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

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COMMUNICATION

Importance based on avian diversity of Pakhibitan Bird & Wildlife Sanctuary, Jalpaiguri District, West Bengal, India

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Abstract: A comprehensive inventory of faunal and floral species in a specific region holds significant value for scientific investigation. This study was conducted between 2015 and 2021, especially during the winter season, in Pakhibitan Bird & Wildlife Sanctuary (also known as Gajoldoba wetland) in West Bengal, which was established in 2016. This wetland surrounded by forests is located on the upper section of the Teesta Barrage in the Dooars region of Jalpaiguri District, and it attracts birds from the Central Asian Flyway. Around 124 bird species belonging to 14 orders and 37 families were documented. Passeriformes with 32 species, and Anatidae with 23 species, are the most abundant groups. Based on the IUCN Red Data Book (2022–23), six species are Near Threatened, four are Vulnerable, and one Endangered. About 50% of birds were resident, 44% migratory, and 6% local migrants.

Keywords: Avian communities, Central Asian Flyway, conservation efforts, Gajoldoba, habitat detoriation, migratory birds, protected areas, Ramsar site, Teesta barrage, wetland.

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Author contributions: ABR provided supervision and helped with the data collection and infrastructural facilities. TS, CSS and AR performed the result analysis and prepared original draft of the manuscript. LC collected the data and clicked pictures of the bird species and DD assisted in data collection in the field. AG provided support and guidance for the study. All authors reviewed the paper.

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INTRODUCTION

The Ramsar Convention recognizes the global significance of wetlands, especially as a habitat for waterfowl. According to the Convention's text (Article 1.1), wetlands are described as areas that can be natural or man-made, permanent or temporary, with either still or flowing water. They can be marshes, fens, peatlands, or bodies of water, including marine areas not deeper than 6m at low tide. Wetlands are crucial ecosystems, interconnected both socially and physically with processes occurring in a broader region. The Ramsar Convention aims to conserve the worldwide degradation of wetlands through sustainable management. It is an intra-governmental treaty that supports national action (Chandra et al. 2021; Roy et al. 2022). As India has increased the Ramsar sites to 85, many wetlands in India still face the threat of degradation and loss due to expanding developmental and commercial activities (Byju et al. 2023a). The risk of wetlands in Ramsar sites has increased with global warming and the rising sea level (Xi et al. 2020). They play a vital role in facilitating the movement of aquatic animals and promoting local species diversity (Amezaga et al. 2002). The shallow and unpredictable water regimes support unique biotic communities characterized by varied plants and animals adapted to these conditions (Weller 1999). The decline and deterioration of wetlands have negatively impacted waterbirds depending on wetlands for survival. Well-managed wetlands can serve as alternative or supplementary habitats for waterbirds and other associated birds, helping to alleviate the adverse effects of wetland decline and deterioration (Ma et al. 2010; Brandolin et al. 2013).

An example of a significant controlled wetland is the Pakhibitan Bird & Wildlife Sanctuary, also known as the Gajoldoba wetland, located in the northern region of West Bengal, India in the Dooars region of Jalpaiguri District in the Himalayan foothills. The upper section of the Teesta Barrage was the first reservoir constructed in the Teesta Basin for irrigation. Due to the dam construction, migratory birds have gathered in this landlocked water body surrounded by forests within the Central Asian Flyway (CAF). The wetland diversity of Gajoldoba, the newly established Pakhibitan Bird & Wildlife Sanctuary, has no detailed studies on the diversity of birds. In this background, the current study highlights the status and diversity of birds.

MATERIALS AND METHODS

Study Area

The Pakhibitan Bird & Wildlife Sanctuary is situated near the eastern bank of the Teesta barrage, specifically between 26.751N and 88.575E (Image 14). The mean temperature in this region varies 6.9–32.8 ^{0}C, and the yearly precipitation is approximately 3,160 mm. The monsoon season, which occurs from June to September, accounts for around 78% of the region's total rainfall. In contrast, the winter months of December to February contribute only 0.98% of the region's precipitation. The water level at Pakhibitan Bird & Wildlife Sanctuary peaks during the winter due to the closure of most of the barrage gates (Datta 2011). The sanctuary is approximately 64km from Siliguri in the Dooars region of West Bengal, India. It is a small yet picturesque area with rich biodiversity and natural beauty. The sanctuary is bounded by the lush and dense tropical forests of Baikunthapur, part of the Terai region of western Dooars. The Mahananda River flows to the west of the sanctuary, while the river Teesta meanders along its eastern side. This forested area supports a diverse array of wildlife, including a population of wild elephants. The sanctuary is divided between two districts: one part lies in the Jalpaiguri district, while the other area is in the Darjeeling district. Additionally, the Apalchand forest is located adjacent to the eastern bank of the Teesta River, further enhancing the ecological significance of the region. The sanctuary's location in Malbazar within the Jalpaiguri district places it in a vital position for conservation efforts and biodiversity studies. The construction of the Teesta barrage, initiated by Late Jyoti Basu, the former Chief Minister of West Bengal, on January 19, 1987, has played a crucial role in shaping the current ecological landscape of the sanctuary.

Methods

The survey was conducted during the winter season every week from 2015 to 2021. The species checklist was recorded through direct observation from 0600 h to 1600 h. The direct observation method used in this study (Bibby et al. 2000) emphasizes systematic and repeatable observations for accurate data collection in ornithological studies. Birds were observed from a boat using Olympus binoculars (10 x 50) for close-up observations. Species photography was carried out using a Nikon B600 camera. The checklist of birds was prepared following Grimmett et al. (2016). The IUCN status of the birds was determined using website (IUCN, 2023). Based on their movements and seasonal occurrence, the birds

were categorized into three groups: Migratory (M), Local Migrant (LM), and Resident (R). Statistical analysis was performed using Microsoft Excel.

RESULTS

A total of 124 bird species representing 14 orders and 37 families were observed in the current study. The order Passeriformes was the most prevalent, with 15 families and 32 species. It was followed by Anseriformes, which had one family and 23 species, Charadriiformes with seven families and 21 species, Accipitriformes with two families and 12 species, Pelecaniformes with two families and 11 species, Gruiformes with one family and six species, and Coraciiformes with two families and four species. Orders Ciconiiformes, Falconiformes, Podicipediformes, and Suliformes, consist of one family with three species each. In the case of Caprimulgiformes, Columbiformes, and Cuculiformes, each order has one family with one species each (Table 1, Images 1–12). Out of the 124 species documented, 77 bird species from 10 orders and 18 families were shown to have a direct dependence or association with the wetland.

Out of the 124 species of avifauna listed in Table 1, 113 are classified as 'Least Concern' (LC) according to the IUCN Red List. Six species—Ferruginous Pochard *Aythya nyroca*, Falcated Duck *Mareca falcata*, Himalayan Griffon *Gyps himalayensis*, Northern Lapwing *Vanellus vanellus*, River Lapwing *Vanellus duvaucelii*, and Great Thick-knee *Esacus recurvirostris*—are categorized as 'Near Threatened' (NT). Four species classified as 'Vulnerable' (VU) are the Common Pochard *Aythya ferina* (VU), Indian Spotted Eagle *Clanga hastata* (VU), Imperial Eagle *Aquila heliaca* (VU), and Lesser Adjutant *Leptoptilos javanicus* (VU). The Steppe Eagle *Aquila nipalensis* is classified as 'Endangered' (EN).

The residential status of observed species shows that 50% of the total species were resident (R) and 44% were migratory (M). Rest 6% of birds were local migrants (LM) (Table 3). Among the avian families, Anatidae and Ardeidae are the only dominant avian families from Winter Migrant and Resident status, respectively.

DISCUSSION

The avian diversity observed in Pakhibitan Bird & Wildlife Sanctuary underscores the ecological significance of this wetland habitat (Image 13). This study provides crucial insights into the bird species composition and their conservation status, which can make targeted conservation efforts. The results of this study showed a dominance of Passeriformes and Anatidae consistent

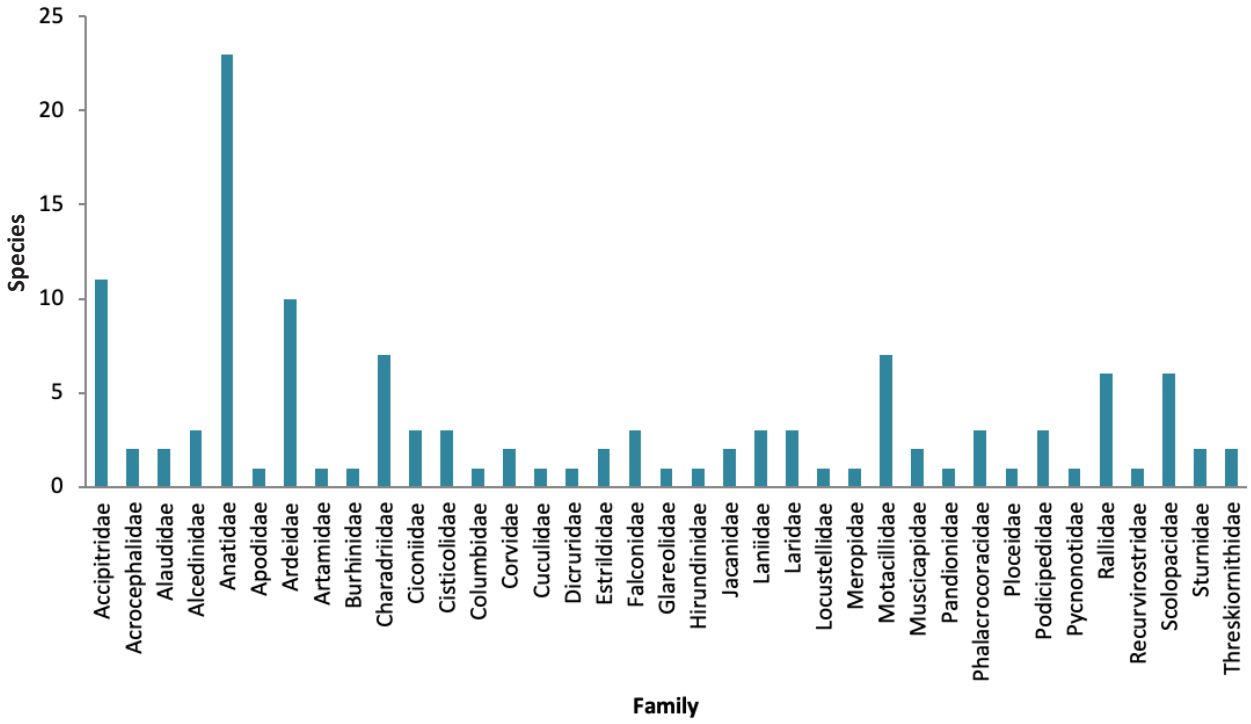

Figure 1. Family-wise distribution of avifauna in Pakhibitan Bird & Wildlife Sanctuary.

Table 1. List of observed species from Pakhibitan Bird & Wildlife Sanctuary 2015 to 2021.

	Common name	Scientific name	IUCN Red List status	Migration status	Dependence on waterbodies
Order: Anseriformes					
Family: Anatidae					
1	Lesser Whistling-duck	*Dendrocygna javanica* (Horsfield, 1821)	LC	R	WA
2	Cotton Pygmy-Goose	*Nettapus coromandelianus* (Gmelin, 1789)	LC	R	WA
3	Bar-headed Goose	*Anser indicus* (Latham, 1790)	LC	M	WA
4	Bean Goose	*Anser fabalis* (Latham, 1787)	LC	M	WA
5	Greylag Goose	*Anser anser* (Linnaeus, 1758)	LC	M	WA
6	Common Shelduck	*Tadorna tadorna* (Linnaeus, 1758)	LC	M	WA
7	Ruddy Shelduck	*Tadorna ferruginea* (Pallas, 1764)	LC	M	WA
8	Gadwall	*Mareca strepera* (Linnaeus, 1758)	LC	M	WA
9	Eurasian Wigeon	*Mareca penelope* (Linnaeus, 1758)	LC	M	WA
10	Northern Shoveler	*Spatula clypeata* (Linnaeus, 1758)	LC	M	WA
11	Mallard	*Anas platyrhynchos* (Linnaeus, 1758)	LC	M	WA
12	Garganey	*Spatula querquedula* (Linnaeus, 1758)	LC	M	WA
13	Northern Pintail	*Anas acuta* (Linnaeus, 1758)	LC	M	WA
14	Common Teal	*Anas crecca* (Linnaeus, 1758)	LC	M	WA
15	Red-crested Pochard	*Netta rufina* (Pallas, 1773)	LC	M	WA
16	Common Pochard	*Aythya ferina* (Linnaeus, 1758)	VU	M	WA
17	Ferruginous Pochard	*Aythya nyroca* (Güldenstädt, 1770)	NT	M	WA
18	Tufted Duck	*Aythya fuligula* (Linnaeus, 1758)	LC	M	WA
19	Falcated Duck	*Mareca falcata* (Georgi, 1775)	NT	M	WA
20	Common Merganser	*Mergus merganser* (Linnaeus, 1758)	LC	M	WA
21	Red-breasted Merganser	*Mergus serrator* (Linnaeus, 1758)	LC	M	WA
22	Smew	*Mergellus albellus* (Linnaeus, 1758)	LC	M	WA
23	Common Goldeneye	*Bucephala clangula* (Linnaeus, 1758)	LC	M	WA
Order: Podicipediformes					
Family: Podicipedidae					
24	Little Grebe	*Tachybaptus ruficollis* (Pallas, 1764)	LC	R	WA
25	Great-crested Grebe	*Podiceps cristatus* (Linnaeus, 1758)	LC	M	WA
26	Black-necked Grebe	*Podiceps nigricollis* (Brehm, 1831)	LC	M	WA
Order: Ciconiiformes					
Family: Ciconiidae					
27	Asian Openbill	*Anastomus oscitans* (Boddaert, 1783)	LC	R	WA
28	Lesser Adjutant	*Leptoptilos javanicus* (Horsfield, 1821)	VU	R	WA
29	Black Stork	*Ciconia nigra* (Linnaeus, 1758)	LC	M	WA
Order: Pelecaniformes					
Family: Threskiornithidae					
30	Glossy Ibis	*Plegadis falcinellus* (Linnaeus, 1766)	LC	LM	WA
31	Red-naped Ibis	*Pseudibis papillosa* (Temminck, 1824)	LC	R	WA
Family: Ardeidae					
32	Indian Pond Heron	*Ardeola grayii* (Sykes, 1832)	LC	R	WA
33	Grey Heron	*Ardea cinerea* (Linnaeus, 1758)	LC	R	WA
34	Purple Heron	*Ardea purpurea* (Linnaeus, 1766)	LC	R	WA
35	Cattle Egret	*Bubulcus ibis* (Linnaeus, 1758)	LC	R	

	Common name	Scientific name	IUCN Red List status	Migration status	Dependence on waterbodies
36	Intermediate Egret	*Ardea intermedia* (Wagler, 1829)	LC	R	WA
37	Great Egret	*Ardea alba* (Linnaeus, 1758)	LC	R	WA
38	Little Egret	*Egretta garzetta* (Linnaeus, 1766)	LC	R	WA
39	Yellow Bittern	*Ixobrychus sinensis* (Gmelin, 1789)	LC	R	WA
40	Black Bittern	*Ixobrychus flavicollis* (Latham, 1790)	LC	R	WA
Order: Suliformes					
Family: Phalacrocoracidae					
41	Little Cormorant	*Microcarbo niger* (Vieillot, 1817)	LC	R	WA
42	Indian Cormorant	*Phalacrocorax fuscicollis* (Stephens, 1826)	LC	LM	WA
43	Great Cormorant	*Phalacrocorax carbo* (Linnaeus, 1758)	LC	LM	WA
Order: Columbiformes					
Family: Columbidae					
44	Spotted Dove	*Spilopelia suratensis* (Gmelin, 1789)	LC	R	
Order: Cuculiformes					
Family: Cuculidae					
45	Greater Coucal	*Centropus sinensis* (Stephens, 1815)	LC	R	
Order: Accipitriformes					
Family: Accipitridae					
46	Black Kite	*Milvus migrans* (Boddaert, 1783)	LC	R	
47	Himalayan Griffon	*Gyps himalayensis* (Hume, 1869)	NT	R	
48	Eurasian Marsh Harrier	*Circus aeruginosus* (Linnaeus, 1758)	LC	M	
49	Indian Spotted Eagle	*Clanga hastata* (Lesson, 1831)	VU	R	
50	Steppe Eagle	*Aquila nipalensis* (Hodgson, 1833)	EN	M	
51	Booted Eagle	*Hieraaetus pennatus* (Gmelin, 1788)	LC	M	
52	Eastern Imperial Eagle	*Aquila heliaca* (Savigny, 1809)	VU	M	
53	Shikra	*Accipiter badius* (Gmelin, 1788)	LC	R	
54	Pied Harrier	*Circus melanoleucos* (Pennant, 1769)	LC	M	
55	Long-legged Buzzard	*Buteo rufinus* (Cretzschmar, 1827)	LC	M	
56	Short-toed Snake Eagle	*Circaetus gallicus* (Gmelin, 1788)	LC	R	
Family: Pandionidae					
57	Osprey	*Pandion haliaetus* (Linnaeus, 1758)	LC	M	WA
Order: Falconiformes					
Family: Falconidae					
58	Common Kestrel	*Falco tinnunculus* (Linnaeus, 1758)	LC	M	
59	Peregrine Falcon	*Falco peregrinus* (Tunstall, 1771)	LC	M	
60	Red-necked Falcon	*Falco ruficollis* (Swainson, 1837)	LC	M	
Order: Gruiformes					
Family: Rallidae					
61	White-breasted Waterhen	*Amaurornis phoenicurus* (Pennant, 1769)	LC	R	WA
62	Ruddy-breasted Crake	*Zapornia fusca* (Linnaeus, 1766)	LC	R	WA
63	Baillon's Crake	*Zapornia pusilla* (Pallas, 1776)	LC	R	WA
64	Common Moorhen	*Gallinula chloropus* (Linnaeus, 1758)	LC	R	WA
65	Eurasian Coot	*Fulica atra* (Linnaeus, 1758)	LC	LM	WA
66	Grey-headed Swamphen	*Porphyrio porphyrio*(Linnaeus, 1758)	LC	R	WA

	Common name	Scientific name	IUCN Red List status	Migration status	Dependence on waterbodies
Order: Charadriiformes					
Family: Charadriidae					
67	Northern Lapwing	*Vanellus vanellus* (Linnaeus, 1758)	NT	M	WA
68	Red-wattled Lapwing	*Vanellus indicus* (Boddaert, 1783)	LC	R	
69	River Lapwing	*Vanellus duvaucelii* (Lesson, 1826)	NT	R	WA
70	Pacific Golden Plover	*Pluvialis fulva* (Gmelin, 1789)	LC	M	WA
71	Little-ringed Plover	*Charadrius dubius* (Scopoli, 1786)	LC	R	WA
72	Kentish Plover	*Charadrius alexandrinus* (Linnaeus, 1758)	LC	LM	WA
73	Lesser Sand Plover	*Charadrius mongolus* (Pallas, 1776)	LC	M	WA
Family: Jacanidae					
74	Bronze-winged Jacana	*Metopidius indicus* (Latham, 1790)	LC	R	WA
75	Pheasant-tailed Jacana	*Hydrophasianus chirurgus* (Scopoli, 1786)	LC	R	WA
Family: Scolopacidae					
76	Common Greenshank	*Tringa nebularia* (Gunnerus, 1767)	LC	M	WA
77	Common Redshank	*Tringa totanus* (Linnaeus, 1758)	LC	M	WA
78	Wood Sandpiper	*Tringa glareola* (Linnaeus, 1758)	LC	M	WA
79	Common Sandpiper	*Actitis hypoleucos* (Linnaeus, 1758)	LC	M	WA
80	Little Stint	*Calidris minuta* (Leisler, 1812)	LC	M	WA
81	Temminck's Stint	*Calidris temminckii* (Leisler, 1812)	LC	M	WA
Family: Recurvirostridae					
82	Black-winged Stilt	*Himantopus himantopus* (Linnaeus, 1758)	LC	LM	WA
Family: Laridae					
83	Pallas's Gull	*Larus ichthyaetus*(Pallas, 1773)	LC	M	WA
84	Brown-headed Gull	*Larus brunnicephalus* (Jerdon, 1840)	LC	M	WA
85	Black-headed Gull	*Larus ridibundus* (Linnaeus, 1766)	LC	M	WA
Family: Glareolidae					
86	Small Pratincole	*Glareola lactea* (Temminck, 1820)	LC	R	WA
Family: Burhinidae					
87	Great Thick-knee	*Esacus recurvirostris* (Cuvier, 1829)	NT	LM	WA
Order: Caprimulgiformes					
Family: Apodidae					
88	Asian Palm Swift	*Cypsiurus balasiensis* (Gray, 1829)	LC	R	
Order: Coraciiformes					
Family: Alcedinidae					
89	White-breasted Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	LC	R	WA
90	Common Kingfisher	*Alcedo atthis*(Linnaeus, 1758)	LC	R	WA
91	Pied Kingfisher	*Ceryle rudis* (Linnaeus, 1758)	LC	R	WA
Family: Meropidae					
92	Asian Green Bee-eater	*Merops orientalis* (Latham, 1802)	LC	R	
Order: Passeriformes					
Family: Dicruridae					
93	Black Drongo	*Dicrurus macrocercus* (Vieillot, 1817)	LC	R	
Family: Artamidae					
94	Ashy Woodswallow	*Artamus fuscus* (Vieillot, 1817)	LC	R	

	Common name	Scientific name	IUCN Red List status	Migration status	Dependence on waterbodies
Family: Sturnidae					
95	Common Myna	*Acridotheres tristis* (Linnaeus, 1766)	LC	R	
96	Jungle Myna	*Acridotheres fuscus* (Wagler, 1827)	LC	R	
97	Asian Pied Starling	*Gracupica contra* (Linnaeus, 1758)	LC	R	
Family: Corvidae					
98	House Crow	*Corvus splendens* (Vieillot, 1817)	LC	R	
99	Large-billed Crow	*Corvus macrorhynchos* (Wagler, 1827)	LC	R	
Family: Hirundinidae					
100	Barn Swallow	*Hirundo rustica* (Linnaeus, 1758)	LC	LM	WA
Family: Laniidae					
101	Brown Shrike	*Lanius cristatus* (Linnaeus, 1758)	LC	M	
102	Grey-backed Shrike	*Lanius tephronotus* (Vigors, 1831)	LC	M	
103	Long-tailed Shrike	*Lanius schach* (Linnaeus, 1758)	LC	R	
Family: Alaudidae					
104	Sand Lark	*Alaudala raytal* (Blyth, 1844)	LC	R	
105	Bengal Bushlark	*Mirafra assamica* (Horsfield, 1840)	LC	R	
Family: Cisticolidae					
106	Plain Prinia	*Prinia inornata* (Sykes, 1832)	LC	R	
107	Zitting Cisticola	*Cisticola juncidis* (Rafinesque, 1810)	LC	R	
108	Common Tailorbird	*Orthotomus sutorius* (Pennant, 1769)	LC	R	
Family: Ploceidae					
109	Baya Weaver	*Ploceus philippinus* (Linnaeus, 1766)	LC	R	
Family: Estrildidae					
110	Scaly-breasted Munia	*Lonchura punctulata* (Linnaeus, 1758)	LC	R	
111	Tricolored Munia	*Lonchura malacca* (Linnaeus, 1766)	LC	R	
Family: Acrocephalidae					
112	Clamorous Reed Warbler	*Acrocephalus stentoreus* (Hemprich & Ehrenberg, 1833)	LC	M	
113	Paddyfield Warbler	*Acrocephalus agricola* (Jerdon, 1845)	LC	M	
Family: Locustellidae					
114	Striated Grassbird	*Megalurus palustris* (Horsfield, 1821)	LC	R	
Family: Muscicapidae					
115	White-capped Water-redstart	*Phoenicurus leucocephalus* (Vigors, 1831)	LC	R	
116	Common Stonechat	*Saxicola torquatus* (Linnaeus, 1766)	LC	R	
Family: Pycnonotidae					
117	Red-vented Bulbul	*Pycnonotus cafer* (Linnaeus, 1766)	LC	R	
Family: Motacillidae					
118	Citrine Wagtail	*Motacilla citreola* (Pallas, 1776)	LC	M	WA
119	White Wagtail	*Motacilla alba* (Linnaeus, 1758)	LC	M	WA
120	White-browed Wagtail	*Motacilla maderaspatensis* (Gmelin, 1789)	LC	R	WA
121	Grey Wagtail	*Motacilla cinerea* (Tunstall, 1771)	LC	M	WA
122	Rosy Pipit	*Anthus roseatus* (Blyth, 1847)	LC	M	
123	Paddyfield Pipit	*Anthus rufulus* (Vieillot, 1818)	LC	R	
124	Olive-backed Pipit	*Anthus hodgsoni* (Richmond, 1907)	LC	R	

EN—Endangered | NT—Near Threatened | VU—Vulnerable | LC—Least Concern | R—Resident | LM—Local Migrant | M—Migratory | WA—Water Associated.

Image 1–12. Some recorded species of Pakhibitan Wildlife Sanctuary: 1—Ruddy Shelduck *Tadorna ferruginea* | 2—Steppe Eagle *Aquila nipalensis* | 3—Common Shelduck *Tadorna tadorna* | 4—Himalayan Griffon *Gyps himalayensis* | 5—Great-crested Grebe *Podiceps cristatus* | 6—Great Thick-knee *Esacus recurvirostris* | 7—Bar-headed Goose *Anser indicus* | 8—Pallas's Gull *Larus ichthyaetus* | 9—Bean Goose *Anser fabalis* | 10—Northern Lapwing *Vanellus vanellus* | 11—Common Merganser *Mergus merganser americanus* | 12—Small Pratincole *Glareola lacteal*. © Lina Chatterjee.

with what has been observed in similar wetland habitats across India. For instance, the Dighal Wetland in Haryana and Beas River in Punjab, another significant bird habitat, report a similarly high diversity of bird species within these orders (Kumar & Kler 2021; Kumar & Kumar 2023). The richness of species in these families highlights the sanctuary's role as a crucial habitat for both resident and migratory birds. The sanctuary is home to a wide variety of bird species, showing its importance as a haven for birds. The different species recorded indicated a healthy ecosystem with diverse habitats and resources. This diversity is crucial for conservation and highlights the sanctuary's significance as a key area for protecting birds in the region. The sanctuary hosts six NT, four VU, and one EN species according to the IUCN Red List (2022), highlighting its importance for

Image 13. Habitats of Pakhibitan Wildlife Sanctuary: A—Sandy bed | B—Bank with stone | C—Marshy and bushy area | D—Open water area. © Lina Chatterjee.

avian conservation. This corroborates findings from the Bharatpur Bird Sanctuary, where the presence of threatened species has increased conservation efforts (Verma 2009; Bhadouria et al. 2012). The residential status analysis revealed that 41.94% of the species are residents, 44.35% are migratory, and 13.71% are local migrants. The predominance of migratory species underscores the sanctuary's importance as a stopover and wintering site for migratory birds, aligning with the findings of Byju et al. (2023b), which highlighted the critical role of Indian wetlands in supporting migratory bird populations. Among the avian families, Anatidae and Ardeidae are dominant during the winter migration and resident status periods, respectively. This pattern is consistent with findings from other wetland ecosystems, such as the Chilika Lake (Balachandran et al. 2020), where these families were also prominent. Furthermore, the dependence of 77 species on the wetland environment highlights the sanctuary's ecological significance for water-associated birds. This aligns with the studies of Sundar & Kittur (2013), who emphasized the crucial role of wetlands in supporting diverse avian communities in India. The family-wise distribution indicates that although Anatidae is the most abundant, several families are represented by only one species each, indicating a need for diversified conservation strategies to support all avian families present in the sanctuary.

CONCLUSION

The Pakhibitan Bird & Wildlife Sanctuary is a vital habitat for diversity bird species, including several that are threatened. The findings of this study highlight the urgent need for conservation actions to protect this biodiversity hotspot. By implementing effective management strategies and fostering community and governmental involvement, the sanctuary can be preserved for future generations, ensuring the continued survival of its avian inhabitants.

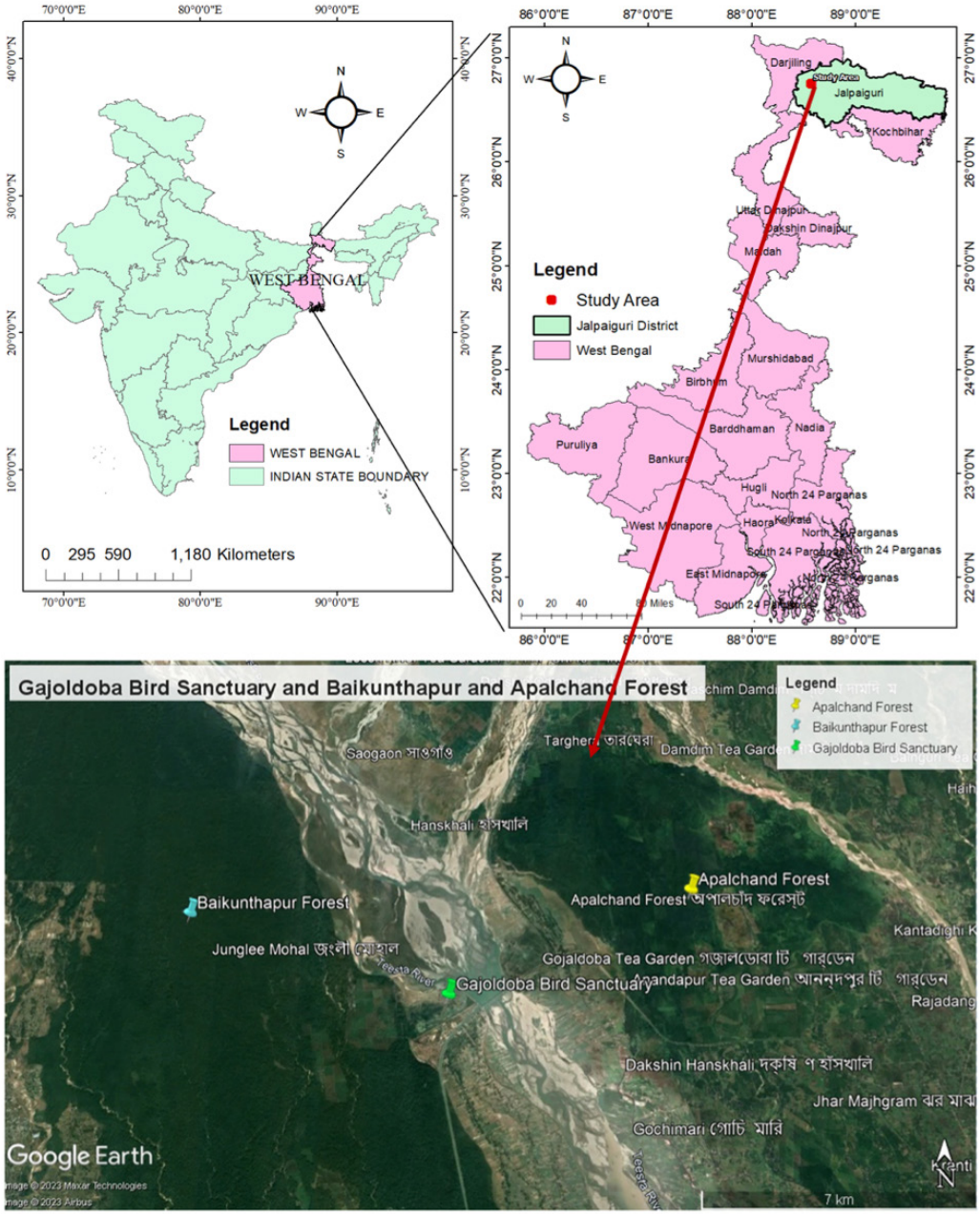

Image 14. Map of the study area.

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