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Avian Diversity around Indus River with Collision Prone Species Abundance at Proposed 765 KV Transmission Line

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Authors' Contribution
ZA and MA conceptualized the study. ZA, UA, RA, IZ, MA and AB collected the data from the field. MA, ZA, RA, UA, AQ, and AB compiled and analyzed the data. MA, RA and UA drafted the manuscript. ZA and AQ reviewed and improved the manuscript.

Key words
Avian collision, Bird mortalities, Species abundance, Transmission lines, Indus River

ABSTRACT

A double circuit 765 kV Dasu Transmission Line (TL) of 250 kilometers length has been planned as Pakistan's first extra high voltage TL in the highlands. Collision risks for birds may be greatest around the Indus River and its tributaries. The study area is 7,951 km^2, stretching from the Dasu Hydropower Project in the north to the Islamabad West Grid Station in the south. Field surveys at 678 observation points were conducted from November 2017 to October 2018. A total of 38,939 birds were sighted, representing 215 different species. Tarbela Reservoir and the future Dasu dam site had the greatest abundance and diversity of avifauna. The number of individuals observed per survey peaked in November, at the height of fall migration; the secondary peak of back migration in March was much smaller. Most abundant species in the study area included Great Cormorant (*Phalacrocorax carbo*), Common Myna (*Acridotheres tristis*) and Carrion Crow (*Corvis corone*) with relative abundance 9.36, 6.58 and 5.73 respectively. Out of 215 species, 27 are collision-prone based on published reports or morphology. Natural birds and migratory sub-routes in the study area highlight the study's significance. Researchers might benefit from this research for similar studies in future developmental projects.

INTRODUCTION

Dasu Hydropower Project (DHP) is a major investment project proposed by the Government of Pakistan (GoP) to modernize and expand the energy sector of the country and to alleviate the shortage of electricity in Pakistan by generating clean and sustainable hydropower. DHP is a run of river project on the Indus River located seven km upstream of Dasu Town, District Kohistan, Khyber Pakhtunkhwa (KP). The site is 74 km downstream of proposed Diamer Basha Dam site and 350 km from Islamabad. DHP will have a total installed capacity of 5400 MW with 12 generating units and is among the priority projects under the National Power Policy 2013 and Vision 2025 of GoP. A 765 kV transmission line is proposed as part of DHP, which will generate 5400 MW of electricity which will be transmitted to National Grid in Islamabad through a 250 km long, 765 kV High Voltage Alternating Current, double circuit transmission line along Indus River which is known for the occurrence of endemic bird species and falls within important flyway routes for migratory birds. The proposed 765 kV transmission line corridor travels along the Indus and crosses the river seven times.

Transmission lines are high voltage power lines that range from 69 kilovolt (kV) to 765 kV. In these lines, electricity can travel through lines in both directions to balance the grid. Transmission lines are thicker than distribution lines, whose main purpose is to connect power plants and sub stations. The voltage range of distribution line is from 4kV to 69 kV (Jeffery, 2020). Transmission lines can have a significant bearing on the environment which has caused a prerequisite to study impacts, including bird interactions.

The risk of bird mortality from power line collision is a function of three interacting factors i.e., local avian population, environment of the area and the configuration/ design of the power line (Bernardino *et al*., 2018; Rollan

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et al., 2010). In general, large, heavily bodied bird species are more susceptible and at greater risk to collision than smaller species (Rollan et al., 2010; Rubolini *et al*., 2005). In addition to the body size, the sensory perception, morphological feature, flight behavior, phenology and health of the birds are also contributing factors to collision. (Bernardino *et al*., 2018). Likewise, the species which tend to form large flocks and fly in groups are also at higher degree of collision risk (Drewitt and Langston, 2008; APLIC, 2012).

The environmental conditions of the site can have a profound impact at the resultant degree of collision risk. Power lines that pass through wetlands, coastal areas, extensive steppes and other major bird congregation habitats are considered to be the most hazardous (Andriushchenko and Popenko, 2012; Faanes, 1987). With respect to weather, low light, fog, rain, heavy wind and inclement weather exacerbate collision risk because power lines can become very difficult for an approaching bird to detect (Savereno *et al*., 1996). Most of the Avian collisions have been reported on high voltage power lines in the foraging and nesting areas of the bird population which are in the close proximity to the transmission lines especially near places used for taking off and landing (Quinn *et al*., 2011). In most documented collisions, it happens because the overhead transmission shield wire (OHSW) is smaller in diameter and is less visible to the bird (APLIC, 2012; Murphy *et al*., 2016).

Avian collision with overhead power lines is an ongoing concern in many countries across the globe (APLIC, 2012; Sporer *et al*., 2013) that may be an important source of mortality for certain species (Loss *et al*., 2014). Power lines are continuously expanding due to the increasing energy demands of growing and expanding communities, ultimately resulting in increased bird-transmission line interactions (Jenkins *et al*., 2010). Power lines can cause significant impacts on the environment both during construction and operation phases (Bagli *et al*., 2010). The most documented and confirmed impact is direct mortality of birds worldwide through collision and electrocution due to transmission lines and it may also impact threatened and endangered local populations negatively (Crowder, 2000; Drewitt and Langston, 2008; Shaw *et al*., 2010; Raab *et al*., 2012). The current study was planned to observe avian species in transmission line corridor and to enlist the collision prone species.

MATERIALS AND METHODS

Study site

The overall study area encompassed over 7,951 km^2, from Raikot Bridge in the North to West Islamabad Grid Station in the South (Fig. 1). The study area is rugged, with elevation ranging from 500 to 2,000 meters above sea level (masl), and diverse, comprising of six ecoregions and twelve unique land cover classifications. The National Transmission and Despatch Company's (NTDC) proposed 765kV, double circuit transmission line running from DHP located in district Kohistan of Khyber Pakhtunkhwa in the North to the Tarbela Reservoir in the South and adjoining mountainous areas at elevations up to 2,000 masl was considered to be main area of concern (Fig. 1).

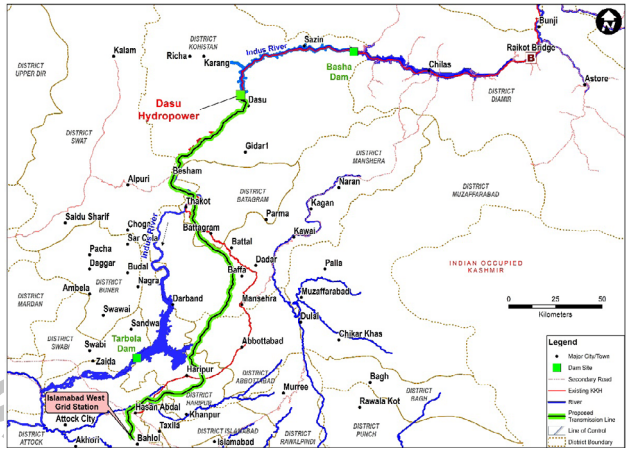

Fig. 1. Study area map (from Raikot to Tarbela reservoir).

Equipment

The equipment used for this study included a Garmin GPS map 76CSx, binoculars (Bushnell power view, 60 X 90 m, Harrier 65mm ED Spotting Scope and camera (Nikon p-900).

Avian surveys

Monthly avian surveys were conducted to obtain an account of the avian species in the study area (Fig. 2). Three primary sampling strategies were adopted including point counts, skyview surveys, and nocturnal surveys. A total of 678 points were surveyed in the 12 months from November 2017 to October 2018.

For the point count method (Verner, 1985), different vantage points were selected randomly during each survey, and observations were taken for fifteen minutes at each point. Nocturnal surveys were conducted to determine the presence of birds such as owls, nightjars and other nocturnal species. The skyview method was adopted to document raptor species and for that matter, the team members used binoculars, spotting scope and cameras at a specified location for one hour. The data were also collected throughout the day in order to completely survey the designated area within 8 to 10 days each month.

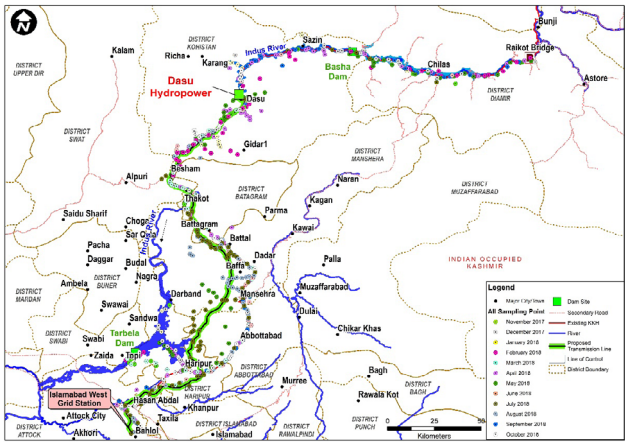

Fig. 2. Avifauna sampling points.

Shannon Weiner index

Shannon wiener index is famous for equalizing diversity among different ecological habitats. It is used to measure the diversity of species. It varies from 0 to 4. If the value of index is higher, it means that area/habitat will have the greater diversity. Species richness and evenness are required to calculate Shannon Wiener index. The land use classes extracted from Pakistan Forest Institute Land use in study area included agriculture land, alpine pasture, dry temperate, moist temperate, oak forest, rangeland, settlements, shrubs and bushes, snow and glaciers, sub-tropical broad leaved, sub-tropical chir pine and water bodies. Shannon wiener index was calculated for each habitat through following formula:

$H' = - [\sum Pi \ln Pi]$

Pi is the proportion of species relative to the total number of species, and lnPi is natural logarithm of this proportion.

RESULTS

In total, 215 avian species (Supplementary Table S1) were documented from a total of 678 observations during 12 months of field data collection. Birds observed during the survey belonged to 18 orders and 61 families. The maximum number of species belonged to the order Passeriformes, followed by Charadriiformes. A total of 38,939 individuals were observed across the study area. Most abundant species in the study area included great cormorant, common myna (*Acridotheres tristis*) and Carrion crow (*Corvis corone*) with relative abundance 9.36, 6.58 and 5.73, respectively

Tarbela Reservoir and the future Basha dam site were areas of greatest Avifauna abundance and diversity. The study revealed that important fall migration routes converge at Tarbela Reservoir, an important stopover for southern migration. The number of individuals observed per survey peaked in November, at the height of fall migration; the secondary peak in March was much smaller, reflecting a more diffused spring migration pattern. The diversity of bird species varied across the area with high numbers and diversity reflected in high Shannon-Weiner values near water such as the Tarbela Reservoir (Fig. 3). The body length was categorized as small (2-24cm), medium (24.1-42cm), large (42.1-82cm) and very large (82.1-182 cm). Out of 215, 115 species fell under the category of small while 59 were medium, 33 were large while 8 were very large (Fig. 4). The wing span was categorized into small (<15) medium (15-65 cm) and large (>65 cm). Out of total, 142 have small wing span while 39 species have medium and 34 species have large wing span (Fig. 5). Out of 215 avian species observed, 27 species (Table I) were determined to be collision prone (Fig. 6). Among collision prone species, 24 were least concern, one was near threatened (Ferruginous duck, *Aythya nyroca*) and two were vulnerable (common pochard (*Aythya ferina*) and Western tragopan (*Tragopan melanocephalus*). Collision- prone species accounted for 10% of the total observations. Most of the collision-prone species have strong associations with water habitats, and most of the point-count observations of collision-prone species were of ducks, geese, cormorants, and rails.

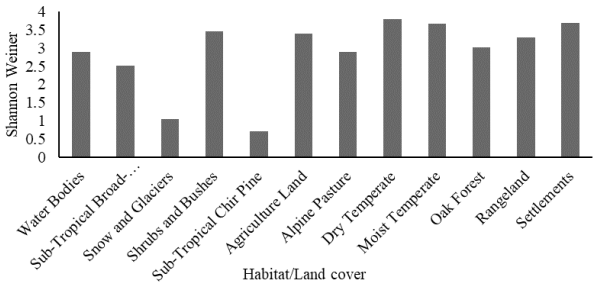

Fig. 3. Shannon-Wiener index by land cover.

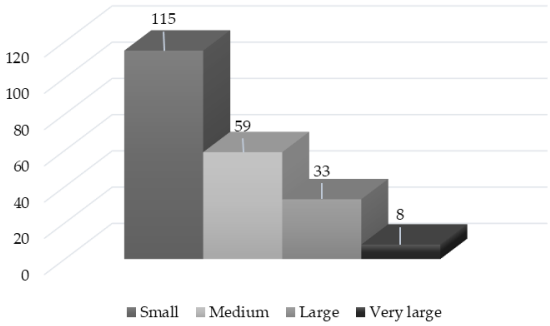

Fig. 4. Body length of avian species.

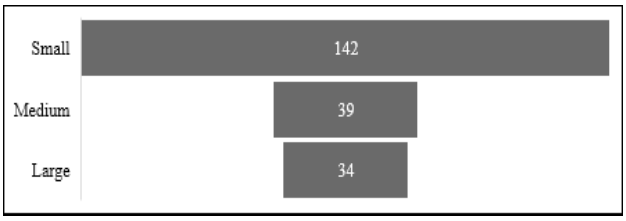

Fig. 5. Wing span of avian species.

Table I. Collision prone species.

S. No.	Scientific name	English name
1	*Amaurornis phoenicurus*	White-breasted waterhen
2	*Anas acuta*	Northern pintail
3	*Anas clypeata*	Shoveler
4	*Anas crecca*	Common teal
5	*Anas penelope*	Wigeon
6	*Anas platyrhynchos*	Mallard duck
7	*Anas strepera*	Gadwall
8	*Anser anser*	Graylag goose
9	*Anser indicus*	Bar- headed goose
10	*Aythya ferina*	Common pochard
11	*Aythya fuligula*	Tufted duck
12	*Aythya nyroca*	Ferruginous duck
13	*Buteo rufinus*	Long-legged buzzard
14	*Aquila nipalensis*	Steppe eagle
15	*Coturnix coturnix*	Common quail
16	*Fulica atra*	Eurasian coot
17	*Gallinago gallinago*	Common snipe
18	*Gallinula chloropus*	Moorhen/ waterhen
19	*Gelochelidon nilotica*	Gull-billed tern
20	*Himantopus himantopus*	Black-winged stilt
21	*Hieraaetus pennatus*	Booted eagle
22	*Phalacrocorax carbo*	Great cormorant
23	*Pucrasia macrolopha*	Koklass pheasant
24	*Circus aeruginosus*	Marsh harrier
25	*Tadorna ferruginea*	Ruddy shelduck
26	*Tragopan melanocephalus*	Western tragopan
27	*Troglodytes hiemalis*	Winter wren

DISCUSSION

Pakistan is a data deficient country for most of the avian species specially in the remote areas and where the developmental projects are expected in future. It is also difficult to estimate the mortalities due to collision with the high voltage transmission lines because of the known population of the collision prone avian species in project areas. This research was conducted to study the avian diversity along the proposed 765 kV extra high voltage transmission line at Indus Cascade. A total of 215 birds species were observed from the study area of 400km belt and from 678 observation points during 12 months (November 2017 to October 2018). A total of 38,939 individuals were observed and maximum number of species belonged to the order Passeriformes, followed by Charadriiformes. Mortalities due to collision are expected to be more during migration (southwards November and northwards March).

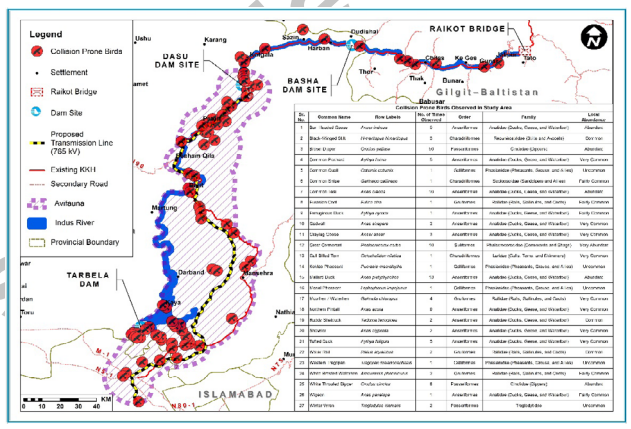

Fig. 6. Locations of collision prone species.

In the study area, 27 species were found to be collision prone. Among such species one was near threatened Ferruginous duck (*Aythya nyroca*) and two were vulnerable common pochard (*Aythya ferina*) and Western Tragopan. Ferruginous Duck has also been reported as collision prone by D'Amico *et al*. (2019). Some of the species in the collected data are rare or unidentified power-line collision sufferers, and exhibit morpho-behavioral traits that make these species not much susceptible to collisions. But, they commonly contain a threatened conservation status having high power-line density in their migratory routes. In such conditions, even infrequent collision events may cause significant consequences at the population level (D'Amico *et al*., 2018, 2019).

Among the sensitive species, Koklass pheasant *Pucrasia macrolopha*, Himalayan monal *Lophophorus impejanis*, and Western tragopan are range restricted (Grimmett *et al*., 2008). South of the Tibetan Plateau are known to be the wintering grounds of ruddy shelduck *Tadorna ferruginea* while the breeding grounds are the north of Himalayas mountain range. Considering this, it

is possible that these species during migration (Parr *et al*., 2019) can collide with the structures like high voltage transmission lines in their migratory routes. According to Rioux *et al*. (2013) waterfowl, grebes, shorebirds and raptors are also more prone to the collision.

Among other species, common quail (*Coturnix coturnix*) is one of the collision prone species and it was found to be the most impacted species due to collision in a study conducted in Saudi Arabia (Shobrak, 2012). According to Mathiasson (1993), the susceptibility to bird collision can be due to poor lift capacity of the species and common quail can be considered one of the examples. Furthermore, among other factors the species vulnerability can be associated with exposure and susceptibility to collision. Moreover, studies suggested that birds with large wing span and body length for example, graylag goose (*Anser anser*), bar-headed goose (*Anser indicus*) and great cormorant are more prone to collision as compared to small birds. Vegetation density, cover, predation and terrain also contribute to bird collision susceptibility (Kerlinger and Curry, 2002; Osborn *et al*., 2000) such as in areas near Pattan, Besham and Dasu. Another research has revealed that the most collision prone species include large (Graylag goose, bar-headed goose) and habitat specialist (Western Tragopan) species (D'Amico *et al*., 2019).

After studying the avian diversity in the area, it is suggested that only a few species (Table I) can collide with the proposed transmission line and will cause outages. Not only the birds' life but the reliability of power supply can also be effected by usage of transmission lines for nesting and roosting by birds causing shutdowns and huge financial losses (Ding *et al*., 2021). Moreover, birds also defecate in a series of activities for example, nesting, laying eggs, brooding, resting, eating and fighting. High conductivity of bird droppings is an important factor causing streamer flashovers of high-voltage transmission line (Wang *et al*., 2018).

The natural presence of the birds and migratory sub-route of the Indus flyway in the proposed transmission line at upper Indus River highlights the importance of this study and the identified collision prone species along with other bird assemblages is an important beginning to invite conservationists and researchers to replicate such studies in other proposed developmental projects.

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Supplementary material

There is supplementary material associated with this article. Access the material online at: https://dx.doi.org/10.17582/journal.pjz/20220507120544

Statement of conflict of interest

The authors have declared no conflict of interest.

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Supplementary Material

Avian Diversity around Indus River with Collision Prone Species Abundance at Proposed 765 KV Transmission Line

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Supplementary Table S1. Species observed in the study area.

Sr. No.	Scientific name	English name	No. of individuals	IUCN status*	WS (cm)	Body length
1	*Accipiter badius*	Shikra	21	LC	60-70	29-32
2	*Accipiter gentilis*	Northern goshawk	1	LC	125-140	40-50
3	*Accipiter nisus*	Eurasian sparrowhawk	95	LC	55-70	28-38
4	*Acridotheres fuscus*	Jungle myna	36	LC	11.8-13	24
5	*Acridotheres ginginianus*	Bank myna	82	LC	11.9-12.5	22.8
6	*Acridotheres tristis*	Common myna	2,566	LC	14-15.1	25
7	*Acrocephalus concinens*	Blunt-winged Warbler	14	LC	5.2-5.8	13
8	*Acrocephalus dumentorum*	Blyth's reed warbler	29	LC	5.9-6.6	14
9	*Actitis hypoleucos*	Common sandpiper	299	LC	38-41	19-21
10	*Aegithalos concinnus*	Black-throated Tit	53	LC	4.8-5.2	11
11	*Aegithalos leucogenys*	White-cheeked Tit	28	LC	5.5	13
12	*Aegithalos niveogularis*	White-throated Tit	115	LC	6.4	10
13	*Aegypius monachus*	Cinereous vulture	4	NT	250-295	100-110
14	*Alauda arvensis*	Eurasian skylark	106	LC	11.4-11.6	16.8-20
15	*Alauda gulgula*	Oriental skylark	28	LC	8.5-10	16-16.5
16	*Alcedo atthis*	Common kingfisher	22	LC	6.9-7.7	18
17	*Alectoris chukar*	Chukar	143	LC	50-54	34-39
18	*Amandava amandava*	Red avadavat	4	LC	49 cm	10.16
19	*Amaurornis phoenicurus*	White breasted waterhen	13	LC	45-54	32

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Sr. No.	Scientific name	English name	No. of individuals	IUCN status*	WS (cm)	Body length
20	*Anas acuta*	Northern pintail	169	LC	80-95	51-66
21	*Hieraaetus fasciatus*	Bonneli's eagle	1	LC	150-180	65-72
22	*Anas clypeata*	Shoveler	71	LC	70-84	44-52
23	*Anas crecca*	Common teal	230	LC	58-64	34-38
24	*Anas penelope*	Wigeon	13	LC	75-86	45-51
25	*Anas platyrhynchos*	Mallard duck	759	LC	81-98	50-65
26	*Anas strepera*	Gadwall	72	LC	84-95	46-56
27	*Anser anser*	Graylag goose	80	LC	152-180	80-90
28	*Anser indicus*	Bar- headed goose	380	LC	150-165	70-78
29	*Anthropoides virgo*	Demoiselle crane	14	LC	165-185	50-53
30	*Anthua spinoletta*	Water pipit	17	LC	8.5-9.5	15-16.5
31	*Anthus campestris*	Tawny pipit	17	LC	8.5-9.5	15-16
32	*Anthus cervinus*	Red-throated pipit	67	LC	7.8-9	13.9-15
33	*Anthus roseatus*	Rosy pipit	7	LC	7.8-8.9	15-16
34	*Anthus rufulus*	Paddy field pipit	66	LC	7.5-8.6	15
35	*Anthus similis*	Long billed pipit	33	LC	9.4-10.5	20-23
36	*Apus affinis*	Little swift	34	LC	34-35	12-15
37	*Apus apus*	Common swift	42	LC	40-42	17
38	*Aquila chrysaetos*	Golden eagle	47	LC	204-220	75-88
39	*Aquila nipalensis*	Steppe eagle	82	EN	174-260	65-77
40	*Ardea alba*	Great egret	8	LC	131-170	80 – 100 cm
41	*Ardea cinerea*	Grey heron	36	LC	175-195	90-98
42	*Ardea intermedia*	Intermediate egret	117	LC	105-115	56-72
43	*Aythya ferina*	Common pochard	188	VU	74-89	42-58
44	*Aythya fuligula*	Tufted duck	120	LC	67-73	40-47
45	*Aythya nyroca*	Ferruginous duck	9	NT	63-67	38-42
46	*Buteo buteo*	Common buzzard	18	LC	102-120	51-55
47	*Buteo rufinus*	Long-legged buzzard	2	LC	126-143	50-65
48	*Calandrella acutirostris*	Hume's lark	26	LC	8.4-9.6	15
49	*Calandrella brachydactyla*	Greater short-toed lark	34	LC	9.1-9.8	15-16.5
50	*Calidris ferruginea*	Curlew sandpiper	77	NT	42-46	18-19
51	*Calidris minuta*	Little stint	32	LC	34-37	12.1-14.1
52	*Caprimulgus europaeus*	Eurasian nightjar	8	LC	57-64	25-27
53	*Carduelis carduelis*	European goldfinch	102	LC	7.6-8.1	14
54	*Carpodacus erythrinus*	Common rosefinch	11	LC	8.3-8.6	14.5
55	*Carpodacus rubicilla*	Great rosefinch	5	LC	11.6-12.2	20-21
56	*Cercomela fusca*	Brown rock chat	41	LC	8.4-9.5	16.5-17
57	*Certhia familiaris*	Eurasian tree creeper	7	LC	6.3-6.6	13.2
58	*Certhia himalayana*	Bar-tailed tree creeper	144	LC	6.5-7.1	14
59	*Ceryle rudis*	Pied kingfisher	36	LC	13.3-14.2	25-29
60	*Charadrius dubius*	Little ringed plover	2	LC	42-48	14.2-15.2

Table continued on next page.....

Sr. No.	Scientific name	English name	No. of individuals	IUCN status*	WS (cm)	Body length
61	*Charadrius hiaticula*	Common ringed plover	6	LC	35–41	17–19.5
62	*Charadrius leschenaultii*	Greater sand-plover	1	LC	12.8-14	22-25
63	*Charadrius mongolus*	Lesser sand-plover	13	LC	45-48	19-20
64	*Chettusia gregaria*	Sociable plover	12	CR	70-76	27-30
65	*Chlidonias leucopterus*	White-winged tern	24	LC	58-67	23-27
66	*Chroicocephalus genei*	Slender-billed gull	25	LC	90-102	37-40
67	*Chroicocephalus ridibundus*	Black headed gull	2,097	LC	91-106	34-37
68	*Chrysomma sinense*	Yellow-eyed babbler	3	LC	6.5-7	17-18
69	*Ciconia nigra*	Black stork	9	LC	145-155	95-100
70	*Cinclus cinclus*	White-throated dipper	399	LC	8.1-10	19-20
71	*Cinclus pallasii*	Brown dipper	468	LC	9.1-10	18-20
72	*Cinnyris asiaticus*	Purple sunbird	2	LC	5.5-5.7	10
73	*Circus aeruginosus*	Marsh harrier	8	LC	115-130	48-56
74	*Circus cyaneus*	Hen harrier	65	LC	100-120	44-52
75	*Columba livia*	Rock pigeon	215	LC	78-84	33
76	*Copsychus saularis*	Oriental magpie-robin	2	LC	9.1-10.6	17-20
77	*Coracias benghalensis*	Indian roller	118	LC	17.7-20	31-35
78	*Coracias garrulus*	European roller	63	LC	18-21	31
79	*Coracina melaschistos*	Black winged cuckoo shrike	3	LC	11.4-12.8	22-23
80	*Corvus corax*	Raven	134	NT	41.9-48.3	46–59
81	*Corvus corone*	Carrion crow	2,234	LC	33-35	50-54
82	*Corvus frugilegus*	Rook	16	LC	15.6-17.1	42
83	*Corvus macrorhynchos*	Large billed crow	1,862	LC	29-36.8	43-50
84	*Corvus splendens*	House crow	1,046	LC	76-85	41-43
85	*Coturnix coturnix*	Common quail	5	LC	32-35	16-20
86	*Delichon dasypus*	Asian house martin	112	LC	10.4-11.3	12.5-15
87	*Delichon urbicum*	Common house-martin	26	LC	10.4-11.3	12.5-15
88	*Dendrocitta vagabunda*	Rufous treepie	25	LC	33–36	46-50
89	*Dendrocopos auriceps*	Brown-fronted woodpecker	7	LC	10.5-13	19-20
90	*Dendrocopos himalayensis*	Himalayan woodpecker	50	LC	12.3-13.6	23-35
91	*Dicrurus leucophaeus*	Ashy drongo	23	LC	12.4-14.5	25-26
92	*Dicrurus macrocercus*	Black drongo	232	LC	12.8-15.6	30
93	*Egretta garzetta*	Little egret	34	LC	88-95	55-65
94	*Elanus caeruleus*	Black-shouldered kite	1	LC	75-87	31-35
95	*Emberiza cia*	Rock bunting	489	LC	7.8-8.7	16-18
96	*Enicurus scouleri*	Little forktail	273	LC	7.2-7.9	12-13.3
97	*Falco subbuteo*	Eurasian hobby	55	LC	82-92	30-36
98	*Falco tinnunculus*	Common kestrel	16	LC	71-80	32-35
99	*Ficedula superciliaris*	Ultramarine flycatcher	49	LC	6.1-6.4	11
100	*Fulica atra*	Eurasian coot	18	LC	70-80	36-38
101	*Galerida cristata*	Crested lark	983	LC	10.3-10.6	17-18

Table continued on next page.....

Sr. No.	Scientific name	English name	No. of individuals	IUCN status*	WS (cm)	Body length
102	*Gallinago gallinago*	Common snipe	17	LC	44-47	25-27
103	*Gallinula chloropus*	Moorhen/ waterhen	118	LC	45-53	30-33
104	*Gelochelidon nilotica*	Gull-billed tern	113	LC	86-102	35-42
105	*Glaucidium brodiei*	Collared owlet	10	LC	9-10.1	16-17
106	*Glaucidium cuculoides*	Asian-barred owlet	10	LC	14.5-16.2	22-23
107	*Gyps himalayensis*	Himalayan griffon	89	NT	261-306.3	115-125
108	*Halcyon smyrnensis*	White throated kingfisher	31	LC	11.8-13.1	25-28
109	*Hieraaetus pennatus*	Booted eagle	14	LC	100-121	45-53
110	*Himantopus himantopus*	Black-winged stilt	24	LC	67-83	35-40
111	*Hirundo rustica*	Barn swallow	420	LC	11.6-13	18-20
112	*Hirundo smithii*	Wire-tailed swallow	188	LC	11.3-11.5	12.7-14
113	*Hodgsonius phoenicuroides*	White-bellied redstart	12	LC	7.2-7.7	18-19
114	*Hydrophasianus chirugus*	Pheasant-tailed jacana	4	LC	18.2-24.2	44-47
115	*Lanius collurio*	Red-backed shrike	9	LC	9-9.7	17
116	*Lanius schach*	Long-tailed shrike	134	LC	9.1-9.7	24-26
117	*Larus brunnicephalus*	Brown-headed gull	368	LC	110-120	42-46
118	*Larus canus*	Mew gull	68	LC	114-126	40 – 46
119	*Leucosticte nemoricola*	Plain mountain finch	18	LC	9.5-10.1	18
120	*Lophophorus impejanus*	Monal pheasant	1	LC	100-110	68-73
121	*Loxia curvirostra*	Red crossbill	20	LC	8.9-9.1	16-18.5
122	*Ixobrychus minutus*	Little bittern	3	LC	40-45	28-36
123	*Melophus lathami*	Crested bunting	15	LC	7.9-8.8	16-16.5
124	*Mergus merganser*	Goosander	7	LC	82-97	58-66
125	*Merops apiaster*	European bee-eater	47	LC	14.5-16	27
126	*Merops orientalis*	Green bee-eater	27	LC	8.9-9.9	21-23
127	*Milvus migrans*	Black kite	118	LC	160-180	55-60
128	*Monticola cinclorhynchus*	Blue-capped rock thrush	297	LC	9.6-10.4	17-18
129	*Monticola solitarius*	Blue rock thrush	46	LC	11.6-12.7	20-23
130	*Motacilla alba*	White wagtail	1,039	LC	8.3-9.8	18-19
131	*Motacilla cinerea*	Grey wagtail	1,040	LC	28	17
132	*Motacilla citreola*	Citrine wagtail	58	LC	7.7-8.8	16-17.75
133	*Motacilla flava*	Yellow wagtail	360	LC	7.5-8.8	17-18
134	*Motacilla maderaspatensis*	White-browed wagtail	139	LC	9.5-10.7	21-24
135	*Myiarchus crinitus*	Great crested flycatcher	21	LC	33	22.2
136	*Myophonus caeruleus*	Blue whistling thrush	741	LC	16.8-19.2	30-33
137	*Numenius arquata*	Eurasian curlew	11	NT	80-100	50-60
138	*Nycticorax nycticorax*	Black-crowned night heron	32	LC	105-112	58-65
139	*Oenanthe albonigra*	Hume's wheatear	283	LC	26–27	14.5
140	*Oenanthe picata*	Variable wheatear	325	LC	8.6-9.8	16.5-17
141	*Oenanthe pleschanka*	Pied wheatear	55	LC	26–32	14.5–15.5
142	*Oriolus oriolus*	Eurasian golden oriole	5	LC	13.5-14.7	23-26

Table continued on next page.....

Sr. No.	Scientific name	English name	No. of individuals	IUCN status*	WS (cm)	Body length
143	*Orthotomus sutorius*	Common tailor bird	17	LC	4.3-5.4	10 to 14
144	*Parus major*	Great tit	92	LC	7.2-7.4	14
145	*Parus rufonuchalis*	Rufous-naped tit	39	LC	7.3-7.7	13
146	*Passer domesticus*	House sparrow	701	LC	7-8.1	13-15.5
147	*Passer hispaniolensis*	Spanish sparrow	285	LC	7.3-8.7	14.5-16
148	*Passer montanus*	Eurasian tree sparrow	445	LC	21	12 – 14
149	*Passer rutilans*	Russet sparrow	8	LC	6.8-8.2	13.4-15
150	*Pastor roseus*	Rosy starling	23	LC	12.4-13.5	22.8-24
151	*Pericroco tusroseus*	Rosy minivet	10	LC	8.3-9.2	18
152	*Pericrocotus ethologus*	Long-tailed minivet	8	LC	8.6-9.6	18-20
153	*Periparus melanolophus*	Black crested tit	109	LC	6.2-6.5	12.5-14
154	*Phalacrocorax carbo*	Great cormorant	3,647	LC	130-150	80-90
155	*Philomachus pugnax*	Ruff	7	LC	54-58	26-30
156	*Phoenicurus fuliginosus*	Plumbeous water redstart	849	LC	7.2-8.3	12.1-14
157	*Phoenicurus leucocephalus*	White-capped water redstart	778	LC	8.5-10.2	19
158	*Phoenicurus ochruros*	Black redstart	164	LC	7.9-8.8	14.5-15.5
159	*Phylloscopus collybita*	Common chiffchaff	119	LC	6-6.6	10
160	*Phylloscopus griseolus*	Sulphur-bellied warbler	2	LC	5.1-5.5	10
161	*Phylloscopus humei*	Hume's warbler	18	LC	5.5-5.8	10
162	*Phylloscopus sindianus*	Mountain chiffchaff	27	LC	5.6-6	11.2-11.9
163	*Phylloscopus subviridis*	Brook's leaf warbler	70	LC	5.1-5.9	10
164	*Phylloscopus trochiloides*	Greenish warbler	121	LC	5.9-6.5	10.2-13
165	*Pica pica*	Eurasian magpie	46	LC	18.2-22.7	30
166	*Podiceps cristatus*	Great crested grebe	14	LC	85-90	46-51
167	*Porzana parva*	Little crake	9	LC	34-39	18-20
168	*Porzana porzana*	Spotted crake	19	LC	37-42	22-24
169	*Porzana pusilla*	Baillon’s crake	6	LC	33-37	17-19
170	*Prinia hodgsonii*	Grey breasted prinia	15	LC	4.1-5.1	11-13.1
171	*Prunella collaris*	Alpine accentor	12	LC	9.2-10.5	15.5-17
172	*Psittacula krameri*	Rose-ringed parakeet	26	LC	15.6-17.1	42
173	*Pteruthius xanthochlorus*	Green shrike-babbler	3	LC	6.2-6.5	12.5-13
174	*Ptyonoprogne rupestris*	Eurasian crag martin	7	LC	12-13.4	14-15.2
175	*Pucrasia macrolopha*	Koklass pheasant	2	LC	55-70	58-64
176	*Pycnonotus cafer*	Red vented bulbul	1,731	LC	8.5-9.5	20-23
177	*Pycnonotus leucogenys*	Himalayan bulbul	1,762	LC	8-9.3	20-22
178	*Rallus aquaticus*	Water rail	39	LC	38-45	23-28
179	*Rhipidura aureola*	White-browed fantail	92	LC	7.3-8.9	17-18
180	*Saxicola caprata*	Pied bushchat	83	LC	7-7.7	12.5-13
181	*Saxicola ferreus*	Grey bushchat	39	LC	6.4-6.9	15-15.25
182	*Saxicola torquata*	Common stonechat	44	LC	6.5-7.3	12.5-13
183	*Saxicoloides fulicata*	Indian robin	11	LC	6.9-8.0	16-19

Table continued on next page.....

Sr. No.	Scientific name	English name	No. of individuals	IUCN status*	WS (cm)	Body length
184	*Seicercus whistleri*	Whistler's warbler	4	LC	8.9-9.7	11.0-12.0
185	*Serinus pusillus*	Red fronted serin	4	LC	6.9-7.9	12.1-13
186	*Sterna aurantia*	River tern	69	NT	80-85	38-46
187	*Sterna capsica*	Caspian tern	69	LC	127-140	50-59
188	*Sterna hirundo*	Common tern	65	LC	79-84	32-40
189	*Streptopelia chinensis*	Spotted dove	24	LC	43- 48	28- 32
190	*Streptopelia decaocto*	Eurasian collared dove	82	LC	47–55	30-32
191	*Streptopelia senegalensis*	Laughing dove	204	LC	12.9-13.5	26-27
192	*Sturnia pagodarum*	Brahminy starling	373	LC	9.9-11.2	20
193	*Sturnus vulgaris*	Common starling	229	LC	10.8-13.5	19-20
194	*Sylvia curruca*	Lesser whitethroat	189	LC	5.8-6.5	13
195	*Tachymarptis melba*	Alpine swift	354	LC	45-60	22
196	*Tadorna ferruginea*	Ruddy shelduck	21	LC	121-145	61-67
197	*Terpsiphone paradisi*	Indian paradise-flycatcher	66	LC	8.9-9.9	20-22
198	*Tichodroma muraria*	Wall creeper	134	LC	9.4-10.2	16-18
199	*Tragopan melanocephalus*	Western tragopan	1	VU	24.5-28.5	69-74
200	*Tringa erythropus*	Spotted red shank	15	LC	61-71	29-31
201	*Tringa nebularia*	Green shank	11	LC	68-70	33 cm
202	*Tringa ochropus*	Green sand piper	14	LC	57-61	21-24
203	*Tringa stagnatilis*	Marsh sandpiper	46	LC	55–59	22–26
204	*Tringa totanus*	Red shank	10	LC	59-66	27-29
205	*Trochalopteron lineatum*	Streaked laughing thrush	250	LC	7.4-7.7	20-21
206	*Troglodytes hiemalis*	Winter wren	3	LC	4.7-5.3	9-9.5
207	*Turdus merula*	Eurasian blackbird	4	LC	14.4-16.1	27-28
208	*Turdus rubrocanus*	Chestnut thrush	76	LC	13.2-14.4	27-28
209	*Turdus ruficollis*	Red-throated thrush	8	LC	12.5-14.3	24-27
210	*Turdus unicolor*	Tickell's thrush	6	LC	11.5-13	21-25
211	*Turnix tanki*	Yellow-legged buttonquail	14	LC	7.9-8.9	15
212	*Upupa epops*	Common hoopoe	64	LC	13.6-16	29-31
213	*Urocissa flavirostris*	Yellow-billed blue magpie	134	LC	17.8-19	63-65
214	*Vanellus indicus*	Red-wattled lapwing	445	LC	80-81	32-35
215	*Zosterops palpebrosus*	Oriental white eye	9	LC	5-5.7	10.1-12

*LC, least concern; NT, near threatened; VU, vulnerable; EN, endangered; CR, critically endangered