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Avifaunal Diversity and Conservation Assessment of Shivapur Wetland, Umrer, Nagpur (M.S.), India

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ABSTRACT

The recent biodiversity assessment at Shivapur Lake and its surrounding area has identified 33 avifauna species from 14 families, each utilizing distinct ecological zones for survival and reproduction amidst global climate shifts. Birds predominantly exploit shoreline vegetation for nesting, employing "green curtain" and "brown curtain" camouflage to evade predation. The wetland, as a dynamic ecosystem, supports unispecies and multispecies congregations of migratory, resident, and vagrant wading birds. Conservation strategies proposed by local communities, NGOs, and the Zoological Survey of India (ZSI) aim to preserve beta-diversity across ecosystems. Urbanization and metropolitan expansion have fragmented habitats and introduced persistent noise pollution, negatively affecting bird assemblages and disrupting chronobiologically regulated breeding cycles. Additionally, agrochemical contaminants and parasite-laden food sources impact avian health, causing observable physiological changes that serve as bioindicators of wetland pollution. Regular bioremediation, guided by systematic water quality assessments, is essential to mitigate toxin accumulation and biomagnification. Shivapur Lake, located 4 km from the Nagpur-Umrer Highway, is a vital junction for wintering and resident wetland birds, enabling movement across a network of directionally distributed water bodies. Its ecological importance necessitates its designation as a protected avian heritage site to safeguard species survival, enhance conservation efforts, and preserve habitat integrity for both unispecies and multispecies assemblages.

Keywords: Shivapur, India, Biodiversity, Avifauna, conservation, climate change.

INTRODUCTION

Wetland ecosystems harbor a distinctive assemblage of floral and faunal biodiversity, playing a critical role in sustaining ecological balance. However, anthropogenic pollution has led to severe degradation of these aquatic environments, transforming them into a

"toxic soup" that jeopardizes the survival of dependent life forms. Among the most prevalent consequences of biodiversity decline is co-extinction, wherein the loss of a keystone species initiates cascading effects throughout the trophic structure of an ecosystem. A classical example of co-extinction is observed in the historical interplay between the Haast's eagle (Harpagornis moorei) and the moa bird (Dinornithiformes), wherein the extinction of the moa precipitated the subsequent extinction of its apex predator (Gilpin & Diamond, 1976).

The relationship between species richness and area size is commonly examined through species-area curves, derived from empirical data on immigration and extinction rates. Given that the complete cessation of extinction risks appears improbable, conservation strategies must prioritize the preservation and restoration of habitats. Wildlife conservation efforts aimed at habitat protection have proven pivotal in preventing species decline. For instance, in 1941, the whooping crane (Grus americana) population had dwindled to merely 16 individuals, warranting its classification as an endangered species (Zimmerman *et al*., 1986).

Empirical research in Amazonia underscores the relevance of the equilibrium theory of island biogeography and species-area relationships in conservation planning. Avian species are known to migrate dynamically in response to resource availability, which is often spatially heterogeneous. Veeramani *et al.* (2018) observed that fewer bird species occupied agricultural landscapes, whereas wetlands, including ponds, rivers, and streams, exhibited significantly higher avian diversity. This disparity in species richness may be attributed to the limited spatial dimensions of wetlands in the Nilgiri region of India.

The present study at Shivapur Lake, Umrer Tehsil, Nagpur District (Maharashtra) aims to evaluate current avifaunal assemblages and address pertinent conservation challenges. Through systematic assessment, this investigation seeks to contribute to the broader discourse on wetland biodiversity conservation and ecological sustainability.

MATERIAL AND METHODS

During the field survey conducted between October 2022 and September 2024 at Shivapur Lake, a systematic approach was employed to document avifaunal diversity. Observations were carried out during early mornings and evenings to ensure comprehensive sampling and maximize species coverage. Optical equipment utilized included Nikon binoculars, along with photographic documentation using Alpha 58 (55-300 mm lens), Alpha 6300 (55-210 mm lens), and Tamron 150-600 mm lens, allowing for precise identification and recording of bird species. Species identification was facilitated through reference to authoritative ornithological field guides, including Grimmett *et al.* (2011) and Pande *et al.* (2013), which provided essential taxonomic information. To assess conservation status, the updated International Union for Conservation of Nature (IUCN) Red List (2021) was consulted for the classification of threatened and endangered species within the study area.

Study area: Shivapur Lake is situated at 4 km north to Umrer - Bhivapur Highway at Latitude-20° 48' 42'N and Longuitude-79° 21' 35' E.

Fig. 1: Map showing the location of Shivapur lake, Umrer (photograph taken from www.googleearth.com)

OBSERVATIONS

Table 1: Shows birds sighted at Shivapur lake and its surrounding area; Umrer (M.S.) India.

Sr. No.	Scientific Name	Common Name	Family	IUCN Status
1.	*Motacilla cinerea*	Grey wagtail	Motacillidae	LC
2.	*Tringa nebularia*	Common greenshank	Scolopacidae	LC
3.	*Anser indicus*	Bar-headed goose	Anatidae	LC
4.	*Tachybaptus ruficollis*	Little grebe	Podicipedidae	LC
5.	*Mesophoyx intermedia*	Intermediate egret	Ardeidae	LC
6.	*Ardea cinerea*	Grey heron	Ardeidae	LC
7.	*Egretta garzetta*	Little egret	Ardeidae	LC
8.	*Halcyon smyrnensis*	White throated kingfisher	Alcedinidae	LC
9.	*Sterna aurantia*	River tern	Laridae	NT
10.	*Ardeola grayii*	Indian pond heron	Ardeidae	LC
11.	*Gallinula chloropus*	Common moorhen	Rallidae	LC
12.	*Anas querquedula*	Garganey	Anatidae	LC
13.	*Anas penelope*	Eurasian wigeon	Anatidae	LC
14.	*Netta rufina*	Red-crested pochard	Anatidae	LC
15.	*Bubulcus ibis*	Cattle egret	Ardeidae	LC
16.	*Porphyrio porphyrio*	Western swamphen	Rallidae	LC
17.	*Anas poecilorhyncha*	Indian spot-billed duck	Anatidae	LC
18.	*Casmerodius albus*	Great egret	Ardeidae	LC
19.	*Himantopus himantopus*	Black-winged stilt	Recurvirostridae	LC
20.	*Ardea purpurea*	Purple heron	Ardeidae	LC
21.	*Anastomus oscitans*	Asian openbill	Ciconiidae	LC
22.	*Anas acuta*	Northern pintail	Ardeidae	LC
23.	*Vanellus indicus*	Red-wattled lapwing	Charadriidae	LC
24.	*Motacilla maderaspatensis*	Large pied wagtail	Motacillidae	LC
25.	*Hydrophasianus chirurgus*	Pheasant-tailed jacana	Jacanidae	LC
26.	*Metopidius indicus*	Bronze-winged jacana	Jacanidae	LC
27.	*Threskiornis melanocephalus*	Black-headed ibis	Threskiornithidae	NT
28.	*Ixobrychus minutus*	Little bittern	Ardeidae	LC
29.	*Oxyura leucocephala*	White-headed duck	Anatidae	LC
30.	*Fulica atra*	Common coot	Rallidae	LC
31.	*Plegadis falcinellus*	Glossy ibis	Threskiornithidae	LC
32.	*Alcedo atthis*	Common kingfisher	Alcedinidae	LC
33.	*Phalacrocorax niger*	Little Cormorant	Phalarocoracide	LC

LC - least concern; **NT -** near threatened; **Vu -** Vulnerable: **EN –** Endangered

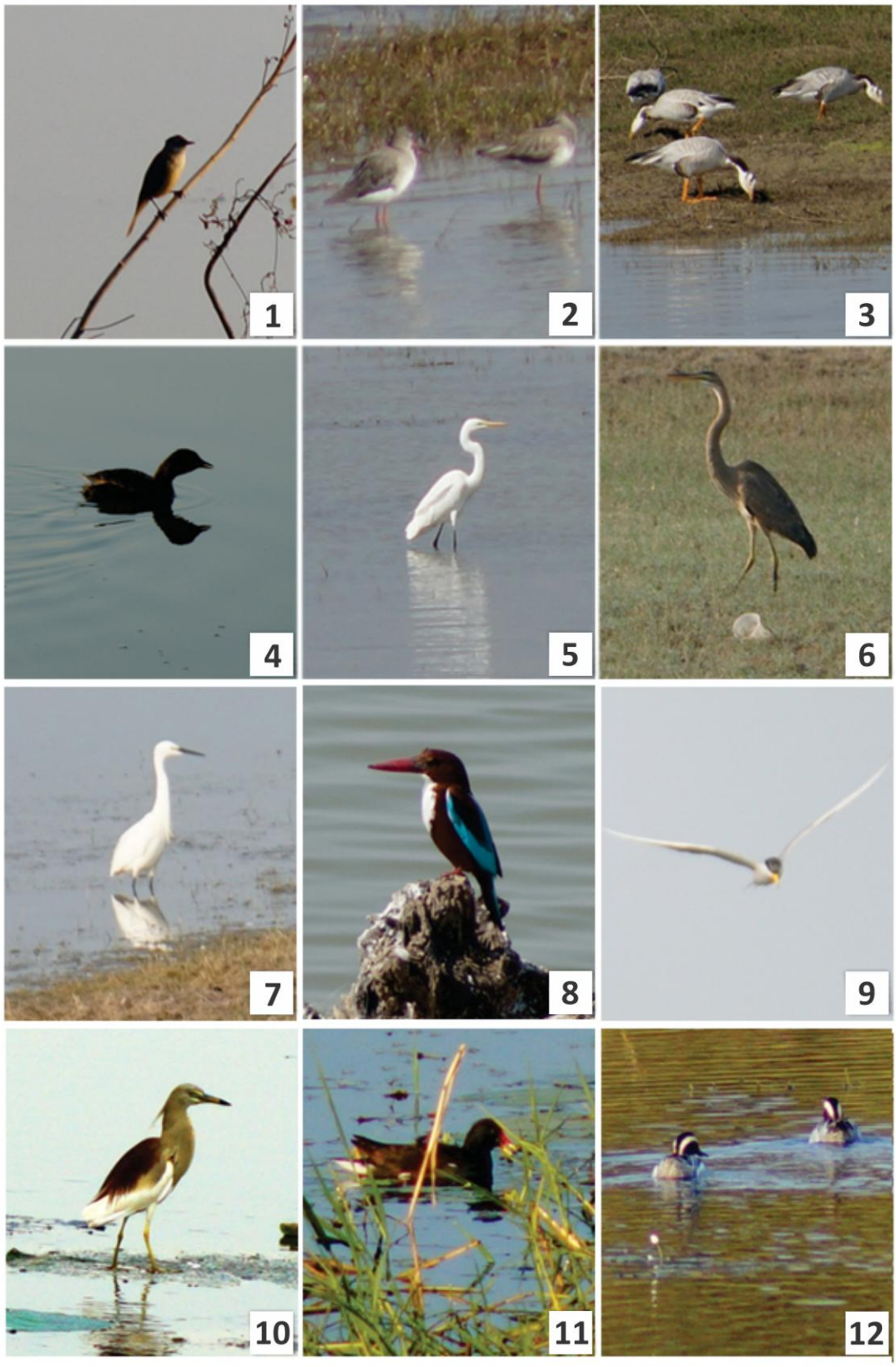

Photo Plate : **1.** *Motacilla cinerea;* **2.** *Tringa nebularia;* **3.** *Anser indicus;* **4.** *Tachybaptus ruficollis;* **5.** *Mesophoyx intermedia* **6.** *Ardea cinerea;* **7.** *Egretta garzetta;* **8.** *Halcyon smyrnensis;* **9.** *Sterna aurantia;* **10.** *Ardeola grayii;* **11.** *Gallinula chloropus;* **12**. *Anas querquedula*

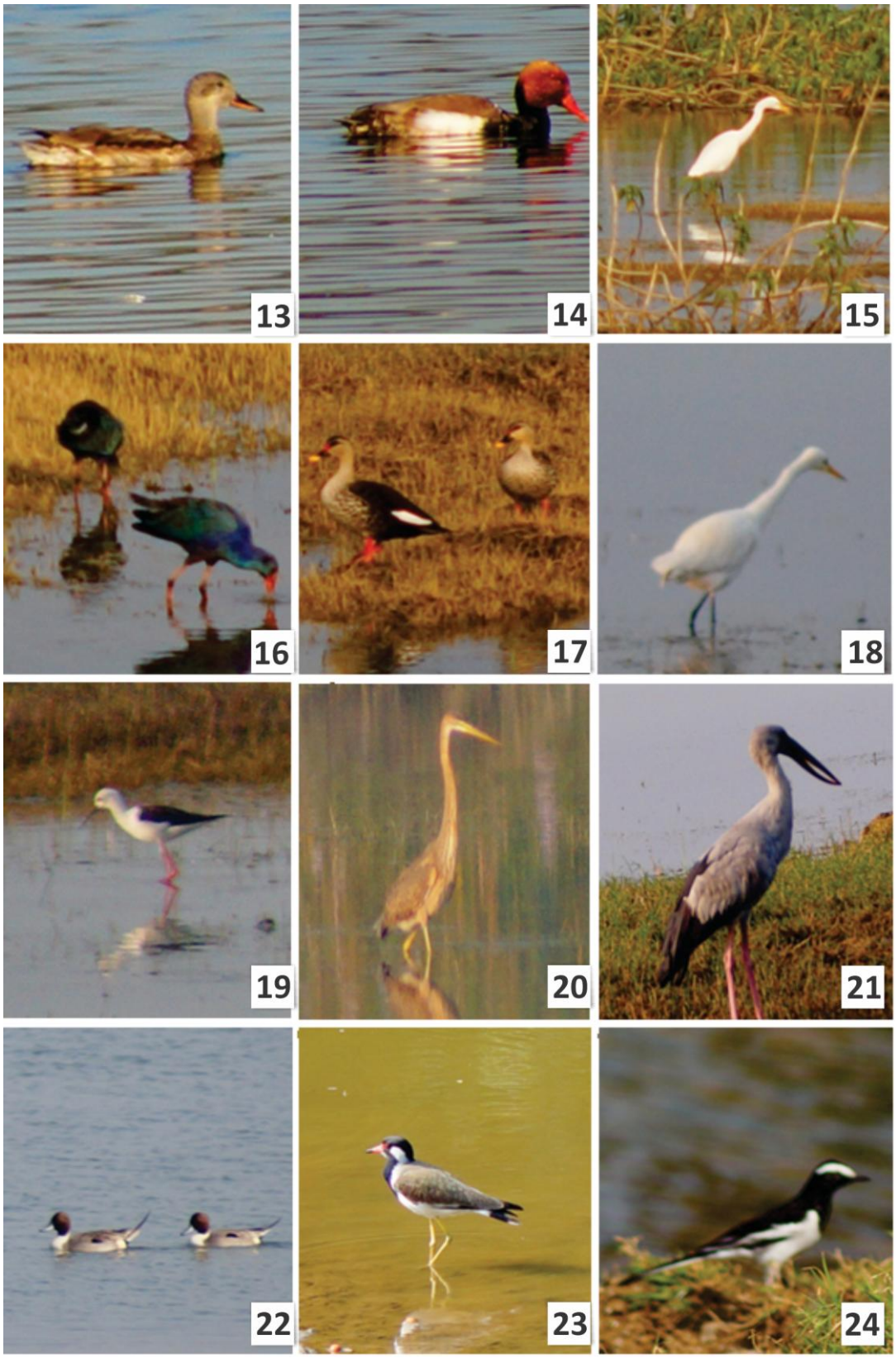

Photo plate: **13.** *Anas penclope* **14.** *Netta rufina;* **15.***Bubulcus ibis;* **16.** *Porphyrio porphyrio;* **17.** *Anas poecilorhyncha;* **18.** *Casmerodius albus;* **19.** *Himantopus himantopus;* **20.** *Ardea purpurea;* **21.** *Anastomus oscitans* **22.** *Anas acuta;* **23.** *Vanellus indicus;* **24.** *Motacilla maderaspatensis;*

Photoplate : **25.** *Hydrophasianus chirurgus* **26.** *Metopidius indicus;* **27.** *Threskiornis melanocephalus*
28. *Ixobrychus minutus;* **29.** *Oxyura leucocephala;* **30.** *Fulica atra;*
31. *Plegadis balcinellus* **32.** *Alcedo atthis;* **33.** *Phalacrocorax niger;*

RESULTS AND DISCUSSION

The present field study on avian biodiversity, conducted between October 2022 and September 2024 at Shivapur Lake, recorded a total of 33 species, representing 14 avian families. Based on the updated IUCN Red List (2021), 31 species were classified under the "Least Concern" category, while two species were categorized as "Near Threatened" (refer to Table 1 and Plate 1). The taxonomic breakdown of recorded bird species at Shivapur Lake is as follows: Family Ardeidae exhibited the highest richness with nine species, followed by Anatidae with six species. Rallidae accounted for three species, while Motacillidae, Alcedinidae, Jacanidae, and Threskiornithidae were represented by two species each. Seven families, namely Charadriidae, Ciconiidae, Laridae, Recurvirostridae, Phalacrocoracidae, Podicipedidae, and Scolopacidae, were documented with a single species each. Previous studies have categorized select avian species under varying conservation statuses. Virani (2017) classified the River Tern (Sterna aurantia) as "Vulnerable" and the Black-headed Ibis (Threskiornis melanocephalus) as "Least Concern."

However, Saxena (2023) re-evaluated these species and designated both as "Near Threatened." Similarly, Ali (2024) reaffirmed this classification. As noted by Saxena, Charde, and Lonkar, avian species classified under lower threat categories may gradually shift toward higher-risk classifications until their populations are no longer observed by ornithologists, environmentalists, researchers, or conservationists. Several anthropogenic and environmental factors, including habitat degradation, urbanization, climate change, pollution, and agricultural encroachments, contribute to the decline of avian populations. The Shivapur wetland, spanning a submerged area of approximately 370×10^4 m^2, serves as a vital habitat for waterfowl, providing food resources and undisturbed nesting grounds essential for breeding. Observations from local fishermen and fish markets indicate a decline in fish populations, corroborating the hypothesis of ecological disturbances within the wetland. Given its ecological significance and function as a perennial water source for drinking, domestic use, and agriculture, Shivapur Lake should be designated as a protected conservation site. Seasonal variation in bird abundance was observed, with winter months exhibiting the highest species diversity, a trend consistent with findings from other wetland studies. The arrival and departure of birds were noted during early mornings and post-4:30 PM, indicative of nocturnal roosting and migratory patterns. The lake provides a diverse range of food resources, including dragonflies, insects, mollusks, crabs, fish larvae, amphibians, non-venomous snakes, and lizards. However, anthropogenic pressures, such as cattle grazing, pose a significant threat by destroying eggs concealed within vegetation, leading to population declines. Notably, Bubulcus ibis actively forages for insects, worms, and lizards in adjoining agricultural fields. However, extensive use of chemical fertilizers, insecticides, and pesticides has led to soil and water contamination, further exacerbating biodiversity loss. Conservation strategies must prioritize community engagement, involving local residents, educational institutions, and environmental organizations in proactive wetland and bird conservation efforts. Avian species play a fundamental role in maintaining ecological stability by facilitating nutrient cycling and energy transfer through linear and branching trophic pathways. They regulate insect populations, indirectly enhancing agricultural yields in balanced ecosystems. Conversely, disruptions to avian food webs—due to the absence of entomophagous, omnivorous, and predatory birds may result in ecosystem destabilization, leading to food chain fragmentation. Apex avian predators may be compelled to abandon deteriorating habitats in search of more favorable conditions or experience population declines toward potential extinction. Moreover, exposure to agrochemicals contaminates water sources, posing lethal risks to non-apex omnivorous bird species through bioaccumulation and direct toxicity. Consumption of contaminated prey leads to secondary poisoning, resulting in mortality either instantaneously or progressively over time.

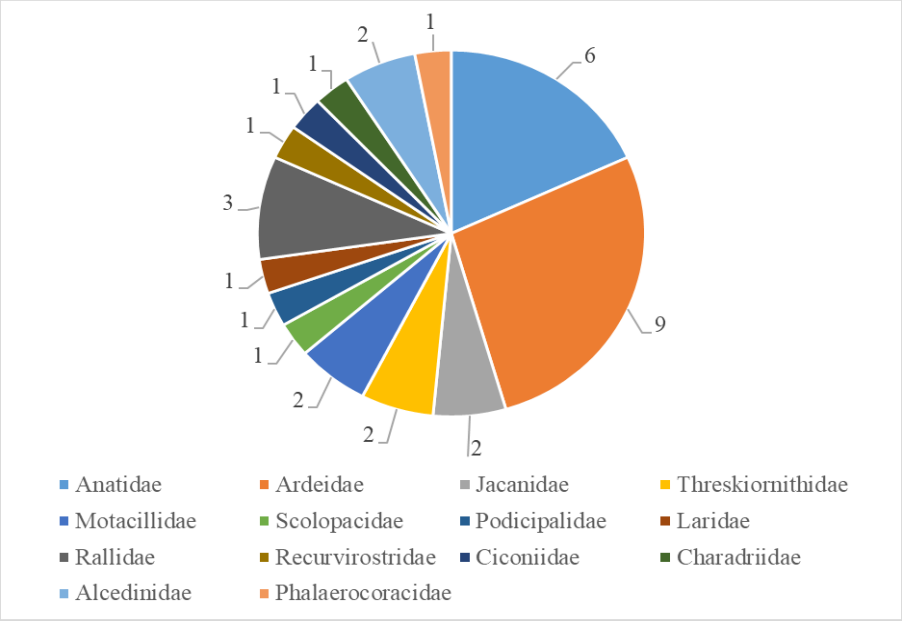

Fig. 1: : Shows Familywise birds sighted at Shivapur lake and its surrounding area; Umrer (M.S.) India

It is imperative that conservation measures are action-oriented, incorporating scientific assessments, habitat restoration, sustainable agricultural practices, and active participation from stakeholders to mitigate ecological threats and ensure the long-term preservation of avian biodiversity within Shivapur Lake. The biodiversity field survey conducted in 2023 at Shivapur (Umrer), Gorewada, Ambazari, and Telengkhedi wetlands in Nagpur has proposed innovative conservation strategies to mitigate threats to avifaunal diversity. The study emphasizes the construction and installation of artificial portable and non-portable "STAIR CASE CONTOUR" models within natural habitats to facilitate multispecies congregations and monospecies consortia of aquatic birds. The implementation of these structures, in conjunction with the expertise of breeder specialists and conservationists, aims to simulate and support the sustained presence of threatened and endangered avian species, as periodically classified under the IUCN Red List. The study suggests securing funding from the Ministry of Environment, Forest and Climate Change (MOEF), Government of India, alongside allied conservation groups, to drive these efforts. Captive breeding programs, while beneficial, require active participation from local communities, farmers, environmental activists, and students to ensure long-term success. Additionally, exchanging healthy adult avian pairs representing genetically robust populations within the country and neighboring regions may help counteract the detrimental effects of genetic bottlenecks. This practice can mitigate inbreeding depression by introducing heterozygous traits, thereby reducing the accumulation of deleterious recessive alleles. Consequently, the genetic diversity of avian populations can be preserved, decreasing the occurrence of weak and imposex offspring prone to premature mortality prior to their reproductive phase. This approach aligns with conservation objectives set forth at both regional and global levels (Saxena *et al*., 2023).

The present research conducted at Shivapur Lake supports the implementation of the aforementioned conservation interventions and further highlights critical challenges undermining biodiversity management efforts. Key threats include rising carbon footprints, excessive fossil fuel consumption, inadequate vegetation restoration initiatives, and unsustainable exploitation of terrestrial, atmospheric, and aquatic resources. Additionally, deforestation for urban expansion and infrastructural development is leading to irreversible habitat loss, exacerbating ecosystem imbalances.

Continuous vehicular emissions and persistent noise pollution from urban environments have been observed to negatively impact the behavioral and reproductive dynamics of diverse faunal taxa. These anthropogenic pressures drive direct and indirect conflicts between human activity and wildlife, further intensifying biodiversity decline (Saxena, 2019; 2021; 2023).

To address these challenges, conservation strategies must integrate robust habitat restoration programs, sustainable resource management, and extensive stakeholder engagement. Collaborative efforts involving governmental agencies, research institutions, conservationists, and local communities are imperative to mitigate environmental degradation, ensuring the preservation and resilience of wetland ecosystems.

The impact of urbanization and metropolitan expansion, particularly infrastructure developments such as bridge construction and metro rail projects in Nagpur, has significantly altered local habitats, imposing substantial stress on biodiversity. According to Saxena *et al.* (2022), these anthropogenic modifications have disrupted the natural locomotion patterns of various species, leading to a marked decline in avian populations previously documented in the region.

Among the affected species, Bubulcus ibis has demonstrated remarkable adaptability, occupying diverse environments such as Nag Nullah, reservoirs, rural and urban market waste sites, agricultural fields, industrial zones, and dry scrubland ecosystems. This species functions as an "ecophene" or edge-adapted bird, thriving in proximity to human settlements where food sources—comprising worms, insect larvae, mollusks, lizards, froglets, and crabs—are readily available (Saxena *et al*., 2021; Saxena *et al*., 2022).

A comprehensive biodiversity survey of Telengkhedi, conducted by Sheikh *et al.* (2019), documented 79 species across various taxonomic groups, including algae, aquatic macrophytes, zooplankton, invertebrates, and vertebrates, forming intricate food chains and trophic networks within the wetland

ecosystem. Similarly, investigations at Nari-Pili Nadi revealed 27 avian species observed over a 15-year period (2007–2022), with negative impacts attributable to sewage discharge, chemical pollution, parasite infestation, and bioaccumulation of contaminants through predation on polluted aquatic organisms (Saxena *et al*.). Although the drainage system experiences seasonal desiccation, it supports colonies of Bubulcus ibis, Egretta intermedia, and Egretta garzetta during favorable periods.

Recent field studies in the Vidarbha region by Saxena *et al.* (2023) recorded 51 bird species across 14 families using a combination of visual surveys and binocular-assisted observations. Seven species were identified as "Near Threatened" based on IUCN assessments (2016). In a separate avian census from 2013–2014, Porte and Singh (2017) reported 4,572 birds spanning 12 families in Chhattisgarh, predominantly winter migratory species frequenting undisturbed wetlands. Contrastingly, polluted aquatic habitats characterized by hunting, waste dumping, and idol immersion exhibited significantly lower avian diversity.

Wang *et al.* (2018) conducted a comparative study on Actophilornis africanus populations within the protected Ruzizi Delta (Burundi) and the unprotected Ruzizi Delta (Democratic Republic of the Congo). Their findings revealed higher bird abundance in the protected area, suggesting habitat fragmentation and ecological threats in unprotected sites as primary factors influencing avian distribution

In studies of bird assemblages at Chirkdhan Dam, Shahana Pond (Shahada Tehsil, Nandurbar), and adjacent dams (Susari, Khaparkheda, and Dudhkhed), researchers attributed low avifaunal richness to intensive agricultural practices and the use of agrochemicals (Chaudhari & Ishi, 2019). Their findings documented 63 bird species across 17 orders and 32 families, with Passeriformes and Lecanformes being dominant groups.

Similar surveys at Lake Pardi, Gadchiroli, utilized line and point transect methods, identifying 50 bird species, with Bubulcus ibis and Egretta garzetta being particularly abundant. Conservation initiatives emphasizing community engagement have been recommended by Patil and Chavhan (2022) to protect avifaunal populations under the "Least Concern" category.

Alexis *et al.* (2023) proposed conservation strategies for Bubulcus ibis, Amaurornis flavirostris, and Actophilornis africanus across five sites in the Ruzizi Delta, advocating for the formal protection of the Congolese portion of the wetland. Observations indicated peak bird presence during the rainy season in May, with the lowest recorded numbers occurring in July.

Lenka *et al.* (2023) assessed avian biodiversity around Thane Creek (Maharashtra), where Bhandup Pumping Station emerged as the most species-rich site, harboring 125 bird species across 90 genera, 47 families, and 18 taxonomic orders. The highest Shannon Index (4.42) was observed in Bhandup, whereas the Flamingo Sanctuary exhibited the lowest diversity index (3.88). Statistical correlations demonstrated significant associations between shrub density and bird species richness, further informing conservation perspectives for mangrove ecosystems.

A study by Meshram *et al.* (2023) documented 23 avian families along a 5 km forest stretch near Pauni-Nagpur Road (Southwest direction), categorizing birds into resident (27 species), resident migrant (7 species), and winter visitor (5 species) groups, with notable observations at Wahi Lake (Pauni, Bhandara).
Bhandarkar *et al.* (2023) conducted an extensive field survey at Shrungarbandh Lake, Gondia (Maharashtra), identifying 79 bird species across 16 families based on IUCN Red Data Book classifications (2022). Seven species were categorized as "Near Threatened," while three were classified as "Vulnerable," exhibiting downward population trends. Among the documented birds, 44 were winter migrants, while 44 were resident species. Proposed conservation measures include anthropogenic noise reduction and habitat preservation.

These collective studies underscore the urgency of avian conservation, habitat restoration, and sustainable management practices to mitigate biodiversity decline across varied wetland and forest ecosystems.

Recent studies on avian biodiversity have provided critical insights into species distribution, habitat

conservation, and ecological impacts across various wetland ecosystems.

Lunge *et al.* (2023) conducted a comprehensive assessment of avian diversity and abundance at five stations within the Upper Wardha Reservoir, Maharashtra. Among the 151 recorded bird species, 84 species belonged to wetland ecosystems, spanning 20 families, while 67 species were wetland-associated birds representing 22 families. The study emphasized habitat conservation and proposed measures to mitigate the trampling of bird eggs by grazing cattle, which poses a significant threat to reproductive success and population stability.

Ali *et al.* (2024) documented 117 bird species inhabiting Malkhed Lake, Amravati (Maharashtra), including 101 aquatic bird species and 18 duck species. Additionally, 31 species of underwater waders and 15 species from the lake's catchment area were recorded. Observations included migratory, resident, and breeding migrant species, as well as waders. The dominant families recorded were Scolopacidae, Anatidae, Ardeidae, Hirundinidae, Charadriidae, and Laridae. Noteworthy occasional sightings included the Greater Flamingo (Phoenicopterus roseus) and the Grey-headed Lapwing (Vanellus cinereus).

Wang & Ma (2025) emphasized the importance of public engagement, particularly among students, in contributing to waterbird conservation efforts through data collection and analysis. Their research advocates for the development of citizen science initiatives to generate empirical datasets that aid conservation planning and bibliometric assessments. Future research focuses on migratory bird hotspots, biodiversity monitoring, and the establishment of habitat networks. The framework of citizen science, as initially outlined by Craig *et al.* (2015), integrates systematic data collection, analytical modeling, and iterative refinement of conservation strategies.

Baldwin *et al.* (1996) examined the toxicological effects of tributylin, a persistent aquatic pollutant, demonstrating its role in inducing metabolic androgenization and imposex syndrome in gastropods, though Daphnia magna was found to be unaffected. The study hypothesized that avian species consuming tributylin-contaminated gastropods may exhibit physiological disruptions due to enzymatic detoxification mechanisms within hepatocytes. These alterations could induce sex gene mutations in both male and female birds, leading to aberrant allelic frequencies within gametes and consequent declines in population viability across successive generations. Additionally, affected species may undergo phenotypic modifications, functioning as "surrogate species," which could either positively or negatively influence ecosystem dynamics.

These findings collectively underscore the necessity for targeted conservation measures, sustainable habitat management practices, and enhanced public participation to mitigate biodiversity decline and ensure ecosystem resilience.

CONCLUSIONS

Birds serve as valuable biological indicators for assessing ecosystem health, offering a cost-effective yet highly sensitive approach to environmental monitoring. Their presence, diversity, and behavioral patterns provide critical insights into habitat quality and ecological stability. Conservation efforts should prioritize mitigating habitat loss, reconnecting fragmented landscapes, and systematically restoring degraded ecosystems through phased and targeted interventions to ensure long-term sustainability

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