

A study on the ecology, status and conservation perspectives of certain rare endemic avifauna of the Andaman & Nicobar Islands

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FINAL REPORT

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Cover photo : Main - Nicobar Megapode Megapodius nicobariensis

Top inset - Narcondam Hornbill Aceros narcondami

Bottom inset - Andaman Teal Anas gibberifrons albogularis

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Executive Summary & Recommendations

Introduction

Island ecosystems with their highly limited resources are vulnerable to any disturbance and species become threatened much faster than those in the mainland. Andaman & Nicobar Islands form a major group of oceanic islands in the Bay of Bengal, India with a total coast line of about 1962 km. The entire island group covers 8,249 km²; the Andaman group has more than 325 islands (21 inhabited) covering 6,408 km² and the Nicobar group with over 24 islands (13 inhabited) has an area of 1,841 km². Vegetation of these islands consists mainly of evergreen, littoral and mangrove forests. The latest report on the status of the flora by Lakshminarasimhan and Rao (1996) shows 1598 taxa of angiosperms including 267 endemics. While 26% of the total species are common to both the Andaman and Nicobar islands, 47% occur in Andamans and the rest in Nicobar alone.

Andaman and Nicobar Islands have a varied and rich fauna. Although there have been several studies on the fauna of the Andaman & Nicobar Islands, many species are yet to be catalogued and more species are being added to the list every year. The recent list by Zoological Survey of India shows a total of 5988 species with more than 9% being endemic. Of the 270 species and subspecies of avifauna recorded from the Andaman and Nicobar islands, 106 are endemic. This high proportion of endemics (39%) is due to a high number of endemic subspecies. Of the endemic species and subspecies, 81 (or 76%) are subspecies of species found on neighbouring mainlands. While the Andaman and Nicobar Islands account for only 0.2% of the landmass of South Asia, they have 12% of the endemic avifauna of the region, thus making the islands a high priority area in the conservation of India's avifauna. However, there has been no systematic effort to assess the status of many such species or to study the ecology.

Conservation problems in general in the Andaman & Nicobar Islands have been discussed such as the manifold increase of human population, especially of the mainlanders, the subsequent changes in land use, hunting or poaching, logging, and introduction of exotics.

Having realized the threats to the island ecosystem and the urgency of systematic studies on the population, distribution and ecology of the rare endemic birds of the Andaman Nicobar Islands for their conservation, this project was taken up with the following **objectives**:



- assess the status of endemic avifauna in the Andaman and Nicobar Islands and to identify
 the taxa which are rare, threatened or endangered.
- 2. study the ecology of the Nicobar Megapode Megapodius nicobariensis, Narcondam Hornbill Aceros narcondami and Andaman Teal Anas gibberifrons albogularis, and
- prepare a conservation management plan for the rare endemic avifauna of the Andaman & Nicobar Islands.

Avifauna of the Andaman Islands and their conservation

The Andaman Islands are divided into South (3990 km²), Middle (1070 km²), and North Andaman (1348 km²). Little Andaman (731.6 km²), though administratively part of South Andaman lies separated far apart by the Duncan Passage. The Andaman group of islands has a hot, humid and uniform tropical coastal climate and vegetation is mostly evergreen forests and mangrove.

Representative areas of different habitats of the Andaman Islands were selected and surveyed seasonally. About 62 localities or sites were covered in the four main areas, namely North, Middle, South, and Little Andaman. Approximate area of the forests and wetlands (in km²) surveyed in each of the above places was 75, 39, 112, and 31 respectively. The survey was conducted during 1992-93 and 1995 to 98 covering each season at least twice. The endemic birds were given more emphasis, especially the Andaman Teal.

One hundred and sixty seven species (including subspecies) were observed during these surveys (Appendix III). A total of 214 species and subspecies of birds including 63 endemics have been recorded earlier from Andamans. Our recent surveys have added 12 more to the list of which two, namely the Blue Rock Pigeon and Indian Drongo-cuckoo were earlier recorded from the Nicobars and the rest were new to the Andaman and Nicobar islands. The new species recorded are the Indian Shag, Grey Heron, Bittern, Oystercatcher, Marsh Sandpiper, Ruff, Dunlin, Whiskered Tern, Great Eared Nightjar, and Orange-headed Ground Thrush.

Andaman islands form one of the 218 endemic bird areas of the world with twelve endemic bird species, four of which occur also in the Nicobar islands; two of the twelve are threatened and 10 near-threatened. Seven species of endemics were very common. These were the Green Imperial Pigeon, Redbreasted Parakeet, Blacknaped Oriole, Racket-tailed Drongo, Fairy Blue Bird, Glossy Stare, and Redwhiskered Bulbul of which the last two occur also in Nicobar. Twenty species were rare considering their global status or their sightings during the study, of which nine were very rare.

The Andaman islands have 98 protected areas covering 1053.6 km² which is 16.4% of the total area. This seems to be adequate as 10% of the area is the minimum suggested for protecting biodiversity. However, the extent of protected area is much less in the Middle Andaman and hence, proposes upgradation of some of the reserve forests and mangroves, especially the habitat of the endangered Andaman Crake.

Rare birds of the Andaman Islands

S.No.	Common name	Scientific name
1.	Andaman Teal ¹	Anas gibberifrons albogularis
2.	Andaman Blackcrested Baza ¹	Aviceda leuphotes andamanica
3.	Andaman Dark Serpent Eagle*	Spilornis elgini
4.	Andaman Bluebreasted Banded Rail ¹	Rallus striatus obscurior
5.	Andaman Banded Crake* 1	Rallina canningi
6.	Andaman Wood Pigeon**	Columba palumboides
7.	Andaman Cuckoo - Dove**	Macropygia rufipennis
8.	Nicobar Pigeon\$	Caloenus nicobarica
9.	Andaman Crow - Pheasant*	Centropus (sinensis) andamanensis
10.	Andaman Scops Owl*	Otus balli
11.	Andaman Hawk-Owl** 1	Ninox affinis
12.	Great Eared Nightjar\$1	Eurostopodus macrotis
13.	Andaman Blue-eared Kingfisher	Alcedo meninting rufigastra
14.	Andaman Ruddy Kingfisher ¹	Halcyon coromanda mizorhina
15.	Narcondam Hornbill	Rhyticeros (Aceros) narcondami
16.	Andaman Black Woodpecker*	Dryocopus hodgei
17.	Andaman Drongo*	Dicrurus andamanensis
18.	Andaman Whiteheaded Myna (Starling)**	Sternus erythropygius
19.	Andaman Tree Pie*	Dendrocitta bayleyi
20.	Andaman Palefooted Bush Warbler 1	Cettia pallidipes

* Species endemics, in bold globally threatened and others near-threatened; 1 very rare ** Occurring also in Nicobar; \$ Birds non-endemic to Andaman & Nicobar Islands

Importance of detailed information on the status, habitat requirements, and other aspects of the biology of the species is well known. Although there are four species which are very rare, only two species could be studied to a certain extent; results of these studies on the Narcondam Hornbill and Andaman Teal are presented in separate sections along with specific recommendations. Short accounts on the two other species which require immediate attention, namely the Andaman Crake and Andaman Hawk-Owl are also given.

Endemic avifauna of the Nicobar Islands and their conservation

The Nicobar Islands can be subdivided into three distinct subgroups. To the south, the Great Nicobar group consists of two islands over 100 km² in area, nine islets of less than 5 km², and a few rocks. The Nancowry group (middle Nicobar islands), 58 km north of the Great Nicobar group, consists of three islands larger than 100 km², two of 36 and 67 km², three less than 17 km², two small islets and a few rocks. The northernmost subgroup, comprising Batti Malv and Car Nicobar, is 88 km north of the Nancowry group. In the Great Nicobar group, all islands are completely forested. A small proportion of the coast of the larger islands is mangrove. The Nancowry group of islands have grasslands, forests and mangrove.

Four islands in the Nicobar group have areas protected as wildlife preserves, and most islands are tribal reserves. Tillanchong, Batti Malv and Megapode Island, all uninhabited, are Wildlife Sanctuaries. Great Nicobar is a Biosphere Reserve (885 km²), whose two core areas are National Parks (536 km²).



Field data were collected over 274 days between 1992 and 1995 in three field surveys. Details of the sightings on individual islands are given, the IUCN criteria for assigning threat status have been applied to each species. Loss of habitat (mainly conversion to coconut plantation, human habitation and use) was estimated using existing land records and substantiated by visual evaluations.

Of the 51 endemic species and subspecies found in the Nicobar islands, five species (with three subspecies) are endemic to the Nicobar islands, seven subspecies (of four species endemic to the Andaman & Nicobar islands) are endemic to the Nicobar islands, 24 are endemic subspecies of species found on neighbouring mainlands and 12 are subspecies endemic to the Andaman and Nicobar islands.

Of the 51 species and subspecies of avifauna endemic to the Nicobar islands, seven are threatened (endangered 2, vulnerable 5), 12 are near threatened, seven are data deficient, 23 are of less concern, and two abundant (Table 4.4). Thus, about 13% of the endemic species and subspecies present on the Nicobar islands are threatened (if only full species endemics to the Andaman and Nicobar islands are considered, then 37.5% are threatened). This is higher than global proportions, where only 11% of the world's avifauna (at the species level) are threatened. However, the latest list (prepared for the Threatened Birds of Asia by BLI) shows only four species, namely Nicobar Serpent Eagle, Nicobar Sparrow-Hawk, Nicobar Megapode and Nicobar Bulbul as globally threatened.

Important islands for the development of protected areas were identified by a hierarchical classification based on the degree of endemism, the number of endemics and the number of threatened endemics in an island subgroup. The distribution of the endemic avifauna indicates that there are three distinct subsets of the Nicobar islands which are found in the three island clusters, Car Nicobar, Nancowry and Great Nicobar. Each subgroup has its own distinct avifauna while sharing some taxa with the other subgroups. The avifauna of the Nancowry subgroup shows a marginally greater affinity to that of the Great Nicobar subgroup than it does to that of Car Nicobar, while the avifauna of both Great Nicobar and Car Nicobar subgroups are relatively dissimilar.

Thus, the Nancowry and the Great Nicobar subgroups can be considered as priority subgroups as they not only have the maximum number of endemics, but have exclusive endemic species as well. Although the Great Nicobar subgroup has apparently adequate protected area to prevent loss of species, the design of the protected area network is inadequate for the protection of endemic birds and hence, a redesigning is proposed. The proposed redesigned Great Nicobar Biosphere Reserve consists of a single core area on Great Nicobar, that merges the two existing ones and includes the Southern tip of the Island, and another core area on Little Nicobar. The proposed Nancowry Biosphere Reserve consists of core areas on Camorta, Katchall and Nancowry. Tillanchong, the only uninhabited island in the subgroup, and already a Wildlife Sanctuary, can be a fourth core area. The buffer zone of both Biosphere reserves is to cover all inhabited areas surrounding the core areas, and include all islets and other islands in the respective sub-groups.

Narcondam Hornbill

The Narcondam Hornbill *Aceros narcondami* shows the greatest degree of endemicity with a very small range of distribution in the Narcondam Island of 6.82 km² in North Andaman. Thus the Narcondam Hornbill is a high priority species for avian conservation in India.

The study on the Narcondam Hornbill was conducted between 26 February and 2 June 1998. Population of the Narcondam Hornbill was estimated following the open width line transect method using two transects, measuring 865 and 620 m. Twenty five variable width circular plots were also used at various locations to assess evenness in hornbill distribution. The age of hornbills was determined whenever possible by counting the number of rings on the casque.

Nests were located either by locating middens below nests, or by listening out for calling chicks and females. Data collected on nest site characteristics included the aspect and slope of the site, vegetation characteristics surrounding the nest tree, details of the nest and nest tree. The density of potential nest holes was determined along the two line transects.

Food of the hornbills was assessed by periodic collection of seeds in the middens below 13 nests. Eight nests were also observed directly for a total of 7826 minutes for feeding and other activities.

Population and nesting

Population of the Narcondam Hornbill is somewhere between 330 and 360 birds, showing a decline from the 400 in 1972. In all, 17 nests were located and studied. The estimated breeding population is about 46% to 53% of the total population, indicating that it is not a growing population. There were 200 to 250 possible nesting cavities per km² on Narcondam, indicating that lack of nesting space was not a regulating factor.

Breeding birds were above four years and males were older than the females. Younger non-breeding birds were in flocks and located mainly above 300m above msl. The majority of nests were found at the lower reaches of the slopes of the hill, and as much as 60% of the nests found were below 100m in altitude. In all, seven species of trees were used for nesting *Tetrameles insignis* (4 nests), an unidentified species (4 nests), *Canarium euphyllum* (2 nests), *Ficus* spp. (2 nests) and two unidentified species (1 nest each). The nest height ranged from 1.8 to 27 m (mean = 13.3 sd 6.1), with the majority (62.5%) occurring between 10 and 20 m. The girth at breast height of the nest trees ranged between 1.55 m and 11 m (mean 3.83, sd 2.67). Cavities in large branches were used equally to cavities in the tree trunk. Amongst branches, half of the nests were in broken branches. Most nests (14) were within the canopy, three of which bordered the bottom of the canopy and two the top. Two nests were below the canopy.

Food

The Narcondam Hornbill was observed feeding on both a wide variety of fruits and animal matter that included mantids, spiders, cicada (?), ground crab, and a lizard (skink?). Fruits

were segregated into two, those which had identifiable seeds, and those like ficus where the seeds were minute and not distinguishable. There are 13 species of ficus on Narcondam, and this forms a significant proportion of the Narcondam Hornbill's diet. Ficus has been excluded from the following account as its seeds were too small to collect.

18777 seeds were collected from below 13 nests, which were of >33 species. (only 11 of which have been identified at least to family). 75% of the seeds collected belonged to just three species. Myristicacea accounting for 29%, followed by *Sterculia rubiginiosa* (25%), and *Caryota mitis* (24%)). A further eight species accounted for between 1 and 5%, seven species accounted for between 0.1 and 1%, and 15 species accounted for less than 0.1% of the total seeds collected.

The Hornbill is quite opportunistic in its diet. The number of species provisioned at various nests varied, with some nests having over 25 species while others had under 20 species. The proportion of different species provided at different nests varied. However, the rate of visits to the nest and the mean regurgitation per visit did not differ significantly between nests. The other species that have been identified in the diet of the Narcondam Hornbill include *Diospyros* sp., *Sideroxylon longipetiolatum*, *Myristica* spp., *Sapindus* sp., *Terminalia* sp. Hussain (1984) lists *Anamrita cocculus*, *Capparis seiara*, *C. tenera* var. *latifolia*, *Garuga pinnata*, *Amoora rohituka*, *Terminalia catappa* and *Ixora brunniscens* as food plants of this species. Detailed studies on this species and Narcondam island need to be done in the non-breeding season. Long-term seasonal studies for monitoring are also essential.

Threats and Conservation measures

In 1976, the police personnel introduced two pairs of goats to Narcondam Island. Over the years the number of domestic goats that are maintained in the camp had at one time crossed over 400 animals, and there was a sizeable feral goat population. Hence, some of the goats were removed in early 1990s as per the directive from the MoEF. Today, there are over 135 - 150 goats being maintained in the camp, and over 200 feral. The goats on Narcondam might have caused a total loss of regeneration; there is virtually no herb and shrub layer, and more importantly no saplings of trees, thereby seriously threatening the species and the island itself. Trees are also felled for firewood. Hunting of the Narcondam Hornbill and pigeons is a common occurrence.

Hence, the following recommendations are given:

- All goats must be removed from Narcondam immediately. The removal must be supervised by a DCF / ACF of the A & N Forest Department, so that total complicity is assured.
- Hunting of the Narcondam Hornbill should be stopped although it could be difficult and slow as it involves the ethics of the individuals involved. This does not warrant the creation of a wildlife outpost as an increase in the human population on Narcondam is detrimental.
- Directives need to be issued to the LOP personnel that live trees should not be cut. Alternately, LPG must be provided to run the kitchen at the LOP camp on Narcondam.

Andaman Teal

The Andaman Teal Anas gibberifrons albogularis is the only threatened and endemic species among the 49 Anatidae recorded in India, except the Pinkheaded Duck Rhodonessa caryophyllacea which is believed to be almost extinct. The Andaman Teal was considered a priority species requiring immediate attention and conservation action, with the report of an alarming rate of decline during the 19th and 20th centuries.

The present study deals with the population, distribution, habitat assessment, feeding and breeding. Studies on the population and distribution were done during 1992-94 and 1995-98 while intensive studies on ecology were during 1996-98 at Mohanpur regularly and at Hanspuri seasonally.

The methods followed were:

- Survey of the Andamn Teal was done by visiting the wetlands and counting the birds periodically in the Island and seasonally in most of the probable locations.
- 2. Behavioural observations were made following focal animal and scan sampling.
- Feeding and food were studied through direct observation whenever possible and also by analyzing faecal matter.
- Breeding studies were conducted by direct observation; nests were located searching physically in the probable areas and by following birds
- 5. Habitat details were recorded. Besides sampling the vegetation cover at the sampling stations, general vegetation in the area was studied by sampling along four transects laid across the wetland at Mohanpur and Hanspuri.
- Availability of food was assessed by sampling vegetation and invertebrates in the water and sediment using standard methods. In order to test the factors determining habitat selection, food availability was analyzed in both the feeding and non-feeding areas.
- 7. Water quality was also studied twice a month while sampling food abundance from the feeding and non-feeding areas looking into the major parameters such as dissolved Oxygen, Carbon dioxide, alkalinity, turbidity following standard methods.

Population and Distribution

Population of the Andaman Teal is estimated to be between 500 and 600. The numbers fluctuated at all locations and the maximum number sighted was around 580. This teal inhabited inland or coastal wetlands, ponds, lakes, marshes or swamps. The major habitats were found in the South Andaman, namely Dhaninala (Rutland), Redskin, Katakatchang, Sippighat-Bimblitang, Jackson Creek (Little Andaman) and in North Andaman, namely North Reef, Interview, Hanspuri and Mohanpur.

Habitat selection

During this study, 77 species of aquatic macrophytes were observed in the teal areas including three species of Pterydophytes. Major plants recorded at Mohanpur and Hanspuri were emergent or amphibious such as *Phragmites karka, scirpus* sp., *Eleocharis* sp, *Ipomoea aquatica* and the fern *Acrostichum* sp. Towards the open areas floating and submerged plants such as *Nymphaea* and *Najas* were observed.



The feeding areas were significantly different in having about 45% vegetation cover compared to the non-feeding areas having only about 8% in summer, whereas during breeding (autumn) they were feeding among reeds, *Phragmites karka* and *Scirpus* sp.with thicker cover than in the non-feeding areas. Moorhens were the only birds seen near the teals using the same habitat in most of the months, although 12 species of birds including the Whistling Teal, egrets and herons were found in the same wetland. Vegetation cover had strong correlation with depth and salinity.

The Andaman Teal preferred sparse vegetation at a depth of 20-50cm for feeding as observed in the case of most of the dabbling ducks. Common Teal, Gadwall and Pintail used very similar habitat with regard to vegetation and water in Bharatpur. Major groups of macro invertebrates in the feeding and non-feeding areas were Mollusca, Crustacea and insects (Coleoptera, Hemiptera, Odonata, Diptera). Fishes were also collected in the samples, mainly small fish or fingerlings. Molluscs were maximum in summer March-April and post-monsoon September to November. There was significantly higher abundance of invertebrates in the water and soil in the feeding areas compared to non-feeding areas (Anova).

Discriminant function analysis showed insects and molluscs in the soil as crucial factors deciding the feeding area of the Andaman Teal explaining 100% variance.

Food and foraging

Molluscs and arthropods formed the major food of the Andaman Teal. There was significant seasonal variation in food with very high proportion of animal food (88%) in summer. Although plant matter was less, it was comparatively higher during monsoon (<50%) than in summer (9%) depending on the availability and requirement of the species. The Andaman Teal used four methods for feeding, namely up-ending, neck-submerged, bill-submerged and picking from surface, the first three being used more often. There was significant variation in up-ending used in different seasons (Anova, p< 0.005). This is mainly correlated with the water depth.

Activity-time budget

Activities of the Andaman Teal were clumped into four major types, namely foraging, resting, flight maintenance (bathing, preening etc) and agonistic (such as fighting, chasing, and alarm). Resting was its main activity during the day. Percentage of birds found foraging during different daylight hours showed peak feeding in the morning (0500 to 0800 h) and evening (1600 to 1800 h). They are found to be feeding at night as done by many other ducks. Variation in the time spent for feeding was significant between the breeding and non-breeding seasons, especially at the beginning of breeding in July 1997 when chasing and other agonistic activities were more.

Breeding

Although the Andaman Teal is a rare and endangered endemic waterfowl, there was no information available on its breeding biology except for the record by Ali and Ripley (1987) and of a nest by Osmaston (1906).

Nesting

Three areas in the North Andaman, namely Mohanpur, Haratikri (near Mohanpur, Mayabunder) and Hanspuri had nests of the Andaman Teal which were studied intensively. Surveys during the breeding season could bring out a few more areas in South Andaman with nests or nesting signs; these were Katakatchang (between Bambooflat and Whimberlygunj), Sippighat - Bimlitang (near Port Blair), Redskin (near Wandoor and in the Mahatma Gandhi Marine National Park), Dhaninala (Rutland island). In Little Andaman also two locations, namely 'Km 2' (near HutBay) and Jackson Creek area had nesting birds. Nests of the Andaman Teal were found on emergent vegetation in a flooded wetland. The nesting habitat had 20 to 50 cm of water mainly brackish being located in the coastal area (50 to 100 m from the hightide line). All these wetlands had a natural or man-made bund for collecting rain water which reduced the salinity and hence promoted the growth of grasses and sedges such as Phragmites karka, Eleocharis spp., Scirpus spp. and ferns such as Acrostichum which were used for constructing nests. In many places the areas adjacent to the wetland was used for cultivating paddy. At Mohanpur one nest was on paddy nearby the pond with birds nesting on Phragmites karka. At Hut Bay also one nest was on tall paddy in a deeper wetland. At Mohanpur and Hanspuri, ten nests were on Phragmites karka and in other areas on Eleocharis spp., Scirpus spp. and Acrostichum sp. The nests, although on P. karka, had the support of Acrostichum in many cases. The nest-site was near the edge of a reed patch, 20-50 cm inside from an open water area.

The nest was a platform of grass or reed mat (made by folding the grass or reed) with a slight central depression lined by fine grass supported by stems of reeds and aquatic fern. No nest was found in tree holes as recorded by Osmaston (1906) which is reported by Ali and Ripley (1987). Altogether 11 nests were located in three areas, five at Mohanpur, six at Hanspuri; one at Haratikri and one more at Hanspuri were noted but details could not be recorded. Breeding of this Teal was observed in 1997 and 98. Nesting season extended from July to October with peak laying in August or October, mainly depending on the southwest monsoon.

The number of nests observed in the two study areas also varied in the two years. At Haspuri observations were not done in 1997 as intensively as at Mohanpur. At Hanspuri, in 1998, only one pair nested early (August) while four nested in October when the wetland was fully flooded. At Mohanpur only one pair nested because of the reduction in the flooded area mainly because the bund between the wetland and the mangrove creek had partly broken and rainwater was flowing out. In 1997 peak laying was during August - September when monsoon was during June - July, whereas it was in October in 1998 when peak monsoon was in September. At Hanspuri one pair had four chicks in September 1998 while two pairs were observed courting and mating. In many aquatic birds such as ducks, teals, jacanas, and storks nesting starts during monsoon and laying eggs after peak monsoon. In the case of ducks, teals and rallids which nested on the emergent or floating vegetation at Bharatpur egg-laying was mostly after the water level was stabilized (Sridharan 1989, Vijayan 1991). This helped in selecting suitable nesting sites and escaping from the nest being flooded and the eggs lost.

Clutch, incubation and nesting success

Seven to ten eggs were laid in a nest with a mean of 8.2 at Mohanpur and 8.7 at Hanspuri. No double brood was noticed. Incubation period was 22 to 26 days. The number of eggs hatched

per clutch was 7 in both the areas. The nesting success was 92% during 1997 and 78% in 1998 with a mean of 85%. The parents and the chicks moved off into thick vegetation cover in the nearby area and came out to the open water with sparse vegetation only for a very short period during dawn and dusk. Hence, survival of the chicks could not be monitored. This might be because of the availability of food for the ducklings (King & Wrubleski 1998) and also as an adaptation to avoid natural predation and poaching by human beings at this vulnerable stage.

Conservation problems

Since this species has a small population (<2500 mature individuals) and small range (extent of occurrence <5000 km²), this should be considered as endangered according to the revised criteria specified for the IUCN threatened categories suggested by Mace and Stuart (1994). The subspecies relatives of this teal is also found in islands, mainly small populations except that in Australia and New Zealand; one subspecies in the Rennell Island is believed to be extinct. Hence, this is suggested to be included in the globally threatened category.

South Andaman holds the majority of the population. In many areas flocks in hundreds used to be sighted during the middle of the 20th century. Such a situation of alarming decrease in their numbers was evident in the whole of Andaman where development activities such as construction of roads and buildings, plantations, and agriculture are on the increase. Habitat loss and hunting are the major causes for the decline of this teal.

Locating and mapping all potential wetland habitats is highly desirable for the management of this species and the sustainable utilization of the wetland resources. Movement patterns of this species needs to be studied by marking the birds in order to estimate their population. Estimating the breeding population is also essential, although it is extremely difficult to travel to all outlying islands during monsoon.

Site specific recommendations are given below which will help the Andaman forest department and administration to take necessary measures for the conservation of the rare endemic avifauna of the Andaman islands, especially the Andaman Teal.

Recommendations

- Dhaninala in Rutland Island where the maximum population of the teal was found needs
 to be protected either including in the Mahatma Gandhi Marine National Park or as a
 separate Sanctuary.
- John Lawrence and Henry Lawrence islands although included in the recently declared Jhansi Rani Marine National Park, protection measures have to be implemented.
- 3. Jackson Creek in Little Andaman also needs more protection
- 4. Protection measures need to be taken up in other teal breeding areas such as Mohanpur, Hanspuri (N. Andamans), Katakatchang, Sippighat-Bimblitang (S. Andaman) declaring these as "Conservation areas" with the participation of the people living around.
- More protection staff with proper facilities should be provided.

- Development projects involving habitat alterations should be avoided as far as possible preserving the pristine habitats in the islands.
- Detailed surveys and ecological studies have to be taken up specifically on the rare endemic birds such as the Andaman Banded Crake, Narcondam Hornbill, Andaman Hawk Owl, and Andaman Scops Owl.
- 8. Wetlands, both freshwater and brackish water, have not been given proper attention; and hence, needs extensive surveys and studies for their conservation and management.
- Some of the reserve forests and mangrove forests in the main Middle Andaman island near Rangat, especially where the endangered Andaman Crake was sighted may be given better protection status.
- Environmental education and public awareness programmes also should be taken up intensively and regularly.

Nicobar Megapode

Megapodes are a unique group of birds which incubate their eggs in mounds of rotting leaves or in burrows at sun or geothermally heated ground. The Nicobar Megapode Megapodius nicobariensis builds incubation mounds of sand, loam, coral bits and rotting vegetation within which eggs are laid.

The survey of the species was conducted in the whole of the Nicobar Islands while the intensive study on the ecology was near Indira Point situated at the southern tip of the Great Nicobar Island (between 6°45′ N - 7°15′ N, and 93°38′ E - 93°55′ E). The status of the Nicobar Megapode was assessed between November 1992 and April 1994. The ecology of the Nicobar Megapode was studied between December 1995 and May 1998, covering three dry seasons and part of one wet season.

Majority of the study area had sandy loam soil, and the area beyond this was comprised either of sandy loam or moist loam substrates. The most abundant tree species in the study area was *Pandanus* spp., followed by *Macaranga peltata* and *Syzygium samarangense*. The tree species were not uniformly distributed in the study area, and only the above three species out of over 28 species present in the study area occurred almost everywhere. There were a few patches where the ground was open and with little vegetation.

The coastline of 17 islands was sampled by walking around each island so that the entire range of this species was covered (a modified belt transect, about 100 m wide starting from the beach. Distances between sampling sites varied between 5 and 8 km on larger islands and the entire coast of small islands was surveyed. Populations were estimated by assessing the number of active mounds.

Distances in the field were measured using a pedometer set at 45 cm. Coastlines were measured from 1:150,000 scale hygrographic charts. Signs of predation, both natural and human, were recorded for every active mound seen. Measurements of the mounds, vegetation cover around (Point Centre Quadrate method) and above the mound (using graduated mirror) were taken.



The study area was systematically mapped, incubation mounds and other landmarks were plotted on the map. In addition, all the incubation mounds were drawn to scale. The location of birds were plotted on the maps and the location and type of activity of the birds on the mounds were plotted on the sketches.

Micro-habitat utilisation (level of utilisation) of the Nicobar Megapode was estimated by using Neu's method. Behaviour of the birds was observed following the focal animal sampling method. Activities of the birds were classified into visit, pit-digging, egg-laying, raking, covering, pit-filling, and random activity.

Mound temperatures and microbial activity were measured every 10 or 15 days using temperature probes and a soil respirometre at depths of 30, 60 and 90 cm. Intensity of light (using a Lux meter), amount of Photosynthetic Active Radiation (using Sunfleck Ceptometer) on and outside the mound were measured. Soil humidity was also measured. During the breeding seasons of 1996, 1997 and 1998, 37 mounds and 33 eggs were marked and monitored.

Adult birds were trapped near their incubation mounds, colour-marked and followed. Of the 28 birds, there were five pairs, 11 of one of the pair, and two un-paired individuals. The sightings of all colour-marked birds were plotted on detailed maps to know the home range and mound use.

Population and Distribution

M. nicobariensis, endemic to the Nicobar islands, is geographically isolated, with its nearest congeneric about 1600 km away. Two subspecies are recognised - *M. n. nicobariensis*, present on the Nancowry group of islands north of the Sombrero Channel, and *M. n. abbotti*, on the Great Nicobar group of islands to the south. The two subspecies have significant dialectic differences in their vocalisations.

The estimate of *M.n. abbotti* was over 800 active mounds in Great and Little Nicobar and a population of adult breeding birds between 3400 and 6000 birds. Dekker estimated 390 active mounds in 1992 on Great Nicobar as against this study's 515. The number of active mounds in the outlying islets in the Great Nicobar group is estimated to be 23, with an adult breeding population between 90 and 160 birds.

M. n. nicobariensis occurs on seven islands of the Nancowry group. At Katchall, considered by Kloss (1903) to be the home of the megapode, only a single location had a high density. The southern half of Nancowry had mound densities similar to that of Great and Little Nicobar, so also on Teressa and Bompoka. The total population of adult breeding birds of M. n. nicobariensis is estimated to be between 1200 and 2100 birds and the number of active mounds to be a little over 300.

The densities of active mounds are similar for six islands, Great and Little Nicobar, Trax, Nancowry, Teressa and Bompoka, where densities ranged between 30 and 36 mounds km². In all other islands, densities ranged between 3 and 22 mounds km².

The proportion of abandoned to active mounds indicates reduction in the populations. The islands with the least damage to coastal forests are Great and Little Nicobar and Nancowry where the proportion of abandoned mounds was low.

Ecology of the Nicobar Megapode

Mound type, location and egg-laying

Three types of mounds are built by the Nicobar megapode and can be classified into Type _A', _B' and _C'. Of the 214 mounds located during this study Type _A' accounted for 50%, Type _B' 23% and Type _C' 27%. Of the 188 active mounds for which measurements were taken during this study, 97% of the mounds were within 100 m of the beach. The only parameter, which showed differences, was the girth at breast height of the four nearest trees; type A had the smallest girth class of trees around while type B were mainly in stands of older trees.

Between December 1996 and June 1997, additionally seven mounds were constructed and two more mounds, which had been missed so far, were located. Two mounds had been abandoned between June 1996 and December 1996. In September - October 1997 two new mounds were constructed, and by November 1997, the study area had 31 active mounds while it was 30 in June 1998. The 38 mounds studied were in nine distinct clusters. 39.5% of the mounds were on sandy soil, 50% in sandy-loam and the rest 10.5% in loamy area. Sand substrates were utilised significantly more than expected but the loam less than expected. When habitat preference was analysed, open forest with *Pandanus* spp., open mixed forest and dense *Pandanus* spp. microhabitats were preferred for mound construction. The mean canopy cover above the mound was 58%, less than the mean percentage (81%).

Both partners participated equally in the construction and maintenance of incubation mounds. On average, a pit was dug once in every 3.7 visits to the mound, and egg was laid in only a few deep pits. Pit-digging activity was distributed throughout the year but varied between months. During the breeding season 24 - 29% of the mound activity was pit digging while in rainy season (September-October) it was only 18%. In general, during breeding season, pit-digging was the major activity (26.4%) followed by raking (26.1%) which is collection of sand and vegetative litter to build up the mound. The egg-pit was filled immediately after the egg was laid.

The peak period of the egg-laying was between February and May. Total number of eggs laid from 1996-1998 was 271. The mean egg-laying interval was about 15 days (n=11 intervals in 17 eggs). The average number of eggs laid in a mound was 4.5 (\pm SE 0.6, n=58). Clutch sizes varied from one to four eggs per season or year (mean 2.75 eggs \pm 0.35, n=12). There was a significant positive correlation between the mound size and number of eggs laid in it (r=0.456, n=71, p<0.001).

Incubation

Mean core temperature at the depth of 50-60 cm in incubation mound was 31.94°C (SE 0.075, N=634) while outside it was 28.72°C (n=105, SE=1.66). The mean soil respiration (gCO $_2$ /m 3 /h) rate on the active incubation mound was 5.55 (n=920, SE=0.13), on abandoned incubation mound 2.88 (n=140, SE=0.92) and on the normal ground 3.7 (n=130, SE=0.86).

The temperature of the egg chamber of 34 eggs in 16 incubation mounds was monitored, and the incubation period for 30 eggs was 70 to 81 days (mean = 74.73 ± 0.52 days). The mean temperature for successful hatching was $32.44 \pm SE 0.21$ °C (N=30). Microbial activity was the source of heat with a role in either the optimisation or the stabilisation of incubation mound core temperatures. Mean hatching success in the 32 incubation mounds was 58.87%. There was no significant correlation between the incubation mound size and hatching success (r=-0.14, n=23, p=0.54).

Territory

The Nicobar megapode is a strongly territorial species. The average size of the territory was 0.81 ha (SE 0.12), ranging from 0.19 to 2.28 ha. Here, the territory overlaps with that of other pairs that use the same mound. While most pairs used only one mound, some pairs laid eggs in more than one mound (up to three mounds) at a time. The use of mound is hierarchical, the dominant pair usually spending most of the time at the mound and disrupting other pairs working on the mound. Solitary birds of either sex do not defend territories, but usually attach themselves to a mound, working on it when pairs that use that mound are absent. Change in mates were observed, so also extra-pair copulations.

Conservation of the Nicobar Megapode

Nicobar Megapode is a globally threatened species. The main threats can be classified into hunting of birds for meat and egg collection, predation and habitat loss.

Localised, heavy hunting pressures on the megapode by Nicobarese are a recent phenomenon, because of the popularization of airguns. Hunting by the mainlanders have declined. Very high hunting pressure, albeit localised, was from Thai poachers who camp in isolated parts of Tillanchong, Great and Little Nicobar.

Natural predators of megapodes and their eggs are the monitor lizard *Varanus salvator*, the reticulate python *Python reticulatus* and species of raptors.

The primary threat to megapodes is loss of habitat. Demographic changes in the Nicobars have resulted in widespread loss of habitat, being most acute in the Nancowry group of islands with conversion into coconut and rubber plantations. Expanding townships and villages, roads, airstrips and infrastructure of defence establishments have all resulted in the loss of habitat, which is the single biggest threat to megapodes. The most immediate threat to the Nicobars is the proposal to make Great Nicobar a free port and to create a dry dock and refueling base for international shipping at the mouth of the Galathea river; if and when implemented, all the Nicobar islands will be lost to conservation. The proposed protected area network in the Nicobar islands would help in the conservation of the Megapode and other endemic birds in these islands.

Consolidated recommendations for the conservation and management of the endemic avifauna of the Andaman and Nicobar Islands

The avifaunal studies in the Andaman and Nicobar Islands covered the status and distribution of the endemic birds in the islands and the ecology of the three endangered endemic species, namely the Narcondam Hornbill, Andaman Teal and Nicobar Megapode. Based on these, specific recommendations were given for each species. Consolidated recommendations are given below which would help in the conservation and management of the endemic birds of the Andaman and Nicobar Islands:

- The Narcondam Hornbill, a species found only in the Narcondam Island of 6.82 km², is a
 globally endangered species, and requires immediate attention. Goats introduced to the
 island must be removed immediately, as they affect regeneration of forest. The removal
 must be supervised by a DCF / ACF of the A & N Forest Department, so that total complicity
 is assured.
- 2. Hunting of the Narcondam Hornbill should be stopped forthwith.
- Directive needs to be issued to the LOP personnel that trees should not be cut. Alternately, LPG must be provided to run the kitchen at the LOP camp in Narcondam.
- 4. Dhaninala in Rutland Island where the maximum population of the Andaman Teal was found needs to be protected either including it in the Mahatma Gandhi Marine National Park or declaring it as a separate Sanctuary.
- Mohanpur, Hanspuri, (N. Andamans), Katakatchang, Sippighat-Bimblitang (S. Andaman)
 may be declared as "Andaman Teal Conservation areas" with the participation of the
 people living around.
- 6. Jackson Creek in Little Andaman needs increased protection status.
- Some of the reserve forests and mangrove forests in the main Middle Andaman island near Rangat, especially where the endangered Andaman Crake was sighted may be given better protection status.
- 8. The Great Nicobar Biosphere Reserve should be redesigned with a single core area including the two existing National Parks and the Southern tip of the Island, and another core area on Little Nicobar. All inhabited areas surrounding the core areas will be the buffer zone.
- 9. The Nancowry Biosphere Reserve is proposed consisting of core areas on Camorta, Katchall and Nancowry. Tillanchong, the only uninhabited island in the subgroup, and already a Wildlife Sanctuary, may be considered as the fourth core area. The buffer zone should cover all inhabited areas surrounding the core areas, and include all islets and other islands in the sub-group.
- 10. The proposal to make Great Nicobar a free port and to create a dry dock and refueling base for international shipping at the mouth of the Galathea river should not be implemented at any cost, as it would be disastrous to the population of the Nicobar Megapode, other endemic species and the whole island ecosystem
- 11. Detailed surveys and ecological studies have to be taken up specifically on the rare endemic birds such as the Andaman Banded Crake, Andaman Hawk Owl, Narcondam Hornbill, Nicobar Serpent Eagle, Nicobar Sparrow- Hawk, and Nicobar Bulbul. Environmental education and public awareness programmes also should be taken up intensively and regularly.

Likely impact of the project on the scientific potential of our country

This project, the first of the kind in the Andaman and Nicobar Islands

- assessed (a) the status of endemic birds , (b) conservation problems of the rare birds and the island ecosystem, (c) impact of human communities on the birds and the island ecosystem,
- brought out the details of the ecology and biology of three endangered endemic birds, namely the Nicobar Megapode, Andaman Teal and Narcondam Hornbill,
- helped to identify the Important Bird Areas in these two Endemic Bird Areas of the world,
- suggested remedial measures for the conservation of the rare endemic birds which would also help conserve the biodiversity of the region, and
- pointed out the potential areas of further studies to be undertaken on priority, especially on birds.