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Cover: A digital art of water birds of Noyyal River and its wetlands in Coimbatore District by Megha A. Kashyap.



A drastic decline in avian diversity in and around the Bordoibam-Bilmukh Bird Sanctuary, Lakhimpur, Assam, India

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Abstract: Bordoibam-Bilmukh is a small wetland located at the boundary of the Dhemaji and Lakhimpur districts of Assam, India that provides shelter and breeding ground to many resident and migratory birds. A survey was conducted between October 2022 and March 2024 on the avian diversity of Bordoibam-Bilmukh Bird Sanctuary. A total of 47 bird species under 16 orders and 29 families were recorded during the survey. Order Passeriformes, recorded with the highest number of avian species (15). Among the families, the highest number of species (5) was recorded under Ardeidae. Out of all the species recorded, three species, viz., Brown Shrike, Citrine Wagtail, and White Wagtail were winter migratory; one species, the Lesser Kestrel, was summer migratory, and the remaining 43 were resident species. Besides, two species, viz., Lesser Adjutant and Greater Adjutant are listed as 'Near Threatened' species on the IUCN Red List. Comparing the avian diversity from 1997 to 2024, a decline in the number of avian species from 167 (as per the 1997 record) to 47 (as per the present study) has been observed in the sanctuary. Various anthropogenic activities such as habitat destruction and disturbance, hunting of birds, are the major causes of the decline of avian diversity. For future species diversity restoration in the sanctuary, these negative anthropogenic activities should be addressed immediately for conservation strategies.

Keywords: Ardeidae, conservation, Greater Adjutant, habitat destruction, IBA, Lesser Adjutant, migratory birds, Passeriformes, population decline, wetland.

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Author contributions: LS did the field surveys and identified the bird species. SSB did the field surveys, helped in identification and wrote the manuscript. KSD supervised the study, reviewed the manuscript, and prepared the final manuscript and communicated. All authors read and approved the final manuscript.

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INTRODUCTION

Assam is one of the biodiversity-rich states of India and home to about 950 bird species including 17 species that are endemic to the state (Choudhury 2000) with 55 Important Bird and Biodiversity Areas (IBAs) that act as the hotspots for various avian species. Many studies have been carried out on the avian diversity of the state including the Panidihing Bird Sanctuary of Sivasagar district with 165 species of birds (Mili & Acharjee 2014); Jhanjimuk-Kokilamuk IBA complex of Jorhat district recorded 205 species of birds (Mahanta et al. 2019); 284 bird species were reported from Orang National Park by Chakdar et al. (2019) and 227 avian species from the Raimona National Park by Mahanta et al. (2022). Recently, Bornodi Wildlife Sanctuary recorded 227 avian species (Chetry et al. 2024) and the Loharghat forest range of Kamrup district, 157 species (Talwar et al. 2024).

Among many important bird areas and hotspots of Assam, Bordoibam-Bilmukh wetland is also one of them. The wetland is located at the boundary of Dhemaji and Lakhimpur District of Assam, northeastern India. This wetland originated from the river Subansiri. A major earthquake created this wetland in 1950 (Sonowal et al. 2018). In 1996, the Assam government designated Bordoibam-Bilmukh as a Bird Sanctuary (BBBS), due to the great diversity of flora and fauna of this area due to its potential for ecotourism. It is also one of the IBAs of the north-eastern region of India (IBA code: IN372) (BirdLife International 2024).

The bird community structure of any area helps in understanding how the landscape changes over time (Kattan & Franco 2004; Byju et al. 2023). Information on avifauna is vital for an ecosystem conservation effort, and for understanding the implications of habitat degradation or loss and climate change (Daniels et al. 1991; Peterson et al. 2000; Llanos et al. 2011). Wetlands provide excellent habitats for migratory waterbirds and shorebirds, for feeding, nesting, and rearing young ones, and as wintering grounds or stopover grounds (Anand et al. 2023). Many wetlands in India face the threat of degradation and loss due to expanding developmental and commercial activities (Fraser et al. 2005; Prigent et al. 2012).

The present work was carried out to record the current avian diversity of the BBBS and to compare the present data with previous studies to determine its current diversity status.

MATERIAL AND METHODS

A survey was conducted for 154 days, between October 2022 and March 2024 on the avian diversity of BBBS. During the study period, field surveys were carried out periodically in all seasons: winter, pre-monsoon, monsoon, and post-monsoon. The surveys were done by randomized walk (Lambert, 1984), visual encounter survey (Heyer et al. 1994), and point count method (Bibby et al. 2000). On average, 10 days of fieldwork were carried out per month. For observations, binoculars (Nikon Prostaff P3 8 x 30) were used. The observations were conducted in the morning (0600–0900 h) and evening (1530–1730 h).

The area of Bordoibam-Bilmukh (27.340°N, 94.337°E) is 11.25 km² and the altitude is 90–95 m (BirdLife International 2024). The mean annual rainfall of the district is 300 cm and experiences 31°C and 7°C maximum and minimum temperatures, respectively, in the district (NWAA 2010).

For the identification of the avian species, Grimmett et al. (2011); Grewal et al. (2016), and Samarpan (2019) field guides were used. The World Bird Database (Lepage 2016) and merlin.allaboutbirds.org were used for updated nomenclature.

RESULTS

A total of 47 avian species have been recorded from the current study in the Bordoibam-Bilmukh Bird Sanctuary. All the 47 bird species recorded from the study area belong to 16 orders and 29 families where the order Passeriformes was recorded with the highest number of avian species (15 species). Among the families, the highest number of species (five species) was recorded under the family Ardeidae. On the other hand, four species were recorded under the families Rallidae and Sturnidae. Family Ciconiidae comprised three species followed by Anatidae, Columbidae, Corvidae, Jacanidae, Motacillidae, and Megalaimidae (each with two species). In case of the families Accipitridae, Alcedinidae, Charadriidae, Cisticolidae, Coraciidae, Cuculidae, Dicruridae, Falconidae, Laniidae, Meropidae, Muscicapidae, Oriolidae, Paridae, Phalacrocoracidae, Psittaculidae, Pycnonotidae, Strigidae, Threskiornithidae and Upupidae only one species each were recorded during the study period.

Three of the recorded bird species, viz., Brown Shrike *Lanius cristatus*, Citrine Wagtail *Motacilla citreola*, and White Wagtail *Motacilla alba*, were winter migratory

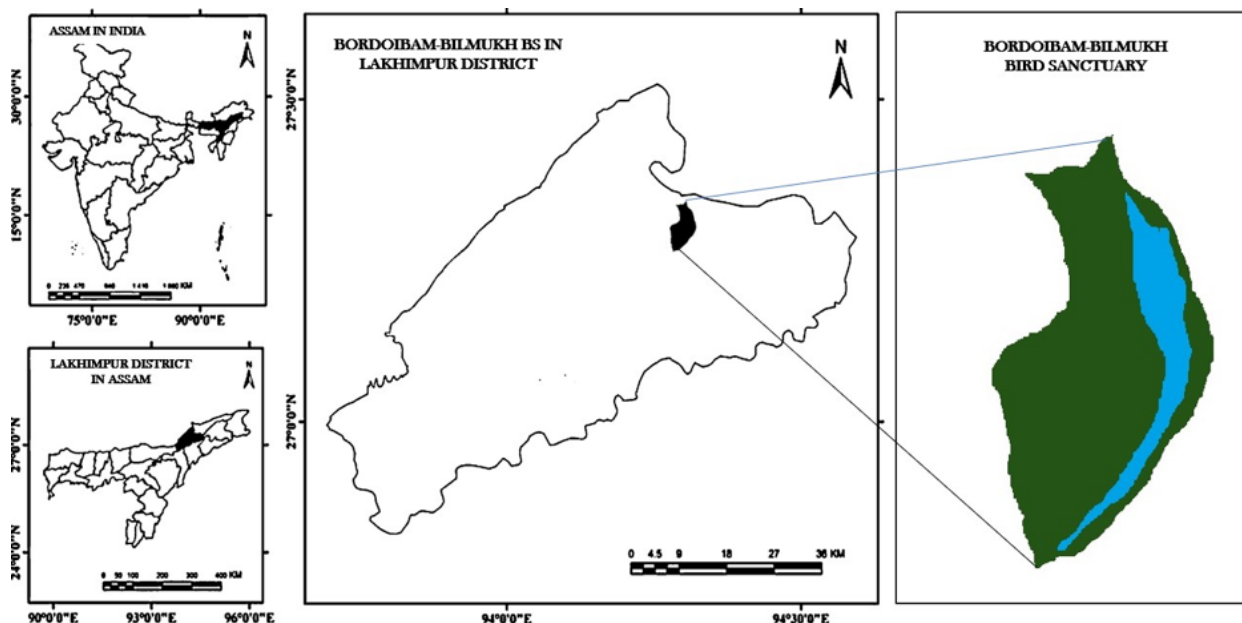


Figure 1. Map of Bordoibam-Bilmukh Bird Sanctuary, Lakhimpur.

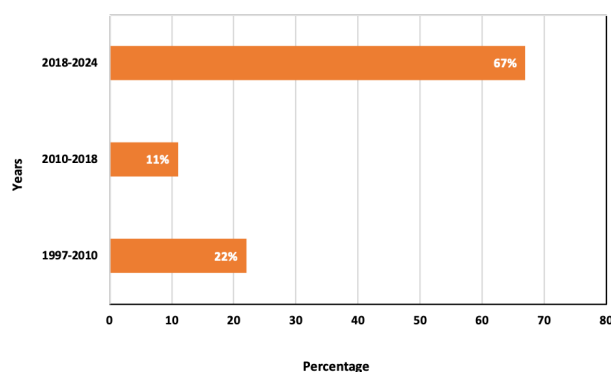


Figure 2. Percentage decline of bird species among the studies.

birds and Lesser Kestrel *Falco naumanni* was a summer migratory. The rest 43 bird species were resident of the wetland and found in different numbers throughout the seasons. Two bird species, viz., Lesser Adjutant *Leptoptilos javanica* and Greater Adjutant *Leptoptilos dubius* are listed as 'Near Threatened' species on the IUCN Red List (Version 3.1, 2023). All the other bird species are listed as 'Least Concern' species.

DISCUSSION

Comparing the diversity data from 1997 to 2024, a drastic decline in bird species is observed. Phukan et al. (1997) recorded 167 bird species earlier. In another

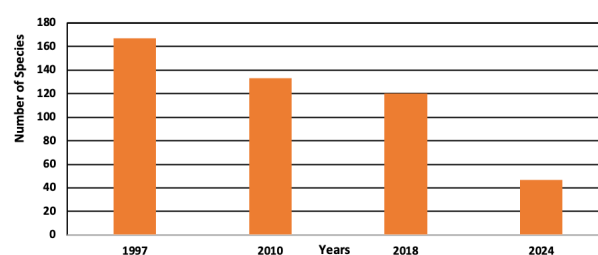


Figure 3. Number of species recorded in previous years (as reported in earlier studies) and present work.

study, a total of 133 species of birds belonging to 41 families were recorded, out of which 86 species were resident, 23 were migratory and 24 were local migrants (Dutta et al. 2011). To evaluate the biodiversity and habitat conservation condition of BBBS, another preliminary study was carried out between April 2017 and March 2018 (Sonowal et al. 2018). The survey recorded 133 species of macrophytes, seven species of aquatic ferns, 68 species of fish, and 120 species of birds. In the present study, a decline in the avian diversity of the sanctuary was observed and the total number of bird species recorded was only 47 (Figure 2) which is significantly lower than the previous records. In every previous study, the avian diversity has been observed to be declining (Figure 3). Many groups of birds such as waterbirds, wood pecker, flower pecker, barbets, bea-eaters, babblers, pigeons and doves, kites, eagles, vultures, falcons, herons, bulbul, sunbirds, weavers and munias which were recorded in previous studies, were

Table 1. Shows all the species recorded along with the details of their families, seasonality, and IUCN Red List status.

| Order | Family | | Scientific name | Common name | IUCN Red List | Phenological status |
|-----------------|-------------------|----|---------------------------------|----------------------------|---------------|---------------------|
| Accipitriformes | Accipitridae | 01 | <i>Milvus migrans</i> | Black Kite | LC | R |
| Anseriformes | Anatidae | 02 | <i>Dendrocygna javanica</i> | Lesser Whistling-Duck | LC | R |
| | | 03 | <i>Dendrocygna bicolor</i> | Fulvous Whistling-Duck | LC | R |
| Bucerotiformes | Upupidae | 04 | <i>Upupa epops</i> | Common Hoopoe | LC | R |
| Charadriiformes | Charadriidae | 05 | <i>Vanellus indicus</i> | Red-wattled Lapwing | LC | R |
| | Jacanidae | 06 | <i>Hydrophasianus chirurgus</i> | Pheasant-tailed Jacana | LC | R |
| | | 07 | <i>Metopidius indicus</i> | Bronze-winged Jacana | LC | R |
| Ciconiiformes | Ciconiidae | 08 | <i>Anastomus oscitans</i> | Asian Openbill | LC | R |
| | | 09 | <i>Leptoptilos javanica</i> | Lesser Adjutant | NT | R |
| | | 10 | <i>Leptoptilos dubius</i> | Greater Adjutant | NT | R |
| Columbiformes | Columbidae | 11 | <i>Spilopelia chinensis</i> | Eastern Spotted Dove | LC | R |
| | | 12 | <i>Treron phoenicopterus</i> | Yellow-footed Green-Pigeon | LC | R |
| Coraciiformes | Alcedinidae | 13 | <i>Alcedo atthis</i> | Common Kingfisher | LC | R |
| | Coraciidae | 14 | <i>Coracias benghalensis</i> | Indian Roller | LC | R |
| | Meropidae | 15 | <i>Merops leschenaulti</i> | Chestnut-headed Bee-eater | LC | R |
| Cuculiformes | Cuculidae | 16 | <i>Eudynamis scolopaceus</i> | Asian Koel | LC | R |
| Falconiformes | Falconidae | 17 | <i>Falco naumanni</i> | Lesser Kestrel | LC | SV |
| Gruiformes | Rallidae | 18 | <i>Gallinula chloropus</i> | Common Moorhen | LC | R |
| | | 19 | <i>Amaurornis phoenicurus</i> | White-breasted Waterhen | LC | R |
| | | 20 | <i>Porphyrio porphyrio</i> | Purple Swampphen | LC | R |
| | | 21 | <i>Gallicrex cinerea</i> | Watercock | LC | R |
| Passeriformes | Cisticolidae | 22 | <i>Orthotomus sutorius</i> | Common Tailorbird | LC | R |
| | Corvidae | 23 | <i>Dendrocitta vagabunda</i> | Rufous Treepie | LC | R |
| | | 24 | <i>Corvus culminatus</i> | Indian Jungle Crow | LC | R |
| | Dicruridae | 25 | <i>Dicrurus macrocercus</i> | Black Drongo | LC | R |
| | Laniidae | 26 | <i>Lanius cristatus</i> | Brown Shrike | LC | WV |
| | Motacillidae | 27 | <i>Motacilla citreola</i> | Citrine Wagtail | LC | WV |
| | | 28 | <i>Motacilla alba</i> | White Wagtail | LC | WV |
| | Muscicapidae | 29 | <i>Copsychus saularis</i> | Oriental Magpie-Robin | LC | R |
| | Oriolidae | 30 | <i>Oriolus xanthornus</i> | Black-hooded Oriole | LC | R |
| | Paridae | 31 | <i>Parus major</i> | Great Tit | LC | R |
| | Pycnonotidae | 32 | <i>Pycnonotus cafer</i> | Red-vented Bulbul | LC | R |
| | Sturnidae | 33 | <i>Gracupica contra</i> | Indian Pied Starling | LC | R |
| | | 34 | <i>Sturnia malabarica</i> | Chestnut-tailed Starling | LC | R |
| | | 35 | <i>Acridotheres tristis</i> | Common Myna | LC | R |
| | | 36 | <i>Acridotheres fuscus</i> | Jungle Myna | LC | R |
| Pelecaniformes | Ardeidae | 37 | <i>Ardeola grayii</i> | Indian Pond-Heron | LC | R |
| | | 38 | <i>Bubulcus ibis</i> | Cattle Egret | LC | R |
| | | 39 | <i>Egretta garzetta</i> | Little Egret | LC | R |
| | | 40 | <i>Ardea intermedia</i> | Intermediate Egret | LC | R |
| | | 41 | <i>Ardea alba</i> | Great White Egret | LC | R |
| | Threskiornithidae | 42 | <i>Plegadis falcinellus</i> | Glossy Ibis | LC | R |

| Order | Family | | Scientific name | Common name | IUCN Red List | Phenological status |
|----------------|-------------------|----|----------------------------------|----------------------|---------------|---------------------|
| Piciformes | Megalaimidae | 43 | <i>Psilopogon haemacephalus</i> | Coppersmith Barbet | LC | R |
| | | 44 | <i>Psilopogon asiaticus</i> | Blue-throated Barbet | LC | R |
| Psittaciformes | Psittacidae | 45 | <i>Alexandrinus krameri</i> | Rose-ringed Parakeet | LC | R |
| Strigiformes | Strigidae | 46 | <i>Glaucidium brodiei</i> | Collared Owlet | LC | R |
| Suliformes | Phalacrocoracidae | 47 | <i>Phalacrocorax fuscicollis</i> | Indian Cormorant | LC | R |

LC—Least Concern | NC—Near Threatened | R—Resident | WV—Winter Visitor | SV—Summer Visitor.

not recorded during the present study.

In the present study, it was observed that the major causes of species decline were various human activities by the local people. The degradation of wetland habitat may cause the water table to drop, the food chain to get disrupted, eventually migratory bird populations to decline, and the nutrient cycle to slow down, all of which are detrimental to the environment, ecosystem, and human beings (Kumar & Kanaujia 2014). Also, the destruction of the breeding grounds for the illegal collection of eggs and meat of various birds for consumption and conversion to farmland makes them unsuitable for migratory as well as resident species. Out of the 154 days of fieldwork, on around 101 days, the people of the nearby localities were observed to be fishing in the wetland area of the bird sanctuary, which is the primary foraging and breeding ground for many residents and migratory bird species. During fishing, they spread nets all over the wetland just below the water surface and wait for 7–8 h. But tragically, the feet of the birds get trapped in the net and the birds suffer, some even die. Both adults and children in the locality were seen with slingshots. They kill birds and destroy their nest on trees and shrubs with the slingshots not only because of their meat but also because of it as a sport. Furthermore, the cultivation of rice and other crops on the lands adjacent to the shore of the wetland using tractors and other farming machinery is also posing a threat to species diversity. Agriculture has been identified as the largest global threat to birds' survival (Green et al. 2005). Maas et al. (2013) also identified agricultural intensification as the major cause of the decline of most bird populations. The noise of these machines and the people involved in cultivation within the boundary of a bird sanctuary disturb its wildlife. Wetlands affected by developing intensive farming systems have lowered the species diversity (Golzar et al. 2019).

Anthropogenic activities such as fishing, and poaching of birds such as Lesser Whistling-Duck *Dendrocygna javanica*, Fulvous Whistling-Duck *Dendrocygna bicolor*,

White-breasted Waterhen *Amaurornis phoenicurus*, Indian Pond-Heron *Ardeola grayii*, Eastern Spotted Dove *Spilopelia chinensis*, Yellow-footed Green-Pigeon *Treron phoenicopterus* and the use of the bird sanctuary land as pasture area, cultivating crops using machines with high decibel sound force the resident and most of the migratory birds to change their foraging and/or breeding grounds to somewhere else. Sonowal et al. (2018) also reported raising cattle, overfishing, harvesting aquatic plants in excess, poaching wild birds, and collecting bird eggs harmed the overall ecosystem and biodiversity including the avian species of the sanctuary. Adverse effects of anthropogenic disturbances, natural calamities, and climate change can greatly affect the quality and quantity of habitats for birds in terms of resources and shelter, which can further affect their diversity, abundance, and distribution (Chen et al. 2011; Şekercioğlu et al. 2012). According to the last IBA conservation assessment result (BirdLife International 2024), some threats identified on the species and their habitats were human intrusion and disturbance, agriculture expansion and intensification, and pollution. Previously, Sonowal et al. (2018) also reported encroachment in the sanctuary area by the local people for agricultural purposes. Encroachment in BBBS was also observed in the present study which corroborates with that of Sonowal et al. (2018) and indicates that there has not been any decrease in the negative human activities in the sanctuary which in turn affects the avian species negatively showing a drastic decline in its diversity.

CONCLUSION

The Bordoibam-Bilmukh Bird Sanctuary has been the home to a large number of avian species with other flora and fauna. A maximum of 167 species of birds have been reported to date from here, which depicts its rich avifaunal wealth. But the rapid decline in avian diversity is a sign of declining overall biodiversity which needs

immediate attention and action for the restoration and conservation of both fauna and flora. If no action is taken immediately, more damage will occur in the coming years and its significance as a bird sanctuary will be lost forever. Immediate steps for habitat restoration and to develop management initiatives in the Bordoibam-Bilmukh Bird Sanctuary to safeguard avian diversity are required.

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