



Avifaunal Diversity and Feeding Guild Structure in and Around Unkal Lake: A Semiarid Urban Wetland in Karnataka, India

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Abstract: The study assessed species composition and distribution of birds through food choices and habitat resources found in wetland and terrestrial habitat in and around Unkal lake. Total of 196 species from 62 families were identified, representing around 35% of the species reported from Karnataka. Rare and coastal birds are sighted due to the region's unique habitat. The avifaunal diversity was $H'=4.44$ and $D=0.979$. Hierarchical cluster analysis of the feeding specialization based on families showed that 119 species (60%) had multiple feeding habits; 75 species (40%) being specific. Insectivore guild with abundance of 37% was the most dominant group distributed in multiple habitats. Terrestrial habitat (26.2%) was the most dominant constituting multiple feeding guilds with greater species diversity & abundance. Correspondence analysis revealed the weakest relationship between arboreal habitat & scavengers, whereas the strongest association among arial habitat & insectivores. Waterbird diversity shows variation with water depth/rainfall changes, as most waterbird diversity depends on shallow water and mud/marsh habitats. This study provides data on avian diversity, concerning threats and feeding guilds, which gives insight about role/information of the habitat. The need for proper conservation and development of this vital ecosystem through long term monitoring is the need of the time.

Keywords: Birds, Hubballi, Dharwad district, Feeding guild, Microhabitat

Wetlands are widely recognized as dynamic ecosystems with diverse attributes, including distinctive avifauna. It has been estimated that about 35% of global wetlands have been lost since 1970 (Darrah et al 2019). The world's freshwater wetland is rich in species composition and serves as a habitat for about 40% of bird species and 12% of all animal species. The microhabitats of a wetland provide rich and quality shelter and food for the avifauna populations throughout the year (Mitsch and Gosselink 2007, Zakaria et al 2009, Zeleke et al 2015). In urban areas wetlands help recharge groundwater aquifers, cleanse polluted waters and act as sponges to mitigate floods. ("Urban wetland/water bodies management guidelines" 2011). In the era of rapid urbanization, the growing urban population can benefit by implementing appropriate planning and management of wetland get ecosystem services that are of prior importance (Maitry et al 2023).

Total wetland area in India is estimated to be 15.98 Mha, which is around 4.86 percent of the total geographic area of the country (Chakraborty 2021). In Karnataka, inland wetlands dominate, which account for 93.44% of the total wetland area (Ramachandra and Ahalya 2009). Dharwad district (13507.14 km²) has a total wetland of 36 with area extent of about 44.0 km² (Profile of Wetlands in Karnataka 2004). In India wetlands loss is due to urbanization, land use changes, and pollution (Bassi et al 2014). Wetland areas

situated in arid and semi-arid places play an important role in supporting migratory bird species (Gardiner 2010). About 10% of the bird species globally rely entirely on wetlands, with about 20% utilizing them for foraging, resting, breeding, and overwintering (Rannestad et al 2015, Kačergytė et al 2021).

Avifauna has long been regarded as an important model system for studying overall biodiversity as they are found in varied climatic zones and habitat types (Junior et al 2016). The number of species and their relative abundance of birds depend upon wetland characteristics such as size, water level, quality of water, availability and distribution of food resources, and presence of suitable roosting and nursery sites (Wiens 1989). Heterogeneity in the habitat affect habitat resources, ultimately determining the species diversity and richness in a given area (Lorenzón et al 2016). Urban areas with fragmented and patchy habitats can still support a high level of biodiversity in their woodlands, scrublands and wetlands (Panda et al 2020) as plentiful untapped resources such as food, shelter, nesting sites, and breeding areas seem to draw birds to urbanized areas (Čanády and Mošanský 2017).

A guild is a fundamental concept in avian ecology and is created when a community of birds uses the same class of environmental resources (Balestrieri et al 2015). Avian feeding guild studies help to explain the complexities in the

structure of an ecosystem and enhance the knowledge about the habitats of that particular ecosystem (Rathod and Padate 2017). In urban areas, where several smaller habitats and feeding guilds are more significant, a rich diversity of birds can be seen (Leveau and Leveau 2016). India is known to have 1377 bird species of which around 81 are endemic to the country (Lepage 2023), constituting about 12% of the world's avifauna (Praveen and Jayapal 2022). Out of the bird species found in India, 310 species rely on wetlands (Kumar et al. 2005; Praveen et al. 2020; Praveen and Jayapal 2022) and 212 species are globally threatened. (Khan and Manakadan 2020). In Karnataka 535 bird species have been reported (Praveen et al 2016).

There are few studies regarding the diversity and ecology of avifauna in this region (Uttangi 1985, Chakravarthy 1993, Desai et al 1999, 2000, 2005, Desai and Kallur 2001, Ghorpadé 2015). However no detailed studies have been conducted to examine the species diversity in relation to feeding guilds of the birds in wetlands of urban area from this region. Hence, the objective of the present study is to describe the species diversity, threat concerns and study feeding guilds based on microhabitat types and ecological status of birds in and around Unkal lake, Hubballi, Karnataka, India.

MATERIAL AND METHODS

Study area: Unkal lake supply potable water to the Hubballi city, Dharwad district of North Karnataka (15.377278° N 75.1067° E with an elevation of 2063ft) (Fig. 1). The total area of the lake measures around 213 acres, 13 gunta. The maximum depth of the lake is about 20-25 feet. The primary source of water to the lake is rain and drainage from catchment areas. The average annual rainfall of the region is about 890mm. Crops such as corn, jowar, green gram, chilly, onion, brinjal, ladies' finger, cucumber, tomato, ground nut, chickpea, soybean, etc are cultivated in the region. The diversity of the avifauna is abundant in the lake and its surroundings due to the presence of diverse habitats such as the marshland, seasonal swamps & grassy scrubland buffering the main water body.

The lake bank with shallow open water and the marshy areas support a variety of aquatic and semi-aquatic vegetation that provides an adequate resource spectrum for the avifauna. Associated with these aquatic florae are a rich population of zooplankton, aquatic & terrestrial arthropods, including insects, molluscs & fishes, which constitute to be the primary resource for the macrofauna, especially the avifauna. The prominent terrestrial and aquatic vegetation thriving in the study area were described. PlantNet, iTree were used to identify the flora.

Bird survey: The methodologies used for bird counts were both point & line transect methods. A total of 10-line transects of 100mtr each and 10-points were covered (Rajashekara and Venkatesha 2017). The distance between each line transect & point was about 200mtrs. For documenting birds around the open water body, in the marshlands, swamps, semi-arid thorn scrub land habitat and farmland, 50mtr radius around each point and the perpendicular distance of 50mtrs from each line transect was observed by walking at a constant pace for both visual and auditory sightings. Total count was used for birds in open waters (Bibby et al 2000) and were counted at three scanning points (Fig. 1) selected based on pilot surveys. To count the large flocks, the flock size was broken into units of 20 individuals (Hodges 1993). The survey was conducted in the peak activity hours of the dawn between (0600-0900 h) and subsequently in the evening hours between (1700-1900 h). Avifauna was identified by sight and call, and individual counts were recorded. Equipment used for photography & observation was NIKON DSLR (D5200) with a 300mm Nikkor telephoto lens and Olympus Binocular 10x50. The individual encounters, habitats, and feeding specialization were noted for further analysis.

As a field guide for identification (Grimmett et al. 2014) and reference for details on distribution, residential status & occurrence status (Mc Kinnon and Philips 1993; Aarif et al. 2017; Grimmett et al. 2014) were utilized and IUCN (2022) was used for information on conservation status. The avifaunal data portrayed here are from 30 surveys between 2016 & 2021, conducted from January to April and between September to December. Observations were recorded to assemble & interpret data on birds' feeding guild based on available literature (Ali and Ripley 1987). The levels of disturbance in and around the site were also recorded for further interpretation.

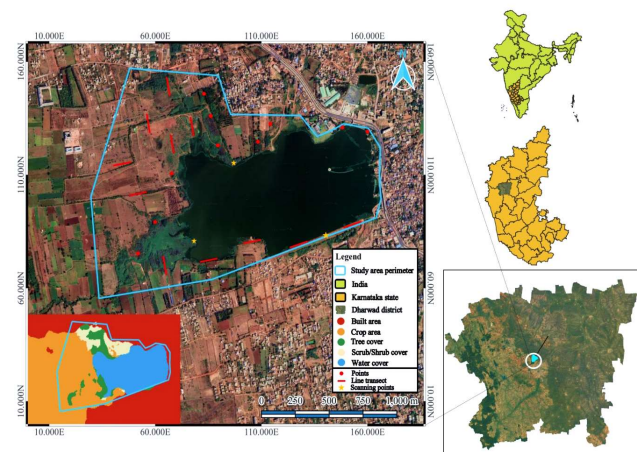


Fig. 1. Study area.-Unkal lake, Hubballi, Karnataka, India

Data analysis: The diversity indices, such as the Shannon-Wiener diversity index, Simpson diversity index, Correspondence analysis, cluster analysis, relative abundance, were calculated using PAST 4 statistical software and Microsoft Excel. The Shannon-Wiener Index is a way to measure the diversity of species in a community. The higher the index, the more diverse the species are in the habitat. If the index equals zero, only one species is present in the community. Simpson's Correspondence analysis is used to describe the relationships between two variables-habitat and feeding guild relationship.

The bird species were pooled into different feeding guilds based on their food preference and foraging areas (DeGraaf et al 1985, Gray et al 2007, Prajapati and Prajapati 2013, Ding et al 2019). The feeding specialization of birds was categorized as carnivores(C); insectivores(I); frugivores(F); granivores(G); nectivores(N); omnivores(O); scavenger(S); vegetable matter(V); piscivores (P), were clustered using the Jaccard similarity index through Unweighted Pair Group Method with Arithmetic mean (UPGMA) relating it to the family groups analysed on PAST4 software.

RESULTS & DISCUSSION

Bird species diversity, composition, and relative frequency: A total of 13,149 individuals from 196 species of birds belonging to 62 families were recorded from the field site (2016-2021). The Shannon and Simpson diversity index of the family-wise diversity was $H'=3.947$ and $D=0.975$. The Anatidae & Accipitridae with 13 species (RDi= 6.63%) was the dominant followed by Ardeidae, Scolopacidae and Muscicapidae with 8 species and Rallidae, Cuculidae and Passeridae with 7 species and Sylviidae with six species are the top five family groups (Table 1). Species composition in terrestrial and water habitats varies, comprising 128 species of terrestrial and 68 species of water birds respectively. The diversity indices indicate a variation in species diversity between the two habitats (Table 2).

There were almost twice the number of species in terrestrial habitats compared to water birds. Most importantly, diverse vegetation in the form of microhabitats around the water body gives an excellent platform for species variety as it provides a diverse niche for different bird species. Vegetation cover has been reported to strongly influence avifauna diversity (Radford et al 2005). Vegetation variety/micro-habitats are among the essential factors due to ample avian diversity. Contrary to the terrestrial habitat, the only reason that could extrapolate for considerably low diversity of water birds compared to terrestrial birds is the high-water level which floods the lake banks/ marshes. Lake water level fluctuates considerably from year to year creating

temporary mud flats, which are crucial for wading birds. Some migratory visitors, such as Little Terns (*Sternula albifrons*), visited the lake only in the particular year when the water level receded to expose muddy banks and puddles with bordering reed vegetation. Species abundance and richness rise with the increase in habitat variety and food availability. During the present study, occurrence of a rare species Great bittern (*Botaurus stellaris*) was first recorded from this region.

In terrestrial diversity Barn swallow (*Hirundo rustica*) tops the diversity index with $H'=1.07$ followed by Feral Rock Pigeon (*Columba livia*), Black Kite (*Milvus migrans*), Rose-ringed Parakeet (*Psittacula krameri*), Green Bee-eater (*Merops orientalis*), Red-rumped Swallow (*Cecropis daurica*), and Little Swift (*Apus affinis*) have the highest diversity index with values ranging from $H'=1.04 - 1.05$, where the species with the lowest diversity index are

Table 1. Relative diversity index (RDI) of all the families of avifauna

Families	Total no. of species	Rdi %	
Anatidae	13	6.632	
Accipitridae			
Ardeidae	12	6.122	
Scolopacidae	8	4.081	
Muscicapidae			
Rallidae	7	3.571	
Cuculidae			
Passeridae			
Sylviidae	6	3.061	
Phasianidae	Hirundinidae	5	2.55
Laridae	Sturnidae		
Columbidae			
Ciconiidae	Estrildidae	4	2.040
Threskiornithidae	Motacillidae		
Cisticolidae			
Phalacrocoracidae	Pycnonotidae	3	1.530
Charadriidae	Phylloscopidae		
Hemiprocnidae	Timaliidae		
Alcedinidae	Emberzidae		
Laniidae			
Jacannidae	Alaudidae	2	1.020
Psittacidae	Dicaeidae		
Bucerotidae	Nectariniidae		
Dicruridae	Ploceidae		
Corvidae			
Podicipedidae	Coraciidae	1	0.510
Anhingidae	Meropidae		
Falconidae	Ramphastidae		
Pandionidae	Picidae		
Turnicidae	Aegithinidae		
Burhinidae	Oriolidae		
Recurvirostridae	Rhipiduridae		
Rostratulidae	Monarchidae		
Glareolidae	Paridae		
Pteroclididae	Paradoxornithidae		
Strigidae	ae		
Caprimulgidae	Zosteropidae		
Upupidae	Fringillidae		

Eurasian Wryneck (*Jynx torquilla*), Western Crowned Warbler (*Phylloscopus occipitalis*), Verditer Flycatcher (*Eumyias thalassinus*), and Indian Courser (*Cursorius coromandelicus*). As the Barn swallow (*Hirundo rustica*) is a migrant, large flocks are seen along the length of telephone and electricity wire lines only during the winter. Among the water bird species, the Eurasian coot (*Fulica atra*) had the highest diversity index with $H'=1.15$, followed by Indian Spot-billed Duck (*Anas poecilorhyncha*), Garganey (*Spatula querquedula*), and Lesser Whistling-Duck (*Dendrocygna javanica*), with a diversity index that ranged from $H'=1.06-1.07$. The relatively higher diversity index of Eurasian coot may be because of the large aggregations during winter months despite being a resident. The lowest diversity index amongst the water birds was of Ruddy-breasted Crake (*Porzana fusca*) with $H'=1.0004$, followed by Black-crowned Night-Heron (*Nycticorax nycticorax*), Baillon's Crake (*Porzana pusilla*), Great Bittern (*Botaurus stellaris*), Caspian Tern (*Hydroprogne caspia*), Brown Crake (*Amauornis akool*), Black-tailed Godwit (*Limosa limosa*) with values that ranged from $H'=1.0008-1.001$.

Amongst the resident species, Shannon's diversity index was $H'=3.774$, and Simpson's diversity index showed $D=0.936$ (Table 3). Eurasian Coot (*Fulica atra*), Indian Spot-billed Duck (*Anas poecilorhyncha*), Lesser Whistling-Duck (*Dendrocygna javanica*), Cotton Pygmy-Goose (*Nettapus coromandelianus*), Purple Swamphen (*Porphyrio porphyrio*), and Little Cormorant (*Microcarbo niger*) had the highest diversity with a range of $H'=1.04-1.14$, where the occurrence of a high abundance of Eurasian coot and the Cotton pygmy goose was not constant throughout the year but only during the winter season. The residents with the lowest diversity index were Ruddy-breasted Crake (*Porzana fusca*) and

Indian Courser (*Cursorius coromandelicus*) with $H'=1.0004$. They were found only once (June 2017) due to their rarity and being elusive/cryptic and also due to lack of stable habitat. Migrant avian diversity had Shannon's diversity index of $H'=3.285$ and Simpson's diversity index of $D=0.934$. Among the migrant species, Barn Swallow (*Hirundo rustica*), Garganey (*Spatula querquedula*), and Northern Shoveler (*Spatula clypeata*) had the highest diversity that ranged from $H'=1.09$ to 1.12 , and migrants with the lowest species diversity were Eurasian Wryneck (*Jynx torquilla*), Western Crowned Warbler (*Phylloscopus occipitalis*) and Verditer Flycatcher (*Eumyias thalassinus*) with $H'=1.001$.

The overall bird diversity of the study area was Simpson diversity index $D=0.96$ and Shannon diversity $H'=4.198$. For further evaluation Eurasian coot was excluded as it occurred only between November 2017 and May 2018, as occurrence of such large gathering only once during more than five-year survey shows that it is not the regular part of the community structure in the ecosystem of the study area and that high abundance would negatively affect the diversity values of the study area. Hence the Shannon index value be $H'=4.44$ and Simpson index $D=0.979$

True diversity is always measured in units of a number of species (Jost, 2006). Converting Shannon entropy ($H'=4.44$) to the effective number of species or true diversity is $=81.45$ effective species and converting the Gini-Simpson index ($D=0.979$) gives $1/(1-0.979) = 47.61$ effective species. This indicates the degree of unevenness or dominance in the community. When there is a degree of dominance, the Shannon effective number of species will be less than the species richness (196), and the Gini-Simpson effective number of species will be less than the Shannon effective number of species. The greater the dominance in the

Table 2. True diversity of terrestrial & aquatic bird species

Parameter	Terrestrial birds	Effective no. of species	Water birds	Effective no. of species
Number of individuals	5321	-	7847	-
Species richness	128	-	68	-
Shannon's diversity index	4.143	62.99151281	3.121	22.669037
Simpson's diversity index	0.9756	40.98360656	0.8974	9.7465887

Table 3. True diversity of resident & migrant bird species

Parameter	Resident species	Effective no. of species for resident species diversity	Migrant species	Effective no. of species for migrant species diversity
Number of individuals	10006	-	3159	-
Species richness	125	-	70	-
Shannon's diversity index	3.774	43.5539	3.285	26.709
Simpson's diversity index	0.936	15.625	0.934	15.1515

community, the greater the differences between these three numbers (Jost 2006). Hence in the present community, the degree of abundance of some species is exponentially higher than many other species.

With the diversity of 47.61 effective species according to the Simpson index means that, the community has the same diversity as the community with around 47 equally common species.

Distribution status & frequency of occurrence: The residents constitute 125 species, among which 44 species (35.5%) were very common, 60 species (48.4%) common category, 17 species (13.7%) were uncommon, three species (2.4%) were rare. Among the 65 species of winter migrants, five species (7.7%) were very common, 20 species (30.8%) were common, 31 species (47.7%) were uncommon, eight species (12.3%) (Table 4) were rare in occurrence, and one species has been only reported once (1.5%). Under the summer migrant category, Pied/Jacobin cuckoo (*Clamator jacobinus*) was the only regular visitor. Four species of passage migrants are under the uncommon category, and two species occur rarely.

Conservation status & population trend: The data for the conservation status was referred from the IUCN Red list. From the total 196 species, 183 species belong to the Least concern category (93.8%), where the population trend of 78 species (42.4%) is stable, 48 species (26%) is decreasing, 29 species (15.8%) is increasing, and population trend of another 29 species (15.8%) is unknown. There are 8 species (4.1%) under the Near threatened category with decreasing population trend (Woolly-necked Stork (*Ciconia episcopus*), Painted Stork (*Mycteria leucocephala*), Black-headed Ibis (*Threskiornis melanocephalus*), Oriental Darter (*Anhinga melanogaster*), Laggar Falcon (*Falco jugger*), Pallid Harrier (*Circus macrourus*), Black-tailed Godwit (*Limosa limosa*), Malabar Pied-Hornbill (*Anthracoceros coronatus*) and four species (2.1%) under Vulnerable category with decreasing population trend (Indian Spotted Eagle (*Clanga hastata*), Lesser Adjutant (*Leptoptilos javanicus*), Common Pochard (*Aythya ferina*), River Tern (*Sterna aurantia*)).

Habitat & Feeding guild structure: The field site habitat was divided further into 8 micro-habitats/niches. From the

total diversity of 196 species richness, 54 species (27%) shared multiple niches from the site habitat. The data representation clearly showed that the Terrestrial habitat dominated the other habitats with species abundance (27.9%) due to the diverse vegetation cover. There are around 16 species of major terrestrial vegetation such as the invasive *Prosopis juliflora* (mesquite) being the dominant, covering around 30% of the study area, whereas Poaceae (three grass sps.) with 20% forming the second most dominant native plant species of the study area. Lantana sps., *Ricinus communis* (castor oil plant), *Azadirachta indica* (Neem), *Millettia pinnata* (Indian beech tree) and *Albizia saman* (Raintree), *Chromolaena odorata*, *Parthenium hysterophorus*, *Hyptis suaveolens*, *Leucaena leucocephala*, *Cocos nucifera*, *Acacia arabica* and *Mimosa pudica* has less than around 15% cover and remaining area is covered mainly by agricultural lands and some parts by horticultural lands. Receding to Terrestrial habitat (27.9%) is open water habitat, Ground, Open bank, Lake marsh, Arboreal, Aerial and the lowest abundance was among the floating vegetation (5.3%) (Fig. 2).

The main reason for the difference in habitat preference by bird species could be due to different vegetation types and abundant food resources such as insects, fishes, frogs, lizards, mice, and vegetable matter. However, other factors include weather (rainfall), social interactions, and predators (Caldwell 1986, Butler and Vennesland 2000, Rivers 2000). In the study area, there is a good amount of marsh and swamp lands, which provide excellent habitats for frogs and toads to breed. Among the aquatic vegetation, Water

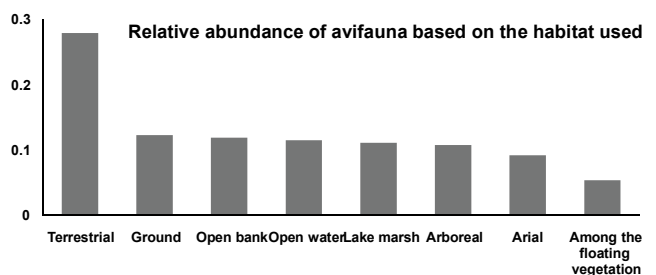


Fig. 2. Plot of the relative abundance of avifauna with different habitat preferences

Table 4. Avifaunal distribution status & frequency of occurrence

Occurrence frequency Distribution status	Very common	Common	Uncommon	Rare	Reported
Resident	44	60	17	4	0
Winter visitor	5	20	31	8	1
Summer visitor	0	1	0	0	0
Passage visitor	0	0	4	2	0

Table 5. Checklist of Avifauna based on the Families, Conservation Status & their population trend, residential and frequency status, feeding and habitat preferences

Common name	Scientific name	Total no. of species	IUCN status- population trend	Residential status	Feeding specialization	Frequency of occurrence	Habitat
Phasianidae							
Indian Peafowl	<i>Pavo cristatus</i>	05	LC- S	R	O	VC	8/5
Gray Francolin	<i>Ortygornis pondicerianus</i>		LC- S	R	O	C	8
Painted Francolin	<i>Francolinus pictus</i>		LC-D	R	V/I	C	8
Common Quail	<i>Coturnix coturnix</i>		LC-D	WV	V/I	UC	8
Rock Bush-Quail	<i>Perdicula argoondah</i>		LC-D	R	V/I	C	8
Anatidae							
Lesser Whistling-Duck	<i>Dendrocygna javanica</i>	13	LC-D	R	V/O	C	2/1/3
Knob-billed Duck	<i>Sarkidiornis melanotos</i>		LC-D	PV	V/O	Ra	3
Ruddy Shelduck	<i>Tadorna ferruginea</i>		LC-U	WV	V/O	UC	2/1/4
Cotton Pygmy-Goose	<i>Nettapus coromandelianus</i>		LC- S	R	V/I	C	2/1
Garganey	<i>Spatula querquedula</i>		LC-D	WV	V/O	C	2/1
Northern Shoveler	<i>Spatula clypeata</i>		LC-D	WV	I/O	C	2/1
Gadwall	<i>Mareca strepera</i>		LC-I	WV	V/I	UC	2/1
Eurasian Wigeon	<i>Mareca penelope</i>		LC-D	WV	V/I	UC	2/1
Indian Spot-billed Duck	<i>Anas poecilorhyncha</i>		LC-D	R	V/O	VC	2/1/3
Northern Pintail	<i>Anas acuta</i>		LC-D	WV	G/O	UC	2/1
Green-winged Teal	<i>Anas crecca</i>		LC-I	WV	V/O	UC	2/1
Common Pochard	<i>Aythya ferina</i>		VU-D	WV	V/O	Ra	1
Podicipedidae							
Little Grebe	<i>Tachybaptus ruficollis</i>	01	LC-D	R	I/C	VC	1
Ciconiidae							
Asian Openbill	<i>Anastomus oscitans</i>	04	LC-U	WV	C/I	UC	4
Woolly-necked Stork	<i>Ciconia episcopus</i>		NT-D	R	C/I	C	8
Lesser Adjutant	<i>Leptoptilos javanicus</i>		VU-D	WV	P/C	UC	4/6
Painted Stork	<i>Mycteria leucocephala</i>		NT-D	R	P/C	C	4
Threskiornithidae							
Glossy Ibis	<i>Plegadis falcinellus</i>	04	LC-D	WV	I/C	UC	8/4
Black-headed Ibis	<i>Threskiornis melanocephalus</i>		NT-D	R	C/I	C	4
Red-naped Ibis	<i>Pseudibis papillosa</i>		LC-D	R	C/I	C	8/4
Eurasian Spoonbill	<i>Platalea leucorodia</i>		LC-U	R	C/I	UC	4
Ardeidae							
Great Bittern	<i>Botaurus stellaris</i>	12	LC-D	WV	C	Ra	3
Yellow Bittern	<i>Ixobrychus sinensis</i>		LC-U	R	C/I	UC	3
Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>		LC-S	R	C/I	UC	3
Gray Heron	<i>Ardea cinerea</i>		LC-U	R/WV	C/I	VC	3
Purple Heron	<i>Ardea purpurea</i>		LC-D	R	C/I	VC	3
Great Egret	<i>Ardea alba</i>		LC-U	R	C/I	C	4/3
Intermediate Egret	<i>Ardea intermedia</i>		LC-D	R	C/I	VC	4/3
Little Egret	<i>Egretta garzetta</i>		LC-I	R	I/C	C	8/4
Western Reef-Heron	<i>Egretta gularis</i>		LC-S	R	C/I	VC	8
Cattle Egret	<i>Bubulcus ibis</i>		LC-I	PV	I/C	UC	4/3

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Table 5. Checklist of Avifauna based on the Families, Conservation Status & their population trend, residential and frequency status, feeding and habitat preferences

Common name	Scientific name	Total no. of species	IUCN status- population trend	Residential status	Feeding specialization	Frequency of occurrence	Habitat
Indian Pond-Heron	<i>Ardeola grayii</i>		LC-U	R	C/I	VC	4/3
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>		LC-D	R	C/I	C	4/3
Anhingidae							
Oriental Darter	<i>Anhinga melanogaster</i>	01	NT-D	WV	P/C	C	1
Little Cormorant	<i>Microcarbo niger</i>	03	LC-U	R	P	VC	1
Great Cormorant	<i>Phalacrocorax carbo</i>		LC-I	WV	P	UC	1
Indian Cormorant	<i>Phalacrocorax fuscicollis</i>		LC-U	WV	P	C	1
Falconidae							
Laggar Falcon	<i>Falco jugger</i>	01	NT-D	R	C	Ra	7/6
Pandionidae							
Osprey	<i>Pandion haliaetus</i>	01	LC-I	WV	P	C	6/1
Accipitridae							
Black-winged Kite	<i>Elanus caeruleus</i>	13	LC-S	R	C/I	C	6
Indian Spotted Eagle	<i>Clanga hastata</i>		VU-D	WV	C	UC	7/6
Booted Eagle	<i>Hieraaetus pennatus</i>		LC-S	WV	C	UC	7/6
White-eyed Buzzard	<i>Butastur teesa</i>		LC-S	R	C/I	UC	7/6/8
Eurasian Marsh-Harrier	<i>Circus aeruginosus</i>		LC-S	WV	C/I	VC	7/8
Pallid Harrier	<i>Circus macrourus</i>		NT-D	WV	C/I	Ra	7/8
Montagu's Harrier	<i>Circus pygargus</i>		LC-D	WV	C/I	Ra	7/8
Shikra	<i>Accipiter badius</i>		LC-D	R	C	VC	6
Eurasian Sparrowhawk	<i>Accipiter nisus</i>		LC-S	WV	C	UC	6
Black Kite	<i>Milvus migrans</i>		LC-S	R	C/S	VC	7/6/1
Black Kite (Black-eared)	<i>Milvus migrans lineatus/formosanus</i>		LC-S	R	C	VC	7/6/1
Brahminy Kite	<i>Haliaeetus indus</i>		LC-D	R	C/S	VC	7/6/1
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>		LC-D	PV	C	UC	6/7/1
Rallidae							
Eurasian Moorhen	<i>Gallinula chloropus</i>	07	LC-S	R	V/O	C	3/2
Eurasian Coot	<i>Fulica atra</i>		LC-I	R	V/O	VC	3/2/1
Purple Swampphen	<i>Porphyrio poliocephalus</i>		LC-U	R	V/O	VC	3
White-breasted Waterhen	<i>Amaurornis phoenicurus</i>		LC-U	R	I/O	VC	3
Ruddy-breasted Crake	<i>Zapornia fusca</i>		LC-D	R	I/O	UC	3
Brown Crake	<i>Zapornia akool</i>		LC-U	R	I/O	UC	3
Baillon's Crake	<i>Zapornia pusilla</i>		LC-U	WV	I/O	UC	3
Turnicidae							
Barred Buttonquail	<i>Turnix suscitator</i>	01	LC-I	R	V/I	C	8
Burhinidae							
Indian Thick-knee	<i>Burhinus indicus</i>	01	LC-D	R	I/O	C	8
Charadriidae							
Yellow-wattled Lapwing	<i>Vanellus malabaricus</i>	03	LC-S	R	I	C	8

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Table 5. Checklist of Avifauna based on the Families, Conservation Status & their population trend, residential and frequency status, feeding and habitat preferences

Common name	Scientific name	Total no. of species	IUCN status- population trend	Residential status	Feeding specialization	Frequency of occurrence	Habitat
Red-wattled Lapwing	<i>Vanellus indicus</i>		LC-U	R	I	VC	8
Little Ringed Plover	<i>Charadrius dubius</i>		LC-S	R	I	UC	4
Recurvirostridae							
Black-winged Stilt	<i>Himantopus himantopus</i>	01	LC-I	R	C/I	VC	4/3
Rostratulidae							
Greater painted Snipe	<i>Rostratula benghalensis</i>	01	LC-D	R	O	C	3
Jacannidae							
Pheasant-tailed Jacana	<i>Hydrophasianus chirurgus</i>	02	LC-D	R	I/O	C	2/3
Bronze-winged Jacana	<i>Metopidius indicus</i>		LC-U	R	V/O	VC	2/3
Scolopacidae							
Temminck's Stint	<i>Calidris temminckii</i>	09	LC-U	WV	I/O	UC	4/3
Little Stint	<i>Calidris minuta</i>		LC-I	WV	I/O	UC	4/3
Common Snipe	<i>Gallinago</i>		LC-D	WV	I/O	UC	4/3
Pin-tailed Snipe	<i>Gallinago stenura</i>		LC-U	WV	I/O	UC	4/3
Common Sandpiper	<i>Rostratula benghalensis</i>		LC-D	WV	I/O	C	4
Green Sandpiper	<i>Actitis hypoleucos</i>		LC-I	WV	I/O	UC	4
Marsh Sandpiper	<i>Tringa ochropus</i>		LC-D	WV	I/O	UC	4
Wood Sandpiper	<i>Tringa stagnatilis</i>		LC-S	WV	I/O	C	4
Black-tailed Godwit	<i>Limosa</i>		NT-D	WV	I/O	UC	3/4
Glareolidae							
Indian Courser	<i>Cursorius coromandelicus</i>	01	LC-S	R	I	Ra	8
Laridae							
Brown-headed Gull	<i>Chroicocephalus brunnicephalus</i>	05	LC-S	PV	P/O	UC	7/1
Little Tern	<i>Sternula albifrons</i>		LC-D	PV	P/I	UC	7/1/4
Caspian Tern	<i>Hydroprogne caspia</i>		LC-D	PV	P	Ra	7/1
Whiskered Tern	<i>Chlidonias hybrida</i>		LC-S	WV	I/P	C	7/1/4
River Tern	<i>Sterna aurantia</i>		VU-D	R	P/I	VC	7/1/4
Pteroclididae							
Chestnut-bellied Sandgrouse	<i>Pterocles exustus</i>	01	LC-S	R	G	UC	8
Columbidae							
Rock Pigeon (Feral Pigeon)	<i>Columba livia</i>	05	Not valid	R	G/F	VC	5
Eurasian Collared-Dove	<i>Streptopelia decaocto</i>		LC-I	R	G/V	C	5
Red Collared-Dove	<i>Streptopelia tranquebarica</i>		LC-D	R	G/V	UC	5
Spotted Dove	<i>Streptopelia chinensis</i>		LC-I	R	G/V	C	5
Laughing Dove	<i>Streptopelia senegalensis</i>		LC-S	R	G/I	VC	5
Psittacidae							
Rose-ringed Parakeet	<i>Psittacula krameri</i>	02	LC-I	R	F	VC	6
Plum-headed Parakeet	<i>Psittacula cyanocephala</i>		LC-D	R	F	C	6
Cuculidae							
Greater Coucal	<i>Centropus sinensis</i>	07	LC-S	R	C/O	C	5/8

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Common name	Scientific name	Total no. of species	IUCN status- population trend	Residential status	Feeding specialization	Frequency of occurrence	Habitat
Blue-faced Malkoha	<i>Phaenicophaeus viridirostris</i>		LC-S	R	I/O	UC	5
Pied Cuckoo	<i>Clamator jacobinus</i>		LC-S	SV	I/O	C	5
Asian Koel	<i>Eudynamys scolopaceus</i>		LC-S	R	F/O	VC	6
Gray-bellied Cuckoo	<i>Cacomantis passerinus</i>		LC-S	R	I	C	5
Fork-tailed Drongo-Cuckoo	<i>Surniculus dicruroides</i>		LC-D	R	I/F	Rp	6
Common Hawk-Cuckoo	<i>Hierococcyx varius</i>		LC-S	R	I/F	UC	6
Strigidae							
Spotted Owlet	<i>Athene brama</i>	01	LC-S	R	I/C	C	5
Caprimulgidae							
Indian Nightjar	<i>Caprimulgus asiaticus</i>	01	LC-S	R	I	C	5
Hemiprocnidae							
Indian Swiftlet	<i>Aerodramus unicolor</i>	03	LC-D	R	I	UC	7
Little Swift	<i>Apus affinis</i>		LC-I	R	I	C	7
Asian Palm-Swift	<i>Cypsiurus balasienis</i>		LC-S	R	I	UC	7
Upupidae							
Eurasian Hoopoe	<i>Upupa epops</i>	01	LC-D	R	I/C	C	8
Coraciidae							
Indian Roller	<i>Coracias benghalensis</i>	01	LC-I	R	C/I	UC	5
Alcedinidae							
Common Kingfisher	<i>Alcedo atthis</i>	03	LC-U	R	P/I	VC	3/1
White-throated Kingfisher	<i>Halcyon smyrnensis</i>		LC-U	R	I/C	VC	5
Pied Kingfisher	<i>Ceryle rudis</i>		LC-U	R	P/I	C	1/5
Meropidae							
Green Bee-eater	<i>Merops orientalis</i>	01	LC-I	R	I	VC	5
Bucerotidae							
Indian Gray Hornbill	<i>Ocyrceros birostris</i>	02	LC-S	R	F/O	C	6
Malabar Pied-Hornbill	<i>Anthraceroceros coronatus</i>		NT-D	R	F/O	C	5
Ramphastidae							
Coppersmith Barbet	<i>Psilopogon haemacephalus</i>	01	LC-D	R	F	C	6
Picidae							
Eurasian Wryneck	<i>Jynx torquilla</i>	01	LC-D	WV	I	Ra	5
Aegithinidae							
Common Iora	<i>Aegithina tiphia</i>	01	LC-U	R	I	VC	6
Laniidae							
Brown Shrike	<i>Lanius cristatus</i>	03	LC-D	WV	I/C	VC	5
Bay-backed Shrike	<i>Lanius vittatus</i>		LC-S	R	I	C	5
Long-tailed Shrike	<i>Lanius schach</i>		LC-U	R	I/C	VC	5
Dicuridae							
Black Drongo	<i>Dicrurus macrocercus</i>	02	LC-U	R	I	VC	5
Ashy Drongo	<i>Dicrurus leucophaeus</i>		LC-U	WV	I	C	5
Oriolidae							
Indian Golden Oriole	<i>Oriolus kundoo</i>	01	LC-U	R	F/O	C	6
Rhipiduridae							
Spot-breasted Fantail	<i>Rhipidura albogularis</i>	01	LC-S	R	I	C	5

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Common name	Scientific name	Total no. of species	IUCN status- population trend	Residential status	Feeding specialization	Frequency of occurrence	Habitat
Monarchidae							
Indian Paradise-Flycatcher	<i>Terpsiphone paradisi</i>	01	LC-S	R	I	C	5
Corvidae							
House Crow	<i>Corvus splendens</i>	02	LC-S	R	O/S	VC	5
Large-billed Crow	<i>Corvus macrorhynchos</i>		LC-S	R	O/S	C	5
Paridae							
Cinereous Tit	<i>Parus cinereus</i>	01	LC-I	R	I/O	C	5
Hirundinidae							
Dusky Crag-Martin	<i>Ptyonoprogne concolor</i>	05	LC-I	R	I	C	7
Barn Swallow	<i>Hirundo rustica</i>		LC-D	WV	I	C	7
Wire-tailed Swallow	<i>Hirundo smithii</i>		LC-I	R	I	C	7
Red-rumped Swallow	<i>Cecropis daurica</i>		LC-S	R	I	VC	7
Streak-throated Swallow	<i>Petrochelidon fluvicola</i>		LC-I	R	I	C	7
Alaudidae							
Rufous-tailed Lark	<i>Ammomanes phoenicura</i>	02	LC-S	R	G/I	C	8
Ashy-crowned Sparrow-Lark	<i>Eremopterix griseus</i>		LC-S	R	G/I	VC	8
Pycnonotidae							
Red-vented Bulbul	<i>Pycnonotus cafer</i>	03	LC-I	R	F/O	VC	5
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>		LC-D	R	F/O	VC	5
White-browed Bulbul	<i>Pycnonotus luteolus</i>		LC-S	R	F/O	C	5
Cisticolidae							
Common Tailorbird	<i>Orthotomus sutorius</i>	04	LC-S	R	I/N	VC	5
Ashy Prinia	<i>Prinia socialis</i>		LC-S	R	I	VC	5
Plain Prinia	<i>Prinia inornata</i>		LC-S	R	I	C	5
Zitting Cisticola	<i>Cisticola juncidis</i>		LC-I	R	I	C	5
Sylviidae							
Booted Warbler	<i>Iduna caligata</i>	06	LC-I	WV	I	UC	5
Sykes's Warbler	<i>Iduna rama</i>		LC-S	WV	I	UC	5
Paddyfield Warbler	<i>Acrocephalus agricola</i>		LC-D	WV	I	C	5
Blyth's Reed Warbler	<i>Acrocephalus dumetorum</i>		LC-I	WV	I	VC	5
Clamorous Reed Warbler	<i>Acrocephalus stentoreus</i>		LC-S	WV	I/O	VC	5
Lesser Whitethroat	<i>Curruca</i>		LC-S	WV	I/O	C	5
Phylloscopidae							
Common Chiffchaff	<i>Phylloscopus collybita</i>	03	LC-I	WV	I/O	UC	5
Greenish Warbler	<i>Phylloscopus trochiloides</i>		LC-I	WV	I/O	C	6
Western Crowned Warbler	<i>Phylloscopus occipitalis</i>		LC-S	WV	I	UC	6
Paradoxornithidae							
Yellow-eyed Babbler	<i>Chrysomma sinense</i>	01	LC-S	R	I/O	C	5
Timaliidae							
Tawny-bellied Babbler	<i>Dumetia hyperythra</i>	03	LC-D	R	I	UC	5
Large Gray Babbler	<i>Argya malcolmi</i>		LC-S	R	I/O	VC	5
Yellow-billed Babbler	<i>Argya affinis</i>		LC-S	R	O	VC	5
Zosteropidae							
Indian White-eye	<i>Zosterops palpebrosus</i>	01	LC-D	R	O	C	5
Sturnidae							
Rosy Starling	<i>Pastor roseus</i>	05	LC-U	WV	O	C	5
Brahminy Starling	<i>Sturnia pagodarum</i>		LC-U	R	O	C	5
Chestnut-tailed Starling	<i>Sturnia malabarica</i>		LC-U	WV	O	C	5
Common Myna	<i>Acridotheres tristis</i>		LC-I	R	O	VC	5

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Table 5. Checklist of Avifauna based on the Families, Conservation Status & their population trend, residential and frequency status, feeding and habitat preferences

Common name	Scientific name	Total no. of species	IUCN status- population trend	Residential status	Feeding specialization	Frequency of occurrence	Habitat
Jungle Myna	<i>Acridotheres fuscus</i>		LC-D	R	O	VC	5
Muscapidae							
Asian Brown Flycatcher	<i>Muscicapa dauurica</i>	08	LC-S	WV	I	C	5
Indian Robin	<i>Copsychus fulicatus</i>		LC-S	R	I	VC	5
Oriental Magpie-Robin	<i>Copsychus saularis</i>		LC-S	R	I/O	C	5
Tickell's Blue Flycatcher	<i>Cyornis tickelliae</i>		LC-S	R	I	C	5
Verditer Flycatcher	<i>Eumyias thalassinus</i>		LC-S	WV	I/O	Ra	5
Bluethroat	<i>Luscinia svecica</i>		LC-S	WV	I/O	UC	5
Siberian Stonechat	<i>Saxicola maurus</i>		LC-S	WV	I	C	5
Pied Bushchat	<i>Saxicola caprata</i>		LC-S	R	I	VC	5
Dicaeidae							
Pale-billed Flowerpecker	<i>Dicaeum erythrorhynchos</i>	02	LC-S	R	F//N	C	6
Thick-billed Flowerpecker	<i>Dicaeum agile</i>		LC-S	R	F//N	C	6
Nectariniidae							
Purple-rumped Sunbird	<i>Leptocoma zeylonica</i>	02	LC-S	R	N	C	6
Purple Sunbird	<i>Cinnyris asiaticus</i>		LC-S	R	N	C	6
Passeridae							
House Sparrow	<i>Passer domesticus</i>	07	LC-D	R	G/O	C	5
Yellow-throated Sparrow	<i>Gymnoris xanthocollis</i>		LC-S	R	G/O	UC	5
Gray Wagtail	<i>Motacilla cinerea</i>		LC-S	WV	I	C	4/8
Western Yellow Wagtail	<i>Motacilla flava</i>		LC-D	WV	I	C	8/4
Citrine Wagtail	<i>Motacilla citreola</i>		LC-I	WV	I	Ra	8/4
White-browed Wagtail	<i>Motacilla maderaspatensis</i>		LC-S	R	I	VC	8
White Wagtail	<i>Motacilla alba</i>		LC-S	WV	I	C	4/8
Ploceidae							
Streaked Weaver	<i>Ploceus manyar</i>	02	LC-S	R	G/O	Ra	5
Baya Weaver	<i>Ploceus philippinus</i>		LC-S	R	G/O	C	5
Estrildidae							
Indian Silverbill	<i>Euodice malabarica</i>	04	LC-S	R	G/O	C	5
Scaly-breasted Munia	<i>Lonchura punctulata</i>		LC-S	R	G/O	C	5
Tricolored Munia	<i>Lonchura malacca</i>		LC-S	R	G/O	UC	5
Red Avadavat	<i>Amandava</i>		LC-S	R	G/O	C	5
Motacillidae							
Paddyfield Pipit	<i>Anthus rufulus</i>	04	LC-S	R	I	C	8
Blyth's Pipit	<i>Anthus godlewskii</i>		LC-S	WV	I	Ra	8
Tawny Pipit	<i>Anthus campestris</i>		LC-S	WV	I	Ra	8
Olive-backed Pipit	<i>Anthus hodgsoni</i>		LC-S	WV	I	UC	5
Fringillidae							
Common Rosefinch	<i>Carpodacus erythrinus</i>	01	LC-D	WV	G/O	UC	5
Emberzidae							
Black-headed Bunting	<i>Emberiza melanocephala</i>	03	LC-U	WV	O	UC	5
Red-headed Bunting	<i>Emberiza bruniceps</i>		LC-S	WV	O	UC	5
Gray-necked Bunting	<i>Emberiza buchanani</i>		LC-S	WV	O	UC	5

Threat Status: CR - Critically Endangered; EN - Endangered; VU - Vulnerable; NT - Near Threatened; LC - Least Concern.

Population trend: S - stable; D - decreasing; I - increasing; U - unknown.

Residential status: R = resident; WV = winter visitor; SV = summer visitor; PV = passage migrant

Feeding specialization: carnivores(C); insectivores(I); frugivores(F); granivores(G); nectivores(N); omnivores(O); scavenger(S); vegetable matter(V); piscivores (P).

Frequency of occurrence: V = very common; C = common; UC = uncommon; Ra = rare; Rp = reported.

Habitat: 1. Open water; 2. Among the floating vegetation; 3. Lake marsh; 4. Open bank; 5. Terrestrial; 6. Arboreal; 7. Aerial; 8. Ground.

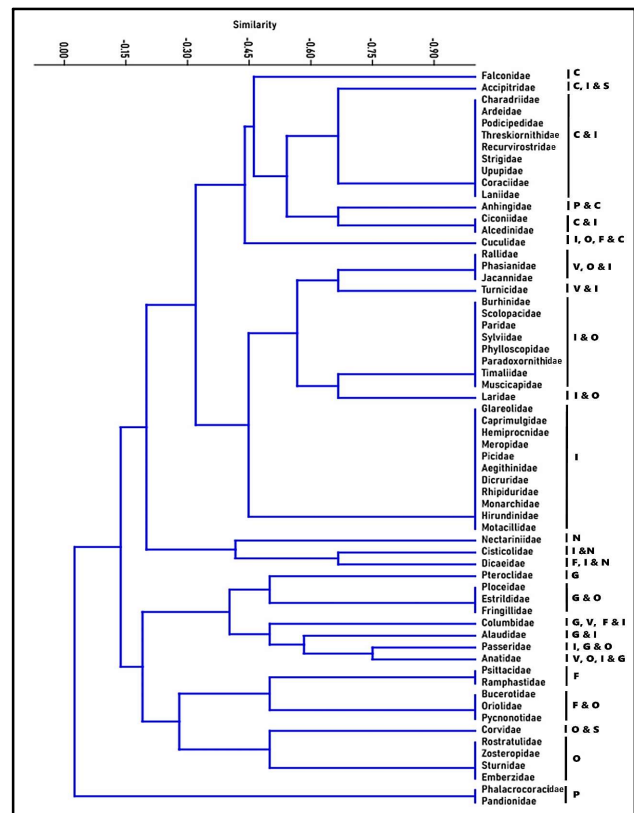
Hyacinth (*Pontederia crassipes*) being invasive covers approximately about 25%, followed by *Typha* spp., and *Ipomoea aquatica* that cover around 20%. The remaining aquatic vegetation cover includes, *Hydrilla verticillata* (water hymes), *Vallisneria*, *Cyperus* (nutsedges), *Spirodela* spp., *Azolla*, *Aeschynomene aspera*, *Eriocaulon setaceum*, *Ottelia*, *Myriophyllum verticellatum*, *Nymphaea* spp., *Potamogeton* spp., *Lemna* spp. *Wolffia globose* and *Spargonium* spp. With a variety of aquatic vegetation and terrestrial scrubs and bushes hosts a wide array of insect population of about more than 30 species of Lepidopterans and Odonata. The seasonal gathering of resident Common coots in hundreds and other migratory ducks during winter, particularly in this wetland, is due to the large water surface with both shallow and deeper areas and the presence of bordering aquatic vegetation and marshes. Other than the aquatic insects, crustaceans such as crabs, a variety of shrimps such as the bamboo shrimps, Amanos, grass and Ghost shrimps, various species of frogs and toads and abundant diversity of univalve molluscs provide a great source of nutrition to the waders and other water birds. More than 13 species of fish, from tiny Gambusia to Barbs, Tilapia to Carps, Minnows to *Ophiocephalus*, and Catfishes act as a food resource for a wide range of birds from divers to waders and Herons to Raptors. The trees, such as the *Acacia arebica* and *Cocos nucifera*, and even electric poles/lines provide good perch sites for resident and migratory Raptors. The reed beds in the lake banks are the only reason elusive species such as the Bitterns and Crake species thrive in the region.

The vegetation diversity and richness of Unkal wetland directly affect species diversity and richness of birds because it provides heterogeneous and suitable sites for foraging, nesting, and roosting (Karr and Roth 1971, Cody 1981, Soderstrom and Part 1999). There is some general agreement that marshes that undergo cyclic vegetation changes resulting from varying water levels show maximum avian use and production during the period when emergent macro-phytes and open water are present in equal proportions in an interspersed pattern (Weller and Spatcher 1965, Weller and Fredrickson 1974, Murkin et al 1997). Study by Chen et al (2016) suggest that the critical land use types for protecting endangered species of birds and good species diversity, in general, are medium grassland, tidal flat, and pond landscapes. Hence wetland restoration projects should keep these three-pointers as the basis of design.

The bird species were divided into eight feeding guilds. The first part of the study where family groups were classified into feeding specialization clusters (Fig. 3). Where the Insectivores covered 43 families, among which 14 were non-

specifics, Carnivores covered 15 families with 14 non-specifics, Omnivores covered 26 families with only four specifics. In contrast, Piscivores covered three families with two specifics, the Frugivores covered seven families with two specifics, the Granivores covered eight families with one specific, Nectivores covered three families with one specifics, Birds consuming Vegetative matter covered six families with all non-specifics and Scavengers covered only two families with all non-specifics. And among the 196 species, 119 (60%) had multiple feeding habits. Analysing the food preference revealed that Insectivores (39%) dominated other feeding guilds compared to Omnivores (22.8%), Carnivores (14%), Vegetable matter (6.9%), Granivores (5.7%), Frugivores (4.7%), Piscivores (3.8%), Nectivores (1.5%), Scavenger (0.6%).

Nudds and Bowlby (1984); Jose and Zacharias (2003) stated that the level of avifaunal diversity in the study area may be due to a wide spectrum of food niches. The different species of birds occupying a particular feeding guild and space have evolved specialized foraging strategies to



Feeding specialization: carnivores(C); insectivores(I); frugivores(F); granivores(G); nectivores(N); omnivores(O); scavenger(S); vegetable matter(V); piscivores (P)

Fig. 3. Hierarchical cluster analysis of feeding specialization based on families

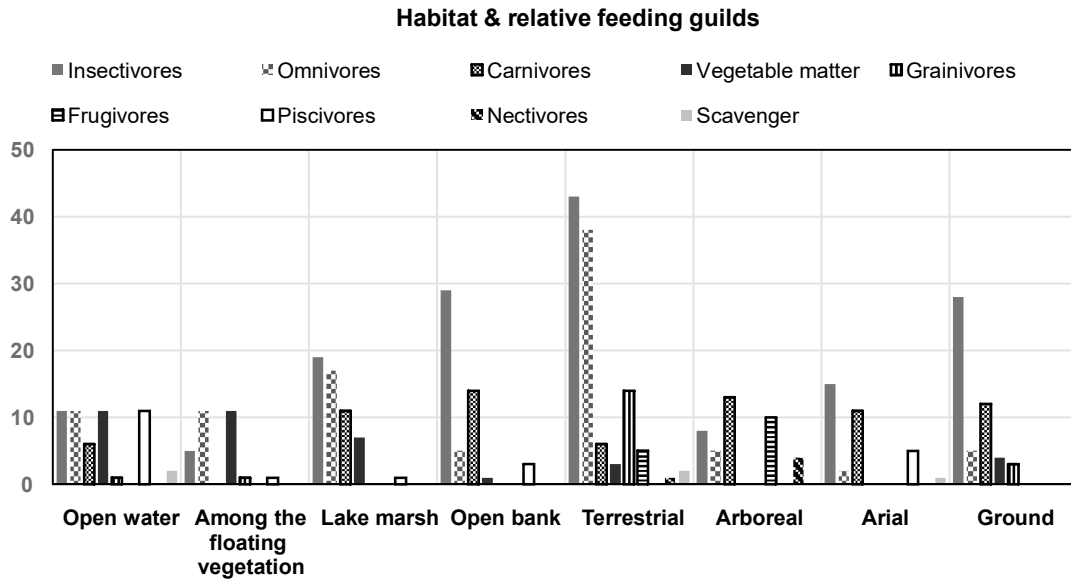


Fig. 4. Relation between avifaunal groups with various habitat preferences and feeding specialization

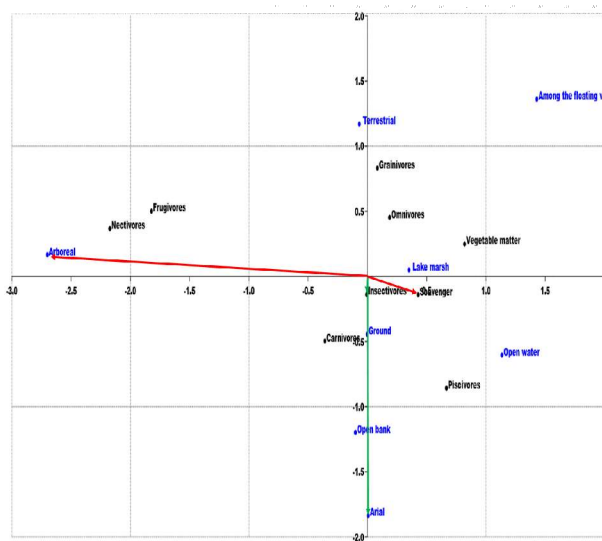


Fig. 5. The most positively related are arial habitat and insectivores and the most negatively related are arboreal habitat and scavengers

explore and obtain food resources efficiently and thus reduce competition among diverse species.

The occurrence of a significant number of insectivorous bird communities indicates that the area consists of rich insect diversity and similar observations have been by (Gregory et al 2004, Gajera et al 2012, Rajashekara and Venkatesha 2015, Sharma and Kichloo 2015). Hence they also plays a significant role as important bio-control agents of insect pest of agriculture, horticulture, and forest ecosystem (Mahabal 2005, Thakur et al 2010).

The composition of feeding guilds based on the presence

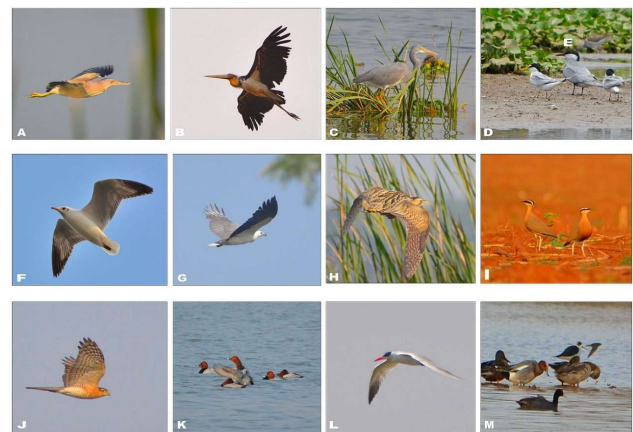


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Image 1: A – *Ixobrychus sinensis*; B – *Leptoptilos javanicus*; C – *Egretta gularis*; D – *Sternula albifrons*; E – *Chlidonias hybrida*; F – *Chroicocephalus brunnicephalus*; G – *Haliaeetus leucogaster*; H – *Botaurus stellaris*; I – *Cursorius coromandelicus*; J – *Accipiter nisus*; K – *Aythya ferina*; L – *Hydroprogne caspia*; M – *Mareca penelope*

Image 1. Few uncommon/rare and elusive Avifauna in & around Unkal lake

in multiple habitats was examined to understand the importance of the habitats for different groups. The study showed that Insectivore with an abundance of (37%) was the most dominant group with most species occupying all habitat types. The least dominant guild was the Nectivores making their presence in just two habitat types (terrestrial, arboreal) (Fig. 4). Considering habitat in relation to feeding guild, terrestrial habitat was the most dominant in comprising most feeding guilds with greater species abundance (26.2%). The least abundance of the same was of floating aquatic vegetation (6.8%) (Fig. 4). Correspondence Analysis was

used to analyse the relationship of different microhabitats with feeding guild structure. The weakest relationship was between the Arboreal habitat & Scavengers, whereas the strongest relationship was among the Arial habitat & insectivores (Fig. 5).

CONCLUSION

The data and observations from the present study portrays that the wetland with habitat heterogeneity and proper wetland physical factors can sustain complex structure of feeding guilds and avifaunal diversity and also study shows how anthropological influence can induce less diversity in an area and more abundance of certain species. The region holds high diversity of migrant species and most of them are regular visitors and considerable number of species are placed under various threatened category of IUCN. Though the study area is located in the core urban environment, the microhabitat surrounding the wetland is capable of supporting the varied avian fauna including generalist coastal and rare species of birds. However, increased urban developmental activities are causing habitat alterations, which has affected the bird population causing irregularity in few of the sensitive bird species including migratory species. Regular monitoring and habitat maintenance with conscious lake development plans are essential to conserve the wetland and the avifaunal population in this area.

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