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Migratory bird species composition, abundance and diversity indices in Govindgarh Lake, Rewa district (M.P.)

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Abstract
The decline in bird's species population and their diversity posed a great challenge to the conservators and the ornithologist. Shannon-Weinner's and Simpson Indies were used to evaluate the migratory bird's species diversity in Govindgarh lake, Rewa district Madhya Pradesh. A systematic sampling method was adopted, in which three (3) transects of 1 km in length were laid at an interval of 200 m apart in the study site. Species of birds sighted along the transect were observed and recorded. The species evenness was determined using the evenness equation E = H'/Ln(S). The distribution of migratory birds species and abundance at Govindgarh lake, Rewa district from (July 2020-June 2022) it is observed that around 12 families and 32 species where found in Govindgarh lake in that maximum no. of species (8) were found in family Anatidae and minimum no. of species (1) where found in family Podicipedidae, Muscicapidae, Accipitridae, Falconidae. In Scolopacidae family *Tringa ochropus* was more dominant (52) 8.33% followed by *Calidr minuta* (46)7.81% and *Tringa ochropus* (41) 6.96%. *Tringa ochropus* was dominant in the month of January and less quantity of it was found in May. Local migratory birds *Gallinula chloropus* (54) 23.08%, *Dendrocygna javanica* (48) 20.51%, *Nettapus coromandelianus* (46)19.66%, *Vanellus malabaricus* (44) 18.80% and *Vanellus indicus* (42) 17.95% at Govindgarh lake Rewa

Keywords: Diversity, migratory birds, Govindgarh lake

Introduction
Biodiversity provides important information about the overall health of an ecosystem (Díaz *et al*., 2007; Dudgeon *et al*., 2006) [6, 7]. Species richness and diversity in an ecosystem are greatly influenced by the availability and distribution of resources in a particular environment (Baer *et al*., 2004; Silvertown, 2004) [1, 15]. Lakes are one of the most important freshwater resources on Earth and support enormous biodiversity (Gibbs, 1993) [8]. Wetlands/lakes are highly complex as well as productive ecosystems that help maintain ecological balance by providing various ecological services such as aquaculture, groundwater recharge, flood control, sewage treatment, sources of drinking water, agricultural water use, soil erosion control, nutrient cycling, habitat for a wide variety of plants and animals, etc. (Joy *et al*., 2005; Bhatta *et al*., 2016) [9, 2]. The structure of a water body also determines the species composition, density and diversity of a particular ecosystem (Watson *et al*., 2004) [18]. It is considered the most important biotope for various types of migratory and resident bird species for their wintering and breeding grounds (Szabo *et al*., 2017) [17]. The ecosystem of freshwater lakes in India has recently been threatened by various anthropogenic activities such as habitat loss and degradation, habitat fragmentation, encroachment or illegal filling of aquatic habitats, pollution, overexploitation of resources, waste dumping, heavy metal contamination, contamination from urban and agricultural sources, etc. This leads to the degradation of aquatic organisms, which threatens the species thriving on the aquatic ecosystem (Bhattacharya, 2014; Sreekumari *et al*., 2016; Roy *et al*., 2022) [3, 16, 14].
Bird diversity is one of the most important ecological factors determining the quality of aquatic ecosystems and acts as a bioindicator. The emerging threats of climate change, habitat loss, habitat fragmentation, over-exploitation of resources and pollution raise new concerns about the degradation of aquatic ecosystems, which in turn threatens the existence

of bird species diversity (Rajashekara *et al*., 2018; Rahmani *et al*., 2022, Naik, Rajashree and Sharma, Laxmi Kant 2022 and Chowdhury, 2023) [13, 12, 11, 5].

Govindgarh Lake is a major local freshwater body located in the Rewa district of Madhya Pradesh, India. The water of this lake is primarily used for fishing, washing, bathing and agricultural activities. This is also a habitat for thousands of resident and migratory bird species. A large number of migratory birds visit this place in the winter season. This lake is in the process of constant changes due to several anthropogenic and climatic activities. Thus, the current status and diversity of bird species is very important to understanding the overall health of this aquatic ecosystem. We tried to understand the current status and diversity of not only living and migratory waterfowl species, but also the species that inhabit the surroundings of this lake. This study will provide important information to determine possible measures to save the lake from upcoming threats.

Materials and Methods

Study area

The Govindgarh lake is one of the unique water body in M.P. and located in south of Rewa district at a distance of 20 km. with a longitude 81°15'0" and latitude 24°20'25". It comes under the Rewa district and in Huzur tehsil. The lake is connected with all-weather Rewa-Shahdol and Satna-Sidhi road. The summer capital of Rewa dynasty is about 13 kilometer from Rewa in Madhya Pradesh. The region is known for its natural beauty and waterfalls. The Govindgarh is also known as mini Vrindavan it is also believed that the name of Govindgarh is based on Govind temple situated there. Govindgarh is one of the oldest reservoirs of Madhya Pradesh. Construction of which was started in 1850 and completed in 1910.

Method of data collection

The data for this study were collected from July 2020-June 2022. Systematic sampling technique was adopted for data collection. Three (3) lines of transect T1, T2 and T3 of one (1) km in length were laid at an interval of 200 m across the study site. All species of migratory bird sighted along each transect with the aid of binoculars and naked eyes were identified and recorded. Two to three minutes of keen observation was usually done on a line transects, which allowed the migratory birds to acclimate to human presence. Also, physical features like the colour of the head, colour of the neck, the colour of the wings and colour of the tail were also observed. The counts were done as early as 6.00 am, because migratory birds are warm blooded and are active almost all the time. Each line transects was visited for five (5) times during the study period. Information on climatic factors of the study area was collected, and this was used for predicting the population of the migratory bird species in the study area.

Fig 1: Picture of some migratory bird species photographed by the author during the study.

Data Analysis: The data obtained was presented in the form of a table, frequencies and percentages. Shannon diversity index was used to estimate migratory bird's species diversity in the study.

Estimation of Diversity Indices and Equitability: The diversity Index was estimated using Shannon diversity index (H') (Equation 1) and Simpson's diversity index (Equation 2), while, species equitability (evenness) (Equation 3) was estimated using Pielou's measure of species evenness.

1. $H = - \sum P_i \log_2 P_i$ Equation (1)

2. $D = \frac{\sum ni(ni-1)}{N(N-1)}$ (Equation (2)

3. E = H'/Ln(S) Equation (3)

Result and Discussion

The distribution of migratory birds species and abundance at Govindgarh lake, Rewa district from (July 2020-June 2022) it is observed that around 12 families and 32 species where found in Govindgarh lake in that maximum no. of species (8) were found in family Anatidae and minimum no. of species (1) where found in family Podicipedidae, Muscicapidae, Accipitridae, Falconidae (Table 1). In Scolopacidae family *Tringa ochropus* was more dominant (52) 8.33% followed by *Calidr minuta* (46)7.81% and *Tringa ochropus* (41) 6.96%. *Tringa ochropus* was dominant in the month of January and less quantity of it was found in May. Local migratory birds *Gallinula chloropus* (54) 23.08%, *Dendrocygna javanica* (48) 20.51%, *Nettapus coromandelianus* (46)19.66%, *Vanellus malabaricus* (44) 18.80% and *Vanellus indicus* (42) 17.95% at Govindgarh lake Rewa (Table 2).

Table 1: Distribution and abundance of Migratory Birds diversity in Govindgarh lake

S. No.	Families	Scientific Name	Habitat Location	Visibility
1.	Scolopacidae	*Tringa ochropus*	Water Edge	Uncommon
2.	Scolopacidae	*Actitus hypoleucos*	Water Edge	Common
3.	Scolopacidae	*Tringa stagnatilis*	Water Edge	Uncommon
4.	Scolopacidae	*Tringa glareola*	Water Edge	Uncommon
5.	Scolopacidae	*Calidr temminckii*	Water Edge	Uncommon
6.	Scolopacidae	*Calidr minuta*	Water Edge	Uncommon
7.	Scolopacidae	*Gallinago gallinago*	Water Edge	Uncommon
8.	Charadriidae	*Charaus dubius*	Water Edge	Common
9.	Charadriidae	*Pluvialis fulva*	Water Edge	Uncommon
10.	Anatidae	*Netta Rufina*	Open Water	Common
11.	Anatidae	*Mareca strepera*	Open Water	Uncommon
12.	Anatidae	*Spatula querquedula*	Open Water	Common
13.	Anatidae	*Mareca penelope*	Open Water	Common
14.	Anatidae	*Anas acuta*	Open Water	Common
15.	Anatidae	*Anas crecca*	Open Water	Common
16.	Anatidae	*Tadorna ferruginea*	Open Water	Common
17.	Anatidae	*Aythya nyroca*	Open Water	Common
18.	Podicipedidae	*Podiceps cristaus*	Open Water	Uncommon
19.	Rallidae	*Fulica atra*	Water Edge	Common
20.	Rallidae	*Zapornia pusilla*	Water Edge	Uncommon
21.	Muscicapidae	*Calliope calliope*	Water Edge	Uncommon
22.	Motacillidae	*Motacilla citreola*	Water Edge	Uncommon
23.	Motacillidae	*Motacilla flava*	Water Edge	Uncommon
24.	Motacillidae	*Motacillia cinerea*	Water Edge	Uncommon
25.	Motacillidae	*Anthus trivialis*	Water Edge	Uncommon
26.	Accipitridae	*Cirus aeruginosus*	Tree	Common
27	Falconidae	*Falco peregrinus*	Tree	Common
	Local Migratory Birds			
	Families	**Scientific Name**	**Habitat Location**	**Visibility**
1.	Charadriide	*Vanellus malabaricus*	Water Edge	Common
2.	Charadriidae	*Vanellus indicus*	Water Edge	Common
3.	Anatidae	*Dendrocygna javanica*	Open Water	Common
4.	Anatidae	*Nettapus coromandelianus*	Open Water	Common
5.	Rallidae	*Gallinula chloropus*	Open Water	Common

Table 2: Distribution of Migratory Birds Species in Govindgarh lake, Rewa (M.P.)

S. No.	Species	Frequency	Percentage
1.	*Tringa ochropus*	52	8.83
2.	*Actitus hypoleucos*	24	4.07
3.	*Tringa stagnatilis*	19	3.23
4.	*Calidr minuta*	46	7.81
5.	*Tringa ochropus*	41	6.96
6.	*Actitus hypoleucos*	39	6.62
7.	*Tringa stagnatilis*	21	3.57
8.	*Charaus dubius*	23	3.90
9.	*Pluvialis fulva*	17	2.89
10.	*Netta Rufina*	15	2.55
11.	*Mareca strepera*	11	1.87
12.	*Spatula querquedula*	13	2.21
13.	*Mareca penelope*	24	4.07
14.	*Anas acuta*	17	2.89
15.	*Anas crecca*	15	2.55

16.	*Tadorna ferruginea*	19	3.23
17.	*Aythya nyroca*	15	2.55
18.	*Podiceps cristaus*	18	3.06
19.	*Fulica atra*	20	3.40
20.	*Zapornia pusilla*	14	2.38
21.	*Calliope calliope*	17	2.89
22.	*Motacilla citreola*	18	3.06
23.	*Motacilla flava*	14	2.38
24.	*Motacillia cinerea*	20	3.40
25.	*Anthus trivialis*	24	4.07
26.	*Cirus aeruginosus*	14	2.38
27.	*Falco peregrinus*	19	3.23
Total		589	100.00
Local Migratory Birds			
1.	*Vanellus malabaricus*	44	18.80
2.	*Vanellus indicus*	42	17.95
3.	*Dendrocygna javanica*	48	20.51
4.	*Nettapus coromandelianus*	46	19.66
5.	*Gallinula chloropus*	54	23.08
Total		234	100.00

Migratory Birds Species Richness, Diversity, and Evenness in Govindgarh lake

The high population distribution of migratory bird's species recorded in the study area indicates that the woodlands of Govindgarh lake are very rich in plant species and a favourable climatic conditions, attracting diverse numbers of migratory bird species types for conservation.

Table 3: Calculation of different Migratory birds family wise diversity indices at Govindgarh lake, Rewa from July 2020-June 2022

S. No.	Family	Govindgarh lake				
		Shannon-Wiener Index	Simpson Dominance Index	Simpson's Diversity Index	Margalef's Index	Pielous Eveness
1	Scolopacidae	2.27	0.1178	0.8822	96.98	0.91
2	Charadriidae	2.17	0.1192	0.8808	15.69	0.90
3	Anatidae	2.33	0.1072	0.8928	51.51	0.94
4	Podicipedidae	2.05	0.1046	0.8954	6.84	0.93
5	Rallidae	2.35	0.0891	0.9109	13.28	0.95
6	Muscicapidae	2.17	0.0809	0.9191	6.44	0.94
7	Motacillidae	2.24	0.1239	0.8761	30.18	0.90
8	Accipitridae	2.26	0.044	0.9560	5.23	0.98
9	Falconidae	2.39	0.0468	0.9532	7.24	0.96
Local Migratory Birds						
1.	Charadriide	2.23	0.1070	0.8930	34.20	0.90
2.	Anatidae	2.30	0.1036	0.8964	37.43	0.93
3.	Rallidae	2.37	0.0936	0.9064	21.33	0.95

Distribution and diversity of migratory birds species the expression of community structure. The species diversity is an indication of level of community organisation. High species diversity indicates a complex community which have higher levels of energy transfer. In several ecological community studies, species diversity has been constructed as a measure of community stability in which variation in species diversity may indicate a stressed environment. However many ecologists argue that there is no direct correlation between diversity and community stability.

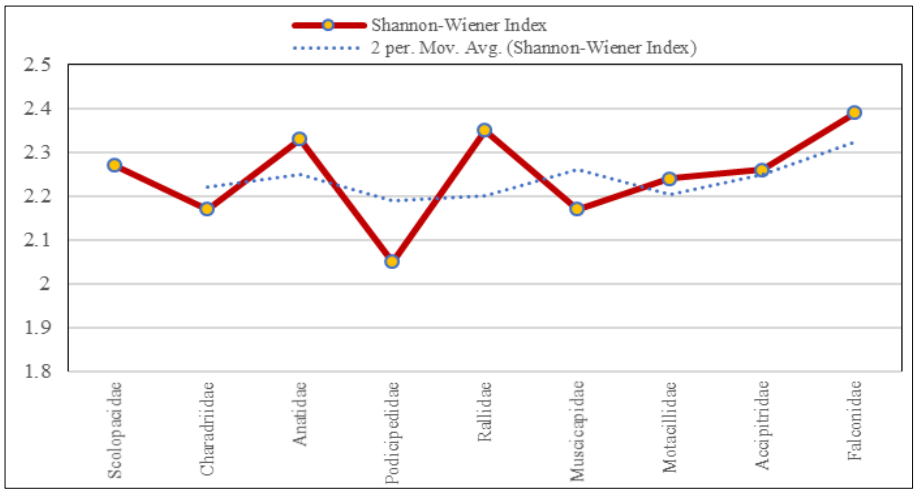

Fig 2: Shannon-Wiener Index

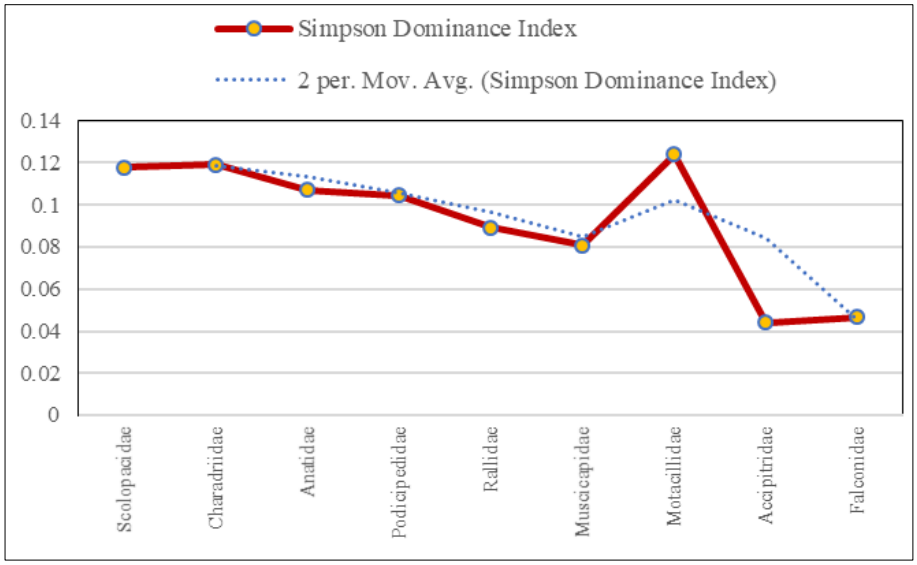

Fig 3: Simpson Dominance Index

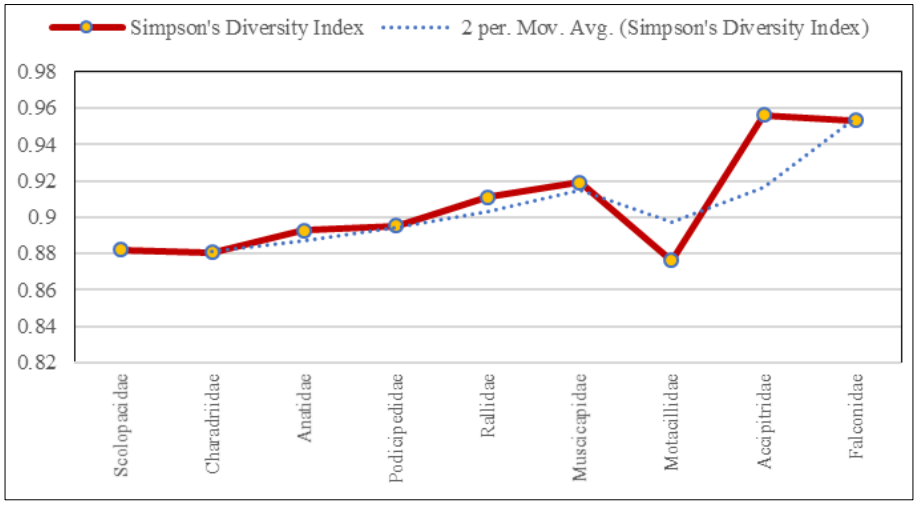

Fig 4: Simpson Diversity Indexes

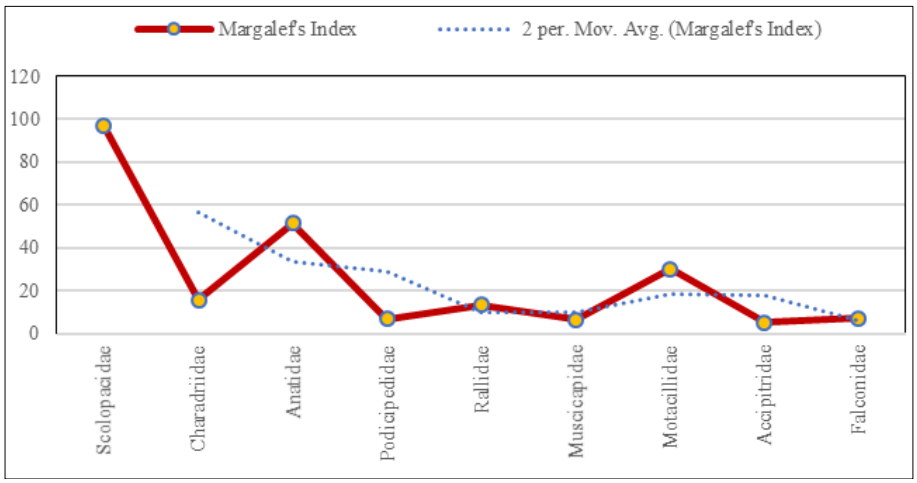

Fig 5: Margalef Index

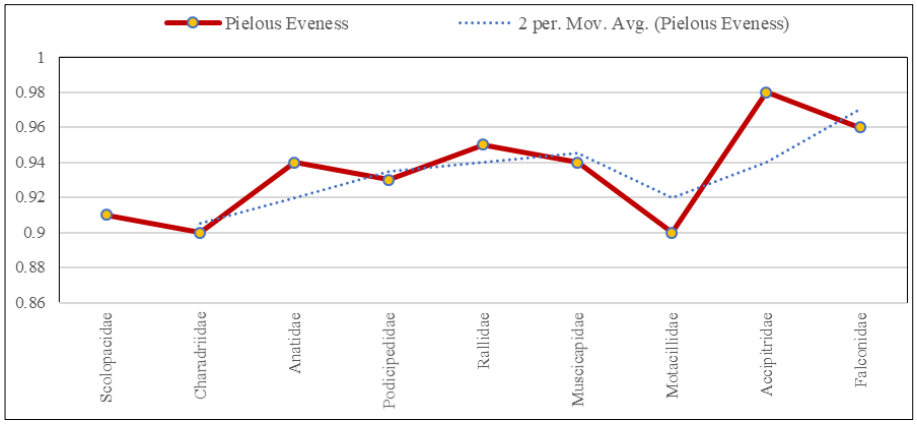

Fig 6: Pielous Eveness

During investigation the Shannon-Weiner index ranged from 2.05 to 2.39. The maximum value 2.39 was calculated for Falconidae family, whereas minimum index 2.05 was computed for *Podicipedidae* family at the Govindgarh lake site Rewa. Local migratory bird the Shannon-Weiner Index ranged from 2.23 (Charadriide family) to 2.37 (Rallidae family) at the Govindgarh lake, Rewa. (Table 3 & Fig. 2).

Simpson Dominance Index was ranged from 0.044 to 0.1192 in the migratory birds. In the local migratory birds the minimum 0.0936 values was recorded for Rallidae while maximum 0.1070 was related with family Charadriide at Govindgarh lake, Rewa (Table 3 & Fig. 3).

In the case of Govindgarh lake the values of Simpson Diversity Indexes were followed the trends *i.e.* maximum value was related with Accipitridae (0.9560) while minimum value was coincided with Motacillidae (0.8761) migratory birds and local migratory birds maximum value was recorded with Charadriide (0.8930) while minimum value was coincided with Rallidae (0.9064) as in the station Govindgarh lake (Table 3 & Fig. 4).

In the present study the Margalef Index ranged from 5.23 to 96.98 migratory birds and local migratory birds ranged 21.33 to 37.43 in Govindgarh lake. The maximum Margalef Index 96.98 was computed for Scolopacidae family, minimum Margalef Index value 5.23 was computed for Accipitridae family and local migratory bird minimum 21.33 was calculated for Rallidae and maximum value 37.43 was calculated for Anatidae family at station Govindgarh lake (Table 3 & Fig. 5).

Pielous Eveness Index expresses how evenly the individuals in the community are distributed over the different species. The Pielous eveness index vary from 0.90 to 0.98 in migratory bird and local migratory bird ranged 0.90 to 0.95 at Govindgarh lake (Table 3 & Fig. 6).

The Shannon Weinner index according to (Bibby *et al.* 2000) [4] bird's conspicuousness can vary with the observer, weather, and time of the day, Hence has the high diversity and abundance of bird species types as a result of good breeding sites, Factors that promoted the high diversity include a wide variety of resources, high productivity and moderate levels of predation (Miller and Hobbs, 2002) [10].

Conclusion

The result of the current study gives a brief account about the present status of a very important natural freshwater Govindgarh lake in Rewa district. This aquatic ecosystem harbours a great number of migratory and residential species of migratory birds throughout the years. This is also a place for some near threatened and vulnerable species of migratory birds during the winter. The habitat structure is unique and suitable for various open water birds and species lives in the edge of aquatic bodies and trees. Agricultural fields also play a crucial role for the migratory birds who prefer the lake's transition zone. The diversity indices also justify the lake's good condition and healthy ecosystem, which can sustain many migratory species. This important habitat is becoming vulnerable and facing serious threat due to anthropogenic activity and rapid encroachment. Pollution generated from excessive tourist activity, ongoing construction activity on the bank of the lake and use of pesticides in the agricultural fields on the lake's edge can be a serious concern for the residential and migratory birds in this area. An urgent need is to implement a conservation plan for this unique biodiversity-rich area through proper government initiative and public awareness generation.

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References

1. Baer SG, Blair JM, Collins SL, Knapp AK. Plant community responses to resource availability and heterogeneity during restoration. Oecologia. 2004;139:617-629.
2. Bhatta, Laxmi D, Chaudhary S, Pandit A, Baral H, Das Partha J, *et al.* Ecosystem Service Changes and Livelihood Impacts in the Maguri-Motapung Wetlands of Assam, India. Land. 2016;5(2):15.
3. Bhattacharya P. A study to investigate the importance of an oxbow lake in West Bengal, India. Conference Proceedings of International Conference on Chemical, Biological and Environment Sciences, ICCBES. 2014, 56-57.
4. Bibby CJ, Burgress ND, Hill D. Birds Census Techniques 2nd Edition London, Academic Press, 2000, 24-41.
5. Chowdhury, Santanu. Diversity, Composition and abundance of avian species of oxbow lake and surrounding area in Purbasthali, West Bengal, India. International Journal of Experimental Research and Review. 2023;30:306-320.
6. Díaz D, Lavorel S, DeBello D, Quétier F, Grigulis K, Robson TM. Incorporating plant functional diversity effects in ecosystem service assessments. Proc. Natl. Acad. Sci. 2007;104(52).

7. Dudgeon D, Arthington AH, Gessner MO, Kawabata Z, Knowler DJ, Lévêque C. Freshwater biodiversity: importance, threats, status and conservation challenges. Biol. Rev. 2006;81(2):163-182.
8. Gibbs JP. The importance of small wetlands for the persistence of local populations of wetland associated animals. Wetlands. 1993;13:25-31.
9. Joy B Zedler, Suzanne Kercher. Wetland Resources: Status, Trends, Ecosystem Services, and Restorability. Annu. Rev. Environ. Resour. 2005;30:39-74.
10. Miller JR, Hobbs RJ. Conservation where people live and work. Conservation Biology. 2002;16:330-337.
11. Naik Rajashree, Sharma Laxmi Kant. Monitoring migratory birds of India's largest shallow saline Ramsar site (Sambhar Lake) using geospatial data for wetland restoration. Wetlands Ecol Manage. 2022;30:477-496.
12. Rahmani AR. Indian Avian Diversity: Status, Challenges, and Solutions. Biodiversity in India: Status, Issues and Challenges, Springer publication. 2022, 175-190.
13. Rajashekara S, Venkatesha MG. Impact of Urban Threats and Disturbance on the Survival of Waterbird Communities in Wetlands of Bengaluru City, India. Proc. Zool. Soc. 2018;71:336-351.
14. Roy J, Samal AC, Maity JP, Bhattacharya P, Mallick A, Santra SC. Distribution of heavy metals in the sediments of Hooghly, Jalangi and Churni river in the regions of Murshidabad and Nadia districts of West Bengal, India. International Journal of Experimental Research and Review. 2022;27:59-68.
15. Silvertown J. Plant coexistence and the niche. Trends in Ecology & Evolution. 2004;19(11):605-611.
16. Sreekumari VM, John SE, Rajan RT. Human interventions and consequent environmental degradation of a protected freshwater lake in Kerala, SW India. Geosci. J. 2016;20:391-402.
17. Szabo JK, Mundkur T. Conserving Wetlands for Migratory Waterbirds in South Asia, Wetland Science, Springer publication. 2017, 105-127.
18. Watson JEM, Whittaker RJ, Dawson TP. Habitat structure and proximity to forest edge affect the abundance and distribution of forest-dependent birds in tropical coastal forests of South Eastern Madagascar. Biol. Conserv. 2004;120(3):311-327.