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Cover: Mauve Stinger *Pelagica noctiluca* by Swaathi Na. Medium used is soft pastels and gelly roll.



The avian diversity of Chemmattamvayal Wetlands and adjacent areas of Kasaragod District, Kerala, India

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Abstract: The avian diversity of Chemmattamvayal Wetlands and adjacent areas, in Kasaragod District, Kerala State, was recorded from December 2014 to March 2018. The methodology followed was mainly incidental observations using binoculars. Findings presented here are also based on the data collected from eBird, a citizen science based online platform. A total of 145 bird species, belonging to 17 orders and 50 families were recorded during the study. Among them, 42 species were winter migrants and 97 were seen throughout the year. The highest number of birds were recorded during the month of January and the lowest in June. The present work gains importance as a literature on the avian fauna of the district. White-throated Kingfisher *Halcyon smyrnensis*, Indian Pond Heron *Ardeola grayii*, and Spotted Dove *Spilopelia chinensis* were recorded highest in terms of relative abundance. The importance of these wetlands and adjacent areas as the stepping stone for trans-continental migrants is discussed.

Keywords: Bird diversity, checklist of birds, relative abundance, guild analysis.

Editor: Anonymity requested.

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Author contributions: SKM has contributed in field data collection, writing of manuscript, preparation of diagrams, mapping the study area, and detailed analysis of the collected data. AR has contributed in consolidation of data, preparation of checklists, editing the manuscript, proofreading, and referencing. MRK has contributed in field data collection, editing the manuscript, and analysis of the collected data.

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INTRODUCTION

Wetlands are beautiful landscapes. They are important habitats for fishes, amphibians, insects, reptiles, birds, and other wildlife (Hosetti 2002). Wetland ecosystems occur in places where precipitation exceeds the rate of evapotranspiration leaving behind an accumulated water surplus (Mitsch & Gosselink 1993). About one-third of India's land area falls under this category, and wetland systems are, thus, common throughout the country (Hosetti 2002).

Ecologically, wetland systems are important ecotones, transitions between open waters and land, having a definite structure and function to perform specific ecological roles (Mahajan et al. 1981a,b; Mahajan 1988). They are productive areas and need to be treated as ecological treasure houses. The hydrology of the landscapes influences and changes the physiochemical environment, which in turn, shapes the biotic communities that are found in here (Mitsch et al. 2009). Lal (2008) opined that to maintain the atmospheric carbon cycle, restoration of wetlands around the world is crucial.

The major objective of the Ramsar Convention is to conserve the global degradation of wetlands through sensible use and sustainable management (Roy et al. 2022). During the Ramsar Convention, it was demonstrated that wetlands were the most fertile waterbodies required for migratory birds and other aquatic biota (Uttangi 2001). Roy et al. (2022) emphasized the importance of Ramsar sites as social-ecological systems that focuses on socio-political, cultural and economic elements that induces biotic and abiotic features to recover. The convention also prescribed the conservation of wetlands as waterfowl habitats (Uttangi 2001). As of now, Kerala has three Ramsar sites namely Vembanad-Kol Wetland, Sasthamkotta Lake, and Ashtamudi Wetland (Ramsar Sites information Service 2023).

Since 1953, studies have documented avian fauna in the wetlands of Kerala and adjacent areas. Nair (1994) studied birds of Aakkulam-Veli back waters. Sivaperuman & Jayson (2000) and Jayson (2002) documented the avian diversity in Kole wetlands, Thrissur. Kumar (2006) made a checklist of avifauna of the Bharathapuzha River Basin, Kerala. Narayanan et al. (2011) documented ornitho-fauna and the importance of its conservation in the Kuttanad Wetland. Recently, Chandran et al. (2023) updated the checklist of birds of Kerala. Apart from the studies on avian diversity, more comprehensive species studies were also conducted in many parts of

Kerala. Ravindran (1993) documented the breeding of Purple Swamphen *Porphyrio porphyrio* in the Kole lands of Kerala, followed by Menon (2004) evaluating the ecology of this species. Narayanan et al. (2006) studied the nesting behaviour of Great Cormorant *Phalacrocorax carbo*. In this present study, an attempt has been made to document the diversity of birds in the wetlands of Chemmattamvayal and adjacent areas.

MATERIALS AND METHODS

Study area

Chemmattamvayal and adjacent wetland areas are located 4 km from Kanhangad, Kasaragod District, Kerala (Figure 1, Image 1). It lies in between 12.28°–12.32° N & 75.10°–75.12° E and is located very close to the Kariangodu River. The wetland has a total area of 330.24 ha (825.6 acres) and the adjacent habitat includes paddy fields, freshwater marshes, ponds, backyards, plantations of coconut, arecanut, plantain and vegetable fields. Major habitats in this region include non-tidal, freshwater systems dominated by grasses, sedges, and other freshwater emergent hydrophytes (Image 2a,b,c). The average temperature in summer is 35°C while the average winter temperature is around 20°C. The area receives both south-west and north-east monsoons, however, the south-west monsoon tends to dominate. The area falls under the tropical monsoon climate (Köppen 1936).

Methods

The study was conducted between December 2014 to March 2018. Regular surveys were conducted by establishing fixed transects through different habitats across the study area. Birds were observed in the morning at 0630–0930 h and in the evening at 1600–1800 h using 8 x 42 Bushnell and 10 x 50 Olympus binoculars. Opportunistic records were also collected during other times of the day. Records were collected as multiple 15-minutes checklists and all the birds observed in a span of 15 minutes were counted as one checklist. Records included species of birds, number of individuals, habitat types, and other habitat & behavioural notes including the breeding observations, if any.

Wherever possible, observations were supplemented with photographs. In most cases, observations were recorded and uploaded to the online platform 'eBird'.

The birds were identified with the help of field guides (Neelakandan et al. 1993; Sashikumar et al. 2011; Rasmussen & Anderton 2012; Grimmett et al. 2014). The

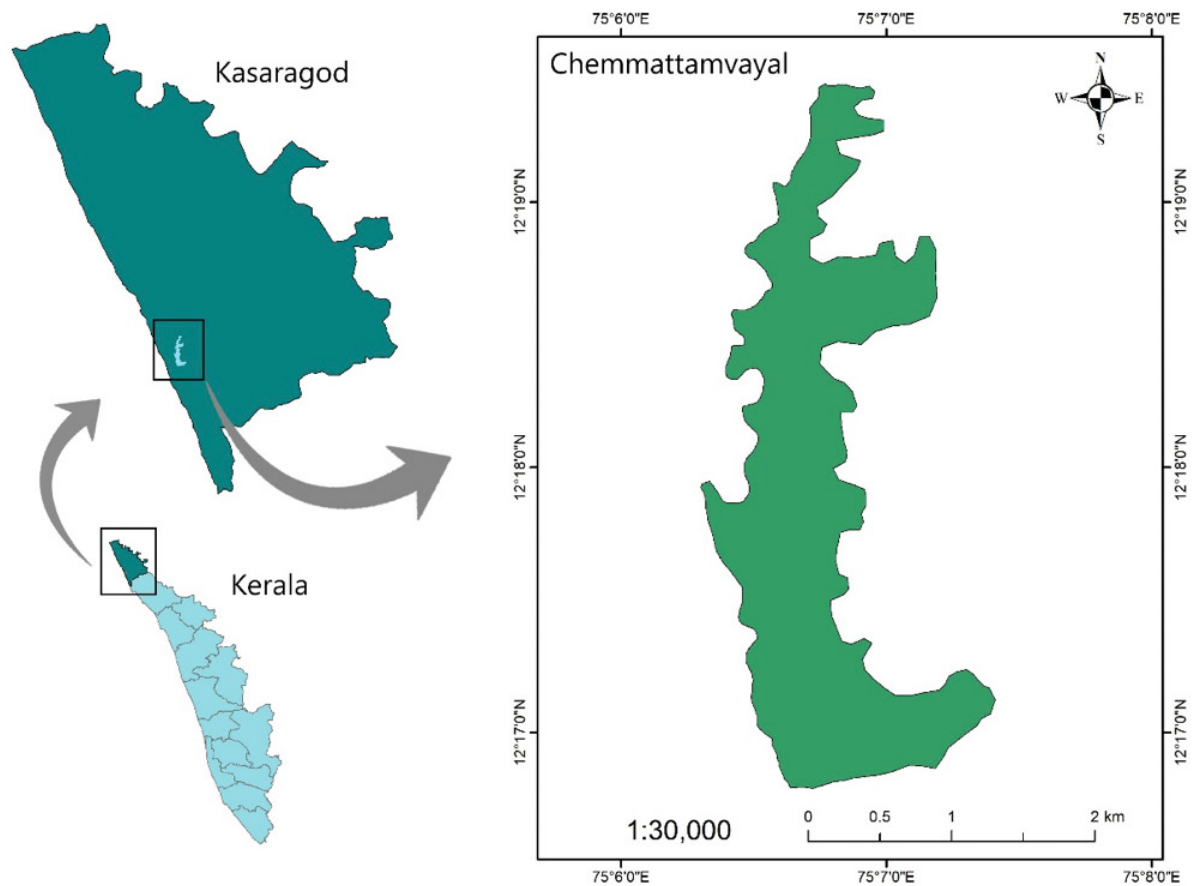


Figure 1. Location of Chemmattamvayal wetlands.



Image 1. Chemmattamvayal wetlands and adjacent areas.

nomenclature, status, and classification of the species follow Praveen (2015), Praveen et al. (2018, 2019), and Praveen & Jayapal (2023).

Following the protocol established by Kumar & Gupta (2009), the status of the species was categorized on the basis of number of sightings as: Common (Co), i.e., recorded 8–10 times out of 10 visits, Uncommon (U) recorded 4–7 times out of 10 visits, and Rare (R) recorded 1–3 times out of 10 visits. Birds were also categorized as Year-round (YR), Winter Migrant (WM), and Uncertain (UC). UC are those species that pop up anytime without a predictable pattern or are those that do not have clear data on sightings.

A measure of relative abundance of all birds was calculated. It is the percentage of occurrence of a species in a checklist which is calculated by the number of checklists in which a bird is recorded, divided by the total number of checklists. This includes checklists that did not report species and provides a measure of how frequently a species was reported relative to other species in the region. Relative abundance was analyzed for different ecological groups of birds such as parasitic cuckoos, primary hole-nesters, raptors and woodland understory birds. We assigned all species to different feeding guilds based on their dietary categories and foraging strata (Ding et al. 2015, 2019; Harisha et al. 2021; Panda et al. 2021; Jangral & Vashishat 2022;

Rodrigues et al. 2023).

$$\text{Relative abundance} = \frac{\text{Number of checklists in which a bird is recorded}}{\text{Total number of checklists}} \times 100$$

RESULTS

A total of 565 checklists of birds were created with a duration of 15 minutes each. A total of 145 species of birds belonging to 17 orders (Figure 2) and 50 families were recorded. Among them, 42 species were winter migrants and 97 species were seen throughout the year (Table 1). The highest number of birds was recorded during the month of January (~5,000 birds) and the lowest in June (~400 birds). The most abundant birds of Chemmattamvayal wetlands were the White-throated Kingfisher *Halcyon smyrnensis*, Indian Pond Heron *Ardeola grayii*, and Spotted Dove *Spilopelia chinensis*. The species of Chemmattamvayal wetlands included, three 'Near Threatened' species—Black-headed Ibis *Threskiornis melanocephalus*, Oriental Darter *Anhinga melanogaster*, and Woolly-necked Stork *Ciconia episcopus*—on the IUCN Red List. The Chemmattamvayal Wetlands also has one species endemic to the Western Ghats, the Malabar Starling *Sturnia malabarica blythii*. Additionally, 14 species (Table 1) observed in Chemmattamvayal wetlands are included

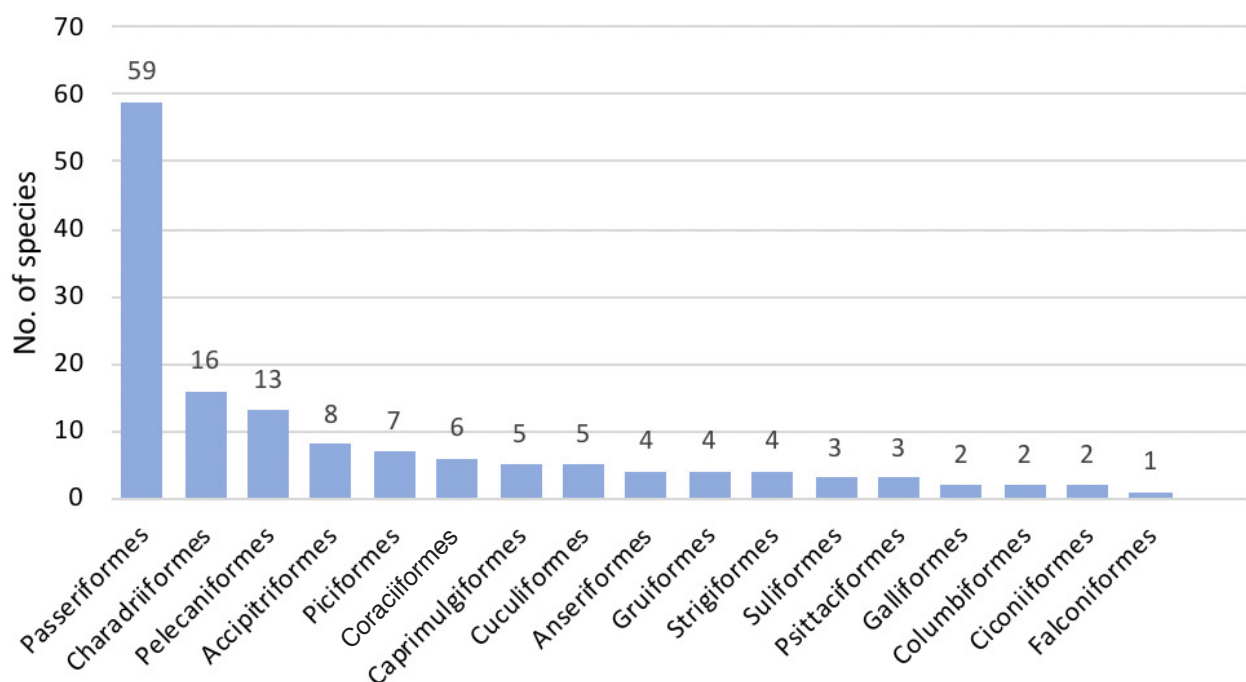


Figure 2. The number of species of birds per different bird orders recorded from Chemmattamvayal Wetlands in Kasaragod, Kerala.

Table 1. Checklist of birds of Chemmattamvayal Wetlands, Kasaragod, Kerala.

Order	Family	English Name	Scientific Name	IUCN	WPA	CITES	Status	Occurrence	Feeding Guild	Relative Abundance
1	Anseriformes	Lesser Whistling Duck [Image 3]	<i>Dendrocygna javanica</i>	LC	Sch. II		YR	Co	O	39.51
2	Anseriformes	Garganey	<i>Spatula querquedula</i>	LC	Sch. II		WM	Co	H	7.41
3	Anseriformes	Common Teal (Eurasian Teal, Green-winged Teal)	<i>Anas crecca</i>	LC	Sch. II		WM	U	H	1.23
4	Anseriformes	Cotton Teal (Cotton Pygmy-Goose)	<i>Nettion coromandelianus</i>	LC	Sch. I		YR	Co	H	3.7
5	Galliformes	Indian Peafowl	<i>Pavo cristatus</i>	LC	Sch. I		YR	Co	O	1.23
6	Galliformes	Red Spurfowl	<i>Gallus gallus</i>	LC	Sch. II		YR	Co	G	1.23
7	Columbiformes	Rock Pigeon (Rock Dove)	<i>Columba livia</i>	LC	Sch. IV		YR	Co	G	27.16
8	Columbiformes	Spotted Dove	<i>Spilopelia chinensis</i>	LC	Sch. II		YR	Co	G	41.98
9	Caprimulgiformes	Jerdon's Nightjar	<i>Caprimulgus atripennis</i>	LC	Sch. II		YR	Co	I	1.23
10	Caprimulgiformes	Savanna Nightjar	<i>Caprimulgus affinis</i>	LC	Sch. II		UC	Co	I	0.62
11	Caprimulgiformes	Asian Palm Swift	<i>Cypsiurus balastensis</i>	LC	Sch. II		YR	Co	I	13.58
12	Caprimulgiformes	Indian House Swift (Little Swift)	<i>Apus affinis</i>	LC	Sch. II		YR	Co	I	5.56
13	Cuculiformes	Greater Coucal	<i>Centropus sinensis</i>	LC	Sch. II		YR	Co	O	35.8
14	Cuculiformes	Blue-faced Malkoha	<i>Phaenicophaeus viridirostris</i>	LC	Sch. II		YR	Co	O	5.56
15	Cuculiformes	Pied Cuckoo (Pied Crested Cuckoo, Jacobin Cuckoo)	<i>Clamator jacobinus</i>	LC	Sch. II		UC	U	I	0.62
16	Cuculiformes	Asian Koel	<i>Eudynamis scolopacea</i>	LC	Sch. II		YR	Co	O	18.52
17	Cuculiformes	Grey-bellied Cuckoo	<i>Cacomantis passerinus</i>	LC	Sch. II		WM	U	I	0.62
18	Cuculiformes	Common Hawk Cuckoo	<i>Hierococcyx varius</i>	LC	Sch. II		YR	Co	I	7.41
19	Gruiformes	White-breasted Waterhen	<i>Amaurornis phaeiurus</i>	LC	Sch. II		YR	Co	O	25.93
20	Gruiformes	Watercock	<i>Gallicrex cinerea</i>	LC	Sch. II		YR	Co	O	3.09
21	Gruiformes	Purple Swamphen (Grey-headed Swamphen) [Image 4]	<i>Porphyrio porphyrio</i>	LC	Sch. II		YR	Co	O	33.62
22	Gruiformes	Common Coot (Eurasian Coot)	<i>Fulica atra</i>	LC	Sch. II		WM	U	O	1.23
23	Ciconiiformes	Asian Openbill [Image 5]	<i>Anastomus oscitans</i>	LC	Sch. II		WM	Co	C	11.5
24	Ciconiiformes	Woolly-necked stork (Asian Woollyneck)	<i>Ciconia episcopus</i>	NT	Sch. II		WM	Co	C	0.62
25	Pelecaniformes	Yellow Bittern	<i>Ixobrychus sinensis</i>	LC	Sch. II		YR	Co	C	8.85
26	Pelecaniformes	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	LC	Sch. II		YR	Co	C	11.15
27	Pelecaniformes	Striated Heron (Green-backed Heron, Little Heron)	<i>Butorides striata</i>	LC	Sch. II		YR	Co	C	6.19
28	Pelecaniformes	Indian Pond Heron	<i>Ardeola grayii</i>	LC	Sch. II		YR	Co	C	46.3
29	Pelecaniformes	Cattle Egret	<i>Bubulcus ibis</i>	LC	Sch. II		YR	Co	C	30.86

	Order	Family	English Name	Scientific Name	IUCN	WPA	CITES	Status	Occurrence	Feeding Guild	Relative Abundance
30	Pelecaniformes	Ardeidae	Grey Heron	<i>Ardea cinerea</i>	LC	Sch. II		YR	Co	C	24.77
31	Pelecaniformes	Ardeidae	Purple Heron	<i>Ardea purpurea</i>	LC	Sch. II		YR	Co	C	35.8
32	Pelecaniformes	Ardeidae	Great Egret	<i>Ardea alba</i>	LC	Sch. II		YR	Co	C	30.08
33	Pelecaniformes	Ardeidae	Intermediate Egret	<i>Ardea intermedia</i>	LC	Sch. II		YR	Co	C	34.57
34	Pelecaniformes	Ardeidae	Little Egret	<i>Egretta garzetta</i>	LC	Sch. II		YR	Co	C	16.63
35	Pelecaniformes	Ardeidae	Western Reef Egret (Western Reef Heron)	<i>Egretta gularis</i>	LC	Sch. II		UC	U	C	1.41
36	Pelecaniformes	Threskiornithidae	Black-headed Ibis [Image 6]	<i>Threskiornis melanoleuca</i>	NT	Sch. II		YR	Co	C	21.6
37	Pelecaniformes	Threskiornithidae	Glossy Ibis	<i>Plegadis falcinellus</i>	LC	Sch. II		WM	Co	C	23
38	Suliformes	Phalacrocoracidae	Little Cormorant	<i>Microcarbo niger</i>	LC	Sch. II		YR	Co	C	34.57
39	Suliformes	Phalacrocoracidae	Indian Cormorant	<i>Phalacrocorax fuscicollis</i>	LC	Sch. II		YR	Co	C	31.32
40	Suliformes	Anhingidae	Oriental Darter	<i>Anhinga melanogaster</i>	NT	Sch. II		YR	Co	C	14.2
41	Charadriiformes	Recurvirostridae	Black-winged Stilt	<i>Himantopus himantopus</i>	LC	Sch. II		WM	Co	C	6.19
42	Charadriiformes	Charadriidae	Pacific Golden Plover	<i>Pluvialis fulva</i>	LC	Sch. I		WM	Co	C	7.07
43	Charadriiformes	Charadriidae	Little-ringed Plover [Image 7]	<i>Charadrius dubius</i>	LC	Sch. II		WM	Co	C	9.91
44	Charadriiformes	Charadriidae	Grey-headed Lapwing	<i>Vanellus cinereus</i>	LC	Sch. II		WM	R	NR	0.53
45	Charadriiformes	Charadriidae	Red-wattled Lapwing [Image 8]	<i>Vanellus indicus</i>	LC	Sch. II		YR	Co	C	38.27
46	Charadriiformes	Jacaniidae	Pheasant-tailed Jacana	<i>Hydrophasianus chirurgus</i>	LC	Sch. II		WM	U	O	4.07
47	Charadriiformes	Jacaniidae	Bronze-winged Jacana	<i>Metopidius indicus</i>	LC	Sch. II		YR	Co	O	13.09
48	Charadriiformes	Scolopacidae	Common Snipe	<i>Gallinago gallinago</i>	LC	Sch. II		WM	Co	O	4.07
49	Charadriiformes	Scolopacidae	Common Sandpiper	<i>Actitis hypoleucos</i>	LC	Sch. II		WM	Co	C	14.51
50	Charadriiformes	Scolopacidae	Green Sandpiper	<i>Tringa ochropus</i>	LC	Sch. II		WM	U	C	2.12
51	Charadriiformes	Scolopacidae	Common Greenshank	<i>Tringa nebularia</i>	LC	Sch. I		WM	Co	C	3.18
52	Charadriiformes	Scolopacidae	Wood Sandpiper	<i>Tringa glareola</i>	LC	Sch. II		WM	Co	C	20.88
53	Charadriiformes	Scolopacidae	Marsh Sandpiper	<i>Tringa stagnatilis</i>	LC	Sch. II		WM	U	C	1.41
54	Charadriiformes	Glaucidae	Little Pratincole (Small Pratincole) [Image 9]	<i>Glaucula lactea</i>	LC	Sch. II		WM	Co	I	4.24
55	Charadriiformes	Laridae	Gull-billed Tern	<i>Gelochelidon nilotica</i>	LC	Sch. I		WM	Co	C	6.54
56	Charadriiformes	Laridae	Whiskered Tern [Image 10]	<i>Chlidonias hybrida</i>	LC	Sch. II		YR	Co	C	21.23
57	Accipitriformes	Accipitridae	Oriental Honey Buzzard (Crested Honey Buzzard)	<i>Pernis ptilorhynchus</i>	LC	Sch. II	App. II	WM	Co	C	3.7
58	Accipitriformes	Accipitridae	Crested Serpent Eagle	<i>Spilornis cheela</i>	LC	Sch. I	App. II	YR	Co	C	5.56
59	Accipitriformes	Accipitridae	Booted Eagle	<i>Hieraaetus pennatus</i>	LC	Sch. I	App. II	WM	Co	C	1.85
60	Accipitriformes	Accipitridae	Western Marsh Harrier (Eurasian Marsh-Harrier)	<i>Circus aeruginosus</i>	LC	Sch. I	App. II	WM	Co	C	3.09

	Order	Family	English Name	Scientific Name	IUCN	WPA	CITES	Status	Occurrence	Feeding Guild	Relative Abundance
61	Accipitriformes	Accipitridae	Crested Goshawk	<i>Accipiter trivirgatus</i>	LC	Sch. I	App. II	YR	U	C	0.62
62	Accipitriformes	Accipitridae	Shikra	<i>Accipiter badius</i>	LC	Sch. I	App. II	YR	Co	C	5.56
63	Accipitriformes	Accipitridae	Brahminy Kite	<i>Haliastur indus</i>	LC	Sch. I	App. II	YR	Co	C	27.16
64	Accipitriformes	Accipitridae	Black Kite [Image 11]	<i>Milvus migrans</i>	LC	Sch. II	App. II	YR	Co	C	13.58
65	Strigiformes	Strigidae	Jungle Owlet	<i>Glaucidium radiatum</i>	LC	Sch. II	App. II	YR	Co	C	1.85
66	Strigiformes	Strigidae	Spotted Owlet	<i>Athene brama</i>	LC	Sch. II	App. II	YR	Co	C	3.09
67	Strigiformes	Strigidae	Indian Scops Owl	<i>Otus bakamoena</i>	LC	Sch. II	App. II	YR	Co	C	1.85
68	Strigiformes	Strigidae	Mottled Wood Owl	<i>Strix ocellata</i>	LC	Sch. I	App. II	YR	Co	C	1.85
69	Piciformes	Picidae	Lesser Golden-backed Woodpecker (Black-rumped Flameback) [Image 12]	<i>Dinopium benghalense</i>	LC	Sch. II		YR	Co	O	17.28
70	Piciformes	Picidae	Rufous Woodpecker	<i>Micropternus brachyurus</i>	LC	Sch. II		YR	Co	O	1.23
71	Piciformes	Picidae	Lesser Yellow-naped Woodpecker (Lesser Yellownape)	<i>Picus chlorolophus</i>	LC	Sch. II		YR	Co	O	1.23
72	Piciformes	Picidae	Greater Golden-backed Woodpecker (Greater Flameback)	<i>Chrysocolaptes guttacristatus</i>	LC	Sch. II		UC	R	O	0.35
73	Piciformes	Picidae	Brown-capped Pygmy Woodpecker	<i>Dendrocopos nanus</i>	LC	Sch. II		YR	Co	O	2.47
74	Piciformes	Megalaimidae	White-cheeked Barbet	<i>Psilopogon viridis</i>	LC	Sch. II		YR	Co	F	26.54
75	Piciformes	Megalaimidae	Coppersmith Barbet	<i>Psilopogon haemacephalus</i>	LC	Sch. II		YR	Co	F	12.35
76	Coraciiformes	Meropidae	Green Bee-eater	<i>Merops orientalis</i>	LC	Sch. II		YR	Co	I	32.1
77	Coraciiformes	Meropidae	Blue-tailed Bee-eater	<i>Merops philippinus</i>	LC	Sch. II		WM	Co	I	30.25
78	Coraciiformes	Alcedinidae	Common Kingfisher	<i>Alcedo atthis</i>	LC	Sch. II		YR	Co	C	27.78
79	Coraciiformes	Alcedinidae	Pied Kingfisher	<i>Ceryle rudis</i>	LC	Sch. II		YR	Co	C	12.38
80	Coraciiformes	Alcedinidae	Stork-billed Kingfisher	<i>Pelargopsis capensis</i>	LC	Sch. II		YR	Co	C	7.96
81	Coraciiformes	Alcedinidae	White-throated Kingfisher (White-breasted Kingfisher)	<i>Halcyon smyrnensis</i>	LC	Sch. II		YR	Co	C	56.17
82	Falconiformes	Falconidae	Peregrine Falcon [Image 13]	<i>Falco peregrinus</i>	LC	Sch. I	App. I	WM	U	C	0.35
83	Psittaciformes	Psittaculidae	Plum-headed Parakeet	<i>Psittacula cyanocephala</i>	LC	Sch. II	App. II	YR	Co	F	12.74
84	Psittaciformes	Psittaculidae	Rose-ringed Parakeet	<i>Psittacula krameri</i>	LC	Sch. II		YR	Co	F	9.55
85	Psittaciformes	Psittaculidae	Vernal Hanging Parrot	<i>Loriculus vernalis</i>	LC	Sch. II	App. II	YR	Co	F	16.63
86	Passeriformes	Campephagidae	Small Minivet	<i>Pericrocotus cinnamomeus</i>	LC	Sch. I		YR	Co	I	3.71
87	Passeriformes	Campephagidae	Orange Minivet (Scarlet Minivet)	<i>Pericrocotus flammeus</i>	LC	Sch. II		YR	Co	I	6.01
88	Passeriformes	Campephagidae	Large Cuckooshrike	<i>Coraciina javensis</i>	LC	Sch. II		YR	Co	I	4.77
89	Passeriformes	Campephagidae	Black-headed Cuckooshrike	<i>Lalage melanoptera</i>	LC	Sch. II		UC	Co	I	1.41

	Order	Family	English Name	Scientific Name	IUCN	WPA	CITES	Status	Occurrence	Feeding Guild	Relative Abundance
90	Passeriformes	Oriolidae	Black-hooded Oriole	<i>Oriolus xanthornus</i>	LC	Sch. II		YR	Co	O	8.14
91	Passeriformes	Oriolidae	Indian Golden Oriole	<i>Oriolus kundoo</i>	LC	Sch. II		WM	Co	O	6.54
92	Passeriformes	Artamidae	Ashy Woodswallow	<i>Artamus fuscus</i>	LC	Sch. II		YR	Co	I	9.91
93	Passeriformes	Vangidae	Common Woodshrike	<i>Tephrodornis pondicerianus</i>	LC	Sch. II		YR	Co	I	6.19
94	Passeriformes	Aegithinidae	Common Iora	<i>Aegithina tiphia</i>	LC	Sch. II		YR	Co	I	18.76
95	Passeriformes	Dicruridae	Black Drongo	<i>Dicrurus macrocerus</i>	LC	Sch. II		YR	Co	O	40.74
96	Passeriformes	Dicruridae	Ashy Drongo	<i>Dicrurus leucophaeus</i>	LC	Sch. II		WM	Co	O	20.17
97	Passeriformes	Dicruridae	Bronzed Drongo	<i>Dicrurus aeneus</i>	LC	Sch. II		YR	Co	O	24.07
98	Passeriformes	Dicruridae	Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	LC	Sch. II		YR	Co	O	20.88
99	Passeriformes	Laniidae	Brown Shrike	<i>Lanius cristatus</i>	LC	Sch. II		WM	Co	I	2.65
100	Passeriformes	Corvidae	Rufous Treepie	<i>Dendrocitta vagabunda</i>	LC	Sch. II		YR	Co	O	17.52
101	Passeriformes	Corvidae	House Crow	<i>Corvus splendens</i>	LC	Sch. V		YR	Co	O	41.98
102	Passeriformes	Corvidae	Large-billed Crow (Indian Jungle Crow)	<i>Corvus macrorhynchos</i>	LC	Sch. II		YR	Co	O	21.9
103	Passeriformes	Monarchidae	Black-naped Monarch	<i>Hypothymis azurea</i>	LC	Sch. II		YR	Co	I	4.95
104	Passeriformes	Monarchidae	Indian Paradise-flycatcher (Asian Paradise-flycatcher)	<i>Terpsiphone paradisi</i>	LC	Sch. II		WM	Co	I	3
105	Passeriformes	Dicaeidae	Pale-billed Flowerpecker	<i>Dicaeum erythrorhynchos</i>	LC	Sch. II		YR	Co	N	8.14
106	Passeriformes	Nectariniidae	Little Spiderhunter	<i>Arachnothera longirostra</i>	LC	Sch. II		YR	U	O	12.21
107	Passeriformes	Nectariniidae	Purple-rumped Sunbird	<i>Leptocoma zeylonica</i>	LC	Sch. II		YR	Co	N	27.16
108	Passeriformes	Nectariniidae	Purple Sunbird [Image 14]	<i>Cinnyris asiaticus</i>	LC	Sch. II		YR	Co	N	9.38
109	Passeriformes	Nectariniidae	Loten's Sunbird (Long-billed Sunbird) [Image 15]	<i>Cinnyris lotenius</i>	LC	Sch. II		YR	Co	N	7.25
110	Passeriformes	Chloropseidae	Golden-fronted Leafbird	<i>Chloropsis aurifrons</i>	LC	Sch. II		YR	Co	O	6.37
111	Passeriformes	Chloropseidae	Jerdon's Leafbird	<i>Chloropsis jerdoni</i>	LC	Sch. II		YR	Co	O	3.89
112	Passeriformes	Ploceidae	Baya Weaver [Image 16]	<i>Ploceus philippinus</i>	LC	Sch. II		YR	Co	G	9.38
113	Passeriformes	Estrildidae	White-rumped Munia	<i>Lonchura striata</i>	LC	Sch. II		YR	Co	G	8.14
114	Passeriformes	Estrildidae	Scaly-breasted Munia [Image 17]	<i>Lonchura punctulata</i>	LC	Sch. II		YR	Co	G	5.13
115	Passeriformes	Motacillidae	Paddyfield Pipit	<i>Anthus rufulus</i>	LC	Sch. II		YR	Co	I	4.24
116	Passeriformes	Motacillidae	Western Yellow Wagtail	<i>Motacilla flava</i>	LC	Sch. II		WM	Co	I	6.37
117	Passeriformes	Motacillidae	Grey Wagtail	<i>Motacilla cinerea</i>	LC	Sch. II		WM	U	I	0.88
118	Passeriformes	Motacillidae	White-browed Wagtail	<i>Motacilla maderaspatensis</i>	LC	Sch. II		YR	Co	I	4.77
119	Passeriformes	Motacillidae	White Wagtail	<i>Motacilla alba</i>	LC	Sch. II		WM	Co	I	0.7
120	Passeriformes	Cisticolidae	Ashy Prinia [Image 18]	<i>Prinia socialis</i>	LC	Sch. II		YR	Co	I	0.62

	Order	Family	English Name	Scientific Name	IUCN	WPA	CITES	Status	Occurrence	Feeding Guild	Relative Abundance
121	Passeriformes	Cisticolidae	Plain Prinia	<i>Prinia inornata</i>	LC	Sch. II		YR	Co	I	4.94
122	Passeriformes	Cisticolidae	Common Tailorbird	<i>Orthotomus sutorius</i>	LC	Sch. II		YR	Co	I	18.52
123	Passeriformes	Acrocephalidae	Blyth's Reed Warbler	<i>Acrocephalus dumetorum</i>	LC	Sch. II		WM	Co	I	6.79
124	Passeriformes	Acrocephalidae	Clamorous Reed Warbler	<i>Acrocephalus stentoreus</i>	LC	Sch. II		WM	Co	I	6.01
125	Passeriformes	Hirundinidae	Streak-throated Swallow	<i>Petrochelidon fluvicola</i>	LC	Sch. II		WM	R	I	0.88
126	Passeriformes	Hirundinidae	Red-rumped Swallow	<i>Cecropis daurica</i>	LC	Sch. II		YR	Co	I	3.89
127	Passeriformes	Hirundinidae	Wire-tailed Swallow	<i>Hirundo smithii</i>	LC	Sch. II		YR	Co	I	1.9
128	Passeriformes	Hirundinidae	Barn Swallow	<i>Hirundo rustica</i>	LC	Sch. II		WM	Co	I	5.3
129	Passeriformes	Pycnonotidae	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	LC	Sch. II		YR	Co	O	19.82
130	Passeriformes	Pycnonotidae	Red-vented Bulbul	<i>Pycnonotus cafer</i>	LC	Sch. II		YR	Co	O	16.99
131	Passeriformes	Pycnonotidae	White-browed Bulbul	<i>Pycnonotus luteolus</i>	LC	Sch. II		YR	Co	O	7.78
132	Passeriformes	Pycnonotidae	Yellow-browed Bulbul	<i>Acritillas indica</i>	LC	Sch. II		YR	Co	O	3.89
133	Passeriformes	Phylloscopidae	Green Leaf Warbler (Green Warbler)	<i>Phylloscopus nitidus</i>	LC	Sch. II		WM	Co	I	3.18
134	Passeriformes	Phylloscopidae	Greenish Leaf Warbler (Greenish Warbler)	<i>Phylloscopus trochiloides</i>	LC	Sch. II		WM	U	I	1.41
135	Passeriformes	Pelloniidae	Puff-throated Babbler	<i>Pellorneum ruficeps</i>	LC	Sch. II		YR	Co	I	4.32
136	Passeriformes	Leiothrichidae	Jungle Babbler	<i>Turdoides striata</i>	LC	Sch. II		YR	Co	O	1.23
137	Passeriformes	Leiothrichidae	Yellow-billed Babbler	<i>Turdoides affinis</i>	LC	Sch. II		YR	Co	O	19.14
138	Passeriformes	Sturnidae	Rosy Starling	<i>Pastor roseus</i>	LC	Sch. II		WM	Co	O	0.88
139	Passeriformes	Sturnidae	Chestnut-tailed Starling	<i>Sturnia malabarica</i>	LC	Sch. II		WM	Co	O	1.94
140	Passeriformes	Sturnidae	Malabar Starling	<i>Sturnia malabarica blythii</i>	LC	Sch. II		UC	Co	O	0.35
141	Passeriformes	Sturnidae	Common Myna	<i>Acridotheres tristis</i>	LC	Sch. II		YR	Co	O	27.78
142	Passeriformes	Sturnidae	Jungle Myna	<i>Acridotheres fuscus</i>	LC	Sch. II		YR	Co	O	18.05
143	Passeriformes	Muscicapidae	Oriental Magpie Robin	<i>Copsychus saularis</i>	LC	Sch. II		YR	Co	I	21.6
144	Passeriformes	Muscicapidae	Asian Brown Flycatcher	<i>Muscicapa dauurica</i>	LC	Sch. II		WM	Co	I	1.23
145	Passeriformes	Muscicapidae	Siberian Stonechat	<i>Saxicola maurus</i>	LC	Sch. II		WM	U	I	1.23

YR—Year-round | WM—Winter Migrant | UC—Uncertain | Co—Common | U—Uncommon | R—Rare | O—Omnivore | H—Herbivore | G—Granivore | I—Insectivore | C—Carnivore | F—Frugivore | N—Nectarivore | NR—Not recorded.

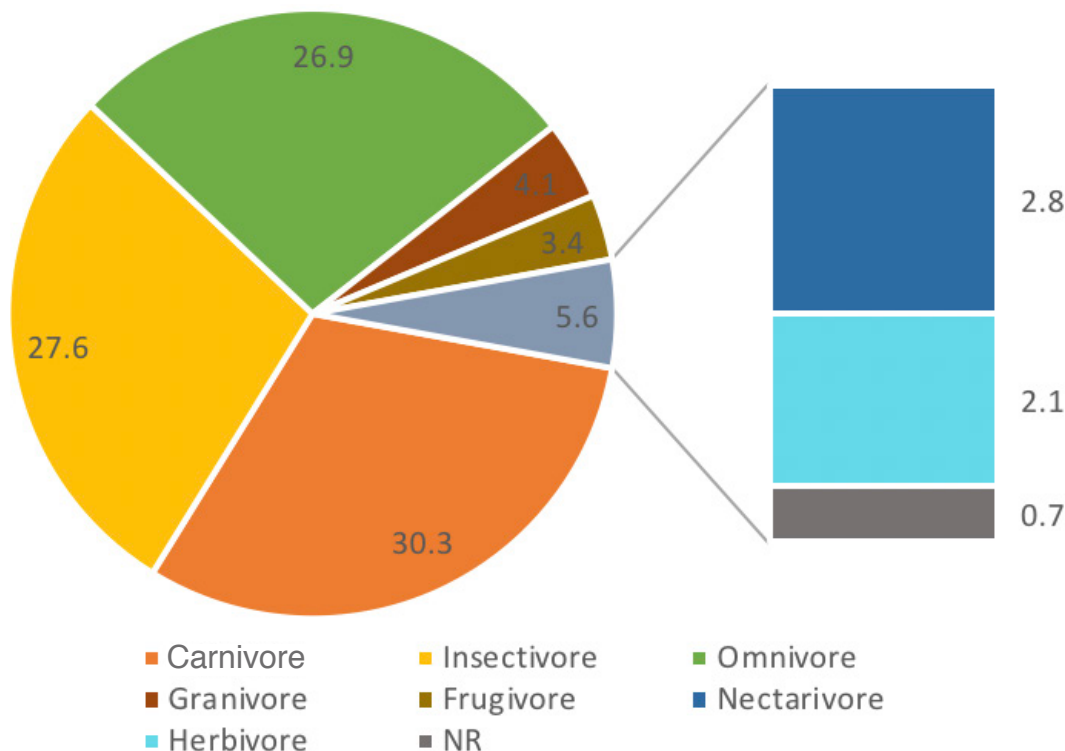


Figure 3. The feeding guild structure of the birds of Chemmattamvayal Wetlands in Kasaragod, Kerala.

in Schedule I and one species, i.e., the Peregrine Falcon *Falco peregrinus* is mentioned in Appendix 1 of CITES, according to the Wild Life (Protection) Amendment Act, 2022 (The Gazette of India 2023). Among the waterfowls, the Lesser Whistling Duck is a resident and is commonly seen in the region, and all other Anseriformes found here are migrants.

Relative abundance of the birds of Chemmattamvayal indicates that the White-throated Kingfisher is the most abundant species, followed by the Indian Pond Heron and Spotted Dove. The survey also documented indicator species such as primary hole nesters, which include, White-cheeked Barbet *Psilopogon viridis*, Coppersmith Barbet *Psilopogon haemacephalus*, and Black-rumped Flameback *Dinopium benghalense*. The presence of primary hole nesting birds is highly significant as they are considered to be keystone species and the existence of the secondary hole nesting birds such as parakeet, myna, and starling are dependent on the primary hole nesters. The present study reported four species of parasitic cuckoos such as Asian Koel *Eudynamis scolopacea*, Common Hawk Cuckoo *Hierococcyx varius*, Pied Cuckoo *Clamator jacobinus*, and Grey-bellied Cuckoo *Cacomantis passerinus*. The study site recorded 12 species of raptors. The presence of a healthy population of raptorial birds is

an indication of healthy habitat. Brahminy Kite *Haliastur indus* was the most common raptor, followed by Black Kite *Milvus migrans*. The presence of the understory dependent birds indicates that areas adjacent to the wetland has sufficient undergrowth. The study location recorded 15 species of birds dependent on the presence of understory. The feeding guild analysis of birds of the study area is given in Figure 3. The canopy-insectivores (18%) form the dominant guild followed by the aquatic-insectivores (13%).

DISCUSSION

Some factors, which threaten the wetland ecosystem and consequently the wetland bird population were identified during the study. Landscape alteration was identified as one of the major factors that leads to biodiversity loss in these wetlands. Areas adjacent to the wetland are being converted into concrete structures and some farmers are trying to convert their paddy fields into vegetable gardens. These altered land use practices have significantly reduced the presence of wetland dependent birds in these areas. Such anthropogenic influences adversely affecting wetlands were also



Image 2a,b,c. Chemmattamvayal Wetlands. © Sreehari K. Mohan.

demonstrated by Galatowitsch (2018) and Ostad-Ali-Askari (2022). The researchers of the present study noted that farmers complaining about the reduction in paddy-yield mainly due to Grey-headed Swampphen *Porphyrio porphyrio*. Additionally, the farmers were observed to

frequently use fire crackers to scare the birds away. At the same time, majority of the people living here are much more concerned about the beauty of this wetland and the birds visiting here.

The presence of the exotic vegetation such as *Eichhornia crassipes* and *Salvinia molesta* was also noticed during the study. However, the density of these exotics are relatively less as compared to similar wetland habitats. It would be prudent to establish mitigation measures to control the spread of these two wetland weeds. Information on other faunal groups dependent on the Chemmattamvayal Wetlands is currently lacking; thus, further steps are needed to document the other forms of biodiversity in this region. Regular biodiversity monitoring of the wetland is needed to study the temporal variation and associated changes in the response of various flora and fauna. Environmental education and awareness with the involvement of local stakeholders is required to stop the vulnerability of inland wetlands (Shah & Atisa 2021). Thus, conservation of these wetlands and adjacent areas can be effectively done with the involvement and support of the local people.

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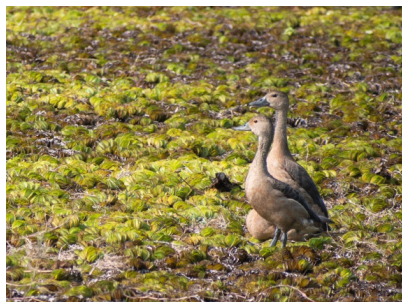


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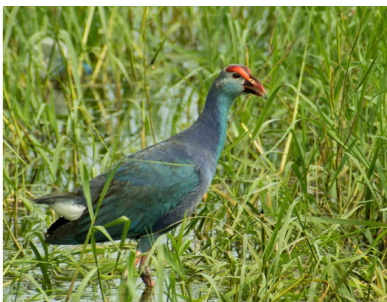


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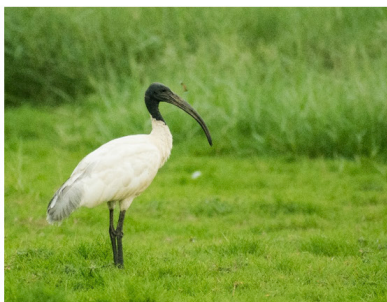


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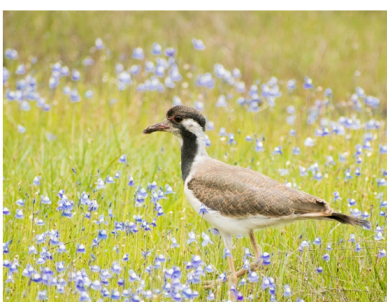


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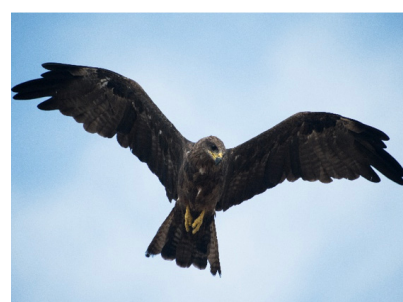


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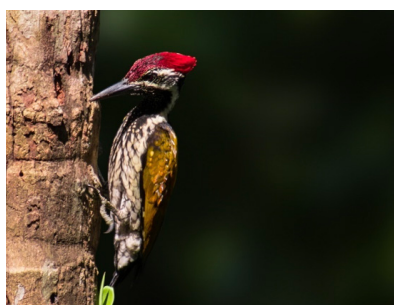


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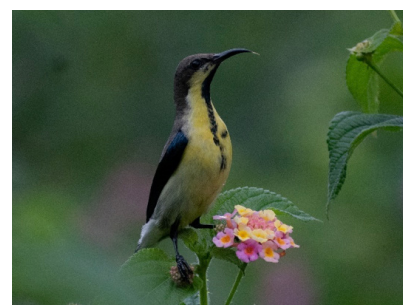


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