

Seasonal Variations of Small Wading Birds in the Pichavaram Mangrove Forest, India

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Abstract

The Pichavaram Mangrove Forest (PMF) is one of the important wetlands in southern India. The PMF is harboring numerous species of shorebirds seasonally. The current study assessed the population characteristics of small wading birds by using direct count method from 2015 to 2016. In total, 27 species of small wading birds were recorded, in which the Little stint showed highest density 177.24 ± 20.515 (No./ha.) and the Bar-tailed godwit showed lowest density 0.13 ± 0.099 (No./ha.). Indeed the Little stint was only species turned highest density across the three different seasons studied. However, the bar-tailed godwit not recorded during the pre-monsoon and post-monsoon seasons, the Dunlin, Grey plover and Great sand plover not sighted during the post-monsoon season. The density, diversity and species richness of small wading birds showed significant differences among the seasons ($P < 0.001$). The study inferred that the population characteristics of small wading birds are declining when compared to the previous studies. However exhaustive studies are essential to explore the quality of the PMF which is need of the hour since it is supporting various species of shorebirds seasonally.



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Introduction


Shorebirds are well known for their long distance migration¹ and they are travelling thousands of kilometer annually from breeding grounds to wintering grounds vice versa.^{2,3} Shorebirds use different aquatic habitats and they are intensely dependent on various stop over sites for rest and

refuel during their migration.⁴ Several wetlands which are situated along the coastal regions are showing critical foraging sites for various species of shorebirds during their migratory periods,^{5,6} coastal wetlands regarded as a most productive and are energetic habitats for numerous species of shorebirds.⁷ Shorebirds are always consuming

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larger quantity of prey in relation to their body size and to fulfil their metabolic requirements.⁸ Hence, shorebirds always selecting their foraging sites on the basis of abundance and distribution of prey and they could deplete greater extent of prey within shortest time.^{9,10,2}

Generally the shorebirds and water birds are categorised into various groups on the basis of their ecology and behaviour in which the wading birds are one of the major categories of shorebirds. In addition to that the wading birds are classified as two different groups on the basis of the length of their legs and other morphological and behavioural characteristics i.e. large wading (long legged) and small wading (small legged) birds. The wading birds are prominent predators in the coastal wetland habitats.¹¹ The wading birds require proper water level and distribution of prey to fulfil their energetic demands.¹² For instance the wading birds are using large home ranges it might be due to their energetic demands since they are travelling thousands of kilometre during their migration.^{13,14} The abundance and diversity of preys could reasonably influence the use of feeding grounds by wading birds and the density of prey also playing major role on the viability of wading bird population in the coastal wetlands.^{15,16,17,18} The wading birds are functioning as one of the top positions in the trophic structure of food pyramids in an aquatic ecosystem the shorebirds are regarded as a important functional

components in the aquatic habitats.¹⁹ Due to their trophic status the wading birds are also considered as one of the significant indicators of the quality of the wetland habitats.^{20,21}

In this perspective the Pichavaram Mangrove Forest (PMF) is one of the vital wetlands in the east coast of southern India and the PMF is situated along the Central Asian Flyway routes of migratory shorebirds. The PMF is attracting several species of wading birds and the birds are using the PMF as a vital stop over sites during their migration since they are providing sufficient nutrient for the wading birds.^{22, 23,24, 25} The current study aimed to carry out the seasonal variations of population characteristics of small wading birds in the PMF and to suggest management recommendations and conservation wading birds visited PMF seasonally.

Study Area

The study was undertaken in the Pichavaram Mangrove Forest (PMF), which is situated at 11°23' to 11°30'N, and 79°45' to 79°50'E, India (Fig. 1). The total area of the PMF is 11 km², in which 50% is tidally conquered, 40% has urban waterways and 10% is sheltered by tidal flats. The annual temperature of PMF is ranging from 18 to 36°C.²⁶ Annually several species of shorebirds were visiting the PMF.²⁷ Various species of waterbirds were using the PMF as effective foraging grounds.²⁷ PMF attracts rare and near-threatened shorebirds annually.²⁸

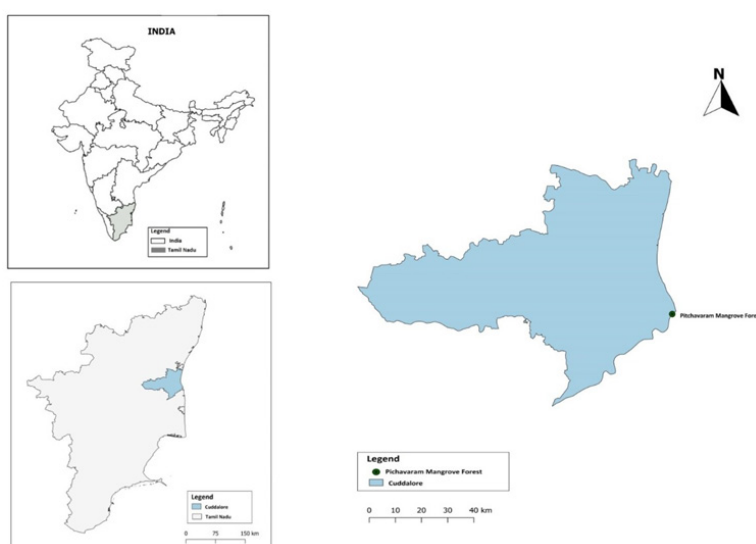


Fig. 1: Map showing the Pichavaram Mangrove Forest, Tamil Nadu, India

Methodology

Assessment of Small Wading Birds

The study was conducted from July 2015 to March 2016. The study periods were categorised into three different seasons on the basis of the migration chronology of shorebirds such as pre-migratory (July-September), migratory (October-December) and post migratory (January-March) seasons. The birds were identified and counted by using the 7 × 50

binocular and 20 x 60 spotting scope.^{29,30,31} The bird census was carried out fortnightly for each month (monthly two censuses) at the randomly selected three different sites of the PMF. Each site one hectare area was chosen on the basis of the greater congregation of shorebirds foraging in the PMF. The bird census was undertaken 6 hours in a day during the morning hours from 06.00 am to 11.00 am.³⁰

Table.1: Density of small wading birds (No./Ha) recorded in the Pichavaram Mangrove Forest (PMF) from August 2015- April 2016. (Values are Mean ± SE)

S.No.	Name of the small wading birds	Density (No./ha.)
1	Common snipe (<i>Gallinago gallinago</i>)	0.61±0.289
2	White-breasted waterhen (<i>Amauornis phoenicurus</i>)	0.85±0.241
3	Black-winged stilt (<i>Himantopus himantopus</i>)	5.33±1.169
4	Bar-tailed godwit (<i>Limosa lapponica</i>)	0.13±0.099
5	Eurasian curlew (<i>Numenius arquata</i>)	3.06±0.872
6	Whimbrel (<i>Numenius phaeopus</i>)	1.35±0.312
7	Little stint (<i>Calidris minuta</i>)	177.24±20.515
8	Temminck's stint (<i>Calidris temminckii</i>)	2.78±0.663
9	Curlew sandpiper (<i>Calidris ferruginea</i>)	7.24±3.443
10	Dunlin (<i>Calidris alpina</i>)	0.89±0.346
11	Spotted-redshank (<i>Tringa erythropus</i>)	7.81±1.223
12	Common redshank (<i>Tringa tetanus</i>)	37.61±5.744
13	Marsh sandpiper (<i>Tringa stagnatilis</i>)	8.54±3.579
14	Common greenshank (<i>Tringa nebularia</i>)	13.54±2.349
15	Green sandpiper (<i>Tringa ochropus</i>)	4.61±1.679
16	Wood sandpiper (<i>Tringa glareola</i>)	7.24±0.963
17	Terek sandpiper (<i>Xenus cinereus</i>)	2.37±0.708
18	Common sandpiper (<i>Actitis hypoleucos</i>)	9.41±1.026
19	Greater-thick knee (<i>Esacus recurvirostris</i>)	0.43±0.254
20	Pacific-golden plover (<i>Pluvialis fulva</i>)	71.02±23.241
21	Grey plover (<i>Pluvialis squatarola</i>)	0.87±0.458
22	Common-ringed plover (<i>Charadrius hiaticula</i>)	2.52±0.655
23	Little-ringed plover (<i>Charadrius dubius</i>)	45.57±6.095
24	Kentish plover (<i>Charadrius alexandrines</i>)	20.81±3.536
25	Lesser sand plover (<i>Charadrius mongolus</i>)	37.93±5.035
26	Greater sand plover (<i>Charadrius leschenaultia</i>)	1.94±0.62
27	Red-wattled lapwing (<i>Vanellus indicus</i>)	8.74±0.811

Data Analysis

The bird density was calculated for each month and season and results were expressed as number per hectare.³⁰ Species richness was arrived on the basis of the number of species recorded for each month.³² The bird diversity was calculated by using Shannon and Wiener diversity Index.³³ The Analysis

of Variance (ANOVA) was applied to understand the impact of temporal factor (seasons and months) on the population characteristics of large wading birds such as density, diversity and species richness. The SPSS 25.0 used for the analysis of the data and the results were interpreted using standard statistical procedures.³⁴

Results

In total, 27 species of small wading birds were recorded from the Pichavaram Mangrove Forest during the study. The Little stint showed the highest density 177.24 ± 20.515 (No./ha.) and the Bar-tailed godwit showed lowest density 0.13 ± 0.099 (No./ha.), when compared to the other small wading birds recorded from the Pichavaram Mangrove Forest during the entire study periods (Table 1). In addition to that the Little stint showed greater density relatively when compared to the other

26 species of small wading birds for all the three seasons studied. However, the Bar-tailed godwit not recorded during the pre and post monsoon seasons and the Dunlin, Grey plover and Great sand plover not observed during post-monsoon season (Table 2). Indeed the monsoon season showed highest density, diversity and species richness of small wading birds. The density, diversity and species richness of small wading birds showed significant differences among the seasons ($P < 0.001$) (Figs.2-4).

Table 2: Seasonal variation of small wading bird density (No./Ha) recorded from the Pichavaram Mangrove Forest, from August 2015- April 2016. (Values are Mean \pm SE)

S. No.	Species Name	Seasons		
		Pre-Monsoon	Monsoon	Post-Monsoon
1	Common snipe	0 \pm 0	1.22 \pm 0.721	0.61 \pm 0.465
2	White-breasted waterhen	0.33 \pm 0.333	0.44 \pm 0.246	1.78 \pm 0.546
3	Black-winged stilt	7.56 \pm 2.709	4.22 \pm 1.668	4.22 \pm 1.492
4	Bar-tailed godwit	-	0.39 \pm 0.293	-
5	Eurasian curlew	4.56 \pm 2.176	3.78 \pm 1.347	0.83 \pm 0.336
6	Whimbrel	1.28 \pm 0.636	2 \pm 0.554	0.78 \pm 0.392
7	Little stint	109.33 \pm 32.422	293.83 \pm 36.754	128.56 \pm 17.994
8	Temminck's stint	0.11 \pm 0.111	6.28 \pm 1.446	1.94 \pm 0.913
9	Curlew sandpiper	15.89 \pm 9.861	4.89 \pm 2.467	0.94 \pm 0.707
10	Dunlin	1.89 \pm 0.907	0.78 \pm 0.44	-
11	Spotted-redshank	4.44 \pm 2.318	12.5 \pm 1.931	6.5 \pm 1.679
12	Common redshank	29.39 \pm 6.256	59.28 \pm 14.43	24.17 \pm 4.358
13	Marsh sandpiper	2.39 \pm 1.208	21.72 \pm 10.122	1.5 \pm 0.715
14	Common greenshank	15.56 \pm 5.348	18.89 \pm 3.856	6.17 \pm 1.733
15	Green sandpiper	0.67 \pm 0.667	12.83 \pm 4.458	0.33 \pm 0.28
16	Wood sandpiper	1.67 \pm 0.542	8.72 \pm 1.409	11.33 \pm 1.856
17	Terek sandpiper	2.33 \pm 0.911	3.61 \pm 1.84	1.17 \pm 0.55
18	Common sandpiper	5.94 \pm 1.251	10.06 \pm 1.436	12.22 \pm 2.24
19	Greater-thick knee	0.2 \pm 0.01	0.31 \pm 0.02	0.23 \pm 0.01
20	Pacific-golden plover	11.94 \pm 8.568	168.22 \pm 62.502	32.89 \pm 15.009
21	Grey plover	0.67 \pm 0.464	1.94 \pm 1.277	-
22	Common-ringed plover	1.67 \pm 0.929	5.22 \pm 1.503	0.67 \pm 0.464
23	Little-ringed plover	20.83 \pm 5.789	63.28 \pm 10.395	52.61 \pm 12.187
24	Kentish plover	17.94 \pm 7.456	22.28 \pm 5.322	22.22 \pm 5.683
25	Lesser sand plover	26.83 \pm 7.8	23.78 \pm 4.094	63.17 \pm 10.148
26	Greater sand plover	5.28 \pm 1.586	0.56 \pm 0.305	-
27	Red-wattled lapwing	8.44 \pm 1.562	9.61 \pm 1.482	8.17 \pm 1.2

Discussion

The study found that 27 species of small wading birds were recorded from the Pichavaram Mangrove

Forest (PMF). However, the density, diversity and species richness varied significantly among the seasons ($P < 0.001$). In fact the study found that

the temporal factors could influence the population characteristics such as density, diversity and species richness of wading birds in the PMF. Generally the abundance and distribution of shorebirds might have determined by the various attributes of aquatic habitats such as water and soil quality characteristics, abundance, density and distribution

of prey, presence of predators and other ecological factors.^{35,36} However the density and distribution of prey could be varied during particular, which will facilitate the reproduction and growth of the prey species of a given aquatic habitat, whereby the number and diversity of predators could be fluctuated.^{37,38, 39, 30}

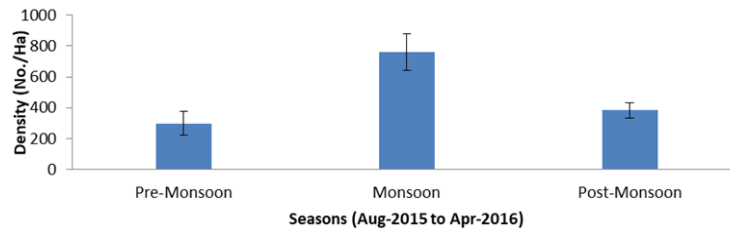


Fig. 2: Overall seasonal variations of bird density of the small wading bird recorded from the Pichavaram Mangrove Forest from August 2015- April 2016. (Values are Mean ± SE)

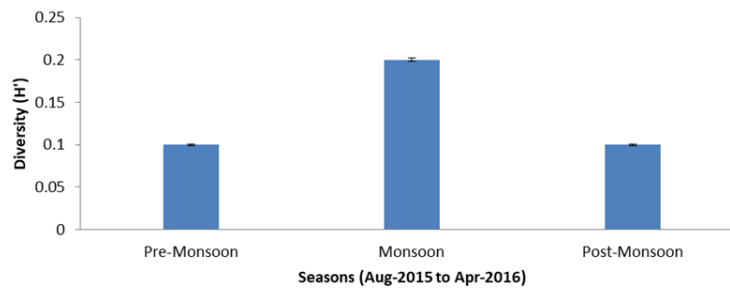


Fig. 3: Overall seasonal variations of bird diversity of the small wading bird recorded from the Pichavaram Mangrove Forest from August 2015- April 2016. (Values are Mean ± SE)

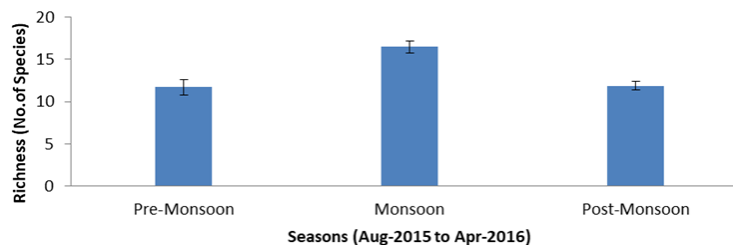


Fig. 4: Overall seasonal variations of bird richness of the small wading bird recorded from the Pichavaram Mangrove Forest from August 2015- April 2016. (Values are Mean ± SE)

Studies are insisted that the population of waterbirds including wading birds could vary depends on the various seasons.^{40,41, 42} Another study revealed that the population characteristic of avian communities fluctuated on the basis of temporal factors and habitat quality including the availability, distribution and density of food, and the availability of suitable sites for reproduction or resting.⁴³ The present study found that the monsoon season showed

greater density, diversity and species richness of small wading birds and the study also found that the density, diversity and species richness of small wading birds varied significantly ($P < 0.05$), it might be due to the immigration of various species of shorebirds since the monsoon season is the migratory season for various waterbirds.³⁰ During migratory season several species of waterbirds

visiting the wetlands as effective feeding and refuel sites or stop over sites during their migration and it could be reason the monsoon showed highest bird density, diversity and species richness than the pre-monsoon and post-monsoon reasons. A study inferred that the variations of avian species diversity may be correlated with the arrival of seasonal migratory species, and monsoon season harbouring of various species dwelling in the wetland habitat.^{44,45} Studies revealed that variations of waterbirds in a given wetland habitat is due to immigration and emigration of avian communities seasonally.^{46,47,48,49}

In fact the current study found that the Little stint showed highest density among the other species of small wading birds recorded from the PMF. The bird density variations among the shorebird species in a given wetland habitat is determined by various ecological factors such as prey choice, foraging techniques, tolerance against various disturbances and predatory pressures, inter and intra species competition during their foraging and other ecological factors including water depth, niche partitioning and overlapping etc. In addition to that the Little stint could forage, hunting and consuming their prey along with the other species of plovers and sandpipers when they are foraging it could be the reason that the density of Little stint was greater than the other species recorded from the PMF, but intensive study should be carried out to understand the variations of wading birds population characteristics in a given wetland habitat. However the density, diversity and species richness of small wading birds is moderately declining when compared to the studies already undertaken in the PMF.^{50,51,23,52} Another study also inferred that the population of shorebirds are declined in the PMF due to various ecological threats.²⁴

Conservation Implication

The Pichavaram Mangrove Forest (PMF) is a Central Asian Flyway (CAF) routes and supporting various species of waterbirds as a viable feeding, roosting and breeding grounds.^{26,50} But the studies stated that the PMF is under severe threat due to various factors influencing the PMF including anthropogenic pressures. A study reported that the PMF is highly polluted through various contaminants⁵³ and a study revealed that the toxic pollution is threatening shorebirds in India.⁵⁴ A recent study explained that the PMF is degrading and the habitat is losing to support various species of shorebirds which are visiting the PMF annually^{3,25} and the current study is also revealed that the population characteristics of wading birds declined. Therefore need of the hour to take proper management and conservation measures including assessment of the soil and water quality characteristics, assessment of prey species, various pollution, and threats both natural and man-made etc., to preserve the PMF to sustain the fauna and flora which are depend on the PMF.

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Conflict of Interest

The authors do not have any conflict of interest.

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