

Seasonal fluctuations in diversity and foraging guild of water birds at Navkhala Pond near Nagbhid in Maharashtra, India

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ABSTRACT

We had undertaken monthly survey of water birds at Navkhala Pond (20°58'85"N and longitude 79°35'24"E) the man-made water reservoir, situated near Nagbhid in eastern part of Vidarbha of Maharashtra State in India between Nov.2019 to Oct. 2022 in order to explore season fluctuations in its diversity and foraging guild. During study period in total 6919 individuals of 40 species, belongs to 29 genera, were recorded. The data on the mean abundance of water birds reveals that, Lesser Whistling Duck, (8.10%), Cattle Egret (11.18 %), and Little Cormorant (10.09%) were the most abundant species during winter, summer, and rainy season respectively. Observations on the conservation status of water birds reveals that, only three species, Woolly Necked Stork, Black Headed Ibis, Darter belongs to Near Threatened (NT) category while and River Tern belongs to Vulnerable (Vu) category of Red Data List of IUCN, while all other species belong to Least Concern (LC) category. Present investigation on the seasonal fluctuations of water bird community at Navkhala Pond indicates that, total count of water birds peaked during winter season (3244) followed by the summer (2110) and monsoon season (1565) that is, overall 48.24 % decline as the paradigm shift in the topographical features of pond undertakes from winter to monsoon season. Community composition across the different orders of water birds greatly fluctuates seasonally, order-Anseriformes recorded peak average number of birds during winter season followed by Gruiformes and Suliiformes while during summer and monsoon season, waterbirds belongs to order - Suliiformes recorded peak values. Observations on seasonal fluctuations in the abundance of water birds reveals that, Order – Charadiiformes recorded maximum abundance followed by Anseriformes during winter season. These gradients in abundance of water bird community slightly change during summer season, as order-Peliconiformes recorded maximum abundance followed by Charadiiformes. Surprisingly, the present study recorded phenomenal decline in number of ducks species belongs to fam-Anatidae of water bird community with exception of Gadwall and Northern Pintail, it may be due covering of open water habitat by the commercial cultivation of water chestnut hence the conservation measures were recommended for this very productive water body.

Key words: Charadriiformes, Anatidae, Darter, Ibis, Guild

Introduction

Wetland acts as an important habitat that supports wide range of diversity especially water birds (Boere, *et al.*, 2006). The birds considered as ecological indicators of an ecosystem (Gregory, 2003). The

birds inhabiting in and around water reservoir and dependent on wetland directly or indirectly for feeding, breeding, nesting or roosting are commonly called as water birds or wetland birds (Ramsar Convention, 2016; Kumar and Gupta, 2013). They forage on small invertebrates and vertebrates and other

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benthic organisms (Nirmal Kumar *et al.*, 2014). Loss of wetlands in recent decade due to intensification of anthropogenic activities like fishing, commercial cultivation of hydrophytes, deposition of domestic waste and agricultural runoff has been posing serious threat to the wetlands and water birds (Zedler and Kercher, 2005; Nirmal Kumar *et al.*, 2007; Dar and Dar, 2009).

Wetlands in India account for 18.4% of the country's geographic area, of which 70% is under paddy cultivation (Parekh and Gadhvi, 2013). Water bird communities have been studied fairly well in India (Arunkumar, *et al.*, 2005; Bhattacharjee and Bergali, 2012; Kumar and Gupta, 2013; Quodros, 2016; Chattterjee *et al.*, 2020; Jamwal, *et al.*, 2020). India checklist reported 310 wetland birds, out of which 243 are water birds and 67 are wetland associated birds (Arunkumar, *et al.*, 2005). Past studies documented water bird community of Maharashtra, mostly in Western Ghat (Balkhande *et al.*, 2012; Kumbhar and Ghatge, 2014; Adhikari, 2019), in Vidarbha by Chitampally, 1993; Wagh, *et al.*, 2015; Bayani and Dandekar, 2017). Most of the study pertaining to diversity of avifauna in this eastern part of the Vidarbha (Maharashtra) carried out in protected forests like Tadoba-Andhari Tiger Reserve (TATR), Nagzira Wildlife Sanctuary and Karhandla Wildlife Sanctuary, Umred (Bayani and Dandekar, 2017).

An effort to conserve wetland habitats are hampered by a paucity of biological data (Streeter *et al.*, 1993; Shuford *et al.*, 2004). There is a paucity of studies on the diversity of birds in the non-protected areas of Chandrapur, Bhandara and Gadchiroli district of Maharashtra which is known for dense moist semi-deciduous forest interspersed with freshwater habitats, ponds, lakes and paddy fields. To address this data gap, we had conducted survey on the

Navkhala Pond to study the fluctuations in the abundance of water birds during different seasons in order to plan conservation strategy of this wonderful wetland.

Materials and Method

Study area

The present study was conducted at Navkhala Talav (20°58'85"N and longitude 79°35'24"E) the man-made water reservoir, situated near Nagbhid town in the eastern part of Vidarbha of Maharashtra State in India (Fig. 1). It spreads over an area of 420516 mts² and located at an elevation of 255 mts from the mean sea level as per Google Earth data. The region experiences strong seasonality with distinct winter (November to February), summer (March to June), and monsoon season (July to October). The total rainfall in the region averaged 550 mm. The highest temperature was 44 °C recorded in summer and lowest (13 °C) in winter season. The study site presents unique agro-forest ecosystem dominated by commercially cultivated hydrophytes especially *Shingada* plantation, *Trapa natans*. Apart from Shingada cultivation, pond area utilized for fishery, washing of cloths and immersion of idols during festive season (Fig. 2).

Bird Sampling

Monthly surveys of water birds were carried out between Nov, 2019 and Oct. 2022. The avian survey was conducted by walking along 4784 mts perimeter of the pond during monthly visit to the study area. Observation of birds was done by Olympus 118760 10x50 DPSI Wide-Angle Binocular and wherever possible photographed by digital camera

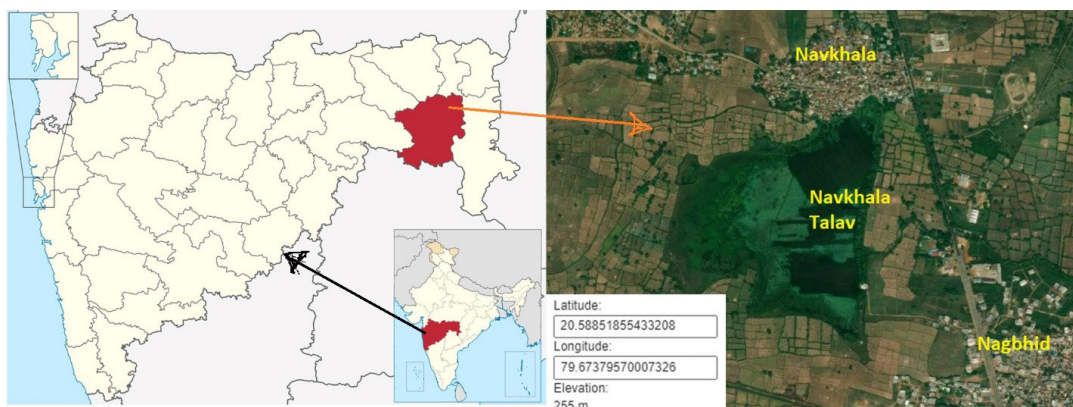


Fig.1. Location map of study site Navkhala Talav



Fig. 2. Habitat showing mudflat to support vegetation and prey base for waterbirds Inset showing A. Wolly Necked Stork and B. Gray Headed Swamphen

Canon EOS 200D. The species identity, counting of birds, foraging habit, and feeding technique of water birds were recorded using the initial observation method (i.e. only the 1st foraging observation of each individual was considered) (Holmes and Robinson, 1988; Bibby *et al.*, 2000). The water birds were counted between 7 am to 9 am in morning during each survey. The counts were attempted for all water birds by using total count method (Sutherland *et al.*, 2004). For the survey of birds, three foraging habitats for water birds have been identified as muddy, shallow water and hydrophytes vegetations (Morrison, 1984). The identification of birds was done as per the photographic guides to the birds of India (Ali and Ripley, 2001; Grimmett *et al.*, 2011). Qualitative data on threats to vegetation and birds were also gathered throughout the study period.

Data Analysis

The information on order, family and species composition, residential status, foraging guild, and IUCN status of observed birds were tabulated. Water birds observed during monthly visits were categorized into groups based on their relative numbers of sightings as, Very Common (VCom) 29 - 36, Common (Com) 22- 28, Uncommon (UnCom) 7 - 21, and Rare (Ra) 1- 6. (Mackinson and Phillips, 1993). Similarly, birds were also categorized according to their feeding guilds and migratory status based on bird observation guides (Ali and Ripley, 2001; Grimmett *et al.*, 2011).

Results

During the study period, spanning from, Nov. 2019

to Oct. 2022, in total 6919 individuals of 40 species, belongs to 29 genera, were recorded. They belong to 13 families and 06 orders (Appendix Table 1). Maximum abundance recorded from Ord - Charadriiformes with 44 % (n=17) of abundance followed by Peliconiformes 23% (n=9) while among the observed community of birds, fam- Scolopacidae recorded maximum abundance with 25 % (n=10), followed by Fam-Ardeidae and Anatidae (Fig.3E and F).

The data on the mean abundance of water birds reveals that, Lesser Whistling Duck, (8.10%), Cattle Egret (11.18 %), and Little Cormorant (10.09%) were the most abundant species during winter, summer and rainy season respectively. These fluctuations during the different season associated with the changes in the climatic conditions and change in vegetation. Foraging guild of water bird reveals that, Insectivorous birds (20%) were the most abundant bird followed by Omnivorous (17.5%) and carnivorous birds (17.5%). Observations on the conservation status of water birds reveals that, only three species, Wolly Necked Stork, Black Headed Ibis, Darter belongs to Near Threatened (NT) category while and River Tern belongs to Vulnerable (Vu) category of Red Data List of IUCN, while all other species belongs to Least Concern (LC) category. Present study indicates the substantial numbers of water bird species were Winter Migrants (WM) or witnessed increased influx of winter migratory birds. It reveals that, maximum abundance 33% (n=44) recorded from uncommon (UCom) bird species followed by Common (Com) and 25% (n=33) each from common (Com) and rare Very common birds (VCom) birds. Uncommon (UCom) and rare (Ra) contributes to the richness of water bird diversity of study area. Residential status of water bird species observed during study period includes, maximum abundance of resident birds showing local migration in limited range (R/LM) 34% (n=45) followed by 27% (n=36) residents birds (R) and 12% (n=16) residents with winter influx as well as showing local migration (R/LM/WM). (Fig. 5), while birds showing Resident with summer influx (R/LM/SM) and Resident with winter influx as well as summer movements (R/WM/SM) show least abundance. Foraging guild of water bird community of study area reveals that, maximum abundance 26% (n=34) recorded of insectivorous (I) birds, followed by 12% (n=16) piscivorous and omnivorous (O) birds.

Table 1. Checklist of waterbird community recorded at the Navkhala Pond.

Sr. N.	Common Name	Zoological Name	Total Count Winter	Total Count Summer	Total Count Monsoon	Total Abundance Winter	Total Abundance Summer	Total Abundance Monsoon	Res. Status	For. Guild	IUCN	Sightings
Order - Ciconiiformes												
Family - Ciconiidae												
1	Woolly Necked Stork	<i>Ciconia episcopus</i>	18	02	0	0.554	6	0.094	0	R/LM/SM	P	UCom
2	Asian Openbill Stork	<i>Anastomus oscitans</i>	109	61	43	3.360	36	2.890	2.747	R/LM/SM	P,C	Com
Order - Peliconiformes												
Family - Ardeidae												
3	Purple Heron	<i>Ardea pupurea</i>	49	22	29	1.510	30	1.042	1.853	R/LM/WM	P,I	UCom
4	Grey Heron	<i>Ardea cinerea</i>	31	14	8	0.955	27	0.663	0.511	R/LM/WM	P,I	Com
5	Indian Pond Heron	<i>Ardea grayii</i>	73	70	89	2.250	36	3.317	5.686	R	P	VCom
6	Intermediate Egret	<i>Ardea intermedia</i>	63	53	45	6.720	36	11.18	8.051	R/LM/SM	P	Com
7	Cattle Egret	<i>Bubulcus ibis</i>	218	236	126	4.069	36	3.933	4.345	R	I	VCom
8	Little Egret	<i>Egretta garzetta</i>	132	83	68	1.479	36	1.800	1.980	R/LM	P	VCom
9	Large Egret	<i>Casmerodius albus</i>	48	38	31	1.942	27	2.511	2.875	R/LM/SM	P,C	Com
Family - Threskiornithidae												
10	Black Headed Ibis	<i>Threskiornis melanocephalus</i>	61	19	35	1.880	27	0.900	2.236	R/WM/SM	P	Com
11	Red Naped Ibis	<i>Pseudibis papillosa</i>	54	43	40	1.664	36	2.037	2.555	R/LM	P	VCom
Order - Suliformes												
Family - Phalacrocoracidae												
12	Little Cormorant	<i>Phalacrocorax niger</i>	198	200	158	6.103	36	9.478	10.09	R/LM	P	VCom
14	Indian Cormorant	<i>Phalacrocorax fuscicollis</i>	52	19	0	1.602	15	0.900	0	R/LM	P	VCom
15	Darter	<i>Anhinga melanogaster</i>	49	38	22	1.510	24	1.800	1.405	R/WM/SM	P	Com
Order - Gruiformes												
Family - Rallidae												
16	White breasted Waterhen	<i>Amaurornis phoenicurus</i>	84	72	55	2.589	36	3.412	3.514	R	O	UCom
17	Eurasian Coot	<i>Fulica atra</i>	146	54	0	4.500	15	2.559	0	WM	O	UCom
18	Common Moorhen	<i>Gallinula chloropus</i>	46	39	73	1.418	36	1.848	4.664	R	O	Com
19	Grey Headed Swampphen	<i>Porphyrio poliocephalus</i>	129	115	111	3.976	36	5.450	7.092	R/LM	O	Com
Order - Charadiiformes												
Family - Charadriidae												
20	Little Ringed Plover	<i>Charadrius dubios</i>	60	41	25	1.849	33	1.943	1.597	R/LM	I	Com
21	Red Wattled Lapwing	<i>Vanellus indicus</i>	98	75	69	3.020	36	3.554	4.408	R	C	Vcom
Family - Scolopaciidae												
22	Temminck's Stint	<i>Calidris temminckii</i>	80	33	0	2.466	24	1.563	0	WM	I	UCom
23	Little Stint	<i>Calidris minuta</i>	49	16	0	1.510	21	0.758	0	WM	I	UCom
24	Common Snipe	<i>Gallinago gallinago</i>	10	6	2	0.308	13	0.284	0.127	R/WM/SM	I	Ra
25	Pintailed Snipe	<i>Gallinago sternura</i>	40	24	21	1.233	27	1.137	1.341	R/WM/SM	I	Com
26	Spotted Redshank	<i>Tringa erythropus</i>	51	24	0	1.572	20	1.137	0	WM	C,I	UCom
27	Common Greenshank	<i>Tringa nebularia</i>	43	10	0	1.325	21	0.473	0	WM	C,I	Ra
28	Green Sandpiper	<i>Tringa ochropus</i>	38	9	0	1.171	22	0.426	0	WM	C,I	Ra
29	Wood Sandpiper	<i>Tringa glareola</i>	66	30	19	2.034	36	1.421	1.214	R/LM/WM	C	Com

Table 1. Continued ...

Sr. N.	Common Name	Zoological Name	Total Count Winter	Total Count Summer	Total Count Monsoon	Abundance Winter	Abundance Summer	Abundance Monsoon	Res. Status	For. Guild	IUCN	Sightings
30	Marsh Sandpiper	<i>Tringa stagnatilis</i>	20	8	0	0.616	0.379	0	WM	I	LC	Ra
35	Common Sandpiper	<i>Actitis hypoleucos</i>	55	20	8	1.695	1.042	0.511	WM	C	LC	Ra
Family - Jacanidae												
31	Bronze Winged Jacana	<i>Metopodius indicus</i>	81	82	95	2.496	3.886	6.070	R/LM	O	LC	Com
32	Pheasant Tailed Jacana	<i>Hydrophasianus chirurgus</i>	49	45	66	1.510	2.132	4.217	R/LM	H	LC	Com
Family - Rostratulidae												
33	Greater Painted Snipe	<i>Rostratula benghalensis</i>	44	39	47	1.356	1.848	3.003	R/WM/SM	C	LC	Ra
Family - Laridae												
34	River Tern	<i>Sterna aurantia</i>	42	47	22	1.294	1.706	1.405	R/LM	P,C	Vu	Com
Family - Recurvirostridae												
35	Black Winged Stilt	<i>Himantopus himantopus</i>	46	32	16	1.418	1.516	1.022	WM	C	LC	UCom
Order - Anseriformes												
Family - Anatidae												
36	Lesser Whistling duck	<i>Dendrocygna jayvanica</i>	263	138	101	8.107	6.540	6.453	R/LM/WM	H	LC	Vcom
37	Gadwall	<i>Mareca strepera</i>	137	36	0	4.223	1.706	0	WM	H	LC	UCom
38	Indian spot billed duck	<i>Anas poecilorhyncha</i>	107	41	57	3.298	1.943	3.642	R/LM/WM	H	LC	Com
39	Northern pintail	<i>Anas acuta</i>	152	70	0	4.685	3.317	0	WM	H	LC	UCom
40	Cotton Pygmy Goose	<i>Nettion coromandianus</i>	153	115	84	4.716	5.450	5.367	R/LM/WM	H	LC	Com

Present investigation on the seasonal fluctuations of waterbird community at Navkhala Pond indicates that, total count of water birds peaked during winter season (3244) followed by the summer (2110) and monsoon season (1565) that is, overall 48.24 % decline as the paradigm shift in the topographical features of pond undertakes from winter to monsoon season. Community composition across the different orders of water birds greatly fluctuates seasonally, order-Anseriformes recorded peak average number of birds during winter season (162.4) followed by Gruiformes (101.25) and Suliiformes (99.66). (Fig.3E&F) while during summer and monsoon season water birds belongs to order – Suliiformes recorded peak values (85.66 and 60 respectively). Interestingly, seasonal fluctuations in the abundance of water birds reveals that, Order – Charadiiformes recorded maximum abundance (26.88) followed by Anseriformes (25.03). These gradients in abundance of waterbird community slightly change during summer season, as order-Peliconiformes recorded maximum abundance (30.09) followed by Charadiiformes (24.92).

Present investigation of seasonal fluctuation in community structure of waterbirds across the different families reveals that, average number of waterbirds from family- Anatidae peaked during winter season (162) followed by Phalacrocoracidae (125). An average number of waterbirds from Fam-Phalacrocoracidae peaked (110) during summer season followed by Anatidae (80) while during monsoon season, water birds belongs to fam-Jacanidae (80) and Phalacrocoracidae had maximum values of average number of birds. Seasonal fluctuations in the waterbirds community belong to different families reveals that, family-Anatidae recorded maximum abundance (25) followed by Ardeidae (18) and Scolopacidae (13). During both summer and monsoon season, family-Ardeidae shows maximum abundance (24.45 and 25.30 respectively) followed by Anatidae and Raliidae (Fig.3C &D).

In the present investigation seasonal fluctuations in the foraging guild structure of water birds community at Navkhala pond indicates that, average number of herbivorous birds peaked during both winter (162.4) and summer (80) followed by omnivorous birds. With the onset of monsoon season, there is heavy decline in the average number of birds (70%) as compared to winter season population. Seasonal fluctuations in the abundance of foraging guild of the waterbirds at Navkhala pond in-

indicates that, herbivorous birds (25.03) peaked during winter season followed by the piscivorous (21.57) and insectivorous feeding habit (16.73). During present study on foraging guild it is observed that water birds having all the kind of foraging guild were recorded with an exception of carnivorous and

insectivorous birds. With the onset of summer, piscivorous birds predominate the foraging guild structure, those trends continue in the monsoon season also. In both, summer and monsoon season, predominance of piscivorous birds followed by omnivorous birds (Fig. 3A & B).

Discussion

The change in habitat surface, the amount and type of food resources available to water birds during the different seasons affects their foraging guild and community structure (Nirmal Kumar *et al.*, 2007). In the same way proximity of human habitation to the water body and their interference also contributes to the maintenance of foraging waders on the mudflats and on hydrophytes (Masero, *et al.*, 2000).

During the present investigation on water birds of Navkhala Pond which represents freshwater habitat wetland, seasonal fluctuations were observed along the different orders, families, and foraging guild structure of water birds. These fluctuations along different gradients, due to the change in season correlated with the change in food resources, configuration of habitat, available surface area (Goss-Custard, *et al.*, 1995; McParland and Paszkowski, 2007). With the onset of winter there was influx of waders from order - charadriiformes mostly due to exposure of mudflat having plenty of organic matter got available for mud probing waders (Manikannan *et al.*, 2012). Water birds from family – Anatidae like Northern Pintail and Gadwal migrates to roosting ground in large numbers during winters due to the fact that paddy fields after *kharip* harvest acts as perfect night roosting ground (Sundar and Subramanya, 2010; Parejo *et al.* 2019). Such group of waders may be considered as wetland bio-indicators for an accurate assessment of the health of a particular wetland (Green, 1995).

The differences among different orders and families at this study site related to their position along fresh water gradients, habitat types and human land use in the vicinity (Ericia *et al.*, 2005). During our study, some water birds like Lesser Whistling Duck shows very distinct peaks during winter, Cattle Egret during summer and Little Cormorant during monsoon representative of particular foraging guild related with the plenty of food available in the fresh water habitat. In case of these dominant species, our investigation revealed that certain species like Lesser Whistling Duck along with other large water

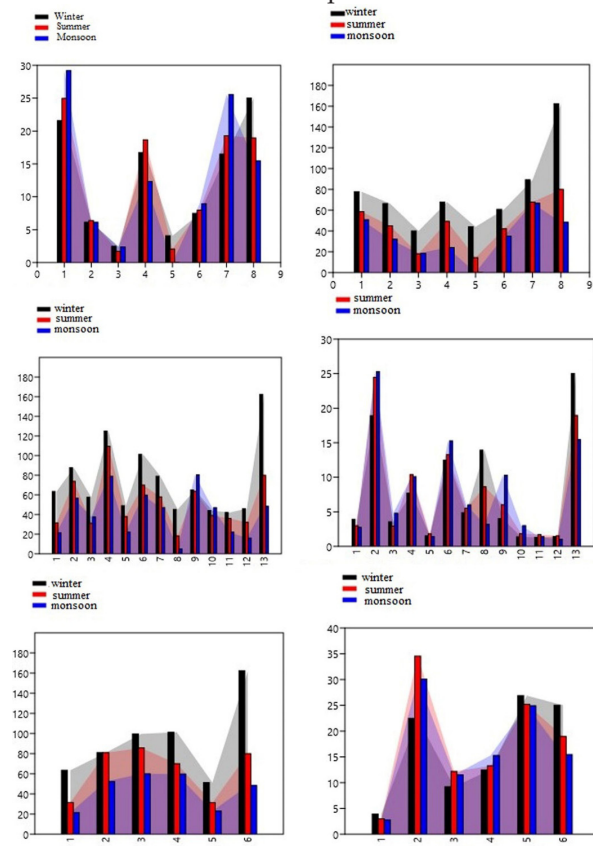


Fig. 3a. Graph showing seasonal fluctuations in the abundance of waterbirds having different foraging guild. Where, 1. Piscivorous (P). 2. Piscivorous & carnivorous, (P&C) 3. Piscivorous & Insectivorous (P&I). 4. Insectivorous, 5. Carnivorous and Insectivorous (C&I) 6. Carnivorous, 7. Omnivorous, 8. Herbivorous

Fig. 3b. Graph showing seasonal fluctuations in the average number of waterbirds having different foraging guild.

Fig. 3c. Graph showing seasonal fluctuations in the average number of waterbirds having different families. Where 1. Ciconiidae, 2. Ardeidae, 3. Threskiornithidae, 4. Phalacrocoracidae 5. Anhimidae, 6. Rallidae, 7. Charadriidae, 8. Scolopacidae, 9. Jacanidae, 10. Rostratulidae, 11. Laridae, 12. Recurvistridae, 13. Anatidae.

Fig. 3d. Graph showing seasonal fluctuations in the abundance of waterbirds belonging to different families.

Fig. 3e. Graph showing seasonal fluctuations in the average number of waterbirds belonging to different orders. Where 1. Ciconiiformes, 2. Pelecaniformes, 3. Suliformes, 4. Gruiformes, 5. Charadriiformes, 6. Anseriformes.

Fig. 3f. Graph showing seasonal fluctuations in the abundance of waterbirds belonging to different orders.

birds from Family-Ardeidae and Phalacrocoracidae reached their peak numbers but gradually their density declines during monsoon season could be related to the low water depth and availability of exposed mudflat island (Masero *et al.*, 2000). During monsoon season, Family – Jacanidae peaked in abundance as the habitat covered with vegetation dominated by commercially cultivated water Chestnut, *Trapa natans* and *Nelumbo nucifera* provides ideal breeding ground for both Bronze Winged Jacana and Pheasant Tailed Jacana. Similar findings reported in elsewhere in India (Gopi and Pandav, 2007; Chatterjee *et al.*, 2020).

The study site although having ideal fresh water habitat due to its large shallow shoreline exposed during winter and summer, species richness of migratory waders were found impacted by the human interference in the form of fishing and commercial cultivation and harvesting of Water Chestnut resulted into absence of winter migratory ducks with exceptions of Gadwal and Northern Pintail. (Goss-Custard *et al.* 1995; Green, 1996). Apart from fishing and commercial cultivation of macrophytes, due to the vicinity of this water reservoir to human settlement of Navkhala village, it has been utilized for washing of cloths, domestic animals, deposition of waste from households were found to be major anthropogenic stresses noticed during the study period (Kar and Debata, 2019). Hydrobiology of the Navkhala pond further deteriorated by the runoff from surrounding paddy fields can lead to nutrient enrichment in the waterbody and may possibly impact water bird abundance through changes in benthic invertebrates (Blann, 2009). Developing effective measures for conservation of water birds in Navkhala Pond depends critically on understanding current status. In this regard present study might be considered as fundamental step for the protection of water birds in Navkhala Pond.

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