

Water bird diversity in Winter and Summer season of Motijheel lake, Murshidabad, West Bengal, India

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Abstract

Wetlands are the most preferred habitats for water birds. They support the birds by way of feeding, roosting, nesting and rearing young ones. Birds are essential animal group of an ecosystem and maintain a trophic level. Therefore, detail study of avifauna and their ecology is important to protect them. The present investigation was carried out to document the variation of water birds in winter and summer season of Motijheel lake near Berhampore town in the Murshidabad district of West Bengal state from June, 2014 to June, 2016. In winter season 39 species of water birds were recorded of 12 different families during the study but in summer season 24 species were recorded of 8 families. Among the recorded species 13 are resident (R), 11 are winter migrant (WM), 6 are resident migrant (RM) and 9 are local migrant (LM). The analysis of the result showed that the diversity of water birds are high in both season, although diversity of birds are somewhat high in winter season than the summer season. Most of the migratory birds are come to the Motijheel Lake in winter season, so this ox-bow lake is particularly important for migratory bird species and marsh land breeding species. The wetland was also found important for long distance migrants as a stopper site for feeding and resting. The bird population shows fluctuation with changing seasons. Various ecological indices were applied to comment on the diversity and community structure of avifauna.

Keywords: Migratory birds, Motijheel lake, Ox-bow lake, water birds, water bird diversity.

Introduction

Wetlands are specialized ecosystems which perform important ecological functions and have many ecological, socio-economic and cultural values. Wetlands are known to be the most productive and diverse ecosystems on earth because they provide direct and indirect

benefits to people as sources of food, recharge of aquifers, regulating water quality, natural purification of waste water, reducing sediment load, water recharge recycling of bio-genic salts as a source of agricultural water, animal husbandry, aquaculture and also as a refuse for

rare and endangered species of plants and animals (Hossetti, 2002). Wetland supports a good diversity of different species of water birds as it has high nutritional and productivity. Birds are one of the most popular life forms of the planet and its diversity leads to a richness of life and beauty. Apart from this, birds have always fascinated mankind with their intrinsically beautiful plumage, melodious songs and artistic behaviour (Shrestha, 2000). The presence of aerial foraging bird species in any lake depends on certain conditions such as habitat types, climatic conditions and resource stability (Weller, 1999).

Ornithological studies indicate that of about 350 taxa out of 2060 taxa, known from the India subcontinent are migrants including both terrestrial and aquatic birds. Generally most of these birds breed outside the subcontinent in the Palaearctic region. India has totally 27403 wetlands of which 23444 are inland wetlands and remaining 3959 are coastal wetlands (Rajakumar, 2012). These rich variety of wetland habits provide wintering grounds for these migratory water birds. The most copious and remarkable winter migrants to the India subcontinent are the ducks and geese (i.e., Anatidae family) which constitute about 85% of the migrant bird populations out of approximately 3 million birds (Scott, 1989; Alfred et al., 2001). Most of the wetlands are facing tremendous anthropogenic pressure, which can greatly influence the structure of the bird community. The loss of water bird habitats through direct and indirect human interferences had lead to a decline in several water bird populations (Harisha, 2016).

Motijheel Lake is one of the important wetland reserve of Murshidabad district under West Bengal state and serves as feeding, resting and wintering grounds for large number of migratory birds during their Palaearctic to

Oriental migration. Monitoring of wetland water bird provides valuable information on the ecological health and status of wetlands and can be an essential tool for developing awareness regarding the conservation value of the wetlands. In the present paper, an attempt has been made to analyze the diversity and richness of water birds of Motijheel Lake, mainly in winter and summer season of the year, 2016. This might be helpful to improve the habitat, pave the way for future research and formulation of an effective strategy for conservation of this important wetland birds.

Materials and Method

Study area

Motijheel Lake is a scenic horse shoe shaped fresh water lake, which was excavated by Nawazesh Mohammad. The jheel was famous for raising golden tinted pearls from *Unio margaitifera* species. The lake is located between 24.9'12" to 24.9'42" N and 88.16'33" to 88.16'13"E, 7 km north of Berhampore town in the Murshidabad district of West Bengal, India (Fig.1).



Fig. 1. Map of the Study Area.

The lake covering an area of 350 acre and formed out of an abandoned bed of river Bhagirathi. The Motijheel derived its name by

extensive pearl cultivation during the Nawabi period. The Motijheel Lake harbor a large number of flora and fauna which attract the birds shown that the entire lake basin is highly productive and conducive to all kinds of birds (Harney, 2014).

Methodology

Field data of birds of the Motijheel Lake was observed during winter season at morning hours between 7:30 am to 11:00 am and afternoon from 3:30 pm to 5:00 pm, during summer season at morning hours between 5:30 am to 8:00 am and afternoon from 4:30 pm to 6:30 pm respectively by using a Sony DSC HX 100V camera. The checklist is prepared based primarily on the field work conducted during June, 2014 to June, 2016. In the heronry, total counts were carried out by direct and point counting methods for the birds (Simpson, 1949). A total of 12 visits per year were spend in the field observing status and diversity of birds. The status of bird was determined and categorized in to four groups such as WM- Winter Migratory, LM- Local Migratory, RM- Resident Migratory and R- Resident on the basis of their movement and seasonality of occurrence. Species richness (number of species) and diversity indices like Shannon-Weaver index and equitability (Krebs, 1985) was calculated for winter and summer season respectively.

Formula used for Statistical Method:

$$\text{Variety Index}(d) = S/\sqrt{N}$$

$$\text{Simpson Index of Dominance}(H) = \sum (n_i/N)^2$$

$$\text{Shannon Index}(\bar{H}) = -\sum (n_i/N) \log(n_i/N)$$

$$\text{Evenness Index}(e) = \bar{H}/\log S$$

Where, n_i = Number of individuals in each species or importance value

S = Number of species also called species richness

N = Total number of individuals

$P_i = n_i/N$ = Relative abundance of each species

Result and Discussion

Species richness

A total of 39 species of water birds belonging to families were recorded in the Motijheel Lake in the month of June, 2014 to June, 2016. Among the 39 species, 27 species were migrant and 12 species residents. The checklist of recorded bird species along with their common and scientific names, residential status, abundance is given in Table-1. The family Anatidae represented by 12 species dominated the water birds community of the study area. It accounted for 71% of the total number of water birds followed by Rallidae (10%); Ardeidae (6%); Jacanidae (4%); Podicipedidae and Phalacrocoracidae (2%); Alcedinidae, Charadriidae, Ciconidae, Scolopacidae (1%), and Anhingidae, Laridae are 0.5% respectively (Fig.2). Among the recorded species 70% are winter migrant (WM), 4.3% local migrants (LM), 14.68% were resident (R), and 10.92% are resident migrant (RM) (Fig.3).

In winter season all the 39 species of water birds belonging to 12 families were observed and total number of water bird counts are 4,759 but in summer season total number of bird counts are very low i.e., 582 of 24 species belonged to 8 families (Anatidae, Rallidae, Jacanidae, Alcedinidae, Ardeidae, Podicipedidae, Phalacrocoranidae and Ciconidae). So, species richness (39) of water birds were high in winter season as compared to species richness (24) of summer season. This is due to presence of migratory species like Gadwal, Northern Pintail, Northern Shoveller, Eurasian Wigeon, Red crested Pochard, Ferruginous Pochard etc.

Table 1. Checklist of water birds of Motijheel Lake, with common/vernacular, scientific names, their status and abundance.

| Sl.No. | Common Name | Scientific Name | Status | Frequency |
|----------------------------------|---------------------------|-----------------------------------|--------|-----------|
| Family: Anatidae | | | | |
| 1. | Cotton Teal | <i>Nettapus coromandelianus</i> | RM* | Abundant |
| 2. | Grey lag goose | <i>Anser anser</i> | R | Common |
| 3. | Gadwal | <i>Anas strepera</i> | WM | Rare |
| 4. | Northern Pintail | <i>Anas acuta</i> | WM | Rare |
| 5. | Northern shoveller | <i>Anas clypeata</i> | WM | Rare |
| 6. | Eurasian wigeon | <i>Anas penelope</i> | WM | Common |
| 7. | Garganey | <i>Anas querquedula</i> | WM | Common |
| 8. | Common pochard | <i>Aythya ferina</i> | WM | Rare |
| 9. | Lesser Whistling Teal | <i>Dendrocygna javanica</i> | WM | Abundant |
| 10. | Red crested pochard | <i>Rhodonessa rufina</i> | WM | Abundant |
| 11. | Ferruginous Pochard | <i>Aythya nyroca</i> | WM | Rare |
| 12. | Large whistling teal | <i>Dendrocygna bicolor</i> | WM | Abundant |
| Family: Rallidae | | | | |
| 13. | Common Moorhen | <i>Gallinula chloropus</i> | R | Common |
| 14. | Purple Moorhen | <i>Porphyrio porphyrio</i> | R | Abundant |
| 15. | White-breasted waterhen | <i>Amaurornis phoenicurus</i> | R | Abundant |
| 16. | Common Coot | <i>Fulica atra</i> | WM | Abundant |
| Family: Jacanidae | | | | |
| 17. | Pheasant-tailed Jacana | <i>Hydrophasianus chirurg</i> | RM | Common |
| 18. | Bronze-winged Jacana | <i>Metopidius indicus</i> | R | Abundant |
| Family: Alcedinidae | | | | |
| 19. | White throated kingfisher | <i>Halcyon smyrensis</i> | R | Common |
| 20. | Pied kingfisher | <i>Ceryle rudis</i> | R | Common |
| 21. | Common Kingfisher | <i>Alcedo atthis</i> | R | Common |
| Family: Ardeidae | | | | |
| 22. | Indian pond heron | <i>Ardeola grayii</i> | R | Common |
| 23. | Little Egret | <i>Egretta garzetta</i> | R | Common |
| 24. | Cattle Egret | <i>Bubulcus ibis</i> | R | Common |
| 25. | Intermediate Egret | <i>Casmerodius albus</i> | R | Common |
| 26. | Grey Heron | <i>Ardea cinerea</i> | RM | Rare |
| 27. | Purple Heron | <i>Ardea purpurea</i> | RM | Rare |
| Family: Podicipedidae | | | | |
| 28. | Little Grebe | <i>Podiceps ruficollis</i> | LM | Common |
| Family: Phalacrocoracidae | | | | |
| 29. | Little cormorant | <i>Phalacrocorax niger</i> | RM | Common |
| 30. | Great cormorant | <i>Phalacrocorax fuscicollis</i> | RM | Rare |
| Family: Charadriidae | | | | |
| 31. | Red wattled lapwing | <i>Vanellus indicus</i> | LM | Common |
| Family: Ciconiidae | | | | |
| 32. | Asian Openbill-stork | <i>Anastomus oscitans</i> | R | Common |
| 33. | Black stork | <i>Ciconus nigra</i> | LM | Rare |
| 34. | Black necked stork | <i>Ephippiorhynchus asiaticus</i> | LM | Rare |
| Family: Anhingidae | | | | |
| 35. | Darter | <i>Anhinga melanogaster</i> | LM | Rare |
| Family: Scolopacidae | | | | |
| 36. | Wood sandpiper | <i>Tringa nebularia</i> | RM | Rare |
| 37. | Common Sandpiper | <i>Actitis hypoleucos</i> | RM | Rare |
| Family: Laridae | | | | |
| 38. | River Tern | <i>Sterna aurantia</i> | LM | Rare |
| 39. | Whiskered Tern | <i>Chlidonias hybridus</i> | LM | Rare |

RM = Resident Migrant; LM = Local Migrant; R = Resident; WM = Winter Migrant

Table 2. Water Bird Diversity of Motijheel Lake in Winter Season.

| Name of the Species | Importance value (ni) | ni/N | (ni/N) ² | log(ni/N) | (ni/N) × log(ni/N) |
|---------------------------|-----------------------|---------------------|-----------------------------------|---------------------------|---------------------------------|
| Cotton Teal | 370 | 0.077 | 0.0059 | -1.11 | -0.058 |
| Grey lag Goose | 20 | 0.0042 | 0.000017 | -2.37 | -0.001 |
| Gadwal | 30 | 0.0063 | 0.000039 | -2.20 | -0.013 |
| Northern Pintail | 25 | 0.0052 | 0.000027 | -2.28 | -0.011 |
| Northern Shoveller | 12 | 0.0025 | 0.000006 | -2.60 | -0.006 |
| Eurasian Wigeon | 40 | 0.0084 | 0.00007 | -2.07 | -0.017 |
| Garganey | 56 | 0.0117 | 0.00013 | -1.93 | -0.022 |
| Common Pochard | 16 | 0.0033 | 0.00001 | -2.48 | -0.008 |
| Lesser Whistling Teal | 2600 | 0.546 | 0.298 | -0.26 | -0.141 |
| Red crested pochard | 190 | 0.0399 | 0.0016 | -1.399 | -0.055 |
| Ferruginous Pochard | 26 | 0.0054 | 0.00029 | -2.26 | -0.012 |
| Large whistling teal | 150 | 0.0315 | 0.00099 | -1.50 | -0.047 |
| Common Moorhen | 90 | 0.0189 | 0.00035 | -1.72 | -0.032 |
| Purple Moorhen | 110 | 0.0231 | 0.00053 | -1.63 | -0.037 |
| White-breasted waterhen | 80 | 0.0168 | 0.00028 | -1.77 | -0.029 |
| Common Coot | 190 | 0.0399 | 0.0016 | -1.399 | -0.055 |
| Pheasant-tailed Jacana | 50 | 0.0105 | 0.0001 | -1.97 | -0.020 |
| Bronze-winged Jacana | 120 | 0.0252 | 0.0006 | -1.59 | -0.040 |
| White throated kingfisher | 18 | 0.0037 | 0.000013 | -2.43 | -0.009 |
| Pied kingfisher | 8 | 0.0016 | 0.000002 | -2.79 | -0.004 |
| Common Kingfisher | 22 | 0.0046 | 0.00002 | -2.33 | -0.010 |
| Indian pond heron | 65 | 0.0136 | 0.00018 | -1.86 | -0.025 |
| Little Egret | 72 | 0.0151 | 0.0002 | -1.82 | -0.027 |
| Cattle Egret | 28 | 0.0058 | 0.00003 | -2.23 | -0.013 |
| Intermediate Egret | 36 | 0.0075 | 0.00005 | -2.12 | -0.015 |
| Grey Heron | 38 | 0.0079 | 0.00006 | -2.10 | -0.016 |
| Purple Heron | 18 | 0.0037 | 0.000013 | -2.43 | -0.009 |
| Little Grebe | 72 | 0.0151 | 0.0002 | -1.82 | -0.027 |
| Little cormorant | 48 | 0.01 | 0.0001 | -2.00 | -0.02 |
| Great cormorant | 16 | 0.0033 | 0.00001 | -2.48 | -0.008 |
| Red wattled lapwing | 42 | 0.0088 | 0.00007 | -2.05 | -0.018 |
| Asian Openbill-stork | 30 | 0.0063 | 0.00004 | -2.20 | -0.013 |
| Black stork | 4 | 0.0008 | .0000006 | -3.09 | -0.002 |
| Black necked stork | 5 | 0.0010 | 0.000001 | -3.00 | -0.003 |
| Darter | 12 | 0.0025 | 0.000006 | -2.60 | -0.006 |
| Wood sandpiper | 16 | 0.0033 | 0.00001 | -2.48 | -0.008 |
| Common Sandpiper | 20 | 0.0042 | 0.000017 | -2.37 | -0.001 |
| River Tern | 8 | 0.0016 | 0.000002 | -2.79 | -0.004 |
| Whiskered Tern | 6 | 0.0012 | 0.000001 | -2.92 | -0.003 |
| S= 39 | N=4,759 | Σni/N= 0.997 | Σ(ni/N)²= 0.311 | Σlog(ni/N)= -81.45 | Σ(ni/N)×log(ni/N)= -0.87 |

Table 3. Water Bird Diversity of Motijheel Lake in Summer Season.

| Name of the Species | Importance value (ni) | ni/N | (ni/N) ² | log(ni/N) | (ni/N)× log(ni/N) |
|---------------------------|-----------------------|-------------------|---------------------------------|--------------------------|---------------------------------|
| Cotton Teal | 38 | 0.065 | 0.0042 | -1.18 | -0.076 |
| Grey lag Goose | 26 | 0.044 | 0.0019 | -1.35 | -0.059 |
| Lesser Whistling Teal | 40 | 0.068 | 0.004 | -1.16 | -0.078 |
| Common Moorhen | 18 | 0.030 | 0.0009 | -1.52 | -0.045 |
| Purple Moorhen | 48 | 0.082 | 0.0068 | -1.08 | -0.088 |
| White-breasted waterhen | 24 | 0.041 | 0.0017 | -1.38 | -0.056 |
| Common Coot | 14 | 0.024 | 0.0005 | -1.62 | -0.038 |
| Pheasant-tailed Jacana | 10 | 0.017 | 0.00029 | -1.76 | -0.029 |
| Bronze-winged Jacana | 36 | 0.061 | 0.0048 | -1.21 | -0.073 |
| White throated kingfisher | 10 | 0.017 | 0.00029 | -1.76 | -0.029 |
| Pied kingfisher | 6 | 0.010 | 0.0001 | -2.00 | -0.020 |
| Common Kingfisher | 16 | 0.027 | 0.0007 | -1.56 | -0.042 |
| Indian pond heron | 70 | 0.120 | 0.014 | -0.92 | -0.110 |
| Little Egret | 56 | 0.096 | 0.009 | -1.01 | -0.096 |
| Cattle Egret | 40 | 0.068 | 0.004 | -1.16 | -0.078 |
| Intermediate Egret | 18 | 0.030 | 0.0009 | -1.52 | -0.045 |
| Grey Heron | 15 | 0.025 | 0.0006 | -1.60 | -0.040 |
| Purple Heron | 6 | 0.010 | 0.0001 | -2.00 | -0.020 |
| Little Grebe | 15 | 0.025 | 0.0006 | -1.60 | -0.040 |
| Little cormorant | 42 | 0.072 | 0.0052 | -1.14 | -0.082 |
| Great cormorant | 8 | 0.013 | 0.0008 | -1.88 | -0.024 |
| Asian Openbill-stork | 20 | 0.034 | 0.0010 | -1.46 | -0.049 |
| Black stork | 3 | 0.005 | 0.00002 | -2.30 | -0.011 |
| Black necked stork | 3 | 0.005 | 0.00002 | -2.30 | -0.011 |
| S=24 | N=582 | ∑ni/N=0.98 | ∑(ni/N)²=0.06 | ∑log(ni/N)=-36.47 | ∑(ni/N)×log(ni/N)=-1.239 |

Table 4. Value of different indices.

| INDICES | WATER BIRD DIVERSITY OF WINTER SEASON | WATER BIRD DIVERSITY OF SUMMER SEASON |
|------------------------------------|---------------------------------------|---------------------------------------|
| Variety Index (d) | 0.565 | 0.995 |
| Simpson Index of Dominance (H) | 0.311 | 0.06 |
| Shannon-Weaver Index (\bar{H}) | 0.87 | 1.239 |
| Evenness Index (e) | 0.547 | 0.897 |

Variety Index (d):

Variety index, have a value near '0' corresponds to less diverse or homogenous ecosystem and value near '1' corresponds to highly diverse or heterogenous ecosystem. Variety index value of water birds of summer season is 0.995 (i.e., very close to 1) and of winter season is 0.565, so the summer season is more diversified than the winter season.

Simpson Index of Dominance (H):

Simpson index of dominance which weight towards the abundance of the most common species. Krebs stated that, this index gives relatively less importance to rare species and more to common species (Krebs,1985). Its value ranging from 1 to 0. The value closer to '0' indicates a low level of dominance i.e., all taxa are equally present, while the value closer to '1'

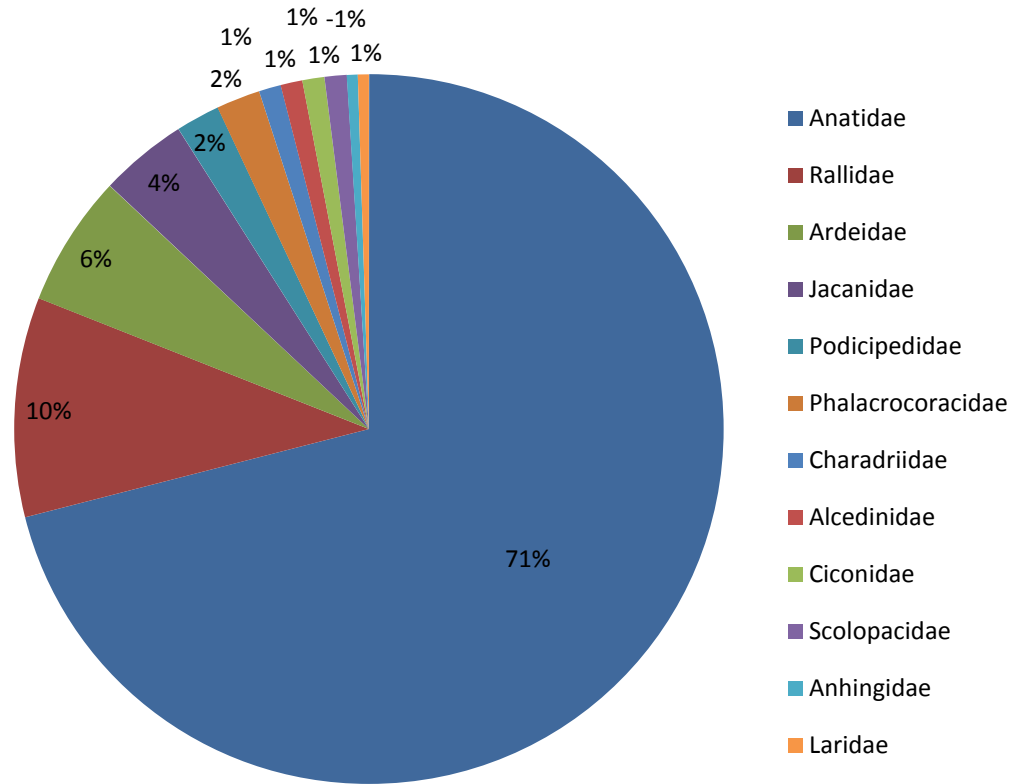


Fig. 2. Species diversity in 12 Families in Motijheel Lake.

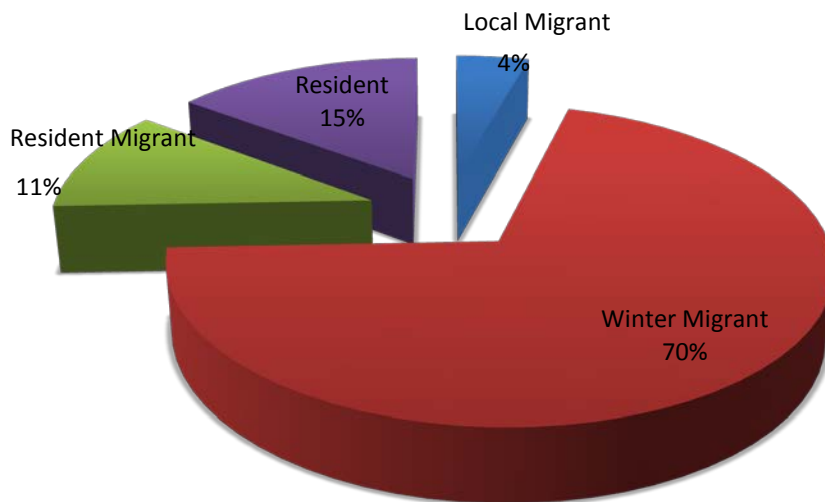


Fig.3. Residential Status of Water Birds in Motijheel Lake.

exhibits higher level of dominance i.e., one taxon dominates the community completely. The value of Simpson's index in winter season is 0.316, having higher dominance as compared to the value 0.06 (i.e., close to 1), indicating the lower dominance in summer season, 2016. Simpson opined that dominance varies inversely with diversity i.e., high level of dominance represents low diversity and low level of dominance represents high diversity (Simpson, 1949).

Shannon-Weaver Index (\bar{H}):

Shannon-Weaver index is also known as Shannon-Wiener index in some text books, measures both variety and commonness of species in a community. Shannon-Weaver index is maximized when individuals of each species or each group are present in equal number. The Shannon-Weaver index value is high ($\bar{H}=1.239$) in summer season than the winter season ($\bar{H}=0.87$) reveals that the water birds population in summer season shows more equality than the winter season.

Evenness Index (e):

Evenness is part and it is an important component of diversity indices (Turchi et al., 1995; Leinster and Cobbold, 2002) and showed evenly distribution of the individuals for the sighted species. The higher value of evenness index ($e=0.897$) in summer than the winter season ($e=0.547$) represents the less variation in communities between the species in summer season. The water birds of summer season shows more evenness than the winter season. The less evenness of winter season also revealed dominance of a single species (Lesser whistling teal).

Conclusion

From the present study it has been found that the species richness is high in winter season

than the summer season due to presence of large number of migratory water birds. Considerable variation also noted in the number of water birds in between winter and summer season. Sharp increase in the water birds count from December to February month of winter season. Lowest water bird counted in May and June month of summer season because of complete absence of winter migratory water birds in the region. In this monitoring study, it has been observed that the Motijheel lake is mostly visited by winter migratory birds because of the comfortable temperature, availability of food and potential habitats. Therefore, it is need to monitor the Motijheel lake systemically in the rapidly changing environment with a focused study on status, frequency, distribution and conservation of water birds.

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