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Insectivorous Birds: Tharangambadi Seashore and Adjoined Places as the Potential for Feed

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The birds which are forage in wetlands are likely to be insectivores. Due to the course of the life cycle of insects, the birds have an enormous amount of feed for their survival. The study revealed that, diversity and distribution of birds in relation to the insect diversity in Tharangambadi Sea shores, Mayiladuthurai District, Tamil Nadu from January 2017 to December 2017. The total count method was employed for the observation of birds. Collection of the insect by the scooping nets in the aquatic environment and quartets in the terrestrial environment was used. The results showed that 56 species of birds were encountered from 14 orders. Among the 56 species of birds,

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insectivores (41%) dominated followed by carnivore (20%), piscivore (14%), omnivore (11%), granivore (9%), frugivore (3%) and nectivores (2%). The insectivorous bird's species richness was high in the season post-monsoon (23) followed by Monsoon (22), pre-monsoon (20), and summer (19). The abundance was high during the post-monsoon (797) followed by monsoon (756), pre-monsoon (372), and summer (279) ($F= 4.059$; $p<0.01$). Simultaneously, the insect species richness was high during the season of post-monsoon, monsoon, pre-monsoon (19), and summer (18). The abundance was high during the post-monsoon (545) followed by monsoon (430), pre-monsoon (399), and summer (377) ($F=0.5647$; $p>0.01$). The insects and insectivorous birds' species richness and abundance were correlated positively. It concluded that insectivorous avian diversity and abundance were high during the insects' abundance and diversity. Therefore, the Tharagambadi seashore is a potential habitat for insectivorous birds.

Keywords: Diversity; insectivores; Tharagambadi; seashore; birds.

1. INTRODUCTION

"The coastal zone is a dynamic area with many cyclic processes owing to a variety of resources and habitats" [1,2]. "Coastal plains and seas include the most taxonomically rich and productive ecosystems on the earth" [3,4]. **"**Birds use wetlands as a main source for feeding, resting, shelter, and social interactions" [5,6]. "Wetlands and water birds are always together elements; the water birds occupy several trophic levels in the food web of wetland nutrient cycles" [7]. "The pressure of abiotic factors on the water bird congregations in wetlands has long been studied by many authors" [8,9]. "Water quality acts as an imperative factor to estimate the health of the wetland, since the same is dependable for the prey availability and productivity of an ecosystem" [10,11]. Likewise, biotic factors such as insects and other fauna have a significant role in water bird density and diversity [12,13]. "This directly or indirectly influences the distribution and habitat use of water birds" [10,14]. As they attract a huge number of migratory and resident birds due to their high nutritional value and productivity [10,15].

"In Point Calimere Bird Sanctuary, many insectivorous birds are attracted by the abundance of insects during winter. During the season of migration, the long-legged and small wanderers, flamingoes, grey herons, purple herons, reef herons, egrets, spoonbills, and painted storks are seen in the seashores" [16,17]. "Long-distant migrants include *Calidris minuta*, *Calidris restacea,* and *Charadris mongolus"* [18]. Similarly, this study area also attracted various migratory birds during the season. Balakrishnan et al., [19] revealed that "many shorebirds depend on their feed as insects". In India, 69% of the area consists of inland wetlands [20], of which many wetlands are threatened and many are already degraded [21]. To overcome this rapid loss of wetlands, it is highly essential to afford an alternate habitat to support water birds [22], and rice fields can act as an alternate habitat for water birds during winter [23-25]. The present investigation was designed and carried out with the diversity and abundance of water birds and land birds in relation to the insect fauna on sea shores of Tharagambadi Taluk, Mayiladuthurai District due to the lack of this type of study in the above-mentioned study area.

2. MATERIALS AND METHODS

2.1 Study Area

The study area is located in the Tharangambadi Taluk of Mayiladuthurai District. The district lies between $10^{o}25'$ and $11^{o}40'$ North Longitude and 79^{o} 49' and 80^{o} 01' East latitude of Tamil Nadu, India. It is semi-urban and characterized by various habitats such as sea shores, agricultural areas, shrubland, channel, human habitation, riverine bed, wasteland, etc. The river Cauvery runs through the study area which ends in Poombukar (Fig. 1). The river Cauvery is the chief water source for agricultural activities in this area. This area receives northeast monsoons from October to December. In the study area number of natural water bodies existed viz., Wells, Ponds, and Puddles. The villagers pump out water through a motor for their agricultural activities also. People in the study area depend more on fishing and agricultural activities. Paddy, banana, coconut, ground nut, sugar cane, cereals, and pulses are grown here.

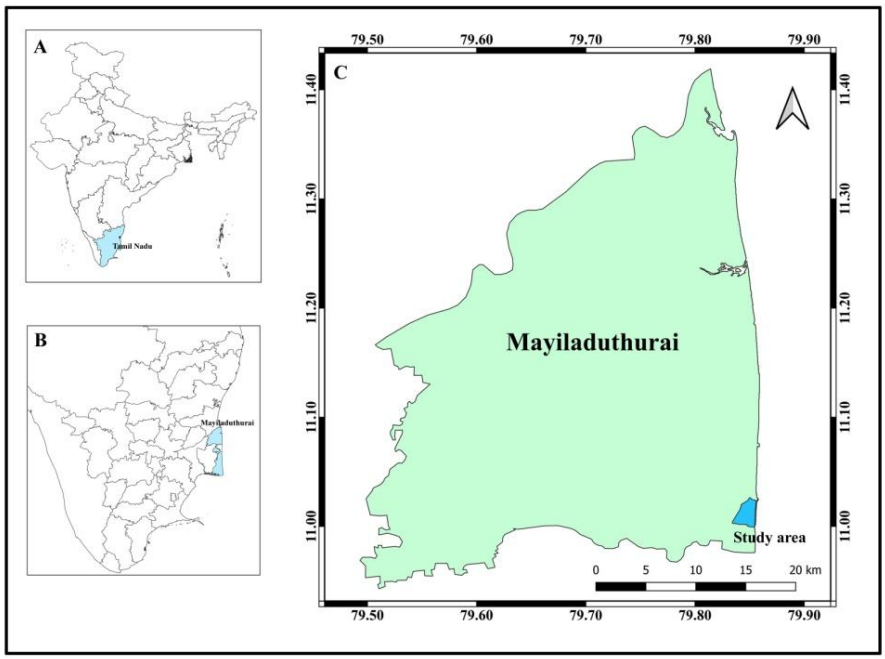

Fig. 1. Map shows the study area in Mayiladuthurai District
Note: A- India; B- Tamil Nadu; C- Mayiladuthurai District with Study area

2.2 Assessment of Birds

The direct count method was used for counting birds fortnightly each month [26]. For direct counting, a suitable vantage point was chosen and all visible birds were counted. This counting was made without any bias and to ensure accuracy. The 'Total count' method was followed for bird census wherever possible, and it was made walking in and around the wetlands or from specific vantage points [9]. Systematic birds count was carried out at different sites (three random sites were selected), each from January 2017 to December 2017. During counts, each site was divided into many sections in each section the birds were counted. All the birds on the ground or in the water were counted using binoculars and any bird flying across the observer was also included in the counting. Birds flying behind the observer were not counted. Migratory, wintering, breeding/ summering, and resident water birds were commonly encountered in the wetlands during the monsoon season. The birds were counted by using binoculars (7x50).

2.3 Assessment of Insects and Larvae

"Five sites were chosen in and around the Tharangambadi Seashore. Each site was sampled for benthic invertebrates at two weeks intervals over the period from January 2017 to December 2017. For aquatic insects and larvae samples were taken to a substrate depth of 5 cm, using a 250 µm mesh Surber Sampler with a sampling area of 100 cm^2. Three, randomly positioned, replicate samples were taken at each site, starting, on each occasion. Samples were preserved in 95% ethanol in the field. In the laboratory, the samples were rinsed with tap water, floated in saturated calcium chloride solution (to help separate the animals from the inorganic substrate), and examined under a dissecting microscope. Individual animals were removed from the surrounding detritus, identified, and preserved in 75% ethanol" [27]. The study area has various habitats ie. agricultural land, road bund, riverside, and non-cultivated sites. All the lands were surveyed by 100-meter insect visitation transects for terrestrial insect abundance [28].

2.4 Diversity Indices

The diversity indices of birds and insects were also calculated. Species richness, abundance, Simpson diversity index, Sahnnon H' index, and Evenness were calculated by using PAST software. Univariate statistical analysis was conducted for data analysis by using SPSS version 16.0. Kruskal-Wallis one-way ANOVA was used to test variation in abundance among the birds and insects.

3. RESULTS AND DISCUSSION

Total of 9784 birds were encountered belonging to 56 species from 14 orders of Class Aves from January 2017 to December 2017 in the Tharangambadi seashore habitat (Table 1). Among the 14 orders of birds Passeriforms has 36% of species followed by Charadriiformes (14%), Pelecaniformes (12%), Coraciiformes (9%) and so on (Fig. 2). The encountered birds were tabulated as food habits and it's showed that insectivores (41%) dominated followed by a carnivore (20%), piscivore (14%), omnivore (11%), granivore (9%), frugivore (3%) and nectivores (2%) (Fig. 3). The study also showed that, 35 species are resident and 21 species are migrants including local migrant. The Painted Stork alone is in the Near Threatened category as IUCN.

While taking into account insectivores birds, the species richness was high in the season of post-monsoon (23) followed by Monsoon (22), pre-monsoon (20), and summer (19). The abundance was high during the post-monsoon (797) followed by monsoon (756), pre-monsoon (372), and summer (279) ($F= 4.059$; $p<0.01$) (Fig. 4). But the dominance index was high in summer (0.113) followed by monsoon (0.0959), pre-monsoon (0.0932) and post-monsoon (0.0844). Simpson diversity index was high during the season post-monsoon (0.9159) followed by pre-monsoon (0.9068), monsoon (0.9041), and summer (0.8867). Shannon H's index was high in post-monsoon (2.718) and least in summer (2.439). The Evenness index was high in pre-monsoon (0.6814) and the least in summer (0.603) (Table 2).

The insect diversity indices were calculated during the study period. It shows that species richness was high during the season of post-monsoon, monsoon, and pre-monsoon (19), and summer (18). The abundance was high during the post-monsoon (545) followed by monsoon (430), pre-monsoon (399), and summer (377) ($F=0.5647$; $p>0.01$) (Fig. 4). The dominance index was during summer (0.1119) followed by pre-monsoon (0.1041), post-monsoon (0.0967) and monsoon (0.0946). The Simpson diversity index was high during the monsoon (0.9054) followed by post-monsoon (0.9032), pre-monsoon (0.8959), and summer (0.8881). But the Shannon H index was in the post-monsoon (2.576) and the least was calculated during summer (2.434). The evenness index was high during monsoon (0.6983) and the least was in the summer (0.6337) (Table 3).

Totally 56 species of birds were encountered on the seashores of Tharagambadi Taluk, Mayiladuthurai District from January 2017 to December 2017. As per IUCN categories, all the birds are under the Least concern (LC) except the Painted stork (NT). The painted stork is frequently visited during the migratory season in many places of Cauvery deltoic regions sea shores and around places [29-31]. Passeriforms are dominated family and it may be due to the associated agricultural lands [31-33]. In the present investigate the relationship with insects by birds. As a result, it classified the birds as per food habits and the insectivores were dominated followed by carnivores and omnivores. It indicated that the availability of insects in the study area from different habitats like agricultural lands, channels, and open water bodies

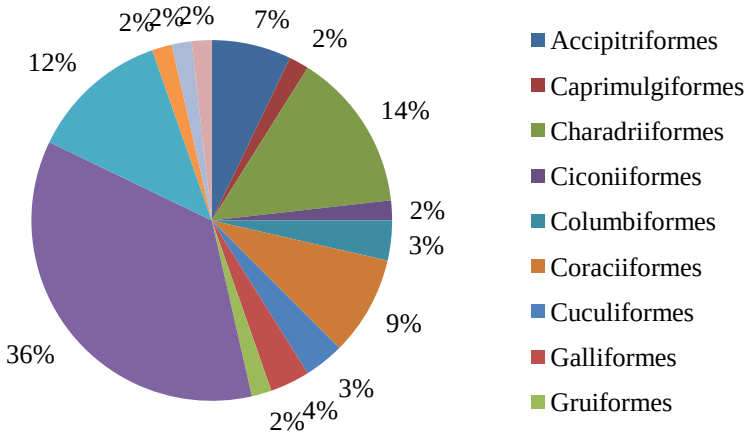

Fig. 2. Order wise of birds encountered in the study area

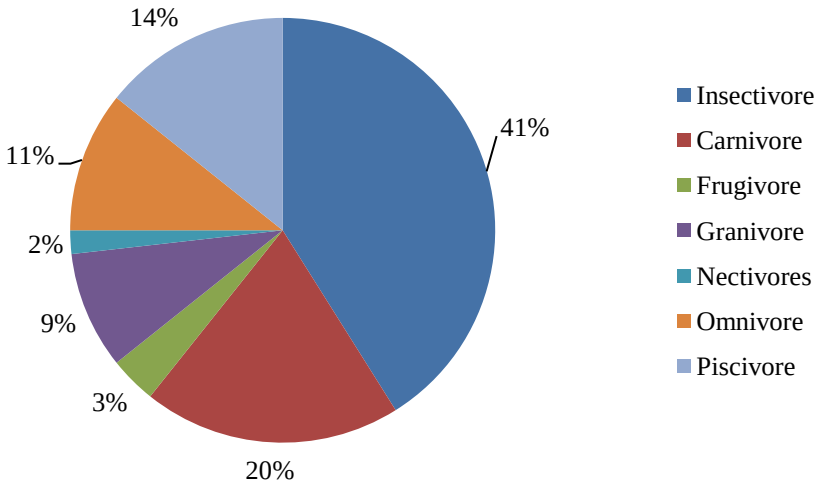

Fig. 3. Food habits of birds recorded in Sea Shores of Tharangambadi Taluk

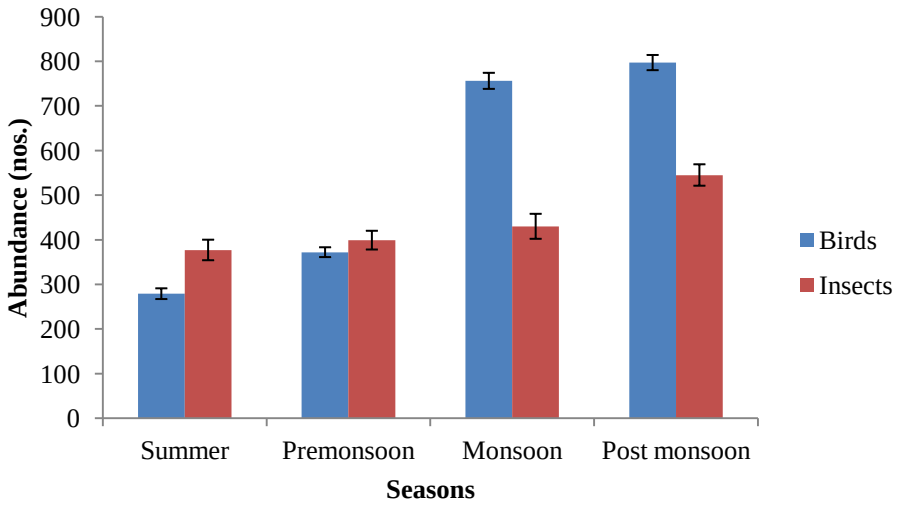

Fig. 4. Abundance of insects and birds in different seasons during the study period

enhanced the insectivore birds. Most of the bird species are insectivores that depend for the most part on insects as prey [34,35]. The species richness of birds was during the post-monsoon and the least was in the summer. The abundance of birds was high during the post-monsoon and the least was in the summer. Similarly, insect abundance directly influences bird species richness as well as abundance. On the other hand, it may be due to the water level and seasonal climatic features [36]. The dominance index was high during the summer and the least was in the post-monsoon. The availability of food makes some birds with a feeding guild of highly abundant food dominate the area [37]. Simpson diversity index and Shannon H index were high during the post-monsoon and least in the summer. The evenness index showed high in the month of pre-monsoon and the least was in the summer. Avian diversity is associated with various habitats with the foraging guild. As well as the habitat heterogeneity will increase the abundance of birds and insects. Each habitat has a specific set of microenvironments that is suitable for a species. Kiros et al. [38] mentioned that "the variation in bird species diversity, richness, and abundance is associated with the vegetation composition that makes changes in food sources, nesting, and protection based on birds' habitat preference and feeding".

Table 1. List of birds were encountered with foraging guild during the study period

S. No	Common Name	Scientific Name	Order	Family	Foraging Guild	Migratory Status
1	Black Kite	*Milvus migrans* (Boddaert, 1783)	Accipitriformes	Accipitridae	C	R
2	Brahminy Kite	*Haliastur indus* (Boddaert, 1783)	Accipitriformes	Accipitridae	C	LM
3	Black shouldered Kite	*Elanus caeruleus* (Desfontaines, 1789)	Accipitriformes	Accipitridae	C	LM
4	Shikra	*Accipiter badius* (Gmelin, 1788)	Accipitriformes	Accipitridae	C	R
5	Asian Palm Swift	*Cypsiurus balasiensis* (Gray, 1829)	Caprimulgiformes	Apodidae	I	R
6	Little-ringed Plover	*Charadrius dubius* (Scopoli, 1786)	Charadriiformes	Charadriidae	I	WM
7	Common-ringed Plover	*Charadrius hiaticula* (Linnaeus, 1758)	Charadriiformes	Charadriidae	I	WM
8	Red-wattled Lapwing	*Vanellus indicus* (Boddaert, 1783)	Charadriiformes	Charadriidae	I	R
9	Common Sandpiper	*Actitis hypoleucos* (Linnaeus, 1758)	Charadriiformes	Scolopacidae	I	WM
10	Little Stint	*Calidris minut* (Leisler, 1812)	Charadriiformes	Scolopacidae	I	WM
11	Black winged Stilt	*Himantopus himantopus* (Linnaeus, 1758)	Charadriiformes	Recurvirostridae	I	WM
12	Caspian Tern	*Hydroprogne caspia* (Pallas, 1770)	Charadriiformes	Laridae	P	WM
13	Painted Stork	*Mycteria leucocephala* (Pennant, 1769)	Ciconiiformes	Ciconiidae	P	WM
14	Blue Rock Pigeon	*Columba livia* (Gmelin, 1789)	Columbiformes	Columbidae	G	R
15	Spotted Dove	*Spilopelia suratensis* (Gmelin, 1789)	Columbiformes	Columbidae	G	R
16	Pied Kingfisher	*Ceryle rudis* (Linnaeus, 1758)	Coraciiformes	Alcedinidae	P	LM
17	Small Blue Kingfisher	*Alcedo atthis* (Linnaeus, 1758)	Coraciiformes	Alcedinidae	P	R
18	White breasted Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	Coraciiformes	Alcedinidae	P	R
19	Small Green Bee-Eater	*Merops orientalis* (Latham, 1802)	Coraciiformes	Meropidae	I	R
20	Indian Roller	*Coracias benghalensis* (Linnaeus, 1758)	Coraciiformes	Coraciidae	C	R
21	Lesser Coucal	*Centropus bengalensis* (Gmelin, 1788)	Cuculiformes	Cuculidae	I	LM
22	Asian Koel	*Eudynamys scolopaceus* (Linnaeus, 1758)	Cuculiformes	Cuculidae	F	LM
23	Grey Francolin	*Francolinus pondicerianus* (Gmelin,1789)	Galliformes	Phasianidae	O	R
24	Indian Peafowl	Pavo cristatus (Linnaeus, 1758)	Galliformes	Phasianidae	O	R
25	White-breasted Waterhen	*Amaurornis phoenicurus* (Pennant, 1769)	Gruiformes	Rallidae	I	R
26	Common Moorhen	*Gallinula chloropus* (Linnaeus, 1758)	Gruiformes	Rallidae	O	R
27	Yellow billed Babbler	*Turdoides affinis* (Jerdon, 1845)	Passeriformes	Leiotrichidae	I	R
28	Common Myna	*Acridotheres tristis* (Linnaeus, 1766)	Passeriformes	Sturnidae	O	R
29	Black Drongo	*Dicrurus macrocercus* (Vieillot, 1817)	Passeriformes	Dicruridae	I	R
30	House Crow	*Corvus splendens* (Vieillot, 1817)	Passeriformes	Corvidae	O	R
31	Jungle Crow	*Corvus macrorhynchos* (Wagler, 1827)	Passeriformes	Corvidae	O	R

S. No	Common Name	Scientific Name	Order	Family	Foraging Guild	Migratory Status
32	Indian Treepie	*Dendrocitta vagabunda* (Latham, 1790)	Passeriformes	Corvidae	I	LM
33	Black headed Munia	*Lonchura malacca* (Linnaeus, 1766)	Passeriformes	Estrildidae	G	R
34	Red vented Bulbul	*Pycnonotus cafer* (Linnaeus, 1766)	Passeriformes	Pycnonotidae	I	R
35	Common Tailorbird	*Orthotomus sutorius* (Pennant, 1769)	Passeriformes	Cisticolidae	I	R
36	House Sparrow	*Passer domesticus* (Linnaeus, 1758)	Passeriformes	Passeridae	G	R
37	Common Swallow	*Hirundo rustica* (Linnaeus, 1758)	Passeriformes	Hirundinidae	G	R
38	Wire-tailed Swallow	*Hirundo smithii* (Leach, 1818)	Passeriformes	Hirundinidae	I	R
39	Tree Pipit	*Anthus trivialis* (Linnaeus, 1758)	Passeriformes	Motacillidae	I	R
40	White Wagtail	*Motacilla alba* (Linnaeus, 1758)	Passeriformes	Motacillidae	I	LM
41	Yellow Wagtail	*Motacilla flava* (Linnaeus, 1758)	Passeriformes	Motacillidae	I	LM
42	Paddy Field Pipit	*Anthus rufulus* (Vieillot, 1818)	Passeriformes	Motacillidae	I	R
43	Asian Paradise Flycatcher	*Terpsiphone paradisi* (Linnaeus, 1758)	Passeriformes	Monarchidae	I	LM
44	Red winged Bush Lark	*Mirafra hypermetra* (Reichenow, 1879)	Passeriformes	Alaudidae	I	LM
45	Purple rumped Sunbird	*Leptocoma zeylonica* (Linnaeus, 1766)	Passeriformes	Nectariniidae	N	LM
46	Indian Robin	*Saxicoloides fulicatus* (Linnaeus, 1766)	Passeriformes	Muscicapidae	I	LM
47	Great Egret	*Ardea alba* (Linnaeus, 1758)	Pelecaniformes	Ardeidae	C	R
48	Intermediate Egret	*Ardea intermedia* (Wagler, 1829)	Pelecaniformes	Ardeidae	C	R
49	Cattle Egret	*Bubulcus ibis* (Linnaeus, 1758)	Pelecaniformes	Ardeidae	C	R
50	Little Egret	*Egretta garzetta* (Linnaeus, 1766)	Pelecaniformes	Ardeidae	C	R
51	Indian Pond Heron	*Ardeola grayii* (Sykes, 1832)	Pelecaniformes	Ardeidae	C	R
52	Purble Heron	*Ardea purpurea* (Linnaeus, 1766)	Pelecaniformes	Ardeidae	P	R
53	Little Green Heron	*Ardea cinerea* (Linnaeus, 1758)	Pelecaniformes	Ardeidae	P	R
54	Rose ringed Parakeet	*Psittacula krameri* (Scopoli, 1769)	Psittaciformes	Psittaculidae	F	R
55	Spotted Owlet	*Athene brama* (Temminck, 1821)	Strigiformes	Strigidae	C	LM
56	Little Cormorant	*Microcarbo niger* (Vieillot, 1817)	Suliformes	Phalacrocoracidae	P	LM

C- Carnivore; I- Insectivore; P-Piscivore; G- Granivore; F- Frugivore; O- Omnivore; N- Nectivore; R- Resident; LM- Local migrant; WM- Winter migrant

Table 2. Diversity indices of insectivore birds recorded in the study area

	Summer	Pre-monsoon	Monsoon	Post-monsoon
Species richness	19	20	22	23
Abundance	279	372	756	797
Dominance index	0.1133	0.09322	0.0959	0.08441
Simpson Diversity index	0.8867	0.9068	0.9041	0.9156
Shannon H' index	2.439	2.612	2.595	2.718
Evenness index	0.603	0.6814	0.6088	0.6585

Table 3. Diversity indices of insects recorded in the study area

	Summer	Pre-monsoon	Monsoon	Post-monsoon
Species richness	18	19	19	19
Abundance	377	399	430	545
Dominance index	0.1119	0.1041	0.09463	0.09676
Simpson Diversity index	0.8881	0.8959	0.9054	0.9032
Shannon H' index	2.434	2.515	2.585	2.576
Evenness index	0.6337	0.6507	0.6983	0.6921

4. CONCLUSION

It is concluded from the present study that insectivore bird species are rich in the Tharagampadi seashore because of the abundance and diversity of insects. Bird species (resident and migratory) numbers and abundance were higher in the post-monsoon according to the habitat suitability, which supports free water and abundant food supply (insects, grasses, and aquatic fauna) as well as nesting and resting sites. Also, most migratory birds as well as resident birds feed on insects. During the winter season, the migratory birds are visiting nearby bird sanctuaries (Point Calimere) and territorial forest (Pichavaram mangroves) agricultural areas (Cauvery deltaic regions).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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