

Diversity, Biodiversity Indices and Conservation Status of Avian Fauna in Tnau Campus at Madurai

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ABSTRACT

Background and Objective: Birds form an important component of the forest ecosystem and they serve as pollinators, consumers, dispersers of plant seeds and predators of insects. Many environmental parameters influence the abundance of birds directly. The present study was conducted on the diversity of birds at Tamil Nadu Agriculture College and Research Institute (TNAU) Campus, Madurai, Tamil Nadu, India. **Materials and Methods:** Birds were surveyed by line transect and identified using field guides. The IUCN Red list status, residential status, relative abundance, feeding guilds, relative diversity index and biodiversity indices such as Simpson index, Shannon index and Margalef index were calculated to estimate the diversity of birds in the study area. **Results:** The 35 species of birds were recorded during the study period. The highest number of species was recorded in March while the lowest in September and October. Species like *Acridotheres tristis* and *Corvus splendens* were documented in higher numbers while *Saxicola caprata* was rare. **Conclusion:** Biodiversity indices revealed the significant results of avian diversity in the study area. Totally 35 species belonging to 23 families were noticed indicating fewer disturbances due to human intervention.

KEYWORDS

Birds, biodiversity, species richness, *saxicola caprata*, shannon index, *corvus splendens*, simpson index

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INTRODUCTION

Biodiversity indicates the number and richness of different species living within a particular region. It represents the variety of living species inhabiting a landscape. Each species, no matter how big or small plays an important role in the ecosystem. Innumerable species of flora and fauna exist on the earth, which is a product of the evolution from 3.5 billion years through processes like speciation, migration extinction and more recently, due to human influence¹. The class Aves comprises more than 10,000 species throughout the world. They were earlier divided into 30 orders, while more recent lists group birds into twenty-three to forty orders. Passeriformes which includes perching birds or song birds, is the most diverse order^{2,3}.

Birds range in size from the small Bee Hummingbird (*Mellisuga hearnor*) to the large flightless Ostrich (*Struthio camelus*)⁴. Research on the bird communities in the Western Ghats to implement to implement biodiversity-friendly development programmes is gaining attention^{5,6}. Various environmental



factors have unswerving control over the bird population. Food availability, detectability, location of nesting sites, availability of nesting materials, and presence of predators and competitors influence the foraging and breeding of birds⁷. Food habits of a species are critical in discerning the pattern of community organization⁸.

Several studies have reported that people living in cities appreciate the wildlife, especially the chance to watch birds. Bird-watching is enjoyed by many people and is treated as a sport and nature study by Reynolds *et al.*⁹. Birds are found nearly all over the world, while each species is unique in its habitat and distribution. Many birds have small ranges while some are restricted to specific habitats. They serve as valuable indicators of global environmental change¹⁰. Hence, the present work has been undertaken to study the diversity of birds in the Tamil Nadu Agriculture College and Research Institute campus in Madurai.

MATERIALS AND METHODS

Study area: The present study was conducted in Tamil Nadu Agriculture College and Research Institute Campus (9.9699°N and 78.2040°E), which is located 12 km (east) from Madurai, Tamil Nadu, India. The college is situated at the foothills of the historical monument Yanamalai, a small rocky mountain, on the western side of the campus. The campus also has the illustrious Chittankulam water tank, which creates a center of attraction for birds and remains an undeclared sanctuary for peacocks. The average annual rainfall of Madurai district is 950 mm and the major part of the rainfall is during North-East monsoon. The district is basically agrarian and the land under forest is 50,452, with 1, 38,055 ha under Gross Cropped Area.

Monitoring, recording and evaluation: For the study of avifaunal diversity and abundance, the line transect method was employed which involves moving along a fixed length of 2 km and recording the bird species seen and voices heard on both sides of the transect path¹¹. The study was carried out from July, 2015 to April, 2016. The survey was conducted twice every month with equal time intervals i.e., alternate weekends of the month from 7.00 to 10.00 am, when birds are more active along the transect that covered most of the study area. The collected data of every month were put together and analysed. Totally 976 birds were monitored and classified up to species level and the watching of birds was done with the help of Olympus (8×40) binoculars. The DSLR camera (Canon 200D mark ii) was employed for photographic documentation. Field guides about the birds of Indian subcontinent and the book of Indian birds were used for the identification of birds¹². Standardized common and scientific names were given to the identified birds from the field of study¹³. Comparison of local status with the global status was done using International Union for the Conservation of Nature (IUCN) Red List status. During the study, other information relevant to birds and their threats to conservation was also noticed. The residential status of the birds was analysed using different status categories such as resident (R), winter migrant (Wm) and passage visitor (Pv). The categories were assigned strictly with reference to the study on the basis of the presence or absence method. The data collected from each survey were noted individually and then they were analyzed for relative abundance based on the frequency of bird sightings and are classified, as very common (Vc) sighted > 10 times, common (Co) sighted 7-9 times, uncommon (Uc) sighted 3-6 times, rare (Ra) sighted 1-2 times. On the basis of direct observations and available literature, feeding guilds of birds were categorized as Carnivorous (C), Insectivorous (I), Omnivorous (O), Grainivorous (G), Frugivorous (F) and Nectarivorous (N)¹⁴.

Data: The relative diversity index (RDI) of families was determined using the following formula¹⁵:

$$RDI = \frac{\text{Number of bird species in a family}}{\text{Total number of species}} \times 100$$

The biodiversity indices such as Simpson index, Shannon index and Margalef index were calculated to estimate the diversity of birds in the study area using the software PAST 4.09.

RESULTS AND DISCUSSION

Birds are fascinating creatures and have been the subject of interest since the ancient period. They are being studied in the field related to diversity, habitat, and distribution. Birds have been studied focusing interest on breeding, feeding, mating, courtship dance, clutch size, territorial behavior, and camouflaging.

Species diversity analysis: In the present study, 35 bird species belonging to 23 families and 11 orders were recorded in Tamil Nadu Agriculture College and Research Institute campus from July 2015 to April 2016 (Table 1). Passerine birds slightly dominated with 18 species (51.4%) compared to non-passerine birds with 17 species (48.6%). During the study period, the highest number of bird species were observed during March, 2016 (27 species), followed by February, 2016 (21 species) and April, 2016 (18 species) and a minimum number of bird species were observed in September and October, 2015 (10 species each). In general, more birds were observed during the winter session (December, 2015 to March, 2016), when compared with the southwest monsoon (June, 2015 to September, 2015), northeast monsoon (October, 2015 to November, 2015) and the beginning of summer (April, 2016) in the study area (Table 2). Distribution and abundance of birds used to differ with reference to various factors including habitat^{16,17}, climatic conditions, availability of food and evolutionary history of the region. The composition of the bird community is extensively associated with altitude and plant species composition of the ecosystem, representing the power of deterministic factors on bird community structure¹⁸. Resource abundance and availability are illustrated as the most significant factors which determine the structure of community¹⁹. The bird families Columbidae, Coraciidae, Cuculidae, Phasianidae, Corvidae, Passeridae, Sturnidae, Picidae and Psittacidae are reasonably present and thus reckoned to be characteristic features of resource availability in the study area. All bird species observed during the study period are classified as Least Concern by IUCN Red List of Birds²⁰. However, all the species of the study area belong to the Least Concern category as per IUCN Red List and there is a need to take proper protective measures to conserve the bird community in the study area.

Diversity indices: The present study divulged that out of 23 families, Ardeidae dominated in the study area with a maximum number of species and RDI value, i.e., 5 species (RDI = 14.29%), followed by Corvidae, Dicruridae, Muscicapidae with 3 species each, respectively (RDI = 8.57%) and Ciconiidae, Phasianidae with 2 species each, respectively (RDI = 5.71%) and Scolopacidae, Columbidae, Alcedinidae, Coraciidae, Cuculidae, Cisticolidae, Hirundinidae, Leiothrichidae, Monarchidae, Nearctiniidae, Passeridae, Pellorneidae, Timaliidae, Sturnidae, Picidae, Psittacidae, Upupidae with one species (RDI = 2.86) each, respectively (Table 3).

Species richness and number of individuals observed were high during winter when compared with southwest monsoon and northeast monsoon (Table 4). Shannon index value normally ranged between 0.0-5.0 and very rarely it exceeded 4.5. The values above 3.0 normally indicate that the ecosystem is healthy²¹. In the study area, Shannon index (Table 4) elevated in the month of March (2.90) and declined in September (1.96). The Shannon index values of all the 10 months of the present study were under 3.0 and this shows that the ecosystem is not healthy and is slightly broken, and in future, it is of great concern. Simpson's index (Table 4) was the highest in February and March (0.92) and it was the lowest in September (0.83). Evenness was maximum in July (0.92) and later declined up to 0.68 in March (Table 4). Margalef index value was high in March (5.06) and low in September (2.15). The post-monsoon had the highest species richness and the highest number of individuals when compared with that of other sessions in the present study. The post-monsoon or winter season was more suitable for migratory and resident birds for their movement every year, whereas the monsoon season was not appropriate for their activity and nesting behaviour. The present study portrays the low diversity index in the monsoon season (Table 4). Rainfall plays an important role in the determination of bird diversity in most of the areas. It was evidenced that the richness and abundance of birds were incredibly low and only very few resident birds

Table 1: Systematic list and status of birds observed in the study area from July, 2015 to April, 2016

Scientific name	Common Name	IUCN	Residential status	Relative abundance	Feeding guilds
Order: Charadriiformes					
Family: Scolopacidae					
<i>Tringa glareola</i>	Wood sandpiper	LC	Wm	Ra	C
Order: Ciconiiformes					
Family: Ciconiidae					
<i>Anastomus oscitans</i>	Asian open bill	LC	R	Ra	C
<i>Mycteria leucocephala</i>	Painted stork	LC	R	Uc	C
Order: Columbiformes					
Family: Columbidae					
<i>Columba livia</i>	Common pigeon	LC	R	Vc	G
Order: Coraciiformes					
Family: Alcedinidae					
<i>Alcedo atthis</i>	Common kingfisher	LC	R	Uc	C
Family: Coraciidae					
<i>Coracias benghalensis</i>	Indian roller	LC	R	Co	C
Order: Cuculiformes					
Family: Cuculidae					
<i>Centropus sinensis</i>	Southern coucal	LC	R	Vc	O
Order: Galliformes					
Family: Phasianidae					
<i>Gallus sonnerati</i>	Grey junglefowl	LC	R	Co	O
<i>Pavo cristatus</i>	Indian peafowl	LC	R	Vc	O
Order: Passeriformes					
Family: Cisticolidae					
<i>Prinia inornata</i>	Plain prinia	LC	R	Ra	I
Family: Corvidae					
<i>Corvus splendens</i>	House crow	LC	R	Vc	O
<i>Hierococcyx varius</i>	Common hawk-cuckoo	LC	R	Uc	I
<i>Corvus macrorhynchos</i>	Large-billed crow	LC	R	Co	O
Family: Dicruridae					
<i>Dicrurus leucophaeus</i>	Ashy drongo	LC	Wm	Uc	I
<i>Dicrurus macrocercus</i>	Black drongo	LC	R	Co	I
<i>Dicrurus caerulescens</i>	White-bellied drongo	LC	Wm	Ra	I
Family: Hirundinidae					
<i>Cecropis daurica</i>	Red-rumped swallow	LC	R	Ra	I
Family: Leiothrichidae					
<i>Turdoides affinis</i>	Yellow-billed babbler	LC	R	Ra	O
Family: Monarchidae					
<i>Terpsiphone paradise</i>	Asian paradise flycatcher	LC	R	Uc	I
Family: Muscicapidae					
<i>Copsychus saularis</i>	Oriental magpie-robin	LC	R	Ra	I
<i>Saxicola caprata</i>	Pied bush chat	LC	R	Ra	I
<i>Saxicoloides fulicatus</i>	Indian robin	LC	R	Uc	I
Family: Nearctiniidae					
<i>Leptocoma zeylonica</i>	Purple-rumped sunbird	LC	R	Uc	N
Family: Passeridae					
<i>Passer domesticus</i>	House sparrow	LC	R	Co	G
Family: Pellorneidae					
<i>Pellorneum ruficeps</i>	Puff-throated babbler	LC	R	Ra	I
Family: Timaliidae					
<i>Turdoides striata</i>	Jungle babbler	LC	R	Ra	O
Family: Sturnidae					
<i>Acridotheres tristis</i>	Common myna	LC	R	Vc	O
Order: Pelecaniformes					
Family: Ardeidae					
<i>Egretta garzetta</i>	Little egret	LC	R	Uc	C
<i>Ardea intermedia</i>	Yellow-billed egret	LC	R	Ra	C
<i>Ardea alba</i>	Great egret	LC	R	Ra	C
<i>Ardea purpurea</i>	Purple heron	LC	R	Ra	C
<i>Ardeola grayii</i>	Indian pond heron	LC	R	Uc	C

Table 1: Continued

Scientific name	Common name	IUCN	Residential status	Relative abundance	Feeding guilds
Order: Piciformes					
Family: Picidae					
<i>Dinopium benghalense</i>	Lesser-goldenback woodpecker	LC	R	Co	I
Order: Psittaciformes					
Family: Psittacidae					
<i>Psittacula krameri</i>	Rose-Ringed parakeet	LC	R	Co	F
Order: Upupiformes					
Family: Upupidae					
<i>Upupa epops</i>	Eurasian hoopoe	LC	R	Uc	I

IUCN Status, LC: Least Concern, Residential status: R: Resident, Wm: Winter migrant, Relative abundance: Vc: Very common, Co: Common, Uc: Un-common, Ra: Rare and feeding guilds, I: Insectivorous, C: Carnivorous, O: Omnivorous, G: Granivorous, F: Frugivorous and N: Nectarivorous

Table 2: Number of birds observed in the study area from July, 2015 to April, 2016

Scientific name	2015						2016				Total
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	
<i>Acridotheres tristis</i>	6	2	14	11	17	18	33	23	14	12	150
<i>Alcedo atthis</i>	0	0	0	1	3	2	0	0	1	0	7
<i>Anastomus oscitans</i>	0	0	0	0	0	0	0	6	0	0	6
<i>Ardea alba</i>	0	0	0	0	0	0	0	0	3	4	7
<i>Ardea intermedia</i>	3	0	0	0	0	0	0	0	0	0	3
<i>Ardea purpurea</i>	0	0	0	0	0	0	0	0	0	1	1
<i>Ardeola grayii</i>	0	0	0	0	0	0	10	11	3	0	24
<i>Cecropis daurica</i>	0	0	0	0	0	0	0	1	0	0	1
<i>Centropus sinensis</i>	5	2	2	0	2	3	5	5	5	3	32
<i>Columba livia</i>	3	2	2	1	2	3	2	1	2	2	20
<i>Copsychus saularis</i>	0	0	0	0	0	0	0	0	3	0	3
<i>Coracias benghalensis</i>	0	2	0	0	3	3	9	5	9	2	33
<i>Corvus macrorhynchos</i>	0	3	0	3	5	0	12	0	6	5	34
<i>Corvus splendens</i>	5	5	19	5	15	16	15	0	29	7	116
<i>Dicrurus leucophaeus</i>	0	0	0	0	0	2	2	5	1	1	11
<i>Dicrurus macrocercus</i>	5	1	0	0	3	8	5	6	6	2	36
<i>Dicrurus paradiseus</i>	0	0	0	2	3	0	0	0	0	0	5
<i>Dinopium benghalense</i>	3	2	1	0	1	2	0	3	2	0	14
<i>Egretta garzetta</i>	10	0	2	0	0	8	0	19	5	0	44
<i>Gallus sonneratii</i>	5	3	0	0	6	11	6	6	2	1	40
<i>Hierococyx varius</i>	9	1	0	0	0	0	0	1	9	1	21
<i>Leptocoma zeylonica</i>	0	0	0	0	0	0	14	9	5	1	29
<i>Mycteria leucocephala</i>	6	0	0	0	17	3	7	0	0	0	33
<i>Passer domesticus</i>	10	7	4	0	0	12	0	22	23	12	90
<i>Pavo cristatus</i>	4	2	8	8	6	6	15	17	10	3	79
<i>Pellorneum ruficeps</i>	0	0	0	2	0	0	0	0	1	0	3
<i>Prinia inornata</i>	0	0	0	0	0	0	0	0	3	0	3
<i>Psittacula krameri</i>	0	0	5	2	4	2	6	19	3	2	43
<i>Saxicola caprata</i>	0	0	0	0	0	0	0	1	0	0	1
<i>Saxicoloides fulicata</i>	0	0	0	0	0	0	3	4	2	0	9
<i>Terpsiphone paradise</i>	0	2	0	5	0	1	0	0	6	0	14
<i>Tringa glareola</i>	0	0	0	0	0	0	0	0	3	1	4
<i>Turdoides affinis</i>	0	0	9	0	0	0	22	0	0	0	31
<i>Turdoides striata</i>	0	0	0	0	0	0	0	10	10	0	20
<i>Upupa epops</i>	0	0	0	0	0	0	0	2	4	3	9
Total	74	34	66	40	87	100	166	176	170	63	976

were active in monsoon in the Eastern Ghats²². The present study also reveals the low diversity in the monsoon season and the highest during the post-monsoon season. The season plays an immense part in the activity pattern of the birds. Hence, seasonal variation in bird diversity and richness has been noticed significantly in wetland and terrestrial birds²³.

Table 3: Relative diversity index (RDI) of avian families in the study area

Family	Number of bird species in a family	Relative diversity index (RDI)
Ardeidae	5	14.285
Corvidae, Dicruridae and Muscicapidae	3	8.571
Ciconiidae and Phasianidae	2	5.714
Alcedinidae, Cisticolidae, Columbidae, Coraciidae, Cuculidae, Hirundinidae, Leiothrichidae, Monarchidae, Nearctiniidae, Passeridae, Pellorneidae, Timaliidae, Scolopacidae, Sturnidae, Picidae, Psittacidae and Upupidae	1	2.857

Table 4: Diversity indices of Birds in the study area during the study period

Parameters	2015						2016			
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Taxa	13	13	10	10	14	16	16	21	27	18
Individuals	74	34	66	40	87	100	166	176	170	63
Dominance (D)	0.09	0.11	0.17	0.16	0.13	0.11	0.10	0.08	0.08	0.11
Simpson (1-D)	0.91	0.89	0.83	0.84	0.87	0.89	0.90	0.92	0.92	0.89
Shannon (H)	2.48	2.41	1.96	2.03	2.31	2.45	2.51	2.69	2.90	2.52
Evenness $e^{-H/S}$	0.92	0.86	0.71	0.76	0.72	0.73	0.77	0.70	0.68	0.69
Margalef	2.79	3.4	2.15	2.44	2.91	3.26	2.93	3.86	5.06	4.10

Residential status and relative abundance: The analysis of data on the residential status exposed that out of 35 species, 32 species (91%) were residents and 3 species (9%) were winter migrants. Further, the relative abundance of avifauna in the study area was calculated based on the quality and quantity of food available which is considered the major factor in any given area^{24,25}. The analysis of relative abundance based on the frequency of sightings indicated that 5 species were very common, 7 were common, 10 were uncommon and 13 were rare species, which accounts for 14, 20, 29 and 37% of the frequency of distribution in the study area.

Feeding guild structure: The wide range of food niches may play a vital role in the diversity of avifauna. The different bird species residing in a meticulous feeding guild explore specialized foraging strategies to acquire food resources proficiently and thus diminish competition among diverse species²⁶. The surveillance on feeding guilds of bird species revealed that the maximum number of bird species belong to Insectivorous [37% (13 bird species)], followed by Carnivorous [28% (10 bird species)], Omnivorous [23% (8 bird species)], Grainivorous [6% (2 bird species)] and Frugivorous and Nectarivorous [3% each (1 species bird each)], respectively. Due to specific diets and penchant for food habits, nectarivores and frugivores are habitually present in minimum quantity²⁷. Maximum representation of insectivorous bird communities in feeding guild analysis shows that insect diversity is very high in the study area as well as minimum fracas in the form of forest fire issues²⁸ and also plays a most important part in bio-control of insect pests in agriculture, horticulture and forest ecosystem^{29,30}. The occurrence of carnivorous bird communities is predominantly influenced by the presence of food sources, however, the result shows the large availability of their prey such as small birds, lizards, snakes and rats in the study area. Different feeding habits of various birds result in an increased population in the study area. The post-monsoon provides further opportunities for the elevation of the insect population which facilitates the occurrence of more insectivorous birds. This creates a significant impact on the feeding guild study. The residential area on the outside edge of agricultural land and forest provides the opening for a high number of omnivorous birds like crows and mynas³¹.

From the documentation of the diversity of avifauna, it can be inferred that ten months were ample to elicit handy information on the antecedent aspects. However, it can be consented that the interim field study was a limitation and without doubt, an enduring study would reveal vigorous ornithological

information on Tamil Nadu Agriculture College and Research Institute Campus. The present investigation created baseline data on the occurrence of bird species in the study area. Changes in the habitat all over the world due to anthropogenic activities create a severe impact on avifauna diversity. Habitat exploitation of human beings should be reduced in order to maintain the bird community. The data acquired through the present study serves to be imperative in the development of future conservation and management programs, which will recognize precedence areas for the long-standing persistence of avifauna communities.

CONCLUSION

Understanding the diversity of birds in a particular landscape indicates the quality of the environment in that region. During the study period, thirty-five avian species were recorded which indicated that the region is not much affected by human intervention. More avian species were noticed during summer than in winter. Effective measures have to be taken to conserve avian diversity during the rainy season. The results of the present work will help in formulating conservative measures.

SIGNIFICANCE STATEMENT

The present work on the diversity of birds can be beneficial for biodiversity programmes for a better understanding of the avian community. This study will help the researchers uncover the critical areas of avian biodiversity that many researchers were not able to explore. Thus a new theory on protecting the avian community from environmental threats may be arrived at.

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