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Parmesh Kumar & Archana Sharma

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Abstract: Located in the Trans-Gangetic Plains of India, Kurukshetra is dotted with a number of man-made, perennial, sacred ponds of great historical and religious importance. These wetlands also serve as important wintering and stopover sites for birds coming from the Palearctic region. Surveys were conducted from April 2014 to March 2015 to record the diversity and status of avifauna in four sacred ponds of Kurukshetra. Point counts and direct observations were used to record the bird species. A total of 126 bird species of 98 genera belonging to 45 families and 16 orders were identified, of which 41 were winter migrants, six were summer migrants, and 79 were residents. Anatidae (n=15) was the most common family, followed by Ardeidae (n=8), and Motacillidae and Muscicapidae (n=7 each). Based on the guilds, 37 species were carnivorous, 36 omnivorous, 29 insectivorous, six herbivorous, six frugivorous, five granivorous, four insectivorous/nectarivorous, and three piscivorous. Of the species recorded, five species are classified as Near Threatened and one species as Vulnerable in the IUCN Red List of Threatened Species; nine species are listed in Appendix II of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and six species are included in Schedule I of the Indian Wildlife (Protection) Act, 1972. We hope that this study will provide a baseline for future research on monitoring the population and seasonal changes in the bird assemblage of sacred ponds.

Keywords: Avifauna, diversity, India, Kurukshetra, sacred ponds, status.

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Author Contribution: PK and AS conceived and designed the study. AS collected the field data and prepared rough draft of the manuscript. PK guided the research, analyzed the data and wrote the final draft of the manuscript.

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INTRODUCTION

Wetlands are the most productive biomes in the world (Kumar et al. 2005) and provide the transitional link between aquatic and terrestrial habitats (Torell et al. 2001; Zedler & Kercher 2005). They have specific ecological characteristics, functions, and values, occupying about 6% of the earth's surface (Maltby & Turner 1983; Green 1996; Getzner 2002) and providing habitat to a wide array of flora and fauna (Buckton 2007). Wetlands are, thus, often considered as treasuries of biodiversity within a region or a landscape (Gopal & Sah 1993; Surana et al. 2007). Birds constitute an important component of the biotic community of wetland ecosystems as they occupy several trophic levels in the food web of wetlands and form the terminal links in many aquatic food chains (Custer & Osborn 1977). Because of their high mobility, birds respond quickly to changes in their habitats (Morrison 1986); they are, thus, valuable indicators of the ecological health, productivity, trophic structure, human disturbance, and contamination of wetland ecosystems (Custer & Osborn 1977; Subramanya 1996).

India, with its varied topography and climatic regimes, supports diverse and unique wetland habitats that occupy an estimated area of 15.26 million hectares (Panigrahy et al. 2012). Apart from natural wetlands, which support 20% of the known biodiversity of India (Kumar et al. 2005), there are a large number of man-made wetlands that also support rich flora and fauna. It is estimated that there are 5,55,557 small-sized wetlands (<2.25 ha) in the form of village tanks/ponds in India (Panigrahy et al. 2012). These wetlands provide suitable habitats and food resources for a wide variety of birds (Stewart 2007; Ali et al. 2013). Of the 1,263 bird species reported from India (Praveen et al. 2016), 310 species are known to be dependent on wetlands (Kumar et al. 2005). Wetlands in India, as elsewhere, however, are under tremendous anthropogenic pressures including encroachment of wetland habitat, unsustainable harvesting of resources, industrial pollution, poisoning, agricultural runoff, eutrophication, siltation, and invasion of alien species (Prasad et al. 2002). These impacts can lead to population declines and changes in community structure of birds (Kler 2002; Verma et al. 2004; Reginald et al. 2007).

Biodiversity inventories or checklists serve as repositories of baseline information on species occurrences, biogeography, and their conservation status (Chandra & Gajbe 2005). They are essential tools for developing our knowledge and understanding

of biodiversity, and often the first step to evolve an appropriate long-term conservation strategy for birds and their habitats (Kumar et al. 2005; Badola & Aitken 2010).

Located in the Trans-Gangetic Plains of India, the landscape of Kurukshetra is dotted with a number of perennial, man-made, sacred wetlands of great historical and religious importance. A large number of pilgrims and tourists visit these sacred tanks to take a holy dip and perform religious ceremonies. These wetlands are also potentially important for birds, not only because they provide foraging, roosting, and breeding habitats for resident species, but also for their role as stopover sites or wintering areas for several migrants of the Palearctic region (Kumar et al. 2016). The avifauna of these sacred wetlands, however, remains poorly known. Lack of adequate information on bird species inhabiting wetlands greatly limits the development and establishment of effective conservation strategies. The present study was hence undertaken to make an inventory of bird species that inhabit sacred ponds of Kurukshetra in the Trans-Gangetic Plains of India along with their conservation and residential status.

MATERIALS AND METHODS

Study area

The present study was carried out in four religious ponds: namely, Brahma Sarovar, Jyoti Sarovar, Baan Ganga, and Sannihit Sarovar located in and around Kurukshetra (29.866–30.200 °N & 76.416–77.066 °E), Haryana, in the Trans-Gangetic Plains of India (Fig. 1, Table 1). These ponds are surrounded by human habitations and agricultural fields. The surrounding agriculture fields, with wheat and paddy as main crops, provide extra foraging space and food for certain wetland bird species. The study area, experiencing sub-tropical climate, has three seasons: rainy (July–September), cool-and-dry (October–February), and the hot-and-dry (March–June); temperature ranges from 3–45 °C and annual rainfall averages to 582mm. The wetlands support many types of macrophytes that may be grouped into marginal, submerged, floating, and emergent categories, of which *Eichhornia crassipes* (a deadly invasive) is the dominant free-floating, *Hydrilla verticillata* the dominant submerged, and *Cynodon dactylon* the dominant marginal species in the wetlands. Various tree species like Jamun *Syzygium cumini*, Mango *Mangifera indica*, *Alstonia* sp., *Acacia nilotica* & *Acacia arabica*, Neem *Azadirachta indica*, Jujube

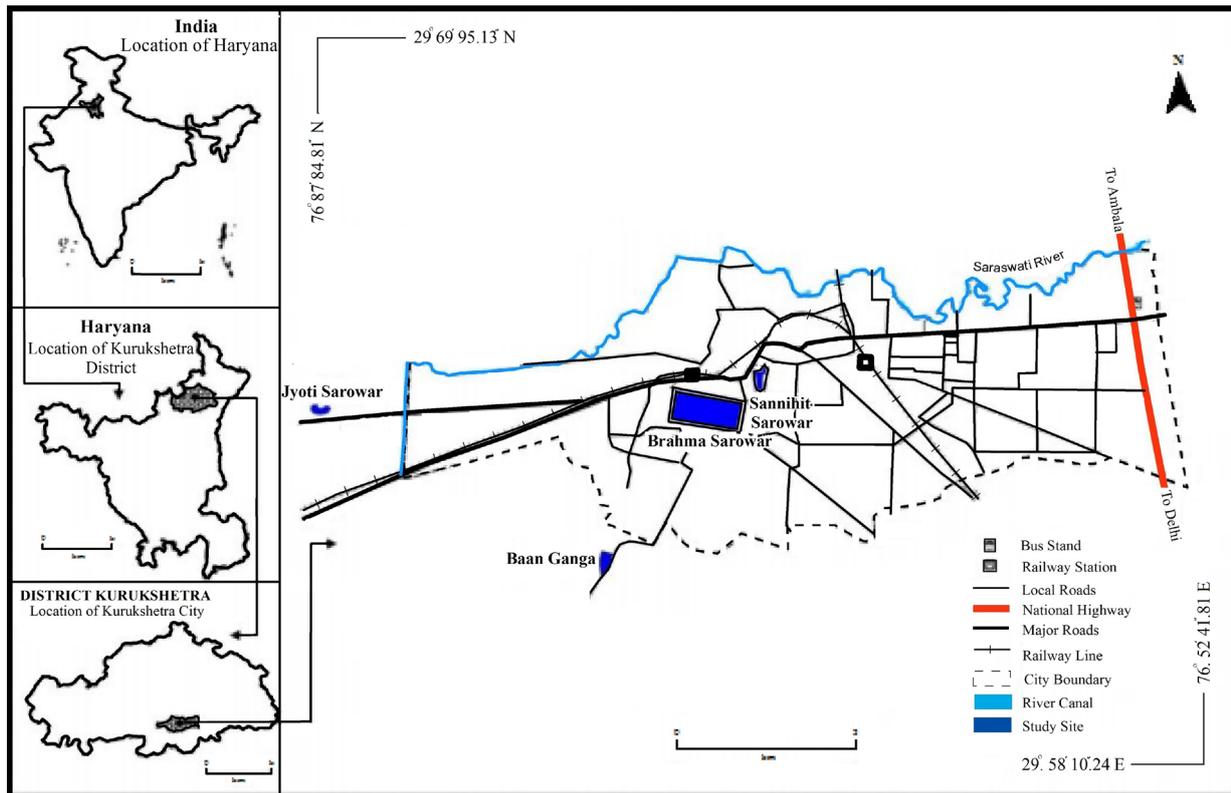


Figure 1. Location of selected study sites

Table 1. Summary of general characteristics of selected sacred ponds

	Sacred Pond	Coordinates	Elevation (m)	General Features
1.	Brahma Sarovar	29.950°N & 76.816°E	245	Rich, healthy, and robust perennial pond situated in the heart of Kurukshetra city; one of largest man-made bathing tanks in Asia; divided into two sections, namely, Eastern and Western Brahma Sarovar. The size of Eastern and Western Brahma Sarovar is 548.64×457.20×4.57 m and 457.20×457.20×4.57 m, respectively; edged with 6.09m wide platforms, stairs, and a 12.19m wide parikrama. Bathing platforms with protective railings have been constructed along the periphery of the tank. Exclusive separate and covered bathing areas have been constructed for use of women pilgrims. The water in the tank is replenished using water from Bhakra irrigation canal. A large number of pilgrims and tourists take holy dips in the tank on auspicious days of the new moon and solar eclipse. To add scenic beauty, the sarovar is decorated on the periphery with lush green lawns, floral beds, and huge trees with thick and dense canopy, which serve as roosting and nesting sites for birds.
2.	Jyoti Sarovar	29.950°N & 76.766°E	253	Perennial, a series of three closely located ponds at the outskirts of Jyotisar village; one is used by the tourists and local people for holy dip. Size of Jyoti Sarovar is 393.7x196.8 x 3.7m. The second is used for lotus cultivation, is mainly fed by direct precipitation and run-off from surroundings, is recharged during summer through a feeder canal, and is surrounded by large marshy swamp fed by local village sewage; third is used for cattle drinking and bathing. Both the second and third ponds are heavily infested with water hyacinth.
3.	Baan Ganga	29.933°N & 76.800°E	254	Perennial, man-made, religious pond located at the outskirts of Dayalpur Village. Size of Baan Ganga is 258.20x127.6x 3.7m. It is mainly fed by direct precipitation and run-off from surroundings, and is recharged during summer through field channels. The tank is flanked by rural human habitations and agricultural fields. In the vicinity of the sacred pond, there is a rural pond used for cattle drinking and bathing, washing of vehicles, and other domestic purposes.
4.	Sannihit Sarovar	29.950°N & 76.833°E	244	Perennial, man-made sacred pond in the heart of Kurukshetra city about 1km from Brahma Sarovar, 457.20x137.16 m in size, surrounded by urban human habitation; used by pilgrims for bathing and 'pindaan'.

Zizyphus jujube, Wild Senna *Cassia tora*, Banyan Tree *Ficus benghalensis*, Bodhi Tree or Peepal *Ficus religiosa*, and the Indian Rosewood *Dalbergia sissoo* at the banks or in the surroundings of the ponds provide suitable

roosting and nesting sites for various bird species. The ponds are also surrounded by Mesquite *Prosopis juliflora*, a deadly invasive shrub, and the non-native *Eucalyptus* sp.

Data collection

Bird surveys were conducted at two-week intervals in all the ponds from April 2014 to March 2015, following the point count method (Bibby et al. 2000). Six to 10 vantage points, at least 250m apart, were selected at the perimeter of each pond, and each point location was surveyed 24 times during the entire study period. The observer waited for a few minutes after arrival at each station before beginning to count. This allowed the birds to settle down following the observer's arrival and 10–20 minutes were spent at each point surveying the birds. Birds were counted directly, aided by 7x35 Nikon binoculars, during hours of peak activity 0600–1000 hr and 1600–1800 hr. In addition to these regular surveys, opportunistic records were also collected during other time periods of the day by walking at a slow pace along the bank of selected ponds and recording the species observed. Field guides (Grimmett et al. 1999; Kazmierczak & Perlo 2000) were used for field identification. Taxonomy and nomenclature follow Praveen et al. (2016). For residential status, birds were categorised as resident, winter visitor, and summer visitor on the basis of their presence in the study area (Ali & Ripley 1987). Feeding guilds were classified on the basis of direct observations and available literature (Ali & Ripley 1987; Grimmett et al. 1999). For national and global conservation status of recorded avifauna, we

followed IWPA (1972), CITES (2012), and IUCN (2017). The relative abundance (RA) of families was calculated using the following formula as per Torre-Cuadros et al. (2007):

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

RESULTS AND DISCUSSION

A total of 126 species of birds belonging to 98 genera, distributed among 45 families and 16 orders were recorded from four sacred ponds of Kurukshetra during the study period (Table 2, Images 1–102). Of these, 62 species were wetland-associated and the rest were terrestrial. Of all species recorded, 31 (24.60%) were observed from all the four sacred wetlands, and 95 (75.39%) were recorded from some specific wetlands alone (Table 2). Passeriformes had the highest diversity with 46 species and 17 families (Fig. 2). The proportion of species richness of birds by family varied from 0.79–11.90%. Anatidae, the richest family represented by 15 species, accounted for 11.90% of the total bird species in the study area (Table 3). Apodidae, Burhinidae, Rostratulidae, Strigidae, Bucerotidae, Upupidae, Picidae, Meropidae, Coraciidae, Campephagidae, Dicruridae, Nectariniidae, Ploceidae, Passeridae, Pycnonotidae,

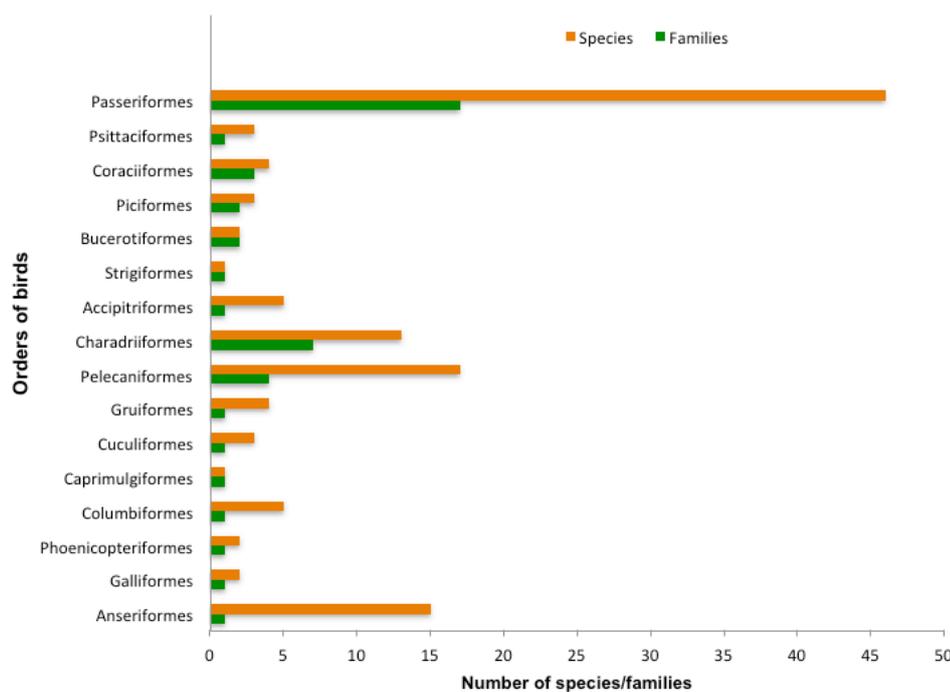


Figure 2. Composition of avian community in sacred ponds of Kurukshetra, India

Zosteropidae, and Timaliidae were poorly represented families with a single species in each. Similarly, Gupta & Kumar (2009) recorded 110 bird species belonging to 41 families and 14 orders from different habitats of Kurukshetra. For comparison, Alfred et al. (2001) reported 216 wetland bird species from various wetland habitats in the much more expansive Sub-Himalayan Terai and Indo-Gangetic Plains of northern India. Ducks and geese (Anatidae) are the most copious and remarkable winter migrants to the Indian-subcontinent, and constitute about 85% of the migrant bird populations (Alfred et al. 2001). These results are in confirmation with findings of earlier workers who have reported Anatidae to be the most dominant family among bird communities in different wetland habitats of Haryana in northern India (Kumar & Gupta 2009, 2013; Tak et al. 2010; Kumar et al. 2016).

Of the 126 species identified, 41 were winter migrants, six were summer migrants, and 79 were residents. The occurrence of a considerable number of winter migratory species can be attributed partly to the study area being on the Central Asian Flyway and serving as a wintering and stopover site for migratory birds that breed in the Palearctic region (Kumar et al. 2016). These migratory birds form a major component of the aquatic bird populations in various wetland habitats of northern India (Alfred et al. 2001; Manral et al. 2013; Kumar et al. 2016). We observed that the majority of the winter migrants stayed in the sacred wetlands from November to February. The summer visitors, including Cotton Teal *Nettapus coromandelianus*, Lesser Whistling Duck *Dendrocygna javanica*, Comb Duck *Sarkidiornis melanotos*, Pied Cuckoo *Clamator jacobinus*, Pheasant-tailed Jacana *Hydrophasianus chirurgus*, and Greater Painted-snipe *Rostratula benghalensis* were spotted during summer season (April–August) in the study area. Little Cormorant *Microcarbo niger* and Black-winged Stilt *Himantopus himantopus*, being common resident species, were recorded in and around the wetlands throughout the year, but their populations augmented due to the influx of migrant birds during the winter season.

Wetland characteristics like size, water depth, quality of water, trophic structure, and presence of suitable roosting and nursery sites influence the abundance and diversity of birds (Wiens 1989; Mukherjee et al. 2002; Ma et al. 2010). During the study period, species richness was recorded to be the highest at Jyoti Sarovar (n=107), followed by Brahma Sarovar (n=88), Baan Ganga (n=53), and Sannihit Sarovar (n=34). Generally, habitats with a complex architecture generate greater

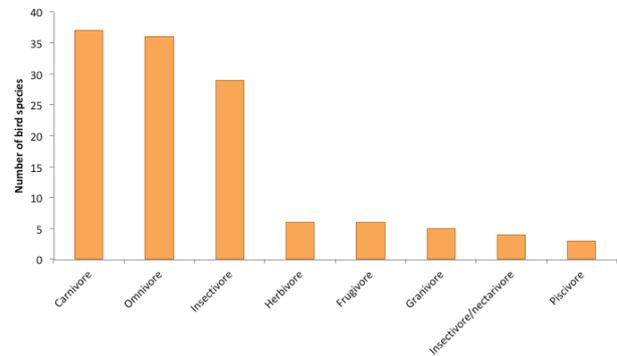


Figure 3. Guild-based classification of avian species recorded in sacred ponds of Kurukshetra, India

resources for birds, allowing the persistence of a greater number of species and guilds than in less complex habitats (MacArthur & MacArthur 1961; Tews et al. 2004; Codesido et al. 2013). In the present study, Jyoti Sarovar wetland, along with the adjacent rural pond, marshy area, and irrigated crop fields, provided a mosaic of habitats leading to multiple and variety of alternative food sources for the birds, and thus registered highest species richness (Aynalem & Bekele 2008). Brahma Sarovar and Sannihit Sarovar, being located in urban areas of the Kurukshetra City, are more exposed to local people and tourists. As a result, bird activities like feeding, nesting, hiding, and breeding are affected at these sites.

The quality and quantity of food available is the major factor that determines the spatio-temporal distribution and relative abundance of birds in a given habitat (Wiens 1989; Ma et al. 2010; Jha 2013). The different species of birds occupying a particular feeding guild and space have evolved specialized foraging strategies to explore and obtain food resources efficiently and thereby to reduce competition (Nudds & Bowlby 1984). As far as foraging habits of the bird community in the study area are concerned, eight major feeding guilds were identified (Fig. 3). This representation of major trophic guilds in the area indicated that the area holds a wide spectrum of food resources for birds. The carnivore guild was the most abundant one with 37 species followed by omnivore (36), insectivore (29), herbivore (six), frugivore (six), granivore (five), insectivore/nectarivore (four), and piscivore (three). Due to their specialized diet and low availability of preferable food resources, the nectarivores and piscivores are generally less represented (Wiens 1989). The diversity of avifauna in the study area may be due to the presence of a wide spectrum of food niches, which reduced food competition among different species (Jose & Zacharias 2003). About half of the recorded bird

species were those associated with wetland habitats, such as ducks, herons, egrets, cormorants, jacanas, grebes, kingfishers, and storks, which were observed to feed on aquatic organisms (worms, insects, snails, fish, and amphibians) at various water depths available in the wetlands and adjoining paddy fields and marshy area.

Bronze-winged Jacana *Metopidius indicus* and Pheasant-tailed Jacana *Hydrophasianus chirurgus* were spotted at Jyoti Sarovar alone, the only pond with lotuses. The vegetation cover of lotuses provides suitable feeding, nesting, and breeding habitat for herons, moorhens, and jacanas. Purple Swamphen *Porphyrio porphyrio*, a common resident species, was observed only in weedy marsh areas flanking the sacred pond of Jyoti Sarovar, where there were frequent human activities; this bird species may be a bio-indicator of enhanced weed infestation and increased vegetation cover in the wetlands of Haryana (Kumar et al. 2016). Waders, shorebirds, Purple Moorhen, and wagtails were also observed foraging in the irrigated wheat and paddy fields flanking the sacred ponds in rural habitats (Jyoti Sarovar and Baan Ganga). This observation is consistent with earlier reports, where foraging by aquatic birds outside the wetlands in surrounding agriculture fields has been recorded (Lane & Fujioka 1998; Mukherjee et al. 2002; Urfi 2003; Jha 2013; Kumar et al. 2016).

Among the recorded avifauna, five species, namely, Painted Stork *Mycteria leucocephala*, Black-necked Stork *Ephippiorhynchus asiaticus*, Black-headed Ibis *Threskiornis melanocephalus*, River Tern *Sterna aurantia*, and Alexandrine Parakeet *Psittacula eupatria* are listed as Near Threatened, and one species, Common Pochard *Aythya ferina*, as Vulnerable in the IUCN Red List (IUCN 2017). All the remaining species (n=120) are placed in the Least Concern category in the Red List of IUCN (2017). Additionally, nine species are included in Appendix-II of CITES (2012). Six species, including five species of Accipitridae and one of Phasianidae, are considered nationally threatened as these are listed under Schedule-I of the Indian Wildlife (Protection) Act, 1972.

Significant records

Painted Stork - Near Threatened: A winter migrant in the study area was recorded in a small flock (4–8 individuals) only at Jyoti Sarovar during winter months (December–January). The birds were often recorded roosting on large trees at the bank of the wetland.

Black-necked Stork - Near Threatened: A lone male individual was recorded foraging in the mud-flat adjacent to Jyoti Sarovar on 25 January 2015. This species is very

widely but thinly distributed in India, with the northern and northwestern regions forming its main strongholds (Rahmani 1989).

Black-headed Ibis - Near Threatened: A resident wader species (Kumar et al. 2016) was recorded in small loose groups (1–4 individuals) only at Jyoti Sarovar throughout the study period. It was often observed foraging with other waders at the margins of the pond, and mudflats and paddy fields adjoining the sacred wetland.

River Tern - Near Threatened: A common resident species in the study area (Kumar et al. 2016) was recorded as 1–7 scattered individuals at all the four sacred ponds throughout the study period.

Alexandrine Parakeet - Near Threatened: A resident species in the study area was recorded in small groups of 5–10 individuals. The birds were frequently observed roosting on trees at banks of all the ponds.

Common Pochard - Vulnerable: This is a common winter visitor in India (Grimmett et al. 1999). The species was recorded in flocks of 6–50 individuals during winter months (November–March) in Brahma Sarovar only.

Comb Duck - Appendix II of CITES: A resident species in the Indian subcontinent with local movements (Grimmett et al. 1999) was recorded only at Jyoti Sarovar in a pair during summer (May 2014).

In addition to the cultural and religious legacy of the region, the presence of significant numbers of migratory species as well as those with conservation priorities underlines the importance of these sacred wetlands as important bird habitats in Haryana. It is evident from the present study that if some attention is provided to these sacred wetlands, these could be developed as a good site for harbouring avifauna and as a haven for bird-watchers. Our efforts contributed towards filling biological information gaps in the region; continuing studies will allow monitoring of the population and seasonal changes in the bird assemblage.

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Table 2. Checklist and status of avifauna recorded in sacred ponds of Kurukshetra in the Trans-Gangetic Plains, India

	Order/family/common name	Scientific name	Residential status	Feeding guild	Conservation status			Sacred pond				Image
					IUCN (2017)	CITES (2012)	IWPA (1972)	BS	JS	BG	SS	
	ANSERIFORMES Anatidae (15)											
1	Lesser Whistling Duck	<i>Dendrocygna javanica</i> (Horsfield, 1821)	SM	O	LC	-	IV	×	✓	×	×	1
2	Common Shelduck	<i>Tadorna tadorna</i> (Linnaeus, 1758)	WM	O	LC	-	IV	✓	×	×	×	
3	Ruddy Shelduck	<i>Tadorna ferruginea</i> (Pallas, 1764)	WM	O	LC	-	IV	✓	×	×	×	2
4	Red Crested Pochard	<i>Netta rufina</i> (Pallas, 1773)	WM	H	LC	-	IV	✓	×	×	×	3
5	Common Pochard	<i>Aythya ferina</i> (Linnaeus, 1758)	WM	O	VU	-	IV	✓	×	×	×	4
6	Tufted Duck	<i>Aythya fuligula</i> (Linnaeus, 1758)	WM	H	LC	-	IV	✓	×	×	×	5
7	Northern Shoveler	<i>Spatula clypeata</i> (Linnaeus, 1758)	WM	O	LC	-	IV	✓	✓	×	×	6
8	Gadwall	<i>Mareca strepera</i> (Linnaeus, 1758)	WM	H	LC	-	IV	✓	✓	×	×	7
9	Eurasian Wigeon	<i>Mareca penelope</i> (Linnaeus, 1758)	WM	H	LC	-	IV	✓	×	×	×	
10	Indian Spot-billed Duck	<i>Anas poecilorhyncha</i> Forster, 1781	WM	H	LC	-	IV	✓	✓	×	×	8
11	Mallard	<i>Anas platyrhynchos</i> Linnaeus, 1758	WM	H	LC	-	IV	✓	✓	×	×	9
12	Northern Pintail	<i>Anas acuta</i> Linnaeus, 1758	WM	O	LC	-	IV	✓	×	×	×	10
13	Common Teal	<i>Anas crecca</i> Linnaeus, 1758	WM	O	LC	-	IV	✓	✓	×	×	11
14	Comb Duck	<i>Sarkidiornis melanotos</i> (Pennant, 1769)	SM	O	LC	II	IV	×	✓	×	×	12
15	Cotton Teal	<i>Nettapus coromandelianus</i> (Gmelin, 1789)	SM	O	LC	-	IV	×	✓	×	×	13
	GALLIFORMES Phasianidae (2)											
16	Indian Peafowl	<i>Pavo cristatus</i> Linnaeus, 1758	R	O	LC	-	I	✓	×	×	×	14
17	Grey Francolin	<i>Francolinus pondicerianus</i> (Gmelin, 1789)	R	O	LC	-	IV	✓	✓	×	×	
	PHOENICOPTERIFORMES Podicipedidae (2)											
18	Little Grebe	<i>Tachybaptus ruficollis</i> (Pallas, 1764)	R	C	LC	-	IV	✓	✓	✓	×	15
19	Great Crested Grebe	<i>Podiceps cristatus</i> (Linnaeus, 1758)	WM	C	LC	-	IV	✓	×	×	×	16
	COLUMBIFORMES Columbidae (5)											
20	Rock Pigeon	<i>Columba livia</i> Gmelin, 1789	R	G	LC	-	IV	✓	✓	✓	✓	17
21	Spotted Dove	<i>Spilopelia chinensis</i> (Scopoli, 1786)	R	G	LC	-	IV	✓	✓	✓	✓	18
22	Eurasian Collared Dove	<i>Streptopelia decaocto</i> Frivaldszky, 1838	R	G	LC	-	IV	✓	✓	✓	✓	19
23	Laughing Dove	<i>Spilopelia senegalensis</i> (Linnaeus, 1766)	R	G	LC	-	IV	✓	✓	✓	×	20
24	Yellow-legged Green Pigeon	<i>Treron phoenicopterus</i> (Latham, 1790)	R	F	LC	-	IV	✓	✓	✓	✓	21
	CAPRIMULGIFORMES Apodidae (1)											
25	Indian House Swift	<i>Apus affinis</i> (Gray, 1830)	R	In	LC	-	IV	×	✓	✓	×	
	CUCULIFORMES Cuculidae (3)											
26	Pied Cuckoo	<i>Clamator jacobinus</i> (Boddaert, 1783)	SM	In	LC	-	IV	✓	×	✓	×	
27	Asian Koel	<i>Eudynamis scolopacea</i> (Linnaeus, 1758)	R	O	LC	-	IV	✓	✓	✓	✓	22

	Order/family/common name	Scientific name	Residential status	Feeding guild	Conservation status			Sacred pond				Image
					IUCN (2017)	CITES (2012)	IWPA (1972)	BS	JS	BG	SS	
28	Greater Coucal	<i>Centropus sinensis</i> (Stephens, 1815)	R	C	LC	-	IV	✓	✓	✓	✓	23
	GRUIFORMES Rallidae (4)											
29	White-breasted Waterhen	<i>Amaurornis phoenicurus</i> (Pennant, 1769)	R	O	LC	-	IV	✓	✓	✓	✓	24
30	Purple Swampphen	<i>Porphyrio porphyrio</i> (Linnaeus, 1758)	R	O	LC	-	IV	✗	✓	✗	✗	25
31	Common Moorhen	<i>Gallinula chloropus</i> (Linnaeus, 1758)	WM	O	LC	-	IV	✓	✓	✓	✓	26
32	Common Coot	<i>Fulica atra</i> Linnaeus, 1758	WM	O	LC	-	IV	✓	✓	✓	✓	27
	PELECANIFORMES Ciconiidae (3)											
33	Painted Stork	<i>Mycteria leucocephala</i> (Pennant, 1769)	WM	C	NT	-	IV	✗	✓	✗	✗	28
34	Asian Openbill	<i>Anastomus oscitans</i> (Boddaert, 1783)	WM	C	LC	-	IV	✗	✓	✗	✗	29
35	Black-necked Stork	<i>Ephippiorhynchus asiaticus</i> (Latham, 1790)	WM	C	NT	-	IV	✗	✓	✗	✗	
	Ardeidae (8)											
36	Black-crowned Night-Heron	<i>Nycticorax nycticorax</i> (Linnaeus, 1758)	R	C	LC	-	IV	✓	✓	✓	✗	30
37	Indian Pond Heron	<i>Ardeola grayii</i> (Sykes, 1832)	R	C	LC	-	IV	✓	✓	✓	✓	31
38	Cattle Egret	<i>Bubulcus ibis</i> (Linnaeus, 1758)	R	C	LC	-	IV	✓	✓	✓	✓	32
39	Grey Heron	<i>Ardea cinerea</i> Linnaeus, 1758	R	C	LC	-	IV	✗	✓	✗	✗	33
40	Purple heron	<i>Ardea purpurea</i> Linnaeus, 1766	R	C	LC	-	IV	✓	✓	✗	✗	34
41	Great Egret	<i>Ardea alba</i> Linnaeus, 1758	WM	C	LC	-	IV	✓	✓	✓	✗	35
42	Intermediate Egret	<i>Ardea intermedia</i> Wagler, 1829	WM	C	LC	-	IV	✓	✓	✓	✗	36
43	Little Egret	<i>Egretta garzetta</i> (Linnaeus, 1766)	R	C	LC	-	IV	✓	✓	✓	✓	37
	Threskiornithidae (3)											
44	Black-headed Ibis	<i>Threskiornis melanocephalus</i> (Latham, 1790)	R	C	NT	-	IV	✗	✓	✗	✗	38
45	Indian Black Ibis	<i>Pseudibis papillosa</i> (Temminck, 1824)	R	C	LC	-	IV	✗	✓	✗	✗	39
46	Glossy Ibis	<i>Plegadis falcinellus</i> (Linnaeus, 1766)	R	C	LC	-	IV	✗	✓	✗	✗	40
	Phalacrocoracidae (3)											
47	Little Cormorant	<i>Microcarbo niger</i> (Vieillot, 1817)	R	C	LC	-	IV	✓	✓	✓	✓	41
48	Great Cormorant	<i>Phalacrocorax carbo</i> (Linnaeus, 1758)	WM	C	LC	-	IV	✓	✓	✗	✓	42
49	Indian Cormorant	<i>Phalacrocorax fuscicollis</i> Stephens, 1826	WM	P	LC	-	IV	✓	✓	✗	✓	43
	CHARADRIIFORMES Burhinidae (1)											
50	Eurasian Thick-knee	<i>Burhinus oedipnemos</i> (Linnaeus, 1758)	R	O	LC	-	IV	✗	✓	✗	✗	44
	Recurvirostridae (2)											
51	Pied Avocet	<i>Recurvirostra avosetta</i> Linnaeus, 1758	WM	C	LC	-	IV	✗	✓	✗	✗	45
52	Black-winged stilt	<i>Himantopus himantopus</i> (Linnaeus, 1758)	R	C	LC	-	IV	✓	✓	✓	✗	46
	Charadriidae (2)											
53	Red-wattled Lapwing	<i>Vanellus indicus</i> (Boddaert, 1783)	R	C	LC	-	IV	✓	✓	✓	✓	47

	Order/family/common name	Scientific name	Residential status	Feeding guild	Conservation status			Sacred pond				Image
					IUCN (2017)	CITES (2012)	IWPA (1972)	BS	JS	BG	SS	
54	White-tailed Lapwing	<i>Vanellus leucurus</i> (Lichtenstein, 1823)	WM	C	LC	-	IV	x	✓	x	x	48
	Rostratulidae (1)											
55	Greater Painted-Snipe	<i>Rostratula benghalensis</i> (Linnaeus, 1758)	SM	O	LC	-	IV	x	✓	x	x	
	Jacaniidae (2)											
56	Pheasant-tailed Jacana	<i>Hydrophasianus chirurgus</i> (Scopoli, 1786)	SM	O	LC	-	IV	x	✓	x	x	49
57	Bronze-winged Jacana	<i>Metopidius indicus</i> (Latham, 1790)	R	O	LC	-	IV	x	✓	x	x	50
	Scolopacidae (3)											
58	Common Sandpiper	<i>Actitis hypoleucos</i> Linnaeus, 1758	WM	C	LC	-	IV	✓	✓	x	x	51
59	Common Greenshank	<i>Tringa nebularia</i> (Gunnerus, 1767)	WM	C	LC	-	IV	x	✓	x	x	52
60	Common Redshank	<i>Tringa totanus</i> (Linnaeus, 1758)	WM	C	LC	-	IV	x	✓	x	x	53
	Laridae (2)											
61	Pallas's Gull	<i>Larus ichthyaetus</i> Pallas, 1773	WM	C	LC	-	IV	✓	x	x	x	
62	River Tern	<i>Sterna aurantia</i> Gray, 1831	R	P	NT	-	IV	✓	✓	x	x	54
	ACCIPITRIFORMES Accipitridae (5)											
63	Black-winged Kite	<i>Elanus caeruleus</i> (Desfontaines, 1789)	R	C	LC	II	I	x	✓	x	✓	55
64	Oriental Honey Buzzard	<i>Pernis ptilorhynchus</i> (Temminck, 1821)	R	C	LC	II	I	✓	✓	x	x	
65	Shikra	<i>Accipiter badius</i> (Gmelin, 1788)	R	C	LC	II	I	✓	✓	✓	x	56
66	Brahminy Kite	<i>Haliastur Indus</i> (Boddaert, 1783)	R	C	LC	II	I	✓	✓	x	x	57
67	Black Kite	<i>Milvus migrans</i> (Boddaert, 1783)	R	C	LC	II	I	✓	✓	✓	✓	58
	STRIGIFORMES Strigidae (1)											
68	Spotted Owlet	<i>Athene brama</i> (Temminck, 1821)	R	C	LC	II	IV	✓	✓	✓	x	59
	BUCEROTIFORMES Bucerotidae (1)											
69	Indian Grey Hornbill	<i>Ocyrceros birostris</i> (Scopoli, 1786)	R	O	LC	-	IV	✓	✓	✓	✓	60
	Upupidae (1)											
70	Common Hoopoe	<i>Upupa epops</i> Linnaeus, 1758	R	In	LC	-	IV	x	✓	✓	x	61
	PICIFORMES Picidae (1)											
71	Lesser Golden-backed Woodpecker	<i>Dinopium benghalense</i> (Linnaeus, 1758)	R	In	LC	-	IV	✓	✓	x	x	62
	Ramphastidae (2)											
72	Brown-headed Barbet	<i>Psilopogon zeylanicus</i> (Gmelin, 1788)	R	F	LC	-	IV	✓	✓	✓	x	63
73	Coppersmith Barbet	<i>Psilopogon haemacephalus</i> (Muller, 1776)	R	F	LC	-	IV	✓	✓	x	x	64
	CORACIIFORMES Meropidae (1)											
74	Green Bee-eater	<i>Merops orientalis</i> Latham, 1802	R	In	LC	-	IV	✓	✓	✓	✓	65
	Coraciidae (1)											
75	Indian Roller	<i>Coracias benghalensis</i> (Linnaeus, 1758)	R	C	LC	-	IV	x	✓	✓	x	66
	Alcedinidae (2)											

	Order/family/common name	Scientific name	Residential status	Feeding guild	Conservation status			Sacred pond				Image
					IUCN (2017)	CITES (2012)	IWPA (1972)	BS	JS	BG	SS	
76	Pied Kingfisher	<i>Ceryle rudis</i> (Linnaeus, 1758)	R	P	LC	-	IV	✓	✗	✗	✗	
77	White-throated Kingfisher	<i>Halcyon smyrnensis</i> (Linnaeus, 1758)	R	C	LC	-	IV	✓	✓	✓	✓	67
	PSITTACIFORMES Psittaculidae (3)											
78	Slaty-headed Parakeet	<i>Psittacula himalayana</i> (Lesson, 1832)	WM	F	LC	II	IV	✓	✗	✗	✗	
79	Alexandrine Parakeet	<i>Psittacula eupatria</i> (Linnaeus, 1766)	R	F	NT	II	IV	✓	✓	✓	✓	68
80	Rose-ringed Parakeet	<i>Psittacula krameri</i> (Scopoli, 1769)	R	F	LC	-	IV	✓	✓	✓	✓	69
	PASSERIFORMES Campephagidae (1)											
81	Scarlet Minivet	<i>Pericrocotus flammeus</i> (Forster, 1781)	WM	In	LC	-	IV	✓	✗	✗	✗	
	Dicruridae (1)											
82	Black Drongo	<i>Dicrurus macrocercus</i> Vieillot, 1817	R	In	LC	-	IV	✓	✓	✓	✓	70
	Laniidae (2)											
83	Bay-backed Shrike	<i>Lanius vittatus</i> Valenciennes, 1826	R	C	LC	-	IV	✗	✓	✗	✗	
84	Long-tailed Shrike	<i>Lanius schach</i> Linnaeus, 1758	R	C	LC	-	IV	✗	✓	✗	✗	71
	Corvidae (3)											
85	Rufous Treepie	<i>Dendrocitta vagabunda</i> (Latham, 1790)	R	O	LC	-	IV	✓	✓	✓	✓	72
86	House Crow	<i>Corvus splendens</i> Vieillot, 1817	R	O	LC	-	V	✓	✓	✓	✓	73
87	Large-billed Crow	<i>Corvus macrorhynchos</i> Wagler, 1827	WM	O	LC	-	IV	✓	✓	✓	✓	74
	Nectariniidae (1)											
88	Purple Sunbird	<i>Cinnyris asiaticus</i> (Latham, 1790)	R	In/N	LC	-	IV	✓	✓	✓	✓	75
	Ploceidae (1)											
89	Baya Weaver	<i>Ploceus philippinus</i> (Linnaeus, 1766)	R	O	LC	-	IV	✓	✓	✓	✗	76
	Estrildidae (2)											
90	Indian Silverbill	<i>Euodice malabarica</i> (Linnaeus, 1758)	R	G	LC	III	IV	✗	✓	✗	✗	77
91	Scaly-breasted Munia	<i>Lonchura punctulata</i> (Linnaeus, 1758)	R	O	LC	-	IV	✓	✓	✗	✗	78
	Passeridae (1)											
92	House Sparrow	<i>Passer domesticus</i> (Linnaeus, 1758)	R	O	LC	-	IV	✗	✓	✓	✗	79
	Motacillidae (7)											
93	Tree Pipit	<i>Anthus trivialis</i> (Linnaeus, 1758)	WM	In	LC	-	IV	✗	✓	✗	✗	
94	Paddyfield Pipit	<i>Anthus rufulus</i> Vieillot, 1818	R	In	LC	-	IV	✗	✓	✗	✗	80
95	Western Yellow Wagtail	<i>Motacilla flava</i> Linnaeus, 1758	WM	In	LC	-	IV	✗	✓	✗	✗	81
96	Grey Wagtail	<i>Motacilla cinerea</i> Tunstall, 1771	WM	In	LC	-	IV	✗	✓	✗	✗	82
97	Citrine Wagtail	<i>Motacilla citreola</i> Pallas, 1776	WM	In	LC	-	IV	✗	✓	✗	✗	83
98	White-browed Wagtail	<i>Motacilla maderaspatensis</i> Gmelin, 1789	R	In	LC	-	IV	✓	✓	✓	✓	
99	White Wagtail	<i>Motacilla alba</i> Linnaeus, 1758	WM	In	LC	-	IV	✓	✓	✓	✓	84
	Cisticolidae (4)											
100	Zitting Cisticola	<i>Cisticola juncidis</i> (Rafinesque, 1810)	R	In	LC	-	IV	✓	✓	✓	✗	

	Order/family/common name	Scientific name	Residential status	Feeding guild	Conservation status			Sacred pond				Image
					IUCN (2017)	CITES (2012)	IWPA (1972)	BS	JS	BG	SS	
101	Ashy Prinia	<i>Prinia socialis</i> Sykes, 1832	R	In/N	LC	-	IV	✓	✓	✓	✗	85
102	Plain Prinia	<i>Prinia inornata</i> Sykes, 1832	R	In	LC	-	IV	✗	✓	✗	✗	86
103	Common Tailorbird	<i>Orthotomus sutorius</i> (Pennant, 1769)	R	In/N	LC	-	IV	✓	✓	✓	✗	87
	Hirundinidae (6)											
104	Northern House Martin	<i>Delichon urbicum</i> (Linnaeus, 1758)	R	In	LC	-	IV	✗	✓	✗	✗	
105	Wire-tailed Swallow	<i>Hirundo smithii</i> Leach, 1818	R	In	LC	-	IV	✓	✓	✗	✗	88
106	Barn Swallow	<i>Hirundo rustica</i> Linnaeus, 1758	R	In	LC	-	IV	✓	✗	✗	✗	
107	Eurasian Crag-Martin	<i>Ptyonoprogne rupestris</i> (Scopoli, 1769)	R	In	LC	-	IV	✓	✗	✗	✗	
108	Plain Martin	<i>Riparia paludicola</i> (Vieillot, 1817)	R	In	LC	-	IV	✓	✗	✗	✗	
109	Sand Martin	<i>Riparia riparia</i> (Linnaeus, 1758)	R	In	LC	-	IV	✓	✗	✗	✗	
	Pycnonotidae (1)											
110	Red vented Bulbul	<i>Pycnonotus cafer</i> (Linnaeus, 1766)	R	O	LC	-	IV	✓	✓	✓	✓	89
	Zosteropidae (1)											
111	Oriental White-eye	<i>Zosterops palpebrosus</i> (Temminck, 1824)	R	In/N	LC	-	IV	✓	✓	✗	✗	90
	Timaliidae (1)											
112	White-browed Scimitar Babbler	<i>Pomatorhinus schisticeps</i> Hodgson, 1836	WM	O	LC	-	IV	✗	✓	✗	✗	
	Leiothrichidae (3)											
113	Large Grey Babbler	<i>Argya malcolmi</i> (Sykes, 1832)	R	O	LC	-	IV	✓	✓	✗	✗	91
114	Common Babbler	<i>Argya caudata</i> (Dumont, 1823)	R	O	LC	-	IV	✓	✓	✓	✓	
115	Jungle Babbler	<i>Turdoides striata</i> (Dumont, 1823)	R	O	LC	-	IV	✓	✓	✗	✗	92
	Sturnidae (4)											
116	Asian Pied Starling	<i>Gracupica contra</i> (Linnaeus, 1758)	R	O	LC	-	IV	✓	✓	✓	✗	93
117	Brahminy Starling	<i>Sturnia pagodarum</i> (Gmelin, 1789)	R	O	LC	-	IV	✓	✓	✓	✗	94
118	Common Myna	<i>Acridotheres tristis</i> (Linnaeus, 1766)	R	O	LC	-	IV	✓	✓	✓	✓	95
119	Bank Myna	<i>Acridotheres ginginianus</i> (Latham, 1790)	R	O	LC	-	IV	✓	✓	✓	✗	96
	Muscicapidae (7)											
120	Indian Robin	<i>Saxicoloides fulicatus</i> (Linnaeus, 1766)	R	In	LC	-	IV	✓	✓	✓	✗	97
121	Oriental Magpie Robin	<i>Copsychus saularis</i> (Linnaeus, 1758)	R	In	LC	-	IV	✓	✓	✓	✓	98
122	Verditer Flycatcher	<i>Eumyias thalassinus</i> Swainson, 1838	WM	In	LC	-	IV	✓	✗	✗	✗	
123	Bluethroat	<i>Cyanecula svecica</i> (Linnaeus, 1758)	WM	In	LC	-	IV	✗	✓	✗	✗	99
124	Red-breasted Flycatcher	<i>Ficedula parva</i> (Bechstein, 1792)	WM	In	LC	-	IV	✗	✓	✗	✗	100
125	Common Stonechat	<i>Saxicola torquatus</i> (Linnaeus, 1766)	WM	In	LC	-	IV	✗	✓	✗	✗	101
126	Brown Rock Chat	<i>Oenanthe fusca</i> (Blyth, 1851)	R	In	LC	-	IV	✓	✓	✗	✗	102

IUCN: International Union for Conservation of Nature and Natural Resources; CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora; IPWA: Indian Wildlife Protection Act; R: Resident; SM: Summer migrant; WM: Winter migrant; LC: Least concern species; NT: Near threatened species; VU: Vulnerable species; I: Schedule- I species of IWPA (high priority species); IV: Schedule - IV species of IWPA (relatively low priority species); BS - Brahma Sarovar; JS - Jyoti Sarovar; BG - Baan Ganga, Dayalpur; SS - Sannihit Sarovar; C-Carnivore; H-Herbivore; In - Insectivore; O - Omnivore; N - Nectarivore; F - Frugivore; G - Grainivore; P - Piscivore; ✓ - Species recorded in the habitat; ✗ - Species not recorded in the habitat.

Table 3. Relative diversity of various avian families in sacred ponds of Kurukshetra, India

Order	Family	No. of species recorded	Relative abundance (%)
Anseriformes	Anatidae	15	11.90
Galliformes	Phasianidae	2	1.59
Phoenicopteriformes	Podicipedidae	2	1.8
Columbiformes	Columbidae	5	3.96
Caprimulgiformes	Apodidae	1	0.79
Cuculiformes	Cuculidae	3	2.38
Gruiformes	Rallidae	4	3.17
Pelecaniformes	Ciconiidae	3	2.38
	Ardeidae	8	6.34
	Threskiornithidae	3	2.38
	Phalacrocoracidae	3	2.38
Charadriiformes	Burhinidae	1	0.79
	Recurvirostridae	2	1.59
	Charadriidae	2	1.59
	Rostratulidae	1	0.79
	Jacaniidae	2	1.59
	Scolopacidae	3	2.38
	Laridae	2	1.59
Accipitriformes	Accipitridae	5	3.96
Strigiformes	Strigidae	1	0.79
Bucerotiformes	Bucerotidae	1	0.79
	Upupidae	1	0.79
Piciformes	Picidae	1	0.79
	Ramphastidae	2	1.59
Coraciiformes	Meropidae	1	0.79
	Coraciidae	1	0.79
	Alcedinidae	2	1.59
Psittaciformes	Psittaculidae	3	2.38
Passeriformes	Campephagidae	1	0.79
	Dicruridae	1	0.79
	Laniidae	2	1.59
	Corvidae	3	2.38
	Nectariniidae	1	0.79
	Ploceidae	1	0.79
	Estrildidae	2	1.59
	Passeridae	1	0.79
	Motacillidae	7	5.55
	Cisticolidae	4	3.17
	Hirundinidae	6	4.76
	Pycnonotidae	1	0.79
	Zosteropidae	1	0.79
	Timaliidae	1	0.79
	Leiothrichidae	3	2.38
	Sturnidae	4	3.17
	Muscicapidae	7	5.55

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Image 1. Lesser Whistling Duck



Image 2. Ruddy Shelduck



Image 3. Red Crested Pochard



Image 4. Common Pochard



Image 5. Tufted Duck



Image 6. Northern Shoveler



Image 7. Gadwall



Image 8. Indian Spot-billed Duck

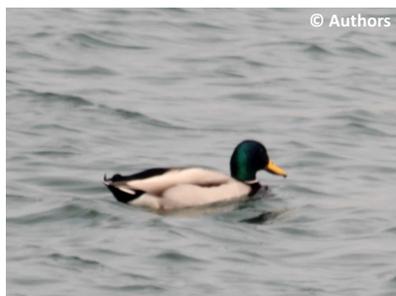


Image 9. Mallard



Image 10. Northern Pintail

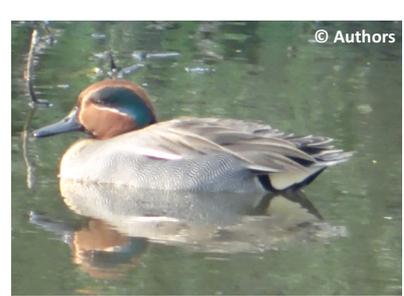


Image 11. Common Teal

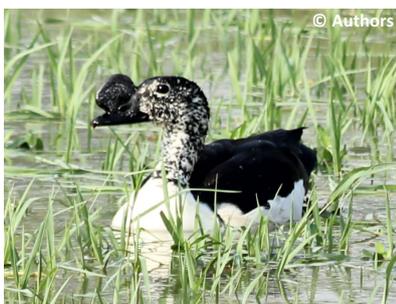


Image 12. Comb Duck



Image 13. Cotton Teal



Image 14. Indian Peafowl



Image 15. Little Grebe



Image 16. Great Crested Grebe



Image 17. Rock Pigeon



Image 18. Spotted Dove



Image 19. Eurasian Collared Dove



Image 20. Laughing Dove



Image 21. Yellow-legged Green Pigeon

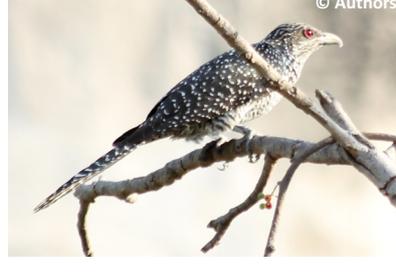


Image 22. Asian Koel



Image 23. Greater Coucal



Image 24. White-breasted Waterhen



Image 25. Purple Swamphen



Image 26. Common Moorhen



Image 27. Common Coot



Image 28. Painted Stork



Image 29. Asian Openbill



Image 30. Black-crowned Night Heron



Image 31. Indian Pond Heron



Image 32. Cattle Egret



Image 33. Grey Heron



Image 34. Purple heron



Image 35. Great Egret



Image 36. Intermediate Egret



Image 37. Little Egret



Image 38. Black-headed Ibis



Image 39. Indian Black Ibis



Image 40. Glossy Ibis



Image 41. Little Cormorant



Image 42. Great Cormorant



Image 43. Indian Cormorant



Image 44. Eurasian Thick-knee



Image 45. Pied Avocet



Image 46. Black-winged Stilt



Image 47. Red-wattled Lapwing



Image 48. White-tailed Lapwing



Image 49. Pheasant-tailed Jacana



Image 50. Bronze-winged Jacana



Image 51. Common Sandpiper



Image 52. Common Greenshank



Image 53. Common Redshank



Image 54. River Tern



Image 55. Black-winged Kite



Image 56. Shikra



Image 57. Brahminy Kite



Image 58. Black Kite



Image 59. Spotted Owlet



Image 60. Indian Grey Hornbill

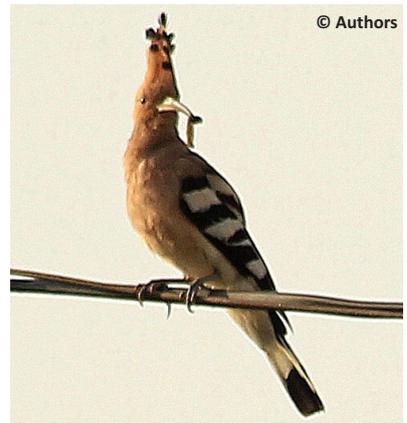


Image 61. Common Hoopoe



Image 62. Lesser Golden-backed Woodpecker



Image 63. Brown-headed Barbet



Image 64. Coppersmith Barbet



Image 65. Green Bee-eater



Image 66. Indian Roller



Image 67. White-throated Kingfisher



Image 68. Alexandrine Parakeet



Image 69. Rose-ringed Parakeet



Image 70. Black Drongo



Image 71. Long-tailed Shrike



Image 72. Rufous Treepie



Image 73. House Crow



Image 74. Large-billed Crow



Image 75. Purple Sunbird



Image 76. Baya Weaver



Image 77. Indian Silverbill

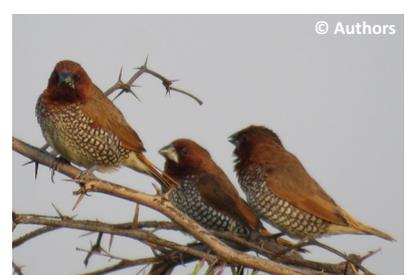


Image 78. Scaly-breasted Munia



Image 79. House Sparrow



Image 80. Paddyfield Pipit



Image 81. Western Yellow Wagtail



Image 82. Grey Wagtail



Image 83. Citrine Wagtail



Image 84. White Wagtail



Image 85. Ashy Prinia



Image 86. Plain Prinia



Image 87. Common Tailorbird



Image 88. Wire-tailed Swallow



Image 89. Red vented Bulbul



Image 90. Oriental White-eye



Image 91. Large Grey Babbler



Image 92. Jungle Babbler



Image 93. Asian Pied Starling



Image 94. Brahminy Starling



Image 95. Common Myna



Image 96. Bank Myna



Image 97. Indian Robin



Image 98. Oriental Magpie Robin



Image 99. Bluethroat



Image 100. Red-breasted Flycatcher



Image 101. Common Stonechat



Image 102. Brown Rock Chat





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Article

Appearances are deceptive: molecular phylogeny recovers the Scaly Gecko *Hemidactylus scabriceps* (Reptilia: Squamata: Gekkonidae) as a member of a scansorial and rupicolous clade

-- Achyuthan N. Srikanthan, Gandla Chethan Kumar, Aishwarya J. Urs & Sumaithangi Rajagopalan Ganesh, Pp. 12147–12162

Communications

Foraging and roosting ecology of the Lesser Dog-faced Fruit Bat *Cynopterus brachyotis* (Mammalia: Chiroptera: Pteropodidae) in southern India

-- T. Karuppudurai & K. Sripathi, Pp. 12163–12172

Diversity and status of avifauna in man-made sacred ponds of Kurukshetra, India

-- Parmesh Kumar & Archana Sharma, Pp. 12173–12193

Diversity and distribution of freshwater turtles (Reptilia: Testudines) in Goa, India

-- Trupti D. Jadhav, Nitin S. Sawant & Soorambail K. Shyama, Pp. 12194–12202

Breeding behaviour of the Coromandel Damselfly *Ceriatrigon coromandelianum* (Fabricius) (Zygoptera: Coenagrionidae) in central India: copulation

-- Nilesh R. Thaokar, Payal R. Verma & Raymond J. Andrew, Pp. 12203–12209

The status assessment of *Corynandra viscosa* subsp. *nagarjunakondensis* (Magnoliopsida: Cleomaceae), endemic to Nagarjunakonda, Andhra Pradesh, India

-- Veeravarapu Hanumantha Rao, Vaidyula Vasudeva Rao, Anuti Baleeshwar Reddy & Vatsavaya Satyanarayana Raju, Pp. 12210–12217

Short Communications

New records of termites (Blattodea: Termitidae: Syntermitinae) from Colombia

-- Olga Patricia Pinzón & Daniel Castro, Pp. 12218–12225

New reports of thrips (Thysanoptera: Terebrantia: Thripidae) from India

-- R.R. Rachana & R. Varatharajan, Pp. 12226–12229

New records of earthworm fauna (Oligochaeta: Glossoscolecidae and Megascolecidae) collected from Satkosia-Baisipalli Wildlife Sanctuary of Odisha, India

-- Rinku Goswami, Pp. 12230–12234

Diversity and endemism of butterflies of montane forests of Eravikulam National Park in the Western Ghats, India

-- E.R. Sreekumar, S. Nikhil, K.G. Ajay & P.O. Nameer, Pp. 12235–12246

Angiosperm diversity of Sonbhadra District, Uttar Pradesh: a checklist

-- Arun Kumar Kushwaha, Lalit Mohan Tewari & Lal Babu Chaudhary, Pp. 12247–12269

Contribution to the Macromycetes of West Bengal, India: 23–27

-- Meghma Bera, Soumitra Paloi, Arun Kumar Dutta, Prakash Pradhan, Anirban Roy & Krishnendu Acharya, Pp. 12270–12276

Notes

Animal-fungal interactions 2: first report of mycophagy by the Eastern European Hedgehog *Erinaceus concolor* Martin, 1837 (Mammalia: Eulipotyphla: Erinaceidae)

-- Todd F. Elliott, James M. Trappe & Aziz Türkoğlu, Pp. 12277–12279

Rostral anomaly in a juvenile Spiny Butterfly Ray *Gymnura altavela* (Linnaeus, 1758) (Elasmobranchii: Myliobatiformes: Gymnuridae) from the Canary Islands

-- Filip Osaer & Krupskaya Narváez, Pp. 12280–12281

A record after 52 years, and additional description of the emesine assassin bug *Emesopsis nubila* (Hemiptera: Reduviidae: Emesinae) from western India

-- Balasaheb V. Sarode, Nikhil U. Joshi, Pratik P. Pansare & Hemant V. Ghatge, Pp. 12282–12285

***Gentiana aperta* (Gentianaceae) - a new record to India from Ladakh Himalaya**

-- Mohd Shabir, Priyanka Agnihotri, Jay Krishan Tiwari & Tariq Husain, Pp. 12286–12289

Notes on *Cinnamomum travancoricum* Gamble (Lauraceae) - a Critically Endangered species from the southern Western Ghats, India

-- A.J. Robi, P. Sujanalal & P.S. Udayan, Pp. 12290–12293

A reassessment and lectotypification of the name *Striga masuria* (Buch.-Ham. ex Benth.) Benth. (Orobanchaceae) and its collection from the Western Ghats of India

-- M. Omalsree & V.K. Sreenivas, Pp. 12294–12297

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