

**Diversity of Large waders in the Periyakulam Lake, Tiruchirappalli,
Tamil Nadu, India**<https://doi.org/10.56343/STET.116.010.004.007><http://stetjournals.com>

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Abstract

Wetlands are the major feeding habitats for water birds. This study was to determine and compare the population density, seasonal diversity and species richness of large waders. It was carried out in the Periyakulam lake and the birds were estimated weekly by using total count method during 06.00 am to 06.00 pm. Totally twelve species of large waders were observed from January, 2011 to December, 2012. Among the 12 species, Oriental white ibis (*Threskiornis melanocephalus*) and Painted stork (*Mycteria leucocephala*) were recorded as the 'Near Threatened' category of water birds in the lake. The density of large wader was greater during the summer season of the year I and monsoon season of the year II than the other seasons. The density, diversity and species richness varied significantly between the years and among the season ($P < 0.001$). The study reveals that the Periyakulam lake is one of the most preferred habitats for water birds in India and provides favourable conditions for the water birds especially large waders.

Keywords: Conservation, habitat interactions, lake, large waders, wetlands, water birds.

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INTRODUCTION

Wetlands are complex and productive ecosystems (Maltby, 1986; Unni, 2002) that occupy about six per cent of the Earth's land surface (Maltby and Turner, 1983). They are the most important habitats for water birds and suitable sites for foraging and roosting (Weller, 1999; Stewart, 2001). Wetland supports congregation of great number of migratory and resident water birds as they are highly productive and endowed with rich nutrients (Paracuellos, 2006). These habitats are also important stop over and wintering sites for large flocks of migratory water birds (Erwin, 1996). They form an important link in the food chain and the change in the population dynamics will directly impact the ecosystem (Custer and Osborn, 1977; Rajashekara and Venkatesha, 2010).

Generally the large waders select their feed from the edges of lakes, reservoirs, rivers, brackish lagoons and salt pans. Large waders acquire important nutrients by feeding on fishes, gastropods, benthic fauna, insects and plankton. However, the benthic invertebrates have been the primary feed of large waders (Rundle, 1982). Besides, the large waders also feed on a variety of benthic organisms such as molluscs, annelid worms,

fishes, insects, reptiles and other mud dwelling organisms (Pandiyan, 1999, 2000, 2002; Pandiyan *et al.*, 2006). Thus the wetland plays a critical and significant ecological role for the fulfillment of the prey predator interactions. In addition to that the wetlands are the most essential habitats for water birds including large wader populations whose survival and annual cycles including breeding, moult, migration, etc., are dependent on these habitats. However, in the wetlands the distributions of water birds are influenced by various factors including the availability of food or prey and the size of the wetland habitat (Paracuellos, 2006). The present article deals with the density, diversity and species richness of large waders in the Periyakulam lake Tiruchirappalli, Tamilnadu.

Study area

Periyakulam lake (10° .78 N; 78° .77 E) is located in the Koothappar Village of Thiruvarampur, Tiruchirappalli District, Tamil Nadu, India. It covers an area of 74.085 ha. The major water source to this lake is Cauvery River via Uyyakondan canal. The water resource is largely used for agriculture and inland aquaculture. About 629.84 ha agricultural land is irrigated from this lake. This wetland attracts thousands of water birds comprising of resident and migrant species. In the lake diversity of flora and fauna were present. The major flora includes *Eichhornia crassipes*, *Phragmites karka*, *Zizania latifolia*, *Cynodon sp.*, *Linnophila sp.*, *Sagittaria sp.*, *Saccharum latifolium*, *Erianthus pucerus*, *Erianthus*

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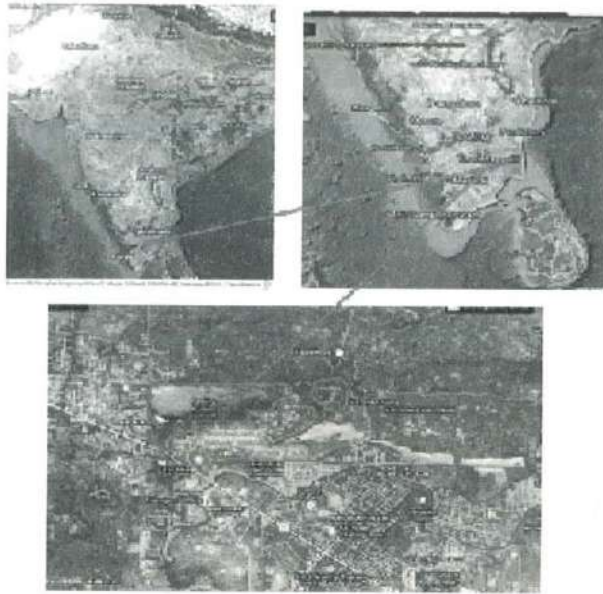


Fig.1. The Map showing the Kothappar Periyakulam Wetland, Tiruchirappalli District, Tamilnadu.

ravennae, *Leersia hexandra* and *Cyperus rotundus*, besides the birds species such as *Euphlyctis hexadactylus*, *Mirghal* sp. *Ctenopharyngodon idella*, *Oreochromis mossambicus*, *Salmophasia bacaila*, *Puntius filamentosus*, *Catla catla* and *Labeo rohita*, and the water insects such as *Rhithrogena germanica* and dragon flies. In addition to that various species of algae, fungi and other flora and fauna were present in the lake which also formed the food substrates for the birds and other taxa. The physical nature of the Periyakulam lake is sloping in nature. Besides there are number of microhabitats viz., mudflats, rocky patches, abundant plant bunds, etc., appeared in the lake.

MATERIALS AND METHODS

Bird counting

Water birds were counted individually using the 'direct count' method following the method described by Yates and Goss-Custard (1991). Since the lake appeared relatively homogenous, birds were counted with 7 × 50m binocular and 20 × 60m spotting scope from vantage points of the lake. Two counts of 3.00h duration were made every day on clear and sunny days to minimize bias arising from variation in weather. During the census, arrival or departure of flocks of birds was carefully counted to avoid missing or duplication of records. Care was taken to see that the birds were not disturbed due to the visits for counting.

Seasons

The study period was divided into four different seasons based on the migration chronology of water birds which included pre monsoon, monsoon, post

monsoon and summer. The Pre-Monsoon season (PrM) includes the months of July, August and September, when birds arrive or pass the lake for wintering; the Monsoon season (Mon) includes the months of October, November and December; the Post Monsoon season (PoM) includes the months of January, February and March; and Summer season (Sum) includes the months of April, May and June (Pandiyan *et al.*, 2006)

Data analysis

Density of large wading birds was calculated as number per hectare. Species richness was calculated based on the number of species of water bird recorded in the lake (Verner, 1985), and species diversity was calculated by using the Shannon- Wiener Index (H' : Shannon and Wiener, 1949). Individual bird density was calculated as number per hectare of the lake in each season. The General Linear Model (GLM) was applied to determine the impact on the characteristic features of the density, diversity and species richness among the seasons. All the statistics were run by using SPSS 16.0. Results of the analyses were interpreted using standard statistical procedures (Sokal and Rohlf, 1981).

RESULTS

Totally 12 species of large waders belonged to 3 families were recorded in the Periyakulam lake from January-2011 to December-2012. Among the twelve species of large waders two birds were under the category of 'Near Threatened' species as per the IUCN category, which include Oriental white ibis (*Threskiornis melanocephalus*) and Painted stork (*Mycteria leucocephala*). All the species used the lake throughout the year and seasons except the Indian pond heron, Oriental Ibis, Glossy Ibis and Eurasian spoonbill (Table 1). The highest density was recorded during the monsoon season ($387.72 \pm 67.789/\text{ha.}$) and lowest density ($52.00 \pm 11.543/\text{ha.}$) was during the pre monsoon of the year II. The bird diversity and species richness were also greater during the monsoon season of the year II than other seasons of the year I and II (Table 1). The overall results showed that there were significant differences between the years and among the seasons ($P < 0.001$).

DISCUSSION

Freshwater wetlands are the most important habitats for various water birds and their importance depends on size, diversity of vegetation, water quality, food resources and topography (Mohanraj and Pandiyan, 2015). Water birds are the most conspicuous and significant component of the freshwater wetland ecosystems and their presence or absence may indicate the ecological conditions of the particular area. The present study reveals that the lake is supporting water birds throughout the year and seasons and this is one of the remarkable findings.

Table 1. Different species of large waders recorded in the Periyakulam lake during January-2011 to December-2012. (Values are Mean ± SD; N=12 for each season).

S. No.	Birds Name	Year I (January-2011 to December-2011)						Year II (January-2012 to December 2012)					
		Seasons			Seasons			Seasons			Seasons		
		PrM	Mon	PoM	Sum	PrM	Mon	PoM	Sum	PrM	Mon	PoM	Sum
1	Little egret (<i>Egretta garzetta</i>)	2.67 ±0.829	32.58 ± 8.656	15.62±8.385	70.17±17.007	20.86±4.003	36.28±8.982	30.5±6.82	88.83±20.633				
2	Large egret (<i>Casmerodius albus</i>)	0.58±0.398	19.75 ±4.66	29.54 ±8.649	22.17 ±6.119	2.43 ±0.924	20.89 ±3.646	27.42±6.341	10.08±6.119				
3	Cattle egret (<i>Bubulcus ibis</i>)	26.42±4.512	25.58±4.819	34.54 ±5.807	25.42 ±5.61	5 ±2.954	100.94±20.089	28.58±16.263	54.33±18.787				
4	Grey heron (<i>Ardea cinerea</i>)	2.08±0.621	5.92±1.738	3.31 ±1.04	20.25 ±8.494	4.43 ±2.228	11.44 ±3.027	13.75 ±3.865	3.58 ±1.751				
5	Purple heron (<i>Ardea purpurea</i>)	1.67 ±0.987	6.67 ±2.359	7.62 ±1.855	14.75 ±5.305	4.21 ±0.853	11 ±2.093	18.25 ±5.158	8.08 ±2.644				
6	Black crowned night heron (<i>Nycticorax nycticorax</i>)	0.25 ±0.25	28.33 ±6.791	14.62 ±6.261	34.67 ±9.183	3.93 ±2.669	36.11 ±9.892	43.67 ±8.671	58.92 ±15.039				
7	Indian pond heron (<i>Ardeola bacchus</i>)	0	0	0	2±2	0	24.28±6.807	4.33 ±2.794	0				
8	Oriental white ibis (<i>Threskiornis melanoleptus</i>)	3.83 ±3.486	0.67 ±0.466	0	0.08 ±0.083	2.21 ±1.254	23.11 ±11.191	2.25 ±1.528	4.83 ±1.842				
9	Glossy ibis (<i>Plegadis falcinellus</i>)	22.5 ±22.5	3.75 ±1.851	0	0	0.14 ±0.143	95.72 ±34.103	0	6.83 ±4.047				
10	Eurasian spoonbill (<i>Platylea leucorodia</i>)	0	0	0	0	0	6.93 ±3.586	0	0				
11	Asian Open bill stork (<i>Anastomus oscitans</i>)	2.17 ±1.673	3 ±1.61	2.85 ±1.836	5.75 ±2.591	0.57 ±0.5	33.33 ±14.163	9.67 ±5.17	13.33 ±7.916				
12	Painted stork (<i>Mycteria leucocephala</i>)	0	4.5 ±4.059	0.31 ±0.308	14.42 ±8.456	1.29 ±0.578	0.24 ±0.235	10.83 ±7.819	0.83 ±0.833				
	Density (No/ ha.)	62.17 ±25.3	130.75 ±11.946	108.38 ±14.924	209.6 ±37.271	52 ±11.543	387.72 ±67.789	189.25 ±23.879	249.67 ±57.588				
	Richness (No. of Species)	4.17±0.458	7.5±0.337	6.77±0.343	7.17±0.534	5.64±0.476	8.44±0.487	6.58±0.529	6.92±0.57				
	Diversity (H')	0.0072±0.0022	0.0146±0.001	0.0124±0.0013	0.02±0.009	0.0066±0.0011	0.0319±0.0043	0.0194±0.0019	0.0231±0.0039				

Among the 12 species the Oriental white ibis (*Threskiornis melanocephalus*) and Painted stork (*Mycteria leucocephala*) are noteworthy species. The lake is supporting large number of large waders during monsoon and rest of the seasons. The intensive utilization of the lake could be due to the presence of wetland, Ayyanar lake, which is a nesting area for the large waders especially Little egret, Cattle egret, Large egret, Night heron, Indian pond heron, Night heron and Ibis species, which is located 25Km away from the lake (Unpublished data). These large waders are using the Periyakulam lake as a foraging ground and the Ayyanar Lake as a nesting ground. Thus these two wetland habitats are being effectively used by the large waders and their sustenance is ensured.

Generally the number and reproductive performance of waterbird species in a wetland could be affected by other nearby wetlands habitats (Craig and Beal, 1992; Dunning *et al.*, 1992; Froneman *et al.*, 2001; Kelly *et al.*, 2008) because some waterbirds show regional and local fidelity to a particular habitat (Warnock and Takekawa, 1996), and hence they move around at landscape scales and make decision on settlement (Skagen and Knopf, 1993; Warnock *et al.*, 1995; Warnock and Takekawa, 1996; Melvin *et al.*, 1999; Plissner *et al.*, 2000). Those species that consumes super abundant but ephemeral prey, make their foraging by traveling among wetlands rather than remaining at a single one (Craig and Beal, 1992). The connectivity between and within wetlands also facilitates the exchange and movement of aquatic animals and plants in a wetland and also among different wetland patches, and thus increases the potential availability of feed for waterbirds (Bancroft *et al.*, 1994).

The Periyakulam lake is holding water level at optimum depth through out the year (PWD unpublished data). Generally the water level is one of the major components for the survival of water birds. Variations of water level in wetlands could be caused by rainfall, flooding, agricultural irrigation, etc. The effect of water level fluctuation on water birds varies among groups and seasons. Generally, water level fluctuation creates habitats with diverse water depths changing in time and space. This provides more foraging opportunities and consequently supports a high species richness and abundance of waterbirds especially large waders (Dimalexis and Pyrovetsi, 1997; Ntiamoa-Baidu *et al.*, 1998). Water level fluctuation, however, may create "ecological traps" and be detrimental for breeding, brood-rearing, and molting of large waders (Kaminski *et al.*, 2006).

In addition to that the Peiryakulam lake is also a habitat for the emergent vegetation which also showed seasonal variation. The availability of vegetation structure is vital for the better survival and foraging

mechanisms of water birds. Besides providing feed such as seeds, leaves, tubers, and rhizomes for herbivorous waterbirds, vegetation is also an important habitat that greatly influences the habitat use of waterbirds. The effect and importance of vegetation depend on the season and on the waterbird group. Emergent plants can provide shelter and decrease human disturbance, which often occur in every wetlands, at both roosting and nesting sites (Hattori and Mae, 2001). In addition, tree islands benefit colonial waterbirds by providing colony sites in open wetlands (Hoffman *et al.*, 1994). Dense vegetation also provides habitat and food requirements for invertebrates, and improves the viability of eggs or diapausing invertebrates, which increases the density of invertebrate biomass, and diversity (Wiggins *et al.*, 1980; Rehfish, 1994). This increases food for waterbirds (Anderson and Smith, 2000). Many studies indicated that species richness and abundance of waterbirds increase with increasing emergent vegetation cover in wetlands, when waterbirds are less mobile and more sensitive to disturbance (Owen and Black, 1990; Losito and Baldassarre, 1995; VanRees-Siewert and Dinsmore, 1996; Post, 1998; Froneman *et al.* 2001). But Dimalexis and Pyrovetsi (1997) stated that the fish-eating waterbird such as herons and egrets avoid foraging in water bodies with submerged vegetation because of the reduced efficiency in searching for prey, however the vegetation is vital for roosting of these birds as in a wetland. In fact the physical nature of the Periyakulam lake is sloping in nature, which is another important feature of the lake to attract water birds. Lakes with gentle sloping sides can also increase topographical variation and attract both short- and long-legged wading birds (Erwin *et al.*, 1994).

The Periyakulam lake supported greater number of waterbirds (Mohanraj and Pandiyan, 2015b and c). It could be due to the large size and several micro habitats in the lake. Many studies indicated that wetland size influenced species richness and abundance of waterbirds (Froneman *et al.*, 2001; Paracuellos and Telleria, 2004; Sánchez-Zapata *et al.*, 2005). Generally, the spatial configurations and habitat heterogeneity of wetlands are related to size (Paracuellos, 2006). Because waterbirds have different preferences with respect to habitat configuration, the larger wetlands, which are more likely preferred than smaller wetlands as they have high habitat heterogeneity that supported a greater diversity of waterbirds than the smaller ones (Colwell and Taft, 2000; Froneman *et al.*, 2001; Warnock *et al.*, 2002; Paracuellos and Telleria, 2004; White and Main, 2004). Besides the growing pressure on wetland resources due to human activities and climatic changes have caused major changes to wetland fauna especially water birds throughout the world (Greenwood *et al.*, 1995; Laurance, 1999; Pandiyan and Asokan, 2015).

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The overall results of the present study indicated that the Periyakulam lake is providing all biological and ecological support to the waterbirds for their day to day survival holistically.

Management implication

Overall ecosystem-based approach for the better wetland management with various targets, including management with the goal of providing waterbird habitat has to be initiated. Global integration of knowledge from different field of the entire wetland ecosystem (including hydrology, geology, agronomy, botany, aquatic biology, landscape ecology, engineering, and ornithology), with reference to multiple spatial scales, temporal variability and the diverse habitat requirements of waterbirds is the need of the hour (Parsons, 2002; Anteau and Afton, 2008; Euliss, 2008; King *et al.*, 2009). Moreover, the social and economic constraints need to be considered when making management targets through the management practices which are to be coordinated with wetland management with local development. Besides, the Government and Public sectors should involve in the activities of conservation issues as a community level participation for the better management and conservation of natural resources especially wetland habitats for the long term survival of avian diversities.

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