

DOI No.: <http://doi.org/10.53550/EEC.2023.v29i04s.022>

Diversity of Charadriiform Birds from a Tropical Wetland

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(Received 15 February, 2023; Accepted 21 April, 2023)

ABSTRACT

Members of the Order Charadriiformes can be collectively called shorebirds. They are a diverse group which comprises small to medium-large birds. Charadriiform birds wade along the shorelines and mudflats for food, especially small aquatic insects, arthropods, crustaceans, etc. Interestingly, shorebirds are considered to be the world's longest migrants. The wetlands in Kollam district, Kerala are part of the Central Asian flyway. This flyway covers migratory water birds including globally threatened and near-threatened species. Polachira wetland which was selected for the study (January 2021-December 2021) is a part of the Central Asian flyway itself and is an abode of Charadriiformes birds. The point count method was employed to census the bird population and standard methods were followed for documenting them. Of 86 bird species identified from Polachira, 10 species belonged to Order Charadriiformes. 1,296 Charadriiformes birds belonging to 5 families and 3 suborders were recorded. In this order, Family Scolopacidae was represented by four species followed by Jacanidae and Charadriidae with two species each. Families Laridae and Recurvirostridae have a single species each. *Metopidius indicus* (Bronze-winged Jacana) was the most numerous species (728) and recorded throughout the year. According to the IUCN, all Charadriiformes identified from here come under the Least Concern (LC) category. Global concern exists about the declining shorebird population. In this context, a bird count and identification and evaluation of the threats faced by these species in Polachira Wetland will help us conserve and protect these birds and their habitat in the future.

Key words: Polachira, Wetland, Waders, Sandpiper, Charadriiformes

Introduction

The Order Charadriiformes includes two different assemblages of families such as shorebirds in the new world and waders in the old world (Gochfield *et al.*, 1984). This order consists of 3 suborders, 19 families, 90 genera, and 366 species (Baker and Pereira, 2009). Charadriiformes include pelagic seabirds having wing-propelled pursuit for diving and have anatomical modifications associated with this derived method of foraging (Smith and Clarke, 2015). Most of the species of the Order

Charadriiformes depend on coastal intertidal areas so that they are able to feed on microbenthic invertebrates for their survival (Piersma *et al.*, 1993). The Neogene pan-alcid is known to be the richest fossil among Charadriiformes (Smith, 2013, 2011; Smith and Mayr, 2013). Shorebirds can be considered as an ideal model to study a diverse range of behavioral, ecological, and macro-evolutionary processes across species (Thomas *et al.*, 2004).

Many avifauna-related studies have happened in and around India. Hussian *et al.* (1984) reported the avian fauna of Chilka lake and its conservation as-

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pects. Sampath and Krishnamurthy (1989) studied the shorebirds of the salt ponds at the Great Vedaranyam Salt Swamps. Balachandran (1995) studied the shorebirds of the Gulf of Mannar Marine National Park in Tamil Nadu. The shorebirds of the Pulicat Lake and its conservation were studied (Kannan and Pandiyan, 2012). The spatial variations of the shorebird community in the salt pans of the East Coast of Tamil Nadu were reported (Pandiyan *et al.*, 2013). The invasion of shorebirds into the inland wetlands of Periyakulam Lake, Tiruchirappalli was documented by Mohanraj and Pandiyan (2014). Pandiyan and Asokan (2016) studied the usage of habitat patterns and tidal mud and sand flats by shorebirds wintering in south India. A study was conducted on the breeding of the vulnerable Indian Skimmer *Rynchops albicollis* (Debata *et al.*, 2017). The diversity of Charadriiformes in Chandertal wildlife sanctuary, Himachal Pradesh was also documented (Singh and Thakur, 2021). Pandiyan *et al.* (2021) identified the factors which determine the population characteristics of migratory shorebirds and their prey species in the coastal salt pans. The shorebird diversity and abundance on the west coast and east coast of India were also reported (Rashiba *et al.*,

2022).

Plenty of avian studies have been published from Kerala also. The abundance and diversity patterns of waders including shorebirds were studied in the Kole wetlands of Thrissur, Kerala (Jayson, 2000). Arif (2009) studied the feeding ecology of the Lesser Sand Plover *Charadrius mongolus* in the Kadalundi estuary. Aarif *et al.* (2011) documented the conservation significance of Kadalundi-Vallikkunnu community reserve. Sivaperuman and Jayson (2012) studied the population fluctuations of shorebirds in the Vembanad-Kole Ramsar site. Arif and Prasad (2014) documented the injured migratory shorebirds and gulls in the Kadalundi community reserve. Roshnath (2017) reported sightings of Grey-headed Swamphen in Kerala. Arif and Mussammilu (2018) studied the pivotal reasons for the decline of shorebirds in Kadalundi-Vallikkunnu Community Reserve, a coastal wetland in Western India. Arif *et al.* (2020) elucidated the distribution and abundance of over-summering shorebirds. Another study was carried out in the Kadalundi-Vallikkunnu Community Reserve about the multiple environmental factors and prey depletion that determine the declines in abundance and timing of departure in migratory

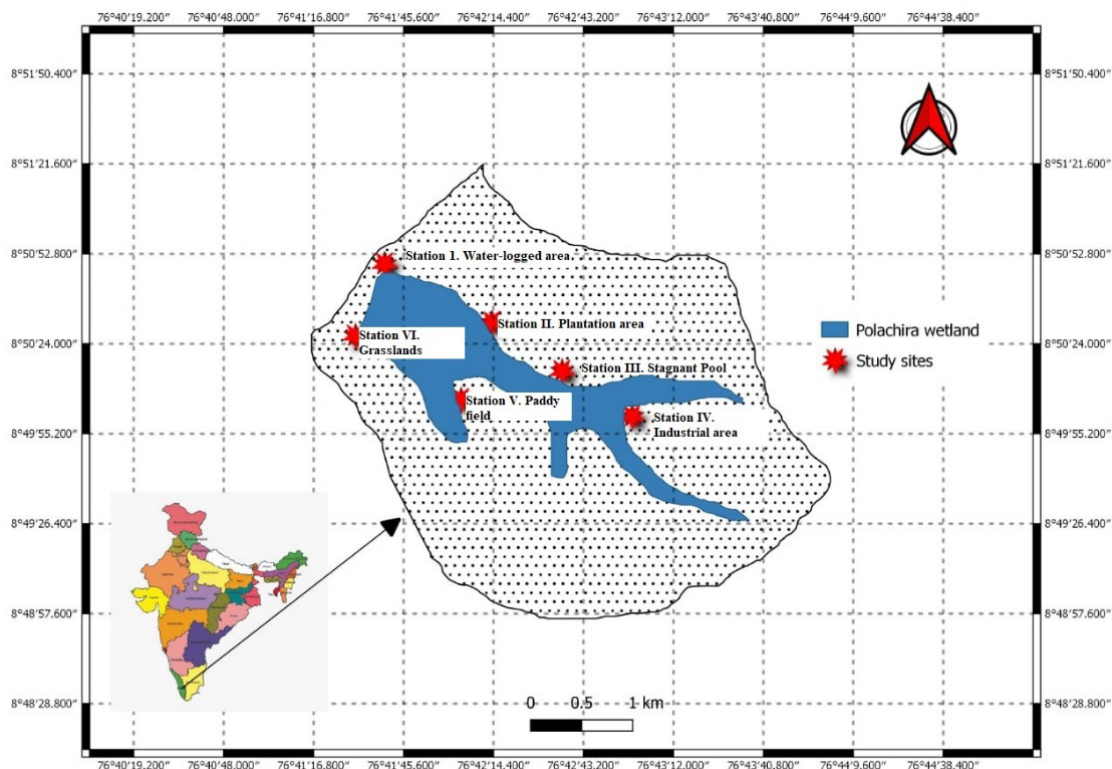


Fig. 1. Map showing the sampling stations at Polachira wetland

shorebirds (Arif *et al.*, 2021).

The international conservation concern is that the shorebird population is declining all over the world with many species on the verge of endangered or extinction (International Wader Study Group, 2003). The study site, Polachira wetland is located on the Central Asian Flyway, but no published literature is available on the monthly and seasonal occurrence of Charadriiformes birds so far. In this context, it is necessary to evaluate the diversity and the current status of the species of the Order Charadriiformes in the Polachira wetland, which is part of the Central Asian flyway. This study may help to undertake responsible measures and adopt conservation policies to protect this wetland which is an important stop-over for Charadriiformes birds.

Materials and Methods

Study area

The study area is restricted to Polachira wetland (8°50'22.6893N and 76°42'20.33E), which spreads over 600 hectares located near Paravur Municipality in the Kollam district of Kerala, India. This wetland is formed in the estuaries of the Ithikkara river and the Paravur backwater is encircled by small rivulets and is thickly vegetated. Polachira consists of paddy fields where farmers can cultivate paddy three times a year ('*Moonupooovu nilam*'). Polachira is an abode of resident birds and also a favourite halt of migratory birds.

A brief description of the six stations selected for the present study follows here:

Station 1 (S1): Waterlogged Area: This station of Polachira is always waterlogged during the rainy season. This area gets completely dried out during the months of March and April every year. The surroundings of this station are full of large trees, shrubs, and bushes. A bund road is going nearby, but vehicles are comparatively fewer compared to the main road. Apart from March and April, Lesser whistling ducks, Cotton Pygmy Geese, Egrets are the most common species found in almost all months. For waterbirds, this station is an important spot for feeding, breeding, nesting, etc.

Station 2 (S2): Plantation Area: This station is the largest station chosen. Tapioca, Ginger, Red and Green spinach, etc. are planted along the sides of this station. A narrow road is passing in the middle of the wetland which is used for transportation pur-

poses. A rivulet is flowing through the station, which connects to the Ithikkara river. This station is also used for the grazing of cows and buffalos.

Station 3 (S3): Stagnant Pool: In this station, water is always at standstill and never dries up. Water Lilly and lotuses are the two dominant emergent plants found in this station. Little Egrets, Great Egrets, White-breasted Waterhens, and Brahminy Kites are commonly sighted here. Stork-billed Kingfisher is occasionally observed in this station. One side of the station is covered by thick vegetation and from the other side, the mud is excavated regularly for brick manufacturing.

Station 4 (S4): Industrial Area: A huge factory for the production of bricks is the main feature of this station. The wastes from both the factory and the adjacent households flow to the waters of the wetland. Little Cormorants, Indian Cormorants, and Oriental Darters are the common sighting in this part of the area.

Station 5 (S5): Paddy Field: This station extends in patches here and there in between the grasses and weeds. Normally paddy cultivation starts in mid-October. Cattle grazing is the main human activity here. Fishing is mainly during the rainy season. Cultivation of Tapioca, Bitterguard, Spinach, Plantain, and Lady's finger can be seen on both sides of this field.

Station 6 (S6): Grassland: This station has vast stretches of grass. Waterlogging is prevalent in this area at all times. A small brick factory is working nearby. Cattle grazing is also seen in this station. Cattle Egrets, Jacanas, and Black-headed Ibises are commonly sighted.

Bird Survey

The data was collected for a period of one year, from January 2021 to December 2021 using the point count method (Buckland *et al.*, 2008; Nadeau *et al.*, 2008) to observe the wader diversity and distribution of the Order Charadriiformes in the Polachira wetland. Six point count stations which are 300 meters apart were selected throughout the study period. Monthly surveys were done for 15 minutes at each station. 15 minute count was followed to record sufficient number of individuals with minimum effort and disturbance. The number of birds detected by sight or sound was recorded. The double count was carefully avoided. The whole area was surveyed on foot. The survey was done twice a month

during morning hours from 6.30 am to 9.30 am. Birds were spotted using Spotting Scope (Celestron 52250 80 mm Ultima Zoom) or Binocular (Nikon Aculon A211 (8x 42). High zooming digital camera was used to take photographs of birds. The recorded birds were identified by using standard field guides (Altman, 1974; Ali, 2002; Grimmet *et al.*, 2011). Old common English names were adopted (Ali and Ripley, 1987). Abundance was also calculated (Francis, 2015).

Statistical analysis

All statistical analyses were performed using the IBM SPSS statistics 22 (IBM Corporation NY, USA). Bird count related to stations and months were analysed by one-way ANOVA after log transformation of the data. If the main effect was significant, the ANOVA was followed by Tukey's test at $P < 0.05$ level of significance.

Results and Discussion

Species composition

The study presents the species diversity of the Order Charadriiformes in Polachira Wetland from January to December 2021. A total of 86 species of birds were observed, out of which, 10 species belonged to the Order Charadriiformes (Table 1). Ten species of Charadriiformes belonging to three suborders and five families were identified from Polachira wetland. The suborder Scolopaci represented two families, Jacanidae and Scolopacidae. Jacanidae included two species (Bronze-winged Jacana and Pheasant-tailed Jacana). Scolopacidae included four species i.e., Common Sandpiper, Wood Sandpiper, Green Sandpiper, and Marsh Sandpiper. The Suborder

Scolopaci and Family Scolopacidae recorded the highest number of species.

Long-distance migrants belonging to the Order Charadriiformes use various stopover sites to rest and recharge their bodies in order to complete their whole migration cycle (Brooks, 1967). Likewise, Polachira wetland also act as an excellent stopover for avian fauna. Family Scolopacidae was found dominant with four species followed by Jacanidae and Charadriidae having two species each. Families Laridae and Recurvirostridae were represented by single species each. The Kole wetland of Thrissur was also recorded to have the highest number of wader species of the Order Charadriiformes of the Family Scolopacidae (Jayson, 2002). The study of the wader diversity in the catchment area of Ujani Reservoir, Solapur District, India (Kumbhar and Mhaske, 2020) also showed similar results of Polachira wetland as Scolopacidae was found dominant among the families of the Order Charadriiformes having six species. Whiskered Tern of the family Laridae and Black-winged Stilt of the family Recurvirostridae were also observed in Kole wetlands though it was comparatively far high in number compared to Polachira wetland (Jayson, 2002). A total of 1,296 individuals belonging to 5 families and 3 suborders were recorded.

Spatial variation

Highest number of birds was found at Station 1 (477) and the lowest at Station 4 (55) (Table 2). Although there exists numerical variation among the station-wise bird count, the results of the one-way ANOVA of the log-transformed data do not show any significant difference ($P > 0.05$). Station 1 of Polachira was a waterlogged area. This station was recorded to have the highest number of species (9)

Table 1. The systematic position of Charadriiformes recorded from Polachira wetland during the study period (January-December 2021)

Order	Suborder	Family	Common Name	Scientific Name
Charadriiformes	Charadrii	Charadriidae	Red-wattled Lapwing	<i>Vanellus indicus</i>
			Little Ringed Plover	<i>Charadrius dubius</i>
	Scolopaci	Recurvirostridae	Black-winged Stilt	<i>Himantopus himantopus</i>
		Jacanidae	Bronze-winged Jacana	<i>Metopidius indicus</i>
			Pheasant-tailed Jacana	<i>Hydrophasianus chirurgus</i>
		Scolopacidae	Common Sandpiper	<i>Actitis hypoleucos</i>
			Wood Sandpiper	<i>Tringa glareola</i>
			Green Sandpiper	<i>Tringa ochropus</i>
	Lari	Laridae	Marsh Sandpiper	<i>Tringa stagnatilis</i>
			Whiskered Tern	<i>Chlidonias hybrida</i>

as well as the highest number of individuals too (477). Except for, Black-winged Stilt, all nine species were observed and recorded from this station. Less number of species (5) and counts (55) recorded from Station 4 which is an industrial area. Though a small portion of this station has a water depth of more than 15 cm, 95% of the area is shallow. In the case of shorebirds, water depth is an important factor that determines the location as a feeding ground (Nagarajan and Thiyagesan, 1996). Most small and medium-sized shorebirds forage in shallow water having a depth of less than 6 cm whereas the other shorebirds forage in water having a depth of 6 to 15 cm (Twedt, 2013). A strong correlation exists between the depth of the water selected by the waterbirds for foraging and their tarsus length (Ntiamoa-Baidu *et al.*, 1998). So, this may be the reason for having a few more birds in the water-logged area although it was not statistically significant. 64 species of waders were recorded from the Kole wetlands which depend heavily on shallow water and mudflats (Sivaperuman, 2002). Station 4 was an industrial area where human activities were taking place. A brick manufacturing factory is functioning there. Human activities can modify or disturb both waterbirds and their habitats thereby affecting the distribution of waterbirds (Burton *et al.*, 2002) and that may attribute to a smaller number of bird population in the industrial area of Polachira (Station 4).

Temporal variation

The results of the one-way ANOVA of the log-transformed monthly bird count data do not show a significant temporal variation ($P > 0.05$). March and December (242) were found to have the highest number in the count of birds followed by November (126) and the lowest was in the month of October (18) (Fig. 2). Bronze-winged Jacana recorded to be the highest species in July (109) and Wood Sandpiper was recorded in December (94). Bronze-winged Jacana was observed throughout the study period and the least observed was Marsh Sandpiper (5) (Fig. 3). As March and December are considered to be the months included in the seasonal migratory chronology of shorebirds, the number of birds will be very high in these months (Pandiyana and Asokan, 2016). Polachira wetland also showcased similar results as the number of birds was high in December and March. Added to that, in December winter visitors can be observed in the Polachira wetland. Common Sandpiper, Marsh Sandpiper, Wood

Sandpiper, and Green Sandpiper were the common winter visitors seen in Polachira wetland. These four shorebird species also visited Kadalundi Vallikkunnu Reserve during the winter season (Aarif and Prasadana, 2014).

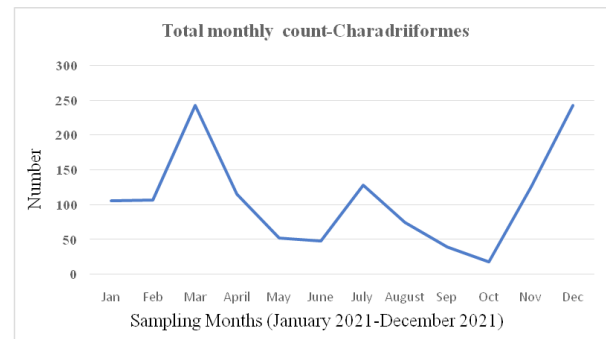


Fig. 2. Temporal variation of Charadriiformes birds from Polachira wetland during the study period

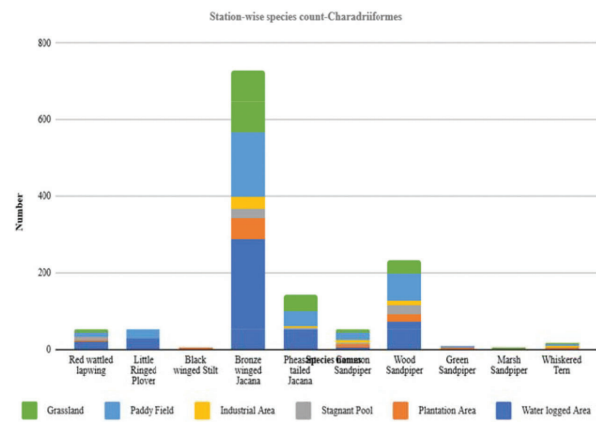


Fig. 3. Station-wise count of Charadriiformes birds from Polachira wetland during the study period (January to December 2021)

Bronze-winged Jacana and Pheasant-tailed Jacana were the two species observed from Polachira wetland of the Family Jacanidae as these were the only Indian species reported so far from wetlands of India (Kasambe *et al.*, 2021). Bronze-winged Jacana was recorded to have the maximum number of individuals (728) which was similar to Bronze-winged Jacanas outnumbering in Bakhira Tal, a natural wetland in Uttar Pradesh (Mishra *et al.*, 2016). Bronze-winged Jacanas and Pheasant-tailed Jacanas were resident Charadriiformes birds observed in Polachira wetland and do perform annual migration. Bronze-winged Jacanas were seen throughout the study period.

The study period can be divided into three sea-

sons: pre-migratory, migratory and post-migratory. The pre-migratory season includes September–October when birds arrive for wintering. The migratory season included November–January as birds migrate inwards to the wintering grounds and hence this period has a stable bird population. The post-migratory season includes February and March when the birds leave for their breeding grounds (Pandiyan and Asokan, 2016).

Migratory status

Seven migratory species were observed. They were Marsh Sandpiper, Common Sandpiper, Wood Sandpiper, Green Sandpiper, Whiskered Tern, Little Ringed Plover, and Black-winged Stilt. Among the seven migratory species, Wood Sandpiper was recorded to be the highest in number (232) followed by Common Sandpiper (52). The least species observed was Marsh Sandpiper (5) (Fig. 4). These seven species were also observed and recorded as migratory species from the Pokkali wetlands and in the Kadalundi-Vallikkunnu Reserve (Deepa and George, 2017). Wood Sandpiper was recorded to be the highest number (351) and the lowest was Marsh Sandpiper (5). December (116) was found to have the highest number and the lowest was in July (1). Wood Sandpipers were found to use paddy fields extensively during stop-overstages (Choi *et al.*, 2021). They are frequently seen near freshwater habitats during migration (Hayman *et al.*, 1986). Kerala receives rainfall from the northeast monsoon (October–December) though the precipitation amount is very low (Gopal and Chauhan, 2001). This causes the rivers of Kerala to be overflowed and flood causing the nutrients to get released from the soil and spread to large areas leading to the growth of thick vegetation and phytoplankton

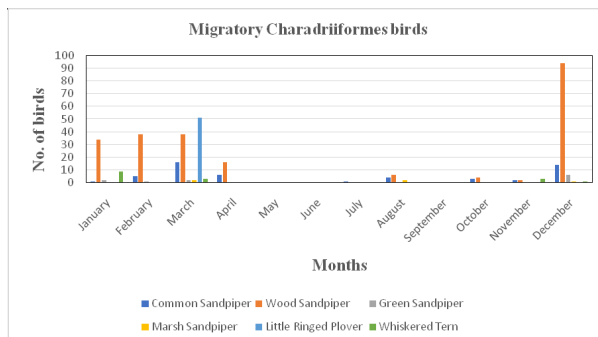


Fig. 4. Migratory Charadriiformes birds from Polachira wetland during the study period (January to December 2021)

(Muzaffar and Ahmed, 2007) which in turn provide a big source of food bowl to the resident shorebirds and to the other waterbirds (Kannan and Pandiyan, 2012). This is a very relevant observation in Polachira wetland as it get flooded during monsoon and water recedes after declining rainfall.

Conservation status

As per Red Data Book (The IUCN, 2022) ten bird species of the Order Charadriiformes from Polachira wetland are of Least Concern (LC) (Table 2). Red-wattled Lapwing is not considered “Threatened” and is currently listed as “Least Concerned” by the IUCN, although the species’ global population trend remains unknown (Bird Life International, 2016). The Little Ringed Plover is a small migrant wader that inhabits open freshwater (Cramp and Simmons, 1983) and is threatened mainly by the degradation and loss of its natural habitat (Hoyo *et al.*, 1996) although the species was classified as Least Concern in the IUCN Red List (Birdlife International, 2016). Bronze-winged Jacana, Pheasant-tailed Jacana, and Wood Sandpiper were common, and Black-winged Stilt and Marsh Sandpiper were rarely sighted from Polachira wetland.

Table 2. IUCN status, abundance, and migratory status of Charadriiformes birds identified from Polachira wetland during the study period (January to December 2021)

Common Name	IUCN Status	Abundance	Migratory status
Red-wattled Lapwing	LC	UC	R
Little Ringed Plover	LC	UC	M
Black-winged Stilt	LC	R	M
Bronze-winged Jacana	LC	C	R
Pheasant-tailed Jacana	LC	C	R
Common Sandpiper	LC	UC	M
Wood Sandpiper	LC	C	M
Green Sandpiper	LC	UC	M
Marsh Sandpiper	LC	R	M
Whiskered Tern	LC	UC	M

LC-Least Concern, UC–Uncommon, C–Common, R–Rare, M–Migrant, R–Resident

Species accounts

Red-wattled Lapwings were recorded in the Polachira wetland from January–April, followed by July, and also seen in August–September and November–December. The highest number of the species was recorded in November. They were found to

be highest in Station 1 (21). No Red-wattled Lapwings were recorded from Station 4. Little Ringed Plovers were recorded only in March with a total number of 51. They were mainly seen in Station 1 and Station 5. Black-winged Stilts were observed only in March and that was seen only in Station 2. They were not sighted in any other stations. Bronze-winged Jacanas were recorded from Polachira wetland throughout the study period. The highest number was recorded in July (109) and the lowest in October (11). Bronze-winged Jacanas were found to be highest in Station 1 (290).

Pheasant-tailed Jacanas were observed in January-April, July-September, and November-December. The highest number of Pheasant-tailed Jacanas was recorded in December (134). They were found to be highest in Station 1 and completely absent in the plantation area. Common Sandpipers were seen in January-March, July-August, and October-December. The highest number of Common Sandpipers was observed in March (16). They were seen in all stations and stands highest in Station 5 (21). Wood Sandpiper was yet another migratory wader recorded from Polachira wetland during January-April, occasionally in August, and in October-December (94). Wood Sandpipers were commonly seen in all stations and found to be highest in Station 1.

Green Sandpiper was also a migratory wader recorded from Polachira wetland in January, March, and December. This species was not recorded in Station 4 and found to be highest in paddy fields (4). Marsh Sandpiper was also another migratory wader species recorded from Polachira wetland during the months of March, August, and December. They were observed in Station 1 and Station 6. Whiskered Terns were sighted from Polachira wetland only in four months. They were seen in all stations, especially in paddy fields (7), and were found to be highest in the month of January (9).

Conclusion

It can be concluded that the Polachira wetland is an excellent abode for Charadriiformes birds which include migratory too. Though these species are Least Concern (LC) category in the IUCN, sooner or later there are chances of a decline in population, if the habitat is not protected. The wetland ensures a migratory stopover location in the Central Asian Flyway even though anthropogenic pressure exists in

some stations. The declining shorebird population is a concern worldwide, so immediate measures have to be adopted by the authorities to protect and conserve such valuable pieces of wetland which offer priceless ecosystem services.

Acknowledgement

The authors are grateful to The Principal, Sree Narayana College, Kollam for providing the facility for carrying out the study. The authors are also acknowledging the research facility provided by DST-FIST (2019-2021) and DBT- Star College Scheme. The first author acknowledges Junior Research Fellowship from University of Kerala for pursuing her Ph.D. programme.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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