



# Avifaunal Community in Neil Island: A Conservation Approaches in the Evergreen Forest Ecosystem

S. Rajeshkumar<sup>\*1</sup>, C. Raghunathan<sup>1</sup> and K. Venkataraman<sup>2</sup>

<sup>1</sup>Zoological Survey of India, Andaman and Nicobar Regional Centre, Port Blair-744 102,  
Andaman and Nicobar Islands, India

<sup>2</sup>Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053, India

\*Email : [rajeshkumar0802@gmail.com](mailto:rajeshkumar0802@gmail.com)

## Introduction

Contemporary anthropogenic activity like continuous logging of forest for agriculture practice renders the ecosystem unstable as well as makes the tropical island biodiversity highly vulnerable. Parameters like type of diversity, indicators of diversity, relationship between the stability and habitat fragmentation are necessary for formulating conservation strategies and provoking an action plan in the ecosystem (Anonymous, 2001). Andaman evergreen forest has glacially changed due to logging for agriculture and other practices (Pandit, 1991). In Neil Island more than 50 % of evergreen forest is continually logged for agriculture practices and tourism development. Habitat disturbance was moderate level in Neil Island measured earlier (Anonymous, 2001). The bird's species diversity maybe influenced by the environmental factors that fluctuates with respect to habitat (Wiens, 1989). Though, studies on community ecology have already been carried out in Andaman Islands (Sankaran, 1995, 2001; Vijayan, 1996, Yahya and Zarri, 2003) which is inadequate. Therefore, an attempt was made to make this study more comprehensive in terms of species abundance and diversity. The information provided through this study may be useful for conservation and management of avifauna in Neil Island.

## Material and Methods

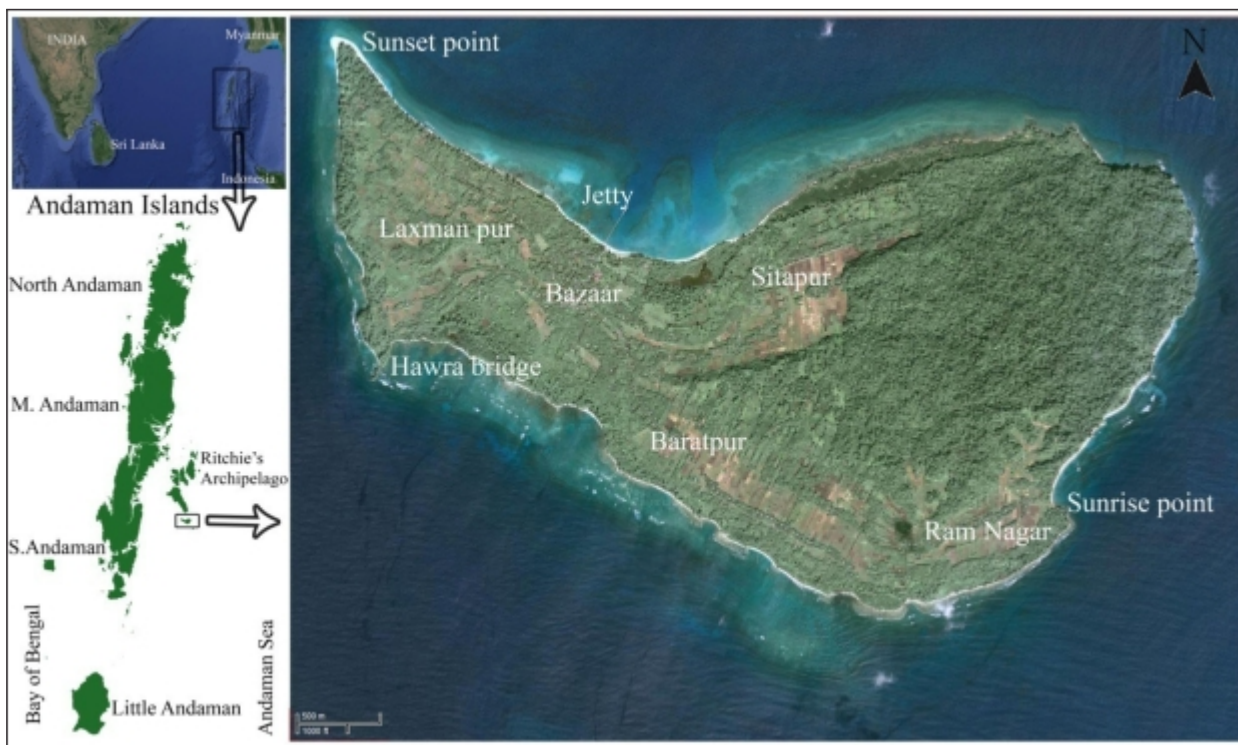
### Study site

Positioned between Sir Hugerose Island Wildlife Sanctuary and northern Fusilier Channel,

Neil Island in the Andaman and Nicobar Islands (Fig. 1) covers an unprotected, more easily accessible area open for tourism. It was one of the landmass of Richie's Archipelago with an area of 18.90 km<sup>2</sup> situated in the Andaman Sea and lies between 11° 48' and 11° 51' N and 93° 00' and 93° 02' E. The terrain is plain, low hills. The eastern part of the island occupies dense evergreen forest and semi-evergreen forest. Remaining of the island is mostly covered by the agricultural land, human settlements, degraded forest, proportion of wetland and few mangrove patches occur in tidal swamps close to the seashore. Plants like, *Pandanus* sp., *Pterocarpus* sp., *Scaevola* sp. are seen to fence the seashore.

Avifaunal surveys in Neil Island were conducted from 2012 to 2014 on the basis of direct observation (Altman, 1974) by line transect method (Burnham *et al.*, 1980) and field techniques adopted by Bibby (1992). The average transect length is 2 km in 1 hr. Sampling was conducted by walking from dawn to dusk in various habitats. During the survey a distance of 6 km was covered in a fixed duration of 120 minutes. The representative habitats namely agricultural land, wetland/seashore area and evergreen forest were studied using line transects to assess diversity, species richness and dominance. The birds were identified using field guides (Ali and Ripley, 1983; Grimmett *et al.*, 2011; Rasmussen and Anderton, 2012). The data was analyzed to calculate Shannon index (H'), Simpson index, species richness, abundance and individual rarefaction by using





**Fig. 1.** Neil Island in the Andaman and Nicobar Archipelago

statistical software (PAST ver.1.34). The Relative Dominance of the selected bird species in different habitats was expressed by Dominance Index =  $n_i \times 100 / N$ , Where,  $n_i$  = Number of Individuals,  $N$  - total number of all the species in entire study period. Percentage of similarity of the bird communities at different stations was calculated by Sorenson's Quotient of Similarity (Sorenson, 1948),  $Q/S = (2j/a+b) 100$ , Where,  $j$  = the number of species common to both sites,  $a$  = the number of species in site A and  $b$  = the number of species in site B. The categories of IUCN status of all species was referred from Birdlife International (2014).

## Results

The distribution of birds was studied in three selective sites viz, Agriculture land, Wetland/

Seashore and Evergreen forest. The present study bares the record of 63 species of Birds belonging to 11 orders, 32 families and 54 genera from Neil Island (Table 1). The majority of families and species come under, Order Passeriformes (18 families, 22 sp.). The main contributing families are Ardeidae (7 sp.), Scolopacidae (6 sp.), Columbidae (5 sp.). Among the habitats, the maximum number of species (50 sp.) encountered in agricultural areas.

Family wise percentage of species and individuals recorded are given in Figure 2. The maximum number of species recorded in family Ardeidae (11.11 %). Percentage of number of individual was found high for family Scolopacidae (7.06 %) while low (0.17 %) for family Burhinidae.



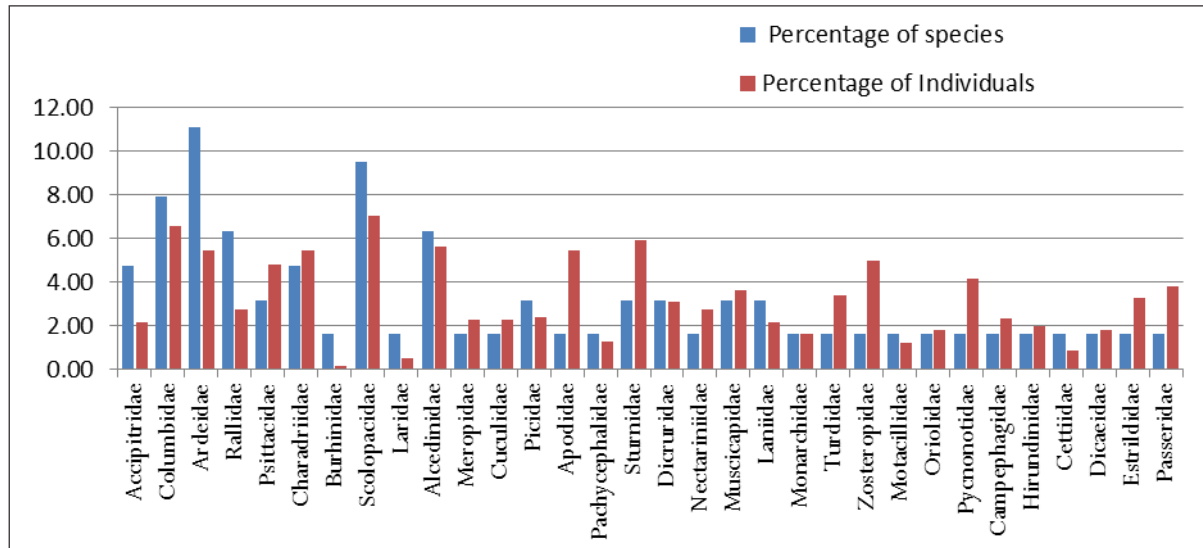


Fig. 2 : Family wise percentage of species and counted individuals

Table 1. List of Birds recorded in different habitats and their dominance index

Scientific name / Authority	Common Name	Distribution			IUCN Status 2012	Category	Dominance Index
		Agriculture land	Wetland/ Seashore	Ever-green forest			
<b>Order: Accipitriformes</b>							
<b>Family: Accipitridae</b>							
<i>Haliaeetus leucogaster</i> (Gmelin, 1788)	White-bellied Sea-Eagle	√	√	√	LC	R	0.92
<i>Nisaetus cirrhatus</i> (Gmelin, 1788)	Changeable Hawk-Eagle	×	√	√	LC	R	0.34
<i>Spilornis elgini</i> (Blyth, 1863)	Andaman Serpent-Eagle	√	√	√	NT	R	0.84
<b>Order: Columbiformes</b>							
<b>Family: Columbidae</b>							
<i>Ducula aenea</i> (Linnaeus, 1766)	Green Imperial-Pigeon	√	√	√	LC	R	1.76
<i>Columba livia</i> Gmelin, 1789	Blue Rock Pigeon	√	×	×	LC	R	1.26
<i>Chalcophaps indica</i> (Linnaeus, 1758)	Emerald Dove	√	×	√	LC	R	1.17
<i>Streptopelia tranquebarica</i> (Hermann, 1804)	Red Collared-Dove	√	×	√	LC	R	1.76
<i>Macropygia rufipennis</i> Blyth, 1846	Andaman Cuckoo-Dove	√	×	√	NT	R	0.42
<b>Order: Pelecaniformes</b>							
<b>Family: Ardeidae</b>							
<i>Ardeola grayii</i> (Sykes, 1832)	Indian Pond-Heron	√	√	×	LC	R	0.42
<i>Ardeola bacchus</i> (Bonaparte, 1855)	Chinese Pond-Heron	√	√	×	LC	M	0.25



Scientific name / Authority	Common Name	Distribution			IUCN Status 2012	Category	Dominance Index
		Agri-culture land	Wetland/ Seashore	Ever-green forest			
<i>Bubulcus ibis</i> (Linnaeus, 1758)	Cattle Egret	√	×	×	LC	R	1.34
<i>Butorides striata</i> (Linnaeus, 1758)	Little Green Heron	√	√	√	LC	R	0.84
<i>Egretta alba</i> (Linnaeus, 1758)	Great Egret	√	√	×	LC	M	0.67
<i>Egretta garzetta</i> (Linnaeus, 1766)	Little Egret	√	√	×	LC	R	0.75
<i>Egretta sacra</i> (Gmelin, 1789)	Pacific Reef-Egret	×	√	×	LC	R	1.01
<b>Order: Gruiformes</b>							
<b>Family: Rallidae</b>							
<i>Gallinula chloropus</i> (Linnaeus, 1758)	Common Moorhen	×	√	×	LC	M	0.67
<i>Amaurornis phoenicurus</i> (Pennant, 1769)	White-breasted Water hen	√	√	√	LC	R	1.26
<i>Gallirallus striatus</i> (Linnaeus, 1766)	Slaty-breasted Rail	√	√	√	LC	R	0.42
<i>Porzana fusca</i> (Linnaeus, 1766)	Ruddy-breasted Crake	√	√	×	LC	R	0.34
<b>Order: Psittaciformes</b>							
<b>Family: Psittacidae</b>							
<i>Loriculus vernalis</i> (Sparrman, 1787)	Indian Hanging-Parrot	√	×	√	LC	R	1.76
<i>Psittacula alexandri</i> (Linnaeus, 1758)	Red-breasted Parakeet	√	√	√	NT	R	2.93
<b>Order: Charadriiformes</b>							
<b>Family: Charadriidae</b>							
<i>Charadrius mongolus</i> Pallas, 1776	Lesser Sand Plover	√	√	×	LC	M	2.60
<i>Charadrius leschenaultii</i> Lesson, 1826	Greater Sand Plover	√	√	×	LC	M	1.17
<i>Pluvialis fulva</i> (Gmelin, 1789)	Pacific Golden-Plover	√	√	×	LC	M	1.51
<b>Family: Burhinidae</b>							
<i>Esacus magnirostris</i> (Vieillot, 1818)	Beach Stone-Plover	×	√	×	NT	R	0.17
<b>Family: Scolopacidae</b>							
<i>Actitis hypoleucos</i> Linnaeus, 1758	Common Sandpiper	√	√	√	LC	M	2.35
<i>Calidris ferruginea</i> (Pontoppidan, 1813)	Curlew Sandpiper	×	√	×	LC	M	0.50
<i>Gallinago gallinago</i> (Linnaeus, 1758)	Common Snipe		√	×	LC	M	0.34
<i>Numenius phaeopus</i> (Linnaeus, 1758)	Whimbrel	×	√	×	LC	M	1.01
<i>Numenius arquata</i> (Linnaeus, 1758)	Eurasian Curlew	×	√	×	NT	M	0.67



Scientific name /Authority	Common Name	Distribution			IUCN Status 2012	Category	Dominance Index
		Agri-culture land	Wetland/ Seashore	Ever-green forest			
<i>Tringa totanus</i> (Linnaeus, 1758)	Common Redshank	×	√	×	LC	M	2.01
<b>Family: Laridae</b>							
<i>Sterna sumatrana</i> Raffles, 1822	Black-naped Tern	×	√	×	LC	R	0.50
<b>Order: Coraciiformes</b>							
<b>Family: Alcedinidae</b>							
<i>Alcedo meninting</i> Horsfield, 1821	Blue-eared Kingfisher	√	√	√	LC	R	0.59
<i>Halcyon capensis</i> (Linnaeus, 1766)	Stork-billed Kingfisher	√	√	√	LC	R	1.09
<i>Halcyon smyrnensis</i> (Linnaeus, 1758)	White-breasted Kingfisher	√	√	×	LC	R	0.67
<i>Todiramphus chloris</i> (Boddaert, 1783)	Collared Kingfisher	√	√	√	LC	R	3.10
<b>Family: Meropidae</b>							
<i>Merops leschenaulti</i> Vieillot, 1817	Chestnut-headed Bee-eater	√	√	√	LC	R	2.18
<b>Order: Cuculiformes</b>							
<b>Family: Cuculidae</b>							
<i>Centropus andamanensis</i> Beavan, 1867*	Andaman Coucal	√	√	√	LC	R	2.18
<b>Order: Piciformes</b>							
<b>Family: Picidae</b>							
<i>Dryocopus hodgei</i> (Blyth, 1860)*	Andaman Black Woodpecker	×	×	√	NT	R	0.50
<i>Dendrocopos analis</i> (Bonaparte, 1850)	Spot-breasted Pied Woodpecker	√	√	√	LC	R	1.84
<b>Order: Apodiformes</b>							
<b>Family: Apodidae</b>							
<i>Collocalia esculenta</i> (Linnaeus, 1758)	White-bellied Swiftlet	√	√	√	LC	R	5.28
<b>Order: Passeriformes</b>							
<b>Family: Pachycephalidae</b>							
<i>Pachycephala cinerea</i> (Blyth, 1847)	Mangrove Whistler	×	√	√	N/A	R	1.26
<b>Family: Sturnidae</b>							
<i>Gracula religiosa</i> (Linnaeus, 1758)	Common Hill Myna	√	√	√	LC	R	1.68
<i>Sturnia erythropygia</i> (Blyth, 1846)*	White-headed Starling	√	√	√	N/A	R	4.10
<b>Family: Dicruridae</b>							
<i>Dicrurus andamanensis</i> Beavan, 1867*	Andaman Drongo	×	√	√	NT	R	0.67
<i>Dicrurus paradiseus</i> (Linnaeus, 1766)	Greater Racket-tailed Drongo	√	√	√	LC	R	2.35
<b>Family: Nectariniidae</b>							
<i>Nectarinia jugularis</i> Linnaeus, 1766	Olive-backed Sunbird	√	√	√	LC	R	2.68





Scientific name / Authority	Common Name	Distribution			IUCN Status 2012	Category	Dominance Index
		Agriculture land	Wetland/ Seashore	Ever-green forest			
<b>Family: Muscicapidae</b>							
<i>Copsychus albigularis</i> (Blyth, 1859)*	Andaman Shama	×	×	√	N/A	R	0.25
<i>Copsychus saularis</i> (Linnaeus, 1758)	Oriental Magpie-Robin	√	√	√	LC	R	3.27
<b>Family: Laniidae</b>							
<i>Lanius cristatus</i> Linnaeus, 1758	Brown Shrike	√	√	√	LC	M	0.92
<i>Lanius cristatus lucionensis</i> Linnaeus, 1766	Philippine Shrike	√	√	√	N/A	M	1.17
<b>Family: Monarchidae</b>							
<i>Hypothymis azurea</i> (Boddaert, 1783)	Black-naped Monarch-Flycatcher	√	×	√	LC	R	1.59
<b>Family: Turdidae</b>							
<i>Zosterops lateralis</i> (Latham, 1790)	Orange-headed Thrush	√	×	√	LC	R	3.27
<b>Family: Zosteropidae</b>							
<i>Zosterops palpebrosus</i> (Temminck, 1824)	Oriental White-eye	√	√	√	LC	R	4.86
<b>Family: Motacillidae</b>							
<i>Motacilla cinerea</i> Tunstall, 1771	Grey Wagtail	√	√	√	LC	M	1.17
<b>Family: Oriolidae</b>							
<i>Oriolus chinensis</i> (Linnaeus, 1766)	Black-naped Oriole	√	×	√	LC	R	1.76
<b>Family: Pycnonotidae</b>							
<i>Pycnonotus jocosus</i> (Linnaeus, 1758)	Red-whiskered Bulbul	√	√	√	LC	R	4.02
<b>Family: Campephagidae</b>							
<i>Pericrocotus cinnamomeus</i> (Linnaeus, 1766)	Small Minivet	√	×	√	LC	R	2.26
<b>Family: Hirundinidae</b>							
<i>Hirundo tahitica</i> Gmelin, 1789	House Swallow	√	√	√	LC	R	1.93
<b>Family: Cettiidae</b>							
<i>Cettia pallidipes</i> (Blanford, 1872)	Pale-footed Bush-Warbler	√	×	√	LC	R	0.84
<b>Family: Dicaeidae</b>							
<i>Dicaeum vireescens</i> (Hume, 1873)*	Andaman Flower pecker	√	×	√	N/A	R	1.76
<b>Family: Estrildidae</b>							
<i>Lonchura striata</i> (Linnaeus, 1766)	White-rumped Munia	√	√	√	LC	R	3.18
<b>Family: Passeridae</b>							
<i>Passer domesticus</i> (Linnaeus, 1758) #	House Sparrow	√	×	×	LC	R	3.69
<b>Total no. of species</b>		<b>50</b>	<b>48</b>	<b>42</b>			
<b>Total no. of Individuals</b>		<b>457</b>	<b>372</b>	<b>365</b>			

\*Endemic species, # Introduced species, LC-Least concern, NT-Near threatened, N/A- Not assessed, R-Resident, M-Migrant



**Table 2.** Endemic & Introduced species Dominance Index in different habitats

Endemic Species/Scientific Name	Common Name	Agriculture land	Wet land / Seashore	Evergreen forest
<i>Spilornis elgini</i> (Blyth, 1863)	Andaman Serpent-Eagle	0.66	0.81	1.10
<i>Macropygia rufipennis</i> Blyth, 1846	Andaman Cuckoo-Dove	0.22	0.00	1.10
<i>Centropus andamanensis</i> Beavan, 1867	Andaman Coucal	3.50	0.54	2.19
<i>Dryocopus hodgei</i> (Blyth, 1860)	Andaman Black Woodpecker	0.00	0.00	1.64
<i>Sturnia erythropygia</i> (Blyth, 1846)	White-headed Starling	2.63	2.42	7.67
<i>Dicrurus andamanensis</i> Beavan, 1867	Andaman Drongo	0.00	0.54	1.64
<i>Copsychus albiventris</i> (Blyth, 1859)	Andaman Shama	0.00	0.00	0.82
<i>Dicaeum virescens</i> (Hume, 1873)	Andaman Flower pecker	1.97	0.00	3.29
<i>Introduced species</i>				
<i>Columba livia</i> Gmelin, 1789	Blue Rock Pigeon	3.28	0.00	0.00
<i>Passer domesticus</i> (Linnaeus, 1758)	House Sparrow	9.63	0.00	0.00

## Relative Dominance

The Relative Dominance of species in Neil Island is given in Table 1. A total of 63 species were encountered, in which, White-bellied Swiftlet, was dominant (5.28 %) in all the three habitats. Selectively, the endemic species and introduced species were used as standards for finding the significant level of dominance in the aforementioned habitats (Table 2). Both, the evergreen forest and wetland/seashore areas, the White-headed Starling registered high dominance index of 7.67, 2.42 respectively. The result showed that the Andaman Coucal was predominant in agriculture land (3.50 %). Two introduced species of birds (House sparrow and Blue Rock Pigeon) were observed particularly in agricultural area during the survey. House sparrow (9.63 %) topped the dominance index in the study area.

## Diversity Indices

Table 3 shows the Species Diversity Indices (Shannon H') recorded for three habitats. Species diversity was high in agriculture land (3.57) and low in evergreen forest (3.43). Species were evenly distributed in evergreen forest (0.9187) but irregularly distributed for wetland/seashore (0.905).

## Similarity Indices

A qualitative approach was adopted for comparing the Similarity Indices between habitats. Sorenson's Quotient of similarity (Q/S) for evergreen forest and agricultural areas was 80.43 % whereas, 66.66 % was calculated for wetland/seashore areas and evergreen forest habitats (Table 4).

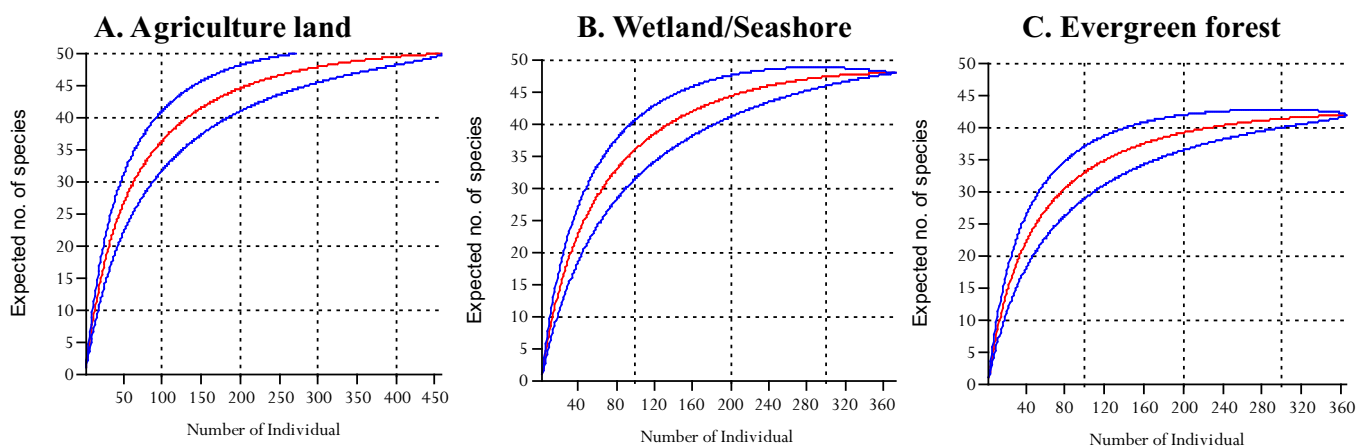


**Table. 3** Comparison of diversity indices between different habitats

diversity	Agriculture land/degraded forest	Wetland/Seashore	Evergreen forest
Shannon Diversity (H?)	3.57	3.507	3.434
Margalef Richness Index	8	7.941	6.949
Species Abundance	457	372	365
Simpson Diversity Index	0.9637	0.9589	0.9605
Pielos evenness (J)	0.9125	0.9059	0.9187

**Table. 4** Comparison of Sorensen similarity indices between different habitats

Sorensen similarity indices	Evergreen forest	Wetland/Seashore areas
Agricultural areas	0.8043478	0.755102
Evergreen forest		0.6666667



**Fig. 3** Comparison of Individual Rarefaction curve between three different habitats

### Individual Rarefaction

Rarefaction technique was used to estimate the species richness from the resultant sampling. The given number of individuals resulted in the expected number of species. A large fraction of rarefaction curve in Agricultural land indicated high species diversity as compared to the remaining two habitats that showed reasonable species diversity (Fig. 3).

### Migration Status

Of the total 63 species of birds, 48 species were residents, whereas the remaining 15 species

migrated especially during the winters (Table 1).

### Habitat preference

Habitat preferred by birds is stated in order: Agriculture land>Wetland and seashore>Evergreen forest. Agriculture land supports maximum number of avifauna.

### Discussion

Andaman and Nicobar Islands harbors a rich biological diversity. The intensive agricultural practices and anthropic invasion to island ecosystem, works either in destroying the natural





equilibrium or it may lead to ecological succession. The primary indicators of global environmental change are habitat loss, invasive alien species, climate change, pollution and over-harvesting (Samways *et al.*, 2010). India has one of the richest bird diversity with ~1,250 valid species, accounting for about 12% of the total world species. Andaman and Nicobar Islands contributes ~218 species, with 30 endemic species though some variations are always observed depending on the taxonomic treatments. A total number of 1194 birds were counted, belonging to 63 species, 11 orders and 32 families including 8 Endemic species and 2 introduced species from Neil Island.

Habitat loss poses a direct threat to the faunal communities. Tropical forests are lost due to agriculture at an annual rate of 0.8% (Sahas, 2009). The major area of Neil Island is utilized for agriculture where the species diversity is high. As the cultivated land provides a variety of food, the habitat preference is high for this region. An apt feeding attitude may influence high number of bird records in cultivated agricultural area. Loss of large canopy trees imposes a negative impact on the abundance of bird species as reported by Aleixo (1999). Changes in species abundance in a particular habitat may depend on the availability of fruiting trees as well as a suitable environment. Majority of nesting sites were observed near wetland and agricultural area. Avian fauna is at risk due to advancement of industrialization and by pollution (Chilke, 2012). Bird groups have known to decrease by 46-78 % at tourist sites as compared to the restricted areas (Nakwa, 2008). Through our

study it is revealed that the logging of evergreen forest is of a major concern than tourism in altering the bird diversity. Bird species diversity shows that, the variety of plant species supports more bird species in tropical areas as compared to the temperate habitats (Orians, 1969; Lee and Rotenberry, 2005). Vegetation structure plays a significant role in defining avian species richness and diversity at the local level (Roth, 1976; Finch, 1989, 1991; Wiens, 1989). Selective logging has an edge over deforestation of forest for agricultural purpose in protecting many species of forest birds (Wiafe, 2012). On the other hand, introduced species are a potential threat to the endemic birds (Sivakumar, 2004; Rajan and Pramod, 2013). In this study the introduced species was found only in agriculture and human inhabiting areas, also they are highly proliferating than native species. Endemic species were found mostly in evergreen forests. Habitat losses and fragmentation due to human invasion as well introduced species have become a major concern. A need of extensive studies that focuses on the ecological attributes of the various bird communities and how they thrive to accustom to a particular habitat is of an utmost importance.

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