

# ANDAMAN AND NICOBAR ISLANDS UNION TERRITORY BIODIVERSITY STRATEGY AND ACTION PLAN



PREPARED UNDER THE NATIONAL BIODIVERSITY  
STRATEGY AND ACTION PLAN- INDIA

GOI/UNDP



MoEF, Government of India



ANDAMAN & NICOBAR ISLANDS ENVIRONMENTAL TEAM

2003

# ANDAMAN AND NICOBAR ISLANDS UNION TERRITORY BIODIVERSITY STRATEGY AND ACTION PLAN

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**NBSAP Funding Agency:** United Nations Development Programme (UNDP) / Global Environment Facility.

**NBSAP Technical Coordination Agency:** Technical Policy Core Group (TPCG) coordinated by Kalpavriksh.

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We would also like to thank Luc Gastmans and Tharaq Andrews for help with production of this document.

**Citation:** ANET. 2003. Andaman and Nicobar Islands Union Territory- Biodiversity Strategy and Action Plan. Prepared Under the National Biodiversity Strategy And Action Plan- India. GOI- UNDP. Administrative coordination by Biotech Consortium India Ltd., Kundan House, 4<sup>th</sup> Floor, 16 Nehru Place, New Delhi- 110 091.

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## **LIST OF ABBREVIATIONS USED**

<b>ANI</b>	Andaman & Nicobar Islands
<b>AN DE &amp; F</b>	Andaman & Nicobar Department of Environment and Forests
<b>AAJVS</b>	Andaman Adim Janjati Vikas Samiti
<b>AH &amp; VS</b>	Animal Husbandry and Veterinary Sciences.
<b>ANET</b>	Andaman & Nicobar Islands Environmental Team
<b>APWD</b>	Andaman Public Works Dept.
<b>ASI</b>	Anthropological Survey of India
<b>ATR</b>	Andaman Trunk Road
<b>BSI</b>	Botanical Survey of India
<b>CARI</b>	Central Agricultural Research Institute
<b>CCF</b>	Chief Conservator of Forests
<b>CWLW</b>	Chief Wildlife Warden
<b>DOD</b>	Department of Ocean Development
<b>DRDA</b>	District & Rural Development Agency
<b>EIA</b>	Environmental Impact Assessment
<b>FCI</b>	Food Corporation India
<b>FSI</b>	Forest Survey of India
<b>GCRMN</b>	Global Coral Reef Monitoring Network
<b>GEF</b>	Global Environment Facility
<b>GIS</b>	Geographic Information System
<b>GPS</b>	Global Positioning System
<b>IBA</b>	Important Bird Areas
<b>ICFRE</b>	Indian Council for Forestry Research and Education
<b>ICRMN</b>	Indian Coral Reef Monitoring Network
<b>IIPA</b>	Indian Institute of Public Administration
<b>IP &amp; T</b>	Information Publicity & Tourism
<b>IUCN</b>	International Union for the Conservation of Nature
<b>JFM</b>	Joint Forest Management
<b>JNRM</b>	Jawaharlal Nehru Rashtriya Mahavidyalaya
<b>MGMNP</b>	Mahatma Gandhi Marine National Park
<b>NGO</b>	Non Governmental Organization
<b>PA</b>	Protected Area
<b>PF</b>	Protected Forest
<b>RF</b>	Reserved Forest
<b>RJMNP</b>	Rani Jhansi Marine National Park
<b>SACON</b>	Salim Ali Centre for Ornithology & Natural History
<b>SANE</b>	Society for Andaman and Nicobar Ecology
<b>SAP</b>	Strategy & Action Plan
<b>TPCG</b>	Technical Policy Core Group
<b>UNDP</b>	United Nations Development Programme
<b>WII</b>	Wildlife Institute of India
<b>WLPA</b>	Wildlife (Protection) Act, 1972
<b>WWF</b>	World Wide Fund for Nature
<b>ZSI</b>	Zoological Survey of India



## **1. Executive Summary**

### ***1. The planning process***

The NBSAP process for the Andaman and Nicobar Islands was initiated in October 2000 with the constitution of a Steering Committee vide A & N I Administration Office order No. F. 16 (G- 1)/19- 642 dated 6- 10- 2000 and the appointment of ANET as the Nodal Agency for preparing the SAP. A Working Group was constituted by ANET and the ANDE& F to prepare the SAP and the first meeting of the Working Group was held during December 2000. At this meeting ANET presented the NBSAP process, methods and submitted a statement of issues and problems to initiate the process of the SAP for the Andaman and Nicobar Islands.

The Working Group met several times until meetings were abandoned due to lack of quorum. A draft report was prepared by ANET, and was circulated to all members of the Working Group for comments as suggested by the Chief Wildlife Warden, the Member Secretary, NBSAP, A & NI. On December 10, 2001, a meeting at the Department of Environment and Forests (AND E & F) convened by the CCF went over this draft and the draft was then substantially modified and expanded.

A final meeting was held on April 12, 2002, chaired by the Chairman NBSAP (PCCF & Secretary, AN DE & F). This meeting was represented by the Vice Chairman (CCF), Member Secretary (The CWLW, A & NI), Dr. Wafar, NBSAP Technical Policy Core Group (TPCG), and members of the working group, several officers from the AN DE & F and from various other departments in the islands. The final draft report that was prepared by ANET was reviewed and discussed in detail. After the review and discussions it was decided that a drafting committee be constituted. This five-member, ANDE & F, BSI, ZSI and ANET representatives, committee met on various occasions and finalized the SAP final draft report.

Various reports and documents were reviewed, and intensive literature search was conducted by ANET to keep the SAP document current and updated. All lists in the document have been compiled and updated from existing literature

## *2. Key issues and recommendations*

Several important themes peculiar to these islands did come up during the entire process. One of the most important issues identified was the continued immigration, which is taking a major toll of the natural resources and the ecosystems of the islands.

Sand mining resulting in loss of beach vegetation and marine turtle nesting habitats.

Tourism was also identified as a cause for concern, and steps needed to be taken to ensure that it is done in an environmentally sustainable fashion.

Logging has also recently become a very contentious issue, with a recent Supreme Court order (Appendix: 1). this allows logging to meet local needs only. The court also ordered that all post-1978 encroachments on forestlands be vacated. It has suggested restrictions on immigration, and on entry into tribal reserves.

Browsing by introduced herbivores is a major source of damage to these forests and small island ecosystems. This affects regeneration, and could be a serious cause in the degradation of natural resources unless populations of deer are controlled.

In terms of research the first priority is a detailed island-wise survey of all major taxa, and the preparation of a GIS- based platform on which future work is to be based. .

Endangered and endemic species that require additional research inputs have been identified. Finally, an effort to understand the wants of the tribal communities needs to be made.

Action plans are presented for each sector, where research, planning and implementation would substantially enhance biodiversity. These include recommendations for renewable energy, forest utilization, fisheries, land use, ecotourism, environmental education and awareness.

The Andaman and Nicobar Administration have a Wildlife Advisory Board and a State Level Environment Council for the islands.

## **2. Introduction**

### ***3. Scope of the SAP***

This SAP covers the Andaman and Nicobar Islands. These are a Union Territory belonging to India, and lie between 6° 45' N to 13° 41' N and between 92° 12' E to 93° 57' E. Also considered are the territorial waters and the Exclusive Economic Zone, since the long-term preservation of marine and coastal and other terrestrial biodiversity is critical to the well being of these islands, and since these are under pressure both by Indian as well as foreign poachers.

#### ***2.1.1. Objectives of the SAP***

The objectives of the SAP were to identify the problems relating to biodiversity conservation and use, identify the ongoing programmes relating to biodiversity conservation and utilization of biological resources, both from the Government sector and from other stakeholder groups, identify the stakeholders, identify the gaps in the coverage, and finally propose actions to fill in the gaps both in knowledge and in vision.

#### ***2.1.2. Methodology used***

Ongoing and past work which has provided major inputs into the NBSAP process are briefly mentioned below:

Members of the Working Group have been co-organisers and participants in the seminar “Planning for Protected Areas management in the Andaman and Nicobars”, in collaboration AN E & F, IIPA and ANET. ANET has prepared the research and management priorities in the ANI, as an output of this seminar (Ali & Uppal, 2002; Andrews & Sankaran, 2002).

Members of the Working Group first identified gaps and ANET used the available funding to initiate short studies on various key themes in biodiversity and these included:

*A study on the shark fin industry.*

This has been completed and the data analysed, and indicates that the bulk of shark catches are by big trawlers. Artisan fishermen catch relatively less even though more people are involved.

*Two studies on feral animals:*

Studies on elephant and chital- and their impact on island ecosystems and rainforest regeneration- has been completed... The elephant study indicates that damage due to debarking is now occurring on tree species that were previously not eaten, due to the reduction in food resources, and this has led to damage to the forest. The study on chital indicates that seedling regeneration is much lower in areas where chital are found, irrespective of past management practises (Ali, 2001; Aul, 2002). These both indicate that damage to wet and moist evergreen forest regeneration is resulting in a serious change in floristic structure due to these feral animals, suggesting that urgent control measures are necessary.

*Socio-economic profiling of the villagers:*

*Socio-economic profiling of the villagers* who live adjacent to the MGMNP has been completed. Preliminary results indicate that the benefits from the park are going largely to outsiders and recent immigrants. Participatory meetings were conducted with the various stakeholders in the park, in collaboration with the park management, to evolve a management strategy that involves them fully (Singh *et al.*, 2001). This management plan is being written up by the ANDE & F.

*A study of agricultural yields in South Andaman* showed a similar pattern of greatly declining productivity that has been documented already for North Andaman. However there is currently surplus rice grown in the Andamans and there is no market for it. Food Corporation (FCI) of India will not buy this rice as it is of sub standard quality and the surplus is mainly due to the increased land area for rice production through encroachments. This however will change now due to the Supreme Court order and the eviction process that has taken place. A study of water harvesting structures around the MGMNP shows how patterns of cooperation between villagers operate in these immigrant communities.

Conducting several meetings with the ANDE & F was also part of the methodology used. Apart from informal consultations throughout the project, the Chief Conservator of Forests (CCF) convened a meeting of all the CFs, after the draft final report was distributed. A detailed discussion followed, and the points raised in this discussion have been incorporated in this report. This has resulted in its quality being considerably enhanced.

The following documents have also been consulted in preparing this report:

- The State Forestry Action Programme has been consulted extensively while preparing this report.
- Coral Reef Management Plan- UNDP and the ANDE & F.
- Tourism plan- WTO/UNDP.
- State Forestry Research Plan- ANDE & F.
- Draft Tenth Five-Year Plan (2002-2007) of Environment & Forests Sector- ANDE & F
- National Forestry Research Plan- ICFRE
- Protected Area Management Plans- ANDE & F
- The Forest Statistics 1997- 1998, 1998- 1999 and 2000-2001- ANDE & F.
- The Andaman and Nicobar Islands- Forests and Environment- ANDE & F.
- Setting biodiversity conservation priorities for India- WWF- India.
- Sustainable management of Protected Areas in the A & N Islands- ANET, IIPA & FFI.
- Master Plan for primitive tribes in ANI- ANI Administration.

Extensive literature search was conducted to keep the document as current as possible and enhanced.

### **3. Area profile**

#### ***4. Geographical area***

The Andaman and Nicobar Islands are the largest archipelago system in the Bay of Bengal, consisting of

306 islands and 206 rocks and rocky outcrops and are latitudinal situated between 6° 45' N to 13° 41' N and longitudinally 92° 12' E to 93° 57' E (Fig: 1). The total geographical area is 8, 249 km<sup>2</sup> with a coastline of 1, 962 km. The northern group of islands, the Andaman group, is 6,408 km<sup>2</sup> and the Nicobar Group is 1,841 km<sup>2</sup>. This large archipelago is separated from mainland India by almost 1000 km; the nearest landmass in the north is Myanmar, roughly 280 km north of Landfall Island, and the northern-most island in the Andaman Group. The closest landmass to the Great Nicobar Island is Sumatra, 145 km south (Fig: 2).

The Great Andaman Group of islands is made up of North, Middle and South Andaman Islands; with Baratang Island situated between Middle and South Andaman Islands. Ritchie's Archipelago, a group of islands, is located east of Middle Andaman and Labyrinth group of islands is situated southwest of South Andaman. Rutland lies southeast of South Andaman and Little Andaman Island 55 km south of South Andaman, across the Duncan passage. The land area of 6408 km<sup>2</sup> of the Andaman Group constitutes almost 90%, (5629 km<sup>2</sup>), as reserve or protected areas of which 36% is Tribal Reserve. The elevation in the Andamans is 0- 732 m, Saddle Peak in North Andaman Island being the highest.

The Nicobar group is spread over an area of 1841 km<sup>2</sup> of which 1542 km<sup>2</sup> are forests. The Nicobars are separated from the Andamans by the 10° Channel, a wide gap of 160 km with heavy tidal flows, making sea transport by small boats difficult. The Nicobars consist of 24 islands in three distinct clusters of which 12 are inhabited with 170 villages and hamlets. The Northern Group consists of Car Nicobar and Batti Malv and the central or the Nancowry Group, consists of Tillanchong, Chowra, Teressa, Bompoka, Trinkat, Kamorta, Katchal and Nancowry. The southern group consists of the two large islands Little and Great Nicobar, together with Pigeon, Megapode, Kondul, Pilo Milo, Menchal, Teris, Trak and, Meroe Islands (Fig: 3). The entire Nicobars is a Tribal Reserve and has four Sanctuaries, three of which are islands. An area of 885 km<sup>2</sup> in the Great Nicobar Island is designated as the Great Nicobar Biosphere Reserve and two other areas within it as National Parks; Great Nicobar Island also has the highest peak in the Nicobar group, Mount Thullier which is 670 m. in height. (Pande, *et al*, 1991; Andrews & Sankaran, 2002).

## 5. *Geology*

The Andaman and Nicobar archipelago lie in a crescent that stretches from Cape Negrais of Myanmar to Banda Arc of Sumatra (Indonesia). The Andamans are considered to be the extensions of the submerged Rakhine Yomas (Arakan Yomas) mountain range of Myanmar, a southward trending branch of the eastern Himalayas that merges in the north with the ranges in north- east India, which forms a complex of sub parallel north- north- east trending ridge. The same ridge rises 135 km south of the Irrawady, in the Bay of Bengal. The Mentawai Island to the south and south- west of Sumatra are presumed to be a southern

**Figure 1**

Andaman and Nicobar location

**Figure 2**

Andaman and Nicobar – South East Asia

**Figure 3**

The Nicobar Islands



continuation of the Nicobars (Rodolfo, 1969; Weeks *et al.*, 1967; Das, 1999). The Nicobar group is considered to be of volcanic origin, with coral reefs contributing to the upheaval of banks (Hochstetter, 1866). The Ritchie's Archipelago, Baratang, Interview and the Cocos are considered to be truncated parts of the Rakine Yomas (Arakan Yomas). Narcondam, a 7 km<sup>2</sup> island and which is 710 m above MSL, is an extinct volcano, situated ca 70 km south of the Ayeyarwady delta shelf and east of North Andaman Island. The origin of this island is believed to be from a single eruption and dated Late Pliocene to Pleistocene (Chibber, 1934; Das, 1999). Barren Island, with a active volcano, lies 135 km south- southwest of Narcondam (Fig: 2). Chemical analysis and norms of the basaltic and andesitic rocks of Narcondam and Barren indicate their origin to a common magma (Washington, 1924). The rocks are highly folded due to frequent tectonic movements in the past and geological formations represent thick layers of marine sediments ranging from late Mesozoic to Quaternary age (Karunakaran *et al*, 1968) and the present configuration probably took shape only 26 million years ago. Oldham (1885), Gee (1925), Rudolfo (1969), Rajshekhar & Reddy (2002), and Chandra *et. al.*, (1999), has previously discussed the geology, fossils and hydrology of these islands. These islands are also seismic and have been discussed by Kumar and Bhatia (1999).

## **6. Climate**

The Andaman and Nicobar archipelago are situated in the equatorial belt and are exposed to marine influences and have a tropical climate, warm, moist and equable. The temperature ranges from 18°C to 35° C. The proximity of the sea and the abundant rainfall prevents extremes of heat and these islands experience both the Northeast and the Southwest monsoons. The southwest monsoon commences during April / May accompanied by high winds with heavy downpours right through July to September. The northeast monsoon usually commences during October and rains continue into December. The average annual rainfall ranges from 3,000 to 3,500 mm and humidity varies from 66% to 85 %. In some years the islands experience rains during all the months of the year. Cyclones occur during the monsoons, accompanied by very strong winds, mainly during May and November and in some years during mid April. A comparative study on temperature and rainfall of the Andamans has been previously discussed by Chakravarty *et al.* (1987).

## **7. Socio-economic profile**

The Andaman Islands were home to several groups of Negrito, hunter- gatherer, and indigenous tribes. The most important in the last century were the Great Andamanese people, consisting of 12 tribes that included different sects (Portman, 1899). These groups of people numbered around 6000 in the 1850's when the islands were colonised by the British for establishing a penal colony here. The British attempted to 'civilise' the Andamanese people, teaching them to eat exotic food, to wear clothes, live in houses, schools, hospitals and to farm. These experiments failed, and led to the total decimation of the Great Andamanese (Portman, 1899). The current number is 34 individuals, who have been marginalised to Strait Island on southeast coast of Middle Andaman. Portman (1899) documents this process extensively in great detail,

and very clearly mentions that the British, in all their attempts, failed and this process should have never been attempted.

The Onge people, who inhabit Little Andaman Island, were the next to be contacted in 1920, and a process similar to what happened to the Andamanese was initiated. Their numbers have drastically gone down from 500 in 1920 to 97 currently, chiefly because the Administration continued the process that the British had started. The Onge people are marginalised and confined to two areas, the mouth of the Dugong Creek and South Bay. Their culture, their movement patterns, their camps, problems and impacts to their island and their resources, has been previously discussed by several authors (Swaminathan *et al.*, 1971; Basu, 1990; Davi, 1990; Cooper, 1992; Pandya, 1993; Reddy, 1994; Andrews, 2000 b)

The Sentinelese and the Jarawa, the other two tribes in the Andamans, have resisted contact until the 1960's. The Sentinelese, numbering 100- 150 (Estimated and this figure cannot be taken literally), have for long inhabited North Sentinel Island, an island 60 km<sup>2</sup> south west of South Andaman Island. These people have been living in total isolation for over hundreds of years except for two contact mission attempts made by the A & N Administration in 1967, 1991 and in 2000. Their current status is not yet known, however there a lot of disturbances around their island due to intensive offshore fishing by fishermen, lobster collectors and Myanmar poachers.

The Jarawas are marginalised to the west coast of South and Middle Andaman Islands. This process and impacts have been previously discussed by Portman (1899), Bonington (1931), Chengappa (1958), Sarkar (1990), Reddy (1994), Andrews (2002) and Chandi (2002). The contact process with some of the Jarawa people was begun in 1974, and, given that the official policy of acculturating and assimilating them by the Government is continuing. In spite of it having failed in the past, for sure extinction is likely and currently this is a source of disagreement within these Islands.

The Nicobarese, people of Mongoloid origin, occupy 12 of the 24 Nicobar groups of islands, some of them live in small villages, but most live in smaller hamlets and in individual family units in various locations and islands. A number of Nicobarese have been assimilated into the society brought from mainland India almost totally, but resent outsiders in their islands. Although up till now, most Nicobar people are referred to, in general, as 'Nicobaris'; however it should be understood that these people are of several different groups with different customs, cultures and separate dialects. These people are probably descendents of different hunter- gatherer tribes from Myanmar and the Indo- Malayan regions.

The Shompen, also of Mongoloid origin, numbering 380 and are marginalised to the inland forests and the east coast of Great Nicobar Island, these people are reported to have numbered in thousands and inhabited the coastal areas of Great Nicobar Island. Their numbers probably got reduced due to influenza in 1918 and poliomyelitis in 1947 (Chengappa, 1953). Currently their status still requires attention, as the male population is higher than that of the female, and there are no more women of marriageable age. They are being subjected to the forces of assimilation similar to those the tribal groups in the Andamans have already undergone.

The next group of interest are the descendants of the convicts and freedom fighters who were jailed in these islands. They brought with them a culture remarkably free of communal or castes biases, and remain so till this day. However, they constitute a very small proportion of the population, being outnumbered by recent immigrants. They occupy the areas in and around Port Blair; and run businesses, including trade and tourism.

To work the forests, 45 Karen families from Myanmar, were sent by the American Baptist Mission in Myanmar at the request of the British in 1925, and a number of them elected to return to Myanmar in the 1960's. These people are the descendants of the several Karen tribes in Myanmar. After Independence the Karen people were settled as agriculturalists in Middle Andaman. There are around 3000 Karen's in the islands now, with the main concentration living just south of Mayabunder in Middle Andaman. The Karen have excellent knowledge of the forests and the seas of the Andamans and their single keel, single log mechanised Karen dug out canoe (Dungi), is the most popular in the islands used by all fishermen, settlers and most researchers, besides government departments.

The current day Ranchi people in the Andamans and the Nicobars were also brought into the islands by the British as labourers to work the forests. These people from Chhota Nagpur have settled on Baratang Island and have also spread themselves throughout the Andaman and Nicobar Islands. There is a significant proportion employed in Government jobs.

Refugees from the erstwhile East Pakistan were brought here in the 1950's. Settlement was opened up in South, Middle and North Andaman for them, and the majority of settlement in the Diglipur area occurred between 1957-1959.

In the 1960's a group of 300 repatriates were brought from Sri Lanka under the Shastri-Sirimavo Pact and settled on Katchal Island in the Nicobars, and this population has increased to over three thousand now. There is controversy going on at the moment about the legality of their settlement there, and the Nicobarese do not want them there and have filed a PIL. These settlers do have an impact on these islands including putting tremendous pressure on the limited resources as well as increasing encroachments.

The first groups of ex- servicemen were settled on Great Nicobar Island in 1969. A forest area of 1,499. 65 hectares was cleared for 337 of these settler families, along the east coast, up 35 km, south of Campbell Bay. Each family was given 11 acres of land and schools, health centres and government offices were established for these people.

In the last three decades there has been a spurt of immigration from mainland India, mainly from Bengal and Tamil Nadu. This immigration is enhanced by subsidised ship fares, subsidised food, and availability of jobs on daily wages. The obvious consequence has been encroachment on a large scale leading to degradation of the forests and increased pressure on natural resources. This will now be reduced with the current Supreme Court Order and the eviction process that has taken place.

Currently there are 503 inhabited villages in the A & N Islands, of which 334 are in the Andaman district

on eleven islands and the remaining 170 villages, hamlets and small and individual family units on 12 islands in the Nicobar district (Census of India, 2001).

## ***8. Political profile***

After Independence in 1947, the islands became a Union Territory of the Republic of India. There was a Chief Commissioner appointed for the islands, and he was the administrator of these islands. This post was later upgraded to Lieutenant Governor. There was an elected council of five Counsellors that looked after various portfolios. This has been replaced by Panchayat Raj, of which a 3-tier system exists- with Zilla Parishad at District level, Panchayat Samiti at middle level and Panchayat at the village level. Because of its strategic role, lying across one of the world's most important shipping lanes, the Straits of Malacca, most decisions regarding the islands are taken in New Delhi. This has had some unsought out consequences. For instance, road transport has been given preference over sea transport, which is much better suited for these islands.

The islands have one Member of Parliament in the Lok Sabha who plays a key role in deciding the policies to be adopted here.

## ***9. Ecological profile***

### ***3.1.1. Land use***

Until Independence in 1947, the Andaman Islands retained most of its forest cover. There was very little demand for timber during the colonial period and a saw mill was established in 1883, which supplied timber to settlers around Port Blair. Later in 1926 WIMCO set up a matchstick factory in Port Blair. There were only small areas during this period that had been cleared, in extreme South, Middle and North Andaman Islands (Khan, 1983).

The 1950's saw an explosion of settlements as people flooded in. While during the war years and immediately after (1942-1952) there was no forestry operation this was resumed and expanded, primarily to make land available for the colonisation, rehabilitation operations and to meet the industrial demands in mainland, especially of the Indian Railways. The tribal reserves for the Jarawa and the Onge that were notified in 1957 had large portions de-notified in the 60's and 70's as there was pressure for land for settlement. A second de-notification was for the construction of the ATR (Sarkar, 1990; Reddy, 1994). Later, 20,000 ha from the Onge Reserve in Little Andaman Island were de-notified of which 1600 ha was used for oil palm plantations (Basu, 1990; Reddy, 1994; Andrews, 2000 b).

The forests in the Andaman and the Nicobar group of Islands occupy 7,606 km<sup>2</sup> or 92.2% of the total geographical area of 8,249 km<sup>2</sup>, of this 5,883 km<sup>2</sup> is forests in the Andaman group and 1,723 km<sup>2</sup> in the Nicobar group. Of the total forest cover, dense forests with crown density of 40% and above constitute 85.9%, open forests with crown density less than 40% constitute 1.7% and mangroves constitute 12.7% (A & N D E & F. 2001). The legally notified forest is 7170.69 km<sup>2</sup>, (86.93% of the geographical area); of this, 4,242 km<sup>2</sup> are protected forests and 2,929 km<sup>2</sup> are Reserved forests (A N D E & F, 2001).

However, the above data are based on FSI surveys using 1:50,000 base maps. This is being repeated at the moment using 1:25,000 base maps, and it is expected that the estimated forest area will reduce once these are available, due to exclusion of areas occupied by creeks and sandy stretches.

The remaining 14 % of land is revenue land and is used for human settlements, agriculture and other human based activities. Most of the revenue land is along coastal areas where people are settled. The entire rural and revenue areas are under CRZ- IV (Coastal Regulation Zone- category IV), except a very small area under CRZ- II and no development is permissible within 200 metres of the high tide line in CRZ- IV areas (A N D E & F, 2001). Of the 14 % of revenue land only 21 % is under intense cultivation and another 11 % is classified as fallow land and cultivable wasteland, plantation crops cover 45% of the revenue land (Sirus, 1999).

### ***10. Forestry***

The notified forest area in the islands is 7, 170. 69 km<sup>2</sup> and of this 41 % area is under Tribal Reserves. The primary objective of Forest management had been protection of the forest ecosystem, and secondly meeting the requirement of local industries and the people settled here under various colonisation schemes. There are several small island forests that were considered nonviable for timber exploitation.

For the purpose of extraction of timber and regeneration of forests, after attempting Selection system and Clearfelling systems, finally after repeated experiments, Andaman Canopy Lifting Shelterwood System was found suitable and this system proposed by B.S. Chengappa was used for forestry operations (Chengappa, 1934, 1937 a, 1937 b, 1944). This was meant for enhancing the value of the forest in commercial terms, and commercial species were encouraged, in tune with the then National Forest Policy. This, as envisaged, resulted in a change of the forest composition and diversity in favour of commercially important species. Recent studies in limited areas show that these changes have occurred (Pandit, 1992). From a biodiversity point of view the number of species might have declined through using this system, besides change in microhabitats, several species of amphibians, plants, insects and freshwater fish might have been lost, in the area set aside for production forestry. Approximately 30% of the forest area was set aside for production forestry and regenerating these areas through Andaman Canopy Lifting System, leaving 70% of the area totally protected in the Protected Area Network, including the tribal reserves, and this remains undisturbed except for interference from settlements. Of the area set aside for working, about 50% has been worked till date, and the balance area may not be worked in view of the recent orders of the Supreme Court.

Changes are particularly evident wherever there are large densities of introduced herbivores such as the Chital (*Axis axis*) in the Andamans, (Aul, 2002). This is particularly obvious in the South, Middle and North Andamans; on Ross Island deer have been observed feeding on garbage.

Settlement has also resulted in the loss of most of the lowland evergreen forest, and small freshwater riverine habitats, which include most of the Andaman Teal and crocodile nesting habitat in the Andamans

(Andrews & Whitaker, 1994; Vijayan, 1996; Vijayan, 1997; Andrews, 1999; 2000 c; 2001). These flat lands close to freshwater streams were thought to be the most suited for agriculture and were preferentially cleared. There is, currently, very little of the lowland forest type left in the Andamans except in Protected Areas and in the Jarawa Reserve along the west coast of South and Middle Andaman Islands.

The Nicobar Islands, on the other hand, have had a long history of horticulture, and sections of coastal forests were cleared to an extent to let coconut trees regenerate together with other forest species that are utilised from time to time, either for food or construction. Since 1996 clearings have occurred on the south east coast of Great Nicobar Island and in the Nancowry group since the 1980s, for settlement of settlers who came there. Clearing here has also concentrated on coastal lowland forest. This in turn has affected the habitat of important endemic birds such as the Nicobar Megapode, (Sankaran, 1995) as well as for the Giant Robber Crab, small crocodiles and sea turtles on the south east coast of Great Nicobar Island (Andrews *et al.*, 2001; Andrews & Sankaran, 2002).

### ***11. Endemicity***

Of special note while discussing the ecological profile of these islands is the high level of endemism. Overall, 9% of the fauna is endemic. 40% of the 244 species and subspecies of birds are endemic. In mammals, 60% of the 58 species are endemic. The A & N I supports a significant diversity of reptile and amphibians with a high level of endemism. Currently seven amphibians and 16 reptile species are endemic to the Andamans and two amphibians and 15 reptiles are endemic to the Nicobars. (Das, 1994, Andrews and Whitaker, 1998; Das, 1999; Andrews, 2001; Andrews & Sankaran, 2002). Representing 700 genera and belonging to 140 families, about 14% of the angiosperm species are endemic to the islands. Among the non-endemic angiosperms about 40% are not found in mainland India, but have only extra-Indian distribution in South East Asia. (Rao, 1996). The butterfly diversity and endemism is also very high, of the 214 species and 236 subspecies in 116 genera, over 50% are endemic (Khatri, 1993).

This endemism is due to the isolation from mainland Asia (Das, 1999). Thus, considering the size and area of the islands, loss of habitat leading to extinctions will have far greater consequences in terms of the loss of genetic diversity than comparable areas elsewhere. A rough calculation using island biogeography theory indicates that with the area of forest down to 86% of what it used to be, about 4.5% of species may have been lost.

### ***12. Brief history***

There was no organised Government in the Andamans until 1858, when the British established a penal colony there. An earlier attempt to establish a penal colony at in Chatham Island near Port Cornwallis in North Andaman, in the 1790's had failed.

The British formally annexed the Nicobars in the 1860's. The islands were used chiefly as a prison colony. There was extensive trade of copra from the Nicobars then, something that continues to this day.

The Japanese occupied the Andaman Islands from 1942 to 1945. They have left almost no legacy apart from fortified bunkers and large guns all along the coast. Their brief rule was marked by savagery. Before withdrawing they destroyed all the jail records, so a fascinating bit of the island's history has been lost.

Forests are worked to meet the requirement of timber-based industries, both small and medium, and to meet the needs of the local population for wood and non-timber forest produce. The major commercial tree – species on the island include gurjan (*Dipterocarpus species*), padauk (*Pterocarpus dalbergioides*), white chuglum (*Terminalia bialata*), and badam (*Terminalia procera*).

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 settlers and tribes 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, for dragging the logs as well as to help in loading and unloading. During the colonial period, demand for wood was not high. A government sawmill was established at Chatham island in 1883 and it supplied sawn timber to the settlements around Port Blair. A matchstick unit was established at Port Blair in 1926 by WIMCO. Logs of padauk and gurjan found a ready market on the mainland (Khan, 1983).

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 non-timber forest produce. Wood based industry also expanded. The extraction of timber in 1950 was around 49, 000 m<sup>3</sup> per annum, which increased to about 145, 000 m<sup>3</sup> per annum in 1986. The number of commercially exploited species also increased.

As per decisions taken by the Island Development Authority (IDA), under the chairmanship of the Prime Minister and recommendations of the Inspector General of Forests, the ANI administration started phasing out forest working and lowered extraction levels from 123, 678 m<sup>3</sup> in 1988 – 89 to 103, 660 m<sup>3</sup> in 1990 – 91. However, this increased again to 135, 523 m<sup>3</sup> in 1994 – 95, to get reduced to about 40,000 m<sup>3</sup> in 1999-2000. At present, due to the intervention of the Supreme Court of India, all forestry operations have been suspended in ANI, and revised Working Plans are under preparation for working only in the areas already worked.

### ***13. Information on previous studies***

**Previous studies carried out relating to biodiversity and allied subjects include:**

#### ***3.1.2. ANET***

- Biogeography of herpetofauna of the A NI.
- Protected Area management Planning.
- Ecology, behaviour and demography of the Andaman Day gecko
- Terrestrial behaviour and geographical variation in the Yellow lipped sea krait.
- Distribution of reptiles and amphibians in the A & N.
- Sea turtle status surveys, studies and their conservation.

- Threatened herpetofauna of A N I.
- Ecology, status and conservation of saltwater crocodiles in A N I
- Utilisation patterns of forest produce at Wandoor.
- Ecological appraisals of RJMP, Mt. Harriet NP, Little Andaman Island
- Botanical appraisals of RJMP, Mt. Harriet NP, Saddle Peak NP, MGMNP & Wandoor
- Socio-economic studies of MGMNP, RJMNP, Saddle Peak NP and Mt. Harriet NP
- Wetlands assessment of Andamans, Little Andaman and Great Nicobar Islands.
- Water management at Wandoor
- Census and impact of feral elephants
- Impact of spotted deer on natural regeneration of small island ecosystems- MGMNP & Little Andaman Island.
- Shark fin harvest in the Andaman Islands
- Ecology and Status of Bats of Andaman & Little Andaman Islands
- Ecology of the Nicobar Tree Shrew

### **3.1.3. BNHS**

- Inventory and distribution of birds & bats A N I.
- Important Bird areas A N I.

### **3.1.4. BSI**

- Preparation of flora of the A N I.
- Enumeration of area wise distribution & species analysis of mangrove vegetation
- Study on wild relative of crop plants of A N I.
- Study on wild ornamental plants of A N I.
- Establishment of botanical gardens at Dhanikari and Kalpong.
- Establishment of a orchidarium and a Fern house
- Studies on economical important plants and wild edible fruits

### **3.1.5. CARI**

- Ecological considerations and Agricultural Development of A N I
- Insects of Agricultural importance in A N I.
- Rice based cropping system for Bay Islands.
- Plantation based cropping system for Bay Islands.
- Perilous Aliens.
- Fodder Resources of Bay Islands.
- Corals of A & N Islands - a status report.
- Under utilized tropical fruits of Bay Islands.
- Indigenous Poultry Germplasm of A N I.
- Feral Goat: Unique Germplasm of Barren Islands.
- Unicellular Algae in A N I.
- Anemone fishes in A N I.
- Butterflies of A N I

### **3.1.6. CAS in Marine Biology**

- Marine resources of Great Nicobar Island.

### **3.1.7. Delhi University**

- Ecosystem dynamics and plant-animal interactions in the Great Nicobar Biosphere Reserve.

### **3.1.8. Dept of Space (IIRS, ISRO, NRSA, VSSAC)**

- Ongoing project on characterisation of biodiversity at landscape level
- Development of a GIS based information system on biodiversity for the islands

### **3.1.9. A N D E & F**

- Flora of Andamans
- Forest regeneration
- Forest Utilization
- Regeneration of padauk
- Teak plantations



- Mangrove area management
  - Timber properties
  - Working Plans
  - Management Plans of MGMNP and Mt. Harriet NP.
  - Status of Corals in A NI.
  - Phenology & nursery behaviour Flora
  - Introduction trials of exotics
  - Plantation trials of native species
  - Growth and Increment studies of native species
  - Survey of grasses
  - Forest statistics
  - ANI forest & environment
- 3.1.10. Fishery Survey of India**
- Fisheries potential of A N I.
  - Socio economics of fishermen
- 3.1.11. FSI**
- Status of Forest reports.
  - Pre-Investment Surveys
  - Report on Forest regeneration in the A & N islands.
- 3.1.12. ICFRE**
- Revision of Parkinson's flora
  - Planting Stock Improvement (Establishment of Seed Production Areas/ Seed Orchards)
- 3.1.13. IIPA**
- Directory of National Parks and Wildlife Sanctuaries for the A & N.
  - Prioritising sites for biodiversity conservation
- 3.1.14. JNRM**
- Butterflies
  - Mangroves
- 3.1.15. KFRI**
- Studies on rattans
- 3.1.16. NAEB (RC) at Jadavpur University**
- Eco-tourism
  - Utilization of minor forest produce
  - Regeneration survey
- 3.1.17. NBRI**
- Medicinal Plants- inventories
- 3.1.18. Pondicherry University**
- Impact of Andaman Shelterwood system
  - Birds of MGMNP
  - Bird survey of selected islands in the Andamans
  - Butterfly survey of selected islands in the Andamans
  - Ecology and behaviour of Nicobar macaques
  - Forest tree diversity of moist evergreen forest.
  - Vascular epiphytes in South Andaman Island
- 3.1.19. SACON**
- Ecology, distribution and conservation of the Nicobar Megapode
  - Ecology, distribution and conservation of the Andaman Teal
  - Status and conservation of the Narcondam Hornbill
  - Census and impact of feral elephants
  - Conservation of the edible-nest swiftlet.
  - Ex-situ farming of the edible-nest swiftlet.

### **3.1.20. WII**

- Survey of coral diversity & land use in the MGMNP

### **3.1.21. WWF-India**

- Biodiversity Characterisation and Conservation Project.
- Watershed management and dependence on forests in Wandoor.

### **3.1.22. ZSI**

- Mangrove fauna
- Reef fishes of A NI.
- Fish families Siganidae and Acanthuridae
- Commercial Fish Families Caesiariidae and Mullidae
- Echinodermata of Nicobars
- Study of coral reefs

## ***14. Information on previous surveys***

- Birds- ANI (BNHS & SACON)
- Birds- selected Andaman Islands (Pondicherry University)
- Butterflies ANI (JNRM & ZSI)
- Butterflies-selected Andaman Islands (Pondicherry University & CARI)
- Bats- Andamans (ANET)
- Coral reefs (A N D E & F, WII, CARI & ZSI)
- Fishes of A N I (ZSI & CARI)
- Forest surveys (AN D E & F, FSI & ICFRE)
- Fresh water fishes - Andamans (ANET)
- Herpetofauna ANI (ANET)
- Floristic survey of grasses (ANDE & F and BSI)
- Herpetofauna survey of Great Nicobar Biosphere Reserve (ANET)
- Floristic Survey of Great Nicobar Biosphere Reserve (BSI)
- Floristic Survey of Saddle Peak National Park Area (BSI &ANET)
- Floristic Survey of Mount Harriet National Park (BSI & ANET)
- Floristic Survey of MGMNP (BSI &ANET)
- Floristic Survey of RJMNP (BSI & ANET)
- Floristic Survey of Kalpong Hydro- Electric Project Area (BSI)
- Floristic Survey of Grasslands of Nancowry Islands (BSI)
- Floristic Survey of Barren Islands (BSI)
- Floristic Survey of Reserve Forests of Shompen & the Jarawa Reserves (BSI)
- Mariculture potential of A N I - an indicative survey. (CARI)
- Medicinal plants (NBRI & ANDE & F)
- Mangroves (JNRM)
- Marine Turtles ANI (ANET)
- Socio economic status of Fisherman in Andamans. (Fisheries Dept, CARI & ANET)
- Socio economic MGMNP (ANET & WII)
- Survey of medicinal plants in South Andaman. (CARI, NBRI and ANDE & F)
- Saltwater crocodiles ANI (ANET)
- Survey of fungi (ANDE & F and FRI)

## 4. Current range and status of biodiversity

### 15. State of forest ecosystems

Till 1870 there were no records of commercial exploitation of forest products. Irregular and selective felling remained confined to commercially important species. Rapid forest activities started after Independence and a number of industries based on timber came up. One of the most productive systems exists here and has trees (592 sp.) shrubs (320 sp), climbers (175 sp) and herbs (491 sp). 16.18% of the forest area is under tribal reserve, 13.57% are mangrove and 7.4% are managed under national parks and sanctuaries. In total 69.58% of the forest area (4989.90 km<sup>2</sup>) is protected in the form of tribal reserves, national parks and sanctuaries (Fig: 4), and further in the form of mangrove conservation working circle and protection working circle even within the area covered by working plans. 30.41% of the forest area (2180.79 km<sup>2</sup>) was set aside for forestry operations and till 2002 only 15.49% of the forest area (1110.52 km<sup>2</sup>) had been regenerated under the Andaman Canopy Lifting System.

#### Some important forest species include:

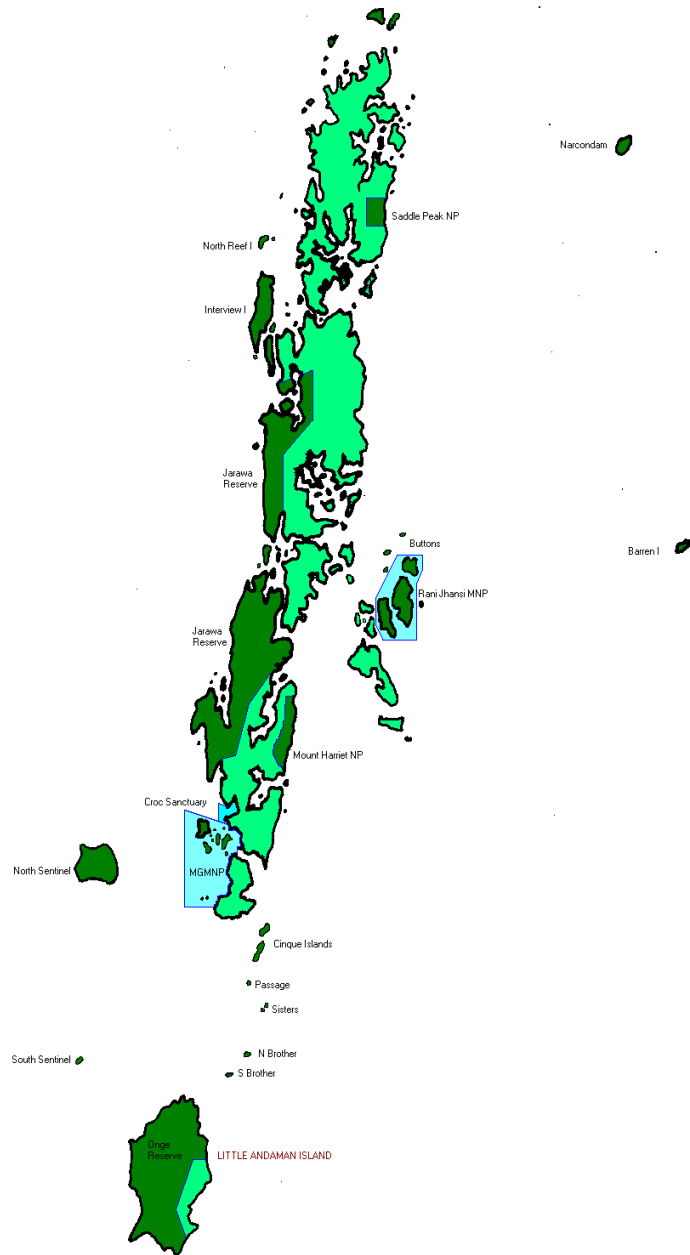
*Dipterocarpus alatus*, *D. grandiflora*, *D. pilosus*, *D. costatus*, *Artocarpus chaplasha*, *A. gomeziana*, *Calophyllum soulteri*, *Amoora wallichii*, *Pterocymbium tinctorium*, *Gnetum scandens*, *Sideroxylon longipetiolatum*, *Croton argyratus*, *Mesua ferrea*, *Canarium manii*, *Euphorbia trigona*, *Pterygota alata*, *Dillenia pentagyna*, *Clerodendron viscosum*, *Ceriops tagal*, *Diospyros marmorata*, *Ventilago sp.* *Acacia sp.*, *Manilkara littoralis*, *Morinda citrifolia*, *Erythrina variegata*, *Calophyllum innophyllum*, *Thespesia populnea*, *Hibiscus tiliaceus*, *Crinum asiaticum*, *Vigna retus*, *Colubrina asiatica*, *Caesalpinia bonducella*, shrubby growths, canes, surface creepers and bamboo.

#### Economically important species include:

*Pterocarpus dalbergioides*, *Sageraea elliptica*, *Diospyros marmorata*, *Murrya exotica*, *Terminalia bialata*, *Terminalia procera*, *Terminalia manii*, *Madhuca butyracea*, *Pajanelia rheedii*, *Albizia lebbek*, *Artocarpus gomeziana*, *Planchonia andamanica*, *Calophyllum inophyllum*, *Lagerstroemia hypoleuca*, *Parishia insignis*, *Artocarpus chaplasha*, *Hopea odorata*, *Adenanthera pavonina*, *Dipterocarpus spp.*, bamboos and canes.

Figure 4

Protected areas in the Andamans



The islands are at a critical juncture, and any further disturbance, whether due to continued immigration and encroachment, continued over-fishing, logging or continued encroachment into the tribal areas, is likely to have serious effects in terms of the loss of biological diversity. Since island ecosystems, being small, fragile and unique unlike continental ecosystems, the problem of very restricted distribution for some species comes in. This, together with the presence of endemics, is central to biodiversity conservation in an island ecosystem Unless management systems are re-evaluated and made more conservation oriented the long term protection of many such species remains doubtful.

An important use of forest ecosystems is the removal of NTFP's. NTFPs in the islands include:

- Canes, suitable for walking sticks, basket making and furniture;
- Resins (eg. *Canarium euphyllum*), for varnishes and bottling wax;
- Gurjan oil (from *Dipterocarpus* spp.), used as an ingredient of lithographic inks and anti-corrosive coatings for iron;
- Gums, from *Lannea coromandelica* have good adhesive properties;
- Tans and dyes (mangroves are rich in tannins, but are not used).
- Pan leaves occur in the wild as well and is collected.
- Vanilla (A high value market product but not tapped)
- Honey and wax are available from the forest, but are not collected commercially
- Bamboo plays a major role in construction, fencing, baskets and mats in rural areas
- Poles are used as a construction material
- Fuel Wood is the main source of fuel in most rural areas
- Fruits of many wild species are consumed.
- Edible tubers form a major part of tribal diet
- Settlers and immigrants eat wild boar, monitor lizard, dugong, sea turtles and their eggs, besides several species of birds and bats.

Many of these NTFP's however, are not commercially collected. Of these NTFPs only canes, bamboos, fuel wood, ballies, posts and thatching leaves are collected for domestic use or for commercial purposes, under permits issued by the Department of Forests and Environment. No other NTFP is being collected in an organised manner.

Forests are down to 86% of what they used to be, and probably another 10-20% has been degraded by human activity. This could lead to a long-term reduction of between 4. 5- 13% of the islands terrestrial endemic fauna and flora (This is derived by using  $Z=0.301$  in applying the MacArthur & Wilson theory of island biogeography) (MacArthur & Wilson, 1967).

### ***16. State of agricultural ecosystems***

The land that was brought under agriculture by 1981 was 14, 953 ha and by end of 1992 the land under high- yielding varieties of rice was 12, 000 ha. Currently it is over 53, 315 ha and of this 27, 890 ha are under coconut and areca nut plantations. This area is decreasing due to urbanisation, industrialisation and the intrusion of seawater. Socio- economic surveys conducted around two national parks show that only 41 % of villagers raise paddy and plantation crops and 54 % raise plantation crops alone (Singh, 1997; Ali 2000). Agricultural ecosystems have been adapted almost in toto from mainland India. Very few indigenous varieties are used and only a little germplasm of different crops is available here. Wild rice

species have been reported from Saddle Peak area and Rutland Island (Ellis, 1987 a; b). The islands also fall within the geographical distribution of coconuts and wild germplasm may be available here. On the whole, loss of agricultural diversity will not be a serious issue here. The exception to this is the necessity for an effort to identify more wild relatives of cultivars.

According to estimates concluded by the Food and Agriculture Organisation of the UN, A & NI can support three persons / ha. at an intermediate level of agriculture and five persons/ ha. at a level of intensive and technologically advanced agriculture. The 1989 production rate that is not a significant increase since then, the Andaman Islands can only support 1.6 persons/ ha. Current increase in population trends, clearly indicate that the agriculture carrying capacity has been well surpassed (Sirus, 1999; Andrews & Sankaran, 2002).

However, a decline in rice yields has been found in two areas in North and South Andaman Islands and there is a surplus of locally grown rice in the Andamans. This is controversial and is discussed later. Fungal infestation at the harvest and post harvest yields has made rice-farming unremunerative in a number of areas. Farmers do not, at the moment, want to phase out this cultivation because it is used for personal consumption and in exchange for labour. The quality is sub standard and FCI will not procure it and most people in the islands prefer purchasing rice imported from Chennai, which indicates that the standard of living has gone up. The decline in yields is likely to result in considerable pressure on the surrounding forests and seas, and this has consequences for the richness of these forests, marine resources and coral reefs.

Silt from wet rice cultivation is damaging coral reefs and mangroves. Exotic weeds such as *Eupatorium* have also been imported with seeds brought from the mainland.

Due to better opportunities and alternative source of income in the forestry and fishery sector relatively few people are engaged in agriculture (16% in cultivation and 4% as agricultural labourers). In fact agriculture in the islands is treated as a secondary enterprise. Minor irrigation is still scarce in Andamans. By digging ponds as impounding rain water for utilization for dry season crops (for which government assistance is available) an area of 952 ha has so far been brought under the minor irrigation scheme.

Fertilizer use by the farmers is negligible (approx. 5 kg/a. or less) and imbalanced and this is presumed to cause low crop productivity in the islands. This use of pesticides and chemical fertilisers is, however, resulting in damage to the ecosystems here: there is paucity of data from the islands, however. The consumption of pesticides, though on the rise, is still not adequate according to Agriculture Dept. norms. Pesticide use is constrained by the heavy rainfall that results in higher applications being necessary. It is also constrained by lack of availability. However pesticide usage is high in Diglipur area in North Andaman Island, Middle, South, Little Andaman, Neil and Havelock Islands, around where some of the best mangroves, fresh water streams and coral reefs occur.

## ***17. State of marine ecosystems***

The A NI coastline is 1, 962 km and around 35, 000 km<sup>2</sup> of continental shelf that provides potential fishing grounds. The 200 miles of Exclusive Economic Zone (EEZ), around A & N group of islands, is vast and covers a sea area of 0. 6 million km<sup>2</sup>, which is about 30% of the EEZ of India. The Census of India (1991) estimated the fisheries potential as 160, 000 tonnes of which 100, 000 tonnes as tuna and tuna like fishes. Reports by CARI show that out of the total 130, 000 tonnes of pelagic stock, only 13, 200 tonnes are currently exploited (Soundarajan, *unpub.*). The Fisheries Department has reported that the fisheries potential is 2,435 lakh tonnes and the current total catch is 30,000 tonnes. Currently there are 2,524 fishermen who ply around 1, 983 boats around A & N (Sirus, 1999; Fisheries report, 2001; Andrews & Sankaran, 2000).

The ANI did not have any fishing communities and the fisheries sector began by bringing fishermen families from the mainland and settling them on the islands, the Department of Fisheries was set up by the A & N Administration in the islands in 1955. Since then fishermen from Kerala, and Andhra were settled in the islands. The A & N Administration provided these people with land, housing, loans and fishing equipment. CARI and the Fisheries Department are also developing inland aquaculture sector.

Efforts have been made by the A NI Administration to promote the growth of commercial fishing, storage, marketing and exports. They have set up the A & N Islands Integrated Development Corporation (ANIIDCO). ANIIDCO has floated a company the Andaman Fisheries Limited (AFL). AFL has set up cold storage and processing plants. The Marine Products Export Development Authority funded by DOD is also in the process of implementing a demonstration project for prawn farming. However there is a lack of co-operatives of self-help groups among fishing communities and the settlers (Sirus, 1999; Singh *et al.*, 2002).

The Bay islands enjoy the status of an archipelago and geographically they are close to Indo-Malayan region, which is supposed to have contributed as a faunistic centre to the recruitment of fauna in the regions of Indo-West Pacific. Because of limited studies on marine fauna of the ANI, the nature of their evolution as isolated populations or their centres of endemism are little known. Nevertheless, it has been clear from the available literature that many marine fauna of these islands are similar to those of Indo-west Pacific.

Marine habitats are quite varied and vast and their diverse fauna range from microscopic plankton to whales. Amongst marine animals the following groups are very important: zooplankton, 70 sponge species are known from Andaman waters and two species are known to be endemic, coelenterates, corals over 200 species have been recorded.

### ***4.1.1. Fish***

The area available for fisheries around the Andamans is 16,000 km<sup>2</sup>. The fisheries potential is estimated at 243,500 tonnes, as against a current (official) catch of 30,000 tonnes. 17% of this is estimated to come from coral reef areas. The vast potential can be envisaged from the following facts that 1/3 of EEZ of our country lies around Andaman and Nicobar Islands and ¼ of total coastal area of our country also belongs to ANI. Shark, sardine, mackerel, trevelly, catfish, mullet, ribbonfish, barracuda, grouper, snapper, seer fish

and tuna form important fish groups in commercial fishery. Recently certain heavily exploited and endangered marine fishes have been accorded protection under the WLPA, 1972 such as Whale Shark, Giant Grouper, Sawfish and six other species of sharks.

#### **4.1.2. Reefs**

A & N are fringed by one of the most spectacular and extensive reefs in the world and currently they are not only significant for the Indian Ocean region but is also globally significant (Kulkarni, 2000; Vousden, 2001; Turner *et al.*, 2001, Andrews & Sankaran, 2002). However, the extent of reefs in the A & N is not accurately known yet and recent surveys report the extent as 11, 939 km<sup>2</sup> (Turner *et al.*, 2001). Pillai (1972) reported 68 species belonging to 31 genera and the same author in 1983 reported 135 species for both island groups. Wafar (1992) also identified 135 species in 59 genera and the same author in 1996 calculated the reef extent for A & N as 11, 000 km<sup>2</sup>, Qasim (1998) reported 189 species for ANI. Outside of MGMNP, very few studies have been done previously. A survey conducted by ZSI in collaboration with UNDP reported 197 species of corals within 58 genera with an average of 65 species at the 13 different sites sampled (Vousden, 2001; Turner *et al.*, 2001). They also reported the extent as 11, 939 km<sup>2</sup> that includes lagoons, banks, reef slopes and reefs. The total area of reef flat was estimated to be 259 km<sup>2</sup>, providing a total area of shallow reef of 520 km<sup>2</sup> around North Andamans alone. Species numbers ranged from 44- 89 and averaged 65 species per site. These same authors have reported that, the Andaman reefs consist of about 83% of maximum coral diversity found any where in the world and is equal to the 'Coral Triangle' off Indonesia, and about 400 species could emerge after further surveys. There are two protected areas for reefs in the Andamans, the MGMNP and the RJMP and both have adjoining reefs that need inclusion. There are also large areas of reef outside these PA's that are largely ignored, with very little protection efforts going into them. A study of the marine fauna in the MGMNP, Wandoor, and South Andaman was done by a project sponsored by the Science and Technology Department of A & N Administration. During this survey 115 coral species were recorded within this NP alone, which included new records for the islands (Kulkarni, 2000), and the same author on a follow up survey around ANI reported 189 species with, again, several new records for the islands (Kulkarni, 2001).

A & N Islands have the last pristine reefs in the Indian Ocean region, and are emerging as one of the most important coral reef sites in the world. Currently reefs have become globally threatened due to various environmental and climatic factors along with greater use of their resources both directly such as over fishing and indirectly through recreational tourism. All scleractinian corals and some associated reef fauna such as sea cucumbers and giant grouper have been brought under the purview of the WLPA, 1972 under Schedule I. Nine species of molluscs have also been placed in various Schedules of WLPA, 1972.

#### **4.1.3. Crustaceans**

Two groups of crustaceans namely, microcrustacea and macrocrustacea exist. The former includes copepods, ostracods, and cladocerans. The latter include lobsters, crabs and prawns. More than 400 species of crustaceans have been recorded which include 14 species of barnacles (sub class: Cirripedia); 146 species of prawns, shrimps and allied forms (sub class: Malacostraca; order: Decapoda; suborder: Ntantia);



217 species of crabs and allied forms (suborder: Reptantia), 7 species of lobsters and 37 species of mantis shrimps (order: Stomatopoda),

#### Lobster

Among lobsters, seven species have been known: *Panulirus* spp. (six) and one *Linuparus* sp. The most common species are *Panulirus versicolor* and *P.longopes*. *P.penicolletus* and *P.ornatus* occur in deeper waters. *Linparus* sp. has been found as an important lobster resource in trawl catches along the east coast of the Andamans. The deep-sea lobster *Purulus sewelli* is also an important exportable lobster resource, caught off Andamans; both along the east and west coasts, are being exported to Malaysia and Singapore.

#### **4.1.4. Molluscs**

These constitute very large group as seashells and they exhibit diversity in shape, size, colour and form. The Gastropoda have single shells, many of which have a high commercial value because of their beautiful colouration and shape. The bivalves have two shells and many of them serve as edible seafood. The nudibranchs have no shell and have little economic importance. The Cephalopods are fast swimming molluscs such as squids and octopi, and have a high commercial value. There are primitive molluscs like Chiton which, live adhering to inter-tidal rocks.

#### **4.1.5. Gastropods**

Some of the important gastropods which are rare on the mainland coast are top shell *Trochus*, turban shell *Turbo*, king shell *Cassis comuta* and queen shell *Cypraea rufa*.

#### Pearl oysters

These bivalves have very high commercial value as they produce pearls. Five species have been known and among them blacklip pearl oyster, *Pinctada margaritifera* is predominant. The pearl culture technique for this species is yet to be developed in India. The most used species in India is *P.fucata* and it is rare in these islands. The very highly valued large pearl oyster species, *P. maxima* is presumed to occur in these islands, even though it has not been authentically collected from Andaman waters so far.

#### **4.1.6. Giant clams**

Four species are known to occur and among them *Tridacna crocea* is most abundant. *T. maxima* has commercial value. The other two species *T. squamosa* and *Hippopus hippopus* are rare. *Tridacna maxima* and *T.squamosa* which grow very large (a few hundred kg in weight), can be cultured.

### **18. State of mangrove and coastal ecosystems**

The estimated area of mangroves in 1957 in the islands was about 1200 km<sup>2</sup>. Another estimate done in 1986/1987 using LANSAT imagery estimated a total of 777 km<sup>2</sup>. for ANI of which 287 km<sup>2</sup> is for the Nicobars. 1999 estimate by the FSI estimated 966 km<sup>2</sup>. In spite of the discrepancy between the last two figures, it is clear that mangroves have declined by at least 20% over the last 40 years. However, in the last 10 years there has been an increase, with the latest estimate being 1012 km<sup>2</sup> (Balakrishnan, 1998). It is known that mangroves form the feeding grounds for commercially important finfish's and crustaceans.

Mangrove areas are also known for their diversity of various marine organisms.

There are 58 mangrove species found in the islands. These include *Rhizophora mucronata*, *R. candelaria*, *Bruguiera conjugata*, *B. parviflora*, *Avicennia*, *Xylocarpus* sp., *Ceriop tagal*, *Sonneratia* sp., *Lumnitzera* sp. *Kandelia kandel*, and *Acanthus ilicifolius*.

ANI mangroves have 253 species of fish, 410 species of polychaetes, and 53 species of meiofauna associated with them. It is clear that any degradation of coastal ecosystems such as coral reefs and mangroves will have an adverse impact not only on the unique biodiversity of fragile coastal ecosystems but also on coastal fisheries and tourism, which is becoming the mainstay of the island's economy.

### ***19. State of wetland ecosystems***

Freshwater wetland ecosystems of the islands have at least two restricted range endemic bird species: Andaman Crake and Andaman Teal (Andrews & Whitaker, 1994; Vijayan, 1996a; b; Vijayan & Sankaran, 2000). Besides being very important nesting habitat for the saltwater crocodile and feeding areas for bat species. Swampy areas in lowland evergreen forests have been almost totally destroyed by conversion to agriculture, with the only substantial tracts remaining in Baratang and Little Andaman Islands, and the Jarawa Reserve off the west coast of South and Middle Andamans (Andrews & Whitaker, 1994; Andrews, 1999; 2000 b; 2000 c; 2001; 2002). Little Andaman Island has wetland ecosystems found no were else in the ANI, these include long stretches of freshwater streams, open saline marshes, peat bogs and large tracts of freshwater grassy marshes (Andrews, 2000 b; Andrews & Sankaran, 2002).

Open swamps have also been drained in a number of places, making this an increasingly rare habitat. Demarcating and protecting these becomes a priority task. There are also significant wetlands in revenue areas that need protection. Areas exist in Chouldhari, Bamboo Flat, Sippighat, Wandoor, Baratang, Mayabunder and North Andaman Island.

### ***20. State of introduced and domesticated livestock***

**Cattle:** Two different genetic groups of cattle are found here, namely local cattle of Andaman and Trinkat cattle. Local cattle of Andaman are distributed in Andaman group of Islands and Campbell Bay. These cattle populations consist of three breeds: Sahiwal, Hariana and Red Sindhi. Trinkat cattle are concentrated in Trinkat Islands only, probably introduced by the Dutch.

**Goat:** There are three genetic groups of this species: the now local goat of Andaman (Black Bengal type), Terressa goat and the feral goat of Barren and Narcondam Island. A small population of Malabari goat is also available with the AH & VS.

**Buffalo:** Buffaloes were introduced from mainland India and these are distributed in the Andaman group of Islands and Campbell Bay.

**Pig:** There are three different genetic groups of pigs in the Islands; however their systematics is currently unknown. They are the local Andaman wild pig, long snouted Little Andaman wild pig and the Nicobar

wild pig. Andaman wild pig was once found all over in the forests of the Andaman group, but have become extremely rare and currently the last strong holds are the Jarawa Reserve, Rutland and Little Andaman Islands. Nicobar wild pig is concentrated in Nicobar group of Islands. Hybrids from mainland India have been domesticated and some of these have been hybridised with the indigenous varieties in the Nicobars and in Mayabunder area.

**Poultry** - Includes chicken, duck, guinea fowl and quail (recently introduced by CARI). The different breeds of fowl include the Nicobari fowl, an endemic that has become extremely rare and pure strains are not found any more. However CARI has developed a hybrid of this species. Others include Naked neck, Frizzle fowl, Barred desi, Aseel. Ducks include mainland Indian domestic species, Khaki Campbell and their crosses.

## **5. Statement of key issues and problems**

### ***21. Loss of forest and conversion to monoculture***

#### ***5.1.1. Status of forest cover***

Although the total forest cover of the islands is still around 92% (according to FSI), out of which 86% is the notified forest area, the 1999 FSI report showed a decline in forest area of just 7 km<sup>2</sup> over the last two years (Fig: 5). 177 ha alone were encroached between 1996 and 1998, and this has probably accelerated since then. The imageries used are too large in scale to show the smaller encroachments. It will be necessary to obtain imageries at a much finer scale to assess the loss of forest more accurately. This is necessary because the present Forest Survey of India analyses are made on a 1:250,000 scale (being upgraded to 1:50,000 scale) and do not detect small encroachments. Also, plantations, which are monocultures, are sometimes identified as natural forest.

Given the recent Supreme Court Order to vacate all post-1978 encroachments, it has become very necessary to be able to identify even the smallest, yet undetected encroachments. The recent imageries available from the NRSA enable the location of very small areas, and these need to be obtained and ground verified.

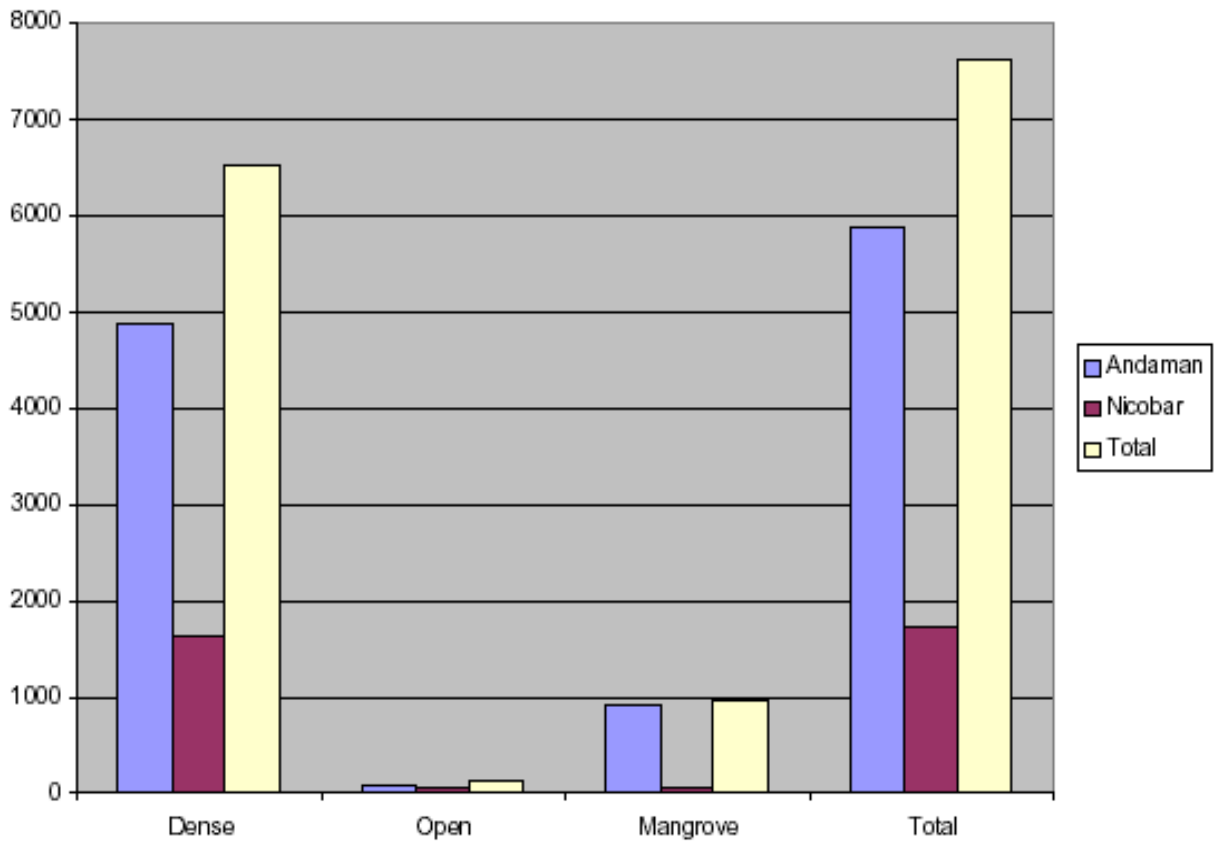
It is also not clear how much of each habitat type is remaining, even though the forest cover is 92%. FSI (2001) statistics show that lowland forest is very limited in extent (around 5% of the total; see below) and imagery will help identify new patches for protection.

#### ***5.1.2. Impacts of encroachment***

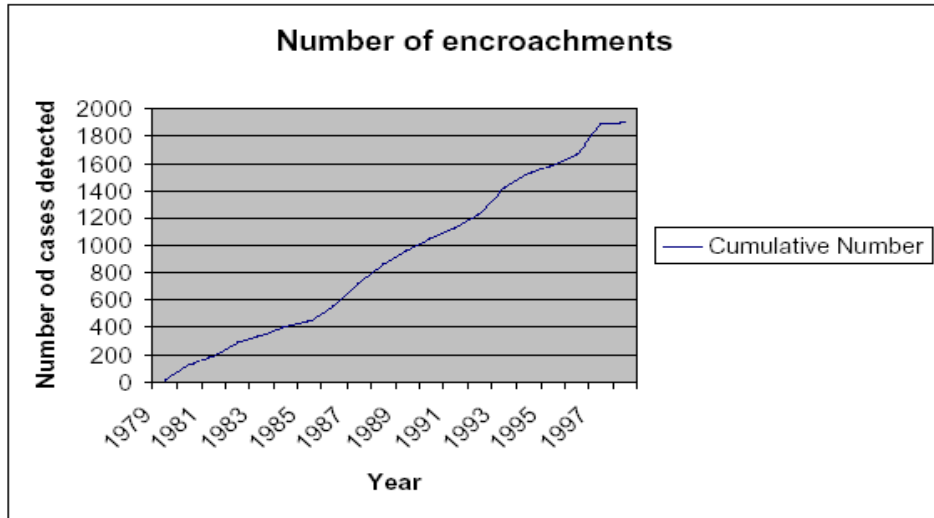
Forest Department statistics indicate that there is a tremendous problem with encroachment. Figure 6 shows the number of cases of encroachment detected over the last decade, and figure 7 shows the total area lost. It is believed that the encroachment problem is linked to the uncontrolled immigration into the islands, and

**Figure 5**

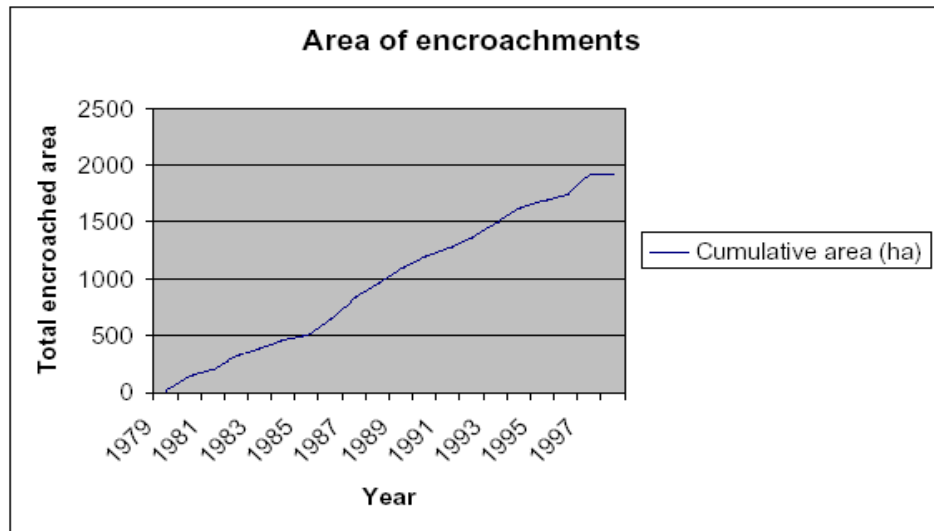
**Area of forest 1997**



**Figure 6**



**Figure 7**

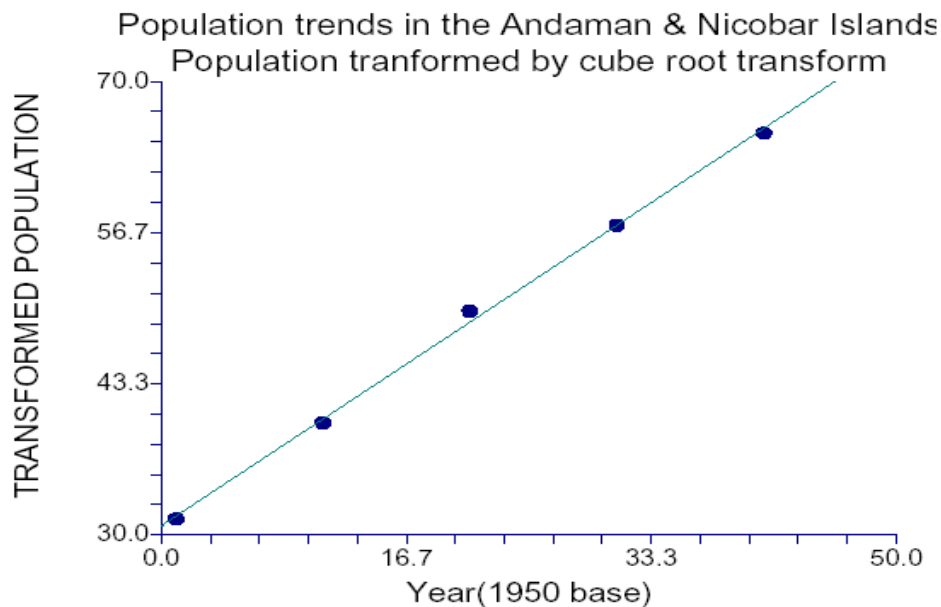


this in turn is linked to the subsidies available on the islands. In this context the 2001 Census of India statistics are revealing. The official figures show that there are 3.56 lakh people in the Andaman & Nicobar group. Extrapolation of the existing data from 1951 to 1991 by ANET, coupled with spot checks on actual populations in randomly selected hamlets, shows that the actual population could be as high as 4.12 lakh people,. This number is also the estimate used for planning developmental projects by the APWD. Controlling immigration is therefore more urgent than is realised.

Figure 8 illustrates the trend and using this, the estimated population for 2001 is 4.12 lakhs, which assumes that the population growth trends have remained constant. The evidence indicates that these trends have actually accelerated, and the actual population now may likely be between 5- 6 hundred thousand.

Encroachments lead to forest fragmentation, a reduction in forest cover, and its conversion to monocultures leading to loss of biodiversity. Encroachments also lead to degradation of the forests near them, since encroachers are not entitled to the NTFP and timber quotas given by the Department of Environment and Forests to regular settlers, and therefore are dependent on illegal use of the forest resources.

**Figure 8**



### 5.1.3. *MFP extraction*

An important aspect of NTFP extraction is that all bonafide agriculturists in possession of agricultural land residing outside municipal area are issued NTFP, viz., two cords of firewood, 500 bamboos, 100 ballies, 20 posts, 2000 thatching leaves and 200 canes per year on collection of a permit fee of Rs.5., but free of royalty, for personal use. This is generally misused, and the NTFP collected is sold for commercial use. Though permission is given only for collection of non-commercial ballies and posts, it is difficult to verify the species of each material collected, and there is a possibility of collection of commercial ballies and posts also which may affect the regeneration of those species adversely. Further, removal of the young regeneration, in the form of ballies and posts is likely to affect the condition of the future forest.

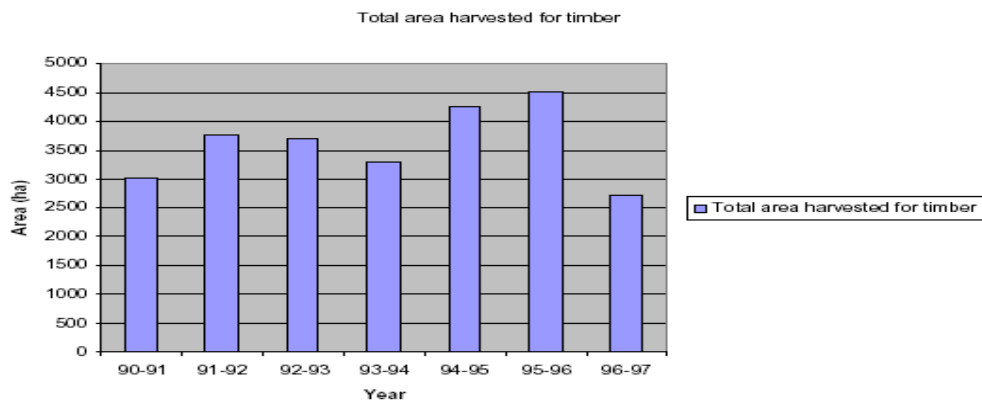
### 5.1.4. *Forests in privately held lands*

Settlers have been allotted hilly lands for horticulture. They were permitted to extract and sell the timber on these lands, on payment of royalty to the Government, if the Department of Environment and Forests was unable to clear the area for horticulture. Since they do not have the infrastructure to do this, middlemen do it for them. In the process the land is cleared and erosion takes place. Such lands under normal circumstances are to be converted into horticulture, usually for the cultivation of arecanut, coconut or spices, but in certain cases they have not been converted so far and are lying fallow and eroded. As per the ALRR, such unconverted areas should be taken back from the allottees. Also as per the Hon'ble Supreme Court ruling all such areas come under the definition of 'forest' and need to be dealt with accordingly.

### 5.1.5. *Timber extraction and its impacts on biodiversity*

There are no detailed vegetation maps of the past to compare with the present for the islands. As a consequence, the extent to which particular vegetation types are affected by timber operations is not known, figure 9 shows the area over which timber operations were done in the recent past.

**Figure 9**



As a consequence, the extent to which particular vegetation types are affected by timber operations is not known. However, the current statistics show that certain vegetation types are very scarce:

**VEGETATED AREA BY FOREST TYPE ON FLAT LAND**

Vegetation Type	Area on Flat Land (Km <sup>2</sup> )	Total Area (Km <sup>2</sup> )	% in this topography
Evergreen	27.06	672.13	4.02
Semi-Evergreen	92.80	1514.68	6.13
Moist deciduous	155.39	3148.83	4.93

**Source:** FSI, 2001

How much of the vegetation type is affected by the land relief is yet to be determined, but it is worth pointing out that recently in Thailand, the Gurney's Pitta (*Pitta gurneyi*), thought to be extinct, was found in the last remnant patch of lowland forest. It is prudent to protect these patches until proper surveys are conducted.

A specific problem, which also affects regeneration in worked areas, is due to the presence of spotted deer (*Axis axis*) in these islands. These browse on seedlings and therefore have affected natural regeneration in timber extraction areas to a very great extent. Species not browsed on include *Planchonia andamanica*, *Nauclea gaganea*, and *Lagerstromia hypoleuca*, and these have become very abundant in natural regeneration areas. Similarly, gaps in littoral forests are dominated by *Derris indica*. In unworked forests also where spotted deer are found regeneration has been very badly affected. However, since there is more regeneration in areas that have been worked the effects will be greater, and this has been well documented from other places overseas (Struhsaker, 1997).

Timber operations are suspended now because of the Supreme Court Order. Timber for local use only will be permitted. Considerable replanting will be done in the future and thought needs to be given to how much planting of endemic and rare species of trees can be incorporated into this.

Another issue that has cropped up with timber extraction is the loss of orchids. A study by Gopal (1990) reports 107 species, a very heavy epiphyte load on most forest trees in South Andaman Island and these are lost during forestry operations.

A study conducted by Pandit (1991) shows that the Andaman Canopy Lifting Shelterwood system leads to a change in the species composition and diversity of the stands. While this was the intention of this forest management system developed for the island over last 100 years to get a crop which is commercially more valuable, its implications for biodiversity conservation need to be analysed in depth. In any case such impact is localised to about 13% land area of the island.

**5.1.6. Damage to watersheds**

Most areas in the islands, especially urban areas, suffer from a drinking water shortage in the months of March and April, in spite of the annual rainfall almost 3500 mm. The geology of the islands does not permit ground water storage. The role of surface storage systems therefore becomes extremely important. For this, it is important that vegetation cover in the catchment areas for each watershed should be as much as possible.

Encroachments in many rural areas have led to the degradation of these watersheds. This has resulted in accentuating the drinking water problem.



## 22. Decreasing agricultural productivity

### 5.1.7. General

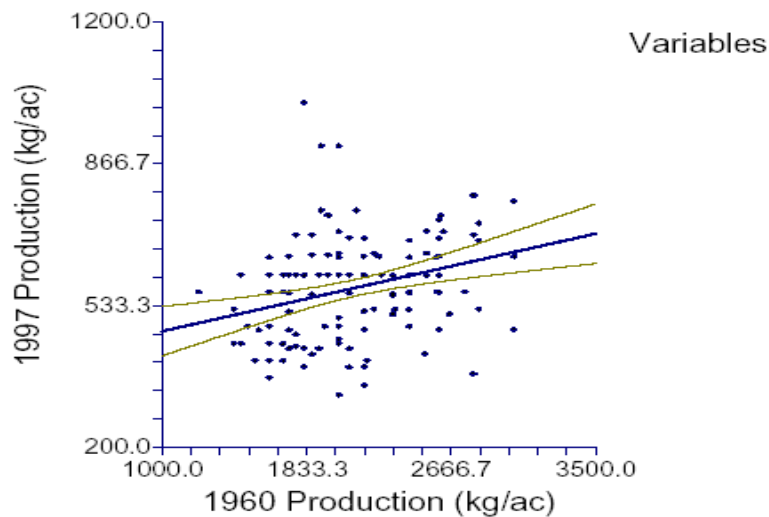
The Andaman ecosystem is not suitable for agriculture and horticulture. This is discussed in detail below, but the point must be made here that if current agricultural practices continue these islands will always be a net economic liability on the rest of India.

### 5.1.8. Rice yield decline in North Andaman Island

A study, conducted in 1999, shows that productivity of rice has declined from what it was 40 years ago: from 5.24 tonnes/ha to 1.57 tonnes/ha, suggesting that converted rainforest soils cannot sustain rice farming for long periods (Fig: 10) (Ali, 2000). However, Dept. of Agriculture statistics show that rice production is now 2.68 tonnes/ha. In North Andaman; they have no figures for past production. It is stated that rice production in North Andaman has in fact increased as there was a shift from cultivation of C – 14 – 8 to high yielding varieties of rice and more areas were brought under HyVs. The two methods need to be reconciled, since the Agriculture Dept. reports higher yields. However, even if ANET's past figures are overestimates and current figures are underestimates, rice yields have declined. Rice farming needs to be phased out because of this. Alternative land uses include agro forestry, involving a mix of vanilla, bamboo, rattan and timber species.

**Figure 10**

Changes in rice production between 1960 and 1997



### 5.1.9. Trends in agricultural productivity in other parts of the Andamans

The trends in North Andaman Island occur in South Andaman Island also. A study at Wandoor and Manjeri comparing the current production with that of 30 years ago. This yield has dropped from 3.80 tonnes/ha in 1970 to 1.80 tonnes/ha now (Fig: 11) (Singh, *et al.*, 2002). A comparison between the Wandoor and the Saddle Peak data indicates that, if the current trends continue, rice production is projected to drop to zero

by the year 2015 at Saddle Peak (Fig:12). Whatever yield there is likely to be will be due to massive inputs of fertilisers.

Only a single local variety of rice was found at Wandoor: the rest of the farmers use high-yielding hybrids. Karen farmers around Mayabunder in Middle Andamans still use a number of local varieties brought over from Burma several decades ago.

CARI identifies the slow diffusion of HYV and cultivation of existing traditional varieties as major bottlenecks to increased productivity. To date no variety has been released from these islands due to the non-functional status of the variety release committee. If these varieties are based on local cultivars, then these need to be encouraged to enhance crop genetic diversity.

#### ***5.1.10. Trends in agricultural productivity in the Nicobars***

Coconut plantations have dropped in productivity because of ageing in the Katchal area. Some recent data collected indicate that the Nicobari methods of cultivating coconut and areca nut may give higher yields than modern methods. Their methods also result in little loss of natural vegetation. There is a sociological problem in increasing productivity, since there appears to be an emotional barrier to replacing trees planted by one's ancestor. A recent drop in demand for copra in the Nicobars has led to a major increase in poverty levels. The growers are only able to get Rs. 8/kg for copra as against a support price of Rs. 28.40. A long-term solution to this is required. It is interesting to note that the drop in demand has resulted from import liberalisation, and the consequent cheap imports from Sri Lanka, Malaysia and elsewhere.

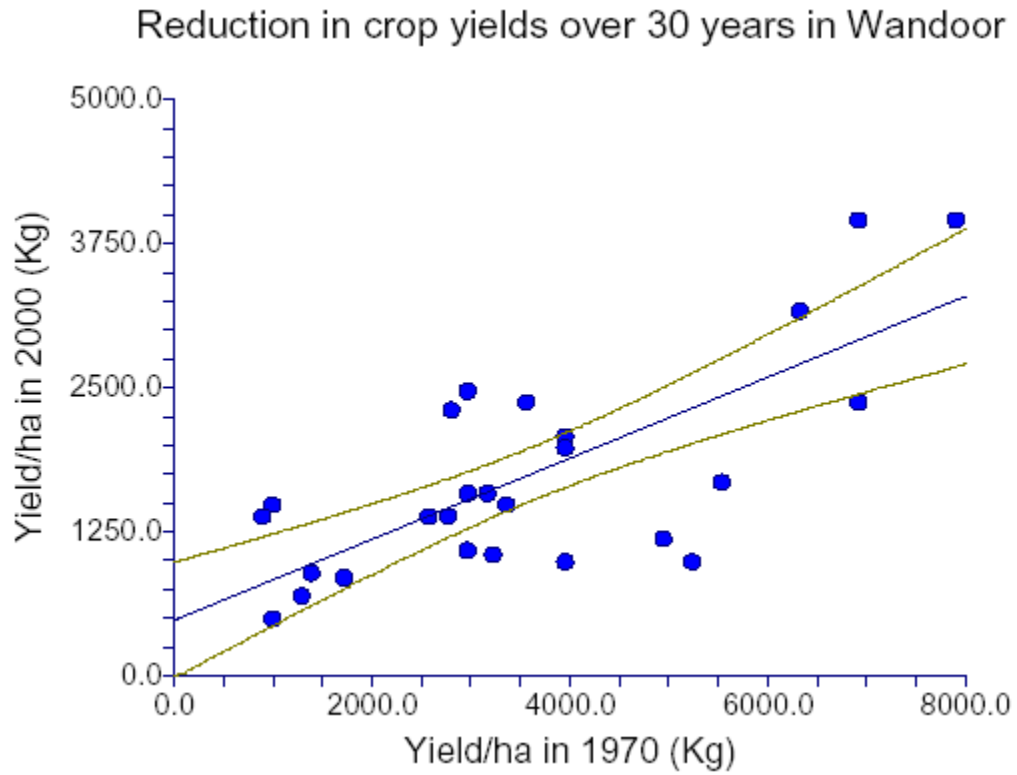
#### ***5.1.11. Loss of biodiversity due to agriculture***

The loss in area to even 86% of the original will lead to the loss of an estimated 4.5% of species, according to the theory of island biogeography. This was calculated using the value of  $Z=0.3$  (Mac Arthur & Wilson, 1997). Additionally, the use of insecticides will have an impact on insectivorous birds, wetland species and predators.

#### ***5.1.12. Use of pesticides and fertilisers***

It has been mentioned above that the use of fertilisers and pesticides would have affected the bird populations and freshwater fish, as well as the mangrove ecosystem. The fertiliser and pesticide loads in the sea and their biomagnifications in marine organisms have never been assessed. It is also extremely likely that the coral reefs are affected. Organic possibilities need to be explored. In the long run, phasing out a number of crops and replacing them with high value agro forestry such as vanilla, cane and bamboo will be required to solve the problem of pesticide use.

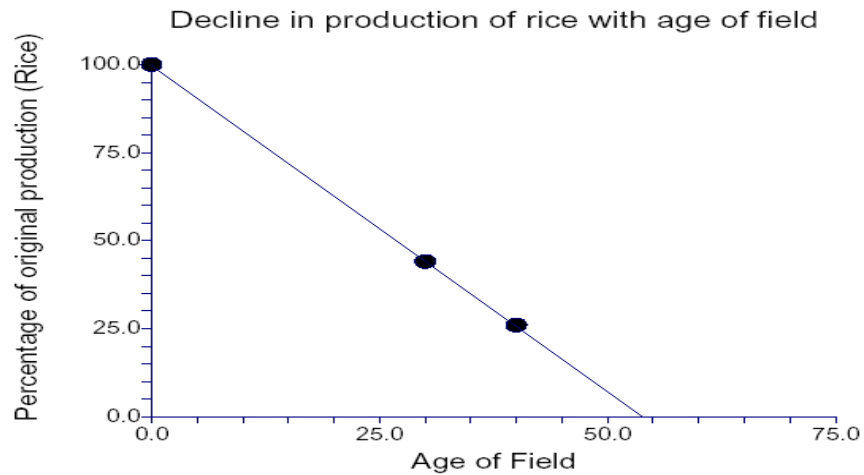
**Figure 11**



**Model Estimation Section**

<b>Parameter Name</b>	<b>Parameter Estimate</b>	<b>Asymptotic Standard Error</b>	<b>Lower 95% C.L</b>	<b>Upper 95% C.L</b>
A	0.4422972	2.721302E-02	0.3866403	0.497954

**Figure 12**



***By the year 2015 the yields in North Andaman will have declined to nothing if the current trends continue!***

**5.1.13. Wild relatives of cultivated plants**

A number of cultivated plants have their wild relatives here. These include vanilla, nutmeg, mango, Coconut and mangosteen. Growing most of these is not commercially viable at the moment.

**5.1.14. Biotic constraints in agriculture**

With the constant temperature and the high relative humidity throughout the year, coupled with high rainfall, the rapid growth and multiplication of insect pests occurs. Given the year round availability of host plants under these conditions, insects are able to breed continuously often with a complete lack of synchronization of the life cycle.

Disease is also a problem here, and causes major crop losses. Newer diseases are getting introduced due to the non-compliance with quarantine regulations. The prevalence of bacterial wilt in solanaceous vegetable crops makes their cultivation almost impossible.

Weeds compete very fast with crop plants, and cause significant loss by sharing nutrients and by hosting insect pests. The use of weedicides is not very common and is very often ineffective.

Stray cattle are another problem, and cause enormous damage to field crops. The pasturing of cattle immediately after the rice season is another serious problem for subsequent dry season crops. Rodent damage to field crops is another important factor, with control measures not being practiced by farmers. High African snail population is a serious constraint for vegetable crops especially during the wet season.

**5.1.15. Abiotic constraints in agriculture**

High salinities, and the high fixation of phosphorus, aluminium and iron toxicities, either individually or in

combination, are a regular phenomenon causing low yield. In acute cases lands are abandoned. During the peak dry season water stress coupled with excess heat makes a heavy dent in production particularly in pulse and vegetable crops, as they are cultivated during this season.

#### **5.1.16. *Ecological constraints in agriculture***

About 86% of the total geographical area is under very fragile tropical rain forest. Any deforestation and conversion of forestland to agricultural land poses a threat to the forest ecosystem, which in turn affects the quality of agriculture.

The soils of the islands are very fragile due to their recent origin, and soils in cultivable areas are shallow. Excessive rainfall of high intensity causes topsoil loss each year and proper soil conservation measures are seldom adopted. Water logging due to excess rainwater and flash floods, and the prevalence of acid sulphate soils are serious hurdles in the islands. Aluminium and iron toxicity in low-lying areas and phosphorus deficiency in the virgin hill slopes are serious constraints.

Harvesting and threshing of fruit crops becomes a problem during the rains. During the dry season extensive moisture stress sometimes leads to the complete loss of a crop.

Small irregular plot sizes are the principal constituents of the major land holdings. These are essentially not amenable to mechanical farming. Thus manual farming is the only alternative which makes agriculture a cost intensive avenue in these labour scarce islands.

#### **5.1.17. *Socio-economic constraints in agriculture***

In contrast to the mainland, there are many job opportunities on the islands. Also, the people living here have more remunerative and short-term mean of income such as fishing and forestry. Thus agricultural activities have become a secondary proposition in many places. Subsidy in the form of seeds, fertilizers, pesticides, and implements impede agricultural development and make people more dependent on the Government.

Agricultural inputs are insufficient and not available in time because of erratic supply from the mainland, which affects agriculture as a whole. The credit facilities extended by different organizations are not fully utilized by the farming community due to ignorance or due to difficulties in fulfilling official formalities.

#### **5.1.18. *Future prospects***

The major thrust for agriculture development will be on high value products from vanilla, floriculture and orchid cultivation, high value products from coconut and arecanut, and the extraction of oil and oleoresin from cinnamon, clove, pepper and ginger. Modern vegetable cultivation in polyhouses and encouragement for the use of bio-fertilizers are included in ongoing schemes.

### **23. *Loss of reef cover***

Collection of shells and sea cucumbers for commercial purposes has led to a drastic decline in the

occurrence of these two taxa. While they are protected now<sup>1</sup>, the Department of Environment and Forests has not been given the additional resources necessary to enforce the ban on their collection.

Assessing reef areas has been identified as a research priority during a recent seminar on protected areas planning<sup>2</sup>. Degradation has been recorded at a few sites. However, the overall condition of the coral resource in the Andamans is poorly documented: only one detailed study has been conducted, in the vicinity of the MGMNP (Kulkarni, 2000). A recent UNDP/ZSI study has identified newer species of coral in the Andamans taking the recorded coral species number from 197 to 235

However coral reefs of the islands are under various degrees of threat such as siltation, sand mining, agricultural runoff and damage due to fishing and tourism activities. These are apart from global climatic factors such as sea temperature rise. Remedial measures would have to emphasise the control of further encroachment of forestland and its consequent degradation. This is because sedimentation from the land clearing is one of the main causes of coral mortality (Whitaker, 1994; Kulkarni, 2000; 2001).

Tourists stepping on the corals also cause damage. The reefs around the main tourist sites of Jolly Buoy and Redskin Islands, in the MGMNP, have been degraded due to this reason. Remedial measures would include restricting the numbers of tourists visiting the MGMNP, as well as a proper awareness programme to educate them on how to prevent damage to corals (Kulkarni, 2000; Singh *et al.*, 2002). There is no recent information from the RJMNP; this becomes a priority since a number of dive shops and adventure tour operators have sprung up in the last couple of years.

A tighter control on trawling and net size is also required. The use of TEDS requires urgent study and an implementation process started soon- annually we lose around 2000- 3000 sea turtles (Bhaskar, 1993; Andrews, 2000; Andrews, *et al.*, 2001). Fishing on or around coral reefs also needs monitoring at the moment to assess its impact. A recent ban on fishing on the six species of shark is going to be extremely difficult to implement without a considerably enhanced protection force with the Forest department and difficulty in identifying shark species from dried fins.

Collection of shells and sea cucumbers for commercial purposes has led to a drastic decline in the occurrence of these two taxa. While all sea cucumbers and nine species of shell have been protected now, the Forest Department has not been given the additional resources necessary to enforce the ban on their collection.

#### ***5.1.19. Damage due to pollution***

Oil spills are rapidly becoming a major concern, especially in the Port Blair region. Ships wash their bilges offshore, and this is damaging coral reefs. Ships also tend to ignore regulations about dumping of sewage at sea. This has been observed in Car Nicobar harbour, even from ships belonging to the Shipping

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<sup>1</sup> These were added to Schedule I of the Wild Life Protection Act, 1972 on July 11, 2001.

<sup>2</sup> Seminar on 'Protected Areas Planning in the Andaman and Nicobar Islands'. Port Blair, July 9-11, 2001.

Corporation of India.<sup>3</sup> The other area of great concern is the Wandoor jetty in the MGMNP, oil and garbage from tourist ferries and fishing boats are all dumped into the sea.

#### **5.1.20. Loss of biodiversity due to fishing**

In spite of only slightly over 10% of the estimated available catch being harvested, catch of certain species in the coastal areas has been badly depleted. Shellfish in danger of being threatened include *Trochus*, *Turbo*, *Nautilus*, black lip pearl oyster and green mussel. This might be either a result of the potential harvest being wrongly calculated, or due to bad fisheries practices. However, the sizes of fish caught have declined noticeably, indicating over fishing. The sizes of crabs and lobsters available have also dropped, and the prices of these items are similar to prices on mainland India (lobster is Rs. 350 per kg. at Wandoor, making this important source of protein unavailable to local residents. This is largely due to the export market to Malaysia and Singapore. Currently crabs are not exported mainly because exportable sizes are not available any more and this is a clear example of over exploitation and unsustainable harvesting methods. These methods have depleted two species of crabs and lobsters all over south East Asia. This requires urgent regulation, mainly closed season during the breeding season and size/ weight limits. Crab and shrimp hunting has also taken a severe toll on mangroves in South America and some parts of south Asia. The prices and catching seasons are shown in figure 13.

It is clear that considerable effort is required to ensure that fisheries are properly managed. Limiting landing sites, preventing fishing in the closed season, and enforcing minimum size rules, mesh sizes are some points that need enforcing.

Indiscriminate fishing of shark for shark fin may also put the shark in the endangered category. The effects on sharks are already noticeable, with the large shark having more or less disappeared, mainly the tiger shark that was once common around the Andamans and has become extremely rare since the late 1980s. The catch effort required to catch sharks is shown in figure 14. Other affected items include sea cucumbers and ornamental shells. Several species in the last three taxa have now been placed on Schedule 1 of the WLPA, 1972. The appropriate enforcement measures will need a considerably enhanced person-power to implement.

### **24. Issues with mangroves and coastal ecosystems**

Extraction of mangroves for commercial purposes was stopped in 1989 in the islands and most these areas have regenerated to its original form (Andrews, 2000, c). However, there are encroachments in mangroves in some of the areas in North, Middle and South Andamans. There is also some degradation due to fuel wood and pole extraction. Recently, there is also a demand to hand over mangrove areas for shrimp farming, a move that will have harmful environmental consequences as it has in South East Asia and South America. There is also a demand for handing over areas for fattening of mud crabs.

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<sup>3</sup>Rauf Ali, personal observation.

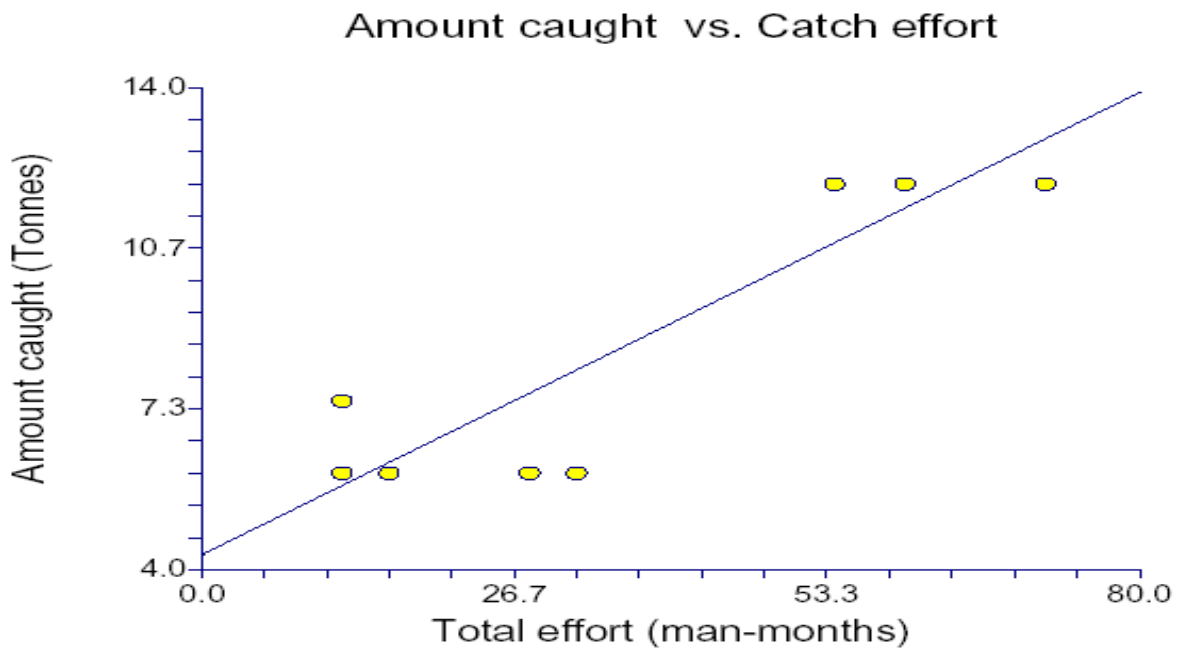
**Figure: 13**

**Summary statistics of individual boats catching crustacea**

<b>T a x o n</b>	<b>N o . o f persons/boat</b>	<b>Monthly catch ( k g )</b>	<b>Price: Rs/kg</b>	<b>Season length ( m o n t h s )</b>	<b>S a m p l e s i z e</b>
<b>Crabs</b>	<b>3</b>	<b>42 (10-150)</b>	<b>210 (Red) 20 (Green)</b>	<b>5</b>	<b>36</b>
<b>Lobsters</b>	<b>4.7</b>	<b>97.5(10- 350)</b>	<b>300</b>	<b>11</b>	<b>6</b>
<b>Shrimp(paste)</b>	<b>4.1</b>	<b>180(20-450)</b>	<b>70</b>	<b>5.33</b>	<b>20</b>

Source: ANET unpublished, 2001.

**Figure 14**



*Amount of shark catch as a function effort.*

### **25. Issues with coastal ecosystems**

The major problem with coastal ecosystems is sand extraction for construction. This has led to loss of marine turtle beaches in ANI and erosion by sea action. In a number of places the sea has destroyed the belts of vegetation bordering it. *Manilkara* forest has been affected at several sites in North, Middle, South Andaman and Baratang Islands. The regeneration of *Manilkara* forest has also been badly affected because of the browsing of seedlings within them by goats, cows and spotted deer.

There has been a detailed plan prepared for the Coastal Regulation Zones. However, its implementation in its true letter and spirit is wanting.



### **5.1.21. *Issues with wetlands***

Very little is known about the species associated with them, and their unique features other than, that reported by Vijayan (1996), Andrews (2000 b, 2000c; 2000 d; 2002) and Andrews & Sankaran (2002). This applies both to forest swamps as well as open swamps. A research effort is required initially to map these areas and do ecological profiles on them. Wetlands are being drained for agriculture and other development. This is most noticeable around Port Blair, near Sippighat. Pesticide residues are also likely to have affected wetland fauna in a number of places.

## **26. *'Island' effects more likely to lead to species extinction***

There are 19 endemic bird species found in the islands. Andaman Teal is critically endangered, with major habitat loss having occurred all over their range, coupled with massive annual poaching (Sankaran, 1995, Andrews, 2000, b; c; Andrews & Sanakaran, 2002). All the others are restricted range species according to the IUCN threat criteria (see Appendix 4), even though none appears to be endangered at the moment. A detailed status survey of all these, and of other taxa, is required. Filling this knowledge gap will lead to proposals pertaining to regulation of tourism, the regulation of fishing, the declaration of more protected areas and additions to the school syllabi leading to increased awareness.

An analysis of the endemic species shows that there are fewer species in common between the Andamans and the Nicobars than would be expected by chance<sup>4</sup>. This seems to indicate that the faunas of the two island groups have evolved separately from each other, and are isolated from each other. This makes research into the fossil record very relevant, as this will help in understanding the processes that have led to the species distributions on these islands.

Another concept that is relevant here is that of stepping-stones. The distances between protected areas are far, and emigration of a new species from one protected area to another becomes difficult as more areas are deforested. Having additional protected areas in between the existing ones could mitigate this. With the current rates of degradation that are occurring, it becomes a priority to identify these areas, taking into account the representation of various slope, relief and soil classes that may affect species compositions.

## **27. *Introduced domestic species: cattle and goats.***

The livestock in the islands as estimated in the livestock censuses conducted in 1992 and 1997 are shown in table 1. Between 1980 and 1990 the Department of Animal Husbandry & Veterinary Services (AHVS) imported about 250 cows for the breeding programme. This was stopped in 1990, and AI is done using frozen semen for upgrading the stock of cattle and buffaloes. 70 Malabari goats were also brought in during this period. There is no stall-feeding done. The problem of free ranging cattle and goats damaging

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<sup>4</sup> The Andamans have 8 endemic birds found only there. The Nicobars have 5, and there are 4 in common. We would normally expect 6-7 in common .

forests has been noted in a number of areas of North Middle, South and Little Andaman Islands, as well as Nancowry and Great Nicobar Islands, including the Jarawa Reserve. While cattle do not normally browse in rainforest because of the lack of grasses, but do so in open coastal forests. Goats have been observed at a number of places inside forest areas, for example near Wandoor. While there has been no documented study except on Narcondam Island, observations indicate that damage by goats is occurring, as happens in every other place in main land areas, mainly in protected areas, where goats are found. This problem should be tackled right now, before it goes out of control.

A list of the introduced domesticated species here follows:

- Cats : Everywhere- feral
- Dogs : Everywhere- feral
- Goats: feral on Narcondam and Barren Islands; domesticated elsewhere.
- Cattle: domesticated and feral, also along the Jarawa Reserve and in Great Nicobar Island.

Problems perceived with poultry and livestock farming that have a relation to biodiversity are: the scarcity of fodder, the scarcity of feed (feed ingredients are imported, from mainland, which becomes a costly affair), and the disease problems resulting from the hot and humid climate,

### ***28. Introduced species in the absence of predators***

Two problem species are the feral chital and feral elephant in the Andamans. In the past few years, studies have been carried out on both of these.

Feral elephants are found on Interview Island and on North Andaman Island. An estimated forty animals were released in 1960 here, and these have formed a breeding population. A study in 1993 estimated their population at 70 (Sivaganesan & Kumar, 1995); a survey done in March 2001 estimates their current population at 35 (Ali, 2001). It was noted that bamboos, rattans and Pandanus, abundant on the other islands, have become very scarce on Interview Island. The debarking of large trees by elephant has led to opening up of the canopy, and the continued existence of elephants will lead to further vegetation degradation.

Chital have created similar problems all over the North Middle and South Andamans including Baratang and other outlying islands. Seedling regeneration is confined to a small fraction of the upper canopy species in forests wherever chital are abundant. Sapling flora is depauperate in most species and it is hypothesised that a few species such as *Pongamia glabra* and *Lagerstromia hypoleuca*, which are not browsed, will eventually replace the forests that exist now (Aul, 2002). Control mechanisms for chital also need to be considered as no natural predators are present.

**Table: 1*****DISTRICTWISE LIVESTOCK AND POULTRY***

Category	Livestock Census 1992			Livestock Census 1997		
	Andaman	Nicobar	Total	Andaman	Nicobar	Total
Cattle	47481	5460	52941	52921	7259	60180
Buffaloes	14265	266	14531	14155	49	14204
Goats	44555	11605	56160	59487	11436	70932
Pigs	1252	35212	36464	3258	39578	42836
Dogs	24098	4645	28743	25363	4205	29568
Horses / Donkeys	--	--	--	12	3	15
Rabbits	-	-	-	92	60	152
<b>Total livestock</b>	<b>107553</b>	<b>52543</b>	<b>160096</b>	<b>129925</b>	<b>58385</b>	<b>188310</b>
<b>Total Poultry</b>	<b>537984</b>	<b>76258</b>	<b>614242</b>	<b>739058</b>	<b>61892</b>	<b>800950</b>

**Source:** Dept. of Animal Husbandry & Veterinary Sciences, 2002.

Feral dogs have been reported digging up nests of sea turtles and killing nesting turtles all over the Andaman and Nicobar Islands (Bhaskar, 1979; 1984; 1993; Andrews, 2000; 2001; Andrews *et al.*, 2001). Controlling their population assumes urgency if sea turtle populations are to be protected. Cats are seen to be a predator of ground lizards, birds and nesting birds.

Mynah's and palm squirrels have also been introduced into the islands, but their effects on the local fauna and flora has not been studied.

**Introduced wild species include:**

Chital: everywhere in Andamans except Little Andaman, North and South Sentinel Islands.

Hog Deer: North and Middle Andamans, eradicated?

Barking deer: Middle, Baratang and South Andaman.

Elephant: Is found on Interview Island and parts of North Andaman

Common Mynah: Abundant in the Port Blair area and South Andamans, and might be competing with resident hole nesters.

Three Striped Palm Squirrel: Common in areas near Port Blair and spreading towards Wandoor area.

African Giant Snail is a major pest of vegetable crops all over the Andamans.

The latest additions are House Crows, which have been recorded from Port Blair in October 2002.

### ***29. Declining tribal populations and loss of indigenous knowledge***

There are four groups of indigenous tribes in the Andamans and two in the Nicobars. The Great Andamanese have almost been wiped out, and are confined to Strait Island. Their population numbers about 30, most of them of mixed racial origin. The Onge number about a hundred and are under constant disturbance from poachers and settlers in Little Andaman Island. The Sentinelese, still hostile, are undisturbed. However fishermen and lobster divers have been observed very close to coast line and inside bays of this island. This may be keeping the Sentinelese away from foraging in the intertidal reefs during low tide and from fishing out at sea in their dugout canoes (Andrews's *per. Observ.*).

The fourth tribe, the Jarawa, typify the debate ongoing in the islands. They were hostile until three years ago. Recent contact has resulted in a lot of the children beginning to beg for food along the Andaman Trunk Road (ATR). The Tribal Welfare Department is committed to increase contacts, and has a programme by which bananas and rice, alien to the Jarawa diet, are still provided (Awaradi, 1990).

This leads to an important debate. One school of thought believes that it is necessary to enable the Jarawa to abandon their forest existence and bring the benefits of "civilisation" to them. Opposed to this is the view that they should be left strictly alone; otherwise they will become extinct. Supporting the latter view are the case histories of what happened to the Andamanese and the Onge tribes (Portman, 1899).

In practice the A & N Administration is implementing the former view. Serious debate is needed urgently on this issue, because the wrong choice now may lead to the extinction of these tribal groups. Under the orders of the Calcutta High Court a Committee is already going into all the issues concerning the Jarawas. The recent Supreme Court may result in the closure of the Andaman Trunk Road though the Jarawa reserve, but whether this will actually stem the cultural contamination they are subject to remains to be seen.

Also at stake here are the largest relatively undisturbed tracts of forests within the islands: the Jarawa reserve, the Onge Reserve on Little Andaman, and the Great Nicobar Biosphere Reserve, which acts as a home to the majority of the Shompen. In the first two cases, assimilation of the tribes into the mainstream will increase pressure on the lands within the reserve for logging and encroachment, as well as increase poaching. In Little Andaman, the Supreme Court has just banned logging by the Government.

### ***30. Impact of developmental activities***

#### ***5.1.22. Construction of RCC structures***

Development activities involving buildings require large quantities of sand. This sand is quarried from the beaches. While the Forest department gets royalty on the sand mined, and the sand taken from each area is regulated in theory, this is impossible to enforce in practice. As a result, serious erosion of beaches has occurred. This has had three major consequences: loss of land and coastal forest, the loss of 21 sea turtle nesting beaches in ANI, and the loss of recreational areas (Andrews, *et al.*, 2001).

In its recent order, the Supreme Court has ordered that the amount of sand utilised must be reduced to 33% of its current usage within five years. The current system of monitoring will not be adequate to ensure this, and this is enforceable only if a new monitoring mechanism is devised and implemented.

#### ***5.1.23. Developmental activities of Port Management Board***

The Port Management Board constructs jetties on remote islands. These jetties very often block the free flow of sand across the beaches. This results in a pile up of sand on one side of the jetty and erosion of sand on the other side. It may be pointed out that computer models exist now to predict the erosion that might occur and to design appropriate structures.

### ***31. Impact of tourism***

Tourism has been developed in the islands for the last decade. This has led to the unplanned development of several areas. The numbers of tourists are increasing in spite of the lack of proper facilities. This has led to pollution using plastic (controlled only in the MGMNP), camping on sea turtle beaches and preventing their nesting, for example, on Ross and Smith Islands and on Little Andaman Island (Andrews, *et al.*, 2001). Fires started by camping tourists have also occurred at Chidiathapu, New Wandoor and on Havelock Islands. Lighting forest fires especially in coastal PF's, cultural contamination resulting from exposure to drugs and nudity, and loss to the exchequer due to tourists benefiting from the subsidies on transport, are major hazards of promoting uncontrolled tourism.

All these aspects except the last two affect biodiversity. Recent proposals to build hotel complexes at several locations will result in problems such as effluent release and habitat degradation.

### ***32. Immigration from mainland***

The 2001 census reports a population of 3.57 lakhs. However, projections from the previous census years show that the population now cannot be less than 4.12 lakhs; a spot survey done by a local NGO shows that 20% of the population remained uncounted; whole hamlets were found of recent immigrants that had been left out. These consisted almost totally of recent immigrants from Tamil Nadu and West Bengal.

Recent immigrants typically, encroach land from forest areas. The control of immigration therefore becomes one of the top priorities if biodiversity is to be conserved in these islands. The introduction of an island identity card is a first step in this direction, and elimination of the subsidy on passenger fares for ships will also help in reducing the influx.

### ***33. Knowledge of medicinal plants***

The Andaman and Nicobar Islands is a vast repository of medicinal plants. The islands enjoy a warm humid tropical climate with an annual rainfall of ~3300 mm, which is very congenial for the growth of medicinal plants. The ANDE & F has reported 336 species for the ANI (ANDE & F, 2002). A total of 427 from 110 families and 317 genera have been reported to be used by the aboriginals and other inhabitants of the islands for the cure of various ailments (Dagar & Dagar, 1999). Awasthi (1987) has discussed the use of 35 species by the Nicobarese, 35 by Shompens, 16 by the Great Andamanese and 10 by the Onge.

Data was gathered by ANET in January 1999 on the plants the Bengali and Chota Nagpuri settlers used, in the areas around Saddle Peak National Park. It was found that the Chota Nagpuri community has begun using mainly local plants and have developed a rich ethno botanical tradition utilising plants new to them, over the last few decades (Appendix 2). The AN DE & F collaboration with the National Botanical Research Institute, Lucknow has inventoried the medicinal plants of the islands. The list is given in Appendix 12.

## **6. Identification of relevant ongoing plans and programmes**

Each Department was asked for a statement on what ongoing programmes and plans it has relevant to the issues raised above. The following Departments and NGO's have responded.

### ***34. Central government departments***

#### ***6.1.1. Anthropological Survey of India***

The Anthropological Survey of India has been active in the Andaman and Nicobar Islands since 1951, and has contributed significantly to understanding the tribal and non-tribal populations of these islands.

Its broad objectives are:

- To take up anthropological studies of tribes and other communities;
- To reflect the priorities set by the Government with respect to environmental conservation, tribal welfare, and assessment of health and nutrition especially of women and children.
- To take steps to preserve cultural traits and artefacts.
- To study and promote awareness of the rich cultural milieu of these islands.

Specific ongoing studies include one on boat typology and fishing communities. This has attained an in-depth understanding of the traditional culture of several of the tribes found here. It has shed light on the craftsmanship in boat making, methods of propulsion and steering, navigational knowledge and different rituals associated with these.

Another project concentrates on Nicobari crafts and its role in their society. Studies on the growth and development of children, and in the urban anthropology of Port Blair and Rangat, are also being carried out.

Of special relevance to our understanding of tribal groups is a study on how tribal communities traditionally use and manage their environment and natural resources, and this is focussed on the Onge and Nicobari communities. Of special relevance to the NBSAP is a study of the contacts and conflicts with Jarawa tribes. This last has generated a list of recommendations that has been handed over to the Administration.

Anthropological Survey of India, Andaman and Nicobar Regional Centre, since its establishment in 1951, has contributed significantly to the understanding of human society by studying tribal and non tribal populations of these islands. The broad objectives behind these activities remain:

- To take up anthropological studies of scheduled tribes and other communities.
- To reflect in its research programme, the priorities set by the government on conservation of environment, welfare of tribes, women and children and assessment of health and nutritional status
- To take steps to salvage and preserve cultural traits and artefacts faced with the threat of extinction and those, which even, otherwise need to be preserved.
- To study and promote awareness of the rich and composite cultural milieu of Andaman and Nicobar group of islands and its contribution to our cultural heritage.

### **6.1.2. Botanical Survey of India (BSI)**

The BSI has been operational in the Andamans since 1972. Its major concerns are the

- Survey and exploration of the plant wealth of ANI
- Compilation of the flora of these islands;
- Conservation and utilisation of the plant wealth here; and
- Studies on the mangroves of these islands.

Minor areas of research include the identification of plant specimens and taxonomic studies, ethno botanical studies on the tribes, environmental impact assessments (Eva's) and ex situ conservation of rare and endangered plants in the experimental garden-cum-arboretum.

The BSI herbarium contains over 21,000 specimens belonging to over 2000 species. The museum has 400 exhibits including timber yielding plants and other botanically important specimens. The library has 3730 books, and subscribes to 20 foreign and 36 Indian Journals.

A Botanical Garden was established in 1977 on 30 ha. of forest land near Dhanikhari 16 km away from Port Blair. The main objectives of this Botanical Garden are:

- Comparative study of herbarium specimens with plants occurring in Nature.
- Introduction of economically important plants from different parts of the islands as well as from the Mainland.
- Introduction of Ethno-Medicinal plants which are used by different tribes of these Islands, so that they can be propagated and useful compounds can be evaluated.
- Introduction of plants that are found in ANI and South East Asia, but not in mainland.
- Introduction and propagation of Wild germplasm.

An orchidarium and fern house are part of this botanical garden, together with bamboos, canes, gymnosperms, wild gingers, medicinal plants, wild edible fruit trees and sources of green manure.

Another botanical garden has been opened at Kalpong in collaboration with the National Hydroelectric

Power Corporation. This botanical garden has different sections such as Medicinal Plant Plot (Dhanvantri Udhyan), Pomological Plant Plot, Palm Plot, Cane Plot, Endemic Plant Plot, Orchid House, Ornamental Garden, Nursery, Green House and Arboretum. About 64 plant species of high medicinal potential were introduced in Dhanvantri Udhyan. Likewise, about 23 species of wild edible fruit trees, 19 species of ornamental plants and 9 species of palm varieties were introduced in the Pomological Plot, Ornamental Plant Plot and Palm Plot respectively. The Endemic Plant Plot houses about 9 species of endemic, rare & endangered plants that were collected from the wild. The conservatory *Vanilla* now has good collections of orchids where 70 accessions of live orchids are conserved and propagated including several endemic and exotic species. BSI here has described 60 new species and 3 new genera; over 310 scientific papers have been published. Vol. II and III of the Flora of the Andaman and Nicobar Islands are under preparation. The Flora of Great Nicobar has been published.

Besides this, wild relatives of nutmeg and betel palm have been explored. BSI was involved with the EIA of the Kalpong project, and is helping various groups in identification of plant species for their commercial exploitation. Emphasis is being laid on the mangrove zonation of these islands, which contain 58 species.

#### **6.1.3. Central Agricultural Research Institute (CARI)**

Central Agricultural Research Institute (CARI) is entrusted with the onerous task of catering to the needs of these islands' ecosystem by forging a research base to enhance crop, livestock and aquatic productivity through the judicious use of the rich and diversified though fragile natural resource base of these islands.

The Institute, which is situated at Port Blair, A & N Islands, has got a clearly defined role to address the issue of ushering sustainable agricultural development in the island ecosystem. Preserving the biological resources found here is of paramount importance. Hence collection, mapping and conservation of agro and animal genetic resources have assumed considerable importance. CARI is in a unique position to assume this responsibility.

There is a need for appropriate technology here. It is in this context that CARI can play a pivotal role in carrying out research and development activities so that technologies may be generated that suit island condition or technologies developed in mainland India can be suitably modified, according to island conditions.

CARI researches various aspects of agricultural activity in the islands, including testing of new cultivars, experimentation with new breeds of domesticated livestock.

#### **6.1.4. Central Drug Research Institute (CDRI)**

The Central Drug Research Institute identifies plants that have medicinal value and carries out tests on their efficacy. They have conducted studies here as well, and a greatly enhanced role for them is required.

#### **6.1.5. Indian Council of Forestry Research and Education**

This is the apex body in the country constituted for the purpose of forestry research and education. It carries out research of national importance as well as regional importance through its research institutes spread throughout the country. The research needs of the A & N Islands are attended to by the Institute of



Forest Genetics and Tree Breeding, Coimbatore. Recently the Institute had funded a Planting Stock Improvement Programme for establishment of Seed Production Areas of *Pterocarpus dalbergioides*, *Casuarina equisetifolia* and *Paraserianthes falcataria* in these islands. The National Forestry Research Plan has identified areas of research, which are required to be carried out by the research wing of AN D E & F Islands in collaboration with the Institute of Forest Genetics and Tree Breeding (IFGTB). The important areas of collaborative research are:

- Biodiversity conservation and utilization
- Biodiversity assessment and monitoring
- Natural regeneration of important tree species
- Soil and water conservation
- Studies of mangrove forests, eco-tourism, wildlife protection, the environmental impact assessment, and nursery techniques of important trees species
- Studies on growth and yield of important tree species
- Human resource management problems
- Protection of endangered species
- Development of marine eco-system
- Planting stock improvement of important species
- Management of wetland and
- Farm forestry package for rural areas

The IFGTB has now proposed the following collaborative projects with the A N D E & F, but the work is yet to start:

1. Regeneration ecology of economically important tree species of A&N Islands.
2. Genetic variability and selection in natural population of *Artocarpus* species.

Besides, IFGTB, Coimbatore, the Forest Research Institute, Dheradun is also carrying out certain projects in these islands. It is now in the process of revising the 'Forest flora of Andamans' by Parkinson. It has proposed projects for establishing a bambusetum and for studying the fungal biodiversity in the islands.

#### **6.1.6. Indian Space Research Organisation (ISRO)**

Many organizations of the Department of Space, viz., Indian Institute of Remote Sensing (IIRS), Dehradun, Indian Space Research Organization (ISRO), Bangalore, National Remote Sensing Agency (NRSA) and Vikram Sarabhai Space Applications Centre (VSSAC), Ahmedabad have been involved with aspects of mapping and remote sensing of natural resources in the Andamans. A project on Biodiversity characterization at landscape level has been undertaken by the Department of Space in collaboration with the Department of Environment and Forests. It is also involved in the preparation of a Natural Resource Information System (NRIS). VSSAC has prepared a Coral Reef Atlas of India, including the areas of these islands.

#### **6.1.7. Zoological Survey of India (ZSI)**

ZSI has been conducting surveys of the various faunal groups in the islands. It has just completed a survey of the coral reefs in the islands, in March and April 2001.

### **35. State govt. departments**

#### **6.1.8. Andaman & Nicobar Island Forest Plantation and Development Corporation (ANIFPDC)**

The ANIFPDC has been involved in the exploitation and protection of leased forest areas of Little Andamans and Mayabunder. It also carried out plantation activity and natural regeneration of tropical forest. It maintains rubber & Red oil palm plantations. It is now becoming involved with ecotourism.

#### **6.1.9. Department of Animal Husbandry and Veterinary Sciences (AH & VS)**

The AH & VS has imported quality animals in the past for upgrading the stock found locally. It is involved in establishing goat farms. While import of cattle has been stopped, Artificial Insemination using frozen semen is now used to upgrade stock. It is estimated that the number of cattle on the islands will decrease because of both the introduction of superior stock as well as the reduction of scrub animals.

#### **6.1.10. Department of Environment and Forests**

The Department of Environment and Forests is the largest manager of land and biological resources in the islands. 7171 km<sup>2</sup> out of the total area of 8549 km<sup>2</sup> area of the islands (86%) is Protected Forest, Reserve Forest or Protected Area, and comes under the management of this department. Protection of forests remains the primary charge of the department. 70% of the forest area is totally protected and therefore the department has to engage a large force to protect the area from all kinds of interference. It implements and enforces a large number of legislations for this purpose. It had set aside 30 % of the forest area for production forestry and had operated 15% of the forest area under the Andaman Canopy Lifting System from 1952 to 2002. This 15% area is now required to be managed for meeting the local needs of timber and NTFP. Though the Department had formulated a State Forestry Action Programme (SFAP) for the period from 1997 to 2017, as a part of the National Forestry Action Programme (NFAP), this would require a drastic change in view of the recent orders of the Supreme Court accepting the recommendations of Prof. Shekhar Singh who was appointed as Commissioner to report on the State of forests and other allied matters. The department also undertakes research in various fields of forestry and wildlife either alone or in collaboration with other reputed organizations, generally following the guidelines formulated in priority areas identified in the National Forestry Research Plan (NFRP), prepared by the Indian Council of Forestry Research and Education. The state level research priorities identified in the National Forestry Research Plan and the prioritized research problems for Andaman & Nicobar Islands are the following:

- Biodiversity Conservation and Utilization
- Biodiversity Assessment and Monitoring
- Natural Regeneration of important species
- Wood Preservation Techniques
- Soil & Water Conservation including Integrated Watershed Management
- Studies on Mangrove Forests
- Protection of Wildlife
- Environmental Impact Assessment of Eco-tourism
- Nursery Techniques
- Studies on growth and yield of important species
- Human Resource Management of Forest Department.

The management of the wildlife and protected areas is carried out as per the National Wildlife Action Plan (2002-2015). Keeping in view the recent trends in forest and ecosystem management the department has proposed new schemes for ecotourism, mangrove area management and forest protection in the 5-year Plan (2002-2007), besides continuing with the schemes on strengthening of the forest administration, training, research, survey and demarcation, natural regeneration, NTFP development, forest extension, resource survey, saw milling and wildlife & biodiversity conservation. In implementation of these programmes and schemes the department takes into considerations the various recommendations of the committees, commissions, workshops, seminars and research organizations which have been accepted by the Government, the notable ones being the Coimbatore Charter on Environment and Forests, Report of the Committee on Prevention of illegal trade in wildlife and its products (Subramaniam Committee), Committee on Improvement in the service conditions of Range Forest Officers (Pande Committee), Committee on Human Resource Development (Tiwari Committee). The department also takes care of all the subjects addressed under the various U.N. Conventions and agreements, including climate change, biodiversity, ozone protection, desertification, wetlands, forestry and hazardous substances. The department is the enforcing agency of various Central legislations like the Indian Forest Act, 1927, Wildlife (Protection) Act, 1972, Forest (Conservation) Act, 1980, Environment (Protection) Act, 1986, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, 1976 and all the rules framed under the above Acts, which have a direct bearing on the conservation of biodiversity. The department in collaboration with the Directorate of Education and the C.P.R. Environmental Education Centre is implementing the programme of National Green Corps, for the purpose of creating environmental awareness among the school children, besides organizing various programmes independently on the occasion of World Forestry Day, World Environment Day, Van Mahotsava and the Wildlife Week.

#### **6.1.11. DRDA**

This Department implements development schemes in the rural areas. Many of these, such as check dams and rural water supply, are dependent on the healthy state of the watersheds.

#### **6.1.12. Fisheries Department.**

Licences fishing boats and, maintains fisheries statistics and enforces regulations laid down by the Fisheries Act. Enforcement lacks any teeth and its advice to fishermen has resulted in over fishing. The current ban on sharks, sea cucumber and shells will mean that the licenses it provides will have to be drastically curtailed. Enforcement of the WLPA (1972) provisions will be in the hands of the Forest Dept.

#### **6.1.13. Information Publicity & Tourism dept.**

The Information Publicity and Tourism (IP &T) Dept. sets tourism policy for the islands. It has built and maintains a number of tourist guesthouses, most notably in Port Blair, and at Cuthbert Bay and Kalipur. It has identified several areas in which tourism is to be expanded. Environmental concerns have not been in the forefront in choosing sites for tourism. For instance, backpack tourism has affected sea turtle nesting on Smith Island; even though night halts at this island are illegal the IP & T is planning the construction of infrastructure there. Proposals for tourism on Rutland Island would likewise have affected turtles nesting has been shelved for the moment, but there is pressure to get them reopened.

Of special note here is the Master plan for Tourism prepared by the World Tourist Organisation<sup>5</sup>. This makes calculations of tourist carrying capacity based on water availability and the capability of treat sewage. The carrying capacity projected appears to be extremely high and caution needs to be exercised before implementing any of this. Further studies are required and these are addressed later in this document.

**6.1.14. Revenue Dept.**

This Department controls most of the other available land in the islands. These include the agricultural lands around the settlements. It also controls access to the Nicobar Islands, by means of administering a tribal areas permit system, as well as to all the tribal Reserves

**6.1.15. Jawaharlal Nehru Rashtriya Mahavidyalaya (JNRM)**

The Jawaharlal Nehru Rashtriya Mahavidyalaya (JNRM) is the only degree college in the islands, and is affiliated to Pondicherry University. Faculty members have carried out research on butterflies and mangroves.

**6.1.16. Tribal Welfare Dept.**

The Tribal Welfare Dept. oversees all aspects of the welfare of the different tribal groups of the ANI and has produced a master plan. The Tribal Reserves are legally Reserved Forests and come under the control of the Dept. of Environment and Forests as well as the Deputy Commissioner, who implements the Andaman and Nicobar Islands (Protection of Aboriginal Tribes) Regulation.

**36. Research institutes**

**6.1.17. Kerala Forest Research Institute (KFRI)**

KFRI has done research on rattans of the islands (Renuka, 1995).

**6.1.18. Pondicherry University**

The Ecology Dept. of Pondicherry University has sent a number of researchers usually working towards their master's theses, supported by ANET. Research done has been on epiphytes, forest regeneration, bird and butterfly distributions, and on little known species such as the Andaman Day Gecko, marine turtles and the Yellow-lipped Sea Krait. The Tourism Administration Dept. has also done some work on aspects of tourism here. Finally the Futurology Dept. has an ongoing project on Jarawa tribes. The University has established a Centre for Ocean and Island Studies which has a Marine Biology department, offering a M.Sc. degree in Marine Biology since 2000, and this will meet the need for marine biologists for these islands.

**6.1.19. Salim Ali Centre for Ornithology and Natural History (SACON)**

The Salim Ali Centre for Ornithology and Natural History has conducted research on a number of important bird species that are endemic to these islands. These include the Nicobar Megapode, the

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<sup>5</sup> Development Strategy for Environmentally Sustainable Tourism in the Andamans. Executive Summary, Madrid, 1997. World Tourism Organisation, UNDP.

Narcondam Hornbill, and the Andaman Teal. Currently there is an important project going on to establish the ranching of Edible Nest Swiftlets as a mechanism for in situ conservation. SACON has also carried out a study of feral elephants on Interview Island in 1993.

**6.1.20. Wildlife Institute of India (WII)**

WII has been involved in a study of the coral reefs of the islands. This includes 30 new records for the islands, and was published in September 2000.

**37. Non-governmental organisations**

**6.1.21. Andaman and Nicobar Island Environmental Team (ANET)**

This is a division of the Madras Crocodile Bank Trust and maintains a research station at Wandoor, South Andaman. It is involved in research covering a number of taxa and education programmes covering several schools. It has advised the Department of Environment and Forests on a number of wildlife related issues. It has trained manpower and is positioned to initiate any ecological study rapidly.

ANET's primary aim is to help ensure the long-term survival of as much of the A&N natural biodiversity as feasible. The Team has found it necessary to tackle several different, though ultimately complementary, fields.

**Research**

ANET conducts a variety of original biological research programmes, including biogeography and ecological studies and survey of herpetofauna, sea turtles and crocodiles since 1977. Another research priority of the Team is to understand the requirements and feelings of the islanders to help develop practical and culturally acceptable means of utilising the islands' natural resources in a sustainable fashion.

Moreover, as the only environmental NGO with good logistical back up and a permanent base in the islands, ANET is frequently requested to collaborate in research by visiting representatives of other Indian institutions.

**Applied Conservation**

As a direct outcome of its biological and ethnological research, ANET is able to develop well-informed and workable conservation strategies to help ensure the survival of endangered species and habitats. Such strategies may include protective legislation, designation of protected areas, reserves, sustainable management schemes and captive propagation of threatened species.

**Education**

ANET aims to teach local people of the "workings" of the fragile island ecology and help them understand the dangers of putting too much pressure on its resources. The Team also endeavours to instil a greater level of environmental awareness; that is, stakeholders are encouraged to appreciate nature and take an active interest in conserving the islands wildlife and habitats. Further to this, ANET supports and trains local teachers, school children, settlers, people from the armed forces and naturalists so that they can build

upon its conservation efforts. It has also helped produce an environmental education book, “Treasured Islands” for teaching schoolchildren, in two languages.

The Team has already found that it is possible to influence government policy in the islands through lobbying and demonstrating workable pilot projects. The Administration is interested in the concept of alternative technology and ecologically sound land management, but all too often lacks the expertise and infrastructure that the Team and its collaborators can mobilise.

**6.1.22. Andaman Adim. Janjati Vikas Samiti (AAJVS)**

This agency is responsible for implementing welfare programmes for the tribal groups in the islands.

**6.1.23. Bombay Natural History Society (BNHS).**

BNHS has conducted several bird surveys in the islands.

**6.1.24. Society for Andaman and Nicobar Ecology (SANE)**

SANE has been at the forefront of environmental activism in the islands. It was responsible for the case that led to the recent judgement of the Supreme Court.

**6.1.25. World Wide Fund for Nature (WWF)**

WWF has funded conservation volunteers here who have worked in the field of watershed management.

## **7. Identification of stakeholders**

Each Govt. Dept. and NGO listed above are also the major stakeholders, was asked to define its stake in biodiversity issues. The following issues relevant to the stakeholders have been identified:

### **38. Central government departments**

**7.1.1. BSI**

The Botanical Survey of India has major research programs, detailed earlier.

**7.1.2. CARI**

CARI does research on various aspects of agricultural productivity, including crop trials and problems caused by insect pests.

**7.1.3. CDRI**

CDRI is conducting studies on medicinal plants and on malaria control.

**7.1.4. Dept. of Space**

The Department of Space would be collaborating with the Department of Environment and Forests in the project of biodiversity characterization at landscape level, and would provide management inputs in identifying the areas that are vulnerable and which need increased protection. It would also help in use of Geographical Information Systems (GIS) in forest administration, planning and resource management. The Natural Resource Information System being developed would be used by the department for preparing its Working Plans and Management Plans.

**7.1.5. ICFRE**

ICFRE would be carrying out collaborative projects with the Department of Environment and Forests, through its institutes, especially, Forest Research Institute, Dehradun and the Institute of Forest Genetics and Tree Breeding, Coimbatore.

#### **7.1.6. NBRI**

Has been carrying out projects on medicinal plants and their use by various communities. The ongoing project on bio prospecting of medicinal plants would continue.

#### **7.1.7. ZSI**

The Zoological Survey of India has recently implemented a major project funded by UNDP where intensive work was done on the taxonomy and classification of marine organisms.

### ***39. State govt. depts.***

#### **7.1.8. Andaman & Nicobar Island Forest Plantation and Development Corporation (ANIFPDC)**

ANIFPDC was involved in logging and plantation operations, especially on Little Andaman Island. It is now getting increasingly involved in promoting eco-development activities.

#### **7.1.9. Department of Environment and Forests**

This is the largest land manager in the Andamans. 7171 km<sup>2</sup> out of the total area of 8549 km<sup>2</sup> area of the islands (83%) is either Protected Forest, Reserve Forest or Protected Area, and comes under the management of the Department of Environment and Forests

Timber operations will be carried out to meet the local needs. Encroachment in forest areas is a major problem, and effective steps have been taken to evict the encroachers and to prevent further encroachments, this process is almost complete. The additions to the schedules under the Wildlife Protection Act, 1972 made this year, and which protect sharks, shells, and sea cucumbers, will be enforced by the Forest Dept. Additional investments in training and new staff will be required if it is to fulfil its role. The increasing importance of wildlife and biodiversity conservation would require strengthening of the wildlife wing, with additional manpower, mobility, research capability and setting up of a Wildlife Crime Records Bureau and Wildlife Forensic Science Lab. The increasing concerns of the environmental protection would require strengthening of the environment wing also with capacity building to detect and abate environmental pollution and also for prosecution of polluters.

#### **7.1.10. Fisheries**

Licences fishing boats and, maintains fisheries statistics and enforces regulations laid down by the Fisheries Act. Enforcement lacks any teeth and its advice to fishermen has resulted in over fishing. The current ban on sharks, sea cucumber and shells will mean that the licenses it provides will have to be drastically curtailed. Enforcement of the WLPA (1972) provisions will be in the hands of the Forest Dept.

#### **7.1.11. IP & T**

The Information Publicity and Tourism (IP &T) Dept. sets tourism policy for the islands. It has identified several areas in which tourism is to be expanded. Environmental concerns have not been in the forefront in choosing sites for tourism. For instance, backpack tourism has affected sea turtle nesting on Smith Island; even though night halts at this island are illegal the IP & T is planning the construction of infrastructure there. Proposals for tourism on Rutland Island would likewise have affected nesting turtles have been shelved for the moment, but there is pressure to get them reopened.

Of special note here is the Master plan for Tourism prepared by the World Tourist Organisation. This makes calculations of tourist carrying capacity based on water availability and the capability of treat sewage. The carrying capacity project appears to be extremely high and caution needs to be exercised before implementing any of this. Further studies are required and these are addressed later in this document.

**7.1.12. Tribal Welfare**

This Dept. is to ensure the welfare of the tribes. It sets the policies for tribal welfare, and the implementation is done by the AAJVS, nominally an NGO but whose executives are civil servants. Staff members come from a social work rather than an anthropological background, and this makes the policies adopted problematical. This Dept. is in potential conflict with the Anthropological Survey of India, whose scientists are better trained to understand tribal issues but who lack any implementation or enforcement powers.

**40. Research institutes**

**7.1.13. CAS in Marine Biology (Annamalai University)**

This is carrying out research on the marine flora and fauna of the Great Nicobar Biosphere Reserve.

**7.1.14. SACON**

SACON has conducted surveys on a number of threatened bird species in the islands, namely, Nicobar Megapodes, Narcondam Hornbills, Andaman Teal and Edible-nest Swiftlets. It is currently implementing a programme for in-situ and ex-situ conservation of the swiftlets.

**7.1.15. WII**

WII has conducted a survey of coral reefs in the MGMNP

**41. NGOs**

There are several NGO's whose activities are relevant to issues relating to biodiversity:

**7.1.16. ANET**

ANET is the oldest environmental NGO in the islands.

**7.1.17. AAJVS**

This organisation implements the tribal policy of the A & N Administration.

**7.1.18. ANDAMAN SCIENCE ASSOCIATION**

The Andaman Science Association publishes a journal where scientists from different disciplines contribute articles relating to these islands. These form a very important reference material.

**7.1.19. SANE**

An environment activist group that has been in the forefront in a seeral issues. Its main thrust nowadays is at the level of policy planning. It has been active in espousing tribal causes, and has Public Interest Litigation ongoing to prevent encroachment in the Onge Reserve as well as to reduce contact with Jarawa.

**7.1.20. WWF**

WWF has a conservation volunteer in the islands at the moment. They have implemented a village project



in Wandoor village for the supply of drinking water during the dry season.

**7.1.21. Kalpavriksh**

Kalpavriksh has been involved in the islands for several years. It has brought out a teachers manual with ANET that has generated a great deal of interest in the environment of the Andaman and Nicobar Islands. It is also involved in litigation regarding logging and tribal affairs.

**7.1.22. CPREEC, Chennai**

This is the Resource Agency for the implementation of the National Green Corps in these islands in collaboration with the Department of Environment and Forests and the Directorate of Education.

**42. Settlers**

The different settler groups that have been identified are:

**7.1.23. Bengali**

Bengalis were brought in as settlers in the 1952-3, with Middle Andamans being used for settlement in the early 1950's and North Andaman around 1957-1959. After this, there has been a continuing influx especially over the last decade. These appear to be predominantly refugees from Bangladesh, and they have become rural farmers. Some of them have converted to fishing. Medicinal plants used are mainly ones brought by them from Bengal. Bengali settlements in Little Andaman happened between 1969-1974, and part of the Onge Reserve was denotified as a result of this.

**7.1.24. Chota Nagpuri**

This community has several components, mainly tribes from the Jharkand and Chattisgarh regions. They were brought here before independence as forest labour; more arrived after 1948 to clear land for the new wave of settlers. They occupy mainly Government jobs. In rural areas they are concentrated around Baratang Island. They have developed rich ethno botany from the local plants.

**7.1.25. Tamil**

These are mainly recent immigrants, and tend to come from the Ramnad area of Tamil Nadu. A number also moved here from Burma, where they had previously been settled. They are mainly urban dwellers, and form a significant part of the fishing community. They are also involved with business, transport, trading, developing, construction labour, sand mining and road work.

**7.1.26. Telugu**

Mainly recent immigrants, these are mainly fishermen. An estimated 75% of the fishermen here belong to this community, and are from Nellore, Srikakulam and Vishakapatnam.

**7.1.27. Sri Lankan Tamil**

Refugees from Sri Lanka were settled here in the 1960's. There is a settlement growing rubber on Katchal Island in the Nicobars.

**7.1.28. Karen**

Karens were brought to the Andamans from Burma as forest labour in 1925. The community numbers 3000 totally, of which 600 live near Mayabunder. They are agriculturalists, fishermen, and work in Gov. Departments, and other communities have adopted their dug out canoes for fishing and transporting.

### **7.1.29. Malayali**

The Moplah community was brought here as convicts in the 1920's. Recently there has been an influx from other parts of Kerala. They are rice cultivators in North Andaman (Keralapuram) and in Middle Andaman (Betapur), a substantial number hold Government jobs or are shopkeepers.

### **43. Hoteliers**

A large number of hotels have sprung up, especially in the last decade, to cater to the increased inflow of tourists. These range from small lodges to large resorts, ranging in quality up to 3-star status.

In urban areas, most of the smaller hotels are badly located and built, and lead to both congestion and the production of untreated effluents. In coastal areas there is pressure from business interests to relax the CRZ regulations to allow new complexes near the beaches. These are likely to lead to major environmental degradation if approved.

### **44. Tour operators**

A lot of new businesses have come up in the islands over the last decade. A substantial number cater to the needs of tourists. These include travel agents, boat operators, tour guides, taxis, van and bus operators. They also include transport vehicle operators who depend substantially on tourism.

Tour operators are an important force deciding policies in the islands. There is pressure on the A & N Administration to open up new areas for tourism. Often this is done in an unplanned fashion leading to pollution and habitat degradation. An example of this is the damage done to the corals in the MGMNP due to excessive tourism. Another is the exposure of Jarawa to cultural contamination and alien foods by tour groups taken to visit them: this is illegal but extremely lucrative for the tour operators.

### **45. Tribes**

The different tribal groups are heavily dependent on natural resource use. The Nicobaris are dependent on fishing; the Andamanese, Jarawa, Onge, Sentinelese and Shompen are hunter-gatherers. The resource use patterns of the different tribal groups are not understood and this needs to be studied as a first step in any programme oriented towards their welfare.

### **46. Fishermen**

These include domestic fishermen and foreign poachers. Information - both primary data as well as from other sources- is being gathered on type of catch, fishing areas, and quantities taken. A preliminary analysis shows that 10 shark fishermen chosen at random account for over 240 tonnes of shark catch per year.

From the fishery point of view the endemic population of the Islands do not have any community having fishing as a vocation even though they are known to catch fish rather hunt for it, for their own consumption. Fishing as a commercial activity is of a relatively recent origin in the Islands. Fishermen from Andhra Pradesh, Kerala, TamilNadu and West Bengal have come to the islands through the settlement scheme of

the Government or voluntarily. There are about 2256 fishermen families with a population of approximately over 11500. The population of active fishermen are around 2150.

Traditional craft, dinghies, and motorized and small-mechanized boats mainly carry out fishing. The fishing fleet of the Islands comprises of 1262 country crafts, 247 motorised and 7 mechanical boats. The various types of craft and gears used by the fishermen in these Islands are as follows.

In some places trawlers are operated, for instance off North, Middle and South Andaman Islands. So far about 18 to 20 trawlers have been given permission to operate. Damage to coral beds due to trawling has been noted.Craft	Gear
Flat bottom dinghy	i. Gill net
Keeled bottom dingy	ii. Cast net
Hoddi	iii. Shore seine net
	iv. Hook & line
	v. Anchor net
	vi. Trawl net.

#### ***47. Defence***

The Navy and Coast Guard play a major protective role in guarding against poaching by foreign vessels. However, there are a number of reports that personnel from these services collect large specimens of corals and shells as trophies. An education programme for defence personnel is essential.

In 2001 the Andaman and Nicobar Command was established and is a joint command for the defence services. This will lead to the induction of many more personnel into the islands and an increased infrastructure. Proper environmental planning has to be integrated into the expansion of this Command to avoid degradation.

#### ***48. Cross-cutting themes***

##### ***7.1.30. Gender***

No special issues pertaining to gender issues have been identified in the course of preparing this document, except for the fact that women do not fish, in some communities they are involved in marketing and trade. Several work in Govt. departments, schools and the college.

##### ***7.1.31. Equity***

Money lending is extremely prevalent in rural areas, especially among the Bengali and Tamil community. Interest rates are usurious, and this leads to a greater use of natural resources than necessary.

##### ***7.1.32. Peoples Empowerment***

The decisions as to where and how Government funds should be spent are taken in the capital, Port Blair, itself, and there is minimal consultation with the villagers about what actions need to be taken. This is a pity because there is a very strong Panchayat framework.

To illustrate this, a recent study shows that the greatest need for the fishermen in Wandoor and Manjeri

panchayats is an ice plant and a deep freeze. For a number of reasons these would effectively double their income. A push is required to make increased contacts between the panchayats and the bureaucracy possible, and to strengthen a cooperative society network. (Singh *et al.*, 2001)

## **8. Actions needed to plug gaps and strengthen ongoing programmes**

The ANI are one of the ecologically most sensitive bio geographic zones of the country. It has been demonstrated that small actions here have major impact, impacts that would not be felt elsewhere. It has to also be noted that 19% of the fauna here is endemic, so loss of area leading to extinction have more serious consequences here than elsewhere.

The NBSAP paradigm here must be to protect as much of this area as possible. Revenue would be earned from tourism and sea-based activities after a careful study. Agricultural activity is deleterious and must be phased out. Immigration and encroachment are the top priority for enforcement agencies.

Site-specific threats have been dealt with in Appendix 3. The more general ones are given below.

### ***49. Impact assessment of tourism on biodiversity***

#### **What is known?**

Existing tourist spots are increasingly polluted, with noise and plastic. Increased encroachment for constructing shops and lodges has occurred. Corals have been damaged.

The infrastructure is inadequate to support increased tourism, with adverse consequences resulting in land, water and noise pollution. There is scope for low volume, high value tourism, preferably eco-tourism on limited circuits without creation of any permanent structure in the forest areas.

#### **Summary of actions to be taken:**

- EIA's to be done before opening up new areas for tourism (see under 'Multi-sectored' action plans).
- Involvement of local residents in development activities, and ensuring that benefits from any development go to them.
- Establishment of the appropriate protection and monitoring mechanism at Manjeri, to control tourism.
- Prevention of environmental degradation to corals and other natural resources through an awareness generation programme.
- Review of the recommendations of the UNDP Sustainable Tourism study.
- Elimination of subsidies for tourists.

#### **Summary of research priorities:**

- Impact assessment of existing tourist sites, the benefits it has brought in terms of development to the area, and the additional income to the residents.
- Determining whether carrying capacity is relevant to the context of the islands and determining limiting factors due to infrastructure, transport and food availability.

## ***50. Impact assessment of forestry operations on biodiversity***

### **What is known?**

Preliminary studies in the past have shown that the forest structure has changed because of logging in most of the areas out of the 15% forest area taken up for operation under the Andaman Canopy Lifting System, as per the objective of management. Timber and MFP are important items for local use. Forest protection is the primary charge of the department, but it's infrastructure for the purpose of mobility and communication is inadequate to perform this function effectively. Boundary disputes exist between the forest and the revenue areas, which need settlement quickly for effective protection. The subordinate forest staffs need training in enforcement of various legislations and also in recent trends in forestry and forest management. The residential buildings available with the department are inadequate for the large manpower, especially in the remote and difficult areas, and this acts as a disincentive for serving in remote areas. There are a large number of protected areas, but many do not have management plans. Timber utilization needs improvement and facilities for timber treatment need augmentation. The coastal ecosystems are threatened by sand collection and need effective protection. The mangroves are rich and need protection. Low volume, high value eco-tourism needs to be promoted in forest areas for the purpose of education.

### **Summary of actions to be taken:**

- Information on various aspects of the functioning of the department needs to be collected, analysed and disseminated for efficiency and for transparent and responsive administration. This should be done through application of Management Information System (MIS) and Geographic Information System (GIS) and establishment of Local Area Network (LAN) connecting all the offices. Effective communication network should be established through VHF and HF wireless communication.
- Since logging is being restricted to meeting only local needs, the introduction of Reduced Impact Logging is possible.
- Large-scale cultivation of cane and bamboo on all degraded land has to be taken up as a high priority long-term activity. The research leading to this has to begin immediately. . Introduction of solid/ thick walled bamboos not found in these islands would help in meeting the constructional needs in the rural areas and reduce the pressure on forests for ballies and posts, which is affecting the regeneration of forests. This should be done after proper trials.
- Removal of trees from private hilly lands should be done by the AND E& F, and not by contractors. Otherwise, suitable legislation has to be enacted to regulate felling in non-forest areas.
- The forestry training needs to be strengthened with in-service training, promotion –linked training, etc., especially in implementation of the various legislations and latest forestry practices.
- The Forest Settlement process needs to be expedited, and forestland records should be created after settling all boundary disputes between forest and revenue areas, for effective protection as well as forest management. Modern technology, such as GIS, should be employed.
- In view of the recent orders of the Supreme Court, all Working Plans will be revised.
- The National Green Corps shall be established in 100 schools, addressing various subjects such as solid waste management, pollution control, afforestation, maintenance of parks and open spaces, dissemination of information and creation of awareness. The extension activity shall be expanded with the involvement of the Panchayati Raj Institutions
- The staff posted in difficult and far-flung remote areas shall be provided with proper accommodation, so that they can effectively attend to forest protection and afforestation.
- The Protected Areas shall be covered by Management Plans and the Wildlife wing shall be strengthened to cope with the increasing pressure, due to extension of the area to be protected to marine ecosystem also. Capacity building in habitat management and monitoring should be the

- priority. Ex-situ conservation when required can be carried out in the Biological Park under construction.
- Poaching and illegal trade in wildlife can be controlled by increasing the mobility and communication facilities of staff, organizing intelligence gathering and crime prevention, better coordination with other law-enforcement agencies and extra vigilance at exit points of this territory.
  - The saw milling should be made more efficient by modernization and timber treatment facilities should be augmented to increase the life of timber and thus reduce its use.
  - The protection along the coastline must be strengthened through increased mobility and communication network.
  - The mangrove areas should be surveyed and mapped; the biodiversity in this ecosystem must be assessed and documented. The mangrove areas degraded by excessive exploitation should be reforested.
  - Bee keeping and vanilla cultivation needs to be encouraged as an income activity especially in areas where pesticides are not used.
  - Cane processing units should be recognised as industries, to supply furniture, etc. for local consumption only. The cultivation of canes and bamboos on private and revenue lands has to be encouraged.
  - The A&N Administration must pass a set of rules to complement the Indian Forest Act, to strengthen its provisions to meet the requirements of these islands, as the current laws have a lot of loopholes.
  - Ecotourism should be promoted on limited circuits mainly with a view to facilitate education and appreciation of nature.

#### **Research priorities:**

**Biodiversity assessment, monitoring, conservation and utilization:** The extent of biodiversity at landscape level, species level and genetic level needs to be assessed and monitored continuously for the purpose of conservation and utilization. Various research organizations such as Dept. of Space, BSI, ZSI and Institute of Forest Genetics and Tree Breeding have to be involved in the process.

**Mapping of forest areas:** A comprehensive exercise to map all existing forest areas, forest types and other land uses, using a combination of satellite imagery and ground truthing is an urgent priority. This will enable identification of priority areas for conservation and help in taking management decisions related to the number of personnel and resources to be deployed in an area. This will also enable the identification of fresh encroachments. This needs to be done within the next three years, and is estimated to cost 20 lakhs.

**Changes in forest structure due to logging:** Enumerations need to be carried out at sites all over the islands to compare the composition of logged sites of various ages with adjacent unlogged ones to establish the extent of the change. A detailed evaluation of Natural Regeneration Areas is also necessary. This will enable areas to be identified for future logging operations that may be necessary to supply local needs.

**Permanent study plots already exist in a number of places:** These include sample plots, preservation plots, tree increment plots, canopy manipulation plots, introduction trial plots, seed production areas, seed orchards, and mangrove plots. This network needs strengthening and expanding.

**Additive effects of browsing by introduced herbivores:** The presence of herbivores has affected forest regeneration both on logged and unlogged sites because some species are selectively grazed. Enclosure

experiments to exclude herbivores in both unlogged forest and natural regeneration areas are required to assess accurately the damage caused by these herbivores and the control measures to be taken. This is very high priority; it should begin immediately with monitoring to last at least 5 years.

**Genetic improvement, seed biology, phenology and nursery technology of important species:** In the area identified for timber extraction to meet the local needs, the tree crop needs to be improved by enrichment plantation using genetically improved planting material. This requires carrying out genetic improvement of the species for getting quality planting stock. Study is required on the seed biology, phenology, nursery techniques and macro propagation methods of a large number of species.

**Need for pilot experiments with indigenous species for afforestation, with special reference to bamboos and cane:** Areas of degraded land are to be found at numerous places. Also, agricultural production in certain areas is already so low as to make farming non-remunerative. These areas need to be brought under tree cover and to avoid any adverse ecological impacts only local species should be used. The silviculture of many species that it is possible to use is not known, and research is required. Along with this demonstration plots need to be set up where local residents can see the benefits of planting various species.

**Alternative livelihoods:** Information on income generation through fisheries, tourism, forest products and other alternatives to wood based industries is urgently required to make informed decisions on redeployment of staff currently involved with timber extraction.

**Rare and endangered plants:** Systematic studies need to be conducted on the geographical distribution, habitat, and propagation of rare and endangered species of plants that have already been identified.

**Forest ecology:** Studies on various aspects of the ecology of the different types of forests in the islands need to be taken up. These include studies on nutrient cycling and hydrology. Soil and water conservation techniques also are important in this high rainfall area.

**Socio-economics:** Detailed studies of the socio-economic aspects of the use of the different kinds of forest produce will enable the identification of critical stakeholder groups who can be targeted for development activities.

**Wood preservation techniques:** Further research to conserve timber resources of which about 20,000 m<sup>3</sup> will continue to be used annually: while considerable progress has already been made, timber preservation techniques appropriate to the local species need to be developed and promoted even further.

Impact assessment of developmental activities on biodiversity

### ***51. Impact of sand mining on biodiversity***

#### **What is known?**

Sand mining leads to the loss of beaches, loss of coastal forest and reduction of sea turtle nesting habitats. It also reduces the value of the beaches for tourism.

Jetty construction leads to the build up of sand on one side of the jetty, and erosion on the other.

**Summary of actions to be taken:**

- Licenses to be given for production of pulverised granite, which is used as a substitute for sand on other oceanic islands. Granite quarrying sites to be selected after proper impact assessment, to prevent the recurrence of ugly landscapes such as that at Corbyn's Cove. Stricter monitoring of illegal sand mining needs to be done.
- The software for the computer simulations of wave actions on the beaches will have to be obtained and personnel trained in its use. Computer simulations should be conducted before the construction of any jetty. They should be carried out for all existing jetties so that modifications can be made that minimise beach erosion.
- Environmental Impact Assessments of all development activities have to be made mandatory, and a strong EIA Cell should be set up immediately with mandatory powers, and including non-official members. . The Supreme Court in its recent orders has ordered that in future all development projects have to be sanctioned only after EIA to be carried out by an agency identified by the M o E F, and this organization needs to be identified.
- Import of river sand from mainland can also be attempted as the requirement of sand is not much and is likely to reduce in future in view of the recommendations of Prof. Shekhar Singh, to use only treated timber in all future constructions and to switch over to "Assam type" constructions which are suitable for such seismic zones, and also in view of the order of the Supreme Court to reduce sand mining.

**Research priorities:**

**Extent of beach loss:** The beach loss and the loss of coastal forest have been obvious. What is not known is the extent of erosion. Obtaining maps from the 1950's, and using a GPS to plot the current coastline at selected sites can estimate the extent of the loss of beaches. Since beach loss is a major cause of concern within these islands this activity also becomes high priority.

**Floating barriers:** Floating barriers consisting of used car tyres have been used in the USA to build up beaches with considerable success. Experiments need to be carried out here to establish the feasibility of using these.

**Tidal flows near jetties:** This information will have to be gathered for each jetty to use as inputs for the simulations. This will then be used to make design modifications to jetties.

### ***52. Impact assessment of fishing on biodiversity***

**What is known?**

There has been a reduction in number, and a reduction in the mean size of individuals caught. The catch per unit effort appears to have declined, though there is no data to back this up. Large sizes in lobsters and crabs have become rare, and sea cucumbers are not commonly seen in shallow depths. The same applies for shells.

**Summary of actions to be taken:**

- Increased monitoring of fisheries catch of all kinds. Improved enforcement of fishing regulations, especially with regard to fishing by local residents.
- Monitoring needs to be done to ensure that these trawlers do not operate in coral bed areas which causes incalculable damage to the ecosystem



**Research priorities:**

**Catch per unit effort of different species:** It is not yet known what species are declining, and to what extent. A database needs to be set up and methodologies evolved to estimate catch per unit effort on a periodic basis. This needs to be done over a long term.

**Assessing impact of ban on shell fishing, etc. on different communities:** The Industries Dept. estimates about 2000 persons involved in the shell trade alone. The recent partial ban on shell collection is going to affect their livelihood adversely. At the same time it is necessary to protect a resource that is rapidly becoming scarce. Research needs to be done on how best they can be re-deployed. The Fishermen of Andaman and Nicobar Islands do traditional fishing for example they employ gill net hook & line, cast net, Bag net, anchor net etc. The above-mentioned gear is in general eco-friendly. If employed with constraint they do not hamper the ecosystem. Provision may be made in the Fisheries law to restrict/ban the particular endangered fin/shell fishes from fishing/ exploitation. Closed fishing during the breeding period may also be observed. For sedentary organisms like mussels / oyster etc. indiscriminate exploitation must be prohibited in the mussel/ oyster beds.

### ***53. Impact assessment of agriculture on biodiversity***

**What is known?**

A reduction in forest area has occurred because of increasing agricultural activity, and this must have led to species loss, given the Theory of Island Biogeography. Crop yields are declining, and this is leading to increased dependence, and degradation of nearby forests. Since there is no proper quarantine at transit points lot of pests and diseases are being introduced in crops brought from mainland India

**Summary of actions to be taken:**

- Monitoring and control of encroachments: Since these are a consequence of immigration, steps to control immigration are also necessary.
- *In situ* and *ex situ* conservation of wild relatives of cultivated species: Development of cooperatives for marketing. Creation of cold storage facilities.
- Increase in number of well-trained development personnel.
- Better transport facilities.
- Information network.
- Control of soil erosion.
- Reclamation of saline land.
- Creation of additional facilities for irrigation and construction of ponds and sunken wells. Establishment of quarantine facilities.

The following are not directly related to biodiversity conservation and are not discussed in detail: Demonstration of multi-cropping in the Nicobars. Introduction of organic farming, orchid cultivation and floriculture. Value addition to coconut and arecanut. Spice cultivation and extraction of oils (cinnamon, pepper, cloves, and ginger).

**Summary of Research priorities:**

**Avifaunal change with pesticide use:** Pesticides have been implicated, both in mainland India and elsewhere, for a loss in bird and insect diversity. An assessment of how species diversity in the Andaman & Nicobar Islands has been affected needs to be carried out to understand whether it is necessary to phase out pesticides.

**Detailed study of agricultural production in the Nicobars:** Agriculture in the Nicobars has been hit by ageing coconut plantations as well as dropping copra prices. Research is required both from a sociological viewpoint (on how plantation productivity can be enhanced) and from an economic point of view, to establish what value addition can be done in the Nicobars. Also relevant is to establish whether the Nicobari methods of farming coconut and arecanut are in fact more productive than those used elsewhere.

**Agro forestry alternatives to agriculture:** Declining crop yields will necessitate shift in land use for agriculture to agro forestry in a significant proportion of the cropped area. Research and development of agro forestry operations therefore needs to be done on a priority basis.

**Control of Crab-eating macaques:** Crab-eating macaques are a major problem in coconut plantations, especially on Great Nicobar Island. It is required to experiment with techniques to prevent the animals from damaging coconuts and other crops.

**Developing methods to identify encroachments rapidly using satellite imagery:** Rapid identification of areas that have been encroached is extremely important in reducing their occurrence. New satellite imagery technology makes it possible to identify land use changes over extremely small areas. These needs to be integrated into the functioning of the Forest and Revenue Departments and a pilot project to develop and demonstrate the technology is required.

#### ***54. Impact assessment of Introduced domestic species***

**What is known?**

Grazing by domestic animal species is already causing degradation in forest areas.

**Summary of actions to be taken:**

- Incentives have to be created for stall-feeding. These could perhaps involve upgrading the breeds of cattle with higher milk yields, which are not allowed to free-range.
- Planting of fodder trees, together with dairying and value addition such as cheese production need to be introduced on a professional level.
- Strict enforcement is necessary to ensure that animals do not graze in forest areas, especially in the tribal reserves.
- Reducing the quantity of livestock by improving quality

**Summary of Research priorities:**

**‘Carrying capacity’ studies:** The daily requirement for milk in the islands is not known. The total requirement of draught animals for farming is not known. The requirement of meat from goats is not known. Research aimed at gathering this information will allow policies to limit livestock to be implemented.

## ***55. Medicinal plants***

### **What is known?**

Every tribal group in the islands has a rich ethno botanical tradition, which is largely not documented. Some groups from mainland India, such as those from Chota Nagpur, have developed their own medicines using endemic plants, over the last fifty years. The Karens in Middle Andamans have their own plant-based medical system based on knowledge brought from Myanmar. MNC pharmaceutical companies have been prospecting for plants with medicinal values over the rest of India, and it is entirely likely that this has been happening in the Andamans as well.

### **Summary of actions to be taken:**

- Steps need to be taken immediately to ensure that any medicine that is obtained from traditional tribal knowledge is patented in the name of the tribe, and a mechanism must be set up to ensure that the benefits go to the tribe.
- Checks at the airport and ports must be extended to plant materials as well.

### **Summary of research priorities:**

**More information:** The work on ethno botany being carried out now needs to be considerably expanded in scope.

**Species information:** After collection, identification and processing in a herbarium of a species of medicinal value, research will have to be done on its propagation, its phytochemical and pharmacological properties, and its conservation.

## ***56. Wild relatives of cultivars***

### **Summary of actions to be taken:**

These need to be identified.

### **Summary of research priorities:**

Systematic experimentation to improve cultivars using wild relatives should be undertaken.

## ***57. Encroachments and their impact on biodiversity***

### **Summary of actions to be taken:**

- A GIS cell must be established to ensure immediate identification of and timely action taken on fresh encroachments.

### **Summary of research priorities:**

**Development of GIS methodology:** A methodology suited to these islands to identify encroachments based on satellite imagery needs to be developed and implemented.

**Training:** FD staff requires training in the use of GIS. Field staffs require training in the use of GPS to quickly and accurately locate and map problem areas.

## ***58. Resource use by different communities and their impact***

### **What is known?**

Until now, attempts to bring tribal groups, excluding the Nicobarese, into the mainstream have led to a decline in their numbers and have brought some of them to the verge of extinction.

### **Summary of actions to be taken:**

- Alternatives to the Andaman Trunk Road, such as strengthening the sea transport system, which is a much more cost effective and viable mode.

### **Summary of research priorities:**

A study to determine to what extent further attempts to integrate the different tribal groups are desirable.

**Human ecology of all the tribal groups:** The population dynamics, foraging patterns, nutrition and behavioural patterns of all these tribal groups are understood at a very superficial level. Intensive studies need to be initiated in all these aspects.

**Use of medicinal plants:** There are many new medicines to be discovered by studying the ethno botany of the different tribal groups. These need to be documented, tested and then patented in the name of the tribal community involved. The implications of doing this need to be considered carefully in advance, since an inflow of plant collectors into the tribal reserves would be undesirable.

## ***59. Immigration patterns and impact of demographic pressures***

### **What is known?**

Increased immigration has led to increasing agricultural activity leading to increased encroachment, resulting in soil loss, loss of productivity and damage to coral reefs.

### **Summary of actions to be taken:**

- Steps have to be taken to prevent further influx into the islands. These can include removing the subsidy on ship fares for non-locals, and introduction of restricted area permits on the lines of those being used in NE India.

### **Summary of research priorities:**

**Population projections** using different scenarios of immigration are required. These would help in proper planning for infrastructure development.

**Reasons for immigration:** We do know, to an extent, what has attracted the inflow of people from main land India. This is mainly due to increased and better business opportunities, higher wages and easy availability of land for encroachment (This would change now due to the extensive eviction process from forest land that is in progress). We do not know where they come from (except for region), the reasons they chose to come here and the employment they get here. We also do not know the role subsidies play in this. Detailed interviews with persons who have come here in the last decade are expected to throw light on this and enable the Administration to come up with measures to control further inflow.

**Impact of human activities:** In general, the impact of human activities on coral reefs, wetlands and rainforest ecosystems and mangroves needs to be studied.

### ***60. Assessment of mangroves***

**What is known?**

Degradation and loss of mangroves is taking place in some areas because of encroachments and cutting for domestic use.

**Summary of actions to be taken:**

- Changing the status of mangroves from Revenue and Protected Forests to Reserve Forests is necessary. Satellite imagery combined with ground truth is an urgent need to enable the delineation of all mangrove areas so that they can be upgraded to RF.

**Research priorities:**

**A long-term mangrove-monitoring network:** Needs to be established using the guidelines lay down by IUCN and GCRMN. This will allow tracking of changes in different areas over a period of time.

**Mangrove fauna:** While samples of mangrove faunas have been collected at several sites, many other sites, especially in the Nicobars, remain unsurveyed for their fauna. The faunas for several localities, and their associations with particular mangrove species, need to be worked out.

### ***61. Assessment of coastal ecosystems***

**What is known?**

Beach erosion has occurred and is occurring because of sand mining; the A & NI have lost 21 marine turtle nesting beaches between 1981 and 2000 due to sand mining. Since a number of coastal forests are classified as Revenue Forests, there is very little check on felling and lighting fires, and encroachments are common. Regeneration in all the major islands in the Andaman group, with the exception of Little Andaman, has been severely affected because of browsing by spotted deer.

**Summary of actions to be taken:**

- Steps need to be taken to declare these forests as Reserve Forests. Pulverised granite has to be introduced immediately as a substitute for sand, and licenses for these have to be granted by the Industries department immediately.

### ***62. Assessment of wetlands***

**What is known:**

These have been drained for agriculture and development activities, mainly those that are close to and around urban areas. Swamp forest is rare now and is found only in protected areas. They harbour a number of endangered and endemic species such as Andaman Teal, crocodiles, freshwater fish and Andaman Crake, besides other migratory wetland birds.

**Summary of actions to be taken:**

- Protection of all wetland areas that have already been identified is urgently required. Routine monitoring of pesticides in these wetlands is also necessary, besides controlling poaching and fishing.

**Research priorities:**

**Identification and mapping of wetlands:** All the open wetlands in the islands need to be identified using remote sensing methods. These should then be surveyed and areas identified should be integrated into the protected areas network.

**Ecological studies:** Studies to be undertaken of the ecology of select wetlands and the different species found in them. This would have to be a multidisciplinary approach and effort.

### ***63. Assessment of coral reefs***

**What is known:**

The area of corals in the Andaman and Nicobar Islands exceeds the land area, and is being damaged due to a number of factors including siltation, trawling, dynamite fishing, tourism and anchor damage.

**Summary of actions to be taken:**

- Establishment of new marine national park off the East and West coast of Middle and North Andamans Islands.
- Improved patrolling on reef areas

**Research priorities:**

**Assessment of extent and diversity of coral reefs:** The species diversity of corals, reef extent and fishes at different depths in different areas needs to be studied in much greater detail to determine which areas should be protected in the future.

Assessment of the impact of fisheries, fertilisers and pesticides on coral reefs.

### ***64. Assessment of medicinal plants***

**What is known?**

Every tribal group in the islands has a rich ethno botanical tradition, which is largely not documented. Some groups from mainland India, such as those from Chota Nagpur, have developed their own medicines using endemic plants, over the last fifty years. The Karens in Middle Andamans have their own plant-based medical system based on knowledge brought from Myanmar. MNC pharmaceutical companies have been prospecting for plants with medicinal values over the rest of India, and it is entirely likely that this has been happening in the Andamans as well.

**Summary of actions to be taken:**

- Steps need to be taken immediately to ensure that any medicine that is obtained from traditional tribal knowledge is patented in the name of the tribe, and a mechanism must be set up to ensure that the benefits go to the tribe.
- Checks at the airport and ports must be extended to plant materials as well.

**Research priorities:**

**More information:** The work on ethno botany being carried out now needs to be considerably expanded in scope.

**Species information:** After collection, identification and processing in a herbarium of a species of medicinal value, research will have to be done on its propagation, its phytochemical and pharmacological properties, and its conservation.

### ***65. Assessment of wild relatives of cultivars***

**Summary of actions to be taken:**

These need to be identified.

**Research priorities:** Systematic experimentation to improve cultivars using wild relatives should be undertaken.

### ***66. Trade in wildlife species and foreign poaching in coastal waters.***

**What is known?**

There is considerable smuggling of coral, crocodile skins, shells, sea cucumbers, turtle carapaces, deer antlers and skin and edible nest swiftlet nests; both through local airports and seaports, and by foreign poachers operating here.

**Summary of actions to be taken:**

- Forest Dept. staff has to be involved with the security checks at the airport and the harbour. Increased staff at the ports is also required, who will conduct checks.

## **9. Key strategies for biodiversity conservation and sustainable use of natural resources**

### ***67. Social forestry and JFM***

**What is known?**

JFM causes moderate levels of disturbance in forest areas. There has been no attempt at JFM in the Andamans. Given the high literacy rate, it should be easier to implement than in most other states.

**Summary of actions to be taken:**

- JFM for a limited purpose of Joint Forest Protection can be tried on an experimental basis at three or four sites where the forest is highly vulnerable.
- Social forestry can be taken up on all cleared land that is taken over after the eviction of encroachers on revenue land. This should involve school children.

**Summary of research priorities:**

**Tree improvement:**

Techniques have to be developed for improving the quality of trees to be planted on degraded land: this could be through ovule culture, embryo culture, pollen culture and spore culture and vegetative propagation, as well as conventional tree breeding through cloned seed orchards, seedling seed orchards, seed production areas of the desired tree species. The advantage of these trees is an improved yield reducing dependence on forest resources; the disadvantage is a lower genetic diversity, eliminating this as an option for planting in forest areas reserved for protection.

## **68. Protected areas management**

### **Summary of actions to be taken:**

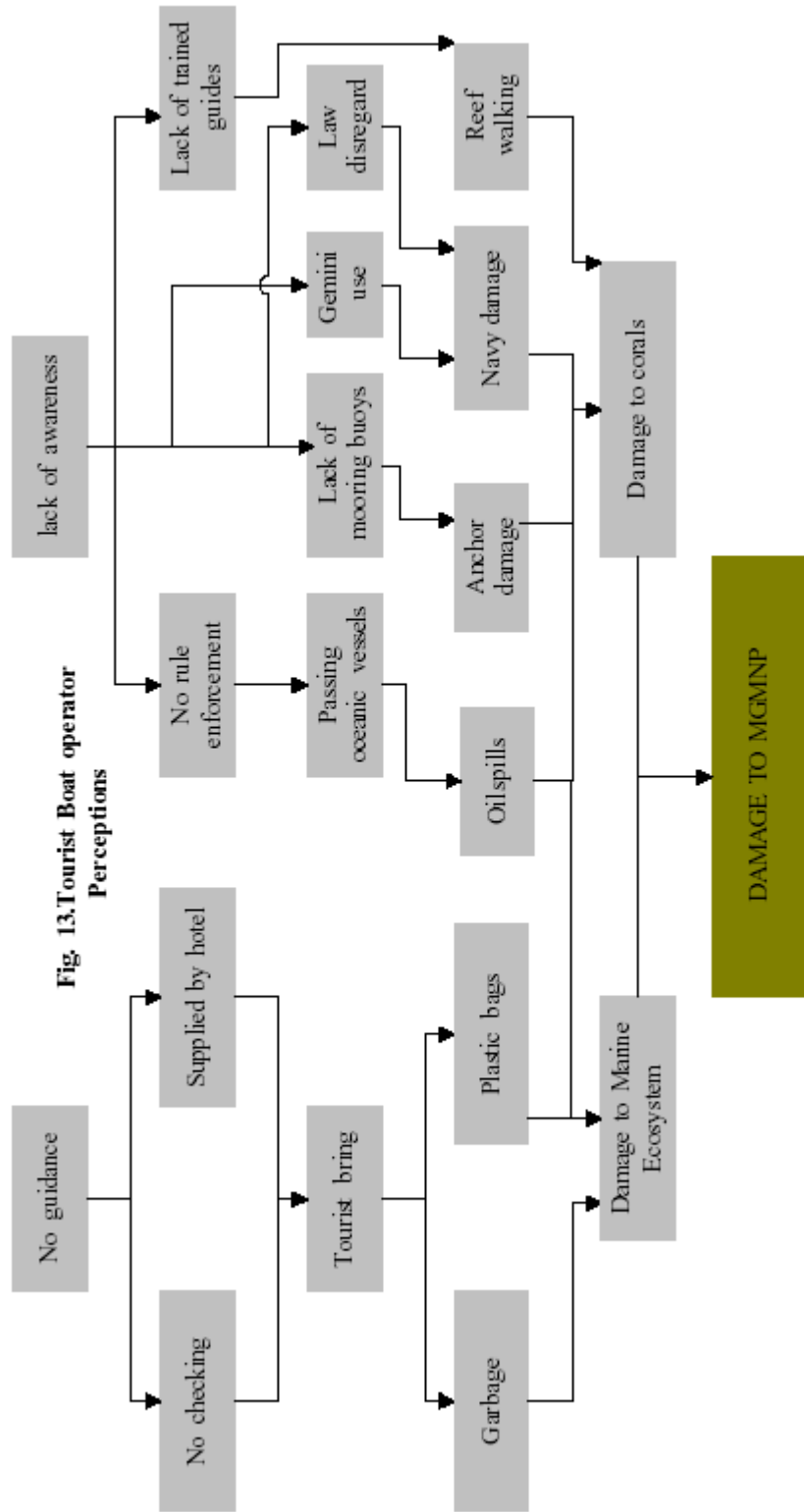
- Establishment of a GIS cell in the Department of Environment & Forests is a priority.
- Demarcation of boundaries of all P.A's.
- Notification of all proposed extensions and buffer zones.
- Improved equipment and communication system for all forest staff.
- More fast boats and vehicles to facilitate patrolling.
- Coastline, coral reefs, sea grass beds and other marine ecosystem monitoring and management.
- Management plans for wetlands, crocodiles and marine turtles.
- Since IBA areas have been identified, these areas now require notification and protection and should be done as soon as possible. Protection generally needs to be enhanced with increased staff and facilities such as boats.
- Reorganisation of certain smaller P.A's as proposed by WII, IIPA, BSI and ANET, so as to make their boundaries ecologically sound and accord them effective protection and management
- Arboretums and proper interpretation centres should be set up in each important protected area for public educational purposes.
- Removal and control of introduced deer, dogs, cats and elephants.
- Co- ordination between Forest Department, Police, Coastguard and the Navy for joint patrolling.

### **Summary of research priorities:**

- Mapping of vegetation types: It is not known now as to the original extent of the different vegetation types in the islands, their current extent, and the condition that these are in at present. A combination of high-resolution satellite imagery combined with ground truthing will enable this.
- Identification of stepping-stones: The above exercise will allow the determination of what areas need to be added to the protected areas network. These areas will then have to be surveyed to find out their suitability for inclusion into the PA network. The identification of wildlife corridors to facilitate the movement of identified animal species, marine and terrestrial, would also be part of this.
- Mapping of coral reef areas: The extent of coral reefs in A & N is still unknown although currently the reefs of the Andamans are globally significant due to species richness and the diversity. Extensive surveys are urgently required and the reef areas mapped; both inside and outside PA's. Satellite imagery can be used in the preliminary stages, but since its accuracy in mapping reefs is not very clear, intensive physical verification will be required.
- Preparation of management plans: Management plans exist only for Mount Harriet National Park and MGMNP, and need updating and revision. Management plans need to be drawn up urgently for all the other protected areas in the islands. An exercise is going on at the moment to involve local residents in discussions about future management, and it is yet to be seen how successful this effort will be. Figure 15 gives an idea of tour operator perceptions as to how park areas are damaged.
- Mangrove ecosystems: The threats to mangrove ecosystems, as well as the dynamics of these systems, are poorly understood. Five sites need to be selected in the Andamans and monitored on a long-term basis to understand the threats. At the same time studies on nutrient cycling and associated fauna of the mangroves should be initiated.



Figure 15



**Areas to be added to PA network:**

**What is known?**

Wetlands and marine areas are not inadequately covered.

**Summary of actions to be taken:** The following areas are to be added to the PA network:

***In The Andamans***

- MGMNP to be expanded to include adjacent Lohabarrak Crocodile Sanctuary, entire Rutland, Twins and the two Cinque Islands.
- Inclusion of Nicholson, Peel, Wilson, English, North, Middle and South Button Islands; this is critical for dugong habitat/ sea grass ecosystem and the high diversity of corals in the reef areas around this entire area, and in the existing Rani Jhansi MNP (Andrews & Sankaran, 2002; Ali, *et al.*, 2002).
- Little Andaman Island, a complete ecological survey including coral reefs is urgently required; the wetlands (Freshwater marshes, peat bogs and freshwater streams) are unlike any found in the Andamans or Nicobars. This island is the last strong hold for the Andaman Teal and other wetland birds, wild pig, crocodile and the leatherback sea turtle (Andrews, 2000); Andrews & Sankaran 2002).
- Kadakchang Wetland- Little is known about this habitat.
- Hanspuri wetland- Important habitat for Andaman teal and the Andaman crane.
- A new marine national park to include Interview, North Reef Island, South reef, Mask, Anderson, Bennet, Roper, Ranger, Entrance, Boudeville and Latouche Islands and the sea around and in between.
- Extension of Cuthbert Bay Turtle Sanctuary along the existing beach on the south and north right up to Phoenix Point (Karamatang) and adjacent vegetation fringe on the landward side (Andrews, *et al.*, 2002).
- Mount Diavolo as a protected area.

***In the Nicobars***

- Central and uninhabited coastal areas of Little Nicobar
- Galathea/South Bay in Great Nicobar Island
- Part of Kamorta
- Grasslands on Teressa & Bompoka

***69. Ex-situ conservation***

Biological/zoological park

Spp. Breeding centres.

Botanical gardens/ Arboretum

Seed banks

Gene banks

***70. Enumeration of biodiversity***

**What is known:**

The BSI and ZSI have carried out extensive surveys of all the major taxa. There are, however, gaps in this.

Coral reefs and herpetofauna are a major gap, and every survey finds new records and new species.

### **Summary of research priorities:**

- Ecosystem/Habitat Survey: Proper surveys need to be conducted on each of the above existing and proposed Pas.
- Surveys of key taxa island-wise and habitat-wise: Amphibians, birds and butterflies are key indicators of the habitat of any place. An island-wise survey for these, and of the flora, will enable understanding of the biogeography of these islands.
- Small mammal survey: There is a very high diversity in bats and rodents in these islands, and many of the species are endemic. There is also likelihood that there are several undescribed species. A systematic effort to collect and identify specimens of these across both the island groups is necessary.
- Archaeological and fossil information: There is no information on the original fauna of these islands since no effort has been made to collect fossil material. The recent excavation to prepare the new airport presented an opportunity to collect fossil material that was unutilised. An initiative to collect this material is required since it will enable the determination of what evolutionary processes occurred here.
- Delineating critical endemic bird areas and their status (BNHS)
- Delineating important areas for herpetofauna and status surveys (ANET).
- Delineating important areas of endemic plant diversity (BSI, ANDE & F).
- Management of Tribal Reserves (ANDE & F)

### ***71. Threats to particular taxa***

#### **Summary of actions to be taken:**

- Continuous monitoring and removal of goats from Narcondam and Barren Islands is needed; so is a large-scale implementation of swiftlet farming and more protection for Megapode habitat along the south east coast of Great Nicobar Island.
- Small PA's for particularly rare and endangered species, such as *Euphorbia epiphylloides* found only on Saddle Peak, Munda Pahar and at Kalpong, should be created.
- Large reptiles, saltwater crocodile and marine turtles, need urgent conservation and management action.

#### **Summary of research priorities:**

- Restricted range species: Surveys should be conducted on other endemic bird species to establish their current status and threats to them.
- Regular surveys need to be done of the following, after identifying particular species under threat:
- Cetacean diversity and status survey (Whales, Dolphins)
- Dugong surveys/status
- Endemic birds
- Endemic reptiles
- Endemic plants
- Marine turtles
- Crocodile and its habitats.

### ***72. Introduced species***

#### **What is known?**

Introduced species include chital, elephant, dogs, cats, rats, and mynahs. Browsing by elephant on Interview Island, and by chital everywhere in the Great Andaman group is affecting forest regeneration and is likely to lead to a loss of species diversity in the future.

**Summary of actions to be taken:**

- Interview Island has about 35 elephants. These need to be removed. Advice needs to be sought on the optimal method of trapping and transport to the mainland.
- Deer ranching and farming: As a matter of principle all introduced species should be removed. Deer ranching may be considered as an income generating activity. An amendment of the Wildlife (Protection) Act allowing for the culling and removal of exotic species, no matter what Schedule they are on, is necessary. Deer farming is an attractive proposition in the islands and a feasibility study should be carried out for this. The standard argument that this will encourage poaching, does not apply here since it is anyway an undesirable introduced species.

**Summary of research priorities:**

- **Enclosure experiments:** It has been established that browsing by spotted deer affects regeneration. It is not clear as to which species are preferred browsing and what the long-term effects of this browsing will be. Fencing off areas and comparing these with browsed areas, in both natural forest and natural regeneration areas will enable a determination of the long-term consequences of browsing.
- **Environmental impacts of each introduced species:** Very little is known about the impacts that dogs, cats, squirrels and mynahs (all introduced) have on the environment. Research needs to be done on this, which will also suggest methods for their removal.

### ***73. Alternative renewables***

**What is known?**

In every field of human enterprise there are alternatives that are environmentally friendly. These include:

- Alternative energy sources such as solar and wind, ideally suited for the A & NI. (Electricity Dept.)
- Alternative construction materials such as pulverised granite, treated wood. (APWD)
- Water conservation and rain water harvesting as an alternative to large storage structures; (APWD, DRDA)
- Bio pesticides as alternatives to the highly toxic chemicals available on the market nowadays; (Agriculture)
- Cash crops with value addition as an alternative to paddy, which is damaging the corals due to runoff even more than the logging;(Agriculture, Forestry)
- The development of ecotourism (IPT, Forestry)

**Summary of actions to be taken:**

- The concerned departments, mentioned above, to give these priority in their annual and 5-year plans.

## ***74. Awareness generation.***

### **What is known?**

ANI has 344 schools and five colleges that include TTI, a B.Ed college, two polytechnics, two Degree colleges and an ITI, spread over 36 islands.

- Information and teaching is more science or geography rather than Environment.
- Lower number of concepts in classes Xth and XIIth.
- Environmental concepts are not integrated across subjects.
- Concept in language textbooks appear before science and geography.
- There is a major gap due to the absence of local specific information on forests, coral reefs, understanding sustainable development, species richness and endemism.

Kalpavriksh and ANET have produced an environmental handbook for teachers 'Treasured Islands' in Hindi and English.

Most teachers find it difficult to use or implement 'Treasured Islands' because there is no clear linkage to the school curricula.

### **Summary of actions to be taken:**

- Awareness generation programmes need to be initiated in all aspects of biodiversity conservation. Programmes should be specifically designed for each stakeholder group.
- A study to evaluate the present status of teaching methods used by teachers to impart environment education.
- Linkages to school curricula through Teachers Training initiatives and Workshops to link non-formal environmental education technologies into mainstream formal educational processes.
- Of special relevance is the introduction of an environmental component in the schools, at all levels. This environmental component must be specific to these islands.
- Awareness generation programmes are also necessary for tour operators, fishermen and other stake holder groups. A start has been made in this direction in the MGMNP, involving both the AND E & F and ANET.
- A mechanism needs to be evolved by which environmentally relevant details can be supplied to the relevant decision makers on a rapid basis, and environmental inputs become part of any development planning process.

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## 11. Action plans

### 1. Agriculture

#### 11.1.1. Control of encroachments

<b>Actions being taken</b>	Clearing of encroachments in areas that have been encroached after 1978.. Schemes to rehabilitate encroachers. Rehabilitation of degraded lands this is to be taken up after all evictions are completed..
<b>Implementing agencies</b>	Forest Dept., Revenue Dept. Industries Dept., Education Dept. Fisheries Dept.
<b>Time frame and proposed time of start</b>	Immediate- Priority : URGENT
<b>Rationale</b>	Eco-restoration of degraded lands following order of Supreme Court.
<b>Key methods</b>	<ol style="list-style-type: none"> <li>1. Identification of land for resettlement (Revenue Dept.)</li> <li>2. Shifting &amp; Relocation (Dept. Environment and Forests. Revenue Dept.)</li> <li>3. Identification and initiation of training for alternate employment (Industries)</li> <li>4. Nursery work and planting of degraded land (DEF)</li> <li>5. Control measures for reducing immigration, including elimination of transport subsidies.</li> </ol>
<b>Fund requirement and source</b>	Rs. 40 crores (approx.)
<b>Integration with other programmes/ plans</b>	Industries Dept & Tourism Dept. to play major supporting role.
<b>Conflict resolution</b>	Marginal decrease in agricultural productivity, increase in unemployment.

#### 11.1.2. In situ and ex situ conservation of wild relatives of cultivated species

<b>Actions to be taken</b>	Identification of areas where wild relatives of cultivated species are found. Identification of mother trees Protection measures for areas found, if necessary. Seed collection and propagation at key sites
<b>Implementing agencies</b>	Forest department (in-situ conservation) Agriculture Dept. CARI
<b>Time frame and proposed time of start</b>	5 years, ongoing Start: 2003.
<b>Rationale</b>	To enable germplasm of wild relatives to be available for genetic improvement of cultivars.
<b>Key methods</b>	Survey, land allocation, nursery practice, plantation.
<b>Fund requirement and source</b>	5 lakhs annually
<b>Integration with other programmes/ plans</b>	Employment for nursery and watch and ward staff through DRDA.
<b>Conflict resolution</b>	NIL

**11.1.3. Cooperatives for transport, marketing and enhanced productivity**

<b>Actions to be taken</b>	Formation of cooperatives (Coop Dept., NGOs) Obtaining finance for deep freeze, cold storage at key spots (Industries, Fisheries & Agri. Depts.) Arrangement of better transport (STS, Marine) Arrangement of training for extension personnel.
<b>Implementing agencies</b>	Agriculture Dept., Fisheries Dept.
<b>Time frame and proposed time of start</b>	2 years for set up Start: 2003.
<b>Rationale</b>	To enhance income opportunities for farmers and fishermen
<b>Key methods</b>	Arranging finance, P.R.A's, negotiations, supervision of construction
<b>Fund requirement and source</b>	30 lakhs A & N Administration
<b>Integration with other programmes/ plans</b>	Similar problems regarding storage and transport faced by fishermen, leading to possibility of integrating both
<b>Conflict resolution</b>	Existing middlemen likely to create problems.

**11.1.4. Introduction of organic farming.**

<b>Actions to be taken</b>	Establishment of demonstration farms (Agri. Dept. & CARI) Identification of farmers willing to grow organic crops (Agri., NGO) Training and facilitation of above (NGO) Arranging marketing linkages (Agri, NGO) Demonstrating advantages of organically grown food (CARI)
<b>Implementing agencies</b>	Agri. Dept., CARI, NGO's
<b>Time frame and proposed time of start</b>	5 years starting June 2003.
<b>Rationale</b>	Reduction of pesticide use, improved health, protection of coral reefs.
<b>Key methods</b>	Demonstration &, Training
<b>Fund requirement and source</b>	15 lakhs annually
<b>Integration with other programmes/ plans</b>	Coordination with agency for pollution monitoring to establish changes in pesticide levels.
<b>Conflict resolution</b>	NIL

### 11.1.5. *Orchid cultivation and floriculture*

<b>Actions to be taken</b>	Collection of wild plants from areas where forestry operations are to occur. Road side collection during monsoons from windblown. Establishment of nursery and demonstration plots Training and supply of material to select farmers Obtaining and distribution of hybrids
<b>Implementing agencies</b>	CARI, BSI & ANET
<b>Time frame and proposed time of start</b>	5 years June 2003
<b>Rationale</b>	Orchid is sustainable for income generation as an eco development programme.
<b>Key methods</b>	Appropriate nursery techniques to be taught, tissue culture laboratory to be set up, seed flasks to be imported.
<b>Fund requirement and source</b>	20 lakhs annually From: MOEF / GEF
<b>Integration with other programmes/ plans</b>	Forest dept. to permit collection of wild specimens for propagation. Only from private land and along roads.
<b>Conflict resolution</b>	Forest Dept. to monitor, to ensure that material collected from the wild does not leave the islands. NB: Smuggling of genetic material likely to occur even if this programme does not exist.

### 11.1.6. *Water management for agriculture and household use.*

<b>Actions to be taken</b>	Construction of structures to prevent runoff and soil erosion. Reclamation of saline land that is not important from biodiversity point of view. Planting trees on degraded hill slopes and along streams. Creation of check dams and protection of catchments. Construction of household rainwater harvest structures. Construction of open ponds. 5. Establishment of management mechanisms for above at village level.
<b>Implementing agency</b>	Agri. Dept (Know-how), PWD, DRDA, Village panchayats & NGO
<b>Time frame and proposed time of start</b>	3 years for pilot in Wandoor & Manglutan panchayats June 2003
<b>Rationale</b>	Enhance agriculture, reduce problems due to water scarcity, protect forested catchments
<b>Key methods</b>	Mapping through GPS and GIS, construction, P.R.A's to organise.
<b>Fund requirement and source</b>	50 lakhs annually
<b>Integration with other programmes/ plans</b>	Will meet drinking and domestic water needs also.
<b>Conflict resolution</b>	Keeping catchments unpolluted will mean restrictions on livestock movement in some cases.

### 11.1.7. Establishment of quarantine facilities

<b>Actions to be taken</b>	Establishment of facilities for isolating and fumigating plants and animals coming into the islands Training and posting personnel at both airport and seaport. Monitoring of disease and pest outbreaks and providing solutions.
<b>Implementing agency</b>	Agriculture Dept., AH & VS, CARI (monitoring)
<b>Time frame and proposed time of start</b>	Ongoing Urgent, immediate
<b>Rationale</b>	To prevent new diseases of plants and animals entering the islands.
<b>Key methods</b>	By establishing clinical, fumigation and isolation facilities and operating them; by research into causes of pest outbreaks, by ensuring new species are not introduced.
<b>Fund requirement and source</b>	50 lakhs establishment 10 lakhs annually
<b>Integration with other programmes/ plans</b>	Silviculture Division of Forest Dept., ICFRE for plant pests; IVRI.
<b>Conflict resolution</b>	

### 11.1.8. Wild relatives of cultivars

<b>Actions to be taken</b>	To map the distribution of wild relatives of cultivars To undertake genetic typing of wild relatives of cultivars To determine conservation status and initiate <i>ex situ</i> and <i>in situ</i> conservation efforts where necessary To identify desirable traits and incorporate into cultivars
<b>Implementing agency</b>	BSI & CARI
<b>Time frame and proposed time of start</b>	June 2003 5 years
<b>Rationale</b>	Wild relatives of the following plants have been noted in the islands: ginger, nutmeg, betel, mango, rice and banana, besides several other fruits and tubers. The germ plasm from wild cultivars must be protected at the earliest.
<b>Key methods</b>	Survey, collection, propagation, nursery, laboratory and field research.
<b>Fund requirement and source</b>	20 lakhs annually.
<b>Integration with other programmes/ plans</b>	Dept. of E & F for monitoring and Agriculture dept. can carry out extension work.
<b>Conflict resolution</b>	NIL

**11.1.9. Avifaunal change with pesticide use**

<b>Actions to be taken</b>	Analysis of pesticide residues in birds in various areas Determination of pesticide use, and compositions of bird communities at different sites.
<b>Implementing agency</b>	SACON and ANET (field surveys), CARI (residue analysis)
<b>Time frame and proposed time of start</b>	June 2003, URGENT 3 Years
<b>Rationale</b>	The use of pesticides has been implicated in other places as leading to a loss in bird diversity, and also the loss of economically important birds, those that eat insect pests. The magnitude of the problem here needs to be understood, as well as determining the urgency for remedial measures.
<b>Key methods</b>	Survey and census; laboratory assays.
<b>Fund requirement and source</b>	40 lakhs over 3 years
<b>Integration with other programmes/ plans</b>	Agri. Dept. for providing information on pesticide use patterns. JNRM student projects can be done as part of this.
<b>Conflict resolution</b>	NIL

**11.1.10. Detailed study of agricultural production in the Nicobars.**

<b>Actions to be taken</b>	Research from a sociological viewpoint, on constraints to plantation productivity. Research from an economic point of view, to establish what value addition can be done in the Nicobars. Viability of Nicobarese methods of farming coconut and arecanut. Viability of introducing multi-cropping here.
<b>Implementing agency</b>	Tribal Council, Agri. Dept. & ANET
<b>Time frame and proposed time of start</b>	June 2003, Priority 3 years
<b>Rationale</b>	Agriculture in the Nicobars has been hit by ageing coconut plantations as well as dropping copra prices. Alternative land uses acceptable to the residents are necessary.
<b>Key methods</b>	Survey, questionnaires, semi-structured interviews, field measurements.
<b>Fund requirement and source</b>	20 lakhs
<b>Integration with other programmes/ plans</b>	Dept. E & F, Tribal Welfare Dept.
<b>Conflict resolution</b>	NIL

**11.1.11. Agroforestry alternatives to agriculture.**

<b>Actions to be taken</b>	To initiate demonstration plots of cane, bamboo, fuel wood fodder and timber on existing agricultural land To monitor to establish economic viability To carry out extension activity where economic feasibility is established.
<b>Implementing agency</b>	Dept of E & F, NGO's
<b>Time frame and proposed time of start</b>	September 2003 2 years to initiate Phase 1; monitoring/ extension ongoing
<b>Rationale</b>	Declining crop yields will necessitate shift in land use for agriculture to agroforestry in a significant proportion of the cropped area.
<b>Key methods</b>	Nursery, plantation, monitoring, extension
<b>Fund requirement and source</b>	100 lakhs to initiate 5 sites; 10 lakhs annually for monitoring and incentives.
<b>Integration with other programmes/ plans</b>	Agri dept. - identification of areas where yields have declined most. Silviculture Division of Forest dept. for design and trial. JRMN to provide students to conduct research
<b>Conflict resolution</b>	Failure of alternatives and/or natural disasters to be countered with cash incentives if necessary.

**11.1.12. Management of Crab-eating macaques.**

<b>Actions to be taken</b>	Establish techniques to prevent crab-eating macaques from raiding fields.
<b>Implementing agency</b>	Forest Dept., Agri. Dept. ANET
<b>Time frame and proposed time of start</b>	2 years July 2003.
<b>Rationale</b>	Crab-eating macaques are a major problem in coconut plantations, especially on Great Nicobar Island. Since they are protected they cannot be hunted.
<b>Key methods</b>	Literature search, visits to areas on mainland, experimentation with different techniques.
<b>Fund requirement and source</b>	15 lakhs
<b>Integration with other programmes/ plans</b>	Agriculture dept. for monitoring of agricultural statistics.
<b>Conflict resolution</b>	NIL

## 2. Tourism

### 11.1.13. Involvement of local residents in tourism development

<b>Actions to be taken</b>	Establishment of extension cell in IPT for: Involvement of local residents in existing tourism operations Involvement of local residents in proposed tourism developments.
<b>Implementing agency</b>	IP & T
<b>Time frame and proposed time of start</b>	Immediate, ongoing
<b>Rationale</b>	The residents of a particular area where tourism development is occurring mostly do not get any economic benefits from it. They often resort to activities that degrade the environment.
<b>Key methods</b>	Establishment of cell; Meetings with Panchayat by IPT; identification of activities related to tourism; training programmes for guides, lifeguards & boatmen.
<b>Fund requirement and source</b>	Initial: 20 lakhs; ongoing 10 lakhs/yr Outlay to be built into each new project
<b>Integration with other programmes/ plans</b>	Wildlife Wing of the Dept of E & F, Dept. Industries & Panchayats
<b>Conflict resolution</b>	NIL

### 11.1.14. Establishment of the appropriate protection and monitoring mechanism at Manjeri

<b>Actions to be taken</b>	Implementation of protection and monitoring mechanism at Manjeri
<b>Implementing agency</b>	Forest Department
<b>Time frame and proposed time of start</b>	Immediate, 6 months
<b>Rationale</b>	With the construction of a road to Pongibalu, a number of tourists have started visiting there. This place provides a more rapid access to Jolly Buoy, and is within the MGMNP
<b>Key methods</b>	Establishment of check post, issuing of tickets; posting of enforcement staff.
<b>Fund requirement and source</b>	10 lakhs; ongoing
<b>Integration with other programmes/ plans</b>	Tourism Dept., Marine dept.
<b>Conflict resolution</b>	NIL



#### ***11.1.15. Awareness in and around protected areas***

<b>Actions to be taken</b>	Increasing awareness among tourists visiting wilderness areas, especially protected areas. Also to school children, teachers and people living around Protected Areas.
<b>Implementing agency</b>	IPT, Forest Dept.
<b>Time frame and proposed time of start</b>	1 year; Immediate
<b>Rationale</b>	Tourist visitations have led to problems such as littering, plastic pollution, damage to corals. Most of these are due to lack of awareness among visitors.
<b>Key methods</b>	Establish interpretation centres at Mt. Harriet, Havelock I, Neil I; training programmes for guide & boatmen.
<b>Fund requirement and source</b>	15 lakhs, IPT
<b>Integration with other programmes/ plans</b>	See Sec 11.1.13
<b>Conflict resolution</b>	NIL

#### ***11.1.16. Review of Tourism development study***

<b>Actions to be taken</b>	Review the UNDP/WHO Sustainable Tourism study
<b>Implementing agency</b>	NGO
<b>Time frame and proposed time of start</b>	1 year June 2003
<b>Rationale</b>	Review of the recommendations of the UNDP Sustainable Tourism study needs to be done. More studies are required to validate many assumptions made by this study.
<b>Key methods</b>	Field work, data analysis
<b>Fund requirement and source</b>	20 lakhs MOEF
<b>Integration with other programmes/ plans</b>	IPT, FD collaboration
<b>Conflict resolution</b>	May result in current projections made by IPT being scaled down

**11.1.17. Elimination of subsidies for tourism**

<b>Actions to be taken</b>	Assessment of subsidies received by tourists in terms of shipping, transport, food, and recovery of these subsidies.
<b>Implementing agency</b>	Revenue Dept
<b>Time frame and proposed time of start</b>	August 2003 6 months
<b>Rationale</b>	It is estimated that the average tourist visiting the islands by ship costs the Administration more than Rs. 10,000 in subsidies. It is unreasonable that this burden, especially that due to foreign tourists, be borne by the taxpayer. If an 'environment' tax is imposed this can be used to fund environmentally friendly tourism.
<b>Key methods</b>	Research, imposition of tax/fare structures.
<b>Fund requirement and source</b>	4 lakhs for study
<b>Integration with other programmes/ plans</b>	Marine dept., SCI, Civil Supplies, STS.
<b>Conflict resolution</b>	Will temporarily lead to protests from foreign visitors. May temporarily lead to a drop in tourism. Tour operators will protest this in the short run.

**11.1.18. Impact assessment research at existing tourist sites**

<b>Actions to be taken</b>	Assessment of the impacts of tourism to date at Chidiyathapu, Wandoor, Mount Harriet National Park, Havelock, Kalipur, Mayabunder, and Little Andaman Island.
<b>Implementing agency</b>	IPT with NGO/ University
<b>Time frame and proposed time of start</b>	June 2003. 1 year
<b>Rationale</b>	Tourism at many sites in the islands has been happening. Enough time has passed for impacts to be obvious. These need to be documented in detail, and incorporated into the planning process.
<b>Key methods</b>	Data collection and analysis. Interviews with key stakeholder groups such as Forest dept., tour operators, hoteliers, shopkeepers.
<b>Fund requirement and source</b>	3 lakhs Ministry of Tourism
<b>Integration with other programmes/ plans</b>	Forest Dept.
<b>Conflict resolution</b>	NIL

### ***11.1.19. Establishment of carrying capacity***

<b>Actions to be taken</b>	Determine bottlenecks and limiting factors in terms of food, accommodation, water resources and transportation in the islands. Assess the extent to which these can be overcome without environmental degradation.
<b>Implementing agency</b>	NGO/ University
<b>Time frame and proposed time of start</b>	June 2003 1 year
<b>Rationale</b>	There is an apprehension that an increased tourist influx will strain the ability of the environment locally to absorb them without damage. For instance the WTO prescription of 155,000 tourists annually is seen as excessive. This needs assessment and incorporation into the planning process.
<b>Key methods</b>	Data collection and analysis
<b>Fund requirement and source</b>	5 lakhs
<b>Integration with other programmes/ plans</b>	Industries department- EIA cell to provide support.
<b>Conflict resolution</b>	NIL

### ***3. Animal husbandry and veterinary science projects***

#### ***11.1.20. Keeping livestock out of forests.***

<b>Actions to be taken</b>	Upgrading to breeds of cattle with higher milk yields Introducing dairying, cheese production and other value addition to milk. Eliminating incentives for goat rearing near forest areas. Growing of fodder trees on Panchayat land
<b>Implementing agency</b>	AH & VS, CARI
<b>Time frame and proposed time of start</b>	5 years, immediate
<b>Rationale</b>	Serious degradation to forests occurs with livestock entering it to browse.
<b>Key methods</b>	Schemes for stall feeding; no bank loans for goat rearing; penalties for goats in forest areas to be enforced.
<b>Fund requirement and source</b>	50 lakhs
<b>Integration with other programmes/ plans</b>	Forest Dept. to provide seedlings for fodder trees, to enforce non-entry of livestock.
<b>Conflict resolution</b>	Goat rearers will lose income and methods to compensate them for it will have to be worked out.

**11.1.21. 'Carrying capacity' studies.**

<b>Actions to be taken</b>	Survey of total milk consumption and estimation of trends Survey of requirement of draught animals and estimation of trends Survey of meat requirement and estimation of trends
<b>Implementing agency</b>	AH & VS, ANET, JNRM
<b>Time frame and proposed time of start</b>	2 years June 2003
<b>Rationale</b>	The daily requirement for milk in the islands is not known. The total requirement of draught animals for farming is not known. The requirement of meat from goats is not known. This study will enable long term planning of livestock requirement.
<b>Key methods</b>	Questionnaires, survey, interviews.
<b>Fund requirement and source</b>	10 lakhs
<b>Integration with other programmes/ plans</b>	JNRM may use students for this for thesis work.
<b>Conflict resolution</b>	

**11.1.22. Reducing the quantity of livestock by improving quality**

<b>Actions to be taken</b>	To reduce the quantity of livestock through improvement of quality.
<b>Implementing agency</b>	AH & VS
<b>Time frame and proposed time of start</b>	Ongoing
<b>Rationale</b>	To reduce pressure on the land by reducing the number of livestock.
<b>Key methods</b>	Import of frozen semen, use of AI methods, import of stud animals of superior breeds.
<b>Fund requirement and source</b>	Rs. 30,0000 A & N Admin.
<b>Integration with other programmes/ plans</b>	Forest Dept.
<b>Conflict resolution</b>	Nil

**11.1.23. Breeding of local domesticated species**

<b>Actions to be taken</b>	Propagation of Nicobari Fowl Propagation of Teressa Goat
<b>Implementing agency</b>	AH & VS
<b>Time frame and proposed time of start</b>	Immediate, Ongoing
<b>Rationale</b>	Nicobari Fowl have been found to consume less feed and produce more eggs than the desi fowls and at the same time having the disease resistance qualities of the mainland poultry birds Teressa goats have been found to be superior in terms of body weight as compared to the nondescript native goats, and are well adopted to the climatic conditions of these islands
<b>Key methods</b>	Breeding
<b>Fund requirement and source</b>	AH & VS
<b>Integration with other programmes/ plans</b>	With DRDA for income generation
<b>Conflict resolution</b>	NIL

**4. Introduced species**

**11.1.24. Control of spotted deer population**

<b>Actions to be taken</b>	Experimentation on various methods of control of spotted deer, and feral dogs, including sterilisation and culling.
<b>Implementing agency</b>	Dept. of Environment & Forests.
<b>Time frame and proposed time of start</b>	Immediate
<b>Rationale</b>	The chital population in the Andaman group of islands has expanded to the point of damaging the local vegetation very severely, as well as affecting forest regeneration. India is responsible under international treaty (Art. 8(h) of the Convention on Biodiversity) to control this.
<b>Key methods</b>	Sterilisation, culling
<b>Fund requirement and source</b>	20 lakhs for pilot project MOEF
<b>Integration with other programmes/ plans</b>	Necessary to implement amendments in WLPA (1972) to authorise CWLW to order removal of animals exotic in a particular region, even if protected otherwise.
<b>Conflict resolution</b>	Objection from animal rights lobbies is anticipated. An awareness programme to educate them about the damage caused by these animals may be necessary.

**11.1.25. Control and relocation of elephants in North Andaman and Interview Island**

<b>Actions to be taken</b>	Removal by capture and translocation to mainland; culling in a very few cases may be necessary
<b>Implementing agency</b>	Dept. of Env. & Forests in collaboration with CZA, WII.
<b>Time frame and proposed time of start</b>	1 year Immediate
<b>Rationale</b>	Populations of feral elephants have been damaging the vegetation on Interview Island and in N Andaman. Increasing population is leading to food shortages.
<b>Key methods</b>	'Khedda' operation
<b>Fund requirement and source</b>	25 lakhs
<b>Integration with other programmes/ plans</b>	Arrangements for sale/ deployment with Forest depts. On mainland.
<b>Conflict resolution</b>	Culling problematic undetr WL (P) A, 1972

**11.1.26. Control of feral cats and dogs**

<b>Actions to be taken</b>	Licensing mechanism for dogs; establishment of pounds, and formation of dog catcher and disposal squads. Weapons for forest staff near sea turtle beaches.
<b>Implementing agency</b>	DEF; PBMC; panchayats.
<b>Time frame and proposed time of start</b>	Ongoing Immediate
<b>Rationale</b>	The population of feral dogs has begun affecting sea turtle populations by eating eggs and adults; feral cats are very likely affecting populations of endemic birds
<b>Key methods</b>	Trapping, removal
<b>Fund requirement and source</b>	30 lakhs establishment
<b>Integration with other programmes/ plans</b>	Coordination with Animal Welfare Board.
<b>Conflict resolution</b>	Problems with animal rights groups.

**11.1.27. Assessment of impact of introduced Common Mynah**

<b>Actions to be taken</b>	Study of ecology and breeding biology of common mynah
<b>Implementing agency</b>	NGO /JNRM
<b>Time frame and proposed time of start</b>	3 years March 2003
<b>Rationale</b>	This is an introduced species that has become extremely common. It may be competing with endemic birds for food resources and nest sites.
<b>Key methods</b>	Field research
<b>Fund requirement and source</b>	5 lakhs MOEF
<b>Integration with other programmes/ plans</b>	DEF to be informed about key findings for implementation if necessary.
<b>Conflict resolution</b>	NIL

**5. Native communities**

**11.1.28. Alternatives to the Andaman Trunk Road**

<b>Actions to be taken</b>	To obtain and put into service a fleet of fast passenger transports for inter-island transport
<b>Implementing agency</b>	Marine Dept.
<b>Time frame and proposed time of start</b>	2 years Immediate
<b>Rationale</b>	Because the ATR is likely to be shut on two sectors due to a Supreme Court ruling (still sub-judice), alternative transport to Middle and North Andaman is urgently required. A fleet of catamarans can be obtained fast and cheaply for passenger transport.
<b>Key methods</b>	Purchase
<b>Fund requirement and source</b>	20 crores
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	Introducing shipping would normally create conflict with the road transport agencies. This does not apply since road transport will be closed. However, this should be implemented even if the road is not closed since it is more cost-effective.

**11.1.29. Integrating tribal groups into the mainstream**

<b>Actions to be taken</b>	As far as possible the Jarawas should be left out of this. To assess the degree to dependence of each tribal group on mainstream society. To assess the impact of integration on each tribal group. To draw up and implement plans for each group.
<b>Implementing agency</b>	Tribal Welfare Dept./ NGO's
<b>Time frame and proposed time of start</b>	Immediate 3 years
<b>Rationale</b>	The Govt. of India has come under scrutiny and potential criticism for its policy of integrating tribes into the mainstream. This is from both within and from outside the country. The issue needs to be re-examined to determine the necessity of this policy, and to determine what modifications need to be made.
<b>Key methods</b>	Data collection, analysis; international seminars inviting eminent experts internationally.
<b>Fund requirement and source</b>	30 lakhs
<b>Integration with other programmes/ plans</b>	ASI & NGOs
<b>Conflict resolution</b>	There are two diametrically opposed views on this issue, and the study will have to be very carefully designed and executed to avoid future criticism.

**11.1.30. Human ecology of all the tribal groups**

<b>Actions to be taken</b>	Study of life styles of tribal groups and documenting their various beliefs and practices.
<b>Implementing agency</b>	NGO/ University
<b>Time frame and proposed time of start</b>	July 2003 5 years
<b>Rationale</b>	The population dynamics, foraging patterns, nutrition and behavioural patterns of all these tribal groups are understood at a very superficial level. Intensive studies need to be initiated in all these aspects. This would be useful in future planning.
<b>Key methods</b>	Data collection, analysis
<b>Fund requirement and source</b>	40 lakhs
<b>Integration with other programmes/ plans</b>	Coordination with Forest Dept.
<b>Conflict resolution</b>	NIL



### ***11.1.31. Use of medicinal plants***

<b>Actions to be taken</b>	To document the use of different plants by each tribal group
<b>Implementing agency</b>	BSI, NGO/ JRMN
<b>Time frame and proposed time of start</b>	August 2003 3 years
<b>Rationale</b>	There are many new medicines to be discovered by studying the ethno botany of the different tribal groups. While some work has been done much remains to be done. These need to be documented, tested and then patented in the name of the tribal community involved.
<b>Key methods</b>	Survey, collection of voucher specimens, interview, herbarium work
<b>Fund requirement and source</b>	40 lakhs MOEF
<b>Integration with other programmes/ plans</b>	CDRI to do assays of potentially useful plant substances BSI to do identification MOEF to monitor patenting.
<b>Conflict resolution</b>	The implications of doing this needs to be considered carefully in advance, since an inflow of plant collectors into the tribal reserves would be undesirable

## ***6. Immigration***

### ***11.1.32. Reducing influx into the Andaman Islands***

<b>Actions to be taken</b>	To identify and implement mechanisms to reduce the inflow of immigrants into the islands
<b>Implementing agency</b>	Revenue Dept.
<b>Time frame and proposed time of start</b>	1 year to implement Immediate
<b>Rationale</b>	The resources on the island are being degraded due to inflow of people. With encroachments being removed as an employment option, pressure is going to occur on natural resources in other ways unless there is a stop to further immigration
<b>Key methods</b>	Removal of the subsidy on ship fares for non-locals. Introduction of restricted area permits. Design and implementation of monitoring mechanism
<b>Fund requirement and source</b>	
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	Nil

## 7. Research on taxa

### 11.1.33. Research on little known mammals

<b>Actions to be taken</b>	To survey for little-known mammals island-wise and prepare island-wise check sheets.
<b>Implementing agency</b>	NGOs/ JNRM
<b>Time frame and proposed time of start</b>	April 2003 3 years
<b>Rationale</b>	While several species of bats and rats have been described as being endemic to these islands, the surveys are still very patchy, especially for these taxa. Island-wise surveys need to be done.
<b>Key methods</b>	Survey, collection, literature search.
<b>Fund requirement and source</b>	40 lakhs
<b>Integration with other programmes/ plans</b>	Coordination with ZSI & ANET.
<b>Conflict resolution</b>	NIL

### 11.1.34. Extension of botanical surveys

<b>Actions to be taken</b>	To conduct botanical surveys of Tillanchong, Bompoka & Little Andaman in the Nicobar group; Ritchie's Archipelago, Tarmugli and Cinque Is. In the Andaman group.
<b>Implementing agency</b>	BSI
<b>Time frame and proposed time of start</b>	3 years April 2003
<b>Rationale</b>	Many islands have not been surveyed at all from a botanical point of view. A proper survey will record the discovery of new species, as well as record range extensions for known ones.
<b>Key methods</b>	Survey, herbarium work
<b>Fund requirement and source</b>	30 lakhs
<b>Integration with other programmes/ plans</b>	Coordination with ongoing programmes involving research on medicinal plants and wild cultivars.
<b>Conflict resolution</b>	

**11.1.35. Medicinal plants of Little Andaman**

<b>Actions to be taken</b>	To collect, propagate and conduct tests on the medicinal plants of Little Andaman, as well as extend the knowledge of Onge ethno botany.
<b>Implementing agency</b>	BSI
<b>Time frame and proposed time of start</b>	3 years April 2003
<b>Rationale</b>	While the ethno botany of the Onges has been studied, considerable more detail needs to be gathered.
<b>Key methods</b>	Survey, trials
<b>Fund requirement and source</b>	Min. of Health/ Medicinal Plants Board 50 lakhs
<b>Integration with other programmes/ plans</b>	CDRI, ICMR
<b>Conflict resolution</b>	

**11.1.36. Compilation of island-wise lists**

<b>Actions to be taken</b>	To compile island –wise lists of the flora of the islands using existing gathered material.
<b>Implementing agency</b>	BSI
<b>Time frame and proposed time of start</b>	Late 2003 6 months
<b>Rationale</b>	To understand the biogeography of the islands, and to identify gaps in the coverage in the surveys done so far.
<b>Key methods</b>	Literature review
<b>Fund requirement and source</b>	2 lakhs
<b>Integration with other programmes/ plans</b>	Will help in planning future surveys Can be done as thesis project by M.Sc. student from JNRM.
<b>Conflict resolution</b>	NIL

**11.1.37. Plant resources and indigenous knowledge of the tribal areas**

<b>Actions to be taken</b>	Survey of Jarawa reserve. Survey of Little Andaman Island
<b>Implementing agency</b>	BSI
<b>Time frame and proposed time of start</b>	April 2003 3 years
<b>Rationale</b>	These areas have never been surveyed from a botanical point of view.
<b>Key methods</b>	Survey, herbarium work
<b>Fund requirement and source</b>	20 lakhs MOEF
<b>Integration with other programmes/ plans</b>	Coordination to be done with Tribal Welfare dept. and A.S.I, should be integrated with other surveys.
<b>Conflict resolution</b>	

**11.1.38. Mangrove epiphytes**

<b>Actions to be taken</b>	To study the epiphytic plants associated with mangroves.
<b>Implementing agency</b>	BSI/ Universities
<b>Time frame and proposed time of start</b>	2 years April 2003
<b>Rationale</b>	Mangroves in the islands are extremely rich in epiphytes. These plant communities have never been characterised.
<b>Key methods</b>	Survey, herbarium work.
<b>Fund requirement and source</b>	10 lakhs MOEF
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	

### ***11.1.39. Conservation of orchids***

<b>Actions to be taken</b>	Collection of orchids; in situ and ex situ conservation; revision of taxa
<b>Implementing agency</b>	BSI / NGO's
<b>Time frame and proposed time of start</b>	3 years establishment April 2003
<b>Rationale</b>	The orchid resource on trees that are cut is wasted. These should be gathered at one place that also serves as a centre for ex-situ conservation and propagation of orchids.
<b>Key methods</b>	Teams for collection at each felling point; nursery work; tissue culture.
<b>Fund requirement and source</b>	50 lakhs establishment
<b>Integration with other programmes/ plans</b>	Orchid collection to be integrated into working plans of forest divisions currently under revision.
<b>Conflict resolution</b>	NIL

### ***11.1.40. Phytochemistry of local medicinal plants***

<b>Actions to be taken</b>	Establish a laboratory to study the phytochemistry of plants, and to develop a programme for the same.
<b>Implementing agency</b>	BSI with NGO's/ JNRM.
<b>Time frame and proposed time of start</b>	2 years establishment; ongoing April 2003.
<b>Rationale</b>	While there are programmes under way to study and propagate a few varieties of medicinal plants, new possibilities for medicinal use and nutritional use are emerging constantly. A mechanism to isolate the active ingredients and study their chemical and medicinal properties is required locally in the case of medicinal plants.
<b>Key methods</b>	Construction; survey, chemical analysis
<b>Fund requirement and source</b>	75 lakhs Medicinal Plants Board
<b>Integration with other programmes/ plans</b>	Coordination with existing programmes researching medicinal plants.
<b>Conflict resolution</b>	

## 8. Multi-Sectoral

### 11.1.41. Establishment of a GIS Cell.

<b>Actions to be taken</b>	Purchase of hardware and software: workstation, A0 scanner, A0 printer, etc. Purchase of Imageries on 6-month basis Training of personnel to operate GIS Cell Execution of specific tasks
<b>Implementing agency</b>	ANET – on BOT basis, and training Forest. Dept., NRSA DRDA, Agri. Dept., Fisheries dept. - users.
<b>Time frame and proposed time of start</b>	IMMEDIATE, URGENT 2 years establishment Ongoing
<b>Rationale</b>	The GIS Cell will enable: Impact assessment of existing tourist sites (Sec. 7.1) Mapping of all forest areas, and their condition (7.2) Changes in forest condition due to past logging (7.2) Identification of areas for bamboo and cane cultivation (7.2) Extent of beach loss (7.3) Agro forestry alternatives to agriculture (7.5) Identification of encroachments (7.5, 7.12) Mapping of mangroves for delineation as reserve forests (7.6) Identification of wetlands (7.8) Identification of stepping-stones and wildlife corridors (7.17) Mapping of coral reef areas (7.17)
<b>Key methods</b>	Training, field work, mapping, ground truth
<b>Fund requirement and source</b>	60 lakhs Establishment 20 lakhs annual running budget
<b>Integration with other programmes/ plans</b>	While beginning will be made with the Forest dept. is, it is anticipated that every Dept. in the A & N Administration will be using this facility intensively.
<b>Conflict resolution</b>	This facility needs dedicated staff of at least a Unit Head at DCF level, and 3-4 support staff. Its mandate normally would be to map the vegetation annually and monitor changes. Other projects should be paid for by user Dept. to avoid resource constraint. To avoid conflict in the priorities of different departments, in case of clashing priorities a resolution mechanism is required.

**11.1.42. Establishment of pollution monitoring and Environmental Assessment mechanism**

<b>Actions to be taken</b>	Establishment of a proper laboratory setup in the islands where water quality, both of fresh water and seawater, can be analysed. Setting up of an EIA Cell with trained staff and proper laboratory equipment.
<b>Implementing agency</b>	Industries Dept. Dept. of Environment Tourism Dept.
<b>Time frame and proposed time of start</b>	IMMEDIATE 1 year establishment, ongoing.
<b>Rationale</b>	A lot of the development activities taking place have harmful effects on the environment. These have seldom been properly assessed for lack of trained staff specialising in this matter
<b>Key methods</b>	Collection of samples, analysis, report preparation Studies using EIA methodology.
<b>Fund requirement and source</b>	60 lakhs
<b>Integration with other programmes/ plans</b>	NGO participation essential for credibility. Prerequisite to any tourism development. Prerequisite to any major construction by APWD, ALHW or Defense.
<b>Conflict resolution</b>	There will be terrific pressure constantly from polluters to suppress results. Hence NGO participation necessary.

**11.1.43. Strengthening the enforcement mechanism**

<b>Actions to be taken</b>	Recruitment of more protection staff by Forest dept. Purchase of high speed boats Purchase of, and training in use of GPS, at Forester level.
<b>Implementing agency</b>	Dept. of Environment & Forests.
<b>Time frame and proposed time of start</b>	IMMEDIATE, ONGOING
<b>Rationale</b>	Many of the site-specific threats that have been identified in this document exist because there are inadequate staff and inadequate facilities for them. With the advent of GPS, new possibilities in information gathering in the field have arisen, and these have to be taken advantage of.
<b>Key methods</b>	Recruitment, training, purchase
<b>Fund requirement and source</b>	Boats: 4 crores GPS : 50 lakhs initially
<b>Integration with other programmes/ plans</b>	Training coordinated with Coast Guard, Police
<b>Conflict resolution</b>	

**11.1.44. Renewable alternatives**

<b>Actions to be taken</b>	Departments to analyse and implement renewable alternatives such as wind energy, novel construction materials, rainwater harvesting, biopesticides, cash crops that do not use pesticides, and the development of eco-tourism.
<b>Implementing agency</b>	Electricity dept., APWD, Agriculture Dept., IPT, Forest Dept., DRDA.
<b>Time frame and proposed time of start</b>	Immediate Ongoing
<b>Rationale</b>	Introduction of these mechanisms into the plans of the above Government departments will reduce energy usage and reduce impacts on biodiversity over the long run. It would also reduce energy impacts, reduce timber use and preserve beaches.
<b>Key methods</b>	Introduction of these concepts as the first priority in the planning stages of all programmes.
<b>Fund requirement and source</b>	Departmental budgets.
<b>Integration with other programmes/ plans</b>	Representatives from each dept. can meet twice a year to discuss new initiatives, along with NGO's.
<b>Conflict resolution</b>	Pressure from contractors and business interests

**9. Environment and forests**

**11.1.45. Direction, administration and management**

<b>Actions to be taken</b>	Establishment of an effective communication network (VHF & HF) Establishment of Local Area Network Establishment of GIS Cell Establishment of MIS Procurement of arms, boats, vehicles for effective communication and protection
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	Needed for effective protection of forests and transparent & efficient administration.
<b>Key methods</b>	Training, Procurement
<b>Fund requirement and source</b>	Rs. 1016 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	This will be integrated with the Centrally Sponsored scheme on forest protection
<b>Conflict resolution</b>	



#### **11.1.46. Silvicultural Research**

<b>Actions to be taken</b>	Ongoing projects: Assessment of regeneration status of logged areas Introduction trials of solid/ thick walled bamboos Genetic improvement of Padauk Genetic improvement of Casuarina Studies on seed biology and phenology of important species Proposed in the next five years: Biofertilizer trials in important species Macro propagation of important tree species Comparative study of selection system vs. irregular shelterwood system Development of agro forestry models Regeneration and development of medicinal and aromatic plants
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	Needed for better understanding of the forest ecosystem and improving its productivity
<b>Key methods</b>	Training, Procurement, Field trials
<b>Fund requirement and source</b>	Rs. 203 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	This will be integrated with the collaborative projects with the Department of Space and National Botanical Research Institute. The institutes of the ICFRE will also collaborate.
<b>Conflict resolution</b>	There can be overlap with the ongoing/ proposed programmes of other research organizations. This can be resolved by collaboration and by following the National Forestry Research Plan in which the areas of research and the agencies have been identified.

#### **11.1.47. Forestry Training and Education**

<b>Actions to be taken</b>	Training of forest executive staff in anti-poaching and implementation of legislations.
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	Needed for effective protection of forests and conservation of biodiversity.
<b>Key methods</b>	Training
<b>Fund requirement and source</b>	Rs. 85 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	

**11.1.48. Natural Regeneration and Enrichment of forests**

<b>Actions to be taken</b>	Aided natural regeneration of areas already harvested
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	Needed for regeneration of forests and their enrichment with species required for local use.
<b>Key methods</b>	Planting operations
<b>Fund requirement and source</b>	Rs. 845 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	Agri. Dept & Silviculture Dept.
<b>Conflict resolution</b>	

**11.1.49. Forest Settlement and Consolidation**

<b>Actions to be taken</b>	Survey and demarcation of forest boundaries Completion of forest settlement process Creation of a Land Cell Establishment of a Forest Land Records System Reconciliation of revenue records with forest notifications HRD for forest boundary management
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	Needed for effective protection of forests and efficient forest management.
<b>Key methods</b>	Training, Procurement
<b>Fund requirement and source</b>	Rs. 145 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	

### ***11.1.50. Forest Resources Survey and Working Plan***

<b>Actions to be taken</b>	Revision of the Working Plans of all the forest divisions as per the directions of the Supreme Court
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	The forests are required to be worked multiple use- to meet the timber and NTFP requirements of the local population and the environmental requirements. Working Plan is a prerequisite for working in any forest area.
<b>Key methods</b>	Survey and enumeration
<b>Fund requirement and source</b>	Rs. 205 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	

### ***11.1.51. Harvesting and Development of Non-timber Forest Produce***

<b>Actions to be taken</b>	Estimation of availability of canes and bamboos in the forests Raising of cane and bamboo plantations Raising of medicinal plants Vanilla cultivation
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	Non-timber forest produce are required to meet even the routine requirement of the local population. The solid bamboos are required to be introduced for meeting the structural needs of the rural population and also to reduce the pressure on the forests for ballies and posts.
<b>Key methods</b>	Survey and enumeration, plantation
<b>Fund requirement and source</b>	Rs. 440 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	Agri. Dept.
<b>Conflict resolution</b>	

**11.1.52. Social Forestry, Agro forestry and Extension Forestry**

<b>Actions to be taken</b>	Raising of plantations on non-forest land, viz., roadside, barren land, community land, agricultural land Seedling distribution to public Extension and publicity activities to create environmental awareness among the public. Funding activities of the National Green Corps in 100 schools
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	Awareness need to be created on the need for protection of forests and environment. The plantation on non-forest land will help in reducing the pressure on forests.
<b>Key methods</b>	Raising of plantations, Conducting awareness creation programmes for school children and public. Publicity programmes through AIR, Doordarshan, local media, etc.
<b>Fund requirement and source</b>	Rs. 506 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	Agri. Dept. & Silviculture Dept.
<b>Conflict resolution</b>	

**11.1.53. Forest Utilization**

<b>Actions to be taken</b>	Harvesting of 15000 cum of timber to meet the local needs.
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	Most of the constructions in the islands are wooden structures and require maintenance. Use of timber, which is a renewable natural resource, is environment friendly in comparison to cement-concrete structures which require materials produced by high energy input and environmental damage due to mining.
<b>Key methods</b>	Reduced Impact Logging
<b>Fund requirement and source</b>	Rs. 1840 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	

#### ***11.1.54. Biodiversity, Wildlife Conservation and Eco-development***

<b>Actions to be taken</b>	Identification and establishment of new protected areas. Strengthening of infrastructure with wildlife wing by procurement of arms, vehicles, vessels, communication equipment and construction of buildings Establishment of Biological Park
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	The Andaman and Nicobar islands are rich in biodiversity and the Protected areas where it is conserved are under the control of the wildlife wing. The wildlife wing is understaffed with limited infrastructure. This needs strengthening for effective conservation of wildlife and biodiversity.
<b>Key methods</b>	Procurement, Construction, Training
<b>Fund requirement and source</b>	Rs. 1680 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	

#### ***11.1.55. Improvement of Government Saw Mills***

<b>Actions to be taken</b>	Procurement of machinery Renovation of old structures and machinery Augmenting facilities for timber treatment
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	The Govt. saw mills in the islands are old and require replacement of the outdated and inefficient machinery in order to ensure efficient utilization of wood. The timber supplied from the mill should be treated so that its life is prolonged leading to less demand for timber and thus conservation of forests.
<b>Key methods</b>	Procurement
<b>Fund requirement and source</b>	Rs. 612 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	

**11.1.56. Protection of forests and coastal ecosystem**

<b>Actions to be taken</b>	Procurement of trucks, jeeps, arms and fast boats. Improvement of communication system
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	The pressure on the forests and coastal ecosystem is on the increase due to increasing population. Effective protection of forests requires augmentation of resources available with the department.
<b>Key methods</b>	Procurement
<b>Fund requirement and source</b>	Rs. 550 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	Coast Guard, Navy and Police
<b>Conflict resolution</b>	

**11.1.57. Conservation of mangroves**

<b>Actions to be taken</b>	Survey of mangrove areas to identify degraded locations Planting of mangroves in the degraded patches
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	Mangroves are essential for the protection of the coastline as well as for the marine life.
<b>Key methods</b>	Survey, Plantation
<b>Fund requirement and source</b>	Rs. 125 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	

### ***11.1.58. Research on coral reefs***

<b>Actions to be taken</b>	Survey, delineation of coral reefs; measurement of land based impacts
<b>Implementing agency</b>	JNRM/NGO's/WII
<b>Time frame and proposed time of start</b>	Immediate 5 years
<b>Rationale</b>	The extent of corals in the Andaman is not known yet. There are yet unidentified species; the damage to the corals from biotic land based factors such as sediment runoff, chemical pesticides and fertilizers has not been quantified yet.
<b>Key methods</b>	Survey, monitoring, analysis of water samples.
<b>Fund requirement and source</b>	5 crores /UNDP
<b>Integration with other programmes/ plans</b>	Inputs from this project will be used by the Agriculture Dept. for better land use planning; by IPT to promote new areas for tourism in a sustainable fashion.
<b>Conflict resolution</b>	

### ***11.1.59. Eco-tourism***

<b>Actions to be taken</b>	Procurement of camping equipment, boats, glass bottom boats for development of ecotourism
<b>Implementing agency</b>	Dept. of Environment and Forests
<b>Time frame and proposed time of start</b>	5 years. 2003 onwards
<b>Rationale</b>	The islands offer tremendous scope for low-volume high value ecotourism which will help in generation of employment and revenue as well as help in the appreciation of nature and education.
<b>Key methods</b>	Procurement
<b>Fund requirement and source</b>	Rs. 335.50 lakhs, Plan scheme (X 5-year plan)
<b>Integration with other programmes/ plans</b>	Tourism dept.
<b>Conflict resolution</b>	

**11.1.60. Biodiversity characterization at landscape level**

<b>Actions to be taken</b>	Characterization of biodiversity at landscape level and mapping of the forest area indicating areas under pressure and areas of high conservation priority, using the satellite imagery and ground truthing.
<b>Implementing agency</b>	Department of Space, Govt. of India and the Department of Environment and Forests
<b>Time frame and proposed time of start</b>	1999- 2002. This is an ongoing project and should have been completed in 2002.
<b>Rationale</b>	The biodiversity of the islands has not yet been characterized at landscape level, in terms of diversity of forest types and ecosystems.
<b>Key methods</b>	Use of satellite imagery, Field survey
<b>Fund requirement and source</b>	Department of Science and Technology, Govt. of India is funding this project.
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	

**11.1.61. Bio prospecting of biodiversity, Conservation of medicinal plants and development of a plant based health system in the Andaman and Nicobar Islands**

<b>Actions to be taken</b>	Inventorization of medicinal plants in the A & N Islands and collection of ethno botanical information. Establishment of conservation plots and nurseries. Chemical prospecting and Gene prospecting of selected medicinal plants. Establishment of a plant based health system.
<b>Implementing agency</b>	National Botanical Research Institute, Lucknow (CSIR) and the Department of Environment and Forests
<b>Time frame and proposed time of start</b>	1999- 2002 (First phase); 2002-2005 (Second phase) The first phase of the project and shall be completed in 2002.
<b>Rationale</b>	These islands are rich in medicinal plants and many are being used by the indigenous tribes as well as by the settlers. This traditional knowledge is required to be recorded and used for development of a plant based health system in the islands.
<b>Key methods</b>	Field survey, Collection of ethno botanical information
<b>Fund requirement and source</b>	Department of Science and Technology, Govt. of India is funding this project.
<b>Integration with other programmes/ plans</b>	BSI
<b>Conflict resolution</b>	



**11.1.62. Revision of the Forest Flora of Andamans**

<b>Actions to be taken</b>	Revision of the Forest Flora of Andamans published by Parkinson in 1923, by incorporating the latest taxonomical changes and also surveying areas that were not surveyed by Parkinson. Illustration of the Flora.
<b>Implementing agency</b>	Forest Research Institute, Dehradun and the Department of Environment and Forests
<b>Time frame and proposed time of start</b>	1999- 2002; The project shall be completed in 2002.
<b>Rationale</b>	The forest flora of Andamans by Parkinson is predominantly a flora of tree species and provides various information required by field foresters for identification of species, in contrast to the normal flora. Though the Flora of Andamans is under preparation by the BSI, the revision of Parkinson's Flora will be of use to the foresters.
<b>Key methods</b>	Field survey. Collection of Herbarium specimens. Illustration of the Flora.
<b>Fund requirement and source</b>	Rs. 6 lakhs. Department of Environment and Forests is funding this project.
<b>Integration with other programmes/ plans</b>	
<b>Conflict resolution</b>	

## 12. Annexures

### *10. Appendix 1: Interim Judgement of Supreme Court Ruling of May 2002*

W.P (C) No. 202 OF 1995

UPON hearing the counsel, the Court made the following:

O R D E R

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After hearing the learned Amicus Curiae, counsel for the parties and taking into consideration the affidavit of the Union of India - Ministry of Environment and Forests in relation to survey of ecosystem of Andaman and Nicobar Islands, the learned Amicus Curiae has made certain suggestions.

There does not seem to be any objection to this Court in accepting the Report of Shri. Shekhar Singh that some modifications have been suggested. We therefore, in the first instance, accept the Report of Shri. Shekhar Singh.

On a query being raised by us, Mr. Altaf Ahmed, learned Additional Solicitor General, appearing for The Union Territory of Andaman & Nicobar Islands on instructions informed the Court that there is no social forestry in Andaman & Nicobar Islands. The wood which is being cut is from the natural forest and plantation of teak, etc. has taken place in the forest, which had been worked

and approximating 40,000 cubic metres of wood is cut from

the forest annually for the purposes of the small mills the total logging of wood being approximately 1,30,000 cubic metres per year. In the last two years, this figure has come down but the fact remains that instead of resorting to social forestry and thereby providing employment to the people in growing forest at the present moment the natural forests are being cut and the timber sawn.

Andaman & Nicobar Islands is one of the hot spots and is in the eco-fragile area and has, therefore, the eco-diversity thereby has to be preserved. For this, it is

Essential that the natural forest is protected and re-generation allowed to take place.

We are also informed that the existing saw-mills have a subsisting license valid till 30th March, 2003. The saw-mills and the other wood-based industries in the Andaman & Nicobar Islands are not permitted to cut the trees and supplies to them are made only by the Government itself or through its Corporation. Some of these saw-mills and industries have logs of wood and sawn timber in their stock. It would therefore be iniquitous to deprive them of an opportunity to utilise the stock for which payment has been made to the Government for the purchase of wood. However, it is to be borne in mind that fresh logging of wood must cease immediately.

**After taking all facts and circumstances into consideration, we issue the following directions:**

1. All felling of trees from the forest of little Andaman Islands, the national park and sanctuaries, the tribal reserves and all other areas shall stand suspended.
2. For the areas in which there are working plans, the Government through the Chief Secretary shall disclose on an affidavit -
  - I. The extent of felling and re-generation permitted under these working plans during the last 10 years.
  - II. The compliance with re-generation/re-plantation/re-forestation targets under the working plans and reasons if any for the shortfall.
3. The working plan of the Andaman & Nicobar Islands should be re-worked on the basis as was applied to the State of M.P. and others, namely that before any felling of trees, there should first be compulsory afforestation/re-generation, the felling permissions would be based upon the extent of re-generation of forest undertaken and not the other way round.
4. No felling of tree (under the working plan or otherwise) shall be permitted for meeting any raw material requirements of the plywood, veneer, black board, match stick or any other wood-based industry.
5. In drawing up the new working plans the Government shall formulate a Committee with one Ecologist who is proficient with the ecology of Andaman.
6. The working plans so formulated shall be placed before this Court within a period of twelve weeks.
7. The trees felled under the working plan in the manner indicated aforesaid should be utilised for the requirements of the local inhabitants.

8. The licenses of all the saw-mills and wood-based industries shall not be renewed after 31st March, 2003. This will not debar the authorities from canceling licenses in accordance with law, if there is no breach of the License Committee by the Licensees before that date.
9. The ecology of the area does not permit any kind of industrial activity for which the wood is likely to be consumed. Therefore, licenses of wood-based industries shall stand cancelled but they will be permitted to exhaust the existing stock till 31st March, 2003.
10. The Union of India if it so adopts and thinks appropriate may take steps for re-locating the dislocated wood-based industries in the main land area anywhere in India as long as it is not within the vicinity of forest area. Henceforth for meeting the local requirements it is only the Government saw-mills which shall operate. No fresh wood or logs shall be given to any of the saw-mills or the wood-based industries till fresh working plans are prepared and submitted to this Court and the approval obtained.
11. With immediate effect, there will be no movement of logs or timber in any form including sawn timber from Andaman & Nicobar Islands to any part of India or anywhere else.
12. Regularisation of encroachments on forest land in any form, including allotment/use of forest land for agricultural or horticultural purposes, shall be strictly prohibited.
13. 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, shall be given one month's notice to vacate their encroachments and shift to the allotted land. Failing this, their allotment shall be cancelled and they shall be forcibly evicted within three months of the deadline being over, without any further claim to land or any other form of rehabilitation. Such notices should be issued within six weeks.
14. Similarly, those among the pre-1978 families that have shifted to their allotted sites but have occupied more land than they were entitled to shall also be given one month's 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 shall be cancelled and they should be forcibly evicted within three months, without any further claim to compensation or land. Such notices should be issued within six weeks.
15. All post 1978 forest encroachments shall be completely removed within three months.
16. For the eviction of encroachers, an effective action plan shall be prepared and implemented under direct supervision, monitoring and control of a Committee under the Chairmanship of the Lt. Governor with Chief Secretary, Principal Chief Conservator of Forests and reputed NGO representatives, its members. The Chief Secretary, Andaman & Nicobar Islands, shall file every month an affidavit about progress of eviction of encroachments.
17. The process of issue of identity cards to all the residents shall be completed within a period of six months.
18. The extraction of sand shall be phased out @ minimum 20% per year on reducing balance basis to bring the sand mining to the level of 33% of the present level of mining within a maximum period of 5 years.
19. The approvals accorded by Ministry of Environment & Forests under the Forest (Conservation) Act, 1980, shall be reviewed by a Committee consisting of Secretary, Environment & Forests, Director General of Forests and at least one non-official member of the Forest Advisory Committee constituted under the Forest (Conservation) Rules to restrict the approvals to the barest minimum needed to serve emergent public purposes. Felling of trees shall commence only after the process of compensatory afforestation has actually been undertaken on the ground. In future, the proposals shall be considered for approval only after detailed Environmental Impact Assessment has been carried out through an independent agency identified by Ministry of Environment & Forests.
20. Specific actions shall be undertaken by Ministry of Environment & Forests/Andaman & Nicobar Islands Administration on the other recommendations of Shri. Shekhar Singh Report which are not specifically dealt with in above orders. Ministry of Environment & forests and the Andaman & Nicobar Islands Administration shall file an affidavit within three months giving details of action taken by them on each of such recommendations.
21. Copy of this order to be sent by the Registry to the Chief Secretary, Andaman & Nicobar Islands for information and compliance.

### 11. Appendix 2: Site-Specific Threats

Area	Threats	Consequences	Actions necessary
Nicobars (General)	Hunting	Pigeon & fruit Bat population affected	Enforcement of closed season at least & checks on air guns
	FD infrastructure inadequate	Mobility and ability to enforce Wildlife laws impaired	Purchase of fast boats; posting of additional patrol staff
	Poaching by foreign boats	Loss of marine resources	As above
	Sand mining	Loss of marine turtle habitat & coastal forest	Enforcement, reduce use
Great Nicobar Island	Immigration pressures from non-tribals	Deforestation, social conflicts between tribals and non-tribals.	Ban, enforcement of Tribal Protection Act in all earnest.
	Crop raiding by macaques	Human-Wildlife conflict leading to killing of macaques, loss of crop	Research methods to reduce crop raiding
	Unchecked population growth	Resource crunch and water scarcity, reduction of Biosphere area	Planned growth
	Rebuilding of East West road year after year.	Increased tourism & more access to Shompens, erosion and sedimentation of streams, wasteful expenditure.	Abandonment of this plan
Katchal	Proposed road	Will destroy last remnant forest as well as reduce population of northern subspecies of Nicobar Megapode	Insufficient details available; Abandonment of this plan is.
Tillanchong	Poachers	Poaching of marine resources, wild pig, and edible nest swiftlets	Monitoring and awareness generation
Car Nicobar	Dumping of garbage by passing ships observed	Marine pollution observed leading to damage of reefs	Marine Act to be enforced strictly
Little Andaman	Tourism activity in Onge Reserve	Threat to tribal life style; sea turtle beaches affected.	ANPATR, 1956 to be strictly implemented.
	Excessive hunting of the Andaman Wild Pig	Decline in population and non availability of wildpig for the Onge people	Monitoring of the Reserve, posting of additional staff
	Excessive poaching of timber resources	Destruction of pristine forest	Monitoring of the Reserve, posting of additional staff
"Great" Andaman group	Excessive browsing by chital	Regeneration of forests seriously affected; species	Ranching/Culling

		diversity reduced	
	Excessive hunting of the Andaman Wild Pig	Decline in population and non availability of wildpig to the Jarawa	Monitoring of the Reserve, posting of additional staff
	Reduced Agricultural productivity	Lower income to residents	Agro forestry initiatives to be launched
	Over harvesting outside and in protected areas to cater to the export markets for reef fishes crab and lobster	Reduction catch, evident reduction in availability and sizes caught	Closed season to be enforced, management and harvesting regimes to be applied urgently.
	Fishermen preferentially hunting shark	Shark populations declining	Enforcement of Fishing Rules: closed season and shark as by catch only
"Great" Andaman group	Inappropriate agricultural practices; declining yields	Pollution due to fertilisers and pesticides; this and siltation lead to damage to coral reefs	Phasing out rice farming by encouraging agro forestry.
	Introduction of exotics	Damage to trees (elephant); reduction of regeneration (chital); competition with endemics for nesting sites (mynahs); destruction of sea turtles and nests (Feral dogs)	Programme to eliminate all exotics; steps to prevent any new exotic being brought into the islands.
Rutland	Sand mining and hunting	Coastal erosion, species loss, loss of marine turtle nesting beaches	Effective enforcement of law
South Andaman	"Jarawa" tourism in spite of Administration ban, hunting within the reserve for pig and deer	Cultural contamination of Jarawa & depletion of their resources, learning of inappropriate dietary habits	Effective enforcement of law
	Opening up of Manjeri for tourism	Increased pressure on MGMNP	Environmental Impact Assessment to be done and implemented
	Encroachment of protected areas continues unabated eg. Loha Barracks	Loss of habitat, Water scarcity	Effective enforcement of law
South Andaman	Port Campbell and other areas along the west coast has become fishermen and poachers camping site	Conflicts, Cultural contamination of Jarawa; learning of inappropriate dietary habits and loss of their resources.	Effective enforcement of law
Baratang	Teak plantations, poaching and Sand mining	Water scarcity, species loss, loss of nesting habitat for marine turtles	Regeneration of evergreen forests, reduction of sand mining and sand use
Middle Andaman	"Jarawa" tourism, poaching	Cultural contamination of Jarawa; learning of inappropriate dietary habits, species loss and depletion of resources for the Jarawa	Effective enforcement of law

Flat Island	Becoming a fisherman camp site	Cultural contamination of Jarawa; learning of inappropriate dietary habits	Effective enforcement of law
MGMNP	Oil spill from boats	Damage to corals and beaches	Marine Act to be enforced strictly
	Tourist damage to corals	Damage to coral reefs	Visitors to be regulated; greater awareness
MGMNP	Lack of local participation	Exploitation of resources, minimal cooperation	Explore possibilities
	Sand mining	Destruction of beaches; reduced areas for turtle nesting.	Ban required; interim Govt. control of collection and sale
	FD infrastructure inadequate,		Explore alternative management strategies
	Propellor use in MGMNP	Damage to coral reefs	Boat traffic routes to be created, mooring buoys to be used.
Ritchie's Archipelago	Unchecked Dive Tourism, poaching, and fishing within the park and over reefs	Loss of revenue, Damage to reef	Create infrastructure & management plan.
North Andaman	Unchecked encroachment of reserve and revenue forests	Resource depletion and unchecked population growth	Effective enforcement is currently taking place
	Uncontrolled resource exploitation from surrounding islets, poaching and illegal timber extraction by settlers	Resource depletion and local extinction	Create infrastructure to monitor region
Interview	Damage by elephants	Damage to forest regeneration	Removal
Delgarno and Trilby	Illegal timber extraction	Habitat loss	Monitoring
Narcondam  Barren Island	Police and Goats	Threat to the Endemic Hornbill, habitat	Monitoring
South Sentinel	fishermen and poachers camps	giant robber crab, marine turtles and pied imperial pigeon nesting habitat.	Monitoring and enforcement required

**Sources:** Andrews, 1999; 2000a; b; c; 2001; 2002; Andrews & Sankaran, 2002; Ali, 2001; Aul, 2002; Chandi, 1998; Gandhi, 2000. Sankaran, 1995; 1998.

12. Appendix 3: Plants used by Chota Nagpur Community

	Plant species	Plant family	Local name	General use
1	<i>Adenanthera pavonia</i>	Mimosaceae	Yewgi	Timber; firewood; rice wine
2	<i>Aglaiia andamanica</i>	Meliaceae	Latou	Construction
3	<i>Albizia chinensis</i>	Mimosaceae	Bonmeza	Timber; rice wine
4	<i>Albizia procera</i>	Mimosaceae	Coco	Rice wine
5	<i>Amoora wallichii</i>	Meliaceae	Lalchini	Timber
6	<i>Amorphophallus campanulatus</i>	Araceae		edible
7	<i>Areca triandra</i>	Arecaceae	Jungli supari	Construction
8	<i>Artabotrys speciosus</i>	Annonaceae		Medicinal
9	<i>Artocarpus lakoocha</i>	Moraceae	lakuch	Construction
10	<i>Bombax insigne</i>	Bombacaceae	Didu	Timber; medicinal
11	<i>Bouea oppositifolia</i>	Anacardiaceae	Mariam	Firewood; wild edible
12	<i>Calamus longisetus</i>	Arecaceae	Jungli beth	Construction
13	<i>Calamus pseudo-rivalis</i>	Arecaceae	Sangabeth	Agricultural implements; thirst quencher
14	<i>Canarium euphyllum</i>	Burseraceae	Dhup	Trapping birds
15	<i>Caryota mitis</i>	Arecaceae	Madi pathi	edible
16	<i>Cinnamomum verum</i>	Lauraceae	Jungli tejpatta	Culinary ingredient
17	<i>Cleistanthus myrianthus</i>	Euphorbiaceae	Gorai	Fish stupefier; rice wine
18	<i>Dinochloa andamanica</i>	Poaceae	Bel bamboo	construction
19	<i>Diospyros oocarpa</i>	Ebenaceae	Kendu	Agricultural implements; Beedi
20	<i>Diploknema butyraceae</i>	Sapotaceae	Jungli Mahua	Timber; firewood; Rice wine
21	<i>Ficus benghalensis</i>	Moraceae	Bargad	Wild edible
22	<i>Garcinia cowa</i>	Clusiaceae	cowa	Wild edible
23	<i>Hibiscus cannabinus</i>	Malvaceae		Culinary ingredient
24	<i>Hopea odorota</i>	Dipterocarpaceae	Thingam	Timber
25	<i>Korthalsia laciniosa</i>	Arecaceae	Lal beth	furniture
26	<i>Leea indica</i>	Leaceae	Bagoda balli	Rice wine; construction
27	<i>Licuala peltata</i>	Arecaceae	Selai pathi	Construction
28	<i>Miliusa andamanica</i>	Annonaceae	Jungli sagan	Timber
29	<i>Myristica sp.</i>	Myristicaceae	Jaiphal	Medicinal
30	<i>Ocimum sanctum</i>	Lamiaceae	Tulsi	Honeybee repellent
31	<i>Orophea indica</i>	Annonaceae		Honeybee repellent
32	<i>Pandanus andamanesium</i>	Pandanaceae	Keora	Wild edible; construction
33	<i>Phoenix sylvestris</i>	Arecaceae	Kajur	Wild edible; construction
34	<i>Piper sp.</i>	Piperaceae	Jungli Pan	Betel leaves

35	<i>Pisonia umbellifera</i>	Nyctaginaceae	Bania	Elephant fodder; basket making
36	<i>Planchonia valida</i>	Myrtaceae	Lal Bombway	1. Veterenary medicine; 2. Timber
37	<i>Pometia pinnata</i>	Sapindaceae	Thitkandu	Firewood; wild edible
38	<i>Pongamia pinnata (L.) Pierre</i>	Fabaceae	Karanj	Timber
39	<i>Pterocarpus dalbergioides</i> (	Fabaceae	Padauk	Dyeing
40	<i>Pterocymbium tinctorium</i>	Sterculiaceae	Papita	Floaters; match sticks
41	<i>Pterospermum aceroides</i>	Sterculiaceae	Makchun; Ullat kambal	Medicinal; Agricultural implements
42	<i>Rauvolfia serpentina</i>	Apocynaceae	Nagbel	Rice wine
43	<i>Rhizophora apiculata</i>	Rhizophoraceae	Khagadagach	Dyeing
44	<i>Sageraea elliptica</i>	Annonaceae	chooi	Timber
45	<i>Schleichera sp.</i>	Sapindaceae	Kusum	Construction; wild edible
46	<i>Semecarpus anacardium</i>	Anacardiaceae	Bhilawa	Wild edible
47	<i>Semecarpus anacardium</i>	Anacardiaceae	Kaju	Medicine
48	<i>Sida acuta</i>	Malvaceae	Boriyari	Medicinal
49	<i>Solanum xanthocarpum</i>	Solanaceae	Jungli Bengan	Medicinal
50	<i>Spondias pinnata</i>	Anacardiaceae	Ambara	Firewood; wild edible
51	<i>Stachytarpheta jamaicensis</i>	Verbenaceae	Billi asra	Cultural
52	<i>Terminalia catapa</i>	Combretaceae	Badam	Timber; wild edible
53	<i>Tetrameles nudiflora</i>	Datisceae	Thitpok	Timber
54	<i>Tinospora cordifolia</i>	Menispermaceae	Kaduva bel	Ricewine
55	<i>Typhonia sp.</i>	Araceae		edible
56	<i>Unidentified</i>		Lohar lakdi	Timber
57	<i>Unidentified</i>		Karmi	Construction; firewood
58	<i>Unidentified</i>		Agia	Medicinal; construction; firewood
	<i>Unidentified</i>		Yemane	Floaters
	<i>Unidentified</i>	Areaceae	Burma beth	Furniture making

Source: Ali, in prep.



13. Appendix 4: Endemic birds

Species	Narcondam	Cocos I	North A	Middle A	South A	Little A	Car Nic	Tillanchong	Teresa	Camorta	Trinkat	Nancauri	Katchal	Little N	Great N	Megapode I	Status
<i>Aceros narcondami</i>	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VU(D1; D2)
<i>Otis balli</i>	P	-	?	-	P	-	-	-	-	-	-	-	-	-	-	-	nt
<i>Dicrurus andamanensis</i>	-	P	P	P	P	P	-	-	-	-	-	-	-	-	-	-	nt
<i>Centropus andamanensis</i>	-	P	-	P	P	P	-	-	-	-	-	-	-	-	-	-	nt
<i>Megapodius nicobaricus</i>	-	E x	-	-	-	E x	-	P	P	P	P	P	P	P	P	P	VU
<i>Rallina canningi</i>	-	-	P	P	P	-	-	-	-	-	-	-	-	-	-	-	VU
<i>Dryocopus hodgei</i>	-	-	P	P	P	P	-	-	-	-	-	-	-	-	-	-	nt
<i>Columba palumboides</i>	-	-	P	P	P	P	P	-	-	P	P	P	-	?	P	-	nt
<i>Dendrocitta baylei</i>	-	-	P	P	P	P	-	-	-	-	-	-	-	-	-	-	nt
<i>Macropygia rufipennis</i>	-	-	P	P	P	P	-	P	P	P	P	P	P	P	P	P	nt
<i>Sturnus erythropegius</i>	-	-	P	P	P	P	P	-	-	-	-	-	P	-	-	-	nt
<i>Spilornis elgini</i>	-	-	P	P	P	P	-	-	-	-	-	-	-	-	-	-	nt
<i>Ninox affinis</i>	-	-	P	-	P	-	P	-	-	P	P	-	-	-	P	-	nt
<i>Accipiter butleri</i>	-	-	-	-	-	-	P	-	P	P	-	-	P	P	P	-	nt
<i>Hypsipetes nicobariensis</i>	-	-	-	-	-	-	-	P	P	P	P	P	P	-	-	-	VU (C1)
<i>Spilornis minimus</i>	-	-	-	-	-	-	-	-	P	P	P	P	P	P	P	-	nt
<i>Psittacula caniceps</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	P	P	-	nt

Source: BNHS, ZSI, SACON, Birdlife International (2000)

“P” present; “Nt” near threatened; “Vu” vulnerable; “DD” data deficient.

**14. Appendix 5: Important Bird Areas**

<b>Important Bird Areas</b>		
	<b>Site Name</b>	<b>Criteria</b>
1	Little Andaman	A1,A2
2	South Sentinel	A1,A2
3	North Sentinel	A1,A2
4	Kadakachang	A1,A2
5	Katakahri naya dera	A1,A2
6	Baratang – Rafter’s Creek	A1,A2
7	Mount Diavalo / Cuthbert Bay	A1,A2
8	Chainpur & Hanspuri	A1,A2
9	Jarawa Reserve (Middle Andaman)	A1,A2
10	Jarawa Reserve (South Andaman)	A1,A2
11	Patti level – Cliff Bay	A1,A2
12	Austin Strait	A1,A2
13	Interview Island WS	A1,A2
14	Landfall Island WS	A1,A2
15	Mount Harriet NP	A1,A2
16	Narcondam Island WS	A1,A2
17	North Reef Island WS	A1,A2
18	Saddle Peak NP	A1,A2
19	Mahatma Gandhi Marine NP	A1,A2

**Source:** BNHS.

**15. Appendix 6: Endangered and Endemic Mammals**

Common Name	Scientific name	A	N	GNI	Status	Remarks
Nicobar Macaque	<i>Macaca fascicularis umbrosa</i>	A	P	P	LRnt	
Nicobar Tree Shrew	<i>Tupaia nicobarica</i>	A	A	P	EN	
Andaman subanus Rat	<i>Rattus flebilis</i>	P	A	A		
Nicobar Spinebacked Rat	<i>Rattus pulliventer</i>	A	A	P		
Nicobar Rat	<i>Rattus palmarum</i>	A	P?	P?	VU(D2)	
Andaman Rat	<i>Rattus stiocus</i>	P	A	A	VU(D2)	
Malaysian Wood rat	<i>Rattus tiomanicus</i>	A	P?	P?	VU(D2)	Not Endemic
	<i>Mus famulus</i>				EN	Not Endemic
Jenkin's Shrew	<i>Crocidura jenkinsi</i>	P	A	A	DD	
Andamans Spiny Shrew	<i>Crocidura hispida</i>	P	A	A	EN(B1,2d)	
Nicobar Spiny Shrew	<i>Crocidura nicobarica</i>				DD	
Andaman Palm Civet	<i>Paguma larvata tytleri</i>	P			DD	Endemic subspecies
Andaman Wild Pig	<i>Sus scrofo</i> Linnacus, 1758.	P				
Dugong	<i>Dugong dugon</i>	P	P	P	CR(A1a,1c,1d)	Marine

**Source:** Andrews & Sankaran, 2002

IUCN Criteria – “C” criteria; “EN” endangered; “VU” vulnerable; “LRnt” lower risk near threatened; “DD” data deficient.

16. Appendix 7: List of bat species found in the Andamans & Nicobars

	Species	Common Name	Conservation status	Distribution
1	<i>Pteropus giganteus</i>	Indian flying fox	Stable	
2	<i>Pteropus vampyrus</i>	Large flying fox	Stable	
3	<i>Pteropus funulus</i>	Nicobar flying fox	No Assessment	N
4	<i>Pteropus hypomelannus</i>	Island flying fox	Stable	
5	<i>Pteropus melanotus tyleri</i>	Blyth's flying fox	Stable	A
6	<i>Cynopterus sphinx</i>	Short-nosed fruit bat	Stable	A
7	<i>Cynopterus brachyotis</i>	Andaman short-nosed fruit bat	Stable	A
8	<i>Eonycteris spelaea</i>	Dawn Bat	Vulnerable	
9	<i>Taphozous melanopogon</i>	Black bearded tomb bat	No Assessment	A
10	<i>Taphozous saccolaimus</i>	Pouch bearing bat		
11	<i>Megaderma spasma</i>	Lesser false vampire	No Assessment	A
12	<i>Rhinolophus affinis</i>	Intermediate horse shoe bat	Stable	
13	<i>Rhinolophus refulgens</i>	Anderson's horseshoe bat	Unknown	
14	<i>Rhinolophus cognatus</i>	Andaman horse shoe bat	No Assessment	A
15	<i>Hippocideros ater</i>	Dusky leaf nosed bat	No Assessment	
16	<i>Hipposideros cinereus</i>	Grey leaf nosed bat	No Assessment	
17	<i>Hippocideros fulvus</i>	Fulvous leaf nosed bat	No Assessment	N
18	<i>Hippocideros pomna</i>	Anderson's leaf nosed bat	No Assessment	A
19	<i>Hippocideros diadema</i>	Diadem Leaf nosed bat	No Assessment	
20	<i>Myotis horsefeildii</i>	Horsefeild's bat	No Assessment	A
21	<i>Scotophilus khulii</i>	Asiatic lesser house bat	No Assessment	N
22	<i>Tylonycteris pachypus</i>	Bamboo bat	No Assessment	A
23	<i>Pipistrellus javanicus</i>	Javan pipistrelle	Stable	A
24	<i>Pipistrellus coromandra</i>	Coramandel pipistrelle	No Assessment	
25	<i>Hesperoptenus tickelli</i>	Tickell's bat	No Assessment	A
26	<i>Miniopterus pusillus</i>	Nicobar long-fingered bat	No Assessment	
27	<i>Hippocideros larvatus</i>	Horsefiled's roundleaf bat	No Assessment	A
28	<i>Rhinolophus yunanensis</i>	Dobson's horse shoe bat	No Assessment	A
29	<i>Cynopterus sp1</i>	Sp under id confirmation	Unknown	A
30	<i>Rhinolophus sp1*</i>	Sp under id confirmation	Unknown	A
31	<i>Myotis sp?*</i>	Sp under id confirmation	Unknown	A

Source: Hill, 1967; Miller, 1902; Bates, 1998; Das, 1998; Aul, 2002.

17. Appendix 8: Endemic reptiles and amphibians

Species	Common Name	Andaman	Nicobar	GNI
<i>Cyrtodactylus rubidus</i>		P	A	A
<i>Cyrtodactylus adleri</i>		A	A	P
<i>Dasia nicobarensis</i>	Nicobar Tree skink	A	P	A
<i>Phelsuma Andamanense</i>	Andaman Day gecko	P	A	A
<i>Cnemaspis aff. kandianas</i>				P
<i>Goniocephalus subcristatus</i>	Green Forest Lizard	P	P	A
<i>Scincella macrotis</i>		A	P?	P
<i>Bronchocelacrisiatella</i>		A	A	p
<i>Lipinia macrotympana</i>		P	P?	P
<i>Typhlops oatesi boulenger</i>		P	A	A
<i>Mabuya tytleri</i>	Tytlers Skink	P	A	A
<i>Scincella macrotis</i>	Whitestriped Skink	A	A	P
<i>Casymbotus aff. platyurus</i>		P	A	A
<i>Dibamus nicobicus</i>		A	A	P
<i>Naja sajittifera</i>	Andaman cobra	p	A	A
<i>Bungarus andamanensis</i>	Andaman Krait	P	A	A
<i>Oligodon woodmasoni</i>	Andaman Banded Kukri	A	A	P
<i>Amphiesm nicobriense</i>		A	P	-
<i>Dendrolaphis pictus andamanensis</i>		A	A	P
<i>Boiga Andamanensis</i>	Andaman Cat Snake	P	A	A
<i>Lycodon tiwarii</i>	Biswas' Wolf Snake	P	P?	A
<i>Boiga wallachi</i>		A	P?	P
<i>Gongylosoma nicobarenense</i>		A	A	P
<i>Trimeresurus andersoni</i>	Andaman Pit Viper	P	A	A
<i>Trimeresurus labialis</i>	Brownspeckled Pit Viper	A	P	A
<i>Trimeresurus cantori</i>	Cantor's Pit Viper	P	P	A
<i>Kalouta baleata ghoshi</i>		P	A	A
<i>Microphyla chakrapani</i>		P	A	A
<i>Limnoectes andamensis</i>		P	A	A
<i>Limnoectes limnocharis</i>		P	A	A
<i>Limnoectes sp1</i>		P	A	A
<i>Limnoectes sp2</i>		P	A	A
<i>Limnoectes shomperorum</i>		A	A	P
<i>Polypedates insularis</i>		A	A	P

Source: Tiwari & Biswas, 1973; Das, I. 1994; 1997, 1998 & 1999.

### 18. Appendix 9: Endemic plants

The presence of over 2000 indigenous and 500 non indigenous angiosperm species within a land area of 8290 sq km is a significant feature of the Andaman and Nicobar islands, making them a cynosure not only for plant taxonomists but also for conservationists. Of the 2000 species known to occur 14% are endemic to the islands. At the generic level endemism is rather less with only three genera viz. *Sphyrnthera* (Euphorbiaceae) with 2 species, *Pubistylis* (Rubiaceae) with one species and *Nicobariodendron* (Celastraceae) with one species.

**Source:** P. N. Rao, (1996)

Editors : P.K.Hajara, & P.S.N.Rao Author: B.P..Sinha.

	Family	Species	Endemic to		
			Gt. Nicobar Island	Nicobar Islands	A&N Islands
1	<b>PTERIDOPHYTES :</b>				
2	CYATHEACEAE:	<i>Cyathea albosetacea</i>	A	P	A
3		<i>Cyathea nicobarica</i>	A	P	A
	<b>DICOTYLEDONS:</b>				
4	RANUNCULACEAE	<i>Clematis smilacifolia var. andamanica</i>	A	A	P
5	DILLENACEAE :	<i>Dillenia andamanica</i>	A	A	P
6	ANNONACEAE:	<i>Artobotrys nicobarianus</i>	P	A	A
7		<i>Friesodielsia forniculata</i>	P	A	A
8		<i>Orophea katschallica</i>	A	A	P
9		<i>Polyalthea parkinsonii</i>	A	A	P
10		<i>Pseuduvaria prainii</i>	A	A	P
11		<i>Uvaria nicobarica</i>	P	A	A
12	MENISPERMACEAE :	<i>Cyclea pendulina</i>	A	A	P
13	STERCULIACEAE :	<i>Sterculia cordata</i>	A	A	P
14	CLUSIACEAE :	<i>Grewia calophylla</i>	A	A	P
15	RUTACEA:	<i>Glyosmis pilosa</i>	A	A	P
16		<i>G. mauritiana var. andamanensis</i>	A	A	P
17		<i>Paramignya andamanica</i>	A	A	P
18	MELIACEAE :	<i>Chisocheton nicobaricus</i>	P	A	A
19		<i>Dysoxylum alliaceum</i>	A	A	P
20	ICACINACEAE:	<i>Codiocarpus andimanica</i>	A	A	P
21		<i>Gomphandra comosa</i>	A	P	A
22	CELASTRACEAE:	<i>Nicobariodendro sleumeri</i>	P	A	A
23	VITACEAE:	<i>Tetrastigma andamanica</i>	A	A	P
24		<i>Leea grandifolia</i>	A	P	A
25	ANACARDIACEAE	<i>Mangifera nicobarica</i>	A	P	A
26		<i>Semecarpus kurzii</i>	A	A	P
27	CONNARACEAE:	<i>Connarus nicobaricus</i>	P	A	A
28	COMBRETACEAE;	<i>Terminalia procera</i>	A	A	P
29	MELASTOMATACEAE	<i>Otanthera nicobarensis</i>	P	A	A
30	MEMECYLACEAE :	<i>Memecylon andamanicum</i>	A	A	P
31	RUBIACEAE :	<i>Coptophyllum nicobaricum</i>	P	A	A
32		<i>Hedyotis paradoxa</i>	A	A	P

33		<i>Ixora brunnescens</i>	A	A	P
34		<i>I. cuneifolia</i> var. <i>macrocarpa</i>	A	P	A
35		<i>I. grandifolia</i> var. <i>kurzlana</i>	A	P	A
36		<i>I. grandifolia</i> var. <i>rosella</i>	A	P	A
37		<i>I. tenuifolia</i>	A	P	A
38		<i>Ophiorrhiza infundibularis</i>	P	A	A
39		<i>O. nicobarica.</i>	P	A	A
40		<i>Psychotria andamanica</i>	A	A	P
41		<i>P. platyneura</i>	A	P	A
42		<i>Tarenna weberaefolia</i>	A	A	P
43	MYRSINACEAE :	<i>Embelia microcalyx</i>	A	P	A
44		<i>Maesa andamanica</i>	A	A	P
45	OLEACEAE:	<i>Jasminum multiflorum</i> var. <i>nicobaricum</i>	P	A	A
46	APOCYNACEAE :	<i>Alstonia kurzii</i>	A	A	P
47		<i>Chilocarpus denudatus</i> var. <i>nicobaricus</i>	P	A	A
48		<i>Tabernaemontana crispa</i>	A	A	P
49	ASCLEPIADACEAE :	<i>Genianthus horei</i>	P	A	A
50	SCROPHULARIACEAE	<i>Cyrtandroemia nicobarica</i>	P	A	A
51	GESNERIACEAE:	<i>Cyrtandra burtii</i>	P	A	A
52		<i>C. occidentalis</i>	P	A	A
53	ACANTHACEAE:	<i>Strobilanthes glandulosus</i>	A	A	P
54	MYRSINACEAE:	<i>Knema andamanica</i> spp <i>andamanica</i>	A	A	P
55	LAURACEAE:	<i>Litsea kurzii</i>	A	P	A
56		<i>Nothophoebe nicobaricus</i>	P	A	A
57	EUPHORBIACEAE	<i>Claoxylon rostratum</i>	A	A	P
58		<i>Cleistanthus balakrish</i>	P	A	A
59		<i>Drypetes bhattacharyae</i>	A	A	P
60		<i>Glochidion calocarpw</i>	A	A	P
61		<i>Macaranga nicobaricia</i>	A	P	A
62		<i>Mallotus oblongifolius</i> var. <i>rubriflorus</i>	A	A	P
63		<i>Sphyranthera lutescen</i>	A	A	P
64		<i>Trigonostemon villosus.</i> var. <i>nicobaricus</i>	P	A	A
65	URTICACEAE:	<i>Pellionia procrdifolia</i>	A	P	A
66		<i>Elatostema novorae</i>	A	P	A
	<b>MONOCOTYLEDONS:</b>				
67	ORCHIDACEAE:	<i>Aerides emericii</i>	P	A	A
68		<i>Anoectochilus nicobar</i>	P	A	A
69		<i>Eria bractescens</i> var. <i>kruzii</i>	A	A	P
70		<i>Dendrobium shompenii</i>	P	A	A
71		<i>Pomatocalpa andamanicum</i>	A	A	P
72		<i>Phalaenopsis speciosa</i> var. <i>speciosa</i>	A	A	P
73		<i>Trichoglottis quadricornuta</i>	A	P	A

74		<i>Vanilla andamanica</i>	A	A	P
75	ZINGIBERACEAE :	<i>Hornstedtia fenzlii</i>	P	A	A
76	MARANTACEAE:	<i>Phrynium paniculatum</i>	P	A	A
77	DIOSCOREACEAE :	<i>Dioscorea vexans</i>	A	A	P
78	AGAVACEAE:	<i>Dracaena brachyphylla</i>	A	A	P
79	ARECACEAE:	<i>Calamus andamanicus</i>	A	A	P
80		<i>C. dilaceratus</i>	A	P	A
81		<i>C. pseudo-rivalis</i>	A	A	P
82		<i>C. uniforms</i>	A	P	A
83		<i>C. nicobaricus</i>	P	A	A
84		<i>Pinanga manii</i>	A	A	P
85		<i>Rhopaloblaste augustata</i>	P	A	A
86	PANDANACEAE:	<i>Pandanus leram var. andamanensium</i>	A	A	P
87	ARACEAE:	<i>Aglanema nicobaricum</i>	P	A	A
88		<i>Homalomena griffithii var. ovata</i>	P	A	A



19. Appendix 10: Rare, endangered and threatened plants

Family	Species	Remarks
Araceae	<i>Amorphophallus carnosus</i>	Rare & Threatened
	<i>Amorphophallus longistylus</i>	Rare & Threatened
	<i>Amorphophallus oncophyllus</i>	Rare & Threatened
Arecaceae	<i>Calamus dilaceratus</i>	Rare & Threatened
	<i>Corypha macropoda</i>	Rare & Threatened
Cyperaceae	<i>Cyperus kurzii</i>	Rare & Threatened
	<i>Hypolytrum balakrishnanii</i>	Rare
Dioscoreaceae	<i>Dioscorea vexans</i>	Rare
	<i>Dioscorea rogersii</i>	Rare
Marantaceae	<i>Stachyphrynium cadellianum</i>	Rare & Threatened
Orchidaceae	<i>Bulbophyllum protractum</i>	Rare & Threatened
	<i>Habenaria andamanica</i>	Rare & Threatened
	<i>Malleola andamanica</i>	Rare & Threatened
	<i>Phalaenopsis speciosa</i>	Rare & Threatened
	<i>Smitinandia helferi</i>	Rare & Threatened
	<i>Taeniophyllum andamanicum</i>	Rare & Threatened
	<i>Zeuxine rolfiana</i>	Rare & Threatened
	<i>Zeuxine andamanica</i>	Rare & Threatened
Poaceae	<i>Oryza indandamanica</i>	Rare
Zingiberaceae	<i>Bosenbergia albo-lutea</i>	Rare
	<i>Globba pauciflora</i>	Rare
	<i>Kaempferia siphonantha</i>	Rare & Threatened
DICOTS		
Acanthaceae	<i>Hypoestis andamanensis</i>	Rare & Threatened
	<i>Hypoestis thothathrii</i>	Rare
	<i>Strobilanthes andamanensis</i>	Rare & Threatened
Anacardiaceae	<i>Mangifera andamanica</i>	Rare & Threatened
Annonaceae	<i>Orophaea torulosa</i>	Rare
Asteraceae	<i>Vernonia andamanica</i>	Rare & Threatened
Bombacaceae	<i>Bombax insigne</i>	Rare
Clusiaceae	<i>Garcinia cadelliana</i>	Rare
	<i>Garcinia kingii</i>	Rare
	<i>Mesua manii</i>	Rare
Euphorbiaceae	<i>Antidesma andamanicum</i>	Rare
	<i>Bridelia kurzii</i>	Rare
	<i>Cnesmone javanica</i>	Rare
	<i>Dimorphocalyx balakrishnanii</i>	Rare
	<i>Dimorphocalyx dilipanus</i>	Rare
	<i>Glochidion bilobulatum</i>	Rare
	<i>Phyllanthus andamanica</i>	Rare & Threatened
	<i>Sphyranthera airy-shawii</i>	Rare
<i>Sphyranthera lutescens</i>	Rare	
	<i>Trigonostemon viridissimus</i>	Rare & Threatened

Fabaceae	<i>Tadehagi triquetrum</i>	Rare & Threatened
Flacourtiaceae	<i>Casaeria insularis</i>	Rare
Hypocrataceae	<i>Hippocratea andamanica</i>	Rare
Icacinaceae	<i>Gomphandra comosa</i>	Rare
Lamiaceae	<i>Scutellaria andamanica</i>	Rare
Lauraceae	<i>Cryptocarya ferrarsii</i>	Rare
	<i>Litsea kurzii</i>	Rare
	<i>Litsea leiantha</i>	Rare
	<i>Neolitsea andamanica</i>	Rare
	<i>Neolitsea balakrishnanii</i>	Rare & Threatened
Loganiaceae	<i>Strychnos narcondamensis</i>	Rare
Loranthaceae	<i>Ginallia andamanica</i>	Rare & Threatened
Malphigiaceae	<i>Hiptage thothathrii</i>	Rare & Threatened
Melastomataceae	<i>Memecylon collinum</i>	Rare
Meliaceae	<i>Aglaia fusca</i>	Rare
	<i>Amoora manii</i>	Rare
Menispermaceae	<i>Stephania andamanica</i>	Rare
	<i>Tinospora andamanica</i>	Rare
Moraceae	<i>Ficus andamanica</i>	Rare
Myristicaceae	<i>Horsfieldia macrocarpa</i>	Rare
Myrsinaceae	<i>Maesa andamancia</i>	Rare
Myrtaceae	<i>Syzygium andamanicum</i>	Rare
	<i>Syzygium kurzii</i>	Rare
	<i>Syzygium manii</i>	Rare
Oleaceae	<i>Jasminum andamanicum</i>	Rare
	<i>Jasminum unifoliolatum</i>	Rare
Rubiaceae	<i>Diplospora andamanica</i>	Rare & Threatened
	<i>Ixora andamanica</i>	Rare & Threatened
	<i>Ixora capituliflora</i>	Rare
	<i>Ixora hymenophylla</i>	Rare
	<i>Nauclea gageana</i>	Rare
	<i>Prismatomeria andamanica</i>	Rare
	<i>Psychotria andamanica</i>	Rare
	<i>Psychotria balakrishnanii</i>	Rare & Threatened
	<i>Psychotria helferi</i>	Rare
	<i>Psychotria pendula</i>	Rare
	<i>Psychotria polyneura</i> var. <i>longipetiolata</i>	Rare
	<i>Pubistylis andamanensis</i>	Rare & Threatened
Verbenaceae	<i>Clerodendrum lankawiense</i>	Rare
Vitaceae	<i>Tetrastigma andamanicum</i>	Rare

**Source:** P V. Sreekumar- list. 2002 & World Conservation Monitoring Centre (1994) lists 365 as threatened.

## **20. Appendix 11: Fishes**

More than 1150 fish species under 507 genera of 151 families have been recorded from the seas around Andaman and Nicobar islands. These species occur in freshwater, brackish water, coastal waters and offshore. The interesting groups are, chimaerids (Chimaeridae), pelagic sharks (Carchaehinidae), deep sea sharks (Squalidae), skates (Rhinobatidae) sting rays (Rajidae), herrings, Moray eels (Muraenidae) sardines (Clupeidae), anchovies (Clupeidae), milk fish, cat fish, (Aruidae), lizard fish (Synodontidae), flying fish (Excoetidae), half beaks (Hemirhamphidae), alligator gar (Belonidae), soldier fish (Holocentridae), pipe fish (syngnathidae), scorpion fish (Scorpaenidae), groupers (Serranidae), grunters (Teraponidae), flag tails (Kuhliidae), Bulls eye (Priacanthidae), cardinal fishes (Apogonidae), whittings (Sillaginidae), sucker fish (Echeneididae), trevellys (Carangidae), silver belly (Leiognathidae), snappers (Lutjanidae), fusiliers (Caesionidae), silver biddys (Gerridae), grunters (Haemulidae), sweetlips (Haemulidae), breams (Sparidae, Lethrinidae), threadfins (Nemipteridae), jaw fish (Sciaenidae), goat fish (Mullidae), bat fish (Ephippidae), butterfly fish (Chaetodontidae), angel fish (Pomacanthidae), Talpia (Cichlidae), demoiselles (Pomacentridae), anemone fish (Pomacentridae), mullets (Mugilidae), barracuda (Sphyraenidae), tassel fish (Polynemidae), wrasses (Labridae), parrot fish (Scaridae), blennids (Blennidae), dragonets (Callionymidae), gudgeons (Eleotrididae), goby (Gobidae), sword fish (Istiophoridae), mackerel (scombridae), tunas (Scombidae), flounders (Pleuronectidae), soles (Cynoglossidae, sollidae), file fish (Balitidae), trigger fish (Balistidae), Box fish (Ostracidae), blow fish (Tetrodontidae), and porcupine fishes (Diodontidae).

**Source:** Fisheries Department, CARI & ZSI.

## 21. Appendix 12: Corals

	Family	Species
1	<b>Astrocoeniidae</b>	<i>Stylocoeniella armata</i> (Ehrenberg, 1834)
2		<i>Stylocoeniella gnentheri</i> Bassen-Smith, 1890
3		Family Pocilloporidae
4		<i>Pocillopora damicornis</i> (Linnaeus, 1758)
5		<i>Pocillopora eydonxi</i> Milne Edwards & Haime, 1860
6		<i>Pocillopora meandrina</i> Dana, 1846
7		<i>Podllopora verrucosa</i> (Ellis & Solander, 1786)
8		<i>Seriaiopora caHendrum</i> Ehrenberg, 1834
9		<i>Seriulopora hystrix</i> Dana, 1846
10		<i>Stylophora pistillata</i>
11	<b>Acroporidae</b>	<i>Acropora aspera</i>
12		<i>Acropora</i> sp. I "brown digitate"
13		<i>Acropora austera</i> (Dana, 1846)
14		<i>Acropora brueggvami</i> [ Brook, 1893)
15		<i>Acropora cardinis</i> (Dana, 1846)
16		<i>Acropora cerealis</i> (Dana, 1846)
17		<i>Acropora chesterjieldensis</i>
18		<i>Acropora clathrata</i> (Brook, 1891)
19		<i>Acropora cophodactyla</i> (Brook, 1842)
20		<i>Acropora cytherea</i> (Dana, 1846)
21		<i>Acropora</i> sp. I. " danai-like"
22		<i>Acorpora digitifera</i> (Dana, 1846)
23		<i>Acropora divaricata</i> (Dana, 1846)
24		<i>Acropora echinata</i> (Dana, 1846)
25		<i>Acropora efflorescens</i>
26		<i>Acropora florida</i> (Dana, 1846)
27		<i>Acroporaformosa</i> (Dana, 1846)
28		<i>Acropora gemmifera</i> (Brook, 1892)
29		<i>Acropora globiceps</i> (Dana, 1846)(?)
30		<i>Acropora grandis</i> (Brook, 1892)
31		<i>Acropora granulosa</i> (Milne Edwards & Haime, 1860)
32		<i>Acropora hemprichi?</i>
33		<i>Acropora humilis</i> (Dana, 1846)
34		<i>Acropora hyacinthus</i> (Dana, 1846)
35		<i>Acropora kosurini</i> Wallace
36		<i>Acropora loiseltae?</i> Wallace, 1994
37		<i>Acropora longicyathus</i> (Milne Edward & Haime, 1860)
38		<i>Acropora loripes</i> (Brook, 1892)
39		<i>Acropora lutkeni</i> Crossland, 1952(?)

40		<i>Acropora monticulosa</i> (Bruggemann, 1879)
41		<i>Acropora nasuta</i> (Dana, 1846)
42		<i>Acropora nobilis</i> (Dana, 1846)
43		<i>Acropora paliferi</i> (Lamarck, 1816)
44		<i>Acropora palmerae</i>
45		<i>Acropora paniculata</i> Verrilli, 1902
46		<i>Acropora proximalis</i>
47		<i>Acropora pulchra</i> (Brook, 1891)
48		<i>Acropora robusta</i> (Dana, 1846)
49		<i>Acropora rudis</i>
50		<i>Acropora samoensis</i> Brook, 1891)
51		<i>Acropora selago</i> (Studer, 1878)
52		<i>Acropora solitaryeniis</i> Veron & Wallace, 1984
53		<i>Acropora spicifera</i> as in Wallace 1999
54		<i>Acropora spicifera</i> as in Wallace 1999
55		<i>Acropora tenuis</i> (Dana, 1846)
56		<i>Acropora valenciennesi</i> (Milne Edwards & Haime, 1860)
57		<i>Acropora vaughani</i> Wells, 1954
58		<i>Acropora gracilis</i> Bernard, 1896
59		<i>Acropora listeri</i> Bernard, 1896
60		<i>Astreopora myriophthalma</i> (Lamarck, 1816)
61		<i>Astreopora randlii</i> Lamberts, 1980
62		<i>Astreopora suggesta</i> Wells, 1954
63		<i>Montipora aequituberculata</i> Bernard, 1897
64		<i>Montipora caliculata</i> (Dana, 1846)
65		<i>Montipora capitata</i> Dana, 1846
66		<i>Montipora digitata</i>
67		<i>Montipora foveolata</i> (Dana, 1846)
68		<i>Montipora meandrina</i>
69		<i>Montipora tuberculosa</i> Lamarck, 1816)
70		<i>Montipora turgescens</i>
71		<i>Montipora venosa</i> (Elirenberg, 1834)
72		<i>Montipora verrucosa</i> (Lamarck, 1816)
73		<i>Montipora vietnamensis</i> Veron, 2000 (or <i>M. porites</i> ?)
74	<b>Poritidae</b>	<i>Poritis annae</i> Crossland, 1952
75		<i>Porites cylindrica</i> Dana, 1846
76		<i>Porites evermani</i> Vaughan, 1907
77		<i>Porites monticulosa</i> Dana, 1846
78		<i>Porites rus</i> (Forsk., 1775)
79		<i>Porites vaughani</i> Crossland, 1952
80	<b>Siderasteridae</b>	<i>Coscinaraea columna</i> (Dana, 1846)
81		<i>Coscinaraea crassa</i>
82		<i>Psammocora contigua</i> (Esper, 1797)
83		<i>Psammocora digitala</i> Milne Edwards, Haime, 1851

84		<i>Psammocora explamilata</i> van der Horst, 1922
85		<i>Psammocora haimeana</i> Milne Edwards & Haime, 1851
86		<i>Psammocora profundacella</i> Gardiner, 1898
87		<i>Psammocora superficialis</i> Gardiner, 1898
88		<i>Coeloseris mayeri</i> Vaughan, 1918
89		<i>Gardineroseris planulala</i> Dana, 1846
90		<i>Leploseris explanata</i> Yabe & Sugiyama, 1941
91		<i>Leptoseris harviiensis</i> Vaughan, 1907
92		<i>Leptoseris incrvstans</i>
93		<i>Leploseris mycetoseroides</i> Wells, 1954
94		<i>Leptoseris scabra</i> Vaughan, 1907
95		<i>Leptoseris yabei</i> (Pillai & Scheer, 1976)
96		<i>Pachyseris gemmae</i> Nemenzo, 1955
97		<i>Pachyseris rugosa</i> (Lamarck, 1801)
98		<i>Pachyseris speciosa</i> (Dana, 1846)
99		<i>Pavona bipartita</i> Nemenzo, 1980
100		<i>Pavona cactus</i> (Forsk., 1775)
101		<i>Pavona clavus</i> (Dana, 1846)
102		<i>Pavona decussata</i> (Dana, 1846)
103		<i>Pavona duerdeni</i> Vaughan, 1907
104		<i>Pavona</i> sp "duerdeni-like"
105		<i>Pavona explanulata</i> (Lamarck, 1816)
106		<i>Pavona maldivensis</i>
107		<i>Pavona various</i> Verrill, 1864
108		<i>Pavona venosa</i> (Ehrenberg, 1834)
109	<b>Fungiidae</b>	<i>Ctenactis crassa</i> (Dana, 1846)
110		<i>Ctenaclis echinata</i> (Pallas, 1766)
111		<i>Fungia concinna</i> Verrill, 1864
112		<i>Fungia fungites</i> (Linnaeus, 1758)
113		<i>Fungia granulosa</i> Klunzinger, 1879
114		<i>Fungia horrida</i> Dana, 1846
115		<i>Fungia klunzingeri</i> Doderlein, 1901
116		<i>Fungia moluccensis</i> Horst, 1919
117		<i>Fungia paumotensis</i> Stutchbury, 1833
118		<i>Fungia repanda</i> Dana, 1846
119		<i>Fungia scutaria</i> Lamarck, 1816
120		<i>Herpolitha limax</i> Houttuyn, 1722
121		<i>Lithophyllon manakensis?</i> Veron, 2000
122		<i>Polyphylla talpina</i> Lamarck, 1801
123		<i>Sandalolitha dentate</i> Quelch, 1884
124	<b>Oculinidae</b>	<i>Galaxea acrhelia</i>
125		<i>Galaxea astreata</i> Lamarck, 1816
126		<i>Galaxea fascicularis</i> Linnaeus, 1767
127	<b>Pectinidae</b>	<i>Echinophyllia aspera</i> (Ellis & Solander, -1788)

128		<i>Echinophyllia echinata</i> (Saville-Kent, 1871)
129		<i>Echinophyllia ecklonoides</i> Veron & Pichon, 1979
130		<i>Myceditium elephantotus</i> (Pallas, 1766)
131		<i>Oxypona crassispinosa</i> Nemenzo, 1979
132		<i>Oxypona lacera</i> Verrill, 1864
133		<i>Pectinia alvicornis</i>
134		<i>Pectinia paeoma</i> (Dana, 1846)
135	<b>Mussidae</b>	<i>Acanthastrea echinata</i> (Dana, 1846)
136		<i>Acanthastrea hemprichii</i> (Ehrenberg, 1834)
137		<i>Acanthastrea ishigakiensis</i> Veron, 1990
138		<i>Australomussa rowleyensis</i> Veron, 1985
139		<i>Cynarina lacrynalis</i> (Milne Edwards & Haime, 1848)
140		<i>Lobophyllia hemprichii</i> (Ehrenberg, 1834)
141		<i>Symphyllia agaricia</i> Milne Edwards & Haime, 1849
142		<i>Symphyllia radians</i> Milne Edwards & Haime, 1849
143		<i>Symphyllia recta</i> (Dana, 1846)
144	<b>Merulinidae</b>	<i>Hydnophora exesa</i> (Pallas, 1766)
145		<i>Hydnophora grandis</i> Gardiner, 1904
146		<i>Hydnophora microconos</i> (Lamarck, 1816)
147		<i>Hydnophora pilosa</i> (Veron, 1985)
148		<i>Hydnophora rigida</i> (Dana, 1846)
149		<i>Merulina ampliata</i> (Ellis & Solander, 1786)
150		<i>Merulina scabricula</i> Dana, 1846
151		<i>Scaphophyllia cylindrica</i> Milne Edwards & Haime, 1848
152	<b>Faviidae</b>	<i>Diploastrea heliopora</i> (Lamarck, 1816)
153		<i>Echinopora gemmacea</i> Lamarck, 1816
154		<i>Echinopora hirsutissima</i> Milne Edwards & Haime, 1849
155		<i>Favia pallida</i> (Dana, 1846)
156		<i>Favia rotundata</i> Veron & Pichon, 1977
157		<i>Favia siccligera</i> (Dana, 1846)
158		<i>Favia trunculus</i> Veron, 2000
159		<i>Favites ahdita</i> (Ellis & Solander, 1786)
160		<i>Favites aculicollis</i>
161		<i>Favites halicora</i> (Ehrenberg, 1834)
162		<i>Favites pentagona</i> (Esper, 1794)
163		<i>Goniasirea edwardsi</i> Chevalier, 1971
164		<i>Goniasirea minuta</i>
165		<i>Goniasirea pectinata</i> (Ehrenberg, 1834)
166		<i>Goniasirea reliformis</i> (Lamarck, 1816)
167		<i>Leptastrea purpurea</i> (Dana, 1846)
168		<i>Leptastrea transversa</i> Klunzinger, 1879
169		<i>Leptoria phrygia</i> (Ellis & Solander)
170		<i>Montastrea colemani</i>
171		<i>Montastrea curta</i> (Dana, 1846)

172		<i>Oulastrea crispata</i> (Lamarck, 1816)
173		<i>Oulophyllia laevis</i>
174		<i>Platygyra acuta</i> Veron, 2000
175		<i>Platygyra daedalea</i> (Ellis & Solander, 1986)
176		<i>Platygyra</i> sp "green"
177		<i>Platygyra lamellina</i> (Ehrenberg, 1834)
178		<i>Plesiastrea versipora</i> (Lamarck, 1816)
179	<b>Caryophylliidae</b>	<i>Euphyllia ancora</i> Veron & Pichon, 1979
180		<i>Euphyllia divisia</i> Veron & Pichon, 1979
181		<i>Euphyllia glubrescens</i> (Clamisso & Eysenliardt, 1821)
182		<i>Euphyllia yaeyamaensis</i> (Shirai, 1980)
183		<i>Euphyllia lichentenslcini</i> Milne Edwards & Haime, 1786
184		<i>Pterogyra sinuosa</i> (Dana, 1846)
185	<b>Dendronhylliidae</b>	<i>Tubastrae coccinea</i> Lesson, 1829
186		<i>Tubastrae diaphana</i>
187		<i>Tubastrae micranthus</i> Ehrenberg, 1834
188		<i>Turbinaria mesenterina</i> (Lamarck, 1816)
189		<i>Turbinaria stellulata</i> (Lamarck, 1816)
190	<b>Heliporidae</b>	<i>Heliophora</i> sp I "short"
191	<b>Clavulariidae</b>	<i>Tubipora musica</i> Linnaeus. 1758
192	<b>Milleporidae</b>	<i>Millepora dichotoma</i>
193		<i>Millepora exaesa</i>
194		<i>Millepora intricate</i>
195		<i>Millepora murrayensis</i>
196		<i>Millepora platyphylla</i>
197	<b>Stylasteridae</b>	<i>Stylaster</i> sp1 orange or pink
198		<i>Distichopora violacea</i> (Ellis & Solander, 1788)

**Source:** Pillai, 1972; 1983; Wafar, 1992; Qasim, 1998; Kulkarni, 2000; 2001; Vousden, D. 2001; Turner, *et al*, 2001.