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Research Article

AVIFAUNAL DIVERSITY AND CONSERVATION IMPORTANCE OF SASTHAMNADA WETLAND THIRUVANANTHAPURAM, KERALA

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ABSTRACT

Birds are recognized as sensitive indicators of the health and functionality of ecosystems in freshwater wetlands. Consequently, the assessment of bird populations in wetland habitats is emphasized from a sustainable management perspective. Bird surveys were conducted from October 2023 to October 2024. The purpose of these surveys was to evaluate the community composition and status of birdlife in the Sasthamnada wetlands, which is a significant bird area located in Thiruvananthapuram, Kerala. Data were collected using point counts and opportunistic methods. A total of 41 bird species from 18 families and 16 orders were documented. Among the avifauna documented, one species is listed as Near Threatened on the IUCN Red List of Threatened Species. These wetlands also support five species of birds that have a declining population trend globally; this research outlines the populations and threats affecting Black-headed Ibis species. Seasonal variations in the populations of these birds were not observed. Major threats identified included the disposal of solid waste, the proliferation of weeds, grazing by animals (such as cattle and goats), and the presence of stray dogs. This study offers foundational data for future research on the monitoring of bird communities and effective management of the Sasthamnada wetlands in Kerala.

Keywords: Ecosystem, Indicator, Migrants, Species richness, Threatened species.

INTRODUCTION

The Indian subcontinent is home to approximately 1,340 bird species, constituting over 13% of the global avian diversity (Sivaperuman *et al.,* 2022). According to the Ramsar Convention (1975), birds that rely on wetlands for their ecological needs are known as waterfowl or aquatic birds. "A wetland is defined as an area of marsh, fen, peat land, or water- whether natural or artificial, permanent or temporary—where the water may be fresh, brackish, saline, or stagnant, including marine water up to a maximum depth of six meters" (Ramsar, 2004; Guptha *et al.,* 2011). Wetlands foster both resident and migratory aquatic bird species, which enhances their productivity and biodiversity (Paracuellos M. 2006). Following tropical rainforests, wetlands rank as the second most productive ecosystems (Ekhande *et al.,* 2012). Nutrient inputs from sewage discharge and agricultural runoff significantly contribute to the degradation and potential loss of wetland habitats (Koiri H. *et al.,* 2024). The population of a species in a specific area is primarily influenced by the presence of an appropriate habitat that provides all necessary resources for its survival and reproduction (Whittaker *et al.,* 1973; Krausman 1999). Ibises belong to the order Pelecaniformes and the family Threskiornithidae within the class Aves (IUCN 2016), which consists of average-sized wading birds characterized by their probing downwardly curved beaks (Hancock *et al.,* 2001; IUCN 2016).

The Black-headed Ibis (*Threskiornis megalocephalus*) is the most widely distributed species found in northern and western India (Hancock *et al.,* 2001; Ali & Ripley 2007; Bird life International 2012). This species typically prefers feeding in seasonal wetlands, where food availability is greater than in perennial wetlands (Sundar 2006; Chaudhury and Koli 2018). The IUCN (International Union

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for Conservation of Nature) has classified this species as "Near Threatened" due to its declining population status over the past few decades, while the Indian Wildlife Protection Act (1972) places it on "Schedule IV" (Bird Life International 2012).However, their habitat faces several threats, including the release of chemicals from industries, accumulation of solid waste, laundry activities in adjacent wetland areas, pesticide spraying in agricultural lands, and the conversion of agricultural land, all of which contribute to a decline in their population (Choudhury 2012). Therefore, some conservation efforts are necessary to protect these species.

Since 1953, numerous studies have documented the bird species residing in the wetlands of Kerala and its adjacent areas. Nair (1994) concentrated on the birdlife of the Aakkulam-Veli backwaters. Sivaperuman and Jayson (2000), along with Jayson (2002), investigated the avian diversity in the Kole wetlands of Thrissur. Kumar (2006) created a comprehensive checklist of the bird species located in the Bharathapuzha River Basin, Kerala. Narayanan *et al*. (2011) analyzed the avian fauna and highlighted the importance of its conservation within the Kuttanad Wetland. Most recently, Chandran *et al.,* (2023) presented an updated checklist of Kerala's birds. In addition to these studies on avian diversity, there has been more extensive research focused on specific species across various locations in Kerala.

Sathamnada is situated in the Varkala Taluk of Thiruvananthapuram district, Kerala. There are ponds surrounded by an agricultural environment featuring a rich variety of plants, including herbs, shrubs, and trees. These wetlands serve as additional habitats and food resources for a wide range of bird species. The objective of this study was to assess the composition and status of the avian fauna in the Sathamnada wetland. Reports of only a few breeding sites of the Black-headed Ibis, *T. melanocephalus,* in India, along with its decreasing population status, highlight the need for more species-specific research on this important aquatic bird species. Therefore, in this study, our objectives were to estimate the current population status and evaluate the various threat factors faced by the ibis species in their respective study sites. This study will be useful in establishing a foundational reference for future conservation efforts aimed at protecting this habitat for long-distance migratory and other water birds.

MATERIALS AND METHODS

Study Area

Sasthamnada is situated in the Varkala Taluk of Thiruvananthapuram district in Kerala (8.714386°N, 76.755549°E). Twelve acres of wetland surround Sasthamnada. Paddy farming is carried out in the research region (Image 1). It is a wetland marsh encircled by abundant plant life. Grazing of livestock has occurred consistently over the years. A variety of tree species exists in that area, and the climate is semi-arid, characterized by limited rainfall. Moreover, the area is inhabited by aquatic plants such as water hyacinth. It consists of multiple wetland regions surrounded by farmland, offering habitat for numerous species. The region experiences a subtropical climate characterized by four distinct seasons.

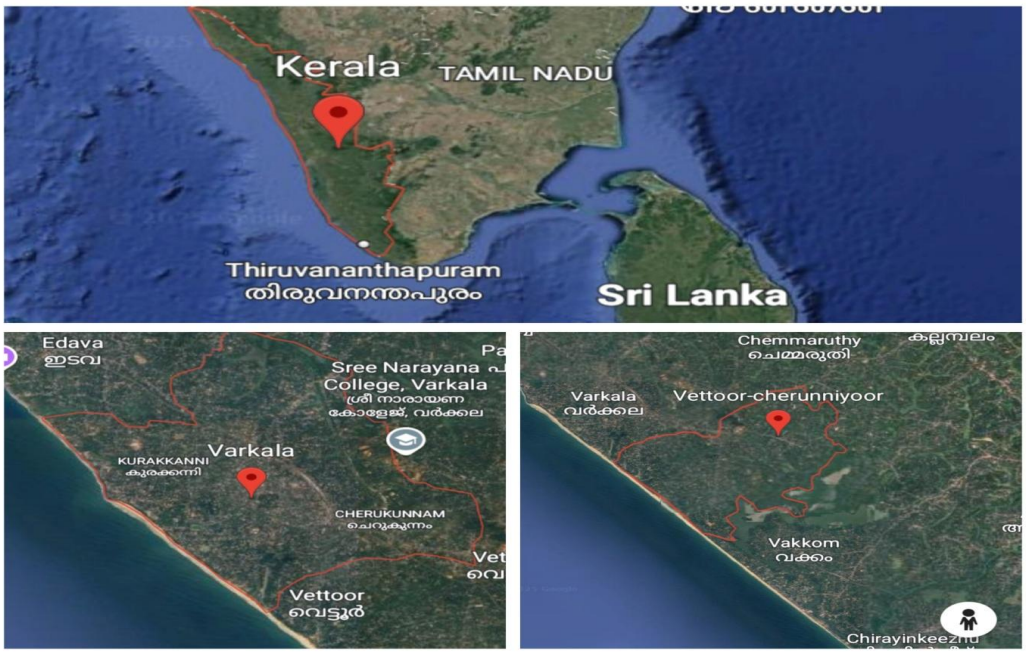

Figure 1. Map showing the study area of Sasthamnada wetlands.

Data Collection

The diversity of avian fauna and their seasonal migration patterns were studied over duration of 1 year from October 2023 to October 2024. Surveys were conducted regularly every two weeks. In winter, the birds were monitored from 07:00 AM to 10:00 AM and 04:00 PM to 07:00 PM, whereas, in summer, observations were made from 06:00 AM to 09:00 AM and 04:00 PM to 07:00 PM (Bibby et *al.,* 2000). The line transect method was utilized in the research during each visit. Birds were spotted using Olympus binoculars (8 × 40), and images were captured with a Nikon P950 camera. Identification of bird species was conducted with the help of a field guide Following Grimmett *et al.,* (2011), bird identification was done using Praveen and Jayapal (2023) as a taxonomic reference. According to Mackinnon and Phillipps (1993), sighting frequency determines abundance status and can be classified as Common (CO), Fairly Common (FC), Uncommon (UC), or Rare (RA). The presence-absence method was employed to determine the residential status (resident, summer migrant, or winter migrant) (Kumar & Sharma, 2018). The assessment of conservation status and global population trend was guided by the IUCN's Red List (2022), while conservation status aligned with IWPA (1972) and CITES (2012).

Relative diversity (RDi) of bird families was computed as

$$RD\ I = \frac{\text{Number of Bird Species in a Family}}{\text{Total Number of Bird Species Following the Torre-Cuadros } et\ al.,\ (2007) \text{ formula}} X100$$

RESULTS AND DISCUSSION

This study of of Sastham Nada Wetlands documented a total of 41 bird species spread across 18 families within 16 orders (Table 1). The Passeriformes order (n = 7) was the most prevalent, followed by Cuculiformes (4), Coraciformes (4), Gruiformes (3), and the reminder in 14 other orders (Table 1). The results of this research aligned with earlier studies regarding the dominance of the Passeriformes order as a common avian group in Kerala. Jasmine *et al*. (2023) found 77 species inhabiting the wetlands surrounding the Changaram wetland. Similarly, Byju *et al.,* (2023) recorded 154 wetland bird species across 16 orders and 48 families in a specified wetland region. Deepa and John George (2017) documented 119 bird species from 18 orders and 45 families at the Pokkali wetland located in the Ernakulum district.

Table 1. List of avian species recorded from Sasthamnada wetlands.

Common Name	Scientific Name	**Family**	Residential Status	Local Status	Conservation status			Global population trend
					IUCN	IWPA	CITES	
Order: ACCIPITRIFORMES								
		Accipitridae						
Brahminy Kite	*Haliastur indus*		W	RA	LC	I	II	↓
Black Kite	*Milvus migrans*		R	FC	LC	I	II	→
Order: ANSERIFORMES								
Lesser-whistling Duck	*Dendrocygna javanica*	Anatidae	S	UC	LC	II	-	↓
Indian Spot-billed Duck	*Anas poecilorhyncha*		R	CO	LC	II	-	→
Order: CHARADIFORMES								
Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	R	CO	LC	IV	-	→
Black-winged Stilt	*Himanto pushimantopus*		R	CO	LC	IV	-	→
Bronze-winged Jacana	*Metopidius indicus*	Jacanidae	R	RA	LC	IV	-	?

Order: Columbiformes								
Rock Pigeon	*Columbia livia*	Columbidae	R	RA	LC	IV	-	↓
Order: CORACIIFORMES								
White-throated King fisher	*Halcyon smyrnensis*	Alcedinidae	R	CO	LC	II	-	?
Stork-billed King fisher	*Pelargopsis capensis*		R	CO	LC	IV	-	?
Common King fisher	*Alcedo atthis*		R	CO	LC	IV	-	→
Order: CUCULIFORMES								
Greater Coucal	*Centropus sinensis*	Cuculidae	R	FC	LC	II	-	↑
Asian Koel	*Eudynamys scolopaceus*		S	UC	LC	II	-	?
Common Cuckoo	*Cuculus canorus*		S	RA	LC	IV	-	↓
Pied Cuckoo	*Clamator jacobinus*		S	RA	LC	IV	-	→
Order: GRUIFORMES								
White-breasted Water hen	*aurornis phoenicurus*	Rallidae	R	UC	LC	II	-	↑
Grey-headed Swamp hen	*Porphyrio poliocephalus*		R	FC	LC	IV	-	?
Watercock	*Gallicrex cinerea*		R	CO	LC	IV	-	→
Order: PASSERIFORMES								
Jungle Babbler	*Argya striata*	Leiothrichidae	R	UC	LC	II	-	?
Common Myna	*Acridotheres tristis*	Cisticolidae	R	FC	LC	IV	-	→
Oriental Magpie-robin	*Copsychus saularis*		R	UC	LC	II	-	?
Common Tailor bird	*Orthotomus sutorius*		R	UC	LC	II	-	→
Zitting Cisticola	*Cisticola juncidis*		R	UC	LC	II	-	→
Ashy Prinia	*Prinia socialis*		R	FC	LC	II	-	↑
Purple Sunbird	*Cinnyris asiaticus*	Nectariniidae	R	UC	LC	II	-	?
Zitting Cisticola	*Cisticola juncidis*		R	UC	LC	II	-	→
Ashy Prinia	*Prinia socialis*		R	FC	LC	II	-	↑
Order: PELICANIIFORMES								
Black-headed Ibis	*Threskiornis melanocephalus*	Threskiornithidae	R	FC	NT	IV	-	↑

Cattle Egret	*Bubulcus ibis*	Ardeidae	R	CO	LC	II	-	→
Great Egret	*Ardea alba*		R	UC	LC	II	-	?
Intermediate Egret	*Ardea intermedia*		R	UC	LC	II	-	→
Little Egret	*Egretta garzetta*		R	UC	LC	IV	-	→
Black-crowned Night Heron	*Nycticorax nycticorax*		R	UC	LC	II	-	↑
Indian Pond Heron	*Ardeolagrayii*		R	CO	LC	II	-	→
Oriental Darter	Anhinga melanogaster	Anhingidae	W*	UC	NT	IV	-	?
Order: PSITTACIFORMES								
Rose-ringed Parakeet	*Psittacula krameri*	Psittaculidae	R	FC	LC	II	-	?
	Order: GRUIFORMES							
Water cock	*Gallicrex cinerea*	Rallidae	R	CO	LC	IV	-	→
Order: PICIFORMES								
Black-rumped Flameback	*Dinopium benghalense*	Picudae	R	CO	LC	II	-	→
White-cheeked Barbet	*Psilopogon viridis*	Megalaimidae	R	CO	LC	IV	-	?
Order: APODIFORMES								
Asian Palm Swift	*Cypsiurus balasiensis*	Apodidae	R	FC	LC	II	-	?
Little Swift	*Apus affinis*		R	FC	LC	II	-	↓

Residential Status: R—Resident | S—Summer Migrant | W—Winter Migrant.

Local Status: CO—Common | FC—Fairly Common | UC—Uncommon | RA—Rare.

Analysis of the relative diversity index revealed that Ardeidae was the most diverse family, with 7 species (RDi = 17.5), followed by Cisticolidae (5 species, RDi = 12.5), Cuculidae (4 species, RDi = 10), and Rallidae, Alcedinidae, Nectarinidae (3 species, RDi = 7.5). Other families include Accipitridae, Anatidae, Charadriidae, and Apodidae (2 species, RDi = 5), as well as Jacanidae, Columbidae, Leiothrichidae, Threskiornithidae, Psittaculidae, Picidae, Anhingidae, and Megalaimidae (1 species, RDi = 2.5) (Table 2).

Table 2. Relative Diversity Index (RDI) of various bird families in Sasthamnada wetlands.

Bird Families	Number of species	RDI value
Ardeidae	7	17.5
	5	12.5
Cuculidae,	4	10
Rallidae, Alcedinidae, Nectrinidaee	3	7.5
Accipitridae, Anatidae, Charadriidae, Apodidae	2	5
Jacanidae, Columbidae, Leiothrichidae, Threskiornithidae, Psittaculidae, Rallidae, Picudae, Megalaimidae, Anhingidae	1	2.5

According to the IUCN Red List of Threatened Species, two species are classified as 'Near Threatened': the Black-headed Ibis (*Threskiornis melanocephalus)* and the Oriental Darter (Anhinga melanogaster), while the remaining species fall under the 'Least Concern' category (Table 1) (IUCN 2017). As per the IWPA (1972), among the 41 species documented, two are listed under Schedule I, twenty-two are under Schedule IV, while the remaining species are categorized in Schedule IV (Table 1). Furthermore, two species are included in Appendix II of CITES (Table 1). The global population trend indicates that wetlands are home to 17 species with stable populations, 5 species experiencing declines, 6 species showing increases, and 13 species for which the global trend remains uncertain (Table 1). In the current study, two species, the Oriental Darter and the Black-headed Ibis, are recorded as near threatened (NT) according to the IUCN. Furthermore, the research by Neena Narayanan et *al.,* (2022) identified three species, including the Oriental Darter, the Black-headed Ibis, and the River Tern, as part of the near-threatened species category. Local abundance data indicate that 12 species (29.2%) are classified as common, another 9 species (21.9%) as fairly common, and 15 species (36.58%) as uncommon, and 5 species (12.19%) as rare within the study area. During the entire study period, a total of 268 individuals (adults and juveniles) of Black-headed Ibis were observed at the study sites (Image 2). In this present study, the population abundance of Black-headed Ibis does not vary significantly among the seasons ($P > 0.05$, $F = 3.49$) (Table 3). Chaudhary and Koli (2018) noted that the population of Black-headed Ibis experiences a marked rise following the monsoon season, coinciding with an increase in seasonal wetlands that enhances their feeding opportunities (Sundar & Kittur 2013). This may be attributed to the elevated water levels in the current wetlands, which are not ideal feeding habitats for these wading birds that prefer shallow waters (Senma and Acharya 2009; Chaudhary and Koli 2018).

Figure 2. Black-headed Ibis Population at Sasthamnada wetland

Table 3. Seasonal population abundance of Black-headed Ibis from October 2023- October 2024.

Seasons	N	%	Mean ±Standard error
Summer	43	16.04%	41.75±0.8539
Autumn	77	28.73%	76.5±0.6455
Winter	82	30.59%	81±0.40825
Spring	66	24.62%	67.5±0.6455
P value		**1.88**	
F value		**3.49**	

*N- Total number of observations. All values are presented in mean ± standard error by one-way ANOVA, significant level at ($P < 0.05$)

Several threat factors were observed throughout the study period, among which the deposition of solid waste and grazing activities by cattle grazers were the major anthropogenic activities in the study areas (Image 3). These dumping sites were found to be very common at all the study locations, primarily near the wetland habitat. Along with these anthropogenic activities, some natural threats, such as stray dogs and excessive growth of weeds like *Eichhornia sp*. (Water Hyacinth), which reduce their feeding stations, appear to be universal

at all respective study sites, as shown in Image 4. Various threats were classified as lesser, significant, and critical in Table 4. The study period also revealed the dumping of solid waste and the proliferation of weeds such as water hyacinth, which seem to pose a significant risk that may ultimately transform wetlands into solid land. This alteration of wetland areas could reduce the feeding grounds for several wading bird species, potentially contributing to their declining populations (Chaudhary 2018).

Table 4. Scoring for the severity of threats to Black-headed Ibis (Harris & Mirande 2013).

S. No	Type of threat	Resulting stress on Black-headed Ibis	Level of threat
1	Solid waste deposition	Habitat unsuitable for nesting, feeding and roosting	1
2	Cattle grazing	Disturbance to Ibis species	3
3	Feral dogs	Leads to population decline	2
4	Invasive species	Loss of important habitat for foraging, roosting and nesting	2

3 lesser threat (has been, or has the potential to be, a detrimental factor in some localities or for some populations, but not with a critical impact on the species as a whole). 2 Significant threat (has been, or has the potential to be, an important though not leading factor in the decline in the population size and/ or restricted to the species range) | 1 Critical threat (has been, or has the potential to be, a major factor in the decline of the population size and/ or restriction of the species range).

Figure 3. Solid waste deposition.

Figure 4. Invasion of Colocasia

CONCLUSION

The current research provides insights into the bird population present in the Sasthamnada wetland. This wetland region, along with adjacent agricultural areas and plantations, creates a favourable environment for both resident and migratory bird species. Consequently, it is essential to prioritize conservation and research efforts in these wetlands and conduct regular assessments of their bird diversity. This study delivers important information regarding the ecological well-being and condition of these wetlands and will help enhance awareness of their conservation significance. In conclusion, the Sasthamnada wetland is a vital habitat for the black-headed ibis; however, the species faces various threats. Therefore, this area requires long-term planning and conservation initiatives to protect its flora and fauna.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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