ISSN 0375-1511

Rec. zool. Surv. India : 114(Part-3) : 467-502, 2014

STATUS SURVEY OF WETLAND BIRDS IN THE RUTLAND ISLAND, ANDAMAN

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OVERVIEW

The Andaman and Nicobar archipelago consists of 572 islands and extending over 800 km (Fig. 1). These islands were once a part of the Asian mainland but got detached some 100 million years ago during the Upper Mesozoic Period due to geological upheaval. The existing groups of islands constitute the physiographic continuation of the mountainous ranges of Naga and Lushai Hills and Arakan Yoma of Burma through Cape Negrais to the Andaman and Nicobar Islands and southeast of Sumatra. The chains of these islands are in fact the camel backs of the submerged mountain ranges projecting above the sea level running north to south between 6º 45´ and 13º 30´ N latitudes and 90º 20´ and 93º 56´ E longitudes with an extent of 8,249 km^2.

The Andaman and Nicobar islands can be broadly divided into two groups, namely, the Andamans and the Nicobars. These two groups are separated by the Ten-degree Channel which is about 150 km wide 400 fathoms deep. The average annual temperature varies from 24º to 28º C. The elevations range from 0 to 732 m at Saddle Peak in North Andaman and 642 m at Mount Thulier in Great Nicobar Island. The rainfall is slightly higher in Nicobar with an annual average of 3000 to 3500 mm.

HISTORY

The Andaman and Nicobar groups of islands belong to a geosynclinals basin. The sediments of this region have gradually changed their characters, according to tectonic movements, to which they have been subjected to from time to time; as such the rocks are highly folded. The six distinct geological formations consisting of various groups of rocks, from these islands were reported.

These formations include Older Sedimentaries, Ophiolite Suite, Mithakhari Group, Andaman Flysch, Archipelago series and the Rutland Shell-Limestone. They represent a period of sedimentation, from Cretaceous (about 100 million years) to Sub-Recent (less than 10,000 years). The surface deposits of gravel beds and raised soil covers, on the other hand, are of very late origin, *i.e.,* Recent to Sub-Recent (*i.e.,* less than 10,000 years). In general, it is believed, that the mountain ridges of the island were formed at the expanse of a narrow but deep oceanic furrow during Late Mesozoic Period (100 million years). The older sediments of Mesozoic formed the basement for younger deposits. The history of later deposition is that of an inconsistent basin *i.e.* associated with movement, volcanism and deposition, side by side with igneous intrusions. Over the older sediments, at the deeper part of the sea bottoms, there was rich accumulation of siliceous tests of radiolarians, possibly and deposition of sediments of late Cretaceous to Oligocene.

During Oligocene, the islands faced a tremendous earth movement resulting in mountain ridges, although well within the sea. Some of the ridges were suited for the growth of corals and also had the rising tendency for developing

the reef islands. The present configuration was, however, achieved by these islands only about 26 million years ago. The Narcondam Island and Barren Island are of volcanic origin. The former is an apparently extinct, while the latter is still active.

ZOOGEOGRAPHY

Zoogeographically, Andaman and Nicobar Islands occupy a unique position. These are closeto the "Indo-Malayan region," which is considered to be a "faunistic centre'from which other subdivisions of the Indo-west Pacific Region recruited their fauna (Ekman, 1953). Although a certain degree of endemicity is known among a few groups of terrestrial animals, the among marine animals is not known, since our knowledge on many groups is far from satisfactory. Some of the typical Indo-West Pacific groups of shore animals are found in these islands. aint clams (Tridacnidae) among mollluscs and fishes such as sea moths (Pegasidae), hitings (Silliginidae), rabbit fishes (Siganidae) and plesiopids (Plesiopidae) which are restricted to the Indo-West Pacific region are found in these Islands. Out of 50 species of sea snakes from the Indo-Pacific region 26 are reported from the waters off these islands. Dugong, a marine mammal which is endemic to Indo-West Pacific is recorded off these Islands. There are many more such marine animals which are typical of Indo-West Pacific and occur in these islands. Although the Islands have a great diversity of marine fauna many groups are yet to be worked out in detail.

BIOGEOGRAPHIC CLASSIFICATION

The biogeographic history of the Andaman and Nicoabr Islands indicates their uniqueness. The scattered islands, covering a small area, have been divided into 11 biogeographic subdivisions (Rodgers and Panwar, 1988). There are two levels of variation in the Andaman and Nicobar Islands. One is an ecological separation into different biomes: beach and reef systems, mangroves, littoral forests, deciduous forests, semi-evergreen, valley evergreen and hill slope evergreen forests, with further variation between calcium-rich and calcium-poor strata. The second is a separation by species composition, with each island having its own characteristic community composition, with its own proportion of endemics.

ECOSYSTEMS

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

The land area of the island chain is restricted but the diversity of forest types, each with its own distinctive floral and faunal composition, is staggering. Some of the larger islands display a veritable mosaic of forest types. The tropical forest ecosystem continuously recycles water. Since most of the islands have very few perennial rivers and streams, the inland wetlands are restricted. Basically, small ponds formed by rainwater accumulate inside the forests. The ponds are valuable sources of freshwater for wildlife and they also serve as a refuge for endangered species, such as the Andaman Teal and several endemic amphibians that are habitat specialists. The least disturbed and the best preserved, mangroves in India can be found in the Andaman and Nicobar Islands. Along with the inland forests, the mangroves are the predominant terrestrial ecosystem of the islands. These mangroves support a rich diversity of fauna and in particular provide breeding and spawning habitats for many aquatic species, the saltwater crocodile, several species of birds and reptiles (Rao and Khan, 1990).

The Andaman and Nicobar coral reefs are the second richest found in the world (Turner *et al.,* 2001). They consist mainly of fringing reefs with a barrier reef only on the western side. Seagrass beds occur in shallow coastal waters and sheltered bays, where clear water allows light penetration. Highly

threatened marine animals, such as dugongs and marine turtles, use this habitat essentially as a feeding ground (Das, 1996).

RUTLAND ISLAND

LOCATION AND TOPOGRAPHY

Rutland Island lies south east of Little Andaman and 55 km south of South Andaman across the Duncan passage; and is an area of high biological productivity (Fig. 2; Plate 1). It is located between latitude 11° 28' 00" to 11° 20' 00" and longitude 92° 35' 00'' to 92° 45' 00'' E. It occupies an area of 140.27 km^2 with an average altitude of 224 meters and a shore length of 98.2 km. Highest peak in Rutland is Mt. Ford - 435m. Rutland with its diverse forest habitats is an important ecotourists paradise. The forests are rich in faunal diversity with birds, and are an ideal place for the bird watchers. The island is partially populated but largely virgin. The island has fresh water streams running throughout the year. Geology of Rutland Island is mainly with basic and ultra-basic igneous rocks. The underlying rocks are essentially sandstone. Rutland is dominantly with rugged terrain, N-S folded structure that is longitudinal to the eastern and western coasts and transverse to northern and southern coasts. The mountainous origin of the islands also gives rise to an extremely convoluted coastline especially on the east with innumerable coves, deep inlets and wide bays. The higher ground is near the eastern shores.

HISTORY

The island was formerly home to the Jangil, one of the indigenous Andamanese groups. The Jangil (also called "Rutland Jarawa" since they were thought to have been related to the Jarawa of south Andaman) occupied much of the interior of the island according to mid 19th century British accounts, however their interactions with outsiders were few. Up to the early 20th century there are only a handful of documented encounters with Jangil individuals. The last documented encounter was in 1907, and when in the 1920s a more extensive expedition to the island's interior was conducted, no traces of their active habitation were found; the Jangil had become extinct. From time to time other indigenous Andamanese, such as the Onge from Little Andaman Island to the south and Great Andamanese tribes to the north had also set up fishing communities on Rutland. However, with the great reduction in numbers of these peoples, and their (enforced) relocations to more restricted areas, the island is presently without any permanent indigenous settlement.

CLIMATE

The climate is wet tropical. It is warm and humid for most of the year. The seasons can be divided into dry and rainy seasons. The extreme winter and summer are practically unknown, but there is a general nip in the air during December, January and February. Months of March, April, May and October can be uncomfortable due to high humidity although the temperature is not high. The average annual temperature ranged from 26.85 - 33.5°C. The humidity varies from 65 to 91 per cent. The highest humidity is experienced from May to November during the southwest monsoon. The southwest monsoon which brings most of the precipitation normally begins in the month of May and ends in October. The northeast monsoon starts during November and ends in December. The annual average rainfall recorded in south Andaman has been presented in Fig. 3.

FLORA OF RUTLAND ISLAND

The Rutland Island is covered with luxuriant, almost dense growth of tropical rain forest, characteristic of warm, humid and wet tropics. The dense forest consists of tangled mass of climbers, lianas, canes and bamboos. The trees grow in an intimate mixture of different species in all type of forests excluding mangroves. The mangrove forests make the border in low-lying banks of creeks and sheltered portions of coastal line subject of tidal action. The vegetation is composed of five major natural classes adapted according to the nature of the soil, elevation, topographical structure and edaphic factors.

Andaman Evergreen forests are most luxuriant type of forest, with canopy formed by giant *Dipterocarpus* sp. Tropical semi evergreen forests include both evergreen and deciduous species. The mangrove forest, which confines to sea washes soil is dominated by *Rhizophora* species while the littoral forest is dominated by *Manilkara littoralis* that forms a pure fringe on sandy beaches. Some of the important tree species are *Dipterocarpus gracilis, Atrocarpus chaplasha, Dipterocarpus grandiflorus, Hopea odorata, Pterospermum acerifolium, Calamus palustris, Dipterocarpus costatus, Cryptocarya ferrarsi, Pterocarpus dalbergioides, Dillenis pentagyna, Xanthophyllum andamanicum, Pongamia pinnata, Calophyllum inophyllum* and *Terminalia catappa.* The mangrove species are *Rhizophora mucronata, Bruguiera conjugate, Bruguiera cylindrical, Bruguiera parviflora, Avicennia officinalis* and *Kandelia candel.*

FAUNA OF RUTLAND ISLAND

This island is rich in fauna in diversity and abundance. Almost all the major fauna repored from Andaman and Nicobar Islands are observed in this Island. The area has a good population of Andaman Wild Pig *(Sus scrofa andamanensis),* Spotted Deer *(Axis axis),* Barking Deer *(Muntiacus muntjak),* Saltwater Crocodile *(Crocodilus palustris),* Water Monitor Lizard *(Varanus salvator*) and pretty number of bird species.

STUDY PERIOD

The study was conducted from April 2008 - April 2012 and it was mainly based on direct observational methods (Altman, 1974). The following points were suryved namely Mitta Nalah, Komeo, Padauk Dikri, Chain Nalah, Surumai Dikri, Arom Point, Aam Dera and Kumda Nalah.

OBJECTIVES

There is not sufficient data available on the wetland birds of Rutland Island. Therefore, an attempt has been made to fill the gap on the wetland birds in this Island. The objectives of this study were to document the status, distribution and population dynamics of wetland brids in this island.

COORDINATES OF DIFFERENT BLOCKS IN RUTLAND ISLAND

The coordinates of the study blocks are given in Table 1.

Table 1. Coordinates of different blocks in Rutland Island

Location	Coordinates	
	Latitude	Longitude
Mitta Nalah	11° 28.541’	92° 40.371’
Komeo	11° 24.314’	92° 39.780’
Padauk Dikri	12° 29.288’	92° 40.141’
Chain Nalah	12° 08.522’	93° 06.551’
Surumai Dikri	11° 25.504’	92° 40.301’
Arom Point	11° 30.541’	92° 38.769’
Aam Dera	11° 24.664’	92° 37.456’
Kumda Nalah	11° 27.091’	92° 36.928’

WETLAND BIRDS OF RUTLAND ISLAND

INTRODUCTION

The major wetland types observed in the Rutland Island are Mangroves, Intertidal Mud-flats, Sandy Beaches, Rivers and Streams. Besides there are Inland wetlands are also found in this Island. According to the "Ramsar Convention", the waterbirds are broadly defined as "*the birds depend on the wetlands for their living*", including ducks and geese, shorebirds and waders, and some other species living depend on wetlands, such as kingfishers, raptors and some passerines. However, there are only 20 families of birds are included in the Species List of "Ramsar Convention" namely, Gaviidae, Podicipedidae, Phalacrocoracidae, Pelecanidae, Aredeidae, Ciconiidae, Threskiornithidae, Phoenicopteridae, Anatidae, Gruidae, Rallidae, Heliornithidae, Jacanidae, Dromadidae, Haematopididae, Recurvirostridae, Glareolidae, Charadriidae, Scolopacidae and Laridae. In these 20 families, there are at least 404 species occurring in Asia-Pacific region and 243 species are migratory. Wetlands are particularly important since 20 per cent of the threatened bird species in Asia inhabit wetlands. Ornithological studies indicate that, of the 1230 species found in the Indian sub-continent, about 350 species are migrants which include both terrestrial and waterbirds. Out of 310 Indian wetland birds 107 species are winter migrants. Most of these bird breed outside the subcontinent in the Palaearctic region.

Wetlands have long attracted the attention of public and scientists because of the charm, copiousness, visibility and social behavior of the waterbirds, as well as for their recreational and economic importance. Recently, waterbirds have become of interest as indicators of wetland quality and as parameters of restoration success and regional biodiversity. Each year, a large number of water birds that breeds in areas of Europe and North and Central Asia in summer undertake migratory journey along major river valleys to spend the winter in more hospitable shelters in southerly latitudes. As the wetlands in northern areas become frozen due to the onset of winter and the food disappears under snow cover.

STUDIES IN ANDAMAN AND NICOBAR ISLANDS

The study on birds in the Andaman and Nicobar Islands has been initiated by Beavan (1867) listing the avifauna of Andaman Islands followed by Hume (1873, 1874 a, b, 1876). Many researchers have listed the birds of Andaman & Nicobar Islands and few studies on individual species *e.g.* Nicobar Magapode (Sankaran, 1995a), Andaman Teal (Vijayan, 1996), Edible-Nest Swiftlet (Sankaran, 2001), Narcondam Hornbill (Yahya and Zarri, 2003). Only, a few of studies have been conducted on the community ecology.

Although considerable amount of general information is available on the avifauna of Andaman and Nicobar Islands, quantitative studies on wetland bird communities of Rutland Island are entirely lacking. Therefore, the following objectives were formulated to address the lack of information about this resource in order to document the status, distribution, abundance and relative density of wetlaland birds.

MATERIALS AND METHODS

The study was mainly based on direct observational methods (Altman, 1974) and area was surveyed on foot, and boot and all the important areas were visited. Total count and Point count methods were used for census the birds (Burnham *et al*., 1980; Hoves and Bakewell, 1989). In this method, representative blocks were identified and birds in the blocks were counted using a telescope (15x - 45x). The census was conducted from 0700 to 1000 hour. Birds were identified based on physical features with the help of field guides and reference books (Ali and Ripley, 1983; Tikader, 1984; Grimmett *et al*., 1998; Kumar *et al.*, 2005).

Species richness and species composition of

birds were computed from the data obtained through census and field observations. Birds were classified as migratory and resident species based on the occurrence data and published literature. Globally threatened species of birds were identified based on BirdLife International (2001). Feeding and guild composition were collected from the available literature (Ali and Ripley, 1983). Bird species have been categorised as aquatic feeders, insectivores, granivores, nectar-frugivores, carnivores, frugivores and omnivores.

SURVEY EFFORT

The approximate percentage of all survey hours involved in wetland bird surveys each location is shown in Fig. 4. Total of 106 hours spent between 2008 and 2012, conducting ground surveys. More effort was focussed on September to March during the migratory season.

QUALITITATIVE ANALYAIS

Species richness and abundance

Species richness and abundance of birds were calculated from the census data and field observations. Margalef Index (R1) and Menhinick Index (R2) were calculated using the formula given by Magurran (1988) to find out the species richness.

Species diversity indices

Shannon-Weiner (H'), Simpson's (λ), and Hill's diversity number N1 and N2 were calculated using the computer program SPDIVERS.BAS developed by Ludwig and Reynolds (1988).

Similarity measures

Jaccard similarity index between the different islands were calculated using the formula of Magurran (1988).

Dominance Index

The dominance of the each bird species in the Rutland Island was calculated using the dominance index.

Distribution models

Species-abundance model was constructed as explained in Magurran (1988). Species of birds were ranked in order of abundance, as represented by individuals seen for each species and this was plotted in decreasing order for all species against the number of individuals for the whole area. Truncated lognormal distribution was fitted to species-abundance data, using maximum likelihood estimation (Slocomb *et al*., 1977).

RESULTS

Occurrence of species

Forty three wetland bird species and eighteen wetland dependant species were recorded from the Rutland Island and these belong to 11 Families under 7 Orders (Table 2; Plate 2-5). Of the 61 species, 40 species were resident, 20 migrants and one species vagrant. Little Egret (*Egretta garzetta*), Cattle Egret (*Bubulcus ibis*), Median Egret (*Mesophoyx intermedia*), Pacific Golden-Plover (*Pluvialis fluva*) and Lesser Crested Tern (*Sterna bengalensis*) were the most abundant species in the Rutland Island.

Table 2. Species of birds recorded from Rutland Island.

Sl. No.	Common Name	Scientific Name	Status
	Ciconiiformes		
	Ardeidae		
1.	Little Egret	*Egretta garzetta* (Linnaeus)	R
2.	Pacific Reef-Egret	*Egretta sacra* (Gmelin)	RM
3.	Large Egret	*Casmerodius albus* (Linnaeus)	RM
4.	Median Egret	*Mesophoyx intermedia* (Wagler)	RM
5.	Indian Pond-Heron	*Ardeola grayii* (Sykes)	R
6.	Little Green Heron	*Butorides striatus* (Linnaeus)	R

Table 2. contd.

Sl. No.	Common Name	Scientific Name	Status
7.	Great-billed Heron	*Ardea sumatrana* Raffles,	V
8.	Purple Heron	*Ardea purpurea* Linnaeus	RM
9.	Grey Heron	*Ardea cinerea* Linnaeus	RM
10.	Cattle Egret	*Bubulcus ibis* (Linnaeus)	RM
11.	Yellow Bittern	*Ixobrychus sinensis* (Gmelin)	RM
	Anseriformes		
	Anatidae		
12.	Lesser Whistling-Duck	*Dendrocygna javanica* (Horsfield)	R
13.	Cotton Teal	*Nettapus coromandelianus* (Gmelin)	R
14.	Andaman Teal	*Anas gibberifrons* (Muller)	R
	Falconiformes		
	Accipitridae		
15.	Brahminy Kite	*Haliastur indus* (Boddaert)	R
16.	White-bellied Sea-Eagle	*Haliaeetus leucogaster* (Gmelin)	R
17.	Andaman Serpent-Eagle	*Spilornis cheela davisoni* Hume	R
18.	Greater Grey-headed Fish Eagle	*Ichthyophaga ichthyaetus* (Horsfield)	R
19.	Western Marsh-Harrier	*Circus aeruginosus* (Linnaeus)	M
20.	Eurasian Sparrowhawk	*Accipiter nisus* (Linnaeus)	M
	Gruiformes		
	Rallidae		
21.	Andaman Crake	*Rallina canningi* (Blyth)	R
22.	Blue-breasted Rail	*Gallirallus striatus* Linnaeus	R
23.	Andaman White-breasted Waterhen	*Amaurornis phoenicurus* (Pennant)	R
24.	Water Cock	*Gallicrex cinerea* (Gmelin)	R
25.	Common Moorhen	*Gallinula chloropus* (Linnaeus)	RM
26.	Purple Moorhen	*Porphyrio porphyrio* (Linnaeus)	R
	Charadriiformes		
	Charadriidae		
27.	Pacific Golden-Plover	*Pluvialis fulva* (Gmelin)	M
28.	Kentish Plover	*Charadrius alexandrinus* Linnaeus	RM
29.	Little Ringed Plover	*Charadrius dubius* Scopoli	RM
30.	Lesser Sand Plover	*Charadrius mongolus* Pallas	RM
	Scolopacidae		
31.	Pintail Snipe	*Gallinago stenura* (Bonaparte)	M
32.	Eurasian Curlew	*Numenius arauata* (Linnaeus)	M
33.	Whimbrel	*Numenius phaeopus phaeopus* (Linnaeus)	M

Table 2. contd.

Sl. No.	Common Name	Scientific Name	Status
34.	Spotted Redshank	*Tringa erythropus* (Pallas)	M
35.	Common Redshank	*Tringa totanus* (Linnaeus)	M
36.	Marsh Sandpiper	*Tringa stagnatilis* (Bechstein)	M
37.	Common Greenshank	*Tringa nebularia* (Gunner)	M
38.	Green Sandpiper	*Tringa ochropus* Linnaeus	M
39.	Wood Sandpiper	*Tringa glareola* Linnaeus	M
40.	Common Sandpiper	*Actitis hypoleucos* Linnaeus	M
41.	Ruddy Turnstone	*Arenaria interpres* (Linnaeus)	M
42.	Little Stint	*Calidris minuta* (Leisler)	M
43.	Temminck's Stint	*Calidris temminckii* (Leisler)	M
44.	Great Knot	*Calidris tenuirostris* (Horsfield)	M
45.	Bar-tailed Godwit	*Limosa lapponica* (Linnaeus)	M
	Laridae		
46.	Gull-billed Tern	*Gelochelidon nilotica* (Gmelin)	RM
47.	Black-naped Tern	*Sterna sumatrana* Raffles	R
48.	Lesser Crested Tern	*Sterna bengalensis* Lesson	R
49.	White-winged Black Tern	*Chlidonias leucopterus* (Temminck)	M
	Coraciformes		
	Alcedinidae		
50.	Small Blue Kingfisher	*Alcedo atthis* (Linnaeus)	RM
51.	Stork-billed Kingfisher	*Halcyon capensis* (Linnaeus)	R
52.	White-breasted Kingfisher	*Halcyon smyrnensis* (Linnaeus)	R
53.	Black-capped Kingfisher	*Halcyon pileata* (Boddaert)	R
54.	Andaman Collared Kingfisher	*Halcyon chloris davisoni* Sharpe	R
	Meropidae		
55.	Small Bee-eater	*Merops orientalis* Latham	R
56.	Blue-tailed Bee-eater	*Merops philippinus* Linnaeus	RM
57.	Chestnut-headed Bee-eater	*Merops leschenaultia* Vieillot	R
	Passeriformes		
	Hirundinidae		
58.	House Swallow	*Hirundo tahitica* Gmelin	R
	Motacillidae		
59.	Large Pied Wagtail	*Motacilla maderaspatensis* Gmelin	R
60.	Yellow Wagtail	*Motacilla flava* Linnaeus	RM
61.	Grey Wagtail	*Motacilla cinerea* Tunstall	M

R = Residents, RM = Resident migrants, M = Trans-continental migrants, V = Vagrant

Order wise classification and feeding guild composition of bird species

The order wise classification of wetland birds species observed in Rutland Island is given in Table 3. The Order Charadriiformes had the highest percentage (37.7 per cent) of species followed by Ciconiiformes (18.03 per cent) and Coraciformes (13.11 per cent). Feeding guild analysis showed that majority of species were aquatic feeders (73.77 per cent) followed by Carnivores and Omnivores (8.8 per cent) respectively (Table 3).

Waders

Waders constitute an important group of wetland species in the Rutland Island. These birds depend heavily on mud flats and shallow water, normally recorded during September to March in the Rutland Island. Details on the occurrence of waders in the intensive study sites are presented in Table 4. The highest number of species of waders was recorded from Komeo and Surmai Dikri (18) followed by Chain Nalah (16), Arom Point (15). Pacific Golden Plover (*Pluvialis fluva*), Little Ringer Plover (*Charadrius dubis*), Lesser Sand Plover (*Charadrius mongolus*), Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*) and Eurasian Curlew (*Numenius arauata*) were recorded from all study block during the migratory seasons.

Comparative occurrence of bird species

A comparison of number of bird species recorded from the Rutland Island with those from Andaman and Nicobar Islands, India, Asia and World is given in Table 5.

Endemic and globally threatened species

Out of the 20 species of birds, which are endemic to Andaman Islands (Jathar and Rahmani, 2006), the Andaman Teal *Anas gibberfrons* was recored from Rutland Island. According to BirdLife International (2001), one hundred and twenty nine threatened bird species occur in India, the following species were recorded from the Rutland Island namely, Andaman Serpent-Eagle, Greate Grey-headed Fish-Eagle, Andaman Crake, Eurasian Curlew, and Great Knot.

Species abundance relations

Species richness and abundance wetland birds

Species richness of birds varied in different locations in the study area. Highest number of species richness and abundance was recorded at Mitta Nallah, followed by Padauk Dikri, Chain nalah and Komeo (Fig. 5 and Table 6).

Overall diversity indices

The overall diversity Index (H') was 3.51, and (λ) 0.04. Species Richness Index (R1) was 6.89 and (R2) was 0.92. Similarly, high values were obtained for Hill's number (N1) and (N2). Hill's number (N1) was 33.39 and Hill's numbers (N2) was 26.27. Evenness index (E1) was 0.86 and (E2) 0.58.

Diversity indices of birds in differnt locations

Most widely used diversity indices like Shannon-Weiner Index, Simpson's Index, Hill's numbers (N1 and N2) and Richness Indices (R1 and R2) were estimated for the birds of Rutland Island. During the period of the study, the highest diversity index (H') was recorded at Komeo (3.21), followed Paduk Dikri (3.20), and lowest (H') was (2.87) at Mitta Nallah (Table 7).

Similarity Index

Jaccard similarity index was calculated, it is an alternative approach to measure the similarity of different sites is using similarity indices. Similarity index between the different locations was computed using qualitative data (Table 8). Similarity index showed high values between Komeo and Padauk Dikri (76.38 per cent) followed by Paduk Dikri and Chain Nalah (72.17 per cent); and Komeo and Chain Nallah (71.09 per cent).

Abundance and dominance of bird species

Of the recorded species of wetland birds observed in the Rutland Island, Wood Sandpiper (6.22 per cent) was highest in dominance followed by Cattle Egret (5.32 per cent), Lesser Whisling Duck (5.29), Median Egret (4.96), Little Egret (4.82 per cent) and Indian Pond Heron (4.54 per cent) (Table 9). Thirty three species were represented in less than 0.1 per cent.

Distribution model

The distribution model indicates the absence of a single dominant species or group of species and the presence of long series of very rare species at Rutland Island. The species, which is represented by less than 2 individuals, can be called as rare. The observed and expected number of species was compared using the χ^2 goodness of fit test. The test showed that there is no significant difference between the observed and expected distribution (χ^2 = 18.23; P = 0.01). The result shows that the bird community is following the truncated lognormal distribution pattern (Table 10).

Population fluctuations of wetland birds in Rutland Island

The population of wetland birds varied in different location in Rutland Island. The detailed population flucatuation of slected species namely Little Egret, Large Egret, Median Egret, Cattle Egret, Pacific Golden Plover, Lesser Sand Plover, Eurasian Curlew, Common Redshank, Marsh Sandpiper, Wood Sandpiper, Common Sandpiper, Little Stint, Gull-billed Tern and Black-naper tern are presented in Figs. 6-8.

Table 3. Order wise classification and feeding guild composition of bird species recorded from the *Rutland* Island

Sl. No.	Order	Status			Feeding guilds						
		R	M	Total	A	I	G	N/F	C	F	O
1.	Ciconiiformes	11	-	11	11	-	-	-	-	-	-
2.	Anseriformes	03	-	03	3	-	-	-	-	-	-
3.	Falconiformes	04	02	06	-	-	-	-	6	-	-
4.	Gruiformes	06	-	06	3	-	-	-	-	-	3
5.	Charadriiformes	06	17	23	23	-	-	-	-	-	-
6.	Coraciiformes	08	-	08	5	3	-	-	-	-	-
7.	Passeriformes	03	01	04	-	1	-	-	-	-	3
Total		**41**	**20**	**61**	**45**	**4**	**-**	**-**	**6**	**-**	**6**

R = Resident, M = Migrant; A = Aquatic feeders, I = Insectivores, G = Granivores, N/F = Nectar-Frugivores, C = Carnivores, F = Frugivores, O = Omnivores

Table 4. Waders recorded from the study blocks in the Rutland Island

Sl. No.	Common Name	Mitta Nalah	Komeo	Padauk Dikri	Chain Nalah	Surumai Dikri	Arom Point	Aam dera	Kumda Nalah
1.	Pacific Golden-Plover	√	√	√	√	√	√	√	√
2.	Kentish Plover		√		√			√	
3.	Little Ringed Plover			√	√		√		√
4.	Lesser Sand Plover	√	√	√	√	√	√	√	√
5.	Pintail Snipe	√	√			√	√		
6.	Eurasian Curlew	√	√	√	√	√	√	√	√
7.	Whimbrel		√		√	√			
8.	Spotted Redshank	√		√					
9.	Common Redshank	√	√	√	√	√	√	√	√

Table 4. contd.

Sl. No.	Common Name	Mitta Nalah	Komeo	Padauk Dikri	Chain Nalah	Surumai Dikri	Arom Point	Aam dera	Kumda Nalah
10.	Marsh Sandpiper	√	√	√	√	√	√	√	
11.	Common Greenshank		√			√			√
12.	Green Sandpiper		√		√			√	
13.	Wood Sandpiper	√	√	√	√	√	√	√	√
14.	Common Sandpiper	√	√	√	√	√	√	√	√
15.	Ruddy Turnstone					√			
16.	Little Stint	√	√	√	√	√	√	√	√
17.	Temminck's Stint		√		√	√	√		
18.	Great Knot					√			
19.	Bar-tailed Godwit			√				√	
20.	Gull-billed Tern	√	√		√	√	√		√
21.	Black-naped Tern	√	√	√	√	√	√	√	√
22.	Lesser Crested Tern	√	√	√	√	√	√	√	√
23.	White-winged Black Tern	√	√			√	√		

Table 5. Comparative occurrence of wetland bird species in the Rutland Island.

Sl. No.	Order and Family	World[1]	Asia[1]	India[2]	A & N Islands[3]	Rutland Island*
1.	**Ciconiiformes**					
	Ardeidae	65	33	20	15	10
2.	**Anseriformes**					
	Anatidae	158	81	41	7	3
3.	**Falconiformes**					
	Accipitridae	235	103	56	22	6
4.	**Gruiformes**					
	Rallidae	130	45	17	9	5
5.	**Charadriiformes**					
	Charadriidae	66	32	19	8	4
	Scolopacidae	89	72	42	24	16
	Laridae	99	65	32	10	4
6.	**Coraciformes**					
	Alcedinidae	92	59	12	10	5
	Meropidae	93	34	5	6	3
7.	**Passeriformes**					
	Hirundinidae	100	24	15	3	1
	Motacillidae	62	27	19	11	3

1 - Gill and Donsker (2012); 2 - Ali and Ripley (1983); 3 - Tikader, 1984; 4 – Present study

Table 6. Percentage of species abundance of wetland birds in different locations in Rutland Island

Commn Name	Mitta Nallah	Komeo	Padauk Dikri	Chain Nalah	Surumai Dikri	Arom Point	Aam Dera	Kumda Nallah
Little Egret	6.67	3.50	3.16	2.97	3.61	3.66	2.78	12.95
Pacific Reef-Egret	0.12	0.73	0.00	0.16	0.00	0.00	0.00	0.68
Large Egret	0.25	0.73	0.00	1.09	3.13	1.57	0.69	0.45
Median Egret	4.20	5.26	5.49	5.47	7.47	3.92	5.09	2.73
Indian Pond Heron	2.96	2.34	3.02	2.81	10.12	6.53	5.32	8.18
Little Green Heron	0.25	0.44	0.69	0.47	0.24	0.52	0.00	0.00
Great-billed Heron	0.12	0.29	0.00	0.00	0.00	0.00	0.00	0.00
Purple Heron	1.48	0.00	0.55	0.47	0.00	1.04	0.00	0.00
Grey Heron	0.86	0.00	1.10	0.00	0.72	0.00	0.46	0.00
Cattle Egret	3.95	4.09	5.08	4.22	5.78	3.13	10.19	8.41
Yellow Bittern	0.12	0.29	0.00	0.00	0.00	0.00	0.23	0.23
Lesser Whistling Duck	8.64	4.38	5.35	8.59	0.00	0.00	8.33	13.64
Cotton Teal	0.00	0.29	0.27	1.88	0.00	0.00	0.00	0.00
Andaman Teal	1.60	0.00	0.00	2.34	0.00	0.00	0.00	0.00
Brahminy Kite	0.86	0.73	0.55	0.63	0.00	0.00	0.00	0.68
White-bellied Sea-Eagle	1.48	0.58	0.82	2.03	3.37	4.44	0.46	1.82
Andaman Serpent-Eagle	0.25	0.29	0.14	0.16	0.00	0.00	0.23	0.23
Greater Grey-headed Fish Eagle	0.74	0.29	0.00	0.63	1.93	0.00	0.00	0.45
Western Marsh-Harrier	0.25	0.00	0.00	0.00	0.00	0.00	0.46	0.45
Eurasian Sparrowhawk	0.49	0.00	0.41	0.31	0.00	0.00	0.00	0.00
Andaman Crake	0.25	0.29	0.27	0.00	0.00	0.00	0.00	0.00
Blue-breasted Rail	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Andaman White-breated Waterhen	0.49	0.58	0.41	0.31	0.24	2.61	1.16	0.45
Water Cock	0.49	0.29	0.14	0.00	0.00	0.00	0.00	0.00
Common Moorhen	0.62	5.26	1.51	4.06	0.00	0.78	0.46	0.45
Purple Moorhen	0.00	9.93	8.23	0.00	7.95	0.00	2.78	0.00
Pacific Golden-Plover	1.60	1.46	3.57	1.72	0.00	10.70	6.25	3.18
Kentish Plover	0.00	0.44	0.00	0.94	0.00	0.00	1.85	0.00
Little Ringed Plover	0.00	0.00	1.65	2.81	0.00	4.18	0.00	3.41
Lesser Sand Plover	3.83	1.75	2.19	1.56	2.65	3.66	2.31	1.36
Pintail Snipe	31.85	17.23	17.97	21.09	0.00	1.04	2.31	1.36
Eurasian Curlew	1.60	0.73	2.19	0.47	0.48	1.04	1.85	2.73
Whimbrel	0.00	0.44	0.00	0.16	0.48	0.00	0.00	0.00
Spotted Redshank	1.60	0.00	2.19	0.00	0.00	0.00	0.00	0.00
Common Redshank	3.46	2.63	3.29	2.66	6.75	7.57	6.25	2.95

Table 6. contd.

Commn Name	Mitta Nallah	Komeo	Padauk Dikri	Chain Nalah	Surumai Dikri	Arom Point	Aam Dera	Kumda Nallah
Marsh Sandpiper	0.74	2.63	2.33	1.09	0.72	2.35	3.01	0.00
Common Greeshank	0.00	1.31	0.00	0.00	1.45	0.00	0.00	1.14
Green Sandpiper	0.00	0.44	0.00	0.31	0.00	0.00	0.93	0.00
Wood Sandpiper	2.59	3.94	2.61	7.97	7.95	6.79	8.10	13.64
Common Sandpiper	1.23	4.38	3.84	5.63	3.61	5.22	6.25	2.05
Ruddy Turnstone	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00
Little Stint	0.74	2.34	3.29	1.88	0.72	0.52	0.46	0.91
Great Knot	0.00	0.88	0.00	0.16	0.72	0.52	0.00	0.00
Bar-tailed Godwit	0.00	0.00	0.82	0.00	0.00	0.00	1.85	0.00
Gull-billed Tern	2.96	1.75	0.00	0.00	10.60	2.87	0.00	1.82
Black-naped Tern	3.46	0.58	2.47	3.28	4.10	4.96	7.41	2.05
Lessser Crested Tern	1.23	6.13	2.19	0.94	1.20	3.66	2.78	2.50
White-winged Black Tern	0.99	1.46	0.00	0.00	0.72	0.78	0.00	0.00
Small Blue Kingfisher	0.37	0.29	0.00	0.31	0.24	0.26	0.46	0.68
Stork-billed Kingfisher	0.49	0.58	0.82	0.00	0.48	0.52	0.00	0.00
Black-capped Kingfisher	0.12	0.00	0.27	0.00	0.00	0.00	0.00	0.23
Andaman Collared Kingfisher	1.23	2.92	2.47	2.50	3.61	5.22	3.94	2.05
Small Bee-eater	0.49	0.73	0.82	1.88	1.20	0.78	2.78	1.82
Chestnut-headed Bee-eater	0.86	2.34	1.65	1.25	5.06	2.35	0.93	1.59
House Swallow	0.74	1.17	4.39	1.25	1.45	5.74	0.93	1.59
Large Pied Wagtail	0.00	0.58	1.10	1.25	0.00	0.00	0.00	0.00
Yellow Wagtail	0.00	0.00	0.27	0.31	0.48	0.52	0.46	0.91
Grey Wagtail	0.25	0.29	0.41	0.00	0.00	0.52	0.23	0.23

Table 7. Diversity indices of bird species in different Islands

Location	Richness indices		Diversity indices		Hills' indices		Evenness indices	
	R1	R2	λ	H'	N1	N2	E1	E2
Mitta Nallah	6.72	1.62	0.12	2.87	17.65	8.04	0.75	0.38
Komeo	6.89	1.76	0.06	3.21	24.88	16.25	0.84	0.54
Padauk Dikri	6.07	1.52	0.06	3.20	24.54	16.47	0.86	0.60
Chain Nalah	6.19	1.62	0.07	3.08	21.69	13.38	0.83	0.53
Surumai Dikri	5.31	1.62	0.06	3.04	20.89	17.34	0.87	0.63
Arom Point	5.38	1.69	0.05	3.16	23.61	20.64	0.90	0.72
Aam Dera	5.60	1.68	0.05	3.12	22.72	19.07	0.88	0.65
Kumda Nallah	5.75	1.72	0.07	2.96	19.32	13.46	0.83	0.54

Table 8. Similarity indices for different islands in Rutland Island

Locations	Mitta Nallah	Komeo	Padauk Dikri	Chain Nalah	Surumai Dikri	Arom Point	Aam Dera	Kumda Nallah
Mitta Nallah	0	58.86	65.11	66.07	45.06	44.93	50.08	55.68
Komeo		0	76.38	71.09	52.91	48.50	55.51	47.82
Padauk Dikri			0	72.17	48.43	54.86	62.02	50.47
Chain Nalah				0	48.91	52.39	60.07	59.26
Surumai Dikri					0	62.91	58.09	52.16
Arom Point						0	65.28	55.41
Aam Dera							0	63.07
Kumda Nallah								0

Table 9. Abundance and dominacne of bird species recorded in Rutland Island

Common Name	Abundance	Dominance
Wood Sandpiper	282	6.22
Cattle Egret	241	5.32
Lesser Whistling Duck	240	5.29
Median Egret	225	4.96
Little Egret	218	4.81
Indian Pond Heron	206	4.54
Common Redshank	184	4.06
Common Sandpiper	175	3.86
Purple Moorhen	173	3.82
Black-naped Tern	148	3.26
Pacific Golden-Plover	142	3.13
Andaman Collared Kingfisher	125	2.76
Lessser Crested Tern	116	2.56
Lesser Sand Plover	110	2.43
Pintail Snipe	102	2.25
Gull-billed Tern	99	2.18
House Swallow	93	2.05
Common Moorhen	85	1.87
Chestnut-headed Bee-eater	84	1.85
White-bellied Sea-Eagle	76	1.68
Marsh Sandpiper	73	1.61
Little Stint	69	1.52
Eurasian Curlew	63	1.39

Table 9. contd.

Common Name	Abundance	Dominance
Little Ringed Plover	61	1.35
Small Bee-eater	55	1.21
Large Egret	38	0.84
Andaman White-breasted waterhen	31	0.68
Spotted Redshank	29	0.64
Andaman Teal	28	0.62
White-winged Black Tern	24	0.53
Purple Heron	23	0.51
Brahminy Kite	23	0.51
Greater Grey-headed Fish Eagle	22	0.49
Grey Heron	20	0.44
Common Greeshank	20	0.44
Large Pied Wagtail	20	0.44
Stork-billed Kingfisher	18	0.40
Kentish Plover	17	0.37
Little Green Heron	16	0.35
Cotton Teal	16	0.35
Bar-tailed Godwit	14	0.31
Small Blue Kingfisher	14	0.31
Yellow Wagtail	14	0.31
Great Knot	12	0.26
Grey Wagtail	11	0.24
Pacific Reef-Egret	10	0.22
Eurasian Sparrowhawk	9	0.20
Green Sandpiper	9	0.20
Andaman Serpent-Eagle	8	0.18
Water Cock	7	0.15
Western Marsh-Harrier	6	0.13
Andaman Crake	6	0.13
Whimbrel	6	0.13
Yellow Bittern	5	0.11
Black-capped Kingfisher	4	0.09
Great-billed Heron	3	0.07
Blue-breasted Rail	3	0.07
Ruddy Turnstone	3	0.07

Table 10. Truncated lognormal distribution at Rutland Island (χ^2 test)

Class interval	Upper boundary	Observed	Expected
1	2.5	0	14.05
2	4.5	4	5.44
3	8.5	6	5.88
4	16.5	10	6.07
5	32.5	12	6.06
6	64.5	4	5.85
7	128.5	10	5.35
8	256.5	9	4.44
9	512.5	3	3.78
10	1024.5	0	0
χ^2	*18.23*	*df*	*7*

SUMMARY

Of the 61 species recorded in Rutland Island, 40 species are residents (66 per cent) and 20 species are migrant (35 per cent) and one species is vagrant. The most abundant species in Rutland Island were egrets and herons, followed by shorebirds, and terns. The most widespread and abundant species was Little Egret (*Egretta garzetta*) followed by Cattle Egret (*Bubulcus ibis*), Median Egret (*Mesophoyx intermedia*), Pacific Golden-Plover (*Pluvialis fluva*) and Lesser Crested Tern (*Sterna bengalensis*). The site wise species abundance and species richness was highest in Mitta Nallah, Padauk Dikri, Chain nalah and Komeo. There appear to be differences during migratory season some migratory species, especially shorebirds showed abundance. The Pacific Golden Plover (*Pluvialis fluva*), Little Ringer Plover (*Charadrius dubis*), Lesser Sand Plover (*Charadrius mongolus*), Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*) and Eurasian Curlew (*Numenius arauata*) were recorded in quite good numbers in the different locations of Rutland Island during migratory season.

The abundance and distribution of bird species in Rutland Island have been examined and the results of this study support that this area represents a unique and important habitat type. The large areas are likely to encompass a greater variety of habitat types and hence to offer suitable habitat for a greater variety of species (Case, 1975 and Lack, 1976), though the size of the Rutland Island is small in size, because of the availability of varies micro habitat this island also support higher number of species. The species richness results from the dynamic equilibrium between immigration and extinction rates, which are dependent on island isolation and area respectively (MacArthur and Wilson, 1967). The bird species richness and diversity may be influenced by factors such as the composition of plant communities, forest type and other environmental factors (Wiens and Rottenberry, 1981). The availability of micro habitats in the study area may influence the species diversity of Rutland Island. Diversity indices are extensively used in environmental monitoring and conservation. As the objective of the world conservation strategy is to maximize diversity of habitats, these indices are extensively used to monitor and evaluate habitats. According to a study conducted by Usher (1986) among the criteria used for evaluation of conservation schemes, diversity is the most frequently adopted criteria. The diversity indices directly correlated with the stability of the ecosystem and it will be higher in biologically controlled ecosystem like tropical

forests and low in disturbed ecosystem. The nature and extent of adjacent habitat might be more important for most species than the existence of forest edge itself (Freemark *et al*., 1995). The local ecological factors are important in determining diversity and abundance of birds. The different features may influence the species distribution in this archipelago *viz.,* the vegetation structure or the floristic richness may explain specific habitat preference, this was not observed in the temperate archipelago (Martin and Lepart, 1989 and Martin *et al*., 1995), the number of habitat types on an islands or habitat diversity, is often considered a determinant of species richness (Murphy and Wilconx, 1986).

The presence of high species diversity and occurrence of many threatened species shows the need for continued protection and preservation of the Tropical Island ecosystem. Although this study was limited in duration and geographic area, our observations of Rutland Island specific bird species suggest that the increase the regional avifaunal diversity by providing abundant resources, unique microhabitats and landscape level habitat heterogeneity that attract a diversity of bird species. Future studies comprising larger samples and censuses throughout the year are important and unique feature of the Rutland Island. The result shows that Rutland Island support unique avian assemblages, comprising of many rare and endemic species and therefore it could be considered as an important birding ground in this archipelago. In conclusion, the community composition appeared to be determined primarily by forest type and patchiness of Islands area.

ACKNOWLEDGEMENTS

The author is grateful to the Ministry of Environment, Forests & climate change, Government of India, for providing facilities to this study. I am thankful to Dr. K. Venkataraman, the Director, Zoological Survey of India and Dr. C. Raghunathan, the Officer-in-Charge, Andaman and Nicobar Regional Centre, Zoological Survey of India, Port Blair for encouragement and providing necessary facilities to undertake this study. I am also thankful to the Shri. Suresh Kumar Shah, Zoological Assistant, Shri. A. Polycap, Field Collector, Shri. G. Ponnuswamy, Photographer for their cooperation and company during the course of this study. I also acknowledge the assistance of ministerial staff for providing all the store items and administrative support. Special thanks are also due to Principal Chief Conservator of Forests & Chielf Wildlife Warden, Department of Environment and Forests, Andaman and Nicobar Islands for their logistic support to carry out this study in Rutland Island.

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Manuscript Received : 31st May, 2013; Accepted : 8th August, 2014.

APPENDIX - I

List of spider species recorded in Rutland Island

Sl. No.	Family	Species name
1.	Araneidae	*Argiope aemula* (Walckenaer)
2.		*Argiope catenulata* (Doleschall)
3.		*Gasteracantha cancriformis* (Linnaeus)
4.		*Nephila maculata* (Fabricus)
5.		*Nephila kuhlii* (Doleschall)
6.		*Ctenus andamanensis* (Gravely)
7.	Sparassidae	*Heteropoda andamanensis* Tikader
8.	Tetragnathidae	*Tetragnatha andamanensis* Tikader
9.		*Tetragnatha parvula* Thorell
10.	Thomisidae	*Thomisus andamanensis* Tikader
11.	Salticidae	*Plexippus andamanensis* (Tikader)
12.		*Bianor incitatus* Thorell
13.		*Pseudicius andamanius* (Tikader)
14.	Hersiliidae	*Hersilia savignyi* Lucas
15.	Pholcidae	*Pholcus kapuri* Tikader
16.		*Artema atlandta* Walckenaer
17.	Oxyopidae	*Oxyopes javanus* Thorell

APPENDIX - II

List of Odonata recorded in Rutland Island

Sl. No.	Family	Species Name
1.	Aeschnidae	*Anax guttatus* (Burmeister)
2.		*Gynacantha hyalina* Selys
3.	Libellulidae	*Acisoma panorpoides panorpoides* Rambur
4.		*Brachydiplax chalybea chalybea* Brauer
5.		*Crocothemis servilia servilia* (Drury)
6.		*Diplacodes nebulosa* (Fabricius)
7.		*Indothemis carnatica* (Fabricius)
8.		*Lathrecista asiatica asiatica* (Fabricius)
9.		*Neurothemis fulvia* (Drury)
10.		*Orthetrum sabina sabina* (Drury)
11.		*Trithemis aurora* (Brumeister)
12.		*Rhyothemis variegata variegata* (Linnaeus)
13.		*Tholymis tillarga* (Fabricius)
14.		*Zyxomma petiolatum* Rambur
15.	Calopterygidae	*Vestalis gracilis gracilis* (Rambur)
16.	Coenagrionidae	*Aciagrion pallidum* Selys
17.		*Pseudagrion pruinosum* (Burmeister)
18.	Lestidae	*Lestes praemorsa praemorsa* Selys

APPENDIX - III

List of Butterflies recorded in Rutland Island

Sl. No.	Family / Common Name	Species Name
	Hesperidae	
1.	Common Snow Flat	*Tagiades japetus* (Stoll)
2.	Common Awl	*Hasora badra* (Moore)
3.	Common Spotted Flat	*Celaenorrhinus leucocera* (Kollar)
	Papilionidae	
4.	Great Jay	*Graphium eurypylus* (Linnaeus)
5.	Andaman Mormon	*Papilio mayo* Atkinson
6.	Great Mormon	*Papilio memnon* Linnaeus
7.	Common Mormon	*Papilio polytes* (Linnaeus)
8.	Lime Butterfly	*Papilio demoleus* (Linnaeus)
9.	Crimson Rose	*Atrophaneura hector* (Linnaeus)
10.	Common Rose	*Atrophaneura aristolochiae* (Fabricius)
	Pieridae	
11.	Three Spot Grass Yellow	*Eurema blanda* (Boisduval)
12.	Common Grass Yellow	*Eurema hecaba* (Linnaeus)
13.	Tree Yellow	*Gandaca harina* (Horsfield)
14.	Common Emigrant	*Catopsilia pomona* (Fabricius)
15.	Mottled Emigrant	*Catopsilia pyranthe* (Linnaeus)
16.	Yellow Orange Tip	*Ixias pyrene* Linnaues
17.	Great Orange Tip	*Hebomoia glaucippe* (Linnaeus)
18.	Andaman Wanderer	*Pareronia ceylanica* (C. & R. Felder)
19.	Striped Albatross	*Appias libythea* (Fabricius)
20.	Chocolate Albatross	*Appias lyncida* (Cramer)
21.	Orange Albatross	*Appias nero* (Fabricius)
22.	Common Albatross	*Appias albina* Felder
23.	Large Cabbage White	*Pieris brsssicae* (Linnaeus)
24.	Lesser Gull	*Cepora nadina* (Lucas)
25.	Pysche	*Leptosia nina* (Fabricius)
	Lycaenidae	
26.	Indian Sunbeam	*Curetis thetis* (Drury)
27.	Yamfly	*Loxura atymnus* (Stoll)
28.	Leaf Blue	*Amblypodia anita* Hewitson

Sl. No.	Family / Common Name	Species Name
29.	Forget-Me-Not	*Catochrysops strabo* (Fabricius)
30.	Lesser Grass Blue	*Zizina otis* (Fabricius)
31.	Dark Blue Royal	*Pratapa icetas* (Hewitson)
32.	Plains Cupid	*Chilades pandava* (Horsfield)
33.	Leaf Blue	*Amblypodia anita* Hewitson
34.	Apefly	*Spalgis epius* (Westwood)
35.	Dark Grass Blue	*Zizeeria karsandra* (Moore)
36.	Common Tit	*Hypolycaena erylus* (Godart)
37.	Silverstreak Blue	*Iraota timoleon* Stoll
	Nymphalidae	
38.	Striped Tiger	*Danaus genutia* Cramer
39.	Dark Glassy Tiger	*Prantica ageloides* (C & R. Felder)
40.	Plain Tiger	*Danaus chrysippus* (Linnaeus)
41.	Blue Tiger	*Tirumala limniace* Cramer
42.	Glassy Tiger	*Parantica aglea* (Stoll)
43.	Spotted Black Crow	*Euploea crameri* Lucas
44.	Andaman Crow	*Euploea andamanensis* Atkinson
45.	Tree Nymph	*Idea agamarschana* (C & R. Felder)
46.	Palmking	*Amathusia phidippus* (Linnaeus)
47.	Common Evening Brown	*Melanitis leda* (Linnaeus)
48.	Long-Brand Bush Brown	*Mycalesis visala* Moore
49.	Andaman Chestnut Palmfly	*Elymanias cottonis cottonis* Hewitson
50.	Leopard Lacewing	*Cethosia cyane* (Drury)
51.	Cruiser	*Vindula erota* Fabricius
52.	Common Sergeant	*Athyma perium* (Linnaeus)
53.	Common Sailer	*Neptis hylas* Linnaeus
54.	Clipper	*Parthenos Sylvia* (Cramer)
55.	Hewitson Andaman Viscount	*Tanaecia cibaritis* Hewitson
56.	Peacock Pansy	*Junonia almana* (Linnaeus)
57.	Yellow Pansy	*Junonia hierta* (Fabricius)
58.	Blue Pansy	*Junonia orithya* (Linnaeus)
59.	Peacock Pansy	*Junonia atlites* (Linnaeus)
60.	Yellow Pansy	*Junonia hierta* (Fabricius)
61.	Grey Pansy	*Precis atlites* (Linnaeus)
62.	Great Egg fly	*Hypolimnas bolina* (Linnaeus)
63.	Danaid Eggfly	*Hypolimnas misippus* (Linnaeus)

APPENDIX - IV

List of Reptiles and Amphibians recorded in Rutland Island

Family	Species Name
Gekkonidae	*Cnemaspis kandianus* (Kelaart)
	Cosymbotus platyurus (Schneider)
	Gecko gecko (Linnaeus)
	Gecko verreauxi (Tytler)
	Gecko smithii (Gray)
	Hemidactylus frenatus (Dumeril & Bibron)
	Phelsuma andamanense (Blyth 1860)
Agamidae	*Calotes andamanensis* (Boulenger)
	Calotes emma alticristatus (Schmidt)
	Calotes mystaceus (Dumeril & Bibron)
	Coryphophylax subcristatus (Blyth)
	Calotes versicolor (Daudin)
Scincidae	*Dasia olivacea* (Gray)
	Eutropis andamanensis (Smith)
	Eutropis tytleri (Theobald)
	Eutropis rudis (Boulenger)
	Eutropis rugifera
	Eutropis multifasciata (Kuhl)
Varanidae	*Varanus salvator* (Laurenti)
Typhlopidae	*Ramphotyphlops braminus* (Daudin)
	Typhlops andamanensis (Laurenti)
Colubridae	*Dendrelaphis pictus andamanensis* (Anderson)
Elapidae	*Bungarus andamanensis* (Biswas & Sanyal)
	Ophiophagus hannah (Cantor)
Viperidae	*Trimeresurus purpureomaculatus andersoni* (Theobald)

Amphibians

Ranidae: *Hylarana erythraea (*Schlegal, 1837)

APPENDIX - V

Checklist of birds species recorded in Rutland Island

Sl. No.	Common Name	Scientific Name
	Ardeidae	
1.	Little Egret	*Egretta garzetta* (Linnaeus)
2.	Purple Heron	*Ardea purpurea* Linnaeus
3.	Grey Heron	*Ardea cinerea* Linnaeus
4.	Median Egret	*Mesophoyx intermedia* (Wagler)
5.	Cattle Egret	*Bubulcus ibis* (Linnaeus)
6.	Indian Pond-Heron	*Ardeola grayii* (Sykes)
	Anseriformes	
	Anatidae	
7.	Andaman Teal	*Anas gibberifrons* (Muller)
	Falconiformes	
	Accipitridae	
8.	Brahminy Kite	*Haliastur indus* (Boddaert)
9.	White-bellied Sea-Eagle	*Haliaeetus leucogaster* (Gmelin)
10.	Greater Grey-headed Fish Eagle	*Ichthyophaga ichthyaetus* (Horsfield)
11.	Andaman Serpent-Eagle	*Spilornis cheela davisoni* Hume
12.	Western Marsh-Harrier	*Circus aeruginosus* (Linnaeus)
	Gruiformes	
	Rallidae	
13.	Blue-breasted Rail	*Gallirallus striatus* Linnaeus
14.	Andaman White-breasted Waterhen	*Amaurornis phoenicurus* (Pennant)
15.	Water Cock	*Gallicrex cinerea* (Gmelin)
16.	Common Moorhen	*Gallinula chloropus* (Linnaeus)
	Charadriiformes	
	Charadriidae	
17.	Pacific Golden-Plover	*Pluvialis fulva* (Gmelin)
18.	Little Ringed Plover	*Charadrius dubius* Scopoli
19.	Lesser Sand Plover	*Charadrius mongolus* Pallas
	Scolopacidae	
20.	Pintail Snipe	*Gallinago stenura* (Bonaparte)
21.	Jack Snipe	*Lymnocryptes minimus* (Brunnich)
22.	Bar-tailed Godwit	*Limosa lapponica* (Linnaeus)
23.	Whimbrel	*Numenius phaeopus phaeopus* (Linnaeus)
24.	Eurasian Curlew	*Numenius arauata* (Linnaeus)
25.	Common Redshank	*Tringa totanus* (Linnaeus)
26.	Common Greenshank	*Tringa nebularia* (Gunner)

Sl. No.	Common Name	Scientific Name
27.	Green Sandpiper	*Tringa ochropus* Linnaeus
28.	Wood Sandpiper	*Tringa glareola* Linnaeus
29.	Common Sandpiper	*Actitis hypoleucos* Linnaeus
30.	Ruddy Turnstone	*Arenaria interpres* (Linnaeus)
31.	Great Knot	*Calidris tenuirostris* (Horsfield)
32.	Little Stint	*Calidris minuta* (Leisler)
	Laridae	
33.	Gull-billed Tern	*Gelochelidon nilotica* (Gmelin)
34.	Black-naped Tern	*Sterna sumatrana* Raffles
35.	Lesser Crested Tern	*Sterna bengalensis* Lesson
36.	White-winged Black Tern	*Chlidonias leucopterus* (Temminck)
	Colimbiformes	
	Columbidae	
37.	Blue Rock Pigeon	*Columba livia* Gmelin
38.	Andaman Wood-Pigeon	*Columba palumboides* (Hume)
39.	Emerald Dove	*Chalcophaps indica* (Linnaeus)
40.	Andaman Green Imperial-Pigeon	*Ducula aenea andamanica* Abdulali
	Psittaciformes	
	Psittacidae	
41.	Indian Hanging-Parrot	*Loriculus vernalis* (Sparrman)
42.	Red-breasted Parakeet	*Psittacula alexandri* (Linnaeus)
43.	Red-cheeked Parakeet	*Psittacula longicauda* (Boddaert)
	Cuculiformes	
	Cuculidae	
44.	Asian Koel	*Eudynamys scolopacea* (Linnaeus)
45.	Andaman Coucal	*Centropus andamanensis* Beavan
	Apodiformes	
	Apodidae	
46.	Common Edible-nest Swiftlet	*Collocalia fuciphaga* Thunberg
	Coraciformes	
	Alcedinidae	
47.	Small Blue Kingfisher	*Alcedo atthis* (Linnaeus)
48.	Stork-billed Kingfisher	*Halcyon capensis* (Linnaeus)
49.	White-breasted Kingfisher	*Halcyon smyrnensis* (Linnaeus)
50.	Black-capped Kingfisher	*Halcyon pileata* (Boddaert)
	Meropidae	
51.	Chestnut-headed Bee-eater	*Merops leschenaultia* Vieillot

Sl. No.	Common Name	Scientific Name
	Piciformes	
	Picidae	
52.	Fulvus-breasted Pied Woodpecker	*Dendrocopos macei* (Vieillot)
53.	Andaman Black Woodpecker	*Dryocopus hodgei* (Blyth)
	Passeriformes	
	Motacillidae	
54.	Large Pied Wagtail	*Motacilla maderaspatensis* Gmelin
55.	Yellow Wagtail	*Motacilla flava* Linnaeus
56.	Grey Wagtail	*Motacilla cinerea* Tunstall
	Campephagidae	
57.	Scarlet Minivet	*Pericrocotus flammeus* (Forster)
	Pycnonotidae	
58.	Red-whiskered Bulbul	*Pycnonotus jocosus* (Linnaeus)
	Muscicapinae	
59.	Asian Brown Flycatcher	*Muscicapa dauurica* Pallas
	Monarchinae	
60.	Asian Paradise-Flycatcher	*Terpsiphone paradisi* (Linnaeus)
61.	Blacknaped Monarch-Flycatcher	*Hypothymis azurea* (Boddaert)
	Dicaeidae	
62.	Andaman Flowerpecker	*Dicaeum concolor virescens* Hume
	Nectariniidae	
63.	Olive-backed Sunbird	*Nectarinia jugularis andamanica* Linnaeus
64.	Crimson Sunbird	*Aethopyga siparaja* (Raffles)
	Zosteropidae	
65.	Oriental White-eye	*Zosterops palpebrosus* (Temminck)
	Sturnidae	
66.	Asian Glossy Starling	*Aplonis panayensis* (Scopoli)
67.	White-headed Starling	*Sturnus erythropygius* (Blyth)
68.	Common Hill-Myna	*Gracula religiosa* Linnaeus
	Oriolidae	
69.	Eurasian Golden Oriole	*Oriolus oriolus* (Linnaeus)
70.	Andaman Black-naped Oriole	*Oriolus chinensis andamansis* Tytler
	Dicruridae	
71.	Greater Racket-tailed Drongo	*Dicrurus paradiseus* (Linnaeus)
	Corvidae	
72.	Andaman Treepie	*Dendrocitta bayleyi* Tytler
73.	Jungle Crow	*Corvus macrothynchos* Wagler

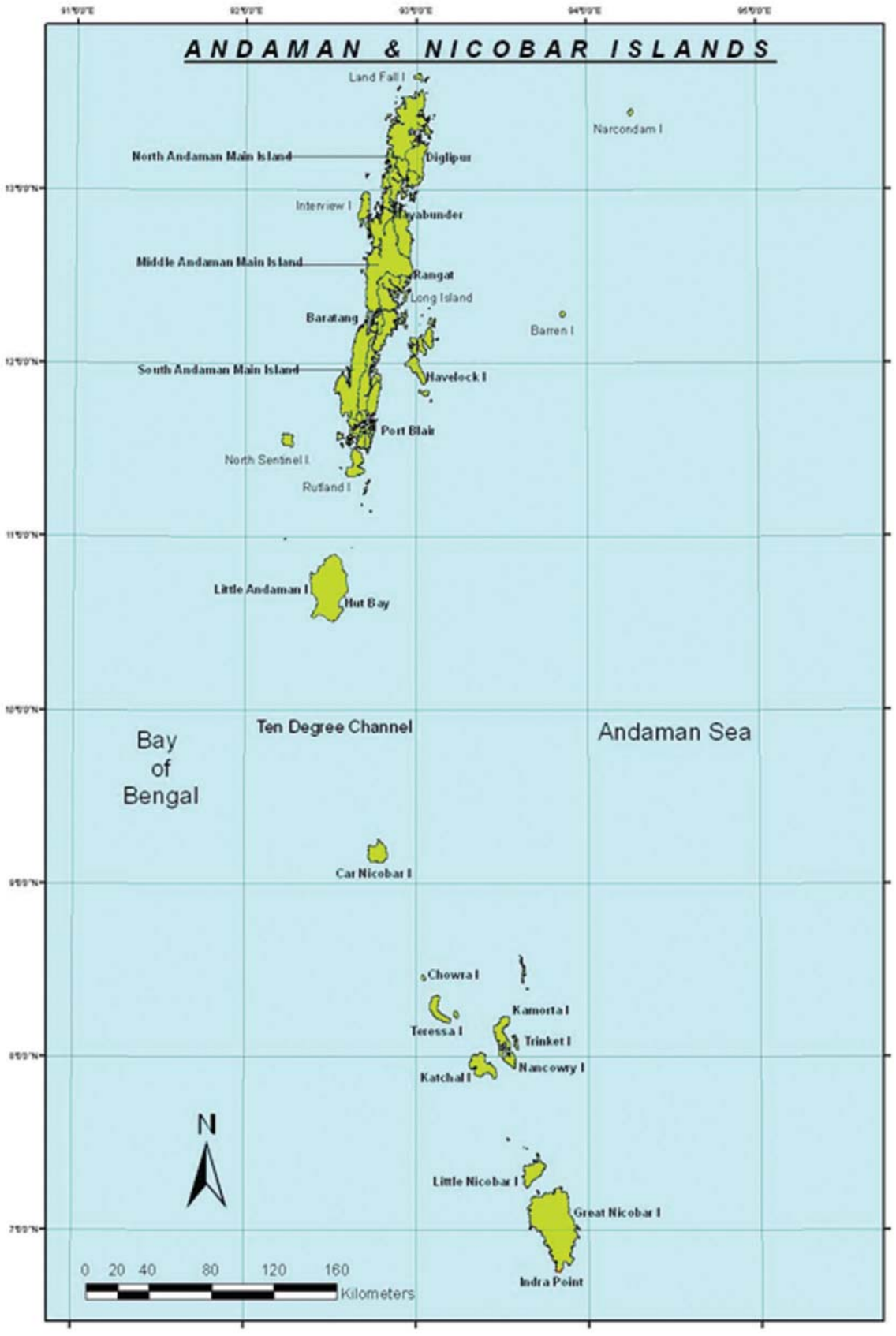

Fig. 1. Andaman and Nicobar Islands

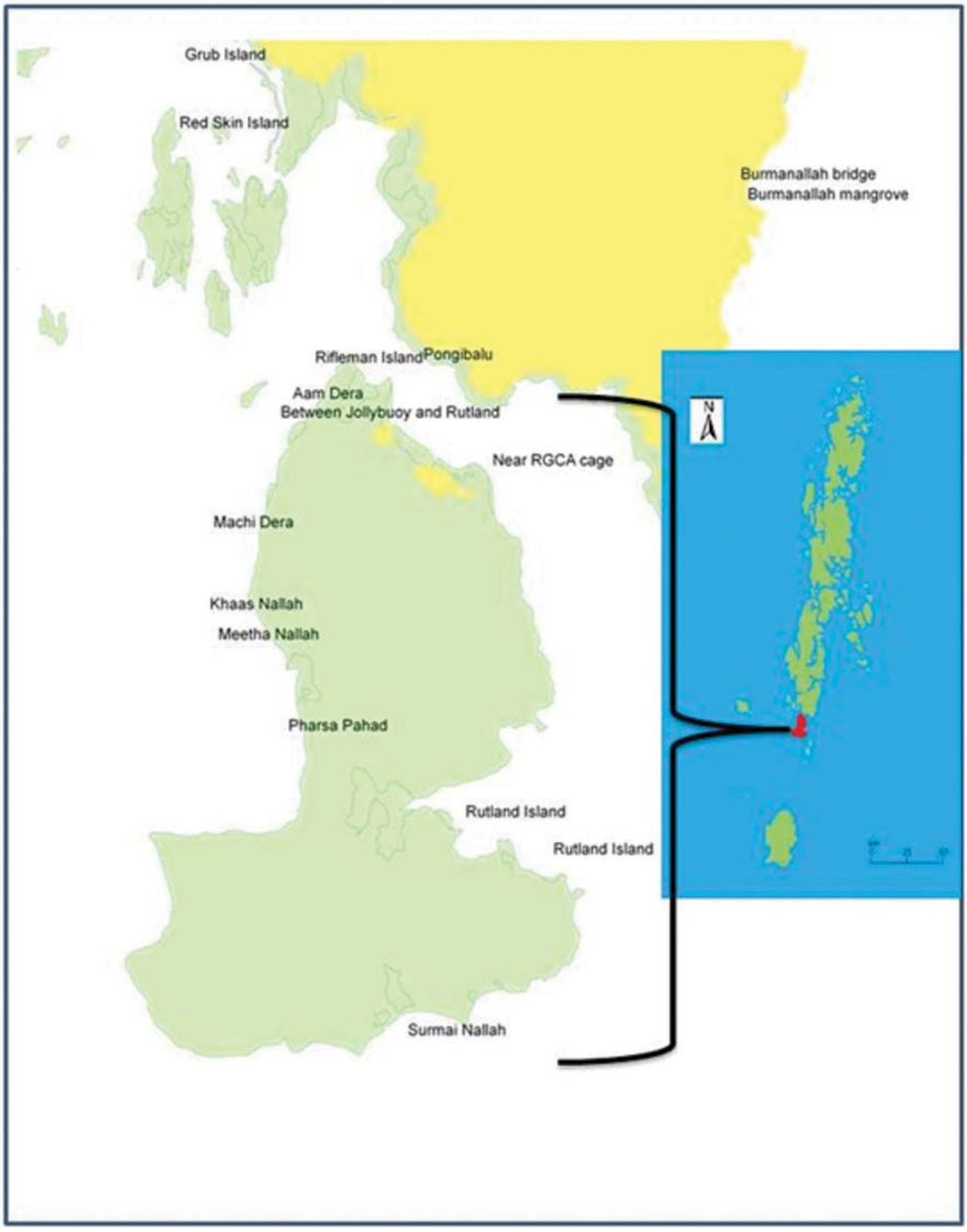

Fig. 2. Rutland Island, Andaman & Nicobar Islands

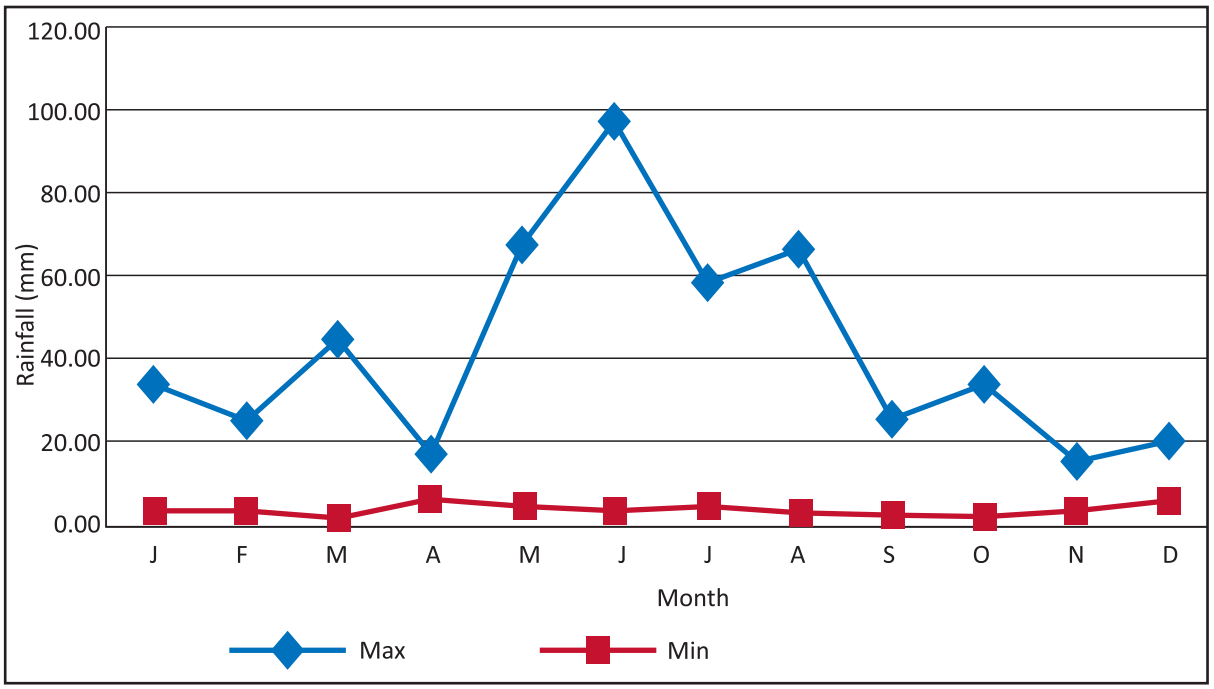

Fig. 3. Annual average rainfall recorded in south Andaman (2009-2011)

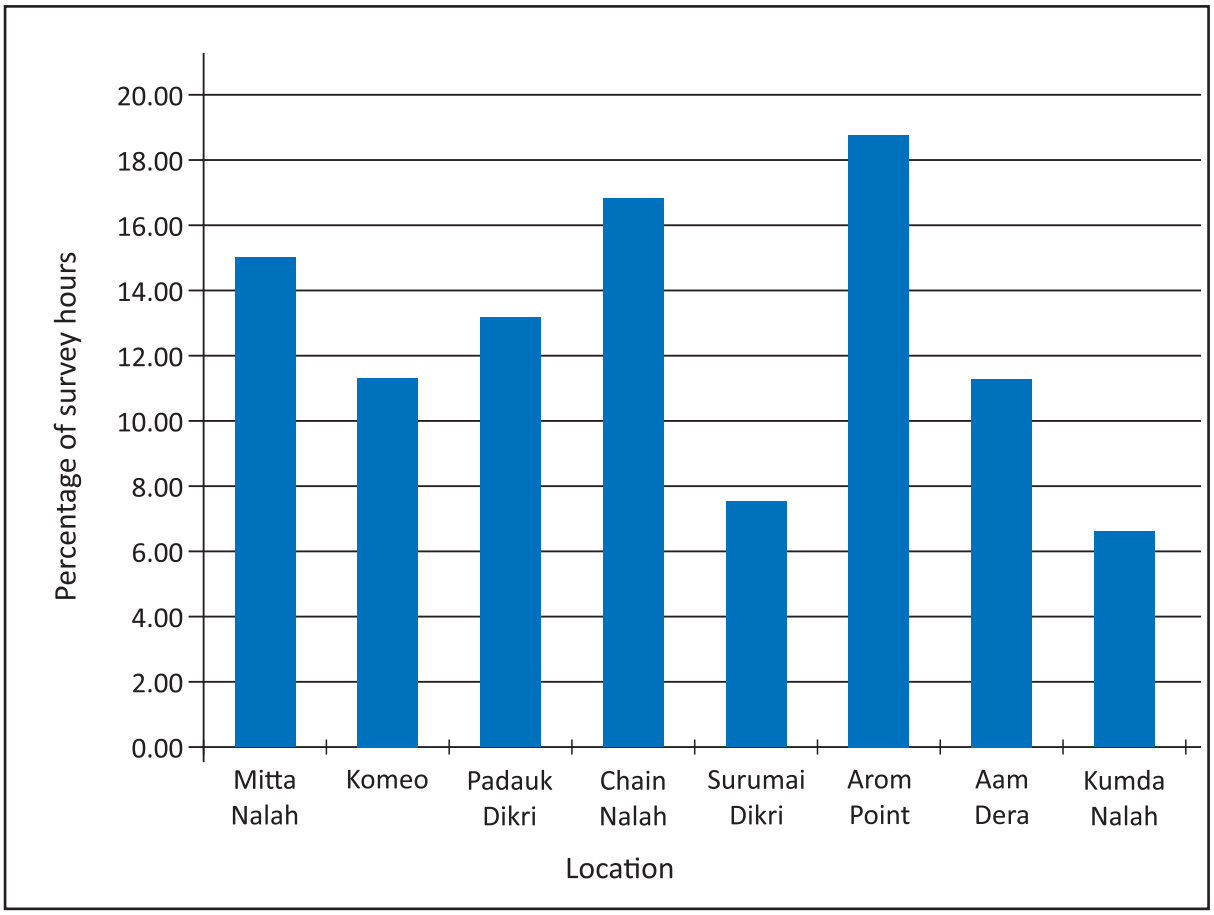

Fig. 4. Percentage of total survey hours for each location (n = 30)

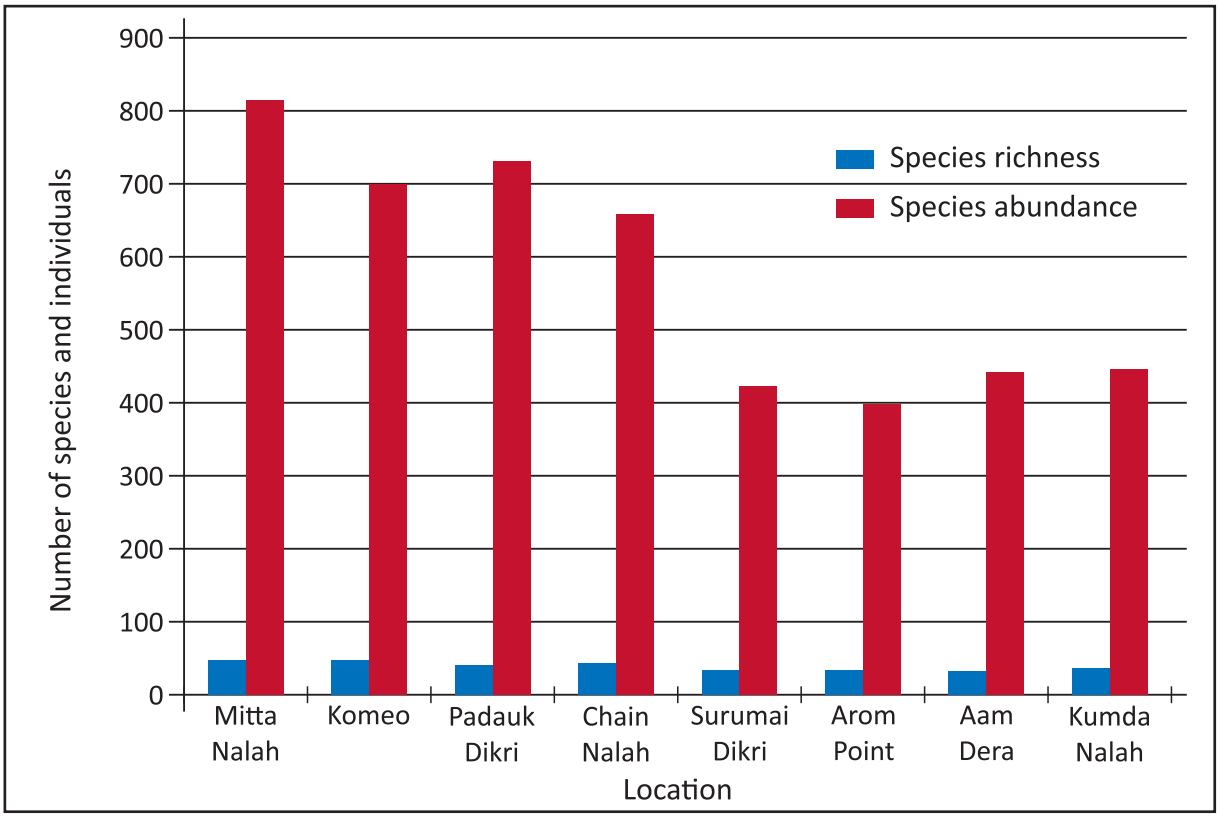

Fig. 5. Species richness and abundance in different locations in Rutland Island

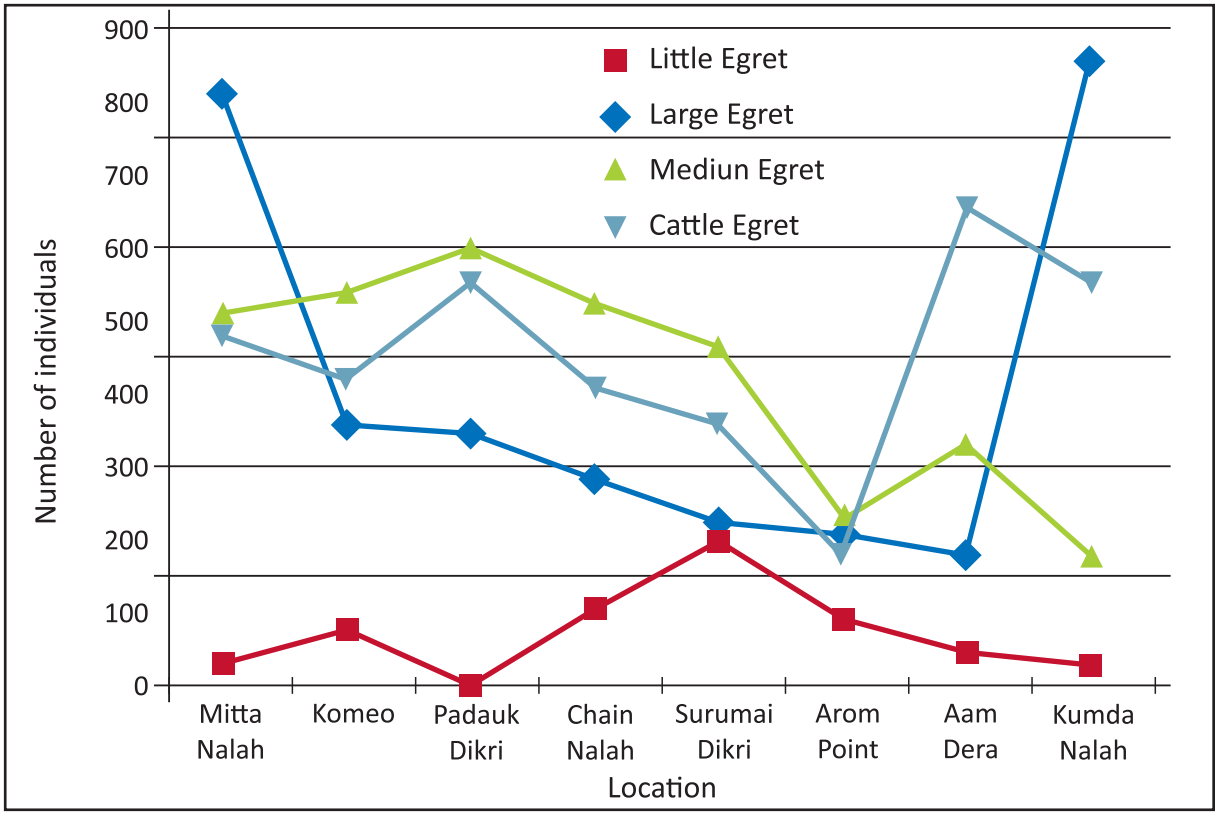

Fig. 6. Population flucations of Little Egret, Large Egret, Median Egret and Cattle Egret in Rutland Island (n = 30)

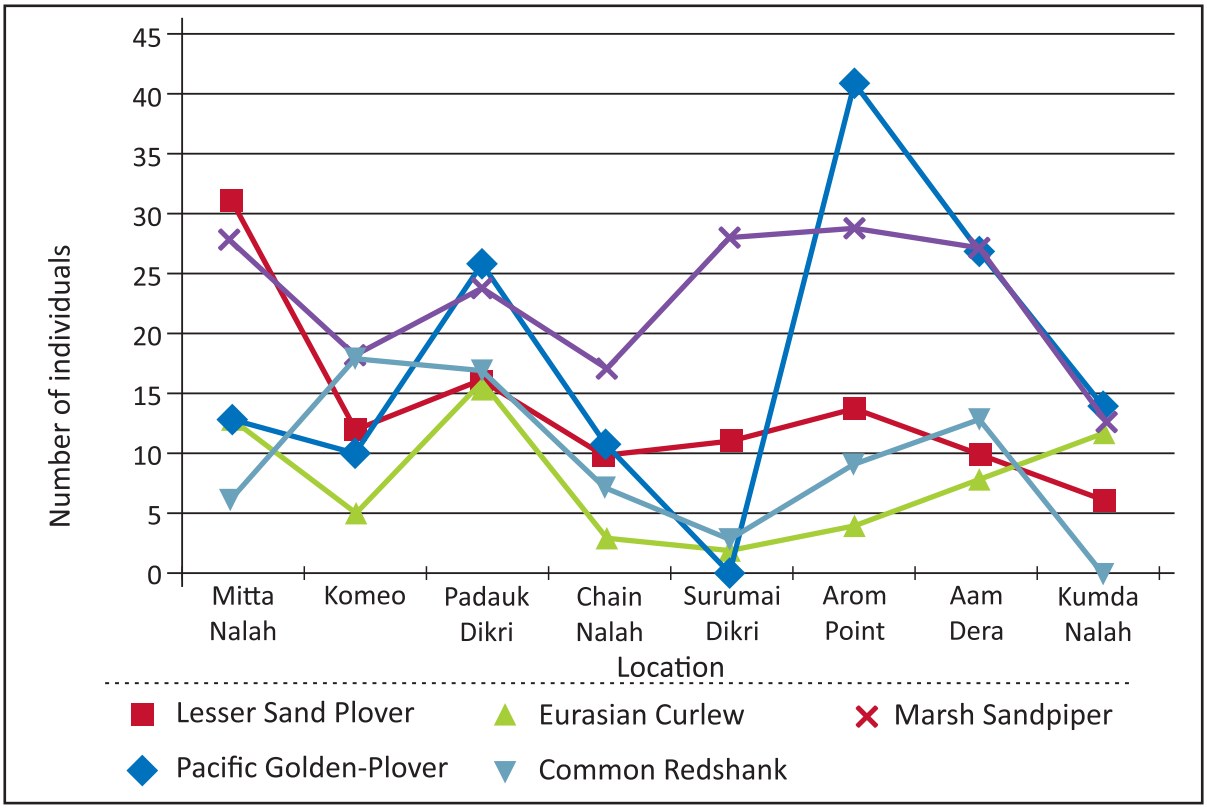

Fig. 7. Population flucations of Pacific Golden-Plover, Lesser Sand Plover, Eurasian Curlew, Common Redshank, and Marsh Sandpiper in Rutland Island (n = 30)

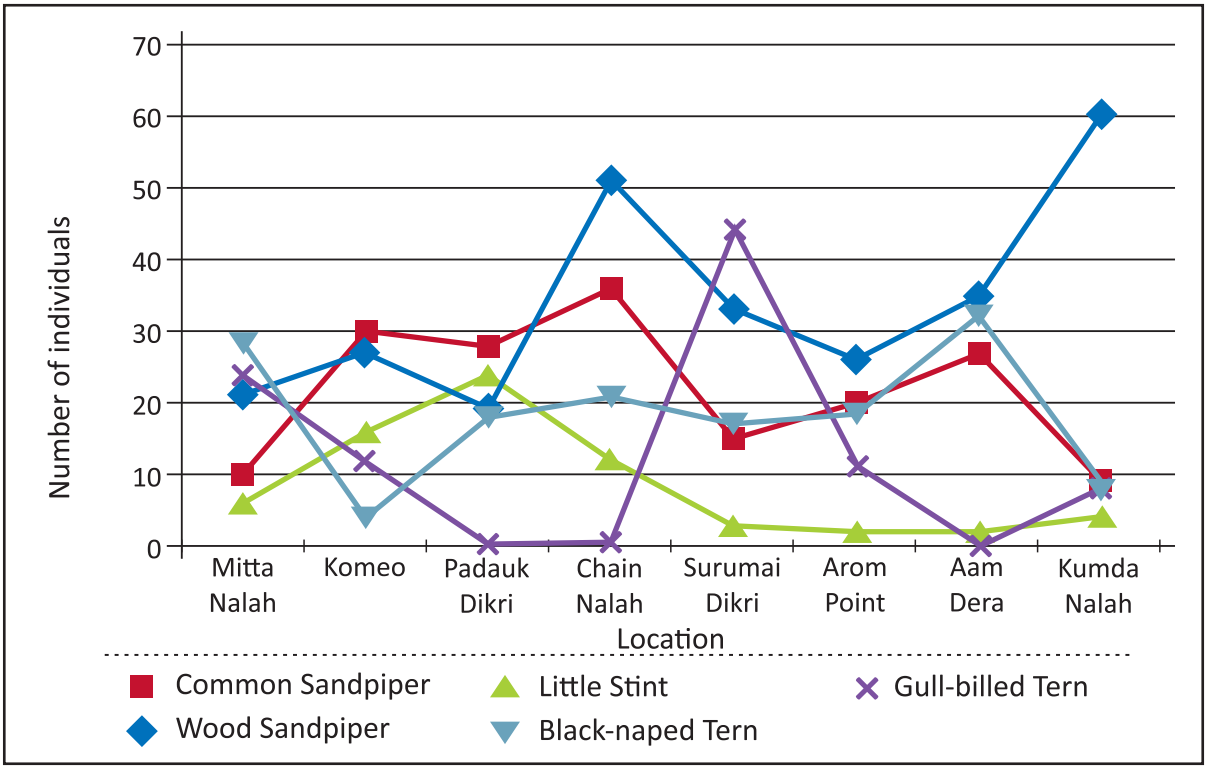

Fig. 8. Population flucations of Wood Sandpiper, Common Sandpiper, Little Stint, Gull-billed Tern and Black-naped Tern in Rutland Island (n = 30)

PLATE 1

Rutland Island, South Andaman

PLATE 2

Wetland birds of Rutland Island, South Andaman

Andaman Teal *Anas gibberifrons* (Muller)

Common Moorhen *Gallinula chloropus* (Linnaeus)

Water Cock *Gallicrex cinerea* (Gmelin)

Purple Moorhen *Porphyrio porphyrio* (Linnaeus)

Andaman Teal *Anas gibberifrons* (Muller)

Common Moorhen *Gallinula chloropus* (Linnaeus)

PLATE 3

Wetland birds of Rutland Island, South Andaman

Little Egret *Egretta garzetta* (Linnaeus)

Large Egret *Casmerodius albus* (Linnaeus)

Pacific Reef-Egret *Egretta sacra* (Gmelin)

Cattle Egret *Bubulcus ibis* (Linnaeus)

Grey Heron *Ardea cinerea* Linnaeus

Median Egret *Mesophoyx intermedia* (Wagler)

PLATE 4

Wetland birds of Rutland Island, South Andaman

Wood Sandpiper *Tringa glareola* Linnaeus

Common Redshank *Tringa totanus* (Linnaeus)

Lesser Sand Plover *Charadrius mongolus* Pallas

Eurasian Curlew *Numenius arauata* (Linnaeus)

Pacific Golden-Plover *Pluvialis fulva* (Gmelin)

Common Sandpiper *Actitis hypoleucos* Linnaeus

PLATE 5

Wetland birds of Rutland Island, South Andaman

White-breasted Kingfisher *Halcyon smyrnensis* (Linnaeus)

Stork-billed Kingfisher *Halcyon capensis* (Linnaeus)

Andaman Collared Kingfisher *Halcyon chloris davisoni* Sharpe

Yellow Bittern *Ixobrychus sinensis* (Gmelin)

White-bellied Sea-Eagle *Haliaeetus leucogaster* (Gmelin)

Lesser Whistling-Duck *Dendrocygna javanica* (Horsfield)