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Cover: Long-tailed Shrike *Lanius schach* resting on a dry branch after courtship. Digital illustration on Procreate. © Aakanksha Komanduri.

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COMMUNICATION

Assessing avifaunal diversity and anthropogenic impacts on Ladhwaya Pond, Gwalior, India

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Abstract: Village ponds serve as important micro-wetland habitats that support diverse avifauna yet are subject to anthropogenic pressures. The present study assessed the avifaunal diversity and seasonal variations in Ladhwaya Pond, Tekanpur, Gwalior (Madhya Pradesh), India, during 2024–2025 using point count and line transect methods. A total of 52 bird species belonging to 33 families and 17 orders were recorded, comprising resident and migratory species. Passeriformes was the dominant order, followed by Columbiformes and Charadriiformes. Diversity indices revealed the highest species diversity during winter (ShannonWiener H' = 1.563; Simpson index = 0.826), indicating the pond's seasonal importance as a refuge for migratory and water-dependent birds. Most species (98.1%) were categorized as 'Least Concern', while one 'Near Threatened' species, the Asian Woolly-necked Stork was documented, emphasizing the conservation value. Field observation indicated that grazing, unregulated fishing, agricultural runoff, and human disturbance significantly influenced habitat quality and bird assemblages, favouring disturbance-tolerant generalist species over sensitive taxa. The study highlights the ecological role of small rural wetlands in sustaining local and migratory bird populations and underscores the urgent need for habitat restoration, disturbance regulation, and community-based conservation measures to maintain avifaunal diversity in such anthropogenically pressured pond ecosystems.

Keywords: Anthropogenic disturbance, aquatic avifauna, conservation, diversity, ecological role, habitat quality, rural ponds, small wetlands, village pond, wetland birds.

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Author contribution: RL contributed to manuscript preparation and scientific writing, conducted field surveys, and performed species identification. He also participated in data collection, interpretation of results, and critical revision of the manuscript for intellectual content. NPG carried out surveys, photography and identification of birds. SS carried out surveys, identification of birds, collecting data. AJ conducted field surveys, performed systematic documentation and identification of avifaunal species, and contributed to data analysis and manuscript preparation. RKG significantly contributed to the conceptualization and design of the study. He was actively involved in field surveys, data collection, and species identification. RJR provided academic guidance, supervised the research work, and critically reviewed the manuscript.

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INTRODUCTION

Birds are one of the most prominent animal groups in the world because of their remarkable splendour, melodious calls, easy recognition, and liveliness (Wenny et al. 2011; Brusatte et al. 2015). Birds are found in different habitats like grasslands, forests, rivers, wetlands, crop fields and urban areas (Byju et al. 2023a; Singh & Tiwari 2024). As pollinators, seed dispersers, insect predators, and environmental health indicators, birds are essential to ecosystems (Sekercioglu 2006). The aquatic avifauna supports nutrient cycling, insect population management, and ecological balance, and hence, it is essential to the conservation of wetland ecosystems (Byju et al. 2025a). Bird populations around the world have significantly declined due to intensifying anthropogenic activities, such as habitat destruction, pollution, and climate change (BirdLife International 2022). Due to urbanization, water pollution, and habitat fragmentation, wetland-dependent bird species have seen significant losses worldwide (Davidson 2014; Rashiba et al. 2022). The Ramsar Convention on Wetlands states that since 1970, around 35% of the world's wetlands have disappeared, which directly impacted the diversity of aquatic birds (Finlayson et al. 2017). Several recent studies from Indian wetlands have demonstrated that even small village ponds function as critical refugia for resident and migratory waterbirds, though they are increasingly affected by land-use change and human disturbance (Byju et al. 2023b).

India, home to over 1,376 bird species, with wetlands supporting a substantial proportion of migratory waterbirds, has also witnessed a similar trend (Praveen & Jayapal 2025). Lamba et al. (2024) reported a sharp decline in several wetland bird populations, attributing the decline to increased pollution, habitat destruction, and unregulated human activities (Byju et al. 2024a). In Madhya Pradesh, wetlands and other water bodies serve as essential habitats for diverse avifauna, including migratory and resident bird species (Rahmani 2012). The region's rich biodiversity is under threat due to agricultural expansion, water pollution, and unregulated fishing. Ladhwaya Village, near Tekanpur in Gwalior District, represents a microcosm of these broader conservation challenges. Despite its ecological significance, the wetland ecosystems in the region have received limited scientific attention, necessitating urgent research to document avifaunal diversity and to assess the impact of anthropogenic pressures. Hence, the present study was conducted in Ladhwaya Pond located in Ladhwaya Village near Tekanpur in Gwalior District on avifaunal diversity and anthropogenic influence on it.

Study area

Ladhwaya pond is situated (25.5915° N and 78.1323° E) in Ladhwaya Village near Tekanpur in Gwalior District, Madhya Pradesh, India (Image 1). The pond covers approximately 5 ha with an average depth of 2.5 m and is primarily rain-fed/perennial. The surrounding land use comprises agriculture and grazing fields, influencing nutrient influx and habitat structure. The climate of Ladhwaya is classified as subtropical, featuring three distinct seasons: summer, monsoon, and winter. Summers, extending from late March to early July, are notably hot, with average high temperatures reaching up to 41°C (106°F) in May. The monsoon season spans from late June/early July to early October, during which the region receives annual rainfall of, averaging 750 mm. Seasonal variations in the area are pronounced, influencing both the natural environment and human activities.

Methods

Field visits were made once in the first week of every month from March 2024–February 2025 in early morning (0700–1000 h) and evening hours (1700–1900 h). The point count and line transect methods were followed for observation of bird species. Four different points were established to cover the water body, and two line transects, 500 m long (Bibby et al. 2000; Archana et al. 2024), were used to collect data to evaluate the avifaunal diversity in Ladhwaya Pond. Avifaunal identification was made by using field guides (Grimmett et al. 2011). Photographs of birds were taken using a DSLR camera, Nikon D-60, for documentation and verification. Nikon Action EX 8 x 40 CF binoculars were used for observation of birds. To understand anthropogenic influences on avifaunal diversity, disturbance factors like grazing, human presence, and land-use changes were documented by personal observation. Species diversity indices such as Shannon-Weiner diversity index (H') and Simpson's diversity index (D), species richness, evenness, and relative abundance were calculated by statistical analysis using PAST statistical software (Hammer et al. 2001). Anthropogenic activities in the study area were assigned a grading scale of 0–5. The most negative influential activities were given a value of 5, and the lowest value, 'zero' (0), through personal observations.

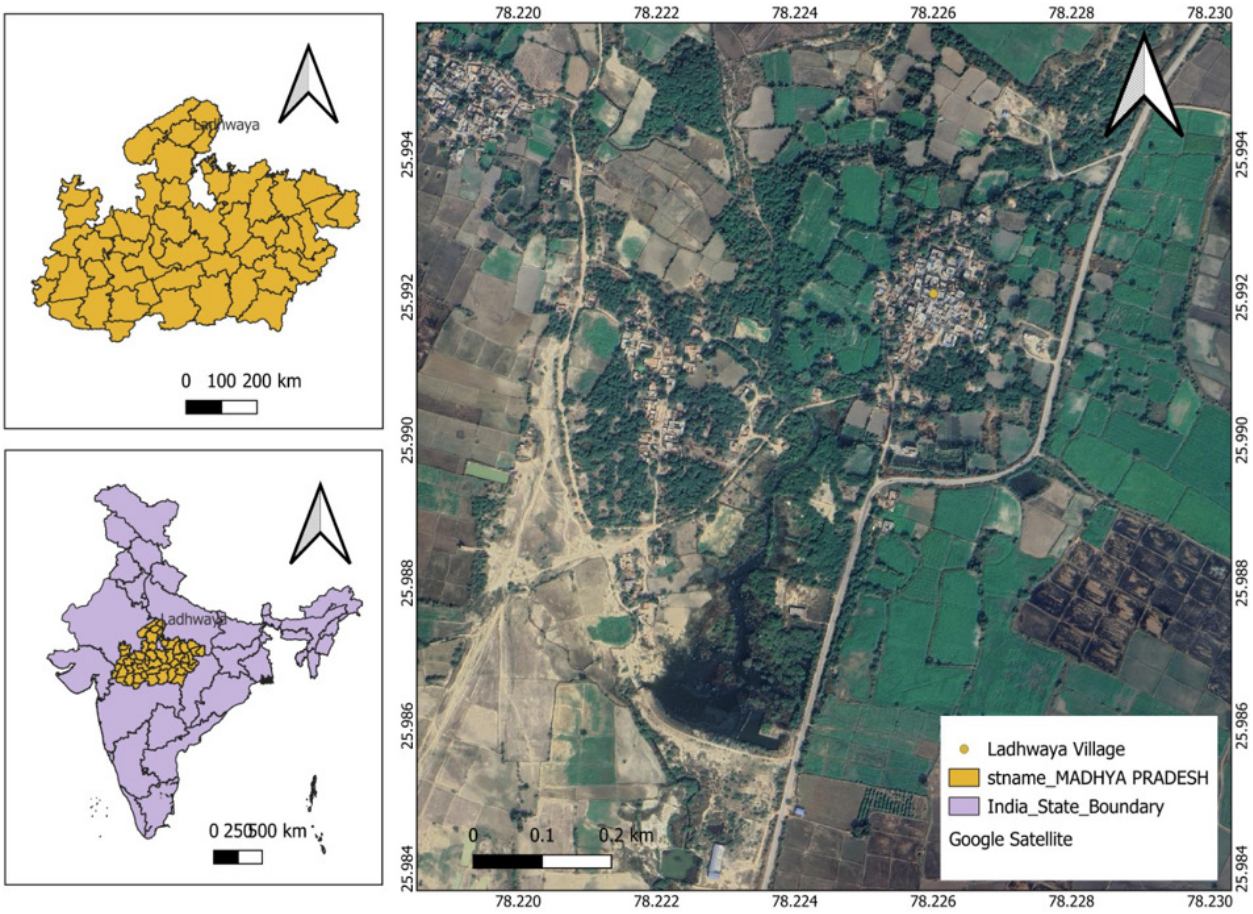

Image 1. Ladhwaya Pond, Tekanpur, Gwalior.

RESULTS

A total of 52 species of aquatic birds representing 33 families and 17 orders were observed in Ladhwaya Pond during the study period (Table 1). The birds are presented with their scientific name, Red List status, and residential status. Order Passeriformes was dominantly represented with 13 species, while Columbiformes had six species, Charadriiformes had five species, Coraciiformes had four species, Galliformes and Pelecaniformes had three species each, Cuculiformes, Gruiformes, Ciconiiformes, Suliformes, Bucerotiformes, and Piciformes had two species each, followed by Caprimulgiformes, Accipitriformes, Strigiformes, and Psittaciformes with one species each.

Among the families, Columbidae was the dominant with six species, followed by Phasianidae and Ardeidae with three species each. Alcedinidae, Anatidae, Cuculidae, Rallidae, Charadriidae, Ciconiidae, Phalacrocoracidae, Megalaimidae, Sturnidae, Muscicapidae were recorded with two species each, Apodidae, Recurvirostridae, Jacanidae, Scolopacidae, Accipitridae, Strigidae, Upupidae, Bucerotidae, Meropidae, Coraciidae, Psittacidae, Dicruridae, Corvidae, Cisticolidae, Pycnonotidae, Leiotrichidae, Nectariniidae, Estrildidae, Passeridae, and Motacillidae with one species each were documented in the study area. In the present study, the Red List status of the total recorded species was classified as 'Least Concern' 51 (98.1%) species and one 'Near Threatened' (1.9%) species (Figure 1). The ecological significance of Ladhwaya Pond as a vital resting place and breeding ground for bird fauna is highlighted by the presence of resident, local migratory and migratory species. Based on residential status, approximately 51.92 % of the species were residents, 36.53% were local migrants, and the remaining species 11.53% were migrants (Figure 2).

Metrics such as species richness, Shannon-Wiener diversity, Simpson Index, and species evenness were derived from the aggregated data across the rainy, winter, and summer seasons. Among the three seasons, the winter season exhibited the highest Shannon diversity

Table 1. List of avian species recorded from Ladhwaya Pond with their taxonomic position, conservation, and residential status.

	Order	Family	Scientific name	Bird name	Red List status	Residential status
1.	Anseriformes	Anatidae	*Dendrocygna javanica*	Lesser Whistling-Duck	LC	LM
2.			*Anas poecilorhyncha*	Indian Spot-billed Duck	LC	M
3.	Galliformes	Phasianidae	*Pavo cristatus*	Indian Peafowl	LC	R
4.			*Ortygornis pondicerianus*	Grey Francolin	LC	R
5.			*Perdicula asiatica*	Jungle Bush-Quail	LC	R
6.	Columbiformes	Columbidae	*Columba livia*	Rock Dove	LC	R
7.			*Streptopelia decaocto*	Eurasian Collared Dove	LC	R
8.			*Streptopelia tranquebarica*	Red Collared Dove	LC	M
9.			*Spilopelia chinensis*	Spotted Dove	LC	R
10.			*Spilopelia senegalensis*	Laughing Dove	LC	R
11.			*Treron phoenicopterus*	Yellow-footed Green-Pigeon	LC	LM
12.	Cuculiformes	Cuculidae	*Centropus sinensis*	Greater Coucal	LC	LM
13.			*Eudynamys scolopaceus*	Asian Koel	LC	R
14.	Caprimulgiformes	Apodidae	*Apus affinis*	Little Swift	LC	R
15.	Gruiformes	Rallidae	*Gallinula chloropus*	Common Moorhen	LC	LM
16.			*Amaurornis phoenicurus*	White-breasted Waterhen	LC	R
17.	Charadriiformes	Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt	LC	M
18.		Charadriidae	*Charadrius dubius*	Little Ringed Plover	LC	LM
19.			*Vanellus indicus*	Red-wattled Lapwing	LC	R
20.		Jacanidae	*Metopidius indicus*	Bronze-winged Jacana	LC	LM
21.		Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	LC	LM
22.	Ciconiiformes	Ciconiidae	*Anastomus oscitans*	Asian Openbill	LC	LM
23.			*Ciconia episcopus*	Asian Woolly-necked Stork	NT	LM
24.	Suliformes	Phalacrocoracidae	*Microcarbo niger*	Little Cormorant	LC	M
25.			*Phalacrocorax fuscicollis*	Indian Cormorant	LC	M
26.	Pelecaniformes	Ardeidae	*Egretta garzetta*	Little Egret	LC	M
27.			*Ardeola grayii*	Indian Pond-Heron	LC	R
28.			*Ardea purpurea*	Purple Heron	LC	LM
29.	Accipitriformes	Accipitridae	*Milvus migrans*	Black Kite	LC	R
30.	Strigiformes	Strigidae	*Athene brama*	Spotted Owlet	LC	R
31.	Bucerotiformes	Upupidae	*Upupa epops*	Eurasian Hoopoe	LC	R
32.		Bucerotidae	*Ocyceros birostris*	Indian Grey Hornbill	LC	LM
33.	Coraciiformes	Meropidae	*Merops orientalis*	Asian Green Bee-eater	LC	LM
34.		Alcedinidae	*Halcyon smyrnensis*	White-throated Kingfisher	LC	R
35.			*Ceryle rudis*	Pied Kingfisher	LC	R
36.		Coraciidae	*Coracias benghalensis*	Indian Roller	LC	LM
37.	Piciformes	Megalaimidae	*Psilopogon haemacephalus*	Coppersmith Barbet	LC	LM
38.			*Psilopogon zeylanicus*	Brown-headed Barbet	LC	LM
39.	Psittaciformes	Psittacidae	*Alexandrinus krameri*	Rose-ringed Parakeet	LC	R
40.	Passeriformes	Dicruridae	*Dicrurus macrocercus*	Black Drongo	LC	LM
41.		Corvidae	*Corvus splendens*	House Crow	LC	R
42.		Cisticolidae	*Prinia inornata*	Plain Prinia	LC	R
43.		Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul	LC	R

	Order	Family	Scientific name	Bird name	Red List status	Residential status
44.	Passeriformes	Leiotrichidae	*Argya striata*	Jungle Babbler	LC	R
45.		Sturnidae	*Sturnia pagodarum*	Brahminy Starling	LC	R
46.			*Acridotheres tristis*	Common Myna	LC	R
47.		Muscicapidae	*Copsychus saularis*	Oriental Magpie-Robin	LC	R
48.			*Saxicola maurus*	Siberian Stonechat	LC	LM
49.		Nectariniidae	*Cinnyris asiaticus*	Purple Sunbird	LC	R
50.		Estrildidae	*Euodice malabarica*	Indian Silverbill	LC	LM
51.		Passeridae	*Passer domesticus*	House Sparrow	LC	R
52.		Motacillidae	*Motacilla maderaspatensis*	White-browed Wagtail	LC	LM

Aberration: LC—Least Concern | NT—Near Threatened | LM—Local Migrant | M—Migrant | R—Residential.

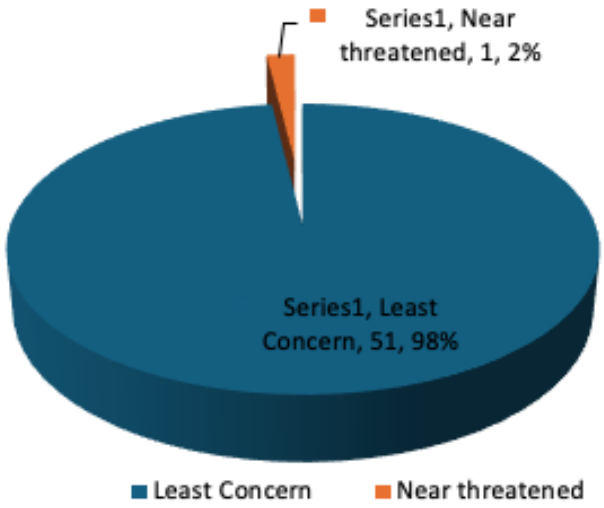

Figure 1. IUCN Red List status of recorded species.

index value (H' = 1.563), followed by the rainy season (H' = 1.228) and the summer season (H' = 0.209). The Simpson diversity index also showed its highest value in the winter season (0.826), summer season (0.699) and rainy season (0.495). In terms of species evenness, the summer season recorded the highest value (0.481), while the rainy season had a value of 0.172, and the winter season had the lowest at 0.093 (Figure 3).

During the present study, anthropogenic impacts through the grading system (0–5) showed that Ladhwaya Pond was highly affected during winter season. The highest levels of sewage impact are recorded at a value of five followed by weed abundance, agriculture with value of four, grazing, grass cutting, fishing, human presence, cattle wading with value of three, water extraction and construction with value of two and it was less affected in rainy season while winter season was moderate. The excessive use of the pond for various purposes affected the environment of the water body.

DISCUSSION

The present study recorded 52 bird species belonging to 33 families and 17 orders from Ladhwaya Pond, reflecting a moderately diverse avifaunal assemblage for a small pond wetland ecosystem. Such patterns are commonly reported from small village wetlands where edge vegetation, surrounding agricultural fields, and open water collectively influence bird assemblages. Similar mixed guild dominance has been documented in Indian wetland complexes where passerines utilize peripheral vegetation while true waterbirds occupy open water and marsh zones (Rahmani 2012). Comparable trends in species composition and habitat-use heterogeneity have also been highlighted in other inland wetlands experiencing anthropogenic habitat modification, where generalist passerines increase in proportion relative to specialist waterbirds (Byju et al. 2024b).

The dominance of Columbiformes (six species) further indicates strong terrestrial–wetland interface usage, suggesting that Ladhwaya Pond is not only a feeding site but also a roosting and nesting landscape influenced by nearby human settlements. Such family-level dominance patterns are typical of semi-urban and rural wetlands where granivorous and omnivorous species adapt to anthropogenic food resources (Boora & Kumar 2023). In contrast, the presence of Charadriiformes (five species) and Pelecaniformes (three species) reflects the functional importance of shallow mudflats and open-water zones, which provide foraging opportunities for waders and piscivorous birds. This structural heterogeneity in microhabitats is crucial

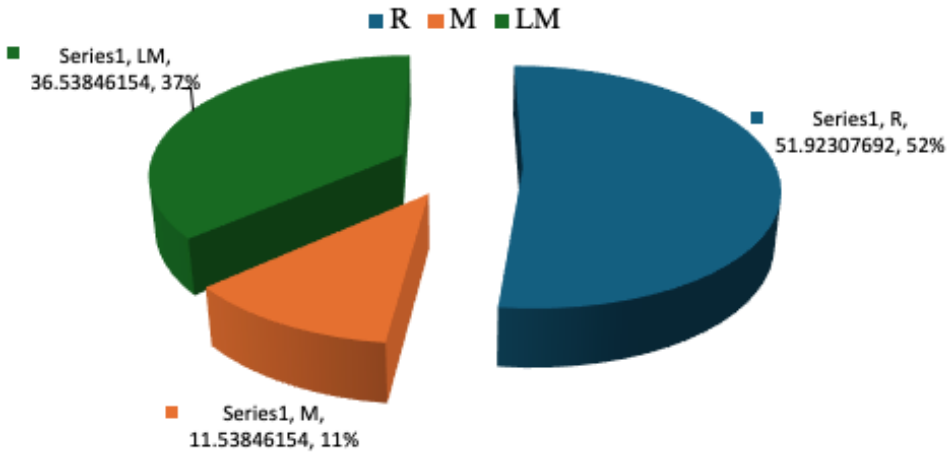

Figure 2. Residential status of recorded species.

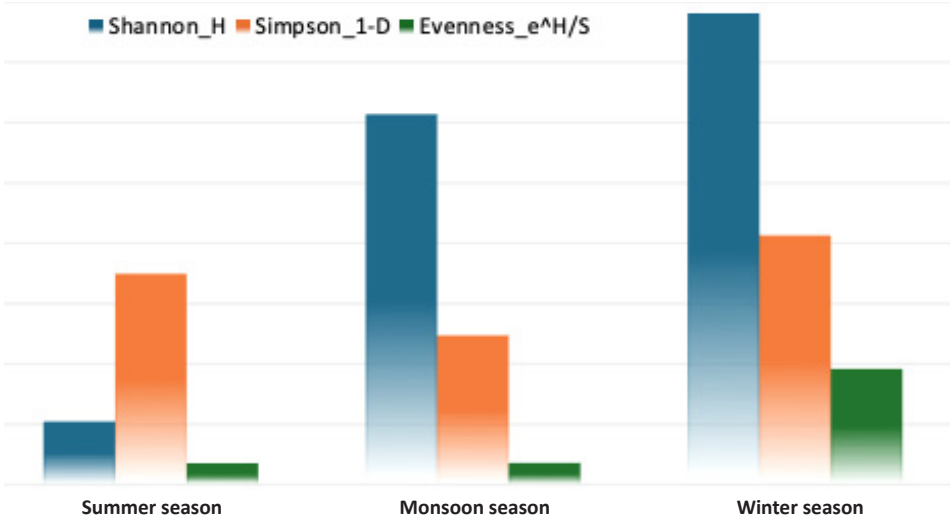

Figure 3. Seasonal diversity index of recorded species.

for sustaining guild diversity, a phenomenon similarly observed in seasonal wetlands across India (Anand et al. 2023; Byju et al. 2025a).

Family-level analysis revealed Columbidae as the most dominant family, followed by Phasianidae and Ardeidae. The prominence of Columbidae indicates strong adaptation to anthropogenic landscapes and the availability of food subsidies from surrounding agriculture and human habitation. On the contrary, the representation of Ardeidae underscores the ecological role of the pond as a foraging ground for herons and egrets, which depend on shallow aquatic zones rich in fish and invertebrates (Aarif et al. 2025). The occurrence of Anatidae, Rallidae, Scolopacidae, and Recurvirostridae, though with fewer species, further confirms the wetland's significance as a seasonal refuge for water-associated birds. Such assemblage structures align with findings from inland wetlands of central and southern India, where waterbird diversity is closely linked to hydrological regimes, vegetation complexity, and anthropogenic disturbance gradients (Jha & McKinley 2015; Lodhi et al. 2017). Long-term observations from Indian wetland ecosystems have also shown that moderate disturbance often results in a shift towards generalist and adaptable families, while specialist taxa decline, leading to biotic homogenization (Byju et al. 2025b,c).

The conservation status pattern in the present study, with 98.1% 'Least Concern' species and only one 'Near Threatened' species, suggests that the pond presently supports common and adaptable taxa. While this may indicate ecological resilience, it may also reflect early

signals of habitat simplification, where disturbance-sensitive species are gradually replaced by generalist species. Similar patterns of declining representation of conservation-priority waterbirds have been reported from wetlands undergoing land-use transformation and hydrological alteration in India (Byju et al. 2025d). Therefore, the dominance of 'Least Concern' species should not be interpreted as the absence of conservation concern, but rather as an indicator of increasing anthropogenic filtering of avifaunal communities.

Seasonal diversity analysis showed the highest Shannon diversity and Simpson index during winter, confirming that Ladhwaya Pond serves as an important seasonal habitat for migratory and winter-visiting birds. The influx of migratory waders, ducks, and other wetland species during winter is a well-documented phenomenon in Indian wetlands, driven by favorable climatic conditions, water availability, and food abundance (Rahmani 2012). Relatively lower diversity during summer corresponds with reduced water levels and elevated temperatures, which limit habitat suitability and food resources. Similar seasonal peaks in winter diversity have been observed across inland and coastal wetlands of India, highlighting the significance of small wetlands as stopover and wintering grounds (Mathibalan et al. 2026). The higher evenness recorded during summer, despite low species richness, indicates a more uniform distribution of a few resident species, suggesting reduced niche overlap and competitive exclusion during resource-scarce periods.

The disturbance grading results indicate that anthropogenic pressure was highest during summer, coinciding with peak bird congregation. Activities such as grazing, fishing, agricultural runoff, and frequent human presence likely disturb foraging and roosting behaviour, leading to altered species composition and reduced abundance of disturbance-sensitive taxa. Studies across Indian wetland landscapes have consistently demonstrated that chronic anthropogenic disturbance modifies habitat structure, reduces water quality, and reshapes avian community composition (Byju et al. 2024a).

Increasing anthropogenic utilization poses a serious threat to habitat quality and the long-term sustainability of bird diversity. Therefore, conservation strategies focusing on habitat restoration, regulation of human activities, and maintenance of hydrological regimes are essential to sustain the ecological integrity of this rural wetland ecosystem, as emphasized in recent wetland conservation assessments across India (Rashiba et al. 2022; Byju et al. 2025b). In the current study, it was noted through a grading scale that Ladhwaya Pond experienced a significant impact during the winter season, while it was less affected comparing the winter season to both the monsoon and summer seasons. The extensive utilization of the pond for various purposes has adversely affected the Ladhwaya Pond.

CONCLUSION

Ladhwaya Pond functions as a seasonally important wetland supporting diverse avifaunal assemblages despite anthropogenic pressures. The observed dominance of disturbance-tolerant species and reduced sightings of sensitive taxa indicate ongoing habitat stress. Long-term monitoring and habitat restoration are essential to prevent ecological simplification, as demonstrated in other Indian wetlands facing similar pressures.

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