Present status and diversity of avian fauna in Purbasthali bird sanctuary, West Bengal, India

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ABSTRACT

Birds play a crucial role in many food webs of aquatic ecosystem and the birds are known as good ‘bio-indicators’ as they are very sensitive to minor environmental changes. The present study was carried out in Purbasthali bird sanctuary of West Bengal (India) and its surroundings from January 2016 to December 2016 to explore the current status and diversity of avian fauna. The point count and line transect methods were implemented in bird counting. A total of 86 species of birds belonging to 31 families were recorded from the study area. Anatidae and Ardeidae were the dominant families with highest relative diversity. Residential status, IUCN Red list status and Relative abundance of bird species were also considered. Different diversity indices were also calculated. Purbasthali bird sanctuary supports a huge amount of bird diversity. So continuous monitoring of avian fauna and health condition of the ecosystem by local or state levels on taking integrated management programs will helpful to maintain a sustainable development of the habitat.

Key words: Avian fauna, Aquatic ecosystem, Diversity, Purbasthali bird sanctuary.

INTRODUCTION

Lakes are highly complex, land interactive, most productive and fertile ecosystems in the world, constituting a treasury of biodiversity (Gibbs, 1993). In India, the meandering nature of the holy river Ganga and its tributaries in its lower course in West Bengal have given rise a large number of floodplain wetlands, mostly open-type oxbow lakes (Ganesan and Khan, 2007). These ox-bow lakes provide habitats and breeding grounds for a huge number of resident and migratory birds. As India is one of the 12 megabiodiversity countries, supports a considerable amount of avifaunal population. There is approximately 9702 bird species recorded throughout the world (Sibley and Monroe, 1990), out of which Indian subcontinent supports 1313 (over 13%) of them (Grimmett et al. 2011). Birds are very sensitive to environmental changes and are used as a "bio-indicator" (Koli, 2014); also, because of their high mobility, birds react very rapidly to changes in their habitats (Morrison 1986; Fuller et al. 1995). But due to some adverse climatic conditions and various anthropogenic activities the global diversity of birds has been decreasing in recent years. According to Birdlife International (2015), 1375 avian species are considered to be threatened with extinction globally out of which 84 species are from Indian subcontinent.

Several studies on local and migratory water-bird population and the effects of bird aggregation on the physico-chemical conditions of lake water and vice versa have been conducted in the state West Bengal of India by many workers (Patra et al. 2010; Datta, 2011; Singha Roy et al. 2011 and 2012; Bhattacharya and Roy, 2013). A few research works have been carried out in Purbasthali bird sanctuary concerning the ecology, environmental threat and socioeconomic issues (Ganesan and Khan, 2007; Ganguly, 2015; Biswas Roy et al. 2016). But the information on community structure, diversity and abundance of indigenous and migratory birds of Purbasthali bird sanctuary is scarce. So the present study is an effort to explore the present status and diversity of avian fauna of this area.

MATERIALS AND METHODS

Study area: Purbasthali bird sanctuary of West Bengal is positioned on 23°27’ N latitude and 88° 20’ E longitude, at an elevation of 14 m. This open type ox-bow lake is situated in the Gangetic alluvial plain and covers an area approximately 20 sq. Km. It is a freshwater wetland and it belongs to Ramsar classification, the marshes, jheels, terai swamps and charland of the Gangetic plain class (Biswas Roy et al. 2016). The daily temperature of the study area varies from 16°C to 36°C and average rainfall is 150 mm. During post-monsoon season of each year a huge number of migratory water bird species aggregate in this wetland from different parts of the world and this phenomenon plays a crucial role for financial support of surrounding people.

Sampling sites: The bird species were collected from 3 sampling sites (Fig.1). The sampling sites were selected based on the following criteria – accessibility, distance...
between the sampling points, variety of habitats and proximity to source of pollution such as sewage channels, bathing areas etc. the final map of study area and sampling sites were prepared through Geographic information system (GIS).

**Data collection and identification:** Monthly observations were carried out from January 2016 to December 2016. The various species of birds were counted with the help of two methods- Fixed radius (20 m) point count method for the forest areas, orchard; and Line transect method was applied to the open areas such as wetland and agricultural fields (Buckland et al. 1993; Sutherland et al. 2005). Observations were conducted with the help of Olympus 8-16×40 zoom DPS I Binocular and photography was carried out with Nikon D7000 DSLR camera and Nikon AF-S DX NIKKOR 55-300 mm f/4.5-5.6 G ED VR lens. Birds were censured 4 times in a month (Froneman et al. 2001; Urfi et al. 2005) and the mean values were taken into consideration.

Bird species were identified with the help of following literatures: Ali and Ripley (1987), Inskipp et al. (1996) and Grimmet et al. (1999). Some inconspicuous bird species were identified based on their calls (Aynalem and Bekele, 2008). IUCN status of the bird species were recognised as per IUCN (2016).

**Data analysis:** Residential status of different bird species like Resident (R), Resident-Migrant (RM) and Migrant (M) were given strictly on the basis of occurrence and sightings in the study area during study period (Singh and Laura, 2013).

Relative abundance was assessed on the basis of frequency of sightings as described by Khan (2005) and these were denoted as – ‘Very common’ (seen on 75–100% of visits), ‘Common’ (seen on 50–74% of visits), ‘Uncommon’ (seen on 25–49% of visits) and ‘Rare’ (seen on <25% of visits).

Relative diversity (RD) of bird families was calculated following the formula of Torre-Cuadros et al. 2007. The Shannon diversity index (H’), Simpson diversity index (D), Margallef diversity index (M) and Bray Curtis cluster analysis of bird population of 3 sampling sites were calculated with the help of Bio-Diversity Pro 2.0 Professional software programme. The cluster analysis was used to prepare a dendrogram to show the similarity in bird families on 3 sampling sites of the study area.

**RESULTS AND DISCUSSION**

**Bird diversity:** From the present study it is revealed that a total of 86 species of birds belonging to 31 families were recorded during the study period from Purbasthali bird sanctuary and its surroundings (Table 1). Anatidae and Ardeidae are found to be the most dominant families in the study area with 7 species each, followed by Scolopacidae (6 species), Motacillidae, Picidae (5 species each), Alcedinidae, Charadriidae, Cuculidae, Rallidae (4 species each), Accipitridae, Columbidae, Estrildidae, Megalaimidae, Sturnidae (3 species each), Ciconiidae, Dicruridae, Jacanidae, Laniidae, Nectariniidae, Phalacrocoracidae, Pycnonotidae, Strigidae (2 species each), Aegithinidae,
| Family                | Scientific name | Common Name                  | Residential status | IUCN status | Relative abundance |
|-----------------------|-----------------|------------------------------|--------------------|-------------|--------------------|
| Accipitridae          | Milvus migrans  | Black Kite                   | R                  | LC          | C                  |
| Accipitridae          | Accipiter badius| Shikra                       | R                  | LC          | C                  |
| Accipitridae          | Gyps bengalensis| white-rumped vulture         | R                  | CR          | RA                 |
| Aegithinidae          | Aegithina tiphia | Common Lora                  | RM                 | LC          | UC                 |
| Alcedinidae           | Alcedo atthis   | Common Kingfisher            | R                  | LC          | C                  |
| Alcedinidae           | Halcyon smyrnensis | White Throated Kingfisher   | R                  | LC          | VC                 |
| Alcedinidae           | Ceryle rudis    | Pied kingfisher              | R                  | LC          | C                  |
| Alcedinidae           | Pterodroma capensis | Stork Billed Kingfisher    | R                  | LC          | UC                 |
| Anatidae              | Dendrocygna javanica | Lesser Whistling Duck      | M                  | LC          | VC                 |
| Anatidae              | Anas crecca     | Common Teal                  | M                  | LC          | RA                 |
| Anatidae              | Anas acuta      | Northern Pintail             | M                  | LC          | RA                 |
| Anatidae              | Anas platyrynchos | Mallard                 | M                  | LC          | RA                 |
| Anatidae              | Anas strepera   | Gadwall                      | M                  | LC          | RA                 |
| Anatidae              | Tadorna ferruginea | Ruddy Shelduck            | M                  | LC          | UC                 |
| Ardeidae              | Egretta garzetta | Little Egret              | R                  | LC          | VC                 |
| Ardeidae              | Ardea intermedia | Intermediate Egret         | R                  | LC          | C                  |
| Ardeidae              | Ardea alba      | Great Egret                  | RM                 | LC          | UC                 |
| Ardeidae              | Bubulcus ibis   | Cattle Egret                 | R                  | LC          | VC                 |
| Ardeidae              | Ardeola grayii  | Indian Pond Heron            | R                  | LC          | C                  |
| Ardeidae              | Nycticorax nyticorax | Black Crowned Night Heron| R                | LC          | RA                 |
| Charadriidae          | Vanellus indicus   | Red Wattled Lapwing       | RM                 | LC          | C                  |
| Charadriidae          | Vanellus cinereus | Grey Headed Lapwing        | RM                 | LC          | UC                 |
| Charadriidae          | Charadrius leschenaultii | Greater Sand Plover       | M                  | LC          | RA                 |
| Charadriidae          | Charadrius mongolus | Lesser Sand Plover      | M                  | LC          | RA                 |
| Ciconiidae            | Anastomus oscitans | Asian Open Bill Stork    | RM                 | LC          | VC                 |
| Ciconiidae            | Leptoptilos javanicus | Lesser Adjutant stork    | RM                 | VU          | RA                 |
| Cisticolidae          | Orthotomus sutorius | Common Tailor Bird    | R                  | LC          | C                  |
| Columbidae            | Spilopelia chinensis | Spotted Dove             | R                  | LC          | C                  |
| Columbidae            | Chalcophaps indica | Emerald Dove             | R                  | LC          | RA                 |
| Columbidae            | Treron phoenicoptera | Yellow Footed Green pigeon | R          | LC          | RA                 |
| Cuclidae              | Cuculus micropterus   | Indian Cuckoo              | R                  | LC          | C                  |
| Cuclidae              | Hierococcyx varius | Common Hawk Cuckoo          | R                  | LC          | UC                 |
| Cuclidae              | Eudynamys scolopaceus | Asian Koel              | R                  | LC          | C                  |
| Cuclidae              | Centropus sinensis | Greater Coucal             | R                  | LC          | VC                 |
| Dicruridae            | Dicrurus macrocercus | Black Drongo            | R                  | LC          | VC                 |
| Dicruridae            | Dicrurus aeneus   | Bronzed Drongo              | RM                 | LC          | RA                 |
| Estrildidae           | Lonchura malabarica | Indian SilverBill         | R                  | LC          | RA                 |
| Estrildidae           | Lonchura punctulata | Scaly Breasted Munia       | R                  | LC          | RA                 |
| Estrildidae           | Lonchura malacca  | Black Headed Munia          | R                  | LC          | UC                 |
| Estrildidae           | Metopidius indicus | Bronze Winged Jacana       | R                  | LC          | C                  |
| Estrildidae           | Hydrophasianus chirurgus | Pheasant Tailed Jacana   | R                  | LC          | VC                 |
| Lonidae               | Lanius cristatus | Brown shrike                | M                  | LC          | C                  |
| Lonidae               | Lanius schach    | Long Tailed Shrike          | RM                 | LC          | UC                 |
| Megalaimidae          | Megalaima haemacephala | Coppersmith Barbet       | R                  | LC          | RA                 |
| Megalaimidae          | Megalaima lineata | Lineated Barbet            | R                  | LC          | UC                 |
| Megalaimidae          | Megalaima asiatica | Blue Throated Barbet       | R                  | LC          | C                  |
| Meropidae             | Merops orientalis | Green Bee-Eater            | R                  | LC          | C                  |
| Motaciliidae          | Motacilla flava   | Yellow Wagtail              | M                  | LC          | UC                 |
| Motaciliidae          | Motacilla cinerea | Grey Wagtail               | M                  | LC          | RA                 |
| Motaciliidae          | Motacilla alba    | White Wagtail               | RM                 | LC          | C                  |
| Motaciliidae          | Motacilla maderaspatensis | White Browed Wagtail   | R                  | LC          | UC                 |
| Motaciliidae          | Anthus rubicollis | Paddy Field Pipit           | R                  | LC          | C                  |
| Nectariniidae         | Nectarinia asiatica | Purple Sunbird          | R                  | LC          | RA                 |
Cisticolidae, Meropidae, Pandionidae, Podicipedidae, Psittaculidae, Recurvirostridae, Rhipiduridae and Zosteropidae (single species each) (Table 1). Roy et al. (2016) have also observed that Anatidae and Ardeidae were the dominant families in Purbasthali bird sanctuary.

The residential status of bird species found in study area is tabulated in the Table 1. Out of 86 bird species, 51 were resident, 14 species were resident-migrant (undergo local migration) and rest 21 species were migratory. The winter migrants are not only coming from different states of India like Jammu and Kashmir, Arunachal Pradesh, but also from different countries like Siberia, Tibet and different range of Himalayas (Roy et al. 2016). The winter migrants like Anas crecca, Anas acuta, Anas strepera, Netta rufina, Charadrius leschenaultia, Gallinago gallinago etc. appeared in the study area from November and stayed till middle of March of a calendar year. The population of migratory birds reached its peak value during December and January. The basic requirements of the migratory birds at their wintering ground are availability of adequate food and safety (Basavarajappa, 2006), which were present in Purbasthali bird sanctuary with its adequate space, vast breeding ground, different niches for diverse species, vast agricultural fields and adjacent forest areas.

Out of 86 species recorded, 13 were categorised as ‘very common’ species such as Halcyon smyrnensis, Dendrocygna javanica, Bubulcus ibis, Pycnonotus cafer etc. Halcyon smyrnensis is considered as state bird of West Bengal. 26 species were considered as ‘common’, 19 species as ‘uncommon’ and rest 28 species were designated as ‘rare’ (Table 1).

Analysis of Relative diversity (RD) of bird families showed that Anatidae and Ardeidae have the highest RD value (8.140), whereas Aegithinidae, Cisticolidae, Meropidae, Pandionidae, Podicipedidae, Psittaculidae, Recurvirostridae, Rhipiduridae and Zosteropidae have the lowest RD value (1.163). The RD values of different bird families were shown in the Fig. 2.

Total avian species recorded from the study area were categorized under different threatened categories by IUCN (Version 2016-3). Only one species (Leptoptilos javanicus) have been enlisted as Vulnerable (V). Gyps bengalensis was placed in Critically endangered (CR)
Table 2: The Shannon, Simpson and Margalef diversity index of bird community in different months of the year 2016 in Purbasthali bird sanctuary.

| Months   | $H'$   | $H_{\text{max}}$ | $J'$   | D     | M     |
|----------|--------|-------------------|--------|-------|-------|
| January  | 1.471  | 1.751             | 0.857  | 0.053 | 30.103|
| February | 1.487  | 1.749             | 0.851  | 0.049 | 30.67 |
| March    | 1.476  | 1.694             | 0.871  | 0.046 | 31.269|
| April    | 1.323  | 1.552             | 0.853  | 0.069 | 30.047|
| May      | 1.272  | 1.495             | 0.852  | 0.077 | 25.534|
| June     | 1.289  | 1.547             | 0.832  | 0.083 | 26.056|
| July     | 1.311  | 1.486             | 0.882  | 0.063 | 27.127|
| August   | 1.333  | 1.515             | 0.881  | 0.059 | 27.383|
| September| 1.301  | 1.481             | 0.878  | 0.066 | 27.583|
| October  | 1.394  | 1.591             | 0.874  | 0.06  | 33.393|
| November | 1.426  | 1.727             | 0.826  | 0.063 | 32.248|
| December | 1.473  | 1.776             | 0.828  | 0.058 | 30.549|

$H'$: Shannon $H'$ Log base 10; $H_{\text{max}}$: Shannon $H_{\text{max}}$ Log base 10; $J'$: Shannon $J'$; D: Simpson diversity index; M: Margalef M Base 10.

category and *Limosa limosa* was positioned in Near threatened (NT) category. Rest of the species (83 species) were listed as Least concerned (LC) (Table 1).

**Diversity index:** Different bird diversity indices calculated from Purbasthali bird sanctuary during study period are tabulated in the Table 2. In the present study the $H'$ ranged from 1.272 to 1.487. According to Derso *et al.* (2015), most values calculated using the $H'$ range from 1.5 to 3.5, rarely exceeding 4.5; Values above 3.0 indicate that habitat structure is very much balanced and stable, whereas values below 1.0 indicate the presence of pollution and degradation of habitat structure. Based on these principles, it was observed that none of the sampling sites of the study area lowered the level
of 1.0 in case of $H'$ (Fig. 3). $D$, calculated from the study area with its lowest value as 0.046 and highest value as 0.083 (Fig. 4). According to Smith and Wilson (1996), $D$ values should be between zero and one. Zero represents minimum evenness and one for the maximum. So the $D$ values of the present study correlate with the aforesaid standards. The values of $M$ of bird were between 25.534 and 33.393 (Fig. 5). The lowest value was observed in the month of May whereas the highest value was seen in the month of October during the study period. The reason for such type of differences in species richness and diversity indices might be due to different anthropogenic activities (Singh and Laura, 2013). Bird species richness has negative relationship with urbanization (Mckinney, 2002).

The much higher values of $H'$ were observed from the study period during the post-monsoon months. It may be due the aggregation of large variety of migratory water bird species into the lake for food and forage. Whereas lesser values of $H'$ were found during pre-monsoon months. This may be due to high temperature, scarcity of nutrients, shelter and migration of local migrant species to nearby agricultural fields for food (Maheswaran et al. 2001).

The dendrogram shows the similarity in the number of avian species between the three sampling sites of the sanctuary (Fig. 6). High similarity in bird species was found between Site-2 and Site-3, followed by Site-1 and Site-2 and Site-1 and Site-3. High amount of species diversity and richness was observed in Site-1 compared to Site-2 and Site-3. Same type of anthropogenic disturbances such as bathing, washing, pisciculture, irrigation, water herbs cultivation, recreational activities (Roy et al. 2016) were observed in Site-2 and Site-3. It may be the reason of such similarity between these two sites. So the result of the present study revealed that higher species diversity in Site-1 was seen due to less pollution, and less human interference than the other 2 sites (Site-2 and Site-3).
Fig. 6: Dendrogram showing the similarity in number of bird families on three sampling sites of Purbasthali bird sanctuary, 2016.

CONCLUSION
From the above study it can be concluded that Purbasthali bird sanctuary not only supports a huge amount of bird diversity but also plays an important role in providing different types of ecosystem services to the local people. The huge avian diversity and richness of this area was probably due to the complex vegetation structure which provides shelter, varied niches, microhabitats and suitable foraging grounds to the different types of water and land birds. Despite of its importance, the lake ecosystems in our country are susceptible from different anthropogenic activities. These play a negative impact on aggregation and diversity of avian population. So the human interferences should be reduced to conserve the species richness and abundance. Moreover, continuous monitoring of avian fauna and health condition of the ecosystem by local or state levels on taking integrated management programs will be helpful to maintain a sustainable development of the habitat.

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