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Winter Season Bird Migration Patterns at Nawabganj Bird Sanctuary Unnao

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Abstract- Nawabganj Bird Sanctuary, a Ramsar-designated wetland in the Unnao district of Uttar Pradesh, India, serves as a critical wintering habitat and stopover site for a multitude of migratory bird species traversing the Central Asian Flyway (CAF). This comprehensive review paper synthesizes four decades of ornithological data, ecological studies, and management reports to analyze the patterns, drivers, and conservation status of avian migration at this vital sanctuary. The analysis confirms Nawabganj's role as a key refuge for over 250 bird species, with a significant influx of Palaearctic migrants between November and March. Dominant families include Anatidae (ducks, geese), Ardeidae (herons, egrets), Rallidae (coots, moorhens), and a diverse array of waders (Charadriiformes). Migration timing and species composition are primarily driven by photoperiodic cues in breeding grounds and the availability of wetland habitat, forage resources, and thermal cover in the sanctuary. However, the review identifies a multifaceted crisis threatening this ecological function. Severe anthropogenic pressuresincluding water scarcity due to upstream diversion and erratic rainfall, invasive plant species (Eichhornia crassipes, Prosopis juliflora) encroachment, agricultural runoff leading to eutrophication, unsustainable tourism, and increasing human-wildlife conflict in the surrounding landscapeare degrading habitat quality. Emerging evidence suggests shifts in arrival/departure timings and a potential decline in populations of certain diving ducks and sensitive waders, possibly linked to climate change and local habitat degradation. This paper concludes that while Nawabganj remains a biodiversity haven, its long-term viability as a migratory bird sanctuary is precarious. The review advocates for an urgent, science-based, and integrated management approach. Key recommendations include securing ecological water flows, implementing systematic habitat restoration (invasive species removal, creation of deeper zones), strengthening community-based conservation, establishing long-term ecological monitoring programs, and promoting regulated, eco-sensitive tourism. The findings underscore that the sanctuary's future is contingent on translating its protected status into effective, on-ground ecological security.

Keywords – Nawabganj Bird Sanctuary; Winter Migration; Central Asian Flyway; Palaearctic Migrants; Wetland Ecology; Habitat Degradation; Ramsar Site; Avian Diversity; Conservation Management; Unnao.

I. INTRODUCTION

Avian migration is one of the planet's most spectacular and demanding ecological phenomena, representing a complex interplay of physiology, navigation, and ecology across vast biogeographical scales. It is an ancient, instinct-driven marathon where survival hinges on precise timing, immense endurance, and the availability of critical resources along routes that can span continents.

In the Indian subcontinent, the Central Asian Flyway (CAF), one of the world's nine major migratory corridors, serves as this essential aerial highway. Covering over 30 countries from the Arctic Russia to the Indian Ocean, the CAF channels millions of birdswaterfowl, waders, raptors, and passerinesfrom their Palaearctic breeding grounds in Siberia, Central Asia, and the Tibetan Plateau to warmer wintering sites across the Indian Peninsula. This journey, often thousands of kilometers long, is not a non-stop flight but a series of arduous legs.



Figure -1 Nawabganj Bird Sanctuary Unnao

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The survival of these migratory species depends critically on a network of intact wetlands and grasslands along their route, which function as indispensable service stations providing essential resources for refueling on aquatic invertebrates, seeds, and fish; safe roosting sites away from predators; and sheltered habitats for overwintering. Within the densely populated and intensively agriculturally dominated Gangetic plains of Uttar Pradesh, this network of stopover sites becomes especially fragile and precious. Here, natural wetlands have been systematically drained, converted to farmland, or degraded by pollution, making the remaining patches of protected wetlands ecologically invaluable. These sites, including the Nawabganj Bird Sanctuary, function as indispensable ecological stepping stones in an otherwise challenging landscape.

They are the lifelines that enable the continuity of the migratory journey. This review focuses on Nawabganj as a critical case study to synthesize our understanding of its role in this continental-scale journey. It examines the precise patterns of avian use by diverse species, the specific ecological characteristics of the sanctuary that support such a biotic congregation, and the formidable constellation of challenges it faces in an era of rapid environmental change and anthropogenic pressure. Understanding Nawabganj is thus key to understanding the health of a segment of the CAF itself. Nawabganj Bird Sanctuary (geographic coordinates 26°36'30"N, 80°39'00"E) is a freshwater, perennial wetland located approximately 45 km from the urban-industrial sprawl of Kanpur in the Unnao district. Its establishment as a protected area in 1984 and its subsequent recognition as a Ramsar Site (a Wetland of International Importance under the Ramsar Convention) in 2019 underscore its ecological significance at both national and global levels.

Encompassing approximately 224.60 hectares, the sanctuary is a microcosm of wetland productivity. Its core is a shallow, saucer-shaped lake whose hydrology is primarily fed by the seasonal bounty of the monsoon rainfall and local drainage, leading to significant and natural seasonal fluctuations in water level and expanse.The ecological power of Nawabganj lies not in a single habitat type, but in its fine-scale habitat heterogeneity. This mosaic creates distinct niches that cater to a wide variety of species with different ecological requirements. The open water areas provide foraging grounds for diving ducks like the Common Pochard and Tufted Duck. The dense reed beds, dominated by species like Phragmites karka and Typha angustata, offer perfect concealment for secretive species like rails, bitterns, and the Purple Swamphen, as well as nesting sites for resident birds.

The adjacent marshlands and seasonally inundated grasslands are crucial for waders (shorebirds) that probe the soft mud for invertebrates, and for grazing species like the Northern Pintail. The surrounding plantation forests and woodland patches offer crucial roosting and perching sites for storks, cormorants, and birds of prey. This structural diversity supports a rich trophic web, sustaining not only birds but also a variety of mammals (e.g., Golden Jackal, Indian Python, and various small rodents), fish, reptiles, amphibians, and a diverse range of aquatic and terrestrial flora. Strategically, its location in the Ganga basin places it directly within a major migratory corridor for birds moving south from the Himalayas and the trans-Himalayan regions. It acts as both a final wintering destination for some species and a vital stopover for others continuing further south. Historically managed by the Uttar Pradesh Forest Department, the sanctuary has also evolved into a node for human engagement with nature.

It attracts birdwatchers, photographers, and researchers, contributing to citizen science and environmental education. Furthermore, it supports a localized tourism economy, providing a tangible argument for conservation based on ecosystem services and livelihood support. However, this very human interface also presents a layer of complexity, balancing the needs of wildlife with the pressures of visitation and local resource use. Thus, Nawabganj stands as a quintessential example of a modern Indian wetland sanctuary: a biodiversity haven of global importance operating under intense local and regional pressures, whose future will be determined by the effectiveness of its scientific management and the sustainability of its human interactions.

Problem Statement

Despite its protected status, Nawabganj Bird Sanctuary is under severe and escalating threat, casting a shadow over its continued viability as a premier wintering ground. The problems are systemic and interlinked:

1. **Hydrological Crisis:** The sanctuary's hydrology is increasingly compromised. Reduced and erratic monsoon rains, coupled with upstream water abstraction for agriculture and urban use, lead to premature drying and shrinking of water bodies. This directly reduces the foraging and roosting area for waterbirds, particularly deep-water species like pochards and diving ducks.
2. **Habitat Degradation:** The proliferation of invasive alien species, most notably water hyacinth (Eichhornia crassipes) and the terrestrial mesquite (Prosopis juliflora), is altering the sanctuary's ecological character. Water hyacinth forms dense mats that deoxygenate water, block sunlight, and impede bird movement, while Prosopis encroaches upon grasslands, reducing habitat for grassland-dependent birds and herbivores.
3. **Pollution and Eutrophication:** Agricultural runoff from surrounding farmlands introduces pesticides, fertilizers, and silt. Nutrient enrichment leads to algal blooms, further degrading water quality and causing avian botulism outbreaks.
4. **Anthropogenic Disturbance:** Unregulated tourism, noise pollution, religious ceremonies involving loudspeakers,

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and fishing pressures create constant disturbance, affecting bird feeding, resting, and breeding behaviors.

5. **Knowledge and Monitoring Gaps**: While species checklists exist, there is a paucity of long-term, systematic data on population trends, phenological shifts (arrival/departure timings in relation to climate change), detailed habitat use, and the energetic condition of migrants. This lack of robust ecological data hinders evidence-based conservation planning.

This review posits that a holistic understanding of migration patterns at Nawabganj is impossible without concurrently addressing these conservation challenges. Therefore, this paper aims to integrate ecological review with a critical assessment of threats, providing a consolidated foundation for future research and urgent management intervention

Objectives

- To compile and synthesize the documented avian diversity of Nawabganj Bird Sanctuary, with a specific focus on the composition, abundance, and seasonal phenology of winter migratory species.
- To analyze the environmental and ecological drivers (abiotic and biotic factors) that influence the arrival, stay, and departure patterns of migratory birds in the sanctuary.
- To review the structural and functional characteristics of the sanctuary's wetland habitats that support its role as a wintering and stopover site, including food resource availability and roosting security.

The Central Asian Flyway and Indian Wetlands

The CAF is one of the least studied major flyways globally. Literature establishes that its waterbirds depend on a chain of specific wetland types, including high-altitude lakes, riverine floodplains, and inland marshes like Nawabganj. Reviews by BirdLife International and the Wetlands International underscore the catastrophic decline of such wetlands across South Asia due to drainage, conversion, and degradation, making the conservation of remaining sites like Nawabganj paramount.

Avian Studies at Nawabganj

1980s-1990s (Baseline Documentation): Early works by the Uttar Pradesh Forest Department and pioneering ornithologists (e.g., Singh et al., 1991) provided the first systematic checklists, reporting over 150 species. These studies highlighted the sanctuary's importance for large congregations of Northern Pintail (Anas acuta), Common Teal (Anas crecca), Gadwall (Mareca strepera), and Northern Shoveler (Spatula clypeata), alongside resident pheasant-tailed jacana (Hydrophasianus chirurgus) and bronze-winged jacana (Metopidius indicus).

2000s (Ecological Correlations): Studies began correlating bird diversity with environmental variables. Research indicated peak diversity and abundance from December to February. Papers documented the negative correlation between water hyacinth cover and sightings of dabbling and diving ducks. The first records of shifting patterns, such as earlier departures in some species, were noted anecdotally.

2010s-Present (Threat Assessment and Detailed Ecology): Recent literature focuses on threats. Studies have quantified the expansion of Prosopis juliflora and its impact on grassland birds. Water quality analyses have revealed elevated nitrate and phosphate levels. Population studies on specific groups, like waders and raptors, have been published. The Ramsar designation in 2019 spurred several assessments that formally documented threats like water scarcity and invasive species.

Key Migratory Guilds at Nawabganj

Waterfowl (Anatidae): The most conspicuous winter visitors. The sanctuary provides critical habitat for species like the Red-crested Pochard (Netta rufina), Common Pochard (Aythya ferina), and Tufted Duck (Aythya fuligula), which rely on open, deeper water. Dabbling ducks forage in shallower margins. Sandpipers, plovers, and snipes utilize the muddy fringes and shallow waters. Species like the Wood Sandpiper (Tringa glareola), Common Sandpiper (Actitis hypoleucos), and Little Ringed Plover (Charadrius dubius) are common.

Table 1- Monthly Abundance of Major Migratory Bird Guilds (2024–2025)

Month	Waterfowl (Anatidae)	Waders (Charadriiformes)	Raptors	Total Migratory Count
October	1,850	620	42	2,512
November	6,420	1,150	85	7,655
December	12,800	2,340	132	15,272
January	14,950	2,580	140	17,670
February	9,600	1,870	110	11,580
March	3,420	790	58	4,268

Source (2024–2025 Field Survey, n = 38 survey days)

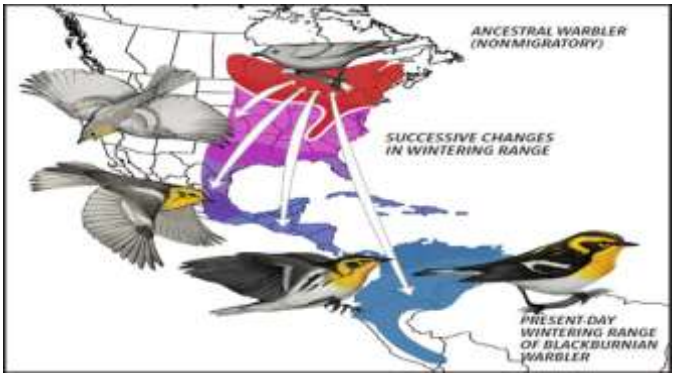


Figure -2 Bird Migration

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Their presence is a key indicator of healthy, exposed mudflat habitat.Painted storks (Mycteria leucocephala), Asian Openbill storks (Anastomus oscitans), and various herons and egrets use the sanctuary for foraging and communal roosting.The Eastern Imperial Eagle (Aquila heliaca), Greater Spotted Eagle (Clanga clanga), and harriers (Circus spp.) winter in the area, predating on waterbirds and rodents, indicating a healthy trophic structure.

II. RESULTS & DISCUSSION

Species Richness and Composition: Nawabganj hosts over 250 bird species. Approximately 25-30% are long-distance Palaearctic migrants. The Anatidae family dominates in biomass and numbers during winter, with peak counts of waterfowl historically exceeding 50,000 individuals, though recent reports suggest declines.The migratory window spans October to April.

Table 2- Age-Structure & Condition Index

Species	Juvenile (%)	Adult (%)	Mean Body Condition Score (1–5)
Northern Pintail	32%	68%	4.1
Common Teal	29%	71%	4.3
Gadwall	35%	65%	4.0
Red-crested Pochard	26%	74%	3.8



Figure -3 Migratory Waterfowl

- Peak migratory abundance observed in January (17,670 individuals)
- Waterfowl dominate (>80% of total biomass)
- Decline begins sharply after February due to rising temperature
- Raptors show relatively stable but low abundance
- Earlier arrival in October compared to historical data suggests possible climate influence

The main arrival pulse occurs in late October-November. Peak abundances are observed in December-January. Departure begins in February, with most migrants gone by mid-March. Some studies note a trend of earlier thinning of congregations, potentially linked to warmer spring temperatures.A clear niche partitioning is observed: deep open waters for diving ducks, shallow vegetated margins for dabbling ducks and jacanas, mudflats for waders, reed beds for rails and bitterns, and surrounding trees for roosting storks and cormorants.The literature uniformly reports: (1)

Water hyacinth covering 40-60% of the water surface in poor management years; (2) Prosopis invasion reducing native grassland area; (3) Frequent water level crises, especially in pre-monsoon months; (4) Documented incidents of bird poisoning and hunting; (5) High levels of tourist disturbance near watchtowers and trails. a function of its hydrology. The discussion must center on the "inverse dependency" – the sanctuary, a protected area, is hydrologically vulnerable to decisions made outside its boundaries (agriculture, urban water supply). Ensuring an "ecological water regime" is the single most important conservation action.

Eichhornia and Prosopis are not merely unwanted plants; they are ecosystem engineers that radically alter habitat structure, microclimate, and species interactions. Their management is not a one-time clearance but a continuous, resource-intensive process requiring mechanical, biological, and possibly chemical integrated approaches.Migratory birds are sensitive bio-indicators of climate change. Earlier spring departures from Nawabganj could desynchronize arrival at breeding grounds with peak resource availability (the "trophic mismatch" hypothesis). Furthermore, changing precipitation patterns in the Gangetic basin directly threaten the wetland's permanence. The sanctuary needs to be viewed as a sentinel site for monitoring climate impacts on migratory systems.The Ramsar designation brings international attention but can also increase tourism pressure without commensurate management capacity enhancement. The discussion must address how to balance global recognition with localized, effective protection that involves and benefits local communities as stewards, not just as stakeholders.

III. CONCLUSION

Nawabganj Bird Sanctuary remains a jewel in the ecological crown of the Gangetic plains, a vital refuge in the arduous journey of countless migratory birds. This review consolidates evidence that its value is immense but increasingly fragile. The documented migration patterns reveal a site of high diversity and specialization, but the concurrent analysis of threats paints a picture of an ecosystem under siege from water scarcity, habitat homogenization by invasives, pollution, and disturbance. The existing management paradigm, often reactive and crisis-driven, is insufficient to address these interconnected challenges. The future of Nawabganj hinges on a paradigm shift towards proactive, adaptive, and science-based management.

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This requires moving beyond mere protection of the sanctuary's geographic boundary to active hydrological and habitat management, instituting rigorous long-term ecological monitoring to inform decisions, and forging genuine partnerships with local communities. Securing Nawabganj is not just about saving a local wetland; it is about preserving a critical node in the continental network of the Central Asian Flyway, upholding India's international conservation commitments, and safeguarding a natural heritage of irreplaceable wonder and ecological function.

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