

Avian Richness Analysis of Wadaj Dam and Ghod River Basin, India

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Abstract

A study of avifaunal diversity was conducted at Wadaj Dam and the Ghod River basin in Pune district, Maharashtra, over the period from February 2023, to December 2024. In the present study, 107 avian species from 47 different groups were documented. The research primarily concentrated on assessing bird biodiversity and related ecological processes around the dam. Observations were consistent for resident species such as the *Bubulcus ibis*, *Ceryle rudis*, *Ardeola grayii*, and *Halcyon smyrnensis*, whereas migratory or seasonally present species, including the *Pseudibis papillosa* and *Upupa epops*, were documented during particular intervals. The substantial avian species richness in this area enhances the ecological significances of the Wadaj Dam and its surrounding habitats, emphasizing the urgent need for sustainable development and conservation of the distinctive avian fauna. According to estimates, the encountered avifauna's Shannon-Weiner diversity index value was 3.09 in 2023 and 3.00 in 2024. A measure of variation that accounts for both evenness and richness is Simpson's Diversity Index. It has proven to be a helpful tool for comprehending the biodiversity profile throughout the study area. The anticipated diversity index value for avi-fauna encountered in 2023 and 2024 was 0.745. Bird densities in 2023 and 2024 were 4.9 and 4.7 birds per hectare, respectively.



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Introduction

According to earlier reports, avian biodiversity offers a wide range of indirect necessary services through natural ecosystems, significant direct economic

advantages to humanity, and a significant role in regulating ecosystem function and stability.¹⁻⁵ The earth's biodiversity is not evenly distributed and may have anything from five to over fifty million species.

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Anthropogenic activity encompasses many human-induced disturbances that can exert both immediate and prolonged effects on wildlife by altering behavior, physiology, and reproduction, thereby impacting biodiversity, as noted by Bharucha and Gogate.⁸ Anthropogenic activities diminish the sustainability of local populations by restricting food and breeding possibilities, compromising habitat suitability, and elevating regional extinction rates of animal species, as indicated by studies conducted by Bhale *et al.*⁵⁻⁷

Asia is regarded as one of the most biodiversity-rich continents, nonetheless, the surge in human population has negatively impacted the region's diversity, since the growing populace need food and shelter, leading to agricultural intensification, urbanization, industrialization, and pollution. According to Bharucha A. K.⁸ and Green A.J.,¹⁵ conservation planning cannot proceed until all species' populations in urbanized and peri-urban areas have been surveyed. India has more than 1300 bird species, accounting for over 13% of all bird species worldwide, according to Ali *et al.*,² Dinesh, K. *et al.*,¹² and Grimmett R. *et al.*^{16,17} Regrettably, India holds the third position among countries with the highest number of endangered and uncommon species, following Brazil and Indonesia.

Birds are crucial for ecosystem management and biodiversity since they serve as bioindicators of healthy ecosystems, regulate disease vectors, recycle biomass, and reduce disposable waste levels. The quantity of birds in an ecosystem indicates the environmental quality, pollution level, security, and availability of food and habitat, according to Harney *et al.*¹⁸ and Hoyer *et al.*¹⁹ Mangroves provide millions of people with food, clean water, raw resources, and resistance against rising sea levels and storms by connecting land and its inhabitants with the sea. According to Dandapat *et al.*,¹¹ 50% of the world's mangrove forests have been destroyed due to coastal alteration and clearing, and mangrove environments support a large portion of the world's tropical biodiversity. Wetlands are home to almost 40% of bird species and about 12% of other faunal species worldwide. According to many researchers,^{7-9,11,14} the numerous resident and passage migrant aquatic birds use the mangrove vegetation as a suitable habitat for foraging, roosting, and breeding.

Materials and Methods

About Study Area

The Wadaj Dam is situated near Parunde hamlet in the Junnar Taluka of Pune District. Maharashtra, India 19.1522992°N, 73.849129°E.

Methodology

Point Count

Points were selected at upstream and downstream of Wadaj Dam and Ghod Basin to observe, count and identify bird species with the help of binocular and camera. From February 2023 to December 2024, two-week intervals from 5:05 pm to 6:35 pm and from 7:05 am to 9:05 am were used to monitor both domestic and migratory birds. Surveys were carried out on the walkways close to the wetland areas.

A Nikon Coolpix, model B700 camera was utilized for photographic documentation. During the study, no bird specimens were collected; instead, photographic images, videos, and audio recordings were prepared as reference materials, as similarly done by previous researchers.^{9-11,14} The field guides "The Book of Indian Birds" (Salim Ali²), "Birds of the Indian Subcontinent" (Grimmett and Inskipp),¹⁶ along with an online bird database, were utilized for avian identification. The avifauna of the Wadaj Dam and its surrounding area was systematically documented, with regular field visits conducted, as done by Bhale *et al.*⁷

Shannon-Weiner Index

Bird diversity, richness of species, additionally species evenness are assessed using the Simpson Index (Simpson, 1949) and the Shannon-Wiener Index^{1,13} as diversity indexes. The foundation of the Shannon-Wiener Index is the presumption that all species are represented in the sample and that individuals are selected at random from a sizable, independently distributed population. For assessing biodiversity across various ecosystems or habitats, this measure is frequently used Ahmad Zamir & Elliot.^{1,13} A measure of variation that accounts for both evenness and richness is Simpson's Diversity Index. It has proven to be a helpful tool for comprehending the biodiversity profile throughout the study area. Using this index, species diversity within each kind of habitat was measured using Hutchinson's (1970)^{1,13} methodology and computed using the formula.

The Shannon-Wiener Index H' is equal to $-\sum(P_i \cdot \ln P_i)$ (1).

$U_s = 1/D_s$, according to Simpson's Diversity Index (13)

$D_s = \sum(P_i \cdot (N_i - 1) / (N - 1))$ is the Simpson's Dominance Index, $P_i = N_i/N$ is the relative abundance of species, There are a total of N unique individuals in the universe, where N_i is the number of people in each species.

Local Occurrence Status

Classifying the proportional abundance with incidence rate of kinds of birds included modifying the categorization criteria proposed by Bull (1974). Species recorded between 200 and 1,000 individuals per day were categorized as abundant, whereas species detected in quantities greater than 1,000 individuals per day were categorized as very abundant. Species with daily counts of 21 to 50 individuals were classified as common, and those with counts between 51 and 200 individuals as very common.

Birds recorded in daily numbers ranging from 7 to 20 individuals were categorized as fairly common, whereas species observed between 1 and 6 individuals

per day were regarded as uncommon. Additionally, species documented in similarly low numbers (1 to 6 individuals) but only on a seasonal basis were considered rare. Finally, species with highly infrequent sightings were classified as very rare.

Results

The study documents the presence of 107 bird species across 17 orders and 47 families which includes information on the scientific and common names as well as the conservation status of the birds as previously reported by researchers.^{6,18-21} This represents the first record of such a diverse avifauna in the Junnar Taluka of Pune District, Maharashtra, highlighting the significant bird diversity at Wadaj Dam. The variety of bird species observed, with some either visiting or permanently residing in the area, may be attributed to the lack of anthropogenic disturbance and the abundant availability of avian food sources within and surrounding the dam. The majority of the recorded species fall under the "Least Concern" (LC) conservation category, with only a small number classified as "Vulnerable" (VU) (Table 1).

Table 1: Composition of avifauna of the Ecosystem Ghod river Basin

Sr. No.	Order	Family	Scientific Name	Status
1	1. Passeriformes	1. Paridae	<i>Parus cinereus</i>	LC
2		2. Muscicapidae	<i>Saxicola torquatus</i>	LC
3			<i>Copsychus fulvicatus</i>	LC
4			<i>Cyornis tickelliae</i>	LC
5			<i>Cyornis whitei</i>	LC
6			<i>Oenanthe fusca</i>	LC
7			<i>Copsychus saularis</i>	LC
8			<i>Copsychus malabaricus</i>	LC
9			<i>Ficedula superciliaris</i>	LC
10			<i>Cyornis rufigastra</i>	LC
11			<i>Saxicola caprata</i>	LC
12	3. Sturnidae	<i>Pastor roseus</i>	LC	
13		<i>Acridotheres fuscus</i>	LC	
14		<i>Acridotheres tristis</i>	LC	
15		<i>Sturnia pagodarum</i>	LC	
16		<i>Sturnus roseus</i>	LC	
17	4. Pycnonotidae	<i>Gracupica contra</i>	LC	
18		<i>Pycnonotus cafer</i>	LC	
19		<i>Hypsipetes guimarasensis</i>	LC	
20		<i>Pycnonotus jocosus</i>	LC	

21		5. Hirundinidae	<i>Petrochelidon luvicola</i>	LC
22			<i>Cecropis abyssinica</i>	LC
23			<i>Cecropis striolata</i>	LC
24		6. Estriladidae	<i>Lonchura punctulata</i>	LC
25			<i>Euodice malabarica</i>	LC
26		7. Ciconiidae	<i>Ciconia episcopus</i>	NT
27		8. Passeridae	<i>Passer domesticus</i>	LC
28			<i>Passer montanus</i>	LC
29			<i>Passer flavolus</i>	LC
31			<i>Cistothorus palustris</i>	LC
32		10. Zosteropidae	<i>Zosterops palpebrosus</i>	LC
33			<i>Zosterops ceylonensis</i>	LC
34		11. Corvidae	<i>Corvus culminatus</i>	LC
35			<i>Corvus macrorhynchos</i>	LC
36			<i>Corvus enca</i>	LC
37			<i>Dendrocitta vagabunda</i>	LC
38		12. Polceidae	<i>Ploceus philippinus</i>	LC
39			<i>Ploceus manyar</i>	LC
40		13. Monarchidae	<i>Terpsiphone paradise</i>	LC
41			<i>Hypothymis azurea</i>	LC
42		14. Nectariniidae	<i>Cinnyris asiaticus</i>	LC
43			<i>Leptocoma zeylonica</i>	LC
44			<i>Cinnyris lotenius</i>	LC
45			<i>Anthrepetes rhodolaemus</i>	NT
46		15. Thraupidae	<i>Loriotus luctuosus</i>	LC
47		16. Dicuridae	<i>Dicrurus macrocercus</i>	LC
48		17. Cisticolidae	<i>Prinia criniger</i>	LC
49			<i>Prinia inornata</i>	LC
50			<i>Prinia hodgsonii</i>	LC
51			<i>Prinia sylvatica</i>	LC
52		18. Fringillidae	<i>Crithagra flaviventris</i>	LC
53		19. Alaudidae	<i>Galerida deva</i>	LC
54		20. Emberizidae	<i>Emberzia melanocephala</i>	LC
55			<i>Emberzia lathami</i>	LC
56			<i>Emberiza buchanani</i>	LC
57		21. Campephagidae	<i>Pericrocotus erythropygius</i>	LC
58			<i>Pericrocotus cinnamomeus</i>	LC
59		22. Leiothrichidae	<i>Turdoides malcolmi</i>	LC
60		23. Rhipiduridae	<i>Rhipidura albicollis</i>	
61		24. Timaliidae	<i>Mixornis gularis</i>	LC
62		25. Vangidae	<i>Tephrodornis pondicerianus</i>	LC
63	2. Coraciiformes	26. Alcedinidae	<i>Halcyon smyrnensis</i>	LC
64			<i>Ceyx azureus</i>	LC
65		27. Coraciidae	<i>Coracias benghalensis</i>	LC
66		28. Meropidae	<i>Merops orientalis</i>	LC
67	3. Suliformes	29. Phalacrocoracidae	<i>Microcarbo pygmaeus</i>	LC
68	4. Piciformes	30. Megalaimidae	<i>Psilopogon haemacephalus</i>	LC
69		31. Picidae	<i>Dinopium benghalense</i>	LC
70	5. Psittaciformes	32. Psittaculidae	<i>Psittacula cyanocephala</i>	LC
71			<i>Psittacula krameri</i>	LC
72			<i>Loriculus vernalis</i>	LC

73	6. Accipitriformes	33. Accipitridae	<i>Accipiter chilensis</i>	LC
74			<i>Haliastur indus</i>	LC
75			<i>Accipiter nisus</i>	LC
76			<i>Accipiter badius</i>	LC
77			<i>Circus aeruginosus</i>	LC
78		34. Pandionidae	<i>Pandion haliaetus</i>	LC
79	7. Ciconiiformes	35. Ciconiidae	<i>Ciconia episcopus</i>	NT
80			<i>Anastomus oscitans</i>	LC
81	8. Columbiformes	36. Columbidae	<i>Streptopelia turtur</i>	VU
82			<i>Patagioenas leucocephala</i>	LC
83			<i>Columba livia</i>	LC
84			<i>Spilopelia chinensis</i>	LC
85			<i>Spilopelia senegalensis</i>	LC
86	9. Gruiformes	37. Rallidae	<i>Porphyrio porphyria</i>	LC
87			<i>Amauornis phoenicurus</i>	LC
88	10. Cuculiformes	38. Cuculidae	<i>Eudynamys scolopaceus</i>	LC
89			<i>Centropus sinensis</i>	LC
90	11. Pelecaniformes	39. Ardeidae	<i>Bubulcus ibis</i>	LC
91			<i>Ardea alba modesta</i>	LC
92			<i>Ardeola grayii</i>	
93		40. Threskiornithidae	<i>Pseudibis papillosa</i>	LC
94	12. Anseriformes	41. Anatidae	<i>Tadorna ferruginae</i>	LC
95			<i>Anser domesticus</i>	LC
96			<i>Anser indicus</i>	LC
97	13. Charadriiformes	42. Charadriidae	<i>Vanellus indicus</i>	LC
98			<i>Charadrius dubius</i>	LC
99			<i>Charadrius alexandrines</i>	LC
100		43. Recurvirostridae	<i>Himantopus himantopus</i>	LC
101	14. Galliformes	44. Phasianidae	<i>Pavo cristatus</i>	LC
102	15. Strigiformes	45. Strigidae	<i>Asio flammeus</i>	LC
103			<i>Bubo bubo</i>	LC
104			<i>Bubo bengalensis</i>	LC
105	16. Bucerotiformes	46. Upupidae	<i>Upupa epops</i>	LC
106	17. Falconiformes	47. Falconidae	<i>Falco tinnunculus</i>	LC
107			<i>Falco chicquera</i>	NT

Species richness was $n = 159$ in 2023 and $n = 151$ in 2024, whereas evenness of bird species compares the similarity of each species' population size recorded in February 2023 to December 2024, which was 0.31 and 0.30, respectively. The projected values of the Shannon-Weiner diversity index^{1,13} for the avifauna encountered in 2023 and 2024 were 3.09 and 3.00, respectively. A measure of variation that accounts for both evenness and richness is Simpson's Diversity Index. It has proven to be a helpful tool for comprehending the biodiversity profile throughout the study area. In 2023 and 2024, the anticipated Simpson's Diversity Index value for avi-fauna encountered was 0.745. Bird densities in

2023 and 2024 were 4.9 and 4.7 birds per hectare, respectively.

Discussion

In and around Wadaj Dam, 47 families and 17 orders of birds totaling 107 species were found throughout the investigation. Out of 107 species, 62 belong to Passeriformes, 04 to Coraciiformes, 01 to Suliiformes, 02 to Piciformes 03 to Psittaciformes, 05 to Accipitriformes, 02 to Ciconiiformes, 06 to Columbiformes, 02 to Gruiformes, 02 to Cuculiformes, 04 to Pelecaniformes 03 to Anseriformes, 04 to Charadiformes, 01 to Galliformes, 03 to strigiformes, 01 to Bucerotiformes and 02 to Falconiformes order.

In present study 102 species are least concern, 4 species are Near Threatened, 1 species is Vulnerable. With 107 species from 17 orders and 47 families—of which Passeriformes make up the majority with 62 species—the current study demonstrates the remarkable bird diversity in and around Wadaj Dam.

This high species richness can be attributed to the ecological diversity of the Wadaj Dam and the Ghod Basin, which provide perennial water sources, varied microhabitats, and abundant food resources. Similar findings have been reported by Grimmett *et al.*¹⁶ and Ali & Ripley,² who observed that wetlands surrounded by agricultural and semi-natural habitats often support a high diversity of avifauna due to their role as feeding, roosting, and breeding grounds.

The majority of the species (102) that have been documented are categorized as Least Concern, while four species are considered to be in danger of extinction along with one that is listed as Vulnerable (Prone to) on the IUCN Red List. This composition indicates a relatively healthy avian community, yet the presence of Near Threatened and Vulnerable species underscores the importance of continuous monitoring and targeted conservation strategies, as emphasized by BirdLife International.¹⁰ However, anthropogenic pressures such as hunting, trapping, and habitat disturbance remain significant threats in the region. Hunting of waterbirds, mammals, and reptiles for meat, coupled with the killing of birds perceived as agricultural pests, mirrors trends reported in other parts of India by Mukherjee *et al.*²⁵ and Sundar & Subramanya.²⁷ These practices, driven by cultural preferences and economic factors, have the potential to cause localized population declines.

The study reaffirms earlier conclusions by Lad *et al.*,²⁴ and Kumar *et al.*,²¹ that comprehensive biodiversity surveys are essential for designing effective conservation programs.²⁶ Community-based conservation approaches, particularly awareness campaigns, can reduce hunting pressure and promote coexistence between humans and wildlife. Furthermore, the development of ecotourism initiatives could provide alternative livelihoods, enhancing local economic well-being while incentivizing biodiversity protection, as suggested by Goodwin¹⁴ and Bhalla *et al.*⁹

Wadaj Dam and the Ghod Basin provide a continuous water supply throughout the year, fostering and flourishing the biodiversity in the region. However, hunting and a lack of awareness are significant threats to the biodiversity in this area. The region is unique in its ecological diversity and habitat, offering both feeding and breeding grounds for numerous organisms. The presence of agricultural land provides feeding opportunities for many bird species, some of which are considered pests by farmers and are often killed or harmed as investigated by Lad *et al.*²⁴ Certain aquatic birds, mammals, and reptiles are hunted for their meat, which is considered a delicacy by the local population. Traps are set both for hunting purposes and to protect agricultural crops. As previously concluded the extensive study of the biodiversity in any study is crucial to support future conservation efforts.^{5,6,16,17,19,22,23} Raising awareness among local communities will likely encourage their participation in conservation activities and could also offer them economic opportunities through the development of ecotourism.

Conclusion

The study area supports a rich avian diversity, according to the observations and data collected from the Wadaj Dam area, located near Parunde village in Junnar Taluka, Pune District, Maharashtra, India. Maximum bird diversity was recorded during the winter season, and the study area serves as both a feeding and breeding ground for numerous bird species. However, anthropogenic activities pose a significant threat to the existing avian diversity by destroying their breeding and feeding grounds. A strategic plan for the sustainable development of breeding and feeding grounds for avian diversity is needed to protect their habitats and preserve the unique biodiversity of the study area.

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Permission to Reproduce Material from other Sources

Not Applicable

Author Contributions

- **Snehal Punde:** Data Collection, Analysis, Writing – Review
- **Aparna Ghadi:** Conceptualization, Methodology and Editing
- **Manisha Kulkarni:** Funding Acquisition, Resource and Supervision

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