Uttar Pradesh Journal of Zoology

Volume 45, Issue 23, Page 221-237, 2024; Article no.UPJOZ.4420
ISSN: 0256-971X (P)

Ecological Survey of Bird Community Structure in the Theni Forest Division, Tamil Nadu, India

R. Parthiban [a++] and N. Ezhilarasi [a#*]

[a] *Department of Zoology, Govt. Arts College, Coimbatore – 18, India.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.56557/upjoz/2024/v45i234703

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.mbimph.com/review-history/4420

Original Research Article

Received: 18/10/2024
Accepted: 18/12/2024
Published: 23/12/2024

ABSTRACT

A study of the bird community in Theni Forest Division recorded 13,299 individuals from 197 species across five habitats: mixed forest, semi-evergreen forest, deciduous forest, shrub forest, and pond areas. Species richness was highest in deciduous forest at lower elevations (< 500 m) and lowest in pond habitats. Endemism was prominent in semi-evergreen forest (50%), with the Malabar Parakeet being the most abundant endemic species. Migratory species, mostly residential migrants, were primarily recorded around ponds. Seasonal variations influenced species richness, with significant declines observed at higher elevations. Conservation concerns included one critically endangered and several vulnerable species, emphasizing the need for targeted protection strategies.

[++] *Ph.D Research Scholar;*
[#] *Associate Professor;*
**Corresponding author: Email: ezhilcbe@gmail.com;*

Cite as: *Parthiban, R., and N. Ezhilarasi. 2024. "Ecological Survey of Bird Community Structure in the Theni Forest Division, Tamil Nadu, India". UTTAR PRADESH JOURNAL OF ZOOLOGY 45 (23):221-37. https://doi.org/10.56557/upjoz/2024/v45i234703.*

Keywords: Western Ghats; Theni forest; bird community; endemic, migrant.

1. INTRODUCTION

The Western Ghats, a UNESCO World Heritage Site and one of the planet's biodiversity hotspots, stands as a testament to the intricate interplay between geological history, climatic variability, and ecological diversity. The avian communities of the Western Ghats are intricately linked to the region's ecological dynamics, participating in a myriad of interactions ranging from pollination and seed dispersal to predator-prey relationships. Birds play vital roles in maintaining the ecological balance of their habitats, making them important indicators of ecosystem health and integrity (Rajesh et al., 2021). However, despite their ecological significance, bird populations in the Western Ghats face numerous conservation challenges, including habitat loss and fragmentation, poaching, and climate change. The conversion of natural habitats for agriculture, urbanization, and infrastructure development poses a significant threat to avian biodiversity, leading to population declines and local extinctions of vulnerable species. Moreover, the illegal trade in birds for the pet trade and traditional medicine further exacerbates the conservation crisis facing avian communities in the region. Birds are the key species in the forest ecosystem for maintain the ecological balance (Haslem and Bennett, 2008). Their positive and negative roles in forest production were very well illustrated (Ali 1949 and 1971). Forest provides a concentrated and highly predictable source of food for birds. These foods in general three kinds (I) seeds, grains and fruits (II) vegetable, plants and nectar (III) insect, other arthropods, rodents, snakes etc., (better knowledge to help conservation. Birds (O'Connor and Shrub, 1989). There are many good reasons for counting birds but this study aims to promote represent one of the important segment of biodiversity. They are regarded as the bio-indicator reflecting richness of natural sites like reserved forest including sacred groves and green patches around the periphery of rural areas.

2. STUDY AREA

We conducted survey at the Theni Forest Division, situated in the southern part of Tamil Nadu (9.9697°N,7.2749°E) (Map1) Theni district encompasses varying altitudes, ranging from approximately 200 meters above sea level in the plains to over 2,500 meters in the Western Ghats. The district's altitude influences its climate, vegetation, and agricultural practices. Lower elevations experience warmer temperatures and are predominantly used for agriculture, while higher altitudes exhibit cooler temperatures and support diverse forest ecosystems. The vegetation in Theni district is diverse, reflecting its varied topography and climatic conditions. It encompasses parts of the Western Ghats, featuring dense forests with a rich variety of flora and fauna. Deciduous forests dominate the lower elevations, while evergreen and semi-evergreen forests thrive at higher altitudes.

Fig. 1. Study area -Theni forest division

In the Forest Division of Theni District, there exist six distinct ranges delineating various ecosystems and habitats. For our research endeavours, we focused on two specific ranges, namely Cumbam West and Bodi. Within the expansive Cumbam West range, our attention was directed towards three distinct beats: Kumily, Ulmanai Saragam, and Thagaval Odai Saragam. Each of these beats presents unique ecological characteristics and biodiversity hotspots deserving of investigation. Additionally, our study extends to one carefully selected pond within these ranges Meenachipuram Pond. These bodies of water serve as crucial components of the local ecosystem, supporting diverse flora and fauna populations. By delving into these selected beats and ponds, our research aims to unravel the intricate interplay between birds, habitat dynamics, and conservation efforts within the Theni District Forest Division.

3. METHODOLOGY

3.1 Fixed Radius Point Count

Regular monthly sampling was carried out in different habitats namely semi evergreen (Kumuli, 870 m), Deciduous forest (Thagavalodaisaragam, 0-500m), moist evergreen forest (Kurangani 1000-1500m) and shrub forest (Ulmanaisaragam 0-500m) and area around the pond (0-100m). Five sampling sites were established in the study area, representing a variety of habitat classes across each of the major vegetation types.

Birds data were collected during June 2022 to May 2023 from 60-point count stations. Fixed distance point counts of 30 m radius were used to sample bird communities. Point count statins we laid out systematically at a minimum distance of 100 m (Bibby et al. 2000). A total of 60 points were marked and numbered (10 points each in three transect of evergreen forest, ten point each in semi evergreen, Deciduous forest, mixed forest and shrub forest and area around the pond) Point count station was established at least 50 m away from the habitat edge. Species, number of individuals and vertical stratum were recorded for each bird encountered lasting for 10 minutes at each point. Count were conducted between 07.00 and 11.00 in the morning except for days with heavy rains, mist or strong wind. Counts at each station were replicated in different days in a month, thus the total data set was for 2518 point counts. Point was scanned for birds while entering and leaving the point to spot any undented birds (Raman 2003).

4. RESULTS

4.1 Bird Community Structure

A total of 13299 individuals belonging to 197 species from five habitats were recorded, 13 species which are endemic to the western Ghats. Opportunistic observations added 13 species (Appendix 1) which are not recorded from the transects. Variation was prominent in terms of the number of species and individuals among different transects. While comparing the transects in the same elevation or sites in elevation above 800 m mixed forest type had the highest species richness (80) followed by semi evergreen forest (78). in low elevation below 500 m deciduous forest had highest species richness with 94 species followed by shrub forest with 75 species. Of the species detected 47.72% was recorded at the Deciduous forest, 42.13% of species detected from mixed forest, 39.59% species detected from Semi-evergreen forest, 38.07% of species detected from shrub forest and 20% detected from area in and around the pond. Of the individual detected 43% were from area in and around the meenakshipuram pond, 17.75% from mixed forest, 14.88% from semi-evergreen forest and 14.28 % from deciduous forest and 10% from shrub forest. Deciduous forest from low elevation had the highest species diversity and pond area from lower elevation had least species diversity (Table 1 & Fig. 2).

In the semi evergreen forest 93.7% (73 out of 80) are were forest affiliated species only 2.3% open country species. Species richness was significantly low in pond and shrub than the other habitat types.

From 2518 point count in the five habitat types, 13299 individual recorded from 197 species, 5711 individuals of 40 species recorded from area around the pond, 2361 detection of 83 species were made in mixed forest, 1979 detections of 78 species were reported from semi-evergreen, 1899 detection from 94 species from deciduous forest and from shrub forest 1341 detection and 75 species.

A strong negative correlation was observed between rainfall and species richness ($r_s = -466$, $p < 0.01$). species richness varied significantly among the altitudinal ranges. Although species richness was negatively correlated with elevation

there was a dearth in species richness and abundance at semi-evergreen forest. Significant differences were found in species richness among the five vegetation types (F = 4.41, d.f = 4, p < 0.00).

Several species showed seasonal trends. Species fall generally into groups as residents and winter visitor, such as European bee-eater, Greenish warbler, Large-billed warbler, Steppe eagle, white tailed eagle (Fig. 3).

Table 1. Bird species richness and abundance observed in relation to habitat types

Elevation	Forest	Species	SD	SE	Individuals	Species %	Individual %
High >800 m	Mixed	83	67.91	7.47	2361	42.13	17.75
	Semi evergreen	78	36.74	4.17	1979	39.59	14.88
Low <500 m	Deciduous	94	43.23	4.47	1899	47.72	14.28
	Shrub	75	38.59	4.45	1341	38.07	10.08
	pond	40	359.34	52.07	5711	20.30	42.94

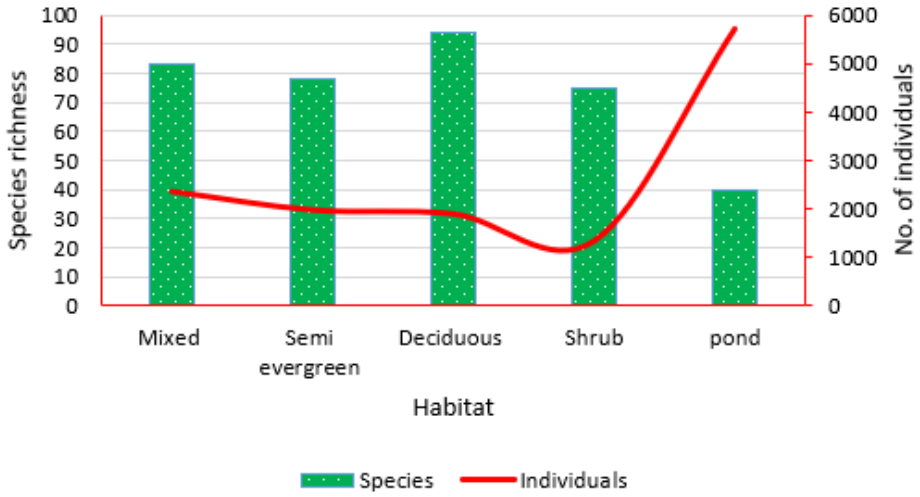

Fig. 2. Bird species richness and abundance observed, in relation to forest types at Theni division (2022-2023)

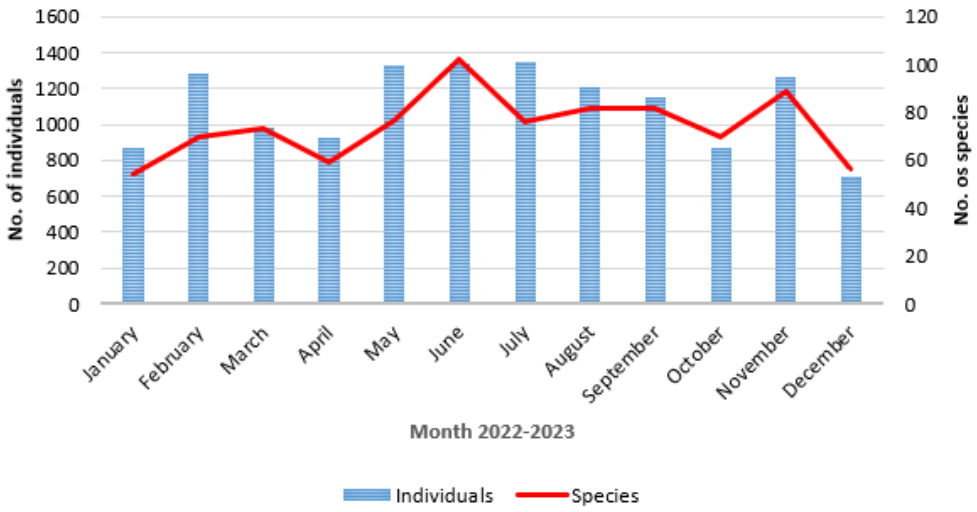

Fig. 3. Month wise record of number of bird species and individuals (2022-2023)

4.2 Birds in Different Habitat

Total of 86 species and 2361 individuals recorded from SEG forest in Kurangani area with the elevation of 1000 to 1500 msl. Maximum of eight species recorded from Musicicapinidae family and maximum of 727 (31 %) individual detected from Pyconodidae family. followed by Leiothrichidae with 394 individual (17%). Mixed forest total of 1979 individual recorded from 78 species. maximum of 227 individual detected from Leiothrichidae family. from MP pond maximum of 1807 little cormorant recorded which comes under phalacrocoracidae family. from deciduous forest maximum of 268 house crow of corvidae family detected. from the habitat shrub which comes under ulmanaisaragam area recorded 1341 birds with highest detection in red-vented bulbul with 216 birds.

4.3 Endemics

of the 29 species considered endemic to the western Ghats (Ramesh et al., 2017) 13 species were recorded from the study area. A comparison of the endemics birds in the study area is shown in Table 2. Of the total 13 endemics recorded, seven endemics were recorded from semi ever green forest, mixed forest and shrub. Whereas, only one endemic namely Malabar parakeet recorded from shrub forest. No endemics were recorded area around pond during this study. Total of 486 endemic individuals were recorded of which maximum number recorded from Semi evergreen forest with 243 (50%), and 130 (27%) individual detected from deciduous forest witch comes under seven species, 97 (20%) individuals of seven species detected from mixed forest, only 16(3%) individual from one species recorded from shrub forest. Semi evergreen forest had highest endemic species and individual number. Malabar parakeet was recorded more in numbers with 251 detections (51%) and Wayanad laughing thrush was very rare in sighting with only one detection (Fig. 4).

There was a variation in the distribution of the endemic birds along the altitudes, for eg. Black and orange flycatcher recorded only above 900 msl, and Wynaad Laughing thrush recorded only in Semi-evergreen forest above 800 msl.

4.4 Migrants

The occurrence of the latitudinal migrants was more or less same at both the low and high altitudes with a record of 29 species of migrants were recorded. which includes one partial migrant Amour falcon, 19 residential migrants and nine winter visitor. Out of 2841 detections of migrants 2450 (86%) were detected from pond area most of them water birds. When compare the migratory species among the four forest type namely semi evergreen, mixed forest, deciduous forest and shrub 34% of birds migrated to semi-evergreen, followed by 30 and 28 percentages to mixed and deciduous forest, whereas in shrub we could record only eight percentages of migratory birds species (Fig. 5).

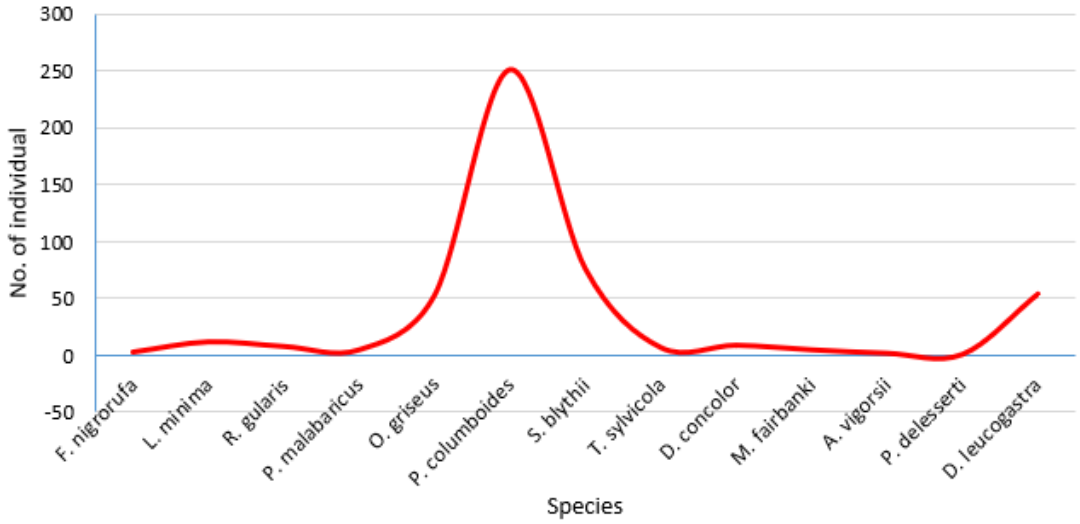

Fig. 4. Number of individuals recorded from different endemic species during (2022-2023) from the study area

Table 2. List of endemic birds recorded from Theni forest division

Family	Common Name	SEG	MF	POND	DF	SHRUB	TOTAL	%
Muscicapidae	Black-and-orange flycatcher	0	3	0	0	0	3	0.62
Nectariniidae	Crimson-backed sunbird	0	0	0	12	0	12	2.47
Pycnonotidae	Flame-throated bulbul	2	6	0	0	0	8	1.65
Megalaimidae	Malabar barbet	5	0	0	0	0	5	1.03
Bucerotidae	Malabar grey hornbill	48	0	0	5	0	53	10.91
Psittaculidae	Malabar parakeet	66	68	0	101	16	251	51.65
Sturnidae	Malabar starling	73	0	0	3	0	76	15.64
Vangidae	Malabar woodshrike	0	5	0	2	0	7	1.44
Dicaeidae	Nilgiriflowerpecker	0	9	0	0	0	9	1.85
Leiothrichidae	Palani laughing thrush	0	0	0	5	0	5	1.03
Nectariniidae	Vigors's sunbird	0	2	0	0	0	2	0.41
Leiothrichidae	Wayanadlaughingthrush	1	0	0	0	0	1	0.21
Corvidae	White-bellied treepie	48	4	0	2	0	54	11.11
		243	97	0	130	16	486	
		50	9.96	-	26.75	3.29		

Table 3. IUCN category of birds recoded from study area and study period (2022-2023)

IUCN	MIXED		SEG		DECIDUOUS		SHRUB		POND	
	SPP.	Number	SPP.	Number	SPP.	Number	SPP.	Number	SPP.	Number
LC	83	2361	76	1930	89	1885	72	1332	34	5500
CR	0	0	0	0	0	0	0	0	1	29
EN	0	0	0	0	1	1	0	0	0	0
NT	0	0	0	0	2	6	2	2	4	158
VU	0	0	2	57	2	7	1	7	1	24

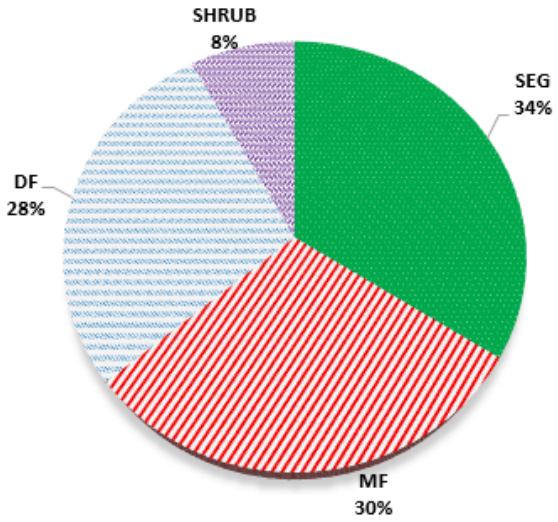

Fig. 5. Migratory bird status in different forest types during the study period in the study area (2022-2023)

The proportionate abundance of latitudinal migrant species was high at 1000 m but low at 800 m. This distribution was statistically different across the sites ($\lambda^2 = 5.53$, d.f = 3, $p < 0.05$). The arrival of winter migrants during September – December significantly influenced the bird fauna of the Theni forest contribution much to the species richness.

Migratory birds were categorised in to three categories residential migrant, partial migrant and winter visitor. Of the 29 migrants 19 species detected as residential migrants, nine winter visitor and one partial migrant. Total of 97 winter visitor individual belonging nine species were detected. No winter visitor species recorded from mixed forest in this study whereas maximum of 81 winter visitor detected from pond.

4.5 IUCN Category

Least concern 83 species and 2361 individual recorded from mixed forest, 76 species and 1930 individual from semi evergreen forest, 89 species and 1885 individual from deciduous forest, 72 species and 1332 individual from shrub and 34 species and 5500 individuals from pond recorded. Critically endangered total of one species and 29 individual recorded from pond. one species of endangered bird recorded from deciduous forest, near threatened total of two species recorded from deciduous forest with six individual, two species from shrub with two individual and four species 158 individual from pond, two vulnerable specie 57 individual from semi-evergreen forest, two species of 7 individual from deciduous forest, one species of seven individual from shrub forest and one species of 24 individuals from pond were recorded during the study period in the study area (Table 3).

5. DISCUSSION

The species richness and species abundance is a significant measure of biodiversity at the habitat level (Bunge and Fitzpatrick 1993, Colwell & Coddington 1994, Mao and Colwell 2005). The total of 197 species in the present study is approximately 70% of the known avifauna in the Western Ghats. The species richness of the birds of the study area at Theni forest division comparable with similar habitats in the western Ghats such as silent valley national park (n = 145, Das 2005), Periary Tiger Reserve (n= 181 species; Nair etal 1985), Chinnar Wildlife Sanctuary (143 species; Nair et al., 1997) Siruvani foothills (129 species; Vijayan et al., 1998), Anaimalai Hills (106 species; Raman 2006), Parambikulam Wildlife sanctuary (134 species; NEST 1994), Nelliyampathy (109 species; Zaibin 2005) and Muthikulam Reserve forest (197 species; Praveen and Nameer 2008) Anaimalai Tiger Reserve (221 species; Rahman 2024). Total of 231 species recorded from Theni forest division. The lack of record of the rest of the species during my sampling in the Theni forest division was partly an outcome of rarity of those unrecorded species and restriction of sampling to the five habitat types at a very localized scale. As said by Williams (1964) observed species richness can seriously

underestimate actual species richness due to under-sampling of rare species.

Community ecology revolves around the study of biotic assemblages, their interactions, patters of occurrence and distribution (Vellend 2011). The structure of community is wide array of factors, competition, niche character and availability, predation, climatic stability, productivity, dispersal, speciation and many more (Velland 2011). The distribution of the species is determined by species composition, abundance, behaviour, morphology and their association with the environment (Das, 2008).

The result of the study suggested that the bird communities in various habitats along the altitudinal gradient varied significantly in terms of bird species richness, composition, abundance and diversity. Similarity between SEG and MF in bird community composition can be the result of similar plant community and other environmental conditions. Habitats with similar tree species composition had more similar bird communities (Raman and Sulumar, 2002). As explained lack of any significant difference in the bird species richness, diversity and evenness between the habitats at low elevation (Das, 2008). Higher abundance, richness and diversity of birds though not significantly different, in the SEG, MF and between DF and Shrub were influenced by the occurrence of less abundance of open country species, in the forest such as Black-hooded Oriole *Oriolusxanthornus* and finches and other than open- wooded specis such as Common Flameback, Rufous Babbler, Brown-necked raven *Corvus ruficollis*, Chestnut-headed bee-eater Merops leschenaultia. Many species have significantly more abundance in the Semi evergreen forest and deciduous forest possibly due to the microhabitat variation between the sites which in turn determine the occurrence of habitat specialists as reported by Margules et al., (2000).

Presence of a many generalist and open-country species such as Large-billed crow, Red-vented bulbul, Rufous babbler, Blyth reed warbler with the forest sites can be regarded as indirect evidences to the effect of localised man made disturbance undergone due to the conversation of surrounding landscape and the past history of selective logging in the site. Similar reports were submitted In Silent valley national park (Das, 2008), Rahman (2004). While analysing the bird community structure and composition, it is very important to classify the component species on the basis of their ecological attributes and habitat occupancy (Kitahara 2000). The present study demonstrates that species assemblages were significantly correlated to the habitat variability as shown by Daniels (1992), Das (2008) and Rahman (2004) Jyothi et al*.,* (2015).

Twelve species showed significantly greater abundance in the lowland forest site. Possibly due to the microhabitat difference of the lowland form that of the high land sites. Semi-evergreen had significantly greater tree density, canopy cover, canopy height and high proportion of lower-canopy trees and trees falling in smaller girth classes, more open and spacious under-story, and varying degree of ground cover than present in the mixed site. Significantly low abundance of many species in Deciduous forest point to the fact that most of them are highly sensitive to microhabitat changes which usually accompanies increase of elevation. The transition tree-line between the semi-evergreen habitat and deciduous forest lies at 800 to 1000 m, and very few species and specialist were recorded above this altitude. Of the 29 species considered endemic to the western Ghats (Ramesh et al., 2017) 13 species were recorded from the study area. Of the total 13 endemics recorded, seven endemics were recorded from semi ever green forest, mixed forest and shrub. Whereas, only one endemic namely Malabar parakeet recorded from shrub forest. No endemics were recorded area around pond during this study.

Migratory birds were categorised in to three categories residential migrant, partial migrant and winter visitor. Of the 29 migrants 19 species detected as residential migrants, nine winter visitor and one partial migrant. No winter visitor species recorded from mixed forest in this study whereas maximum of 81 winter visitor detected from pond. Every year after the onset winter season in most parts of the northern hemisphere, a large number of avian species move towards the south for wintering. After spending the winter season at their respective destination they return back to their native ground. Most migratory birds are aquatic species and their wintering destination are comprised of terrestrial water bodies ranging from small ponds to large-sized lakes and wetland (Newton, 2003; Somveille et al*.,* 2013). Garganey is a small dabbling duck. it mainly breeds in European countries it migrates to India during winter (Clements and James (2007). Great white pelican also migrate from Europe. White stork migrates to the Indian

subcontinent as part of their long distance migration from Europe to Africa. The white storks migration up to 16000 km round trip and it take up to four months. Birds face a number of threats during migration, ranging from natural disaster to anthropogenic activities (Kirby et al., 2008). Due to these factors, many populations of migratory bird species are on the decline several species showed seasonal trend. Bird species richness and the numerical dominance of single bird species also decreased with increases in altitude (Das 2008, Rajesh et al., 2021).

Image 1. Great hornbill

Image 2. Malabar grey hornbill

Image 3. Black-rumpedflameback

Image 4. Indian paradise flycatcher

Image 5. Shikra

Image 6. Black-winged kite

Image 7. Common iora

Image 8. Purple sunbird

Image 9. Indian pond heron

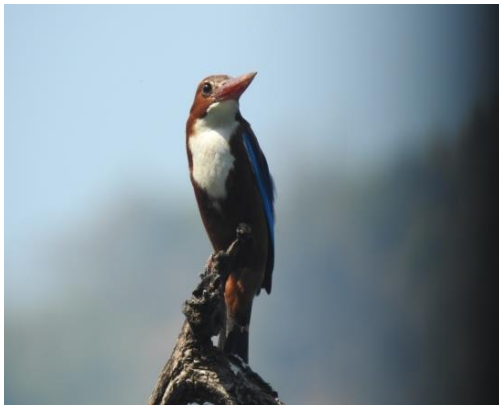

Image 10. White-throated kingfisher

6. CONCLUSION

This study was undertaken in a large area of continuous forest without any obvious habitat discontinuities. The lack of significant association between community composition and geographic distance confirmed that no dispersal barriers were present. Bird community composition was most strongly associated with spatial variance in the environment, implying that deterministic ecological processes such as habitat and altitude are of greater importance in structuring spatial variation observed in the bird assemblage. it is likely that spatial contrast in vegetation, elevation and slope are influencing distribution of essential resources for bird species including food, shelter and territorial space, and thus also influencing the strength of ecological interactions. From a conservation management perspective these result indicate that attention should be given for maintaining (i) structurally complex forest with variation in gap-phase structure and tree size variables (ii) large areas of continuous forest with an altitudinal gradient.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

ACKNOWLEDGEMENT

The authors are thankful to Tamil Nadu forest department for giving permission to carry out the study. we also thank Theni forest division for their timely help and guidance during data collection. We express our sincere thanks to Faculty members of OSAI NGO, Coimbatore for Constance guide and support to complete the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Ali, S. (1949). Bird friends and foes of the cultivator. *Indian Farming, 10*, 385-387.

Ali, S. (1971). Sunder Lal Hora memorial lecture. Ornithology in India: Its past, present and future. *Proceedings of the Indian National Science Academy, B37*, 99-113.

Bibby, C. J., & Burgess, N. D. (2000). *Bird census techniques* (p. 302). Academic Press.

Bunge, J., & Fitzpatrick, M. (1993). Estimating the number of species: A review. *Journal of the American Statistical Association, 88*(421), 364-373.

Clement, P., & James, F. (2007). *The Clements checklist of birds of the world*. Cornell University Press.

Colwell, R. K., & Coddington, J. A. (1994). Estimating terrestrial biodiversity through extrapolation. *Philosophical Transactions of the Royal Society of London, 345*, 101-118.

Daniels, R. J., Joshi, N. V., & Gadgil, M. (1992). On the relationship between bird and woody plant species diversity in the Uttara Kannada district of South India. *Proceedings of the National Academy of Sciences, 89*(12), 5311-5315.

Das, A. K. S. (2008). Bird community structure along the altitudinal gradient in Silent Valley National Park, Western Ghats, India (Doctoral dissertation). Bharathiar University, Coimbatore.

Haslem, A., & Bennett, A. F. (2008). Birds in agricultural mosaics: The influences of landscape pattern and countryside heterogeneity. *Ecological Applications, 18*, 185-196.

Jyothi, K. M., & Nameer, P. O. (2015). Birds of sacred groves of Northern Kerala, India. *Journal of Threatened Taxa, 7*(15), 8226-8036.

Kirby, J. S., Stattersfield, A. J., Butchart, S. H., Evans, M. I., Grimmett, R. F., Jones, V. R., & Newton, I. (2008). Key conservation issues for migratory land and water bird species on the world's major flyways. *Bird Conservation International, 18*(S1), S49-S73.

Kitahara, M. (2000). Food resource usage patterns of adult butterfly communities in woodland habitats at the northern foot of Mt. Fuji, central Japan. *Japanese with English summary*.

Mao, C. X., & Colwell, R. K. (2005). Estimation of species richness: Mixture models, the role of rare species, and inferential challenges. *Ecology, 86*(5), 1143-1153.

Margules, C. R., Davies, K. F., & Lawrence, J. F. (2000). Which traits of species predict population decline in experimental forest fragments? *Ecology, 81*, 1450-1461.

Nair, P. V., Ramachandran, K. K., Vijayan, V. S., Easa, P. S., & Balakrishnan, P. V. (1985). An ecological study in Periyar Tiger Reserve with special reference to wildlife. *Report, Kerala Forest Research Institute, Peechi*.

Nair, V. P., Ramachandran, K. K., & Jayson, E. A. (1997). Distribution of mammals and birds in Chinnar Wildlife Sanctuary. *Kerala Forest Research Institute Report, Peecjo, Thrissur*.

NEST. (1994). Checklist of birds of Parambikulam. Accessed on June 12, 2005. http://www.parambikulam.org/assets/checklist/birds.pdf

Newton, I. (2003). Geographical patterns in bird migration. In P. Berthold, E. Gwinner, & E. Sonnenschein (Eds.), *Avian migration* (pp. 12-19). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-05957-9_14

O'Connor, R. J., & Shrubb, M. (1989). *Farming and birds*. Cambridge University Press.

Praveen, J., & Nameer, P. O. (2008). Bird diversity of Siruvani and Muthikulam Hills, Western Ghats, Kerala. *Indian Birds, 3*(6), 210–217.

Rahman, T. R. S. (2004). Effects of landscape matrix and plantation on birds in tropical rainforest fragments of the Western Ghats, India. *CERC Technical Report No. 9*. Nature Conservation Foundation, Mysore, India.

Rajesh, M., Gangadharan, A., Kishore, R., & Ganapathi, S. (2021). Avian diversity in Manjamalai Sacred Grove, Madurai District, Tamil Nadu, India. *Journal of Science and Technology, 6*(4), 110-122.

Raman, T. R. S. (2003). Assessment of census techniques for inter-specific comparison of tropical rainforest bird densities: A field evaluation in the Western Ghats, India. *Ibis, 145*, 9-21.

Raman, T. R. S. (2006). Effects of habitat structure and adjacent habitats on birds in tropical rainforest fragments and shaded plantation in the Western Ghats, India. *Biodiversity and Conservation, 15*, 1577-1607.

Raman, T. R. S., & Sukumar, R. (2002). Responses of tropical rainforest birds to abandoned plantations, edges, and logged forest in the Western Ghats, India. *Animal Conservation, 5*, 199-216.

Ramesh, V., Gopalakrishna, T., Barve, S., & Melnick, D. J. (2017). IUCN greatly underestimates the threat level of endemic birds in the Western Ghats. *Biological Conservation, 210*, 205-221.

Someville, M., Manica, A., Butchart, S. H., & Rodrigues, A. S. (2013). Mapping global diversity patterns for migratory birds. *PLoS ONE, 8*(8), e70907.

Vellend, M., Cornwell, W. K., Magnuson-Ford, K., & Mooers, A. (2011). Measuring phylogenetic biodiversity. *Biological Diversity: Frontiers in Measurement and Assessment, 14*, 194-207.

Vijayan, L., Prasad, S. N., Balasubramanian, P., Gokula, V., Ramachandran, N. K., Stephen, D., & Mahajan, M. V. (1998). Impact of human interference on the plant and bird communities in the Nilgiri Biosphere Reserve. In R. K. Maikhuri, K. S. Rao, & R. K. Rai (Eds.), *Biosphere reserves and management in India* (Proc. Workshop, June 11-15, 1997, Joshimath, UP, pp. 155-162). GB Pant Institute of Himalayan Environment & Development, Almora, UP.

Williams, C. B. (1964). *Patterns in the balance of nature*. Academic Press.

Zaibin, A. P. (2005). Vertical stratification and community structure of birds in the southern Western Ghats: A study in forest and plantation (MSc. thesis). Department of Wildlife Sciences, Aligarh Muslim University, India.

APPENDIX

Appendix 1. Bird species recorded in Theni forest division during 2022-2023

S. No	Family	Common Name	Scientific Name	Resident Status	IUCN
1	Accipitridae	Black eagle	*Ictinaetus malaiensis*	R	LC
2	Accipitridae	Black-winged kite	*Elanus caeruleus*	R	LC
3	Accipitridae	Brahminy kite	*Haliastur indus*	R	LC
4	Accipitridae	Changeable hawk-eagle	*Nisaetus cirrhatus*	R	LC
5	Accipitridae	Crested goshawk	*Accipiter trivirgatus*	R	LC
6	Accipitridae	Crested serpent eagle	*Spilornis cheela*	R	LC
7	Accipitridae	Lesser fish eagle	*Icthyophaga humilis*	R	NT
8	Accipitridae	Pallid harrier	*Circus macrourus*	R	NT
9	Accipitridae	Shikra	*Accipiter badius*	R	LC
10	Accipitridae	Steppe eagle	*Aquila nipalensis*	WV	EN
11	Accipitridae	White-tailed eagle	*Haliaeetus albicilla*	WV	LC
12	Acrocephalidae	Clamorous reed warbler	*Acrocephalus stentoreus*	R	LC
13	Aegithinidae	Common iora	*Aegithina tiphia*	R	LC
14	Alaudidae	Indian bush lark	*Mirafra erythroptera*	R	LC
15	Alcedinidae	White-throated kingfisher	*Halcyon smyrnensis*	R	LC
16	Alcippeidae	Brown-cheeked fulvetta	*Alcippe poioicephala*	R	LC
17	Anatidae	Garganey	*Spatula querquedula*	WV	LC
18	Anatidae	Indian spot-billed duck	*Anas poecilorhyncha*	R	LC
19	Anhingidae	Oriental darter	*Anhinga melanogaster*	RM	NT
20	Apodidae	Little swift	*Apus affinis*	RM	LC
21	Apodidae	White-rumped spinetail	*Zoonavena sylvatica*	R	LC
22	Ardeidae	Cattle egret	*Bubulcus ibis*	RM	LC
23	Ardeidae	Great bittern	*Botaurus stellaris*	R	LC
24	Ardeidae	Great egret	*Ardea alba*	R	LC
25	Ardeidae	Grey heron	*Ardea cinerea*	RM	LC
26	Ardeidae	Indian pond heron	*Ardeola grayii*	R	LC
27	Ardeidae	Intermediate egret	*Ardea intermedia*	R	LC
28	Ardeidae	Little egret	*Egretta garzetta*	R	LC
29	Ardeidae	Purple heron	*Ardea purpurea*	RM	LC
30	Ardeidae	Striated heron	*Butorides striata*	R	LC
31	Ardeidae	Western reef heron	*Egretta gularis*	R	LC
32	Ardeidae	White-bellied heron	*Ardea insignis*	R	CR
33	Artamidae	Ashy woodswallow	*Artamus fuscus*	R	LC
34	Bucerotidae	Great hornbill	*Buceros bicornis*	R	VU
35	Bucerotidae	Malabar grey hornbill*	*Ocyceros griseus**	R	VU
36	Campephagidae	Ashy minivet	*Pericrocotus divaricatus*	R	LC
37	Campephagidae	Black-headed cuckooshrike	*Lalage melanoptera*	RM	LC
38	Campephagidae	Orange minivet	*Pericrocotus flammeus*	R	LC
39	Campephagidae	Scarlet minivet	*Pericrocotus speciosus*	R	LC
40	Campephagidae	Small minivet	*Pericrocotus cinnamomeus*	R	LC
41	Chloropseidae	Jerdon's leafbird	*Chloropsis jerdoni*	R	LC
42	Chloropseidae	Golden-fronted leafbird	*Chloropsis aurifrons*	R	LC
43	Ciconiidae	Black-necked stork	*Ephippiorhynchus asiaticus*	R	NT
44	Ciconiidae	Painted stork	*Mycteria leucocephala*	RM	LC
45	Ciconiidae	White stork	*Ciconia ciconia*	WV	LC

S. No	Family	Common Name	Scientific Name	Resident Status	IUCN
46	Cisticolidae	Ashy prinia	*Prinia socialis*	R	LC
47	Cisticolidae	Common tailorbird	*Orthotomus sutorius*	R	LC
48	Cisticolidae	Grey-breasted prinia	*Prinia hodgsonii*	R	LC
49	Cisticolidae	Jungle prinia	*Prinia sylvatica*	R	LC
50	Columbidae	Common emerald dove	*Chalcophaps indica*	R	LC
51	Columbidae	Eurasian collared dove	*Streptopelia decaocto*	R	LC
52	Columbidae	Green imperial pigeon	*Ducula aenea*	R	NT
53	Columbidae	Laughing dove	*Spilopelia senegalensis*	R	LC
54	Columbidae	Rock Pigeon	*Columba livia*	R	LC
55	Columbidae	Spotted dove	*Spilopelia chinensis*	R	LC
56	Columbidae	Yellow-footed green pigeon	*Treron phoenicopterus*	R	LC
57	Coraciidae	Indian roller	*Coracias benghalensis*	RM	LC
58	Corvidae	Brown-necked raven	*Corvus ruficollis*	R	LC
59	Corvidae	House crow	*Corvus splendens*	R	LC
60	Corvidae	Indian jungle crow	*Corvus culminatus*	R	LC
61	Corvidae	Rufous treepie	*Dendrocitta vagabunda*	R	LC
62	Corvidae	White-bellied treepie*	*Dendrocitta leucogastra**	R	LC
63	Cuculidae	Asian koel	*Eudynamys scolopaceus*	R	LC
64	Cuculidae	Banded bay cuckoo	*Cacomantis sonneratii*	R	LC
65	Cuculidae	Chestnut-winged cuckoo	*Clamator coromandus*	R	LC
66	Cuculidae	Common hawk-cuckoo	*Hierococcyx varius*	R	LC
67	Cuculidae	Square-tailed drongo-cuckoo	*Surniculus lugubris*	R	LC
68	Cuculidae	Greater coucal	*Centropus sinensis*	R	LC
69	Cuculidae	Pied cuckoo	*Clamator jacobinus*	R	LC
70	Cuculidae	Sirkeer malkoha	*Taccocua leschenaultii*	R	LC
71	Cuculidae	Blue-faced malkoha	*Phaenicophaeus viridirostris*	R	LC
72	Dicaeidae	Nilgiri flowerpecker*	*Dicaeum concolor**	R	LC
73	Dicaeidae	Pale-billed flowerpecker	*Dicaeum erythrorhynchos*	R	LC
74	Dicaeidae	Thick-billed flowerpecker	*Dicaeum agile*	R	LC
75	Dicruridae	Ashy drongo	*Dicrurus leucophaeus*	RM	LC
76	Dicruridae	Black drongo	*Dicrurus macrocercus*	R	LC
77	Dicruridae	Bronzed drongo	*Dicrurus aeneus*	R	LC
78	Dicruridae	Crow-billed drongo	*Dicrurus annectens*	R	LC
79	Dicruridae	Greater racket-tailed drongo	*Dicrurus paradiseus*	R	LC
80	Dicruridae	Lesser racket-tailed drongo	*Dicrurus remifer*	R	LC
81	Dicruridae	White-bellied drongo	*Dicrurus caerulescens*	R	LC
82	Estrildidae	Chestnut munia	*Lonchura atricapilla*	R	LC
83	Estrildidae	Scaly-breasted munia	*Lonchura punctulata*	R	LC
84	Falconidae	Amur falcon	*Falco amurensis*	PM	LC
85	Hemiprocnidae	Crested treeswift	*Hemiprocne coronata*	R	LC
86	Hirundinidae	Dusky crag martin	*Ptyonoprogne concolor*	R	LC
87	Hirundinidae	Red-rumped swallow	*Cecropis daurica*	RM	LC
88	Hirundinidae	Wire-tailed swallow	*Hirundo smithii*	R	LC
89	Irenidae	Asian fairy-bluebird	*Irena puella*	R	LC
90	Laniidae	Brown shrike	*Lanius cristatus*	RM	LC
91	Lcteridae	Hooded oriole	*Icterus cucullatus*	R	LC

S. No	Family	Common Name	Scientific Name	Resident Status	IUCN
92	Leiothrichidae	Common babbler	*Argya caudata*	R	LC
93	Leiothrichidae	Jungle Babbler	*Argya striata*	R	LC
94	Leiothrichidae	Large grey babbler	*Argya malcolmi*	R	LC
95	Leiothrichidae	Palani laughingthrush*	*Montecincla fairbanki**	R	NT
96	Leiothrichidae	Wayanad laughingthrush*	*Pterorhinus delesserti**	R	LC
97	Leiothrichidae	Yellow-billed babbler	*Argya affinis*	R	LC
98	Megalaimidae	Brown-headed barbet	*Psilopogon zeylanicus*	R	LC
99	Megalaimidae	Coppersmith barbet	*Psilopogon haemacephalus*	R	LC
100	Megalaimidae	Malabar barbet*	*Psilopogon malabaricus**	R	LC
101	Megalaimidae	White-cheeked barbet	*Psilopogon viridis*	R	LC
102	Meropidae	Blue-tailed bee-eater	*Merops philippinus*	RM	LC
103	Meropidae	Blue-beared bee-eater	*Nyctyornis athertoni*	R	LC
104	Meropidae	Chestnut-headed bee-eater	*Merops leschenaulti*	R	LC
105	Meropidae	European bee-eater	*Merops apiaster*	WV	LC
106	Meropidae	Asian green bee-eater	*Merops orientalis*	R	LC
107	Monarchidae	Black-naped monarch	*Hypothymis azurea*	R	LC
108	Monarchidae	Indian paradise flycatcher	*Terpsiphone paradisi*	RM	LC
109	Motacillidae	White-browed wagtail	*Motacilla maderaspatensis*	R	LC
110	Motacillidae	White wagtail	*Motacilla alba*	RM	LC
111	Muscicapidae	Asian brown flycatcher	*Muscicapa dauurica*	RM	LC
112	Muscicapidae	Blue rock thrush	*Monticola solitarius*	RM	LC
113	Muscicapidae	Indian blue robin	*Larvivora brunnea*	RM	LC
114	Muscicapidae	Indian robin	*Copsychus fulicatus*	R	LC
115	Muscicapidae	Rusty-tailed Flycatcher	Ficedula ruficauda	WV	LC
116	Muscicapidae	Malabar whistling thrush	*Myophonus horsfieldii*	R	LC
117	Muscicapidae	Oriental magpie-robin	*Copsychus saularis*	R	LC
118	Muscicapidae	Tickell's blue-flycatcher	*Cyornis tickelliae*	R	LC
119	Muscicapidae	White-rumped shama	*Copsychus malabaricus*	R	LC
120	Muscicapidae	Bluethroat	Luscinia svecica	R	LC
121	Muscicapidae	Black-and-orange flycatcher*	*Ficedula nigrorufa**	R	LC
122	Nectariniidae	Crimson-backed sunbird*	*Leptocoma minima**	R	LC
123	Nectariniidae	Little spiderhunter	*Arachnothera longirostra*	R	LC
124	Nectariniidae	Loten's sunbird	*Cinnyris lotenius*	R	LC
125	Nectariniidae	Purple-rumped sunbird	*Leptocoma zeylonica*	R	LC
126	Nectariniidae	Purple sunbird	*Cinnyris asiaticus*	R	LC
127	Nectariniidae	Vigors's sunbird*	*Aethopyga vigorsii**	R	LC
128	Oriolidae	Black-hooded oriole	*Oriolus xanthornus*	R	LC
129	Oriolidae	Indian golden oriole	*Oriolus kundoo*	R	LC
130	Pandionidae	Osprey	*Pandion haliaetus*	R	LC
131	Paradoxornithidae	Yellow-eyed babbler	*Chrysomma sinense*	R	LC
132	Paridae	Cinereous tit	*Parus cinereus*	R	LC
133	Paridae	Great tit	*Parus major*	R	LC
134	Pelecanidae	Great white pelican	*Pelecanus onocrotalus*	WV	LC
135	Pelecanidae	Spot-billed Pelican	*Pelecanus philippensis*	RM	NT
136	Pellorneidae	Buff-breasted babbler	*Pellorneum tickelli*	R	LC

S. No	Family	Common Name	Scientific Name	Resident Status	IUCN
137	Pellorneidae	Puff-throated babbler	*Pellorneum ruficeps*	R	LC
138	Phalacrocoracidae	Great cormorant	*Phalacrocorax carbo*	R	LC
139	Phalacrocoracidae	Indian cormorant	*Phalacrocorax fuscicollis*	R	LC
140	Phalacrocoracidae	Little cormorant	*Microcarbo niger*	RM	LC
141	Phasianidae	Grey francolin	*Ortygornis pondicerianus*	R	LC
142	Phasianidae	Grey junglefowl	*Gallus sonneratii*	R	LC
143	Phasianidae	Indian peafowl	*Pavo cristatus*	R	LC
144	Phasianidae	Red junglefowl	*Gallus gallus*	R	LC
145	Phasianidae	King quail	*Synoicus chinensis*	R	LC
146	Phasianidae	Painted spurfowl	*Galloperdix lunulata*	R	LC
147	Phylloscopidae	Green warbler	*Phylloscopus nitidus*	R	LC
148	Phylloscopidae	Greenish warbler	*Phylloscopus trochiloides*	WV	LC
149	Phylloscopidae	Large-billed leaf warbler	*Phylloscopus magnirostris*	WV	LC
150	Phylloscopidae	Tickell's leaf warbler	*Phylloscopus affinis*	R	LC
151	Picidae	Brown-capped pygmy woodpecker	*Yungipicus nanus*	R	LC
152	Picidae	Greater flamback	*Chrysocolaptes guttacristatus*	R	LC
153	Picidae	Heart-spotted woodpecker	*Hemicircus canente*	R	LC
154	Picidae	Rufous woodpecker	*Micropternus brachyurus*	R	LC
155	Picidae	Streak-throated woodpecker	*Picus xanthopygaeus*	R	LC
156	Picidae	White-naped woodpecker	*Chrysocolaptes festivus*	R	LC
157	Picidae	Yellow-crowned woodpecker	*Leiopicus mahrattensis*	R	LC
158	Picidae	Black-rumped flameback	*Dinopium benghalense*	R	LC
159	Picidae	Common flameback	*Dinopium javanense*	R	LC
160	Ploceidae	Baya weaver	*Ploceus philippinus*	R	LC
161	Podicipedidae	Black-necked grebe	*Podiceps nigricollis*	R	LC
162	Podicipedidae	Little grebe	*Tachybaptus ruficollis*	R	LC
163	Podicipedidae	Red-necked grebe	*Podiceps grisegena*	R	LC
164	Psittaculidae	Malabar parakeet*	*Psittacula columboides**	R	LC
165	Psittaculidae	Plum-headed parakeet	*Psittacula cyanocephala*	R	LC
166	Psittaculidae	Rose-ringed parakeet or ringneck parrot	*Psittacula krameri*	R	LC
167	Psittaculidae	Vernal hanging parrot	*Loriculus vernalis*	R	LC
168	Pycnonotidae	Flame-throated bulbul*	*Rubigula gularis**	R	LC
169	Pycnonotidae	Red-vented bulbul	*Pycnonotus cafer*	R	LC
170	Pycnonotidae	Red-whiskered bulbul	*Pycnonotus jocosus*	R	LC
171	Pycnonotidae	Square-tailed bulbul	*Hypsipetes ganeesa*	R	LC
172	Pycnonotidae	White-browed bulbul	*Pycnonotus luteolus*	R	LC
173	Pycnonotidae	Yellow-browed bulbul	*Acritillas indica*	R	LC
174	Pycnonotidae	Yellow-throated bulbul	*Pycnonotus xantholaemus*	R	VU
175	Rallidae	Common moorhen	*Gallinula chloropus*	R	LC

S. No	Family	Common Name	Scientific Name	Resident Status	IUCN
176	Rallidae	Eurasian coot	*Fulica atra*	R	LC
177	Rallidae	Western swamphen	*Porphyrio porphyrio*	R	LC
178	Rallidae	White-breasted waterhen	*Amaurornis phoenicurus*	R	LC
179	Recurvirostridae	Black-winged stilt	*Himantopus himantopus*	R	LC
180	Scolopacidaeidae	Broad-billed sandpiper	*Calidris falcinellus*	WV	VU
181	Stenostiridae	Grey-headed canary-flycatcher	*Culicicapa ceylonensis*	R	LC
182	Strigidae	Jungle owlet	*Glaucidium radiatum*	R	LC
183	Sturnidae	Common hill myna	*Gracula religiosa*	R	LC
184	Sturnidae	Common myna	*Acridotheres tristis*	R	LC
185	Sturnidae	Golden-crested myna	*Ampeliceps coronatus*	R	LC
186	Sturnidae	Jungle myna	*Acridotheres fuscus*	R	LC
187	Sturnidae	Malabar starling*	*Sturnia blythii**	R	LC
188	Sturnidae	Southern hill myna	*Gracula indica*	R	LC
189	Threskiornithidae	Black-headed ibis	*Threskiornis melanocephalus*	R	NT
190	Threskiornithidae	Eurasian spoonbill	*Platalea leucorodia*	R	LC
191	Threskiornithidae	Red-naped ibis	*Pseudibis papillosa*	R	LC
192	Timaliidae	Dark-fronted babbler	*Dumetia atriceps*	R	LC
193	Timaliidae	Indian scimitar babbler	*Pomatorhinus horsfieldii*	R	LC
194	Trogonidae	Malabar trogon	*Harpactes fasciatus*	R	LC
195	Upupidae	Common hoopoe	*Upupa epops*	R	LC
196	Vangidae	Malabar woodshrike*	*Tephrodornis sylvicola**	R	LC
197	Zosteropidae	Indian white-eye	*Zosterops palpebrosus*	R	LC

** Endemic, CR – Critically endangered, VU – Vulnerable, NT – Near threatened, LC – Least concern, R – Resident, RM – Residential migrant, PM – Partial migrant, WV – Winter visitor*

Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.mbimph.com/review-history/4420