Indian Journal of Ecology (2025) 52(5): 1036-1044
DOI: https://doi.org/10.55362/IJE/2025/4612

Manuscript Number: 4612
NAAS Rating: 5.38

Avian Species Richness and Feeding Guild Patterns in Urban Lakes of Mysore, Southern India

Hebbal Rajendra Abhilash and Charles Sylvester[1]

Department of Zoology, Yuvaraja's College (Autonomous), University of Mysore, Mysore-570 005, India
[1]Unit for Human Genetics, All India Institute of Speech and Hearing, Manasagangothri, Mysore-570 005, India
E-mail: abhilash2787@gmail.com

Abstract: This study investigates the avian diversity in two freshwater lakes, Hinkal Lake and Bogadi Lake, located in Mysore city of Karnataka, India. Both lakes are subjected to pollution from domestic waste and have distinct hydrological and vegetative characteristics. Data were collected from November 2024 to February 2025 through bi-monthly surveys, by total count method. A total of 2042 individual birds, representing 89 species across 17 orders and 41 families, were recorded. Bogadi Lake exhibited higher species diversity and evenness compared to Hinkal Lake, with notable species from families like Ardeidae, Accipitridae, and Sturnidae. The study identified eight feeding guilds, with carnivorous birds being dominant. Temporal changes in bird populations were linked to fluctuating water levels and increasing temperatures. The results highlight the importance of these urban lakes as critical habitats for migratory and resident birds, particularly in the winter season, and emphasize the role of vegetation and wetland features in shaping avian diversity.

Keywords: Bird diversity, Feeding guilds, Relative diversity index, Urbanization

Birds are an essential part of ecosystems, playing a significant role in the food chain and serving as key seed dispersers, pollinators, pest controllers, and bio-indicators of ecosystem health (Neelgund and Kadadevaru 2020). Presently, bird population diversity is on the decline due to a range of environmental disturbances and human actions. These include habitat loss caused by domestic and industrial effluents, agricultural runoff, wetland degradation, expansion of agriculture, overgrazing in grasslands, and urbanization (Grimmet et al., 2016). Avifaunal diversity is a crucial ecological indicator used to assess habitat quality (Ashwini and Vijaya Kumara 2023). Conserving species diversity is one of the key global priorities. As such, bird surveys are essential in formulating strategies for protecting endangered species.

Urbanization is one of the three main factors driving species extinction (Ordóñez-Delgado et al., 2022). The growing human population living in and around urban areas now makes up more than 50% of the global population (Ritchie et al., 2024). The increasing demand to house the growing human population in cities is accelerating the rate and extent of land conversion into urban areas (Seto et al., 2012). This trend has major implications for biodiversity and the survival of species in the remaining natural habitats (Tali et al., 2022). Studies on urban bird communities frequently explore the effects of natural environmental factors, including the characteristics of small-scale vegetation and the size and spatial distribution of natural habitat patches (Lawal and Iwajumo 2020). Urban bird communities are typically marked by low species richness and high overall density or biomass when compared to surrounding natural areas (Barth et al., 2015). Intermediate levels of suburban development are often linked to a peak in bird diversity, as both urban-avoiding native species and urban-adapted exotic species thrive in these areas, where abundant food and low predation pressure contribute to higher reproductive success and density (Patankar et al., 2021). Exploring the relationship between urban environments and avian habitats has significantly expanded our understanding, playing a crucial role in biodiversity conservation and ecosystem health monitoring (Tali et al., 2022). The present study was undertaken on species richness and diversity of various bird species of two urban wetlands of Mysore city to highlight the importance of urban water bodies in sustaining the bird population, despite rapid urbanization.

MATERIAL AND METHODS

Study area: The avian diversity was investigated in two freshwater lakes in the Mysore city of Karnataka state (Fig. 1). The Hinkal Lake (Lake 1) lies between 12˚31'73"N longitude " and 76˚59'95"E with a water-spread area of 11.5 acres bordered by dump yard and crematorium. The lake water is replenished by rainfall, surface runoff and sewage. However, it completely dries during summer season. The Bogadi Lake (Lake 2) lies between 12˚30'98"N longitude" and 76˚60'25"E latitude with a water-spread area of 19.9 acres. The lake is fed by direct rainfall, surface flow and sewage, which tend to dry moderately during the summer. It has a fair portion of submerged and floating vegetation (water hyacinth, water lettuce) that attracts plenteous migratory birds during post monsoon season. Both the lakes were

polluted with domestic waste and garbage. The predominant vegetation surrounding the lakes includes common lantana *(Lantana camara),* yellow trumpetbush *(Tecoma stans),* crown flower *(Calotropis gigantean),* peepal *(Ficus religiosa),* oil cake tree *(Albizzia amara)*, *Ficus* sp., and *Acacia* sp.

Bird survey: Data was collected from November 2024 to February 2025. Observation was taken twice a month. Birds were counted by total count method (Bibby et al., 2012) using Binocular (Olympus 8X40 and Pentax SP 8X40), which involves searching a designated area for a specific duration and recording the number of birds observed and heard. Calls of unsighted birds were recorded using Cornell Lab's Merlin Bird ID (Cornell University (Version 2.1.5)) and the checklist was uploaded on eBird app. The conservation status of the birds was derived from the IUCN Red List of Threatened Species (IUCN 2024). The recorded birds were classified into different feeding guilds according to their ecological food preferences, such as carnivore, insectivore, omnivore, granivore, frugivore, mixed guild, nectivore, and herbivore (Basnet et al., 2016, Grimmett et al., 2016, Jangral and Vashishat 2022).

Data analysis: The Paleontological Statistics (PAST) 4.03 educational software (Hammer et al., 2001) was used to measure various α-diversity indices such as Fisher's-α diversity, Shannon-Weiner index, and Evenness index for the summarised data for each habitat type. The relative diversity (RD_i) of each bird family was estimated (Torre-Cuadros et al., 2007).

$$RD_i = \frac{\text{Number of species in the family}}{\text{Total number of species}} \times 100$$

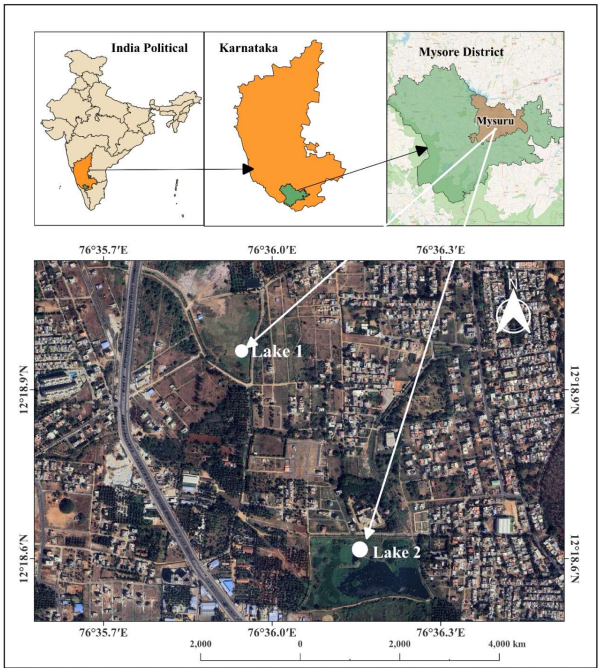

Fig. 1. Study area (Lake 1-Hinkal Lake, Lake 2- Bogadi Lake)

Sorensen's similarity index was performed to measure the similarity between the two water bodies (Magurran 2004):

$$C_s = \frac{2c}{a + b}$$

where 'a' is the number of species of birds found in Hinkal Lake, 'b' is the number of species found in Bogadi Lake and 'c' is the number of species found in both sites.

RESULTS AND DISCUSSION

Species diversity: In present study, 2042 individual birds, including 89 species, 17 orders, and 41 families, were recorded in the study area (Hinkal Lake - 981; Bogadi Lake - 1061) (Table 1, Fig. 2 & 3). The order Passeriformes is represented by the highest number of species (N = 35) and lowest was in the orders Strigiformes, Psittaciformes, and Podicipediformes, with a single species each. Among all recorded avian species, only one was in the vulnerable category, the Tawny Eagle (*Aquila rapax*); the rest were the least concerned species. The two areas had similar species composition, with a Sorenson index of 66% (Cs = 0.66) reflecting a very high similarity, which indicates that the species diversity is fairly similar across the habitats. In general, overall bird species diversity was higher in Bogadi Lake (H' = 3.243) than Hinkal Lake (H' = 2.88). Similarly, highest evenness index (J = 0.35) and Fisher's α-diversity index (17.79) was observed in Bogadi Lake as compared to Hinkal Lake (J = 0.30) and Fisher's α-diversity index (13.79). The relative diversity (RDi) among avian families revealed that three families Ardeidae, Accipitridae and Sturnidae had maximum relative diversity (4 species, RDi =6.78) in Hinkal Lake (Fig. 4) while Ardeidae family (6 species, RDi =8.11) followed by Rallidae, Threskiornithidae, and Accipitridae (4 species, RDi =5.41) recorded highest relative diversity index in Bogadi Lake (Fig. 5) representing dominant group. There was a gradual decline in the abundance of the bird population during different months of the study period (Fig. 6), which can be attributed to the receding water levels and an increase in temperature over time. The trophic composition of birds in this study showed that carnivorous birds dominated the feeding guild, followed by insectivorous, omnivorous, granivorous, frugivorous, nectivorous, herbivorous, and mixed guilds across both lakes (Fig. 7). Panda et al. (2021) also in their guild study, attributed that feeding guilds with a higher number of species also had a greater number of individuals. The studies on bird feeding guilds provide valuable insights into species ecology and are especially useful in identifying the specific ecological factors driving community changes (Jangral and Vashishat 2022). The identification of eight feeding guilds across both lakes suggests a clear trophic segregation within the community,

Table 1. Checklist of bird species recorded during the study period, with their common name, scientific name, order, family, IUCN status, and feeding guild

Order/Family	Common name	Scientific name	IUCN status	Food habit
1. Order – Galliformes				
Phasianidae	Gray Francolin	*Ortygornis pondicerianus* (Gmelin, 1789)	LC	I
Phasianidae	Indian Peafowl	*Pavo cristatus* (Linnaeus, 1758)	LC	O
2. Order – Anseriformes				
Anatidae	Indian Spot-billed Duck	*Anas poecilorhyncha* (Foster, 1781)	LC	H
Anatidae	Northern Shoveler	*Spatula clypeata* (Linnaeus, 1758)	LC	O
Anatidae	Garganey	*Spatula querquedula* (Linnaeus, 1758)	LC	O
3. Order – Apodiformes				
Apodidae	Alpine Swift	*Tachymarptis melba* (Linnaeus, 1758)	LC	I
Apodidae	Asian Palm Swift	*Cypsiurus balasiensis* (J.E. Gray, 1829)	LC	I
4. Order – Cuculiformes				
Cuculidae	Greater Coucal	*Centropus sinensis* (Stephens, 1851)	LC	C
Cuculidae	Asian Koel	*Eudynamys scolopaceus* (Linnaeus, 1758)	LC	I
Cuculidae	Blue-faced Malkoha	*Phaenicophaeus viridirostris* (Jerdon, 1840)	LC	I
5. Order – Columbiformes				
Columbidae	Rock Pigeon (Feral Pigeon)	*Columba livia* (Gmelin, 1789)	LC	O
Columbidae	Spotted Dove	*Spilopelia chinensis* (Scopoli, 1786)	LC	G
Columbidae	Eurasian Collared-Dove	*Streptopelia decaocto* (Frivaldszky,1838)	LC	G
6. Order – Gruiformes				
Rallidae	Eurasian Coot	*Fulica atra* (Linnaeus, 1758)	LC	O
Rallidae	Eurasian Moorhen	*Gallinula chloropus* (Linnaeus, 1758)	LC	O
Rallidae	Gray-headed Swamphen	*Porphyrio poliocephalus* (Latham, 1801)	LC	O
Rallidae	White-breasted Waterhen	*Amaurornis phoenicurus* (Pennant, 1769)	LC	O
7. Order – Podicipediformes				
Podicipedidae	Little Grebe	*Tachybaptus ruficollis* (Pallas, 1764)	LC	O
8. Order – Charadriiformes				
Charadriidae	Little Ringed Plover	*Charadrius dubius* (Scopoli, 1786)	LC	I
Charadriidae	Red-wattled Lapwing	*Vanellus indicus* (Boddaert, 1783)	LC	MG
Charadriidae	Yellow-wattled Lapwing	*Vanellus malabaricus* (Boddaert, 1783)	LC	I
Recurvirostridae	Black-winged Stilt	*Himantopus himantopus* (Linnaeus, 1758)	LC	C
Jacanidae	Bronze-winged Jacana	*Metopidius indicus* (Latham, 1790)	LC	C
Scolopacidae	Common Sandpiper	*Actitis hypoleucos* (Linnaeus, 1758)	LC	C
Scolopacidae	Wood Sandpiper	*Tringa glareola* (Linnaeus, 1758)	LC	C
Scolopacidae	Green Sandpiper	*Tringa ochropus* (Linnaeus, 1758)	LC	C
9. Order – Ciconiiformes				
Ciconiidae	Painted Stork	*Mycteria leucocephala* (Pennant, 1769)	LC	C
10. Order – Suliformes				
Phalacrocoracidae	Indian Cormorant	*Phalacrocorax fuscicollis* (Stephens, 1826)	LC	C
Phalacrocoracidae	Little Cormorant	*Microcarbo niger* (Vieillot, 1817)	LC	C
Anhingidae	Oriental Darter	*Anhinga melanogaster* (Pennant, 1769	LC	C
11. Order – Pelecaniformes				
Ardeidae	Indian Pond-Heron	*Ardeola grayii* (Sykes, 1832)	LC	C

Cont...

Table 1. Checklist of bird species recorded during the study period, with their common name, scientific name, order, family, IUCN status, and feeding guild

Order/Family	Common name	Scientific name	IUCN status	Food habit
Ardeidae	Little Egret	*Egretta garzetta* (Linnaeus, 1766)	LC	C
Ardeidae	Medium Egret	*Ardea intermedia* (Wagler, 1829)	LC	C
Ardeidae	Eastern Cattle-Egret	*Ardea coromanda* (Boddaert, 1783)	LC	C
Ardeidae	Gray Heron	*Ardea cinerea* (Linnaeus, 1758)	LC	C
Ardeidae	Purple Heron	*Ardea purpurea* (Linnaeus, 1766)	LC	C
Threskiornithidae	Red-naped Ibis	*Pseudibis papillosa* (Temminck, 1824)	LC	C
Threskiornithidae	Black-headed Ibis	*Threskiornis melanocephalus* (Latham, 1790)	LC	C
Threskiornithidae	Eurasian Spoonbill	Platalea leucorodia (Linnaeus, 1758)	LC	C
Threskiornithidae	Glossy Ibis	Plegadis falcinellus (Linnaeus, 1766)	LC	C
12. Order – Accipitriformes				
Accipitridae	Black Kite	*Milvus migrans* (Boddaert, 1783)	LC	C
Accipitridae	Brahminy Kite	*Haliastur indus* (Boddaert, 1783)	LC	C
Accipitridae	Oriental Honey-buzzard	*Pernis ptilorhynchus* (Temminck, 1821)	LC	C
Accipitridae	Tawny Eagle	*Aquila rapax* (Temminck, 1828)	VU	C
Accipitridae	Shikra	*Tachyspiza badia* (Gmelin,1788)	LC	C
13. Order – Strigiformes				
Strigidae	Brown boobook	*Ninox scutulata* (Raffles, 1822)	LC	C
14. Order – Coraciiformes				
Alcedinidae	White-throated Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	LC	C
Alcedinidae	Common Kingfisher	*Alcedo atthis* (Linnaeus, 1758)	LC	C
Meropidae	Green Bee-eater	*Merops orientalis* (Latham, 1801)	LC	I
Meropidae	Blue-tailed Bee-eater	*Merops philippinus* (Latham, 1767	LC	I
15. Order – Piciformes				
Megalaimidae	White-cheeked Barbet	*Psilopogon viridis* (Boddaert, 1783)	LC	F
Megalaimidae	Coppersmith Barbet	*Psilopogon haemacephalus* (Müller, 1776)	LC	F
Picidae	Black-rumped Flameback	*Dinopium benghalense* (Linnaeus, 1758)	LC	I
16. Order – Psittaciformes				
Psittaculidae	Rose-ringed Parakeet	*Psittacula krameri* (Scopoli, 1769)	LC	F
17. Order – Passeriformes				
Cisticolidae	Ashy Prinia	*Prinia socialis* (Sykes, 1832)	LC	I
Cisticolidae	Common Tailorbird	*Orthotomus sutorius* (Pennant, 1769)	LC	I
Cisticolidae	Zitting Cisticola	*Cisticola juncidis* (Rafinesque, 1810)	LC	I
Paridae	Cinereous Tit	*Parus cinereus* (Vieillot, 1818)	LC	I
Acrocephalidae	Booted Warbler	*Iduna caligata* (Lichtenstein, 1823)	LC	I
Corvidae	House Crow	*Corvus splendens* (Vieillot, 1817)	LC	O
Dicaeidae	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos* (Latham, 1790	LC	N
Dicruridae	Black Drongo	*Dicrurus macrocercus* (Vieillot, 1817	LC	I
Hirundinidae	Red-rumped Swallow	*Cecropis daurica* (Laxmann, 1769)	LC	I
Hirundinidae	Barn Swallow	*Hirundo rustica* (Linnaeus, 1758)	LC	I
Motacillidae	Grey Wagtail	*Motacilla cinerea* (Tunstall, 1771)	LC	I
Motacillidae	Paddyfield Pipit	*Anthus rufulus* (Vieillot, 1818)	LC	I
Motacillidae	White-browed Wagtail	*Motacilla maderaspatensis* (Gmelin, 1789)	LC	I

Cont...

Table 1. Checklist of bird species recorded during the study period, with their common name, scientific name, order, family, IUCN status, and feeding guild

Order/Family	Common name	Scientific name	IUCN status	Food habit
Motacillidae	Western Yellow Wagtail	*Motacilla flava* (Linnaeus, 1758)	LC	I
Muscicapidae	Indian Robin	*Copsychus fulicatus* (Linnaeus, 1766)	LC	I
Muscicapidae	Oriental Magpie-Robin	*Copsychus saularis* (Linnaeus, 1758)	LC	I
Muscicapidae	Pied Bushchat	*Saxicola caprata* (Linnaeus, 1766)	LC	I
Nectariniidae	Purple Sunbird	*Cinnyris asiaticus* (Latham, 1790)	LC	N
Nectariniidae	Purple-rumped Sunbird	*Leptocoma zeylonica* (Linnaeus, 1766)	LC	N
Laniidae	Brown Shrike	*Lanius cristatus* (Linnaeus, 1758)	LC	C
Laniidae	Long-tailed Shrike	*Lanius schach* (Linnaeus, 1758)	LC	C
Alaudidae	Jerdon's Bushlark	*Plocealauda affinis* (Blyth, 1845)	LC	I
Leiothrichidae	Yellow-billed Babbler	*Argya affinis* (Jerdon, 1845)	LC	O
Leiothrichidae	Large Gray Babbler	*Argya malcolmi* (Sykes,1832)	LC	O
Passeridae	House Sparrow	*Passer domesticus* (Linnaeus, 1758)	LC	G
Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer* (Linnaeus, 1766)	LC	O
Pycnonotidae	Red-whiskered Bulbul	*Pycnonotus jocosus* (Linnaeus, 1758)	LC	O
Pycnonotida	White-browed Bulbul	*Pycnonotus luteolus* (Lesson, 1841)	LC	O
Estrildidae	White-rumped Munia	*Lonchura striata* (Linnaeus, 1766)	LC	G
Estrildidae	Scaly-breasted Munia	*Lonchura punctulate* (Linnaeus, 1758)	LC	G
Rhipiduridae	Spot-breasted Fantail	*Rhipidura albogularis* (Lesson, 1831)	LC	I
Sturnidae	Chestnut-tailed Starling	*Sturnia malabarica* (Gmelin, 1789)	LC	O
Sturnidae	Rosy Starling	*Pastor roseus* (Linnaeus, 1758)	LC	O
Sturnidae	Common Myna	*Acridotheres tristis* (Linnaeus, 1766)	LC	O
Sturnidae	Jungle Myna	*Acridotheres fuscus* (Wagler, 1872)	LC	O

Abbreviations: IUCN – International Union for Conservation of Nature Status, LC – Least Concern, VU – Vulnerable. Key: C (Carnivore), F (Frugivore), G (Granivore), I (Insectivore), MG (Mixed Guild), N (Nectarivore), O (Omnivore), H (Herbivore)

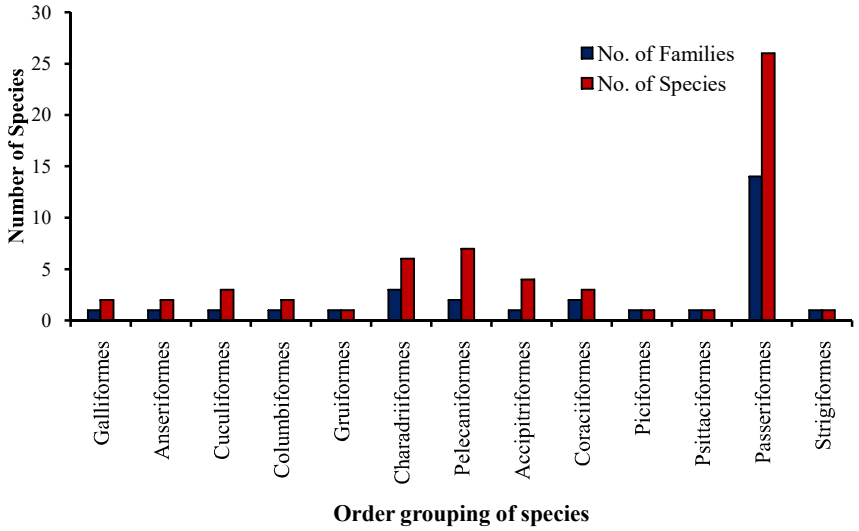

Fig. 2. Bird orders and number of species in Hinkal Lake

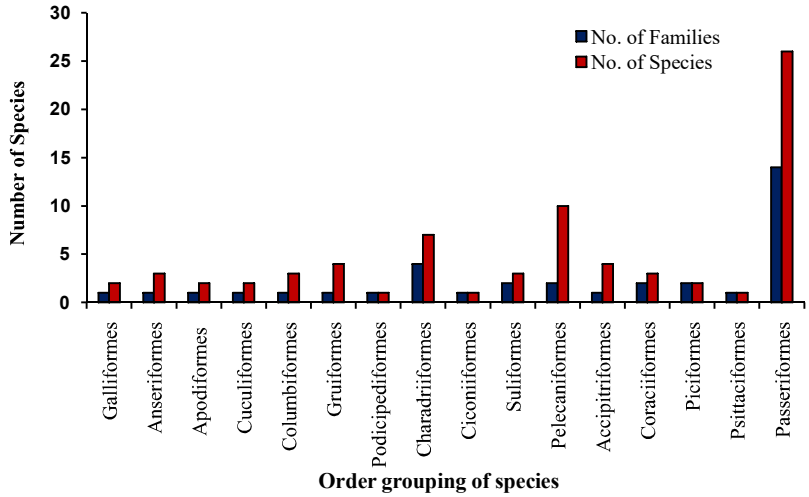

Fig. 3. Bird orders and number of species in Bogadi Lake

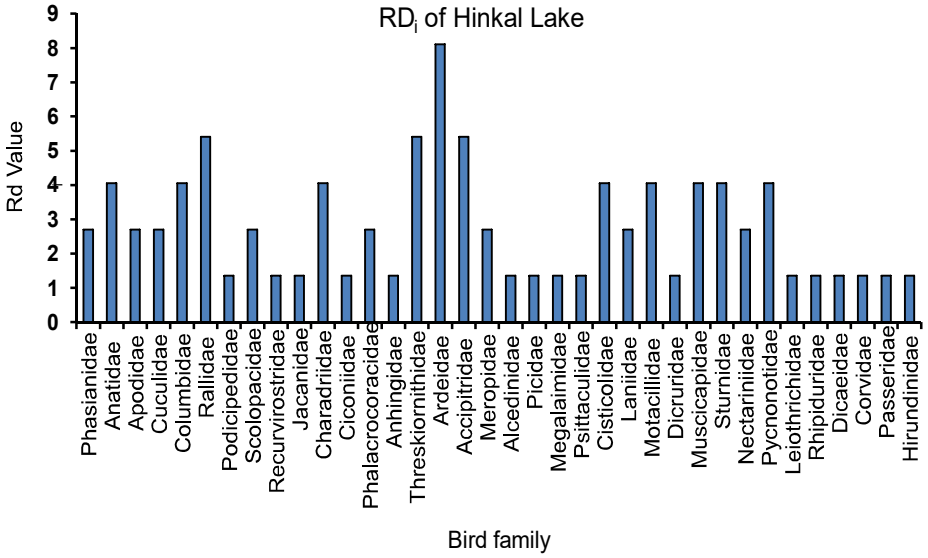

Fig. 4. Relative diversity (RD_i) of various bird families recorded from Hinkal Lake, Mysore, India

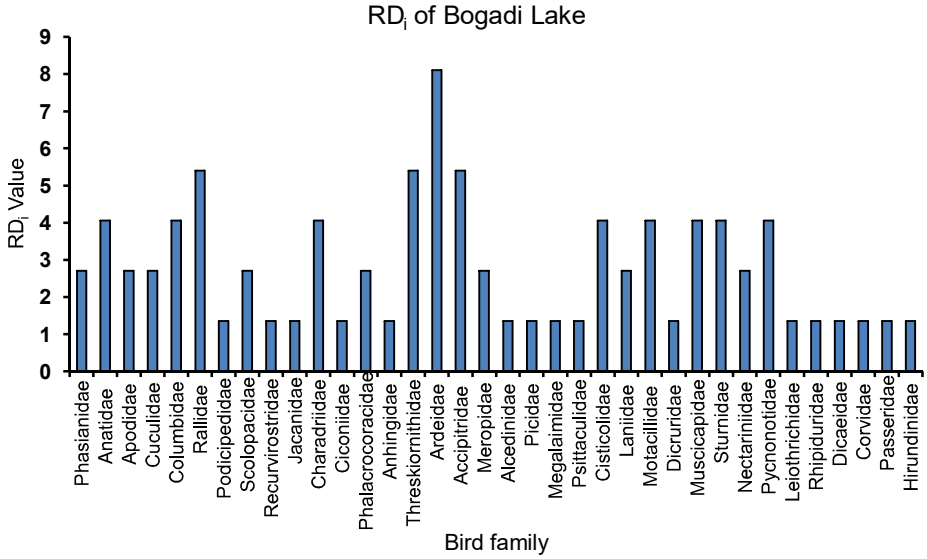

Fig. 5. Relative diversity (RD_i) of various bird families recorded from Bogadi Lake, Mysore, India

with species utilizing a range of food sources through various behavioural strategies and morphological adaptations (Rajpar et al., 2018).

The diversity and spatio-temporal distribution of bird species are influenced by the type of vegetation and the characteristics of the wetlands such as water depth, water quality and habitat structure (Malik and Joshi 2013, Choudaj and Wankhade 2023). Furthermore, species composition is shaped by the arrival of migratory species and the presence of resident species; migratory species tend to maintain more specialized niches in their wintering habitats and may be less tolerant of human disturbance and habitat changes in urban environments (Leveau et al., 2021).

Wetland birds were observed to choose aquatic habitats based on their needs for feeding, nesting, hiding, and breeding (Jamakhandi and Kadadevaru 2024). Birds from the order Anseriformes, such as the Indian Spot-billed Duck, Northern Shoveler, and Garganey, favoured open, deep-water zones with submerged vegetation. These species steered clear of dense emergent vegetation due to limited movement and decreased foraging efficiency in those areas

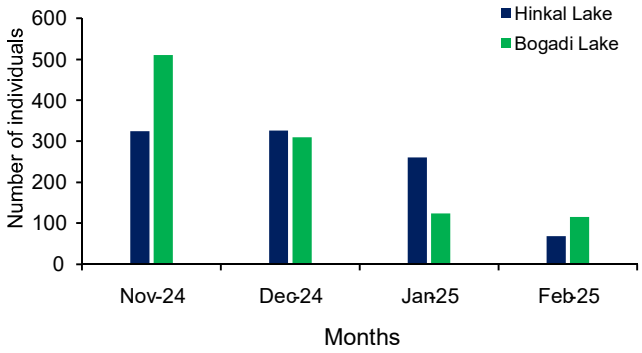

Fig. 6. Monthly variation in number of individuals observed during the study period

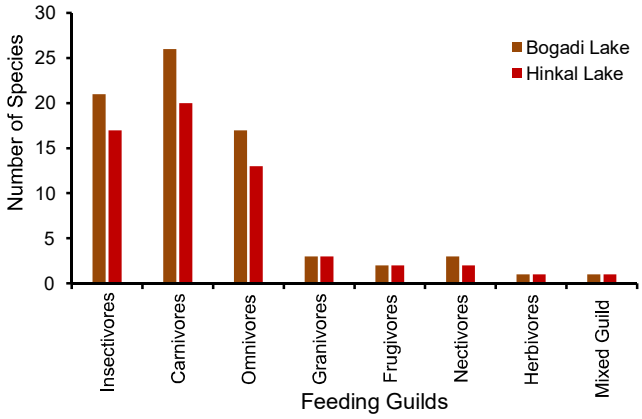

Fig. 7. Feeding guilds of bird species in Hinkal Lake (Lake 1) and Bogadi Lake (Lake 2)

Fig. 8. Black-winged Stilt (*Himantopus himantopus)*

Fig. 9. Red-wattled Lapwing (*Vanellus indicus)*

(Ramamurthy and Rajakumar, 2014, Sekhon et al., 2023). Wading birds like herons, egrets, painted storks, ibises, and spoonbills were restricted to shallow waters and marshes, as deep water has been shown to reduce the availability and accessibility of invertebrates for feeding (Kumar 2021). Shorebirds such as lapwings, stilts, jacanas, plovers, sandpipers, and wagtails were restricted to the edges of the ponds. Interestingly, we recorded a high abundance of Black-winged Stilt (Fig. 8) and Red-wattled Lapwing (Fig. 9) in both the water bodies, suggesting their rapid adaptation to the urban conditions (Muralidhar and Barve 2013). The spotted multiple breeding pairs of Red-wattled Lapwings, along with their chicks, through the shores of both water bodies was also observed. Numerous studies have emphasized that the shallow shores of lakes, particularly those with islands, provide ideal breeding sites for Lapwings (Muralidhar and Barve 2013, Elhassan et al., 2021). The dominance of the order Passeriformes could be attributed to the diverse vegetation. The shrubs and trees provide a variety of flowers and fruits, attracting a broad range of insects, which, along with the berries, serve as the primary food sources for these birds (Kukreti 2021). Additionally, the vegetation provided shelter from predators and harsh weather, as well as suitable

nesting spots (Rajpar and Zakaria 2011,Sharma and Tripathi,2023).

In general, lakes in urban areas play a crucial role as feeding and breeding grounds for birds. The presence of water birds can be an indicator of the health of water ecosystems, as their numbers often reflect the quality of wetland habitats (Green and Elmberg, 2014). Other studies have reported similar findings (Bachheti et al., 2023, Awash and Tekalign 2023, Mishra et al., 2024). This research highlighted that the studied habitats provide suitable feeding and roosting areas for migrating and resident birds, particularly during the winter season.

CONCLUSION

Hinkal Lake and Bogadi Lake are highly productive avian habitats, supporting a wide range of bird species. A total of 89 bird species were recorded during the winter season across both lakes. Although, the lakes currently support various bird populations, anthropogenic activities in the vicinity are reducing the available habitat for birds, which could significantly impact their abundance and the long-term survival of the water bodies in the area. The greater diversity of birds observed in this study in close proximity to human settlements implies that land-use patterns can be optimized in urban landscape planning to support resident bird species while maintaining the richness of local indigenous species.

REFERENCES

Ashwini R and Vijaya Kumara 2023. Status, diversity and conservation of Avifauna at Turahalli Minor Forest, Bangalore, Karnataka, India. *Advances in Zoology and Botany* **11**(4): 257-269.

Awash N and Tekalign W 2023. Comparison of bird assemblage structures and diversity patterns between seasons among two Ethiopian wetlands. *BMC Zoology* **8**(1): 3.

Bachheti A, Arya AK, Tyagi S and Deepti 2023. An Assessment of Wetland and Water-Dependent Avifaunal Diversity in Selected Wetlands of Uttarakhand, Western Himalayas, India. *Biology Bulletin* **50**(4): 729-735.

Barth BJ, FitzGibbon SI and Wilson RS 2015. New urban developments that retain more remnant trees have greater bird diversity. *Landscape and Urban Planning* **136**: 122-129.

Basnet TB, Rokaya MB, Bhattarai BP and Münzbergová Z 2016. Heterogeneous Landscapes on Steep Slopes at Low Altitudes as Hotspots of Bird Diversity in a Hilly Region of Nepal in the Central Himalayas. *PloS One* **11**(3).

Bibby CJ, Burgess ND and Hill DA 2012. *Bird Census Techniques*. 2nd edition. Academic Press, London. 93-303.

Choudaj K and Wankhade V 2023. Study of the interrelationship between woody plants and birds in Pune urban area, insights on negative impacts of exotic plants. *Tropical Ecology* **64**(2): 264-275.

Cornell Lab of Ornithology 2023. *Merlin Bird ID* (Version 2.1.5) [Mobile application software]. Cornell University, retrieved from Play Store

Elhassan EE, Sládeček M, Badaam S, Brynychová K, Chajma P, Firlová V, Janatová V, Kubelka V, Pešková L, Vozabulová E and Almuhery A 2021. An artificial lakes system intended for human recreation supports a vital breeding population of Red-wattled Lapwing in the Arabian Desert. *Avian Conservation & Ecology* **16**(2).

Green AJ and Elmberg J 2014. Ecosystem services provided by waterbirds. *Biological Reviews* **89**(1): 105-122.

Grimmett R, Inskipp C and Inskipp T 2016. *Birds of the Indian Subcontinent: India, Pakistan, Sri Lanka, Nepal, Bhutan, Bangladesh and the Maldives*. Bloomsbury Publishing.

Hammer Ø, Harper DAT and Ryan PD 2001. Past: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica* **4**(1): 1.

IUCN 2024. The IUCN red list of threatened species. Version 2024-2.

Jamakhandi H and Kadadevaru GG, 2024. Avifaunal diversity and feeding guild structure in and around Unkal Lake: A Semiarid Urban Wetland in Karnataka, India. *Indian Journal of Ecology* **51**(2): 453-467.

Jangral S and Vashishat N 2022. Feeding guild structure of birds at Keshopur Chhamb wetland, Gurdaspur. *Indian Journal of Entomology* 1-6. https://doi.org/10.55446/IJE.2021.391

Kukreti M 2021. Patterns of forest bird assemblages and feeding guild structure in lesser Garhwal Himalayas, Uttarakhand, India. *Indian Journal of Ecology* **48**(1): 128-137.

Kumar P 2021. Avifaunal diversity from Shahpur campus of the central university, Himachal Pradesh India. *Indian Journal of Ecology* **48**(1):138-146.

Lawal SO and Iwajumo SB 2020. The assessment of avifaunal potential of lagos state urban green spaces. *Journal of Reproduction and Development* **19**(1): 382-394.

Leveau LM, Jokimäki J and Kaisanlahti-Jokimäki ML 2021. Urbanization buffers seasonal change in composition of bird communities: A multi-continental meta-analysis. *Journal of Biogeography* **48**(10): 2391-2401.

Magurran AE 2004. *Measuring biological diversity*. Blackwell Publishers, Oxford., 76-78.

Malik DS and Joshi N 2013. Habitat selection pattern of migratory avifauna in relation to nutrients in Asan wetland at Doon Valley (Garhwal Himalaya), India. *International Journal of Recent Scientific Research* **4**(10): 1470-1475.

Mishra H, Bano F, Prateek, Mishra A, Kumar A and Kumar V 2024. Elucidation of Diversity and Habitat Utilization of Waterbirds in Khajuha Wetland, Northern India. *Biology Bulletin* **51**(3): 800-812.

Muralidhar A and Barve S 2013. Peculiar choice of nesting of Red-wattled Lapwing Vanellus indicus in an urban area in Mumbai, Maharashtra. *Indian Birds* **8**(1): 6-9.

Neelgund HD and Kadadevaru G 2020. Avifaunal diversity of some selected water bodies of Khanapur Taluka, Belagavi District, Karnataka, India. *Journal of Threatened Taxa* **12**(5): 15572-15586.

Ordóñez-Delgado L, Iñiguez-Armijos C, Díaz M, Escudero A, Gosselin E, Waits LP and Espinosa CI 2022. The good, the bad, and the ugly of urbanization: Response of a bird community in the neotropical Andes. *Frontiers in Ecology and Evolution* **10:** 844944.

Panda BP, Prusty BAK, Panda B, Pradhan A and Parida SP 2021. Habitat heterogeneity influences avian feeding guild composition in urban landscapes: Evidence from Bhubaneswar, India. *Ecological Processes* **10**(1): 31.

Patankar S, Jambhekar R, Suryawanshi KR and Nagendra H 2021. Which traits influence bird survival in the city? A review. *Land* **10**(2): 92.

Rajpar MN and Zakaria M 2011. Bird species abundance and their correlationship with microclimate and habitat variables at Natural Wetland Reserve, Peninsular Malaysia. *International Journal of Zoology* **2011**(1): 758573.

Rajpar MN, Zakaria M, Ozdemir I, Sheryar S and Rab A 2018. Ascertain the productivity of heterogenous wetland and adjacent

habitats through avian foraging guilds. *The Journal of Animal & Plant Sciences* **28**(5): 1372-1384.

Ramamurthy V and Rajakumar R 2014. A study of avifaunal diversity and influences of water quality in the Udhayamarthandapuram Bird Sanctuary, Tiruvarur district, Tamil Nadu, India. *Wetlands* **3**(1): 8851-8858.

Ritchie H, Samborska V and Roser M 2024. *Urbanization.* Available online: https://ourworldindata.org/urbanization' (accessed on 24 July 2025).

Sekhon GS, Aulakh RK and Kler TK 2023. Village ponds as unexplored habitation sites for resident migratory and migratory bird species in Punjab state, India. *Indian Journal of Ecology* **50**(3): 864-869.

Seto KC, Guneralp B and Hutyra RL 2012. Global Forecasts of Urban expansion to 2030 and direct impacts on biodiversity and carbon Pools. *PNAS* (*Proceedings of the National Academy of Science* **109**(40): 16083-16088.

Sharma AK and Tripathi AK 2023. Winter assemblage of avifauna at Chawandiya, Bhilwara, Rajasthan, India. *Indian Journal of Ecology* **50**(5): 1531-1535.

Tali H, Nsor CA, Joseph J, Murna T and Atukpa, ME 2022. Avian species assemblage in three tertiary campuses mirrors species composition in a semi-protected forest in Gombe State-Nigeria. *FUTY Journal of the Environment* **16**(2): 50-60.

Torre-Cuadros MDLÁ, Herrando-Pérez S and Young KR 2007. Diversity and structural patterns for tropical montane and premontane forests of central Peru, with an assessment of the use of higher-taxon surrogacy. *Biodiversity and Conservation* **16**: 2965-2988.

Received 02 July, 2025; Accepted 23 September, 2025