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**EXECUTIVE SUMMARY**

Biodiversity is the natural wealth, where the variability among living things and ecological systems presents and maintains the life sustaining systems provided with vital goods and services in the world. In, recent decades due to hysterical development of many anthropogenic activities, the world is changing as fast as humans appropriate more and more of its resources, over drawing on the earth’s renewable supplies and eating heavily into natural capital caused the effect of massive deforestation. In current scenario, we have cleared half of the world’s natural habitats and a third of what is left will go within a human generation, if current trends continue. Which resulting 16 million km2 of tropical rainforest habitat that originally existed worldwide, less than nine million km2 remain today.

Biodiversity hotspots in the world are chiefly tropical region is featuring high concentration of endemic species and has claimed half of the world’s terrestrial species, if all hotspots are combined. These natural habitats are under threat now due to habitat loss and destruction. Consistently the islands, a small body of landmass are having a major role of its high endemism in the world. Nevertheless, the increasing demands on resources in the islands have resulted in their ecosystems being severely threatened and facing in its extreme habitat destruction. For example over 12.1 % of all bird species in the world are threatened with extinction today in which the majority of these are found in tropical forest and islands.

There is little disputing that global biodiversity is declining, but accurate measures are very hard to come by. Birds, the best known major group of organisms and just one component of biodiversity and far from the most significant in species numbers or biomass can help us to understand the problems and piece together the solutions, where the maintenance or restoration of the biological integrity of urban and suburban areas must begin with a comprehensive study of the links between biota and land use. In this context bird communities are often used in investigations of habitat changes as the best indicators of the environment.

Though the Indian mainland harbors rich avifaunal diversity the Andaman and Nicobar Islands form one of the 218 endemic bird areas (Andaman islands: EBA-125 and Nicobar Islands: EBA-126) of the world. The information on community structure and general bird ecology of these islands are little known and very few attempts have been made to study the bird community along their island distribution. Hence, the present study was initiated with the major objectives to: i) document the avifaunal diversity and status in different islands/vegetation, ii) observe the bird species distribution pattern in the Andaman Islands with their biogeographical importance, iii) study the nested-subsets of the birds in different outer islands in terms of their presence/absence which will be providing a risk assessment of the extinction probability of the various species’ populations isolated on the islands of fragmented habitat, and iv) understand the insular biology of the endemic and threatened species in Andaman Uslands as of baseline information of their conservation.

Andaman and Nicobar Islands the Union Territory of India, a group of archipelagic islands stretches over 800 km in Bay of Bengal. The geographical landscape is characterized by high and low formations, sloping down to coast of the Andaman Sea in the east. This archipelago comprises 572 islands, reefs and rocks. The entire island group covers 8249 km2 with a total coastline of about 11962 km. The Andaman group has more than 325 islands (21 inhabited) covering 6408 km2 and the Nicobar group with over 24 islands (13 inhabited) has an area of 1841 km2. It is a storehouse of unique flora and fauna showing great diversity, and high level of endemism in its floral component. Both these island groups are a distinct eco region and are classified as one of the 12 biogeographical zones of India. Biogeography values of the intensive study area of Andaman Islands are comes under the Indomalaya Ecozones, one of the richest bird species areas (about 17.6 % of the total number) in the world. These offshore islands lie in the Indo-Burma Biodiversity hotspot; mostly differ from the closest and large landmass of Burma, and Malaysia.

Bird survey was carried out in 52 outer (islands lying separated from main islands) and five major islands, namely North, Middle, South (incl. Rutland Island) and Little of Andaman Islands during the periods from November to December 2003; January to May 2004 and August to October 2004. Due to the poor climatic climax during the month of June and July 2004 the bird survey was leave out for the next month. To assess the bird species abundance, diversity, habitat use, population trend and habitat association within the bird population in Andaman Islands across all forest types *Point survey method*, is most appropriate method in island terrains was employed.

*Variable Distance method* one of the point count type, which estimates the radial distance to the detected each species in each points, was attempted for absolute abundance estimation of birds either seen or heard/actively used study area. Observations were made the number of individuals, distance from the observer, vertical position and major activity for estimating density. Most of the points were replicated 1-3 during the study period irregularly (not in temporal).

Since, the present study aimed for a wider bird survey across the islands within the short period of time vegetation sampling was not done. However for vegetation analysis data of land cover and land use pattern of the Andaman Islands was acquired. Nevertheless the direct observations of major plant/tree species present in each point were recorded and the habitats were classified into eleven types.

Anticipated results drawn by the present study collected bird data were documented in detail by region and habitat wide. Primarily checklist of birds in the Andaman Islands includes the status, migratory and conservation details were preferred. While concentrating on the distribution of endemic birds to the Andaman Islands recently promoted endemic species were also taken for consideration.

A total of 26487 individuals belonging to 153 species which includes twenty rare/vagrant and new birds were recorded during 473 working hours between November and December 2003, January and October 2004 (excluded June and July 2004). The species accumulation curve from pooled data sampled throughout the Andaman Islands begins with the total 79 species and end up with 153 during the present study. It shows increase of species from the second month of survey and became almost stable at the end. In regional-wise documentation of birds out of 153 species highest number was recorded from South Andaman (126) followed by North (110), Little (96) and Middle (80) where the species abundance also followed the same pattern, however. Though 56 endemic species (including subspecies)among the bird community of Andaman Islands were found, the present study recorded 11 of 12 species endemics from different habitats and an addition of 7 of 9 recently considered as species endemics, overall 18 full species endemics was observed.

Total of twenty rare, secondly recorded and new birds from the Andaman Islands each species status and distribution were discussed in the results by reviewing the available ornithological literatures. Among the ten new birds recorded from these islands only three were confirmed literally such as Tickelle’s Blue Flycatcher *Muscicapa (Cyornis) tickelliae*, Grey-headed Flycatcher *Culicicapa ceylonensis* and Blue-fronted Robin *Clinclidium frontale*, perhaps the status of other rare, vagrant or passage migrants and winter visitors yet to be confirmed.

The collective bird sampling data has been studied for its community attributes such as species richness and abundance. However, classification has been made into forest/land and wetland/water birds, based on the habitat preference mainly to execute in different analysis in the following chapters. Species diversity across the habitats also followed. From the bird community total eight categories, based on the guild structure have been studied for better understanding of habitat-species association in the Andaman Islands. To identify the natural group of bird species among the bird community in Andaman Islands the systematic way of phylogenetic classification has been performed.

In contrary to superficial appearances of the Andaman Islands this diversified archipelago is a complex mosaic of different size of islands-islands which vary from isolated forests in more or less same vegetation. Hence the completeness of sampling and observed species either from the region or habitat is necessary. To avoid the sampling bias on the empirical data set from different region/habitats in Andaman Islands different extrapolating methods for species richness and accumulation patterns were performed used by Estimates S: Chao1, Chao2, Jackknife1, Jacknife2, Bootstrap, Cole, Abundance-based Coverage Estimator or ACE and Incidence-based Coverage Estimator or ICE. The results showed that the completeness of sampling by means of the estimated species richness accumulation curves, across the region/habitats were perfectly approached asymptote against the effort (point count).

While discussing the distribution of individual species among the population the specie abundance follows the lognormal distribution pattern was observed in which the determination of bird community structure is involved various independent factors. The model exhibits the equilibrium in natural habitats (undisturbed) rather than disturbed habitats of Plantation, Forest edge, Field and Degraded. The present study showed very few rare and common species in arrangement of species with moderate abundance and the model fits well, where the community is at equilibrium or free from disturbance. The study has been over viewed with the major perspectives by locally of relationship between the number of species and the internal structure of the habitat. Nevertheless, the structural complexity of the habitat and disturbance mechanisms, along with competition process, would explain the abundance of species.

Samples from eleven habitats of the Andaman Island were scrutinized and computed for bird species diversity, richness and evenness. The various diversity indices showed greater diversity in all natural and disturbed habitats by means of species richness and abundance at 5% significant level. However, Sorensen indices were analyzed to find similarity of bird communities between forest types. The most similarity species were found between evergreen and semi-evergreen followed by evergreen and moist deciduous rather than disturbed habitats. The greatest difference of species, among the bird assemblages and habitat were found between evergreen and coastal habitats which is apparent. This is not unexpected because the samples showed most of the forest dwelling birds are natural forest dependents rather than disturbed habitats.

In order to know the biogeography of bird community in Andaman Islands the Nestedness pattern was studied considering the “nested subsets” where the species in smaller biotas comprise a proper subset of those in richer assemblages. The Nestedness would assessed a ‘temperature’, ranged between 0 and 100˚ where the temperature close to 0˚ is very nested and one that is near 100˚ is deceidedly not nested. Further the pattern will execute results from the predictable sequences of species undergoing extinction from fragments: where the species that need vast areas to sustain minimum viable populations would go extinct quickly from each of the patches, notoriously the less needy species would find sufficient resources on a larger proportion of fragments. However the Nestedness calculator was used to provide a risk assessment of the extinction probability of the various species’ populations isolated on the islands of fragmented habitat by presence-absence data of the species from different islands.

In Nestedness calculator the presence/absence matrix of species distribution in 52 outer islands from the Andaman was analyzed where the islands arranged by in rows and species in columns. The species ranged from 7 to 39 among 52 islands in the matrix the composition of these ranges is highly nested (T=19.78˚, p<<0.0001) which indicate a strongly ordered pattern of brid species distributions in the Andaman Islands. The categorization of species with scores was resulting as 30 out of 95 species with strongly nested, five with distinctively idiosyncratic and 23 are generally confined to the 14 islands, which are richest in species.

Species that exhibits a nested pattern were divided into two main groups as their probability of state occupancy; i) 21 of 95 species were nested at 10-20% and below probability of state occupancy in the matrix, includes three near-threatened species and ii) nine of 95 were strongly nested between 50-100% probability of state occupancy in the matrix. Roughly a five of 95 species in this archipelago exhibited pronounced idiosyncratic distributions. With regard to the islands (n=52) the most distinctively nested were the Redskin, Table (Excelsior), Bluff, Thorn Hill, Table (Dalgarne), Stewart, Anderson, West, Ox, Trilby and Benette, whereas the species poor islands Brush, Boat, East, South Reef, Helicopter, Avis, Oyster 1, Oyster 2, Mayo, Oliver supported relatively idiosyncratic avifauna. Results of this analysis showed that the level of observed nestedness was still highly significant (p<0.0001), but the temperature increased to 52˚.

For ornithobiogeographic affinities of the Andaman Islands total of 153 species, belongs to 36 families of 16 orders recorded during the study period was used. The species similarity in terms of occurrence amongst the mainland’s of Southeast Asia and India was performed. In which out of 136 species (consist of 43 endemics and 93 non-endemics) having affinity with Southeast Asia, 129 species (consist of 37 endemics and 92 non-endemics) affinity with mainland India, and 124 species (consist of 36 endemics, 88 non-endemics) affinity with together Southeast Asia and mainland India, was found. There is no subspecies affinity with together Southeast Asia and mainland India, was found. There is no subspecies affinity was found from Southeast Asia and mainland India together.

In biogeographic distribution, classification of islands based on the area has been made. Accordingly the bird species richness and abundance were scrutinized considering with different vegetation structure available in all major and outer islands. Overall the high bird abundance from the littoral habitat, which presents in various classes of islands, was found as follows: in very small (703), small (939), medium (1012) and very large (4514) islands. Inherently in large island groups the evergreen habitat harbored more number of birds (560).

To acquire the knowledge on avian population biology, community ecology and conservation of Andaman island bird community the size/density of the population was estimated by using variable circular-plot (VCP) method, which also known as variable area surveys or point transects. From a fixed 10-min sampling period and 200m intervals between the stations each bird seen or heard was counted particularly those birds which were actively using the study area and the birds flying overhead which actively used area. The straight-line distance from the station centre to the birds was estimated. The birds that were flushed while approaching the station were counted and their distance from the station centre was estimated. The raw data was consisted a list of birds, observed with individuals and their estimated distance from the station centre.

The estimation of density (bird/m2) for each species the bird abundance vs distance, within the concentric bands (minimum 0 to 10m and maximum 50 to 60 m width) was plotted. The calculated area for 10m concentric bands are as follows: 0-10m = 314m2, 10-20 = 943m2, 20-30m = 1570m2, 30-40 = 2200m2, 40-50m = 2827m2, 50-60m = 3456m2. Further the population density (birds/km2) for each species in region/habitat-wise was then estimated by summing the densities (both the number of individuals and the areas was summed). Since the greater than one station was used the estimated bird densities for all stations was divided by total number of stations, to provide an estimate of density for the species as a whole.

Totally 144 bird species were counted, which actively used the study area. Overall the estimated bird species density (birds/km2) in the Andaman Islands was ranged between >0.05 and <133.7, where the occurrence of 58 species to all four regions, 16 from three regions, 31 from two regions and 39 in one region. Importantly more attention has been given to estimate the density for red listed species, twelve near-threatened birds from Andaman Islands.

After tsunami the habitat assessment in select wetlands (inland and coastal) of Andaman Islands during non-monsoon period (from December 2007 to May 2008) was conducted. During the rapid survey, covering 14 sites the status and population of the Andaman Teal was recorded by total count method. Based on the habitat information gathered most of the major habitats of Andaman Teal in Andaman Islands were drastically affected due to the major earthquake 2004 occurred in Indian Ocean followed by tsunami. Further a qualitative assessment of damages was looked at: a) whether the water marshes and wetlands were functioning or destroyed and dried up and, b) whether the vegetation in nalla’s and tidal creeks was green or scorched and vanished. Further select wetlands was categorized by the level of damage occurred.

A total of 99 individuals of the Andaman Teal were recorded from 14 sites. Among the three major island groups maximum of 73 birds was counted from North Andaman, whereas no birds were found in Little Andaman including some inland wetlands. Among the eight coastal wetlands from Little and South Andaman Islands no birds were found except at Sippighat (11).

Of total 153 bird species detected in Andaman Islands during the present study is representing 66.52 % from the overall 237 bird species reported in Andaman Islands by various studies in the earlier decades. The present study executes the birdlife and their importance of these Islands. Particularly in the outer islands, though most of them are under protected network programme till pressure on the natural resources and bid populations was observed. Whereas in the major islands habitat alteration and destruction causes high damage to the bird population in these islands was found and this serious problem should be controlled. During the study period implementation of immediate conservation measures for the protection of avifauna considering all the above facts has been recommended to the department of environment and forests, Andaman and Nicobar Administration. Moreover the necessary protection to the endemic birds and important bird areas, which are not in the protected network programme, has been suggested.

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