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continued on the back inside cover

Cover: Tamil Lacewing *Cethosia nietneri* with colour pencils and watercolours for the background; detailing with fine liners by Elakshi Mahika Molur.

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COMMUNICATION

Avian diversity in wetlands of southwestern Kerala of India during COVID

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Abstract: The COVID-19 pandemic, known as the COVIDian era, has impacted ecosystems worldwide, including wetlands, which are essential habitats for avian biodiversity. The study on bird diversity in the wetlands of Kollam District, southwestern part of Kerala, employed a combination of field surveys and observational methods to assess the avian communities across various habitats. The survey areas were selected based on their significance as wetland ecosystems and included Polachira, Pozhikkara, and associated wetlands within Kollam District. The study documented 98 bird species across 41 families and 15 orders. Passeriformes was the most diverse order with 37 species, followed by Pelecaniformes and Charadriiformes with 13 species each. Apodiformes, Podicipediformes, and Psittaciformes each had a single recorded species. Ardeidae was the most abundant family with 10 species, followed by Rallidae (six species), Sturnidae, and Scolopacidae (five species each). Among the bird species recorded, 16 were migratory, 76 were resident, and six were local migrants. The study assessed bird diversity across Polachira, Pozhikkara, and associated wetlands using various indices, including Simpson, Simpson's λ, Simpson's D, Margalef, Berger-Parker, Shannon-Wiener, and Pielou. Shannon-Wiener diversity index at Polachira is 4.46, Pozhikkara 4.47 and associated wetlands is 4.45, which suggests that the overall avian diversity is comparable among these wetlands. Pozhikkara appears to have slightly higher species richness (Margalef's index 14.64) and slightly lower dominance (Berger-Parker index 35.90) compared to the other two sites. This study elucidates the effects of pandemic-related disruptions on bird populations, highlighting the resilience and vulnerabilities of avifauna in wetland ecosystems.

Keywords: Avian diversity, Berger-Parker, biodiversity indices, COVIDian era, Margalef, Pielou, Polachira, Pozhikkara, Shannon-Wiener.

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Author contributions: The authors contributed equally in the preparation of the manuscript.

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INTRODUCTION

The onset of the COVID-19 pandemic in early 2020 introduced unprecedented challenges to both human society and natural ecosystems, potentially influencing bird populations and their habitats in complex ways (Warrington et al. 2022).

While wetlands in India are recognized for their ecological significance, there is a notable gap in understanding the dynamics of wetland bird populations, particularly in the context of the COVID-19 pandemic, termed the COVIDian era (Madhok & Gulati 2022). The impact of the pandemic on wetland ecosystems and avian biodiversity remains understudied, despite its potential to induce both direct and indirect effects on bird populations. Investigating the diversity of wetland birds in the Kollam District during the COVIDian era can elucidate how anthropogenic disturbances and environmental changes interact to shape avian communities in these critical habitats.

The COVID-19 pandemic has influenced the diversity and distribution of wetland birds in Kollam District, with potential alterations in species composition and abundance. The reduction in human disturbances, such as tourism and industrial activities, during lockdown periods, may have provided temporary respite for certain bird species, leading to shifts in their population dynamics (Cooke et al. 2021; Friedrich et al. 2021). Conversely, changes in land use patterns and habitat degradation may have posed challenges to wetland bird conservation efforts, affecting the overall resilience of avian communities. This study is to enhance the understanding of the dynamics of wetland bird populations in the context of the COVID-19 pandemic, contributing valuable insights to conservation and management efforts in wetlands and beyond. This study aimed to investigate the impact of the COVID-19 pandemic on avian diversity within the diverse wetland ecosystems of Kollam District, southwestern Kerala, India. The study sites, Polachira, Pozhikkara, and associated wetlands within the district, were specifically chosen to represent a range of wetland types. This diversity allowed for a comprehensive assessment of avian responses to potential pandemic-related disruptions across different wetland ecosystems.

MATERIAL AND METHODS

Study area

The study area encompassed Kollam District, located along the southwestern coast of Kerala, India, bordering the Arabian Sea. Within the district, this study specifically focused on the avian diversity of Polachira, Pozhikkara, and associated wetland ecosystems. The location map of the study area is depicted in Figure 1.

Polachira

Polachira (8.83 °N, 76.70 °E) holds a diverse range of aquatic habitats, including marshes and shallow water bodies spanning over 600 ha. Polachira is primarily composed of paddy fields, characterized as 'Moonupoovu Nilam,' allowing farmers to cultivate rice thrice annually. Soil is highly fertile promising substantial yield. A significant challenge faced by farmers is the perpetual waterlogging of the fields. Polachira's rich biodiversity, particularly the abundance of fish and mussels, attracts numerous avian fauna including migratory birds. Its proximity to urban centres makes it an accessible location for studying wetland bird diversity.

Pozhikkara

Pozhikkara (8.81 °N, 76.65 °E) is a small town on the western border of the Paravur in Kollam District, flanked by the Arabian Sea on one side and the backwaters on the other side. Pozhikkara is a heritage site in Kerala blessed with estuaries, backwaters and a sublime beach. The ecology of this region is unique. It has flora and fauna that adapt to both saltwater and freshwater. This coastal wetland presents a unique opportunity to examine the avian fauna associated with estuarine and coastal habitats, offering insights into the ecological significance of these transitional ecosystems.

Associated wetlands

In addition to Polachira and Pozhikkara, the study also includes associated wetlands (8.82 °N, 76.67 °E) in the form of paddy fields and marshy areas between Polachira and Pozhikkara. These diverse wetlands provide habitat for a variety of bird species, contributing to the overall richness of avian biodiversity in the region.

Methods

The study on bird diversity in the wetlands employed a combination of field surveys and observational methods to assess the avian communities. Field observations were conducted from May 2020 to April 2021. Bird species richness, abundance, and distribution patterns were documented using standardized bird-watching protocols and ecological surveys. Field surveys were conducted monthly over 12 months to investigate bird

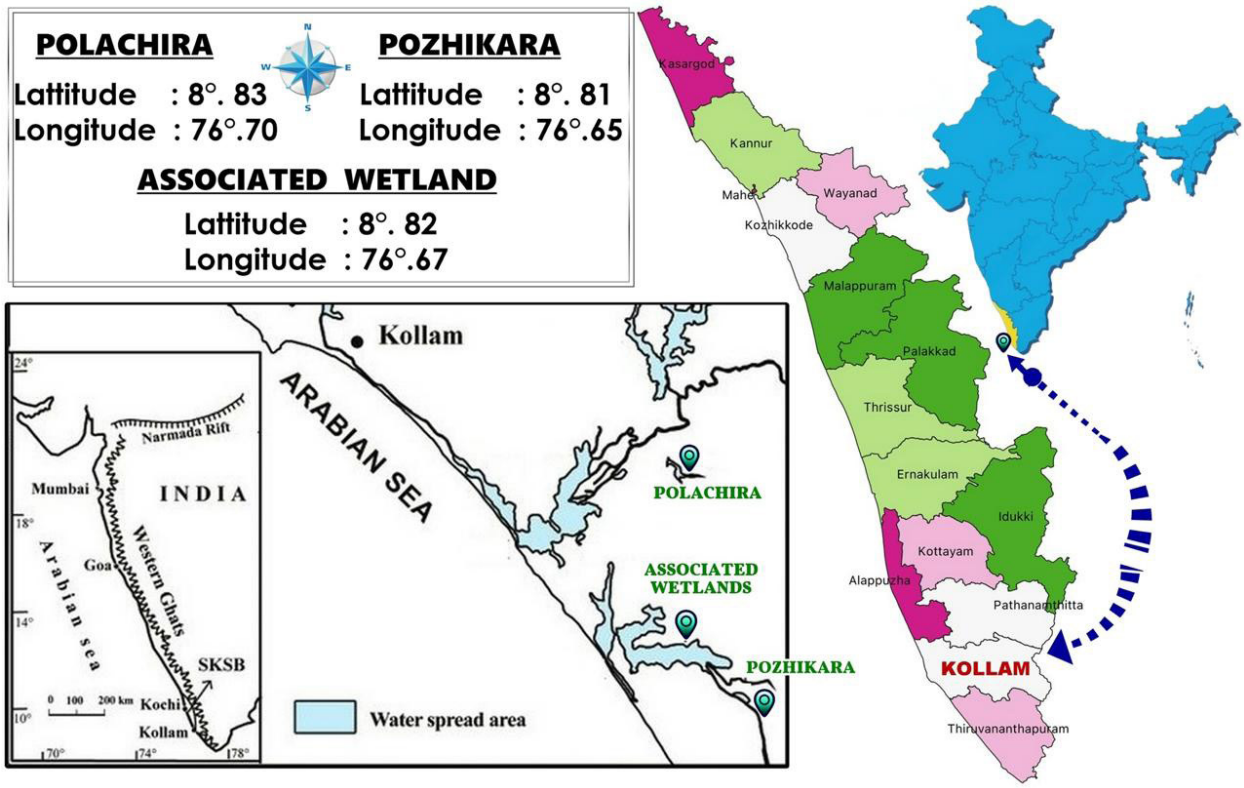

Figure 1. ***Sphaeroma taborans*** **sp. nov. (ZSI/WGRC/1.R.-INV.28482) holotype: A—dorsal view | B—antennule | C—antenna | D—epistome | E—right mandible | F—maxilla.**

diversity within each wetland. Surveys were conducted during morning (0600–1000 h) and evening (1600–1900 h) (Byju et al. 2023) to capture diurnal and nocturnal avian activity, with particular attention being paid to dawn and dusk periods when bird activity is typically high. Field researchers and trained ornithologists conducted systematic surveys of wetland habitats, utilizing binoculars, telescopes, and field notebooks to record bird sightings. Transect surveys along pre-established routes ensured comprehensive coverage of the diverse wetland habitats and microenvironments within the study area (Buckland et al. 2008). Bird surveys were conducted along established transects within the wetlands. Three- line transects were established within each of the three wetlands. Each transect was 500 × 100 m^2. Line transect methodology was employed, with observers walking along predetermined paths and recording all bird species detected within a specified distance of 50 m on either side. Along each transect, three sampling points were designated at 150-m intervals. At each sampling point, a point count method was employed. Observers remained stationary for a 30-min period, recording all bird species seen or heard (Nadeau et al. 2008) within a 50-m radius. A 5-min settling period was allowed at each point to minimize disturbance to bird activity.

Avian diversity indices at different sites were calculated using the Shannon- Wiener index (Shannon & Weaver 1949), Berger-Parker index (Berger & Parker 1970), Pielou index (Pielou 1969) Margalef index and Simpson index D (Margalef 1958).

I. Shannon- Wiener Diversity Index:

The Shannon Diversity Index is represented as H', where pi denotes the relative abundance of each group of organisms.

$H' = -\sum pi1n(pi)$

II. Berger-Parker Index:

The Berger-Parker Index, denoted as d, is calculated as Nmax divided by N, where Nmax represents the number of individuals in the most abundant group, and N represents the total number of individuals.

III. Margalef Index:

The Margalef Index, denoted as dMa, is computed as (S–1) divided by the natural logarithm of N, where S stands for the species number and N indicates the total

number of individuals.

IV. Simpson Index:

The Simpson Index, represented as λ, is calculated as the sum of the squared proportions of individuals, where pi represents the proportion of individuals belonging to each species.

$\lambda = \sum pi^2$

V. Gini-Simpson index:

The Gini-Simpson Index, labeled as D, is derived as 1 minus the Simpson Index (λ), where λ denotes the Simpson Index.

VI. Pielou index:

The Pielou Index, represented as E', is calculated as the sum of pi multiplied by the logarithm of pi, divided by the logarithm of the total number of species (R), where pi represents the relative abundance of each species.

RESULTS

In the present study, 98 species of birds belonging to 41 families and 15 orders were recorded. Order Passeriformes dominated with 37 species followed by Pelecaniformes and Charadriiformes with 13 species each. The orders Apodiformes, Podicipediformes, and Psittaciformes exhibited the lowest species richness, each represented by a single species. Family Ardeidae dominated with 10 species followed by Rallidae with six species and Sturnidae and Scolopacidae with five species each. Among 98 recorded avifauna, 16 were migratory, 76 were residents and six were local migrants. Order Charadriiiformes dominated with eight migratory species followed by Passeriformes with four species, Coraciiformes with two species. The lowest number of migratory bird species were reported from orders Ciconiiformes and Palecaniformes with one species each. Order Passeriformes dominate with 33 resident bird species followed by Pelecaniformes, Gruiformes, Coraciiformes, Piciformes, Ciconiiformes, Anseriformes, Cuculiformes, Accipitriformes, Podicipediformes, Psittaciformes, Suliformes, and Apodiformes. Six species of local migrants were observed of which order Pelecaniformes dominated with four bird species. According to the IUCN Red List (2024), the Asian Woolly-necked Stork was the only 'Near Threatened' species, while all other bird species observed in the study were categorized as 'Least Concern'. Residential status, IUCN status, order, and family-wise distribution of bird species are depicted in Table 1.

Biodiversity indices

The diversity indices such as Simpson index, Simpson index —λ, Simpson index —D, Margalef index, Berger-Parker index, Shannon- Wiener index and Pielou index in the Polachira, Pozhikka associated wetlands are shown in Table 2.

The Berger-Parker index, which measures the dominance of the most abundant species, is consistently

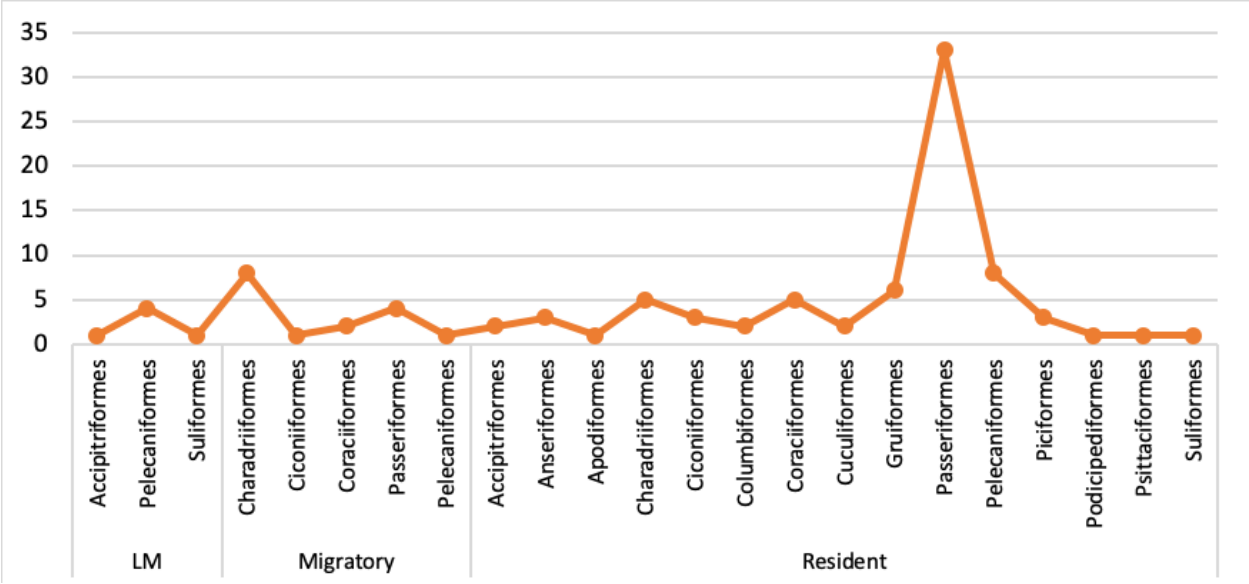

Figure 2. Residential status: order-wise distribution of birds.

Table 1. Residential status, IUCN status, order, and family-wise distribution of bird species.

	Common name	Scientific name	Order	Family	Residential status	IUCN Red List status
1	Brahminy Kite	*Haliastur indus*	Accipitriformes	Accipitridae	LM	LC
2	Black Kite	*Milvus migrans*	Accipitriformes	Accipitridae	R	LC
3	Western Marsh Harrier	*Circus aeruginosus*	Accipitriformes	Accipitridae	R	LC
4	Lesser Whistling-Duck	*Dendrocygna javanica*	Anseriformes	Anatidae	R	LC
5	Indian Spot-billed Duck	*Anas poecilorhyncha*	Anseriformes	Anatidae	R	LC
6	Asian Palm Swift	*Cypsiurus balasiensis*	Apodiformes	Apodidae	R	LC
7	Indian Swiftlet	*Aerodramus unicolor*	Apodiformes	Apodidae	R	LC
8	Red Wattled Lapwing	*Vanellus indicus*	Charadriiformes	Charadriidae	R	LC
9	Kentish Plover	*Charadrius alexandrines*	Charadriiformes	Charadriidae	M	LC
10	Tibetan Sand-Plover	*Charadrius mongolus*	Charadriiformes	Charadriidae	M	LC
11	Pacific Golden-Plover	*Pluvialis fulva*	Charadriiformes	Charadriidae	M	LC
12	Bronze- winged Jacana	*Metopidius indicus*	Charadriiformes	Jacanidae	R	LC
13	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	Charadriiformes	Jacanidae	R	LC
14	Brown-headed Gull	*Chroicocephalus brunnicephalus*	Charadriiformes	Laridae	R	LC
15	Black-winged Stilt	*Himantopus himantopus*	Charadriiformes	Recurvirostridae	R	LC
16	Green Sandpiper	*Tringa ochropus*	Charadriiformes	Scolopacidae	M	LC
17	Common Sandpiper	*Actitis hypoleucos*	Charadriiformes	Scolopacidae	M	LC
18	Common Greenshank	*Tringa nebularia*	Charadriiformes	Scolopacidae	M	LC
19	Temminck's Stint	*Calidris temminckii*	Charadriiformes	Scolopacidae	M	LC
20	Common Snipe	*Gallinago gallinago*	Charadriiformes	Scolopacidae	M	LC
21	Painted Stork	*Mycteria leucocephala*	Ciconiiformes	Ciconiidae	R	LC
22	Asian Woolly-necked Stork	*Ciconia episcopus*	Ciconiiformes	Ciconiidae	R	NT
23	White Stork	*Ciconia ciconia*	Ciconiiformes	Ciconiidae	M	LC
24	Asian Openbill	*Anastomus oscitans*	Ciconiiformes	Ciconiidae	R	LC
25	Yellow-footed Green-Pigeon	*Treron phoenicopterus*	Columbiformes	Columbidae	R	LC
26	Spotted Dove	*Spilopelia chinensis*	Columbiformes	Columbidae	R	LC
27	Common Kingfisher	*Alcedo atthis*	Coraciiformes	Alcedinidae	R	LC
28	Pied Kingfisher	*Ceryle rudis*	Coraciiformes	Alcedinidae	R	LC
29	Indian Roller	*Coracias benghalensis*	Coraciiformes	Coraciidae	R	LC
30	White-throated Kingfisher	*Halcyon smyrnensis*	Coraciiformes	Halcyonidae	R	LC
31	Chestnut-headed Bee eater	*Merops leschenaultia*	Coraciiformes	Meropidae	R	LC
32	Blue-tailed Bee-eater	*Merops philippinus*	Coraciiformes	Meropidae	M	LC
33	Asian Green Bee-eater	*Merops orientalis*	Coraciiformes	Meropidae	M	LC
34	Greater Coucal	*Centropus sinensis*	Cuculiformes	Cuculidae	R	LC
35	Asian Koel	*Eudynamys scolopaceus*	Cuculiformes	Cuculidae	R	LC
36	Common Moorhen	*Gallinula chloropus*	Gruiformes	Rallidae	R	LC
37	White- breasted Waterhen	*Amaurornis phoenicurus*	Gruiformes	Rallidae	R	LC
38	Western Swamphen.	*Porphyrio porphyrio*	Gruiformes	Rallidae	R	LC
39	Grey-headed Swamphen	*Porphyrio poliocephalus*	Gruiformes	Rallidae	R	LC
40	Eurasian Coot	*Fulica atra*	Gruiformes	Rallidae	R	LC
41	Watercock	*Gallicrex cinerea*	Gruiformes	Rallidae	R	LC
42	Blyth's Reed Warbler	*Acrocephalus dumetorum*	Passeriformes	Acrocephalidae	M	LC
43	Clamorous Reed Warbler	*Acrocephalus stentoreus*	Passeriformes	Acrocephalidae	R	LC

	Common name	Scientific name	Order	Family	Residential status	IUCN Red List status
44	Ashy Woodswallow	*Artamus fuscus*	Passeriformes	Artamidae	R	LC
45	Common Tailorbird	*Orthotomus sutorius*	Passeriformes	Cisticolidae	R	LC
46	Zitting Cisticola	*Cisticola juncidis*	Passeriformes	Cisticolidae	R	LC
47	Plain Prinia	*Prinia inornata*	Passeriformes	Cisticolidae	R	LC
48	Ashy Prinia	*Prinia socialis*	Passeriformes	Cisticolidae	R	LC
49	House Crow	*Corvus splendens*	Passeriformes	Corvidae	R	LC
50	Indian Jungle Crow	*Corvus culminatus*	Passeriformes	Corvidae	R	LC
51	Rufous Treepie	*Dendrocitta vagabunda*	Passeriformes	Corvidae	R	LC
52	Large-billed Crow	*Corvus macrorhynchos*	Passeriformes	Corvidae	R	LC
53	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	Passeriformes	Dicaeidae	R	LC
54	Black Drongo	*Dicrurus macrocercus*	Passeriformes	Dicruridae	R	LC
55	Black/Ashy Drongo	*Dicrurus adsimilis*	Passeriformes	Dicruridae	R	LC
56	White-rumped Munia	*Lonchura striata*	Passeriformes	Estrildidae	R	LC
57	Tricolored Munia	*Lonchura malacca*	Passeriformes	Estrildidae	R	LC
58	Scaly-breasted Munia	*Lonchura punctulata*	Passeriformes	Estrildidae	R	LC
59	Barn Swallow	*Hirundo rustica*	Passeriformes	Hirundinidae	LM	LC
60	Red-rumped Swallow	*Cecropis daurica*	Passeriformes	Hirundinidae	M	LC
61	Brown Shrike	*Lanius cristatus*	Passeriformes	Laniidae	R	LC
62	Jungle Babbler	*Argya striata*	Passeriformes	Leiothrichidae	R	LC
63	Yellow-billed Babbler	*Argya affinis*	Passeriformes	Leiothrichidae	R	LC
64	Western Yellow Wagtail	*Motacilla flava*	Passeriformes	Motacillidae	M	LC
65	Paddyfield Pipit	*Anthus rufulus*	Passeriformes	Motacillidae	R	LC
66	Oriental Magpie-robin	*Copsychus saularis*	Passeriformes	Muscicapidae	R	LC
67	Purple-rumped Sunbird	*Leptocoma zeylonica*	Passeriformes	Nectariniidae	R	LC
68	Black hooded Oriole	*Oriolus xanthornus*	Passeriformes	Oriolidae	R	LC
69	Indian Golden Oriole	*Oriolus kundoo*	Passeriformes	Oriolidae	R	LC
70	Green Warbler	*Phylloscopus nitidus*	Passeriformes	Phylloscopidae	M	LC
71	Baya Weaver	*Ploceus philippinus*	Passeriformes	Ploceidae	R	LC
72	Red-whiskered Bulbul	*Pycnonotus jocosus*	Passeriformes	Pycnonotidae	R	LC
73	Red-vented Bulbul	*Pycnonotus cafer*	Passeriformes	Pycnonotidae	R	LC
74	Common Myna	*Acridotheres tristis*	Passeriformes	Sturnidae	R	LC
75	Jungle Myna	*Acridotheres fuscus*	Passeriformes	Sturnidae	R	LC
76	Chestnut-tailed Starling	*Sturnia malabarica*	Passeriformes	Sturnidae	R	LC
77	Common/Jungle Myna	*Acridotheres tristis*	Passeriformes	Sturnidae	R	LC
78	Malabar Starling	*Sturnia blythii*	Passeriformes	Sturnidae	R	LC
79	Cattle Egret	*Bubulcus ibis*	Pelecaniformes	Ardeidae	LM	LC
80	Large Egret	*Ardea alba*	Pelecaniformes	Ardeidae	LM	LC
81	Little Egret	*Egretta garzetta*	Pelecaniformes	Ardeidae	R	LC
82	Median Egret	*Ardea intermedia*	Pelecaniformes	Ardeidae	R	LC
83	Purple Heron	*Ardea purpurea*	Pelecaniformes	Ardeidae	R	LC
84	Indian Pond Heron	*Ardeola grayii*	Pelecaniformes	Ardeidae	R	LC
85	Night Heron	*Nycticorax nycticorax*	Pelecaniformes	Ardeidae	LM	LC
86	Medium Egret	*Ardea intermedia*	Pelecaniformes	Ardeidae	R	LC
87	White Egret sp.	*Ardea alba modesta*	Pelecaniformes	Ardeidae	R	LC
88	Grey Heron	*Ardea cinerea*	Pelecaniformes	Ardeidae	R	LC

	Common name	Scientific name	Order	Family	Residential status	IUCN Red List status
89	Oriental Darter	*Anhinga melanogaster*	Pelecaniformes	Phalacrocoracidae	R	LC
90	Oriental White Ibis	*Threskiornis melanocephalus*	Pelecaniformes	Threskiornithidae	LM	LC
91	Glossy Ibis	*Plegadis falcinellus*	Pelecaniformes	Threskiornithidae	M	LC
92	White-cheeked Barbet	*Psilopogon viridis*	Piciformes	Megalaimidae	R	LC
93	Black-rumped Flameback Woodpecker	*Dinopium benghalense*	Piciformes	Picidae	R	LC
94	Common Flameback Woodpecker	*Dinopium javanense*	Piciformes	Picidae	R	
95	Little Grebe	*Tachybaptus ruficollis*	Podicipediformes	Podicipedidae	R	LC
96	Rose-ringed Parakeet	*Psittacula krameri*	Psittaciformes	Psittaculidae	R	LC
97	Little Cormorant	*Phalacrocorax niger*	Suliformes	Phalacrocoracidae	R	LC
98	Indian Cormorant	*Phalacrocorax fuscicollis*	Suliformes	Phalacrocoracidae	LM	LC

LM—Local Migrant | M—Migrant | R—Resident | LC—Least Concern | NT—Near Threatened.

high across Polachira, Pozhikkara, and associated wetlands. The Margalef index, which primarily reflects species richness, shows relatively high values across all sites. Simpson's index λ and Pielou's evenness index both indicate relatively high evenness within the avian communities. The Shannon-Wiener index, a comprehensive measure of diversity, shows very similar values across all three sites (4.46, 4.47, and 4.45). This suggests that the overall avian diversity is comparable among these wetlands.

DISCUSSION

Increases in human population facilitate urbanization globally which in turn leads to changes in the structure and ecology of landscape ultimately leading to biodiversity loss due to anthropogenic threats (McKinney 2006; Rocha & Fellowes 2018). Populations of birds, which are one of the most common wild fauna in the urban area, are facing threats and have been declining as a result of the rapid urbanization-expansion process (Bolwig et al. 2006; Strohbach 2009; Evans et al. 2011; Gatesire et al. 2014). In the present study, 98 species of birds belonging to 41 families and 15 orders from Pozhikkara, Polachira, and associated wetlands were recorded. Twenty-four species of birds in 11 families and nine orders were reported from wetlands in Kollam, mainly Kandachira and nearby paddy fields (Anoop et al. 2017). From large stretches of wetlands in the form of paddy fields, ponds and canals in Chadayamangalam and Nilamel in Kollam District 14 species of birds belonging to five families were identified (Lekshmy 2014). The Berger-Parker index, which measures the dominance, in the present study suggests that a few species such as *Anas poecilorhyncha*, *Ardea intermedia*, *Fulica atra*, *Porphyrio poliocephalus*, *Dendrocygna javanica*, *Hirundo rustica*, *Egretta garzetta* dominate the avian communities in these wetlands. Simpson's index λ (0.01) and Pielou's evenness index (0.97) suggests that some species such as *Anas poecilorhyncha*, *Ardea intermedia* may be more abundant than *Vanellus indicus* and *Corvus culminatus*, the distribution of individuals among species is relatively equitable. The Margalef index indicates a considerable number of bird species present in each wetland. The Shannon-Wiener index (Polachira 4.46, Pozhikkara 4.47, and associated wetlands 4.45) suggests that the overall avian diversity is comparable among these wetlands of study. Species richness showed similar values among the three study sites, with minimum variations and associated wetland had slightly higher dominance (based on Berger-Parker index 37.20) compared to the other two sites. Overall, all three wetland sites exhibit relatively high species richness, moderate dominance, and high evenness in their avian communities. The similar values of the Shannon-Wiener index (4.45–4.47) across all sites suggest that the overall avian diversity is comparable among these three wetlands. Laseetha et al. (2023) reported 86 bird species in Polachira and associated wetlands. The study recorded a higher bird diversity of 98 species across Pozhikkara, Polachira, and associated wetlands. This apparent increase in species richness, particularly during a period of restricted human activity (lockdown), may suggest increased human encroachment on these natural habitats.

The COVID-19 pandemic brought about unexpected changes in humans such as social distancing, remote work, and lockdowns (Zellmer et al. 2020) which, throughout the world, led to a marked pollution

Table 2. Biodiversity indices.

Wetland	Berger-Parker index	Margalef index	Simpson index λ	Simpson index D	Shannon-Wiener index	Pielou index
Polachira	34.70	14.52	0.01	0.99	4.46	0.97
Pozhikkara	35.90	14.64	0.01	0.99	4.47	0.97
Associated Wetlands	37.20	14.67	0.01	0.99	4.45	0.97

reduction in the air (Venter et al. 2020) and noise (Lecocqm et al. 2020), which created an environment potentially benefiting bird communication, foraging, and breeding success and improved air quality had positive impacts on bird health and foraging opportunities. Noise pollution negatively affects bird abundance and distribution (McClure et al. 2013; Shannon et al. 2015), as it interferes with mating signals and defense mechanisms (Slabbekoorn 2013). Water bodies polluted with biological wastes, which in turn affect biological oxygen demand, can cause significant damage to the abundance of aquatic invertebrates, zooplankton and fish (Schirmel et al. 2016), and can also affect bird populations (Klemetsen & Knudsen 2013; Mallin et al. 2016). The analysis of water quality parameters such as suspended particulate matter (SPM) concentration in Asthamudi Lake in Kollam District using Landsat 8 OLI image shows that the concentration of SPM values in lockdown (mean SPM 8.01 mg/l) is lower than that of pre-lockdown (10.03 mg/l) and last five-year average (9.1 mg/l) (Aswathy et al. 2021). Noise pollution significantly impacts avian abundance and occupancy by disrupting critical acoustic communication pathways (Shannon et al. 2015). Elevated noise levels can mask crucial vocalizations, such as mating calls and alarm calls, hindering successful reproduction and increasing vulnerability to predation (Slabbekoorn 2013). Air quality is also attributed for increase in avifauna diversity. Lockdowns led to significant reductions in PM 2.5 and other pollutants in megacity of Delhi (Mahato et al. 2020) and 22 cities covering different regions of India (Sharma et al. 2020). Air Quality Index (AQI) temporal variability in Kollam demonstrated improved air quality during the lockdown period (median: 49, range: 30–105) compared with both the pre-lockdown (median: 89, range: 48–205) and post-lockdown (median: 75, range: 47–124) periods (Thomas et al. 2023). The exposure to particulate matter can negatively impact species diversity (Sanderfoot & Holloway 2017; Liang et al. 2020). The observed increase in bird diversity in this study may be partly attributed to the improved air quality conditions experienced during the lockdown period.

Decreased human activity due to lockdowns and travel restrictions have led to reduced disturbance to bird habitats as restricted movement of humans helped the unrestricted movement of wild animals and birds during the pandemic period (Sahagun 2020). Diversity is an important ecological indicator for estimating the health and quality of ecosystems and birds play crucial roles in natural activities such as pest control, pollination and seed dispersal (Jaman et al. 1999). Anthropogenic activities such as poisoning, hunting, trapping, killing and destroying the habitat of birds compel birds to change their habitats due to scarcity of food and shelter (Rajia et al. 2015; Shome et al. 2020). A survey conducted by Lekshmy (2014) in the Nilamel and Chadayamangalam regions in Kollam and post COVID avian survey of Laseetha et al. (2023) in the Polachira Wetland reported a total of 14 and 86 bird species respectively. In the present study, conducted during the COVID-19 lockdown period, documented an extensive avian diversity in the Kollam region. This notable increase in bird diversity, observed during the time of reduced anthropogenic activity, suggests the relationship between human disturbance and local avifauna.

CONCLUSION

This study provides valuable insights into the avian diversity within the Polachira, Pozhikkara, and associated wetlands of Kollam District during the COVID-19 pandemic. The study reveals a consistent pattern of high species richness and moderate evenness across all study sites. The study suggests a moderate level of dominance by a few species, the overall avian diversity remains remarkably similar among these wetlands. These findings emphasize the importance of these wetland ecosystems in supporting diverse avian communities within Kollam District.

REFERENCES

Anoop, C., P.V. Bhanu, R. Devika, B.S. Thasni, V. Devipriya, S. Reshma & S. Fathima (2017). An investigation of the avian diversity in the wetlands of Kollam District. B.Sc *Project Report*. University of Kerala, 57 pp

Aswathy, T.S., A.L. Achu, S. Francis, G. Gopinath, S. Joseph, U. Surendran & P.S. Sunil (2021) Assessment of water quality in a tropical Ramsar Wetland of southern India in the wake of COVID-19, Remote Sensing Applications. *Society and Environment* 23: 100604. https://doi.org/10.1016/j.rsase.2021.100604

Berger, W.H. & F.L. Parker (1970). Diversity of planktonic Foraminifera in deep-sea sediments. *Science* 168(3937): 1345–1347. https://doi.org/10.1126/science.168.3937.1345

Bolwig, S., D. Pomeroy, H. Tushabe & D. Mushabe (2006). Crops, trees, and birds: biodiversity change under agricultural intensification in Uganda's farmed landscapes. *Geografisk Tidsskrift - Danish Journal of Geography* 106(2): 115–130. https://doi.org/10.1080/00167223.2006.10649561

Buckland, S.T., S.J. Marsden & R.E. Green (2008). Estimating bird abundance: making methods work. *Bird Conservation International* 18(S1): S91–S108. https://doi.org/10.1017/S0959270908000294

Byju, H., N. Raveendran, S. Ravichandran & R. Kishore (2023). An annotated checklist of the avifauna of Karangadu mangrove forest, Ramanathapuram, Tamil Nadu, with notes on the site's importance for waterbird conservation. *Journal of Threatened Taxa* 15(3): 22813–22822. https://doi.org/10.11609/jott.8356.15.3.22813-22822

Cooke, S.J., P. Soroye, J.L. Brooks, J. Clarke, A.L. Jeanson, A. Berberi & J.R. Bennett (2021). Ten considerations for conservation policy makers for the post-COVID-19 transition. *Environmental Reviews* 29(999): 1–8. https://doi.org/10.1139/er-2021-0014

Evans, K.L., D.E. Chamberlain, B.J. Hatchwell, R.D. Gregory & K.J. Gaston (2011). What makes an urban bird? *Global Change Biology* 17(1): 32–44. https://doi.org/10.1111/j.1365-2486.2010.02247.x

Friedrich, J., J. Zscheischler & H. Faust (2021). Social-ecological transformation and COVID-19: the need to revisit working-class environmentalism. *GAIA-Ecological Perspectives for Science and Society* 30(1): 18–22. https://doi.org/10.14512/gaia.30.1.5

Gatesire, T., D. Nsabimana, A. Nyiramana, J.L. Seburanga & M.O. Mirville (2014). Bird diversity and distribution in relation to urban landscape types in Northern Rwanda. *Scientific World Journal* 2014: 1–12. https://doi.org/10.1155/2014/157824

Jaman, M.F., S.U. Sarker & N.J. Sarker (1999). Food habits and feeding behavior of Black Drongo, *Dicrurus macrocercus albirictus* (Hodgson). *Bangladesh Journal of Zoology* 26(2): 57–66.

Klemetsen, A. & R. Knudsen (2013). Diversity and abundance of water birds in a subarctic lake during three decades. *Fauna Norvegica* 33: 21–27. https://doi.org/10.5324/FN.V33I0.1584

Laseetha, T.G., K.J. Mohan, S. Jisha & B. Hari (2023). Diversity of Charadriiform birds from a tropical wetland. *Ecology, Environment & Conservation* 29: S129–S137. http://doi.org/10.53550/EEC.2023.v29i04s.022

Lecocq, T., S.P. Hicks, K. van Noten, K. van Wijk, P. Koelemeijer, R.S.M. de Plaen, F. Massin, G. Hillers, R.E. Anthony, M.T. Apoloner & H. Xiao (2020). Global quieting of high-frequency seismic noise due to COVID-19 pandemic lockdown measures. *Science* 369(6509): 1338–1343. https://doi.org/10.1126/science.abd2438

Lekshmy, S. (2014). Biodiversity of wetland birds in Nilamel and Chadayamangalam, Kollam, Kerala. *Journal of Aquatic Biology and Fisheries* 2: 303–307.

Liang, Y., I. Rudik, E.Y. Zou, A. Johnston, A.D. Rodewald & C.L. Kling (2020). Conservation cobenefits from air pollution regulation: evidence from birds. *Proceedings. National Academy of Science* 117: 30900–30906. https://doi.org/10.1073/pnas.2013568117

Madhok, R. & S. Gulati (2022). Ruling the roost: avian species reclaim urban habitat during India's COVID-19 lockdown. *Biological Conservation* 271: 109597. https://doi.org/10.1016/j.biocon.2022.109597

Mahato, S., S. Pal & K.G. Ghosh (2020). Effect of lockdown amid COVID-19 pandemic on air quality of the megacity Delhi, India. *Science of the Total Environment* 730: 139086. https://doi.org/10.1016/J.SCITOTENV.2020.139086

Mallin, M., M. McIver, E. Wambach & A. Robuck (2016). Algal blooms, circulators, waterfowl, and eutrophic Greenfield Lake, North Carolina. *Lake and Reservoir Management* 32: 168–181. https://doi.org/10.1080/10402381.2016.1146374

Margalef, R. (1958). Information theory in ecology. *General Systematics* 3: 36–71.

McClure, C.J.W., H.E. Ware, J. Carlisle, G. Kaltenecker & J.R. Barber (2013). An experimental investigation into the effects of traffic noise on distributions of birds: avoiding the phantom road. *Proceedings of the Royal Society B*. 280(1773): 1–9. https://doi.org/10.1098/rspb.2013.2290

McKinney, M.L. (2006). Urbanization as a major cause of biotic homogenization. *Biological Conservation* 127: 247–260. https://doi.org/10.1016/j.biocon.2005.09.005

Nadeau, C.P., C.J. Conway, B.S. Smith & T.E. Lewis (2008). Maximising detection probability of wetland- dependent birds during point-count surveys in northwestern Florida. *The Wilson Journal of Ornithology* 120(3): 513–519. https://doi.org/10.1676/07-041.1

Pielou, E.C. (1969). *An Introduction to Mathematical Ecology*. Wiley, New York, viii + 286 pp. https://doi.org/10.1002/bimj.19710130308

Rajia, S., M.M. Alam, G.W. Chowdhury, M. Akash & M.A. Islam (2015). Status and diversity of birds of Ramna Park, Dhaka, Bangladesh. *Bangladesh Journal of Zoology* 43(2): 291–301. https://doi.org/10.3329/bjz.v43i2.27399

Rocha, E.A. & M.D.E. Fellowes (2018). Does urbanization explain differences in interactions between an insect herbivore and its natural enemies and mutualists? *Urban Ecosystems* 21: 405–417. https://doi.org/10.1007/s11252-017-0727-5

Sahagun, L. (2020). Coyotes, falcons, deer, and other wildlife are reclaiming L.A. territory as humans stay at home. *Los Angeles Times*. Available at: https://www.latimes.com/environment/story/2020-04-21/wildlife-thrives-amid-coronavirus-lockdown Accessed on ?

Sanderfoot, O.V. & T. Holloway (2017). Air pollution impacts on avian species via inhalation exposure and associated outcomes. *Environmental Research Letters*. 12: 083002. https://doi.org/10.1088/1748-9326/aa8051

Schirmel, J., M. Bundschuh, M.H. Entling, I. Kowarik & S. Buchholz (2016). Impacts of invasive plants on resident animals across ecosystems, taxa, and feeding types: a global assessment. *Global Change Biology* 22(2): 594–603. https://doi.org/10.1111/gcb.13093

Shannon, C.E. & W. Weaver (1949). *A Mathematical Model of Communication*. University of Illinois Press, Urbana. https://doi.org/10.1002/j.1538-7305.1948.tb01338.x

Shannon, G., M.F. McKenna, L.M. Angeloni, K.R. Crooks, K.M. Fristrup, E. Brown, K.A. Warner, M.D. Nelson, C. White, J. Briggs, S. McFarland & G. Wittemyer (2015). A synthesis of two decades of research documenting the effects of noise on wildlife. *Biological Reviews* 91: 982–1005. https://doi.org/10.1111/BRV.12207

Sharma, S., M. Zhang, J.A. Gao, H. Zhang & S.H. Kota (2020). Effect of restricted emissions during COVID-19 on air quality in India. *Science of the Total Environment* 728: 138878. https://doi.org/10.1016/J.SCITOTENV.2020.138878

Shome, A.R., M.M. Alam, M.F. Rabbe, M.M. Rahman & M.F. Jaman (2020). Diversity, status, and habitat usage of avifauna at Sadar Upazila, Magura, Bangladesh. *Bangladesh Journal of Zoology* 48(2): 441–456. https://doi.org/10.3329/bjz.v48i2.52434

Slabbekoorn, H. (2013). Songs of the city: noise-dependent spectral plasticity in the acoustic phenotype of urban birds. *Animal. Behaviour* 85: 1089–1099. https://doi.org/10.1016/J.ANBEHAV.2013.01.021

Strohbach, M.W., D. Haase & N. Kabisch (2009). Birds and the city:

urban biodiversity, land use, and socioeconomics. *Ecology and Society* 14(2): 31.

Thomas, G., J. Thomas, R.S. Devika, A. Krishnan, V.M. Anju & J.N. Amrutha (2023). Impact of COVID-19 lockdown on ambient air quality in the southwest coastal urban regions of India. *Aerosol Science and Engineering* 7: 303–314. https://doi.org/10.1007/s41810-023-00180-x

Venter, Z.S., K. Aunan, S. Chowdhury & J. Lelieveld (2020). COVID-19 lockdowns cause global air pollution declines. *Proceedings of the National Academy of Sciences* 117: 18984–18990. https://doi.org/10.1073/pnas.2006853117

Warrington, M.H., M.B. Schrimpf, P.D. Brisay, M.E. Taylor & N. Koper (2022). Avian behaviour changes in response to human activity during the COVID-19 lockdown in the United Kingdom. *Proceedings of the Royal Society B*. 289: 20212740. https://doi.org/10.1098/rspb.2021.2740

Zellmer, A.J., E.M. Wood, T. Surasinghe, B.J. Putman, G.B. Pauly, S.B. Magle, S.L. Jesse, A.M.K. Cria & M. Fidino (2020). What can we learn from wildlife sightings during the COVID-19 global shutdown? *Ecosphere* 11(8): e03215. https://doi.org/10.1002/ecs2.3215

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