

Annual variation in the Foraging behavior of Selected Wetlands Birds in the Periyakulam Lake of Tiruchirappalli, Tamil Nadu, Southern India

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Abstract:- Wetlands are amongst the most productive ecosystems on the earth. They support the birds by way of feeding, roosting, nesting and rearing young ones. The Periyakulam Lake in, Tiruchirappalli district of, Tamil Nadu, India is one such habitat frequently used by aerial foraging water birds. Current status of the aerial forager and habitat was studied for the present investigation. A total of six species of aerial foragers were observed from January 2011 to December 2013. We used total count method for estimation. The density was higher recorded for Little Tern (*Sternula albifrons*) among the other five species recorded at Periyakulam Lake (63.5 ± 21.11 No./ha.). The density, species richness and diversity varied significantly between the years. The richness was highest during the year 2013 among the years studied. The density, diversity, and species richness of aerial foragers varied significantly among the years ($P < 0.001$).

Keywords:- Biology, Diversity, Annual variation, Populations, Wetlands, Conservation.

I. INTRODUCTION

Wetlands may widely with respect to local and regional difference in topography, climate, water and soil chemistry leading to variation floral and faunal diversity. Wetlands are the important bird habitats and they use them for feeding, roosting and breeding (Weller, 1999 and Stewart, 2001). A recent study has shown about 38% loss of inland wetland in India 1971 to 2001 (Prasad et al, 2004). Birds are often very sensitive to environmental change so that they considered excellent indicators of ecosystem (Bibby, 1999; Gregory and Strien, 2010; Temple and Wiens, 1989). Waterbirds are persistently associated with the fresh water, coastal and marine habitats (Ogden et al, 2014). Birds are one of the best indicators of the status of wetland. It is transitional zone between terrestrial and aquatic ecosystem nursing unique flora and fauna. Despite their widespread use as biological indicators (Custer and Osborn 1977, Kushlan, 1993).

Understanding the mechanisms that bird diversity is important to biodiversity and ecological conservation of wetlands (Jamoneau et al., 2018; Li et al., 2019). Since the wetlands are providing sufficient energy for the various species of waterbirds the wetlands are attracting migratory and resident bird species waterbirds (Manikannan, 2011).

The abundance and distribution of waterbirds mostly depend on the quality of wetlands (Pandiyan et al., 2020). Studies on the foraging ecology of birds have been used to explain the community structure, resources use and competition in a particular habitat. According to the optimal foraging theory animals always choose the most efficient and advantageous habitat patches for foraging in order to minimize their costs and maximize their income in the form of energy (Paez et al, 2018). In India, wetlands are facing severe threats due to various populations. The wetland is facing enormous anthropogenic pressure. Therefore the present study intended to evaluate the density, species richness and diversity of especially aerial foraging waterbirds to understand their status and year wise distribution in the Periyakulam wetland, Tiruchirappalli, Southern India and to suggest the management recommendations of the sanctuary.

II. MATERIALS AND METHODS

A. Study area:

The study was conducted for the period of three years from 2011 to 2013. Periyakulam wetland located ($10^{\circ}.78$ N; $78^{\circ}.77$ E) in the Koothapar Village of Thiruvarampur, in the state of Tamil Nadu in Tiruchirappalli district, Southern India. The average temperature of the wetland is 32° C. The wetland is supporting numerous species of migratory, resident migratory and resident waterbirds annually (Jegadheesan and Pandiyan, 2015). It covers an area of 74.085 ha. (Fig1). The major water source for 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. It receives drainage water from its free basin of 0.86 sq.m besides the surplus of four upper tanks and the 4 supply canals from the Uyyakondan channel through a sluice at its left bank about 1.6 km from the Thiruverumbur Railway station and surplus over a masonry weir $63' - 4''$ long at the right bank and also over a way escape towards the right of the weir. The wetland have many faunal communities such as *Euphyctis hexadactylus*, *Mirghal sp.*, *Ctenopharyngodon idella*, *Oreochromis mossambicus*, *Salmophasia bacaila*, *Puntius filamentosus*, *Catla catla* and *Labeo rohita*; and the water insects include *Rhithrogena germanica* and dragon flies. In addition to that various species of algae and other flora and fauna were present in the lake.



Fig. 1: Map of the study area Periyakulam wetland, Tamil Nadu, India.

B. Aerial forager waterbird counts:

Birds were counted using direct count method (Pandiyana *et al.*, 2006). For direct counting a suitable vantage point was selected and all visible birds were counted. The waterbird were counted by using binocular (7×50) and spotting scope (20×60). This method was very useful for counting the water birds. This counting was made without any bias and to ensure accuracy. Total count (direct count) method was followed for bird census wherever possible, and it was made walking a round the wetlands or from specific vantage points (Nagarajan and Thiyagesan, 1996). Wherever the area was not completely covered, the percentage of coverage was marked. Systematic water birds count was carried out at different sites (three random sites were selected), each during 2011 to 2013.

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 binocular 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 (Mohanraj and Pandiyana, 2015). Species diversity has two components: the species richness in the community and species evenness or equitability (Verner, 1985). The diversity was measured most directly as number of species and expressed as an index that incorporated the interplay of species richness and relative abundance of species into single value for the given community (Wiens, 1989). A number of indices have been used to calculate diversity. Species richness was calculated using the number of species recorded in various habitat types. Species richness was measured by the number of water bird species recorded from different habitats of the wetland during monthly censuses (Verner, 1985). The species richness was also enumerated for all ecological groups.

Species diversity was calculated by using Shannon-Weiner (1949) index.

$$H' = -\sum P_i (\ln P_i)$$

Where

H' = Shannon-Weiner Index

P_i = the proportion of the each species in the sample (Pielou, 1966)

III. RESULT

Annual variations: There were six different species of aerial foragers identified and recorded in the lake during the study periods. Among the six species of aerial foragers the Little Tern (*Sternula albifrons*) showed higher density during the year 2012 than the other five species (63.5 ± 21.11 No./ha.) (Table 4.9). The Small Blue Kingfisher (*Alcedo atthis*) and Little Tern (*Sternula albifrons*) were not observed during the year 2011. The density of aerial foragers was highest during the third year 2013 (157.6 ± 32.96 No./ha.) and lowest during the first year 2011 (6.5±1.52 No./ha.) (Table 1) (Fig.2-4). The richness was also showed highest during the year 2013 among the years studied. The density, species richness and diversity of aerial foragers varied significantly among the years (P<0.001) (Table 1).

S. No	Aerial Foragers	Years (January 2011 - December 2013)		
		2011	2012	2013
1	White breasted KingFisheser	3.4±1.23	5.1±1.22	3±0.65
2	Lesser Pied KingFisheser	2.2±0.63	8.6±1.77	4.7±0.72
3	Small blue KingFisheser	0	0.3±0.25	0.5±0.31
4	Little Tern	0	63.5±21.11	56.4±14.62
5	Whiskered Tern	0.1±0.18	30.4±8.47	58.5±12.85
6	Indian River Tern	0.7±0.51	16.2±5.99	34.3±6.58

Table 1: Overall year wise variations of Aerial Foragers density (No./ha) recorded from 2011 to 2013. (Values are Mean ± SE).

S. No	Aerial Foragers	Years (January 2011 - December 2013)		
		2011	2012	2013
1	Density (No. /ha.)	6.5±1.52	124.3±25.96	157.6±32.96
2	Diversity (H')	0.001±0.0001	0.03±0.004	0.03±0.005
3	Richness (No. of species)	1.1±0.15	3.4±0.31	4.5±0.30

Table 2: Overall year wise variations of Aerial Foragers density, diversity and richness recorded from 2011 to 2013. (Values are Mean ± SE).

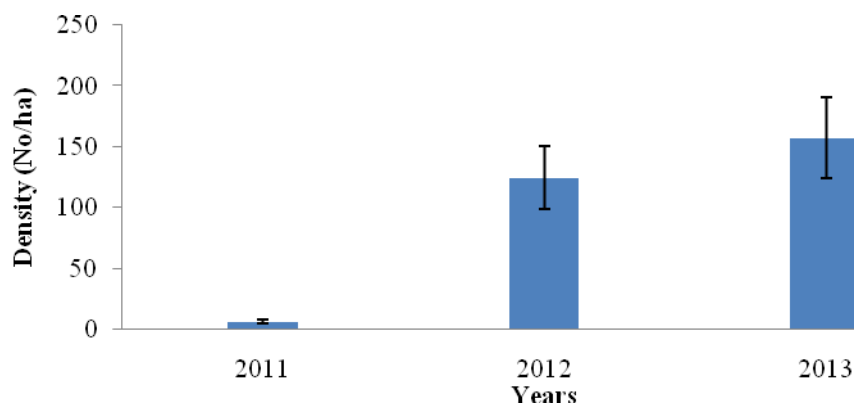


Fig. 2: Overall year wise variations of aerial foragers density recorded from 2011 to 2013. (Values are Mean ± SE) (N= 432).

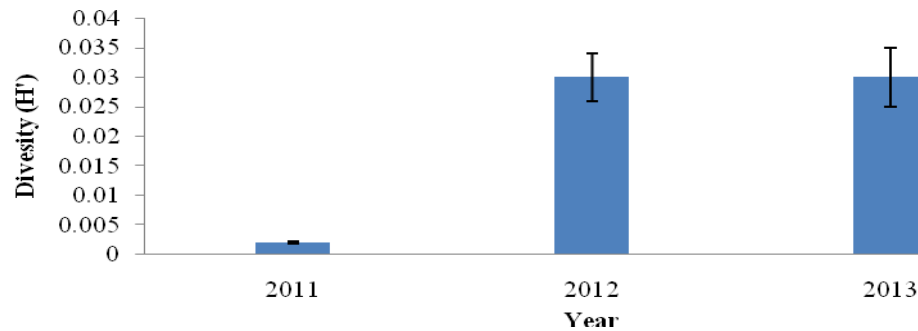


Fig. 3: Overall year wise variations of aerial foragers diversity recorded from 2011 to 2013. (Values are Mean \pm SE) (N= 432).

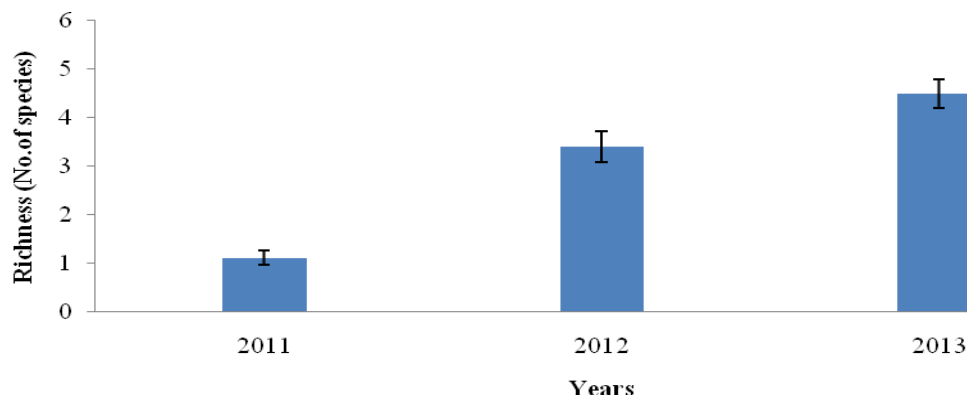


Fig. 4: Overall year wise variations of aerial foragers species richness recorded from 2011 to 2013. (Values are Mean \pm SE)

IV. DISCUSSION

The Periyakulam lake attracts many waterbirds including migratory, resident migratory and local species, and the lake is generally considered as one of the significant wetlands in the Trichirapalli District, Tamil Nadu, India, which can be declared as one of the Important Bird Areas (IBA) in India. Totally six aerial foragers individuals of waterbirds were recorded in the Koothapar Periyakulam lake from January 2011 to December 2013. The Kothaipar Periyakulam wetland facilitates one of the significant wetland habitats for the waterbirds including aerial foragers waterbirds (**Table 1**). Apart from these observations the physico-chemical factors of the water and soil, and the environmental factors were also recorded during the study to understand their relationship with the waterbird community.

Variation of aerial forager population in relation to year: Totally six species of aerial forager were recorded in the lake during the study periods from January 2011 to December 2013. Among the 6 species of waterbirds the Little Tern (*Sternula albifrons*) showed high density during the year than the other five species of waterbirds recorded in the lake during the study period January 2011 to December 2013 (**Table. 1 and 2**). This could be due to fact the lake prey, provides hospitable parameter and act as a rich source of prey species to the aerial forager. The present investigation revealed that the prey for the aerial forager particularly fishes were assessed and showed aerial foragers the Little Tern (*Sternula albifrons*) showed higher density during the year 2012 than the other five species. That nearby Periyakulam lake there is a another wetland namely

Ayyanar lake, which is one of the active breeding site for the Little Tern (*Sternula albifrons*) but that lake size was very small in which the prey was also very less (unpublished data) when compared to this Periyakulam lake. Hence obviously, Indian little cormorant used the Periyakulam lake as a feeding ground and Ayyanar lake as a breeding ground and the distance between these two lakes is just 12 Km. Many studies reported that the abundance of which is comprised of nomadic and sedentary resident species, which could be due to variations in food (fish) availability, water surface accessibility and breeding behaviour large number of Little Tern (*Sternula albifrons*) observed in the wet season coincided with the main breeding season of the guild.

The density, species richness and diversity of aerial foragers significantly among the seasons, months and years ($P < 0.05$) during the period of study (**Tables 1 and 2**). It has been reported that the year, could influence the abundance and density of waterbirds (Sampath and Krishnamoorthy 1993) stated that the waterbird population could show maximum density during the year 2012 which the compared to other in the Pichavaram wetlands, India, and attributed these yearly parameters for the arrival of aerial foragers from their breeding grounds as the reason. In addition to that the yearly variations on waterbirds abundance, population and diversity had been reported from other wetlands in different parts of India as well (Ali 1986; Ali and Vijayan 1986, Vijayan 1986, 1988; Sampath and Krishnamoorthy 1989, Pandiyan et al. 2006, Mohanraj and Pandiyan, 2015). The density of aerial foragers, showed linear trends (**Tables**

1, 2 and Fig 2,3,4), which could be due to the lake constant in flow of water and other prevailing favorable environmental factors, and the availability of food and prey. The records of the Public Works Departments, Trichichirapalli for the period of 2010, 2011 and 2013 indicate that the water level was constant, but during the year 2012, the lake showed 4 feet less than the other years (Unpublished data) and the current study also recorded the same water level in the lake. This could be the major reason for the constant fluctuation of birds. Besides, no wetland provides water throughout the year other than this Periyakulam lake, except summer and which is also another reason for the stable bird density in the lake.

Nevertheless several studies reported that the temporal variations of bird populations is one of the significant aspects to be considered in the ecological studies. According to the bird population is never entirely stable, even the yearly fluctuations facilitated new births of the birds. In normal condition the variations from one year to another are always slight, but in exceptional circumstances, such as an unusually winter, produce considerable modification to the waterbirds populations. Had also stated that wetland species especially birds seem to have adapted to natural instability of their substrate by population shifts on either a year-to-year or long term basis. Apart from these annual variations the aerial foragers population varied significantly yearly during the study. Yearly variations in aerial forager population, abundance and diversity had been reported for other wetlands in different parts of India (Hussain et al., 1984; Ali, 1986; Vijayan, 1986, 1988; Sampath and Krishnamurthy, 1989a, 1993). However, the aquatic habitats can attract more or less aerial foragers and it purely depends on the quality of the wetlands i.e. physico-chemical and other environmental factors of the wetlands (Pandiyan and Asokan, 2015).

In addition to that the aquatic habitats are dynamic in nature. Level of the substratum fluctuates rapidly within a day due to water level, and the annual variations caused by precipitation and evaporation. The precipitation and evaporation also influence. However, it has been reported that variations in abundance and diversity of aerial forager waterbird populations result from numerous and complex population processes and environmental events (Poulin et al., 1993; DuBowoy 1998; Romano et al., 2005) including migration, breeding success, moulting regimes, years, floods and droughts. Hence, the fluctuations in the density of aerial forager waterbirds occur annually or temporally, which could not be avoided.

V. CONCLUSIONS

Aerial forager water birds require proper habitat for their day to day survival. The current study found that 6 species of aerial foraging birds and are effectively using the Periyakulam wetland as potential foraging grounds yearly. But result of the present study showed that the Periyakulam wetland is not supporting a maximum number of Aerial foraging bird compared to the previous studies. Therefore the Periyakulam wetland is to be assessed with an intensive survey of various ecological factors such as physical and

chemical characteristics of soil and water assessment of food and prey availability of Aerial foragers, threats, pollution and other factors that the directly or indirectly affecting the Aerial foraging waterbird communities, for proper monitoring, management and conservation of Aerial foraging water birds.

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