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A study on avian biodiversity of Kadamakkudy Wetlands, Ernakulam District, Kerala

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ABSTRACT

Birds are an integral part of nature and constitute one of earth's most important and diverse species, which inhabits various habitats, including forests, grasslands, swamps, shores, agricultural fields, scrubs, lakes, etc. A study on the avian biodiversity of Kadamakkudy wetlands in Ernakulam district. Kerala, was carried out from February 2018 to February 2019. The observations from the study reveals that, the rivers, lakes, marshes and Pokkali rice fields of Kadamakkudy are a suitable habitat for residents and migratory birds. A total of 100 species of birds belonging to 14 orders and 40 families were recorded during the study. Out of the 100 species, 55 were resident species, 37 were transcontinental migrants, five species were local migrants and three species were vagrants. Order Passeriformes represented highest number of species followed by Charadriiformes, Anseriformes, and Pelecaniformes. The total number of species ranged from 58 to 11 in a month with the highest number during February 2018 and lowest during June 2018. Maximum number of individuals were recorded during February 2018 and a minimum during August 2018. Piscivores were dominant in the study area followed by the granivores. Lesser whistling duck (Dendrocygna javanica), Garganey (Spatula querquedula), Little Cormorant (Microcarbo niger), Glossy Ibis (Plegadis falcinellus), Pacific Golden Plover (Pluvialis fulva) and Lesser Sand Plover (Charadrius mongolus) were the bird species observed in greater numbers. The Nesting of Streaked Weaver (Ploceus manyar) was observed in the adjacent reeds during March-April. Even though, Kadamakkudy wetlands are a paradise for wetland birds, the habitat faces several threats. Anthropogenic activities like illegal land reclamation, unscientific developmental activities, poaching and tourism create lots of menace.

1. Introduction

India is one of the twelve megadiverse countries of the world with more than 1300 species of birds of the world. India accounts for more than 13% of the world's avifauna (Grimmett and Inskipp, 2010). The state of Kerala has about 550 bird species including the residents as well as the migrants (eBird, 2023). Geographically, Kerala is mainly divided into highlands, coastal areas and wetlands, including the backwaters, lakes, rivers etc. Wetlands are complex ecosystems with several interacting organisms (Smith and Johnson, 2018). IUCN (1971) defined wetlands as areas of marsh, ponds, or swamps, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh or brackish or salt, including that of marine water, the depth of which at low tide does not exceed six meters. Wetlands are vital worldwide for wildlife protection, recreation, pollution and sediment control, flood prevention, and food production.

Kerala is well known for its diversity on wetlands, which spread all along the coast and inland. Major coastal wetlands in Kerala are Vellayani Kayal, Aakkulam-Veli backwater stretch, Kayamkulam Pozhi, Kumarakom, Mangalavanam, Kole wetlands, Purathur estuary, Manoor Kayal, Chervarpur Kayal, Kadalundy estuary, Azhinjilam, Dharmadom estuary, Kattampalli, Ezhimala, Chempallikundu and Mangrove areas (Kurup,1996). The important freshwater bodies include Sasthamkotta, Pookot and Muriyad.

Birds are considered an integral part of a wetland ecosystem (Custer and Osborn, 1977). Since wetlands serve as ideal ecosystems for birds throughout the year, the wetlands **ARTICLE HISTORY**

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are declared important bird areas by Birdlife International (Deepak *et al.*, 2017). According to Kumar *et al.*, 2005, 23% of the total bird species found in India depend on the wetlands. The distribution of the birds in a habitat depends on the water depth, type of vegetation, the salinity of the water, pollution, anthropogenic disturbances in the habitat and the relative abundance depends directly on the habitat, habitat structure, vegetation and availability of food resources (Wienes, 1992; Caziani and Derlindate 2000). Kadamakkudy is an important area for Pokkali and shrimp cultivation (Babu and Thomas, 2022). 154 species of birds have been reported from this site (eBird, 2023). In a comparative study (2016- 2019) conducted by Babu and Thomas in the Pokkali fields of Ernakulam district, Valiya Kadamakudy reported the highest species richness of 83.

2. Materials and Methods

2.1 Study area

Kadamakkudy islands is a group of fourteen islands consisting of Murikkal, Palyam Thuruth, Kandanad, Cheriya Kadamakkudy, Pulikkapuram, Moolampilly, Puthussery, Chariyam Thuruth, Chennur, Kothad, Pizhala, Korambadam, and Karikkad Thuruthu (Fig.1).

The wetland provides a home to a variety of indigenous as well as migratory birds. Kadamakkudy is also an important area of Pokkali cultivation. The wetland is used for Pokkali cultivation for 6 months and the rest 6 months are used for prawn farming. The area is highly influenced by the tides. More number of birds are observed during the low tides. The area is considered one of the birding hot spots in the Ernakulam district. The wetland is under threat due



Fig. 1. Map showing Kadamakkudy, the study location

to recent developmental activities. The District Tourism Promotion Council (DTPC) has initiated plans to facelift Kadamakkudy by setting up mangrove parks, floating restaurants, handicraft markets, and adventure water sports. These activities and an increase in the number of visitors could affect the rich diversity of birds in this area.

2.2 Methodology

The study was conducted from February 2018 to February 2019. Continuous observations were carried out in the study area during these months. The study area was covered on foot and the data were collected fortnightly. The most preferred time for recording bird activity was from 6.00 am to 9.00 am. The line transect and point count method were used to record the birds. Birds were individually counted in the case of small flocks and the block count method was employed in the case of large folks. Identification of birds were done as per Ali (1969), Ali and Ripely (1969), Grimmet and Inskipp (2005). Website ebird.org and help from expert birders were also availed for bird identification. Binoculars (Nikon Aculon) and a digital camera with a lens of 70-300 mm were used to observe birds. The data collected was analysed. Dominance (D), Simpson index (1-D), Shannon Weiner index (H) and Evenness (e^AH/S) were calculated using the PAST Software (PAST verion 4.03) (Hammer et al., 2001). The common English names used in this paper follows Chandran et al., (2023).

3. Results

A total of 100 species of birds belonging to 14 orders and 40 families were recorded during the study, out of which, 55 were resident species, 37 were transcontinental migrants, 5 were local migrants and 3 were vagrants (Table 1). River Tern (*Sterna aurantia*), listed as Vulnerable category and Bar- tailed Godwit (*Limosa lapponica*) as well as Black-tailed Godwit (*Limosa limosa*) listed as Near Threatened

category on Red List by IUCN were recorded from Kadamakkudy during the present study.

A greater number of bird species were observed during the months of October, November, February and March which is the migratory season of birds in Kerala. Species richness was highest in the month of February 2018 with 58 species and lowest in the month of June 2018 with 11 species. During the present study, maximum number of individuals were recorded in February 2018 (1548) and the minimum in June 2018 (30) (Table 2).

The Simpson diversity index was maximum in May 2018 (0.95) and minimum in July 2018 (0.25), whereas the. In contrast, the was observed maximum as in the month 3.33) and minimum in the month of July 2018 (0.76) (Table 3). This diversity indices can be compared with other wetlands. Jayson 2005, in a study on ecology of wetland birds in the Kole wetlands of Kerala recorded Shannon diversity index as 3.11.

The waders and waterfowls were present in abundance in the study area. According to the data, most abundant species are Lesser Whistling-duck (*Dendrocygna javanica*), Garganey (*Spatula querquedula*), Little Cormorant (*Microcarbo niger*), Glossy ibis (Plegadis falcinellus), Pacific Golden Plover (*Pluvialis fulva*), and Lesser Sand Plover (*Charadrius mongolus*) (Table 1). Species like Little Egret (*Egretta garzetta*), Indian Pond Heron (*Ardeola grayii*), White-throated Kingfisher (*Halcyon smyrnensis*), Stork-billed Kingfisher (Pelargopsis capensis), House Crow (Corvus splendens), Brahminy Kite (*Haliastur indus*) and Grey Heron (*Ardea cinerea*) were seen in almost every month of a year.

Dominant orders recorded was Passeriformes followed by Charadriiformes. Order Columbiformes, Cuculiformes, Piciformes and Psittaciformes were the least represented orders (Fig. 2).

 Ruddy S Gargane; Indian S; Northerr Rock Pig Greater G Rock Pig Greater G Asian Ko Asian Co Asian Pa Common Grey-hei White-bi Baillon's Baillon's Baillon's Black-wat Lesser S Greater G Black-tai Lesser S Common Kentish Black-tai Brown-h Little Tei Gull-bill Black-hei Brown-h Little Tei Gull-bill Whisker River Te Asian Oj Oriental Little Cei Great Eg Intermed Little Cg Intermed Little Eg Intermed Elack-tai Black-tai Glossy II Black-tai Stork-bil Stork-bil Ranmin Commor Stork-bil Ranmin Ranmin Ranmin Rospin Black-tai White-th Black-tai Black-tai White-th Rospin Black-tai Kestern Black-tai Kestern Black-tai Kestern Ranmin Common Stork-bil Rospin Black-tai White-th Black-tai Black-tai White-th Black-tai Black-tai Kestern Black-	er Whistling Duck					T IC	$\frac{Mean \pm SD}{27.95 \pm 5(.10)}$
 Gargane, Gargane, Indian Sj. Northerri Rock Pig. Greater Q Roke Neiger Greater Q Asian Pa Common Grey-hea White-bi Balck-ta Black-ta Black-ta Common Brown-h Black-ta Commor Black-ta Commor Black-ta Commor Black-ta Commor Black-ta Black-ta Sourch Black-ta Sourch Black-ta Sourch Black-ta Black-ta Sourch Black-ta Black-ta Sourch Black-ta Sourch Black-ta Sourch Black-ta Sourch-bil Sourch-bil	dy Shaldnak	Dendrocygna javanica Tadoma famuginaa	Anatidae Anatidae	Anseriformes Anseriformes	Resident	Least Concern Least Concern	$\begin{array}{c} 27.85 \pm 56.19 \\ 0.08 \pm 0.28 \end{array}$
 Indian Sj Northerri Rock Pig Greater Q Asian Ka Common Grey-hea White-bi Baillon's White-bi Baillon's Black-ta Common Kentishi Black-ta Common Brown-h Black-ta Common Brown-h Black-ta Little Ter Gull-bill Black-ta Little Co Rever Te Asian Op Oriental Little Eq Black-ta Little Eq Black-ta Server Te Gester Eg Indian C Great Eg Intermed Black-ta Estern Black-ta Black-ta Estern Black-ta Stork-bil White-th Black-ta Black-ta Black-ta Black-ta Black-ta Stork-bil Reader B Reader B	•	Tadorna ferruginea Spatula querquedula	Anatidae	Anseriformes	Vagrant Winter Visitor	Least Concern	0.08 ± 0.28 20.23 ± 0.28
 Northerri Rock Pig Greater G Asian Ka Greater G Asian Ka Common Common Common Grey-hei White-bi Baillon'S Black-wat Lesser S Greater G Red-wat Lesser S Greater G Black-ta Easter S Common Brown-h Black-ta Common Brown-h Black-ta Common Brown-h Black-ta Common Brown-h Little Tet Gull-bill Whisker Scher Te Gull-bill Whisker Scher Te Gull-bill Brown-h Little Tet Gull-bill Whisker Brown-h Little Tet Gull-bill Whisker Gull-bill Whisker Black-he Great Eg Intermed Uttle Eg Western Glossy II Black-he Osprey Western Serons II Stork-bil Stork-bil White-th Black-ru Black-bil Black-ta Stork-bil Keren B Black-ru Black-ru Keren B Serons II Serons II Serons II Keren B	an Spot-billed Duck	Anas poecilorhyncha	Anatidae	Anseriformes	Winter Visitor	Least Concern	0.08 ± 0.28
 Rock Pig Greater G Asian K Asian K Asian Pa Commot Grey-hea White-bn Baillon's Black-wi Pacific C Red-wat Lesser S Greater G Red-wat Lesser S Greater S Black-ta Easter Sa Commot Brown-h Brown-h Brown-h Brown-h Brown-h Brown-h Brown-h Little Tet Gull-bill Whisker River Te Gull-bill Whisker River Te Gull-bill Intermed Little Eg Western Careat Eg Western Glossy It Black-ta Stork-bil Stork-bil Stork-bil Stork-bil Rend-win Stork-bil Rend-tail Black-ta Stork-bil Roemmon Stork-bil Roemmon Stork-bil Roemmon Stork-bil Roemmon Stork-bil Roemmon Roemmon Stork-bil Roemmon Stork-bil Roemmon Stork-bil Roemmon Stork-bil Roemmon Stork-bil		Anas acuta	Anatidae	Anseriformes	Winter Visitor	Least Concern	0.08 ± 0.28 0.54 ± 1.45
 Greater G Asian KG Grey-hei Watercon White-bi Baillon's Baillon's Black-twith Lesser S Kentish I Back-tai Back-tai Commor Brown-h Brown-h Brown-h Little Tei Gull-bill Whisker Scommor Black-tai Little Tei Gull-bill Whisker Reiver Te Gull-bill Whisker River Te Gull-bill Little Co Indian C Great Eg Indian C Gasy In Black-tai Subsch Black-tai Commor Black-tai Brown-h Eittle Co Black-tai Brown-h Eittle Co Black-tai Black-tai Great Eg Intermed Black-tai Black-tai Black-tai Subsch Subsch Subsch Subsch Subsch Black-tai Subsch S		Columba livia	Columbidae	Columbiformes	Resident	Least Concern	0.54 ± 1.43 0.54 ± 1.33
 Asian Ko Asian Pa Common Grey-hei Watercoo White-bi Baillon's Black-wi Pacific C Red-wat Lesses Z Greater S Black-tat Lest Sa Black-tat Lest Sa Common Black-tat Brown-h Brown-h Little Ter Gull-bill Whisker River Te Asian Oj Oriental Little Co Indian C Great Eg Intermod Little Eg Western Cattle Eg Black-tat Suestern Commor Slack-tat Black-tat Black-tat Commor Glossy II Soprey Western Stork-bil Stork-bil Stork-bil Ricer B Black-tat Black-tat Black-tat Black-tat Black-tat Black-tat Stork-bil Koren B Rene B Soprey White-tat White-tat Black-tat Rose-rin Rose-rin 		Centropus sinensis	Cuculidae	Cuculiformes	Resident	Least Concern	0.34 ± 0.6
 Asian Pa Common Grey-hea Watercoo White-bi Rudy-b Baillon's Black-wat Pacific C Red-wat Lesser S Greate S Common Kentish I Black-ta Edsage Common Black-ta East-taile Black-ta Common Kentish I Black-ta Common Bar-taile Black-ta Common Common Bar-taile Black-ta Common Common Black-ta Common Black-ta Common Black-ta Common Black-ta Common Black-ta Common Black-ta Subord Common Black-ta Common Black-ta Great Eg Asian Oj Oriental Little Co Indian C Great Eg Intermed Intermed Black-ta Subsetrin Cattle Eg Mersen Black-ta Subsetrin Cattle Eg Black-ta Subsetrin Common Stork-bil Subsetrin Suback-ta Suback-ta Suback-ta Black-ta Black-ta Black-ta Black-ta Black-ta Black-ta Black-ta Black-ta White-th Rose-rin Rose-rin 		Eudynamys scolopaceus	Cuculidae	Cuculiformes	Resident	Least Concern	0.25 ± 0.0 0.46 ± 0.78
 Common Grey-hea Watercoo White-bh Ruddy-b Ruddy-b Baillon's Black-wat Pacific C Red-wat Lesser S Greater S Greater S Greater S Kentish I Black-ta Terek Sa Common Black-ta Brown-h Brown-h Little Ter Gull-bill Whistern River Te Gull-bill Whistern River Te Gasan Gull-bill Whistern Intitle Co Indian C Great Eg Intermed Intermed Black-the Intermon Glossy II Black-the Stork-bil Stork-bil Stork-bil Stork-bil Stork-bil Stork-bil Reen B Black-ta Black-ta 	n Palm Swift	Cypsiurus balasiensis	Apodidae	Apodiformes	Resident	Least Concern	0.62 ± 1.71
 Grey-hei Watercoi White-bi Ruddy-b Baillon'S Black-wi Black-wi Pacific C Red-wat Lesser S Greater S Black-tai Lesser S Common Black-tai Common Black-tai Common Black-tai Brown-h Little Tei Gull-bill Whisker Gull-bill Whisker Gull-bill Whisker Gull-bill Whisker Grey Hei Purple H Grey Hei Purple H Grey Hei Indian C Gattrerged Interrege Meron Black-tac Server Te Black-tai Black-tai Server Te Black-tai Grest Eg Indian C Grest Eg Western Cattle Eg Heron Black-tai Server Server Black-tai Server Black-tai Server Black-tai Server Black-tai White-th Black-tai White-tai White-tai White-tai Rose-rin Rose-rin 	mon Moorhen	Gallinula chloropus	Rallidae	Gruiformes	Resident	Least Concern	0.02 ± 0.28
 Watercou Watercou White-bi Ruddy-b Baillon's Black-wat Black-wat Lesser S Greater S Black-ta Black-ta Ererk Sa Common Black-ta Common Common Brown-h Black-ta Common Brown-h Little Ter Gull-bill Brown-h Little Ter Gull-bill Whisker Sing Common Black-ta Common Brown-h Little Ter Gull-bill Whisker Gull-bill Whisker Gull-bill Utitle Co Indian C Great Eg Intermed Little Eg Western Cattle Eg Western Cattle Eg Western Sillack-he Sillack-he<!--</td--><td>-headed Swamphen</td><td>Porphyrio poliocephalus</td><td>Rallidae</td><td>Gruiformes</td><td>Resident</td><td>Least Concern</td><td>3.77 ± 4.04</td>	-headed Swamphen	Porphyrio poliocephalus	Rallidae	Gruiformes	Resident	Least Concern	3.77 ± 4.04
13. White-br 14. Ruddy-b 15. Baillon's 16. Black-w 17. Pacific C 18. Red-wat 19. Lesser S 20. Greater S 21. Kentish I 22. Bar-taile 23. Black-ta 24. Terek Sa 25. Commor 26. Commor 27. Marsh Si 28. Wood Sa 29. Commor 30. Black-he 31. Brown-h 32. Little Ter 33. Gull-bill 34. Whisker 35. River Te 36. Asian Or 38. Little Co 39. Indian C 40. Grey He 41. Purple H 42. Great Eg 43. Intermed 44. Little Eg	1	Gallicrex cinerea	Rallidae	Gruiformes	Resident	Least Concern	0.08 ± 0.28
15. Baillon's 16. Black-wit 17. Pacific C 18. Red-wat 19. Lesser S 20. Greater S 21. Kentish I 22. Bar-taile 23. Black-ta 24. Terek Sa 25. Commor 26. Commor 27. Marsh S: 28. Wood Sa 29. Commor 30. Black-he 31. Brown-h 32. Little Te: 33. Gull-bill 34. Whisker 35. River Te 36. Asian Oj 37. Oriental 38. Little Co 39. Indian C 40. Grey Hei 41. Purple H 42. Great Eg 43. Intermed 44. Little Eg 45. Western 46. Cattle Eg 47. Indian P4 </td <td>te-breasted Waterhen</td> <td>Amaurornis phoenicurus</td> <td>Rallidae</td> <td>Gruiformes</td> <td>Resident</td> <td>Least Concern</td> <td>0.38 ± 0.51</td>	te-breasted Waterhen	Amaurornis phoenicurus	Rallidae	Gruiformes	Resident	Least Concern	0.38 ± 0.51
 Black-wi Pacific C Red-wat Lesser S Greater S Greater S Kentish J Bar-taile Black-ta Bar-taile Black-ta Terek Sa Commor Marsh Si Wood Sa Commor Black-he Brown-h Brown-h Little Ter Gull-bill Whisker Gull-bill Whisker Scill Commor Brown-h Little Ter Gull-bill Whisker Grey Hei Intermed Intermed Black-ter Great Eg Intermed Black-ter Great Eg Intermed Black-ter Great Eg Intermed Black-ter Black-ter Black-ter Soprey Western Stork-bil Stork-bil White-th Black-fue Black-fue White-th Black-fue Black-fue Black-fue Black-fue 	ly-breasted Crake	Zapornia fusca	Rallidae	Gruiformes	Resident	Least Concern	0.15 ± 0.38
 Pacific C Pacific C Red-wat Lesser S Greater S Greater S Bar-taile Black-ta Bar-taile Black-ta Terek Sa Common Common Back-ta Terek Sa Common Marsh Si Wood Sa Wood Sa Wood Sa Common Brown-h Brown-h Brown-h Little Ter Gull-bill Whisken Scill-bill Whisken Grey Hei Intian C Grey Hei Intermed Intermed Black-the Intermed Black-the Strey Hei Great Eg Intermed Black-the Strey Hei Great Eg Intermed Black-the Strey Hei Great Eg Intermed Black-the Strey Hei Strey Hei Strey Hei Stork-bil Stork-bil Stork-bil White-th Black-the Black-the Black-the Black-the Stork-bil White-th Black-tru Black-tru Black-tru Black-tru Black-tru 	on's Crake	Zapornia pusilla	Rallidae	Gruiformes	Winter Visitor	Least Concern	0.08 ± 0.28
 Red-wat Lesser S Greater S Kentish I Bar-taile Black-ta Terek Sa Commor Commor Marsh S Commor Black-ta Brown-h Little Tei Gull-bill Whisker Gull-bill Uttle Co Gull-bill Uttle Co Indian C Grey Hei Purple H Great Eg Intermed Little Eg Western Cattle Eg Intermed Black-hei Sussern Sussern	k-winged Stilt	Himantopus himantopus	Recurvirostridae	Charadriiformes	Winter Visitor	Least Concern	9.77 ± 14.52
 Lesser S Greater S Greater S Bar-taile Black-ta Black-ta Terek Sa Common Common Common Brown-h Black-ta Common Brown-h Black-ta Brown-h Little Ter Gull-bill Whisker Gull-bill Whisker Gull-bill Uttle Co Indian C Grey Hei Dirental Little Co Indian C Great Eg Western Cattle Eg Western Cattle Eg Western Soprey Western Sillack-hei Osprey Western Sillack-hei Sillack-ru Sillack-r	fic Golden Plover	Pluvialis fulva	Charadriidae	Charadriiformes	Winter Visitor	Least concern	13.46 ± 36.29
 Greater S Kentish J Bar-taile Black-ta Black-ta Terek Sa Commor Commor Marsh Si Wood Sa Commor Black-he Brown-h Little Ter Gull-bill Whisker Gull-bill Whisker Gull-bill Whisker River Te Gull-bill Little Co Indian C Grey He Purple H Great Eg Intermed Intermed Intermed Black-he Sever Te Grey He Little Co Indian C Grey He Purple H Great Eg Western Black-he Strey Eg Western Sever Heron Sever Heron Sever Si Sever Si Black-he Black-he Sever Si Black-he Sever Si Black-he Black-he Black-he Sever Si Sever Si Sever Si Sever Si Black-he Black-ru Black-ru Black-ru Sever Si Sever Si	wattled Lapwing	Vanellus indicus	Charadriidae	Charadriiformes	Resident	Least concern	0.92 ± 1.04
 Kentish I Bar-taile Bar-taile Bar-taile Black-ta Black-ta Terek Sa Commor Commor Commor Black-ta Wood Sa Commor Black-ta Wood Sa Commor Black-ta Brown-h Little Ter Gull-bill Whisker Gull-bill Whisker Gull-bill Whisker Gull-bill Whisker Grey Hei Purple H Grey Hei Intermed Intermed Intermed Intermed Grey Hei Grey Hei Uittle Eg Intermed Black-ta Black-ta Singery Western Osprey Western Sogna Black-ta Osprey Western Stork-bil Stork-bil White-th Black-ru Black-ru Black-ru Black-ru Sogna Black-ru Sommor Stork-bil Reren B Black-ru Black-ru Rose-rin 	er Sand Plover	Charadrius mongolus	Charadriidae	Charadriiformes	Winter Visitor	Least concern	19.15 ± 67
 Bar-taile Black-tai Black-tai Black-tai Terek Sa Commor Commor Marsh Sr Commor Black-hei Brown-h Brown-h Little Ter Gull-bill Whisker Gull-bill Whisker River Te Gull-bill Whisker River Te Asian Oj Indian C Great Eg Intermed Little Eg Great Eg Intermed Edick-cr Heron Black-hei Osprey Western Osprey Black-hei Stork-bil Stork-bil White-th Black-ru Black-ru Koren B Black-ru Koren B Stork-bil Koren B Stork-bil Koren B Black-ru Koren B Black-ru Koren B Rose-rin 	ter Sand Plover	Charadrius leschenaultii	Charadriidae	Charadriiformes	Winter Visitor	Least concern	7.92 ± 28
 Black-ta Black-ta Terek Sa Commor Commor Marsh Si Wood Sa Commor Brown-h Brown-h Little Ter Gull-bill Whisker Grey Hei Intermed Intermed Intermed Intermed Black-ter Heron Black-ter Black-ter Stork-bil Western Commor Stork-bil White-th Black-ru Black-ru White-cl Black-ru Rose-rin 	ish Plover	Charadrius alexandrinus	Charadriidae	Charadriiformes	Winter Visitor	Least concern	0.15 ± 0.38
 Terek Sa Commor Commor Commor Marsh S: Wood Sa Commor Black-he Brown-h Little Ter Gull-bill Whisker Gull-bill Whisker Gull-bill Whisker Gull-bill Whisker River Te Asian Op Oriental Little Co Indian C Grey Hei Purple H Great Eg Intermed Little Eg Intermed Little Eg Mestern Galssy II Black-hei Sprey Black-kei Sprey Western Glossy II Sprey Western Sprey Black-kei Stork-bil Stork-bil Stork-bil Black-ru Black-ru Black-ru Karahmin Commor Stork-bil Rose-rin Rose-rin 	tailed Godwit	Limosa lapponica	Scolopacidae	Charadriiformes	Winter Visitor	Near threatened	0.15 ± 0.55
 Commor Commor Commor Marsh S: Wood Sa Commor Black-he Brown-h Little Ter Gull-bill Whiskere Gull-bill Urver Ter Asian Op Oriental Little Co Indian C Great Eg Intermed Great Eg Western Cartel Eg Western Cattle Eg Western Cattle Eg Western Black-cre Heron Black-he Black-he Stork-bil Stork-bil Stork-bil White-th Black-ru Black-ru Black-ru Kase-rin 	k-tailed Godwit	Limosa limosa	Scolopacidae	Charadriiformes	Winter Visitor	Near threatened	
 Commor Marsh Si Wood Sa Commor Black-he Brown-h Little Tei Gull-bill Whisker Gull-bill Whisker Gull-bill Whisker Gull-bill Whisker Gull-bill Urttle Co River Te Sain Op Oriental Little Co Indian C Grey Hei Purple H Greey Hei Intermed Intermed Intermed Little Eg Western Cattle Eg Western Black-hei Osprey Western Black-hei Silack-hei Silack-hei Silack-hei Soprey Western Gossy II Stork-bil Stork-bil Stork-bil White-th Black-ru Black-ru Black-ru Koreen B Blue-tail White-cli Black-ru Rose-rin 	k Sandpiper	Xenus cinereus	Scolopacidae	Charadriiformes	Winter Visitor	Least concern	0.92 ± 2.4
 Marsh Si Wood Sa Commot Black-he Brown-h Little Ter Gull-bill Gull-bill Whisker River Te River Te Asian Of Driental Little Co Indian C Grey He Purple H Grey He Intermed Intermed Utitle Eg Mestern Grey He Little Co Indian C Grey He Little Cg Intermed Untermed Untermed Black-he Stern Black-he Stern Sprey Western Sprey Western Stork-bil Stork-bil Stork-bil White-th Seren B Black-ru Black-ru Black-ru 	mon Sandpiper	Actitis hypoleucos	Scolopacidae	Charadriiformes	Winter Visitor	Least concern	0.85 ± 1.40
 Wood Sa Commor Black-hei Brown-h Little Tei Gull-bill Whisker Gull-bill Whisker River Te Asian Op Arier Te Asian Op Indian C Grey Hei Purple H Grey Hei Intermed Intermed Intermed Intermed Subschweizer Great Eg Intermed Little Eg Intermed Black-hei Subschweizer Glossy II Black-hei Osprey Western Osprey Black hei Stork-bil Stork-bil White-th Black-ru Black-ru Black-ru Black-ru 	mon Greenshank	Tringa nebularia Tringa stagnatilis	Scolopacidae	Charadriiformes	Winter Visitor Winter Visitor		0.85 ± 0.99
 Commor 30. Black-he Brown-h Little Ter 33. Gull-bill Whisker 35. River Te Gall-bill Whisker 35. River Te Asian Oj Oriental Little Co Indian C Grey Hei Purple H Great Eg Interned Little Eg Interned Little Eg Western Cattle Eg Black-hei Black-hei Osprey Western Osprey Western Osprey Western Stork-bil Stork-bil White-th Green B Black-ru Black-ru Black-ru Koren B Black-ru Koren B Rose-rin 		Tringa stagnatilis Tringa glaveola	Scolopacidae	Charadriiformes Charadriiformes	Winter Visitor Winter Visitor	Least concern	1.92 ± 6.64
 Black-he Brown-h Little Tei Gull-bill Whisker Gull-bill Whisker River Te Asian Oj Oriental Little Co Indian C Grey Hei Intermed Intermed Little Eg Intermed Little Eg Intermed Black-cr Heron Black-cr Black-cr Black-de Osprey Western Osprey Western Stork-bil Stork-bil White-th Black-ru Black-ru Black-ru Black-ru Black-ru Koren B Black-ru Black-ru Karen B Koren B Rose-rin 	d Sandpiper mon Redshank	Tringa glareola Tringa totanus	Scolopacidae Scolopacidae	Charadriiformes	Winter Visitor Winter Visitor	Least concern Least concern	0.54 ± 1.05 1.54 ± 3.13
 Little Tei Gull-bill Whisker River Te Asian Op Priental Little Co Indian C Grey Hei Purple H Great Eg Intermed Little Co Intermed Little Eg Western Cattle Eg Western Cattle Eg Western Cattle Eg Indian Pa Black-cr Heron Black-hei Black-hei Stork-bil Stork-bil White-th Green B Black-ru Black-ru 	k-headed Gull	Chroicocephalus ridibundus	Laridae	Charadriiformes	Winter Visitor	Least concern	1.54 ± 3.13 0.15 ± 0.55
 Gull-bill Whisker River Te Asian Oj Oriental Little Co Little Co Indian C Grey Hei Purple H Great Eg Intermed Intermed Little Eg Intermed Cattle Eg Indian Pa Black-cre Heron Glossy II Black-hei Osprey Western Black-hei Osprey Western Black-hei Stork-bil Stork-bil White-th Black-ru Black-ru Black-ru 	vn-headed Gull	Chroicocephalus brunnicephalus	Laridae	Charadriiformes		Least concern	0.15 ± 0.38
 34. Whisker 35. River Te 36. Asian Op 37. Oriental 38. Little Co 39. Indian C 40. Grey Het 41. Purple H 42. Great Eg 43. Intermed 44. Little Eg 45. Western 46. Cattle Eg 47. Indian Pa 48. Black-cre 48. Black-cre 50. Black-het 51. Osprey 52. Western 53. Black Kii 54. Brahmin 55. Commor 56. Stork-bil 57. White-th 58. Green Bi 59. Blue-tail 60. White-ce 61. Black-ru 62. Rose-rin 		Sternula albifrons	Laridae	Charadriiformes	Winter Visitor	Least concern	1.38 ± 2.63
 River Te Asian Oj Oriental Little Co Indian C Grey Hei Purple H Great Eg Intermed Little Eg Intermed Little Eg Intermed Little Eg Intermed Little Eg Western Cattle Eg Nerson Black-te Osprey Black-te Osprey Black-te Stork-bil Stork-bil Stork-bil White-th Black-ru Black-ru 	-billed Tern	Gelochelidon nilotica	Laridae	Charadriiformes	Winter Visitor	Least concern	0.77 ± 1.7
 Asian Oj Oriental Little Co Indian C Indian C Indian C Indian C Grey Hei Purple H Great Eg Intermed Little Eg Western Cattle Eg Western Cattle Eg Indian Pi Black-ter Glossy II Black-hei Osprey Western Black-kei Sprey Western Black-kei Soprey Western Black Ki Stork-bil Stork-bil White-th Black-ru Black-ru Rose-rin 		Chlidonias hybrida	Laridae	Charadriiformes	Winter Visitor	Least concern	4 ± 6.72
 Oriental Oriental Little Co Indian C Grey Hei Purple H Great Eg Intermed Little Eg Intermed Little Eg Western Cattle Eg Meron Black-er Heron Glossy II Soprey Black-hei Stork-bil Stork-bil Stork-bil Stork-bil White-th Green B Black-ru Black-ru Black-ru 		Sterna aurantia	Laridae Ciconiidae	Charadriiformes Ciconiiformes	Resident	Vulnerable	0.46 ± 0.97
 Little Co Indian C Indian C Grey Hei Purple H Great Eg Intermed Intermed Little Eg Western Cattle Eg Western Cattle Eg Indian Pd Black-er Heron Black-hei Soprey Western Black Kit Stork-bil Stork-bil Sheck Kit Stork-bil White-th Black-ru Black-ru Black-ru 	1	Anastomus oscitans		Suliformes	Local migrant Resident	Least concern Near threatened	$0.15 \pm 0.55 \\ 0.92 \pm 0.95$
 Indian C Grey Hei Purple H Great Eg Intermed Little Eg Intermed Little Eg Western Cattle Eg Indian Pa Black-crn Heron Black-hei Black hei Stork-bil Stork-bil Stork-bil White-th Green B Black-ru Black-ru Black-ru 		Anhinga melanogaster Microcarbo niger	Anhingidae Phalacrocoracidae		Local Migrant	Least concern	0.92 ± 0.93 11.62 ± 15.34
 Grey Hei Purple H Qreat Eg Intermedg Intermedg Little Eg Western Cattle Eg Western Black-crr Heron Glossy II Black-hei Osprey Western Black Anni Common Stork-bil White-th Green B Blue-tail White-cl Black-ru Rose-rin 	an Cormorant	Phalacrocorax fuscicollis			Local migrant	Least concern	6.53 ± 13
 41. Purple H 42. Great Eg 43. Intermed 44. Little Eg 45. Western 46. Cattle Eg 47. Indian Pd 48. Black-cre 49. Glossy II 50. Black-hee 51. Osprey 52. Western 53. Black Ki 54. Brahmin 55. Commor 56. Stork-bil 57. White-th 58. Green Bd 59. Blue-tail 60. White-ch 61. Black-ru 62. Rose-rin 		Ardea cinerea	Ardeidae	Pelecaniformes	Local migrant	Least concern	3.92 ± 3.17
 42. Great Eg 43. Intermed 44. Little Eg 45. Western 46. Cattle Eg 47. Indian Pa 48. Black-cre 49. Glossy II 50. Black-hei 51. Osprey 52. Western 53. Black Ki 54. Brahmin 55. Commor 56. Stork-bil 57. White-th 58. Green Bi 59. Blue-tail 60. White-ch 61. Black-ru 62. Rose-rin 		Ardea purpurea	Ardeidae	Pelecaniformes	Resident	Least concern	1.46 ± 1.33
 Intermed Intermed Little Eg Western Cattle Eg Western Cattle Eg Indian P4 Black-cr Heron Glossy II Slack-he Osprey Western Black-ke Osprey Western Black Ki Stork-bil Stork-bil White-th Green Bi Blue-tail White-ch Black-ru Rose-rin 		Ardea alba	Ardeidae	Pelecaniformes	Resident	Least concern	4.07 ± 5.75
 45. Western 46. Cattle Eg 47. Indian Pe 48. Black-er 49. Glossy II 50. Black-he 51. Osprey 52. Western 53. Black Ki 54. Brahmin 55. Commoo 56. Stork-bil 57. White-th 58. Green Bi 59. Blue-tail 60. White-cl 61. Black-ru 62. Rose-rin 	mediate Egret	Ardea intermedia	Ardeidae	Pelecaniformes	Resident	Least concern	3.46 ± 9.35
 46. Cattle Eg 47. Indian Pd 48. Black-ere 49. Glossy II 50. Black-hei 51. Osprey 52. Western 53. Black Kii 54. Brahmin 55. Commoo 56. Stork-bil 57. White-th 58. Green Bi 59. Blue-tail 60. White-ch 61. Black-ru 62. Rose-rin 	e Egret	Egretta garzetta	Ardeidae	Pelecaniformes	Resident	Least concern	5.77 ± 11.63
 Indian Pé Indian Pé Black-cri Heron Glossy II Black-hei Black-hei Osprey Western Black Kii Brahmin Common Stork-bil TWhite-th Green Bi Blue-tail White-ch Black-ru Rose-rin 	ern Reef Egret	Egretta gularis	Ardeidae	Pelecaniformes	Resident	Least concern	2.30 ± 0.6
 Black-cr Heron Glossy II Black-he Black-he Osprey Western Black Ki Brahmin Commor Stork-bil Commor Stork-bil White-th Green B Blue-tail White-cl Black-ru Rose-rin 	e Egret	Bubulcus ibis	Ardeidae	Pelecaniformes	Resident	Least concern	0.77 ± 2.49
Heron 49. Glossy II 50. Black-he 51. Osprey 52. Western 53. Black Ki 54. Brahmin 55. Commor 56. Stork-bil 57. White-th 58. Green B 59. Blue-tail 60. White-ch 61. Black-ru 62. Rose-rin	in Pond Heron	Ardeola Greyii	Ardeidae	Pelecaniformes	Resident	Least concern	4.7 ± 5.8
 Black-he Osprey Western Black Ki Brahmin Common Stork-bil Common Stork-bil White-th Green B Blue-tail White-ch Black-ru Rose-rin 		Nycticorax nycticorax	Ardeidae	Pelecaniformes	Resident	Least concern	0.15 ± 0.38
 51. Osprey 52. Western 53. Black Ki 54. Brahmin 55. Commoo 56. Stork-bil 57. White-th 58. Green B 59. Blue-tail 60. White-cl 61. Black-ru 62. Rose-rin 		Plegadis falcinellus	Ardeidae	Pelecaniformes	Vagrant	Least concern	18.77 ± 45.82
 Western Black Ki Brahmin Commot Stork-bil Stork-bil White-th Green B Blue-tail White-cl Black-ru Rose-rin 		Threskiornis melanocephalus Pandion haliaetus	Threskiornithidae Pandionidae	Accipitriformes	Resident Winter Visitor	Near threatened Least concern	3.23 ± 7.54 0.30 ± 0.48
 Black Ki Brahmin Brahmin Common Stork-bil Stork-bil White-th Green B Blue-tail White-cl Black-ru Rose-rin 	tern Marsh Harrier	Circus aeruginosus	Accipitridae	Accipitriformes	Winter Visitor	Least concern	0.30 ± 0.43 0.31 ± 0.63
 54. Brahmin 55. Common 56. Stork-bil 57. White-th 58. Green Bi 59. Blue-tail 60. White-ch 61. Black-ru 62. Rose-rin 		Milvus migrans	Accipitridae	Accipitriformes	Resident	Least concern	0.01 ± 0.03 0.08 ± 0.28
 Common Stork-bil Stork-bil White-th Green B Blue-tail White-ch Black-ru Rose-rin 	miny Kite	Haliastur indus	Accipitridae	Accipitriformes	Resident	Least concern	4.23 ± 4.55
 56. Stork-bil 57. White-th 58. Green Be 59. Blue-tail 60. White-cl 61. Black-ru 62. Rose-rin 	mon Kingfisher	Alcedo atthis	Alcedinidae	Coraciiformes	Resident	Least concern	1.08 ± 1.03
 57. White-th 58. Green B 59. Blue-tail 60. White-ch 61. Black-ru 62. Rose-rin 	k-billed Kingfisher	Pelargopsis capensis	Alcedinidae	Coraciiformes	Resident	Least concern	1.31 ± 1.60
 58. Green Bo 59. Blue-tail 60. White-ch 61. Black-ru 62. Rose-rin 	te-throated Kingfisher		Alcedinidae	Coraciiformes	Resident	Least concern	1.15 ± 1.07
59. Blue-tail60. White-ch61. Black-ru62. Rose-rin	n Bee-eater	Merops orientalis	Meropidae	Coraciiformes	Resident	Least concern	0.54 ± 1.94
60. White-ch61. Black-ru62. Rose-rin	-tailed Bee-eater	Merops philippinus	Meropidae	Coraciiformes	Local migrant	Least concern	2.54 ± 3.1
62. Rose-rin	te-cheeked Barbet	Psilopogon viridis	Megalaimidae	Piciformes	Resident	Least concern	0.69 ± 1.70
	k-rumped Flameback	guttacristatus	Picidae	Coraciiformes	Resident	Least concern	0.54 ± 1.39
63. Ashv Wo	e-ringed Parakeet	Psittacula krameria	Psittaculidae	Psittaciformes	Resident	Least concern	2.23 ± 5.1
	Woodswallow	Artamus fuscus	Artamidae	Passeriformes	Resident	Least concern	0.23 ± 0.83
	vn Shrike	Lanius cristatus	Laniidae	Passeriformes	Winter Visitor	Least concern	0.08 ± 0.28
	n Golden Oriole	Oriolus kundoo	Oriolidae	Passeriformes	Winter Visitor	Least concern	0.15 ± 0.38
	k Drongo	Dicrurus macrocercus	Dicruridae	Passeriformes	Resident	Least concern	0.08 ± 0.28
	ous Treepie	Dendrocitta vagabunda	Corvidae	Passeriformes	Resident	Least concern	0.53 ± 1.2
68. House C		Corvus splendens	Corvidae	Passeriformes Passeriformes	Resident Resident	Least concern	4.62 ± 4.15
	e-billed Crow Swallow	Corvus macropus Hirundo rustica	Corvidae Hirundinidae	Passeriformes	Winter Visitor	Least concern Least concern	0.46 ± 1.4 3.23 ± 4.04
	vented Bulbul	Pycnonotus cafer	Pycnonotidae	Passeriformes	Resident	Least concern	3.23 ± 4.04 0.15 ± 0.55
	whiskered Bulbul	Pycnonotus jocosus	Pycnonotidae	Passeriformes	Resident	Least concern	0.13 ± 0.33 0.08 ± 0.28

Table 1. List of birds recorded from the study area

73.	Green Warbler	Phylloscopus nitidus	Phylloscopidae	Passeriformes	Winter Visitor	Least concern	0.23 ± 0.44
74.	Booted Warbler	Iduna caligata	Acrocephalidae	Passeriformes	Winter Visitor	Least concern	0.15 ± 0.38
75.	Paddyfield Warbler	Acrocephalus agricola	Acrocephalidae	Passeriformes	Winter Visitor	Least concern	0.08 ± 0.28
76.	Blyth's Reed Warbler	Acrocephalus dumetorum	Acrocephalidae	Passeriformes	Winter Visitor	Least concern	0.46 ± 0.78
77.	Clamorous Reed Warbler	Acrocephalus stentoreus	Acrocephalidae	Passeriformes	Winter Visitor	Least concern	1.08 ± 1.26
78.	Pallas's Grasshopper	Helopsaltes certhiola	Locustellidae	Passeriformes	Winter Visitor	Least concern	0.62 ± 1.33
	Warbler	1					
79.	Common Tailorbird	Orthotomus sutorius	Cisticolidae	Passeriformes	Resident	Least concern	0.85 ± 1.21
80.	Grey-breasted Prinia	Prinia hodgsonii	Cisticolidae	Passeriformes	Resident	Least concern	0.08 ± 0.28
81.	Ashy Prinia	Prinia socialis	Cisticolidae	Passeriformes	Resident	Least concern	1.77 ± 1.30
82.	Plain Prinia	Prinia inornata	Cisticolidae	Passeriformes	Resident	Least concern	1.69 ± 1.18
83.	Zitting Cisticola	Cisticola juncidis	Cisticolidae	Passeriformes	Resident	Least concern	1 ± 1.58
84.	Lesser Whitethroat	Curruca curruca	Sylviidae	Passeriformes	Vagrant	Least concern	0.07 ± 0.28
85.	Jungle Babbler	Argya striata	Leiothrichidae	Passeriformes	Resident	Least concern	0.15 ± 0.55
86.	Asian Brown Flycatcher	Muscicapa dauurica	Muscicapidae	Passeriformes	Winter Visitor	Least concern	0.08 ± 0.28
87.	Oriental Magpie Robin	Copsychus saularis	Muscicapidae	Passeriformes	Resident	Least concern	0.54 ± 0.97
88.	Siberian Stonechat	Saxicola maurus	Muscicapidae	Passeriformes	Winter Visitor	Least concern	0.38 ± 0.77
89.	Rosy Starling	Pastor roseus	Sturnidae	Passeriformes	Winter Visitor	Least concern	0.30 ± 1.11
90.	Malabar Starling	Sturnia blythii	Sturnidae	Passeriformes	Resident	Least concern	0.54 ± 1.94
91.	Common Myna	Acridotheres tristis	Sturnidae	Passeriformes	Resident	Least concern	1.31 ± 2.14
92.	Jungle Myna	Acridotheres fuscus	Sturnidae	Passeriformes	Resident	Least concern	0.38 ± 0.96
93.	Purple-rumped Sunbird	Leptocoma zevlonica	Nectariniidae	Passeriformes	Resident	Least concern	0.46 ± 0.97
94.	Purple Sunbird	Cinnvris asiaticus	Nectariniidae	Passeriformes	Resident	Least concern	0.69 ± 1.93
95.	Loten's Sunbird	Cinnyris lotenius	Nectariniidae	Passeriformes	Resident	Least concern	0.31 ± 1.11
96.	Western Yellow Wagtail	Motacilla flava	Motacillidae	Passeriformes	Winter Visitor	Least concern	0.38 ± 0.77
97.	Streaked Weaver	Ploceus manyar	Ploceidae	Passeriformes	Resident	Least concern	1.92 ± 4.03
98.	Baya Weaver	Ploceus philippinus	Ploceidae	Passeriformes	Resident	Least concern	0.23 ± 0.83
99.	Scaly-breasted Munia	Lonchura punctulata	Estrildidae	Passeriformes	Resident	Least concern	0.31 ± 1.1
100.	Tricolored Munia	Lonchura malacca	Estrildidae	Passeriformes	Resident	Least concern	13.46 ± 27.75

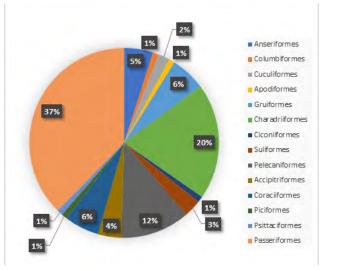


Fig. 2. Orders of birds recorded from the study area

Table 2. Number of bird species and total number of	
birds recorded during the study period	

Month	Number of bird species recorded	Total Number of individuals observed
Feb-18	58	1548
•	45	637
Mar-18		
Apr-18	16	91
May-18	42	602
Jun-18	11	70
Jul-18	20	282
Aug-18	12	30
Sep-18	23	101
Oct-18	46	439
Nov-18	57	489
Dec-18	26	83
Jan-19	24	198
Feb-19	17	172

Table 3. Diversity	indices o	f birds re	corded d	luring th	e study period

	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19
Dominance_D	0.22	0.21	0.16	0.05	0.21	0.75	0.12	0.11	0.17	0.18	0.076	0.14	0.18
Simpson_1-D	0.78	0.79	0.83	0.95	0.79	0.25	0.88	0.88	0.82	0.88	0.92	0.86	0.82
Shannon_H	2.36	2.25	2.11	3.33	1.9	0.76	2.28	2.54	2.5	2.95	2.86	2.35	2.04
Evenness_e^H/S	0.18	0.21	0.55	0.7	0.61	0.11	0.81	0.55	0.26	0.35	0.7	0.44	0.48

4. Discussion

The study reveals that Kadamakudy wetlands support a rich avian biodiversity. The number of species and the total number of birds recorded in each month showed variations. Species richness and diversity is influenced by the presence of migratory species. Monsoon also plays a role. Highest dominance was noted in July 2018 due to the presence of winter visitor Lesser Sand Plover in large numbers. Hence

Simpson diversity index, Shannon index and evenness is low in July 2018. Lowest dominance was noted in May 2018 which correspondingly lead to higher Simpson diversity index and Shannon index.

The tidal phenomena have a significant impact on the variations in bird populations. Large flocks were present during low tides as it favoured the foraging behaviour of birds. Their physical features help to feed them during the high tide conditions. Larger, longer-legged birds, can withstand higher water levels. The tide cycle has an impact on how birds use intertidal mudflat areas also. It was found that the birds mainly depended on wetlands for their feeding requirement. Both deep-water divers like ducks, cormorants, teals, and shallow water feeders like Pond Heron (Ardeola grayii), Cattle egret (Bubulcus ibis), Little Egret (Egretta garzetta) were spotted from the wetland. There were also granivores like Tri-coloured munia (Lonchura malacca), Scaly-breasted munia (Lonchura punctulate), Baya weaver (Ploceus philippinus), present in large folks and fed on the paddy. Nests of Munias were sighted in some of the paddy stalks. They were made of dried leaves and grass. The main birds of prey include Brahminy kite (Haliastur indus), Black kite (Milvus migrans), Western Marsh Harrier (Circus aeruginosus) and Osprey (Pandion haliaetus). They feed on fishes, rodents, snakes and other smaller birds. It was found that the smaller birds like Munias and weavers, avoided the area inhabited by these birds of prey. Damage to cultivation by birds is a menace faced by the farmers. They were seen roaming around in boats and driving away the birds. Scaring devices, tapes of audio, and video cassettes were also placed as the light reflected from the tape scares the birds. Polythene bags were also used to drive the birds away from the fields.

4.1 Impact of flood on bird diversity

Kadamakkudy, a cluster of islands in the river Periyar was one of the most affected areas in Ernakulam district during 2018 Kerala flood. Damage includes loss of infrastructure, agriculture and livestock.

Interactions with the local farmers and an understanding of the previous avian biodiversity of the area reveals that the impact of Kerala flood 2018 had no pronounced effect on the avian biodiversity of Kadamakkudy. There was no significant increase in water level in the areas of Pokkali fields where the birds used to get inhabited. It is also a fact that flood occurred during the paddy cultivation period (June to September) when the bird activity is usually low.

5. Conclusion

Kadamakkudy wetlands has high species richness, abundance and diversity of birds. The area provide ample feeding grounds, roosting sites and nesting places for birds. For migratory birds Kadamakkudy is a favourite habitat. Almost throughout the study period bird diversity remained high. This wetland has to be conserved not only owing to the diversity of birds but also for protecting the overall ecosystem.

Various developmental activities have begun to meet the increasing number of both local and international tourists. Reports claim that these wetlands will exist only for a few years if the present trend of exploitation continues. The area should be well protected with the active participation of landowners, residents, NGOs and government authorities. Measures have to be taken to control the poaching of birds. Farmers should be made aware of the significance of wetlands and associated bird species. Illegal reclamation of wetlands has to be mooted. Tourism and infrastructural facilities could be developed only after adopting necessary conservation strategies. For the betterment of both the human race and the ecosystem, conservation and development should go hand in hand.

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