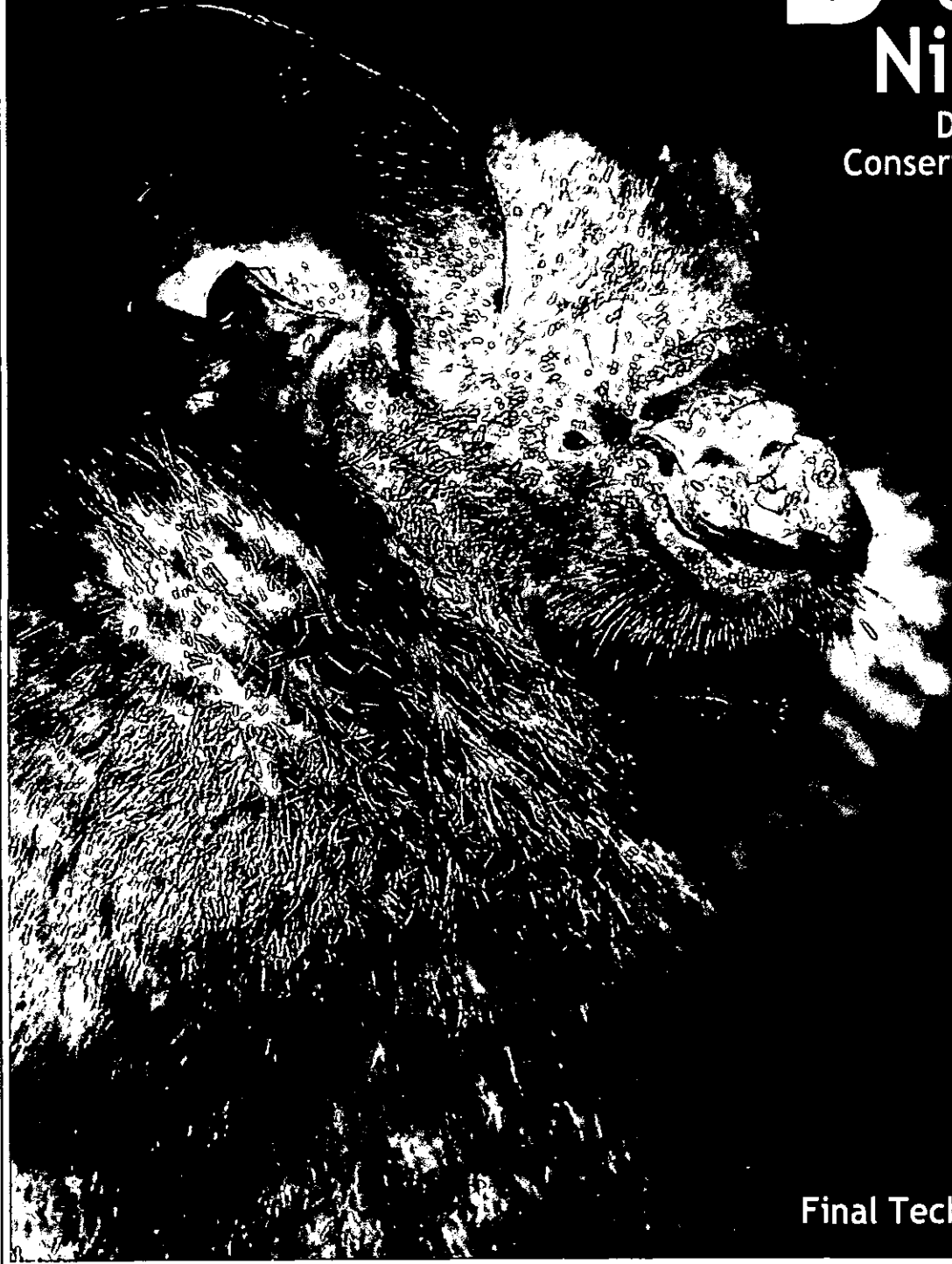


Bats of Nicobar

Distribution &
Conservation Status



Final Technical Report



the bp conservation programme



To
The Programme Manager,
The BP Conservation Programme

Dated: 8th Jan 2004

Sub: Submission of the Final Technical Report of the Project – “Nicobar Bats 2003”

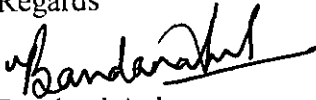
Dear Marianne,

My team would like to thank the Bp conservation Programme for giving us the opportunity to be a part of the BP Programme and the vast family and friends we made through them. The Nicobar bats project which was completed as per the time frame proposed in the study proposal submitted last year i.e. June 2003 to December 2003. We have compiled our results of the study and presented them in the form of a Technical report, which is enclosed with this letter as well as a soft copy on a CD as requested. The financial statement is not included in the report as this report is also being sent to the various conservation organizations in our country. These organizations have either been associated in bat conservation work or have aided in our work in one way or the other.

I will be sending you the financial statement as well as the scanned images with relevant titles and the team's experiences on and off field. These will be in the second parcel.

Hope to hear soon from you. A very happy new year to all of you and all the best.

Regards



Bandand Aul

Research Associate

Maduai Kamraj Univeristy, Tamil Nadu, India

Andaman & Nicoabr Islands Environmental Team (ANET)

Encl: Printed copy of the technical report titled “Bats of Nicobar – Distribution & Conservation Status” and a Soft copy of the same on a CD.

**DISTRIBUTION & CONSERVATION
STATUS OF THE BATS (ORDER: CHIROPTERA)
OF NICOBAR ISLANDS, INDIA**

FINAL TECHNICAL REPORT
Nicobar Bats 2003

TEAM MEMBERS

Researchers : *Bandana Aul and S.P. Vijayakumar*

Research Assistants : *Saw Johnny, Saw Victor, Saw Jonathan, Naveen Ekka.*

Supported by



Citation : Bandana Aul* & Vijayakumar, S.P. (2003). Distribution & Conservation status of the Bats (Order: Chiroptera) of Nicobar Islands, India. Final Technical Report submitted to BP Conservation. pp 49, plates 1-7. email*bandana_aul@rediffmail.com

Front Cover : *Hipposideros diadema nicobarensis* Geffroy, E., 1813 An Endemic sub species restricted to the Central Nicobars, Nicobar Islands, India.

This project has been an amalgamation of a lot of good wishes and labour of a lot of people both in and out of field.

BP, Flora and Fauna International, BirdLife International, Conservation International and Wildlife Conservation Society for funding this project through the BP Conservation Programme.

The Director, Mr Harry.V.Andrews of the Madras Crocodile Bank Trust/Andaman and Nicobar Islands Environmental Team (ANET) for logistics and support for the initiation of this study.

The Chief Conservator of Forests/Chief Wildlife Warden Shri Khazan Singh and all the officials at Van Sadan for their support for the project. The Inspector General of Police, Mr Alok Varma and his staff for their prompt action when it came to getting us connected to the outside world and our homes. The District Commissioner (Andaman Is.), District Commissioner (Nicobar District), Assistant Commissioner (Great Nicobar and Nancowrie Is) and the Assistant Conservator of Forests Campbell Bay, Nicobar district for permission to work in the Nicobar group of islands.

The Team is indebted to the Tribal Council, Nancowrie group, Great Nicobar group and Car Nicobar Islands. Just to mention a few, Mrs. Ayesha Masjid, Mr Thomas Phillip, Mr Paul Ura and Mr Rashid Yusufji (Rasheed Traders) for the local logistics. Mr Mark Paul, for all the support and contacts that he gave us. His effort in making our study known to the people and emphasizing the importance of the species is commendable.

Being such an extensive survey of 14 islands we have come across a lot of people and our list to thank and acknowledge is very long and brings back some lovely field experiences. These people were not such local assistants or liaisons but part of our conservation effort to protect the bats in the Nicobar Islands. The village heads (Captains) are specially thanked for their support and hospitality in their areas.

SOUTHERN NICOBAR GROUP:

GREAT NICOBAR IS: S.R.Choyal, D.S.P., Capt. Bharat, Jugloo, Jagananth, khurma Rao, Simons, Capt Sunil (Pilo Bhabi), Joseph., Capt.Shetty. **LITTLE NICOBAR:** Capt. Augustin, Stephen **KONDUL Is:** Jugnoo Ulyssess, Herbert Paul, Capt.Darius, Bryl Cream, Bagat Singh **PILO MILO:** Cyrus, Mosses

CENTRAL NICOBAR AND NORTHERN NICOBAR GROUP :

NANCOWRIE Is: Mr. Majid, Mr. Mohammed, Mr.Ariyaz Aktar, **CHAMPIN** Captain, Capt. Hilary Atkinson & family, **TAPONG**, Nikonor, Lesing, Netab, Jeress Philip, Raman, Shimun, Mallais, Misak, Ramanna. **KAMORTA Is:** Rasheed Traders: Ramanna, Apanna, Mr.Choyal (DSP), Robert Pee, Rasheed (Range officer). **MUNAK:** Mrs. Caecillia, Captain, Mr. Thomas Ton, Tribal Council, Mr.K.K.Allen, Ms.Leomean, Simon, Joel, Amul, Mr. Martin, Samiel, Health Centre, Benedick, Christopher, Terik, Emoss, Clement, Urial. **PILPILO:** Capt. Mohammed Ali, Prem Kumar, Nagaraj, **GULWARI** : Jackson, Beisy Jackson, Titimus. **KAKANA:** Capt. Lucas, Stephen, Jalil, M.Daniel, Livingston, Rethi. **DARING:** Lilly, Capt.Alexus, Mosses, Giffus, Solomon, Zebedee, Hamilton, Capt. Albert, Francis, Padmos vill., Danny, Jonathan, Ramyuk Vill. **TRINKAT Is:** **TRINKAT:** Mohammed, Theophilus, Samuel Theophilus, Unial Umyuk, Charles **TAPYANG:** Amber and family. **SAFEDBALU:** Adman, Vinu, Simus, Capt.Tang Kumar, James, Alfred, Haek. **KATCHAL Is:** **KAPANGA:** Mohammed, Razak Ali, Robert Pee, Robin Kujoor, Capt. Samuel Alba. **WEST BAY:** Abusol, Capt. Mariam Suresh, Rajkumar, Morisson, Ayub, Livingston, Christy Livingston. **PONDHA:** Capt. Mosses, Thomas, Justin **KAMRIAK:** Balwan Benjamin, Benjamin Lawrence, Theophilus, Christopher, Jerom, Yakub, Solomon (West Bay), **UPPER KATCHAL:** Capt. Daniel. **CHOWRA IS:** Capt. Abner, Simon, David, Herriot, Police Personnels. **BOMPUKA Is:** Teacher Watch Full, Capt. Ian, Oliver. **TERESSA Is:** Venket, A.E (PWD), Chief wise Capt. Peter, Capt. Eric, Ajay (port Control), Christopher, Raju, Nelson, VLW, Khalasi capt. Paul, Jonna., Montu, Bengla Vill. **CAR NICOBAR:** Dr.Anwar Moosa and Family, Deputy commissioner, Chief captain Aberdeen Blair, Capt.Samiel Abel, Capt. Samiel Edward, Capt. Albern

Mr.Saravanakumar, Ecotone for scanning the slides. Mrs. Aparna Singh, Educational officer, ANET, Mr. Uday, Mr. Anand Kumar, ZSI.

Mr Atanu Roy (Studio Profile) & Birender Singh and Rajesh (Digital Expressions, New Delhi) for design and layout.

Dr.John, Boston University and Dr.Tigga Kingston, Boston University for their comments on the draft report. Dr Paul Bates, Dr D Harrison, Harrison Zoological Museum, Kent for taxonomic clarification. Dr Paul Racey and Dr Allyson Walsh for useful comments and inputs on the project.

The Dean, Forest and Ecology Division (Indian institute of Remote Sensing, Dehradun) and Ms Stutee Gupta, Mr Gaurav (IIRS) and Mr Ramesh, Wildlife Institute of India for helping us with the maps.

Acknowledgements	
Project Summary	7
Chapter 1: Introduction, Objectives, Study area, Methods and Materials	9-13
1.1 Introduction	
1.2 Objectives	
1.3 Past research on bats in the Nicobar Islands	
1.4 Study area	
1.5 Methods and Materials	
1.5.1 Study Design	
1.5.2 Selection of sampling sites	
1.5.3 Sampling and surveying bats	
1.5.4 Species Identification	
1.5.5 Assessment of Conservation priority	
1.5.6 Photodocumentation of bats	
1.5.7 Education and training	
1.5.8 Data Analysis	
Chapter 2: Distribution of bat fauna in the Nicobar Islands	14-15
2.1 Inventory of Bats: Species composition and endemism	
2.2 Distribution patterns	
2.2.1 Species occurrence patterns	
2.2.2 Biogeographic subdivisions	
2.3 Implications for conservation and management	
Chapter 3: Mapping of permanent bat roosts	16-21
3.1 Introduction	
3.2 Permanent and temporary bat roosts:	
3.2.1 Number and location of roosts	
3.2.2 Distribution of caves in the Nicobar Islands: Numbers and associated bat species	
3.2.2.1 Caves in the North Nicobar group of Islands	
3.2.2.2 Caves in the Central Nicobar group of Islands	
3.2.2.3 Caves in the South Nicobar group of Islands	
3.2.3 Cave bat assemblages	
3.2.4 Synanthropy: A paradox of human influence	
3.2.4.1 Bridges	
3.2.4.2 Road culverts	
3.2.4.3 Bunkers	
3.2.4.4 Abandoned building and thatched houses	
3.2.5 Foliage and Tree roosts	
3.3 Significant areas for conservation and monitoring	
Chapter 4: Species descriptions: Taxonomy, Natural history, Distribution and Conservation Status	22-34
4.1 Introduction	
4.2 Species accounts for 12 species of Bats	
Chapter 5: Threats and Conservation of bats of Nicobar Islands	43-45
5.1 Identification of threats	
5.1.1 Types of threats	
5.1.2 Nicobar flying fox: Hunting pressure threatening its future survival	
5.1.3 Caves: Bat habitat under pressure	
5.2 Conservation education and awareness: Present and Future	
5.2.1 Target Groups	
5.2.1.1 Nicobarese	
5.2.1.2 Forest department and other govt. officials	
5.2.1.3 School children and teachers	
5.3 Significant findings and recommendations for management and conservation	
References:	46-47

List of tables

Table 1: Summary of Islands sampled for bats in the Nicobar archipelago.

Table 2: Sites sampled for bats in the Nicobar Islands.

Table 3: Classification of caves in the Nicobar Islands

Table 4: Distribution of bat species in the Nicobar Islands.

Table 5: Number and Ownership status of caves surveyed in the Nicobar Islands

Table 6: Location of Japanese bunkers and associated bat species

Table 7: Caves identified for conservation priority in the Nicobar Islands

Table 8: Conservation status of bat species in the Nicobar Islands

Table 9: Morphometrics: Comparison of *Hipposideros ater nicobarule* and *H. pomona*

Table 10: Morphometrics: Comparison of *Pipistrellus javanicus* and *P. coromandra*

List of figures

Fig 1: Occurrence patterns of bats in the Nicobar Islands

Fig 2: Subdivisions in the Nicobar group of Islands based on bat species composition.

Fig 3: Frequency distribution of the caves in the Nicobar islands.

List of Maps

Map 1: Study area: Nicobar Islands, an archipelago.

Map 2: Distribution of caves in the Central and Northern Nicobar Islands

Map 3: Distribution of caves in Southern Nicobar Islands

Map 4: Bunker Location with associated species in the Nicobar Islands

Map 5: Distribution of the endemic Nicobar flying fox in the Nicobar archipelago

List of Plates: Species

Plate 1: Genus: *Pteropus*

Plate 2: Genus: *Cynopterus* and Genus *Taphozous*

Plate 3: Genus: *Hipposideros*

Plate 4: Genus: *Hipposideros* (contd)

Plate 5: Genus: *Myotis* and Genus *Murina*

Plate 6: Genus: *Pipistrellus*

Plate 7: Genus: *Miniopterus*

Abbreviations used in the text

CAR Car Nicobar

CHO Chowra

BOM Bompuka

TIL Tillangchong

KAT Katchall

NAN Nancowrie

KAM Kamorta

TRI Trinkat

PIL Pilo Milow

MEN Menchal

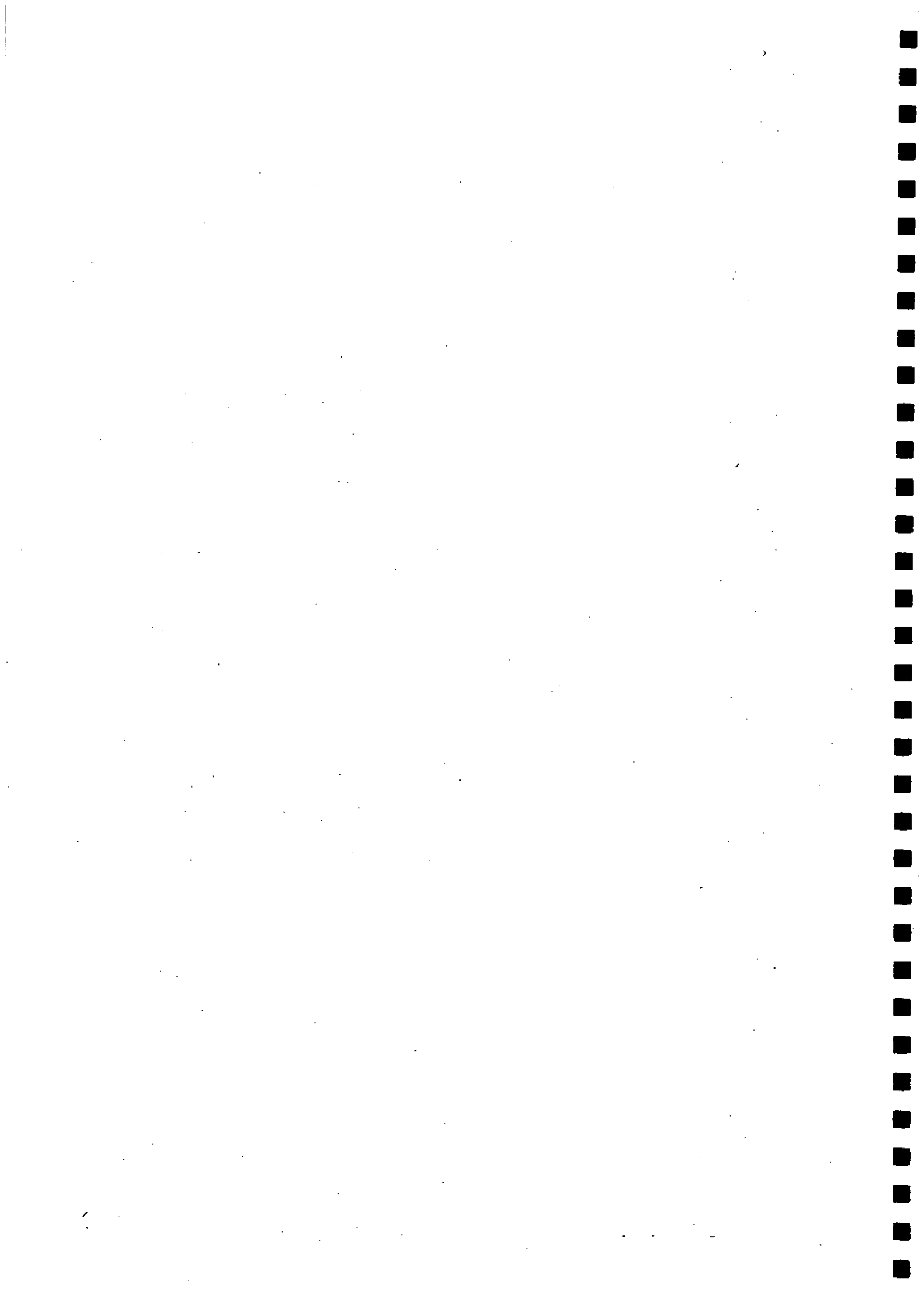
LNI Little Nicobar

KON Kondul

GNI Great Nicobar

A survey of 14 islands in the Nicobar archipelago was carried out to determine the geographic distribution and conservation status of the bat fauna. Two major techniques were employed to sample bats: survey of bat roosts and mist netting. Mist netting effort included more than 600 hrs in seven habitat types. More than 200 bat roost sites were located and mapped. This included 55 caves. The study resulted in the identification of 12 species of bats belonging to four families and eight genera. The team was also successful in locating the endemic Nicobar flying fox, *Pteropus faunulus*, and the first record since its description. Many endemic sub species including *Hipposideros diadema nicobarensis*, *Pipistrellus coromandra camortae* and *Myotis horsfieldii dryas* were also rediscovered. Two new geographic range records were identified for this island group and also one new record for the Nicobars. An albino of the endemic subspecies *Hipposideros diadema nicobarensis* was discovered during the course of the study. For the first time, the research team also photographed all the 12 species of bats and their habitats.

Two divisions of islands, which differ in bat species composition, were identified using cluster analysis. Species richness and endemism of bats was greater in the central Nicobar group of islands. Species occurrence patterns revealed the short nosed fruit bat *Cynopterus brachyotis* as the most widespread species, occurring on all the islands sampled. The data on the distribution patterns of bats elucidated the gaps in the current protected area network in the Nicobar archipelago. These results and its implications for conservation are discussed in chapter 2. A detailed account of both permanent and temporary bat roosts is provided in chapter 3. A list of priority areas for conservation and monitoring is also provided. As part of the study, data on species morphology and ecology were collected for many species of bats. A summary of this information is provided in chapter 4 along with conservation status for each bat species occurring in the Nicobar Islands. An assessment of the threats and conservation priority carried out for the bats showed the existence of high hunting pressure on the endemic Nicobar flying fox and also evidence of declining populations. The need for initiation of a conservation programme targeting the endemic fruit bat is highlighted. The disturbance and threats to the caves and cave bat assemblages and the results of the initiation of an education and awareness programme targeting local communities, students and forest department officials are discussed in chapter 5. The feedback from these programmes was positive and encouraging. Coordination with the local NGO and Education coordinator helped in sensitizing the students and teachers to the importance of bats. The forest department was appreciative of our efforts to involve them in our projects.



1.1 Introduction

The Andaman and Nicobar Islands (06° 45' N to 13° 41' N and 92° 12' E to 93° 57' E) sprawl in a crescent from, south off the Myanmar coast to near Sumatra. Politically, most of the islands are part of the Republic of India, with a few northern islands administered by Myanmar. These islands contain some of the last remaining pristine rainforest habitats, with unique assemblage of flora and fauna distinct from the mainland (Rodgers and Panwar, 1988). These islands along with Northeast India form the western boundary of the Indo-Burma biodiversity hotspot (see Myers et al., 2000). The mammalian fauna of the Andaman and Nicobar Islands comprises a rich assemblage of largely rodents and bats (Miller, 1902; Hill, 1967; Saha, 1980; Pande *et al.*, 1991). The other mammalian fauna represented are the spotted deer, elephant, goats, cows, dogs, and cats all of which have been introduced in the islands. Endemism is high among many groups of vertebrates including mammals, birds, amphibians, reptiles and invertebrates such as earthworms, arachnids, molluscs and termites (Rao *et al.*, 1985). Very little information exists on the ecology and distribution of most faunal groups (Rodgers and Panwar, 1988).

Biogeographically the islands have been divided into two major divisions, the Andaman archipelago consisting of more than 500 islands and islets and the Nicobar archipelago consisting of around 23 islands (Rodgers and Panwar, 1988). The Andamans are considered to be extensions of the Arakan Yomas range, a southward trending branch of the eastern Himalayas that merges in the north with the ranges in northeastern India, which form a complex of sub parallel north-north-east trending ridges. The same ridge rises 135 km south of the Ayeyarwadi, in the Bay of Bengal, The Nicobar group is the continuation of the Mentaweri islands to the south and south west of Sumatra (Rodolofó, 1969; Das, 1999c).

Bats have been one of the neglected taxa, for which very few information exists. Much of this information is from sporadic surveys (e.g. Hill, 1967). Being an island ecosystem and lacking in large mammal diversity, the importance of bats to the islands cannot be ignored. Increasing human population, habitat conversion, deforestation, hunting pressure, exotic species introduction and other development activities are causing a great threat to the faunal and floral diversity of these islands (Saldanha, 1989; Nair, 1989; Sankaran, 1995). Being vulnerable to human-induced disturbances, the effects of the above activities on the bat fauna remain unknown. The Previous study on the bats of Andaman Islands (by B. Aul, the team leader of the current project) resulted in interesting data including a discovery of an undescribed bat species, on which taxonomic work is in progress (Aul, 2002). Even baseline information for most bat species of the Nicobar Islands is unavailable. Information on species distribution patterns and ecological requirements are of great theoretical

interest besides being crucial for management of protected areas (Das, 1997). Taking into account these major gaps in our knowledge, the present project was initiated to determine their distribution and conservation status of bats in the Nicobar Islands.

1.2 Objectives

The main aims of the study were –

- To inventory bat species and their roosts in the Nicobar group of Islands.
- To assess conservation status and threats, especially for the rare and endemic Nicobar bat species.
- To photo document bat species and their respective habitats.
- To make recommendations for management plans to the Andaman and Nicobar Dept. of Environment and Forest.
- To train Forest Department frontline staff in field techniques and monitoring, and to sensitize them to the importance of bats in islands.

1.3 Past research on bats in the Nicobar Islands

The bat diversity of the Nicobar Islands has long been ignored. There have been occasional attempts in the past to list the fauna in the islands but no specific studies were attempted to identify the bats species in the island groups. A few attempts in the past did list some species, mostly from the Andaman Islands and a few from the Nicobar Islands (Abdulali 1976a, 1976b, Das, 1998, Deb, 1998). Much of the existing information on bats was derived from general faunal explorations, especially birds, in the past (e.g. Abdulali, 1976a). These past distribution records were also unclear as they generally grouped bats as present in the islands as a whole, and gave no clear information on species representation on the different islands. Based on the past records (Miller 1902, Hill 1967, Rao 1992 and Bates, 1998), a total of 12 species were compiled for the Nicobars Islands by the project team including - *Pteropus vampyrus* (Large flying fox) *Pteropus faunulus* (Nicobar flying fox), *Pteropus melanotus*, *Cynopterus sphinx* (Short nosed fruit bat), *Pipistrellus coromandra camorate* (Indian pipistrelle), *Pipistrellus javanicus* (Javan pipistrelle), *Miniopterus pusillus* (Nicobar long-fingered bat), *Hipposideros fulvus* (Fulvus leaf-nosed bat), *Hipposideros ater nicobarulae* (Dusky leaf-nosed bat), *Hipposideros pomona* (pomonaleaf-nosed bat), *Taphozous saccolaimus* (Naked-rumped pouch-bearing bat), *Scotophilus kuhlii* (Lesser Asiatic yellow house bat). The taxonomic identity of these species needs to be verified. The exact distributional data for many species is also ambiguous.

1.4 Study area

The Nicobar group of islands (Map1) is currently included in BirdLife International's Endemic Bird Areas (EBA). Zoogeographical isolation has led to a number of endemic species of flora and fauna. There are two National Parks, four Wildlife Sanctuaries and a biosphere reserve. This

archipelago comprises of a group of 23 islands, covering a total area of 1930 sq km. It comes under the biogeographic province 9B proposed for the Indian region forming three spatially discrete clusters, North, Central and South Nicobars. These have been recognized as three biogeographic sub-divisions (Rodgers and Panwar, 1988).

The southern group consists of two islands larger than 100 sq km, nine islets smaller than 5 sq km, and a few rocks. Four islands are inhabited. The human population on the Great Nicobar has both tribal as well as mainland Indians. Little Nicobar has no mainland settlers and the tribal people are distributed all around the island. Kondul and Pulo Milo are inhabited islets. Meroe, Tries, Trax, Menchal, Megapode, Cabra and Pigeon are uninhabited islets

About 58 km north of the Southern Nicobar group is the Central Nicobar group, which consists of three islands larger than 100 sq km, two of 36 and 67 sq km, three less than 17 sq km, two islets and a few rocks. Seven islands in this group are inhabited both by tribal people and mainlanders.

The northern most subgroup comprising of Batti Malv and Car Nicobar is 88 km north of the Central Nicobar group. Batti Malv is uninhabited and Car Nicobar has a population of over 19,000 people (ANI, Census 1991), Majority of

who are tribal. People of the Car Nicobar Island are also the most exposed to the outside world as compared to the other inhabited islands in the Nicobar Archipelago. Misguided development in this Island has already resulted in the reduced forest cover.

The climate of the Nicobar Islands is tropical in nature with moderate temperature (max. 36.1 °C and min. 16.7 °C) and high average relative humidity (75%). The islands receive rainfall from both the northeast and southwest monsoons with a mean annual rainfall of 3800 mm. The terrain is mostly undulating, barring a few islands like Great Nicobar, which is more rugged with five hill ranges and many fresh water streams and rivers (Saldanha, 1989).

1.5 Methods and Materials

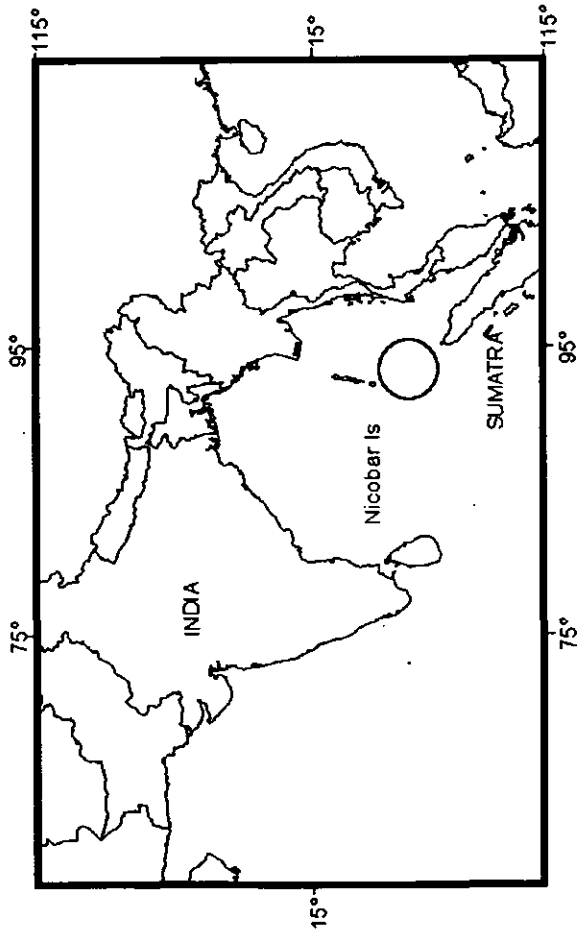
1.5.1 Study design:

Fieldwork was conducted from November 2002 to April 2003 (Phase 1) and from August 2003 to November 2003 (Phase 2). Extensive surveys were carried out in 14 of the 23 islands (Table 1) in the Nicobar group, namely Great Nicobar Island, Pulo Milo, Little Nicobar Island, Menchal, Kondul, Nancowrie, Kamorta, Trinket, Katchal, Tillanchong, Chowra, Teressa, Bompuka and Car Nicobar Islands.

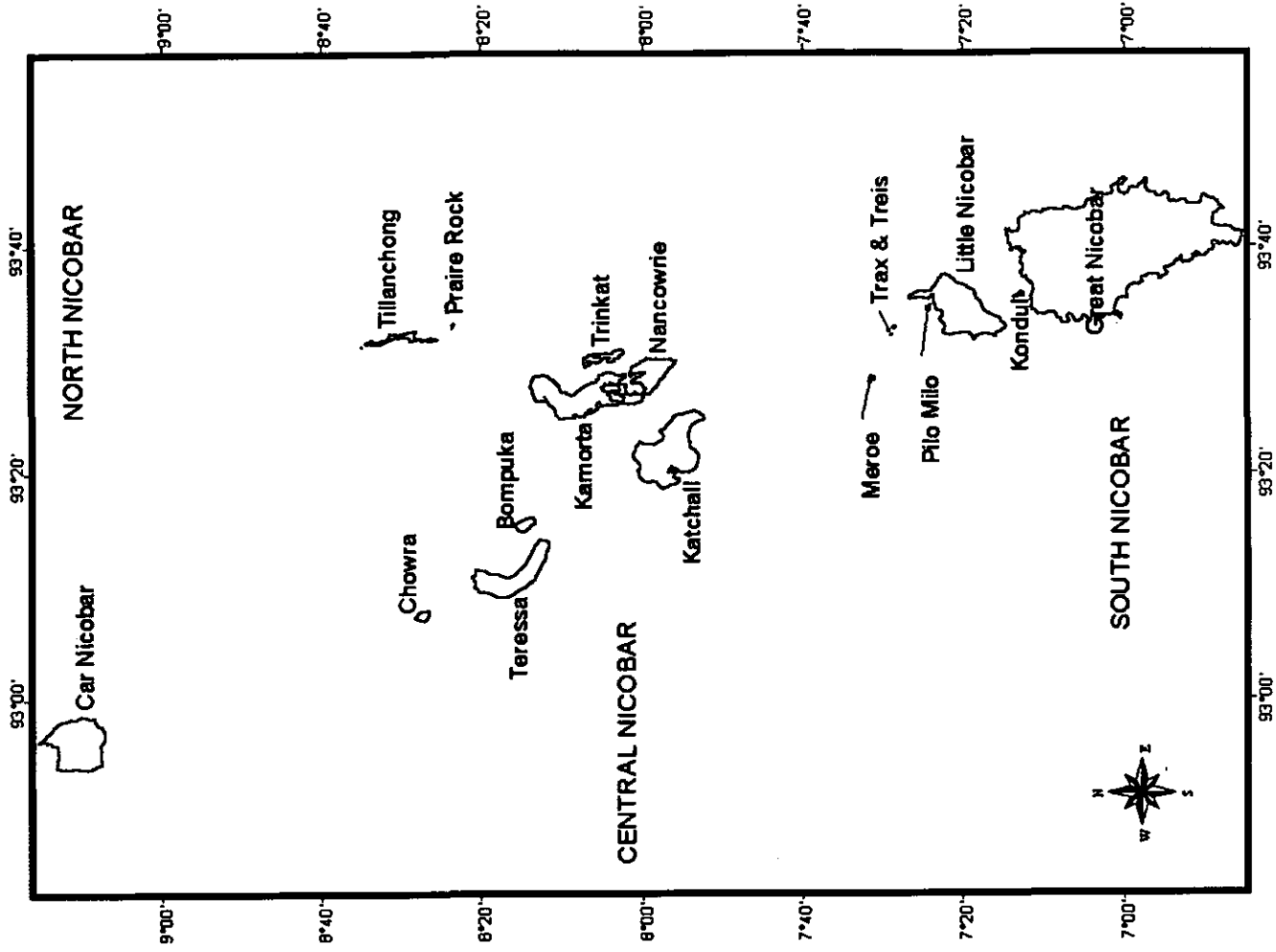
Table 1: Summary of Islands sampled for bats in the Nicobar archipelago.

Island	Area (Sq km)	Inhabited	Habitat	Protected area status	Fresh water
1.Car Nicobar	126.9	Yes	Grasslands, Evergreen forests, Mangroves, Plantations.	Nil	+
2.Chowra	8.2	Yes	Secondary forest, Plantations.	Nil	-
3.Teressa	101.4	Yes	Evergreen forest, Grasslands, Mangroves, Plantations	Nil	+
4.Bompuka	13.3	Yes	Evergreen forest, Grasslands, Plantations	Nil	+
5.Tillanchong	16.82	No	Evergreen forest, Plantations	Yes	+
6.Katchal	174.2	Yes	Evergreen forest, Mangroves, Plantations	Nil	+
7.Kamorta	188.2	Yes	Evergreen forest, Grasslands, Mangroves, Plantations	Nil	+
8.Nancowrie	66.9	Yes	Evergreen forest, Grasslands, Mangroves, Plantations	Nil	+
9.Trinkat	36.3	Yes	Evergreen forest, Grasslands, Mangroves, Plantations	Nil	+
10.Great Nicobar	1045.1	Yes	Evergreen forest, lowland forests, Mangroves, Plantations	Yes	+
11.Little Nicobar	159.1	Yes	Evergreen forest, Mangroves, plantations	Nil	+
12.Kondul	4.6	Yes	Secondary forest, Plantations	Nil	+
13.Pulo Milo	1.3	Yes	Secondary forest, Plantations	Nil	+
14.Menchal	1.5	No	Secondary forest, Plantations	Nil	+

Note: + Present - Absent



Bompoka Is: view from Teresa Is.



MAP 1: STUDY AREA - NICOBAR ARCHIPELAGO

1.5.2 Selection of sampling sites:

Intensive sampling was carried out at different sites, the number of which was decided based upon the island area and species turnover between sites. Availability of habitat types and logistic, were also taken into account while

deciding on the sampling sites. A total of 36 sites were sampled during the present study (Table 2). These sites represented all the different types of habitats present in the islands groups, namely evergreen forests (lowland & hill slope) grasslands, mangroves and plantations.

Table 2: Sites sampled for bats in the Nicobar Islands. GPS points (in decimal degrees) refer to a location established as research base. Sampling points are usually scattered around this point.

LOCAL NAME	ISLAND	Latitude	Longitude
Forest	Nancowrie	8.005142	93.323379
Champin	Nancowrie	8.013705	93.32449
Tapong	Nancowrie	8.000165	93.343077
Munakh	Kamorta	8.003944	93.30224
Forest	Kamorta	8.090157	93.292512
Pilpillo	Kamorta	8.105932	93.283607
Kakana	Kamorta	8.103122	93.312549
Daring	Kamorta	8.053042	93.29221
Trinkat	Trinkat	8.045272	93.3458
Koi'karp/ Safed balu	Trinkat	8.07242	93.344398
Tapiyang	Trinkat	8.04175	93.35254
Kapanga	Katchal	8.001117	93.241004
Ponda	Katchal	7.88672	93.3736
Aldelein	Katchal	7.564461	93.265317
Upper Katchal	Katchal	7.9458	93.4481
West Bay	Katchal	7.95636	93.3144
Mathai'tha'karu	Tillangchong	8.272985	93.373
Cheehla	Tillangchong	8.262063	93.371552
Village	Chowra	8.27328	93.032277
Bompuka	Bompuka	8.142592	93.132367
Bengla/Khalasi/Aluerong	Teressa	8.182365	93.075408
Navy Dera	Great Nicobar	7.134907	93.884461
Mugger Nallah	Great Nicobar	6.991269	93.915054
Shompen Hut	Great Nicobar	6.966898	93.825662
Galathea	Great Nicobar	6.816866	93.859854
Kopen Heat	Great Nicobar	6.974361	93.742944
Pulo Bha	Great Nicobar	6.879668	93.784668
Pulo Bhabi	Great Nicobar	-	-
Kondul	Kondul	7.214499	93.718674
Pulo Panja	Little Nicobar	7.389325	93.734627
Village	Little Nicobar	7.388547	93.68977
Menchal	Menchal	7.39522	93.765167
PuloMilo	Pulo Milo	7.400842	93.693573
Chukchucha	Car Nicobar	9.216183	92.810982
Arong	Car Nicobar	9.171197	92.722775
Passah	Car Nicobar	9.161997	92.73515

1.5.3 Sampling and Surveying Bats:-

A combination of techniques was employed to sample bats in different habitat types in the islands. Two major methods were employed: Survey of bat roosts and Mist netting.

1.5.3.1 Survey of bat roosts:

The following types of bat roosts were identified: Caves, tree roosts, tree hollows, man made roosts including culverts, bridges, abandoned buildings, old Japanese bunkers. Roost sites were located based on active field surveys, existing literature and local information. Most of the roosts of flying foxes were located by interviewing the local inhabitants who hunt flying foxes. Insectivorous bats were located by surveying the caves and tree hollows, and using local knowledge of the inhabitants who look for edible swiftlet nests. These birds share the cave roosts with bats (Sankaran, 1998). Bats were captured using hand nets attached to extension poles within the caves. Fruit bats (*Pteropus spp*) were captured from their day roost sites and occasionally specimens were provided by the local inhabitants. Caves were classified into separate groups depending on their location – inland forest caves and seashore caves and subdivided into various categories. A descriptive list of cave categories recognized during this survey is given in (Table 3). Caves were located and mapped with the aid of a Global Positioning System (see appendix II). Most of the seashore caves were easily accessible by foot during low tide. Other coastal caves were accessed by boats and by swimming.

Table 3: Classification of caves in the Nicobar Islands

Category	Subcategories	Description
A	A1	<i>SEA SHORE</i> Entrance submerged / partially submerged, accessible by swimming
	A2	Entrance on a cliff face / on shore, accessible in low tide / walking into them.
B	B1a	<i>INLAND FOREST</i> Entrance above ground level, water present
	B1b	Entrance above ground level, water absent
	B2a	Entrance below ground level, water present
	B2b	Entrance below ground level, water absent

1.5.3.2 Sampling active bats:

Mist netting was used to sample bats active in different habitats outside protected areas. A total of more than 600 hrs of mist netting was carried out. Sampling was normally carried out between 17:00 hrs and 24:00 hrs. Habitats sampled include: evergreen forest floor, grasslands, perennial streams, plantations (coconut, areca nut, mixed

and manmade water bodies (tanks, ponds etc.). Mist nets over streams and freshwater pools were placed so that the lowest or the fourth shelf was just above the water level. In order to cover more areas, three mist nets each 9 feet long with four shelves were erected in a single night; the time of erection and removal was recorded. Bats caught in the net were immediately removed and temporarily kept in cloth bags. After recording morphometric data from live individuals they were released close to the capture location. These methods are in accordance with internationally accepted procedures described (see Kunz, 1989).

1.5.3.3 Variables collected:

Measurements on the captured samples included the forearm length (FA), ear length (EL), sex, weight, presence or absence of tail, nose length (NL), nose width (NW) and pelage color were recorded. Captured individuals were categorized into juveniles or adults and reproductive state of the females was also recorded. Measurements of specimens up to 200 mm were taken with vernier calipers to the nearest 0.1mm and those longer, with a tape measure to the nearest 1.0 mm. Pesola spring balances of 10 g, 30 g, 50 g, 100 g and 1000 g were used for weights. The forearm measurements were used to confirm the genus as well as species level of the individual that were examined.

1.5.4 Species Identification

The last taxonomic account of the bats in India was undertaken through a series of museum specimens' work and selected fieldwork. This appeared in the form of a book on "Bats in the Indian Subcontinent" by Bates and Harrison (1997). This was the first comprehensive volume dealing with bats of the Indian region. For the species identification we have followed this book. Taxonomy of species was confirmed by Dr Paul Bates, Harrison Zoological Museum, Kent, UK. Voucher specimens were collected for identification and confirmation and these have been deposited in the National repositories (Zoological Survey of India, Kolkatta) for future reference.

1.5.5 Assessment of conservation priority for bats in the Nicobar Islands:

1.5.5.1 Variables Used

The following variables were taken into consideration for assigning a conservation priority for each species of bat in the Nicobar Islands.

1. Geographical range, which was determined based on the number of islands occupied by a bat species.
2. The Endemic status of the species, refers to species which are restricted to the Andaman Islands or to the Nicobar Islands or are found on both the Island groups.
3. Habitat specificity of the bat species, which was determined based on the occurrence of species in different habitat types.
4. Commonness, which was determined based on the

number of individuals captured in mist nets or by numbers observed in the roosts.

5. Observed threats which was based on field data. Both direct threats (e.g. hunting) and indirect threats (e.g. nest collection) were considered.

1.5.5.2 Conservation Priority

Four different categories (P1, P2, P3 and P4) were recognised based on the composite of above variables used, which are defined below. Each species was assigned to one of these three categories (Table 8).

P1: endemic species with narrow geographical range, habitat specific, locally rare & under severe threat due to habitat loss or hunting.

P2: species with narrow geographical range; habitat specific, locally abundant and threatened due to habitat loss/hunting.

P3: species with broad geographical range, no habitat specific, locally abundant.

P4: species with incomplete set of information.

1.5.6 Photo documentation of bats:

Photographic images of most species of bats occurring in the Nicobar Islands are not available. An attempt was made for the first time to photo document the species and its habitats. A total of 12 species of bats were photographed (see plates 1 to 7). Photographs include characteristic features of different species apart from general profiles. Close-up images of the species were made using a 105mm Nikkon lens. Images were recorded both in prints and transparencies. Representative shots of all bat habitats were also taken. Some noteworthy natural shots of bat roosts have also been photographed. Also for the first time, the team was successful in locating and photographing an "albino" of the endemic sub-species *Hipposideros diadema nicobarensis*. Representative collection of the images have been scanned and stored on CD for future use and distribution.

1.5.7 Education and training

During the survey three important target groups were identified for ensuring successful conservation efforts in the Nicobar Archipelago. These target groups were: (1) The Nicobaries or the local inhabitants; the main threat to the bat fauna with reference to the fruit bats in the islands, (2) The Andaman and Nicobar forest department: the decision making bodies in the islands & (3) The school children and educators in both Andaman & Nicobar Island Groups. The involvement of children was mainly to encourage the concepts of conservation and biodiversity. Discussions were held with the Nicobaries and the ANI forest dept. officials to sensitize them about the possible impact of unstained forest use and hunting activities. The forest training school trainees were introduced by the team to bat sampling techniques with emphasis on the threats to bat fauna in the island ecosystem. Education camps were held for school children to introduce them to the world of bats and their importance on islands as dispersers and insect controls. Field trips were conducted with the aid of local

NGO's and defense establishments to show bats in their natural habitats. This was effective in giving the children first hand information on bats. The locals in the Nicobar islands were shown photographs of bats occurring in their islands. Apart from this we also assessed the dependence of local communities on bat meat and other endemic species. This was primarily through informal talks and discussions held with them in their villages.

1.5.8 Data Analysis:

Identifying Island groups/clusters: (Chapter 2)

Cluster Analysis based on species presence/absence matrix of bats was used to identify biogeographic subdivisions. Hierarchical cluster analysis was performed using SPSS 7.5 software. Squared Euclidean method was used to calculate distance from binary data: Presence (1), absence (0). A Dendrogram was generated to identify Island groups (clusters). Islands within a cluster have greater similarity (less distance) in bat species composition than with the neighboring cluster. A distance of greater than 20 was used to identify distinct clusters.

Species occurrence patterns: (Chapter 2)

The number of islands occupied by a species was graphically plotted in a bar chart and the occurrence patterns discussed.

Mapping Caves and important permanent roosts: (Chapter 3)

GPS points were recorded at places closest to the roosts. These data were converted to decimal degrees and imported into ArcView ver 3.1 GIS software. All the points (Vectors) were plotted on to a base map of the Nicobar Islands at appropriate scales. Maps were created in ArcView GIS.

Morphological Variables: (Chapter 4)

For each species data on morphological variables have been used to obtain the following descriptive statistics: Mean, standard deviation. N in the results corresponds to the sample size (number of bats measured). Only adults were used to obtain the above statistics.



Introducing Nicobarese to the Bat species in their Islands.

**CHAPTER 2: DISTRIBUTION OF BAT FAUNA
IN THE NICOBAR ISLANDS**

2.1 Inventory of Bats: Species composition and endemism

A total of 12 species of bats belonging to eight genera and four families were recorded during the present study (Table 4). The majority (75%) of the bat species belonged to the sub-order Microchiroptera. The Megachiroptera (fruit bats) was represented by three species, including the endemic *Pteropus faunulus*. The mist net success rate was higher in the central northern group (83.94%) as against the Great Nicobar Island group (16.35%). A total of 685 individuals represented by nine species (Table 4) were sampled using mist nets. Maximum number of endemic species was observed in Katchal Is. Generally, Central Nicobar Islands housed more endemic species than the relatively larger Southern Islands. Species richness was also greater in the Central Nicobar Islands. *Pteropus vampyrus* was reported to be a seasonal migrant to the Nicobar Islands but was not found in the present study.

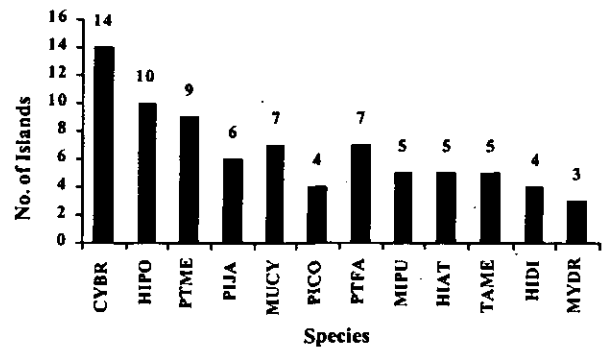
2.2 Distribution patterns

2.2.1 Species occurrence patterns:

The short nosed fruit bat (*Cynopterus brachyotis*) is the most widely distributed species in the Nicobar Islands. This species occurs in all the 14 islands (100%) sampled. *Myotis horsfieldii dryas* has the most restricted distribution occurring in only three Islands (21%). Species occurring

in 50% of the islands or less include- *Pteropus faunulus*, *Hipposideros ater nicobarulae*, *Hipposideros didaema nicobarensis*, *Taphozous melanopogon*, *Miniopterus pusillus*, *Pipistrillus coromandra camortae*, *Pipistrellus javanicus* and *Murina cyclotis*. Other species were widely distributed occurring in 8 (57%) to 10 (72%) islands (Fig 1).

Fig 1 : Occurrence patterns of bats in the Nicobar Islands



Note : *Pteropus melanotus*(PTME), *Pteropus faunulus* (PTFA), *Cynopterus brachyotis* (CYBR), *Taphozous melanopogon*(TAME), *Hipposideros pomona* (HIPO), *Hipposideros diadema nicobarensis*(HIDI), *Hipposideros ater nicobarulae*(HIAT), *Miniopterus pusillus*(MIPU), *Pipistrellus javanicus* (PIJA), *Pipistrellus coromandra camortae* (PICO), *Myotis horsfieldii dryas*(MYDR), *Murina cyclotis* (MUCY).

Table 4: Distribution of bat species in the Nicobar Islands

Species	Northern Nicobar	Central Nicobar								Southern Nicobar					No of Islands
	CAR	CHO	TRE	BOM	TIL	KAT	NAN	KAM	TRI	PIL	MEN	LNI	KON	GNI	
<i>Pteropus melanotus</i>	-	-	+	+	+	+	+	+	-	-	-	+	-	+	8
<i>Pteropus faunulus</i> *	+	-	+	+	-	+	+	+	+	-	-	-	-	-	7
<i>Cynopterus brachyotis</i> [†]	+	+	+	+	+	+	+	+	+	+	+	+	+	+	14
<i>Taphozous melanopogon</i>	-	-	-	+	-	-	+	-	-	-	-	+	+	+	5
<i>Hipposideros pomona</i> [†]	-	+	+	+	+	+	+	+	+	-	-	-	+	+	10
<i>Hipposideros ater nicobarulae</i> *	+	-	-	-	-	-	-	-	-	+	+	+	-	+	5
<i>Hipposideros diadema nicobarensis</i> *	-	-	+	+	+	+	-	-	-	-	-	-	-	-	4
<i>Pipistrellus coromandra camortae</i> *	+	-	+	+	+	-	-	-	-	-	-	-	-	-	4
<i>Pipistrellus javanicus</i> [†]	+	-	+	+	+	+	-	+	-	-	-	-	-	-	6
<i>Myotis horsfieldii dryas</i> *	+	-	-	-	-	-	-	-	-	-	-	+	-	+	3
<i>Miniopterus pusillus</i> [†]	-	-	+	+	+	+	-	+	-	-	-	-	-	-	5
<i>Murina cyclotis</i> [†]	-	-	+	+	+	+	-	+	+	-	-	-	-	+	7
Total Number of species	6	2	9	10	8	9	5	7	4	2	2	5	3	7	
Number of endemics	3	0	2	3	3	2	1	2	2	0	0	2	1	3	

Note: * endemic species in Nicobar group of islands
[†]trapped in mist nets

2.2.2 Biogeographic subdivisions

Two distinct groups of islands were identified using cluster analysis (Fig 2). Islands in the Central Nicobar (except for the Chowra Is.) and Car Nicobar Is. (northern most island in the Nicobar) formed one cluster. Islands in the Southern Group formed the second cluster. Islands in a cluster are more similar in bat species composition than with the neighboring cluster. All twelve species of bats occur in the northern division with four species exclusive to these islands. The bat species in the southern cluster (division) was found to be a sub-set of the species occurring in the northern division.

2.3 Implications for conservation and management

These results have important conservation implications. Only four of the 23 Islands are covered in the current protected area network in the Nicobar Islands. Three islands, Battimalv, Tillanchong and Megapode are wildlife sanctuaries and one; Great Nicobar Islands is a biosphere reserve, with two national parks; the Campbell Bay and Galathea (Pande *et al.*, 1991). Three of the current protected Islands are less than five sq km. Larger islands in the Central Nicobar and North Nicobar remain unprotected (see Table 1). Patterns of species distribution and endemism have not been taken into account in designing the current network of protected areas. The proportion of habitat loss in the Nicobars varies among islands and island groups. It is greater on North Nicobar and Central Nicobar; with an average of 45% and 21% of the natural forest cover loss over the past few decades

(Sankaran, 1998). Our data clearly elucidates the inadequacies in the current protected area network for the conservation of bat assemblages in the islands.

One of the important objectives of assigning protected area status is to manage and conserve the local biodiversity. But designing a protected area network requires considerable information on the components of the biodiversity. Studies on endemic birds of Nicobars have also pointed out this inadequacy in the current protected area network in the Nicobar Islands (Sankaran, 1997). Sankaran (1997) also proposed a biosphere reserve consisting of a core area on central portions of Kamorta, Katchall, and Nancowrie with all other area and islands as a buffer zone. However, areas set aside to maximize protection of one taxonomic group may not maximize protection of other taxonomic groups. In our case, islands and areas proposed as buffer zones by Sankaran (1997) have the presence of the endangered Nicobar flying fox (*Pteropus faunulus*). Also, this study has discovered many caves with significant bat populations including the endemic subspecies of Diadem's bat (*Hipposideros diadema nicobarensis*) in the proposed buffer areas (e.g. Teressa Island, see Chapter 3). A cross-taxonomic approach in designing a protected area network will relatively maximize species conservation (Oliver *et al.*, 1998). This requires that data from different taxonomic groups be incorporated. Considerable information is available on avifauna, and there is an ongoing research project on amphibians and reptiles, which will provide data on these vertebrates.

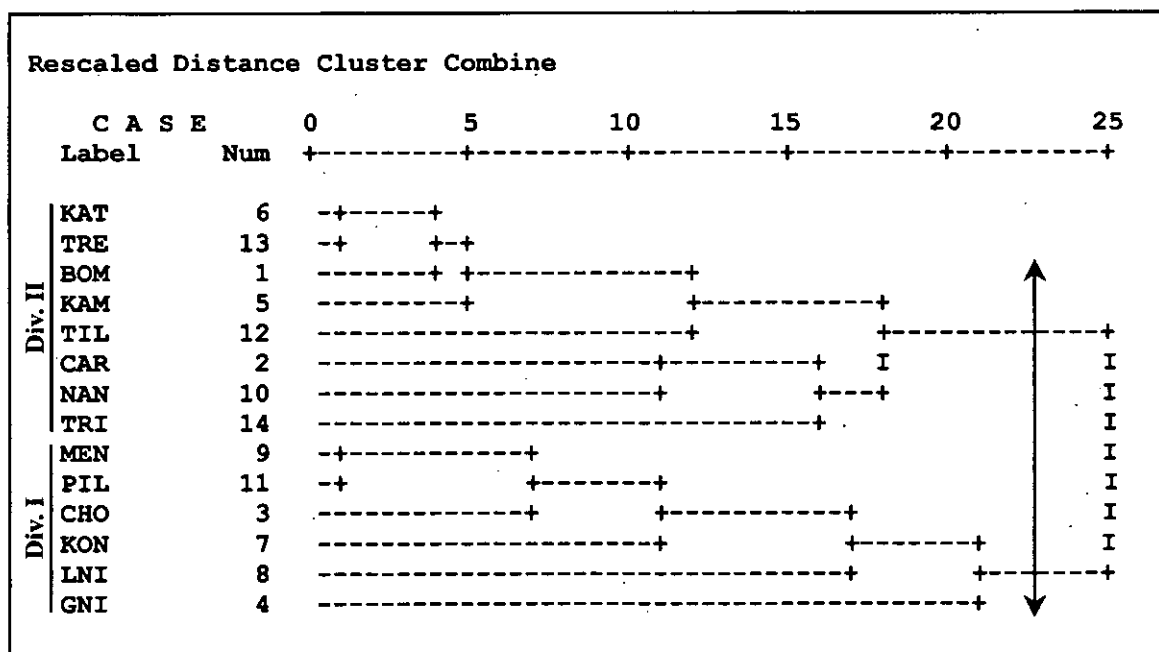


Fig 2: Subdivisions in the Nicobar group of islands based on bat species composition. Two island groups with dissimilar bat assemblages were identified by cluster analysis based on presence absence data. Dendrogram was generated using SPSS 7.5 software.

3.1 Introduction:

Bats shelter in caves, crevices, tree cavities, and buildings, and some roost in exposed locations on trees. Roosts provide sites for mating, hibernation and rearing of young; they promote social interactions and also provide protection from adverse conditions and predators (Kunz, 1989). Predation risk, the distribution and abundance of food resources, social organizations and an energy economy imposed by body size and physical environment determine the roost requirements of a bat species (Findley, 1993, Kunz, 1989, Fenton, 1983). Roost sites also might determine the geographic distribution of a species (Findley, 1993). An understanding of the roost habits of bats in the Nicobar Islands may shed light on the causes of the species geographic occurrence patterns in the islands. In this chapter we provide a detailed account of bat roosts in the Nicobar Islands.

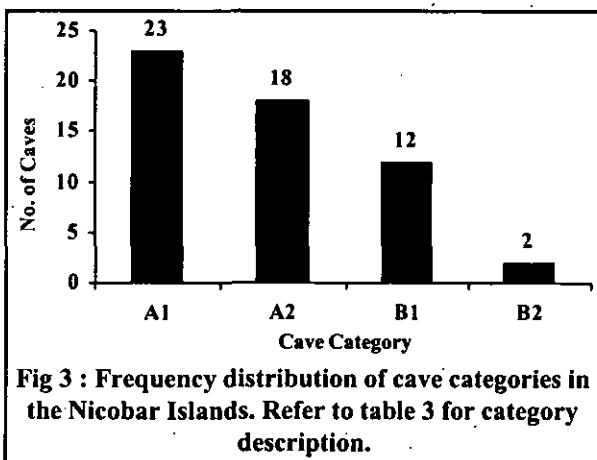
3.2. Permanent and temporary bat roosts:

3.2.1. Number and location of roosts:

The majority of the roosting sites in the Nicobar Islands are caves, bridges, crevices, road culverts and abandoned buildings apart from the species, which roost only in foliage. Of the 221 roosting sites identified in the survey - 54 are caves, 8 bridges, 11 bunkers, 136 road culverts, 4 abandoned building or thatched roofs and 7 tree or foliage roosting were located and mapped.

3.2.2. Distribution of caves in the Nicobar Islands

Caves were found on 13 of the 14 islands sampled in Nicobar. Great Nicobar, the largest island in the Nicobars also had the greatest number of caves (Table 5). The majority of caves in the Nicobar Islands were seashore type with fewer inland forest caves (Fig 3). The largest caves were found in the Central Nicobar group of islands. Many large forest caves in central Nicobar Islands had a fresh water source. The Nicobar group of islands does not support many cave complexes, in contrast to the cave complexes in the Andaman Group.



3.2.2.1 Caves in the North Nicobar Group of Islands:

In the island of Car Nicobar (Map: 2) only two caves were found of which one is an old Japanese dug cave where swiftlets (White bellied) and *Hipposideros pomona* were found to be roosting. The other cave was a huge tunnel in the sea and a boat could sail into it in high tide. This cave was however devoid of any bat occupancy.

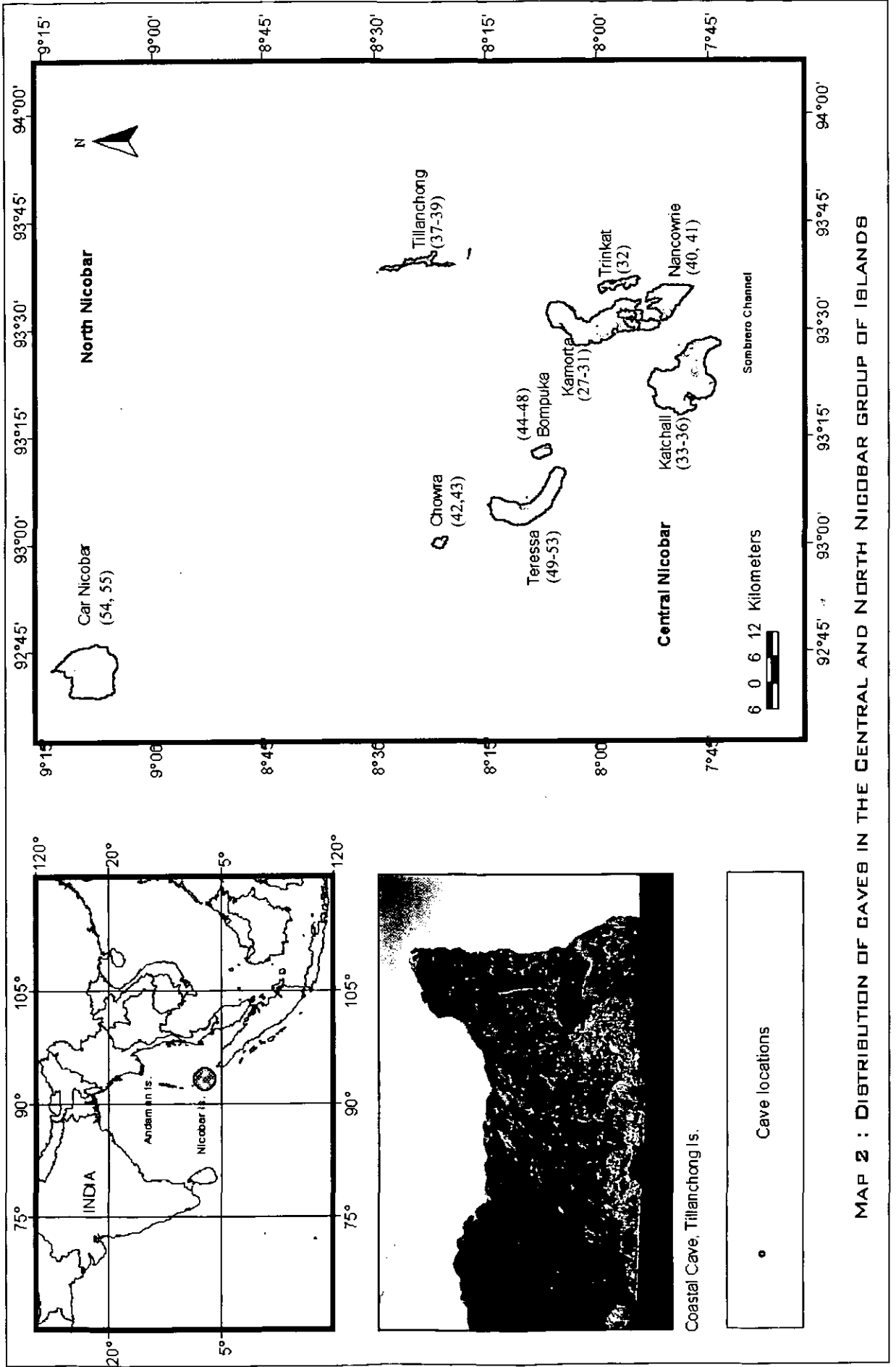
3.2.2.2 Caves in the Central Nicobar Group of Islands:

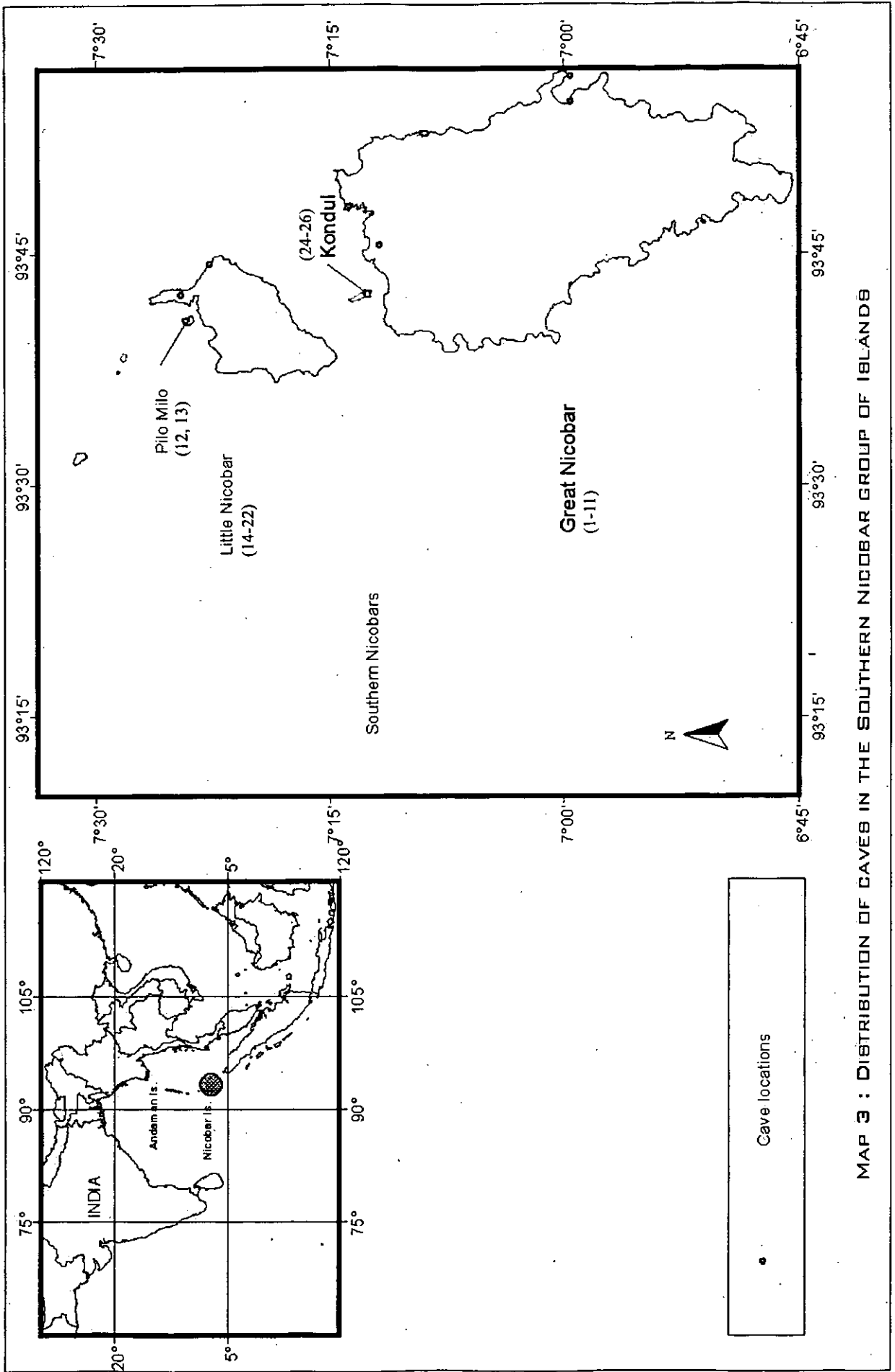
The Central Nicobar or Nancowrie group of islands consists of 10 islands and islets (Map:3). Single families own most caves in the central group and the entry into them are restricted to the family members only (Table 5). Some caves were shown to us on a confidential term, the owners however did not object to us mapping these caves for future reference. There were myths associated with each of these caves but the changing trend has created an air of indifference about past traditions and practices.

In Tressa island six caves were located in this island for the first time. These caves were all inland forest caves. *Hipposideros pomona* exclusively occupied one cave, two caves were shared by *Hipposideros diadema nicobarensis*, *Miniopterus pusillus*, *Pipistrellus javanicus*, *Pipistrellus coromandra camortae* and swiftlets (edible nest), while one was exclusively inhabited by edible nest swiftlet and two were vacant. The maximum number of cave dwelling species (s=5) were found on this island group. Chowra Island had two inland forest caves and *Hipposideros pomona* shared only one cave with -swiftlets and one was exclusively occupied by edible nest swiftlets. These caves were located on cliff faces. Nancowrie Island had only one seashore cave, which was occupied by *Taphozous melanopogon*. Kamorta Island had four seashore caves. Of these caves only one was occupied by *Hipposideros pomona* and swiftlets, one exclusively by *Hipposideros pomona* and two were vacant. Katchal Island had four in forest caves, two of which were occupied exclusively by *Hipposideros pomona*. The other two caves were shared by *Hipposideros diadema nicobarensis*, *Miniopterus pusillus*, *Pipistrellus sp* and swiftlets. Tillangchong Island had three seashore caves all inhabited by swiftlets and no bats. The caves in this island are also frequently used by swiftlet nest collectors. The inland forest caves were not located. Bompuka Island had five caves. Two caves were inland forest caves and three were seashore caves. *Miniopterus pusillus*, *Pipistrellus sp*, *Taphozous melanopogon* and swiftlets shared three caves; one was exclusively occupied by *Taphozous melanopogon* and one was vacant.

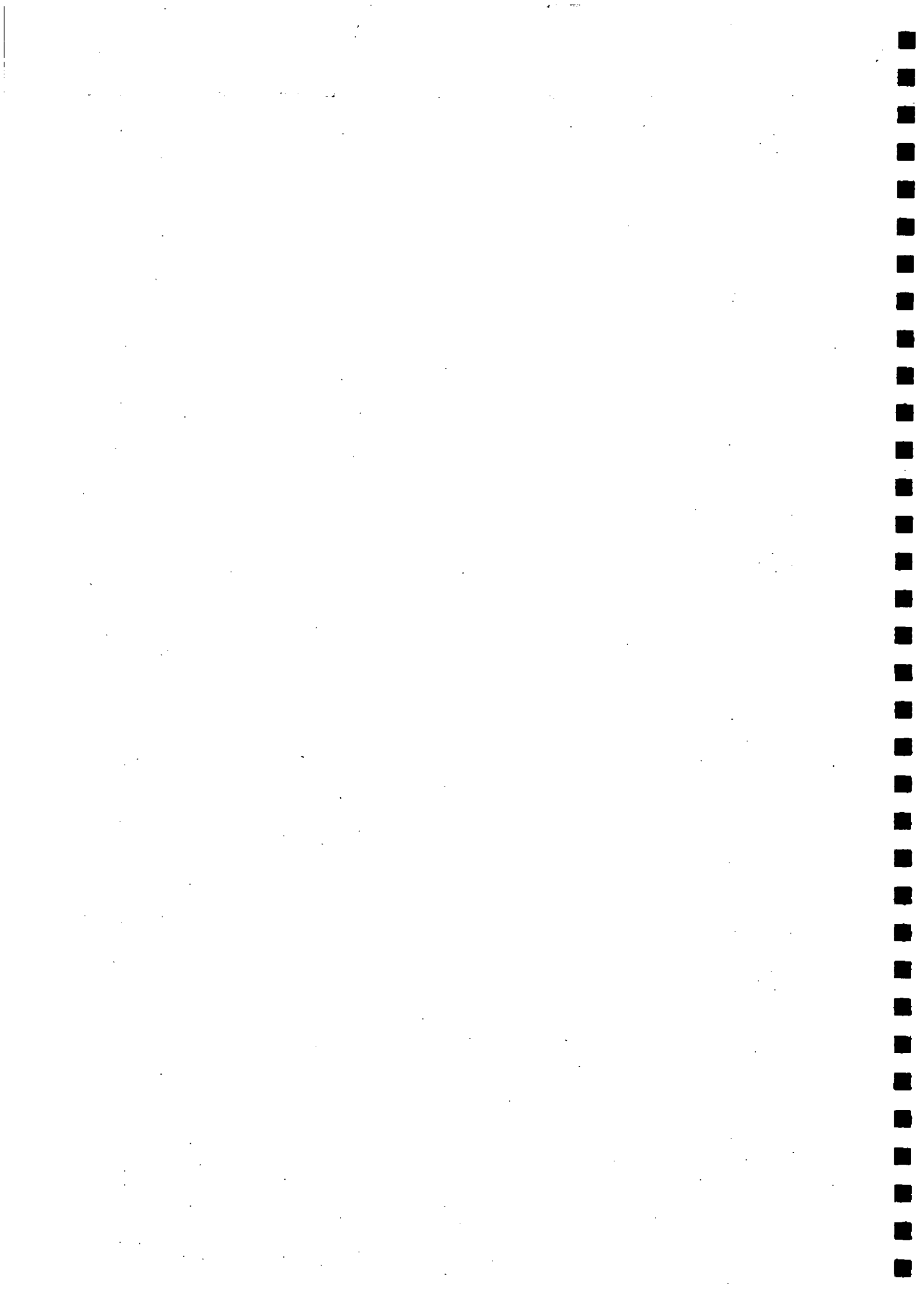
3.2.2.3 Caves in the Southern Nicobar Group

The Southern Nicobar group of islands comprising of Great Nicobar Island (11 caves), Little Nicobar Island (10 caves), Kondul (3 caves) and Pulo Milo (2 caves) islands were





MAP 3 : DISTRIBUTION OF CAVES IN THE SOUTHERN NICOBAR GROUP OF ISLANDS



surveyed. A total of 26 caves were located on these islands (appendix 1). All these caves were seashore caves. *Taphozous melanopogon*, *Hipposideros pomona*, *H. ater nicobarulae* and swiftlets occupied only 14 caves, four caves were exclusively inhabited by swiftlets and eight caves were vacant.

Table 5: Number and ownership status of caves surveyed in the Nicobar Islands

Islands	No of caves	Ownership status	No of bat species
Great Nicobar	11	None	2
Little Nicobar	10	None	1
Pulo Milo	2	None	1
Kondul	3	All Owned	1
Nancowrie	1	All Owned	2
Trinket	1	None	0
Kamorta	4	All Owned	1
Katchal	4	Two Owned	5
Tillangchong	4	None	0
Chowra	2	All Owned	1
Bompuka	5	Two Owned	4
Tressa	6	Five Owned	4
Car Nicobar	2	None	1
Total No	55		

3.2.3 Cave bat assemblages

Caves are very important roosting site for bats. We discuss our findings separately considering their importance for bat species conservation in the Nicobar Islands. Caves have evolved into a mini ecosystem of its own (Fenton, 1983; Findley, 1995, Darlington, 1995). A number of insects - cockroaches, centipedes and fungi were also seen to be flourishing in these unique habitats. Apart from these, snakes were also seen to be occupying the niche of the top predator in the cave ecosystem. Pit vipers (*Trimeresurus* sp.) and monitor lizards (*Varanus salvator*) were commonly sighted in the caves. The Pit vipers usually occurred on the entrances and occasionally even on the cave ceiling. On one occasion, stomach flushing of the snake revealed it to have fed on *Hipposideros diadema nicobarensis*. The presence of snakes also appears to be major deterrent to people.

There are distinct differences in the zones (Fenton, 1983) occupied by bats and birds within the cave. The white bellied and the edible nest swiftlet were found to be limited to the twilight zones while the bats, which have very well developed echolocation, tended to roost deeper in the dark zone of the caves. Segregation of the bats and swiftlets was very prominent, though some intermixing was observed. There was a distinct preference that was noted between species that roosted together and in which cave type they were found. *Hipposideros pomona* was one of the most abundant cave dwelling species found, this species was found to occupy sea shore as well as inland forest caves. This species was observed to share the roost with *Miniopterus pusillus*, *Pipistrellus* sp., On the other hand, species like *Hipposideros diadema nicobarensis* and

Taphozous melanopogon. *Hipposideros diadema nicobarensis*, *Miniopterus pusillus* and *Pipistrellus* sp. were mainly found in inland forest caves while *Taphozous melanopogon* occurred only in sea shore caves and rocky crevices. Cave complexes are important for determining species presence as well as diversity in an area. Nicobar Islands (s=12) have less bat diversity in comparison to Andaman's (s=22). Andaman Is. has larger cave complexes: 190 caves in a single area (Baratang Is.) The caves in Nicobar's varied from small crevices to large caves >1/2 km long. A few large caves in the Nicobar Islands for example cave no 35 in Katchall Is., supported large aggregations (n>2000 indivi. Approx.) of single and multiple species bat roosts. The presence of chambers and alleys within the cave might determine the number of species in a cave for e.g. cave no 5, Great Nicobar Island, is one of the large caves in the Southern Nicobar group. This cave has two small inner chambers and was occupied by *Taphozous melanopogon* and *Hipposideros pomona* apart from edible nest swiftlet. *Hipposideros pomona* occupied the inner chambers in the cave while *Taphozous melanopogon* occupied the outer zone in the cave where light easily penetrated.

3.2.4 Synanthropy: A paradox of human influence

Many bats successfully adapt to a variety of man-made structures using them as roosts. The exploitation of these structures as substitutes for caves, tree cavities and other natural roosts supports the view that most bats are highly adaptable and opportunistic, in roost selection. Buildings, road culverts, and other structures of stone and brick are regularly used by cave dwelling species (Kunz, 1989, Wilson, 1996). In the following paragraphs we discuss bat assemblages in man-made structures: bridges, road culverts, bunkers, abandoned buildings and thatched houses.

3.2.4.1 Bridges

Bridges and bats have had a long association and a number of bridges have been marked as important sites for many vulnerable species. We surveyed eight bridges to estimate use of bridges as a roosting site for bats, of which only two bridge had a colony of bats (*Myotis horsfieldii dryas*) roosting under it. Of the eight bridges surveyed only two were concrete or cement made bridged while six were metal bridges. Only cement made bridges, which had squares or grooves under them were inhabited by bats. Bats were not found under metal bridges.

3.2.4.2 Road culverts

These structures were very abundant in locales where roads have been planned or roads were built but are now closed down due to landslides. For example, in Great Nicobar Island the east-west road, 47 km in length, has some 118-road culverts. All of the 118 road culverts were surveyed and only 50 were occupied only by *Hipposideros pomona*. In Katchal there is a 26 km long road with four road culverts, but only one instance we observed *Hipposideros pomona* to use the road culvert as a night roost. this

observation was made in the night. Only two individuals were seen in the culvert. On checking the same culvert in the morning, it was found to be vacant. Kamorta has eight km tar road and eight km unmettled road. This unmettled road stretch has some seven road culverts and five were inhabited by *Hipposideros pomona*. Bats occupied only 56 of the total 136 road culverts surveyed. All occupied culverts were utilized by a single species, *Hipposideros pomona*. These occupied culverts were old and had vegetation cover their entrances. New road culverts and culverts present in places with regular traffic were not occupied by bats; some culverts in unused areas were also not inhabited. These culverts did not have any vegetation cover.

3.2.4.3 Bunkers

A number of historically significant gun locations are present in the Nicobar Islands. The Japanese used these sites as defense locations and as hideouts during the second world war. We mapped 11 bunkers (Map:4) in total of which only five were inhabited by bats (Table 6). Only two species were found roosting in the bunkers, namely *Hipposideros pomona* and *Hipposideros diadema nicobarensis*. These two species were found roosting together and alone in the bunkers. When found together there was a distinct segregation in roosting areas within the bunker. *H. diadema nicobarensis* was found to roost in the centre while *H. pomona* occupied the side walls and the remaining area in the roof of the bunker. Some of the bunkers were located near the sea shore and were exposed to strong winds, such bunkers were not inhabited by bats nor was there any indication (such as the presence of faeces) of prior occupancy. *H. diadema nicobarensis* was not found in any other island using bunkers as roosting places.

Table 6: Location of Japanese Bunkers and associated bat species

Bunker no	Island	Species	Type
1	Trinket	No Bats	Seashore
2	Trinket	No Bats	Seashore
3	Trinket	HIPO	Inforest
4	Trinket	HIDI, HIPO	Inforest
5	Trinket	HIPO	Inforest
6	Kamorta	HIPO	Inforest
7	Kamorta	HIPO	Inforest
8	Kamorta	No bats	Inforest
9	Car Nicobar	No bats	Inforest
10	Car Nicobar	No Bats	Seashore
11	Car Nicobar	No Bats	Seashore

Note: *Hipposideros pomona* (HIPO), *Hipposideros diadema nicobarensis* (HIDI)

3.2.4.4 Abandoned buildings and thatched houses

The most dominant type of houses found in the Nicobar group of islands is called "Ngyo-Pul" or round huts. These

are typically built on stilts and are wooden, and thatched with fronds of Nypa Palm for roofs. Bats were found to be using the roofs of such houses as roosts. On one occasion the owner informed us that the bats (*Pipistrellus javanicus*) had been roosting in his roof for four years. He also informed us that the bats left the roost in the early evening and did not return before 2 am. In other places we located similar roosts by showing the inhabitant photographs and explaining the potential type of roost we find bats in. The inhabitants were extremely aware of their surroundings and we were successful in locating roosting bats. Such roosts could otherwise be recognized by their characteristic pungent odour and orangish-yellow markings due to their dropping. Such roosts were predominately inhabited by the following bat species, *Pipistrellus coromandra comortae*, *Pipistrellus javanicus* and *Myotis horsfieldii dryas*.

3.2.5 Foliage / tree roosts

Bats have been dependent on plants for food as well as shelter (Marshall, 1985, Kunz, 1996, 1994; Kunz *et al.* 1996;) There are some species of bats that roost either in tree hollows or in leaves using them as a clever camouflage (Marshall, 1985, Kunz, 1989,). Three megachiropterans - *Pteropus melanotus*, *Pteropus faunulus* and *Cynopterus brachyotis*, and three species of insect-eating bats were found to be using tree hollows as roosts, *Pipistrellus coromandra* (coconut tree hollow,), *Hipposideros pomona* (*Manilkara* sp.,) and *Murina cyclotis* (dry leaves of banana tree).

Flying foxes were reported to roost in large aggregations in the mangle swamps during the rainy season (sec. Sources). However, a day roost of *Pteropus melanotus*, n<600) on an uninhabited island - Tillangchong, in the dry season was located. We also checked some sites previously reported by tribals to be occupied by flying foxes in the rains were found to be vacant. Only in the north of Great Nicobar Island was there an aggregation of *Pteropus melanotus* (n<200).

3.3 Significant permanent roosts for conservation and monitoring:

The caves listed in Table 7 were found to be significant for bat species conservation and monitoring in the Nicobar Islands. The following factors were taken into consideration in the identification of these caves.

- Presence of multiple species
- Large in areal extent thereby supporting greater population size and species richness
- Presence of threats like disturbance due to edible nest swiftlet collection.
- Presence of endemic species

The caves listed in (table 7) are the largest in the Nicobar group and are located in the Central Nicobar Group of islands. Six species of bats inhabit these caves. The presence of endemic species and disturbance in cave numbers 33, 35, 36, 44, 49 and 50 was essential for determining conservation action for these cave complexes. The threats

to these cave-dwelling species are primarily due to nest collection activities by both local inhabitants and mainlanders settled in areas close to these caves. Unplanned and indiscriminate nest collection involves the intrusion of humans into these caves causing disturbance to bats residing in them. Prolonged and frequent activities of such nature might even lead to roost abandonment. These

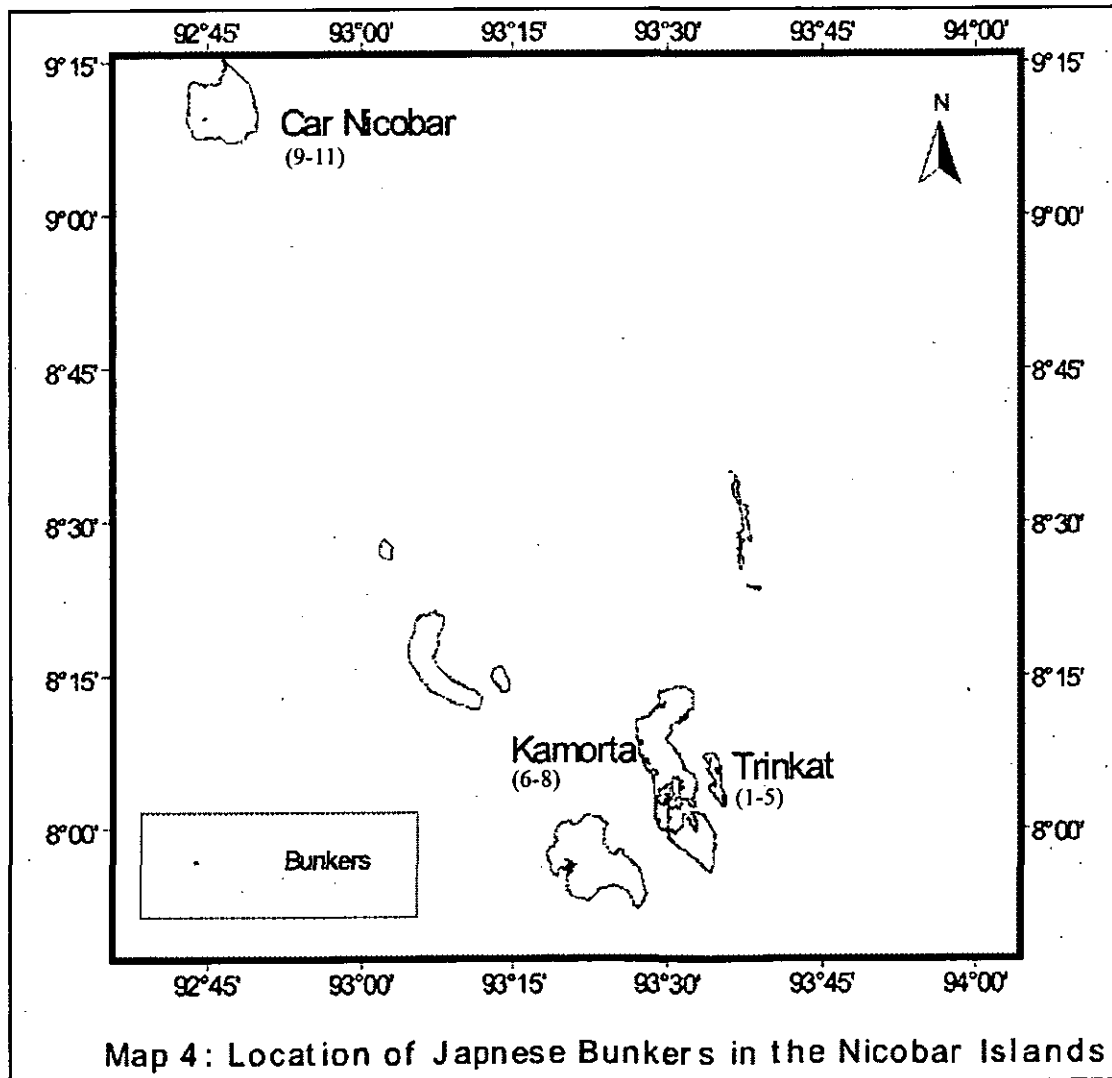
activities are a threat to the survival of species like *Miniopterus pusillus*, *Hipposideros diadema nicobrensis* and *Taphozous melanopogon* for which no alternate roosts are available in the islands. Though *H. diadema nicobrensis* was found to use bunkers in Trinket island, the availability of roosts in other islands like Kamorta and Car nicobar did not support this species in them.

Table 7: Caves identified for conservation priority

Cave* No	Location	Total number of species	No Endemic species /sub species	Threats due swiftlet Nest collection
33	Upper Katchal	2	1	+
35	"	3	2	+
36	"	1	1	+
44	Bompuka	3	1	+
46	"	1	0	+
49	Tressa	2	1	+
50	"	3	1	+
51	"	1	0	+

“*” same as in the appendix I

“+” denotes presence “-” denotes absence



**CHAPTER 4: SPECIES DESCRIPTIONS:
TAXONOMY, NATURAL HISTORY, DISTRIBUTION
AND CONSERVATION STATUS**

4.1 Introduction:

In this chapter a detailed account on the species observed during this study is provided. For each species, the following notes are provided: taxonomic, ecological and conservation. Conservation priority was determined for

each species encountered in the study. This was done to effectively design immediate action plans for bat species. The Conservation priority was determined as described in section 1.5.4 (Chapter:1). Species under P1 are in need of immediate conservation action.

Table 8: Conservation priority of bat species in the Nicobar Islands

Species	Geo. Range	Endemic Status	Habitat Specificity	Commonness	Observed threats	IUCN status	Conservation priority
<i>Pteropus melanotus</i>	Broad	NE	High*	Uncommon	Hunting, Habitat Loss	DD	P2
<i>Pteropus faunulus</i>	Narrow	E	High*	Rare	Hunting, Habitat Loss	VU	P1
<i>Cynopterus brachyotis</i>	Broad	NE	Low	Common	Habitat Loss	LRlc	P3
<i>Tapochozous melanopogon</i>	Narrow	NE	High	Uncommon	Nest collection activities	DD	P2
<i>Hipposideros ater nicobarule</i>	Narrow	E	Uncertain	Uncertain	Nest collection activities	Not evaluated	P4
<i>Hipposideros pomona</i>	Broad	NE	Low	Common	Nest collection activities	LRnt	P3
<i>Hipposideros diadema nicobarensis</i>	Narrow	E	High	Common	Nest collection activities	LRnt	P2
<i>Miniopterus pusillus</i>	Narrow	NE	High	Common	Nest collection activities	Not evaluated	P2
<i>Pipistrellus javanicus</i>	Narrow	NE	High	Common	Nest collection activities	LRnt	P2
<i>Pipistrellus coromandra camortae</i>	Narrow	E	High	Uncertain	Uncertain	DD	P4
<i>Myotis horsfieldii dryas</i>	Narrow	E	Uncertain	Rare	No Information	DD	P4
<i>Murina cyclotis</i>	Broad	NE	Uncertain	Uncertain	No Information	Not evaluated	P4

Note: * data from secondary sources.

Ethno of Bats:

Due to the abundance of forms and the myriad legends and superstitions concerning them, bats have been given vernacular names in practically all languages. The vernacular names for the various bat species were found to vary slightly from each island group. In Nicobar, the belief is that these species are only two types – one big bat and one small. Following are the list of names referred to different bat groups.

Car Nicobar. *Tayam law* (biggest fruit bat), *Tayam peh* (medium sized fruit bat), *Allah* (-small fruit bat) and *Alkelein* (insect-eating / funny-faced bat).

Central Nicobar Group. *Mok-neaka law* (big fruit bat), *Mok-neaka peh* (medium and small fruit bat) and *Hinglenea* (insect-eating/ funny-faced bat).

Please Note: Species account starts from the next Page

Pteropus melanotus Blyth, 1863

plate 1

Sub Order – Megachiroptera
 Family - Pteropodidae : Old World Fruit Bats

Taxonomic notes:

This medium sized fruit bat is the largest species of bat in the Nicobar group with a FA of 165.5 ± 8.03 mm, EL of 18.1 ± 5.8 mm and a body mass of 619.8 ± 57 g. (N=8). The tail is short, rudimentary, or absent. The tail membrane is only a narrow border. The body mass varied between 650-750 grams. The ears are large with broadly rounded off tips. The nose is deeply emarginated and two tubular nostrils were noted. The ventral surface is dark brown to blackish brown, with paler hair sometimes giving it a grizzled appearance. The back and rump are blackish, sprinkled with a few gray hairs. The mantle is rufous in males and lesser or absent in females.

Natural History :

P. melanotus were seen to be roosting in mangroves and also in Nypa palm in two islands namely – Tillanchong, in Central Nicobar Islands and North Bay in Great Nicobar Island. *P. melanotus* was observed to feed on *Bombax* sp. in most places while on Kamorta it was seen on *Sterculia* sp. In Tillangchong Is, more than 500 individuals were observed and the number per palm frond ranged from 10 to 15 individuals. This colony was located in the month of March 2003 and several young pups were also seen clinging to the mother. The colony in Great nicobar Island housed

more than 300 individuals in a mangrove creek. This colony was located in the month of august 2003 and no pups were seen in this colony. There was a distinct musky odor where the colony was located.

Threats :

Hunting of this species and habitat degradation has probably resulted in the decline of their population (sec sources). Signs of hunting were observed in Great Nicobar island (Site: Navy Dera). These were remains of the bats (*Pteropus* sp) which we were able to ascertain through FA bones remains and skulls present at the site. A total of 6-7 individuals could be counted. *P. melanotus* are kept as pets in some of the islands (Trinket, Kamorta, Katchal, Pulo Milo and Car Nicobar Is). The wings of these bats are clipped to prevent them from flying away. They were fed with bread, and coconut.

Distribution :

Great Nicobar, Kondul, Trinket, Nancowrie, Kamorta, Katchal, Bompuka, Teressa, Tillangchong, Car Nicobar.

Status :

IUCN Status: DD (Data Deficient).

Conservation Priority: P2 (Table: 8)

Sub Order Megachiroptera
Family Pteropodidae : Old World Fruit Bats

ENDEMIC SPECIES

Taxonomic notes :

This is a much smaller species than *P. melanotus* with an average FA length of 118.5±11.5mm, EL of 18.4±4.6mm and a body mass of 172.8±60.4g. (N=6). The pelage color is dark rufous brown on the back with dark roots, the hairs on the face are interspaced with grey and white hair giving it a grizzled look. The pelage is thick and long and very lustrous. The ears are triangular in appearance. The nostrils are tubular and well emarginated. The ears are broad at the base and acutely pointed at the tips giving it a triangular appearance.

Natural History :

Roosts of this species was not located in the present study but interviews with hunters and local inhabitants suggest that *P. faunulus* is a solitary roosting species not forming large aggregations like *Pteropus melanotus*. It was reported to roosts in the fronds of Jungali supari trees. We were able to observe this endemic bat in the night while foraging. It was seen feeding on fruits of *Bombax sp.* It was observed to feed at a sub canopy level. In all the occasions only one individual was observed foraging in a tree. It probably avoids interaction with *Pteropus melanotus* by feeding at sub canopy height, lower than *Pteropus melanotus*. No signs of defending of foraging area was observed. The first record of this species was from the Northern Nicobar group (Car Nicobar Is) in 1902. However, our team was unable to find any signs of this endemic species from the previously reported Island.

Threats :

This is the most threatened species of fruit bat in the Island. Hunting pressure of this endemic species may be driving it to critical numbers. In a night we could observe at least 4-5 people with air guns in most villages hunting for this

species. Its meat is believed to be a cure for asthma. In some places even the bones are crushed and prepared as medicine. The first encounter with this species was made in Trinket Is. A local inhabitant also a hunter after having shot the mother had reared the orphaned baby. He informed the team that the *Pteropus faunulus* pet he was keeping was 3 years old. The pet bats were fed on tender coconut other locally available fruits. It was always kept in a cage and looked unhealthy. Similar incidents were encountered on Tressa Is and Katchal Is as well.

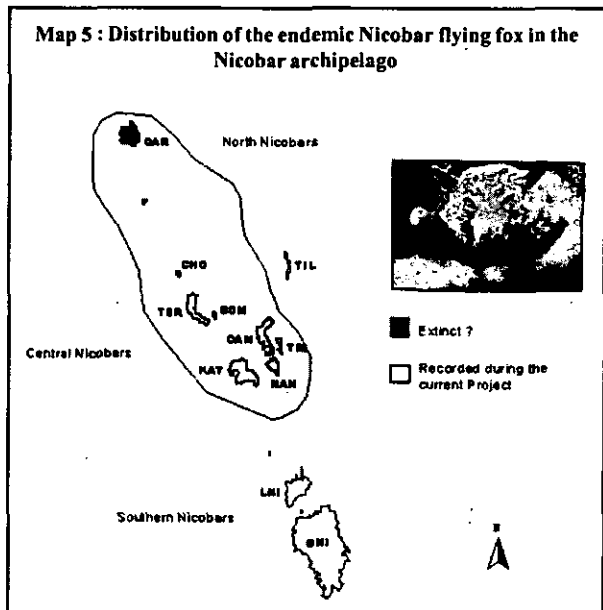
Distribution :

Trinket, Nancowrie, Kamorta, Katchal, Bompuka, Teresa (Map 5).

Status :

IUCN Status: VU (Vulnerable)

Conservation Priority: P1 (Table: 8)



Taxonomic notes :

This is a small fruit bat with a FA of 65.82 ± 1.2 mm, EL of 16.1 ± 1.5 mm and a body mass of 29 ± 4.6 g (n=522 individuals). The taxonomic status of the sub species *sphinx* and *brachyotis* is unclear in India and also the islands. *C. sphinx* was reported from the Nicobar Islands but it was not found in the survey, instead *C. brachyotis* was identified. The two species (*C. sphinx* and *C. brachyotis*) are present in both Andaman and Nicobar group of islands. The FA <70 mm was used as a cut off point for *C. brachyotis*. All the individuals in the Nicobar group fell well below this cut off point. This species was on an average smaller than *sphinx*. The white borders on the ears were pale and in some instances absent in *C. brachyotis* while the white borders on the ears of *C. sphinx* is very prominent

Natural History :

Cynopterus brachyotis occurred on all the 14 islands surveyed and it was caught in all the habitats that were sampled using mist nets. This species were found in many different habitats, mainly mangrove fringes, evergreen forests, plantation and human habitations. They were

observed visiting fruit plantations frequently and in some areas were reported to be very damaging to the plantations. The local inhabitants also reported that these species often roost in coconut tree, (*Cocos nucifera*), under leaves by making tents either in groups or solitary. A number of roosts were located in the forest, and in plantations. these were under the leaves of coconut trees. A maximum of 10-15 bats were seen in a single group. They begin foraging early evening and continue until dawn. A distinct "click - click" sound can be heard while they move from tree to tree for foraging. On getting trapped in the nets their alarm call attracts a number of other individuals to the site.

Distribution :

Great Nicobar Island, Kondul, Little Nicobar, Pulo milo, Menchal, Trinket, Nancowrie, Kamorta, Katchal, Bompuka, Teressa, Tillangchong, Chowra, Car Nicobar.

Status :

IUCN Status: LRLc (Low risk, least concern).

Conservation Priority: P3 (Table: 8)

Sub order Microchiroptera
Family Emballonuridae: Sac-winged Bats

NEW RANGE RECORD

Taxonomic notes :

A medium sized bat with FA60.88±2.1mm, EL17.67±1.6 mm and a body mass of 22.06±3.6 g (n=48). Most members of this family were greyish-brown (Central Nicobars), or black (Great Nicobar Island) in color. The pelage color varied on Bompuka Island, where the individuals were a light buff coloured with white under belly. The face and lips are smooth. The ears are often united across the top of the head, and a tragus is present. In this family, the tail pierces the tail membrane . The tip appears completely free on the upper surface of the membrane with the base of the tail being loosely enclosed in the membrane. The hind legs are slender. Adult males were observed to have a black patch under the chin. This patch is referred to as a beard.

Natural History :

T. melanopogon was observed in the sea shore caves. It shares the roost with other micro-chiropterans and birds. *T. melanopogon* occupy smallest of cracks in caves. These bats are agile in their retreats, scrambling about with

considerable dexterity and often clinging to vertical walls or crawling into crevices. The number of individuals in a roost, varied from 25 to 200. The flight is swift and strong, they were observed to take off into the strong winds also. When disturbed it is quick to take flight even in the bright sunlight. These bats were not captured in mist nets, presumably because this species typically forages high above the canopy. It was readily identified in flight by a distinct squeaking sound , easily distinguished without the use of a bat detector. The percentage of males (41.6%) to females (58.3%) was very low when captured using hand held nets from the caves.

Distribution :

Great Nicobar, Kondul, Nancowrie, Bompuka, and Little Nicobar.

Staus :

IUCN Status: LRnt (Low risk, not threatened).
Conservation Priority: P2 (Table: 8)

Sub order Microchiroptera

Family Hipposideridae : Leaf-nosed bats

ENDEMIC SUB SPECIES

Taxonomic notes :

Hipposideros ater nicobarulae are small sized leaf nosed bats (FA=39mm). *Hipposideros ater*, and *Hipposideros pomona* were distinguished on the basis of the FA measurement (table: 10). The ear shape of *Hipposideros ater* is broad at the base and rounded off at the tips. The taxonomy of these two species will need to be carefully worked on in their entire range (Harrison, *D pers comm*). The noseleaf of both these species are almost similar (Bates, 1998). There are no supplementary leaflets or emarginations. It is lightly covered with hairs. The muzzle has an elaborate leaf like outgrowth of skin. This nose leaf consists of an anterior horseshoe-shaped part, sometimes with smaller accessory leaflets, and an erect transverse leaf. The feet are small. The tail is long and enclosed within the interfemoral membrane except the tip. The pelage is variable in color ranging from pale brown / grey to rufous. The base of the hair are paler than the back.

Natural History :

Hipposideros ater was found to be roosting in caves in Little Nicobar Island, Pulo Milo and Car Nicobar. It was found in caves (Cave no: 14-16 and 20, Little Nicobar island; Cave no 12 and 13, Pulo Milo; Cave no 54, Car Nicobar island) inland as well as seashore. Only one individual was caught roosting in an abandoned building in Galatea, Great Nicobar Island. A total of 5-6 individuals were reported to roost in it but at the time of our visit only one was observed. It was mist netted across a fresh water stream located in a secondary forest in Menchal Island.

Distribution :

Great Nicobar Island, Pulo Milo, Menchal, Little Nicobar islands and Car Nicobar Is.

Status :

IUCN Status: LRnt (Low risk, not threatened).

Conservation Priority: P4 (Table: 8)

Sub order Microchiroptera
 Family Hipposideridae : Leaf-nosed bats

Taxonomic Notes :

Hipposideros pomona is a medium sized leaf nosed bat with an average FA of 40 ± 0.53 mm (Table:10). Differing only slightly from *Hipposideros ater*, we distinguished individuals on the basis of the FA measurements. Individuals with $FA > 40$ mm were grouped as *H. pomona* and individuals with $FA < 40$ mm were grouped under *H. ater nicobarulae*. The ear shape of *H. pomona* is broad at the base and tapering into a pointed tip. There are no supplementary leaflets or emarginations. It is lightly covered with hairs. The muzzle has an elaborate leaf like outgrowth of skin. This nose leaf consists of an anterior horseshoe-shaped part, sometimes with smaller accessory leaflets, and an erect transverse leaf. The tail is long and enclosed within the interfemoral membrane except the tip. The pelage is variable in color ranging from pale brown / grey to rufous. The base of the hairs are paler than the tip. In Bompuka island the pelage color was a rich orange.

Natural History :

H. pomona was found in caves – inland as well as seashore. It is a widely distributed species in the Islands , it was

found on 10 out of the 14 islands surveyed . It was found in sympatry with *H. diadema nicobarensis*, *Miniopterus pusillus* and *Pipistrellus sp.* as well as singly in some caves and under culverts. *H. pomona* was also found on Chowra Island (cave no 42) where natural fresh water sources are absent. It was also found to adapt and roost under road culverts and abandoned building. In the month of March pups were seen clinging on to the mothers. Some of these pups had not opened their eyes. *H. pomona* hangs singly from a point on the roof of the roost. They do not form close clusters like *Miniopterus sp* (plate: 7) or *Pipistrellus sp.* They are very difficult to capture in mist nets as they avoid the net very easily.

Distribution :

Great Nicobar, Kondul, Kamorta, Nancowrie, Katchal, Trinket, Tillangchong, Bompuka, Chowra, and Tressa.

Staus :

IUCN Status: DD (Data deficient).

Conservation Priority: P3 (Table: 8)

Table 10: Morphometrics: Comparison of *Hipposideros ater nicobarulae* and *H. pomona*

Characteristics	<i>H. ater nicobarulae</i>	<i>H. pomona</i>
FA (mm)	39.3 ± 0.6	40.5 ± 0.53
EL (mm)	16.9 ± 0.9	15.2 ± 0.8
NW (mm)	4.8 ± 0.12	4.6 ± 0.1
NL (mm)	5.2 ± 1.2	4.4 ± 1.1
Body mass (g)	7 ± 0.3	7.3 ± 0.5
N	52	245

Sub order Microchiroptera

Family Hipposideridae : Leaf Nosed Bats

ENDEMIC SUB SPECIES

Taxonomic notes

This large endemic subspecies of leaf nosed bats has an average FA 65.32 ± 1.24 mm, EL 22.7 ± 1.7 mm, NW 9.43 ± 0.43 , NL 8.71 ± 0.47 and a body mass of 25.2 ± 4.7 g (n=96). The ears are of moderate size, broad at the base and acutely pointed tips. The nose leaf is well developed with four lateral supplementary leaflets: the fourth one is almost absent. The intermediate leaf is expanded with a prominent medium projection flanked laterally by two smaller leaflets. The pelage is light brown on the back and whitish on the belly. The back has four patches of white; two on the shoulder and two on the hip place. These white spots were in the shape of small patches and did not run down the length of the body. There was little variation in pelage colour between males and females, the males were slightly lighter coloured as compared to the females.

Natural History :

H. diadema nicobarensis was previously reported only on Trinket Island in a seashore cave (Cave no 32, trinket Is) which is now vacant. This endemic sub species was found to roost in forest caves and in one occasion in old World War II bunkers (Trinket Is). It was observed to share the roost with other *Hipposideros* sp. These bats were

found to roost in large (n>500) to small colonies (n>30). It hangs singly from a point on the roost roof. Individuals were frequently observed to roost in high chambers within a cave. In cave no 35, Katchal an albino of the species was observed. This is a first time record of an albino bat in India. This individual was a male and was not found to be roost with other individuals. Preliminary observation of the food habit of the species shows to be composed of beetles (Order: Coleoptera) in their diet. The species is a low flier in the forest, captured between 2 to 4 m in the mist nets (pers obs.). In Bompuka we netted an individual with a bullet wound and puncture in its wing. This species was found in gallery forest, over water pools and even in disturbed forests. Pregnant females were observed in the month of march 2003. One instance, stomach flushing of a pit viper (*Trimeresures* sp) in a cave, revealed it to have fed on this species of bat.

Distribution :

Trinket, Katchal, Bompuka, Teressa, Tillangchong.

Staus :

IUCN Status: NE (Not evaluated).

Conservation Priority: P2 (Table: 8)

Sub order Microchiroptera
Family Vespertilionidae: Evening bats

ENDEMIC SUB SPECIES

Taxonomic notes

This medium sized endemic subspecies of bat has an average FA of 39.4±0.6 mm, EL of 13.8±1.3 mm, and body mass of 12.73±0.33 g (n=10). The ears are naked, dark, elongated and straight with the tragus slender and straight. The well-developed tail extends to the rear edge of the tail membrane or slightly beyond. The pelage coloration is jet black with a white belly. The well-developed tail extends to the rear edge of the tail membrane or slightly beyond. The feet are enlarged and the wings are attached to the outer metatarsal of each foot. The interfemoral membrane and wing membrane are dark colored. Some light hairs were seen on the wing membrane close to the body.

Natural History :

M. horsfieldii dryas seen to be roosting under bridges in Great Nicobar Island. It was also found to roost in the cracks of the beams in wooden houses. Such roosts in cracks and hollows between wooden beams was also

occupied by *Pipistrellus javanicus* (Arong, Car Nicobar). The presence of this bat species on an island is restricted by the availability of fresh water (Bates and Harrison, 1997). It was observed to fly extremely low on the water surface and favors caves, crevices or small holes as day roosts. *Myotis h. dryas* is extremely sensitive to human presence and mist net, they had to be chased into the net while two people held the nets upright. It was also mist netted (Pulo Panja, Little Nicobar Is.) across a forest stream.

Distribution:

This is the first report of *Myotis horsfieldii dryas* in the Nicobar Islands. Great Nicobar, Little Nicobar and Car Nicobar.

Staus :

IUCN Status: LRnt (Low risk, not threatened).

Conservation Priority: P4 (Table: 8)

Sub order	Microchiroptera
Family	Vespertilionidae: Evening bats

Taxonomic notes :

P. javanicus is a medium sized pipistrelle with an average FA of 32.05 ± 0.5 mm (table:11). This species was distinguished from *P. coromandra camortae* on the basis of color variation and the length of the FA. The pelage color of *P. javanicus* is golden brown with dark hair bases. The ventral surface is paler in appearance. The ear and membranes are naked with very little hair on the interfemoral membrane and on wing membrane surrounding the body. The ears are elongated with a number of ridges present. The tragus is small and not curved outward. In Car Nicobar we found two colour morphs of this species, one chestnut brown and one rufous coloured.

Natural History :

P. javanicus were found to roost in caves, abandoned building, occupied homes and electricity switchboards. The presence of such roost were characteristic with a pungent odour and orangish-yellow dropping markings under them. The morphology enables the bat to crawl into the tiniest of slits in wood and cracks in windowsills and wooden

beams. They were also found to be roosting in forest caves in numbers exceeding 2000 individuals approx (Teresa cave no 49,50 and Bompuka cave no44). Apart from this they were found in thatched roove and coconut tree hollows. The roost size in coconut tree hollows was limited to 6 to 7 individuals. In one occasion two individuals were seen to enter homes and fly about in quick circles (Kakana, Kamorta). They were also caught in mist nets in the 2nd shelf over a forest stream in a gallery forest, while in mistnets set away from streams captured bats in the 3rd and 4th shelf. On some islands (Cave no 44 Bompuka, cave no44 ,Tressa cave no 49) we found *P. javanicus* in sympatry with *P. coromandra camorta* and *Miniopterus pusillus*.

Distribution :

Kamorta, Katchal, Tillangchong, Bompuka, Teresa, Car Nicobar.

Staus :

IUCN Status: NE (Low risk, not evaluated).

Conservation Priority: P2 (Table: 8)

Sub order Microchiroptera

Family Vespertilionidae: Evening bats

ENDEMIC SUB SPECIES

Taxonomic notes :

These small sized pipistrelle with a FA 30.59 ± 0.9 mm. (table:11). The differentiation between the two species is based only on the difference in the FA lengths of the species. The individuals with $FA < 31$ mm were grouped in *P. coromandra comortae* and individuals with $FA > 31$ were grouped as *P. javanicus*. Both *Pipistrellus* spp had almost similar pelage color with *P. javanicus* more on the lighter golden brown with dark roosts while *P. coromandra* was on the darker brown pelage with dark roosts. The ventral surfaces paler in appearance in both the species. The ear and membranes are naked with very little hair on the interfemoral membrane and also on the wing membrane surrounding the body. The ears are elongated with a number of ridges present. The tragus is small and not curved outwardly.

Natural History :

The *Pipistrellus* spp are ready to adapt to changing environment and conditions. They were found to roost in caves, abandoned building, occupied homes and electricity switchboards. Roost habit of the two *Pipistrellus* sp is similar.

Distribution :

Teressa, Tillangchong, Bompuka and Car Nicobar.

Staus :

IUCN Status: LRnt (Low risk, not threatened).

Conservation Priority: P4 (Table: 8)

Table 11: Morphometrics: Comparison of *Pipistrellus javanicus* and *P. coromandra*

Characteristics	<i>P. javanicus</i>	<i>P. coromandra</i>
FA (mm)	32.05 ± 0.5	30.59 ± 0.9
EL (mm)	9.4 ± 0.8	9.46 ± 0.9
Body Mass (g)	7.2 ± 1.3	5.08 ± 0.4
N	84	12

Sub order Microchiroptera
Family Vespertilionidae: Evening bats

Taxonomic notes

A small vespertilionid bat with an average FA of 39.1 ± 1.2 mm, EL of 8.12 ± 0.6 mm, body mass of 8.41 ± 0.41 g (n=85). The pelage is black throughout with greyish tips and extends right up to the nostrils. The ear is typically triangular shaped with broadly rounded tips. Its characteristic shape of the tragus, slightly curved forward, distinguishes it from the genus *Pipistrellus*. All *Miniopterus* sp. are called 'bent-winged bats' because the proximal phalanx of 3rd digit < 40% of length of terminal phalanx so that wing at rest bends. The cheeks are devoid of hair below the eyes. The tail, interfemoral membrane is well developed and long. The membranes are uniformly brown. The pelage extension up to its nostrils gives an impression of a fur-helmet present on its head.

Natural History :

M. pusillus is restricted to the inland forest caves in the Central Nicobars. They are colonial roosters, forming large aggregations (see plate 6) on the cave roof. In one instance (Cave no 44, Bompoka Is), aggregation of the individual of the species were found intermixed with individuals of *Pipistrellus* sp. One individual of the *Taphozous* sp. was

also observed in the centre of this multispecies aggregation. This species was also observed in sympatry with *Pipistrellus* sp and *H.d. nicobarensis* (Cave no.36, Katchal Is.). No multispecies aggregation was observed with a clear spatial separation among these species. Individuals of this species use their well developed claws to cling onto the flat surface of the roof. It emerges early evening from the caves for foraging and was observed to frequently return to its roost during the night. When disturbed, unlike other species, they do not attempt to fly out of the caves in the day light. On two occasions it was mistnetted in evergreen forest stream. It was caught in the 2nd shelf of the mistnet placed 0.5m above water. No breeding individuals were encountered during the study. Individuals were found infested with ecto parasites (see plate 6).

Distribution :

Kamorta, Katchal, Tillangchong, Bompoka and Teresa.

Status :

IUCN Status: DD (Low risk, data deficient).

Conservation Priority: P2 (Table: 8)

Sub order Microchiroptera
Family Vespertilionidae: Evening bats

NEW RECORD

Taxonomic notes

The average FA of this species is 33.9 ± 1.5 mm, EL of 13.48 ± 1.48 mm, body mass of 8.26 ± 1.3 g (n=16). The pelage is light brownish orange and extends up to the interfemoral membrane. The nostrils are however devoid of hair. The claws are covered with hair till the tips. The ears are long and rounded at the tips. Tragus is present and it is characteristic to the genus convex on the anterior and posterior border is concave above and slightly convex below. The nose is very characteristically tubular projecting (tube nosed bats).

Natural History :

It was mist netted in gallery evergreen forests and across fresh water streams. All our observations were based on individuals captured from mist nets. Percentages of males (62.5%) captured in mist nets was more than females

(31.25%). It is a solitary forager (Bates & Harrison, 1997),. It was observed flying in and around foliage and trees. A low flier it was always captured in the 2nd or 3rd shelf in the mist net, when the mist net was placed 1 m above the ground. We were unable to locate the day roost of the species. Judging by its pelage color, it probably is a foliage roosting species. Further studies are needed to ascertain its roosting habits and habitat.

Distribution :

This species is a new record for the Nicobar Islands. It was found in Great Nicobar, Trinket, Nancowrie, Kamorta, Tillangchong, Katchal, Bompuka, Teressa.

Staus :

IUCN Status: DD (Low risk, Data deficient).

Conservation Priority: P4 (Table: 8)

Bats of Nicobar

Photographic guide
to the Bats of
Nicobar Islands

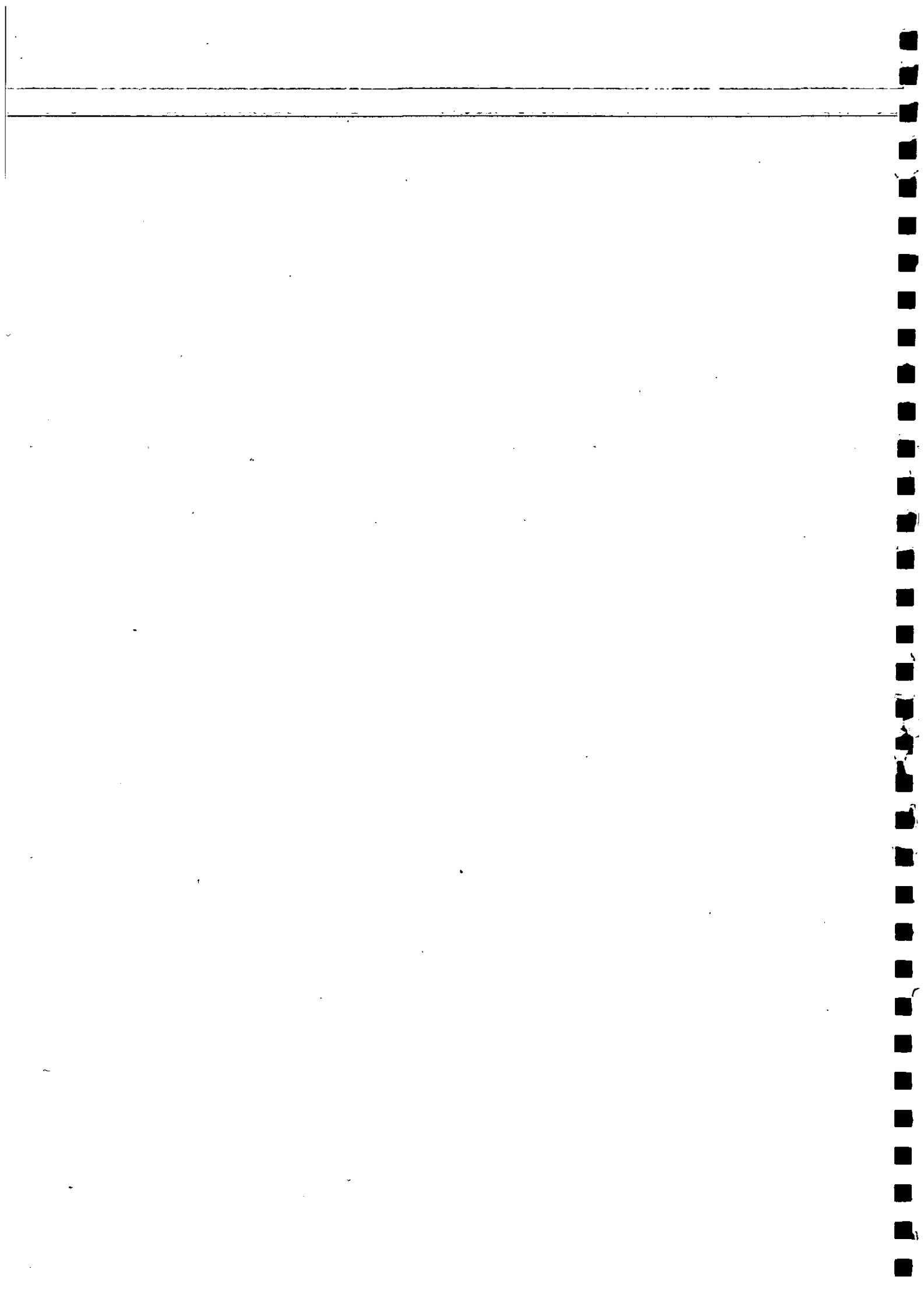
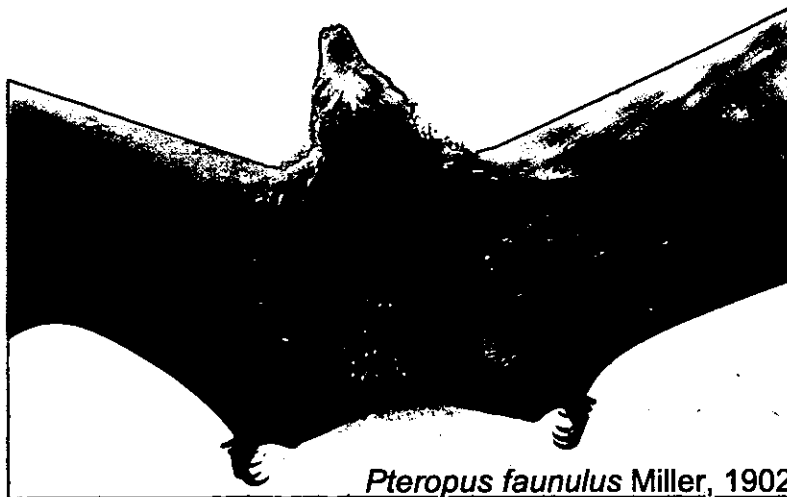


Plate 1 Genus: Pteropus

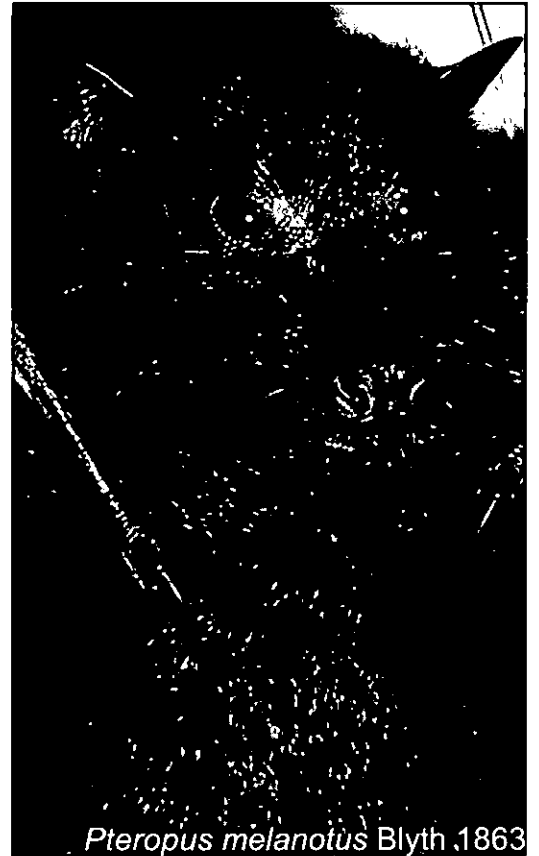


Pteropus faunulus Miller, 1902

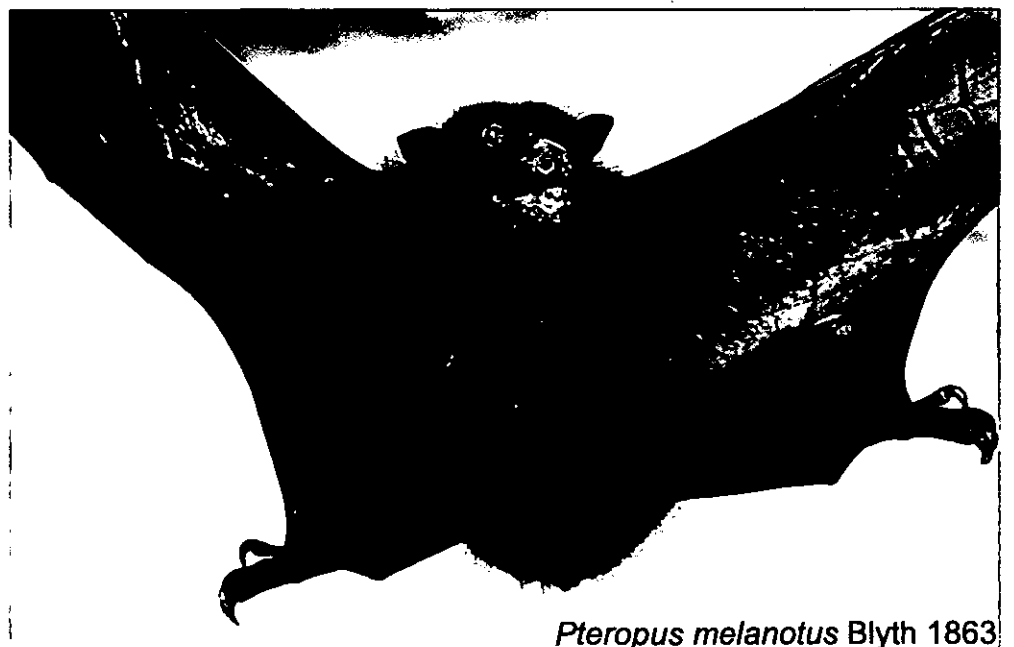
Pteropus faunulus
FA=118.5±11.5mm
Body Mass=172.8±60.4g.



Pteropus faunulus Miller, 1902



Pteropus melanotus Blyth, 1863



Pteropus melanotus
FA=165.5±8.03mm
Body Mass=619±57g.

Pteropus melanotus Blyth 1863

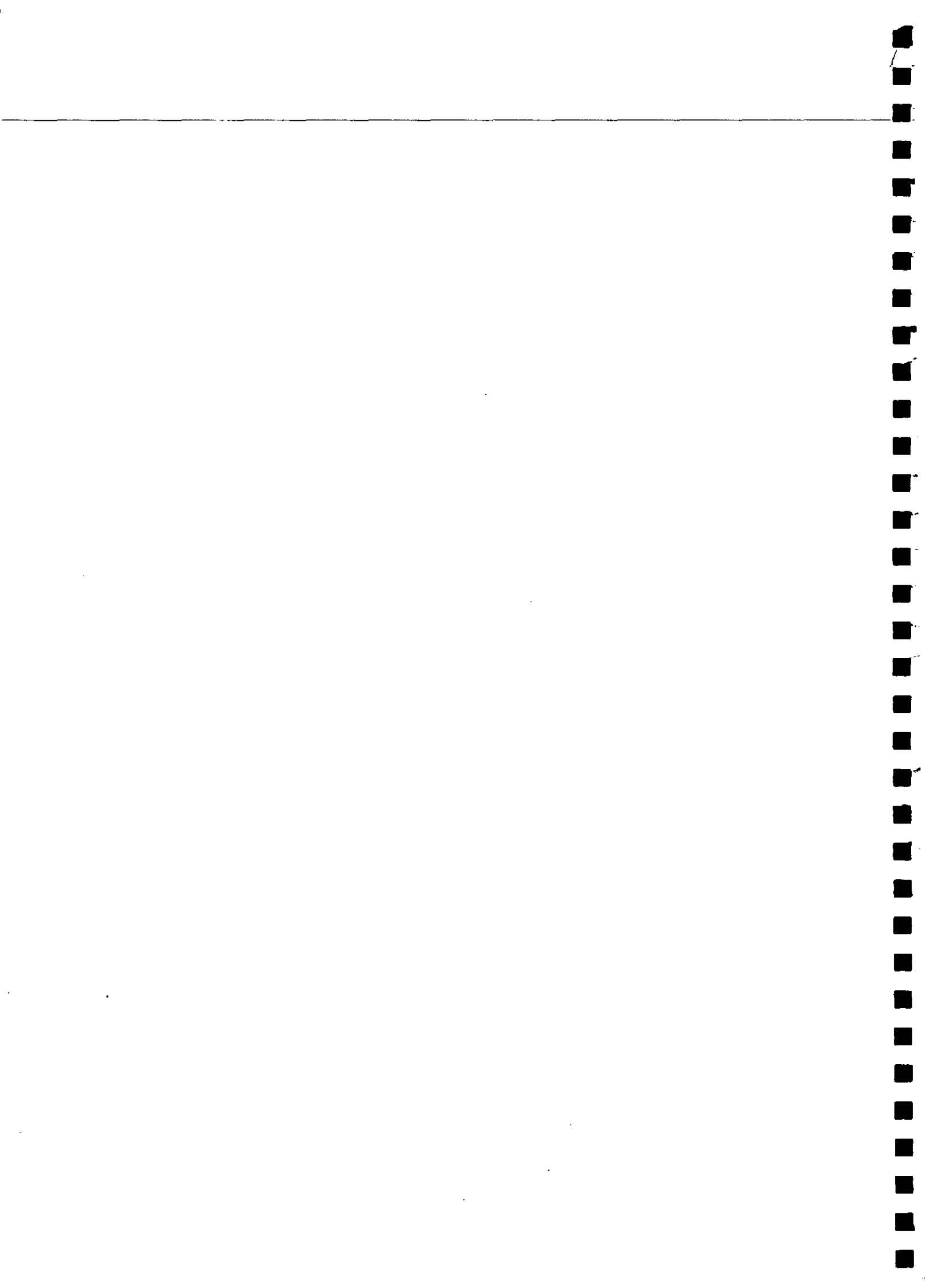


Plate 2 Genus: *Cynopterus*



Cynopterus brachyotis Müller, 1838



Cynopterus brachyotis Müller, 1838



Cynopterus brachyotis Müller, 1838

Cynopterus brachyotis
FA=65.82±1.2mm
Body Mass=29±4.6g.

Genus: *Taphozous*



Tail of *T. melanopogon*

Taphozous melanopogon
FA=60.88±2.1mm
Body Mass=22.06±3.6g.



Taphozous melanopogon Temminck 1841

Plate 3 Genus: *Hipposideros*

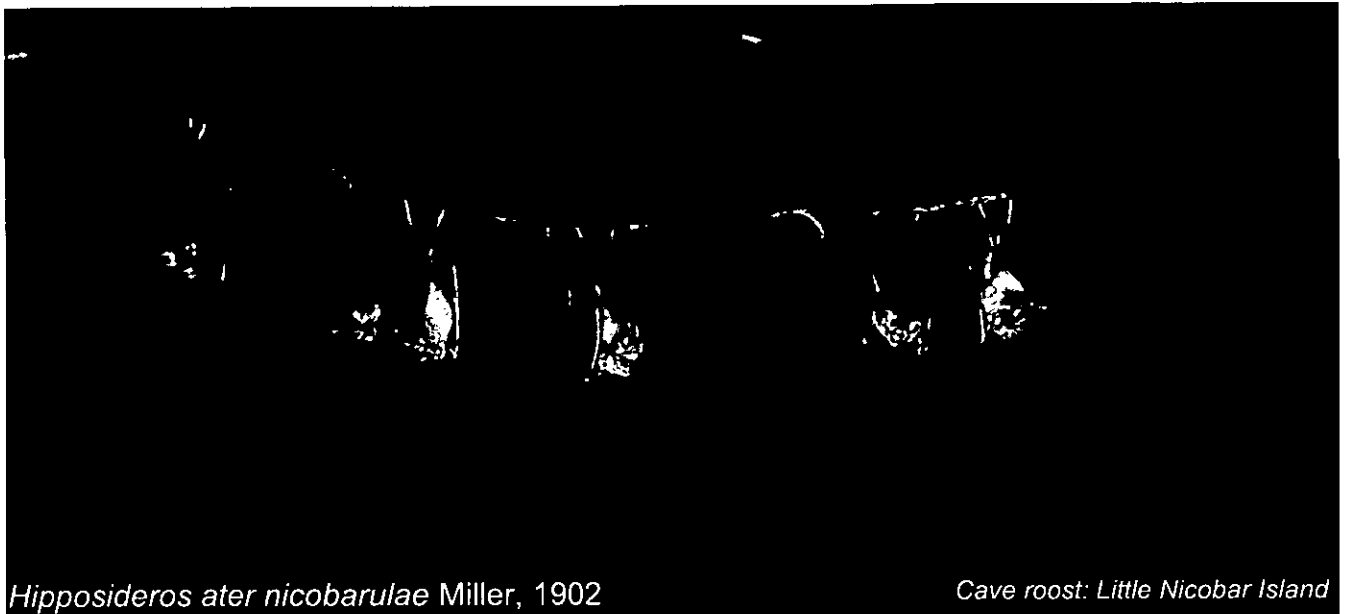


Hipposideros pomona Andersen, 1918



Hipposideros pomona Andersen, 1918

Hipposideros pomona
FA=40.5±0.53mm
Body Mass=7.3±0.5g.



Hipposideros ater nicobarulae Miller, 1902

Cave roost: Little Nicobar Island



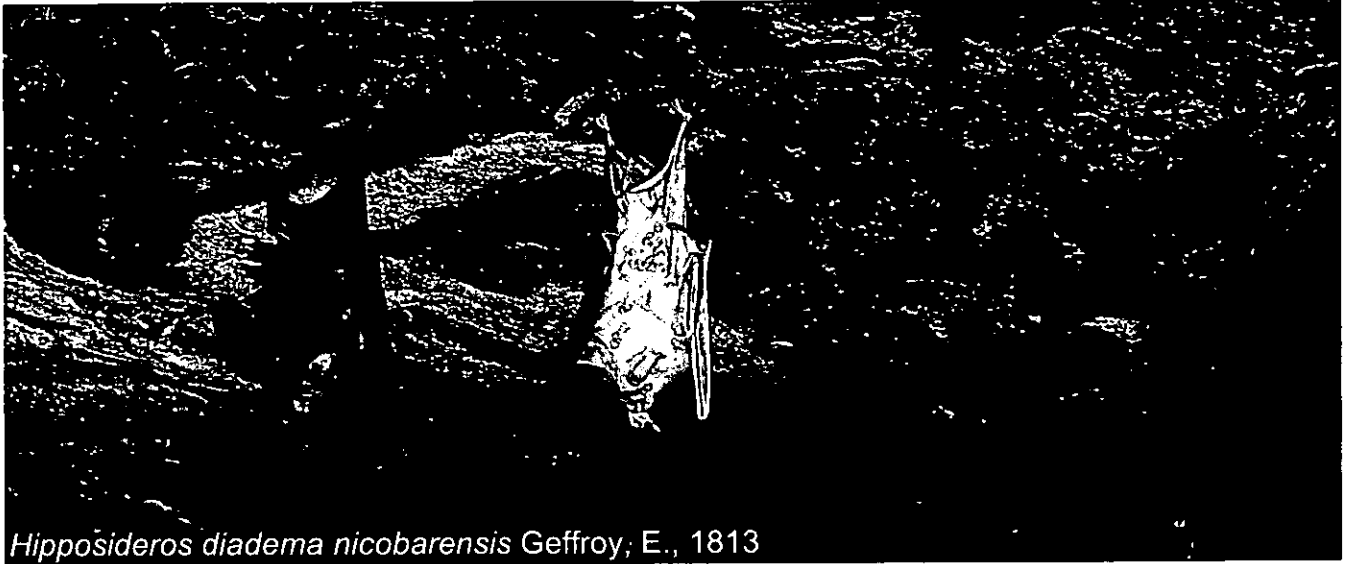
Hipposideros ater nicobarulae Miller, 1902



Hipposideros ater nicobarulae
FA=39.3±0.6mm
Body Mass=7±0.3g.



Plate 4



Hipposideros diadema nicobarensis Geffroy, E., 1813



Brown Form



Albino Form



Dorsal View: showing white patches on shoulder

H. diadema nicobarensis
FA=65.32±1.24mm
Body Mass=25.2±4.7g.



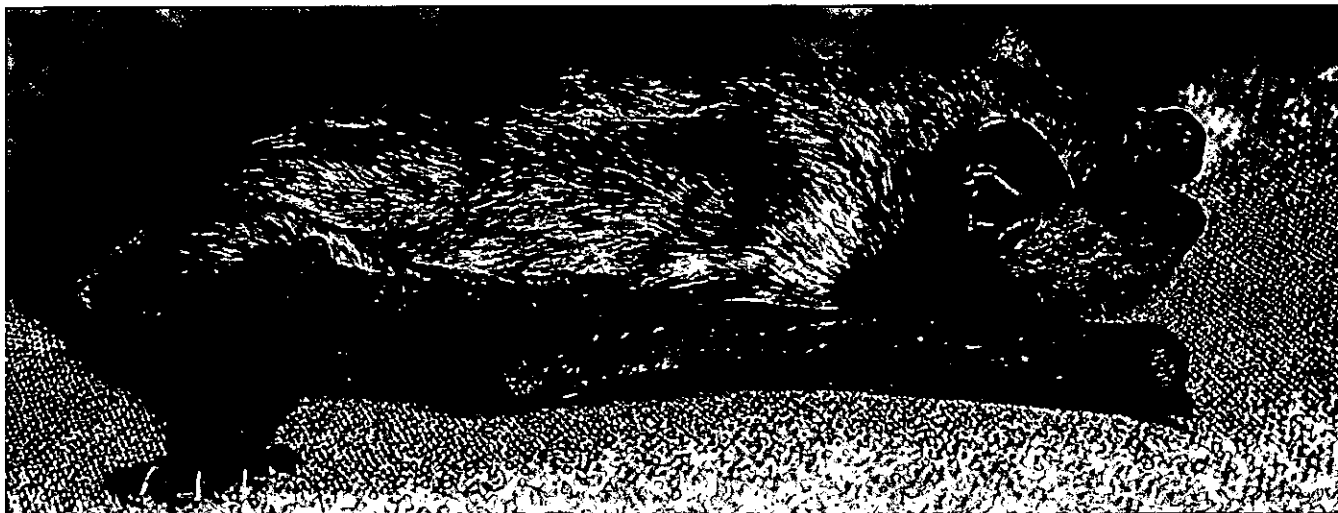
Plate 5 Genus: Pipistrellus



Pipistrellus coromandra camortae (Gray, 1838)



Pipistrellus coromandra camortae
FA=30.59±0.9mm
Body Mass=5.08±0.4g.



Pipistrellus javanicus (Gray, 1838)



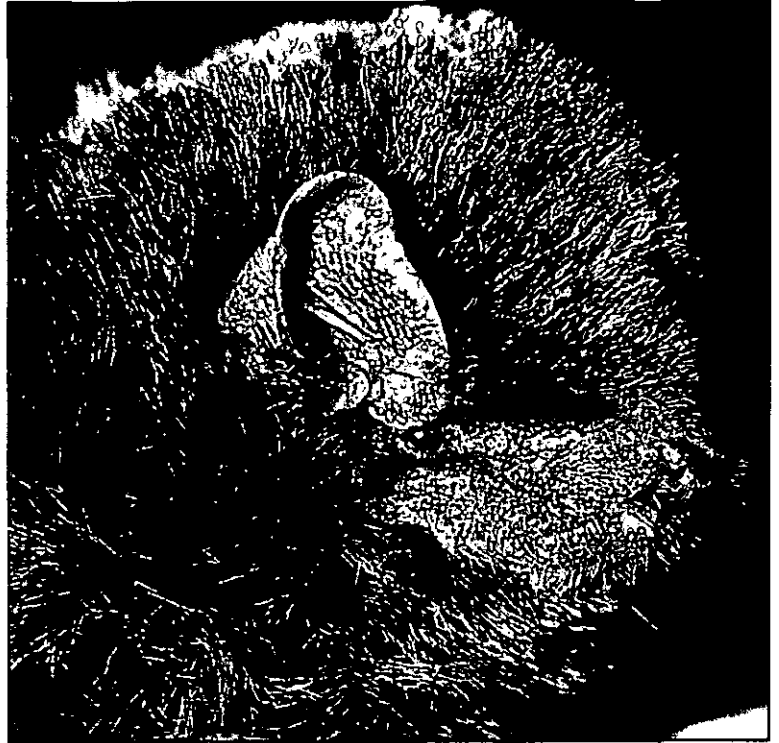
Pipistrellus javanicus
FA=32.05±0.5mm
Body Mass=7.2±1.3g.



Plate 6 Genus: *Miniopterus*



Miniopterus pusillus Dobson, 1876



Miniopterus pusillus
FA=39.1±1.2mm
Body Mass=8.41±0.41g.



Colonial roost in cave, Katchal Island



Plate 7 Genus: Myotis

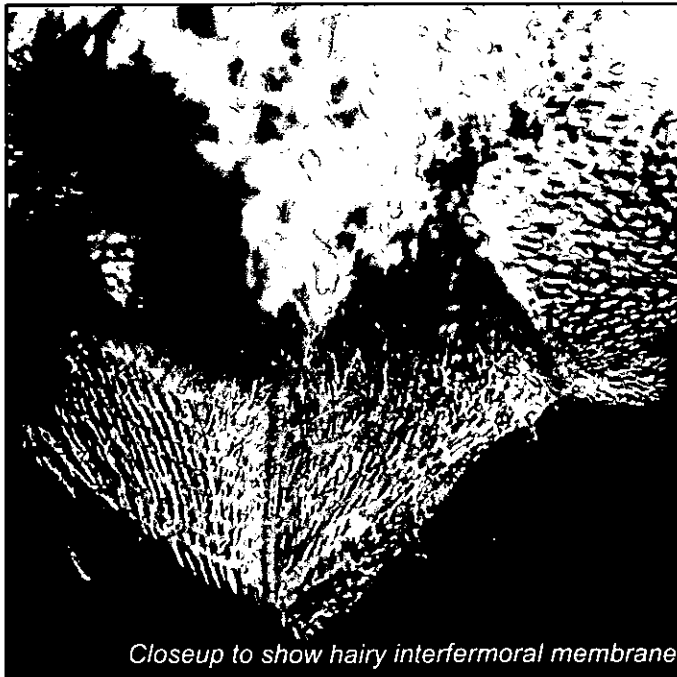


Myotis horsfieldii dryas (Temminck, 1840)



Myotis horsfieldii dryas
FA=39.4±0.6mm
Body Mass=12.73±0.33g.

Genus: Murina



Closeup to show hairy interfemoral membrane

Murina cyclotis
FA=33.9±1.5mm
Body Mass=8.26±1.3g.



Closeup to show tubular nostrils

Murina cyclotis Dobson, 1872



5.1 Introduction:

About 25% mammals and 11% bird species are currently threatened with extinction (IUCN 1996). An understanding of the impact of extinction processes on different species is vital for ensuring that viable populations of native species can be conserved and maintained (Jones *et al.*, 2001). Comparative studies of birds and mammals species have suggested that conservation attention should be focused on large species that reproduce slowly and that are restricted to small geographical areas. However the importance of these biological characteristics for predicting species extinction risk may be dependent on type of environmental disturbances prevalent in the area (Jones *et al.* 2001).

5.2 Global Scenario: Genus *Pteropus*

Of the 58 species and numerous subspecies in the *Pteropus* genus five are thought to be extinct, *Pteropus brunneus* and *P. tokudae* having become Extinct (EX) within the last 50 years (Baillie and Groombridge, 1996). The most obvious threats to fruit bats all over the world are hunting and habitat loss. Hunting bats for food has long been practiced in most of the areas where fruit bats and man coexist. They can be found for sale, alive or dead, in markets in Indonesia and Malaysia where they are eaten by the Chinese and Manadonese communities (Fujita and Tuttle, 1991). Some communities believe eating fruit bats can cure such diverse ailments as asthma, kidney complaints and even tiredness (Fujita and Tuttle, 1991), but in most places they are simply seen as good eating. This is particularly so on Pacific islands. The market for fruit bats (*Pteropus* spp. and *Acerodon* spp.) for sale on islands like the Commonwealth of North Mariana Islands (CNMI), Guam and Saipan, where they are eaten as a luxury food item, has boomed over the last three decades, placing great pressure on the populations of bats on those and neighbouring Pacific islands. Bat populations have been hit hardest on the islands of Palau, Chuuk and Pohnpei, which have become the main exporters of fruit bats in the region (Pierson and Rainey, 1992; Wiles, 1992).

This impact is especially pronounced on islands. The Mariana's fruit bat (*Pteropus mariannas*) was reported to be in serious danger of extinction if its population decline was not halted. The reason for its plight was that these bats were a native to the Mariana Islands with <500 individuals reported. This arose due to the demand for this bat for personal consumption and commercial exploitation by market hunters. They are a delicacy with the native Chamorro cultures (Lemke, 1986).

5.3 Regional Scenario: Bats in India

Legal protection of bats in India has long been ignored. Bats are nocturnal and often habitat specific, and are considered difficult to locate and study. The flying foxes and the insectivorous bats are listed in schedule 5 of the Wildlife (Protection) Act, 1972, which classifies them as

vermin. IUCN and the Red Data Book classified the species/subspecies found on Nicobar as not assessed and vulnerable. Many species are poorly known with scanty information present on their status, ecology, behavior and distribution (Anon, 1994). While the bats are not protected under the Wildlife (Protection) Act, 1972 in India they are particularly vulnerable to over exploitation, even in the islands.

5.4 Types of threats

The following major types of threat were identified during the study: *Hunting and habitat disturbance or alterations*. Hunting appears to be major threat for the islands' fruit bats affecting both the species of fruit bats: *Pteropus melanotus* and *Pteropus faunulus*. The advent of air guns from Port Blair and mainland India brings a quicker and more efficient way to hunt birds and bats. The hunters shoot down these bats and adopt the orphaned babies. To prevent the bat from flying away the forearm of the bat is removed and the wings are clipped in some instances. On some occasions we were able to see the locals rear the babies belonging to *Pteropus melanotus* (four households) and *Pteropus faunulus* (two households). There has been a rising trend to shoot the bats and birds in the forest. This is in contrast to the primitive crossbows that were used for hunting prior to the use of air guns. Most of the hunting is carried out in the foraging sites and few in the roosting areas. The seasons of the fruiting of the silk cotton tree and a number of preferred fruit trees by bats coincides with the reproductive time of the fruit bats. The bats are eaten for their meat and for the belief that bat meat is a cure for asthma and provides strength. The bones of the bat too find use as a traditional medicine in the Nicobar Islands.

5.5 Nicobar flying fox: Hunting pressure threatening its future survival

Extensive interviews with the local inhabitants were conducted to determine the hunting pressure on the endemic Nicobar flying fox in the Central group of islands. Daytime hunting of the Nicobar flying fox is often opportunistic, whereas the island flying fox (*Pteropus melanotus*) is hunted deliberately in the daytime roosts, specially during the rainy season when large aggregation of *Pteropus melanotus* occur in mangroves. Night hunting is deliberate and not species-specific. The heaviest impact seems to be on the Nicobar flying fox as we observed it to be a medium height (<20 m, N=7) forager. This appears to increase their chances of getting shot by hunters. There is an urgent need to initiate a conservation programme for this species. A well-designed conservation education programme coupled with community participation and study on the species ecological requirements could save this species from extinction. Our initial attempts to impart this problem into peoples mind have been encouraging.

5.6 Caves: Bat habitat under pressure

Due to their patchiness in space, caves are more prone to disturbances, both natural and manmade. Human intrusion in the caves has been documented to adversely affect the bat populations (Culver, 1986). The caves in the Nicobar Islands are of economic value to the owners as they harvest the nest of the edible nest swiftlet (*Collocalia fuciphaga*). The nests are an important item in Chinese cuisine and pharmacy. The medicinal properties of the nest have made them extremely valuable and at the same time they have been exploited throughout the swiftlets' range (Sankaran, 1998). In the Nicobars, the edible nest swiftlets roost only in caves. This is a serious problem for the bats as a number of bats, including endemic subspecies (*Hipposideros diadema nicobaresis* and *Pipistrellus coromandra camortae*), were seen to roost in sympatry with the birds. Some of these caves are privately owned, that is the caves are located in a plantation and the person owning the plantation by default owns the caves (see table 7). Private ownership has in some cases restricted access to outsiders, thus reducing the visitation rate. But the trend is changing as evidenced in some islands. Guided by the local people, settlers at some islands like Katchal have been reported to regularly visit caves for swiftlet nest collection. Another fact for consideration is the accessibility to the caves. Many caves are located on the coast (see chapter 3) making them easily accessible by locals as well as outsiders. Monitoring of bat populations in some of these caves must be initiated to assess the magnitude and intensity of these anthropogenic activities.

5.7 Conservation education and awareness: Present and Future

Scientific research coupled with education and awareness is a key to success for any research project. Our team also carried out a number of talks with students, teachers, forest department officials and the local communities to increase the level of understanding for both the people and the research team for the needs and to get a feel of the pulse of the people.

5.7.1 Target Groups:

5.7.1.1 GROUP 1 The Nicobaries

This group is our focus group as they are the cause of the present plight of the Nicobar flying fox. We are aiming at them so that in future they will be the protectors of the same.

These tribes are coastal settlers and majority of the villages are set on the coasts, with coconut and arecanut their major agricultural produce. The staple diet of these people is predominately fish, pork, chicken, rice, and pandanus. They rear pigs and poultry and consume these when required.

It was concluded from the field observations that there is no dependence on the bat meat as food. The general pulse of the people was also accessed when we suggested the government establish protected areas and fence them. The thought of the government coming in their area was not welcomed and the village heads were receptive to the idea

of initiating a local people-based conservation programme. They also understood the reason for protecting the Nicobar flying fox - and in some cases the people took it with pride that this medium sized fruit bat inhabits only their islands and no other place in the world.

Going in to the myths in the islands we came across a mention of bats in the Primer of the Car Nicobar Island.

The legend goes.....

It was the time when there was a war in the forest between the birds and the mammals and the birds were gaining an edge over the mammals when the bat took refuge with the winning side on the pretext of having wings and its ability to fly. The birds accepted it as a different type of a bird. The seas changed and the war between the groups still raged this time in the favour of the mammals, again the bat changed sides and took refuge with the mammals on the pretext that it could raise and produce young like them and so is a mammal. The mammals accepted the bat in their group. Like all wars this unusual war came to an end on a peaceful note with the birds and mammals becoming friends, the bat now was faced with the charges of cheat from both sides and thus came to be shunned by the birds and mammals and cursed to move out only in the night.

A local legend was that an old lady was very unwell and the cold was making it worse for the lady to survive. On a compassionate note a well-wisher gave the lady his blanket to keep her out of the cold. The cold stayed out and the blanket became a part of the back of the lady. Feeling conscious of the appearance and the blanket stuck on her back the lady came out only in the night when all the creatures are presumed to be asleep. Till day she is supposed to roam about the forest exploring.

5.7.1.2 GROUP 2 Forest department and other government officials

Our second target group for bat awareness in the islands was the forest department officials and trainees and the other government agencies in the area. This was done so that the decision-making bodies were sensitized about the urgent need to conserve the bat fauna in the islands and they are also more sensitive to research teams efforts in bringing this to them. The first week of October i.e October 1st to October 8th is celebrated as the wildlife week in the country. It was a good opportunity for us to present a presentation "Bat fauna of the bay islands - an insight" to the forest department. The chief conservator of forests/ chief wildlife warden, the conservator of forests and the deputy conservator of forests were present along with 44-forest training school's trainees. The focus of this presentation was to bring to their attention the intensive

pressure of hunting on the fruit bats in the islands with special reference to the endemic Nicobar flying fox (*Pteropus faunulus*).

5.7.1.3 Group3: Children and schools and educators

School children were introduced to the world of bats. Education materials were distributed to them. Courtesy of the Zoo Outreach organization in collaboration with Chester Zoo, UK. These education camps were also held in some schools in Andaman's as an extension of the work done on bats and to emphasize other biodiversity aspects in the islands.

Schools that participated were the government senior secondary school, Campbell Bay in Great Nicobar Island and the Naval Public School, Port Blair. A total of 150 children and teachers were present for these camps.

Children are very receptive to what is happening around them and we thought of getting them aware and involved

by organizing a camp for visiting bat roosts and getting first hand experience in handling them and knowing the secret world of bats. Some stickers, masks and leaflets were also given to them. The role of the insectivorous bats and fruit bats was emphasized and we were amazed to find out the acceptance and interest these children had in bats. A trip into an old war bunker was also done to show the roosting habits of bats and this was greatly cherished by the participants. The roosting bats colony of *Taphozous melanopogon* will now always be remembered and these children pledged to be there for the bats!!!

An important event occurred which we think must not go unnoticed. A young girl named Ms Sheetal Singh aged 8-years gave a small talk on bats to her classmates in her school. It was encouraging to see interest in nature being nurtured in such a young age. As a form of encouragement Sheetal will be our official volunteer for any bat camp and programmes held for educators and children.

Significant findings and recommendations for management and conservation

SIGNIFICANT RESULTS and FINDINGS:

- Geographical distribution and natural history of 12 species of bats.
- Identification and mapping of permanent bat roosts, including 55 caves, many reported for the first time.
- Identification of threats to bat species especially fruit bats.
- Identification of the gaps in the current protected area network.
- Initiation of conservation education and awareness programme.
- Photo documentation of 12 species of bats including roosts and habitats.
- Two new range extensions and one new record for the Nicobar group identified.
- Albino of endemic subspecies *Hipposideros diadema nicoabrensis* discovered.
- Endemic Nicobar flying fox rediscovered after 91 years.
- Liaison with the tribal council and village heads – a precursor for future work.

RECOMMENDATIONS

- Rectifying the gaps in the protected area network. Exploring the possibilities for a community based protected area network in the Nicobar Islands.
- Nicobar flying fox: need for conservation action.
- Intensive ecological research on Island endemics and threatened species.



Education Camp,
Naval Public
School, Andaman
Island.

Background :
Ross Island

REFERENCES:

- Abdulai, H. 1976a. The Birds of Great and Car Nicobars with some notes on wildlife conservation in the islands. *J. Bombay Nat. Hist. Soc.*, 75: 744-772.
- Abdulai, H. 1976b. Wildlife in Bay Islands. *Yojana*, 20 (13): 72-73.
- ANI, F.D. 1999. Forest statistics, 1998-1999. Andaman and Nicobar Administration, Department of Environment and Forests, Van Sadan, Haddo, Port Blair, India.
- Anon. 1994. The Wildlife (Protection) Act, 1972 (Amended upto 1991). Natraj Publishers, Dehra Doon.
- Aul, B. 2002. the Status and distribution of the bats in Andaman and Little Andaman Islands. Andaman and Nicobar Islands Environmental Team (ANET) Technical Report.
- Baillie, J. and B. Groombridge, (eds.) 1996. IUCN Red List of threatened animals. *IUCN, Gland, Switzerland*.
- Bates, J. J. P. and D. I. Harrison. 1997. Bats of the Indian Subcontinent. Harrison Zoological Museum, Sevenoaks, Kent.
- Culver, D. C. 1986. Cave faunas. In ed. Michael J. Soule *Conservation Biology The science of scarcity and diversity*. Pp.427-443.
- Darlington, J.P.E.C. 1995. Ecology and fauna of the Tamana Caves, Trinidad, West Indies. *Studies in Speleology*. 10: 37-50.
- Das, I. 1997. A new species of *Cyrtodactylus* from the Nicobar Islands, India. *J. Herpetol.* 31(3): 375-382
- Das, I. 1998. An Ecological Reconnaissance of Rani Jhansi Marine National Park, Andaman Islands, India. Report - Andaman and Nicobar Islands Environmental Team. (Post bag-1, Junglighat 704 103)
- Das, I. 1999a. A noteworthy collection of mammals from Mt Harriet, Andaman Islands, India. *South Asian Nat. Hist.* 4: 181-185.
- Das, I. 1999b. Biogeography of the Amphibian and reptiles of the Andaman and Nicobar Islands, India. 43-75pp. In Ota, H. (Ed). *Int. Symp. Diversity of reptiles, amphibians and other terrestrial animals on tropical islands; Origin, current status and conservation*. 5th - 7th June 1999., University of Ryukyus, Okinawa, Japan
- Das, I. 1999c. Biogeography of the herpetofauna of the Andaman and Nicobar Islands. In: *Diversity of reptiles, amphibians and other terrestrial animals on tropical Islands: Origin, Current Status and Conservation*. H. Ota (ed.). Elsevier Science B.V. Amsterdam.
- Deb, D. 1998. The Human ecology of Ritchie's Archipelago: The Anthropogenic impacts on Rani Jhansi Marine National Park. Report - Andaman and Nicobar Environmental Team, Post bag-1, Junglighat 704 103, Port Blair.
- Fenton, M.B. 1983. *Just Bats*. University of Toronto Press, London.
- Findley, J.S. 1995. *Bats : A community perspective*. Cambridge University press
- Fujita, M. S. and M. D. Tuttle, (1991) Flying foxes (Chiroptera: Pteropodidae): Threatened Animals of key Ecological and Economic Importance. *Conservation Biology* 5 (4), 455-463.
- Hill, J.E. 1967. The bast of Andaman and Nicoabr Islands. *J. Bom Nat Hist. Soc.* 64(1):1-9.
- Jones K.E, Barlow, K.E, Vaughan, N, Rodriguez-Duran, A and M.R. Gannon. 2001. Short term impacts of extreme environmental disturbance on the bats of Puerto Rico. *Animal Conservation* 4; 59-66.
- Kunz, T and G.F. McCracken. 1996a. Tents and harems: apparent defense of foliage roosts by tent making bats. *J. Trop. Ecol.*, 12: 121-137.
- Kunz, T. 1988. *Ecological methods for the study of bats / edited by Thomas H. Kunz*. Washington : Smithsonian press.
- Kunz, T. H, 1994. The world of tent making bats. *Bats* 12 (1) : 6 - 12
- Kunz, T.H. 1996b. Obligate and opportunistic interactions of Old World tropical bats and plants. *Conservation and Faunal biodiversity in Malaysia*.
- Lemke, T.O. 1986. Marianas Fruit Bats Near Extinction. *Bats Newsletter for Bat Conservation international*, Vol 3(1).
- Marshall, G.A 1985. Old world phytophagous bats (Megachiroptera) and there food plants: a survey. *Zoo J. Linnean Soc.*. 85: 351-369
- Mickleburgh, S. P.; Huston, A. M. and P.A. Racey, (1992) *Old World Fruit Bats: An Action Plan for their Conservation*. International Union for the Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland.
- Miller, G.S. 1902. Mammals of the Andaman and Nicobar Islands. *U.S. Nat. Mus.* 24: 751-795.
- Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. and J. Kent 2000. Biodiversity hotspots for conservation priorities. *Nature* 403, 853-858.
- Nair, C.T.S. 1989. Environmental issues in forest land use in the Andaman islands in Andaman, Nicobar and Lakshadweep; An Environmental Impact Assessment. Saldanha. 1989. Oxford and IBH publishing Co. Pvt.Ltd. New Delhi.
- Nath, B and Y. Chattervedi. 1975. On a collection of mammals from Andaman and Nicobar Islands. *Bull. Indian Mus.* .8: 44-49
- Novak, R.M. 1991. *Walker's Bats of the world*. The Johns Hopkins University Press, Baltimore and London.
- Oliver, I. Beattie, A.J. and A. York 1998. Spatial fidelity of Plant, Vertebrate, and Invertebrate Assemblages in Multiple-Use Forest in Eastern Australia. *Conservation Biology*. 12 (4): 822 - 835.
- Pande, P., Kothari, and S. Singh (eds) 1991. *Directory of National parks and sanctuaries in Andaman and Nicobar Islands*. Management Status and profiles. IIPA, New Delhi, India.
- Pierson, E. D. and W. E Rainey 1992. The biology of flying foxes of the genus *Pteropus*: A review. In Wilson, D. E. and Graham, G. L. (1992) *Pacific island flying foxes: Proceeding of an international convention conference held on February 1-2, 1990*. Fish and Wildlife Service, US

Department of the Interior.

Rao, G.C. and M.K.DevRoy. 1985. The Fauna of the Bay Islands. *J.Andaman Sci.Assoc.* 1:1-17.

Rao, G.C.,D.V.Rao and K.Devi. 1994. A faunal exploration of the North Reef Island Sanctuary, North Andaman. *J.Andaman Sci.Assoc.* 10 (1 and 2): 68-81.

Rao, G.C.1992.Protection of Endangered Animals of the Bay Islands.Torism dav. And Proc.42-51.

Rodgers, W.A. and H.S.Panwars. 1988. Planning a protected area network in India. Vol-I.Field document No.9.A report submitted for the department of Env.For. and WL, GOI at WII.

Rodolfo, K.S. 1969. Bathymetry and marine geology of the Andaman basin and tectonic implications for South Asia. *Geol. Soc. of American Bull.* 80: 1203-1230.

Saha, S.S. 1980. Notes on some mammals recently collected from Andaman and Nicobar Islands. *Rec. Zool.Surv.India.*77 (1-4): 119-126.

Saldanha, C.J. 1989. Andaman, Nicobar and

Lakshadweep;An Environmental Impact Assessment. Oxford and IBH publishing Co. Pvt.Ltd. New Delhi.pp114.

Sankaran, 1995. The decline of the Edible nest swiftlet In the Nicoabr islands. *Oriental Bird Club Bulletin.* 22: 51-54.

Sankaran, R 1998. The Impact of nest collection on the Edible Nest Swiftlet *Collocalia fuciphaga* in the Andaman and Nicobar islands. SACON- Report. Salim Ali Centre for Ornithology and Natural History, Coimbatore – 641 010, India.41pp

Sankaran, R. 1997. Developing a protected area network in the Nicobar Islands: The Perspective of endemic avifauna. *Biodiversity and Conservation* 6.

Wiles, G. J. 1992. Recent trends in the fruit bats trade in Guam. Division of Aquatic and Wildlife Resources, Department of Agriculture, PO Box 2950, Agana, Guam 96910.

Wilson, D.E.1997 Bats in question: the Smithsonian answer book. Washington: Smithsonian press.

APPENDIX 1: CAVES SURVEYED, CATEGORIES AND ASSOCIATED BAT SPECIES.

Island	Cave Number	Cave Category	Bat Species Present	Swiftlets	Roaches
Great Nicobar Island	1	A1	No bats	+	+
	2	A1	TAME	-	-
	3	A1	TAME	-	-
	4	A1	TAME	-	-
	5	A1	TAME, HIPO	+	+
	6	A1	HIPO	-	+
	7	A1	HIPO	-	-
	8	A1	No bats	-	-
	9	A1	No bats	-	-
	10	A1	No bats	-	-
	11	A1	No bats	-	-
Pulo Milo	12	A2	HIPO	+	+
	13	A2	HIPO	+	+
Little Nicobar Island	14	A2	HIPO	-	+
	15	A2	HIPO	-	+
	16	A1	HIPO	-	+
	17	A1	No bats	+	-
	18	A1	No bats	+	-
	19	A1	No bats	-	-
	20	A2	HIPO	+	+
	21	A1	No bats	-	-
	22	A2	No bats	-	-
	23	A1	No bats	-	-
Little Nicobar Island Kondul	24	A1	TAME1	+	?
	25	A1	TAME	+	?
	26	A1	No bats	+	?
Kamorta	27	A2	HIPO	-	-
	28	A2	HIPO	+	+
	29	A2	No bats	-	-
	30	A2	No bats	-	-
	31	A1	No bats	-	-
Trinket Katchal	32	A1	No bats	-	-
	33	B2a	HIPO, HIDI	-	-
	34	B1b	HIPO	-	-
	35	B1a	HIDI	+	+
Tillangchong	36	B1a	HIPO, MIPU, PIJA / PICO	+	+
	37	A1	No bats	-	-
	38	A1	No bats	-	-
Nancowrie	39	A1	No bats	-	-
	40	A2	No bats	+	?
Chowra	41	A2	TAME	-	-
	42	B1b	No bats	-	-
Bompuka	43	B1b	Hip.pom	+	-
	44	B1b	No bats	+	-
	45	B1a	MIPU, PIJA / PICO, TAME	+	-
	46	B1b	No bats	-	-
	47	A2	TAME	+	-
Tressa	48	A2	TAME	-	-
	49	A2	TAME	-	-
	50	B2a	MIPU, PIJA/PICO	-	-
	51	B2b	HIDI, MIPU	+	-
	52	B1b	HIPO	-	-
Car Nicobar	53	B1b	No bats	+	-
	54	A2	No bats	-	-
	55	A1	HIPO	+	+

Note: *Pteropus melanotus*(PTME), *Pteropus faunulus* (PTFA), *Cynopterus brachyotis* (CYBR), *Tapohezous melanopogon*(TAME), *Hipposideros pomona* (HIPO), *Hipposideros diadema nicobarensis*(HIDI), *Hipposideros ater nicobarulae*(HIAT), *Miniopterus pusillus*(MIPU), *Pipistrellus javanicus* (PIJA), *Pipistrellus coromandra camortae* (PICO), *Myotis horsfieldii dryas*(MYDR), *Murina cyclotis* (MUCY).

APPENDIX: 2 CAVE COORDINATES

Cave numbers	Island	Latitude	Longitude
1 to 4	GREAT NICOBAR		
5 to 6	GREAT NICOBAR	7 8 57.4	93 53 13.6
7 to 8	GREAT NICOBAR	7 8 53.9	93 53 12.9
9 to 11	GREAT NICOBAR	7 11 53.1	93 45 40.6
12 to 13	PULO MILO	7 13 47.4	93 48 13.44
15 to 17	LITTLE NICOBAR	7 24 18.5	93 41 2.0
20	LITTLE NICOBAR	7 22 54.8	93 44 54.5
24 to 26	KONDUL	7 24 45.5	93 42 24.7
27	KAMORTA	7 12 39.8	93 42 32.8
28 to 30	KAMORTA	8 5 23.5	93 29 22.1
31	KAMORTA	8 6 31.1	93 28 0.3
32	TRINKET	8 3 44.4	93 29 6.9
33	KATCHAL	8 4 16.1	93 35 24.1
34	KATCHAL	7 53 25.7	93 22 5.2
36	KATCHAL	7 55 35.3	93 23 51.6
35	KATCHAL	7 56 33.1	93 26 1.5
39	TILLANGCHONG	7 56 23.9	93 27 20.3
38	TILLANGCHONG	8 27 52.6	93 38 22.7
37	TILLANGCHONG	8 28 14.1	93 37 55.1
40 to 41	NANCOWRIE	8 32 27.4	93 36 41.7
42	CHOWRA	7 58 56.4	93 31 8.4
47	BOMPUKA	8 26 28.6	93 3 23.8
46	BOMPUKA	8 13 51.8	93 13 58.9
45,48	BOMPUKA	8 13 53.2	93 13 57.7
49	TERESSA	8 13 49.9	93 14 00.8
50	TERESSA	8 17 51.9	93 5 45.8
52,53	TERESSA	8 16 49.4	93 7 30.4
51	TERESSA	8 17 53.3	93 5 52.2
54	CAR NICOBAR	8 16 15.3	93 7 8.7
55	CAR NICOBAR	9 13 11.6	92 46 17.1

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

A survey of 14 islands in the Nicobar archipelago was carried out to determine the geographic distribution and conservation status of the bat fauna. Two major techniques were employed to sample bats: survey of bat roosts and mist netting. Mist netting effort included more than 600 hrs in seven habitat types. More than 200 bat roost sites were located and mapped. This included 55 caves. The study resulted in the identification of 12 species of bats belonging to four families and eight genera. The team was also successful in locating the endemic Nicobar flying fox, *Pteropus faunulus*, and the first record since its description. Many endemic sub species including *Hipposideros diadema nicobarensis*, *Pipistrellus coromandra camortae* and *Myotis horsfieldii dryas* were also rediscovered. Two new geographic range records were identified for this island group and also one new record for the Nicobars. An albino of the endemic subspecies *Hipposideros diadema nicobarensis* was discovered during the course of the study. For the first time, the research team also photographed all the 12 species of bats and their habitats.

Two divisions of islands, which differ in bat species composition, were identified using cluster analysis. Species richness and endemism of bats was greater in the central Nicobar group of islands. Species occurrence patterns revealed the short nosed fruit bat *Cynopterus brachyotis* as the most widespread species, occurring on all the islands sampled. The data on the distribution patterns of bats elucidated the gaps in the current protected area network in the Nicobar archipelago. These results and its implications for conservation are discussed in chapter 2. A detailed account of both permanent and temporary bat roosts is provided in chapter 3. A list of priority areas for conservation and monitoring is also provided. As part of the study, data on species morphology and ecology were collected for many species of bats. A summary of this information is provided in chapter 4 along with conservation status for each bat species occurring in the Nicobar Islands. An assessment of the threats and conservation priority carried out for the bats showed the existence of high hunting pressure on the endemic Nicobar flying fox and also evidence of declining populations. The need for initiation of a conservation programme targeting the endemic fruit bat is highlighted. The disturbance and threats to the caves and cave bat assemblages and the results of the initiation of an education and awareness programme targeting local communities, students and forest department officials are discussed in chapter 5. The feedback from these programmes was positive and encouraging. Coordination with the local NGO and Education coordinator helped in sensitizing the students and teachers to the importance of bats. The forest department was appreciative of our efforts to involve them in our projects.



Orphaned *Pteropus melanotus* (juvenile), Katchal Island, Nicobar (India)