. are common. (Source: *Andaman and Nicobar Islands: Forests and Environment, Department of Environment and Forests, ANI Administration, March 2001)* The geographic isolation of these islands has resulted in a high degree of endemism. The surrounding seas are equally rich in marine biodiversity. Endemism is more pronounced in land animals (ANI F&E 2001).

Although marine mammals are not endemic, they are often highly threatened. Dugongs *Dugong dugon*, which are listed as Vulnerable in the IUCN Red List of Threatened

Species (IUCN 2000), occur in limited and scattered small populations in areas where there are good seagrass beds. The current status of dugongs in the A&N Islands is however virtually unknown and they are very rarely sighted. Settlers heavily hunted dugong for meat and oil in the Andamans. Currently fishermen and Nicobarese people have reported seeing large numbers of dead dugongs and whales floating close to the 6° channel south of Great Nicobar Island. These deaths are mainly due to propeller strikes due to the heavy ship and boat traffic from other parts of South-east Asia that transits through the Strait of Malacca between peninsular Malaysia and Sumatra, and passes south of Great Nicobar. The same phenomenon has been observed for leatherback turtles that come to nest on Great Nicobar Island (Andrews *et al*. 2001). The common dolphin *Delphinus delphis* is abundant and is frequently seen in open waters and near the shore. Sightings of blue whale *Balaenoptera musculus* (Endangered) and sperm whale *Physeter catodon* (Vulnerable) in the open seas are occasionally reported.

Sea cucumbers

In the sheltered bay and lagoons these animals breed and subsist happily. The sea cucumber prefers muddy or Sandy flats, the sea urchins rocky coasts and algal beds.

Of the 40 species of Sea cucumber found in the Andaman and Nicobar islands, only a few species are useful as commercial species.

Holothuria atra, a sea sea cucumber, is abundant in the islands & ocean on dead coral reef with sandy and muddy patches. It prefers areas where there are calcarious alga *Halimeda* sp to feed on. *H. scabra* occurs in abundance in N. Andamans. Besides, *Actinopyga mauritiana, A.echimites*, are of commercial importance.

Sea Urchins

The gonads of Sea urchins are said to be a delicacy and are eaten fresh, adding a little vinegar or lime.

Tripneustes gratilla is found on the algal bed. *Diadema sectosum* is found in the wall of the jetty at Aberdeen (Port Blair) and Nan Cowry harbour. *Echinometra mathaei* occurs on the rocky coasts.(Chaudhury 1987)

Sea Cucumbers

Bohadschia marmorata Jaeger

This species is popularly known as chalky fish and the local name is *Nool attai* since is ejects copious white sticky threads known as Cuvierian tubules. In the Indian region this species is known from the Gulf of Mannar and Palk Bay, Andaman and Nicobar Islands and the Lakshadweep. It grows to 400 mm in length. The colour is highly variable. In general it is yellowish-brown with black spots. It is found in the lagoons and often covered by a coating of fine mud.

Bohadschia argus Jaeger

This species is popularly known as Leopard or Tiger fish. In the Indian region it is distributed in the Andaman and also at Lakshadweep. The eye- like spots are very characteristic for this species. It grows to a length of 400 mm. In some of the islands of the Lakshadweep this species is abundant. It lives freely in the lagoon on coarse sand. A few coral pieces and sand particles are found attached to the body which is very smooth. It is distributed in 2-6 metres depth. At the slightest disturbance white sticky threads are thrown out.

Actinopyga militaris (Quoy & Gaimard)

This is popularly known as Black fish. This species is known from the Andaman and Nicobar Islands and the Lakshadweep in the Indian region. It grows to a length of 350 mm. Adults are found in depths more than 2 m, juveniles of 20-35 mm beyond are generally found in murky shallow waters and are black in colour.

Actinopyga mauritiana (Quoy & Gaimard)

This is popularly known as Surf Red Fish since it occurs at the low tide mark where the surf breaks on the reef. In the Indian region it occurs at Andaman and Nicobar Islands and the Lakshadweep. It grows to a length of 400 mm. On the dorsal side it is brick red and on the ventral side it is white in colour.

Stichopus variegates Semper

This is popularly known as curry fish. In the Indian region this species occurs in the Gulf of Mannar, Palk Bay, Lakshadweep and the Andaman and Nicobar Islands. The specimens that occur in the Andamans are massive, reaching a length of 500 mm. This species has to be processed quickly after it is collected otherwise the body wall will become gelatinous. It is locally known as *Mul Attai*.

Stichopus chloronotus Brandt

This species is popularly known as Greenfish. It is distributed in the Andaman and Nicobar Islands and in the lagoon of Kiltan Island. It lies out in the open without making any attempt to conceal its body under

Holothuria scabra Jaeger

Over 96% of the sea cucumbers at present processed belongs to this species. It is distributed in the Gulf of Mannar and Palk Bay and also in the Andaman and Nicobar Islands. Reported from the west coast also, but very little is known about the resource from there. It is popularly known as sand fish and the local (Tamil) name is *Vella attai.*

It grows to a length of 400 mm and weighs 500 g. Found in silty sand often near estuaries and frequently on *Cymadocea* beds. It is distributed from 1 to 10 m depth.

Holothuria nobilis (Selenka)

This species is popularly known as Teat fish or Mammy fish. This is the most valuable species for *Beche-de-mer* processing. It is abundant in the Lakshadweep and also reported from the Andaman and Nicobar Islands. It grows to 400 mm length and live weight varies from 2-3 kg. Body wall is very thick (10-15 mm). Occurs in two colour forms, white one which is more valuable is sometimes referred to as *Holothuria fuscogilva*. The black variety is abundant in some of the Islands of the Lakshadweep. White form is most abundant on clean sand and turtle grass. Black form is found in shallow water of about 3 m on clean sand bottom where there is live coral.

Zooplankton in Coastal Water

Only selected areas have been investigated which do not reveal the resources of planktonic flora and fauna.

Abundance of *Copepod, Calamaid Copepod*, molluscan larvae, bulk occurrence of larvae of *penaeid* prawn are marked in some sites, molluscan larvae, *chaetognaths*, *decapod* larvae *lucifer* and *appendicularian* are interesting fauna. *Pteropods* are noted in Shoal bay, *lucifer* in Camorta, *Gastropod* larvae in abundance are noted near Nicobar Island and in some special sites in the coastal water.(Chaudhury 1987)

Fish

Over 700 species of fish have been identified on the Islands. Of these, the deep-sea fish are a commercially valuable resource for the fishery industry. A special mention must be made of the vast diversity of reef fish. These brightly coloured species are in great demand for live export as ornamental fish. Other reef-associated fish, such as the clupids and apogonids, are important as live bait for the tuna industry.

Corals

There is also an extraordinary diversity of corals and reef-associated invertebrates. The reefs are rich in soft corals. (Pillai 1996, Kulkarni 2001, Turner *et al*. 2001) and arborescent genera like *Acropora*, *Procillopora*, *Seriatopora*, *Stylophora*, etc. are abundant. The reefs harbour a rich diversity of sponges, coelenterates, worms, molluscs, echinoderms, etc. Some are known to possess antibiotic, anti-coagulant and anti-leukaemic properties and they have an enormous potential value in the pharmaceutical industry. Important molluscs include the 'top' and 'turbo' shells, five species of pearl oysters, giant clam *Tridacna* sp., the beautiful pearly nautilus *Nautilus* sp. etc., which are used to make ornaments. Sea cucumbers such as *Holothuria* spp., *Stichopus* spp., *Actinopyga* spp. and *Synapta* spp. are found in the shallow lagoons and have become extremely rare.

The Andaman & Nicobar coral reefs are the second richest among those found in the world. Coral reefs surround every island and are estimated to cover around 11,939 km^2 (Turner et al 2001). They consist mainly of fringing reefs with a barrier reef only on the western side. They are the largest reef formations of the Indian sub-continent and contain as many as 197 species belonging to 58 genera (Turner et al 2001, Vousden 2001), out of the total reported 342 species and 76 genera found in India (Pillai 1971, as quoted in Pernetta 1993). However there still remain large tracts of coral areas, including

the four west coral-banks of the Andamans, that are yet to be surveyed (Andrews and Sankaran 2002).

There is also an extraordinary diversity of reef-associated invertebrates. The reefs are rich in soft corals. (Pillai 1996, Kulkarni, 2001; Turner et al., 2001) and arborescent genera like *Acropora*, *Procillopora*, *Seriatopora*, *Stylophora*, etc. are abundant. The reefs harbour a rich diversity of sponges, coelenterates, worms, molluscs, echinoderms, etc. Some are known to possess antibiotic, anti-coagulant and anti-leukaemic properties and they have an enormous potential value in the pharmaceutical industry. Important molluscs include the 'top' and 'turbo' shells, five species of pearl oysters, giant clam *Tridacna* sp., the beautiful pearly nautilus *Nautilus* sp. etc., which are used to make ornaments. Sea cucumbers such as *Holothuria spp., Stichopus spp., Actinopyga spp.* and *Synapta spp.*, are found in the shallow lagoons and have become extremely rare (Andrews and Sankaran 2002).

The coral reefs have an abundance of *Acropora* spp. staghorn corals, *Porites* spp. reef building corals, *Lobophylla* spp. brain corals, Turner et al. (2001) reported over 80 coral species just around South Button Island and all the associated marine life such as jelly fishes, several species of sea cucumbers, including the commercially valuable species *Holothuria scabra*, brittle stars, starfishes, a wide variety of coral fishes, sea urchins, giant clams *Tridacna* spp. and other molluscs. Luxuriant sea grasses (Das 1996), along with food-forming algae in shallow coastal waters, support one of the last remaining dugong population in the Andaman group. Kulkarni (2000) identified 115 coral species for the Wandoor National Park in South Andaman.

The richness of the coral reefs in the A&N Island, especially in relation to those in the rest of the country, can be seen from the table below.

	Genera	Species	Source
Lakshadweep	27	105	(Pillai and Jasmine, 1989)
Gulf of Kutch	24	37	(Pillai and Patel, 1988)
S.E. coast of India	37	94	(Pillai, 1986)
Andaman and Nicobar	58	197	(Turner et al 2001, Vousden 2001),
West coast of Kerala and Tamil Nadu	17	29	(Pillai and Jasmine – in press)
Total for India	76	342	(Pillai 1971, in Pernetta 1993).

Flora

The flora of Andaman and Nicobar Islands is known for its close affinities towards the Burmese and Malesian flora and for its richness and endemism. The isolation caused by sea barrier through encourage speciation on the one hand, the restrictions on the population to escape from natural catastrophes on the other can lead to extinction of species. The impacts of human activities hasten the rate of extinction at alarming rates and many species would disappear even before they are known to science. Since replenishment from the original continental stocks is barred due to isolations, the losses to the flora would be greater than at the continents.

Within the Andaman and Nicobar Islands, floristic diversity and degree of endemism varies from one another depending upon the size, age, altitude, water resources, impacts of natural calamities and influence of human activities. The larger and elevated islands like the North Andaman and Great Nicobar contain richer flora with more localized endemics, while the smaller ones are poorer and contain very few endemics. Botanical collections from North Andamans (especially Saddle Peak) and Great Nicobar has revealed many new taxa, while the northern islands of Andaman and Nicobar islands. Moreover these islands in the Nicobar group are thickly populated.

An estimate on the total number of species occurring in the islands could only be a wild guess since hardly 50% of the islands have been explored. Most of the islands explored are inhabited and many explorations sporadic and collections made at random. Balakrishnan (1996) indicated about 2100 species of Angiosperms of which 216 are endemic. Intensive explorations in under-explored areas and new ventures on unexplored islands may raise the figure perhaps to 2300. The overall endemicity among higher plants would be 10% or slightly above. One must also take note of the fact that endemism at the generic level is very poor with only three genera treated endemic viz., *Spranthera* Hook.f, (Euphorbiaceae), *Pubistylis* Thoth. (Rubiaceae) and *Jainia* Balakr. (Rubiaceae). If we take into consideration the well-recognized assumption that the island plants show different types of variation from their continental representatives, a good number of taxa considered endemic may fall within range of species variation. The taxonomic status of a plant is subjected to change as more areas in the adjacent continental masses are explored

intensively and plant species identified. Revisions of various genera have treated some Andaman species conspecific to species of wider distribution in the Indo-Malayan region. Similarly material from the islands considered under widely distributed species have been assigned taxonomic status. Ranking a species often depends on the material available for examination, their quality and representation from different areas etc. The taxonomic judgement of the botanist, which plays the major plays the major role in ranking, depends on his exposure and understanding of tropical plants. Often it is felt that the plants are being treated as poisoned, pressed, dried and preserved herbarium specimens than living entities. An effective conservation strategy demands an urge and ability to breathe life in to obscure plant names and dead and dry herbarium specimens.

The species composition of communities and distribution pattern of species show marked difference between the Andamans and Nicobars. The Andaman flora is predominated by Burmese elements, while that of Nicobars, Malesian. Thaktajan (1986), based on the affinities show by the species of the islands, treated Andamans under the Indo-Chinese floristic region and the Nicobar group under the Malesian Region.

The striking difference observed between the two groups is in the absence of the most important Andaman timber trees like *Pterocarous dalbergioides* (Paduk) and *Dipterocarpus spp.*(Gurjan) in the Nicobars. Several common plants in the Andamans like *Ancistrocladus tectorius, Crypteronia paniculata, Pemphis acidula, Tetramelus nudiflora, Pomatia pinnata, Scyphiflora hydrophyllaceae* etc are absent in the Nicobars. Similarly, plants like *Amomum fenlii, Astronia macrophylla, Burmannia championii, Otanthera nicobarica, Ophioglossum pendulum, Pandanus leram, Phanera nicobarica, Rophaloblaster augusta, Trichoglottis quadricornuta, Kibara coreaceae, Cyrtandra burttii etc* found in the Nicobars is absent in the Andamans. It is also interesting to note that the tree fern Cyathea and the endangered palm Bentickia nicobarica (the only other species of the genus is endemic to the Travancore-Tinnelveli rages of Western Ghats) is confined to Nicobars.

In an analysis of the distribution of indigenous angiosperm taxa, Rao (1986) estimates that the flora contains about 14% endemics, about 54% shared between Indian mainland, and 32% extending their distribution to south east Asia and Malesia only (not found in the Indian mainland). Balakrishnan (1996) estimates about 40% of the species of

the islands as Southeast Asian, extending from Burma to Malesia and are absent in the mainland India.

With more and more areas explored intensively the percentages would change and it is most likely that the additional species identified, especially from the Nicobars, would contain more Malesian elements. It is also interesting to note that many genera are represented in the flora by single species and many families with single genus. This is considered as a feature of island floras (Van Steenis 1964). Genera like *Antidesma, Calmus, Dendrobium, Derris, Diospyros, Dipterocarpus, Dysoxylum, Elaeocarpus, Ficus, Garcina, Glochidion, Jasminum, Leea, Macarange, Memecylon, Polyalthia, Psychotria* have better representation in the islands.

Many species occurring in these islands show variations from the representative taxa they belong. *Antidesma ghaesembilla, Bulbophyllum lilacinum, Bridelia tomentosa, Caralia brachiata, Coelogyne thailandica, Globba marantina, Glochidion calocarpum, Ixora finlaysoniana, Lepidopetalum rubiginosa,* are a few. But the variations should not be overemphasized since populations in isolations generally show variations of one kind or other from the typical representative taxa.

Botanical studies in these islands are primarily oriented on higher plants and adequate emphasis on lower taxa is warranted. This in general is applicable to mainland India too. Prasad and Misra (1992) identified 587 fresh water algae from the islands, of which 22 are endemic (Chlorophyceae: 15, Diatoms: 7). The fresh water algal flora shows affinities to the mainland Indian flora than to Southeast Asia. It is pointed out (Prasad and Misra 1992) that, “in spite of geographical proximity with Southeast Asia; the fresh water algal flora of Andaman-Nicobar area shows a distinct closeness to the Indian Flora than to other South-East Asian Regions. It may, perhaps be accounted for by the greater contact and communication with India in the course of our long history”.

The diversity among the Lichens is considered very high, and much work in this field is to be undertaken. Among the 307 species known so far, 73 lichens are endemic showing 23.7% endemism. Liverworts are represented by 53 species distributed among 12 families and 40 genera. Out of the 66 species of Mosses recorded 10 species are endemic to the islands. Pteridophytes known from the islands number 125 species

belonging to 60 genera. Intensive work in these groups of lower plants cold reveal many novelties.

Trees also have not received adequate attention from the recent Botanical collectors. Though a good number of endemics were describe after the establishment of Botanical survey of India, tree species, especially larger ones, scarcely find a place. It is certain that the Nicobar Islands can contribute a good number of trees till unrecorded, many of which may turn new to science. This will also increase the number of species from the islands, altering the percentages of endemics and other elements. The difficulty in collecting specimens of trees still remaining, it would be desirable to work out a regular and joint programme with the Forest Department, linking botanical collection with felling operations. Many sun-loving orchids and epiphytes could also be collected along with this work.

The endemic flagship floral species of the Andamans are *Dipterocarpus andamanicus, Dysoxylum andamanicum, Planchonella kingiana, Litsea leiantha* and *Glochidion subsessile* while the keystone endemic species are *Garcinia andamanica* var. *andamanica, Mangifera andamanica, Syzygium kurzii* var. *andamanica, Syzygium manii, Canthium andamanicum, Canthium gracilipes, Phyllanthus andamanica.* The endemic flagship species of the Nicobar group of islands are *Nathophoebe panduriformis* var. *paucinervia, Nathophoebe nicobarica, Macaranga nicobarica, Trigonossiemon nicobaricus, Amoora wallichii* and *Terminalia manii*, while the keystone endemic species of this region are *Embelia microcalyx, Dillenia andamanica* and *Measa andamanica* (Nayar 1996, quoted in Ellis *et al*. 2000). The World Conservation Monitoring Centre, U.K., has recorded 365 species of plants in the Andaman & Nicobar Islands as threatened (WCMC, 1994).

Surveys report that, in Great Nicobar alone, 11% of the vascular flora are endemic to the island, 30 species are rare, endangered and confined to a few locations on the island, and about 30% of the flora are extra-Indian, i.e. not found on the Indian mainland. Characteristic endemics such as the tree-fern *Cyathea albo-setacea* and an ornamental orchid *Phalaenopsis speciosa* are found only on Great Nicobar and adjacent islands (Pande *et al*. 1991).

The Islands are a vast and precious storehouse of plant genetic resources, medicinal plants, and wild relatives of economically important cultivated plants. Rao (1996) reported 2000 species of which 14 % were thought to be endemic.

Table 2.5 shows the distribution of endemic and threatened plants of the A&N Islands, while Table 2.6 gives the patterns of exploitation of the Andaman islands' wildlife, including naturally occurring plants.

Table 2.5: Distribution of Endemic and Threatened Plants of Andaman and Nicobar Islands

Island Group	Island	No. of endemic plants	No. of threatened plants
Andamans	North Andaman	17	6
	Middle Andaman	16	14
	Narcondam	2	2
	South Andaman	61	54
	Little Andaman	7	-
Nicobars	Car Nicobar	1	-
	Camorta	-	11
	Katchall	-	10
	Great Nicobar	29	38

Sources: 1) Threatened Plants from Pande *et al*. (1991); 2) Endemic Plants from Saldanha (1989).

Andaman & Nicobar Plants In Iucn Red List
Classified Chart Of Threatened Species

	TOTAL	ANDAMAN	NICOBAR	A & N BOTH
Threatened	116	69	39	8
Ex/E	1		1	
E	7	5	1	1
V	10	5	3	2
R	23	16	5	3
I	75	43	29	2

NOTE : There are 8 species of plants which are on Schedule II of CITES List.

Total number of species of vascular plants in Red Data List = 116

Ex/E – Plants that are suspected of recently becoming extinct – 1

E – Endangered Taxa in danger of extinction –7

V – Vulnerable or Taxa that are likely to move in endangered category – 10

R – Rare – Taxa with small world population, presently not in "E" or "V", but are at risk – 23

I – Indeterminate – Taxa that are surely known to be "E", "V", or "R" but data deficient to assign the proper category - 75

Forests

The wet evergreen and semi-evergreen forests on larger islands are the reservoirs of Andaman biodiversity, containing many rare and endemic species and habitat specialists. However, as will be discussed later, they are under severe pressure due to logging and encroachments (Davidar 2001b).

There are two levels of variation in the Andaman and Nicobar Islands. One is an ecological separation into different biomes: beach and reef systems, mangroves, littoral forests, deciduous forests, semi-evergreen, valley evergreen and hill slope evergreen forests, with further variation between calcium-rich and calcium-poor strata. The second is a separation by species composition, with each island having its own characteristic community composition, with its own proportion of endemics.

Though plants have greater powers of dispersal than most animal groups, due to wind, water and animal seed transport, it is not uncommon to find even large trees with tiny restricted distributions within the Andaman & Nicobar Island chain.

An extraordinary variety of habitat types, ranging from sandy beaches to coral reefs, mangroves, and mountains with dense forests, characterize the Andaman & Nicobar Islands. They are located in the equatorial belt and have been endowed with an abundance of flora and fauna. A number of species are endemic and restricted to small areas because of the islands' geographic isolation.

The land area of the island chain is restricted but the diversity of forest types, each with its own distinctive floral and faunal composition, is staggering. Some of the larger islands display a veritable mosaic of forest types.

A large proportion of the islands is covered by tropical evergreen rain forests that are not only the richest forest types in terms of biodiversity but also most vulnerable to human use and interference. The islands are primarily volcanic with extensive coral reefs surrounding them. They are ringed by sandy beaches, circled by extensive mangroves and dotted with estuaries and lagoons. Each of these ecosystems have their special biological and economic values and their peculiar sensitivities and vulnerabilitiesThere are twelve forest and vegetation types and sub-types (as classified by Champion and Seth, with their codes given in brackets) found in these islands. These are:

1. **Giant Evergreen Forests (1A/C1).**

The Giant Evergreen Forests are the most luxurient type of multitier forests occurring in deep alluvial soil near the banks of larger streams. Main species include *Dipterocarpus spp., Calophyllum soulattri, Artocarpus chaplasha, Amoora wallichii etc.*

2. **Andaman Tropical Evergreen Forests (1A/C2)**
The Andaman Tropical Evergreen Forests are similar to the giant evergreen forests but not so luxurient. They occur mostly on hilltops. Major species include *Dipterocarpus grandiflorus, Xanthophyllum andamanicum, Artocarpus chaplasha, Myristica andamanica* etc.

3. **Southern Hilltop Evergreen Forests (1A/C3)**
The Southern hilltop evergreen forests occur on the exposed upper slopes and tops of hills and sometimes on steep slopes lower down. Major species include *Dipterocarpus costatus, Mesua ferrea, Canarium manii, Hopea andamanica* etc.

4. **Andaman Semi-evergreen Forests (2A/C1)**
The Andaman semi-evergreen forests are luxurient types of forests with many giant trees both of evergreen and deciduous nature. Climbers are often heavy. Occur in valleys. Important species include *Dipterocarpus* spp., *Pterocymbium tinctorium, Sterculia campanulata, Terminalia bialata, T.procera, Albizzia chinensis, A.lebbek* etc.

5. **Andaman Moist Deciduous Forests (3A/C1)**
The Andaman moist deciduous forests are distributed extensively in Andamans but not so much in Nicobar group of Islands. Top storey is irregular with tall deciduous trees followed by a second storey which comprises numerous species including some evergreen trees. Important species are *Pterocarpus dalbergioides, Terminalia bialata, T.Manii, T.procera, Pterocymbium tinctorium, Tetrameles nudiflora, Dillenia pentagyna* etc.

6. **Andaman Secondary Moist Deciduous Forests ((3A/C1/2S1)**
The Andaman secondary moist deciduous forests occur in worked over areas of the primary type. Major species include *Canarium euphyllum, Pterocymbium tinctorium, Salmalia insignis, Tetrameles nudiflora, Terminalia manii, T.procera, Albizzia lebbek* etc.

7. **Littoral Forests (4A/L1)**
The Littoral forests occur all round the coast wherever a fair width of sandy beach occurs. *Manilkara littoralis* is the most characteristic species of this type in these islands. Other species include *Scavela frutescens, Hibiscus tiliaceus, Morind citrifolia, Terminalia catappa, Pandanus tectoriums* etc.

8. **Mangrove (Tidal Swamp) Forests (4B/TS2)**
The Mangrove forests (Tidal swamp forests) occupy shores, mouth of creeks and inland channels of these islands. These are salt tolerant species and occupy 966 sq.km. area of these islands. Important mangroves species are *Rhizophora mucronata, R.candelaria, Bruguiera conjugata, B.parviflora, Avicennia officinalis, Ceriops tagal, Kandelia candel Sonneratia caseolaris, Excoecaria* etc.

9. **Brackish Water Mixed Forests (4B/TS4)**
The Brackish water mixed forests are considered finest development of tidal forests and may be a closed forest of 35 m height. These are found in larger deltas and creeks along the outer periphery and at places where salt water mixes

with fresh water. Major species include *Heriteria littoralis, Barringtonia racemosa, B.asiatica, Brownlowia lanceolata, Nypa fruticans, Phoenix paludosa* etc.

10. **Submontane Hill Valley Swamp Forests (4C/FS2)**
The Sub-montane hill valley swamp Forests is an irregular forest of a limited number of mainly evergreen species. Trees are usually low, crowded and branchy. There is often a dense growth of *Calamus,* while *Ficus* and monocotyledons such as *Alpinia* often form the undergrowth.

11. **Cane Brakes (1/E1)**
The Cane brakes are found through out the evergreen and semi-evergreen climaxes and locally in moist deciduous forests. Cane brakes are impenetrable thorny thickets sometimes with a few tall trees. Major species include *Calamus* spp. and sometimes creeping bamboo *Dixochloa andamanica.* Other species include *Calamus andamanicus* (Mota beth), *Calamus palustris* (Malaibeth), *Calamus longisetus* (Junglibeth), *Daemenorops kurzianus* (Sanga beth), *Calamus viminalis* (Hosalibeth), *Korthalsia laciniosa* (Lalbeth), *Calamus pseudorivalis*.

12. **Wet Bamboo Brakes (1/E2)**
The Wet Bamboo Brakes are often very dense and occur throughout tropical evergreen tracts of Andamans. Major species include *Dendrocalamas brandisi, Oxytenthera spp, Bambusa schizostachyoides, Oxytenanthera nigrociliata, Bambusa auriculata, Schizostachyoides regersii, Dinochloa andamanica.* (FD A&N 2001)

Mangroves

The least disturbed, and the best preserved, mangroves in India can be found on the Andaman & Nicobar Islands. Along with the inland forests, the mangroves are the predominant terrestrial ecosystem of the islands. Their value in conserving soil and protecting creeks and harbours from siltation and erosion cannot be over-emphasised, particularly in the small islands. The mangrove cover has been variously estimated to be 929 km^2 in the Andamans and 37 km^2 in the Nicobars (Anon. 1999), and 1,011 km^2 in the Andamans alone (Balakrishnan 1998). According to Quereshi (1957), the Andaman-Nicobar Islands have about 1,19,000 ha. of mangroves. Other estimates of the extent of mangroves in the islands include:

MANGROVE FAUNA

- Mammals - 8 species
- Birds - 53 species
- Reptiles - 7 species
- Amphbian- 3 species
- Fish - 253 species
- Polychaetes- 410 species
- Meiofauna- 53 species

Source: Savant 2001

Mathauda	(1957)	1,15,200 ha.
Waheed Khan	(1957)	1,20,434 ha.
Blasco	(1976)	1,00,000 ha.
Landsat	(March 1986 & September 1987)	77,768.75 ha.
Forest Survey of India	(1999)	96,600 ha.

In any case, the A&N Islands have the second largest area in India under mangroves, after the famous Sunderbans mangroves of Bengal. The table below gives the relative position.

Regional distribution of mangroves in India

State	Locality	Area in ha.
W. Bengal	Delta system of Ganges	4,18,888
Orissa	Mouth of Mahanadi	12,000
Andhra Pradesh	a) Mouth of Godavari	13,304
	b) Mouth of Krishna	5,120
Tamil Nadu	Cauvery delta	2,640
Maharashtra	Bombay region	62,208
Gujarat	Saurashtra and Kutch	52,616
Andaman-Nicobar Islands	Bay of Bengal	1,15,200
	Total	6,81,976

(Source: After Sidhu, 1963, as quoted in Menon and Pillai 1996)

These mangroves support a rich diversity of fauna and in particular provide breeding and spawning habitats for many aquatic species (Rao & Khan 1990), and to the saltwater crocodile and several species of birds and reptiles. A list of some of the floral species is given below.

Floristic Compostion of Mangroves in the A&N Islands

Tree species : *Avicennia marina, A.officinalis, Bruguiera cylindrica, B.gymnorrihza, B.parviflora, B.sexangula, Ceriops tagal, C. decandra, Cynometra iripa, Excoecaria agallocha, Heritiera littoralis, Kandelia kandel, Lumnitzera littorea, L. littoralis.(?) L.racemosa, Rhizophora apiculata, R.lamarckii, R.mucronata, R.stylosa, Scyphiphora hydrophyllacea, Sonnertia alba, S.apetala, S.caseolaris, S.grifithii, Xylocarpus gangeticus, X,granatum, X.moluccensis (?).*

Shrubs : *Acanthus ebracteatus, A.illicifolius, A.volubilis, Aegialtis rotundifolia, Aegiceros corniculatum.*

Palms : *Nypa fruticans, Phoenix paludosa.*

Fern : *Acrostichum aureum.*

(Source: Savant 200; FD A&N 2001)

Mangroves of Andaman Island occupy an area of 115200 ha. in most of the creeks. They occur at the fringes of littoral and evergreen forests – the width of these forests would be just 100 – 300 m. There is a very long coastline where mangrove thrive. The mangrove swamps protect an abundance of microscopic & macroscopic algae. The higher forms are Padina gymnospora, Laurencia, Papillosa, Dictyota dichotoma & Ulva lactuca and micro algal forms are Entermorpha, Chaetomorpha, Cladophora & Ectocarpus.

An association dominated by seagrasses Zstera, Thalassia, Cymodocea can be seen in bay of Nan Cowry & Konaka region of Camorta Island. The mangroves of the creeks have various species of Seaweeds and of animals such as Trochus, Turbo, Cerithedium, Tekescopium, edible oyster, Crab, Ocypod, Periophthalmus, Ambassis, Therapon, Penaeus, Metapenaeus, Scylla, Portanus, etc. (Chudhuri 1987)

Miscellaneous

The tropical forest ecosystem continuously recycles water. Since most of the islands have very few perennial rivers and streams, the inland wetlands are restricted. Basically, small ponds formed by rainwater accumulate inside the forests. The ponds are valuable sources of freshwater for wildlife and they also serve as a refuge for endangered species, such as the Andaman teal, and several endemic amphibians that are habitat specialists.

Grasslands are an unusual feature found only in a few islands of the Nicobar group. They occur as patches on low hillsides, surrounded by good forest growth, on the islands of Bompoka, Teressa, Katchall and Camorta. There are varied viewpoints regarding their origin. According to one school of thought, they are man-made. This view suggests that the grasslands were created when the forest was cleared over a hundred years ago as part of a Danish effort to develop dairy farming. However, this view is not accepted by a number of scientists who consider the grasslands to have occurred naturally.

Seagrass beds occur in shallow coastal waters and sheltered bays, where clear water allows light penetration. Highly threatened marine animals, such as dugongs and marine turtles, use this habitat essentially as a feeding ground (Das 1996).

THREATS TO THE ECOSYSTEM

V POLICY AND LAW

India has a plethora of policies and laws designed to protect the environment. Article 48A of the Indian Constitution specifies that "The state shall endeavourer to protect and improve the environment and to safeguard the forests' and wildlife of the country".

Some of the main laws relevant to the A&N Islands include:

- The Indian Forest Act, 1927
- The Forest Conservation Act 1980
- The Wildlife (Protection) Act, 1972
- The Water (Prevention and Control of Pollution) Act 1974
- The Air (Prevention and Control of Pollution) Act 1981
- The Environment Protection Act, 1986

The Indian Forest Act 1927

This act provides for the setting up of reserved and perotected forests and for restricting and regulating activities and use in such forests.

The Forest Conservation Act 1980

This act prohibite the use of forest land for non-forest purposes without the specific clearance of the Government of India.

The Wildlife (Protection) Act 1972

This act provides for the setting up of national parks and sancturies. National parks have higher level of protection and no human use activities are allowed within. In sanctuaries, grazing by livestock and other limited uses can be permitted in so far as they are in consonance with the conservation objectives of the area. In the schedulaes of this act, various species of fauna and flora are listed and, depending on the schedule they feature in, are accorded various levels of protection, including a total ban on killing, capturing and exploitation (schedule 1). The act also prescribes processes and institutional structures for the protection of wildlife (both fauna and flora).

The Water (Prevention and Control of Pollution) Act 1974

Water quality standards are prescribed under this act. The act also lays down penalties and processes and specifies the institutional structures required for the control and prevention of water pollution.

The Air (Prevention and Control of Pollution) Act 1981

Air quality standards are prescribed under this act. The act also lays down penalties and processes and specifies the institutional structures required for the control and prevention of air pollution.

The Environmental Protection Act 1986

This is an "umbrella" act that covers almost all aspects of environment protection. Section 3 (1) states that the Central Government 'shall have the power to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing, controlling and abating environmental pollution'.

Its special significance to the Andaman and Nicobar Islands is because of the rules to this act regarding the regulation of activities in coastal regions, called Coastal Regulation Zones (CRZ). These rules, essentially, restrict or regulate construction and other activities in and around the coastal areas, especially on beaches.

Coastal Regulation Zones

Coastal Regulation Zones were gazetted by Notification under the Act in 1991, in exercise of the powers contained in Rule 5 of the Environmental (Protection) Rules, 1986. The zones apply to all coastal areas 500 metres from the High Tide Line (HTL) of seas, bays, estuaries, creeks, rivers and backwaters.

A wide range of activities have been prohibited in these areas. These are detailed under Section 2 of the Notification and include:

- The setting up of new industries and expansion of existing industries excepting those requiring waterfront or foreshore facilities;
- Manufacturing or handling of hazardous materials;
- Setting up or expansion of fish processing units including warehousing;
- Discharge of untreated wasters and effluent from industries, cities or towns and other settlements;
- Dumping activities of urban waste such as landfills and ash or waters from thermal power stations etc;

- Mining of sands, rocks and other material (other than those not found outside CRZs)
- Harvesting or withdrawal of ground water within 200 metres of HTL and only by manual means through wells in the 200 to 500 metres zone;
- Construction activities in ecological sensitive areas;
- Any construction activity between HTL and LTL except for specified infrastructure and;
- Dressing or alteration of sand dunes, hills, natural features including landscape changes except where permissible

The notification also directs the States, and Union Territory Administrations to prepare Coastal Zone Management Plans in accordance with guidelines laid out in the Annexures. These plans, directed to be prepared within 12 months of the Notification, require the approval of the Ministry of Environment and Forests (MoEF), Government of India. The annexures classify CRZs into four categories, including a specific category for the Andaman and Nicobar Islands and other islands. Special norms apply to each zone.

I) Category I (CRZ 1)

These are areas that are 'ecologically sensitive and important'. Listed under Annexure I (6(1)) of the Notification they include national parks/marine parks, sanctuaries, reserve forests and wildlife habitats, mangroves and corals. Here, no new construction is permitted within 500 metres of the HTL.

II) Category II (CRZ 2)

These are areas already developed, such as existing coastal towns and settlements. They are defined as 'areas within municipal limits or in any other designated urban area which is substantially built up and which has been provided with drainage and approach roads and other infrastructure facilities such as water supply and sewerage mains'. Here no buildings are permitted on the seaward side of existing or proposed roads, nor on the seaward side of authorized structures. Reconstruction of buildings or new buildings on the landward side are subject to existing Town and Country Planning Regulations and must respect the surrounding landscape and architectural style.

III) Category III (CRZ3)

These are defined as 'areas that are relatively undisturbed and those which do not belong to either category I or II'. They consist of undeveloped coastal zones in rural areas and areas within municipal limits or legally designated urban areas as yet unbuilt. Here, no new building is allowed up to 200 metres from the HTL, this being designated as a no development zone. Vacant plots between 200 metres and 500 metres of the HTL can be developed for hotel/beach resorts subject to approval by MoEF and according to special guidelines (as stipulated in Annexure II of the Notification). Construction of dwelling units is also allowed here as long as it is within traditional rights and does not exceed certain standards, for example, exceeding twice the number of existing dwelling units.

IV) Category IV (CRZ 4)

This category relates specifically to the Andaman and Nicobar Islands, as well as to other islands. Given the significance of this set of regulations, an extract of the regulations is provided in full.

Andaman and Nicobar Islands

i) No new construction of buildings shall be permitted within 200 metres of the HTL;

ii) The buildings between 200 and 500 metres from the High Tide Line shall not have more than 2 floors (ground floor and 1st floor), the total covered areas on all floors shall not be more than 50 per cent of the plot size and the total height of construction shall not exceed 9 metres;

iii) The design and construction of buildings shall be consistent with the surrounding landscape and local architectural style;

iv) Corals and sand from the beaches and coastal waters shall not be used for construction and other purposes;

v) Dredging and underwater blasting in and around coral formations shall not be permitted and

However, in some of the islands, coastal stretches may also be classified into categories CRZ 1 or II of III, with the prior approval of Ministry of Environment and Forests and in such designated stretches, the appropriate regulations given for respective Categories shall apply.'

VI THREATENED FORESTS

Of a total land area of 8249 sq km, 6515 sq km (79%) is covered by closed forests (canopy cover above 40%), 125 sq km (1.5%) is covered by open forest (10 to 40 % canopy cover) as per the Forest Department, A&N Islands (as quoted in Singh 2002). The total recorded forests[2] in the A&N Islands are about 7,170.69 km^2. 41% of this area constitutes tribal reserves.

Given the unique biodiversity values of the forests of Andaman and Nicobar Islands and their extreme ecological fragility, the major objective of forest management in these Islands should be biodiversity conservation. The other objectives that need to be concurrently kept in mind are:

- Protection of ecological services, like soil and water conservation.
- Provision of timber and non-timber products for local use.
- Protection of the habitat of the forest based tribals of the Islands.
- Recreation.

The fact that the A&N Islands has a preponderance of evergreen and semi-evergreen tropical rain forests makes the conservation of forests from the point of view of both biodiversity and ecological services particularly important. Rain forests are not only the richest biodiversity pools in the world but are also very fragile. Most of the nutrients are in the vegetation and the forest litter and the soils are usually shallow. The slightest disturbance of the forest leads not only to significant loss in biodiversity but also to aggravated water runoff and soil erosion. The erosion of soil depletes the land and adversely affects the marine ecosystem, which receives the eroded soil. This is especially true of the A&N Islands, where the topography is undulating and rainfall high. The fact that most forestry operations are carried out so as to finish just before the monsoons further aggravates the situation, as the soils that have been disturbed by the forestry operations do not have time to stabilise before torrential rains wash them out to the sea. Consequently, the coastal and marine ecosystem, including the very rich corals reefs and other marine life, gets badly affected.

[2] Recorded forest means the area that is legally forest land, irrespective of whether it has forest cover or not. Therefore, you can have actual forests outside recorded forest land and recorded forest land with no forests.

The loss in floral biodiversity has an effect on the faunal biodiversity, affecting species of insects, birds, mammals, reptiles and others. This, in turn, also affects the coastal and marine biodiversity.

On the face of it, the forest cover in the islands would appear to be adequate, especially if one compares it to the prescribed 33% and the actual 19.3 % for the country as a whole. However, given the specific bio-geographic profile of these islands, especially the preponderance of evergreen and semi-evergreen forests, the mainly hilly undulating terrain, the rich biodiversity, the high rainfall, the shallow soils and the extensive coral reefs surrounding the islands, the cover appears to be inadequate. The fact that much of the deforestation has occurred in a few of the larger islands further exacerbates the adverse impact.

Though detailed assessments are not available, over the years deforestation has resulted in severe soil erosion and a consequent pollution of the coastal waters and coral reefs with the run-off soil. There has also been a loss of sub-soil moisture and fresh water aquifers, changes in the micro-climate and in related ecosystem values.

The major threats to the forests of the A&N Islands emanate from:

- Inappropriate and excessive commercial forestry
- Extensive encroachments on forest land
- Conversion of forests and forest land into human settlements and for infrastructure and other projects and activities

Breakup Of Forest Area In Andamans

	FOREST DIVISION (AREA IN SQ KM)							
	Little Andaman	**South Andaman**	**Baratang**	**Middle Andaman**	**Mayabunder**	**Diglipur**	**Total**	**Percent**
WORKED								
Evergreen	5.41	139.67	57.34	26.69	19.43		248.54	24.96
Semi – evergreen	27.06	139.67	139.24	74.74	136.02		516.73	40.82
Moist deciduous		44.44	81.91	106.77	38.86		271.98	26.22
Total	32.47	323.78	278.49	208.20	194.31		1037.25	
UNWORKED								
Evergreen	48.71	95.23	65.53	42.71	106.87	64.54	423.59	20.10
Semi-evergreen	140.71	76.19	81.91	133.46	262.33	303.34	997.94	47.23
Moist Deciduous		25.4	49.15	85.41	233.18	296.89	696.03	32.48
Total	189.42	196.82	196.59	261.58	602.38	664.77	2111.56	

(Source: FSI 1992)

Commercial Forestry

Forests have been worked for the last over 75 years to meet the requirement of timber based industries, both small and medium. The major commercial tree-species on the island include Gurjan (*Depterocarpus species)*, Padauk (*Pterocarpus dalbergioides*), White Chuglam (*Terminalia bialata*), Badam (*Terminalia procera*) etc.

The rugged topography and poor communication facilities have made forestry operations difficult and wasteful. Harvested logs are shipped to the mainland, or to local plywood factories, or sawmills. Forestry work is carried out with labour from among settlers and tribals from Ranchi, in Jharkhand state in the Indian mainland, who immigrated especially to work in the forestry sector. Since the logs are huge and heavy, elephants are used in forestry work, to help in loading and unloading.

One of the major threats to the biodiversity of the forests of the A&N Islands is the stress on commercial forestry. For over a hundred years the forests have been subjected to increasing commercial exploitation. The forest department currently follows a "conversion" forestry system where natural forests are worked, commercial species extracted and the worked forests regenerated and managed in a manner such that there is a resultant preponderance of commercial species for future harvesting. In the process, biodiversity is destroyed deliberately. For example, the *Working Plan for The Forests of Little Andaman Islands (1999 to 2009)* states:

> **"Measures to Attain Special Objectives of Management:** It is Proposed to attain the special objectives of management by adopting a suitable natural regeneration technique, supplemented by artificial means wherever necessary, without any deterioration in the site quality, so that the natural forests of Evergreen, Semi-Evergreen and Deciduous types are converted into forest areas containing a higher percentage of more valuable timber species thus increasing the productivity and potential value of these forests. In such places where natural regeneration technique does not result in adequate stocking, it is augmented by dibbling/broadcasting of seeds of valuable species like padauk, gurjan, White Chuglam, Badam etc. and if necessary artificially planting seedlings from nursery stock." (Emphasis added. Written By Prakash M. Bhatt, IFS**,** Deputy Conservator of Forests,)

Similar passages are found in other working plans of the A&N Islands forest divisions. What is surprising is that the Ministry of Environment and Forests (MoEF) is, even now, approving working plans with such objectives. (For a look at the historical attitudes to forestry in the islands, please see annex 1).

In some areas the natural forests have been totally cleared and replaced with plantations of padauk, gurjan, teak, or a combination of these and other commercial species.

Forests were also leased out to the private industries and, from 1977, to the Forest Corporation, to fell and "regenerate". Though the practice of leasing forests to the private industry finally stopped in 1990-91, the corporation continues to directly fell and regenerate forests in Little Andaman and in North Andaman Islands.

Whereas this approach might have been in consonance with earlier thinking about forest management, for over two decades now the value of conserving biodiversity is well understood and accepted.A Government saw mill was established at Chatham Island in 1883 and it supplied cut timber to the settlements around Port Blair. A match splint unit was established at Port Blair in 1929 by WIMCO. Logs of Padauk and Gurjan found a ready market on the mainland. After independence (1947) the wood-based industry expanded in the islands. The extraction of timber in 1950 was around 49,000 cubic m per annum, which increased to 1,45,000 cubic m per annum in 1986. The number of commercially exploited species has increased from 4 in 1952 to 40 in 1990.

The forests of Andamans have been systematically converted from natural, biodiversity rich, forests to commercial "plantations" primarily to meet the raw material demand of the four medium sized wood based industries that were established in the Islands. These were:

a) WIMCO in South Andaman
b) Andaman Timber Industry (ATI) in South Andaman (Installed capacity 31,160 cum pa)
c) Jayshree Timber Products, Middle Andaman (28, 300 cum pa)
d) Kitply Industries Ltd. in Middle Andaman (31,650 cum pa)

(Singh, 2002)

Of these, WIMCO closed down some years back and the Andaman Timber Industry and Jayshree Timber Products closed down recently, for various reasons. Only Kitply Industries is still functioning (Singh, 2002).

These industries, apart from getting timber from the forests, were also provided a handsome transport subsidy by the government, to bring in materials and to export their finished products (Singh, 2002).

These industries, apart from getting timber from the forests, have also been provided a handsome transport subsidy by the government, to bring in materials and to export their finished products.

The Ministry of Industry, Government of India, had sanctioned a Transport Subsidy Scheme for the wood based industries in the A&N Islands from 1971. Under this scheme, 90% of the cost of transportation of raw material from the main land to the islands and 90% of the cost of transportation of the finished goods to the mainland was reimbursed to the medium and small-scale units by the ministry of Industry. This scheme was amended in 1993 to benefit wood based industries for a period of five years only from the date of commencement of commercial production.

This scheme was again amended, in 1995, and subsidy continued to be paid to the units, irrespective of size, beyond the stipulated 5 years, from March 1995 to March 2000. There is now a proposal to further extend this scheme for, it is argued, that such subsidies are necessary to ensure that employment is provided in the forest based industries. (Source: Note from the Planning Commission).

It is interesting to note that while the three industries, ATI, Jayshree and Kitply, totally employed 1994 persons directly**,** in the last four years (1997-2001) they drew transport subsidies from the government of around Rs.15 crores, with an annual peak of over 5 crores in just 1999-2000.

It is questionable, therefore, as to how much, if any thing at all, they contributed to the local economy.

In fact, the Minutes of the Island Development Authority (IDA)[3] meeting of December, 1986, under the chairmanship of the then Prime Minister, record that:

[3] The IDA was constituted on 8th August, 1986 with the Prime Minister as the Chairperson. The members include the Finance Minister, Deputy Chairman of the Planning Commission and ministers of various other

" Shri Romi Khosla stated that 75 percent of the timber extracted in the islands is used for plywood and match factories, and not for construction purposes. In fact, timber is not used at all as an economic base for durable assets of the Islands. ….Large factories are consuming large amounts of timber in ways which only destroy the inheritance. PM said that such industry should be shut down at the earliest…" (Proceedings of the first meeting of the IDA, 27 December 1986, para 14).

In January 1989, again under the chairmanship of the then Prime Minister, the IDA decided that:

"…wood extraction to feed the existing industries should be completely phased out in the next few years; if necessary, one should even import the wood needed" (Minutes of the Fifth Meeting of the IDA, January 1989, item No. 6, ix e)).

The then Inspector General of Forests (now re-designated as the Director General of Forests) visited the Islands in October 1989, and also recommended that:

"Timber extraction in A&N Islands should be restricted to maximum of 1,15,000 cu.m. which is the current requirement and it should be further reduced in subsequent years by phasing out supply of timber to major wood base industries." (*Timber Extraction in Andaman & Nicobar Islands*, AG Oka, 1989).

Despite this, the Ministry of Environment and Forests and the A&N Administration, after affecting an initial decline in extraction levels from 1,23,678 cum in 1988-89 to 1,03,660 cum in 1990-91, again raised the level of extraction to 1,35,523 cum in 1994-95 (See table on following page). Considering there was no subsequent decision of the IDA or the Prime Minister, reversing the earlier decision, it is not clear on what basis this was done. Fortunately, with the closing down of three of the wood based industries, the extraction levels have now come down.

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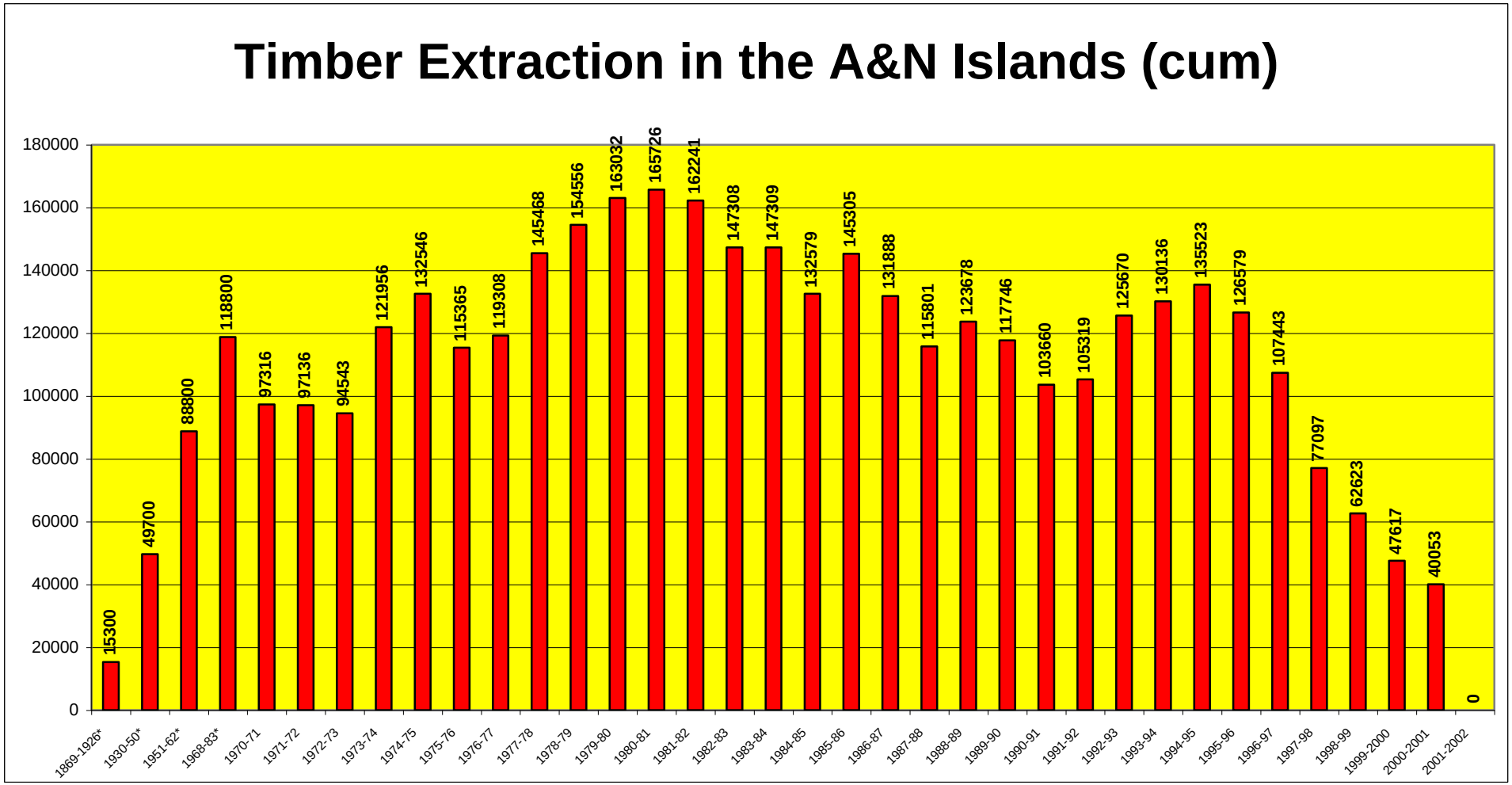
ministries (transport, tourism, planning, communications, defence, environment & forests, information and broadcasting, various officials and experts. The functions of the IDA are to (i) decide on policies and programmes for an integrated development of the Islands (ANI and Lakshadweep) keeping in view all aspects of environmental protection as well as the special technical and scientific requirement of the Islands, and (ii) review progress of implementation and impact of the programmes of development.



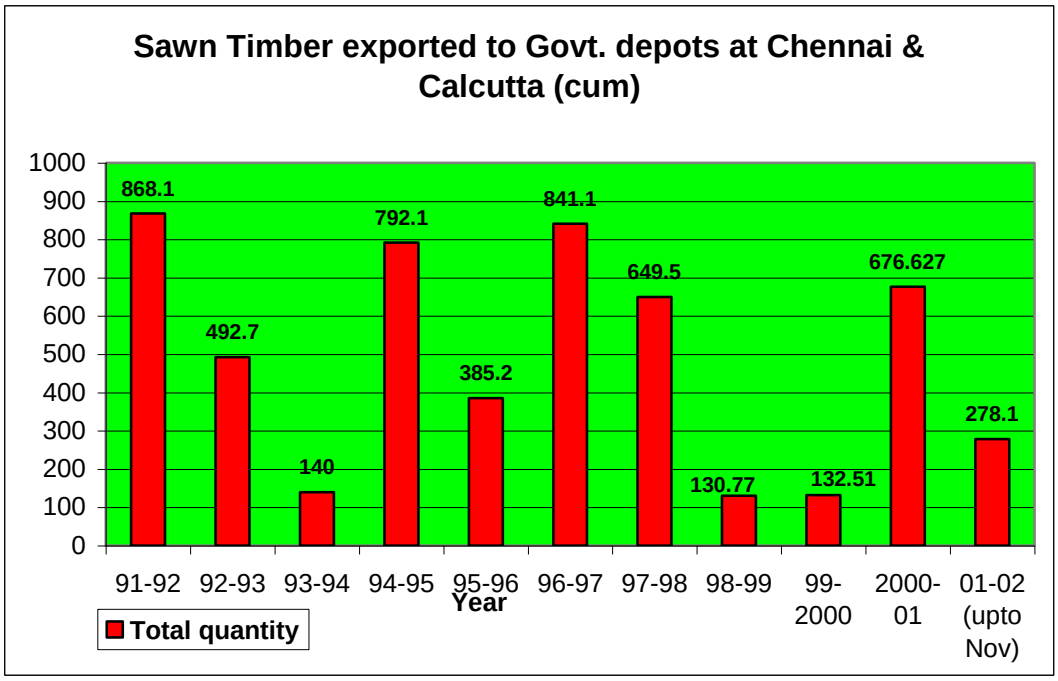
* Average Annual Extraction

In addition, timber is also being supplied to the two government saw mills (see table below), one in Chatham, South Andaman (installed capacity 24,000 cum pa) and one in Betapur, Middle Andaman (5000 cum pa).

Sawn Timber Production In The Two Govt. Saw Mills (In Cum.)

Year	Production	Local sale			
		Govt. Dept.	Private	Forest Dept.	Total
1996-97	9000	1014	3750	1911	6675
1997-98	6952	1141	4654	719	6514
1998-99	6507	1264	4185	459	5908
1999-2000	5515	1224	4626	369	6219
2000-2001	6199				5360

Some of the timber sawn is being exported to the mainland. This is mainly sold in Chennai and Kolkata. The the A&N Islands administration maintains depots in these two cities for selling the timber it exports. However, the quantity of sawn timber exported by the administration has not crossed 1000 cum pa for the last 10 years and has fluctuated between 130.77 cum in 1998-99 to 868.1 cum in 1991-92 (see table below).



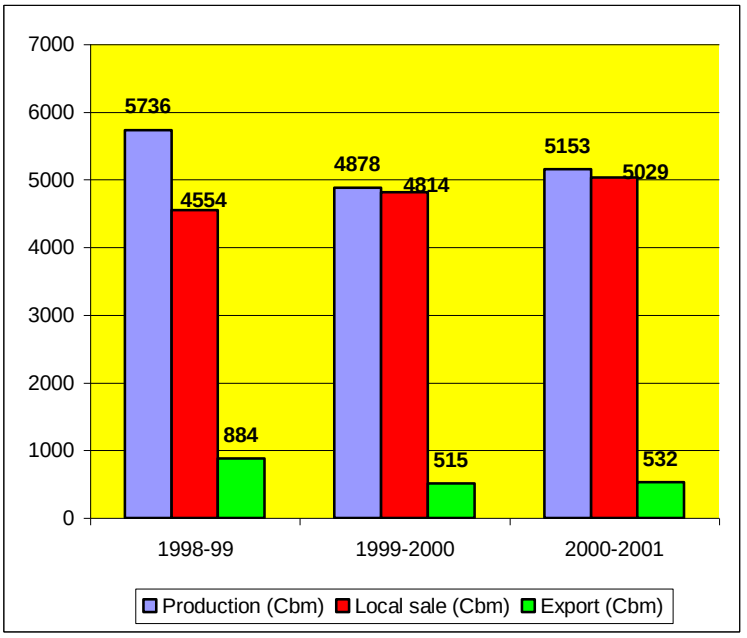
The Government of India set up the Andaman and Nicobar Islands Forest and Plantation Development Corporation (ANIFPDC) in 1980. The ANIFPDC was given over areas in Little Andaman and in North Andaman for harvesting and regenerating.

Locally, timber has been used by small-scale sawmills, which numbered about 35 in 2001 (see table below). In addition, there are also over 130 small furniture manufactures using about 1600 cum of sawn timber (equivalent to about 3000 cum of logs) per year (Singh, 2002).

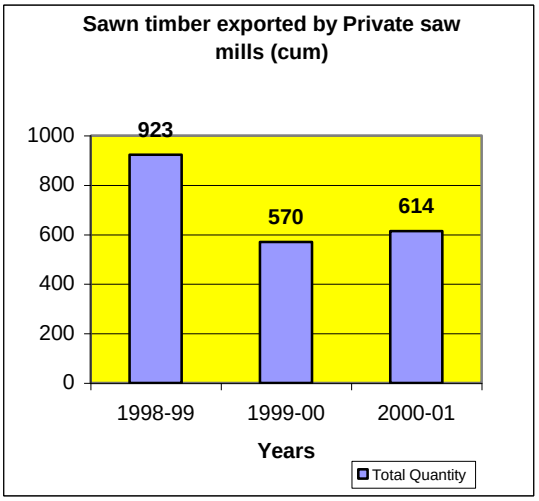
Consumption level of round logs between 1996-2000

Category	**No. of Units**	**Licensed (cbm.)**	**Actual Capacity (cbm.)**	**CONSUMPTION (in cbm.)**					**Employment (no)**
Year				96-97	97-98	98-99	99-00	00-01	
MEDIUM SCALE INDUSTRIES									
Plywood	3	91.110	66.148	60.886	53.015	35.601	13.752	11.509	1899
SMALL SCALE INDUSTRIES									
Pencil Slat	6	11.400	3.871	2.480	1.234	706	439	1.192	223
Cottage-match	3	14.800	11.806	1.459	1.833	1.078	2.830	1.019	198
SAW MILLS									
Private Saw Mill	22	35.564	8.308	15.488	7.594	5.713	11.582	11.314	226
Govt. Saw Mill	2	29.000	18.000	17.657	11.684	1.4464	12.173	14.495	975

Production of Sawn Timber by Private Saw Mills

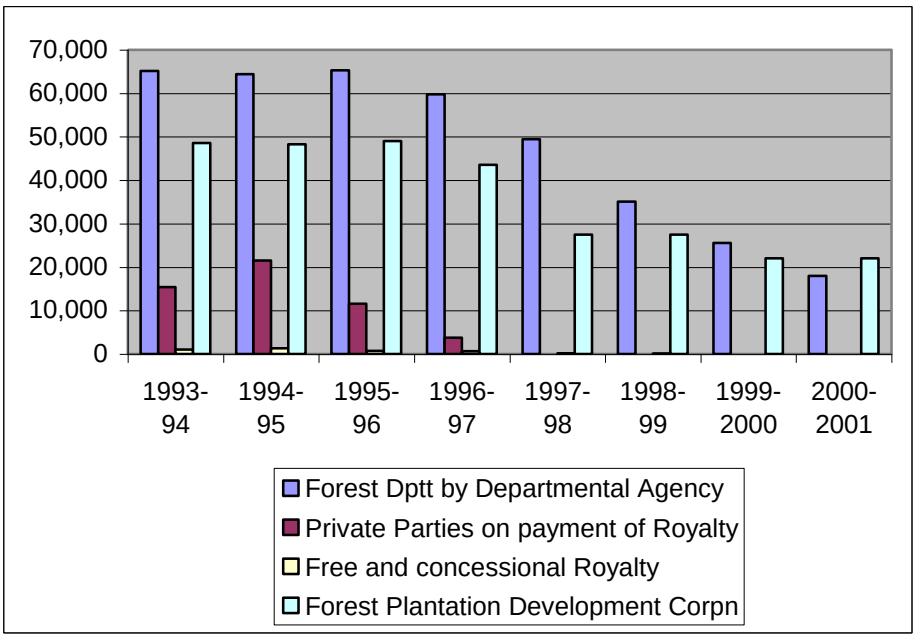


The small-scale industries, as also private parties, have been exporting some timber to the mainland (see tables below).



In short, timber has or is being extracted in the A&N Islands by private parties (Industry), by the forest department, by the Forest Development and Plantation Corporation and, to a limited extent, by the local people as a part of their free and concessional royalty rights. The table below gives the overall picture.

Trends in timber extraction between 1993-2001 (cum)



In the last few years some timber has also been imported from abroad, for use by the plywood industry. Details are given in the table below.

Timber Imported into A & N Islands

Year	Quantity (No. of Logs)	Quantity (Cbm)	Category	Country
1997-98	5061	17414.080	Plylogs	Malaysia
1998-99	12721	22,200.884	Plylogs & Hardwood (8.6%)	Malaysia & Singapore
1999-2000	7630	18086.380	Plylogs & Hardwood (22%)	Malaysia & Mayanmar
2000-2001	1427	4823.162	Hardwood (100%)	Malaysia & Mayanmar

The Government has supported the industrial sector in various ways. Sales Tax is not levied on goods in the A&N Islands. Small-scale units are exempted from octroi duty when importing plant machinery and equipment from the mainland. Many other concessions are given while setting up an industry. As per the Government of India's policy, 90% of the freight charges towards importing raw materials and exporting finished products are allowed as transport subsidy from 1986. During the year 1991–92, an amount of Rs. 17,160,000 was sanctioned as transport subsidy to 18 industrial units functioning in the A&N Islands (Census of India, 1991).

Only the government saw mills are permitted to saw padauk, the major hardwood in the Islands. This is reportedly being done in order to prevent theft of padauk from the forests. However, as the government saw mills are located only in South and Middle Andaman, the availability of such hardwoods to the people in other parts of the Islands is a problem.

As a result of the commercial orientation of forestry in the Islands, at present nearly 60% of the exploitable forests (excluding the tribal reserve and protected areas) in South Andamans, Mayabandar and Baratang, have already been "worked" and exploited and, consequently, their natural profile significantly changed and their biodiversity value compromised, perhaps forever. Though the A&N Islands forest department have stated that the total area of forests that they work is only 30%, this includes the area of the numerous outlying islands, mostly very small. Given the nature of island ecology, the biodiversity values of the larger islands are much higher, by and large, than those of

small islands of usually 1 sq km or less. Though this is an accepted scientific fact, the actual position in the A&N Islands does not seem to have been studied in detail. The only study that could be found was by Dr Priya Davidar of the Salim Ali School of Ecology and Environmental Sciences. She states:

" ….forests on large islands are very important in the conservation of biodiversity. All the 47 species of forest birds and 57 species of butterflies (out of a total of 65 species recorded in this survey) were recorded on islands larger than 30 sq km in area. Islands smaller than 1 sq km had records of 36 species of forest birds and 39 species of butterflies. On islands smaller than 0.1 sq km, in area, only 20 species of forest birds and 21 species of butterflies were recorded" ('Conservation Priorities for the Andaman and Nicobar Islands', *Journal, Bombay natural History Society*, 93(3), December 1996, p 556).

Therefore, though many of these small islands, which are in any case mostly inaccessible and therefore not economically viable to work, have been excluded from the "working circle", much of the larger islands, which are far richer in biodiversity, have been worked. Also, in terms of ecological services, like soil and water conservation, the larger islands are far more vulnerable as they are the ones where a majority of the population resides.

In all these areas the vast majority of non-commercial species have either disappeared or their composition been significantly changed. Though enough evidence of this exists, there appear to be very few studies documenting exactly what changes have actually occurred and what species have been lost or decreased in distribution and number. The two studies

"In some misinformed circles, an impression seems to prevail that these islands offer an opportunity to relieve the extreme pressure of population on the mainland. Nothing can be father from the truth. Due to local climatic and soil conditions, even if the islands were completely deforested in clean shave fashion, and converted into agricultural lands, they can only sustain a small population of cultivators for a very limited period of time……..

"The magnificent forest wealth of these islands indisputably offers the main source of their economic development……

"As regards the development of agriculture, the fertility of the local virgin soil is as alluring to the eye as it is lurid in scientific fact. The average annual rainfall exceeds 123 inches and the topography of the islands is such that unless the soil remains bound together by profuse forestation, whatever little of its exists, is likely to be rapidly washed away unchecked into the sea…….

"The dramatic first year yields is virgin soils are a story of the past already and subsequent yields are maintaining a progressively downward trend. Stringent measure are necessary for adoption, if the holdings of such cultivators are to be saved from complete depletion of soil fertility."

Raja Surendra Singh of Nalagarh, Adviser (Colonisation) – 1962, as quoted in A&N 1983

found dealt with just tree species. One is an unpublished MSc dissertation of Sonali Pandit, of the Salim Ali School of Ecology and Environmental Sciences, Pondicherry University, (*Regeneration of Important Rainforest Tree Species in Virgin and Selectively Logged Sites in the South Andaman Islands*, not dated). This dissertation was based on a field study of three sites in South Andaman, one that was undisturbed, and the other two that had been worked, of which one was regenerated from 1955 and the other from 1986. According to this study, there were major differences between the composition of the first, undisturbed, patch and the remaining two. Most notable was the fact that the undisturbed site had a predominance of rare, non-commercial species, while in the latter two these had almost disappeared and the preponderance was of commercial species.

The second study, done by the Forest Survey of India (FSI) of the Ministry of Environment and Forests, Government of India, also suggested a similar decline in biodiversity.

During the second visit to Andamans, the forest department organised for me a visit to what was presumably a good regeneration site. This was a forest "regeneration" site of 1951, in South Andaman. This visit also revealed that the regenerated area had a preponderance of commercial species and that the species composition had drastically changed from its natural profile.

Plantations

The Forest Department was set up in 1883. The plantation of teak was started along with plantation of local species like Padauk and Pyinma, which were considered valuable timber at that time. Artificial plantation of Padauk was started in South Andaman in the year 1883. The following year, Burma teak was planted. It was followed by plantations of various exotics including eucalyptus. 10,000 ha of teak was planted till 1976. The remark by the ex-Inspector General of Forests in 1970 that teak plantations were not coming up to expectations and was leading to degradation of the forest floor, finally led to the gradual phasing out of teak plantations.

> "Ever since the inception of the Forest Department in 1883 attempts made in raising plantations of various species amounting to about 500 acres are of interest only in as much as they provide an illustration par excellence of what is not to be attempted under the conditions obtaining in the Andamans. …..The prohibitive costs involved put artificial regeneration of these forests out of courts….."
>
> Shri M.D. Chaturvedi, I.F.S., Inspector General of Forests, Govt. of India – 1951., as quoted in A&N 1983.

Mahogany, teak, eucalyptus and tropical pines were raised as monoculture plantations at various times. It was thought that they would provide commercially viable timber that could be exported to the mainland. The plantations failed, perhaps due to the local soil and ground water conditions (Saldanha, 1989). The Corporation has leased 19,600 ha of forest area in Little Andaman and 11,188 ha in North Andaman. Rubber plantations occupy an area of 614 ha in Katchal Island.

> "Teak is doing well in the islands and if proper areas gently undulating with good drainage and good soil are chosen, there is no doubt that excellent results will be obtained without any loss in soil or fertility. ……Provided, therefore, the site is properly selected and the plantations are properly tended I see nothing but bright future for these plantations. At worst, it is axiomatic that financially a bad teak is better that the best miscellaneous."
>
> Shri G.G. Take, I.F.S., Inspector General of Forests, Govt. of India – 1957, as quoted in A&N 1983.

There are over 12500 ha plantations of hardwoods done in the A&N Islands. However, since the 1990s no new plantations have been undertaken. Commercial exploitation of mangroves has also been stopped since 1988 (Singh, 2002).

The Government of India had sanctioned a project for raising 2400 ha of Red Oil Palm (*Elaeis guineensis*) plantation in Little Andaman Island. The Forest Department initiated work on a Red Oil Palm Plantation in Little Andaman in 1975. The Plantation was taken over by the ANIFPD.C in 1980. Since then, 1,593 ha have been planted and an additional 208 ha clear felled but not planted. It was envisaged that after the first phase of plantations involving 2400 ha, the plantation area would be extended to 5000 ha to make the project viable. However, in 1985-86, there was a sudden shift in the policy and the Government of India, in January 1986, imposed a ban on further extension of the plantation in these Islands in view of the adverse ecological impact perceived due to monoculture cultivation of Red Oil Palm (ANI F&E 2001).

The Statistics supplied by the Corporation indicate a steady increase in F.F.B (Fresh Fruit Bunch) yields as well as in palm oil production. The F.F.B. which was 321.48 Mt in 1982-83 is reported to have gone up to 1845.95 for the first 5 months of 1987-88. The reported recovery of Palm Oil has risen from 25.76 Mt in 1982-83 to 281.05 MT for the same period. The percentage of recovery has doubled from 7.80% to 15.22%.

There have been hurdles in the plantation operations, which have been overcome with a fair degree of success. The rodent menace is reported to be under control. A weevil *Elaedobium Kamerunicus* has been introduced as a pollinator thus increasing the fruiting.

There are further problems to be faced. The present oil mill is working to capacity but cannot handle the entire crop. As a consequence some of the crop is not being harvested. In the absence of a nut-cracking unit, the Kernel Oil is not extracted by the Corporation. Better use needs to be made of the 208 ha of clear-felled land. Immediate action is called for.

The important point at issue is whether a unique type of vegetation that now covers the island should be destroyed for the sake of a commercial crop even if in itself it is economically viable. This unique forests type once destroyed will in all probability be lost for all time. (Saldhana 1987)

Local Needs

During the colonial period, demand for wood was not high. The colonisation of the island by settlers from the mainland led to an increased demand for wood. They were given free timber for building houses and had access to free supply of wood products.

Locally, timber is used by small-scale sawmills, which numbered about 35 in 2001, with a total installed capacity of around 60,000 cum per annum and an operating capacity of about 25,000 cum pa. In addition, there are also over 130 small furniture manufacturers using about 1600 cum of sawn timber (equivalent to about 3000 cum of logs) per year. Much of the timber processed by these two categories is for domestic use, though a small proportion (614 cum in 2000-01) is sent out to Chennai and Kolkata.

Encroachments on Forest Land

Another major threat to the forests of the Islands is because of encroachment of forest areas. Forest encroachment is not a phenomenon peculiar to these islands. In most parts of the country large tracts of forests have been and continue to be encroached upon by a variety of people and interests.

> "I was told during my say in the islands, that a number of encroachments have take place, mainly in South and North Andaman Islands. It is, therefore, necessary that Andaman Administration should take immediate concrete steps for controlling it. If considered necessary a regular protection squad on the similar lines as it is done in the mainland may be organised'……..
>
> Shri R.C. Soni., I.F.S., Inspector General of Forests, Govt. of India – 1970, as quoted in A&N 1983.

The A&N Administration had already identified and regularised the forest encroachments of 1367 families who had encroached up to 1978, on over 2500 ha. of forestland. They were to be regularised/resettled in one hectare land each and 1367 hectares of forestland had, with the approval of the MoEF, been denotified in 1988 for the purpose. However, a large proportion of the families that had to be shifted have not been shifted to their designated sites. Therefore, they continue to occupy forestland and to further expand and degrade their holdings. There is no obvious reason why these families have not yet been shifted, despite decisions in the IDA and other bodies to this effect.

Meanwhile, many of the families who continue in, or have been shifted to, their designated sites of 1 ha each have, reportedly, encroached additional land and are now sitting on areas far in excess of those allotted to them. Concurrently, those families who have not yet been shifted continue to reside in forest areas on sites that are mostly much larger than 1 ha and often progressively increasing.

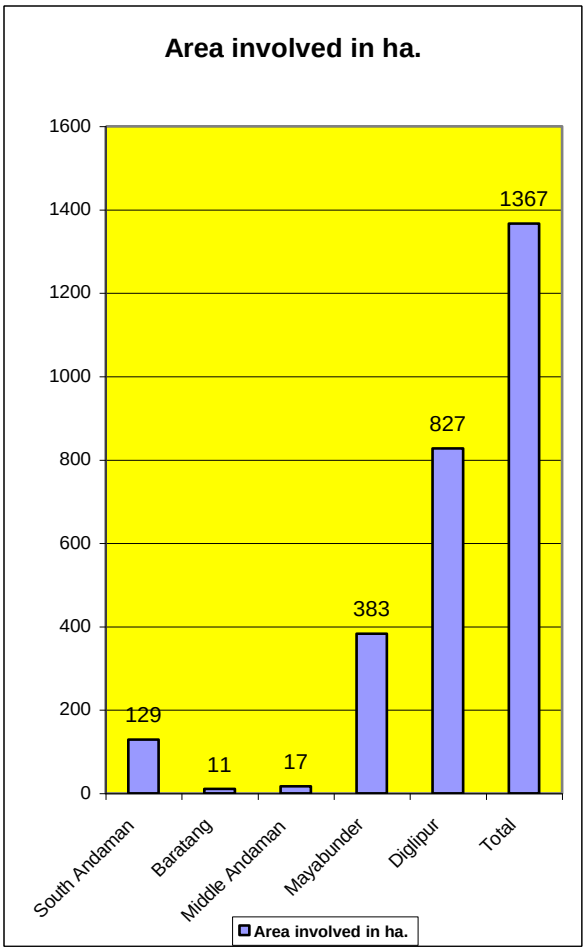
Besides, reportedly some of the families originally identified as pre 1978 have now moved away and in their place new families have settled on their encroached land. These families are reportedly now claiming pre-1978 status.

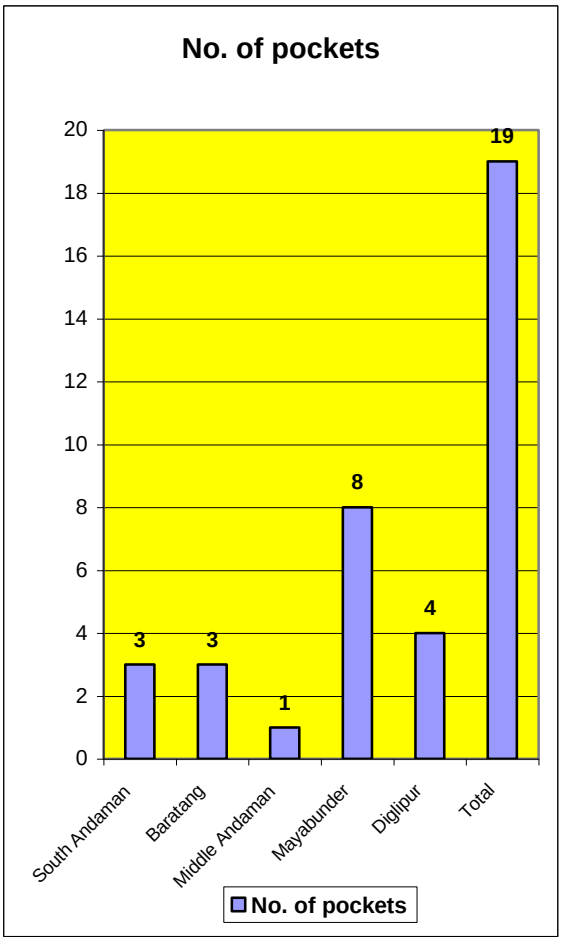
In addition, an estimated 2325 families have encroached subsequent to 1978 on 2633.654 ha of forestland. These have now been identified though little action seems to have been taken to remove them from the forest areas.

Unfortunately, many of these encroachments are in some of the last remaining natural lowland forests in North Andaman. Also, they appear to each be growing in size and collectively growing in numbers (For details, see tables below).

Details of Encroachments in the A&N Islands

Division	No. of cases for in situ settlement	No. of cases for shifting	Total
S/Andaman	79	50	129
Baratang	5	6	11
M/Andaman		17	17
Mayabunder	142	241	383
Diglipur	454	373	827
Total	680	687	1367





VII THREATENED BEACHES, CORALS AND MANGROVES

Beaches

The A&N Islands have a coast of 1962 km, which is a quarter of the coast of the mainland India. much of which is fringed with sandy beaches. Most of the 300 odd islands also sport magnificent beaches. The the A&N Islands has four species of turtles nesting on these beaches.

With an Exclusive Economic Zone of 600,000 km^2. The Andaman & Nicobar Islands have a significant marine ecosystem. Although the land area is only 8,249 km^2, the EEZ of the islands extending to 200 nautical miles from the shoreline is 75 times larger, approximately 6 lakh (0.6 million) km^2 (Saldanha 1989). The extraordinary marine biodiversity recorded includes more than 1,200 species of fish, 350 species of echinoderms, 1,000 species of molluscs and many more lower forms of life (ANI F&E 2001).

The main threats to the beaches has been the indiscriminate extraction of sand for construction. Inappropriate construction activities and the destruction of coral reefs, discussed later, have also resulted in the erosion of beaches by the sea.

The erosion of the beaches and the depletion of coastal and marine species all have an impact on the forests and on the overall ecological status of the Islands. Coastal erosion affects the forests and degrades them directly. Besides, the complex interaction between insects, birds and forest plants gets disrupted as soon as there is degradation of coasts and coastal and marine species. Forest working also affects the coastal ecosystem, especially the coral reefs, by accentuating the flow of silt into the water.

Under the Coastal Regulation Zone (CRZ) notification under section 3(1) and section 3(2)(v) of the Environment (Protection) Act, 1986 and rule 5(3)(d) of the Environment (Protection) Rules, 1986 declaring coastal stretches as coastal regulation zone (CRZ) and regulating activities in the CRZ, “Mining of sands, rocks and other substrata materials, except those rare minerals not available outside the CRZ areas;” were banned. However, a special exception was made for the A&N Islands, as under.

> “Provided that in the Union Territory of the Andaman and Nicobar islands, mining of sands may be permitted by the Committee which shall be constituted by the Lieutenant Governor of the Andaman and Nicobar Islands consisting of

Chief Secretary; Secretary, Department of Environment; Secretary, Department of Water Resources; and Secretary, Public Works Department. Committee may permit mining of sand from non-degraded areas for construction purposes from selected sites, in a regulated manner on a case-to-case basis, for a period up to the 30th September, 2000. The quantity of sand mined shall not exceed the essential requirements for completion of construction works including dwelling units, shops in respect of current year and 2000-2001 annual plans. The permission for mining of sand may be given on the basis of a mining plan from such sites and in such quantity which shall not have adverse impacts on the environment."

The MoEF has further extended the period up to 30 September, 2002. However, there is no assessment of the either the general environmental impact on the ecosystem of the Islands because of the extraction of sand, nor a location-specific assessment of the impact of extraction on each specific beach/coastal stretch from where such extraction takes place. Therefore, it is not clear on what basis the MoEF has allowed and continues to allow the extraction of sand. .

According to the figures supplied by the A&N Islands administration, approximately 2,23,937 cubic metres of sand was officially extracted from the beaches of the Islands in the three years 1998-2001. 72 beaches around the islands were used for extraction. In addition, it is alleged by local people that there is also illegal extraction of sand, which is considerable.

Sand is primarily extracted for construction purposes. It is undeniable that the extraction of sand is causing a lot of environmental damage and that this is not a sustainable method of resource use. However, there appears to be no effort to phase out the extraction and to move towards other, more sustainable, methods of construction. Also, as the Islands are located in a high earthquake-risk zone, it is undesirable to construct concrete buildings there. Alternative construction material is available in the Islands and the small amount of concrete that still might be needed can easily be made using rock dust.

Corals

Threats to coral reefs include siltation caused by inland forestry operations. This can have serious consequences for the health of the coral reefs. This, in turn, can affect the tourism industry as the coral reefs are a major tourist attraction. Coral polyps can be killed by direct deposition of silt, or indirectly through nutrients washed off from the land that increase the algal growth, which in turn increase the population of coral predators such as the Crown-of-Thorns starfish *Acanthaster plancii* (Soundarajan 1989).

Siltation: In a recent survey of the Wandoor Marine Park area in South Andamans, it was observed that siltation has caused mass mortality to ramose corals at Wandoor. Sea erosion was rampant and vast areas in May 1989 was found covered by silt along the shore, killing mostly ramose corals. Mass mortality to corals was also observed in and around Port Blair and Labrynthene Islands; probably due to siltation. Along the Wandoor coast the reef flat is basically composed of massive species. Opposite to the Helipad, sea erosion was very rampant and large scale death to ramose corals such as *Acropora*, *Montipora*, *Pocillopora* and *Seriatopora* was observed. Similar mortality to *Acropora* thickets were observed at the northern side of Chester Island. The reefs around Malay Island, Tarmugil Island are found to be healthy mostly dominated by massive Porites. At Jolly Buoy which is a tourist center, the outer reefs are found to be dead. The near shore shows patchy growth of corals.

In Burmanella the exposed reef flat is found to harbour few live coral colonies. The reef of Chideathope is also mostly dead. The reasons are not ascertained. Quarrying of sand from the nearshore area was reported to be the reason for sea erosion and subsequent siltation. Dorairaj et al (1987) reported on an incidence of large scale mortality to corals due to the construction of an approach road to Pongi Balu Jetty. (Menon & Pillai 1996)

The propellers and anchors of ships plying through or anchoring in coral reefs are also destroying corals. There has been extensive collection of corals by tourists and local inhabitants in the past. However, the export of corals from the islands has now been banned. Construction of sea walls, jetties, etc. can alter currents, obstruct light and may become the point source of pollution.

Trampling, littering, overturning of coral boulders, snorkeling and scuba diving in the reef areas may damage coral formation. Oil spillage

Coral mining : Dorairaj et al (1987) also cite instances of large scale destruction of corals due to mining of the reefs and coastal sand for construction work in the various parts of the island.

The effluents from timber factories around Port Blair and in middle Andamans is reported to have caused damages to coral growth (Arif, et al, 1987).

Shell collection and dynamiting for fishing are also causing damage. Invasion of *Acathaster planci* was studied by James, et al (1989) from the Wandoor Marine Park. *A.planci* was recorded from Grub Island, Alexandra Island, Red Skin Island and Twin Island. In several places *Acropora* spp. were found to be grazed by this star fish. Average intensity of the starfish population in Grub Island at some sites was to the tune of 124 individuals per 1000 sq.m. No follow up studies have been made and the present situation is not known. Tourism is being encouraged in the Labrynthine Islands enclosing the Marine Park. Though collection of marine animals from the Park area is strictly disallowed other implecations of the extended tourism needs assessment.

A case of White Band Disease Prevalence is also reported from Andamans. (Menon & Pillai 1996)

pollutes the ecosystem. Mining of sand and coral boulders for construction in many places have adversely affected the reef. Collection of corals and shells in an unsustainable manner and scale will affect reef health. Disposal of wastes, the fragility of the soil and availability of fresh water may be the other limiting factors.

Major climatic changes too, like global warming, remain a serious threat. Sea-level rise and coral bleaching, which are the consequences of this warming, can be disastrous for these islands.

Today, among the Indian reefs, only some sites in Andamans and Nicobar still remain in pristine condition without human interference.

Mangroves

Mangroves have been adversely affected in the A&N Islands for primarily three reasons. First, till recently, mangroves close to human habitation were being cut for fuel wood and poles. Apart from being used by the local people, some of the wood based industries, especially the ply, match and veneer industries, were using mangroves as fuel for their boilers! It was also being used by wood based steam boats belonging to the government and to private parties. The felling of mangroves has been banned by the government from 1990.

Secondly, the construction of jetties, roads, buildings and other infrastructure also severely impacted on the mangroves. Pollution from towns and cities and oil spillage and pollution from ships has also affected the mangroves, though again accurate assessments are not yet available.

Extraction of Mangroves by various agencies (in tonnes):				
Years	**By Govt. agency**	**By Permit holders**	**Total**	**For Charcoal**
81-82	**287**	**25774**	**26061**	**12.44**
82-83	**272**	**17685**	**17957**	**13.87**
83-84	**1519**	**14177**	**15696**	**11.66**
84-85	**219**	**13745**	**13967**	**14.47**
85-86	**400**	**13616**	**14018**	**12.22**
86-87	**-**	**11797**	**11797**	**9.175**
87-88	**-**	**216**	**216**	**7.20**
88-89	**-**	**-**	**-**	**3.94**

(Source: Savant 2001)

VIII THREATS TO SPECIES

Poaching and Over-exploitation

Both the government and the local people reported the incidence of poaching of trees, other forest produce, wild animals and marine life. It was stated by many of the citizen groups that poachers from Myanmar and other neighbouring countries also come to poach timber, sea cucumbers and other species, especially in North Andaman. There are also local poachers operating in the Islands. The forest department does not appear to have the infrastructure, especially in terms of manpower, arms and fast boats, to prevent poaching. Also, they appear not to have requisite powers to deter poaching and effectively apprehend poachers.

Apart from poaching, many species are being over-exploited for commercial and other uses. A current atatus is given uin the table below.

Status and Exploitation of Wildlife Resources of the Andamans

Name	Species	Status	Use
Sea cucumbers	Holothurians 40 species including commercial species	Critically endangered	Food (export)
Shells (molluscs)	Many species including *Trochus, Turbo*	Endangered	For mother of pearl and fancy work (export)
Lobsters	12 species	Endangered	Food/export
Prawns	12 species	Abundant locally	Food/export
Crabs	60 species including 3 commercial species	Abundant / commercial species / endangered	Food/export
Sea weeds	55 species including commercial species	Abundant	Food
Oyster	Blacklip pearl oyster	Status unknown	For mother of pearl and fancy work (export)
Giant clam	*Tridacna*	Highly endangered	Food
Fish	1200 species, 2 endemic	Most status unknown	Food, sport
Deer	*Axis axis, Muntiacus muntjak*	Abundant in most areas but not Little Andaman	Food, sport, skin, velvet (export)
Wild pig`	*Sus andamanensis*	Critically engangered	Food for tribals
Crocodile	*Crocodylus porosus*	Critically endangered	Food, leather, medicine (export)
Sea turtles	Green turtle, olive ridley, hawksbill & leatherback	Critically endangered	Food, leather, calipee (export)
Water monitor lizard	*Varanus salvator*	Endangered	Food, leather (export)
Venomous snakes	Six species	Critically endangered	Venom (export)
Orchids	Many species	Some species abundant on felled trees	Export market
Bee honey	Several species	Seasonally abundant	Trade item for tribals

Name	Species	Status	Use
Butterflies, moths, other arthropods	Many species	Some species abundant most status unknown	Export market
Swiftlet nests	*Collocalia fuciphaga*	Critically endangered	Trade item for tribals (export)
Medicine herbs	Many species	Status unknown	Medicines (export)

Source:Harry Andrews, 2001 & personal comments, 2002, as in Andrews and Sankaran 2002

Introduction of Exotics

The introduction of exotics is always a threat to ecosystems, but it is a special threat to Island ecosystems, as is obvious in the A&N Islands.

Over the years, many exotic species of animals and plants have been introduced in the Islands, some deliberately and many accidentally. Some of those that have had a very destructive impact on forest regeneration include the spotted deer (cheetal) and the elephant. The deer, reportedly brought for aesthetic purposes, have proliferated widely due to the absence of any natural predator in the Islands and have significantly retarded forest regeneration. The elephants were brought to the Islands by a timber logging company, which subsequently abandoned them. Reportedly about sixty of them have become feral and are seriously impacting on the forests in the regions that they are found. The introduction of dogs and cats, many of which have turned feral, also pose a great threat to turtle breeding and other indigenous species.

> Timber extraction in the Andamans is dependent in the main on elephants. In March 1942, at the time of evacuation there were 81 adults and 10 claves. These elephants were left loose in the forest and their gear was dumped into the sea. The Japs, during their occupation, recaptured the elephants only to let them loose again while leaving….. To feed an elephant on 20 lbs. of paddy and 5 lbs. Of gram a day is to pay scant regard to the famine conditions on the mainland"……
>
> The introduction of chital (spotted deer) from the mainland in the twenties has resulted, as was only to be expected, in its uncontrolled multiplication….. There is nothing so serious as the thoughtless introduction of exotics divorced from their natural enemies, which keep them under control. On the mainland, food, drinking water supply, rinder pest, panthers and sportsmen keep chital in check. It will be worthwhile considering the introduction of a couple of male panthers on islands infested by chital and watch the results carefully. We dare not let panthers multiply on these isles.
>
> Shri M.D. Chaturvedi, I.F.S., Inspector General of Forests, Govt. of India – 1951., as quoted in A&N 1983.

There has also been infestation by various exotic species of weeds, which could prove to be a major deterrent to the regeneration of degraded forest areas, especially areas freed from encroachment.

The introduction of oil palms in Little Andaman and of teak in various parts of the islands has also had a significant negative impact. In fact, the areas in Little Andaman where oil palms were introduced show up clearly as degraded forests in the remote sensing map prepared by the Forest Survey of India (FSI). The faunal distribution in the A&N Islands has been influenced by the fauna of both the Indo- Chinese and Indo-Malayan regions. Large mammals are absent in both the Andaman and Nicobar Islands.

Species introduced to the Andaman and Nicobar islands which have caused un-anticipated ecological problems on islands elsewhere.

Sl. No.	Common Name	Scientific Name	Island of Introduction	Remarks
1.	Water hyacinth	Eichhornia crassipes	Many African and Asian Countries	Entry into these countries has resulted in the choking of lakes and waterways.
2.	Giant African snail	Achatina fulica	Reunion (By the 1950's it had gained entry either accidentally or through deliberate introduction by man into a number of islands in the Pacific and Indian Oceans)	Introduced in 1803 by the then Governor, so that his lady friend who had acquired a taste for snail soup while on a visit to Madagascar could continue to enjoy this delicacy. It soon multiplied to uncontrollable numbers becoming a serious pest of crops on the island.
3.	Predatory snail	Euglandina rosea	Hawali	Introduced as a biological control agent in 1955, it failed to control the giant African snail. Its rapid establishment and spread, however brought about the extinction of half the 44 species of the Hawalian Achatinella snails.
			Moorea (French Polynesia)	Caused the exinction of 7 species of endemic snails belonging to the genus Partula, when introduced as a bio control agent against the giant African snail. This led the IUCN to pass a resolution at the 17th session of its General Assembly in Costa Rica in 1988, recommending that carnivorous snails should not be introduced into areas with an endemic snail fauna.
4.	Mouse	Mus sp.	Mana island (New Zealand)	Accidentally introduced to these islands. Today they have a population of about 15 million. Feeding voraciously on insects, birds and lizards, they may be driving more than a few species to extinction.
5.	Rat	Rattus sp.	Lord Howe Island	Accidentally introduced, following a ship wreck in 1988. they not only damage the local palm trees which are the only export crop of the island, but also prey on the rare Lord Howe wood hen.
6.	Barn Owl	Tyto alba	Lord Howe Island	Introduced to control rats in 1930. Today, instead

				of preying on rats they feed on the tastier native birds thus becoming a problem themselves.
7.	Indian mynah	Acridotheres tristis	Hawali	Intentionally Introduced, they have now become obnoxious pests.
8.	Goat	Capra sp.	St. Helena	Introduced In 1513. Only 31 species of endemic plants were found on this island when the first systematic botanical survey was conducted between 1805 and 1810. Of these, 11 species have definitely been driven to extinction by goats. It is estimated that the island should have had over 100 endemic plant species before the introduction of goats when systematic surveys had yet to be undertaken.
			Socotra	Overgrazing by goats has been implicated as the major cause for the extinction of a number of species of endemic plants. Before the introduction of goats the island has 93 endemic species of plants many of which are now extinct.
9.	Rabbit	Oryctolagus cuniculus	Australia	Twelve pairs were deliberately introduced in 1859 onto a ranch in Victoria. They multiplied and spread so rapidly that by 1900 they could be seen almost every where in Australia. Their activity denuded large areas of grass and soil was loosened so that quantities of it could be swept away by erosion. The destruction of vegetation by these introduced rabbits it is felt, could have had deleterious consequences for the survival of at least some species of native birds.
10.	Cattle	Bos sp.	Australia	Five cows and two bulls were the only cattle that the first English settlers took to Australia. In the course of two centuries, the 7 cattle multiplied to 30 million. Beetles belonging to the subfamily Scarabaeinae are the main disposal agents of cattle dung. The native Australian herbivores produced less dung, of a drier consistency than the large, moist droppings of cattle. The native dung beetles were not adapted to cope with this kind of dung, which consequently accumulated, smothering and putting out of use about 6 million acres of pasture land each year. Finally, suitable adapted African beetles had to be imported to Australia, from Africa, to eliminate the vast quantities of dung and save the pasture lands (Which they did).
11.	Cat	Felis sp.	Great Britain	It is estimated that Britain's 5 million house cats take an annual toll of 70 million birds and animals. Small mammals including wood mice, field voles, and common shrews along with an occasional rabbit, weasel or pipistrelle bat accounted for 64% of their diet. Studies indicate that 30 to 50% of all sparrow deaths in Britain

				were caused by domestic cats.
12.	Man	Homo sapiens	Rodriguez	Completely forested in 1691 when the islands was first colonized by man. Today the forests have been replaced by cultivated crops, rough pasture, introduced weeds and eroded hills. Most endemic species have been wiped out and no natural ecosystems have survived – the result of thoughtless human action.
			Marquesas	Almost entirely forested once. Today, men along with their goats, cattle, horses and donkeys have denuded large tracts of land. Cultivation, grazing and the introduction of numerous alien weeds have disrupted the flora of the lower slopes.

Source: Anon; 1989; Barrett, 1989; Chester and Lawton, 1989; Fosberg, 1970; Lee, 1979; Renvoize, 1979; Simon, 1976, as quoted in Mohanraj et al 1999.

Proportion of introduced plant species relative to native and total flora in Andaman and Nicobar Islands

Period	**No. of introduced species (cumulative total)**	**No. of indigenous species**	**Introduced: indigenous species**	**% introduced species (relative to the total flora)**
Till 1866	76	1081	1 : 10	6.57
Till 1890	155	1081	1 : 7	12.54
Till 1985	382	1081	1 : 3	26.11
Till 1997	566	1225	1 : 2	31.60

Source : Prain, 1890; Vasudeva Rao, 1986; Lakshminarasimhan and Rao, 1996; Sreekumar, 1997, as quoted in Mohanraj et al 1999.

Rates of introduction of non-indigenous plant species to Andaman And Nicobar islands

Period	**Number of years**	**Number of introduced species**	**Rate of introduction (per annum)**
Up to 1866	11	7676	6.91
1866-1890	24	79	3.29
1890-1985	95	227	2.39
1985-1997	112	184	1.64
Total	**242**	**566**	**2.34**

Source : Prain, 1890; Vasudeva Rao, 1986; Sreekumar, 1997, as quoted in Mohanraj et al 1999.

Species Introduced deliberately to the Andaman and Nicobar Islands

Common Name	Scientific Name	Year/Period of Introduction	Remarks
VIRUS	Baculovirus oryctes	1989	Introduced by the Central Agricultural Research Institute, Port Blair for the biological control of the rhinoceros beetle. Reported to have significantly lowered beetle populations in the islands of release.
PLANTS Cocao; Coffee, Manila hemp; Maize; Rice; Sugar Cane; Turmeric; Numerous shade, ornamental and fruit trees; various vegetables and garden plants.		At various times commencing from 1789	Some were introduced during the period of the first settlement (1789-96); the rest were brought to these islands since 1858, the time of the second settlement.
Coconut	Cocos nucifera	Late 1700's	Though it is native to the Nicobars it did not occur in the Andamans till it was introduced by the British.
Teak	Tectona grandis	1884	Monocultures raised by the British may still be seen in various places; Planting has been discontinued.
Rubber	Hevea brasiliensis		Stands of Rubber trees may be seen in pockets in some islands.
Red Oil Palm	Elaeis guineensis	1975	From 1975 to 1986, 1593 ha. were planted with red oil palm in Little Andaman. Further planting was stopped in January 1986 for environmental reasons under instructions from the Government of India.
SNAILS Giant African snail	Achatina fulica	1942-45	Reportedly introduced by the Japanese into South Andaman as a protein supplement. Has today spread to all the major islands. Continues to be a garden pest. All attempts at its control have so far failed.
	Euglandina rosea	1964	A predatory snail imported from Hawaii and introduced into South Andaman for the biocontrol of the giant African snail. It failed to do so. Now poses a serious threat to the endemic snails of these islands.
	Gonaxis quadrilateralis	1964	A second predatory snail mported from Hawaii and introduced into

Common Name	Scientific Name	Year/Period of Introduction	Remarks
			South Andaman to control A. fulica. It too failed to achieve control.
INSECTS Lac insect	Laccifer lacca	1964-65	Introduced by the Agriculture Department but not taken up by the local farmers as a cottage industry.
Honey bee	Apis cerana indica	1964, 1976 and 1985-86	This was introduced as the indigenous rock bee (Apis dorsata) is difficult to hive. Except for a few colonies at the Lt. Governor's house the others deserted due to heavy infestation by the wax mouth (Galleria sp.) and severe predation by the wasp, Vespa sp.
Pollinating weevi1	Elaeidobius kamerunicus	1986	Brought from Kerala and released in the Red oil Palm plantation in Little Andaman; it considerably reduced bunch failure with a consequent increase in yield.
Silkworm moth	Bombyx mori	1987	Introduced for promotion as a cottage industry. Yet to catch on among the local farmers.
FRESHWATER FISHES		Not known	Complete absence of native fresh water fishes. All have been introduced by man.
Carps	Labeo rohita; Catla catla; Cirrhinus mrigala; Rasbara daniconius; Puntius sophore		
Mullets	Channa punctatus: C. orientalis; C. gachua; C. Stewartii		
Cat fish	Heteropneustes fossilis		
Anabas	Anabas testudineus		
Tilapia	Oreochromis mossambica		
Freshwater eel	Anguilla bicolor		
BIRDS Common Crow	Corvus splendens	Between 1862 & 1864	Introduced to the Andaman islands by Col. R.C. Tytler for 'sanitary purposes', but failed to survive in the islands.
Common mynah	Acridotheres tristis	Around 1867	Introduced to Ross Island. Has spread to South Andaman. Could competitively displace native

Common Name	Scientific Name	Year/Period of Introduction	Remarks
			species.
Pea fowl	Pavo cristatus	1868	Introduced to Ross Island. Wiped out during the period of Japanese occupation. Re-introduced by the Indian Administration.
House sparrow	Passer domesticus	1882 & 1895	Introduced twice to Ross Island. Now seen in plenty in South Andaman. Could competitively displace native species.
Grey partridge	Francolinus pondicerianus	1890	Now established around Port Blair.
Spotbill duck	Anas poecilorhyncha	1960	Escaped during a storm, after being kept captive in a specially built iron-mesh enclosure on Ross Island. Current status not known.
Common quail	Coturnix coturnix	1961	Brought from Madras and released in Ross Island. Current status unknown.
Jungle bush-quail	Perdicula asiatica	1961	-do-
Painted bush quail	Perdicula erythrorhyncha	1961	-do-
Comb duck	Sarkidiornis melanotos	1961	Birds obtained from Calcutta released on a lake in Neil Island. Present status not known.
Openbill stork	Anastomus oscitans	1964	Introduced from Calcutta to South Andaman for the control of snails on the recommendation of the Lt. Governor of Himachal Pradesh. Failed to establish on the islands.
Domestic fowl	Gallus sp.	Not known	More and more of them are being introduced to meet the demands of an expanding poultry industry.
Domestic duck	Anas sp.	Not known	Not as common as the domestic fowl.
Barn owl	Tyto alba	1991	Six pairs were brought to Port Blair from Tamil Nadu for release in the oil palm plantation at Hut Bay, Little Andaman to control rats. As a result of protests from environmentalists these owls were not sent to Little Andaman but were sent back to Tamil Nadu within a week.
MAMMALS Domestic dog	Canis sp.	1850s	Introduced by the British. The tribals use them regularly for hunting. Their population is on the increase.

Common Name	Scientific Name	Year/Period of Introduction	Remarks
Domestic cat	Felis sp.	1850s	Brought as a pet and possibly to control rats and mice. A serious threat to native species of birds and small animals.
Spotted deer (Chital)	Axis axis	1920	A pest of cultivated crops and forest plants. Has spread extensively in the Andaman islands. Its meat is shunned by the tribals.
Barking deer	Muntiacus muntjak	Around 1915	Locally common in Middle Andaman.
Sambar	Cervus unicolor	About 1915	Status not known.
Hog deer	Axis porcinus	1905-1930	Rare
Domestic goat	Capra sp.	1891	Herds of goats may be seen on all the major islands. A population of about 200 goats was taken from Port Blair and released on Barren island. Today feral goats roam the island.
Domestic cattle	Bos sp.	Not known	Present on all the major islands. Large predators being absent, they are let free to graze in forests. Frequently let loose on Rutland island when not yielding milk. Feral herd at Trinkat, being the descendants of a few let loose in 1888 when the settlement at Nankauri was abandoned.
Leopard	Panthera pardus	1952	Two females released in Middle Andaman to keep the spotted deer in check. Not seen after release.
Elephant	Elephas maximus	Before 1960	About 50 were let loose when a private timber company folded up in the 1960s. Now feral in Interview Island and North Andaman. Occasionally destroys crops.
Rabbit	Oryctolagus sp.	Not known	Kept as pets and for meat.
Horse	Equus sp.	Not known	Introduced by the British. No horses remain on the islands.

Source : Abdulali 1964; Gee 1969; Kloss, 1903; Rao, 1987; Temple, 1909; Thangam, 1966; Tikader, 1984; Tikader and Das, 1985; Whitaker, 1985, as quoted in Mohanraj et al 1999.

Intentional Vs. Unintentional introductions up to 1890 in Andaman and Nicobar islands.

Number of species

	Introduction	**Up to 1866**	**1866-1890 Up to 1890 (Total)**
Intentional (I) (Naturalised)	15	23	38
Unintentional (U)	61	56	117
I/U Ratio	1:4.1	1:2.4	1:3.1

Source : Prain, 1890; Vasudeva Rao, 1986; Sreekumar, 1997, as quoted in Mohanraj et al 1999.

IX GENERAL THREATS

Inappropriate Tourism

The ability of the fragile ecosystem of these islands to withstand the impact of tourism is limited. Apart from disturbance to the forests, there is also disturbance to the marine and coastal ecosystem, especially to the coral reefs. This can be seen in the Wandoor National Park where the coral reefs, in the two islands open to tourists (Jolly Buoy and Redskin), have almost totally been destroyed. There is also the problem of water availability, disposal of garbage, generation of electricity and the construction of other infrastructure. Also, as most of the food and other goods sold in the Islands are imported form the mainland and the government pays a hefty subsidy for their transportation to the Islands, it is unlikely that the expenditure by the tourists for goods and services in the islands, would result in any net benefit to the economy. In fact, tourists coming by ship are often a net drain on the economy, as the government subsidy on each passenger ticket is also very high.

The Islands offer a great potential for high value, low volume, specialised eco-tourism that can be done with minimal infrastructure and follows the principles of dispersion and flexibility. Special-interest tourists, wanting to view the unique and rich biodiversity of the Islands, can be accommodated in wilderness areas in small clusters of tents with low concentrations in any one place. The location of these tents can be shifted every two or three years to ensure that no one site is inordinately impacted. Besides, there can be some ship-based tourism where specialised tourists are taken around in a ship that anchors at spots of tourist interest and allows day trips in small numbers. In fact, there are already foreign yachts coming and anchoring in the islands, but very little benefit flows from them to the local economy .

Diversion of Land and Felling Of Trees

From time to time the Ministry of Environment and Forests (MoEF) has been granting permission under the Forest Conservation Act for the diversion of forestland for non-forest uses. Naturally grown trees are also being cut for various purposes including for the development of tourist and defence infrastructure. However, there appears to be no land use plan for the Islands and clearances seem to be given on a case by case basis

without determining the optimality of the land use and the future options that such a clearance could compromise.

The defence forces have recently constituted a combined command of the Navy, Air force and Army, in the Islands. However, there appears to be no clear understanding of how much land they would require and how many trees need to be cut in the process. There have been requests from them for allowing the felling of over a thousand trees for clearing approaches to runways and for other such requirements. However, no one was able give a consolidated picture of the requirements. Though efforts were made on both the visits to talk to the armed forces representatives on this matter, they were not available.

Distribution of Timber and Non-Timber Forest Produce

Apart from commercial timber, the forests of these Islands are also providing timber and NTFP for use by the local people. There is also "royalty free" distribution of timber.

In addition, government departments like PWD (for construction and repairs of roads) and the defence forces also directly access fuel wood. This not only leads to unregulated extraction but, in some cases, as along the Andaman Trunk Road, is leading to perceptible forest destruction.

Use of NTFPs in A & N Islands

Year	Bamboo (Nos.)	Cane (Rmt)	Thatch (Nos).	Posts (Nos)	Ballies (Nos.)	Fuel wood (Cbm)
1996-97	12,82,601	7,84,182	79,57,285	56,800	2,37,748	40.789
1997-98	13,61,577	6,17,132	42,55,613	53,656	2,03,108	30.443
1998-99	12,00,275	58,64,10	43,49,423	9,906	2,11,244	30.671
1999-2000	12,43,139	38,22,54	47,91,656	13,980	2,02,857	25.692
2000-2001	16,81,982	64,35,68	59,72,341	19,445	2,70,628	32.816

Source: FSI 2000

STRATEGY FOR SUSTAINABLE DEVELOPMENT

X CONSTRAINTS AND OPPORTUNITIES

Given the biological and cultural values of the Islands, as described above, it is imperative that development strategies for the Islands are in harmony with the imperatives for environmental and cultural conservation. The major constraints can be summarised as follows.

Given the climate and topography of the Islands, it is imperative that land based activities, especially those that involve the clearing of forests, should be minimised. Most of the area of the Islands is undulating and, given the high rainfall and the shallow soils, clearing the forest cover almost immediately results in soil erosion not only making the land barren but also adversely affecting the beaches, coasts and coral reefs. Studies have shown that the conversion of forest land to other types of uses significantly aggravates soil erosion (see table below).

Table 10.1: Rate of soil erosion in tropical ecosystems under different land use systems

Land Use System	Rate of erosion (t/ha/year)	
	Minimum	*Maximum*
Multistorey tree gardens	0.01	0.14
Natural rain forests	0.03	6.16
Shifting cultivation fallow period	0.05	7.40
Forest plantation undisturbed	0.02	6.20
Tree crops with over crop or mulch	0.10	5.60
Shifting cultivation, cropping period	0.40	70.05
Taungya cultivated period	0.63	17.37
Tree crops, clean weeded	1.20	182.90
Forest plantations, litter removed or burned	5.92	104.80

Source: Wiersum (1986).

The destruction of forests also significantly affects the hydrological cycle and the availability of water in the soils and in aquifers.

Most of the flat lands in the Islands have already been converted to agricultural lands and the few that are left harbour the last remaining stands of the Giant Evergreen Forests. These must, therefore, be conserved at all costs.

Development activities must also safeguard the biodiversity of the Islands. This is a particularly challenging task because, as the islands are very small in area, impacts of pollution or disturbance in one part of an Island is likely to affect the whole Island. Besides, from species diversity point of view, the three large islands of the Andaman

group, namely the South, Middle, and North Andamans, are the ones with the greatest amount of diversity. However, these are also the islands with the major human population and infrastructure and industrial development.

To add to this, any activities on land also affect the coastal and marine biodiversity, especially the mangroves and the corals, of which the islands have exceptional diversity. The inherent fragility of rain forest ecosystems and our fundamental ignorance about their ecological processes makes their protection a harrowing task.

Being an Island ecosystem, endemism is high but, even in the best of situations, populations of many of the endemic species is small. Therefore, there is a constant danger that even a seemingly innocuous activity could set off a chain reaction that could wipe out the small population of one or more endemic species.

However, the Andaman and Nicobar islands are also a land of unique conservation opportunities. For one despite the rapid increase in human population over the last two decades, the population density and numbers is relatively small, compared to the rest of India. Though even this small number, if allowed to exploit the natural resources in an unregulated manner, could quickly destroy the ecosystem, in terms of developing alternate, environmentally sustainable, livelihood options there are many possibilities which involve investments that are small in comparison to the value of what would get conserved.

The islands are also relatively remote, over a thousand kilometres from the mainland, and are spread over a large area, making it difficult for people to access most of the islands. Being of strategic importance, both from the point of view of security and of economic resources, there is a strong presence of civil and military forces that can, given proper direction, prove an effective deterrence to poachers and illegal immigrants. There is a relatively integrated system of governance with the Administrator (Lt. Governor) located in the islands and with sufficient resources and authority to meet all challenges.

Therefore, it would not be incorrect to say that these islands, of all the parts of India, offer perhaps the best chance of developing and implementing a strategy of development that is both environmentally sustainable and economically and socially just.

Livelihood Concerns

Not surprisingly, the single largest source of employment in the islands is forest based activities, including forest based industry, both large and small, the forest department and the forest corporation. Detailed figures are given below.

Details of the employment generated in A&N through Forestry and allied activities like sawmills, furniture making, wood based industry etc.

	Direct Employment**	**Indirect Employment***
Forest Department	7000 persons	
ANIFPDC	2650 persons	
Medium Scale Industry (Plywood Industry)	1994 persons***	500 persons
Furniture making	831 persons	450 persons
Wood based Industries	594 persons	200 persons
Total	13069 persons	1150 persons

Source: Singh 2002

The next major employer is the fisheries sector, with employment being generated in various activities related to fisheries. Details are given below.

Licensed fisherman as on date	2524 Nos.
Traders	50 Nos.
Processing	78 Nos.
Fish Sellers	300 Nos.
Departmental Staff	265 Nos.
Total	3217 Nos.

Note: All the Mechanized and non mechanized Fishing crafts are made up of wood, thereby material required for the construction of these crafts depends on Forests.
Source: Singh 2002

Agricultural and horticultural activities, mining and quarrying, transportation and construction activities also provide a significant proportion of employment (see tables below).

Agriculture

1.	Raising of Live Stock	165
2.	Agricultural services & Hunting	808
	Total	973

Note: The above information is based on Economic Census Result 1998
Source: Singh 2002

Mining & Quarrying

1.	Mining & Quarrying	362 persons
	Total	362 persons

Source: Singh 2002

Building and Construction

1.	Construction	980 persons
	Total	980 persons

Source: Singh 2002

Categorywise Breakup of Employment

S.No	Major activity Group	Persons Employed
1.	Manufacturing	17481
2.	Electricity, Gas & Water	1004
3.	Wholesale Trade	277
4.	Retail Trade	9089
5.	Restaurant & Hotels	2359
6.	Transport	3708
7.	Storage & warehousing	614
8.	Communications	478
9.	Financial, instance, real estate & Business services	834
10.	Community, Social & Personal Services	24784
11.	Other (unspecified) activities	0
	Total	60628

Source: Singh 2002

Employment by sector in the Andaman and Nicobar Islands

Sector	Employment	Source data comment
Agriculture	19,514	Census of population 1991
Forestry	N/A	Statistical Bureau 1993/4
Fishing	3,650	Statistical Bureau 1993/4
Government employees (1994)	33,606	Statistical Bureau 1993/4
Registered factories	5,116	Census of population 1991
Household industry	4,976	Statistical Bureau 1993/4
Shops and commercial Establishment	3,040	Statistical Bureau 1993/4
Restaurants and Theatres	550	Economic Census 1990
Hotels and restaurants	1,615	Census of Population
Total employment	**90,800[(i)]**	

Note: (i) This is a census figure not the sum of those above.
Source: Andaman and Nicobar Administration Statistical Bureau 1994; Basic Statistics and Third Economic Census, 1990, as quoted in UNDP 1997

Territory Net Domestic Products 1992-93

Sector	Territory net domestic product (I)	
	R 000s	%
Agriculture	732,100	35
Forestry & logging	309,214	15
Fishing	258,358	12
Mining and quarrying	14,490	1
Primary subtotal	1,134,162	62
Manufacturing (registered)	25,160	1
Manufacturing (unregistered)	95,328	5
Construction	171,886	8
Electricity, gas & water	-97,807	-5
Secondary subtotal	94,570	9

Sector	Territory net domestic product (I)	
	R 000s	%
Transport and storage	-203, 753	10
Communications	21,538	1
Trade, hotel and restaurants	201,370	10
Community & personal services	550,701	26
Services subtotal	569,856	27
Total all sectors	2,078,588	100

Note:

(i) Net Domestic Product is grass domestic product less capital consumption; grass domestic product estimates fro the territory is not available.

(ii) Negative figures reflect low revenues and high depreciation; in the case of transport, ship passenger services are subsidized and the Administration has made large investment in new ships, which accounts for the negative figures.

Sources: Basic Statistic 1994 Andaman and Nicobar Administration, as quoted in UNDP 1997.

Development Concerns

Most remote regions in India, as elsewhere, have got less than their fair share of development inputs and resources. In fact, in India if a map of forest cover is superimposed on a map of well-developed regions, there is almost an inverse relationship with most well forested areas being under developed and vice versa. However, in some senses, the Andaman and Nicobar Islands are an exception. Though extensively forested, they appear to not have done badly in most development indicators. They have an extensive education system, health services, government infrastructure and even a good communication and transport network, given the number of Islands and their distance from the mainland.

There are 16 flights a week to Port Blair, the head quarters of the Islands, from Kolkatta (Calcutta) and Chennai (Madras) in the mainland. In addition there is a regular ship service from both these cities. There are inter island ferries and, for a while, there was even a helicopter service between some of the islands. There is some disruption of the air services during the peak monsoon period, however, the runway at Port Blair is being expanded and modernised and soon this might also be something of the past.

Passenger fares and freight, by ship, are highly subsidised by the government. Subsidised passenger fares have for long been seen as a major factor encouraging mass immigration from the mainland.

One major sign of underdevelopment appears to be the almost total absence of industry, except for forest based industry. This is especially significant because of the

almost total dependence for daily consumer goods from the mainland. Initially, the small population of the Islands might have discouraged the development of the manufacturing sector but, more recently, the high subsidies available for transporting goods from the mainland have contributed to this continued dependence. There is also a lack of professional training and education facilities, especially in medicine, engineering and such like. Again, because of the small population of the Islands it might not be feasible to set up medical and engineering colleges here and the government has been providing assistance of various types to students who would like to pursue higher studies in the mainland.

Potential for Economic Development

The Islands have three major areas that offer potential for economic development:

- Forests
- Fisheries
- Tourism

In addition, there is a potential for the islands to become far more self-sufficient in the manufacture of consumption goods. There is also a potential for developing the handicrafts sector, mainly for sale to tourists, and for the cultivation of medicinal plants, spices, and other high value products, as will be discussed later.

Unlike most other parts of the country, there is very little potential for agricultural development in these islands. This is primarily because of the poor soils, associated with tropical rain forests, the paucity of flat land and the disastrous ecological consequences of clearing forests for agriculture.

There is also little potential for developing large industry, especially because of the lack of raw materials (except for wood), small local markets, lack of fuel sources for generating thermal energy, poor potential of hydro-power, shortage of water especially during the dry months and, most important, the prohibitive cost of transporting finished products to the markets in the mainland or in neighbouring countries. However, in the long run non-polluting, low energy intensive, high value manufacturing sectors could be developed.

Protecting Forests and Biodiversity

As has been described earlier in detail, the forests of these Islands have already been heavily exploited and, in many cases, over exploited, without significant contributions to the economy of the islands. The wood based industries located on the islands were manufacturing goods for export to the mainland. They were owned by mainlanders and multi-nationals and directly employed less than 2000 people, many of whom had also been brought in from the mainland. Though there was significant ancillary employment by the forest department, the forest corporation and, for a while, by the industries themselves for logging and transportation of wood and wood products, this was mostly at the lower end of the wage spectrum with the labour getting little more than the minimum wages. Due to the inherent shortage of labour in the islands, a lot of the labour was again transported from the mainland and most of them have opted to stay on in the islands, often encroaching on forest land and otherwise taxing the carrying capacity of the ecosystem.

In any case, because of ecological concerns, including the imperative to conserve the unique biodiversity of the Islands, it is no longer advisable to promote forest based industries for export out of the islands. In fact, what is required is the closing down of even the existing forest based industries and the use of forests only to meet the needs of the local people. Besides, given the high level of transport subsidies being given to the forest-based industries in the islands, they were actually a net loss to the economy and it is unlikely that they would prove profitable, even financially, once the subsidies were removed. To this end, the strategy that needs to be followed in the A&N Islands, with regards to forests, is outlined below.

Meeting Local Demand

1) Felling of trees and collection of non-timber forest produce (NTFP) should be banned from the forests of Little Andaman Island and all tribal reserves except for i) collection of NTFP from already worked forests of Little Andaman and from forest areas designated for the purpose in the Nicobar group of Islands, for meeting the legitimate consumption of local inhabitants; and ii) collection of timber and other forest produce by tribals living within tribal reserves for meeting their bonafide needs.

2) Harvesting of all forest produce including timber and NTFP should be completely prohibited from National Parks and Sanctuaries.
3) In addition to areas covered under 1 & 2 above, no felling of trees should be allowed in any unworked forest area, i.e., area where felling of trees as per working plans, working schemes, felling schemes or approved working plans, has not taken place earlier. There should also be no diversion of forestland from any such unworked area or from areas covered under 1 and 2 above.
4) No felling of trees for whatsoever reasons or justification should be carried out to supply to, or to meet the raw material requirement of, plywood, veneer, blockboard, match stick or any other such wood based units except to local small-scale units (including saw mills) solely for meeting the local requirement for sawn timber and other wood based products.
5) For meeting the timber and other forest produce requirements of inhabitants of the A&N Islands, felling of trees from forest areas not covered under 1, 2 & 3 above, i.e., forest area worked earlier in accordance with working plans, working schemes, felling schemes or approved working plan and excluding areas falling within national parks, sanctuaries, tribal reserves, or Little Andaman, may be allowed. Such felling may be undertaken as per prescriptions of the approved working plans. These plans should also contain action plans for removing, in a phased manner, trees of commercial species that are in number or concentration in excess of what is found in a natural forest of the same type and similar location. Concurrently, efforts should be made to bring back the forest to its natural profile by encouraging /reintroducing those species of fauna and flora that naturally occurred in these forests prior to their being “converted”. The working plan should also contain sufficient provisions for regeneration of felled areas.
6) In the meanwhile, the local requirement of timber and other forest produce may be met by utilising the already felled trees and sawn timber lying with the forest department and the ANIFPDC.
7) Once the stock of already felled trees and sawn timber is depleted, the local requirement of timber should be met, as far as possible, by harvesting the mono culture and mixed plantations of padauk, gurjan, teak and other species. The felling of

trees from already worked natural forest, as specified in 5 above, should be undertaken only to meet the balance requirement.

8) There should be no expansion of monoculture or commercial plantations on forestland. The existing plantations of oil palm, rubber and teak are reportedly no longer viable and should be phased out. The land so released should, in so far as it is forestland, be regenerated as specified earlier. Consequently, the Andaman and Nicobar Islands Forest Plantation and Development Corporation Ltd. (ANIFPDC) should be wound up as it was primarily set up to promote commercial forestry and plantations, especially in Little Andaman.

> "Efforts should be made to find alternative constructional material to the 6" x ½" planks for walling purposes. I have seen in Assam that wallings are made of wooden frame- work and bamboo reinforced concrete. I think similar things may perhaps be tried in these islands but till then we would have to consider substantial increase in the price of the 6" x ½" planks or such other sizes suitably so that the Forest Department does not suffer any loss on account of its production"…….
>
> Shri R.C. Soni., I.F.S., Inspector General of Forests, Govt. of India – 1970, as quoted in A&N 1983

9) At the same time, efforts should be made to reduce the level of demand for timber and for firewood. For the purpose, the A&N Administration should investigate and implement methods of achieving this, including the conversion to the wood and bamboo based "Assam type" construction, which is both less timber intensive, and safer in earthquakes, than the present all-timber or RCC buildings.

10) The practice of distributing timber and NTFP free to settlers should be discontinued. Instead, rural populations should be formed into village forest protection committees and, as per the joint forest protection norms prevalent in other parts of the country, the amount of timber and NTFP required by village communities should be given to them on the basis of a memorandum of understanding, in return for their role in protecting the forests adjacent to their settlements and in detecting and preventing encroachments.

11) Government departments, including defence and PWD, should be supplied fuel wood and other required forest produce by the forest department and should not be permitted to directly collect these from the forests.

12) Concurrent efforts should be made to minimise demand for forest-based resources. The Administration should encourage the use of sawdust as fuel, as is the practice in many other parts of the country. They should also investigate the possibility of replacing firewood as a domestic fuel by gas and consider giving a one-time subsidy for the purchase of gas stoves and cylinders to the poor rural population. Adequate supply of LPG to the Islands should be ensured on a priority basis.

The estimated quantity of fuelwood consumed in A&N Islands (Sale) in Cum.

Area	96-97	97-98	98-99	99-2000	2000-01
South Andaman	4536	2590	1741	1201	1618
Baratang	3075	2513	3072	3546	2828
Middle Andaman	11091	4828	5240	5902	4314
Mayabunder	2562	2397	7291	1980	1700
Digllipur	13555	10437	10094	9769	19153
Nicobar (Div)	3486	4086	1229	266	695
Little Andaman	4688	3659	2004	3028	2508
Total	42749	30508	30671	25692	32816

The species that are preferred for fuel wood in A&N Islands

Sl.No.	Local Name	Botanical Name	Category
1.	Gurjan	Dipterocarpus Species	Hardwood
2.	Badam	Terminalia procera	Hardwood
3.	Mohwa	Madhuca butyracea	Hardwood
4.	Thingham	Hopea odorata	Hardwood
5.	Red Bombay	Planchonia andamanica	Hardwood
6.	Yeugicv	Adenanthera pavonina	Hardwood
7.	Thikala	Nauclea gageana	Hardwood
8.	Pyma	Lagerstroemia hypoleuca	Hardwood
9.	Poon	Calophyllum inophyllum	Hardwood
10.	Jungli Am	Mangifera andamanica	Hardwood
11.	Sea mohwa	Manilkara littoralis	Hardwood
12.	Jaiphal	Myristica species	Hardwood (N/C)
13.	Thitkandu	Pometia pinnata	Hardwood (N/C)
14.	Kattaphal	Baccaria sapida	Hardwood (N/C)
15.	Ambra	Spondias mangifera	Hardwood (N/C)

Wood Based Industry

13) There should be a complete ban on the establishment of any new wood based unit for the next 10 years.

14) All existing small-scale wood based units (saw mills) should be relocated within industrial estates or, where industrial estates are not feasible, in locations contiguous to forest offices or otherwise convenient for the forest department to monitor. This relocation should be completed within one year, after which the non-complying saw mills should be closed down. These saw mills should also be required to obtain a licence from the A&N Islands Forest Department within three months and to maintain such records as may be prescribed by the forest department. Their licence may be renewed every year at the discretion of the A&N Islands Forest Department, after the department has satisfied itself that a) the unit was not involved in the use of any illegal timber; b) the prescribed records were properly maintained; c) all provision of the act, rules and the terms and conditions stipulated by the forest department from time to time have been complied with. Necessary rules, guidelines etc., for the purpose, should be prescribed by the forest department within three months.

15) No subsidy of any type, including transport subsidy, should be given to any wood based unit.

16) Existing medium and large scale wood based industries (including plywood, veneer, and match industries) can be allowed to function provided they import their entire requirement of wood and other forest based raw materials from the mainland or from abroad. No subsidies should be allowed to them.

17) No timber, either as logs or as sawn timber or plywood/veneer, or in any other form, should be transported out of the Islands through any means whatsoever. This should not, however, inhibit the transportation, as personal baggage, of a reasonable quantity of wooden handicrafts by tourists or of personal articles by those permanently leaving the islands. Also, where a wood based industry, as specified in 16 above, imports its entire wood and forest based raw material requirement, then it should be permitted to export its finished product.

18) Another factor contributing to an increasing demand of timber is the fact that most of the timber used in the Islands is not treated prior to being used for construction

purposes. This results in its having a very short life, requiring replacement every three or four years. Despite the fact that the then Inspector General of Forests, Government of India, had recommended way back in 1989 that: "No timber should be used without proper preservative and seasoning treatment to prolong the life of timber" (Oka 1989), the current installed capacity for treating timber is only 1,900 cum per annum, which is far below the local requirement of treated timber, estimated to be around 5 to 10 thousand cum per annum. Treated timber has a life that is reportedly ten times greater than that of untreated timber. Therefore, by treating all timber, the demand should come down ten fold.

All timber, bamboo and cane used for construction and requiring treatment in order to extend its durability and life, should be so treated. Currently, there is reportedly capacity to pressure treat only 900 cum per annum and to season another 1000 cum per annum (Singh 2002). The administration should ensure that requisite capacity to treat all such timber is in position within a period of six months. After the expiry of this period, no timber, bamboo or cane of the type requiring treatment should be sold for use in building and construction activities, or used for such purpose, unless it has been appropriately treated.

Encroachments

19) Any further regularisation of encroachments on forestland in any from, including allotment/use of forestland for agricultural or horticultural purposes, should be strictly prohibited.

20) All those families who have been identified as having encroached on forest land prior to 1978 and have not yet shifted to their allotted rehabilitation sites, should be given three months notice to vacate their encroachments and shift to the allotted land. Failing this, their allotment should be cancelled and they should be forcibly evicted within three months of the deadline being over, without any further claim to land or any other form of rehabilitation.

21) Similarly, those among the pre-1978 families that have shifted to their allotted sites but have occupied more land than they were entitled to, should also be given three months notice to vacate the extra land occupied by them. On the expiry of this notice period, the allotments of those who have not complied with this notice should be

cancelled and they should be forcibly evicted within three months, without any further claim to compensation or land.

22) All post 1978 forest encroachments should be completely removed forthwith and, in any case, within six months. Post 1978 encroachers (except for foreign nationals) should be allotted homesteads in revenue land and training and opportunity for self-employment or for other types of livelihood activities provided.

23) The forest officials in the A&N Islands should be given requisite powers to do this, including:

- Power of summary eviction of encroachments.
- Magisterial powers to assistant conservators of forests: The Assistant Conservators of Forests should be appointed as executive magistrates/special executive magistrates in order to oversee the evictions carried out by the Range Officers on receipt of orders of eviction from the estate officers.

24) For the purpose, an effective action plan should be prepared and implemented under direct supervision, monitoring and control of a committee comprising of the Lt. Governor, Chief Secretary, Principal Chief Conservator of Forests of the A&N Islands, and reputed local NGO representatives. The Chief Secretary, the A&N Islands, may be asked to file a monthly progress report in the Supreme Court.

25) In order to prevent any further encroachments and rampant immigration, the Administration should, within three months, regulate the entry of people to the islands by having the Islands declared as an inner line area and by imposing relevant restrictions under section 3 and other provisions of the Environment (Protection) Act of 1986. In accordance with this, non-residents entering the islands should have to invariably register themselves so that those who do not return to the mainland within a reasonable time can be traced and, where they have illegally encroached on land, can be evicted from these encroachments at the earliest. In addition, entry to the more vulnerable and forested areas of the Islands should be restricted.

26) Once this regulation is in position, the administration should in a time bound manner issue identity cards to all the residents so that there is no gap in the period of identification and issuance of ID cards. This would ensure that fresh illegal

encroachers are easily identified. Subsidised travel to the Islands should, once identity cards have been issued, be available only to bonafide residents of the Islands.

27) Divisional Forest Officers and, where relevant, village protection committees, as described later, should be made responsible for prevention, early detection and quick eviction of new forest encroachers.

28) The forest department should be strengthened and appropriate village institutions set up for the purpose, as detailed later.

Biodiversity Conservation

29) The Forest Department should be immediately strengthened in order to be able to effectively prevent poaching.

30) Forest officers should be given adequate powers, under the Indian Forest Act of 1927 (IFA,) as has been done in other states, to meet the threat of poaching. These could include:

- Power of confiscation.
- Increase in the limit fixed for amount of compensation for trees under. The present limit of Rs. 50 should be increased to at least Rs. 10000/-.

31) A co-ordination mechanism should be set up where the forest department, the civil administration, the Coast Guard and the Combined Defence Command in the A&N Islands can take co-ordinated action against poachers, especially against foreign poachers.

32) No exotic species of fauna or flora should be introduced into the islands. Accordingly, a suitable set of guidelines and procedures should be developed for the purpose.

33) A time bound action plan should be drawn up to deal with the exotics already on the island, including weeds, and their removal/eradication should be taken up on a war footing, including the translocation of elephants back to the mainland and the inhibition of breeding, by deer, by darting the alpha males with anti-fertility drugs, as has been successfully tried in other countries.

34) For the conservation and protection of the forests and other ecosystems, an effective action plan should be prepared by the A&N Islands Forest Department, in consultation with local NGOs and experts. This plan should also envisage a suitable

enhancement of the protected area network, especially in the main islands of the Andaman and in the Nicobar Group. All unworked forest areas in Diglipur, Mayabunder, Middle Andamans and Baratang should be made into national parks, leaving a buffer belt between the national park boundary and the edge of revenue settlements, for protection by village protection committees. In addition, there should be a consolidation of the nearly hundred small island parks and sanctuaries and they should be constituted into viable units encompassing the marine areas surrounding them. This plan, after being approved by the MoEF, should be strictly implemented. The necessary funds, vehicles, equipment, human power, police help and legal power required for the effective implementation of this action plan should be made available by the A&N Islands administration.

35) Appropriate regulations under existing Acts like the Environment (Protection) Act of 1986, with similar objectives as The Delhi Preservation of Trees Act, 1994, currently in force in the Union Territory of Delhi, should be set in place in the A&N Islands, within six months, to regulate the felling of trees on non-forest land.

Conservation of Beaches

36) The extraction of sand should be phased out and no further extension should be granted after the current extension is over on 30 September, 2002.

37) As already mentioned earlier, alternate material for construction, including treated bamboo and soft woods, should be encouraged as this is less damaging to the environment and safer in case of an earth quake. Stone dust should be utilised where use of concrete is essential.

Miscellaneous

38) The forest department and the administration of the A&N Islands should make public at the beginning of each year the proposed uses of natural resources, including forests. This detailed information specifying, among other things, uses, locations, quantum, purpose and users, and giving details of the basis on which these decisions have been made, should be published in the local news papers and also made available on a web site to be maintained for the purpose by the administration. At the end of each year, actual use, deviations from the proposals and the reasons thereof, must also be similarly made public.

39) The various forest working plans/protected area management plans should also be made accessible to the public, as soon as they are approved. Copies should be kept at all public libraries and other accessible places in the Islands. In addition, copies should be freely made available to the general public, on demand, after charging actual costs of photocopying.

40) All officers of the administration, including forest officers, should undergo an orientation training of at least five days, every three years, to acquaint themselves with the ecological characteristics of the Islands and the options available for their economic development in an environmentally and socially sustainable manner. Officers being posted from the mainland to these islands should be so oriented within three months of their posting.

41) The Government of India and the A&N Islands Administration should consider setting up an Island Development Institute in the A&N Islands, that can become a centre of research, training and education for managing island and coastal ecosystems in a sustainable manner. This institute could not only cater to national needs but, over time, also become a regional institution. A proposal to the effect already exists and was submitted to the IDA many years back. It can be suitably modified and considered.

42) There are many areas that need to be properly researched and many problems that need innovative solutions. These include:

- A assessment of the ecological differences between worked and un-worked forests.
- Methods of returning the worked and encroached forests to their natural (or near natural) state.
- Methods of working forests in a manner that minimises impact on biodiversity and the environment.
- Methods of conserving soil and water.
- Feasibility of generating energy through non-conventional methods, including wind and tidal energy.
- Methods of treating garbage and other pollutants, thereby protecting the coastal and marine environment from degradation.

- Methods of using alternate building materials that are environmentally friendly and sustainable.

These and other required studies should be commissioned on a priority basis so that their findings can be urgently applied for the betterment of the islands.

Implications of these Recommendations

1. There is likely to be some loss of employment, as detailed below, if these recommendations were followed.
    a. Loss of about 300 jobs if Kitlpy Industries close down as a result of these recommendations.
    b. Loss of about 2000 jobs if the Andaman & Nicobar Islands Forest and Plantation Development Corporation closes down.
    c. Loss of some employment (exact quantum not known) due to the ban on export of timber. However, this is likely to be very small, as very little timber was being sent to the mainland by private sawmills. In 1998-99 it was 923 cum, in 99-2000 it was 570 cum and in 2000-01 it was 614 cum.
    d. Surplus staff in the forest department due to curtailing of forest working and extraction.
    e. Some loss of livelihood due to the banning of extraction of sand.
    f. Some loss of road transport related employment due to the banning of traffic on the Andaman Trunk Road.
    g. Need for additional sources of livelihood for about 2300 post 1978 forest encroachers, once they are removed from the forests.
2. There is also some concern expressed by the A&N Islands forest department that if felling in unworked forests was banned then the worked forests and plantations would not be able to support even the local demands for timber. However, detailed discussions with the department and a scrutiny of documents and data brings out the following facts:
    a. The total area of worked forests in the Andamans, excluding Little Andaman, is approximately 1,00,000 ha.

b. Most of these forests were worked in a manner such that only a proportion of the mature trees of commercial species were extracted and the immature ones left.
c. Therefore, in each hectare of the worked forests there should now be a large number of mature trees that were either left behind as mother trees or that were immature when the logging was done fifty to sixty years ago, but are now mature and ready for harvesting.
d. As the surplus number of commercial trees, in excess of what would have been their numbers in a natural forest, have to be removed in order to allow the forests to return to as close a natural form as possible, the extraction of these mature trees would serve the dual purpose of providing timber for local consumption and returning the forests to a near-natural profile.
e. It has been estimated that at least 10 cum per hectare can be safely and sustainably extracted from these worked forests, though once working plans are made the figure might go up. Therefore, given that the total available worked forest is 1,00,000 ha, the total availability of commercial timber would work out to 10,00,000 cum. This would be enough to meet the local timber demands (calculated at 30,000 cum per year currently, but likely to go down once timber conservation efforts are put in place) for at least 30 years, by which time additional timber would have become mature and harvestable.
f. In addition. There are over 12,500 ha of plantations of hardwoods done in the islands. It is estimated that these plantations, that in any case need to be cleared so that the land can be regenerated, will provide 300 to 500 cum per hectare, depending on the species. This would work out to between 37,50,000 cum to 62,50,000 cum of timber, which would by itself be enough to meet the local hardwood requirements (calculated to be about 25,000 cum per annum) for between 150 and 250 years. Needless to say, both in the plantations and in the worked forest areas, extraction should start first in the earliest plots and proceed to newer ones so that adequate time is given for regeneration.

3. The forest department has also expressed a concern that if no export of timber is allowed to the mainland then this might lead to the artificial manipulation of timber

prices locally and prices would be artificially forced down, as the forest department would have no option but to sell their timber locally or have it perish. However, considering that the forest department saw mills have a combined capacity of 29,000 cum pa they could, if required, process all the timber that is harvested in a year, thereby preventing it from deteriorating. Besides, once the capacity to treat timber has been enhanced, as recommended, there should be no danger of any timber being wasted if the local sawmills do not pick it up. In case timber in any month is not picked up, felling for subsequent months or seasons could be trimmed to take this into consideration.

4. A concern has also been expressed that forests need to be worked in case they are to remain healthy and "over mature" and dead trees need to be removed. There is also the view that once a tree reaches a certain age, it has a "negative increment" and, therefore, must be cut. However, these arguments do not stand up to scientific scrutiny. Forests have existed and continue to exist in areas where they have never been "managed" by human beings. There are many examples of this in the Andaman and Nicobar Islands itself. The concern for negative increment and for "healthy" forests is a concern that might be relevant to commercial plantations but is certainly not tenable where natural forests are concerned. In fact dead trees are as important a part of natural ecosystems, both as habitat to specialised species of fauna and flora and an input into the soil, as are live trees.

New Avenues of Employment and Development

Following from the recommendations, there will also be significant cost saving and additional employment opportunities, as detailed below.

a. Savings on transport subsidies to the forest based industry to the tune of rupees five to six crores per year.
b. Savings from the closing down of two forest depots, one in Chennai and one in Kolkata, reportedly around rupees one crore a year.
c. Additional employment for setting up forest protection forces.
d. Additional employment in regenerating encroached areas and earlier worked forests.

e. Additional employment in the shipping sector due to increased ferry traffic after closing down the Andaman Trunk Road.

Some of the sectors that can be developed to provide additional employment and revenues are described below.

Fisheries

"The ANI with a coastline of nearly 2,000 kms and about 35,000 km^2 of Continental Shelf provides ample opportunity for potential fishing grounds. With the declaration of 200 miles economic zone for our country, the Exclusive Economic Zone (EEZ) of the Islands are about 0.6 million km^2. The estimated fishery potential is 1,60,000 tons of which tuna and tuna-like fishes comprise about 1,00,000 tons" (Census of India, 1991).

A UNDP report (Sirur, 1999) has graphically represented the data given by CARI scientist Soundarajan, which shows that out of a total of 130,000 tonnes of pelagic stock, only 13,200 tonnes are exploited now. The demersal stock is of the order of 225,000 tonnes.

It was estimated in 1986 (Anon 1986) that there were 2,250 full-time professional fisher-folk and 10,000 tribals engaged in part-time fishing. The annual catch was in the order of 6,000 tonnes. The current trends given by the Director of Fisheries (Workshop 2001) indicate an estimated fishery potential of 2,43.5 million tonnes. Current total fish catch per annum is 30,000 tonnes, licensed fishermen number around 2524 and ply 1983 crafts on the seas. The catch is mostly consumed as fresh fish, though a small quantity is dried and exported from the islands. One processing plant and cold storage is available at Port Blair and another one is nearing completion at Campbell Bay.

Fisheries

Andaman and Nicobar Islands are the subaerial expression of the Andaman and Nicobar Ridge separating the Andaman Sea from the Bay of Bengal. These two water bodies are connected to each other through the prepares Channel, the Ten Degree Channel and Great Channel. The area of the Andaman sea is about 7.30 x 105 km^2 and has considerable economic importance. The exploitable living and non-living resources of Andaman Sea are considerable. The near shore area of Andaman Sea have extensive creeks and bays suitable for mariculture. The extensive mangrove farms around these islands provide enough scope for the development of mangrove oriented fishery. Some of the cyclones originate in the Andaman Sea and South-East bay of Bengal and effect the weather over Eastern India causing heavy rainfall.

The Exclusive Economic Zone (EEZ) around Andaman and Nicobar archipelage comprising 30% of the total EEZ of India is a great object in terms of fisheries potential for the country in general, and for the islands in particular. The protected bays, lagoons, inlets and creeks in the archipelagic water which are unique for our subcontinent project add another dimension with great potential for mariculture. The present production of 6,500 tonnes of fish catch about

0.38 per cent of the total marine fish production of the country, from 30 per cent of EEZ areas is next to nothing as compared to the potential which as been estimated for the area based on various parameters. Its denotes just the subsistence level of fishing carried out from a few centers to meet the local needs which are rather small.

Since the potential of Andaman Sea is very rich and vast, mapping of fisheries resources is very essential. There is a scope for deep sea fishing and subsequent processing of the products for making fish meal from the trash fish, fish protein concentrates, processing of prawn and fish, fish liver oil etc. There is a tremendous potential for artificial pearl culture using oysters. There is also scope for cultivation of seaweed for making agar, algenic acid, sodium alginate extensively used in the industries. A Fishery Development Corporation may be set up to exploit and develop various marine resources of the island.

Improvements of Artisanal sectors by providing inputs such as craft building, net making, training programme for fishermen using boats provided with motors should be taken up. Exploitation of tuna and tuna – like fish at Campbel, Bay and Nicobar islands should be undertaken. Fish culture in the near shore and inland water needs to be developed. Brackish water fish and prawn culture should be given highest priority with a view to increase the yield of the fish. S&T inputs for the development of the fisheries in Andaman and Nicobar Islands utilizing cold storage and refrigeration facilities should be under taken. In view of the acute shortage of drinking water, there is a great scope for supply of potable water using desalination process. The may be examined indicating the total package with economics.

The Andaman and Nicobar islands have almost ¼ the of the coastal line of entire India. This constitute a vast fisheries potential. In fact fish from the seas and creeks is a major diet for Andamanese and Nicobarese. At present, around 2,000 fishermen are engaged in fishing. The fishermen operate from 950 country boats, 20 mechanised boats and 101 mechanised country boats. Processing and storage facilities like could storage, ice-plant etc, are available only at Port Blair. At present the total exploitable stock of fishes is around 50,000 tonnes annually in Andaman seas. Being nearer to the equator this region is considered to be the tuna run channel and provide the natural choice for exploitation of tuna, seer, bonite, barracuda, shell fish and other oceanic species. Other rich fishery resources like perches, bream, eels and sharks are also found. (CSIR 87)

The Details of existing potential in each of the categories is as under.

Existing and Potential Harvesting of Fish: Demersal (Species wise)

S.No	Fish Group	Potential (in tonnes)	Present Harvest (in tonnes)	Remarks
1.	Perches & Others	22,500	6,500	Under exploited
a.	Perches		2,000	Under exploited
b.	Mullets		1,000	Under exploited
c.	Pomfrcts		500	Under exploited
d.	Polynemids		200	Under exploited
e.	Scianids		500	Under exploited
f.	Silver bellies		1,400	Under exploited
g.	Cat fishes		500	Under exploited
h.	Prawns		300	Under exploited
i.	Crabs		100	Under exploited

Source: A&N Administration, as quoted in Singh 2002

Estimate of Exploitable Fishery Resource Potential off A & N Islands

Class of vessel	Area of EEZ KM^2	Potential yield t/KM^2	Total potential yield
Up to 12M	8290	2.8	23,212
12-18M	159,220	2.8	445.816
18-30M	352,080	1.0	352,080

	519,590		821,108
Source: FSI Bombay 1987, as quoted in IDA 1988			

Marine Fish Landings (000MT)

	1975	1980	1981	1982	1983	1984	1985	1986	1987	1988
Elasmobranchs	.048	.056	.045	.381	.305	.338	.230	.400	.291	.250
Perches	.157	.302	.198	.061	.603	.938	.608	.938	.884	.617
Tunnies (Blue)	.009	.550	.042	.034	.107	.215	.156	.293	.212	.175
Others	.890	1.390	.906	3.403	2.853	4.734	3.464	9.007	7.478	6.833
Total	1.104	1.803	1.910	3.879	3.868	6.225	4.458	10.638	8.865	7.875

Fish landings for 1950-86

Year	Catch (tones)	Year	Catch (tones)	
1950	44	1968	341	
1951	65	1969	412	
1952	71	1970	500	
1953	61	1971	509	
1954	61	1972	780	
1955	69	1973	854	
1956	80	1974	920	
1957	99	1975	1104	
1958	110	1976	1334	
1959	109	1977	1532	
1960	129	1978	1579	
1961	131	1979	1721	
1962	155	1980	1803	
1963	159	1981	1910	
1964	148	1982	3879	
1965	224	1983	3869	
1966	330	1984	6226	
1967	410	1985	4462	
		1986	10638	
		1987	88635	
		1988	7875	(Up to August)

Source : Island Development Possibilities – Report of the Expert Group constituted by the Island Development Authority – Volume II

There is, obviously, a great potential for developing fisheries in the area. In order to promote local employment fisheries, especially coastal with local involvement, is a very important sector. Current estimates suggest that only a small proportion of the fishery potential is being tapped. The islands have a continental shelf of 16 to 35 thousand sq km

(according to different sources) and an exclusive economic zone (EEZ) of 600,000 sq km., which is 28% of the total Indian EEZ. The total potential has been variously calculated to be between 12,000 and 1,60,000 tonnes of fish (M*aster Plan for Andaman and Nicobar islands for the Development of Fisheries*, Government of India, Ministry of Agriculture, 1989*)*, just from the shelf area. However, more recent estimates are between 45,000 and 1,60,000 tonnes pa. According to the A&N Islands administration, the current levels of harvest are just a fraction of the harvestable potential (for details, see annex 2).

The Andaman and Nicobar islands have certain unique features distinct from those of its counterparts in the Arabian sea, and Lakshadweep islands. These islands have a total coastal length of about 2000 kms. Which is the largest among the maritime states and Union Territories. The coast line is 26 per cent of the total for the country. In order to appreciate the fisheries potential of the islands, it is necessary to understand the ecology of the coastal belt and regime of the islands. These islands are in the zone of the tropical rain forests. The annual rainfall is more than 300 cum. which is precipitated during nine months of the South West and North East mansoons. Up welling of nutrient rich bottom water is a common phenomenon of the east coast of the islands. Sea erosions occur in most of the islands. The in shore waters, particularly, along the unprotected shores are often turbid due to the presence of terrigenous sand and mud. There are extensive mangroves and these have been well preserved in these islands. The near shore areas of most of the islands have sandy or muddy bottom, sometimes with a cover of sea grass. Away from shore, profuse growth of corals is noticeable with intermediate sandy areas.

There is no organized fishing in the Andaman and Nicobar islands. The small aboriginal population of Onges, Andamaneses, Shompes, Jarawas and Sentinelese use spears and arrows for catching fish as food, Only Nicobarese have some instinct for fishing and developed prescriptive fishing methods. The absence of traditional fishing population has been the greatest negative factor in the fisheries development of the territory. Fishermen migrate from Andhra Pradesh, Tamil Nadu, Kerala and West Bengal were helped to settle at few places with certain incentives which were not adequate to start meaningful fishing operations. Commercial fishing is restricted to a few centers such as Port Blair, Rungail, Bayadandar and Diglipur where the fish caught can be marketed.

The present production from artisanal fisheries is very small as compared to the estimated potential. The prospect for development of artisanal sector, small mechanised center and oceanic tuna fishing appear good and investment decisions are required. Sardines, anchories, mackerel, perehics, elasmobranchs, catfish, silver bellies, lobsters, nonpenaid prawns, tuna are some of the resources which stand for higher level of extraction with appropriate modern fishing vessels. The unique ecosystem of the islands offers good scope for development of mariculture. Prawn farming, fish-liver oil production, sea-weed farming, pearl culture have immediate potential for development. There is a good scope for making fish meal from trash fish and also fish protein concentrates. The mangroves ecosystem has to be judiciously utilized for mariculture purposes without affecting the ecological balance. Marine turtles, salt water crocodiles need appropriate conservation and rehabilitation measures.

Appropriate strategies and action plan for integrated fisheries development specific to Andaman and Nicobar islands should be developed and implemented.

Physical inputs

The following physical inputs are also essential to meet this challenging target.

a) Need for quick and commercial survey for pelagic resources.

b) Infrastrucural facilities like fishing harbours, repair and maintenance of fishing ships, cold storages, ice plants and fishing vessels like mother ship with cold storage facilities for deep sea fishing.

c) Training centers for fisher-men, tribals and other operators for this kind of deep sea fishing and fish handling.

It is very essential to take stock of all needs in this areas, as fisheries is the likely source of revenue of these islands. (CSIR 1987)

Production of Food Items and Consumer Goods

There is a great potential for manufacturing consumer goods and for the production of food items, required for local use. This would not only provide employment and enhance the local economy but would also lower the financial outflow on the subsidy being paid by the government for transportation of consumer goods and food items from the mainland. Given below is a list of the industries that were identified by a study done by the Council for Scientific and Industrial Research, in 1987:

Suggested industries

1. Utilisation of wood wool, saw dust briquettes for domestic stoves.
2. Charcoal making from tree branches and leaves and forest wastes.
3. Cane produce industries.
4. Fish meal from trash fish and chemicals like chitin and chito-san from prawn shells.
5. Prawn and fish processing industries.
6. Electronic industries.
7. Watch industries.
8. Plastic industries.
9. Small scale cement industry from limestone.
10. Integrated coconut, arecanut, coir based industries.
11. Mini rice mills.
12. canning and food processing industries.
13. Bottling of coconut water.
14. Coconut oil.
15. Copra waste
16. Coir
17. Coconut leaves
18. Supari
19. Rubber based industries
20. Natural fiber reinforced polymer industries
21. Forest and Agriculture implement industries.
22. Shell ornament industries

(Source: CSIR 87)

Marine products and marine based industries

The assessed fishery resources in this area is estimated to be around 5 to 10 lakh tonnes of fish per annum, while present catch is barely 6,500 tonnes per year. This indicates, that it is essential to introduce modern methods like mechanised fishing; fiber reinforced boats and encourage fishermen with sufficient incentives to follow newer techniques. Besides fishing, subsequent industrial processes for caning, fish meal production from trash fish, fish protein concentrate production action from trash fish, fish protein concentrate production have substantial industrial potential. Studies can also be made on prawn culture, cultivation of sea-weed, production f artificial pearls, chemicals like chitin and chitosan from prawn shells which are used in textile industry could be made. (CSIR 1987)

Handicrafts

There is great potential for developing artisanal handicrafts industry and this could provide significant additional employment.

Swiftlet Nest Cultivation

This is potentially a very lucrative activity. There is great demand for swiftlet nests in the nearby Southeast Asian countries, and 1 kg fetched between Rupees one and two lakhs. A note describing the potential has been enclosed as annex 3.

Orchids Cultivation

This, again, has tremendous potential, as these islands have a large number of very beautiful and rare orchids.

Cultivation of Spices/ Medicinal plants

This could be done without expanding agricultural land. All official settlers in the islands were given two hectares of flat (valley) land and two hectares of hill land. Much of this hill land is still forested and its conversion to agricultural land, apart from not being economically viable, would also cause significant soil erosion and disrupt the water cycles. Therefore, this land can be used for activities conducive to soil and water conservation, like high value spices/medicinal plants. There are many valuable spices and medicinal plants that are found in the Islands.

> "Spices, aromatic and medicinal plants are highly valued crops whose cultivation has great potential in the agro-climatic conditions prevailing in A&N islands. Area under spices like clove, nutmeg, cinnamon and pepper should be increased and their agro technology and economics of cultivation should be studied. Cultivation of Java, Citronella (Cymbopogon winterianus), an aromatic grass should be encouraged for soil conservation and proper land utilization. Forest areas should be earmarked for

inter cropping valuable spices, fruits, aromatic and medicinal plants which can co-exist with forest and produce more wealth." (CSIR 1987)

"The medicinal plants constitute one of the important biological resources of Andaman and Nicobar Islands. There are about 250 medicinal plant species of medicinal value reported so far. Out of these 80 species are having the potential for economic exploitation. For the sustainable development and economy of the islands we suggested here 27 promising fast growing herbaceous, shrubby or climbing plant species, which can be easily grown along with the naturally growing tree species in their natural habitats with little or no adverse environmental impact. The details of these promising medicinal plants i.e. growth pattern, soil suited, plant part used and nature of ailment for prevention and cure are also shown in the table (Sinha & Rao 1998).

Cultivable medicinal plants in the A&N Islands

Species	**Type**	**Suitable Soil**	**Plant Part Used**	**Used for/as**
Acalypha indica	Herb	Sandy loam	1f	Gastrointestinal trouble
Achyranthes aspera	Herb	do	1f, rt	Piles, Wounds, Urinary trouble
Amomum fenzlii	Shrub	Rocky loam	rh, f1	Fever, Stomach disorder
Apama tomentosa	Herb	Sandy loam	1f, rt	Skin disease, boil Urinary trouble
Ageratum conyzoides	Herb	do	wp	Antiseptic
Ampelocissus barbata	Climber	do	tb, st	Eczema, wounds Body pain
Amischotolype mollissima	Herb	do	rt	Rheumatic pain
Ardisia solanacea	Shrub	do	1f	Mumps, antiabortifacient
Aristolochia tagala	Climber	Sandy loam	1f, tb, sb	Severe stomachache
Asparagus racemosus	Climber	do	rt	Anthelmintic, aphrodisiac, dysentery, Urinary trouble
Bacopa monnieri	Herb	do	wp	Epilepsy, Asthma, Urinary trouble
Barleria prionitis	Shrub	do	1f	Tooth ache, Fever, Piles, Expectorant
Boerhavia diffusa	Herb	do	rt	Asthma, Epilepsy, Jaundice, Urinary trouble
Caesalpinia bonduc	Lianas	do	sd	Malarial fever, Colic pain,

Species	Type	Suitable Soil	Plant Part Used	Used for/as
				Asthma Rheumatic Pain
Calotropis gigantea	Shrub	do	bk, 1f	Epilepsy, Skin diseases, Burns, Leprosy, Wounds
Catharanthus roseus	Herb	Sandy loam	1f, rt	Cancer, diabetes, Mental disorder
Centella asiatica	Herb	do	wp	Improve memorary power, general debility
Curculigo orchioides	Herb	do	rh	Jaundice, Piles, Asthma, Epilepsy
Dioscorea spp.	Climber	do	tb	Antifertility, Vigour
Eclipta alba	Herb	do	wp	Asthma, Jaundice, Filaria , Anthelmintic Skin
Gloriosa superba	Herb	do	tb	Anthelmintic, Skin diseases, piles, Leprosy
Globa marantian	Herb	do	rh	Asthma
Ophiorrhiza mungos	Herb	do	wp	Antiseptic, stomach-ache
Paederia scandens	Climber	do	1f	Herpes, Dysentery, Urinary trouble
Phyllanthus urinaria	Herb	Do	wp	Gonorrhoea, Jaundice, Urinary trouble
Tabernaemontana crispa	Shrub	Rocky loam	fr, bk, if	Dysentery, Skin-infection
Tylophora indica	Climber	do	1f	Asthma

Note: 1f: Leaf; rt; Root; rh: Rhizome; wp: Whole plants; tb: Tuber; st: stem; sd: Seed; bk: Bark; fr: Fruit. Source: Sinha & Rao 1998.

Eco Tourism

As already described earlier, these Islands offer a great potential for high value, low volume, specialised eco-tourism that can be done with minimal infrastructure and follows the principles of dispersion and flexibility. Special-interest tourists, wanting to view the unique and rich biodiversity of the Islands, can be accommodated in wilderness areas in small clusters of tents with low concentrations in any one place. The location of these

tents can be shifted every two or three years to ensure that no one site is inordinately impacted. Besides, there can be some ship-based tourism where specialised tourists are taken around in a ship that anchors at spots of tourist interest and allows day trips in small numbers. In fact, there are already foreign yachts coming and anchoring in the islands, but very little benefit flows from them to the local economy.

Therefore, ecotourism has tremendous potential. High value specialised ecological tourism can generate a fair amount of local employment at all levels. However, in order to avoid possible adverse impacts of promoting tourism in the islands, the following guidelines need to be followed.

- No concrete or permanent infrastructure for tourism should be built on any forest area in the Islands. Tourist activities in forest areas should be restricted to tented accommodation or temporary wooden/prefabricated structures that can be dismantled easily and moved to another site. These areas should remain under the control of the forest department who should be responsible for ensuring that the quantum and type of tourism is such that it does not in any way degrade the forests or other ecosystems.
- A proper eco-friendly tourism plan should be developed for the Islands within one year. This plan should also do an economic and a distributional analysis to highlight how tourism can make a net contribution to the economy of the Islands and how the economic benefits can be equitably distributed among the various segments of the local society and generate local employment.
- Such a plan must be in conformity with the requirement for conserving the ecological and cultural integrity of the Islands and not pose a security threat to this strategically important area

Water And Soil Conservation Works

These are desperately needed in the A&N Islands, which has acute water shortage and is also losing a lot of its topsoil, thereby disrupting the terrestrial, coastal and marine ecosystem. Existing schemes of the government of India, like the watershed programme, can be extended and strengthened in these islands to both conserve the environment and generate employment.

Utilisation of Sawdust

The various saw mills in the islands produce a large amount of saw dust, much of which is wasted and even dumped into the sea, causing further ecological damage. The total production of saw dust is not known but, given general trends, if the annual demand for sawn wood is about 45,000 cum in the islands then the saw dust generated should be about 700 cum per annum. These could be converted in brickets and otherwise used as fuel, both generating some employment and lowering the demand for fuel wood.

Conclusion

Consequently, the potential for additional employment, if properly developed, is enough to offset any adverse impacts of the recommendations. Besides, if the Island is developed as a centre of education, research and training in island and coastal management, as recommended earlier, many additional jobs can be created. In fact, over time, caution will have to be exercised to ensure that the requirement for human power in the Islands does not exceed the local supply, necessitating further migration from the mainland.

ANNEXES

Annex 1

FORESTRY: HISTORICAL PERCEPTIONS

"The work done by the Forest Officers of the Andaman is, to a very large extent, confined to exploitation conversion and marketing, with particular regard to the necessity for showing a profit on the working, and it is impossible for them to devote any but a very small portion of their time to silviculture and to permanent improvement and development of the forests, which should be regarded as their first duty"……

Sir Alexander Rodger, Inspector General of Forests, Govt. of India – 1929, as quoted in A&N 1983.

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"…. 120 sq. miles of forests should be reserved within easy reach of the settlement and that a Working Plan for these forests for supply of fire wood and timber to the settlement should be drawn up… for the remainder of the area of the islands, a pre-arranged plan of a more simple nature should be drawn dealing with

1. *Clearing to aid natural regeneration;*
2. *Girdling with a view to seasoning;*
3. *Exploitation of the seasoned timber;*
4. *Cultural operations;*
5. *Weedings*

On a systematic rotation at the necessary intervals of years" …….

Mr. H. C. Hill, Officiating Inspector General of Forests, Govt of India – 1891, as quoted in A&N 1983.

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"I regret to have to say that in the past the policy does not appear to have been one of the forest utilisation but of forest exploitation Forest Department officers in the Andamans have constituted themselves into traders and a very unsatisfactory type at that. They have paid little attention to forestry proper. There has been very little regeneration and fellings in many places have been indiscriminate"……..

Shri Shivadasani, I.C.S., Secretary, Ministry of Home Affairs – 1949, as quoted in A&N 1983.

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".....in all the years the Department has been at work in the Andaman's the efforts made to obtain regeneration in natural forests have mostly failed"……

Sir George Hart, Inspector General of Forests, Govt. of India - 1919 as quoted in A&N 1983

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Nancowrie Group

"….. some cashew plantations were tried in the past and although the results are not very impressive, with better techniques and with superior seeds, it may be possible to restock much of the grassland and inferior forest area with this species. ……It is not advisable to take up extraction in other islands of this Group as the stock of commercial timber is very low".

Little Andaman:

"It is considered that industrial units in the Joint Sector for manufacturing plywood and match splints and match box veneers can be properly sited in Hut Bay and other suitable areas."

North Andaman:

"It will also be worthwhile to consider setting up of industries in the joint sector in the island for manufacturing knock-down furniture items, sawn material, plywood, and match splints and veneers."

Shri S.K. Seth, IFS, Inspector General of Forest, Govt. of India – 1976, as quoted in A&N 1983.

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"The technique of natural regeneration of these tropical train forests has been completely developed in these islands. Much of the credit for this successful solution of the Silvicultural problems goes to the local Forest Department which through their assiduous efforts have been able to evolve a new technique of natural regeneration, locally known as Andaman Canopy Lifting Shelter-wood System"….

"I saw some of the naturally regenerated areas. They are excellently stocked with commercial species. They will yield at maturity much more timber than what is available from existing virgin forests"……

"A few plywood industries have been established in the islands. They have been getting timber from the Forest Department. They are now ready to take up certain areas for working on payment of royalty as is done in the mainland". There is thus a definite trend towards the exploitation of forests by private entrepreneurs. With better road system, this trend is likely to increase which would relieve the forests staff to devote their greater attention to conservation, management and development of forests'……..

"It is felt that timber exploitation operation should be separated from the forestry operations and constituted into a Timber Development Board. There should be one General Manager of the rank of Chief Conservator of Forests."

Shri R.C. Soni., I.F.S., Inspector General of Forests, Govt. of India – 1970, as quoted in A&N 1983

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"As regards policy, the lack of regeneration under selection fellings led to the adoption of clear fellings and artificial regeneration which was only partially successful. Subsequently this was abandoned for selection fellings which were nothing else that lumbering operations undisguised by any attempt to work on a sustained yield basis or to obtain normal regeneration, both of which considerations are of fundamental to the practice of sound forestry. Such a policy or lack of policy cannot be accepted by any

professional forester, the while guiding principle of whose training is the sustained yield; leaving the capital intact for future generations"……

Sir Gerald Trevor, Inspector General of Forests, Govt. of India – 1936, as quoted in A&N 1983

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"The need for large quantities of timber as well as the protection which is provided by large forests is realized by the intelligentsia even in our country. But unfortunately, that realization is not often accompanied by any deep-seated desire to improve the status of forests. Andamans forests are no exception to the rule. There had been an administrator who expressed the view: "……there is something to be said in favour of 'lumbering' versus scientific forestry, i.e, cutting all the timber for which a market can be obtained"…….

"Complaints there have been glare (sic) that the Forest Department is not extracting enough from these inexhaustible (?) reservoirs of timber. Also to be heard are accusations that the Forests Department is absorbed too much in lumbering and pays too little attention to silviculture. This last-mentioned imputation can only be made by those who have not seen the magnificent regeneration established and being established by techniques which are the special contribution of the Andaman Forest Officers to tropical silviculture – These are aspects of forestry in the Andamans which deserve to be known better outside the small forest circles of these remote islands……

"if one bears these facts in mind, one would understand the need for caution, far-sight and sympathetic consideration before the application or drastic measures either of lumbering or of conversion into agriculture, or replacement by economic crops, to this unique forests complex"……

"The Andaman and Nicobar Islands constitute a big timber reserve which will be more and more useful in the years to come, (as forests continue to diminish in extent on the mainland). Hence, too, it is imperative that there should be no significant diminution in the extent of there forests"……

I am mentioning these facts to show that circumstances even in these remote islands are changing, and that unless early steps are taken to offer protection to whatever forests are left, the local people will gradually destroy them, and we shall later be looking in vain for the 'tropical sylvan luxuriance' that was once their striking characteristic. If people are not protected against their own improvidence they are likely to destroy the very environment, which has provided them shelter, and plenty of raw material. There is a Rani in Nancowrie and a Rani in Katchal; and population are building up around them. It is time that forest reservation be thought of in respect of this Nicobar group of islands as well."…….

"The most discouraging feature, however, is the total absence of gurjan and padauk, two of the timbers which make the forests of the Andaman group of islands so valuable. Until some hitherto unknown species of great potential value could be found it will be difficult to make timber extraction from this island a paying proposition."……

Shri V.S. Rao, I.F.S, Inspector General of Forests, Govt. of India – 1963, as quoted in A&N 1983.

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Annex 2

ANNUAL FISH PRODUCTION (qty. in tonnes) AND SPECIES WISE COMPOSITION (in %)

No.	Name of the Species	1996		1997		1998		1999		2000	
		Qty.	%	Qty.	%	Qty.	%	Qty.	%	Qty.	%
1.	Elasmobranches	985	3.71	886	3.55	1157	3.99	941	3.53	1523	5.02
2.	Sardines	3214	12.11	3194	12.79	3926	13.55	5237	19.63	3823	12.60
3.	Thissocles	1201	4.52	1118	4.48	2581	8.91	312	1.17	738	2.43
4.	Anchovies	1408	5.30	1395	5.59	1073	3.70	1361	5.10	1216	4.00
5.	Silver Bellies	1420	5.35	1405	5.63	1090	3.76	1098	4.12	1557	5.13
6.	Mackeral	1589	5.99	1430	5.73	1087	3.75	1213	4.55	1939	6.39
7.	Carangids	1456	5.48	1350	5.41	1139	3.93	2249	8.43	1007	3.32
8.	Seer Fish	799	3.01	729	2.92	882	3.05	1172	4.40	1210	3.99
9.	Tuna	981	3.69	970	3.88	3823	13.19	1362	5.11	467	1.54
10.	Sail & Sword Fish	348	1.31	328	1.31	342	1.18	241	0.90	1307	4.31
11.	Baracuda	942	3.55	842	3.37	1022	3.53	1021	3.83	617	2.04
12.	Pomfrets	393	1.48	345	1.38	472	1.63	499	1.87	1856	6.12
13.	Mullets	904	3.41	805	3.22	1262	4.36	1153	4.32	1417	4.67
14.	Hilsa	1680	6.33	1580	6.33	729	2.52	478	1.79	416	1.37
15.	Perches	1951	7.35	1926	7.71	1482	5.11	3356	12.58	5636	18.58
16.	Belonidae	358	1.35	390	1.56	113	0.39	133	0.50	364	1.20
17.	Chirocentridae	359	1.35	340	1.36	331	1.14	83	0.32	237	0.78
18.	Cat Fish	560	2.11	540	2.16	431	1.49	388	1.45	510	1.68
19.	Polynemids	218	0.82	209	0.84	201	0.69	430	1.61	62	0.20
20.	Scienids	253	0.95	249	1.00	276	0.95	82	0.31	86	0.28
21.	Prawns	250	0.94	405	1.62	601	2.07	785	2.94	351	1.16
22.	Crabs	140	0.53	145	0.58	578	1.99	556	2.08	738	2.43
23.	Ribbon Fish	481	1.81	395	1.58	597	2.05	527	1.98	424	1.40
24.	Miscellaneous	4661	17.55	3998	16.00	3788	13.07	1996	7.48	2838	9.36
	TOTAL	**26551**		**24974**		**28983**		**26673**		**30339**	

(Source: Singh 2002)

Annex 3

Implementation of an In-situ & ex-situ conservation programme for the Edible-nest Swiftlet *Collocalia fuciphaga* in the Andaman & Nicobar Islands

Introduction

Ever since the 16th century, when swiftlet nests became an important item in Chinese pharmacy and cuisine, the edible nests of swiftlets have been exploited throughout their range (Medway 1963, Lau & Melville 1994). Today, at prices between US$ 2000 – 4000 per kilogram (approximately 100 nests), the wholly white edible nests of swiftlets rank amongst the world's most expensive animal products.

Swiftlets construct their nests by using saliva to bind materials together (Kang* et al. *1991). While most species use saliva to bind leaf, moss, or feathers into nests, the Edible-nest Swiftlet* Collocalia fuciphaga *builds nests wholly of `saliva', a mucilaginous secretion of the paired sublingual glands (Marshall and Folley 1956), which enlarge during the breeding season (Medway 1962). Upon drying, the saliva forms a hard cement, and secures the bracket shaped nest to the wall as well as forming the cup (Kang* et al. *1991). These wholly white nests are under immense collection pressures as they have been traditionally believed to possess powerful medicinal and aphrodisiac properties, and wide spread declines in populations have been documented (Lau & Melville 1994). However, when scientifically managed, the nests of swiftlets can be harvested sustainably, without reducing breeding populations (Medway 1966), and even increasing them (Mardiastuti & Soehatono 1996, Nugruho & Whendrato 1996, Phach 1996).

Two species of swiftlets are present in the Andaman & Nicobar Islands. The commercially important Edible-nest Swiftlet* C. fuciphaga*, which ranges from the Andaman & Nicobar Islands in the west through Indonesia and to the Philippines in the east, and the non-commercial Whitebellied Swiftlet* C. esculenta *which is common in the Andaman & Nicobar Islands.

Swiftlets in the A & N Islands

<u>The Problem</u>

Sankaran (1988, 2001) identified the problem of conserving swiftlets at two levels: collection and trade. Protection, as a conservation measure is not feasible for the following reasons.

First, to protect swiftlet-breeding sites, a protection camp has to be established at the mouth of the cave. Since protection has to be done round the clock, at least four watchmen are required per cave. Thus, an extremely high number of people will have to be employed, and intensively supervised, for protection, by itself, to be an effective conservation tool. This is clearly not feasible over larger areas.

Second, protection camps established some distance from the caves are ineffective, as nest collectors are then able to bypass the protection camp or raid the cave in the night. As the majority of swiftlet breeding sites are at inaccessible locations, establishing protection camps at the mouth of the cave for over 95% of swiftlet caves cannot be done.

Third, the watchmen should be very highly motivated for effective protection. To ensure this they will have to be intensively supervised and the caves periodically surveyed to ensure that there is no pilferage of nests. This is also not feasible over larger areas.

As the entire trade in swiftlet nests is across international borders, there was a strong case for the inclusion of swiftlets into the CITES appendices, whereby trade can be effectively controlled. However, as there have been innovative harvesting systems, where free-living swiftlets nest in human habitation and are optimally managed, and the population of swiftlets has significantly increased, the species was not included in the CITES Appendices, and swiftlet nests can be legally traded in the international market. This non-inclusion will make an Indian attempt at stopping trade ineffective, exacerbated by fact that swiftlet nests can be easily concealed and smuggled.

Scientific management and harvesting systems has been recognized and recommended as the correct conservation approach for swiftlets worldwide.

The Solution

A simple and innovative method for the ex-situ conservation of swiftlets has been developed in Indonesia, where existing structures in which the non-commercial Whitebellied Swiftlet nest are developed and renovated, or new structures are built so as to attract the Whitebellied Swiftlet. Eggs of the commercially important Edible-nest Swiftlet are then transferred from specifically protected caves to the nests of the Whitebellied Swiftlet, who act as foster parents by incubating the eggs and rearing the young Edible-nest Swiftlet. As swiftlets are very parochial, the young Edible-nest Swiftlet when fledged continue to return to the house and when mature begin nesting there, a new population of the Edible-nest Swiftlet is established. As the house is `owned', and as it is in the best interests of the owner to manage his swiftlets scientifically, the population is safe and secure from indiscriminate nest harvesting, and therefore grows. Indonesia now produces over 65,000 kilograms of swiftlet nests per annum from houses, indicating a base population of over four million breeding birds. Swiftlet farming in Indonesia generates revenue of over US$ 100 million and considerable employment opportunity both in swiftlet houses as well as in the cleaning, processing and packaging of swiftlet nests.

The conservation of the Edible-nest Swiftlet lies in both an in-situ and ex-situ approach. The in-situ conservation programme should revolve around the protection of a few cave or cave complexes, so as to build up wild populations and to source eggs of the Edible-nest Swiftlet as well as to provide livelihoods for locals augmented by incomes from the sale of nests once nesting is completed and the chicks have fledged. The ex-situ programme should revolve around the creation of new populations of the Edible-nest Swiftlet in houses that already have populations of Whitebellied Swiftlet, and develop new, cost effective houses, in which the Whitebellied Swiftlet can be induced to breed, and subsequently populations of the Edible-nest Swiftlet established by transferring eggs from the protected caves. A central facility, for example the house at Tugapur, needs to be developed so as to facilitate the dissemination of knowledge and technology as well as for the distribution of eggs. In the Andaman & Nicobar Islands, this innovative conservation programme will not only result in the survival of the Edible-nest Swiftlet, but also form an important source of revenue and employment for the islands.

Implications of the Programme in the Andaman & Nicobar Islands

Survival of the species

The Edible-nest Swiftlet in the Andaman & Nicobar Islands is threatened (Sankaran 1998, 2001), with further declines in population between 1997 and 2002, strengthening the view that extinction is imminent in most breeding sites. By protecting certain caves, this programme will result in the prevention of extinction of the species in the Andaman & Nicobar Islands.

Economic benefit for the islands

The economy of the Andaman & Nicobar Islands runs almost wholly on subsidies from the Government of India. As a result, there are immense pressures on the islands to generate revenue, thereby significantly reducing the current levels of subsidy. In the islands, all programmes to generate revenue will be largely natural resource based. Considering the biological importance and fragility of these islands, virtually any revenue-generating programme is inherently seriously damaging to the environment. There is an urgent need to develop sustainable and environmentally non-damaging programmes that will generate adequate revenue for these islands. Swiftlet nests are valued at well over Rs 100,000/- (US$ 2000/-) per kg, and under optimal conditions production can be as high as a kilogram of nests per six m^2 of farm area. Thus, swiftlet farming as well as sustainable harvesting regimes from caves has the potential of becoming a significant earner of revenue in the islands.

Employment

An important offshoot of the production of nests from swiftlet farms is in the processing and packaging of swiftlet nests industry. As each nest has to be cleaned individually by hand, there is tremendous scope for generating employment opportunities, particularly for women. A single worker is able to process and clean about 250 grams of swiftlet nests

per day. Thus the scope of employment is directly proportional to the amount of nests produced.

Biological control of pests

Swiftlets are insectivorous, preying exclusively on aerial insects. They therefore play a very major role in the biological control of insect pests.
Recognising the above and considering the following, the State Wildlife Advisory Board, Andaman & Nicobar Islands, under the Chairmanship of the Chief Secretary, A & N Islands, approved in 2001, the implementation of the programme for the in-situ & ex-situ conservation of the Edible-nest Swiftlet in the Andaman & Nicobar Islands.

a) The Edible-nest Swiftlet is neither globally critical, endangered, or threatened, (BirdLife Red Data Book);
b) The Swiftlets are not protected under any of the schedules of the Indian Wildlife (Protection) Act, 1972, and that harvesting and trade is permissible under International Laws including CITES;
c) Under existing Indian laws, the conservation of the Edible-nest Swiftlet is well within the purview of the powers of the Chief Wildlife Warden under the Indian Wildlife (Protection) Act, 1972;
d) Scientifically managed harvesting regimes of Swiftlets has been recommended by CITES, and accepted by the Conference of Parties, of which India is a signatory;
e) Innovative conservation strategies are required not only to conserve the Edible-nest Swiftlet but also to provide alternate sources of livelihood for nest collectors, particularly because protection of the species is neither feasible nor practical and is therefore not a pragmatic solution;
f) The programme is ethically acceptable, as it neither involves the killing of young or adults, nor are the birds constrained in anyway; that Swiftlet nest harvesting is analogous to milking of free ranging cows; and,
g) The implementation of innovative programmes of sustainable utilisation of natural resources alternate to current development strategies are crucial to the economic development of fragile biodiversity hotspots like the A & N islands;

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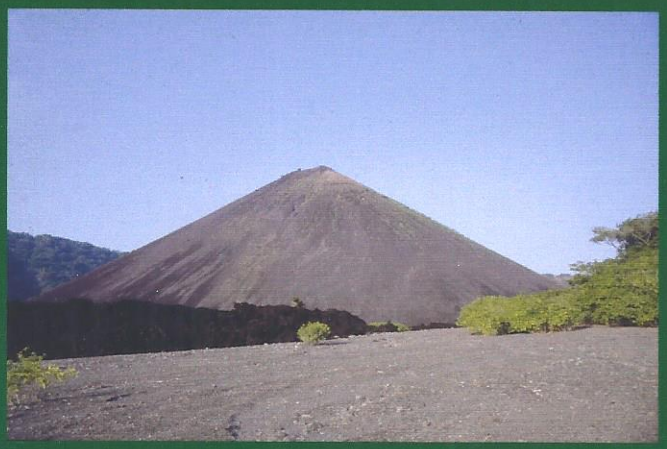

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