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Tweeting Trends: Unmasking the Birds of Madurai South, Tamil Nadu, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Wetlands, acting as complex ecosystems bridging aquatic and terrestrial habitats, play a vital role in avian conservation. Despite the extensive use of bird communities in biodiversity conservation, there is a notable lacunae in baseline data, particularly for common avian species. This study aims to address this knowledge gap, providing a foundational dataset for avifauna in the wetlands of Madurai, Tamil Nadu. The survey conducted from January 2022 to December 2023 covered five wetlands: Madakulam, Thenkarai, Koothiyarkundu, Avaniyapuram, and Samanatham. A total of 151 species belonging to 55 families have been observed during the study period. The results highlight the prevalence of Passeriformes, with 51 species. Among the study sites, Samanatham recorded the highest species count, with 124 species, while Thenkarai site recorded the lowest with 82 species. Analysis of feeding guild revealed a diverse range of feeding habits, with 36% being insectivores. The analysis of relative abundance showed that 55% of the population is common (C), and concurrent analysis revealed 64% as residents and 27% being winter visitors. Notably, eight "Nearly threatened" such as Pallid Harrier *Circus macrourus*, Osprey *Pandion haliaetus*, Bar Tailed Godwit *Limosa lapponica*, Black Tailed Godwit *Limosa limosa*, Oriental Darter *Anhinga melanogaster*, Painted Stork *Mycteria leucocephala*, Spot Billed Pelican *Pelecanus philippensis*,

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Black Headed Ibis *Threskiornis melanocephalus* and three “Vulnerable” species, such as the River Tern *Sterna aurantia,* Greater Spotted Eagle *Clanga clanga* and Indian Spotted Eagle *Clanga hastata*, were observed. Throughout the study period, the months of March and April recorded the highest number of individuals across all study sites. A noticeable correlation between the abundance of microhabitats within the wetlands and the concentration of individuals was observed in the Madakulam site. In conclusion, this study serves as a critical step in addressing the dearth of baseline data for avian diversity in Madurai's wetlands. The findings contribute to the broader understanding of ecological dynamics and provide essential information for effective conservation strategies. To ensure a comprehensive approach in safeguarding the delicate balance within wetland ecosystems, ongoing monitoring will extend to environmental conditions, vegetation dynamics, other biotic resources, and potential threats to the avifauna.

Keywords: Wetlands; Madurai South; Avian population; Resources; Microhabitats.

1. INTRODUCTION

“Wetlands are one of the complex and interlinking ecosystems between aquatic and terrestrial habitats” (Torell *et al*. 2001; Zedler and Kercher, 2005). “Wetlands play a pivotal role in bird conservation and support diverse biological diversity. For years, evaluation of bird communities has been used in biodiversity conservation, monitoring or identifying areas that are in need of conservation actions” [1]. The avian community places great value on wetlands as wetlands are critical habitats for both resident and migratory bird species. Furthermore, wetland ecosystems offer shelter, nesting & breeding sites, food resources, [2] and migratory stopovers [3]. Wetland attracts not just waterfowls, and waders but also other water-dependent avian species.

“Madurai is located at 9.93°N 78.12°E. It is situated in the Eastern Ghats and has an average elevation of 101 meters. The city has a total area of 22 sq km. Madurai, which witnesses year-round heat and humidity, is regarded as one of the hottest districts in Tamil Nadu. The district experiences the southwest monsoon from June to September and the northeast monsoon from October to December. Madurai District is mainly agrarian with an average rainfall of 874.5 mm (District administration, Madurai, 2024) and an average temperature of 31ºC - 36ºC” (The Global Historical Weather and Climate Data, 2024). Madurai is situated on the flat and fertile plain of the Vaigai River. Surrounding Madurai are several small hills, such as Nagamalai, Pasumalai, and Yanaimalai, which contribute to the overall topography of the region (topographic-map.com). The city of Madurai is surrounded by an enormous number of water tanks. These are the traditional ‘kanmais’ (man-made tanks) that were created for irrigation, which is mostly arid. The smaller tanks around Madurai seem to be disappearing because of various factors, and so the significance of the remaining waterbodies is increasing. A total of 1338 tanks are found in Madurai from Melur to Thirumangalam (District administration, Madurai, 2024).

India is home to 1,370 bird species (eBird.2021). Nearly 40% of the bird species found in India, can be found in Tamil Nadu among which 317 species are known to occur in and around Madurai (eBird.2021). Despite having such diversity of avian species, there is very less information available from Madurai on bird communities in published form, particularly the wetland depended species. The lists of globally threatened bird species (BirdLife International 2000) or species of conservation concern within specific continents, countries, or regions [4,5] are based largely on data related to population size. Furthermore, surveys serve as valuable tools for gathering information not only on population metrics but also on the spatial distribution of birds in relation to various habitats. This allows for a comprehensive assessment of habitat associations, enhancing our understanding of the ecological dynamics involved. Surveys can be used to collect information on where birds are in relation to different habitats, and so assess habitat associations. There are limited research on the bird population in Madurai, with only a few older studies available (Nichols 1944 a,b, 1945) and recent investigations focusing mainly on urban areas (Sathasivam, 2015) or thorn forest environments (Roopha *et al.* 2022) or surveys in selected localities (Rajagopal, 2022) or wetland study restricted to only Samanatham [6,7] Baseline data from any site is essential for any long-term conservation efforts [8,9]. Keeping this in view, a survey of avifaunal diversity was carried out in the five chosen wetlands in

Madurai South namely Madakulam, Thenkarai, Koothiyarkundu, Avaniyapuram, and Samanatham. Avifauna in these five study sites has been observed and documented for the period of two years from January 2022 to December 2023. This paper highlights the bird diversity, status, composition & feeding guilds.

According to the State of India's Birds 2023, 86 species found in Tamil Nadu, including birds such as garganey, northern shoveler, common sandpiper, and common teal, are under "rapid decline". These rapidly declining species are observed and documented across all five study sites which signifies the need to have a baseline data in order to study the long-term trends as well as to conserve the avifaunal diversity along with the wetlands.

2. MATERIALS AND METHODS

2.1 Study Site

Five wetlands have been chosen for the study which are situated in the south of Madurai. They are Madakulam [(9.9144933°N,78.0851507°E) Site 1], Thenkarai [(9.8849° N, 78.0714° E) Site 2], Koothiyarkundu [(9.8646° N, 78.0288° E) Site 3], Avaniyapuram [(9.8828° N, 78.1194° E) Site 4] and Samanatham [(9.866674°N, 78.14719°E) Site 5]. The selection of study sites was determined by several criteria, such as, availability of water, convenient accessibility, anthropogenic activities and existence of significant bird population, all of which were assessed prior to the commencement of the study as prerequisites. These five sites have trees, shrubs, wetlands, agricultural land, and grassland surrounding them. Among the five study sites, only Samanatham has a published checklist of birds [6,7] of recent times. All the other wetlands remain with no published checklist.

2.2 Data Collection

Survey has been done from January 2022 to December 2023. Survey was conducted thrice every month in each wetland throughout the study period. Birds were surveyed in the most active period of the day, from 7.00 am to 10.00 am. The study was primarily focused on wetland birds followed by terrestrial birds. The observed birds were meticulously documented, including details such as habitat type, season, and frequency of occurrence.

The survey methods employed the Point Count and Grid methods, as outlined by Gregory *et al.* [10]. Additionally, bird calls were considered, following the approach suggested by Whitman *et al.* [11]. Each site comprises seven to ten scanning points ranging from 150m-250m of distance between each point. Birds were observed using field binoculars and documented using a camera (Sony cybershot DSC-HX400v). Bird identification was done using suitable field guides [12], (Ali 2012).

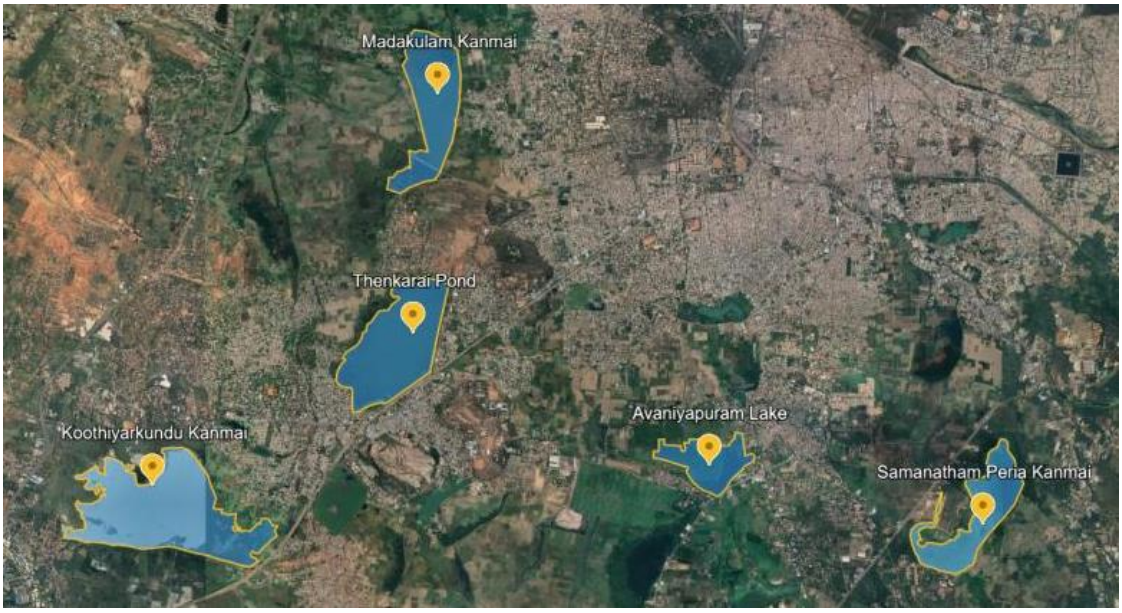

Fig. 1. Five wetlands in Madurai South chosen for the study

At each scanning point, a standard 15-minute observation period was maintained. The checklist was prepared using standardized common and scientific names of the birds [13]. Feeding guild analysis was conducted with reference to existing literature [14,15,6,7]. To establish relative abundance, the frequency of sightings was considered, categorizing birds as per the criteria of MacKinnon & Phillips [16]: common (C) if sighted from seven to nine times; un-common (UC) if sighted from three to six times; rare (R) if sighted once or twice across various seasons throughout the study.

3. RESULTS AND DISCUSSION

In this comprehensive study of five wetlands, the number of species recorded in each wetland have been documented and summarized in Table (1). The highest number of species was recorded in Samanatham (site 5) with 124 species, meanwhile the lowest number of species was recorded in Thenkarai (site 2) with 82 species. The cumulative species count across all study sites reached 151, encompassing 55 families within 17 taxonomic orders. The exposition of species-specific attributes, such as common name, scientific name, residential status, IUCN status, feeding guilds and relative abundance are represented in Table:2. Among the 17 orders, the taxonomic order Passeriformes emerged as dominant, contributing significantly with 51 species. This was followed by Order Charadriiformes with 22 species, Order Pelecaniformes with 21 species, Accipitriformes with 14 species, and Anseriformes with 10 species. In contrast, the taxonomic order Bucerotiformes, Psittaciformes, Pterocliformes and Strigiformes exhibited lower representation, each having only one species recorded (Fig: 2).

Table 1. Total number of species recorded in each wetland during the study period

S. No	Name of the Study Site (Wetlands)	Total No. of Species recorded during the study
1.	Madakulam	93
2.	Thenkarai (Thiruparankundram)	82
3.	Koothiyarkundu	90
4.	Avaniyapuram	85
5.	Samanatham	124

Table 2. Checklist of birds recorded in the five study sites

S. No	Order Name/ Family Name/ Common Name	Scientific Name	IUCN Status	Residential Status	Guild	Relative abundance
	Accipitriformes: Accipitridae					
1. .	Black kite	*Milvus migrans*	LC	R	C	C
2.	Bonelli's Eagle	*Aquila fasciata*	LC	WV	C	Ra
3. .	Booted Eagle	*Hieraaetus pennatus*	LC	WV	C	UC
4. .	Common Buzzard	*Buteo buteo*	LC	WV	C	Ra
5.	Eastern Marsh Harrier	*Circus Spilonotus*	LC	WV	C	Ra
6. .	Greater Spotted Eagle	*Clanga clanga*	VU	WV	C	UC
7. .	Indian Spotted Eagle	*Clanga hastata*	VU	WV	C	UC
8. .	Oriental Honey-Buzzard	*Pernis ptilorhynchus*	LC	LM	C	UC
9.	Pallid Harrier	*Circus macrourus*	NT	WV	C	Ra
10. .	Shikra	*Accipiter badius*	LC	R	C	C
11.	Short-toed Snake Eagle	*Circaetus gallicus*	LC	LM	C	Ra
12.	Western Marsh	*Circus*	LC	WV	C	Ra

		Harrier	*aeruginosus*				
13.		White-eyed Buzzard	*Butastur teesa*	LC	R	C	Ra
	Pandionidae						
14.		Osprey	*Pandion haliaetus*	NT	WV	C	Ra
	Anseriformes: Anatidae						
15.		Bar-headed Goose	*Anser indicus*	LC	WV	O	UC
16.	C	Cotton Pygmy Goose	*Nettapus coromandelianus*	LC	WV	C	Ra
17.		Fulvous Whistling Duck	*Dendrocygna bicolor*	LC	LM	O	C
18.		Garganey	*Spatula querquedula*	LC	WV	O	UC
19.		Green Winged Teal	*Anas crecca*	LC	WV	O	UC
20.		Indian Spot-billed Duck	*Anas poecilorhyncha*	LC	R	O	C
21.		Knob-billed Duck	*Sarkidiornis melanotos*	LC	R/NB	O	UC
22.		Lesser Whistling Duck	*Dendrocygna javanica*	LC	R/NB	O	C
23.		Northern Pintail	*Anas acuta*	LC	WV	O	Ra
24.		Northern Shoveler	*Spatula clypeata*	LC	WV	O	UC
	Bucerotiformes: Upupidae						
25.		Eurasian Hoopoe	*Upupa epops*	LC	R	I	UC
	Phoenicopteriformes: Phoenicopteridae						
26.		Greater Flamingo	*Phoenicopterus roseus*	LC	LM	I	Ra
	Podicipedidae						
27.		Little Grebe	*Tachybaptus ruficollis*	LC	R	C	C
	Caprimulgiformes: Apodidae						
28.		Asian Palm Swift	*Cypsiurus balasiensis*	LC	R	I	C
29.		Alpine Swift	*Tachymarptis melba*	LC	R	I	UC
	Caprimulgidae						
30.		Indian Nightjar	*Caprimulgus asiaticus*	LC	R	I	UC
	Charadriiformes: Charadriidae						
31.		Little Ringed Plover	*Charadrius dubius*	LC	WV	I	UC
32.		Red-wattled Lapwing	*Vanellus indicus*	LC	R	O	C
33.		Yellow-wattled Lapwing	*Vanellus malabaricus*	LC	R	O	Ra
	Jacanidae						
34.		Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	LC	R	I	C
	Laridae						
35.		Common Tern	*Sterna hirundo*	LC	WV	C	Ra

36.		Gull-billed Tern	*Gelochelidon nilotica*	LC	WV	C	Ra
37.		River Tern	*Sterna aurantia*	VU	WV	C	Ra
38.		Whiskered Tern	*Chlidonias hybrida*	LC	WV	C	UC
	Recurvirostridae						
39.		Black Winged Stilt	*Himantopus himantopus*	LC	R	I	C
	Rostratulidae						
40.		Greater Painted Snipe	*Rostratula benghalensis*	LC	R/NB	I	UC
	Scolopacidae						
41.		Bar Tailed Godwit	*Limosa lapponica*	NT	WV	I	UC
42.		Black Tailed Godwit	*Limosa limosa*	NT	WV	I	UC
43.		Common Greenshank	*Tringa nebularia*	LC	WV	I	UC
44.	C	Common Redshank	*Tringa Totanus*	LC	WV	I	UC
45.		Common Sandpiper	*Actitis hypoleucos*	LC	WV	I	UC
46.		Green Sandpiper	*Tringa ochropus*	LC	WV	I	UC
47.		Little Stint	*Calidris minuta*	LC	WV	I	UC
48.		Marsh Sandpiper	*Tringa stagnatilis*	LC	WV	I	UC
49.		Pin Tailed Snipe	*Gallinago stenura*	LC	WV	I	UC
50.		Ruff	*Calidris pugnax*	LC	WV	O	UC
51.		Small Pratincole	Glareola lactea	LC	WV	I	UC
52.		Wood Sandpiper	*Tringa glareola*	LC	WV	I	UC
	Columbiformes: Columbidae						
53.		Eurasian Collared Dove	*Streptopelia decaocto*	LC	R	G	C
54.		Laughing Dove	*Spilopelia senegalensis*	LC	R	G	C
55.		Rock Pigeon	*Columba livia*	LC	R	G	C
56.		Spotted Dove	*Spilopelia chinensis*	LC	R	G	C
	Coraciiformes: Alcedinidae						
57.		Common Kingfisher	*Alcedo atthis*	LC	R	C	C
58.		Pied Kingfisher	*Ceryle rudis*	LC	R	C	C
59.		White Throated Kingfisher	*Halcyon smyrnensis*	LC	R	C	C
	Coraciidae						
60.		Indian Roller	*Coracias benghalensis*	LC	R	I	C
	Meropidae						
61.		Asian Green Bee-eater	*Merops orientalis*	LC	R	I	UC
62.		Blue Tailed	*Merops*	LC	R	I	C

	Bee-eater	*philippinus*				
Cuculiformes: Cuculidae						
63.	Asian Koel	*Eudynamys scolopaceus*	LC	R	O	C
64.	Blue Faced Malkoha	*Phaenicophaeus viridirostris*	LC	R	O	C
65.	Common Hawk Cuckoo	*Hierococcyx varius*	LC	R	O	Ra
66.	Greater Coucal	*Centropus sinensis*	LC	R	C	C
67.	Pied Cuckoo	*Clamator jacobinus*	LC	R	I	C
Galliformes: Phasianidae						
68.	Gray Francolin	*Ortygornis pondicerianus*	LC	R	G	C
69.	Indian Peafowl	*Pavo cristatus*	LC	R	O	C
Gruiformes: Rallidae						
70.	Eurasian Coot	*Fulica atra*	LC	R	C	C
71.	Eurasian Moorhen	*Gallinula chloropus*	LC	R	C	C
72.	Gray-Headed Swamphen	*Porphyrio poliocephalus*	LC	R	C	C
73.	Slaty Breasted Rail	*Lewinia striata*	LC	R	I	C
74.	White Breasted Waterhen	*Amaurornis phoenicurus*	LC	R	C	C
Passeriformes: Acrocephalidae						
75.	Blyth's Reed Warbler	*Acrocephalus dumetorum*	LC	R/NB	I	UC
76.	Booted Reed Warbler	*Iduna caligata*	LC	R/NB	I	Ra
Aegithinidae						
77.	Common Iora	*Aegithina tiphia*	LC	R	I	UC
Alaudidae						
78.	Jerdon's Bushlark	*Mirafra affinis*	LC	R	I	C
79.	Oriental Skylark	*Alauda gulgula*	LC	R	I	C
Artamidae						
80.	Ashy Woodswallow	*Artamus fuscus*	LC	R	I	C
Cisticolidae						
81.	Ashy Prinia	*Prinia socialis*	LC	R	I	C
82.	Common Tailorbird	*Orthotomus sutorius*	LC	R	I	C
83.	Jungle Prinia	*Prinia sylvatica*	LC	R	I	C
84.	Plain Prinia	*Prinia inornata*	LC	R	I	C
85.	Zitting Cisticola	*Cisticola juncidis*	LC	R	I	C
Corvidae						
86.	House Crow	*Corvus splendens*	LC	R	O	C
87.	Large Billed Crow	*Corvus macrorhynchos*	LC	R	O	C
88.	Rufous Treepie	*Dendrocitta vagabunda*	LC	R	O	C

	Dicaeidae					
89.	Pale Billed Flowerpecker	*Dicaeum erythrorhynchos*	LC	R	N	UC
	Dicruridae					
90.	Black Drongo	*Dicrurus macrocercus*	LC	R	I	C
	Estrildidae					
91.	Indian Silverbill	*Euodice malabarica*	LC	R	G	C
92.	Scaly-breasted Munia	*Lonchura punctulata*	LC	R	G	C
93.	Tricolored Munia	*Lonchura malacca*	LC	R	G	C
	Hirundinidae					
94.	Barn Swallow	*Hirundo rustica*	LC	WV	I	C
	Laniidae					
95.	Bay Backed Shrike	*Lanius vittatus*	LC	R	O	Ra
96.	Brown Shrike	*Lanius cristatus*	LC	WV	I	C
97.	Long Tailed Shrike	*Lanius schach*	LC	R	C	C
	Leiothrichidae					
98.	Large Gray Babbler	*Argya malcolmi*	LC	R	I	UC
99.	Yellow-billed Babbler	*Argya affinis*	LC	R	I	C
	Monarchidae					
100.	Indian Paradise Flycatcher	*Terpsiphone paradisi*	LC	R/NB	I	UC
	Motacillidae					
101.	Citrine Wagtail	*Motacilla Citreola*	LC	WV	I	UC
102.	Gray Wagtail	*Motacilla cinerea*	LC	R/NB	I	UC
103.	Paddyfield Pipit	*Anthus rufulus*	LC	R	I	C
104.	Western Yellow Wagtail	*Motacilla flava*	LC	WV	I	UC
105.	White-browed Wagtail	*Motacilla maderaspatensis*	LC	R	I	C
106.	White Wagtail	*Motacilla alba*	LC	WV	I	Ra
	Muscicapidae					
107.	Asian Brown Flycatcher	*Muscicapa dauurica*	LC	WV	I	UC
108.	Indian Robin	*Copsychus fulicatus*	LC	R	I	C
109.	Oriental Magpie Robin	*Copsychus saularis*	LC	R	I	C
110.	Pied Bushcat	*Saxicola caprata*	LC	R	I	C
	Nectariniidae					
111.	Loten's Sunbird	*Cinnyris lotenius*	LC	R	N	UC
112.	Purple Rumped Sunbird	*Leptocoma zeylonica*	LC	R	N	C
113.	Purple Sunbird	*Cinnyris asiaticus*	LC	R	N	C
	Oriolidae					
114.	Indian Golden	*Oriolus kundoo*	LC	R	O	UC

	Oriole					
Passeridae						
115.	House Sparrow	*Passer domesticus*	LC	R	G	C
Pittadae						
116.	Indian Pitta	*Pitta brachyura*	LC	WV	I	Ra
Ploceidae						
117.	Baya Weaver	*Ploceus philippinus*	LC	R	G	C
Pycnonotidae						
118.	Red Vented Bulbul	*Pycnonotus cafer*	LC	R	F	C
119.	Red Whiskered Bulbul	*Pycnonotus jocosus*	LC	R	F	UC
120.	White Browed Bulbul	*Pycnonotus luteolus*	LC	R	F	Ra
Sturnidae						
121.	Brahminy Starling	*Sturnia pagodarum*	LC	R	F	UC
122.	Common Myna	*Acridotheres tristis*	LC	R	F	C
123.	Chestnut-tailed Starling	*Sturnia malabarica*	LC	WV	F	UC
124.	Rosy Starling	*Pastor roseus*	LC	PM	F	UC
Vangidae						
125.	Common Woodshrike	*Tephrodornis pondicerianus*	LC	R	I	Ra
Pelecaniformes: Anhingidae						
126.	Oriental Darter	*Anhinga melanogaster*	NT	R	C	UC
Ardeidae						
127.	Black-crowned Night Heron	*Nycticorax nycticorax*	LC	R	C	C
128.	Cattle Egret	*Bubulcus ibis*	LC	R	C	C
129.	Great Egret	*Ardea alba*	LC	R	C	C
130.	Gray Heron	*Ardea cinerea*	LC	R	C	C
131.	Indian Pond Heron	*Ardeola grayii*	LC	R	C	C
132.	Intermediate Egret	*Ardea intermedia*	LC	R	C	C
133.	Little Egret	*Egretta garzetta*	LC	R	C	C
134.	Purple Heron	*Ardea purpurea*	LC	R	C	C
135.	Striated Heron	*Butorides striata*	LC	R	C	C
136.	Yellow Bittern	*Ixobrychus sinensis*	LC	R/NB	C	UC
Ciconiidae						
137.	Asian Openbill Stork	*Anastomus oscitans*	LC	R	C	C
138. As	Asian Woolly Necked Stork	Ciconia episcopus	LC	WV	Ra	C
139.	Painted Stork	*Mycteria leucocephala*	NT	R	C	C
Pelecanidae						
140.	Spot Billed Pelican	*Pelecanus philippensis*	NT	R	C	C

Phalacrocoracidae						
141.	Great Cormorant	*Phalacrocorax carbo*	LC	R	UC	C
142.	Indian Cormorant	*Phalacrocorax fuscicollis*	LC	R	C	C
143.	Little Cormorant	*Microcarbo niger*	LC	R	C	C
Threskiornithidae						
144.	Black-headed Ibis	*Threskiornis melanocephalus*	NT	R	C	C
145.	Eurasian Spoonbill	*Platalea leucorodia*	LC	R	C	C
146.	Glossy Ibis	*Plegadis falcinellus*	LC	R	C	C
Piciformes: Megalaimidae						
147.	Coppersmith Barbet	*Psilopogon haemacephalus*	LC	R	F	C
Picidae						
148.	Black Rumped Flameback	*Dinopium benghalense*	LC	R	F	C
Psittaciformes: Psittacidae						
149.	Rose-ringed Parakeet	*Psittacula krameri*	LC	R	F	C
Pterocliformes: Pteroclidae						
150.	Chestnut-bellied Sandgrouse	*Pterocles exustus*	LC	R	G	UC
Strigiformes: Strigidae						
151.	Spotted Owlet	*Athene brama*	LC	R	C	C

LC- Least Concerned, NT- Near Threatened, VU- Vulnerable, R- Resident, WV- Winter Visitor, R/NB- Non-Breeding Residents, LM- Local Migrant, PM- Passage Migrant, I- Insectivore, C- Carnivore, O-Omnivore, G-Granivore, F- Frugivore, N- Nectivore, C- Common, UC- Uncommon, Ra- Rare

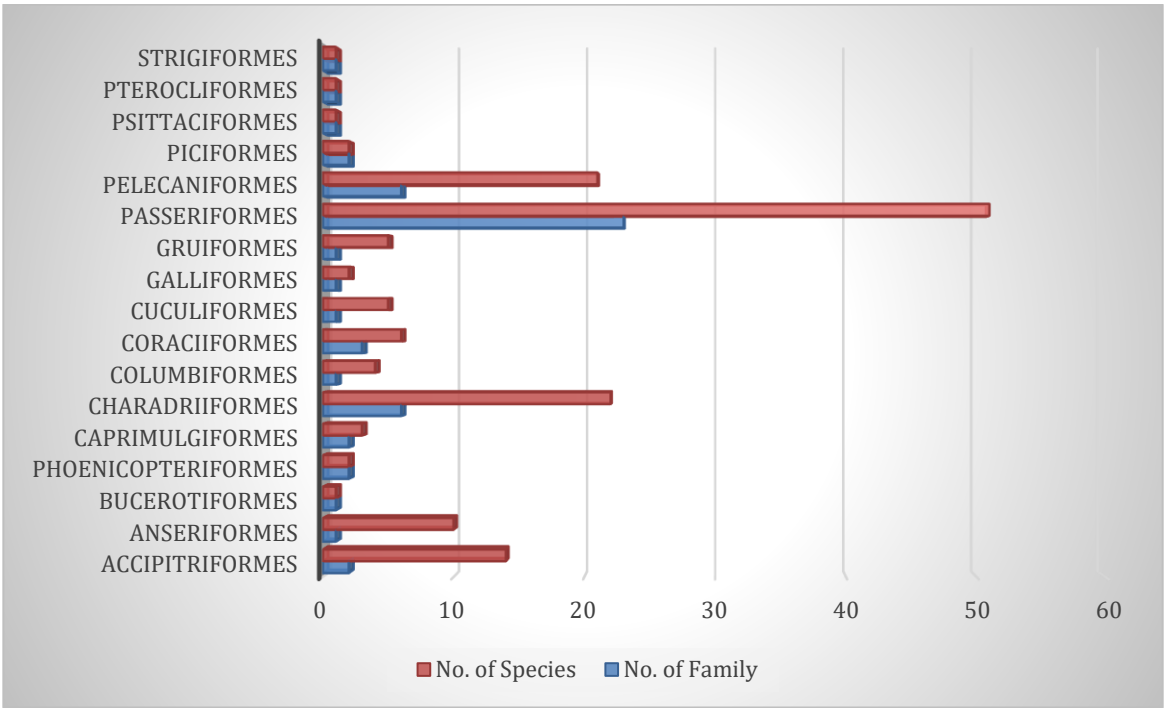

Fig. 2. Distribution of total no. of families and species recorded under taxonomical order

Within the familial spectrum, Scolopacidae takes precedence with 12 species, followed by Anatidae and Ardeidae, each with 10 species, and Motacillidae with 6 species. The remaining families made modest contributes to the dataset (Table:2). In accordance with IUCN status assessment, a discerning analysis of 151 observed avian species revealed a noteworthy composition. A subset of 8 species falls under the "Nearly threatened" (NT) category, encompassing notable species such as Pallid Harrier, Osprey, Bar Tailed Godwit, Black Tailed Godwit, Oriental Darter, Painted Stork, Spot Billed Pelican, Black Headed Ibis. Reviewing literature, similar studies conducted by Anand *et al.* (2023) in Changaram wetlands, Kerala, highlighted the presence of six similar Nearly Threatened species and Jagadheesan and Pandiyan [17] reported two similar Nearly Threatened species in Point Calimere Wildlife Sanctuary, Tamil Nadu. Additionally, three species, River Tern, Greater Spotted Eagle and Indian Spotted Eagle are classified as "Vulnerable" (VU). The remaining 140 species fall within the "Least concerned" (LC) category (Fig: 3).

The analysis of feeding guild among the recorded avian species yielded insightful categorizations. Among the 151 observed species, a diversified array of feeding habits was identified. Notably, 54 species were classified as Insectivores (36%), 51 species as carnivores (34%), 21 species as Omnivores (13%), 11 species as Granivores (7%), 10 species as Frugivores (7%) and 4 species as Nectarivores (3%) (Fig: 4). This breakdown elucidates the diverse ecological roles and dietary strategies adopted by the avifauna found within the study sites.

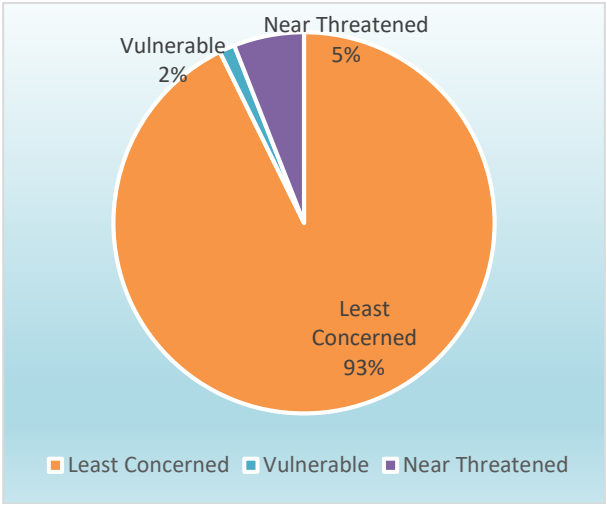

Fig. 3. Distribution of the observed birds under the categories of IUCN status

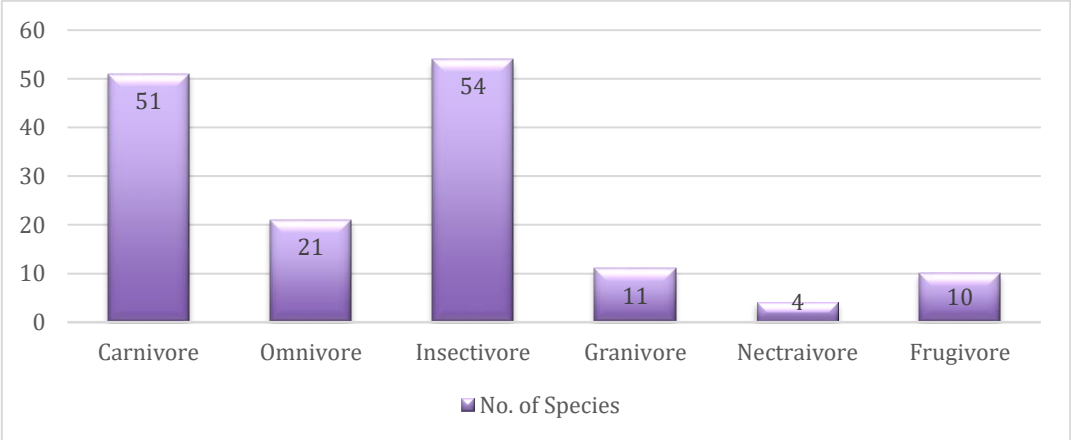

Fig. 4. Distribution of feeding guild of the total no. of species observed

The analysis of relative abundance (Table: 2), assessed through the frequency of sightings, indicates that 55% (83 species) were categorized as Common (C), 30% (46 species) as Uncommon (UC) and 15% (22 species) as Rare (Ra). This segmentation provides a nuanced understanding of the prevalence and distribution patterns exhibited by avian taxa within the study sites.

Simultaneously, an analysis of residential status (Table: 2) sheds further light on the ecological dynamics of avian assemblage. The results showed that 97 species were residents (64%), 41 species were Winter visitors (27%), 8 species were non-breeding residents (6%), 4 species were local migrants (2%) and 1 passage migrant (1%). This analysis contributes valuable insights into the temporal and spatial dynamics of avian residency and migratory patterns within the study sites.

The empirical observations obtained from the study sites render valuable insights into the breeding and migratory patterns of several avifauna. Notably, species such as the Spot billed pelican, Painted stork classified as “Nearly threatened” were observed breeding in Samanatham (site 5). Likewise, the Oriental darter was observed breeding in Madakulam (site 1) and Samanatham (site 2). Bar-tailed Godwit has been recorded to migrate non-stop for over 13,000 km, the longest known continuous journey by a vertebrate [18]. Further contributing to the ornithological significance of the study, long-distance migrant shorebirds like Bar tailed godwit and Black tailed godwit were observed in substantial congregations, with flocks comprising up to 300 individuals in Koothiyarkundu (site 3) and Samanatham (site 5). Such congregations of sizeable flocks indicate the importance of these wetland sites as crucial stopovers and habitats for these migratory birds.

The avian assemblage observed across all surveyed sites exhibited a spectrum of both commonly and rarely sighted species. Among the commonly sighted birds in all sites were, Cattle Egret, Eurasian Coot, Indian Cormorant, White Throated Kingfisher, Indian Pond Heron, Purple Heron, Eurasian Moorhen, Purple Sunbird, Purple Rumped Sunbird, and Greater Coucal. In contrast, some of the rarely sighted birds included Asian Woolly Necked Stork, Bonelli’s Eagle, Greater Flamingo, Northern Pintail, Eastern Marsh Harrier, River Tern, and Yellow Wattled Lapwing.

The graphical representation (Fig: 5&6) illustrating the number of individuals observed throughout the study reveals a distinct population pattern, with March and April emerging as the pinnacle of avian activity. These months recorded highest number of individuals across all study sites. Notably, Samanatham (site 5) dominated the study with the highest number of individuals, followed by Koothiyarkundu (site 3), Madakulam (site 1), Thenkarai (site 2), and Avaniyapuram (site 4). This concentration of avian individuals during the months of March and April underscores the ecological capacity of these wetlands and highlights their resource-rich nature.

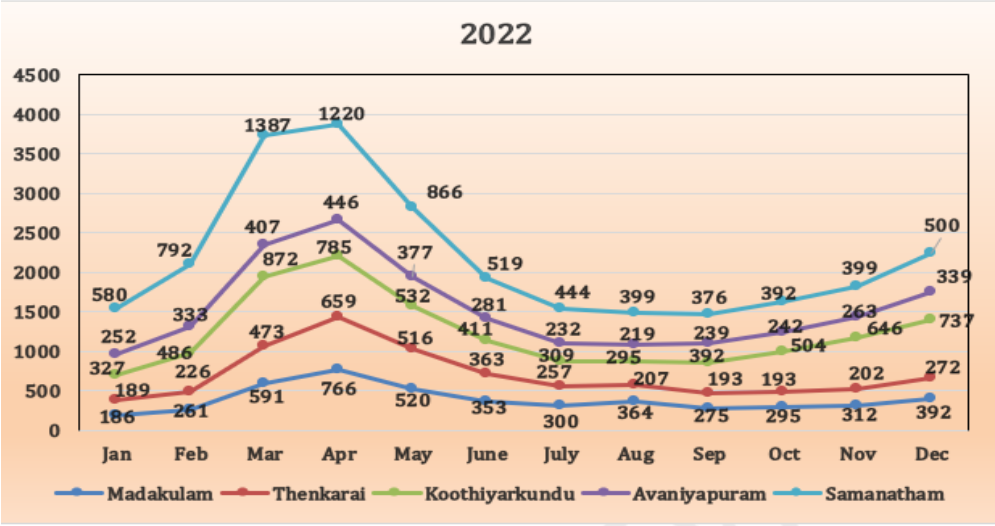

Fig. 5. Total no. of individuals observed in five study sites during 2022

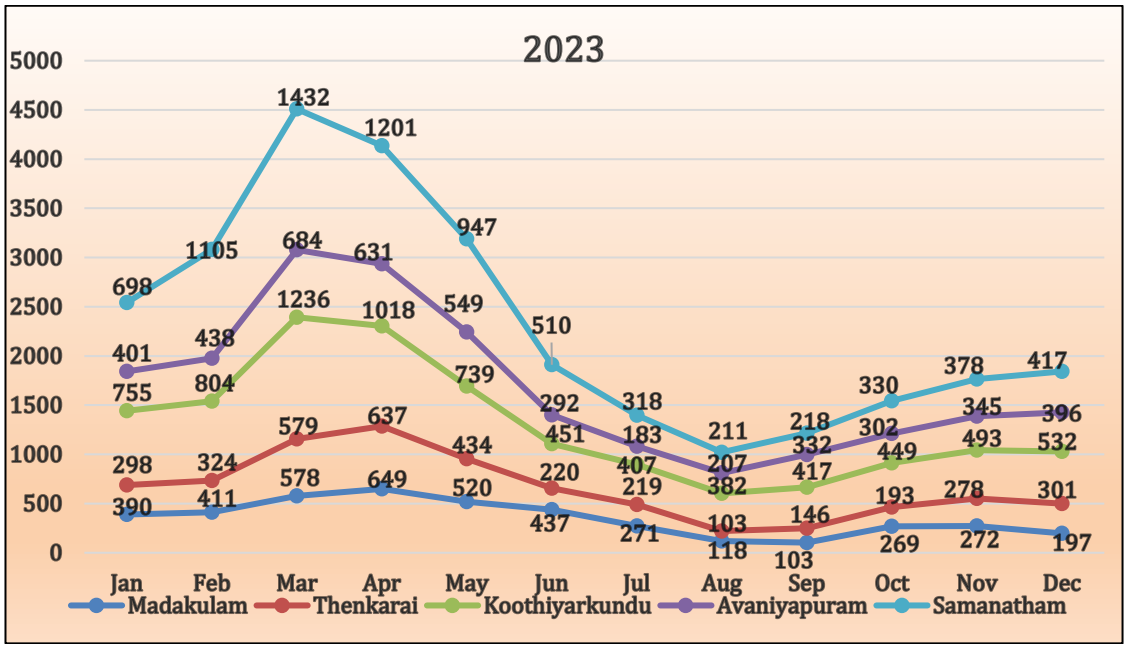

Fig. 6. Total number of individuals observed in five study sites during 2023

The observed avifauna were found utilizing various habitats such as trees, grassland, agricultural land, and open scrubs surrounding the wetland habitats. These diverse environments served as crucial spaces for birds to engage in feeding, nesting and roosting activities. In general, water birds occupying at or near the top of most wetland food chains are primarily susceptible to habitat disturbances, making them reliable indicators of the general condition of aquatic habitats (Kushlan, 1992; Jayson and Mathew, 2002; Kler, 2002). The richness of observed species can be attributed not only to the aquatic conditions but also to the availability of diverse resources, ranging from emerged vegetation and fringed vegetation to planktons and invertebrates. This aspect is currently under extensive study as a continuation of the ongoing project. A notable common characteristic across all wetlands is the presence of cluster of platforms within the water bodies serving as microhabitats for wetland avifauna, especially for basking during winters.

Water birds require a cluster of platforms within the water bodies in order to sit there for basking during the winters [19]. The connection between the cluster of platforms within the wetlands and the concentration of individuals has been notably observed in Madakulam (site 1), where the wetland is divided by a railway track. An intriguing pattern emerged, with the left side, featuring a higher number of platforms, evidently favored by birds over the relatively sparser platforms on the right side. In Kurukshetra, artificial platforms were made available within the ponds with thick cover of vegetation, to facilitate easy means of roosting and perching [19]. This correlation adds depth to our understanding of avian habitat preferences. Despite these favorable conditions, the study highlights several threats to these wetlands, including both direct and indirect factors resulting in habitat destruction, fragmentation, anthropogenic activities such as mass bathing, cutting & burning of emerged and fringed trees, and dumping garbage, fishing, grazing & cultivating crops. Additionally, developmental activities like the construction of roads, walls, and buildings pose significant challenges. Anthropogenic activities pave the way for degradation of habitat and resulting in competition between species for foraging and disturb the bird abundance and diversity [20-21]. The ongoing study continues to extensively explore and document these threats to better inform conservation efforts for the wetland ecosystem in the (study sites) [22-23].

4. CONCLUSION

Many avian studies predominantly focus on globally threatened species, creating a notable gap in baseline data crucial for monitoring birds, especially the common and widespread species [12]. Recognizing this knowledge gap, the current study has been undertaken with the aim of

establishing a foundational dataset for avifauna. The study reveals 151 species across the study sites and highlights the significance of the chosen wetlands. For instance, Koothiyarkundu and Samanatham serves as a migrational stopover for bar-tailed godwits and black-tailed godwits, Madakulam acts as a breeding site for oriental darter and Samanatham acts as breeding site for spot billed pelican and painted stork. The significant congregations of birds and the entire array of biodiversity could be lost if effective regulation of the wetland and its resources is not ensured and this initiative holds critical importance for the long-term monitoring of bird populations. Wetlands like these, hold considerable importance, and ongoing research will enable us to advocate for legal measures to regulate them. By implementing conservation strategies, we can safeguard both the wetlands and the bird populations they support. If all the necessary criteria are met, these areas could potentially be designated as "important bird areas" in the future. As an extension of the study mentioned above, various factors and facets, including environmental conditions, vegetation, other biotic resources, and numerous threats, are also being meticulously monitored and investigated. This holistic approach underscores the delicate balance between ecological attractions and potential hazards within the wetland ecosystems. Such analyses offer early insights into the underlying causes of trends in species numbers [10].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Site 1. Madakulam

Site 2. Thenkarai

Site 3. Koothiyarkundu

Site 4. Avaniyapuram

Site 5. Samanatham

Garganey

Northern Shoveler

Whiskered tern

Black Tailed Godwit

Greater flamingo

Oriental darter

Spot billed pelican

Wood Sandpiper

Glossy ibis in breeding plumage

Flock of painted stork and spot billed pelican

Brahminy Starling

Asian paradise flycatcher

Booted eagle

Chestnut starling

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