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RESEARCH ARTICLE

SPATIO-TEMPORAL VARIATIONS AND BOTTOM SEDIMENTAL INFLUENCE ON THE DIVERSITY OF WATER BIRDS IN KOOTHIAPPAR WETLANDS, TIRUCHIRAPPALLI DISTRICT TAMILNADU, SOUTH INDIA

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ABSTRACT

Wetland is the land area that is saturated with water, either permanently or seasonally such that it takes on the characteristics and distinctiveness of that particular ecosystem. Koothaippar wetland ecosystemis one such highly potential wetland area, which attracts more number of water birds in and around the world. Data for this research was collected from August 2013 to January 2014, covering three seasons, Pre – Monsoon (August and September), Monsoon (October – December) and Post Monsoon (January). Significant species - wise and overall variations in the population size of (as highest count in a month and region) water birds belonging to different ecological groups were recorded in two regions of the lake during different months of 2013 and 2014. Totally 34 species of water birds were recorded in region 1 and 30 species of water birds recorded in region 2. Water birds were categorised into different ecological groups like 4 species of divers, 12 species of large waders, 8 species of swimming birds, 5 species of small waders, and 5 species of aerial foragers were present in region1 and 4 species of divers, 10 species of large waders, 7 species of swimming birds, 4 species of small waders, and 5 species of aerial foragers were present in region 2 which attracts more number of water birds in region 2. Present paper highlights the influence of water temperature, air temperature, and physico-chemical characteristics of bottom sediments of two regions of Koothaippar lake ecosystems. Among all the water parameters tested, Electrical Conductivity, P^H, Calcium, Magnesium, Potassium, Sulphate, Chloride, Fluoride, Atmospheric temperature and Turbidity are the factors which influences significantly the distribution and diversity of water birds in the study area during the study period.

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INTRODUCTION

The freshwater ecosystem covers only 0.2% of the total earth's surface area with the volume of 2.0 × 105 km3, despite of which these lentic ecosystem supports a variety of endangered and exotic species which contributes to aesthetic and environmental quality in every state (Leith, 1975). Freshwater wetlands are ecosystem that are affected by temporary or permanent inundation and are considered as one of the most important resources and as habitats for the survival of all the living organisms of the biosphere (Singh *et al*., 2010). Bird assemblages are affected by various factors like the food availability, the size of the wetland and the abiotic changes in the wetlands. Not only the birds but also the other organisms belonging to the plant and animal communities are affected by the physical and chemical characteristics of the environment.

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Wetland ecosystem has been an area of great research interest since 1940s. Lindeman was the first to study on Cedarbog Lake (Lindeman, 1942). Wetlands occupy 18.4% of the countries area (excluding river) of which 70% are under paddy cultivations. In India, it has been estimated that 4.1 million hectares are wetlands (excluding paddy fields, rivers, and streams), whereas 1.5 million hectares are natural and 2.6 million hectares are manmade. In Tamil Nadu it has been estimated that 31 natural wetlands covering an area of 58,068 hectares and 20,030 manmade wetlands with an area of 2, 01,132 hectares (Venkatraman, 2005). These in turn, affect the wetland dependent water bird communities as well as ecosystem attributes such as species richness, its distribution and density (Burkert *et al.*, 2004). In a wetland ecosystem, these biotic factors are mostly dependent on the seasons and hydrology (Hussain, 1995). Thus, wetlands being integrated systems are affected by the changes. Bottom sediments of the wetlands also play a key role in regulating the concentration of nutrient in the pond water and aquatic flora and fauna of an

aquatic ecosystem. The productivity of an ecosystem depends upon the quality and characteristics of bottom sediments. Some parameters were above permissible limit and some below permissible limit which affect the quality and productivity of lake. The productivity of any lake depends largely on the quality of bottom sediment quality that act as a "store house of nutrients." Sedimental characteristics of an aquatic ecosystem largely depends upon their geography, particular location, siltation rate, concentration of total suspended solids and the suspended load inflow, outflow ratio etc. calcium in sediment results from passage through deposit of lime stones, gypsum etc. plays a pre-dominant role in the composition of cell wall and protoplasm. It has been associated with carbohydrates and various organic acids. Magnesium is water – soluble cat-ion and it is necessary for chlorophyll pigment in green plants. Based on the above consideration, we have designed this study, to evaluate the physico-chemical characteristics of bottom sedimental parameters, across the months, between 2013 to 2014 in two regions of Koothiappar wetland ecosystem, Tiruchirapalli District, Tamilnadu, South India with the following objectives.

- To assess the diversity, distribution and abundance of water birds and
- To identify the influence of bottom sedimental parameters affecting the density and diversity of water birds.

groundnut and betel. The lake is under the control of PWD and the Forest Department has no direct role to play with reference to its fauna and flora. This lake is an attraction for a variety of birds, representing both resident and migratory forms. Koothaippar lake and its watershed are situated in the rain shadow region of Southwest Monsoon (June – August) and receive Northeast Monsoon (September – December) only. The climate is subtropical. Hot weather prevails in the months of March to May, and the Maximum temperature varies from 38° C to 40° C.

Study period

Data were collected from August 2013 to January 2014, so as to cover six months, three season *viz.,* pre-monsoon (August and September), Monsoon (October – December), post—monsoon (January).

MATERIALS AND METHODS

Water birds

Lake has been divided into two regions and total counts were made for all bird populations once in a week by following the method of Spindler *et al*. (1981). Individual birds were counted when the numbers present were small. Assistance of bird

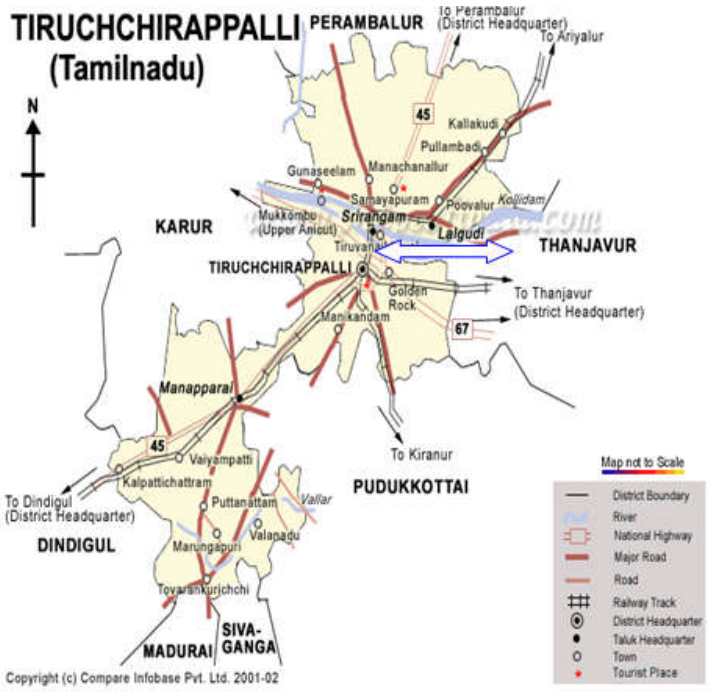

Fig. 1. Map showing the study area

Study Area

Koothaippar Lake(10°47'50''N; 78° 46'16''E) is situated in Tiruchirapalli District, Tamilnadu, South India about 15 km south of Tiruchirapalli (Fig.1.). There are many small villages, and towns on all sides of the lake. There are totally eight outlets in both the regions of the lake through which more than twenty five thousand acres of fields are getting irrigation, besides lending it for aquaculture practices. The crops cultivated using the water from the lake are paddy, sugarcane,

watchers and local volunteers were also obtained during the census operations. Field binoculars (10×42) view angle 6.35°, Nikon 12x wide optical zoom camera was used to observe birds from all sides of the lake. The birds were identified with the help of their special features (Ali 1969; King *et al*., 1978;Woodcock 1979;Sonobe and Usui 2000). The birds recorded were categorized into five groups on the basis of their activities as dividing birds, swimming birds, small waders, large waders, and aerial foragers.

Data Analysis

The data were subjected to detailed analysis which included Shannon Weiner's index, Species richness index, Species dominant index, species diversity index.

Shannon index of diversity (H1)

H1= -∑pi In Pi

Where 'pi' is the proportion of the i^{th} species to total abundance value. Shannon – Weiner Index assumes that individuals are randomly sampled from an independent large population and all the species are represented in the sample. Shannon diversity is very widely used index for comparing diversity between various habitats (Clarke and Warwick, 2001). It was calculated in order to know the species diversity in different habitat (Hutchison, 1970) based on the abundance of the species by the following formula: **H ′= - [∑pi In Pi].**

Water & Atmospheric Temperature

Temperatures were recorded during early morning hours using a digital, hand held thermometer.

Soil (Bottom Sediment) Analysis

Levels of pH, mud electrical conductivity and macro and micro nutrients in the bottom sediment were estimated. The samples collected were sent to the Soil Testing Laboratory, Trichy and results were obtained directly from them.

RESULTS AND DISCUSSION

Water birds Diversity and Distribution

Water birds belonging to different ecological group's wise distribution were recorded in two regions of the lake during different months of 2013 to 2014. Totally 34 species of water birds were recorded in region 1 and 30 species of water birds from region 2, representing five different ecological groups, out of which, 4 species of divers, 12 species of large waders, 8 species of swimming birds, 5 species of small waders, and 5 species of aerial foragers were present in region I and 4 species of divers, 10 species of large waders, 7 species of swimming birds, 4 species of small waders, and 5 species of aerial foragers were present in region II were recorded during the study period. Region I, which attracts more number of water birds when compared to region II(Fig.2& Table1).

There are number of important parameters which are governing the distribution and diversity of water birds in a particular ecosystem. Adverse climatic and environmental parameters like water and atmospheric temperature, availability of nutrients in the habitat, prey community, suitability and the seasonal fluctuations of all these parameters pose them to decide upon the habitat selection (Maheswari and Thiyagesan, 2014). When all these find suitable and flexible, generally birds tend to prefer that ecosystem as its permanent habitat.

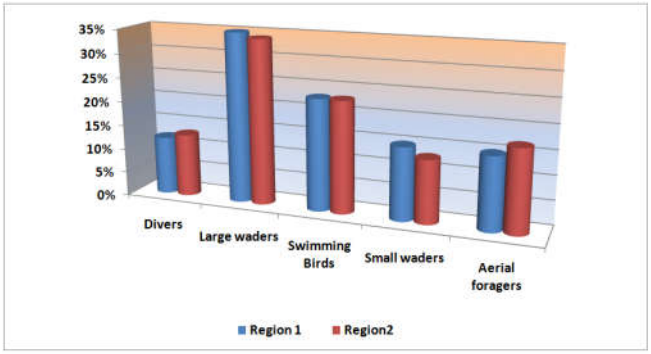

Fig.2. Percent distribution of water birds representing different ecological groups in Region I & Region II of Koothaippar lake during the study period

Table 1.Spatio-temporal variations in the diversity of water birds in Region I & Region II of Koothaipparlake during the study period

S.No.	Seasons	Birds Diversity(R1)	Birds Diversity(R2)
1	Pre monsoon	-2.055	-2.055
2	Monsoon	-3.616	-2.191
3	Post monsoon 2014	-2.277	-2.266

Bottom Sedimental Characteristics

Overall variations in the physico-chemical characteristics of bottom sediments in the Koothaippar Lake during different seasons of the study period are given in table 2. Soil pH ranged between 7.5-8.4for all the three seasons, electrical conductivity between 0.10-0.46 m.mho/cm, nitrogen between 45.57-81kg/ha, phosphorus between 1.3-10.06 kg/ha, potassium between 232.5-277 kg/ha and the micro nutrients like Iron between 5 – 8.76, Manganese between 3.24 – 11.76, Zinc between 0.85 – 1.12, Copper 0.96 – 1.53 were recorded during the study period. The availability of major macro and micro nutrients in the bottom sediments of Koothaippar wetland

Table 2. Physico - chemical characteristics of bottom sediments from Region I and Region II of Koothaipparlake, recorded during the study period

S.No.	Bottom sedimental characteristics	Premonsoon 2013		Monsoon 2014		Postmonsoon2014	
		R1	R2	R1	R2	R1	R2
	Water temperature (°C)	32	30	28	27	30	28
	Atmospheric temperature (°C)	34	32	30	29	32	30
1	N (kg/ha)	45.57	59	72.56	69	70.52	81
2	P (kg/ha)	2.77	9.7	1.33	1.5	5.56	10.06
3	K(kg/ha)	232.5	277	261.1	243	256.3	241
4	Fe(mg/l)	8.76	8.55	5.29	5.33	5	5.27
5	Mn(mg/l)	10.01	11.76	3.25	3.24	4.17	4.2
6	Zn(g/mol)	1.06	1.12	0.94	0.94	0.85	0.88
7	Cu(g/mol)	1.45	1.53	1.04	1.04	0.96	1.08
8	Ec(m.mho/cm)	0.12	0.12	0.39	0.46	0.29	0.45
9	pH	8.39	8.3	8.4	8.4	7.55	7.8

ecosystem varies significantly in both the regions with regard to different seasons of the study period and the physico – chemical parameters also varied and fluctuated spatio – temporally. Soil electrical conductivity was reported to influence macrophyte growth (Barke and Smart, 1986). Benthic macro invertebrates were reported to be sensitive to pH changes in the soil (Bell, 1971). Okland, (1980) Raddum, (1980) Haines, (1981) Eilers *et al.* (1984). So, the water birds which depend on them should also show population fluctuations in response to benthic substrate qualities (Murphy *et al.* (1984) Nagarajan, (1990).

Conclusion

It is observed from the study that the water birds tend to show preference over a particular habitat especially the Koothaippar wetlands, based on the distribution of nutrients in the bottom sediments and extreme temperature fluctuations of both water and atmosphere. The parameters taken for this study, reveal that they significantly influence the distribution of the water birds of this ecosystem. All the bottom sediment parameters were observed to influence significantly the distribution of water bird species in different regions of the study area excepting sediment pH, which is regulating the functional distribution of fauna over this lake ecosystem. They also act as the deciding factors in determining the type of water bird species that visits the lake. Qualities of bottom sediments in the wetlands could also influence significantly the faunal and floral composition in them.

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