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continued on the back inside cover

Cover: Fish species recorded in the Gowthami-Godavari Estuary, Andhra Pradesh: *Lutjanus johnii* (top left), *Triacanthus biaculeatus* (top right), *Acentrogobius cyanomos*, *Elops machnata*, *Trypauchen vagina*, *Oxyurichthys microlepis*. © Paromita Ray.

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COMMUNICATION

Avifaunal diversity in unprotected wetlands of Ayodhya District, Uttar Pradesh, India

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Abstract: Nine unprotected wetlands of Ayodhya district, Uttar Pradesh, India were studied to assess the bird species composition and richness from March 2019 to February 2020 using point count method. A total of 105 species of birds belonging to 79 genera, distributed among 35 families and 12 orders were recorded. Passeriformes had the highest diversity with 25 species and 12 families. Anatidae was the most dominant family with 15 species, constituting 14.29% of the wetland bird community in the study area. These wetlands provided habitat for 62 residential species, 42 winter migrants and one vagrant. The carnivore guild was the most dominant with 46 species. The wetland sites under study were continuously used by humans mainly for land encroachment, fishing activities and livestock grazing apart from other minor uses. Out of the nine selected wetlands, three wetlands (<2 ha) had very few bird species (≤3), therefore were excluded from further calculations. But the rest of the six selected wetlands (>5 ha) provided habitat for 12 bird species of conservation importance (one Endangered species, five Vulnerable species, and six Near Threatened species) according to the IUCN Red list. These wetlands also supported 39 species of birds having a declining population trend globally. These findings highlight the role of medium and large-sized unprotected wetlands in providing critical habitat to the birds throughout the year in Ayodhya district. Future research must concentrate on understanding the key factors influencing the presence and absence of birds in such unprotected wetlands so that these wetlands can be managed effectively to secure the potential habitat of birds.

Keywords: Birds, conservation importance, feeding guild, relative diversity index, species richness.

Hindi: बिंदु गणना पद्धति का उपयोग करके मार्च 2019 से फरवरी 2020 तक पक्षी प्रजातियों की संरचना और समृद्धि का आकलन करने के लिए अयोध्या जिले, उत्तर प्रदेश, भारत की नौ असरक्षित जलीय क्षेत्रो का अध्ययन किया गया।12 वर्गों तथा 35 कुलों से सम्बन्ध रखने वाली पक्षियों की 79 वंशो की उपस्थिति का पता चला जो कि 105 प्रजातियों को निरूपित करते है। पेसैरीफार्मिस सबसे अधिक कुल (12) और 25 पक्षी प्रजाति के साथ सबसे अधिक विविधता वाला गण था। एनाटिडे 15 प्रजातियों के साथ सबसे प्रमुख कुल था, जो अध्ययन क्षेत्र में मौजूद पक्षी समुदाय का 14.29% था। ये जलीय क्षेत्रो में 62 स्थानीय प्रजातियां, 42 शीतकालीन प्रवासी पक्षी और एक घुमन्तु पक्षी को आवास प्रदान करते है। 46 प्रजातियों के साथ मांसाहारी गिल्ड सबसे प्रमुख था। अध्ययन के तहत आने वाले जलीय क्षेत्रो का उपयोग मनुष्यों द्वारा मुख्य रूप से मछली पकड़ने, पशुओं को चराने तथा भूमि अतिक्रमण के लिए किया जाता था । नौ चयनित जलीय क्षेत्रो में से, तीन जलीय क्षेत्रो में (<2 हेक्टेयर) बहुत कम पक्षी प्रजातियां (≤3) थीं, इसलिए आगे की गणना में उन्हें नगण्य माना गया है। लेकिन शेष छह चयनित जलीय क्षेत्रो (>5 हेक्टेयर) ने आईयूसीएन रेड लिस्ट के अनुसार 12 संकटग्रस्त पक्षी प्रजातियों (एक संकटापन्न प्रजाति, पांच संवेदनशील प्रजातियों और छह संकट निकटवर्ती प्रजातियों) के लिए आवास प्रदान किया। इन जलीय क्षेत्रो ने विश्व स्तर पर घटती जनसंख्या प्रवृत्ति वाले पक्षियों की 39 प्रजातियों भी पायी गई। ये निष्कर्ष अयोध्या जिले में पूरे वर्ष पक्षियों को महत्वपूर्ण आवास प्रदान करने में मध्यम और बड़े आकार की असुरक्षित जलीय क्षेत्रो की भूमिका को उजागर करते हैं। भविष्य में किए जाने वाले अनुसंधान को ऐसी असुरक्षित जलीय क्षेत्रो में पक्षियों की उपस्थिति और अनुपस्थिति को प्रभावित करने वाले प्रमुख कारकों को समझने पर ध्यान केंद्रित करना चाहिए ताकि इन जलीय क्षेत्रो को पक्षियों के संभावित आवास को सुरक्षित करने के लिए प्रभावी ढंग से प्रबंधित किया जा सके।

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Author contributions: Y-U was involved in data collection. Both the authors were involved in data compilation, analysis, manuscript writing, editing and finalizing the manuscript.

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INTRODUCTION

Wetlands are transitional zones between terrestrial and aquatic ecosystems, which can be permanently or seasonally flooded but retain saturated soils throughout the unflooded period (TWI 2020). Wetlands occupy about 6% of the earth's surface, comprising bogs (30%), fens (26%), swamps (20%), and flood plains (15%) (Shine & Klemm 1999). Wetlands are highly diverse and biologically rich, providing habitats to many groups of species like waterbirds, fish, amphibians, reptiles, invertebrates, mammals, and plants. Wetlands play an important role in maintaining the hydrological cycle. The other services provided by wetlands include flood protection, water purification and recreational opportunities (Woodward & Wui 2001). Birds are an inseparable entity in wetland ecosystems as they play an important role in nutrient recycling and occupy different trophic levels in the food web (Custer & Osborn 1977; Rajashekara & Venkatesha 2010). Birds also act as useful bio-indicators reflecting the ecological health of the wetland ecosystems (Custer & Osborn 1977). Wetlands are important for resident as well as migratory birds as they provide them with foraging, breeding, & nesting habitats and sometimes also serve as stopover sites (Kumar et al. 2016). India has around 4.7% of the total geographical area of the country under wetlands (Bassi et al. 2014). Nearly 310 bird species are reported to be wetland dependent in India (Kumar et al. 2005). Uttar Pradesh has 12,42,530 ha of area under wetlands, i.e., 5.16% of the total geographical area, whereas Ayodhya district has 23,050 ha, i.e., 1.86% of land under wetlands (NWA 2010). Many wetlands in this region are under threat due to anthropogenic pressure like conversion of wetlands into agricultural lands or for commercial fishing purposes, fertilizers run-offs from surrounding agricultural lands, hunting, unsustainable harvest of wetland resources, invasion of alien species, eutrophication, extraction of edible nuts of *Trapa natans*, pumping out water for agricultural purposes (Yashmita-Ulman pers. Comm. February 2020) thus, threatening the very existence of the resident and migratory wetland birds. Unprotected wetlands defined as those wetlands which have no official protection or conservation status and are also open for public use (Blanckenberg et al. 2020), are usually ignored, but such wetlands too provide the required habitat to the birds. So, to understand the anthropogenic impacts on wetland birds and their habitat in the future, it is necessary to have a baseline information on the species occurrences and habitat choices. Such information will also help in long term monitoring of the habitat and preparing conservation and management strategies for the species as well as their habitat. This exercise will also highlight the ecological health of the wetlands. The bird species checklist thus generated will provide a base for further research.

The state of Uttar Pradesh has been reported to host 528 bird species (eBird 2021). It has eight wetlands listed under Ramsar Sites, which is the highest in India as compared to any other state. In addition to this, the state has many unprotected wetlands. But most of the studies on biodiversity in wetlands of Uttar Pradesh are concentrated on Ramsar and protected wetland sites. Studies have been conducted on plant diversity (Reddy et al. 2009), land-use changes (Behera et al. 2012) in Samaspur Bird Sanctuary, Rae Bareli, on plant diversity (Jha 2013) in Sandi Bird Sanctuary, Hardoi, and on butterfly diversity (Sharma 2007), medicinal plant diversity (Rani et al. 2009) & water quality monitoring (Gopal et al. 2015) in Sur Sarovar wetlands. There has been a study on bird diversity in agricultural landscapes of Ayodhya district (Yashmita-Ulman & Singh 2021), but there are no studies on wetlands of this district. As most of the wetlands present in Ayodhya district are either isolated, disturbed, unprotected or not designated as Ramsar sites, the inventories of these wetlands have not been done so far. So, this study is the first attempt to prepare a checklist of birds present in some selected unprotected wetlands of Ayodhya district.

MATERIALS AND METHODS

Study Area

Depending upon factors like easy accessibility and financial feasibility, three tehsils namely, Milkipur, Sohawal and Sadar of Ayodhya district (Figure 1) were chosen for the survey. Regular monitoring of the selected wetlands in these tehsils was possible as these tehsils fell in the daily commute route of the authors, i.e., from Rikabganj (Sadar tehsil) to Acharya Narendra Deva University of Agriculture and Technology (Milkipur tehsil) via NH 330A. The areas under these three tehsils were thoroughly searched for the presence of wetlands through google maps. Once the wetlands were identified, the areas were visited for ground truthing and preliminary bird survey. Depending on the presence of motorable roads, preliminary bird surveys and information from local people, a total of nine wetlands, three from each tehsil were selected for monthly bird surveys. Out of these nine wetlands, three wetlands

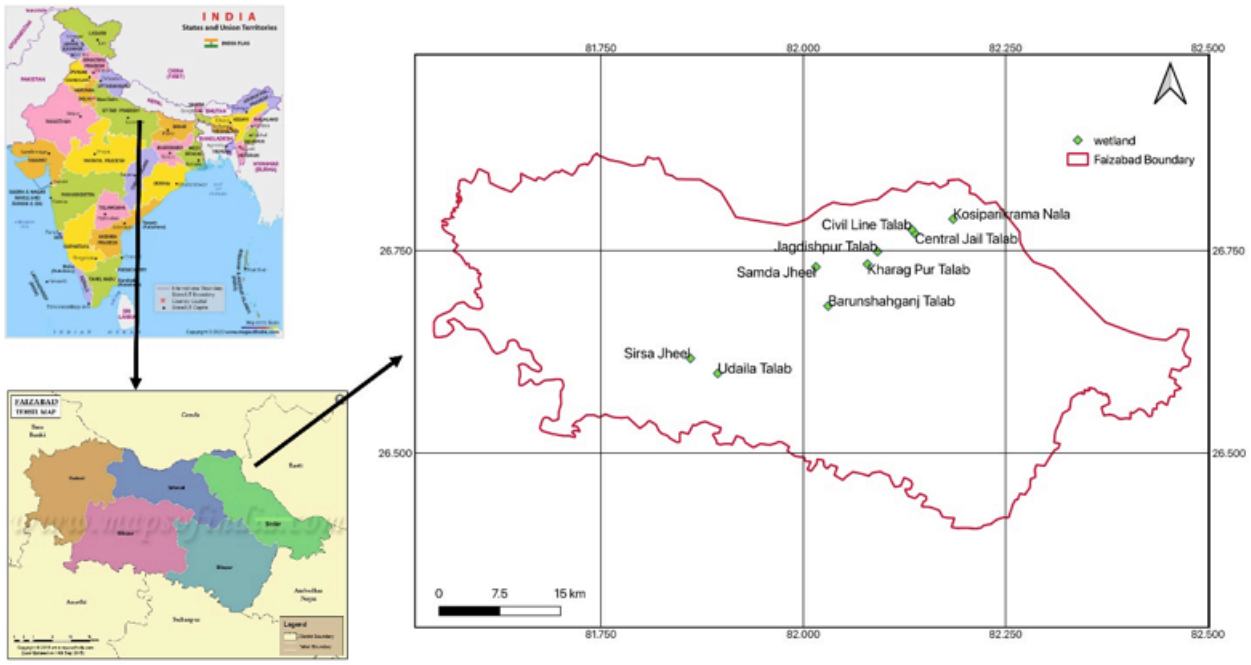

Figure 1. The study area and study locations.

(<2 ha) supported very few bird species (≤3) and that too on an irregular basis (Table 1). So, data from these wetlands was not included in further analysis to avoid discrepancies in results. Therefore, this study reports the analyzed results only from six unprotected wetlands, three from Milkipur tehsil (Udaila Talab (Figure 1 & Image 1a), Sirsa Jheel (Figure 1 & Image 1b), & Barunshahganj Talab (Figure 1 & Image 1c); two from Sohawal tehsil (Jagdishpur Talab (Figure 1 & Image 1d) & Samda Jheel (Figure 1 & Image 1e); and one from Sadar tehsil (Kosiparikrama Nallah (Figure 1,2f) of Ayodhya district, Uttar Pradesh.

Ayodhya district is situated between 26.7730 °N and 82.1458 °E, and has an elevation of 93 m (KVK 2021). This district has an area of around 2,764 km^2 (KVK 2021). Ayodhya city is situated on the banks of the river Ghagra locally known as 'Saryu'. The climate is humid (Kumar 2018) and experiences summer season from March to June, rainy season from July to October and winter season from November to February (Sundar & Kittur 2012). The annual rainfall of the district is around 1,067 mm. The average temperature is 32 ^{0}C during summer season and 16 ^{0}C during winter season (KVK 2021). *Oryza sativa – Triticum aestivum* is the main cropping system. *Saccharum officinarum* and *Brassica juncea* are also grown in the area along with horticultural crops (*Mangifera indica, Psidium guajava, Phyllanthus emblica*, and *Musa* sp.) (KVK 2021). The detailed description of the selected unprotected wetlands is given in Table 1.

Methods

Bird surveys were conducted monthly using point-count method (Bibby et al. 2000) in the selected study sites from March 2019 to February 2020. Two point counts were fixed on the perimeter of each wetland making a total of 18 point counts in the whole district. In the same wetland the distance between the two point counts was at least 250 m. Each point count was surveyed 24 times during the entire study duration. After arriving at each point count, the observations of the initial 5 mins were not recorded giving time for the birds to settle down. After the initial 5 mins, bird species were recorded for the next 15 mins at the same point. During winters, fog conditions affected visibility early in the morning, so the observations were made whenever visibility was good (usually between 1000 to 1230 h) and for the rest of the seasons survey was conducted between 0600 to 0830 h. Birds were recorded directly with the help of field binoculars (Nikon 7x35). On each sighting, the details such as, species name, number of individuals and habitat were recorded. Birds flying across were not counted. The opportunistic counts were also recorded during other times of the day by scanning the periphery or banks of the wetlands. Grimmett et al. (2011) was used for bird identification and for knowing the residential status of birds (residents, winter visitor,

Image 1. Some of the selected unprotected wetland sites for study: a—Udaila Talab | b—Sirsa Jheel | c—Barunshahganj Talab | d—Jagdishpur Jheel | e—Samda Jheel | f—Kosiparikrama Nallah. © Authors.

summer visitor). Praveen et al. (2020) was followed for the taxonomic position and names. The classification of birds into major feeding guilds was done using Ali & Ripley (1987) and field observations. The IWPA (1972) and CITES (2012) were followed for assigning the conservation status of species. The Red List of IUCN (2021) was followed to compile the conservation status and the global population trend (decreasing, increasing, stable, unknown) of the recorded species.

Species richness was calculated as total number of bird species recorded in the study area.

The following community parameters were calculated using the below given formulae:

[i] Relative diversity of bird families (RDi) (Torre-Cuadros et al. 2007)

$$RDi = \frac{\text{Number of bird species in a family}}{\text{Total number of species}} \times 100$$

[ii] Shannon Weiner index (Shannon & Weiner 1963)

$$H' = \sum_{i=1}^{s} p_i \ln p_i$$

where, p_i is often the proportion of individuals

belonging to the 'i'th species in the dataset and 's' is the species richness. The values usually lies between 1 and 4 where 1 shows less diversity and 4 shows high diversity.

[iii] Margalef Richness Index (Margalef 1958)

$$\text{Margalef Richness Index (D)} = \frac{S-1}{\text{Log (n)}}$$

where, 'S' is the total number of species and 'n' is the total number of individuals in the sample.

[iv] Simpson's index (Simpson 1949)

This was calculated according to Simpson (1949) to measure the concentration of dominance (CD) of bird species.

$$CD = \sum_{i=1}^{s} (pi)^2$$

where pi is the proportion of the Importance Value Index (IVI) of the 'i'th species and IVI of all the species (ni/N). The values of Simpson's index is limited to 1 where 1 shows dominance by a single species.

[v] Pielou's evenness index (Pielou 1966) = H'/ $\log_{10}$N(S)

where H' is the Shanon Weiner Index of diversity and S is the total number of species.

This index ranges from 0 (no evenness) to 1 (complete evenness).

[vi] Sorenson's similarity coefficient (Sorenson 1948)

$$\text{Sorenson similarity coefficient} = \frac{2C}{A+B}$$

where C is the number of species common to both sites, A is the total number of species in site A, and B is the total number of species in site B. Sorenson's coefficient gives a value between 0 and 1, the closer the value is to 1, the more the communities have in common.

RESULTS

Out of nine wetlands, three wetlands (<2 ha) had very few bird species (≤3) and that too on an irregular basis and were not considered in calculations to avoid discrepancies in results (Table 1). A total of 105 species of birds belonging to 79 genera, distributed among 35 families and 12 orders were recorded from the six unprotected wetlands of Ayodhya district, Uttar Pradesh during the study period (Table 2). Out of 105 species found, 73 species were wetland-associated and 32 species were terrestrial. Among the recorded bird species, 45 species (42.85%) were found commonly at all the six unprotected wetlands and 60 species (57.14%) were found at specific unprotected wetlands sites (Table 2). Passeriformes had the highest diversity with 25 species and 12 families, followed by Charadriiformes with 22 species from eight families (Figure 3). Anatidae was the most dominant family with 15 species and the highest RDi value (14.29) (Table 3). This was followed by Accipitridae with 10 species (Figure 2). Acrocephalidae, Alaudidae, Anhingidae, Columbidae, Dicruridae, Falconidae, Glareolidae, Gruidae, Laridae, Leiothrichidae, Pandionidae, Passeridae, Phylloscopidae, Recurvirostridae, Rostratulidae were represented by just a single genus and were the least represented (Figure 2).

Of all the bird species recorded, 62 species (59.05%) were resident, 42 species (40.00%) were winter visitors and one species (0.95%) was vagrant. As far as the foraging habit of the bird community in the selected wetland sites were concerned, five major feeding guilds were identified (Figure 3). The carnivore guild was the most dominant with 46 species (43.81%), followed by omnivore 42 species (40.00%), insectivore 15 species (14.29%) and frugivore and granivore with one species each (0.95%) (Figure 3). The maximum number of bird species were recorded in the months of January and February (89 each) and the least was recorded in the month of August (Figure 4). The unprotected wetland sites of Ayodhya district supported one Endangered species—*Aquila nipalensis*, five Vulnerable species—*Antigone antigone, Aquila rapax, Aythya ferina, Clanga hastata*, & *Sterna aurantia*, and six Near Threatened species—*Anhinga melanogaster, Ciconia episcopus, Mycteria leucocephala, Vanellus duvaucelii, Esacus recurvirostris*, & *Threskiornis melanocephalus* (Table 2). Moreover, these wetlands supported 39 species (37.14%) of birds having a declining population trend globally (Table 2).

The Shannon-Weiner index and Margalef richness index across the six unprotected wetland sites revealed that Udaila Talab was the most diverse and species rich wetland (3.86, 26.94) with 92 species (Table 4). This was followed by Samda Jheel (3.82, 25.41), Sirsa Jheel (3.80, 24.52), Jagdishpur Jheel (3.63, 23.66), Kosiparikrama Nallah (3.62, 23.82). Barunshahganj Talab (3.55, 22.59) was found to be the least diverse of all (Table 4). All the wetlands showed diverse species and no single species showed dominancy (Table 4). The similarity in species composition of birds was measured using Sorenson's similarity index (Table 5), the results of which highlighted that Udaila Talab and Samda Jheel showed the highest similarity (0.91) in bird communities, followed by Udaila Talab and Sirsa Jheel (0.89) and Samda Jheel and Sirsa Jheel (0.88) (Table 5). The least bird species similarity was shown between Jagdishpur Jheel and Kosiparikrama Nallah (0.76) (Table 5).

Table 1. Brief description about the surveyed unprotected wetlands of Ayodhya district, Uttar Pradesh, India.

	Name of wetland	Name of tehsil	Co-ordinates	Size (ha)	Features	Species (No. of individuals) observed	Remark
1	Udaila Talab	Milkipur	26.59822° N 81.8937° E	62	This wetland is surrounded by main road on one side and agricultural land on the other side. There are aquatic plants and trees surrounding the wetland. The undulating topography has created many natural bunds in this wetland which are used as resting sites by the birds. Fishing and cattle grazing activities are carried out in this wetland. This is a stagnant water body.	92 (2381)	Data included in analysis
2	Sirsa Jheel	Milkipur	26.6174° N 81.86063° E	90	This wetland is surrounded by agricultural land and human habitation. The wetland is also surrounded by trees and bushes in its vicinity and has abundant aquatic weeds supporting aquatic zooplankton. This is a stagnant water body.	81 (1828)	Data included in analysis
3	Barun-shahganj Talab	Milkipur	26.68102° N 82.03081° E	13.3	This wetland is surrounded by human habitations on one side and agricultural land on other side and lies adjacent to state highway NH 330A. The wetland is also surrounded by trees and bushes and has abundant aquatic weeds supporting aquatic zooplankton. This wetland is used for fishing and irrigation purposes. This is a stagnant water body.	72 (1387)	Data included in analysis
4	Samda Jheel	Sohawal	26.789° N 82.185° E	78	This wetland is surrounded by agricultural land and is bisected by a road. The bisecting road on both the sides is lined with trees and the wetland is also surrounded with trees and bushes and has plenty of aquatic weeds. The forest department has recently developed raised platforms or bunds to provide artificial resting and nesting sites for the wetland birds. This is a stagnant water body.	85 (2019)	Data included in analysis
5	Jagdishpur Talab	Sohawal	26.732° N 82.018° E	12.6	This wetland is surrounded by agricultural land on one side and human habitation on the other side. This wetland has trees planted on its periphery and has abundant aquatic weeds. The water from this wetland is used for irrigation purposes. This wetland is being encroached upon for paddy cultivation. It is used for extraction of edible nuts of *Trapa natans*. This is a stagnant water body.	78 (1796)	Data included in analysis
6	Kharagpur Talab	Sohawal	26.73324° N 82.07941° E	1.10	This wetland is surrounded by agricultural fields from three sides and a village road on one side. Fishing and cattle grazing activities are carried out in this wetland. This is a stagnant water body.	*Bubulcus ibis* (8) *Vanellus indicus* (4)	Data excluded from analysis
7	Kosipari-krama Nallah	Sadar	26.74853° N 82.09177° E	6.38	This wetland is surrounded by main road (Kosi-Parikrama road) on one side and *Psidium guajava* orchard on the other side. This wetland in some parts has high abundance of aquatic weeds and reeds, but in some areas is devoid of aquatic vegetation as it has been cleared for fishing purposes. This wetland is also used for cattle grazing and some area is being encroached upon for conversion into agricultural land. The Nallah primarily is used to dump the sewage of the city and finally meets with the Saryu river. This is a flowing water body.	76 (1404)	Data included in analysis
8	Central Jail Talab	Sadar	26.77113° N 82.13801° E	0.69	This wetland is surrounded by the District Jail on one side, plantation on two sides. A railway track is also present on one side of this wetland creating high noise levels. This wetland is used by the locals for fishing activities. This wetland has abundant aquatic weeds. This is a stagnant water body.	*Bubulcus ibis* (8) *Microcarbo niger* (5)	Data excluded from analysis
9	Civil Line Talab	Sadar	26.77586° N 82.13421° E	1.75	This wetland is surrounded by human settlements (residential and commercial) on all sides creating high noise levels. This is a stagnant water body.	*Bubulcus ibis* (6) *Microcarbo niger* (7)	Data excluded from analysis

Table 2. Checklist and status of avifauna recorded in unprotected wetlands of Ayodhya district, Uttar Pradesh, India

	Order/Family/ Common name	Scientific name	Residential status	Feeding guild	Conservation status			Global status	Wetland sites						Plate No.
					IUCN (2021)	CITES (2012)	IWPA (1972)		UDT	SDJ	SSJ	JDJ	KPN	BST	
Accipitriformes Accipitridae (10)															
1	Black Kite	*Milvus migrans* (Boddaert, 1783)	R	C	LC	II	I	→	√	√	√	√	√	√	
2	Black-winged Kite	*Elanus caeruleus* (Desfontaines, 1789)	R	C	LC	II	I	→	√	√	√	√	√	√	
3	Indian Spotted Eagle	*Clanga hastata* (Lesson, 1831)	R	C	VU	II	I	↓	√	√	×	√	×	×	
4	Long-legged Buzzard	*Buteo rufinus* (Cretzschmar, 1829)	WV	C	LC	II	I	→	√	√	√	×	×	×	
5	Oriental Honey Buzzard	*Pernis ptilorhynchus* (Temminck, 1821)	R	C	LC	II	I	↓	√	√	√	×	√	√	
6	Shikra	*Accipiter badius* (Gmelin, 1788)	R	C	LC	II	I	→	√	√	√	√	√	√	
7	Steppe Eagle	*Aquila nipalensis* (Hodgson, 1833)	WV	C	EN	II	I	↓	√	√	√	×	√	×	
8	Tawny Eagle	*Aquila rapax* (Temminck, 1828)	R	C	VU	II	I	↓	×	×	×	√	×	×	
9	Western Marsh Harrier	*Circus aeruginosus* (Linnaeus, 1758)	WV	C	LC	II	I	→	√	√	×	×	√	×	
10	White-eyed Buzzard	*Butastur teesa* (Franklin, 1831)	R	C	LC	II	I	→	√	√	√	×	√	√	
Pandionidae (1)															
11	Osprey	*Pandion haliaetus* (Linnaeus, 1758)	WV	C	LC	II	I	↑	√	×	√	√	×	√	
Anseriformes Anatidae (15)															
12	Bar-headed Goose	*Anser indicus* (Latham, 1790)	WV	O	LC	-	IV	↓	√	√	×	√	√	×	
13	Common Pochard	*Aythya ferina* (Linnaeus, 1758)	WV	O	VU	-	IV	↓	√	×	√	×	×	×	
14	Common Teal	*Anas crecca* (Linnaeus, 1758)	WV	O	LC	-	IV	?	√	√	×	×	×	×	
15	Cotton Pygmy-goose	*Nettapus coromandelianus* (Gmelin, 1789)	R	O	LC	-	IV	→	√	√	√	√	√	√	
16	Gadwall	*Mareca strepera* (Linnaeus, 1758)	WV	O	LC	-	IV	↑	×	√	√	×	√	×	
17	Garganey	*Spatula querquedula* (Linnaeus, 1758)	WV	O	LC	-	IV	↓	×	×	√	√	×	√	
18	Graylag Goose	*Anser anser* (Linnaeus, 1758)	WV	O	LC	-	IV	↑	√	√	×	×	×	×	
19	Indian Spot-billed Duck	*Anas poecilorhyncha* (Forster, 1781)	R	O	LC	-	IV	↓	√	√	√	√	√	√	
20	Knob-billed Duck	*Sarkidiornis melanotos* (Pennant, 1769)	R	O	LC	II	IV	↓	√	√	√	×	√	×	
21	Lesser Whistling Duck	*Dendrocygna javanica* (Horsfield, 1821)	R	O	LC	-	IV	↓	√	√	√	√	√	√	
22	Mallard	*Anas platyrhynchos* (Linnaeus, 1758)	WV	O	LC	-	IV	↑	×	×	×	×	√	×	
23	Northern Pintail	*Anas acuta* (Linnaeus, 1758)	WV	O	LC	-	IV	↓	√	√	√	√	√	×	
24	Northern Shoveler	*Spatula clypeata* (Linnaeus, 1758)	WV	O	LC	-	IV	↓	√	√	√	×	√	×	
25	Ruddy Shelduck	*Tadorna ferruginea* (Pallas, 1764)	WV	O	LC	-	IV	?	√	√	√	×	√	×	

	Order/Family/ Common name	Scientific name	Residential status	Feeding guild	Conservation status			Global status	Wetland sites						Plate No.
					IUCN (2021)	CITES (2012)	IWPA (1972)		UDT	SDJ	SSJ	JDJ	KPN	BST	
26	Tufted Duck	*Aythya fuligula* (Linnaeus, 1758)	WV	O	LC	-	IV	→	×	×	√	×	×	×	
Charadriiformes Burhinidae (2)															
27	Eurasian Thick-knee	*Burhinus oedicnemus* (Linnaeus, 1758)	R	O	LC	-	IV	↓	√	√	√	√	√	√	
28	Great Thick-knee	*Esacus recurvirostris* (Cuvier, 1829)	R	C	NT	-	IV	↓	√	√	√	√	×	×	
Charadriidae (6)															
29	Grey-headed Lapwing	*Vanellus cinereus* (Blyth, 1842)	WV	C	LC	-	IV	↓	√	√	×	×	×	×	
30	Kentish Plover	*Charadrius alexandrinus* (Linnaeus, 1758)	WV	C	LC	-	IV	↓	×	×	×	√	√	√	
31	Little Ringed Plover	*Charadrius dubius* (Scopoli, 1786)	R	O	LC	-	IV	→	√	√	√	√	√	√	
32	Red-wattled Lapwing	*Vanellus indicus* (Boddaert, 1783)	R	O	LC	-	IV	?	√	√	√	√	√	√	1a
33	River Lapwing	*Vanellus duvaucelii* (Lesson, 1826)	R	C	NT	-	IV	↓	√	√	√	√	√	√	
34	Yellow-wattled Lapwing	*Vanellus malabaricus* (Boddaert, 1783)	R	C	LC	-	IV	→	√	√	√	√	√	√	
Glareolidae (1)															
35	Small Pratincole	*Glareola lactea* (Temminck, 1820)	R	I	LC	-	IV	?	√	√	×	×	×	×	
Jacanidae (2)															
36	Bronze-winged Jacana	*Metopidius indicus* (Latham, 1790)	R	O	LC	-	IV	?	√	√	√	√	√	√	1b
37	Pheasant-tailed Jacana	*Hydrophasianus chirurgus* (Scopoli, 1786)	R	O	LC	-	IV	↓	√						
Laridae (1)															
38	River Tern	*Sterna aurantia* (Gray, 1831)	R	C	VU	-	IV	↓	√	√	√	√	×	×	
Recurvirostridae (1)															
39	Black-winged Stilt	*Himantopus himantopus* (Linnaeus, 1758)	WV	C	LC	-	IV	↑	√	√	√	√	√	√	1c
Rostratulidae (1)															
40	Greater Painted-snipe	*Rostratula benghalensis* (Linnaeus, 1758)	R	O	LC	-	IV	↓	√	√	√	√	√	√	
Scolopacidae (8)															
41	Common Greenshank	*Tringa nebularia* (Gunnerus, 1767)	WV	C	LC	-	IV	→	√	√	√	√	√	√	
42	Common Redshank	*Tringa totanus* (Linnaeus, 1758)	WV	C	LC	-	IV	?	√	√	√	√	√	√	
43	Common Sandpiper	*Actitis hypoleucos* (Linnaeus, 1758)	WV	C	LC	-	IV	↓	√	√	√	√	√	√	
44	Common Snipe	*Gallinago gallinago* (Linnaeus, 1758)	WV	O	LC	-	IV	↓	×	×	×	×	√	√	
45	Green Sandpiper	*Tringa ochropus* (Linnaeus, 1758)	WV	O	LC	-	IV	↑	√	√	√	√	×	√	
46	Little Stint	*Calidris minuta* (Leisler, 1812)	WV	O	LC	-	IV	↑	×	×	×	√	×	×	
47	Temminck's Stint	*Calidris temminckii* (Leisler, 1812)	WV	O	LC	-	IV	?	√	√	√	√	√	√	

	Order/Family/ Common name	Scientific name	Residential status	Feeding guild	Conservation status			Global status	Wetland sites						Plate No.
					IUCN (2021)	CITES (2012)	IWPA (1972)		UDT	SDJ	SSJ	JDJ	KPN	BST	
48	Wood Sandpiper	*Tringa glareola* (Linnaeus, 1758)	WV	O	LC	-	IV	→	√	√	√	√	×	√	
Columbiformes Columbidae (1)															
49	Yellow-footed Green-pigeon	*Treron phoenicopterus* (Latham, 1790)	R	F	LC	-	IV	↑	√	√	√	√	×	√	
Coraciiformes Alcedinidae (4)															
50	Common Kingfisher	*Alcedo atthis* (Linnaeus, 1758)	R	C	LC	-	IV	?	√	√	√	√	√	√	
51	Pied Kingfisher	*Ceryle rudis* (Linnaeus, 1758)	R	C	LC	-	IV	?	√	√	√	√	√	√	
52	Stork-billed Kingfisher	*Pelargopsis capensis* (Linnaeus, 1766)	R	C	LC	-	IV	↓	√						
53	White-throated Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	R	C	LC	-	IV	↑	√	√	√	√	√	√	
Falconiformes Falconidae (1)															
54	Common Kestrel	*Falco tinnunculus* (Linnaeus, 1758)	WV	C	LC	II	IV	↓	√	×	√	√	√	×	1g
Gruiformes Gruidae (1)															
55	Sarus Crane	*Antigone antigone* (Linnaeus, 1758)	R	O	VU	-	IV	↓	√	√	√	√	×	√	1h
Rallidae (5)															
56	Common Coot	*Fulica atra* (Linnaeus, 1758)	R	O	LC	-	IV	↑	√	√	√	√	√	√	
57	Common Moorhen	*Gallinula chloropus* (Linnaeus, 1758)	R	O	LC	-	IV	→	√	√	√	√	√	√	
58	Purple Swamphen	*Porphyrio porphyrio* (Linnaeus, 1758)	R	O	LC	-	IV	?	√	√	√	√	√	√	2a
59	Watercock	*Gallicrex cinerea* (Gmelin, 1789)	R	C	LC	-	IV	↓	√	√	×	√	√	√	
60	White-breasted Waterhen	*Amaurornis phoenicurus* (Pennant, 1769)	R	O	LC	-	IV	?	√	√	√	√	√	√	2b
Passeriformes Acrocephalidae (1)															
61	Blyth's Reed Warbler	*Acrocephalus dumetorum* (Blyth, 1849)	WV	O	LC	-	IV	↑	√	√	×	√	√	√	
Alaudidae (1)															
62	Sand Lark	*Alaudala raytal* (Blyth, 1845)	R	O	LC	-	IV	→	√	√	√	√	√	√	
Cisticolidae (2)															
63	Ashy Prinia	*Prinia socialis* (Sykes, 1832)	R	I	LC	-	IV	→	√	√	√	√	×	√	2c
64	Plain Prinia	*Prinia inornata* (Sykes, 1832)	R	I	LC	-	IV	→	√	√	√	√	×	×	2d
Dicruridae (1)															
65	Black Drongo	*Dicrurus macrocercus* (Vieillot, 1817)	R	C	LC	-	IV	?	√	√	√	√	√	√	
Estrildidae (2)															
66	Indian Silverbill	*Euodice malabarica* (Linnaeus, 1758)	R	G	LC	-	IV	→	√	√	√	×	√	√	

	Order/Family/ Common name	Scientific name	Residential status	Feeding guild	Conservation status			Global status	Wetland sites						Plate No.
					IUCN (2021)	CITES (2012)	IWPA (1972)		UDT	SDJ	SSJ	JDJ	KPN	BST	
67	Scaly-breasted Munia	*Lonchura punctulata* (Linaeus, 1758)	R	O	LC	-	IV	→	√	√	√	√	×	√	
Hirundinidae (4)															
68	Barn Swallow	*Hirundo rustica* (Linnaeus, 1758)	WV	I	LC	-	IV	↓	×	×	×	√	√	√	
69	Plain Martin	*Riparia paludicola* (Vieillot, 1817)	R	I	LC	-	IV	↓	√	√	√	×	√	√	
70	Streak-throated Swallow	*Petrochelidon fluvicola* (Blyth, 1855)	R	I	LC	-	IV	↑	√	√	√	√	√	√	
71	Wire-tailed Swallow	*Hirundo smithii* (Leach, 1818)	R	I	LC	-	IV	↑	√	√	√	√	√	√	
Leiothrichidae (1)															
72	Common Babbler	*Argya caudata* (Dumont, 1823)	R	O	LC	-	IV	→	√	√	√	√	√	×	
Motacillidae (5)															
73	Citrine Wagtail	*Motacilla citreola* (Pallas, 1776)	WV	I	LC	-	IV	↑	√	×	√	√	√	√	
74	Grey Wagtail	*Motacilla cinerea* (Tunstall, 1771)	WV	I	LC	-	IV	→	×	√	×	√	×	×	
75	Western Yellow Wagtail	*Motacilla flava* (Linnaeus, 1758)	WV	I	LC	-	IV	↓	√	×	√	√	√	√	
76	White Wagtail	*Motacilla alba* (Linnaeus, 1758)	WV	I	LC	-	IV	→	√	√	√	×	√	√	
77	White-browed Wagtail	*Motacilla maderaspatensis* (Gmelin, 1789)	R	I	LC	-	IV	→	√	√	√	√	√	√	
Muscicapidae (2)															
78	Black Redstart	*Phoenicurus ochruros* (Gmelin, 1774)	WV	I	LC	-	IV	↑	√	×	×	√	√	√	
79	Bluethroat	*Luscinia svecica* (Linnaeus, 1758)	WV	I	LC	-	IV	→	√	√	×	×	×	×	2f
Passeridae (1)															
80	House Sparrow	*Passer domesticus* (Linnaeus, 1758)	R	O	LC	-	IV	↓	√	√	√	√	√	×	
Phylloscopidae (1)															
81	Hume's Warbler	*Phylloscopus humei* (Brooks, 1878)	WV	I	LC	-	IV	→	×	×	×	×	√	×	
Sturnidae (4)															
82	Asian Pied Starling	*Gracupica contra* (Linnaeus, 1758)	R	O	LC	-	IV	↑	√	√	√	√	√	√	
83	Bank Myna	*Acridotheres ginginianus* (Latham, 1790)	R	O	LC	-	IV	↑	√	√	√	√	√	√	
84	Brahminy Starling	*Sturnia pagodarum* (Gmelin, 1789)	R	O	LC	-	IV	?	√	×	×	√	√	√	
85	Common Myna	*Acridotheres tristis* (Linnaeus, 1766)	R	O	LC	-	IV	↑	√	√	√	√	√	√	
Pelecaniformes Anhingidae (1)															
86	Oriental Darter	*Anhinga melanogaster* (Pennant, 1769)	WV	O	NT	-	IV	↓	√	√	√	√	×	√	
Ardeidae (8)															
87	Black-crowned Night Heron	*Nycticorax nycticorax* (Linnaeus, 1758)	R	O	LC	-	IV	↓	√	√	√	√	√	√	

	Order/Family/ Common name	Scientific name	Residential status	Feeding guild	Conservation status			Global status	Wetland sites						Plate No.
					IUCN (2021)	CITES (2012)	IWPA (1972)		UDT	SDJ	SSJ	JDJ	KPN	BST	
88	Cattle Egret	*Bubulcus ibis* (Linnaeus, 1758)	R	C	LC	-	IV	↑	√	√	√	√	√	√	
89	Great Egret	*Ardea alba* (Linnaeus, 1758)	R	C	LC	-	IV	?	√	√	√	√	√	√	
90	Grey Heron	*Ardea cinerea* (Linnaeus, 1758)	WV	C	LC	-	IV	?	√	×	×	√	√	×	2f
91	Indian Pond Heron	*Ardeola grayii* (Sykes, 1832)	R	C	LC	-	IV	?	√	√	√	√	√	√	
92	Intermediate Egret	*Ardea intermedia* (Wagler, 1829)	R	C	LC	-	IV	↓	√	√	√	√	×	√	
93	Little Egret	*Egretta garzetta* (Linnaeus, 1766)	R	C	LC	-	IV	↑	√	√	√	√	√	√	
94	Purple Heron	*Ardea purpurea* (Linnaeus, 1766)	R	C	LC	-	IV	↓	√	√	√	√	√	√	2g
Ciconiidae (3)															
95	Asian Openbill	*Anastomus oscitans* (Boddaert, 1783)	R	C	LC	-	IV	?	√	√	√	√	√	√	1d
96	Painted Stork	*Mycteria leucocephala* (Pennant, 1769)	WV	C	NT	-	IV	↓	√	×	√	√	×	×	1f
97	Woolly-necked Stork	*Ciconia episcopus* (Boddaert, 1783)	R	C	NT	-	IV	↓	√	√	√	×	√	√	1e
Phalacrocoracidae (2)															
98	Indian Cormorant	*Phalacrocorax fuscicollis* (Stephens, 1826)	WV	C	LC	-	IV	?	√	√	√	√	×	√	
99	Little Cormorant	*Microcarbo niger* (Vieillot, 1817)	R	C	LC	-	IV	?	√	√	√	√	√	√	
Threskiornithidae (2)															
100	Black-headed Ibis	*Threskiornis melanocephalus* (Latham, 1790)	V	C	NT	-	IV	↓	×	√	√	×	√	√	2h
101	Red-naped Ibis	*Pseudibis papillosa* (Temminck, 1824)	WV	C	LC	-	IV	↓	√	√	√	√	√	√	
Phoenicopteriformes Podicipedidae (2)															
102	Great Crested Grebe	*Podiceps cristatus* (Linnaeus, 1758)	WV	C	LC	-	IV	?	×	√	×	×	√	×	
103	Little Grebe	*Tachybaptus ruficollis* (Pallas, 1764)	R	C	LC	-	IV	↓	√	√	√	√	√	√	
Strigiformes Strigidae (2)															
104	Jungle Owlet	*Glaucidium radiatum* (Tickell, 1833)	R	C	LC	-	IV	→	√	√	√	√	√	√	
105	Spotted Owlet	*Athene brama* (Temminck, 1821)	R	C	LC	II	IV	→	√	√	√	√	√	√	

IUCN: International Union for Conservation of Nature and Natural Resources; CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora; IWPA: Indian Wildlife Protection Act; R: Resident, WV: Winter Visitor, V: Vagrant; C: Carnivorous; O: Omnivorous; I: Insectivorous; F: Frugivorous; G: Granivorous; LC: Least Concern; EN: Endangered; VU: Vulnerable; NT: Near Threatened; CITES II: Appendix-II species of CITES are the ones that are not necessarily threatened now with extinction but may become so unless trade is closely controlled; IWPA I: Schedule - I species of IWPA (high priority species); IV: Schedule - IV species of IWPA (relatively low priority species); ?: Unknown; →: Stable; ↑: Increasing; ↓: Decreasing; UDT: Udaila Talab; SDJ: Samda Jheel; SSJ: Sirsa Jheel; JDJ: Jagdishpur Jheel; KPN: Kosiparikrama Nallah; BST: Barunshahganj Talab; √: Species recorded in the site; ×: Species not recorded in the site.

Table 3. Relative diversity (Rdi) of various avian families in unprotected wetlands of Ayodhya district, Uttar Pradesh, India

Avian family	Number of species recorded	Rdi value
Anatidae	15	14.29
Accipitridae	10	9.52
Ardeidae	9	8.57
Scolopacidae	8	7.62
Charadriidae	6	5.71
Rallidae	5	4.76
Motacillidae	5	4.76
Alcedinidae	4	3.81
Hirundinidae	4	3.81
Sturnidae	4	3.81
Ciconiidae	3	2.86
Burhinidae	2	1.90
Jacanidae	2	1.90
Cisticolidae	2	1.90
Estrildidae	2	1.90
Muscicapidae	2	1.90
Phalacrocoracidae	2	1.90
Threskiornithidae	2	1.90
Podicipedidae	2	1.90
Strigidae	2	1.90
Pandionidae	1	0.95
Glareolidae	1	0.95
Laridae	1	0.95
Recurvirostridae	1	0.95
Rostratulidae	1	0.95
Columbidae	1	0.95
Falconidae	1	0.95
Gruidae	1	0.95
Acrocephalidae	1	0.95
Alaudidae	1	0.95
Dicruridae	1	0.95
Leiothrichidae	1	0.95
Passeridae	1	0.95
Phylloscopidae	1	0.95
Anhingidae	1	0.95

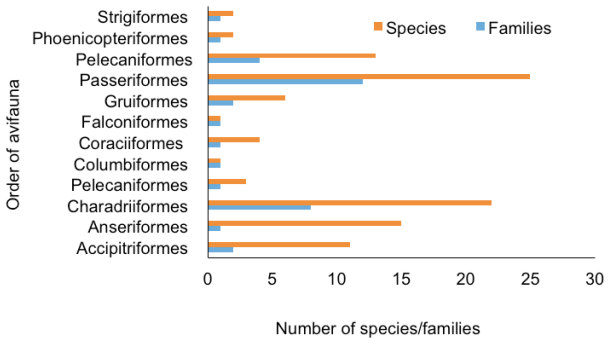

Figure 2. Composition of avian community in unprotected wetlands of Ayodhya district, Uttar Pradesh, India.

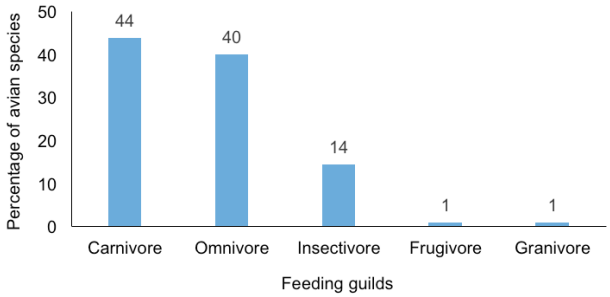

Figure 4. Guild-based classification of avian species recorded in unprotected wetland sites of Ayodhya district, Uttar Pradesh, India

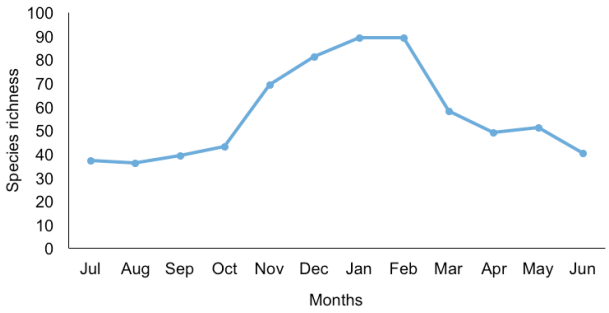

Figure 5. Monthly variation in species richness of avifauna recorded in unprotected wetland sites of Ayodhya district, Uttar Pradesh, India

DISCUSSION

In this survey, the Passeriformes was the dominant order which conforms to the studies of Kumar & Sharma (2018). Family Anatidae was the most dominant of all families of bird species found in the selected unprotected wetlands of Ayodhya district. Similar results were found by Kumar & Gupta (2009), Tak et al. (2010), Chopra & Sharma (2012), and Kumar et al. (2016). Nearly 60% of the bird species found were resident. This result conforms to the studies of Mazumdar (2019) who also recorded the majority of birds to be resident in nature. In the present study, it was found that the birds belonged to five feeding guilds, the dominant guild being carnivores, followed by omnivores. This finding implies that the wetlands catered to the needs of the birds providing them with diverse food items like fish, crustaceans, invertebrates, water plants and plankton

Table 4. Measurements of avian diversity and richness at unprotected wetland sites of Ayodhya district, Uttar Pradesh, India.

Wetland sites	Species richness	Shannon-Weiner Diversity Index (SDI)	Margalef's Richness Index (MRI)	Simpson's Dominance Index	Pielou's Evenness Index (PEI)
Udaila Talab	92	3.86	26.94	0.03	0.85
Samda Jheel	85	3.82	25.41	0.03	0.86
Sirsa Jheel	81	3.80	24.52	0.03	0.86
Jagdishpur Jheel	78	3.63	23.66	0.05	0.83
Kosiparikrama Nallah	76	3.62	23.82	0.03	0.83
Barunshahganj Talab	72	3.55	22.59	0.04	0.83

Table 5. Sorenson's Similarity Index of avian species between selected unprotected wetland sites of Ayodhya district, Uttar Pradesh, India.

Wetland sites	Udaila talab	Samda Jheel	Sirsa Jheel	Jagdishpur Jheel	Kosiparikrama Nallah	Barunshahganj Talab
Udaila talab	0.000					
Samda Jheel	0.915	0.000				
Sirsa Jheel	0.890	0.880	0.000			
Jagdishpur Jheel	0.847	0.798	0.830	0.000		
Kosiparikrama Nallah	0.810	0.795	0.803	0.766	0.000	
Barunshahganj Talab	0.817	0.803	0.850	0.853	0.824	0.000

(Basavarajappa 2006).

The highest species richness was recorded in the months of January and February (89 species each) which conforms to the observations of Mazumdar (2019) in Okhla Bird Sanctuary, Uttar Pradesh. It was found that the bird species starts to increase from October and reaches the maximum in the months of January and February (Figure 4). This is due to the migrating waterfowls which arrive in the wetlands during this season as Uttar Pradesh is a part of the Central Asian Flyway serving as a wintering ground for these species. This is also one of the reasons for recording a high number of winter visitors (42 species) in this study. The wetlands along with the agricultural landscapes in Ayodhya district prove to be a good habitat for these migratory birds and therefore support a high diversity, especially in winters (Yashmita-Ulman & Singh 2021). These migratory species gradually start flying back to their breeding grounds from March so, the species richness declines slowly from March and reaches the lowest in the monsoon months (Figure 4).

The wetland avian diversity and composition are influenced by factors like wetland size, location, vegetation (Sundar & Kittur 2013), type and level of anthropogenic activities, presence of additional and diverse foraging ground (Yashmita-Ulman & Singh 2021), water depth and quality (Saygili et al. 2011). Moreover, water birds usually prefer shallow water bodies with variations in depth (Helmers 1992; Colwell & Taft 2000). The Udaila Talab was surrounded by agricultural fields and had diverse vegetation like floating hydrophytes (*Azolla pinnata, Eichhornia cracipes, Jussiaea repens, Ipomoea aquatica*) and submerged hydrophytes (*Najas graminea, Potamogeton nodosus*). Trees like *Eucalyptus tereticornis, Phyllanthus emblica*, and *Mangifera indica* were found on the edge of the water body. It was a large sized water body with shallow water. Moreover, the undulating topography of the wetland gave rise to natural mounds and small isolated islands which served as resting places for the various bird species. As, Udaila Talab might have met all the requirements of bird species like alternative and diverse food supply, water depth variations, diverse microhabitats, it has registered as the wetland with the highest species richness and diversity. As far as both Sirsa and Samda Jheel were concerned, they both were surrounded with agricultural fields and trees, haboured rooted and emergent plants and had large areas under shallow water and marshy lands. Artificial mounds had been built in Samda Jheel by the Forest department to provide resting places to the water birds. All these factors might have attracted birds towards these jheels. So, both the wetlands supported a high avian diversity after Udaila Talab.

Deep waters are less preferred by waterbirds as they reduce the availability and accessibility of invertebrates (Murkin & Kadlec 1986). The Jagdishpur Jheel and Kosiparikrama Nallah therefore, had less to offer to the

Image 2. A—*Vanellus indicus* | b—Female of *Metopidius indicus* | c—*Himantopus himantopus* | d—*Anastomus oscitans* | e—*Ciconia episcopus* | f—*Mycteria leucocephala* | g—*Falco tinnunculus* | h—*Antigone antigone*. © Authors.

Image 3. a—*Porphyrio porphyrio* | b—*Amaurornis phoenicurus* | c—*Prinia socialis* | d—*Prinia inornata* | e—*Luscinia svecica* | f—*Ardea cinerea* | g—*Ardea purpurea* | h—*Threskiornis melanocephalus*. © Authors.

birds as they had higher water depths. Most of the birds found in these sites were restricted to the edge of the water bodies where the water was shallow. Only some ducks were found foraging in deep water. Moreover, the sewage water of the city of Ayodhya is drained into the Kosiparikrama Nallah and later this nallah merges with the Saryu river. So, mainly the birds like *Himantopus himantopus* which prefer feeding in polluted waters were found abundantly in this wetland. Both these wetlands were also smaller in size as compared to the other six wetlands in the study area. All these factors might be the reason for lower bird diversity in these wetlands as compared to Udaila Talab. On the other hand, though the Barunshahganj Talab has shallow water depth, it is a highly disturbed site as it lies next to the state highway NH 330A and has increasing land encroachment problems and is, therefore, shrinking in size and thus might have resulted in the lowest avian diversity as compared to the other wetlands in the study area.

It can be clearly understood from this study that all the wetlands in the study area have a great potential for conservation of avian communities. Though all the six wetlands under study were unprotected and had tremendous anthropogenic pressure, they were still capable of fulfilling the feeding, nesting and breeding requirements of the birds, and thus proved to be an optimum habitat. All the six wetlands in the study area had highly heterogeneous and mosaic of microhabitats as they were surrounded either by agricultural fields, orchards or plantations. The various tree species on the banks of wetlands provided the sites for perching, roosting and nesting of kingfishers, egrets, raptors, herons, cormorants and storks. The wading birds like storks, herons, ibises, snipe, redshank were found in shallow water and marshes. The wagtails, swamphens, waterhens and kingfishers were found in the adjoining agricultural fields as also reported by Urfi (2003). The plovers and sandpipers were found in the marshes. The waders like jacanas, egrets, herons, storks, ibises were found mostly feeding on *Nymphea* sp. The swimming and diving birds like coots, swamphens, ducks, cormorants, teal feasted on submerged vegetation (*Vallisneria* sp., *Ceratophylum* sp.) and emergent hydrophytes (*Oryza rufipogon, Polygonum barbatum*). So, all these might be the reasons for registering a high avian community composition even though these sites are unprotected and highly disturbed.

This survey shows 12 bird species (11.42%) of conservation importance in six unprotected and disturbed wetlands of Ayodhya district, Uttar Pradesh. In addition to this, species like *Sarkidiornis melanotos* and other raptor species listed in Appendix II of CITES are also found in these wetlands. All the species recorded in these wetlands are also listed under Schedule of Indian Wildlife (Protection) Act, 1972. Moreover, the global population trend of 39 bird species recorded from these wetlands is declining. So, from a global bird conservation point of view, the protection of these species and their habitat is of utmost importance.

On the other hand, three wetlands surveyed in this district yielded very few bird species (≤3) (Table 1) due to which they were removed from further analysis. The size of all three wetlands was less than 2 ha which was very less as compared to the other wetlands currently under study. So, the size of the wetlands might have influenced the bird diversity. This finding is well supported by Sarkar et al. (2013) who found similar results. This study also brings to the notice that though the medium and large sized wetlands in this area support sensitive species, the existence of the wetlands is itself in peril due to invasion of species like *Eichhornia crassipes* and anthropogenic activities such as fishing, land encroachment for fishing and agriculture, cattle grazing, fertilizer run-off, harvesting of *Trapa natans*, and urban development. Thus, endangering the habitat and survival of these bird species.

CONCLUSION

The sighting of 12 bird species of conservation importance and 39 species of birds having a declining population trend globally, highlights the significance of the medium and large sized unprotected and highly disturbed wetlands from the bird conservation point of view. The wetlands intermingled with the adjacent agricultural landscapes, orchards, plantations which created a congenial environment for resident as well as migratory birds as both of them have been reported in high numbers in the study area. But at the same time, small sized wetlands have reported very few bird species (≤3). This finding puts emphasis on the need for further research and replication of management activities like the ones taken up by the Forest Department in Samda Jheel in other potential medium and large sized unprotected wetlands of the district. So, this study acts as a reminder that medium and large sized wetlands, though isolated, disturbed and not designated as Ramsar sites, have the potential to be critical habitats for the most endangered species. Therefore, such wetlands should be given conservation and research priorities or else there is a

possibility of losing these valuable water bird habitats forever as is evident from the three wetlands which yielded just three bird species.

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