SPECIES

To Cite:
Kushwaha S, Kumar A, Singh A, Kumar D. Assortment of Avian Fauna and consequences of human activities at Pahuj and Sukma Dukma Reservoir of Jhansi District in Uttar Pradesh, India. *Species* 2023; 24: e55s1555
doi: https://doi.org/10.54905/disssi/v24i73/e55s1555

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Peer-Review History
Received: 05 April 2023
Reviewed & Revised: 11/April/2023 to 10/June/2022
Accepted: 14 June 2023
Published: 24 June 2023

Peer-Review Model
External peer-review was done through double-blind method.

Species
pISSN 2319–5746; eISSN 2319–5754

Assortment of Avian Fauna and consequences of human activities at Pahuj and Sukma Dukma Reservoir of Jhansi District in Uttar Pradesh, India

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ABSTRACT

With the depleting biodiversity every day, birds are becoming the most flanking fauna around human beings. For sheer charisma, embellishment, adaptability and accessibility the avifauna is evidently unsurpassable and incomparable. With the ecological services rendered by the bird species particularly in maintaining the healthy environment, it is of utmost importance to learn about them. For that reason, scientific study on bird species and the threats to them was carried out at important reservoirs-Pahuj and Sukwa Dukwa located in Jhansi district from December 2015- December 2022. This was to provide attention-grabbing information on the avian fauna of these reservoirs and to recognize them as an important bird watching sites for the citizens of Jhansi and neighboring areas. Pahuj reservoir built on Pahuj River, also known as Simardha Reservoir is located at 7 km from Jhansi city. The Sukwa Dukwan dam about 40 km from Jhansi is built on river Betwa. The International Commission on Irrigation and Drainage named it as the World Heritage Irrigation Structure in 2022. Lines transect and Point count methods were used to carry out birds' survey. Total number of 181 bird species in 47 families was recorded during study including both residential and migratory species. The observations showed that there was a significant relationship between winter temperature and bird species diversity; because as temperature increases, diversity of bird species decreases. The results conclude that birds are good indicators of these two reservoirs and reveal the disturbances caused by human activities. It is therefore recommended that regular monitoring of the sites should be carried out so as to protect the birds and manage the unwanted changes due to human activities.

Keywords: Avian Fauna; human activities; ecology; bird species

1. INTRODUCTION

With the depleting biodiversity every day, birds are becoming the most flanking fauna around human beings. For sheer charisma, embellishment, adaptability and accessibility the avifauna is evidently unsurpassable and incomparable. With the

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ecological services rendered by the bird species particularly in maintaining the healthy environment, it is of utmost importance to learn about them. With the so-called developments, technology and the hectic life, humans have started looking for solace in nature. Bird watching is one of the activities that rejuvenate the mind and soul. Many people consider it as a therapy to heal them.

In Japan, there is a practice called forest bathing or Shinrin-yoku. Shinrin in Japanese means "forest" and yoku means "bath" that is taking in the forest through our senses. Forest bathing is basically to be with nature through all the senses like watching with eyes, listening through ears, tasting with tongue, smelling with nose and contact with our hands and feet. The singing birds and the air flowing through the leaves have magical impact. Watching the different shades of greens and browns of the trees and the sunlight that filters through them are absolutely amazing. Breathe in the aroma of the jungle and inhale in the fresh aromatherapy of phytoncides. Place hands on the trees, hug them or immerse the feet in the graceful stream. All these simple activities connect directly with the nature.

Wetlands harbor a large number of threatened birds and are vital to their conservation. The 20% percent of bird species that inhabit wetlands in the Asiatic region are threatened which is much more than the 10% of the globally threatened birds. Out of 310 Indian wetland birds, 107 species are winter migrants. Water birds are not only the most prominent groups which attract people to wetlands, but also are excellent indicators of biodiversity that are valuable for studying a variety of environmental problems (Urfi et al., 2005).

The study on the avifauna associated with two reservoirs near Jhansi district was undertaken to explore the rich diversity and to ensure protection to the feathered bipeds. Scientific observations of wetland birds on a regular basis are valuable source of information that reflects the ecological healthiness and condition of water bodies. In addition to this, monitoring can be instrumental in creating awareness about the conservational significance of the wetlands.

In order to realize the value of local landscapes for conservation of avifauna, it is a must to know the composition of the bird community of the particular region (Kattan and Franco, 2004). For long term studies, there should be proper data about the migration time and breeding season of the bird species so as to know the trending changes in timing of breeding in the ongoing climate changes (Parmesan and Yohe, 2003).

Study Area

The Pahuj reservoir built on Pahuj River is also known as Simardha Reservoir. It is located at 7 km from city (N 25°29′51.81″ E 078°32′37.65″). Pahuj River, flowing through the historic city of Jhansi, Uttar Pradesh probably originates near the hills of Jhansi or in Tikamgarh district of Madhya Pradesh. It has been referred as the Pushpavati in religious texts. Pahuj also flow passes by Unnao Balaji, famous for Sun Temple located at 20 km from Jhansi. It is a small tributary of the River Sindh that later merges into the Yamuna River in Etawah, Uttar Pradesh, just when the Chambal flow in the Yamuna. Pahuj is a small and seasonal river which flows through the Indian Grassland and Fodder Research Institute located in Jhansi. With the construction of Pahuj reservoir, the water level has risen in the river and site serves as an important picnic spot for the city-dwellers.

The Sukwa Dukwan dam was built in 1906 (N 25°11′27.47″ E 078°32′20.63″). An engineering marvel, it is located over River Betwa about 45 km from Jhansi and is still in working condition. The Sukwa Dukwan reservoir has a capacity of 57 million cubic meters. It has the facility to irrigate nearly 2 lakh hectares of land every year and supports the agriculture and domestic water requirements of Jalaun, Jhansi and parts of Hamirpur in Uttar Pradesh as well as Datia district in Madhya Pradesh (The Times of India, 2022).

Figure 1a Pahuj Reservoir

Figure 1b Pahuj Reservoir (Source: Google Earth image)

Figure 2a Sukwa Dukwa Reservoir

Figure 2b Sukwa Dukwa Reservoir (Source: Google Earth image)

2. METHODOLOGY

Survey work were carried out during the winter months (November to February) for 4 hrs in the morning and 2 hrs in the evening (morning: 07:00-11:00 am, evening: 03:00-5:00 pm). During the summers, the surveys were carried out for 2 hours in the morning (6:00-8:00 am) and for 2 hours in the evening (5:00-7:00 pm). Observations were made along line transects with the aid of 10x50 mm binoculars and Canon 7D SLR Camera. Boat surveys were also carried out for more accurate data. For Point count method, stations were marked within the study area both systematically and randomly. GPS was noted using 20e-trex meter. The distance between the two points was at least 200 meters. Photographs of birds and their habitat were taken in most cases.

For each species recorded, it was tried to assign its status, i.e., whether it is a year-round Resident (R) or migrant (M). Further the team tried to categorize the Abundance code of each species as Common (C = seen frequently, more than 10 sightings); Fairly

Common (FC= less than 10 sightings) and Uncommon (UC = less than 5 sightings and irregularly seen). The Appendix also cites the level of threat for each species based on the data available through the IUCN, (2023). This includes Critically Endangered (CR); Endangered (EN); Vulnerable (VU); Near Threatened (NT), Least Concern (LC) and Not Assessed (NA). The bird species were identified using key reference books (Grewal and Pfister, 2002; Ali and Ripley, 1996; Grimmett et al., 2007). All the observations were visual with no capturing of any bird.

3. RESULTS AND DISCUSSION

Total number of 181 bird species from 47 families was recorded during study including both residential and migratory species (Table 1). The Pahuj reservoir supports 167 bird species while the Sukma Dukma reservoir has 173 bird species. This difference may be attributed to the cliffs near Sukma Dukma reservoir. However, the bird richness was much higher at Pahuj reservoir as compared to Sukma Dukma. The reservoir areas harbor diverse fauna which in turn attracts the migratory as well as non-migratory birds reflecting the high productivity and advantages to all kinds of birds as apparent from present studies (Wanjari, 2016).

There was great difference in species composition between the terrestrial and aquatic habitats. Terrestrial habitat (104 species) contributed much in terms of species composition than aquatic habitat (77 species). Accordingly, if the area and quality of reservoir is substantially reduced, populations' birds in the area also can be expected to decrease (Medona et al., 2015).

Table 1 Bird species recorded from Pahuj and Sukwa Dukwa Reservoir

S. No	Common Name	Zoological Name	Local name	Family	PR	SDR	R/M	AC	IUCN Status
1	Lesser whistling duck	*Dendrocygna javanica*	Seelhi, Seelkahi	Dendrocygnidae (1)	✓	✓	R	C	LC
2	Ruddy Shelduck	*Tadorna ferruginea*	Laal surkhab	Anatidae (13)	✓	X	M	C	LC
3	Comb duck	*Sarkidiornis melanotos*	Nakta		✓	X	R	FC	LC
4	Cotton Pygmy Goose	*Nettapus coromendelianus*	Girja		✓	✓	R	FC	LC
5	Gadwall	*Anas strepera*	Beykhur		✓	✓	M	C	LC
6	Mallard	*Anas platyrhynchos*	Nilsir		✓	X	M	FC	LC
7	Spot-billed duck	*Anas poecilorhyncha*	Gugral		✓	✓	R	C	LC
8	Northern shoveller	*Anas clypeata*	Ghirah		✓	✓	M	C	LC
9	Northern pintail	*Anas acuta*	Seenkh par		✓	✓	M	C	LC
10	Brahminy shelduck	*Tadorna ferruginea*	Chakwa/Lal		✓	✓	M	C	LC
11	Cotton teal	*Anas crecca*	Kerra		✓	✓	M	C	LC
12	Red crested Pochard	*Netta rufina*	Laal sir		✓	✓	M	FC	LC
13	Tufted Pochard	*Aythya fuligula*	Dubaru		✓	✓	M	C	LC
14	Common Pochard	*Aythya ferina*	Burar nar		✓	✓	M	C	LC
15	Barred buttonquail	*Turnix suscitator*	Salui gundra	Turnicidae (1)	X	✓	R	FC	LC

16	Common Kingfisher	*Alcedo atthis*	Chhota Kilkila	Alcedinidae (4)	✓	✓	R	FC	LC
17	White breasted Kingfisher	*Halcyon smyrnensis*	Kilkila		✓	✓	R	C	LC
18	Pied Kingfisher	*Ceryle rudis*	Kilkila		✓	✓	R	C	LC
19	Stork-billed Kingfisher	*Pelargopsis capensis*	Bada Kilkila		✓	✓	R	C	LC
20	White-breasted Waterhen	*Amaurornis phoenicurus*	Dauk, Dawak	Rallidae (4)	✓	✓	R	C	LC
21	Purple Moorhen	*Porphyrio porphyrio*	Khima		✓	✓	R	C	LC
22	Common Moorhen	*Gallinule chloropus*	Jal murgi		✓	✓	R	C	LC
23	Common Coot	*Fulica atra*	Thekari		✓	✓	M	C	LC
24	Common snipe	*Gallinago gallinago*	Chaha	Scolopacidae (9)	✓	✓	M	FC	LC
25	Wood Sandpiper	*Tringa glareola*	Titvari		✓	✓	M	C	LC
26	Green Sandpiper	*Tringa ochropus*	Hara retal chaha		✓	✓	M	FC	LC
27	Common Sandpiper	*Actitis hypoleucos*	***		✓	✓	M	C	LC
28	Spotted Redshank	*Tringa erythropus*	Batan		✓	✓	M	C	LC
29	Common Redshank	*Tringa tetanus*	Chhota batan		✓	✓	M	C	LC
30	Common Greenshank	*Tringa nebularia*	Timtima		✓	✓	M	C	LC
31	Little Stint	*Calidris minuta*	Chhota panlowwa		✓	✓	M	C	LC
32	Temminck's Stint	*Calidris temminckii*	Chhota panlowwa		✓	✓	M	C	LC
33	Bronzed-winged Jacana	*Metopidius indicus*	Jal pipi	Jacanidae (2)	✓	✓	R	C	LC
34	Pheasant tailed Jacana	*Hydrophasianus chirurgus*	Pihuya		X	✓	R	FC	LC
35	Black – winged Stilt	*Himantopus himantopus*	Tinghur	Charadriidae (5)	✓	✓	R	C	LC
36	Yellow-wattled Lapwing	*Vanellus malabaricus*	Zirdi		X	✓	R	UC	NA
37	Red –wattled Lapwing	*Vanellus indicus*	Titeeri		✓	✓	R	C	LC
38	River	*Vanellus*	***		✓	✓	R	FC	NT

	Lapwing	*duvaucelii*							
39	Little ringed plover	*Charadrius dubius*	Merwa		✓	✓	R	C	LC
40	Small Pratincole	*Glareola lacteal*	Chota babuibatan	Glareolidae (1)	X	✓	R	FC	LC
41	Black-headed Gull	*Larus ridibundus*	Kal-siri gangachilli	Laridae (5)	✓	✓	M	C	LC
42	Brown-headed Gull	*Chroicocephalus brunnicephalus*	Dhomra		✓	✓	M	C	LC
43	Pallas's gull	*Larus ichthyaetus*	Dhomra		✓	✓	M	UC	LC
44	River tern	*Sterna aurantia*	Kinai		✓	✓	R	C	NT
45	Gull-billed tern		Koorari		✓	✓			LC
46	Little Grebe	*Tachybaptus ruficollis*	Pandubi	Podicipedidae (2)	✓	✓	R	C	LC
47	Crested Grebe		Shiva-hans		✓	✓	M	FC	LC
48	Great Cormorant	*Phalacrocorax carbo*	Pan-kowwa	Phalacrocoracidae (3)	✓	✓	R	FC	LC
49	Little Cormorant	*Phalacrocorax niger*	Pan-kowwa		✓	✓	R	C	LC
50	Indian Cormorant	*Phalacrocorax fuscicollis*	Pan-kowwa		✓	✓	R	C	LC
51	Darter	*Anhinga melanogaster*	Panwa	Anhingidae (1)	✓	✓	R	FC	NT
52	Little Egret	*Egretta garzetta*	Karchia bagla	Ardeidae (10)	✓	✓	R	C	LC
53	Great Egret	*Casmerodius albus*	Bada bagla		✓	✓	R	C	LC
54	Intermediate Egret	*Mesophoyx intermedia*	Karchia bagla		✓	✓	R	C	LC
55	Cattle Egret	*Bubulcus ibis*	Surkhia bagla		✓	✓	R	C	LC
56	Grey Heron	*Ardea cinerea*	Nari		✓	✓	M	C	LC
57	Purple Heron	*Ardea purpurea*	Lal anjan		✓	✓	R	C	LC
58	Indian Pond Heron	*Ardeola grayii*	Andha bagla		✓	✓	R	C	LC
59	Black-crowned Night Heron	*Nycticorax nycticorax*	Kokrai		✓	✓	R	FC	LC
60	Black bittern	*Dupetor flavicollis*	Kala bagla		✓	✓	R	UC	LC
61	Cinnamon Bittern ·	*Ixobrychus cinnamomeus*	Lal bagla		✓	X	R	UC	LC
62	Black Ibis	*Pseudibis papillosa*	Kala Baza	Threskiornithidae (2)	✓	✓	R	FC	LC
63	White ibis	*Threskiornis melanocephalus*	Didhar		X	✓	R	UC	NT
64	Painted Stork	*Mycteria leucocephala*	Janghil/Dokh	Ciconiidae (5)	✓	✓	R	C	NT
65	Asian Open bill-Stork	*Anastomus oscitans*	Ghungil		✓	✓	R	FC	LC
66	White-necked Stork	*Ciconia episcopus*	Laglag		✓	✓	R	FC	V

67	Black- necked Stork	*Ephippiorhynchus asiaticus*	Loha sarang		✓	✓	R	FC	NT
68	Lesser adjutant	*Leptoptilos javanicus*	Chhota garur		X	✓	R	UC	V
69	Plain Martin	*Riparia paludicola*	***	Hirundinidae (4)	✓	✓	R	C	LC
70	Barn Swallow	*Hirundo rustica*	***		✓	✓	M	C	LC
71	Wire-tailed Swallow	*Hirundo smithii*	***		✓	✓	R	FC	LC
72	Streak-throated swallow	*Hirundo fluvicola*	***		✓	✓	R	FC	LC
73	White Wagtail	*Motacilla alba (personata and dukhunensis)*	***	Passeridae (5)	✓	✓	M	C	NA
74	White-browed Wagtail	*Motacilla maderaspatensis*	Khanjan		✓	✓	R	UC	NA
75	Citrine wagtail	*Motacilla citreola*	Pani-ka-pilkya		✓	✓	M	C	LC
76	Yellow Wagtail	*Motacilla flava*	Pilkya		✓	✓	M	C	NA
77	Grey Wagtail	*Motacilla cinerea*	***		✓	✓	M	UC	LC
Terrestrial birds associated with the reservoirs									
78	Indian peafowl	*Pavo cristatus*	Mor	Phasianidae (1)	X	✓	R	C	LC
79	Brown-capped pygmy Woodpecker	*Dendrocopos nanus*	Katphora	Picidae (4)	✓	✓	R	FC	LC
80	Lesser Golden-backed Woodpecker	*Dinopium benghalense*	Kathfudwa		✓	✓	R	C	LC
81	Yellow-crowned Woodpecker	*Dendrocopus mahrattensis*	Katphora		✓	✓	R	C	NA
82	Eurasian Wryneck	*Jynx torquilla*	Gardan eyengtha		✓	✓	M	FC	LC
83	Brown-headed Barbet	*Megalaima zeylanica*	Bada basanta	Megalaimidae (2)	✓	✓	R	FC	NA
84	Coppersmith Barbet	*Megalaima haemacephala*	Chota basanta		✓	✓	R	C	LC
85	Indian Grey Hornbill	*Ocyceros birostris*	Dhanesh	Bucerotidae (1)	✓	✓	R	FC	LC
86	Common Hoopoe	*Upupa epops*	Hudhud	Upupidae (1)	✓	✓	R	C	LC
87	Indian Roller	*Coracias benghalensis*	Neelkanth	Coraciidae (1)	✓	✓	R	C	LC
88	Green Bee-Eater	*Merops orientalis*	Harrial	Meropidae (2)	✓	✓	R	C	NA
89	Blue-tailed Bee-eater	*Merops philippinus*	Bada patringa		✓	✓	R	C	LC

90	Pied Crested Cuckoo	*Clamator jacobinus*	Kala Papiya	Cuculidae (3)	✓	✓	R	FC	LC
91	Common Hawk Cuckoo	*Hierococcyx varius*	Papiya		✓	✓	R	FC	LC
92	Asian Koel	*Eudynamys scolopacea*	Koel		✓	✓	R	C	LC
93	Greater Coucal	*Centropus sinensis*	Mahoka	Centropodidae (1)	✓	✓	R	C	LC
94	Rose-ringed Parakeet	*Psittacula krameri*	Tota	Psittacidae (2)	✓	✓	R	C	LC
95	Plum-headed Parakeet	*Psittacula cyanocephala*	Tuiya tota		✓	✓	R	FC	LC
96	House Swift	*Apus affinis*	Ababeel	Apodidae (1)	✓	✓	R	C	LC
97	Brown fish owl	*Ketupa zeylonensis*	Amrai-kaghughu, Ullu	Strigidae (5)	✓	✓	R	UC	LC
98	Spotted Owlet	*Athenebrama*	Chughad		✓	✓	R	C	LC
99	Jungle Owlet	*Glaucidium radiatum*	Jangli Choghad		✓	✓	R	FC	LC
100	Mottled wood owl	*Strix ocellata*	Girnari ghuvad		X	✓	R	UC	LC
101	Indian Eagle owl	*Bubo bengalensis*	***		X	✓	R	FC	LC
102	Common Indian Nightjar	*Caprimulgus asiaticus*	Chapka	Caprimulgidae (1)	✓	✓	R	FC	LC
103	Rock Pigeon	*Columba livia*	Kabutar	Columbidae (6)	✓	✓	R	C	LC
104	Laughing dove	*Streptopelia senegalensis*	Chhota fakta		✓	✓	R	C	LC
105	Red collared dove	*Streptopelia Tranquebarica*	Lali pohu		✓	✓	R	FC	LC
106	Spotted dove	*Streptopelia chinensis*	Chitroka fakhta		✓	✓	R	C	LC
107	Eurasian collared dove	*Streptopelia decaocto*	Panduk		✓	✓	R	C	LC
108	Yellow- footed Green- Pigeon	*Treron phoenicoptera*	Harilal		✓	✓	R	C	LC
109	Black-shouldered kite	*Elanus caeruleus*	Kapassi	Accipitridae (11)	✓	✓	R	FC	LC
110	Black Kite	*Milvus migrans*	Cheel		✓	✓	R	C	LC
111	Brahminy Kite	*Haliastur indus*	Brahmani cheel		✓	✓	R	C	LC
112	Egyptian Vulture	*Neophron percnopterus*	Gobar giddh		✓	✓	R	UC	LC
113	Indian Vulture	*Gyps indicus*	Giddh		X	✓	R	UC	CR
114	Crested Serpent Eagle	*Spilornis cheela*	Dogra cheel		X	✓	R	FC	LC
115	Eurasian Marsh Harrier	*Circus aeruginosus*	Safed Sira		✓	X	M	C	LC

116	Shikra	*Accipiter badius*	Chipka		✓	✓	R	C	LC
117	Common Kestrel	*Falco tinnunculus*	Karontia		✓	✓	M	FC	LC
118	Osprey	*Pandion haliaetus*	Machhlimar		✓	✓	M	FC	LC
119	Oriental honey buzzard	*Pernis ptilorhynchus*	Madkare		✓	✓	R	FC	LC
120	Eurasian hobby	*Falco subbuteo*	Morassani	Falconidae (1)	✓	X	M	UC	LC
121	Rufous –backed Shrike	*Lanius schach*	Kajala latora	Laniidae (2)	✓	✓	R	C	LC
122	Bay-backed Shrike	*Lanius vittatus*	***		✓	✓	R	FC	LC
123	Indian Treepie	*Dendrocitta vagabunda*	Mahalat	Corvidae (12)	✓	✓	R	C	LC
124	Eurasian Golden Oriole	*Oriolus oriolus*	Peelak		✓	✓	R	C	LC
125	Black- headed Oriole	*Oriolus xanthornus*	***		✓	✓	R	FC	LC
126	House Crow	*Corvus splendens*	Kowwa		✓	✓	R	C	LC
127	Jungle Crow	*Corvus macrorhynchos*	Kala kowwa		✓	✓	R	C	LC
128	Small minivet	*Pericrocotus cinnamomeus*	Saheli		X	✓	R	FC	LC
129	White- browed fantail	*Rhipidura aureola*	***		✓	✓	R	FC	LC
130	Black drongo	*Dicrurus macrocerus*	Bhujanga		✓	✓	R	C	LC
131	Ashy Drongo	*Dicrurus leucophaeus*	Bhujanga		✓	✓	M	FC	LC
132	Common Iora	*Aegithina tiphia*	Shaubeegi		✓	✓	R	FC	LC
133	Common Woodshrike	*Tephrodornis pondicerianus*	Keroula		✓	✓	R	FC	LC
134	Asian Paradise-Flycatcher	*Terpsiphone paradise*	Doodhraj		X	✓	R	FC	LC
135	Large cuckoo-shrike	*Coracina macei*	Kasya	Campephagidae (1)	✓	✓	R	UC	LC
136	Blue Rock Thrush	*Monticola solitarius*	Pala tiriv	Musciapidae (11)	✓	✓	M	UC	LC
137	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	Zard-phutki		✓	✓	M	FC	LC
138	Verditer Flycatcher	*Eumyias thalassina*	Nil-katkatia		✓	✓	M	FC	LC
139	Tickell's Blue Flycatcher	*Cyornis tickelliae*	Adharanga		✓	✓	R	FC	LC
140	Blue throat	*Luscinia*	Nil kanthi		✓	✓	M	FC	LC

		svecica							
141	Oriental Magpie-Robin	*Copsychus saularis*	Dhaiyar		✓	✓	R	C	LC
142	Indian Robin	*Saxicoloides fulicata*	Kalchuri		✓	✓	R	C	LC
143	Black Redstart	*Phoenicurus ochruros*	Thirthira		✓	✓	M	FC	LC
144	Common Stonechat	*Saxicola torquata*	***		✓	✓	M	C	LC
145	Pied Bushchat	*Saxicola caprata*	***		✓	✓	R	C	LC
146	Indian Chat	*Cercomela fusca*	Dauma		✓	✓	R	FC	LC
147	Brahminy Starling	*Sturnus pagodarum*	Brahmini myna	Sturnidae (5)	✓	✓	R	C	LC
148	Rosy Starling	*Sturnus roseus*	Gulabi myna		✓	✓	M	FC	LC
149	Asian Pied Starling	*Sturnus contra*	Ablak myna		✓	✓	R	C	LC
150	Common Myna	*Acridotheres tristis*	Desi myna		✓	✓	R	C	NA
151	Bank myna	*Acridotheres ginginianus*	Ganga myna		✓	✓	R	C	LC
152	Great Tit	*Parus major*	Ramgangra	Paridae(1)	✓	✓	R	FC	LC
153	Red-vented Bulbul	*Pycnonotus cafer*	Bulbul	Pycnonotidae (1)	✓	✓	R	C	LC
154	Ashy Prinia	*Prinia socialis*	Kali phutki	Cisticolidae (4)	✓	✓	R	C	LC
155	Jungle Prinia	*Prinia sylvatica*	Tot-rungi		✓	✓	*R*	FC	LC
156	Plain Prinia	*Prinia inornata*	Phutki		✓	✓	R	C	LC
157	Zitting cisticola	*Cisticola juncidis*	Ghas-ki-pitpiti		✓	✓	R	FC	LC
158	Oriental White-eye	*Zosterops palpebrosos*	Baboona	Zosteropidae (1)	✓	✓	R	C	LC
159	Common Tailorbird	*Orthotomus sutorius*	Darzee	Sylviindae (8)	✓	✓	R	C	LC
160	Common Chiffchaff/Brown Leaf Warbler	*Phylloscopus collybita*	***		✓	✓	M	C	LC
161	Hume's Warbler	*Phylloscopus humei*	***		✓	✓	M	C	LC
162	Yellow- eyed Babbler	*Chrysomma sinense*	Gulab-chasm		✓	✓	R	C	LC
163	Common Babbler	*Turdoides caudatus*	Genga/dumri		✓	✓	R	FC	LC
164	Jungle Babbler	*Turdoides striatus*	Sat bhaina		✓	✓	R	C	LC
165	Large Grey Babbler	*Turdoides malcolmi*	Sat bhaina		✓	✓	R	C	LC

166	Striated babbler	*Turdoides earlei*	Chilchil		✓	✓	R	C	LC
167	Ashy-crowned Sparrow Lark	*Eremopterix grisea*	Deoli	Alaudidae (4)	✓	✓	R	FC	LC
168	Oriental Skylark	*Alauda gulgula*	Bharat		✓	✓	R	C	LC
169	Indian bushlark	*Mirafra erythroptera*	Aggiya		✓	✓	R	FC	LC
170	Rufous tailed lark	*Ammomanes phoenicura*	***		✓	X	R	FC	LC
171	Purple Sunbird	*Nectarinia asiatica*	Phul soohgni	Nectariniidae (1)	✓	✓	R	C	LC
172	House Sparrow	*Passer domesticus*	Gauriya	Passerinae (10)	✓	✓	R	C	LC
173	Chestnut-shouldered Petronia	*Petronia xanthocollis*	Jangli chiria		✓	✓	R	FC	LC
174	Paddyfield Pipit	*Anthus rufulus*	Charchari		✓	✓	R	C	LC
175	Tawny Pipit	*Anthus Pipit*	***		✓	✓	M	FC	NA
176	Indian Silver bill	*Lonchura malabarica*	Pidda		✓	✓	R	C	LC
177	Spotted Munia	*Lonchura punctulata*	Seenabaz		✓	✓	R	FC	LC
178	Black headed munia	*Lonchura Malacca*	Pora munia		✓	✓	R	FC	LC
179	Red Avadvat	*Amandava amandava*	Lal munia		✓	X	R	FC	LC
180	Baya Weaver	*Ploceus philippinus*	Baya/son chiri		✓	✓	R	C	LC
181	Common Rosefinch	*Carpodacus erythrinus*	Lal tuti		X	✓	M	FC	LC

***Not Available; R-Residential; M-Migratory; AC-Abundance Code; C-Common; FC-Fairly Common; UC-Uncommon; R-Rare; NA-Not Assessed; LC-Least Concern; NT-Near Threatened; V-Vulnerable; E-Endangered; CE-Critically Endangered; PR-Pahuj Reservoir; SDR-Sukma Dukma Reservoir

The Abundance code shows that 101 species were common, 64 fairly common and 16 bird species were Uncommon (Table 2). Some uncommon species including the owl and vulture species were also breeding successfully near these reservoirs. However, since 2018, the number of vulture nests started declining and at present there are no nests. This may be attributed to the increase in the number of monkeys around the cliff as no other threat was observed.

During the summers large congregations of Asian Open-bill were recorded at both the reservoirs. According to the previous study on stork species in Bundelkhand region, the Asian Open-bill (*Anastomus oscitans*) was mostly observed in flocks that ranged from 6 to 500±. Woolly-necked Stork, also called White-necked stork were observed either in pairs or in small groups of 4 to 8. This was due to the limited water sources during the summer months (Kushwaha and Kumar, 2018).

Table 2 Abundance code of Bird Species

Commom	Fairly Common	Uncommon	Total
101	64	16	181

The IUCN Status shows one species of Critically Endangered and Endangered each, 2 species that are Vulnerable, 6 Near Threatened, 162 Least Concerned and for 9 species the data is not assessed (Figure 3).

Table 3 IUCN Status of the Birds reported

Not Assessed	Least Concern	Near Threatened	Vulnerable	Endangered	Critically Endangered	Total
9	162	6	2	1	1	181

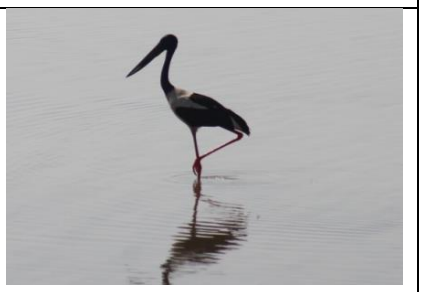

Indian Vulture


Egyptian Vulture


White-necked Stork


Lesser adjutant


River Tern


Black necked Stork


White ibis


Painted stork


Darter


Stork-billed Kingfisher


Lesser whistling duck


Purple Heron


Common Hawk Cuckoo


Little ringed plover


Oriental honey buzzard


Red crested pochard


Common Redshank


Asian Opeb-bill Stork

Figure 3 Bird Species reported from the study area

The observations show that there was a significant relationship between winter temperature and bird species diversity; because as temperature increases, diversity of bird species decreases. During the winters 46 species of birds migrate to these reservoirs although the number is declining every year. There are several reasons attributed to the falling number. First is of course the unpredictable rise and fall in the temperature due to climatic changes that can now be seen in day-to-day life. The second reason is uncontrolled hunting by the local people. Fishing is common in the reservoirs and contracts are given to the people for commercial fishing as well. At times, the birds might get entangled in the fishing nets. The village peoples in addition use the reservoir water for domestic work such as bathing, washing clothes as well as cattle-bathing (Kumar et al., 2019).

The local people visit the sites for enjoyment, hunt the birds, cook and consume them at the sites itself. Large number of plucked feathers with remaining of fire around the sites was very common (Figure 4). Hence, occupying the topmost level of wetland food chains bird species are very susceptible to the changes and disturbances in the habitats, therefore they serve as good indicators of the general condition of wetland habitats (Harisha, 2016; Kushlan, 1992).

Figure 4 Birds killed and cooked near the reservoirs by the local people

Grazing also seemed to be an emerging threat and might be of detrimental effect to bird species diversity in long terms. Livestock grazing is a major problem (UP-IBCN, 2015). All these unremitting disturbances particularly during the migration and wintering time may cause direct consequences on the energy level of the birds (Korschgen et al., 1985).

The results conclude that birds are good indicators of these two reservoirs and reveal the disturbances caused by human activities such as organic pollution and lack of maintenance. It is therefore recommended that regular monitoring of the sites should be carried out so as to protect the birds and manage the unwanted changes due to human activities. Following are suggestions for better conservation of avian diversity at these two reservoirs:

1) Educational institutions should conduct detailed seasonal studies by giving project work to the students.

2) Forest department should allocate few forest guards during the winter season to stop hunting of the migratory species.

3) Fishery department should keep a check on the contractors and also create awareness programs regarding the conservation of the native fishes, other aquatic species and their importance.

4) The insertion of bird boards at these reservoirs will help the visitors to know about the rich avifaunal diversity and play a vital role in awareness.

5) Forest department and local NGOs should involve local communities through nature-based campaigns for conservation of aquatic and terrestrial flora and fauna.

The analysis and documentation of bird species within habitat regions has a number of advantages. Many of the threatened birds in the habitat regions share broadly similar conservation needs and for that reason it is further competent to reflect on the conservation of these well-studied regions rather than to cover the species individually that are supported by the habitat (Kushwaha et al., 2017).

4. CONCLUSION

Besides studying and promoting the conservation of species mentioned in the Red Data List and Schedule I and II of Wildlife Protection Act, 1972, it is significant to recognize the local biodiversity and to study the factors affecting it. The conservation of water bodies should be a priority particularly in a region where droughts reoccur and affect all forms of lives. The reservoirs support a promising diversity of bird species and can be promoted as bird watching sites for the residents particularly the students. The maintenance of the natural flora without creating the concrete structures in the name of beautification will assist in the survival as well as enhancement of the bird population.

Informed consent

Not applicable.

Ethical approval

The Animal ethical guidelines are followed in the study for species observation & identification.

Conflicts of interests

The authors declare that there are no conflicts of interests.

Funding

The study has not received any external funding.

Data and materials availability

All data associated with this study are present in the paper.

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