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Cover: Whale Shark *Rhincodon typus* and Reef - made with poster colours. © P. Kritika.



## INTRODUCTION

Wetlands make up 5–8% of the earth's surface. According to the national wetland inventory and assessment prepared by the Indian Space Research Organization (ISRO), wetlands cover 1,52,600 km<sup>2</sup> (4.63%) of the total land area of India and support one-fifth of the biodiversity (Bassi et al. 2014). Of the total area Inland, natural wetlands make up 43.4% whereas coastal natural wetlands make up 24.3% (SAC 2011; Panigrahy et al. 2012). In the last three centuries, global wetland loss is estimated to be 54–57%, but it might be as high as 87% (Davidson 2014). Scientific estimates show that 64% of the world's wetlands have disappeared since 1900 (Ramsar Fact Sheet 2014) due to human activity & urbanization, which has affected ecosystem health & quality (Ballut-Dajud et al. 2022). It is significant to mention the recent notification (in 2022) of the Government of India to designate more sites into Ramsar wetlands and the total number of Ramsar sites stands at 75, covering an area of about 13,26,677 ha (Government of India website 2022). Over the past 20 years, tidal wetlands have lost 4,000 km<sup>2</sup> of their land area, but ecosystem restoration and natural processes are helping to reverse the trend (Murray et al. 2022).

Kerala stands up among all the states of India in having a large proportion of land under wetlands (Nayar & Nayar 1997) with about 217 wetland areas (Kokkal et al. 2008) which forms one-fifth of the total land area of the state. Prominent coastal wetlands in Kerala are Vellayani Kayal, Aakkulam–Veli backwater stretch, Kayamkulam Pozhi, Kumarakom, Mangalavanam, Kole wetlands, Purathur estuary, Manoorkayal, Chervapur Kayal, Kadalundi estuary, Dharmadam estuary, Kattampally, Ezhimala, Chemballi Kundu, and mangrove areas (Kurup 1996).

Wetlands provides an excellent habitat for migratory waterbirds and shorebirds, for feeding, nesting, rearing young ones, and as wintering grounds/stopover grounds. The degradation of wetland habitat may cause the water-table to drop, the food chain to get disrupted, eventually migratory bird populations to decline, and the nutrient cycle to slow down, all of which are detrimental to the environment, ecosystem, and human beings (Kumar & Kanaujia 2014). Wetlands in Kerala are under threat due to accelerated developmental activities and indiscriminate land & water use. However, no reports on the precise rate of wetlands destruction in Kerala is available, other than some reports on its qualitative degradation (Kokkal et al. 2008). The major issues leading to wetland degradation are pollution,

eutrophication, encroachment, reclamation, mining, and biodiversity loss (Kokkal et al. 2008; Ballut-Dajud et al. 2022). The habitat destruction may lead to a decline in the abundance of shorebirds, as they are the top level predators, and hence they can be considered as bio-indicators of ecosystem health. Thus, understanding the structure of bird community in a habitat is essential to identify the local landscapes for the conservation of avifauna and their ecosystem (Kattan & Franco 2004).

Changaram wetland is an important stopover ground for migratory shorebirds, gulls, terns, and other waterbirds in the west coast of Kerala and it encompasses major habitats like exposed mudflats, mangrove fringes, and an agroecosystem. Hence it draws the attention of conservation biologists to formulate strategies for the protection of this significant ecosystem and its components. Being the ecological indicators, the present study of avifaunal observations from Changaram wetland will serve as baseline data for conservation measures to be taken up in this key wintering site of long-distance migratory shorebirds and other waterbirds in the near future.

## MATERIALS AND METHODS

### Study Site

Changaram (9.797438°N, 76.28876°E) (Image 1), spreads across 145 acres (57.87 ha) in the Kodamthuruth panchayats of Cherthala Taluk in Alappuzha District, western coast of Kerala. It is a waterlogged, palm fringed village with a narrow strip of land, on the coastal belt, with the Arabian Sea on the west, and Thazhappu Kayal (backwaters) on the east, Ezhupunna wetland on the north, and Pallithodu wetland on the south. Interconnected extensive paddy fields are seen in Changaram wetlands where Pokkali system of agriculture—a single crop of rice is cultivated on mounds during the low saline phase of the production cycle (June–mid October), followed by shrimp farming (*Penaeus monodon*, *Penaeus semisulcatus*) during the high saline phase (November–April) is practiced (Chandramohan & Mohanan 2011). Changaram wetland has no direct connection to the estuary so it is barely affected by tidal activity. During shrimp farming, bunds are constructed, and water is pumped into it. After the shrimp culture, the water is drained out exposing the mudflats, which offer potential foraging ground for hundreds of wintering and resident waterbirds, particularly shorebirds. It also serves as an ideal breeding ground for several waterbird species. A short stretch of mangrove forests (major

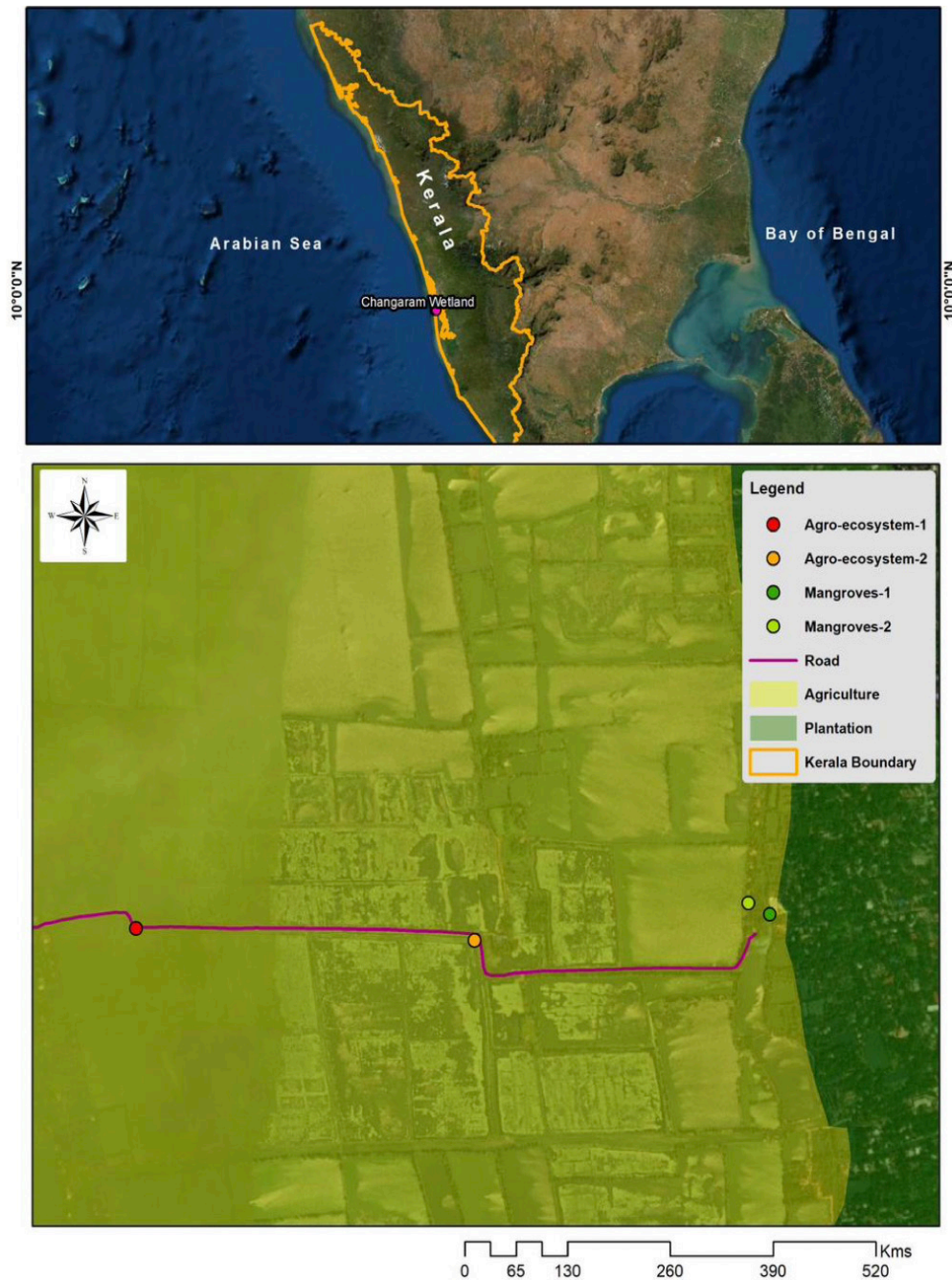


Image 1. Map showing the study area of Changaram wetlands. A total of four scanning points (two each at agroecosystem and mangroves) were selected to carry out the survey during the study period.

species—*Avicennia officinalis*, *Rhizophora mucronata*, *Excoecaria agallocha*, and *Bruguiera cylindrica*) of about 0.607 ha area extends on the edges of the Changaram wetland. The wetland is flanked by coconut trees and populated areas except from intermittent patches of these mangroves.

## Methods

Waterbirds survey (including shorebirds, large wading birds, gulls, and terns) was carried out once a month (0700–1100 h) between 2018 and 2019. Observations were made using binoculars (10 x 50 Nikon) and a 4k series Nikon Coolpix p1000 camera. Data was collected following direct count (Howes & Bakewell 1989) and block count methods (Jadhav & Parasharya



2004; Urfi 2004). Shorebirds were encountered at four scanning points (Image 1) in both agro-ecosystem and mangroves which covered the whole area. The observations recorded while moving from one scanning point to another were entered as incidental records.

The status of waterbirds based on the frequency of sightings were categorized into Common (seen during most of the visits), Uncommon (seen less than five times), and Rare (seen once or twice). Migratory statuses of waterbirds were classified into Resident but not breeding (R/B—Resident but not breeding, which means, those birds are breeding at adjoining areas of the study site), Local Migrant (LM—Locally migrant, which means birds are breeding within the country), Breeding (Br—Breeding, means commonly or uncommonly breeding in the study site) and Winter Visitor (WV—Winter Visitor, birds visiting from another region or other countries) (Mc Kinnon & Philips 1993; Aarif et al. 2017a). The species-level identification was done with the help of a field guide (Grimmet et al. 1999) and based on our field experience.

## RESULTS AND DISCUSSION

The total count of waterbirds during the year 2018 was 20,100 individuals and that of the year 2019 was 18,600 individuals. 77 species were identified from this fragile ecosystem. Among the 77 species recorded, 38 species of shorebirds, 23 species of other waterbirds (large wading birds), five species of gulls, and 11 species of terns were also recorded from the study area (Table 1–3). Among the shorebirds listed, 31 species were winter visitors, two species—Kentish Plover *Charadrius alexandrinus* and Great Thick-knee *Esacus recurvirostris* were local migrants, three species were resident but not breeding, and the two remaining species were breeding. Further, 16 species of shorebirds were common, three species were uncommon, and the remaining 19 species were classified as rare (Table 1). The most dominant species among the observed shorebirds was the Black-tailed Godwit *Limosa limosa* (Peak count at one time—2,534 in April) followed by Wood Sandpiper *Tringa glareola* (Peak count at one time—1,123 in May).

IUCN listed Near Threatened shorebird species recorded from the study area included, Bar-tailed Godwit *Limosa lapponica*, Black-tailed Godwit, Curlew Sandpiper *Calidris ferruginea*, Eurasian Curlew *Numenius arquata*, Asian Dowitcher *Limnodromus semipalmatus* (Image 2), Great Thick-knee, and one endangered species, Great Knot *Calidris tenuirostris*.

Among the 23 species of waterbirds listed, 18 species were most common, three species were uncommon, and two species were rare (Table 2). The most dominant waterbird species identified were, Median Egret *Ardea intermedia*, Little Egret *Egretta garzetta*, Great Egret *Ardea alba*, Little Cormorant *Microcarbo niger*, and Indian Pond Heron *Ardeola grayii*. Four other waterbirds species reported, having Near Threatened status are: Oriental Darter *Anhinga melanogaster*, Black-headed Ibis *Threskiornis melanocephalus*, Painted Stork *Mycteria leucocephala*, and Spot Billed Pelican *Pelecanus philippensis* (Table 2).

Apart from the shorebirds and waterbirds, five species of Gulls viz. Slender-billed Gull *Chroicocephalus genei*, Black-headed Gull *Chroicocephalus ridibundus*, Brown headed Gull *Chroicocephalus brunnicephalus*, Pallas's Gull *Ichthyaelus ichthyaelus*, and Lesser Black-backed Gull *Larus fuscus* were documented from this site. Of these, the most dominants ones were Black-headed Gulls and Brown-headed Gulls. Further, 11 species of terns, viz., Little Tern *Sternula albifrons*, Gull-billed Tern *Gelochelidon nilotica*, Caspian Tern *Hydroprogne caspia*, Whiskered Tern *Chlidonias hybrida*, Common Tern *Sterna hirundo*, Greater-crested Tern *Thalasseus bergii*, Lesser-crested Tern *Thalasseus bengalensis*, Sandwich Tern *Thalasseus sandvicensis*, Saunders Tern *Sternula saundersi*, White-winged Tern *Chlidonias leucopterus*, and River Tern *Sterna aurantia* were also encountered (Table 3). Whiskered Tern being the most dominant species of tern throughout the study period. Black-headed Gull, Brown-headed Gull, Little Tern, and Gull-billed Tern encompassed the other dominant species, coming under the Laridae family, reported from the study site. This observation goes in parallel with the report from KVCR (Aarif et al. 2015; Aarif et al. 2017c).

A total of two species of shorebirds; Black-winged Stilt *Himantopus himantopus* & Red-wattled Lapwing *Vanellus indicus* and 10 species of waterbirds, viz., Oriental Darter, Little Cormorant, Great Cormorant *Phalacrocorax carbo*, Indian Cormorant *Phalacrocorax fuscicollis*, Little Egret, Great Egret, Median Egret, Indian Pond Heron, Purple Heron *Ardea purpurea*, and Spot-billed Pelican were observed regularly to be breeding in Changaram wetlands. Further, due to the presence of mangrove fringes, this Changaram wetlands serves as a key foraging and roosting ground for these shorebirds and other waterbirds. A similar observation was documented from KVCR (Aarif et al. 2011, 2014).

Most of the shorebird species were documented during their northward return migratory season, i.e., March, April, and May, while some other shorebird

Table 1. List of shorebirds identified from Changaram wetland.

	Common name	Scientific name	Species status in Changaram wetland	Migratory status	IUCN Red List status	Peak count at one time observation
1	Black-tailed Godwit	<i>Limosa limosa</i> (Linnaeus, 1758)	Common	WV	NT	2534
2	Wood Sandpiper	<i>Tringa glareola</i> (Linnaeus, 1758)	Common	WV	LC	1123
3	Lesser Sand Plover	<i>Charadrius mongolus</i> (Pallas, 1776)	Common	WV	LC	508
4	Marsh Sandpiper	<i>Tringa stagnatilis</i> (Bechstein, 1803)	Common	WV	LC	85
5	Black-winged Stilt	<i>Himantopus himantopus</i> (Linnaeus, 1758)	Common	Br	LC	395
6	Pacific Golden Plover	<i>Pluvialis fulva</i> (Gmelin, 1789)	Common	WV	LC	240
7	Curlew Sandpiper	<i>Calidris ferruginea</i> (Pontoppidan, 1763)	Common	WV	NT	154
8	Greater Sand Plover	<i>Charadrius leschenaultii</i> (Lesson, 1826)	Common	WV	LC	112
9	Little Stint	<i>Calidris minuta</i> (Leisler, 1812)	Common	WV	LC	67
10	Little-ringed Plover	<i>Charadrius dubius</i> (Scopoli, 1786)	Common	WV	LC	61
11	Common Greenshank	<i>Tringa nebularia</i> (Gunnerus, 1767)	Common	WV	LC	60
12	Red-wattled Lapwing	<i>Vanellus indicus</i> (Boddaert, 1783)	Common	Br	LC	30
13	Pied Avocet	<i>Recurvirostra avosetta</i> (Linnaeus, 1758)	Rare	WV	LC	3
14	Kentish Plover	<i>Charadrius alexandrinus</i> (Linnaeus, 1758)	Rare	LM	LC	5
15	Whimbrel	<i>Numenius phaeopus</i> (Linnaeus, 1758)	Uncommon	WV	LC	30
16	Common Redshank	<i>Tringa totanus</i> (Linnaeus, 1758)	Common	WV	LC	32
17	Broad-billed Sandpiper	<i>Limicola falcinellus</i> (Pontoppidan, 1763)	Rare	WV	LC	7
18	Common ringed Plover	<i>Charadrius hiaticula</i> (Linnaeus, 1758)	Rare	WV	LC	12
19	Ruff	<i>Calidris pugnax</i> (Linnaeus, 1758)	Rare	WV	LC	9
20	Common Sandpiper	<i>Actitis hypoleucos</i> (Linnaeus, 1758)	Common	WV	LC	26
21	Temminck's Stint	<i>Calidris temminckii</i> (Leisler, 1812)	Rare	WV	LC	25
22	Pin-tailed Snipe	<i>Gallinago stenura</i> (Bonaparte, 1831)	Common	WV	LC	3
23	Common Snipe	<i>Gallinago gallinago</i> (Linnaeus, 1758)	Common	WV	LC	7
24	Eurasian Curlew	<i>Numenius arquata</i> (Linnaeus, 1758)	Rare	WV	NT	56
25	Ruddy Turnstone	<i>Arenaria interpres</i> (Linnaeus, 1758)	Rare	WV	LC	3
26	Terek Sandpiper	<i>Xenus cinereus</i> (Güldenstädt, 1775)	Rare	WV	LC	5
27	Green Sandpiper	<i>Tringa ochropus</i> (Linnaeus, 1758)	Uncommon	WV	LC	7
28	Grey Plover	<i>Pluvialis squatarola</i> (Linnaeus, 1758)	Rare	WV	LC	2
29	Great Knot	<i>Calidris tenuirostris</i> (Horsfield, 1821)	Rare	WV	EN	1
30	Sanderling	<i>Calidris alba</i> (Pallas, 1764)	Rare	WV	LC	3
31	Bar-tailed Godwit	<i>Limosa lapponica</i> (Linnaeus, 1758)	Rare	WV	NT	1
32	Greater Painted Snipe	<i>Rostratula benghalensis</i> (Linnaeus, 1758)	Rare	R/B	LC	5
33	Long-toed Stint	<i>Calidris subminuta</i> (Middendorff, 1853)	Rare	WV	LC	10
34	Spotted Redshank	<i>Tringa erythropus</i> (Pallas, 1764)	Rare	WV	LC	5
35	Great Thick-knee	<i>Esacus recurvirostris</i> (Cuvier, 1829)	Rare	LM	NT	1
36	Asian Dowitcher	<i>Limnodromus semipalmatus</i> (Blyth, 1848)	Rare	WV	NT	1
37	Oriental Pratincole	<i>Glareola maldivarum</i> (Forster, 1795)	Rare	WV	LC	1
38	Yellow-wattled Lapwing	<i>Vanellus malabaricus</i> (Boddaert, 1783)	Uncommon	LM	LC	1

WV—Winter visitor | LM—Locally migrant | R/B—Resident but not breeding in our study area | Br—Breeding.

Table 2. List of large wading birds recorded from Changaram wetland.

	Common name	Scientific name	Species status in Changaram wetland	IUCN Red List status	Migratory status
1	Oriental Darter	<i>Anhinga melanogaster</i> (Pennant, 1769)	Common	NT	Br
2	Little Cormorant	<i>Microcarbo niger</i> (Vieillot, 1817)	Common	LC	Br
3	Great Cormorant	<i>Phalacrocorax carbo</i> (Linnaeus, 1758)	Rare	LC	LM
4	Indian Cormorant	<i>Phalacrocorax fuscicollis</i> (Stephens, 1826)	Common	LC	Br
5	Little Egret	<i>Egretta garzetta</i> (Linnaeus, 1766)	Common	LC	Br
6	Great Egret	<i>Ardea alba</i> (Linnaeus, 1758)	Common	LC	Br
7	Median Egret	<i>Ardea intermedia</i> (Wagler, 1827)	Common	LC	Br
8	Indian Pond Heron	<i>Ardeola grayii</i> (Sykes, 1832)	Common	LC	Br
9	Grey Heron	<i>Ardea cinerea</i> (Linnaeus, 1758)	Common	LC	LM
10	Purple Heron	<i>Ardea purpurea</i> (Linnaeus, 1766)	Common	LC	Br
11	Little -green Heron	<i>Butorides virescens</i> (Linnaeus, 1758)	Common	LC	LM
12	Black- crowned Night Heron	<i>Nycticorax nycticorax</i> (Linnaeus, 1758)	Common	LC	R/B
13	Western- reef Heron	<i>Egretta gularis</i> (Bosc, 1792)	Common	LC	LM
14	Yellow Bittern	<i>Ixobrychus sinensis</i> (Gmelin, 1789)	Common	LC	R/B
15	Black-headed Ibis	<i>Threskiornis melanocephalus</i> (Latham, 1790)	Common	NT	LM
16	Glossy Ibis	<i>Plegadis falcinellus</i> (Gmelin, 1789)	Common	LC	LM
17	White-breasted Waterhen	<i>Amaurornis phoenicurus</i> (Pennant, 1769)	Common	LC	Br
18	Greater Flamingo	<i>Phoenicopterus roseus</i> (Pallas, 1811)	Uncommon	LC	LM
19	Lesser Flamingo	<i>Phoeniconaias minor</i> (Geoffroy Saint-Hilaire, 1798)	Rare	LC	LM
20	Painted Stork	<i>Mycteria leucocephala</i> (Pennant, 1769)	Uncommon	NT	LM
21	Eurasian Spoonbill	<i>Platalea leucorodia</i> (Linnaeus, 1758)	Uncommon	LC	LM
22	Asian openbill Stork	<i>Anastomus oscitans</i> (Boddaert, 1783)	Common	LC	LM
23	Spot-billed Pelican	<i>Pelecanus philippensis</i> (Gmelin, 1789)	Common	NT	LM

Common (seen on most of the visits) | Uncommon (seen less than five times) | Rare (seen once or twice).

species were found over-summer in small numbers during June and July in the study area. The over-summering shorebirds were Black-tailed Godwit, Common Sandpiper *Actitis hypoleucos*, Wood Sandpiper, Marsh Sandpiper *Tringa stagnatilis*, and Pacific Golden Plover *Pluvialis fulva*. Similarly, several over-summering species have been reported from KVCR and it was pointed out that the over-summering birds were either juveniles or adults which were physically or sexually unfit (Aarif et al. 2017a, 2020). Hence it can be elucidated that the over-summering shorebirds are provided with food resources and shelter in the habitat, throughout the year.

## CONSERVATION ISSUES

Many long-distance migrant shorebirds are well known to be highly reliant on a series of key stop-over sites between wintering and breeding grounds (Boere et al. 2006). As it is home to several important long-

distance migrant species, the link between this coastal wetland and many other major shorebird habitats within India and other countries along the Central Asian Flyway must be unraveled through regular and systematic monitoring.

Thousands of migratory waterbirds use the western coast of India as a refuge during the winter, yet there are only a few systematic studies that are reported from KVCR in Kerala State (Aarif et al. 2014, 2020, 2021a; Athira et al. 2022; Rashiba et al. 2022) and Sindhudurg District of Maharashtra State (Rao et al. 2022), that provide data on continuous population monitoring. The ability of the migratory shorebirds to live in varied coastal environments makes them a global indicator species for any changes in habitat (Piersma & Lindstrom 2004).

For long-distance migrant shorebirds, the ecological quality of wintering grounds appears to be of key importance (Aarif et al. 2014, 2021a) and in the west coast, this quality is greatly affected by environmental



**Table 3. List of gulls and terns recorded from Changaram wetland.**

	Common name	Scientific name	Species status in Changaram wetland	IUCN Red List status	Migratory status
1	Slender-billed Gull	<i>Chroicocephalus genei</i> (Breme, 1839)	Uncommon	LC	WV
2	Black-headed Gull	<i>Chroicocephalus ridibundus</i> (Linnaeus, 1766)	Uncommon	LC	WV
3	Brown-headed Gull	<i>Chroicocephalus brunnicephalus</i> (Jerdon, 1840)	Uncommon	LC	WV
4	Palla's Gull	<i>Ichthyaetus ichthyaetus</i> (Pallas, 1773)	Uncommon	LC	WV
5	Lesser-black backed Gull	<i>Larus fuscus</i> (Linnaeus, 1758)	Uncommon	LC	WV
6	Little Tern	<i>Sternula albifrons</i> (Pallas, 1764)	Uncommon	LC	WV
7	Gull-billed Tern	<i>Gelochelidon nilotica</i> (Gmelin, 1789)	Uncommon	LC	WV
8	Caspian Tern	<i>Hydroprogne caspia</i> (Pallas, 1770)	Uncommon	LC	WV
9	Whiskered Tern	<i>Chlidonias hybrida</i> (Pallas, 1811)	Common	LC	WV
10	Common Tern	<i>Sterna hirundo</i> (Linnaeus, 1758)	Uncommon	LC	WV
11	Greater-crested Tern	<i>Thalasseus bergii</i> (Lichtenstein, MHC, 1823)	Uncommon	LC	WV
12	Lesser-crested Tern	<i>Thalasseus bengalensis</i> (Lesson, 1831)	Uncommon	LC	WV
13	Sandwich Tern	<i>Thalasseus sandvicensis</i> (Latham, 1787)	Uncommon	LC	WV
14	Saunders Tern	<i>Sternula saundersi</i> (Hume, 1877)	Uncommon	LC	WV
15	White-winged Tern	<i>Chlidonias leucopterus</i> (Temminck, 1815)	Uncommon	LC	WV
16	River Tern	<i>Sterna aurantia</i> (J.E. Gray, 1831)	Common	VU	LM

Common (seen on most of the visits) | Uncommon (seen less than five times) | Rare (seen once or twice).



**Image 2. Mixed flocks (Lesser Sand Plover and Curlew Sandpiper) of shorebirds from Changaram wetland. © S. Abhijith**



**Image 3. Asian Dowitcher (rarely seen ) from Changaram wetland. © S. Abhijith**

threats due to tremendous anthropogenic pressures—e.g., habitat destruction and organic solid waste dumping (Aarif et al. 2014, 2020, 2021a). Therefore, it is imperative that continuous monitoring throughout the wintering season should be undertaken in this wetland too.

Changaram wetland is under tremendous anthropogenic pressures like plastic litter dumping, habitat incursion leading to alterations, also left-over nettings & plastic traps from shrimp farming, which may lead to bird injury (Aarif & Prasad 2014; Aarif et al. 2021b) and thus the reduction of waterbirds. While the mudflats exposed after shrimp farming serve as ideal foraging grounds for wading birds, the left-over synthetic fiber threads pose a constant danger to waterfowls, as reported from KVCR (Aarif et al. 2011, 2014). Proactive steps, to alleviate these man-made impacts, like timely removal of discarded fishing accessories and spurious remains from wetlands may abate migratory bird injuries (Aarif et al. 2021b). Other threats include electrocution, feral predators like cats and stray dogs, as reported elsewhere (Blancher 2013).

## CONCLUSION

To sum up, this study may be a trailblazer as there is no other systematic investigation reported from Changaram wetland and adjoining areas till date. This could serve as a baseline information in assessing population trends, dynamics, and habitat use of regular winter migrant shorebirds and other waterbirds from the area. Regular long-term monitoring and assessment should be conducted in future so as to establish the importance of this wetland in the world avian map. Further, the local community inhabiting the area may be given awareness of the importance and need for maintaining and conserving a healthy ecosystem. Nevertheless, this study provides the first comprehensive baseline data of selected shorebirds and other waterbirds from Changaram wetland and would be extremely helpful for future research in this site and for upholding the need of designating this as an area of conservation importance.

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