



Field Validation of Avian Diversity at Uchalli Wetland Complex: A Ramsar Site in Khushab, Pakistan

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ABSTRACT

Wetlands are one of the major habitats that play a vital role in the survival of biodiversity. The recent study aimed to evaluate diversity, abundance and threats to birds of an important Ramsar site, Uchalli Wetland Complex, along with Ahmedabad lake. Data were collected by direct (point count) as well as indirect method (interviews) from December 2020 to May 2021. In total, 139 avian species of 27,450 individuals were recorded at study sites. Results revealed that the species richness was maximum at Uchalli (133), followed by Khabbaki (92), Jahlar (88), and Ahmedabad lake (79). The Shannon Weiner index and Simpson index values for Jahlar lake, Uchalli lake, Khabbaki lake, and Ahmedabad lake were (2.99, 0.90), (2.32, 0.82), (2.26, 0.66) and (1.72, 0.51) respectively. The omnivore was the most abundant (40%) feeding guild followed by carnivores (32%) and insectivores (20%). Four vulnerable species sarus crane (*Grus antigone*), southern grey shrike (*Lanius excubitor*), imperial eagle (*Aquila heliaca*), and common pochard (*Aythya ferina*), four near-threatened species ferruginous pochard (*Aythya nyroca*), northern lapwing (*Vanellus vanellus*), alexandrine parakeet (*Psittacula eupatria*), and pallid harrier (*Circus macrourus*), and one endangered species steppe eagle (*Aquila nipalensis*) were observed during the study. These species require special attention for conservation as illegal hunting is one of the major threats to the species in the study area. Other threats include fishing, use of insecticides and pesticides.

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Authors' Contribution

ZA and AK conceptualized the study. AK, RA, ZA, AB and SS collected the data from field. AK, ZA, SS and RA compiled the data. AK, RA, ABI, and ZA drafted the manuscript. ZA reviewed and improved the manuscript.

Key words

Ahmedabad lake, Feeding guilds, Ramsar site, Salt range, Uchalli wetland complex, Shannon Weiner index, Simpson index

INTRODUCTION

Wetlands are the most productive and complex ecosystem that encompass about 6% of the earth's land surface (Maltby and Turner, 1983; Maltby, 1986; Umri, 2002). These are providing a vast range of habitats for fauna and flora. Aquatic birds rely on wetlands for their feeding, breeding, nesting, roosting, and moulting (Kumar and Gupta, 2009). Wetlands are not only the shelter of resident bird species but also an important refuge for migratory bird species. Based on altitude, method of formation and geographical location wetlands are highly diverse in nature. Aquatic vegetation characteristic is the

primary factor that differentiates wetlands from other water bodies or landforms (Butler *et al.*, 2010). Pakistan has a vast range of ecosystems that entertains rich diversity of avifauna (Khan *et al.*, 1996). More than 650 species have been reported from Pakistan in relation to three Zoogeographical zones, Palaearctic, Ethiopian and Oriental which are globally unique (Grimmett *et al.*, 2001; Mirza and Wasiq, 2007).

Punjab Salt Range encompasses the area east of Jehlum river and west to Kalabagh on the Indus River. Punjab Salt Range is 175 km long and 80 km wide between the Indus and Jehlum river. Punjab Salt Range is the result of the evaporation of the sea which was extended over the Potohor plateau eight hundred million years ago (Ahmed, 1967). Uchalli Wetlands Complex comprises three independent wetlands Uchalli, Khabbaki, and Jahlar located in the Salt Range, Soan Valley Khushab, the north-central part of Punjab, Pakistan with a water surface area of 1,243 hectares and a catchment area of 381 km². This complex has international importance as it has been declared as a Ramsar site since 1996. This complex is an important wintering site for many vulnerable species including white-headed duck *Oxyura leucocephala*, graylag goose

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Anser anser, and greater flamingo, *Phoenicopterus roseus* (Ali, 2005; Nawazish *et al.*, 2006; Arshad, 2011).

Uchalli lake is the largest lake of Uchalli Wetlands Complex with an area of 943 (9.43 km²) hectares, 764 m above mean sea level, located 60 km northwest of Khushab and 13 km west of village Naushehra. It is brackish to hypersaline water lake (Afzal *et al.*, 1998). The depth of this lake varies from 0.2 to 6 m and pH of about 10. The lake was first declared as a wildlife sanctuary in 1985 and included in the Ramsar list on 22 March 1996 (Ali, 2005; Arshad, 2011).

Khabbaki lake is the second largest lake of Uchalli Wetlands Complex covering an area of 283 (2.83 km²) situated 63 km northwest of Khushab and northwest of Naushehra village. Khabbaki lake was listed as a Ramsar site in 1976. It is a shallow brackish water lake located at an elevation of 740 m above mean sea level. The source of water of the lake is through the rain and streams along the hills. There was a decrease in salinity of lake water due to an increase in water level 30 to 60 cm in recent years (Arshad, 2011).

Jahlar lake is a globally important wetland with an area of 17 hectares located 17 km southwest of Naushehra village and 18 km southwest of Uchalli lake in the Salt Range. It is located at an elevation of 819 meters above mean sea level with a small brackish to saline water. The depth of the lake varies from 0.2 to 6 meters based on rainfall. Runoff from the surrounding hills of the Salt Range is also a source of water of the lake (Arshad, 2011).

Ahmedabad Lake (Kothaka) is a seasonal lake present in the Salt Range, Tehsil Naushehra, 60 km northwest of Khushab. The lake is formed due to heavy rains and water from irrigation. The depth of the lake varies, depending on the rainfall. People are mostly linked with agriculture and armed forces. The crops which are grown in winter are vegetables and in summer wheat (Ali, 2005). In winter many migratory birds are attracted to the site due to the availability of high food.

There is a marked reduction in migratory bird population every year and there was a decrease in the population of avifauna at Uchalli Wetlands Complex (Ali, 2006; Khan and Ali, 2015). The human impact on wetland natural resources increased due to failure to understand the consequences of variation in natural habitats on wetland biodiversity including avifauna (Brown and Aebischer, 2005). The major objectives of this study were to study the diversity, abundance, and threats to avifauna at an important Ramsar site, Uchalli Wetlands Complex as well as Ahmedabad lake which is an important site for migratory birds as per locals and wildlife staff.

MATERIALS AND METHODS

The present study was carried out at Uchalli Wetlands Complex, which comprises three wetlands, Uchalli (72°0'18.6474"E, 32°32'58.128"N), Khabbaki (72°13'36.516"E, 32°37' 32.844"N) and Jahlar (72°5'18.5994"E, 32°29'59.784"N). Ahmedabad lake (72°16'19.85"E, 32°37'7.93"N) being an important site for migratory birds, was included in this study (Fig. 1). Data were collected from December 2020 to May 2021 via both direct and indirect methods.

The direct method (point count) was used to observe the diversity and abundance of avian species on monthly basis with the help of binoculars and identification of species was carried out through a field guide (Grimmett *et al.*, 2008). The point count method was used after selecting multiple points and the observations were recorded half an hour before and two hours after the sunrise while 3:00 pm onward to sunset at each wetland. The indirect method was the interview of local people who were linked with these lakes via agriculture or livestock rearing.

The probabilities of multiple individuals of species were analyzed by the Simpson index.

Mathematically it can be expressed as $D = 1 - \sum (n-1) / N(N-1)$ where n is total number of individuals of a particular species, N is total number of individuals of all species.

Relative abundance of the species is the calculation of the proportion of individuals of the given species to the total number of individuals in a community (Bull, 1964). Relative abundance was calculated by the following formula: $R.A = n / N \times 100$, where n is number of individuals of a species, N is total number of birds.

The Census index was investigated by dividing the total population of birds by area. The formula of census index is as follows: $C.I = N / A$, where N is total number of birds, A is total study area.

To know about the diversity of bird species in different habitats, Shannon Weiner Diversity Index was calculated (Hutcherson, 1970). The formula for H' is as $H' = \sum P_i \ln (P_i) \times -1$, where H' is diversity index, P_i is proportion of species p_i relative to the total number of species, LnP_i is natural logarithm of proportion.

Species evenness described how many species were evenly distributed. It was calculated by the following formula:

$$\text{Species Evenness} = \text{Shannon Weiner Index} / \ln \text{ of } (N)$$

RESULTS

A total of 27,450 bird individuals belonging to 139 bird species were observed at the selected sites collectively; 133 bird species belonging to 19 orders and

47 families were observed at Uchalli lake with a total count of 18,331 individuals. Most of the birds were observed in the family Anatidae with a count of 9,592 individuals. On account of the seasonal occurrence, 41% of species were year-round resident, 38% of species were winter migrants, 15% species were passage migrants and 5% species were summer breeders and Sarus Crane *Grus antigone* was the chance occurrence at the concerned site.

At Khabbaki lake, 3,053 birds belonging to 92 species, 35 families and 16 orders were observed. Out of the total 92 species, order Gruiformes had the maximum bird count (1774), followed by order Passeriformes and Anseriformes with 736 and 205 individuals, respectively. Minimum bird count was recorded in order Piciformes with only one species. Among the observed species, 50% were year-round resident, 37% wintering, 8% passage migrant and irregular year-round visitors, and 5% were summer breeders. The top most abundant species of study area are given in Table I.

Table I. Five most abundant species at different study sites.

Species	Relative Abundance
Uchalli Lake	
Common coot (<i>Fulica atra</i>)	32.84
Northern shoveler (<i>Anas clypeata</i>)	20.02
Common pochard (<i>Aythya ferina</i>)	17.29
Common teal (<i>Anas crecca</i>)	5.02
Northern pintail (<i>Anas acuta</i>)	4.53
Khabbaki Lake	
Common coot (<i>Fulica atra</i>)	57.84
House sparrow (<i>Passer domesticus</i>)	4.16
House crow (<i>Corvus splendens</i>)	4.06
Common myna (<i>Acridotheres tristis</i>)	4.00
Common pochard (<i>Aythya ferina</i>)	1.38
Jahlar Lake	
Common coot (<i>Fulica atra</i>)	22.77
Common pochard (<i>Aythya ferina</i>)	12.78
Black-headed gull (<i>Larus ridibundus</i>)	12.53
Northern shoveler (<i>Anas clypeata</i>)	5.60
House crow (<i>Corvus splendens</i>)	3.01
Ahmedabad Lake	
Common coot (<i>Fulica atra</i>)	70.01
House crow (<i>Corvus splendens</i>)	2.40
Little grebe (<i>Tachybaptus ruficollis</i>)	2.23
Common pochard (<i>Aythya ferina</i>)	2.07
Common myna (<i>Acridotheres tristis</i>)	1.96

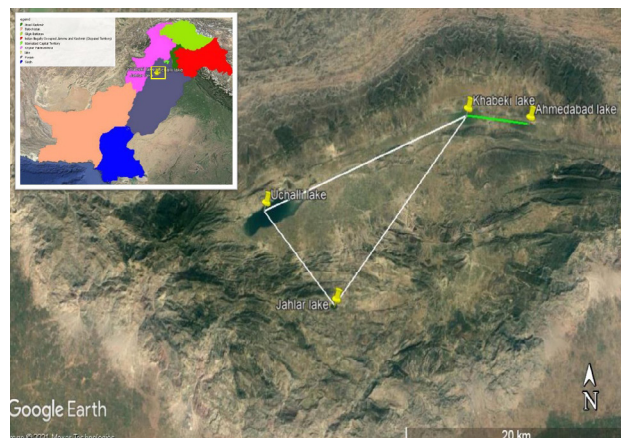


Fig. 1. Study sites.

Eighty-eight bird species of 14 orders and 34 families with 2394 individuals were observed at Jahlar Lake. The most abundant family with a bird count of 572 was Anatidae followed by the family Rallidae with a count of 554, while the least count of birds was in the family Laniidae with only one species. Out of the total, 51% were year-round resident, 39% winter migrant, 6% passage migrant and 4% species were summer breeders.

Out of the total 79 bird species at Ahmedabad Lake, maximum individuals belonged to order Gruiformes (2,588), followed by Passeriformes, Anseriformes, and Charadriiformes with 516, 254, and 111 individuals, respectively. Among them 54% species were year-round resident, 33% species winter migrant, 9% passage migrant and 6% species were summer breeders.

The value of various indices such as Shannon wiener, Simpson, and Census along with species evenness are presented in Table II. At Uchalli lake, near threatened species were ferruginous pochard *Aythya nyroca*, northern lapwing *Vanellus vanellus*, alexandrine parakeet *Psittacula eupatria*, and pallid harrier *Circus macrourus*. Vulnerable species included sarus crane *Antigone antigone*, southern grey shrike *Lanius excubitor*, imperial eagle *Aquila heliaca*, and common pochard *Aythya ferina*. At Khabbaki and Ahmedabad lakes, common pochard *Aythya ferina* was vulnerable and steppe eagle *Aquila nipalensis* was the endangered species, while at Jahlar lake common pochard *Aythya ferina* was the only vulnerable species (Fig. 2). The trend (increasing, decreasing and stable) of recorded species at concerned sites as per IUCN is given in Figure 3.

Most abundant species were omnivores (40%) followed by carnivores (32%) and insectivores (20%), while herbivores (3%), granivores (2%), frugivores (2%) and nectarivores (1%) were the least in count (Fig. 4).

Table II. Population of birds recorded at Uchalli Wetland Complex and Ahmedabad Lake.

Sr. No.	Common name	Scientific name	Uchalli lake	Khabbaki lake	Jahlar lake	Ahmedabad lake	Total
1	Asian koel	<i>Eudynamys scolopacea</i>	2	1	1	2	6
2	Bank myna	<i>Acridotheres ginginianus</i>	29	24	17	32	102
3	Barn swallow	<i>Hirundo rustica</i>	102	28	35	27	192
4	Bay-backed shrike	<i>Lanius vittatus</i>	4	1	0	4	9
5	Black drongo	<i>Dicrurus macrocercus</i>	37	6	6	16	65
6	Black kite	<i>Milvus migrans</i>	7	4	3	11	25
7	Black redstart	<i>Phoenicurus ochruros</i>	8	1	6	3	18
8	Black-headed gull	<i>Larus ridibundus</i>	702	12	300	0	1014
9	Black-necked grebe	<i>Podiceps nigricollis</i>	14	2	2	0	18
10	Black-rumped flameback	<i>Dinopium benghalense</i>	1	1	1	0	3
11	Black-shouldered kite	<i>Elanus caeruleus</i>	2	0	0	0	2
12	Black-winged stilt	<i>Himantopus himantopus</i>	99	24	24	24	171
13	Blue-cheeked bee-eater	<i>Merops persicus</i>	9	5	4	6	24
14	Blyth's reed warbler	<i>Acrocephalus dumetorum</i>	8	2	2	6	18
15	Cattle egret	<i>Bubulcus ibis</i>	19	19	8	13	59
16	Common babbler	<i>Turdoides caudatus</i>	14	19	19	19	71
17	Common coot	<i>Fulica atra</i>	6020	1766	545	2570	10901
18	Common greenshank	<i>Tringa nebularia</i>	15	2	7	13	37
19	Common hoopoe	<i>Upupa epops</i>	4	2	4	5	15
20	Common kestrel	<i>Falco tinnunculus</i>	1	0	0	0	1
21	Common myna	<i>Acridotheres tristis</i>	110	124	245	72	551
22	Common pochard	<i>Aythya ferina</i>	3170	42	306	72	3590
23	Common raven	<i>Corvus corax</i>	2	0	0	0	2
24	Common redshank	<i>Tringa totanus</i>	14	0	6	5	25
25	Common sandpiper	<i>Actitis hypoleucos</i>	29	18	21	27	95
26	Common snipe	<i>Gallinago gallinago</i>	5	0	1	0	6
27	Common stonechat	<i>Saxicola torquata</i>	8	2	2	2	14
28	Common wood shrike	<i>Tephrodornis pondicerianus</i>	1	0	0	0	1
29	Crested lark	<i>Galerida cristata</i>	17	7	16	9	49
30	Desert wheatear	<i>Oenanthe deserti</i>	1	0	2	2	5
31	Common chiffchaff	<i>Phylloscopus collybita</i>	2	2	0	0	4
32	Eurasian collared dove	<i>Streptopelia decaocto</i>	37	42	17	12	108
33	Eurasian griffon	<i>Gyps fulvus</i>	0	1	0	0	1
34	Eurasian marsh harrier	<i>Circus aeruginosus</i>	2	1	1	1	5
35	Ferruginous pochard	<i>Aythya nyroca</i>	4	0	0	0	4
36	Graceful prinia	<i>Prinia gracilis</i>	6	0	2	6	14
37	Great crested grebe	<i>Podiceps cristatus</i>	6	4	0	0	10
38	Greater coucal	<i>Centropus sinensis</i>	2	1	1	1	5
39	Greater flamingo	<i>Phoenicopterus ruber</i>	22	0	0	0	22

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Sr. No.	Common name	Scientific name	Uchalli lake	Khabbaki lake	Jahlar lake	Ahmedabad lake	Total
40	Greater painted-snipe	<i>Rostratula benghalensis</i>	1	0	0	0	1
41	Green bee-eater	<i>Merops orientalis</i>	9	4	6	9	28
42	Green sandpiper	<i>Tringa ochropus</i>	17	8	16	15	56
43	Grey heron	<i>Ardea cinerea</i>	12	0	0	0	12
44	House crow	<i>Corvus splendens</i>	203	124	72	88	487
45	House sparrow	<i>Passer domesticus</i>	74	127	56	56	313
46	Imperial eagle	<i>Aquila heliaca</i>	1	0	0	0	1
47	Indian pond heron	<i>Ardeola grayii</i>	17	12	3	4	36
48	Indian robin	<i>Saxicoloides fulicata</i>	4	6	3	1	14
49	Indian roller	<i>Coracias benghalensis</i>	1	2	0	1	4
50	Intermediate egret	<i>Mesophoyx intermedia</i>	22	7	0	6	35
51	Jungle babbler	<i>Turdoides striatus</i>	34	22	18	15	89
52	Kentish plover	<i>Charadrius alexandrinus</i>	9	0	0	0	9
53	Laughing dove	<i>Streptopelia senegalensis</i>	14	4	7	11	36
54	Lesser whitethroat	<i>Sylvia curruca</i>	2	0	1	0	3
55	Little egret	<i>Egretta garzetta</i>	34	32	6	17	89
56	Little grebe	<i>Tachybaptus ruficollis</i>	302	31	67	72	472
57	Little ringed plover	<i>Charadrius dubius</i>	17	1	2	3	23
58	Little stint	<i>Calidris minuta</i>	12	0	0	7	19
59	Long-legged buzzard	<i>Buteo rufinus</i>	1	0	0	0	1
60	Long-tailed shrike	<i>Lanius schach</i>	2	2	1	4	9
61	Oriental skylark	<i>Alauda gulgula</i>	12	1	1	1	15
62	Pied bushchat	<i>Saxicola caprata</i>	17	26	7	17	67
63	Plain martin	<i>Riparia paludicola</i>	34	34	14	34	116
64	Plain prinia	<i>Prinia inornata</i>	14	7	9	6	36
65	Purple heron	<i>Ardea purpurea</i>	1	0	0	0	1
66	Red-crested pochard	<i>Netta rufina</i>	212	0	0	0	212
67	Red-vented bulbul	<i>Pycnonotus cafer</i>	52	21	18	24	115
68	Red-wattled lapwing	<i>Vanellus indicus</i>	44	11	8	11	74
69	Rock pigeon	<i>Columba livia</i>	3	2	2	0	7
70	Rose-ringed parakeet	<i>Psittacula krameri</i>	2	0	0	0	2
71	Rufous treepie	<i>Dendrocitta vagabunda</i>	9	7	4	11	31
72	Southern grey shrike	<i>Lanius meridionalis</i>	1	0	0	0	1
73	Striated babbler	<i>Turdoides earlei</i>	0	11	14	0	25
74	Temminck's stint	<i>Calidris temminckii</i>	8	4	4	5	21
75	Tufted duck	<i>Aythya fuligula</i>	93	0	42	0	135
76	Variable wheatear	<i>Oenanthe picata</i>	2	1	2	1	6
77	Water pipit	<i>Anthus spinoletta</i>	16	5	4	2	27
78	White wagtail	<i>Motacilla alba</i>	22	9	17	3	51
79	White-tailed lapwing	<i>Vanellus leucurus</i>	1	1	1	0	3
80	White-throated kingfisher	<i>Halcyon smyrnensis</i>	5	3	5	2	15

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Sr. No.	Common name	Scientific name	Uchalli lake	Khabbaki lake	Jahlar lake	Ahmedabad lake	Total
81	Wood sandpiper	<i>Tringa glareola</i>	8	0	5	0	13
82	Yellow wagtail	<i>Motacilla flava</i>	9	6	6	2	23
83	Yellow-eyed babbler	<i>Chrysomma sinense</i>	11	7	6	0	24
84	Common teal	<i>Anas crecca</i>	920	34	62	54	1070
85	Gadwall	<i>Anas strepera</i>	290	31	24	28	373
86	Garganey	<i>Anas querquedula</i>	145	4	0	16	165
87	Grey francolin	<i>Francolinus pondicerianus</i>	2	0	4	0	6
88	Mallard	<i>Anas platyrhynchos</i>	202	32	4	12	250
89	Northern pintail	<i>Anas acuta</i>	830	18	0	7	855
90	Northern shoveler	<i>Anas clypeata</i>	3670	42	134	65	3911
91	Tawny pipit	<i>Anthus campestris</i>	12	6	2	1	21
92	White-eyed buzzard	<i>Butastur teesa</i>	1	0	0	0	1
93	Baya weaver	<i>Ploceus philippinus</i>	13	0	3	0	16
94	Black redstart	<i>Phoenicurus ochruros</i>	6	6	4	3	19
95	Bluethroat	<i>Luscinia svecica</i>	2	1	1	1	5
96	Greenish warbler	<i>Phylloscopus subviridis</i>	1	0	1	0	2
97	Common merganser	<i>Mergus merganser</i>	4	2	0	0	6
98	Common moorhen	<i>Gallinula chloropus</i>	0	8	9	18	35
99	Common shelduck	<i>Tadorna tadorna</i>	22	0	0	0	22
100	Eurasian golden oriole	<i>Oriolus oriolus</i>	1	0	0	0	1
101	Eurasian wigeon	<i>Anas penelope</i>	24	0	0	0	24
102	Grey wagtail	<i>Motacilla cinerea</i>	17	3	7	1	28
103	House swift	<i>Apus affinis</i>	16	28	18	16	78
104	Pied kingfisher	<i>Ceryle rudis</i>	2	1	0	0	3
105	Red collared dove	<i>Streptopelia tranquebarica</i>	8	6	0	7	21
106	Rufous-fronted prinia	<i>Prinia buchanani</i>	6	0	0	0	6
107	Sarus crane	<i>Grus antigone</i>	12	0	0	0	12
108	Shikra	<i>Accipiter badius</i>	2	1	2	1	6
109	Steppe eagle	<i>Aquila nipalensis</i>	0	2	0	2	4
110	Striated prinia	<i>Prinia criniger</i>	6	9	17	4	36
111	White browed wagtail	<i>Motacilla maderaspatensis</i>	14	15	6	3	38
112	Demoiselle crane	<i>Grus vigro</i>	14	0	0	0	14
113	Northern lapwing	<i>Vanellus vanellus</i>	1	0	0	0	1
114	Brown rock-chat	<i>Cercomela fusca</i>	8	8	12	9	37
115	Purple sunbird	<i>Nectarinia asiatica</i>	21	25	19	14	79
116	Citrine wagtail	<i>Motacilla citreola</i>	15	3	8	2	28
117	Great egret	<i>Casmerodius albus</i>	24	8	0	0	32
118	Little cormorant	<i>Phalacrocorax niger</i>	8	8	0	0	16
119	Great cormorant	<i>Phalacrocorax carbo</i>	8	4	0	0	12
120	Indian cormorant	<i>Phalacrocorax fuscicollis</i>	2	2	0	0	4
121	Pallas's gull	<i>Larus cachinnans</i>	42	8	0	0	50

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Sr. No.	Common name	Scientific name	Uchalli lake	Khabbaki lake	Jahlar lake	Ahmedabad lake	Total
122	Grey plover	<i>Pluvialis squatarola</i>	6	0	0	1	7
123	White eared bulbul	<i>Pycnonotus leucotis</i>	4	24	0	8	36
124	Rufous backed redstart	<i>Phoenicurus erythronota</i>	3	0	2	0	5
125	Glossy ibis	<i>Plegadis falcinellus</i>	18	0	0	0	18
126	Ruff	<i>Philomachus pugnax</i>	1	0	0	0	1
127	Spotted owlet	<i>Athene brama</i>	0	6	0	1	7
128	Yellow crowned woodpecker	<i>Piciformes piciformes</i>	1	1	1	0	3
129	Common starling	<i>Sturnus vulgaris</i>	4	4	8	6	22
130	Chukar	<i>Alectoris chukar</i>	1	0	1	0	2
131	Alexandrine parakeet	<i>Psittacula eupatria</i>	6	0	0	0	6
132	Red necked phalarope	<i>Phalaropus lobatus</i>	1	0	0	0	1
133	Eurasian sparrowhawk	<i>Accipiter nisus</i>	1	0	0	0	1
134	Blue rock thrush	<i>Monticola solitarius</i>	2	0	2	0	4
135	Paddyfield pipit	<i>Anthus rufulus</i>	5	2	7	3	17
136	Common quail	<i>Coturnix coturnix</i>	2	0	4	0	6
137	Smew	<i>Mergellus albellus</i>	6	0	0	0	6
138	Pallid harrier	<i>Circus macrourus</i>	1	0	0	0	1
139	Grey bushchat	<i>Saxicola ferrea</i>	0	0	1	0	1
	Species richness		133	92	88	79	139
	Total Number of Individuals		18,332	3053	2394	3671	27,450
	Census index		19.44	10.79	140.82	61.18	-
	Simpson index		0.82	0.66	0.9	0.51	-
	Shannon weiner index		2.32	2.26	2.99	1.72	-
	Species evenness		0.24	0.28	0.38	0.21	-

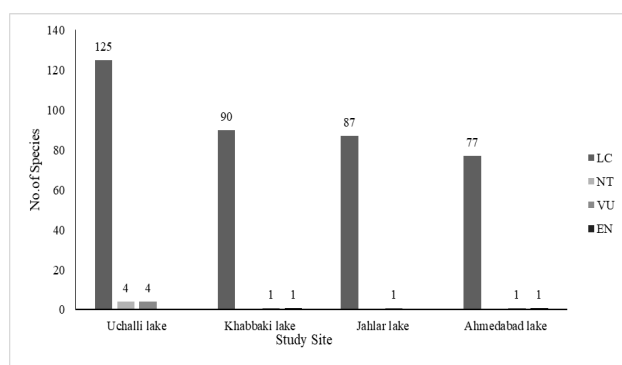


Fig. 2. IUCN status of species recorded at concerned sites. LC, least concern; NT, near threatened; VU, vulnerable; EN, endangered.

Moreover, the trend line was developed using the previously available data and an increase in species richness was observed (Fig. 5). Furthermore, in the overall study area, illegal hunting was the major threat to these

species. There were also other threats including agriculture use of wetlands, excessive fishing, use of insecticides and pesticides in fields across the wetlands, and forest fires which were observed during April encompassing an area of 2 to 3 kilometers around Uchalli lake.

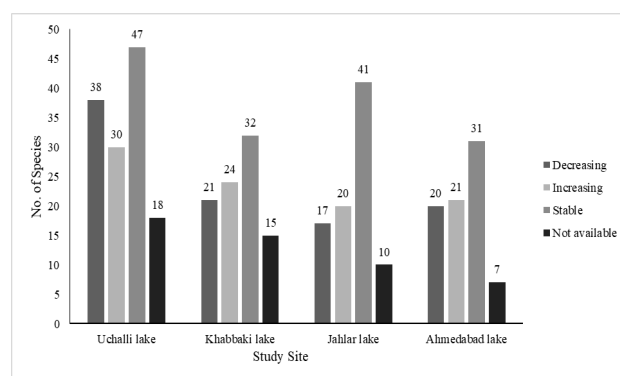


Fig. 3. Trends of species recorded at concerned sites.

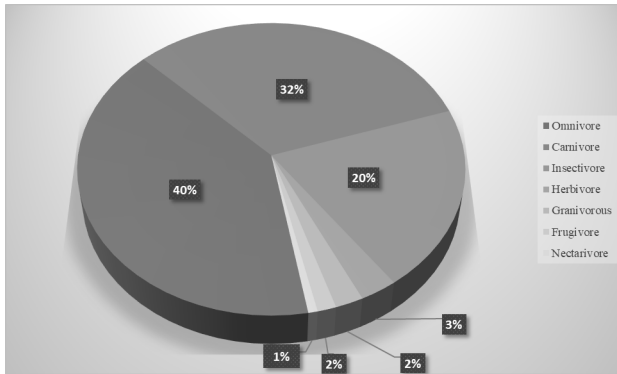


Fig. 4. Feeding guilds of bird species recorded at concerned sites.

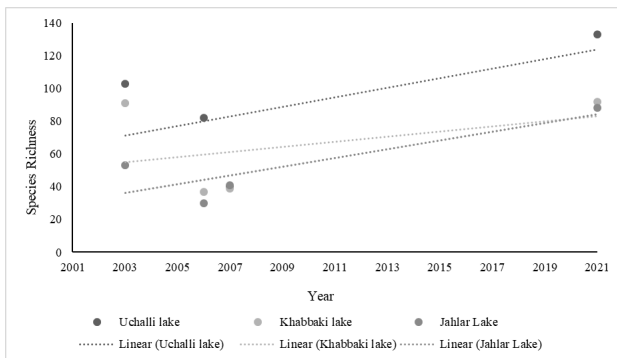


Fig. 5. Trend line of species recorded in different years at Uchalli wetlands complex.

Source: [Ali and Akhtar, 2005](#) (Study duration 2003), [Arshad, 2011](#) (Study duration 2007), [Ali et al., 2011](#) (Study duration 2011), Current Study 2021.

DISCUSSION

Migratory birds start their migration in winter and most of them come to wetlands of Pakistan and India from Siberia and Europe due to snow cover and unavailability of food. Birds prefer migration when the winds are favorable and less risk of predation such as at dusk ([Ali, 2005](#)). Most of the fascinating and diverse winter visitors of Pakistan that make up the 85 percent population of aquatic avifauna are waders and ducks. Wetlands are the protective sites that provide, food, defense, nesting, and breeding sites to aquatic birds ([Cumming et al., 2012](#)). Food abundance is a crucial factor that influences the winter abundance and distribution of migratory birds including shorebirds ([Hockey et al., 1992](#)).

Out of 133 species observed at Uchalli lake, the highest species abundance was observed in order Anseriformes with 9592 individuals. [Ashraf et al. \(2019\)](#) recorded 36 bird species of 13,342 individuals from October 2015 to

September 2016 in the same area. Among them, 56% were resident, while 39% were winter visitors and 5% summer breeders. [Arshad et al. \(2014\)](#) observed bird species for two consecutively years in 2010 and 2011 and found 1139 individuals belonging to eleven bird species and 18,606 individuals belonging to 34 bird species, respectively. [Arshad \(2011\)](#) recorded 40 bird species of 12 orders and 31 families in August 2007 in which 65% of birds were resident. [Ali and Akhtar \(2005\)](#) found 103 bird species of 1591 individuals at Uchalli lake from January to February 2003.

Out of the total 92 bird species at Khabbaki lake, order Gruiformes was associated with the most bird count (1774 individuals) followed by order Passeriformes and Anseriformes 736 and 205 bird count respectively. [Arshad \(2011\)](#) observed 39 species of 11 orders and 28 families at Khabbaki lake in which 80% of birds were resident. [Ali et al. \(2011\)](#) found 37 birds species of 428 individuals at Khabbaki lake in the year 2006. [Ali and Akhtar \(2005\)](#) recorded 91 bird species of 1246 individuals at Khabbaki lake in 2003.

Among 88 bird species at Jahlar lake, order Passeriformes represented the most bird count (698). [Arshad \(2011\)](#) found 41 birds species of 12 orders and 30 families at Jahlar lake in August 2007, in which 80% of species were resident. [Ali and Akhtar \(2005\)](#) observed 53 species of 370 individuals at Jahlar lake in the year 2003. [Ali et al. \(2011\)](#) found 47 species of 2275 individuals at Jahlar lake in 2006.

One of the objectives of the study was also to point out the threats to wetlands under study. As a result of irrigation and drainage projects, many natural wetlands have disappeared. The major threats to the bird species include illegal hunting, fishing, use of pesticides and insecticides.

CONCLUSION

Results of the present study revealed that there was an increase in the number of birds at Uchalli Wetlands Complex as compared to previous studies of the sites. Although there were common threats to all water birds, such as illegal hunting and fishing which needs to be checked and monitored. Furthermore, due to heavy rainfall, there was an abundance of water and food resources at the study sites. Keeping in view these results it can also be concluded that the main threat faced by wetland birds is not lack of resources but human threats of hunting, poaching and hurdles in migration.

Statement of conflict of interest

The authors have declared no conflict of interest.

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