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STATUS AND DISTRIBUTION OF AQUATIC BIRDS ASSOCIATED TO WETLANDS OF UJANI RESERVOIR, MAHARASHTRA, INDIA

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between both authors. Author DSK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author DKM managed the analyses of the study and the literature searches. Both the authors read and approved the final manuscript.

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ABSTRACT

The present study deals with the diversity and distribution of water birds at the wetlands of Ujani Reservoir from Solapur district. Fifteen different study sites were selected from the periphery of Ujani Water reservoir and study was carried out for the period of two years. During the study period the checklist of the water birds was prepared individually from all the study sites. The investigation revealed that 81 aquatic birds belonging 59 genus, 11 orders and 23 families were recorded. Throughout the study sites Scolopacidae was recorded as dominant family. The study also included the classification based on the feeding guilds, abundance, IUCN status, microhabitats and migratory status. According to feeding guilds near about 36% were carnivores, 25% were omnivores, 9% were insectivores, 6% were piscivores, and 5% were herbivores. On the basis of microhabitat, some of the birds' strictly preferred single microhabitat; few of them preferred dual microhabitat while remaining has recorded multiple microhabitats. The niche selection study revealed that 5 species were divers, 15 species were swimmers, 19 species were large waders, 27 species were small waders and 15 were areal foragers. However, on the basis of migratory status, 26 species were resident, 19 were migratory and 36 were resident migratory. Moreover, 76 species were Least Concerned, 6 were Near Threatened, 2 were Vulnerable and 1 species as Endangered as per the IUCN red list data. On the basis of the present study, it can be concluded that the distribution of birds among various sites has shown considerable variation. The variation might be due the availability of food, level of human interference and also level of water.

Keywords: Wetlands; avifauna; diversity, distribution; Ujani reservoir.

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1. INTRODUCTION

Biodiversity simply means variety of living species of organisms including both flora and fauna in an ecosystem having specific ecological conditions. The Indian sub-continent is very rich in avifaunal diversity. Out of total number of bird species of the world, over 13% birds are resided in the Indian sub-continent [1], which boasts 48 bird families of the total 75 families in the world [2]. Study of avifaunal diversity is an integral part of the study or assessment of entire biodiversity of a particular area means that biodiversity study cannot be completed by ignoring avifaunal diversity. Birds plays very vital role in the ecosystem as pollinators and scavengers, hence are aptly called as Bioindicators. Various techniques and methodologies can be used to study avifaunal diversity. Many researchers all over the world working on various aspects of avifauna and estimating the avifauna at local, national, international and regional level. The ornithology is having great potential of work in the biological sciences, biodiversity and conservation studies.

Ujani reservoir is considered as a 'Bird biodiversity hotspot', as it provides microhabitats for most of the wetland birds classified under status; migratory, resident, passage migrant, breeding migrant, winter migrant during all the seasons of year in general and winter season in particular. Ujani reservoir is having many temporary wetlands which are active during rainy and winter seasons. Wetlands form the transition zone between land and water [3], where water is near the surface or the land is covered by shallow water [4] As per the mostly accepted definitions of Wetland given by **IUCN** (International Union of Conservation of Nature and Natural Resources), wetlands are characterized by multiple microhabitats, *viz.* open water, shallow water, marshy, mud flats and semi-dry banks. Basically wetlands are either natural or artificial, permanent or temporary, static or flowing water, fresh, brackish or salt, including areas of marine water; having depth less than six meters. Wetlands are of great important as they proved themselves as world's most productive environments [5]. Wetlands involved in retention of water and flood control (hydrological), support to diverse type of organisms (biological) and regulation of recycling of nutrients (biogeochemical), ground water recharge and climate change mitigation [6]. The values of wetlands concerned with mankind are socio-economic and cultural and aesthetic values. In this regard, the human interference is the one of the important concern in the conservation measure.

2. STUDY AREA

Study area is located around Ujani reservoir, Ujani, Tehsil Madha, Dist Solapur, Maharashtra, India **(Map)**. Sampling sites are distributed among three different districts Solapur, Ahmednagar and Pune are selected for study. Selected 15 sampling sites are dispersed around Ujani reservoir**.** The selection of sampling sites was made after miscellaneous survey of Ujani reservoir including terminal Bhima basin. Habitat structure and geographical locations were considered for site selection so that selected sites cover every type of habitat available. Among 15 selected sites 5 sampling sites represents terminal Bhima river basin and later 10 sampling sites represents Ujani reservoir area. The geographical locations of sampling sites were recorded during the survey by using GARMIN eTrex 20X with 240 X 320 display pixels GPS instrument.

3. MATERAILS AND METHODS

On the basis of skill, bird sampling was made in the field considering the habitat status and area of each study site by walking at a deliberate and constant speed (about 1-1.5 km/h) along the bank of the reservoir as suggested by Gaston (1975) and Bibby et al. (2000). Still, wherever required, birds were recorded by point count method within the observable radius by stopping for a short time of two minutes as followed by other workers (Blondel et al., 1981, Bibby et al., 2000, Froneman et al., 2001, Kaul and Howman, 1992; Turner, 2003; Urfi et al., 2005). Surveys were conducted once in a month for the period of November 2015 to September 2017. Birds were counted at their point of first exposure and care was taken to ensure that same birds were not counted again. Canon- EOS 700D camera with 100-400 mm. lens and Olympus 10 X 50 binocular was used to identify birds. The number of aquatic birds of various species was noted in a data sheet as prescribed by AWC data sheet at each sampling point of the reservoir. Preferably the counting of the birds was completed at different timings such as morning 07.00 to 10.00 AM and at evening 05.00 PM to 6.30 PM as they are most active and conspicuous at these timings. The investigation was interrupted during rainy season due to heavy rain. Identification of bird species was made with the help of field guides such as Book of Indian birds [7], Birds of Indian sub-continent [1], Handbook of Birds of India and Pakistan [2] and A pictorial bird guide to birds of India, Pakistan, Nepal, Bhutan, Sri Lanka and Bangladesh [8].

Migratory status and feeding guilds were classified based on frequent observations and standard literature [2]. According to feeding habits, birds were classified as herbivores (H), carnivores (CV), Piscivores (P),

insectivores (I) and omnivores (O) as per the suggestions of Urfi [9], Kumar and Gupta [5]. The abundance of birds was classified according to frequency of sightings [10] as common (C), fairly common (FC), uncommon (UC) and rare (RA). The conservation status of the bird species was assessed according to IUCN (2020) as least concern (LC), near threatened (NT), vulnerable (VU) and endangered (EN).

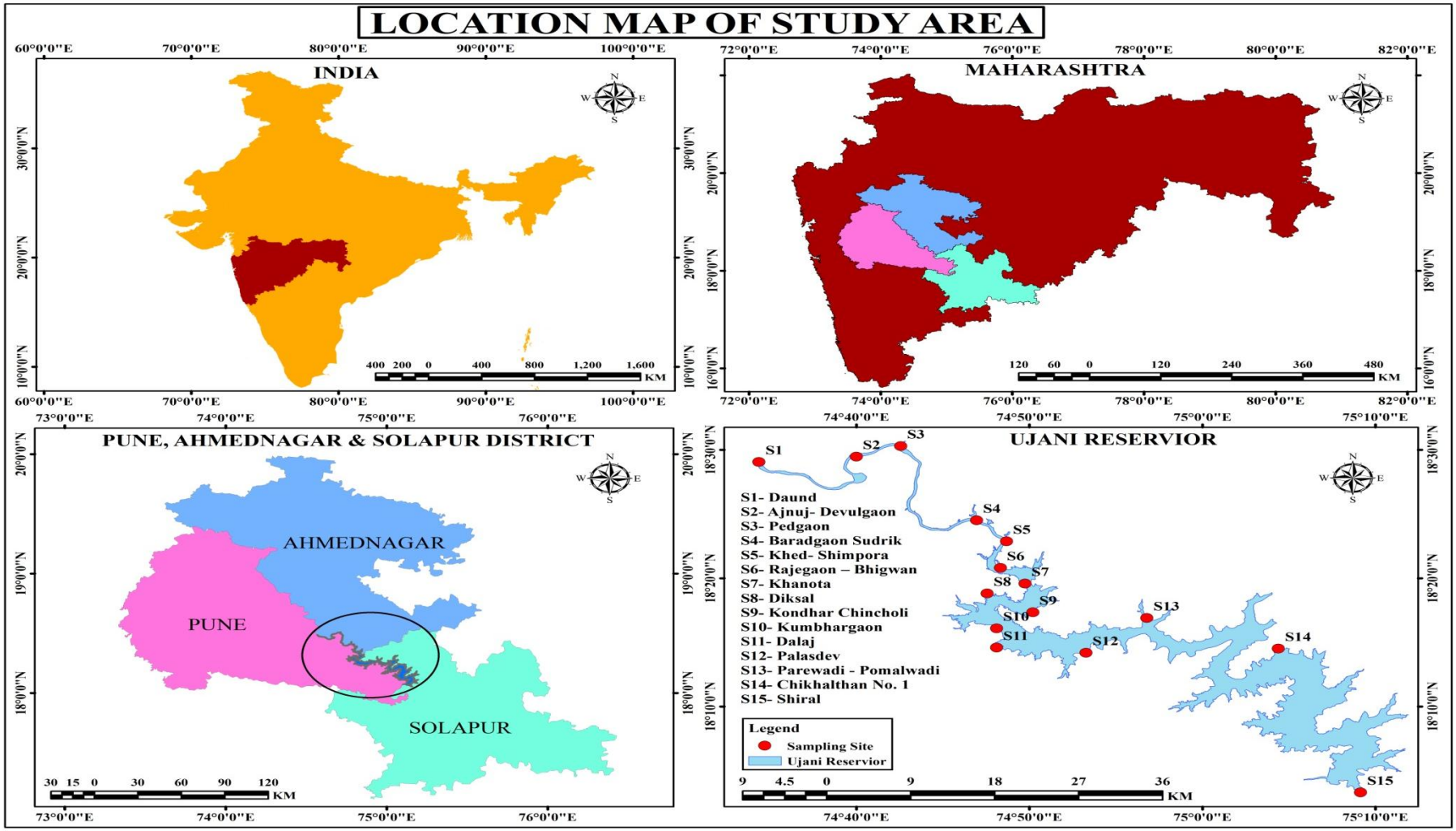
Diversity indices like Shannon's evenness index (H), Simpson (1-D), Dominance (D) indices were estimated by using PAST Version 4.16 as suggested in standard literature [11].

4. RESULTS AND DISCUSSION

In the present investigation, diversity and distribution of water birds from the Ujani freshwater reservoir was studied. Furthermore, study was extended to reveal taxonomic status, feeding guilds, niche selection, migration status, conservation status and microhabitats of these water birds. The study depicts that total 82 species of water birds belonging to 59 genuses, 11 orders and 23 families were recorded from the overall study sites (Table 1). During the study period it was noted that the order Charadriiformes was dominant followed by Anseriiformes while birds from order Podicipediformes was the least recoded (Fig. 1). Moreover, on the basis of family, Anatidae was dominant which was followed by Scolopacidae. Bhatnager et al. [12] were also found similar results and they have found that order Anatidae was dominant order. The migratory status was also studied which depicts that about 44% of water birds were resident migrants, 32% were resident and 24% were migratory (Fig. 2). The conservation status of birds shown (Fig. 3) that more than 89% birds were considered as least concerned, 7% were nearly threatened, 3% vulnerable and 1% was endangered species. During this study, only the species Pallas's Fish-Eagle which is considered as endangered species was recorded from the study area. The abundance of the water birds was also noted (Fig. 4) by regular visits. The study indicated that 33% of the birds were common and 27% were and nearly common. The Fig. 5 indicates the feeding guilds of birds. The study exhibits 45% of birds were carnivores while 31% were omnivores. This indicates that the reservoir provides a healthy environment for the birds which depend on the other animals for their food. Perhaps few of the species were specialist to feed upon fishes (7%). On the basis of microhabitat, most of the birds dwell at the various places as per the availability of the food. During this study it was noted that more than 45 species of the birds roam at the marshy places, fringe areas and mud flats. Though all the waterbirds were observed in or near water bodies but each species spent much more time at their specific microhabitats. Marshy habitat was dominant and preferred by most of the aquatic birds followed by mudflats, shallow water (fringe area), dry sandy banks and open water [13]. The niche selection study revealed that 5 species were divers, 15 species were swimmers, 19 species were large waders, 27 species were small waders and 15 were areal foragers.

The study was extended to reveal diversity status on the basis of quantitative data obtained during the study period. The study was carried out to estimate comparative dominance, richness and evenness ration of the birds at all study sites (Tables 2 and 3). The study depicts that S-1 was showing more dominance ratio during 2015-16 and S-15 was showing more dominance ration during 2016-17 as compared to the other sites. Simpson_1-D was comparatively similar at all study sites. The Shannon richness ratio was more at the S-8 and less at S-1 during year 2015-16. It was more at site S-9 and less at S-15 during the year 2016-17. The study sites S-8 to S-13 shown an even distribution of the water birds during both the years. The sitewise distribution of the water birds was exhibited in the Table 4.

Waterbirds greatly adapted for aquatic habitats with respect to their feeding, breeding and size. The global avifaunal diversity especially aquatic avifauna is under threat due to many reasons viz. agricultural expansion along the bank of rivers and reservoirs, extensive use of pesticides, weed infestation, unplanned irrigation and tourism, sand extraction, unlimited fishing, utilization of marshy vegetation for grazing of live stock, hunting etc. [14,15,16,17]. The lower Bhima basin and Ujani reservoir area provides feeding and breeding grounds to most of the resident, resident migrant and migratory birds. The resident birds were observed at different sampling sites throughout year, but migratory birds were mostly observed during winter months. This is because of climatic conditions of northern hemisphere become adverse to these birds, whereas at the same time in India especially south-western Maharashtra, this season is best for getting food and shelter. All the migratory species were winter visitors [18,19,16,20]. Studies on the effects of bird aggregation on the physico-chemical conditions of water and vice versa have been made by several authors [20,21,22]. Rathore and Sharma [23] also indicated that most of the members of family Anatidae are herbivore in nature and depend on aquatic flora. They dive up to the depth of 3 m for feeding. Hence a habitat of open water with submerged vegetation is the most suitable habitat for migratory birds [24,25,26].



Map 1. Map showing study area

Table 1. Checklist of avifauna recorded during study period

Sr. No.	Scientific Name	Common Name	Order	Family
1	*Tachybaptus ruficolllis*	Little Grebe	Podicipediformes	Podicipedidae
2	*Phalacrocorax fuscicollis*	Indian Shag	Suliformes	Phalacrocoracidae
3	*Microcarbo niger*	Little Cormorant	Suliformes	Phalacrocoracidae
4	*Anhinga melanogaster*	Oriental Darter	Suliformes	Anhingidae
5	*Nycticorax nycticorax*	Black-crowned Night Heron	Pelecaniformes	Ardeidae
6	*Ardeola grayii*	Indian Pond Heron	Pelecaniformes	Ardeidae
7	*Butorides striata*	Striated Heron	Pelecaniformes	Ardeidae
8	*Ardea purpurea*	Purple Heron	Pelecaniformes	Ardeidae
9	*Ardea cinerea*	Grey Heron	Pelecaniformes	Ardeidae
10	*Bubulcus ibis*	Cattle Egret	Pelecaniformes	Ardeidae
11	*Egretta garzetta*	Little Egret	Pelecaniformes	Ardeidae
12	*Mesophoyx intermedia*	Median Egret	Pelecaniformes	Ardeidae
13	*Casmerodius albus*	Large (Great) Egret	Pelecaniformes	Ardeidae
14	*Mycteria leucocephala*	Painted Stork	Ciconiiformes	Ciconiidae
15	*Anastomus oscitans*	Asian Openbill	Ciconiiformes	Ciconiidae
16	*Ciconia episcopus*	White-naked Stork	Ciconiiformes	Ciconiidae
17	*Threskiornis melanocephalus*	Oriental White Ibis	Pelecaniformes	Threskiornithidae
18	*Pseudibis papillosa*	Black Ibis	Pelecaniformes	Threskiornithidae
19	*Plegadis falcinellus*	Glossy Ibis	Pelecaniformes	Threskiornithidae
20	*Platalea leucorodia*	Eurasian Spoonbill	Pelecaniformes	Threskiornithidae
21	*Phoeniicopterus ruber*	Greater Flamingo	Phoenicopteriformes	Phoenicopteridae
22	*Dendrocygna bicolor*	Lesser Whistling Duck	Anseriformes	Anatidae
23	*Anser indicus*	Bar headed Goose	Anseriformes	Anatidae
24	*Tadorna ferruginea*	Ruddy Shelduck	Anseriformes	Anatidae
25	*Sarkidiornis melanotos*	Comb Duck	Anseriformes	Anatidae
26	*Anas Penelope*	Eurasian Wigeon	Anseriformes	Anatidae
27	*Anas strepera*	Gadwall	Anseriformes	Anatidae
28	*Anas crecca*	Common Teal	Anseriformes	Anatidae
29	*Anas platyrhynchos*	Mallard	Anseriformes	Anatidae
30	*Anas poecilorhyncha*	Spot billed Duck	Anseriformes	Anatidae
31	*Anas acuta*	Northern Pintail	Anseriformes	Anatidae
32	*Anas querquedula*	Garganey	Anseriformes	Anatidae
33	*Spatula clypeata*	Northern Shoveler	Anseriformes	Anatidae
34	*Rhodonessa rufina*	Red Crested Pochard	Anseriformes	Anatidae
35	*Aythya farina*	Common Pochard	Anseriformes	Anatidae
36	*Grus grus*	Demoiselle Crane	Gruiformes	Gruidae
37	*Porzana pusilla*	Baillon's Crake	Gruiformes	Rallidae
38	*Amaurornis phoenicurus*	White-breasted Waterhen	Gruiformes	Rallidae
39	*Gallinula chloropus*	Common Moorhen	Gruiformes	Rallidae
40	*Porphyrio porphyrio*	Purple Swamphen	Gruiformes	Rallidae
41	*Fulica atra*	Eurasian Coot	Gruiformes	Rallidae
42	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	Charadriiformes	Jacanidae
43	*Metopidius indicus*	Bronze-winged Jacana	Charadriiformes	Jacanidae
44	*Rostratula benghalensis*	Greater Painted Snipe	Charadriiformes	Rostratulidae
45	*Himantopus himantopus*	Black Winged Stilt	Charadriiformes	Chradriidae
46	*Glareola pratincola*	Collard Pranticole	Charadriiformes	Glareolidae
47	*Glareola lacteal*	Small Pranticole	Charadriiformes	Glareolidae
48	*Vanellus malbaricus*	Yellow -wattled Lapwing	Charadriiformes	Charadriidae
49	*Vanellus indicus*	Red wattled Lapwing	Charadriiformes	Charadriidae
50	*Charadrius dubius*	Little Ringed Plover	Charadriiformes	Charadriidae

Sr. No.	Scientific Name	Common Name	Order	Family
51	Charadrius alexandrines	Kentish Plover	Charadriiformes	Charadriidae
52	*Limosa limosa*	Black-tailed Godwit	Charadriiformes	Scolopacidae
53	*Numenius arquata*	Eurasian Curlew	Charadriiformes	Scolopacidae
54	*Tringa tetanus*	Common Redshank	Charadriiformes	Scolopacidae
55	*Tringa stagnatilis*	Marsh Sandpiper	Charadriiformes	Scolopacidae
56	*Tringa nebularia*	Common Greenshank	Charadriiformes	Scolopacidae
57	*Tringa ochropus*	Green Sandpiper	Charadriiformes	Scolopacidae
58	*Tringa glareola*	Wood Sandpiper	Charadriiformes	Scolopacidae
59	*Actitis hypoleucos*	Common Sandpiper	Charadriiformes	Scolopacidae
60	*Gallinago gallinago*	Common Snipe	Charadriiformes	Scolopacidae
61	*Lymnocryptes minimus*	Jack Snipe	Charadriiformes	Scolopacidae
62	*Calidris minuta*	Little Stint	Charadriiformes	Scolopacidae
63	*Philomachus pugnax*	Ruff	Charadriiformes	Scolopacidae
64	*Larus brunnicephalus*	Brown headed Gull	Charadriiformes	Laridae
65	*Chlidonias hybridus*	Whiskered Tern	Charadriiformes	Laridae
66	*Sterna aurantia*	River Tern	Charadriiformes	Laridae
67	*Sterna hirundo*	Common Tern	Charadriiformes	Laridae
68	*Haliastur Indus*	Brahminy Kite	Accipitriformes	Accipitridae
69	*Haliaeetus leucoryphus*	Pallas's Fish-Eagle	Accipitriformes	Accipitridae
70	*Pandion haliaetus*	Osprey	Accipitriformes	Pandionidae
71	*Alcedo atthis*	Small Blue kingfisher	Coraciiformes	Alcedinidae
72	*Halcyon capensis*	Stork-billed Kingfisher	Coraciiformes	Halcyonidae
73	*Halcyon smyrnensis*	White-breasted Kingfisher	Coraciiformes	Halcyonidae
74	*Ceryle rudis*	Lesser Pied Kingfisher	Coraciiformes	Cerylidae
75	*Hirundo rustica*	Common Swallow	Passeriformes	Hirundinidae
76	*Hirundo smithii*	Wire-tailed swallow	Passeriformes	Hirundinidae
77	*Hirundo daurica*	Red-rumped Swallow	Passeriformes	Hirundinidae
78	*Motacilla alba*	White Wagtail	Passeriformes	Motacillidae
79	*Motacilla maderaspatensis*	Large Pied Wagtail	Passeriformes	Motacillidae
80	*Motacilla flava*	Yellow Wagtail	Passeriformes	Motacillidae
81	*Motacilla cinerea*	Grey Wagtail	Passeriformes	Motacillidae

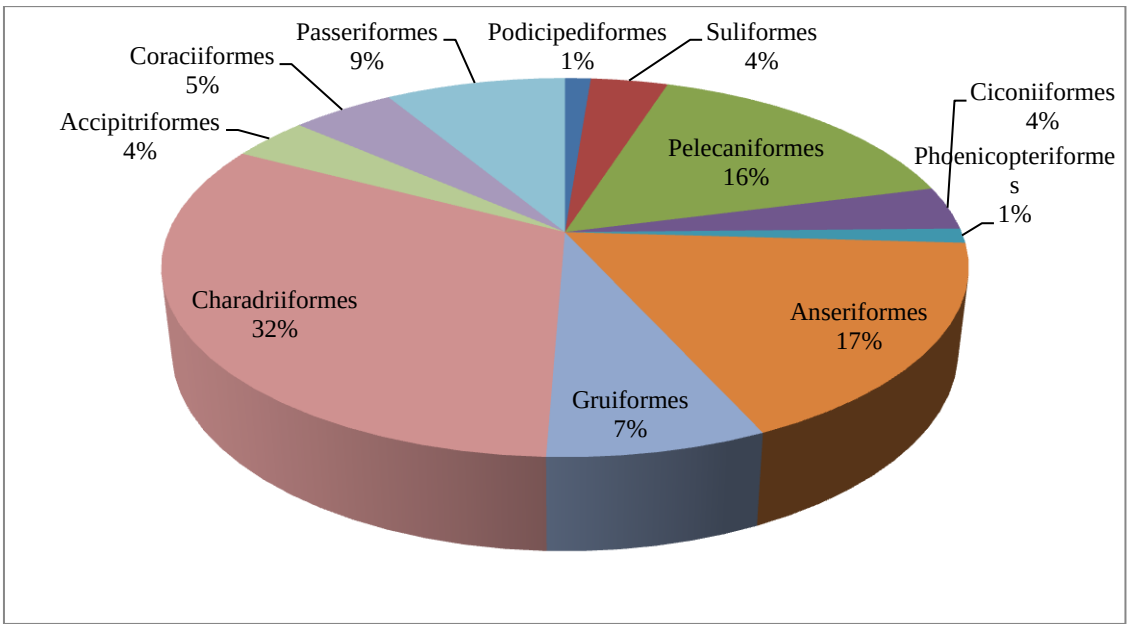


Fig. 1. Order-wise distribution of water birds recorded during study

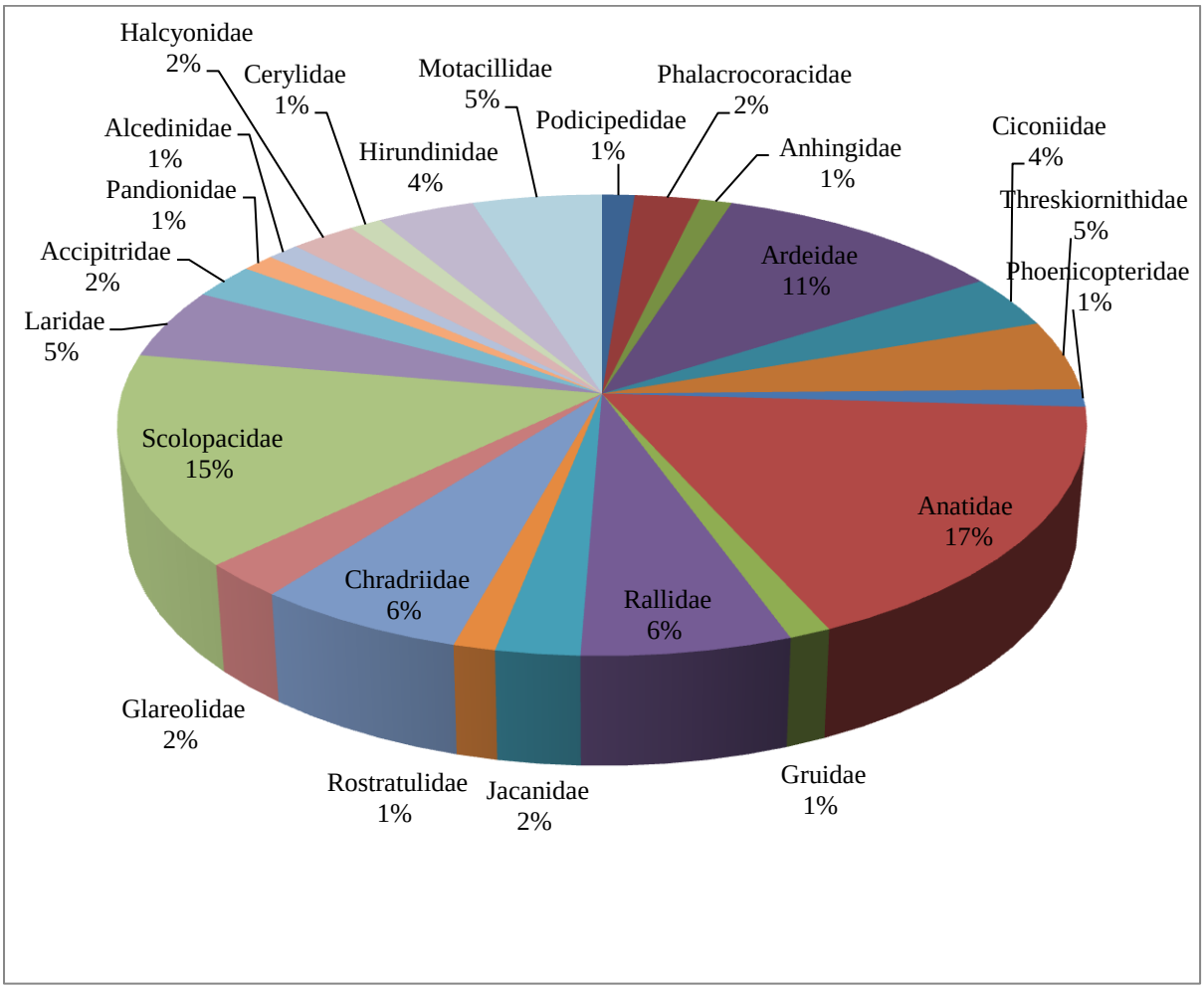


Fig. 2. Family-wise distribution of water birds recorded during study

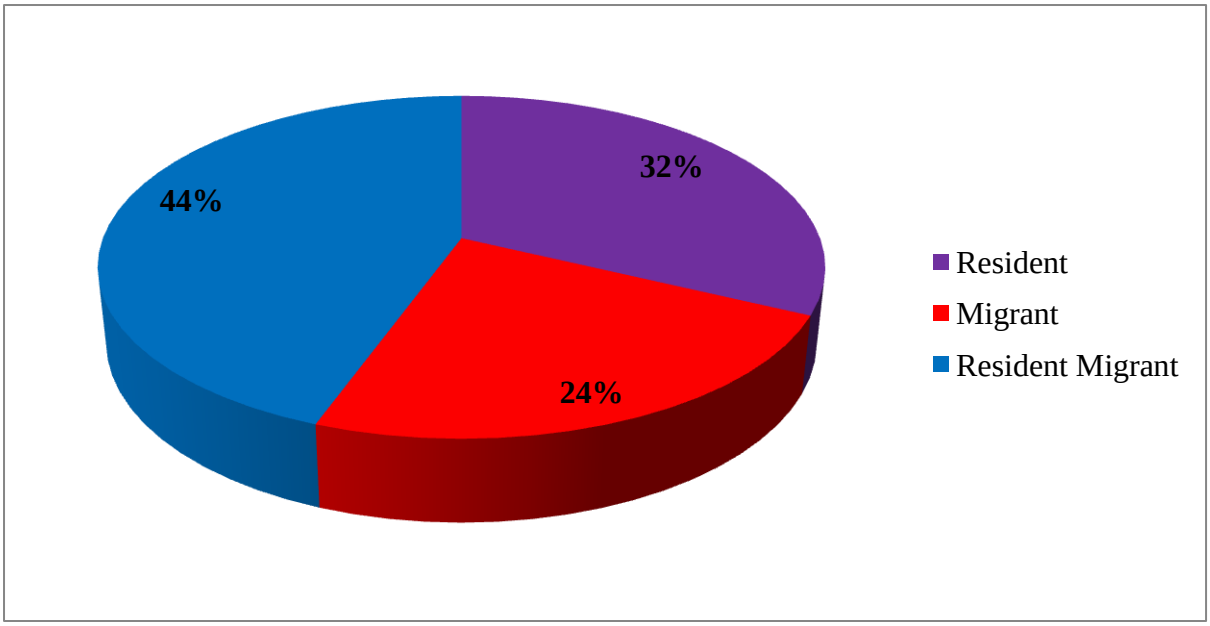


Fig. 3. Migratory status of waterbirds observed during study

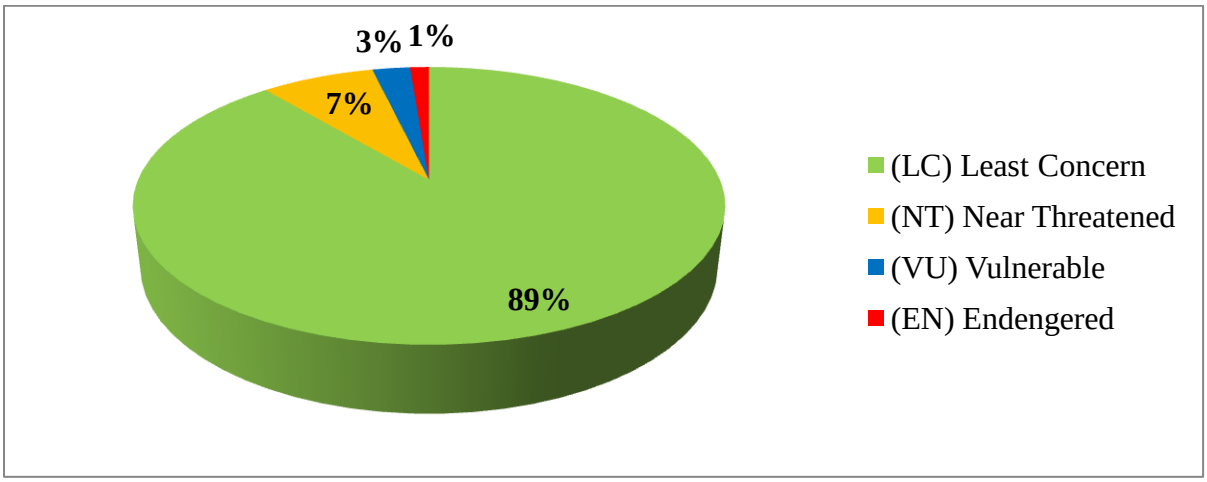


Fig. 4. Conservation status of water birds observed during study

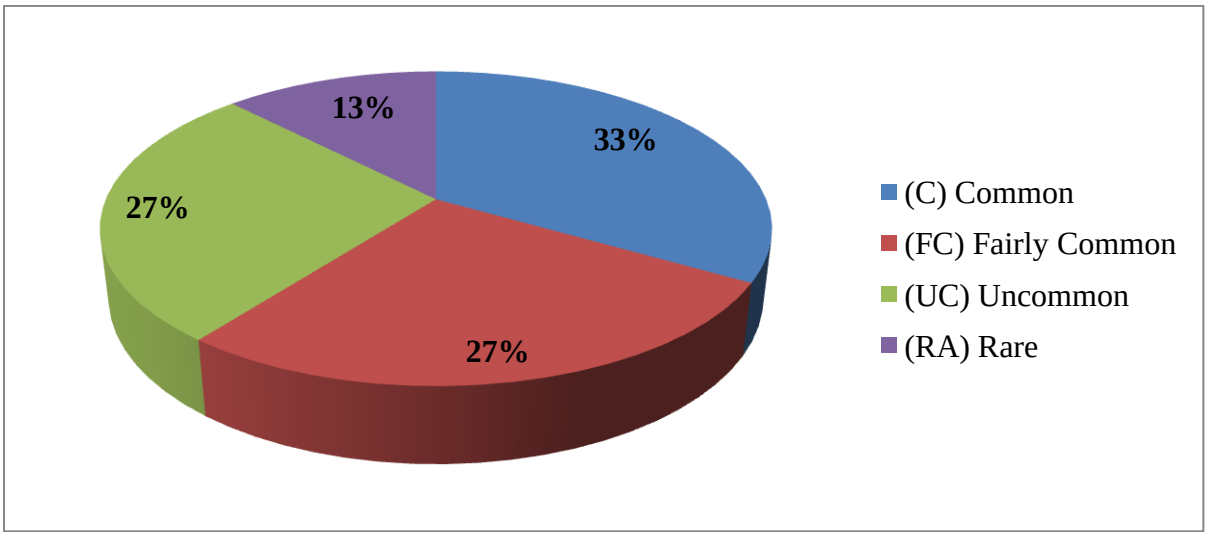


Fig. 5. Abundance of water birds observed during study

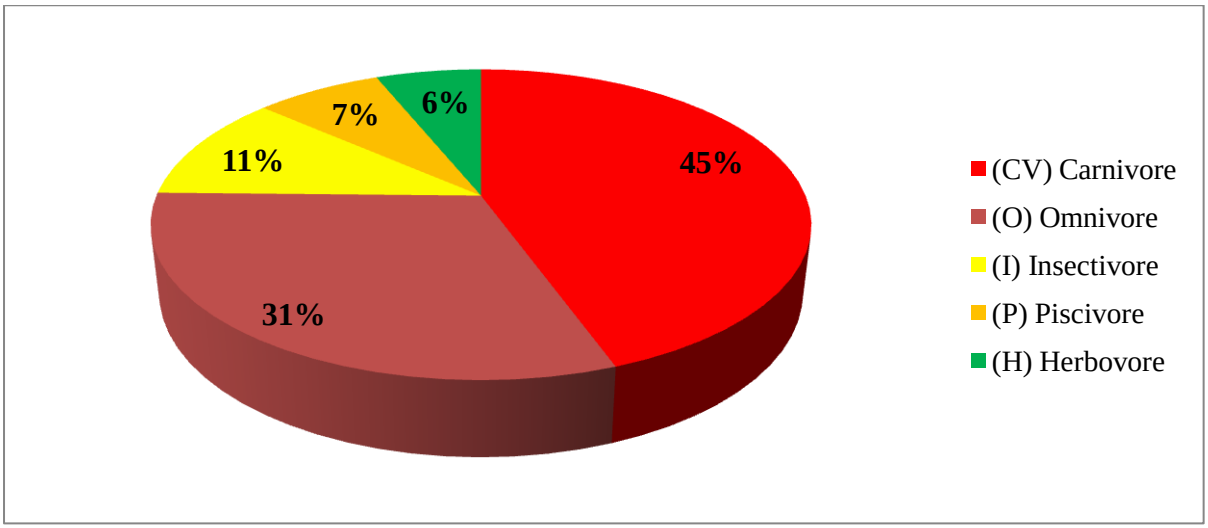


Fig. 6. Feeding Guilds of water birds observed during study

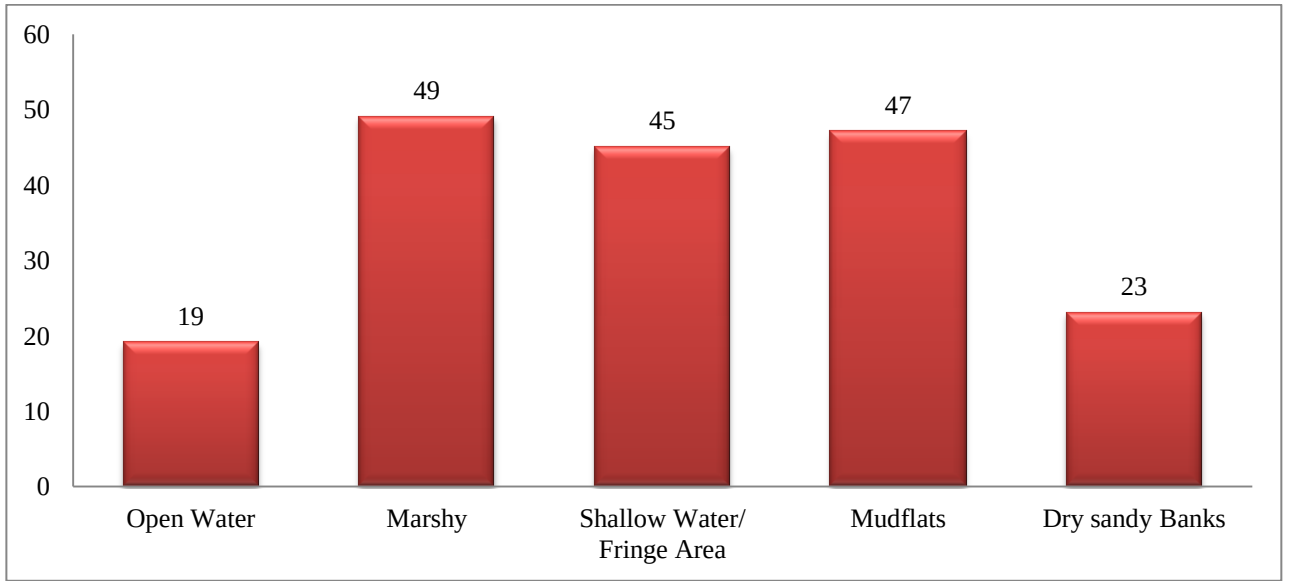


Fig. 7. Microhabitats of water birds observed during study

Table 2. Richness of species at all selected sites of the ujani reservoir for the year 2015-16

Diversity indices/ sites	**S-1**	**S-2**	**S-3**	**S-4**	**S-5**	**S-6**	**S-7**	**S-8**	**S-9**	**S-10**	**S-11**	**S-12**	**S-13**	**S-14**	**S-15**
Taxa_S	47	57	55	43	59	66	64	71	65	67	57	44	42	45	51
Individuals	2172	1998	1871	1087	1940	4857	3443	4354	3683	3859	1422	910	789	743	1775
Dominance_D	0.2526	0.07909	0.08049	0.06938	0.06081	0.08823	0.07077	0.03803	0.0633	0.04824	0.04273	0.06191	0.05568	0.06065	0.162
Simpson_1-D	0.7474	0.9209	0.9195	0.9306	0.9392	0.9118	0.9292	0.962	0.9367	0.9518	0.9573	0.9381	0.9443	0.9393	0.838
Shannon_H	2.248	3.004	3.102	2.993	3.206	3.199	3.324	3.627	3.438	3.578	3.446	3.147	3.216	3.157	2.551
Evenness_e^H/S	0.2015	0.354	0.4045	0.4636	0.4181	0.3715	0.4339	0.5298	0.4788	0.5345	0.5503	0.5287	0.5933	0.5222	0.2514

Table 3. Richness of species at all selected sites of the ujani reservoir for the year 2016-17

Diversity indices/ sites	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
Taxa_S	42	50	58	44	57	67	62	63	67	65	58	46	42	43	48
Individuals	2601	2183	2254	1131	1815	4122	3965	4380	4372	4618	1938	887	851	739	1669
Dominance_D	0.1296	0.07372	0.1237	0.06641	0.06026	0.09326	0.07869	0.04973	0.03511	0.05137	0.04437	0.04434	0.06214	0.06067	0.1904
Simpson_1-D	0.8704	0.9263	0.8763	0.9336	0.9397	0.9067	0.9213	0.9503	0.9649	0.9486	0.9556	0.9557	0.9379	0.9393	0.8096
Shannon_H	2.678	3.038	2.939	3.013	3.203	3.133	3.244	3.472	3.666	3.517	3.455	3.31	3.113	3.107	2.535
Evenness_e^H/S	0.3465	0.4173	0.3257	0.4623	0.4316	0.3425	0.4135	0.5112	0.5836	0.5183	0.5457	0.5953	0.5353	0.5199	0.2629

Table 4. Distribution of water birds at study sites

Sr. No.	Name of the bird species	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
1	Little Grebe	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2	Indian Shag	+	+	+	-	-	+	+	+	+	+	+	-	-	+	+
3	Little Cormorant	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4	Oriental Darter	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-
5	Black-crowned Night Heron	+	-	+	-	-	+	-	-	-	+	-	-	-	-	-
6	Indian Pond Heron	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
7	Striated Heron	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+
8	Purple Heron	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-
9	Grey Heron	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
10	Cattle Egret	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
11	Little Egret	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
12	Median Egret	-	+	+	-	+	+	+	+	+	+	-	-	-	-	-
13	Large (Great) Egret	+	+	+	+	+	+	+	+	+	+	+	-	+	-	-
14	Painted Stork	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+
15	Asian Openbill	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
16	White-naked Stork	+	-	+	+	-	+	-	+	-	-	+	+	-	1	-
17	Oriental White Ibis	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
18	Black Ibis	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
19	Glossy Ibis	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
20	Eurasian Spoonbill	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+
21	Greater Flamingo	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+

Sr. No.	Name of the bird species	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
22	Lesser Whistling Duck	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+
23	Bar headed Goose	-	-	-	-	+	+	+	+	+	+	+	+	-	-	-
24	Ruddy Shelduck	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
25	Comb Duck	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
26	Eurasian Wigeon	-	-	+	-	+	+	+	+	+	+	+	-	-	+	-
27	Gadwall	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
28	Common Teal	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+
29	Mallard	-	+	+	-	+	+	+	+	+	+	+	-	-	-	-
30	Spot billed Duck	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
31	Northern Pintail	-	+	+	+	-	+	+	+	+	+	+	+	+	-	-
32	Garganey	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
33	Northern Shoveler	-	+	-	-	+	+	+	+	+	+	+	+	-	-	-
34	Red Crested Pochard	-	-	-	-	-	+	+	+	+	+	+	-	-	-	+
35	Common Pochard	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
36	Demoiselle Crane	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
37	Baillon's Crake	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	White breasted Waterhen	+	+	+	-	+	+	+	+	+	+	+	+	-	+	+
39	Common Moorhen	+	-	-	+	-	+	+	-	+	+	+	-	-	-	+
40	Purple Swamphen	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+
41	Eurasian Coot	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
42	Pheasant- tailed Jacana	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
43	Bronze-winged Jacana	-	+	+	+	+	+	-	+	+	+	-	-	+	-	-
44	Greater Painted Snipe	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-
45	Black Winged Stilt	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
46	Collard Pranticole	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+
47	Small Pranticole	-	+	-	-	+	+	+	+	+	+	+	+	+	+	+
48	Yellow -wattled Lapwing	-	-	+	+	+	+	-	-	-	-	+	+	-	-	-
49	Red wattled Lapwing	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
50	Little Ringed Plover	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
51	Kentish Plover	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+
52	Black-tailed Godwit	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
53	Eurasian Curlew	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
54	Common Redshank	-	-	-	-	-	+	+	-	+	+	-	-	+	+	+
55	Marsh Sandpiper	+	+	-	+	+	-	+	-	+	+	-	-	-	-	-

Sr. No.	Name of the bird species	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
56	Common Greenshank	-	+	+	-	-	+	+	+	+	+	+	+	-	-	+
57	Green Sandpiper	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
58	Wood Sandpiper	-	-	+	-	-	-	-	+	+	+	-	+	-	-	-
59	Common Sandpiper	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
60	Common Snipe	-	-	-	+	+	+	-	+	+	+	-	-	-	+	-
61	Jack Snipe	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
62	Little Stint	-	-	+	-	+	+	+	+	+	+	+	-	-	-	-
63	Ruff	-	-	+	+	+	+	+	+	+	+	+	-	-	+	+
64	Brown headed Gull	+	+	+	-	+	+	+	+	+	+	+	-	+	-	+
65	Whiskered Tern	+	+	+	-	+	+	+	+	+	+	+	+	-	-	+
66	River Tern	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+
67	Common Tern	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+
68	Brahminy Kite	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-
69	Pallas's Fish-Eagle	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
70	Osprey	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
71	Small Blue kingfisher	+	+	+	+	-	-	+	-	-	+	-	-	-	-	-
72	Stork-billed Kingfisher	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
73	White-breasted Kingfisher	-	-	-	-	+	+	+	+	+	+	+	-	-	-	-
74	Lesser Pied Kingfisher	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	Common Swallow	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
76	Wire-tailed swallow	+	+	+	+	+	+	+	+	+	+	+	-	-	-	+
77	Red-rumped Swallow	-	-	+	-	+	-	+	+	+	-	-	-	+	-	+
78	White Wagtail	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
79	Large Pied Wagtail	-	-	+	+	-	+	+	+	+	+	+	+	-	+	-
80	Yellow Wagtail	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
81	Grey Wagtail	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Note- + indicates presence while – indicates absence of species during qualitative analysis of sites with respect to birds

5. CONCLUSION

The present study can be concluded that the diversity status of birds in the context with the quality and quantity, it was rich at all the study sites selected for the study. The richness and evenness indices are comparatively similar at all the study sites during the tenure of study period. It indicates that all the study sites are ecologically supportive for the feeding and foraging of the water birds. The investigation proved that the current ecological features of the reservoir prepared the birds unable to inhabit throughout the year. Siltation, pollution, anthropological activities and weed invasion are the few of the near future problems which may affect the diversity of birds at Ujani reservoir. However, this can be mitigated though proper management action plans. Furthermore, it can be concluded that if the suitable environment available for the water birds, they can tolerate some extent of anthropogenic pressure.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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