

Faunal Diversity of Andaman and Nicobar Islands, Threats and Conservational Measures

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Introduction

The Andaman and Nicobar archipelago comprises of 572 islands and extending over 800 km (Fig. 1). These islands were once a part of the Asian mainland but got detached some 100 million years ago during the Upper Mesozoic Period due to geological upheaval. The existing groups of islands constitute the physiographic continuation of the mountainous ranges of Naga and Lushai Hills and Arakan Yoma of Burma through Cape Negrais to the Andaman and Nicobar Islands and southeast of Sumatra (Achin Head). The chains of these islands are in fact the camel backs of the submerged mountain ranges projecting above the sea level running north to south between 6°45'N and 13°30'N latitudes and 90°20'E and 93°56'E longitudes. The total area of Andaman and Nicobar is 8249 km².

The Andaman and Nicobar islands can be broadly divided into two groups of islands, namely, the Andaman and the Nicobar. The two groups are separated by the 10° Channel which is about 150 km wide 400 fathoms deep. Average annual temperature varies from 24°C to 28°C. Elevations range from 0 to 732 m at Saddle Peak in North Andaman and 642 m at

Mount Thulier in Great Nicobar Island. The precipitation is slightly higher in Nicobar with an average annual rainfall of 3000 to 3500 mm. The Andaman and Nicobar groups of islands belong to a geosynclinal basin. The sediments of this region have gradually changed their characters, according to tectonic movements, to which they have been subjected to from time to time; as such the rocks are highly folded.

Geography

The Andaman group of islands is made up of North, Middle and South Andaman Islands. There are **105 protected areas (9 National Parks and 96 Wildlife Sanctuaries)** have been established over an area of 1271.12 km² on land and 349.04 km² in surrounding territorial sea. The Rowe Island and Goose Island jointly share the distinction of being smallest sanctuary having 0.01 km² area while Campbell Bay National Park is the largest (425.23 km²) among the all the protected areas in Andaman and Nicobar. The Great Nicobar Island in Nicobar has a Biosphere Reserve. There are two National Parks inside Great Nicobar Biosphere Reserve *viz.*, the Campbell and Galathea. Altogether, protected areas occupy 16.71% of the notified forest area. The Andaman has 12.52% of notified forests within protected areas and Nicobar has 30.23%.

Fauna of Andaman and Nicobar Islands

About 8425 species of fauna, 8464 species are endemic and more than 60% of biodiversity have been reported from marine habitat. The details of the fauna reported from Andaman and Nicobar Islands are presented in Table 1.

The main terrestrial mammals are Long-tailed macaque, Wild boar, Civets, and several species of Bats, Rats and Shrews. From the faunistic point of view, the most interesting feature is the absence of large mammals and the presence of a considerable number of endemics among the inland vertebrates (Ellis *et al.*, 2000).

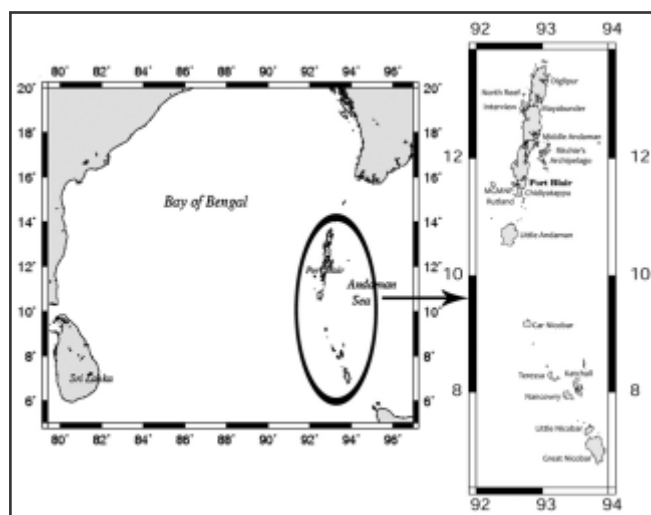


Fig.1 : GIS Map showing Andaman and Nicobar Archipelago

Table 1 : Faunal diversity of Andaman and Nicobar Islands

| Sl. No. | Faunal Group | World | India | A & N Islands | Endemic | % of Endemic |
|---------|----------------------------------|------------------|-----------------|---------------|----------|--------------|
| 1. | Sponges | 5,100 | 519 | 112 | 5 | 7.14 |
| 2. | Helminthes (Flatworm marine) | 400 - | 19 - | 19 - | - - | - - |
| 3. | Corals | 700 | 600 | 600 | - | - |
| 4. | Earthworms | 4,000 | 585 | 21 | 7 | 33.33 |
| 5. | Leeches | 500 | 59 | 10 | - | - |
| 6. | Polychaetes | 8,000 | 428 | 186 | - | - |
| 7. | Arachnids | 120 | 21 | 14 | - | - |
| 8. | Gastrotricha | 2,500 | 88 | 32 | 6 | 18.75 |
| 9. | Chinorincha | 100 | 10 | 4 | 2 | 50.00 |
| 10. | Crustaceans | 24,375 | 2,970 | 607 | 56 | 9.22 |
| 11. | Spiders & Scorpions | 35,810 | 1,352 | 113 | 28 | 45.16 |
| 12. | Centipede | 3,000 | 100 | 17 | - | - |
| 13. | Millipedes | 7,500 | 162 | 5 | - | - |
| 14. | Insects | 86,7391 | 59,353 | 2,274 | 485 | 21.5 |
| 15. | Mollusks | - | - | - | - | - |
| | Land | 15,000 | 950 | 110 | 75 | 68.18 |
| | Freshwater | 8,765 | 284 | 51 | 12 | 23.52 |
| | Marine | 56,235 | 32,751 | 1,422 | 2 | 0.2 |
| | Opisthobranchia | 6,500 | 180 | 180 | - | - |
| 16. | Siphonculates | 202 | 38 | 25 | - | - |
| 17. | Echninoderms | 6,226 | 765 | 430 | 2 | 0.59 |
| 18. | Fishes | 21,723 | 2,546 | 1,484 | 2 | 0.14 |
| 19. | Amphibians | 550 | 219 | 23 | 3 | 16.66 |
| 20. | Reptiles | 5,817 | 456 | 104 | 23 | 25.55 |
| 21. | Aves | 9,026 | 1,232 | 284 | 105 | 36.97 |
| 22. | Mammals | 4,629 | 390 | 62 | 33 | 55.00 |
| | | 11,04,169 | 1,06,115 | 8,425 | 6 | - |

(Source : Sivaperuman, C. and Raghunathan, C. 2012, Fauna of the Protected Areas of Andaman and Nicobar Islands: 1-26.)

The Andaman Horseshoe bat *Rhinolophus cognatus* and Car Nicobar flying fox *Pteropus faunulus*, rats such as *Rattus burrus*, *Rattus palmarum*, and *Rattus pulliventer* and shrews such as the Andaman Spiny Shrew *Crocidura*

hispidus and Nicobar Tree Shrew *Tupaia nicobarica* are among the endemic mammalian species. Endemic subspecies include two wild boar: the Andaman Wild Pig *Sus scrofa andamanensis* and the Nicobar Wild Pig *Sus*

Photographs of some important animals in the protected areas



Macac fascicularis umbrosa



Phelsuma andamanens



Python reticulatus



Lepidochelys olivacea



Dugong dugong



Columba palumboides



Psittacula caniceps



Ducula aenea



Spilornis elgini



Lonchura striata



Ninox obscura



Saxicola torquatus

Photographs of some important animals in the protected areas



Sturnus erythropygius



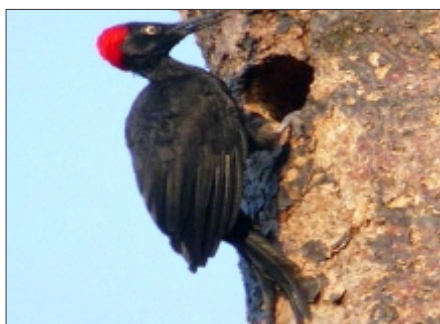
Haliaeetus leucogaster



Irena puella



Chrysococcyx xanthorhynchus



Dryocopus hodgעי



Aerodramus fuciphagus

All photo sources: (<https://www.google.co.in/search?q=fauna+of+andaman+and+nicobar+islands&source>)

scrofa nicobarensis. The only other species of large land mammals, Spotted Deer *Axis axis* and a population of Elephants *Elephas maximus*, were introduced into the region. The spotted deer have proliferated and are now widespread. The elephants, abandoned after the discontinuation of logging operations, have now become feral.

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

The bird diversity of the Andaman and Nicobar Islands is remarkable with a total of 284 species. Of these, 126 are exclusive to the Andamans and 56 to the Nicobars. Birdlife International (Stattersfield *et al.*, 1998) has separately designated the Andaman Islands and the Nicobar Islands as two of the 221 major 'Endemic Bird Areas' of the world. Among the well-known flagship species are the Nicobar Megapode, the Narcondam Hornbill and the Nicobar Serpent-eagle. The Andaman Serpent-eagle, Andaman Crow-pheasant, and the Andaman Tree-pie are some of the other endemic species in the Andaman group.

The Nicobar Sparrow hawk, Nicobar Parakeet and Nicobar Bulbul are among the endemics birds in the Nicobar group. The endemic subspecies include the Andaman Flower pecker *Dicaeum concolor virescens*, large Andaman Parakeet *Psittacula eupatria magnirostris*, Andaman Glossy Starling *Aplonis panayensis tyleri*, Nicobar Ground Thrush *Zoothera citrina albogularis*, Andaman Teal *Anas gibberifrons albogularis*. The other

important species, are Nicobar Pigeon, Andaman Koel, Red-breasted Parakeet, Andaman Hill Myna, Andaman Wood-Pigeon, Andaman Green Imperial Pigeon, Andaman Cuckoo Dove, Pied Imperial Pigeon, Andaman Black Wood-pecker etc.

There is also an extraordinary diversity of corals and reef-associated invertebrates. The genera like *Acropora*, *Protillopora*, *Seriatopora*, *Stylophora*, etc. are abundant. The reefs harbour a rich diversity of sponges, coelenterates, worms, molluscs, echinoderms. Some are

known to possess antibiotic, anti-coagulant and anti-leukaemic properties and they have an enormous potential value in the pharmaceutical industry. Important molluscs include the 'top' and 'turbo' shells, five species of pearl oysters, giant clam *Tridacna* sp., the beautiful pearly nautilus *Nautilus* sp. etc., which are used to make ornaments. Sea cucumbers such as *Holothuria* spp., *Stichopus* spp., *Actinopyga* spp. and *Synapta* spp. are found in the shallow lagoons and have become extremely rare.

Endemic Birds of Andaman and Nicobar Islands

| S.No. | Common Name | Scientific Name | Distribution |
|-------|-------------------------------|------------------------------------|-----------------|
| 1. | Andaman Teal | <i>Anas aJbogularis</i> | Andaman Islands |
| 2. | Andaman Crake | <i>Rallina canningi</i> | Andaman Islands |
| 3. | Andaman Wood-pigeon | <i>Columbo palumboides</i> | Andaman Islands |
| 4. | Andaman Cuckoo-dove | <i>Macropygia rufipennis</i> | Andaman Islands |
| 5. | Andaman Barn-owl | <i>Tyto deroepstorffi</i> | Andaman Islands |
| 6. | Andaman Hawk-owl | <i>Ninox affinis</i> | Andaman Islands |
| 7. | Hume's Hawk-owl | <i>Ninox obscura</i> | Andaman Islands |
| 8. | Andaman Scops-owl | <i>Otus balli</i> | Andaman Islands |
| 9. | Andaman Nigbtjar | <i>Caprinwlgus andamanicus</i> | Andaman Islands |
| 10. | Narcondam Hornbill | <i>Aceros narcondami</i> | Andaman Islands |
| 11. | Andaman Woodpecker | <i>Dryocopus hodgei</i> | Andaman Islands |
| 12. | Andaman Cuckooshrike | <i>Coracina dobsoni</i> | Andaman Islands |
| 13. | Andaman Bulbul | <i>Pycnonotus fuscof lavescens</i> | Andaman Islands |
| 14. | Andaman Shama | <i>Copyschus albiventris</i> | Andaman Islands |
| 15. | Andaman Flower pecker | <i>Dicaeum virescens</i> | Andaman Islands |
| 16. | Andaman White-headed Starling | <i>Stumia erythropygia</i> | Andaman Islands |
| 17. | Andaman Tree pie | <i>Dendrocitta bayleyi</i> | Andaman Islands |
| 18. | Nicobar Sparrowhawk | <i>Accpiter butleri</i> | Nicobar Islands |
| 19. | Great Nicobar Serpent-eagle | <i>Spilornis klossi</i> | Nicobar Islands |
| 20. | Nicobar Megapode | <i>Megapodius nicobariensis</i> | Nicobar Islands |
| 21. | Nicobar Imperial-pigeon | <i>Ducula nicobarica</i> | Nicobar Islands |
| 22. | Nicobar Parakeet | <i>Psittacula caniceps</i> | Nicobar Islands |
| 23. | Nicobar Scops-owl | <i>Otus alius</i> | Nicobar Islands |
| 24. | Nicobar Bulbul | <i>Hypsipetes nicobariensis</i> | Nicobar Islands |
| 25. | Nicobar Jungle-flycatcher | <i>Rhinomyias nicobaricus</i> | Nicobar Islands |

(Source : Rasmussen. P.C., & Anderton J.C., 2005, Birds of South Asia : The Ripley Guide. Vols. 1 &2, Smithsonian and Lynx Editions, Washington, D.C. and Barce1ona)

Birds "Near Endemic" to Andaman Islands

| S. No. | Common Name | Scientific Name |
|--------|----------------------|--|
| 1. | Andaman Green Pigeon | <i>Treron chloropterus</i> |
| 2. | Andaman Coucal | <i>Centropus (sinensis) andamensis</i> |
| 3. | Andaman Drongo | <i>Dicrurus andamanensis</i> |

(Source: Rasmussen P.C., & Anderton J.C. (2005). Birds of South Asia: The Ripley Guide. Vols. 1 & 2, Smithsonian Institution and Lynx Editions, Washington, D.C. and Barcelona)

Birds species introduced to the Andaman & Nicobar Islands

| S. No. | Common Name | Scientific Name | Period | Remarks |
|--------|--------------------|----------------------------------|---------------------|--|
| 1. | Common Crow | <i>Corvus splendens</i> | Between 1862 & 1864 | Introduced to the Andaman Islands by Col.R.C. Tytler for sanitary purposes but failed to survive in the islands. |
| 2. | Common myna | <i>Acridotheres tritis</i> | Around 1867 | Introduced to Ross Island. Has spread to South Andaman. Could competitively displace native species. |
| 3. | Pea fowl | <i>Pavo cristatus</i> | 1868 | Introduced to Ross Island. Wiped out during the period of Japanese occupation. Re-introduced by the Indian Administration |
| 4. | House sparrow | <i>Passer domesticus</i> | 1882 & 1895 | Introduced to Ross Island. Now seen in plenty in South Andaman. Could competitively displace native species. |
| 5. | Grey partridge | <i>Francolinus pondicerianus</i> | 1890 | Now established around Port Blair. |
| 6. | Spotbill duck | <i>Anas poecilorhyncha</i> | 1960 | Escaped during a storm, after being kept captive in a specially built iron-mesh enclosure on Ross Island. Current status not known. |
| 7. | Common quail | <i>Coturnix coturnix</i> | 1961 | Brought from Madras and released in Ross Island. Current status unknown. |
| 8. | Jungle bush-quail | <i>Perdica asiatica</i> | 1961 | -do- |
| 9. | Painted bush quail | <i>Perdica erythrohyncha</i> | 1961 | -do- |
| 10. | Comb duck | <i>Sarkidiornis melanotos</i> | 1961 | Birds obtained from Calcutta released on a lake in Neil Island. Present status not known. |
| 11. | Openbill stork | <i>Anastomus oscitans</i> | 1964 | Introduced from Calcutta to South Andaman for the control of snails on the recommendation of the Lt. Governor of Himachal Pradesh. Failed to establish on the islands. |
| 12. | Domestic fowl | <i>Gallus sp.</i> | Not known | More and more of them are being introduced to meet the demands of an expanding poultry industry. |
| 13. | Domestic duck | <i>Anas sp.</i> | Not known | Not as common as the domestic fowl. |

| S.No. | Common Name | Scientific Name | Period | Remarks |
|-------|-------------|------------------|--------|--|
| 14. | Barn owl | <i>Tyto alba</i> | 1991 | Six pairs were brought to port Blair from Tamil Nadu for release in the oil palm plantation at Hut Bay, to control rats. As a result of protests from environmentalists these owls were sent back to Little Andaman. |

(Source : Prashnath Mohanraj, Veenakumari K.,and A.K. Bandyopadhyay, 1999, Perilous Abiens, Central Agricultural Research Institute, Port Blair)

Birds species in the Andaman & Nicobar Islands included in Schedule 1 (Part III) of the Indian Wildlife (Protection) Act, 1972

| S.N. | Schedule 1 | Common Name | Scientific name |
|------|------------|-----------------------------|---------------------------------------|
| 1. | 1 | Andaman Teal | <i>Anas gibberifrons albogularis</i> |
| 2. | 1B | Andaman Baza | <i>Aviceda sp.</i> |
| 3. | 4A | Hawks | <i>Accipitridae</i> family |
| 4. | 7 | Large Falcon | <i>Falco sp.</i> |
| 5. | 9 | Narcondam Hornbill | <i>Rhyticeros narcondami</i> |
| 6. | 10 | Nicobar Megapode | <i>Megapodius freycinet</i> |
| 7. | 10A | Nicobar Pigeon | <i>Caloenas nicobarica pelewensis</i> |
| 8. | 10B | Osprey or Fish Eating Eagle | <i>Pandium haliaetus</i> |
| 9. | 11 | Common peafowl | <i>Pavo cristatus</i> |
| 10. | 16 | White Bellied Sea Eagle | <i>Haliaetus leucogaster</i> |

(Source : Prashnath Mohanraj, Veenakumari K.,and A.K. Bandyopadhyay, 1999, Perilous Abiens, Central Agricultural Research Institute, Port Blair)

Threat assessment

There are several direct threats to ecosystem function and species diversity in Andaman and Nicobar, including:

- Agricultural expansion, Timber exploitation, Uncontrolled livestock grazing;
- Fuel wood collection/charcoal production, Hunting, Corporate and small-scale mining;
- Ornamental plant and wildlife collection and Introduction of exotic species.

Estimates of forest destruction indicate that as much as 80% of Andaman and Nicobar's original forest cover has disappeared in the 1,500-2,000 years since the arrival of humans.

Agricultural expansion

In Andaman and Nicobar, the production of paddy, coconut, arecanut, oilseeds and spices accounts for about 80% of the national economy, and this exerts continual pressure on remaining forested areas. Due to high pressure of agriculture unfortunately, the average fallow time in much of Andaman and Nicobar is far less than that required to regenerate nutrients, and this results in a net loss of both original vegetation and arable land.

Uncontrolled livestock grazing

Cattle grazing affect natural forest ecosystems through the clearance of vegetation, the annual burning to encourage new grass growth, and overgrazing in

general. These problems are concentrated in the west and south, where cattle are the principal source of wealth.

Fuel wood collection/ charcoal production

Every year, large areas of natural forest in Andaman and Nicobar Islands are destroyed to provide fuel wood and charcoal for cooking. This problem is especially severe in the spiny desert forests of the south, where roadside charcoal stands are a common sight and help supply the needs of people living in distant towns.

Hunting and trade

Meat hunting is a major threat in Andaman and Nicobar, especially for a number of the larger species as well as smaller, variety of birds are hunted as well. Overall, hunting should probably be considered a greater threat than the wildlife trade, since it affects many of the larger, more endangered species.

Corporate and small-scale mining

Andaman and Nicobar are rich in valuable minerals and gemstones. As a result, it has attracted foreign attention for such valuable resources as titanium, which is mined on a commercial scale. It has also attracted itinerant miners in search of gold, sapphire and other precious stones.

Ornamental plants and wildlife collection

The unique biota of Andaman and Nicobar attracts an illicit and illegal trade in native plants and animals. Among vertebrates, reptiles and amphibians are the most heavily poached, and the scale of this trade is estimated at millions of dollars annually.

Introduction of exotic species

The introduction of invasive plants and animals is by far the most serious threat to native wildlife in the smaller islands of this hotspot. Introduced feral animals and game species have been particularly detrimental to island flora that had evolved no defenses against these species. Wet forests seem to be more susceptible than dry forests to invasion and degradation by exotic species.

In addition to the proximate threats described here, there are a number of indirect, but equally serious, threats to ecosystem functions and species diversity,

especially in Madagascar, the principal focus of this profile. These include:

- Policy-making practices, governance and rule of law, training and capacity.
- Limited biodiversity information, disruptive effects of forest fragmentation and lack of conservation benefits to local communities.

Legal measures for protection of biodiversity of Andaman and Nicobar islands

The rich marine biodiversity of Andaman and Nicobar Islands has been accorded protection under the following legal framework:

Regulation of Fishing by Foreign Vessels Act, 1981: Within India's maritime zone, fishing by foreign vessels is regulated by Regulation of Fishing by Foreign Vessels Act, 1981, which prohibits fishing in country's territorial waters as well as carrying of any explosives, poisonous or noxious substance, which can be used for illegal fishing, dynamiting and poisoning.

Coastal Regulation Zone, 1991/ Island Protection Zone, 2011 Notification: The coastal areas and ecosystems have been provided further protection against internal threats under the Central Government Notification of 1991, declaring a Coastal Regulation Zone (CRZ) under Section 3(1) & Section 3(2)(v) of the Environment (Protection) Act, 1986 (now IPZ as per Notification dated 6th January 2011). Under CRZ/IPZ, ecologically important as well as fragile ecosystems, such as mangroves, corals/coral reefs, areas close to breeding and spawning grounds of fish and other marine life, along with National Parks, Marine National Parks, Sanctuaries, Reserved Forests and wildlife habitats, have been put under the Island Coastal Regulation Zone-I (ICRZ-I), which accords the highest level of protection against rampant unplanned development and resultant degradation.

Wild Life (Protection) Act, 1972: Some of the important endangered marine animals have been accorded special protection under the Wild Life (Protection) Act, 1972 (WPA) wherever they occur in Indian territories. These include all species of Cetaceans such as whales and dolphins, dugongs, reptiles such as Salt water or Estuarine crocodile and sea turtles such as Green Sea, Hawksbill, Leatherback, Olive Ridley turtles, hard corals, some fishes specially

shark species, sea cucumbers, certain molluscs etc. Other marine animals get full protection within the Protected Areas (PAs), such as National Parks and Sanctuaries, which are constituted under the WPA.

Establishment of marine protected areas: To make the process of creation of PAs in marine areas easier, an amendment was made in the WPA in 1991 under section 26A. According to this section, any important or critical wildlife area occurring within the territorial waters of India can be declared as a sanctuary in consultation with the Chief Naval Hydrographer of the Central Government.

International Conventions: India is also a signatory to various international conventions related to protection of fauna and flora, such as Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Ramsar Convention, United Nations Convention on Law of Sea (UNCLOS), Convention on Biological Diversity (CBD), Convention on the Conservation of Migratory Species of Wild Animals (CMS), etc.

As it is clear, sufficient legal measures exist both at the national and international level which can provide effective protection to the endangered marine animals and critical ecosystems of Andaman and Nicobar Islands. However, still there are several tricky challenges specially the issue of poaching of the marine species which need immediate redressal.

Management of biodiversity in Andaman and Nicobar Islands

To protect and conserve the fauna and flora of these islands, many Protected Areas, both terrestrial and marine, have been constituted under the WPA. At present there are 9 National Parks and 96 sanctuaries which have been established in these islands.

Administrative set up for management of Biodiversity

The management of the PAs in Andaman and Nicobar Islands is mainly the responsibility of the Wildlife Wing of the Environment and Forest Department. However, other Departments under the Andaman & Nicobar Islands administration such as the Coastal Police and Coast Guards also help in the protection of the marine resources of the islands. Additionally, a Coordination Committee has been

constituted which acts as a nodal body to monitor the issues of poaching and illegal exploitation of the biodiversity of the region. Details of the set-up and steps taken by the various Departments involved in the management of biodiversity in Andaman and Nicobar Islands are as described below:

Coordination committee

As part of the efforts to control poaching, the Andaman and Nicobar Island Administration has constituted a full time Coordination Committee which has a toll free helpline number 1093. The said Coordination Committee has representatives from Intelligence Bureau, Forest Department, Coast Guard, Civil Society Organizations, etc. This Committee acts as a nodal body to monitor and ensure coordinated action for protection of the biodiversity of the Andaman and Nicobar Islands.

Forest department

The Wildlife Wing of the Environment and Forests Department of A & N Administration is responsible for protecting and managing the PAs. The present administrative set up of the wildlife wing is **headed by a Chief Wildlife Warden (CWLW)** who is of the rank of Principal Chief Conservator of Forests with Headquarters at Port Blair. Under the CWLW there are **four field Divisions**, headed by a DFO/DCF rank officer with Headquarters at Port Blair, Mayabunder in Middle Andaman and Campbell Bay at Great Nicobar Island respectively. The fourth division has recently been created with its Head Quarters at Havelock close to the Rani Jhansi Marine National Park in the Ritchie's Archipelago. (Committee Constituted To Holistically Address The Issue Of Poaching In The Andaman And Nicobar Islands, Government Of India Ministry Of Environment And Forests September 2011).

Integrating local groups and individuals in the management of protected areas and reserves

Throughout the hotspot, and especially in Andaman and Nicobar, increased financial and technical support for NGOs is needed to enhance the management of existing parks and reserves. Approximately one-third (15) of these protected areas currently have no management authority assigned to them, which limits their contribution to biodiversity conservation.

Private-sector conservation initiatives

Private-sector conservation initiatives can have a catalytic effect in a number of key areas including nature tourism, plantation farming and carbon sequestration. Small nature tourism programs have been established in a number of local communities adjacent to parks, reserves and proposed protected areas.

Biodiversity conservation and management training

Training in the techniques of biodiversity conservation is required in order to strengthen the scientific and NGO communities in scar. This should include support for programs based at national universities.

Awareness and advocacy mechanism

Awareness and advocacy efforts are needed to improve public involvement in conservation, encourage sound legislative frameworks, and to promote reconciliation of Andaman and Nicobar's international

biological importance with its pressing needs for economic growth. NGO leaders can play an important role in this process by involving themselves in promotions that highlight the importance of biodiversity.

Creating a participatory monitoring and coordination network

In order for the strategy, as laid out in this profile, to be implemented successfully, an overall monitoring and coordination mechanism is required. It is envisioned that the mechanism, or network, will consist of a core alliance of organizations having significant technical capacity and strong program history in the region. It should also include some form of advisory panel of top scientists to ensure that efforts focus on identified priorities for the region (Ecosystem Profile Madagascar Ecosystem of the Madagascar & Indian Ocean Islands Biodiversity Hotspot Final Version December 14, 2000)

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