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Srivari Illam, No. 61, Karthik Nagar, 10th Street, Saravanampatti, Coimbatore, Tamil Nadu 641035, India  
Registered Office: 3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore, Tamil Nadu 641006, India  
Ph: +91 9385339863 | [www.threatenedtaxa.org](http://www.threatenedtaxa.org)  
Email: [sanjay@threatenedtaxa.org](mailto:sanjay@threatenedtaxa.org)

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



## 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

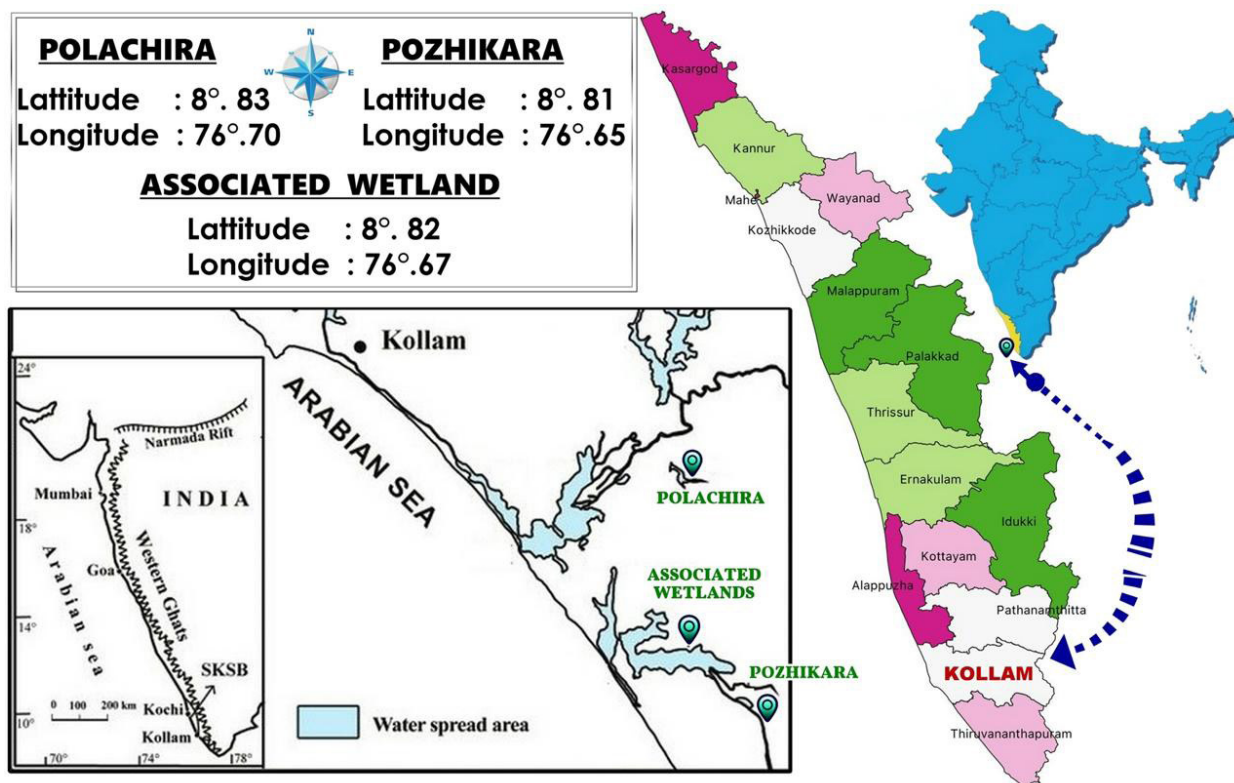


Figure 1. *Sphaeroma taborans* sp. nov. (ZSI/WGRC/1.R.-INV.28482) holotype: A—dorsal view | B—antennule | C—antenna | D—epistome | E—right mandible | F—maxilla.

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<sup>2</sup>. 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  $p_i$  denotes the relative abundance of each group of organisms.

$$H' = -\sum p_i \ln(p_i)$$

#### II. Berger-Parker Index:

The Berger-Parker Index, denoted as  $d$ , is calculated as  $N_{\max}$  divided by  $N$ , where  $N_{\max}$  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  $\lambda$ , is calculated as the sum of the squared proportions of individuals, where  $p_i$  represents the proportion of individuals belonging to each species.

$$\lambda = \sum p_i^2$$

#### V. Gini-Simpson index:

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

#### VI. Pielou index:

The Pielou Index, represented as  $E'$ , is calculated as the sum of  $p_i$  multiplied by the logarithm of  $p_i$ , divided by the logarithm of the total number of species ( $R$ ), where  $p_i$  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 Charadriiformes 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 Pelecaniformes 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 — $\lambda$ , 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

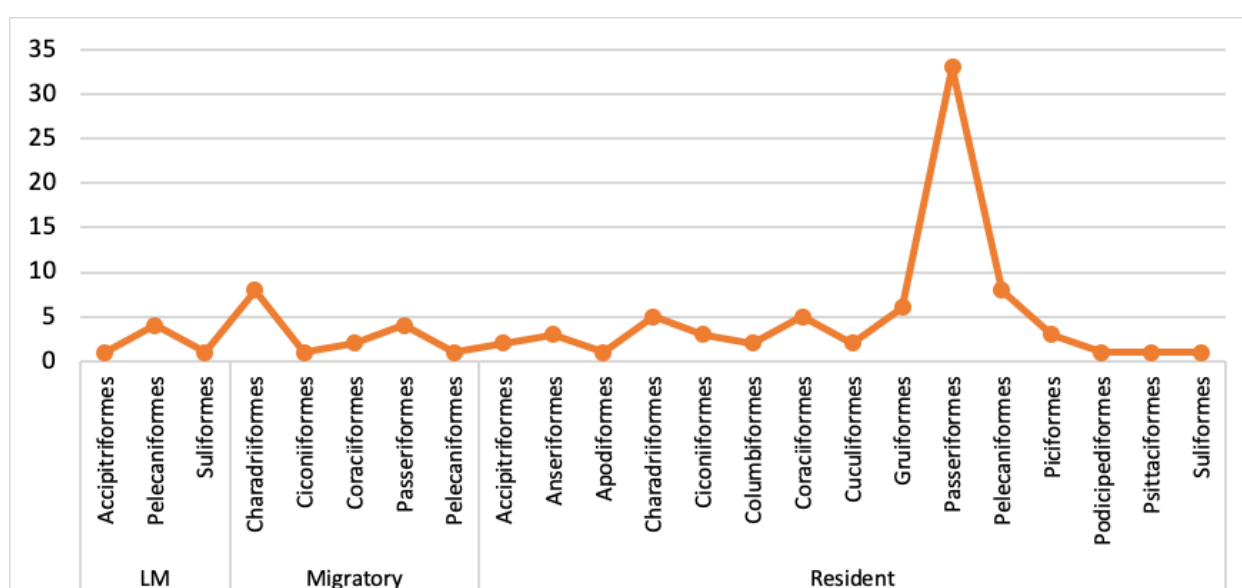


Figure 2. Residential status: order-wise distribution of birds.



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

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



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



Mr. Jatishwor Singh Irungbam, Biology Centre CAS, Branišovská, Czech Republic.  
Dr. Ian J. Kitching, Natural History Museum, Cromwell Road, UK  
Dr. George Mathew, Kerala Forest Research Institute, Peechi, India  
Dr. John Noyes, Natural History Museum, London, UK  
Dr. Albert G. Orr, Griffith University, Nathan, Australia  
Dr. Sameer Padhye, Katholieke Universiteit Leuven, Belgium  
Dr. Nancy van der Poorten, Toronto, Canada  
Dr. Kareen Schnabel, NIWA, Wellington, New Zealand  
Dr. R.M. Sharma, (Retd.) Scientist, Zoological Survey of India, Pune, India  
Dr. Manju Siliwal, WILD, Coimbatore, Tamil Nadu, India  
Dr. G.P. Sinha, Botanical Survey of India, Allahabad, India  
Dr. K.A. Subramanian, Zoological Survey of India, New Alipore, Kolkata, India  
Dr. P.M. Sureshan, Zoological Survey of India, Kozhikode, Kerala, India  
Dr. R. Varatharajan, Manipur University, Imphal, Manipur, India  
Dr. Eduard Vives, Museu de Ciències Naturals de Barcelona, Terrassa, Spain  
Dr. James Young, Hong Kong Lepidopterists' Society, Hong Kong  
Dr. R. Sundararaj, Institute of Wood Science & Technology, Bengaluru, India  
Dr. M. Nithyanandan, Environmental Department, La Ala Al Kuwait Real Estate. Co. K.S.C., Kuwait  
Dr. Himender Bharti, Punjabi University, Punjab, India  
Mr. Purnendu Roy, London, UK  
Dr. Saito Motoki, The Butterfly Society of Japan, Tokyo, Japan  
Dr. Sanjay Sondhi, TITLI TRUST, Kalpavriksh, Dehradun, India  
Dr. Nguyen Thi Phuong Lien, Vietnam Academy of Science and Technology, Hanoi, Vietnam  
Dr. Nitin Kulkarni, Tropical Research Institute, Jabalpur, India  
Dr. Robin Wen Jiang Ngiam, National Parks Board, Singapore  
Dr. Lionel Monod, Natural History Museum of Geneva, Genève, Switzerland.  
Dr. Asheesh Shivam, Nehru Gram Bharti University, Allahabad, India  
Dr. Rosana Moreira da Rocha, Universidade Federal do Paraná, Curitiba, Brasil  
Dr. Kurt R. Arnold, North Dakota State University, Saxony, Germany  
Dr. James M. Carpenter, American Museum of Natural History, New York, USA  
Dr. David M. Claborn, Missouri State University, Springfield, USA  
Dr. Kareen Schnabel, Marine Biologist, Wellington, New Zealand  
Dr. Amazonas Chagas Júnior, Universidade Federal de Mato Grosso, Cuiabá, Brasil  
Mr. Monsoon Jyoti Gogoi, Assam University, Silchar, Assam, India  
Dr. Heo Chong Chin, Universiti Teknologi MARA (UiTM), Selangor, Malaysia  
Dr. R.J. Shiel, University of Adelaide, SA 5005, Australia  
Dr. Siddharth Kulkarni, The George Washington University, Washington, USA  
Dr. Priyadarsanan Dharma Rajan, ATREE, Bengaluru, India  
Dr. Phil Alderslade, CSIRO Marine And Atmospheric Research, Hobart, Australia  
Dr. John E.N. Veron, Coral Reef Research, Townsville, Australia  
Dr. Daniel Whitmore, State Museum of Natural History Stuttgart, Rosenstein, Germany.  
Dr. Yu-Feng Hsu, National Taiwan Normal University, Taipei City, Taiwan  
Dr. Keith V. Wolfe, Antioch, California, USA  
Dr. Siddharth Kulkarni, The Hormiga Lab, The George Washington University, Washington, D.C., USA  
Dr. Tomas Ditrich, Faculty of Education, University of South Bohemia in Ceske Budejovice, Czech Republic  
Dr. Mihaly Foldvari, Natural History Museum, University of Oslo, Norway  
Dr. V.P. Uniyal, Wildlife Institute of India, Dehradun, Uttarakhand 248001, India  
Dr. John D.D. Caleb, Zoological Survey of India, Kolkata, West Bengal, India  
Dr. Priyadarsanan Dharma Rajan, Ashoka Trust for Research in Ecology and the Environment (ATREE), Royal Enclave, Bangalore, Karnataka, India

Fishes

Dr. Topiltzin Contreras MacBeath, Universidad Autónoma del estado de Morelos, México  
Dr. Heok Hee Ng, National University of Singapore, Science Drive, Singapore  
Dr. Rajeev Raghavan, St. Albert's College, Kochi, Kerala, India  
Dr. Robert D. Sluka, Chiltern Gateway Project, A Rocha UK, Southall, Middlesex, UK  
Dr. E. Vivekanandan, Central Marine Fisheries Research Institute, Chennai, India  
Dr. Davor Zanella, University of Zagreb, Zagreb, Croatia  
Dr. A. Biju Kumar, University of Kerala, Thiruvananthapuram, Kerala, India  
Dr. Akhilesh K.V., ICAR-Central Marine Fisheries Research Institute, Mumbai Research Centre, Mumbai, Maharashtra, India  
Dr. J.A. Johnson, Wildlife Institute of India, Dehradun, Uttarakhand, India  
Dr. R. Ravinesh, Gujarat Institute of Desert Ecology, Gujarat, India

Amphibians

Dr. Sushil K. Dutta, Indian Institute of Science, Bengaluru, Karnataka, India  
Dr. Annemarie Ohler, Muséum national d'Histoire naturelle, Paris, France

Reptiles

Dr. Gernot Vogel, Heidelberg, Germany  
Dr. Raju Vyas, Vadodara, Gujarat, India  
Dr. Pritpal S. Soorae, Environment Agency, Abu Dubai, UAE.  
Prof. Dr. Wayne J. Fuller, Near East University, Mersin, Turkey  
Prof. Chandrashekher U. Rivonker, Goa University, Taleigao Plateau, Goa. India  
Dr. S.R. Ganesh, Chennai Snake Park, Chennai, Tamil Nadu, India  
Dr. Himansu Sekhar Das, Terrestrial & Marine Biodiversity, Abu Dhabi, UAE

Birds

Dr. Hem Sagar Baral, Charles Sturt University, NSW Australia  
Mr. H. Byju, Coimbatore, Tamil Nadu, India  
Dr. Chris Bowden, Royal Society for the Protection of Birds, Sandy, UK  
Dr. Priya Davidar, Pondicherry University, Kalapet, Puducherry, India  
Dr. J.W. Duckworth, IUCN SSC, Bath, UK  
Dr. Rajah Jayapal, SAGON, Coimbatore, Tamil Nadu, India  
Dr. Rajiv S. Kalsi, M.L.N. College, Yamuna Nagar, Haryana, India  
Dr. V. Santharam, Rishi Valley Education Centre, Chittoor Dt., Andhra Pradesh, India  
Dr. S. Balachandran, Bombay Natural History Society, Mumbai, India  
Mr. J. Praveen, Bengaluru, India  
Dr. C. Srinivasulu, Osmania University, Hyderabad, India  
Dr. K.S. Gopi Sundar, International Crane Foundation, Baraboo, USA  
Dr. Gombobaatar Sunde, Professor of Ornithology, Ulaanbaatar, Mongolia  
Prof. Reuven Yosef, International Birding & Research Centre, Eilat, Israel  
Dr. Taej Mundkur, Wetlands International, Wageningen, The Netherlands  
Dr. Carol Inskipp, Bishop Auckland Co., Durham, UK  
Dr. Tim Inskipp, Bishop Auckland Co., Durham, UK  
Dr. V. Gokula, National College, Tiruchirappalli, Tamil Nadu, India  
Dr. Arkady Lelej, Russian Academy of Sciences, Vladivostok, Russia  
Dr. Simon Dowell, Science Director, Chester Zoo, UK  
Dr. Mário Gabriel Santiago dos Santos, Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados, Vila Real, Portugal  
Dr. Grant Connette, Smithsonian Institution, Royal, VA, USA  
Dr. P.A. Azeez, Coimbatore, Tamil Nadu, India

Mammals

Dr. Giovanni Amori, CNR - Institute of Ecosystem Studies, Rome, Italy  
Dr. Anwaruddin Chowdhury, Guwahati, India  
Dr. David Mallon, Zoological Society of London, UK  
Dr. Shomita Mukherjee, SAGON, Coimbatore, Tamil Nadu, India  
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Tamil Nadu 641006, India  
ravi@threatenedtaxa.org & ravi@zooreach.org

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