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## Diversity Of Wetland Birds In Gumla District Of Jharkhand, India.

<sup>1,2</sup>SANJAY XAXA, <sup>3</sup>SHRIKANT VERMA, <sup>4</sup>AVINASH KUMAR, <sup>5</sup>DASHRATH THAKUR

<sup>1</sup>IBCN Member <sup>2</sup>Ph. D Research Scholar <sup>3</sup>Divisional Forest Officer, <sup>4</sup>GIS Expert, <sup>5</sup>Director

<sup>3</sup>Divisional Forest Officer- Gumla Forest Division, Jharkhand India,

<sup>4</sup>Nature Conservation Society, Old ITO Road Redma, Daltonganj, Jharkhand India,

<sup>5</sup>Jharkhand Ban BachaoSamiti, Bokaro, Jharkhand India.

<sup>1</sup>Bombay Natural History Society, Hornbill House, Mumbai 400 001, Maharashtra, India,

<sup>2</sup>Department of Botany, Kolhan University, Chaibasa, West Singhbhum, Jharkhand India

**Abstract:** This study has been undertaken to determine the estimated number of wetland and wetland dependent birds observed during the migratory season and find out their diversity in different wetland area of Gumla district. The threats to the specific wetlands were identified and possible recommendations have been suggested. During the study estimated number of 3,784 wetland birds and wetland dependent birds belonging to 41 species and 13 families were recorded. Out of these 33 species were wetland birds (WB) and 8 species were wetland dependent birds (WDB). Out of 41 species, 17 species were resident birds (R) while 9 species was resident migrants (RM), and rest 15 species were winter migratory (WM) birds. Estimated number of 1053 were migratory birds. The maximum number of birds was observed at Sisi Katri dam /Banki Reservoir (1887) followed by Nawagain dam/ Upper Sankh Reservoir (802), Datli Dam (410), Masaria Dam (375), and the minimum number was seen at Dhan Singh dam (310). A comparison between residential status (Resident, Resident Migratory, Winter Migratory) and habits (Wetland Bird, WDB- Wetland Dependent Bird) were made for all five wetlands. The highest number of Migratory and Resident birds were observed at Sisi Katri wetland followed by Upper Sankh wetland, Masaria wetland, Datil wetland and Dhan Singh wetland. The highest number of Wetland birds were observed at Sisi Katri wetland, followed by Upper Sankh wetland, Datil wetland, Masaria wetland and Dhan Singh wetland. The maximum number of species (n =11) recorded from the study area belonged to the family Anatidae comprising of ducks and geese. This was followed by the families Ardeidae (herons, egrets, and bitterns) represented by eight species, and Alcedinidae, Motacillidae, Phalacrocoracidae, and Rallidae represented by three species, respectively. Of the rest, seven families were represented by one to two species only.

**Keywords-** Wetland birds, Gumla, Dhan Singh dam, Datil wetland, Masaria wetland, Sisi Katri dam /Banki Reservoir, Upper Sankh Reservoir

### I. INTRODUCTION

Birds which are ecologically dependent on wetlands are broadly defined as wetland birds (Kumar et al. 2003). These include groups such as waterfowl, seabirds, and waders. There are several other birds such as kingfishers, raptors, and some passerines which are also dependent on wetlands. These are called wetland dependent birds (Kumar et al. 2003). Wetland birds and wetland dependent birds are often collectively referred to as wetland birds (Kumar et al. 2005). Such birds form vital links in the food webs and nutrient cycles, making them important components of most wetland ecosystems. They play significant roles in the lives of humans culturally, socially, scientifically and as a food resource (Kumar et al. 2003). Birds also play an important role in attracting tourists to wetlands.

Many wetland birds are migratory, moving annually along various flyways to traverse between their breeding and non-breeding grounds. The concept of flyway is essentially an operational concept linked to waterfowl whose populations one wishes to manage over their entire migration space (Boere and Stroud 2006). These flyways often span across considerable distances and cross several international boundaries. Thus, monitoring and conservation of such wetland birds and therefore the wetlands must be a collective responsibility of all nations (Li et al. 2009). The Convention on Wetlands of International Importance, better known as the Ramsar Convention (Wetlands International 2002), deals with this. The member nations are bound to ensure the holistic conservation of their wetlands. India has been a signatory to this convention since 1981.

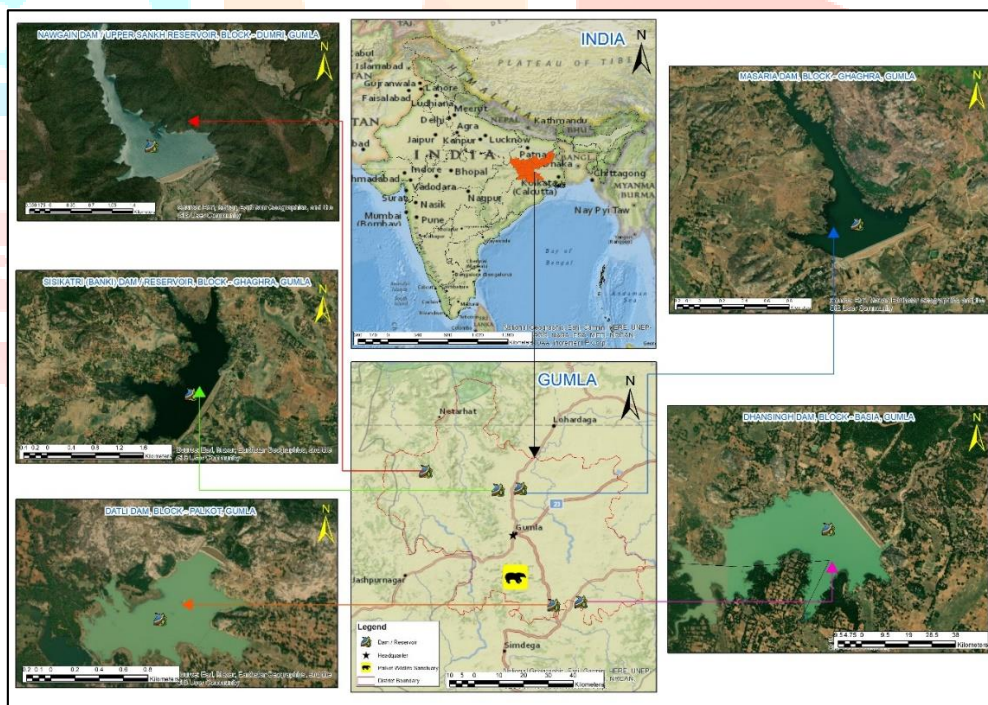
India lies along the Central Asian Flyway (CAF). The CAF covers a large continental area of Eurasia between the Arctic Ocean and the Indian Ocean and associated island chains. The flyway comprises several important migration routes of wetland birds, most of which extend from the northernmost breeding grounds in Siberia to the southernmost non-breeding wintering grounds in West Asia, South Asia, the Maldives, and the British Indian Ocean Territory (Convention on the Conservation of Migratory Species 2006). This Central Asian Flyway is largely responsible for the significant number of migrant species to the Indian subcontinent.

The avifauna of India includes around 1313 species of birds (Grimmett et al. 2011). India has a total of 310 wetland species of birds of which 130 species are migrants and 173 residents while the status of seven species is not known (Kumar et al. 2005). In 2015, Asian Wetland bird Census a total of 78 wetland species of birds including 11 threatened bird species were recorded during the census in Jharkhand (Prakash et al. 2015). Out of 78 species, 26 species were resident birds while 23 were resident migrants and the rest 29 were migratory birds. In 2016, Asian Wetland bird Census a total of 71 species of wetland were sighted belonging to 18 families (Prakash et al. 2016). Out of these 54 species were water birds (WB) and 17 species were wetland dependent birds (WDB). Out of 71 species, 25 species were resident birds (R) while 21 species were resident migrants (RM), and rest 25 species were migratory (M) birds.

Wetland birds are valuable indicators for the ecological health and productivity of wetlands (Li et al. 2009). They may also hold the key to generating awareness among people regarding the importance of wetland conservation. A major threat towards the viability of all wildlife populations is the fragmentation of their habitats (Wiens 1995), and the same is true of wetland birds and their habitats, the wetlands. Baseline information is prerequisite for planning and monitoring management actions for wetland birds as well as their habitat (Kumar et al. 2003, Kumar et al. 2005).

## II. STUDY SITES

Gumla is located at 23°N 84.50°E. Geographically, Gumla is located on southern part of the Chota Nagpur plateau which forms the eastern edge of the Deccan plateau system. The terrain is highly undulating and there is existence of many rivers and streams. There are four major rivers, which flow through the Gumla district viz. the South Koel, the North Koel, Banki and the Sankh. There are various streams/ tributaries to the main rivers on which there are some picturesque waterfalls, as for example Sadni Falls. Sisi katri (Banki) Dam Reservoir is located on Banki river, and the upper Sankh Reservoir (Nawagain dam) is located on Sankh river.



**Figure 1.** Map of the study area showing all five wetlands studied (Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community)

The forest cover of the district is 1.35 lakh hectares out of the total 5.21 lakh hectares of land i.e., around 27% of the total area of the district. The district enjoys a good climate characterized by a pleasant cold and temperate weather conditions. It has a sub-tropical climate. Temperature ranges from maximum 40 to 20 °C during summer, and minimum 21 to 3 °C during winter. The annual rainfall is about 1450 mm. From June to September the rainfall level is about 1,150 mm ([https://forest.jharkhand.gov.in/Administration/pdf/gumla\\_ns](https://forest.jharkhand.gov.in/Administration/pdf/gumla_ns)). Palkot Wildlife Sanctuary is a wildlife sanctuary located near Palkot. It is spread over Gumla and Simdega districts of Jharkhand in India presents a rugged area, consisting partly of flat-topped hills called pat and partly of an undulating plateau, in the south-western portion of Chhotanagpur Plateau. Three major rivers – the Sankh, South Koel and North Karo - along with their numerous tributaries, drain the area. The hilly area has large deposits of Bauxite. 93.7% of the population lives in rural areas (District Census Handbook, 2011) (Chota Nagpur plateau. Britannica, 2021). It was established in 1990. It covers an area around 760 sq. km of which 182.83 sq. km is forest area. It has Dry Deciduous Forest. It provides a refuge for elephants, leopards, bears, jackal, monkey, porcupine, hare, and many migratory birds

(Untitled Page, 2021) (Palkot Wildlife Sanctuary. wildtrails, 2017) (Green belt for bear park. Telegraphindia, 2015). It is located at 25 Km from Gumla and 92 Km southeast of Ranchi(Palkot Wildlife Sanctuary. india9, 2015).

The study was conducted in five wetlands viz. Dhan Singh Dam, Datli Dam, Masaria Dam, Sisikatri dam/ Banki Reservoir and Nawagain dam/ Upper Sankh Reservoir located in Gumla district, in the state of Jharkhand. All the wetlands are man-made reservoirs. During the months of winter, they attract a large number of migratory birds. Each of the wetlands is described in detail below.

**Table-1** Details of the study sites selected for wetland bird survey.

Study Sites	Description of the Study Sites	Geographical Parameters	
		Latitude	Longitude
Site 1	<b>Dhan Singh wetland</b> also known as Dhan Singh tola and Sakia dam is a man-made reservoir located approximately 4 Km from Longa, and 15 km from Basia the nearest small town. The reservoir is fed by seasonal river Khakhrajor. It lies across the Basia block in Gumla district of Jharkhand. Dhan Singh reservoir was established in the year 1984 for irrigation purpose.	22.79507222 <sup>0</sup> N	84.78416389 <sup>0</sup> E
Site 2	<b>Datli wetland</b> also known as Tapkara dam is a man-made reservoir located approximately 12.2 Km from Palkot the nearest biggest town. The reservoir is fed by seasonal river Datli. Tapkara wetland exists inside the Palkot Sanctuary area in Gumla district of Jharkhand wildlife forest division with its headquarter at Ranchi. It was made for irrigation purpose and water is available throughout the year in the catchment area.	22.77919722 <sup>0</sup> N	84.67830556 <sup>0</sup> E
Site 3	<b>Masaria wetland</b> is a man-made reservoir located approximately 9.9 Km from Ghagra the nearest biggest town. The reservoir is fed by seasonal river Masaria. It lies across the Ghagra block in Gumla district of Jharkhand It was made for irrigation purpose and water is available throughout the year in the catchment area.	23.20485833 <sup>0</sup> N	84.55969722 <sup>0</sup> E
Site 4	<b>Banki wetland</b> also known as Sisi Katri dam or Banki dam reservoir is a man-made reservoir located approximately 10.9 Km from Ghagra the nearest biggest town. The reservoir is fed by seasonal river Banki. It lies across the Ghagra block in Gumla district of Jharkhand. It was made for irrigation purpose and water is available throughout the year in the catchment area.	23.20116944 <sup>0</sup> N	84.48150833 <sup>0</sup> E
Site 5	<b>Nawagain wetland</b> also known as Upper sankh reservoir is a man-made reservoir located approximately 19.5 Km from Chainpur the nearest biggest town. The reservoir is fed by river Sankh and it is perennial. It lies across the Dumri block in Gumla district of Jharkhand. It was made for irrigation purpose and water is available throughout the year in the catchment area.	23.26684167 <sup>0</sup> N	84.22075278 <sup>0</sup> E

### III. Materials And Methods

No single survey can provide all data to answer every research question (Turner, 2003). However, basic data for any study provide a framework upon which more detailed investigations may be conducted (Turner, 2003). Based on our experience of bird sampling in the field considering the habitat status and area of each study sites, bird sampling was made by walking at a slow pace (about 1-1.5 km/h) along the bank of the reservoirs (as the aquatic birds are usually found around or in the reservoir area) as followed by Gaston (1975) and Bibby *et al.*, (2000). However, wherever necessary point count of birds was also made within the visible radius by stopping briefly for 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). The survey was conducted in the winter migratory month of January 2023. Birds were counted at their point of first detection and care was taken to ensure that same birds were not counted again. The number of aquatic birds of various species was recorded in a data sheet at each sampling lake on each census day. Call notes of the birds were also used for locating the birds. Counting of the birds was made at different timings of the day from morning 07.00 AM to evening 06.00 PM when they are most active and conspicuous. Birds were sighted with the aid of binoculars Nikon 8245 ACULON A211 8X 42 and all photographs were taken with still camera Cannon Power Shot SX50HS and Cannon 1000D. The species were identified using recognized field guides such as (Grimmett *et al.* 2009) and (Kazmierczak, 2000). Listing of birds was done as per the checklist provided by (Kumar *et al.* 2003). Residential status of the birds has been described as per (Ali, 2002). The status of threatened birds was identified as per IUCN Red list and Schedule birds were from the Wildlife (Protection) Act 1972. The checklist was prepared using family, English and Zoological names, habit, their residential status, IUCN status, the Wildlife (Protection) Act, 1972 status and their counts. In addition to the wetland birds, other terrestrial birds sighted and noted during the survey, but were not included in the list.

**Data analysis:** Wetland bird species diversity index was assessed which provides information about quantitative measure that reflects how many different types of species are there in the study area and that can simultaneously take into account the phylogenetic relations among the individuals distributed among those types. The cumulative number of species observed in each site was considered as the species richness for that site. Shannon-Wiener diversity index ( $H'$ ) (Shannon and Wiener, 1963)

was calculated by the formula below:

$$H' = \frac{1}{S} \log_{10} N - \left\{ \sum_{i=1}^S \frac{n_i}{N} \log_{10} \frac{n_i}{N} \right\}$$

$$H' = - \sum_{i=1}^S P_i (\log_2 P_i)$$

- Where,  $H'$  = Index of species diversity derived from information statistics
- $S$  = Total number of species in the count
- $P_i = n_i / N$  = Proportion of total sample belonging to the  $i$ th species
- $n_i$  = Number of individuals of the species ' $i$ '
- $N$  = Total number of individuals in the count

Simpson's index of diversity was calculated by the formula below:(Simpson, 1949)

Simpson's index is a measure of dominance. The value of  $C_d$  ranges between 0 and 1. With this index, 0 represents infinite diversity and 1, no diversity. That is, the bigger the value of  $C_d$ , the lower the diversity.

$$D = 1 - \sum_{i=1}^S \left( \frac{n_i}{N} \right)^2$$

- Where,  $D$  = Diversity
- $S$  = Total number of species in the count
- $n_i$  = Number of individuals of the species ' $i$ '
- $N$  = Total number of individuals in the count

Shannon wiener evenness

$$E = \frac{H'}{\ln S}$$

- Where,  $S$  = Species richness
- $H'$  = Shannon's index of diversity
- Usually ' $E$ ' approaches to zero, as a single species becomes more and more dominant in a community.
- The data were calculated using the Window's Microsoft Excel.

#### IV. Result And Discussion

During the study, estimated number of 3,784 wetland birds and wetland dependent birds belonging to 41 species and 13 families were recorded. Out of these 33 species were wetland birds (WB) and 8 species were wetland dependent birds (WDB). Out of 41 species, 17 species were resident birds (R) while 9 species was resident migrants (RM), and rest 15 species were winter migratory (WM) birds. Estimated number of 1053 were migratory birds. The maximum number of birds was observed at Sisi Katri dam /Banki Reservoir (1887) followed by Nawagain dam/ Upper Sankh Reservoir (802), Datli Dam (410), Masaria Dam (375), and the minimum number was seen at Dhan Singh Dam (310).

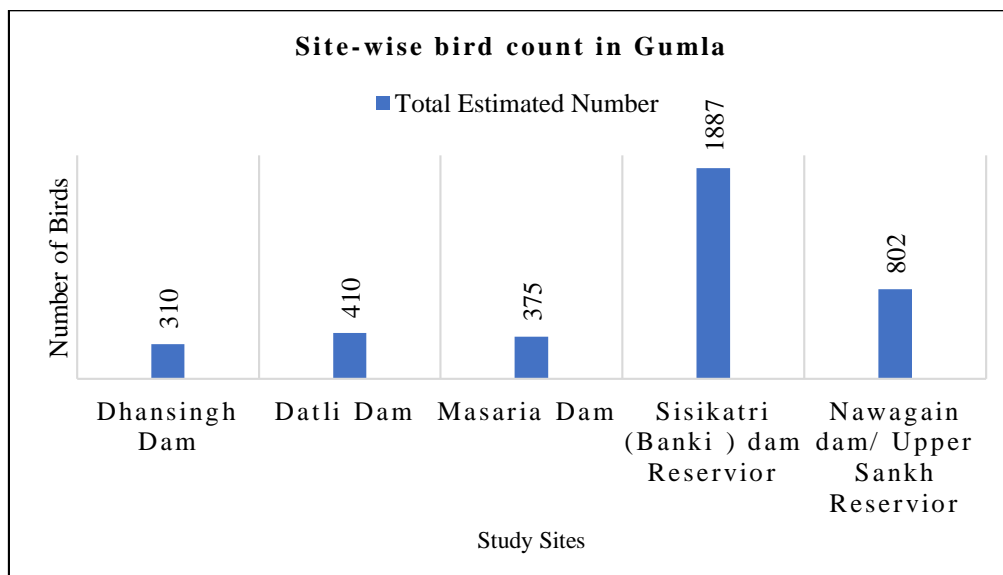


Figure 2. Site – wise bird count recorded during survey.

The highest count of bird species observed was Lesser Whistling Duck (2069) which were observed in maximum number at Sisi Katri dam /Banki Reservoir (1265) followed by Nawagain dam/ Upper Sankh Reservoir (326) and Datli Dam (220). Bar headed goose (308) observed in maximum number at Nawagain dam/ Upper Sankh Reservoir (300) and Sisi Katri dam /Banki Reservoir (8). Tufted duck (120) seen only at Banki dam Reservoir. Ruddy shelduck (80) seen in equal numbers at Banki dam Reservoir (40) and Upper Sankh Reservoir (40). Red crested pochard (80) observed in maximum number at Banki dam Reservoir (30) and Upper Sankh Reservoir (30) minimum number was observed at Masaria Dam (20). Eurasian wigeon (62) observed at Banki dam Reservoir (50) and Upper Sankh Reservoir (12). Gadwall (60) observed at Banki dam Reservoir (40) and Upper Sankh Reservoir (20). The details of other species are provided in (Table-2). No threatened bird species were sighted during the study. All birds recorded are categorized under Least Concern as per IUCN red list and Scheduled IV of the Wildlife (Protection) Act, 1972.



Figure 3. Mixed flock of Bar Headed Goose and Ruddy Shelduck © Sanjay Xaxa

Table-2. List of wetland birds and wetland dependent Birds recorded from the study sites.

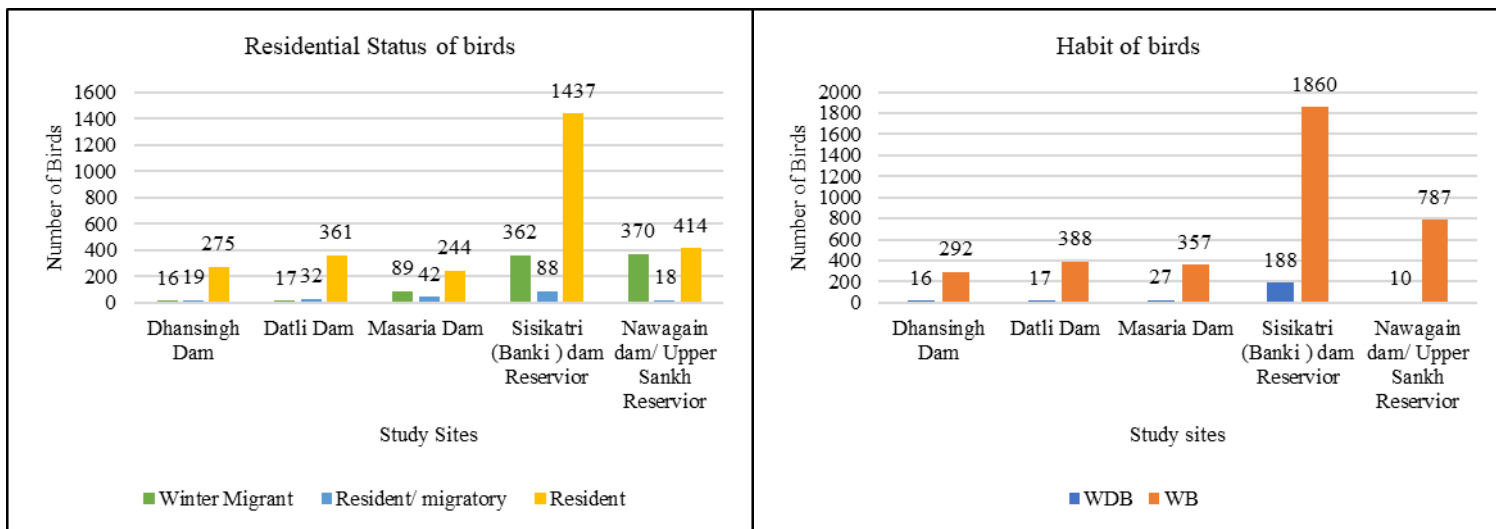
Sl. No.	Family	Common Name	Zoological name	Habit	Residential status	IUCN Status	WPA 1972	Site 1	Site 2	Site 3	Site 4	Site 5	Total Estimated Number
								Dhan Singh dam	Datli dam	Masaria dam	Sisi Katri (Banki) dam Reservoir	Nawagain dam/ Upper Sankh Reservoir	
1	Alcedinidae	White-throated kingfisher	<i>Halcyon smyrnensis</i>	WD B		IV	LC	6	4	2	3	3	18
2		Little kingfisher	<i>Ceyx pusillus</i>	WD B	R	IV	LC		2	2	4		8
3		Pied kingfisher	<i>Ceryle rudis</i>	WD B	R	IV	LC					1	1
4	Anatidae	Lesser whistling duck	<i>Dendrocygna javanica</i>	WB	R	IV	LC	160	220	98	1265	326	2069
5		Eurasian coot	<i>Fulica atra</i>	WB	R	IV	LC	2	12	8	50		72
6		Cotton pygmy goose	<i>Nettapus coromandelianus</i>	WB	RM	IV	LC				8		8
7		Ruddy shelduck	<i>Tadorna ferruginea</i>	WB	WM	IV	LC				40	40	80
8		Gadwall	<i>Mareca strepera</i>	WB	WM	IV	LC			20	40		60
9		Bar headed goose	<i>Anser indicus</i>	WB	WM	IV	LC				8	300	308
10		Northern Pintail	<i>Anas acuta</i>	WB	WM	IV	LC				22		22

1 1		Common pochard	<i>Aythya ferina</i>	WB	WM	IV	LC			12	26		<b>38</b>
1 2		Red crested pochard	<i>Netta rufina</i>	WB	WM	IV	LC			30	30	20	<b>80</b>
1 3		Tufted duck	<i>Aythya fuligula</i>	WB	WM	IV	LC				120		<b>120</b>
1 4		Eurasian wigeon	<i>Mareca penelope</i>	WB	WM	IV	LC			12	50		<b>62</b>
1 7	Ardeidae	Indian pond heron	<i>Ardeola grayii</i>	WB	WM	IV	LC	20	16	12	40	32	<b>120</b>
1 9		Cattle egret	<i>Bubulcus ibis</i>	WB	R	IV	LC	23	30	37	33	14	<b>137</b>
1 5		Purple heron	<i>Ardea purpurea</i>	WB	R	IV	LC			1			<b>1</b>
1 6		Black crown night heron	<i>Nycticorax nycticorax</i>	WB	RM	IV	LC		3	3	3		<b>9</b>
1 8		Little egret	<i>Egretta garzetta</i>	WB	RM	IV	LC	9	8	12	18	10	<b>57</b>
2 0		Intermediate egret	<i>Ardea intermedia</i>	WB	RM	IV	LC	7	3	9	11	2	<b>32</b>
2 1		Great egret	<i>Ardea alba</i>	WB	RM	IV	LC	1	4	1	6	2	<b>14</b>
2 2		Grey heron	<i>Ardea cinerea</i>	WB	RM	IV	LC				2		<b>2</b>
2 3	Charadriidae	Red-wattled lapwing	<i>Vanellus indicus</i>	WB	WM	IV	LC	3	7	5	7		<b>22</b>
2 4		Grey headed lapwing	<i>Vanellus cinereus</i>	WB	R	IV	LC		4				<b>4</b>
2 5	Ciconiidae	Asian openbill stork	<i>Anastomus oscitans</i>	WB	R	IV	LC	3	2	12	24	8	<b>49</b>
2 6	Jacanidae	Pheasant tailed jacana	<i>Hydrophasianus chirurgus</i>	WB	R	IV	LC	2	4	8			<b>14</b>
2 7		Bronze-winged jacana	<i>Metopidius indicus</i>	WB	R	IV	LC		8	8	6		<b>22</b>
3 0	Motacillidae	White browed wagtail	<i>Motacilla maderaspatensis</i>	WD B	R	IV	LC		2				<b>2</b>
2 8		White wagtail	<i>Motacilla alba</i>	WD B	RM	IV	LC	2	5	3	2		<b>12</b>
2 9		Grey wagtail	<i>Motacilla cinerea</i>	WD B	WM	IV	LC	6	4	5	8	4	<b>27</b>
3 1	Muscicapidae	White capped water redstart	<i>Phoenicurus leucocephalus</i>	WD B	WM	IV	LC					2	<b>2</b>
3 2	Phalacrocoracidae	Little cormorant	<i>Microcarbo niger</i>	WB	RM	IV	LC	28	13	22	10	25	<b>98</b>
3 4		Little Grebe	<i>Tachybaptus ruficollis</i>	WB	R	IV	LC	4	1	3	6		<b>14</b>
3 3		Great cormorant	<i>Phalacrocorax carbo</i>	WB	R	IV	LC			8		2	<b>10</b>
3 5	Podicipedidae	Great Crested grebe	<i>Podiceps cristatus</i>	WB	RM	IV	LC	8	4	4	6	6	<b>28</b>
3 6	Rallidae	White-breasted waterhen	<i>Amaurornis phoenicurus</i>	WB	WM	IV	LC	3	2	5	1		<b>11</b>
3 7		Purple swamphen	<i>Porphyrio poliocephalus</i>	WB	R	IV	LC		20	10	10		<b>40</b>
3 8		Common moorhen	<i>Gallinula chloropus</i>	WB	R	IV	LC	19	23	14	18	0	<b>74</b>
3 9	Scolopacidae	Common greenshank	<i>Tringa nebularia</i>	WB	R	IV	LC		4				<b>4</b>
4 0		Common sandpiper	<i>Actitis hypoleucos</i>	WB	WM	IV	LC			3			<b>3</b>
4 1	Threskiornithidae	Red naped ibis	<i>Pseudibis papillosa</i>	WD B	WM	IV	LC	4	5	6	10	5	<b>30</b>
<b>Total</b>								<b>310</b>	<b>410</b>	<b>375</b>	<b>1887</b>	<b>802</b>	<b>3784</b>

\*Note: WB- Water Bird, WDB- Wetland Dependent Bird, R- Resident, RM- Resident Migratory, WM- Winter Migratory, IUCN (International Union for Conservation of Nature): IWPA (Indian Wildlife Protection Act 1972), LC- Least Concern

**Comparison between wetlands**

A comparison between residential status (Resident, Resident Migratory, Winter Migratory) and habits (Wetland Bird, WDB- Wetland Dependent Bird) were made for all five wetlands. The highest number of Migratory and Resident birds were observed at Sisi Katri wetland followed by Upper Sankh wetland, Masaria wetland, Datil wetland and Dhan Singh wetland. The highest number of Wetland birds were observed at Sisi Katri wetland, followed by Upper Sankh wetland, Datil wetland, Masaria wetland and Dhan Singh wetland.



**Figure 4.** Residential status of birds observed from different study sites. **Figure 5.** Habit of birds observed from different study sites

\*Note: WB- Wetland Bird, WDB- Wetland Dependent Bird



**Figure 6.** A- Tufted duck, B- Mixed Flock of Red Crested Pochard, Northern Pintail, Gadwall and Eurasian Wigeon and C - Great Crested Grebe.

The maximum number of species (n =11) recorded from the study area belonged to the family Anatidae comprising of ducks and geese. This was followed by the families Ardeidae (herons, egrets, and bitterns) represented by eight species, and Alcedinidae, Motacillidae, Phalacrocoracidae, and Rallidae represented by three species, respectively. Of the rest, seven families were represented by one to two species only.

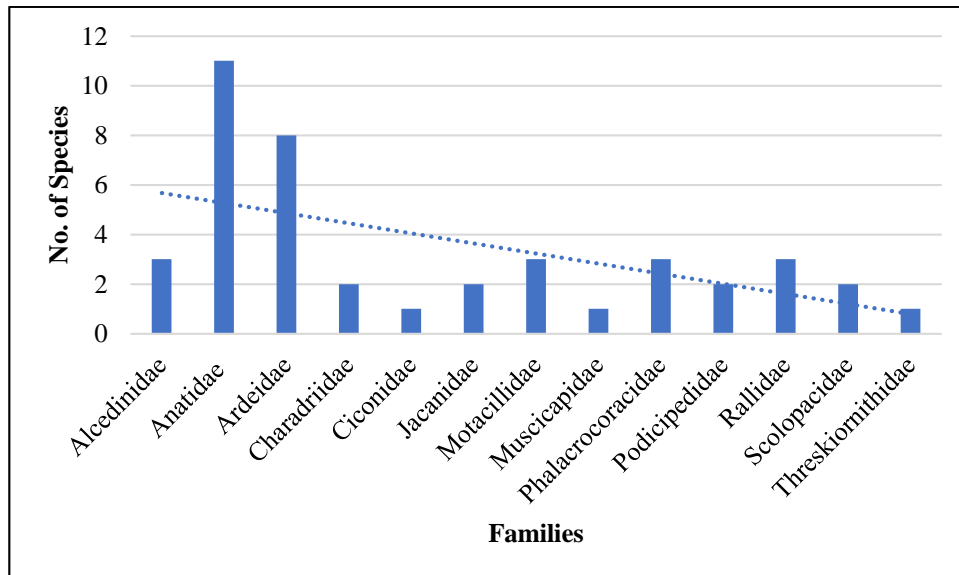


Figure 7. Family – wise species richness.

Table 3. Species Richness, Shannon Wiener Diversity Index (H) Evenness (E) and Simpson's Index of Diversity in all five study sites.

Study Site	Species Richness	Shannon Wiener Diversity Index (H)	Evenness (E)	Simpson's Index of Diversity
1	19	1.897944309	0.33085	0.710805
2	26	2.010963152	0.33	0.697
3	30	2.821161443	0.48	0.901
4	32	1.601355982	0.212304	0.54262
5	18	1.594936457	0.238509	0.689313

Wetlands and wetland birds are inseparable elements and thus form a rich array of wetland bird communities. They are important indicators of changes in aquatic systems. Monitoring of water birds can be used as an indicator in conservation management and in studying the ecological effects of various man-made environmental changes. Further study of the abundance of wetland birds at Gumla district will enrich our knowledge and ultimately contribute to the conservation and management of wetland birds and wetlands.

### Identified Threats

The most important threat to the wetland birds at all five wetlands is the loss of habitat due to human encroachment. The human pressure on the wetlands has increased over the years. The rapidly increasing human population settled around the wetlands has resulted in reclamation of wetland area for agriculture and development purposes. This has become a key threat to all the five wetlands. There is also dumping of solid waste from local villages into the wetlands, thereby polluting the water.

Majority of the villagers own livestock. Increased grazing pressure from these animals is also degrading the wetlands.

Another key threat to wetland birds is hunting and direct physical damage to eggs and chicks. Local hunting of wetland birds is rampant at all five sites. Local children often destroy eggs and chicks. There is also the problem of feral dogs running rampant in the area and disturbing the birds.

Commercial fishing is carried out in all five wetlands under the jurisdiction of the Fisheries Department. Often the boats of the fishermen disturb the large congregations of wetland birds. Some of the fishermen also practice illegal hunting of the birds.

Another major threat to the wetlands is the spread of algae and other invasive species such as *Ipomoea carnea*. These invasive species have been taking over the wetlands, and slowly choking the native plant species found at the sites. If not controlled in the coming years, these could cause major degradation of the wetlands as important habitats for wetland birds.



## Recommendations

The paper makes the following recommendation for the conservation of wetland birds and the management of their habitats, the wetlands. The recommendations are in general.

- The concerned Irrigation Departments, Forest Departments and Fisheries Departments need to work together to ensure that the waterbirds at the wetland are not harmed by the commercial fishing being carried out at the sites.
- The concerned Irrigation Departments should consult the Forest Department and scientific experts regarding management of the water levels in the reservoirs.
- The concerned Irrigation Department and Forest Departments need to work together in controlling the encroachment of wetland areas, intensive grazing pressures, and other illegal activities rampant at the sites. The cooperation of the local Police Department should be sought for ensuring preventive action in the area.
- All development work around the wetlands should be monitored and should have to obtain permission from the forest department. An advisory committee comprising of representatives from all concerned Government departments, scientific experts, and local community members could be constituted.
- The Irrigation Department should seek the support of the Forest department and scientific experts to remove the various invasive species taking over the wetlands.
- Regular awareness programmes should be organized for the local villagers, and other stakeholders. Special awareness camps should be organized for the local children. NGOs could play a role in designing the modules.
- Intensive studies should be carried out on the vegetation, water quality, and landuse changes at the sites. Regular and sustained monitoring of waterbirds at the sites need to be ensured.

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