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Journal of Threatened Taxa

10.11609/jott.2024.16.10.25951-26062
www.threatenedtaxa.org

26 October 2024 (Online & Print)
16(10): 25951–26062
ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

Open Access

ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

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

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 October 2024 | 16(10): 26001–26006

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

https://doi.org/10.11609/jott.9262.16.10.26001-26006

#9262 | Received 04 July 2024 | Final received 14 September 2024 | Finally accepted 01 October 2024

OPEN ACCESS

COMMUNICATION

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.

Editor: H. Byju, Coimbatore, Tamil Nadu, India.

Date of publication: 26 October 2024 (online & print)

Citation: Saikia, L., S.S. Bora & K.S. Das (2024). A drastic decline in avian diversity in and around the Bordoibam-Bilmukh Bird Sanctuary, Lakhimpur, Assam, India. *Journal of Threatened Taxa* 16(10): 26001–26006. https://doi.org/10.11609/jott.9262.16.10.26001-26006

Funding: Self funded.

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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.

Competing interests: The authors declare no competing interests.

Acknowledgements: The authors would like to thank the authority of Bordoibam-Bilmukh Bird Sanctuary, Lakhimpur, for the permission to conduct the fieldwork in the bird sanctuary. The authors would also like to express their gratitude to Mr. Dipak Raito for his help in getting the permission from concerned authority for the present survey.

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^{0}N, 94.337^{0}E) is 11.25 km^2 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

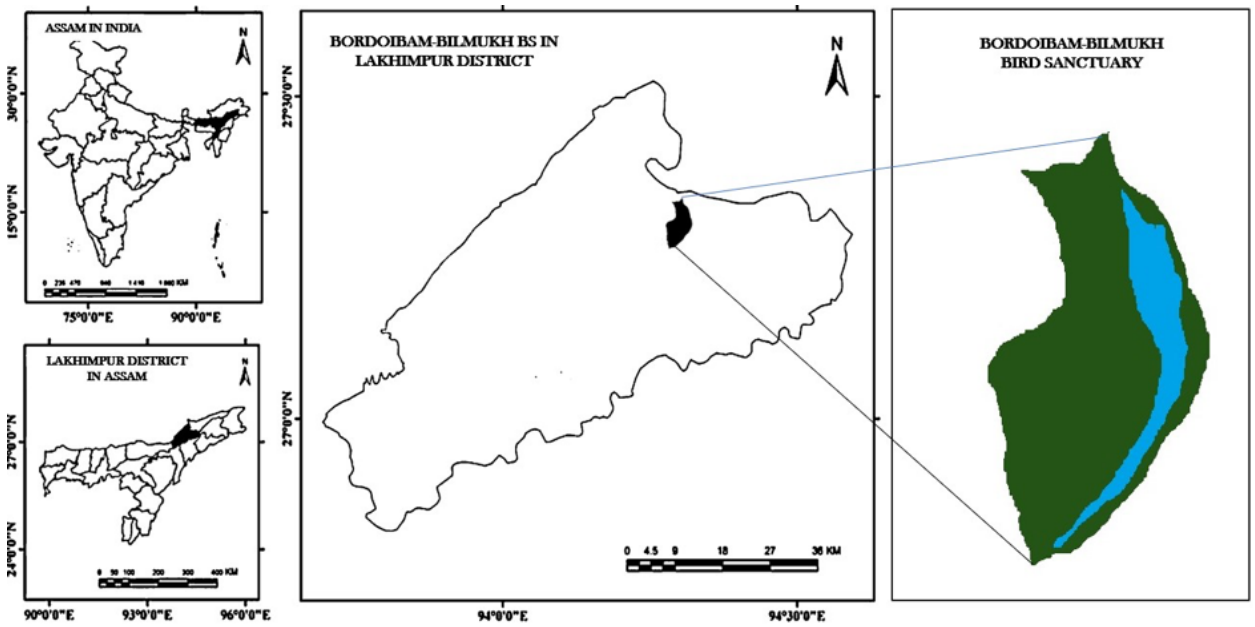

Figure 1. Map of Bordoibam-Bilmukh Bird Sanctuary, Lakhimpur.

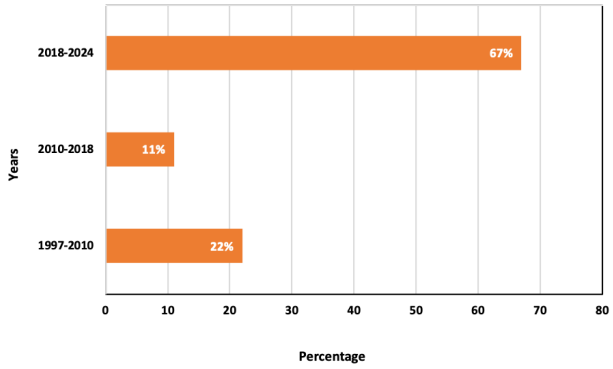

Figure 2. Percentage decline of bird species among the studies.

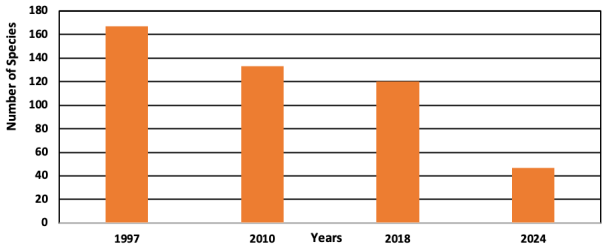

Figure 3. Number of species recorded in previous years (as reported in earlier studies) and present work.

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

Order	Family		Scientific name	Common name	IUCN Red List	Phenological status
Piciformes	Megalaimidae	43	*Psilopogon haemacephalus*	Coppersmith Barbet	LC	R
		44	*Psilopogon asiaticus*	Blue-throated Barbet	LC	R
Psittaciformes	Psittacidae	45	*Alexandrinus krameri*	Rose-ringed Parakeet	LC	R
Strigiformes	Strigidae	46	*Glaucidium brodiei*	Collared Owlet	LC	R
Suliformes	Phalacrocoracidae	47	*Phalacrocorax fuscicollis*	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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Journal of Threatened Taxa is indexed/abstracted in Bibliography of Systematic Mycology, Biological Abstracts, BIOSIS Previews, CAB Abstracts, EBSCO, Google Scholar, Index Copernicus, Index Fungorum, JournalSeek, National Academy of Agricultural Sciences, NewJour, OCLC WorldCat, SCOPUS, Stanford University Libraries, Virtual Library of Biology, Zoological Records.

NAAS rating (India) 5.64

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Journal of Threatened Taxa

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

October 2024 | Vol. 16 | No. 10 | Pages: 25951–26062
Date of Publication: 26 October 2024 (Online & Print)
DOI: 10.11609/jott.2024.16.10.25951-26062

Publisher & Host

WILD zoOreach
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