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Communication

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COMMUNICATION

Species diversity and abundance of birds on Bharathiar University Campus, Tamil Nadu, India

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Abstract: University campuses play a significant role in the conservation of avifaunal diversity, but there are very few studies on birds of such local biodiversity hotspots in India. Here, we document the patterns of abundance and species diversity of birds in Bharathiar University campus located in western Tamil Nadu, India. Birds were sampled using point counts. A total of 37 species belonging to 23 families were recorded from 144 point count samples. Mean species richness per point count sample was 13.85±0.47 species (±SD), and Shannon diversity index (*H'*) was 0.74. This study provides baseline data for monitoring the avifauna in the university campus, and demonstrates the importance of university campuses in bird conservation.

Keywords: Birds, India, point counts, Shannon diversity, University campus.

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Author Contribution: LAP - designing of research work, data analysis, and paper writing. MM - field work and data collection.

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INTRODUCTION

The combined effect of climate change (Opdam & Wascher 2004; Knudsen et al. 2011) and urbanization (McKinney 2006; Paton et al. 2012; Tscharntke et al. 2012; Ferenc et al. 2014; Rayner et al. 2015) leading to habitat loss remains one of the most challenging issues for conservation of bird diversity. Under this situation, remnants of wild vegetation and plantations in walled university campuses provide a hope for bird conservation. In India, there are 744 universities with varying land size, and most of them have at least a few patches of natural vegetation and plantations. Documentation of birds in such areas, however, was not given importance on par with forests and other reserve areas. Bharathiar University (BU) in western Tamil Nadu with c.1000 acres of land area in tropical climatic zone is one among the last citadels of biodiversity in an increasingly urbanized landscape. An attempt was made in the present study to achieve the following main objectives: (1) to determine species diversity, frequency, abundance and importance value index of birds on BU campus, and (2) to study the patterns of dominance among the birds of BU.

MATERIALS AND METHODS

Study Area

The present study was carried out on BU campus located in Coimbatore, Tamil Nadu, India (Fig. 1). It covers ca. 1,000 acres and lies between 11.031–11.047^{0}N & 76.869–76.870^{0}E at tropical climatic zone. The terrain of the campus is almost plain, and the elevation gradually varies from 482–512 m. The campus is predominantly covered with non-calcareous sandy loam red soil, with low organic carbon. It has a few remnants of wild vegetation and plantation forests of about 25 years old.

The available climate data (Karthick & Pragasan 2014) for the study area (for the period 2002–2011) revealed that the average annual rainfall was 645mm, and the rainfall was maximum (54% of the total rainfall) during October–November (Fig. 2). Mean monthly temperature for the same period was 27^{0}C (Fig. 3). The mean minimum and maximum temperatures were 22^{0}C and 32^{0}C, respectively.

Methods

Abundance of birds in BU campus was estimated using point counts survey method (Bibby et al. 1992; Horak et al. 2013). In the present study, point count stations were established at every 100m distance along a 500-m line transect, and at each survey point 10 minutes were spent counting birds (Jiguet et al. 2012) within a radius of 50m. A total of 144 point counts were done in 97 non-rainy days from February 2014 to July 2014. Samples were carried out soon after sunrise in the morning (06:00–08:00 hr) or before sunset in the evening (16:00–18:00 hr). Birds were identified using the field guide by Ali (2012). The IUCN Red List of Threatened Species was followed for nomenclature and taxonomy.

Species richness was calculated as the total number of bird species recorded from the 144 point count samples. Abundance and frequency were calculated for all the bird species recorded in this study. Abundance was determined as the total number of bird counts, and frequency was determined as the total number of occurrence of birds in each sample (n=144).

Diversity of birds in the university campus was determined using Shannon diversity index (*H'*) following Magurran (2004), $H' = - \sum p_i \times \ln p_i$, where, p_i is the proportion of the total number of individuals of species 'i'. Chao 2, a non-parametric estimator of species richness which uses occurrence data from multiple samples in aggregate to estimate the species diversity of the whole, was determined using Biodiversity Pro (version 2). The observed species richness was compared with expected species richness (Chao 2) using species-sample curve, as number of samples on x-axis against cumulative number of species on y-axis.

Modified important value index (IVI), a measure of relative prominence of various species was calculated for all the species to find the key species in the university campus following Suripto et al. (2015), IVI = rF + rA, where rF is relative frequency of the species; rA is relative abundance of the species.

Based on abundance all the birds recorded were classified into four dominant/rare categories, viz., predominant (birds with >1000 counts), dominant (500–1000 counts), rare (100–500 counts) and very rare (<100 counts).

RESULTS

A total of 37 bird species belonging to 23 families were recorded from 16,689 bird sightings in 144 point counts bird survey samples (Table 1). The density of birds recorded per sample was 115.90±56.89 birds (± S.D.), this high value can be attributed to large flocks of birds in movement, and it ranged from just one to 313 birds per sample. The mean species richness (number

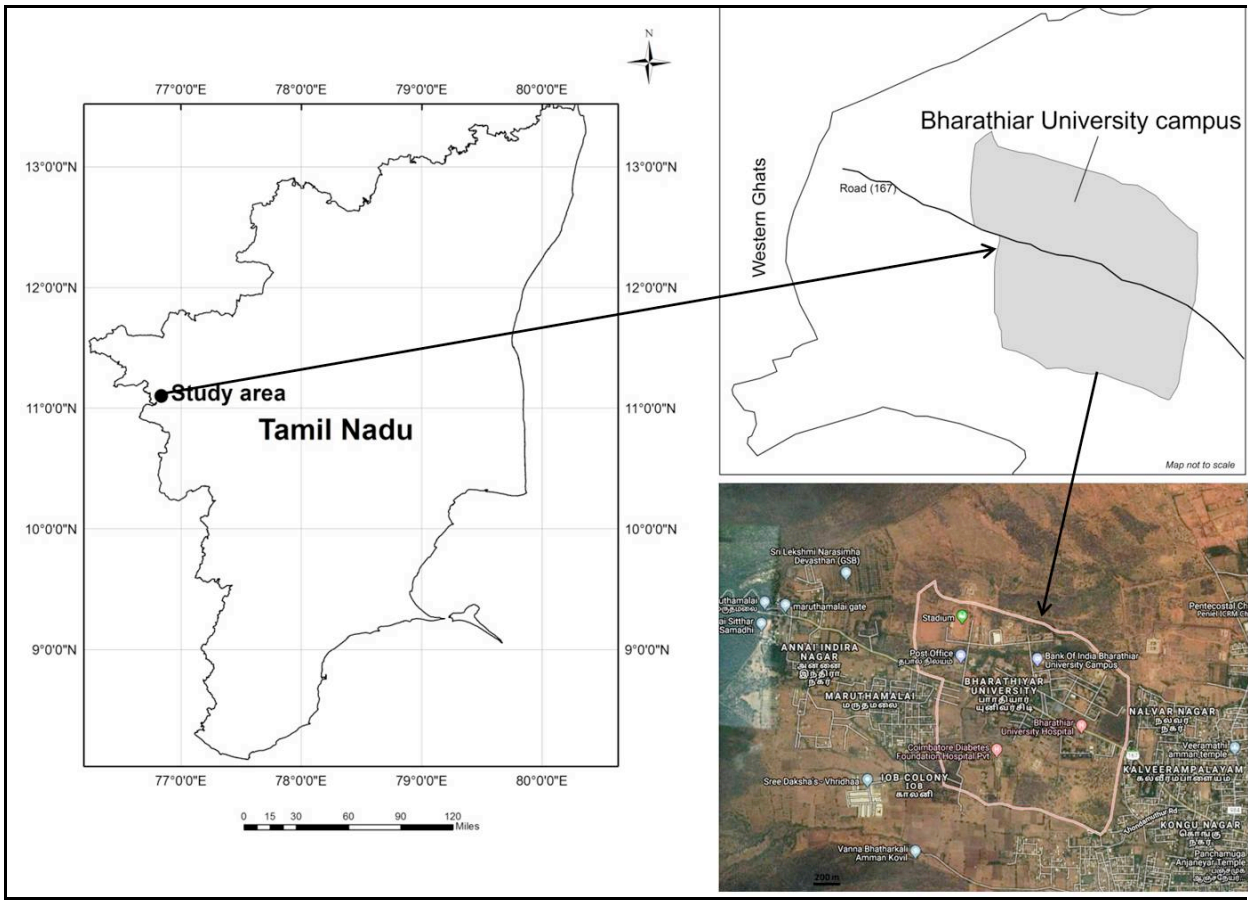

Figure 1. Map showing location of the study area in Tamil Nadu, India

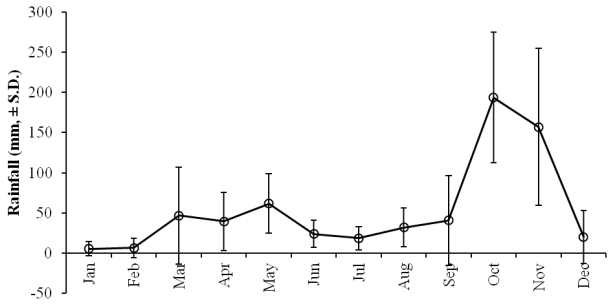

Figure 2. Mean monthly rainfall pattern for the study area

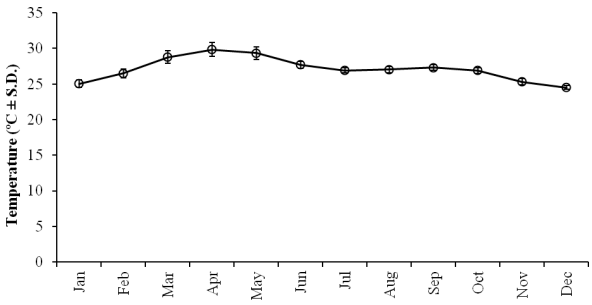

Figure 3. Mean monthly temperature pattern for the study area

of bird species) per sample was 13.85±5.58 species, and species richness ranged from one to 26 species per sample. Shannon diversity index calculated for BU campus was 0.74. The observed and expected (Chao 2) species richness for the present study had almost a similar trend (Fig. 4). The frequency (n=144) of bird occurrence was maximum for Indian Peafowl with 97, followed by Common Myna (96), Rufous Treepie (95), Western Koel (94) and Large-billed Crow, House Crow and Purple Sunbird had 93 each (Table 2). Total abundance was greater for House Crow (3,237), followed by Indian Peafowl (2,512), Common Myna (2,191), Yellow-billed Babbler (1,947) and Cattle Egret (851) (Table 2). House crow scored maximum IVI value 24.06, followed by Indian Peafowl (19.92), Common Myna (17.94), Yellow-billed Babbler (16.28) and Cattle Egret (9.06) (Table 2).

Among the four dominant/rare categories, the predominant category alone contributed a maximum (59%) to total abundance but had just 11% of total species richness (Fig. 5). In contrast, the very rare category with almost twenty times lesser than the contribution

of predominant category in total abundance, shared 43% of the total species richness. Birds such as House Crow, Indian Peafowl, Common Myna and Yellow-billed Babbler with high abundance fell under the predominant category (Table 2). According to IUCN Red List, all the species recorded in the present study come under Least Concern category.

DISCUSSION

Birds are used for assessing ecosystem quality (Ridley et al. 1984). To have effective conservation measures in place, it is necessary to study the population size of birds. Population studies were, for long, used to monitor long time changes in natural and manmade ecosystems (Wiens 2001). The study area, Bharathiar University campus with a few patchy remnants of wild vegetation, plantation, garden, avenue plants and lawn, structurally provides a complex landscape that supports a fair diversity of bird species. Empirical and theoretical evidence have proved that local species richness is highly influenced by the landscape and regional species pools (Lawton 1999; Gaston 2000), and structurally complex landscapes support more species than simple landscapes.

When compared, the species richness of the present study (37 species) is almost fifty per cent lesser than the value (73 species) reported for Assam University campus located in Silchar, India (Chakdar et al. 2016). Shannon diversity index recorded for the present study (0.74) is lesser than the evergreen forests of Silent Valley (3.3) and moist deciduous forests of Mukkali (3.45) (Jayson & Mathew 2000), both located around 60 km away from the present study area.

It is important to study the diversity of avifauna in the university campus to help to monitor and conserve the biological diversity of the region where buildings are increasing in numbers replacing the green vegetation and agricultural lands that support avifauna. In the present study, the maximum species (37 species) was achieved at the 35th point count sample (one-fourth of the total sample size) indicating the sampling adequacy. When compared, the observed species richness and the expected (Chao2) species richness were almost similar in terms of cumulative species richness (Fig. 4). The total abundance was recorded greater for House Crow as expected, and it was followed by Indian Peafowl, Common Myna, Yellow-billed Babbler and Cattle Egret (Table 2). While, the frequency of bird occurrence was maximum observed for Indian peafowl (4.9%) indicating that the national bird occupies all nook and corners of the campus, and it was surprising to observe such a big bird scored high against the most abundant House Crow. In fact, the latter scored less than Common Myna, Rufous Treepie and Western Koel, and scored the same as Large-billed Crow and Purple Sunbird (Table 2).

Categorizing birds into dominant/rare category helps to understand the structure of a bird population. In the present study, although there are 37 species, about 43% of them belong to very rare category (<100 bird counts). This explains the bird population structure of the campus. Though, all the species of the campus come under Least Concern category according to the IUCN Red List, there is a pressing need for prompt steps to conserve bird populations in the campus. To maintain a viable population, conservation measures are needed. There are several factors that influence changes in bird populations such as availability of food, location of nesting sites, availability of nesting materials, introduced diseases, introduced and invasive flora, predators, and competitors (Margules et al. 2000; Ramesh & McGowan 2009), however, habitat loss is considered atop among the others. At this stage, educational institutions like BU with natural and plantation forests serve as a good habitat for the bird community.

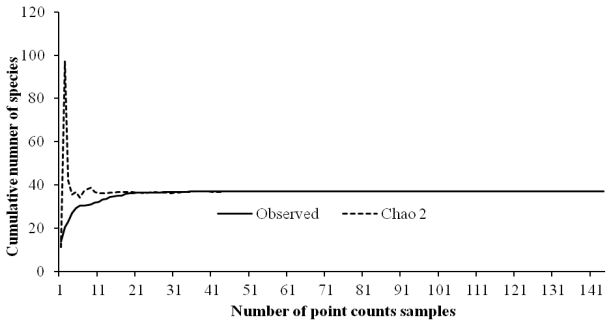

Figure 4. Comparison of observed and expected species richness (Chao 2)

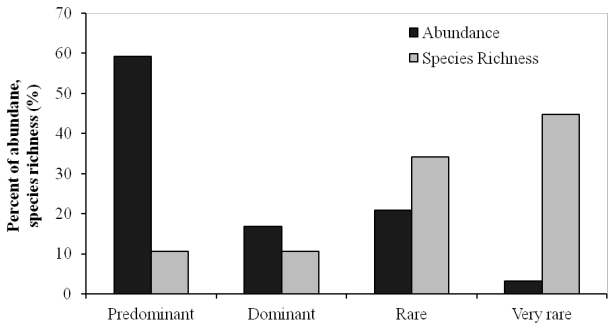

Figure 5. Percent of abundance and species richness of birds by four dominant/rare categories

Table 1. List of birds recorded from the Bharathiar University Campus located in Tamil Nadu

Order/Family	Species Name (with Authority)	Common Name	Category
Pelecaniformes			
Ardeidae	*Bubulcus ibis* (Linnaeus, 1758)	Cattle Egret	D
Accipitriformes			
Accipitridae	*Milvus migrans* (Boddaert, 1783)	Black Kite	VR
Galliformes			
Phasianidae	*Francolinus pondicerianus* (Gmelin, 1789)	Grey Francolin	D
	Pavo cristatus Linnaeus, 1758	Indian Peafowl	PD
Columbiformes			
Columbidae	*Chalcophaps indica* (Linnaeus, 1758)	Emerald Dove	VR
	Columba livia Gmelin, 1789	Rock Dove	D
	Streptopelia chinensis chinensis (Scopoli, 1786)	Spotted Dove	VR
Psittaciformes			
Psittacidae	*Psittacula krameri* (Scopoli, 1769)	Rose-ringed Parakeet	VR
Cuculiformes			
Cuculidae	*Centropus sinensis* (Stephens, 1815)	Greater Coucal	R
	Eudynamys scolopaceus (Linnaeus, 1758)	Western Koel	R
Strigiformes			
Strigidae	*Athene brama* (Temminck, 1821)	Spotted Owlet	R
Caprimulgiformes			
Apodidae	*Cypsiurus balasiensis* (Gray, 1829)	Asian Palm-swift	R
Coraciiformes			
Alcedinidae	*Halcyon smyrnensis* (Linnaeus, 1758)	White-breasted Kingfisher	VR
Meropidae	*Merops orientalis* Latham, 1802	Asian Green Bee-eater	R
Piciformes			
Megalaimidae	*Psilopogon haemacephalus* (Müller, 1776)	Coppersmith Barbet	R
Picidae	*Dinopium benghalense* (Linnaeus, 1758)	Black-rumped Flameback	VR
	Dinopium javanense (Ljungh, 1797)	Common Flameback	VR
Passeriformes			
Campephagidae	*Pericrocotus flammeus* (Forster, 1781)	Scarlet Minivet	VR
Cisticolidae	*Orthotomus sutorius* (Pennant, 1769)	Common Tailorbird	R
Corvidae	*Corvus macrorhynchos* Wagler, 1827	Large-billed Crow	D
	Corvus splendens Vieillot, 1817	House Crow	PD
	Dendrocitta vagabunda (Latham, 1790)	Rufous Treepie	R
Dicruridae	*Dicrurus caerulescens* (Linnaeus, 1758)	White-bellied Drongo	VR
Dicruridae	*Dicrurus macrocercus* Vieillot, 1817	Black Drongo	R
Motacillidae	*Dendronanthus indicus* (Gmelin, 1789)	Forest Wagtail	VR
	Motacilla maderaspatensis Gmelin, 1789	White-browed Wagtail	VR
Cisticolidae	*Prinia socialis* Sykes, 1832	Ashy Prinia	R
Leiotrichidae	*Turdoides affinis* (Jerdon, 1845)	Yellow-billed Babbler	PD
Monarchidae	*Terpsiphone paradisi* (Linnaeus, 1758)	Indian Paradise-flycatcher	VR
Nectariniidae	*Cinnyris asiaticus* (Latham, 1790)	Purple Sunbird	R
	Cinnyris lotenius (Linnaeus, 1766)	Loten's Sunbird	R
	Leptocoma zeylonica (Linnaeus, 1766)	Purple-rumped Sunbird	R
Passeridae	*Gymnoris xanthocollis* (Burton, 1838)	Yellow-throated Sparrow	VR
	Passer domesticus (Linnaeus, 1758)	House sparrow	VR
Pycnonotidae	*Pycnonotus cafer* (Linnaeus, 1766)	Red-vented Bulbul	VR
	Pycnonotus jocosus (Linnaeus, 1758)	Red-whiskered Bulbul	VR
Sturnidae	*Acridotheres tristis* (Linnaeus, 1766)	Common Myna	PD

(Category (dominant/rare category); VR - very rare; R - rare; D - dominant; PD - predominant)

Table 2. Frequency, abundance and IVI value of the 37 bird species recorded

Species Name	Frequency (n=144)	Abundance			IVI
		Total	Mean	±SD	
Corvus splendens Vieillot, 1817	93	3237	22.48	18.15	24.06
Pavo cristatus Linnaeus, 1758	97	2512	17.44	13.65	19.92
Acridotheres tristis (Linnaeus, 1766)	96	2191	15.22	12.27	17.94
Turdoides affinis (Jerdon, 1845)	92	1947	13.52	11.81	16.28
Bubulcus ibis (Linnaeus, 1758)	79	851	5.91	9.38	9.06
Corvus macrorhynchos Wagler, 1827	93	684	4.75	5.05	8.76
Francolinus pondicerianus (Gmelin, 1789)	79	635	4.41	5.17	7.77
Columba livia Gmelin, 1789	77	641	4.45	5.17	7.70
Eudynamys scolopaceus (Linnaeus, 1758)	94	426	2.96	2.74	7.27
Dendrocitta vagabunda (Latham, 1790)	95	398	2.76	3.30	7.15
Cinnyris asiaticus (Latham, 1790)	93	387	2.69	2.60	6.98
Dicrurus macrocercus Vieillot, 1817	91	353	2.45	2.51	6.68
Orthotomus sutorius (Pennant, 1769)	83	328	2.28	3.34	6.13
Centropus sinensis (Stephens, 1815)	90	219	1.52	1.71	5.83
Psilopogon haemacephalus (Müller, 1776)	76	235	1.63	2.18	5.22
Leptocoma zeylonica (Linnaeus, 1766)	63	243	1.69	2.78	4.62
Cinnyris lotenius (Linnaeus, 1766)	63	238	1.65	2.11	4.59
Merops orientalis Latham, 1802	66	186	1.29	1.67	4.42
Athene brama (Temminck, 1821)	60	165	1.15	1.79	4.00
Halcyon smyrnensis (Linnaeus, 1758)	64	86	0.60	1.15	3.72
Prinia socialis Sykes, 1832	50	133	0.92	1.42	3.30
Cypsiurus balasiensis (Gray, 1829)	34	170	1.18	2.42	2.72
Motacilla maderaspatensis Gmelin, 1789	30	32	0.22	0.45	1.70
Pericrocotus flammeus (Forster, 1781)	26	51	0.35	0.83	1.61
Pycnonotus cafer (Linnaeus, 1766)	24	36	0.25	0.99	1.42
Streptopelia chinensis chinensis (Scopoli, 1786)	25	26	0.18	0.40	1.41
Dendronanthus indicus (Gmelin, 1789)	22	24	0.17	0.41	1.25
Dinopium benghalense (Linnaeus, 1758)	21	28	0.19	0.53	1.22
Gymnoris xanthocollis (Burton, 1838)	17	32	0.22	0.75	1.04
Pycnonotus jocosus (Linnaeus, 1758)	18	19	0.13	0.36	1.02
Passer domesticus (Linnaeus, 1758)	10	61	0.42	2.84	0.87
Milvus migrans (Boddaert, 1783)	15	17	0.12	0.36	0.85
Dicrurus caerulescens (Linnaeus, 1758)	13	29	0.20	0.78	0.83
Psittacula krameri (Scopoli, 1769)	12	26	0.18	0.65	0.76
Dinopium javanense (Ljungh, 1797)	13	14	0.10	0.32	0.74
Terpsiphone paradisi (Linnaeus, 1758)	10	18	0.13	0.55	0.61
Chalcophaps indica (Linnaeus, 1758)	10	11	0.08	0.29	0.57

(D/R Cat.- dominant/rare category; VR- very rare; R-rare; D-dominant; PD-predominant)

CONCLUSION

Bharathiar University campus supports a fair diversity of birds. The present study provides baseline data for monitoring bird diversity in the campus. This study creates awareness on documenting birds in other university campuses in the nation. Future research on the behavior and feeding ecology of birds in the campus will help to understand birds more accurately and thereby pave the way for better conservation measures. Birds play ecologically significant role in plant pollination and seed dispersal, and their conservation is highly necessary for the proper functioning of the ecological system. Although there are natural and plantation forests in the BU campus as habitat for birds of this region, conservation measures are of immense need for their future survival. We suggest following conservation measures for protecting the diversity of birds in the university campus: (1) awareness program for conservation of bird species among the campus aspirants, and (2) initiating biomonitoring program is necessary for monitoring and conservation of the birds of BU campus.

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