Volume 1, Issue 4 September 2015 ISSN NO: 2454 - 2326

North Asian International Research Journal Consortium

North Asian International Research Journal Of Multidisciplinary

NAIRJC JOURNAL PUBLICATION

North Asian
International
Research Journal Consortium

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ISSN NO: 2454 - 2326

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MONITORING WATER BODY: SEASONAL VARIATIONS IN DENSITY AND SPECIES RICHNESS OF DINOPHYCEAE OF YASHWANT LAKE, TORANMAL (M.S.) INDIA.

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ABSTRACT

The density of Dinophyceae shows significant seasonal variations, it was maximum in summer, while it was minimum in winter. Maximum species richness of Dinophyceae was recorded in postmonsoon, while minimum species richness was recorded in summer at Yashwant Lake Toranmal. The Dinophyceae structure depends on a variety of environmental factors that include biotic as well as various abiotic factors. The Pearson correlation was calculated by keeping Dinophyceae as dependent variable while biotic and abiotic factors as independent variables.

***Key Words**: Toranmal, Dinophyceae, Seasonal variation, density, species richness, correlation, abiotic factors.*

INTRODUCTION

The dominant genera in algal groups change not only spatially (vertically and horizontally within a lake) but also seasonally in response to seasonal changes in physical, chemical and biological conditions of the water body. Hence a general pattern of seasonal succession of phytoplankton of many lakes has been correlated with environmental factors. The precise reasons for many of these changes are not well known (Wetzel, 2001). These seasonally changing microhabitats influence the phytoplankton communities seasonally. Hence, the study of phytoplankton distribution is important in understanding the ecology (because they are important source of fish diet) and their role as pollution indicator, as they project the trophic status of the water body (Naik and Neelkanthan, 1990).

In the present study at Yashwant Lake that receives the southwest monsoon and has altitudinal effect, an attempt is made to find out the effect of season on Dinophyceae community.

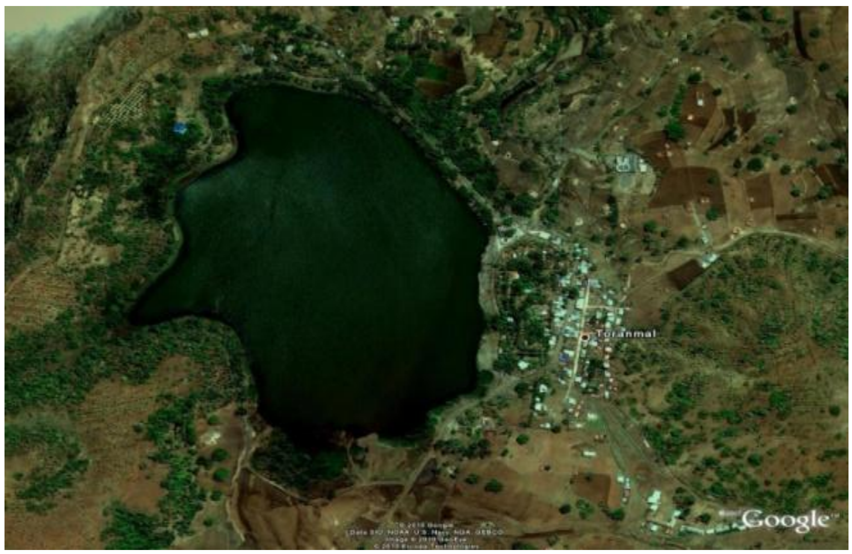
The dinoflagellates, at the Yashwant Lake, (Dinophyceae of the Phyrrophyta) are unicellular flagellated algae, many of which are motile. Although a few species are naked or without a cell wall (*e.g.*

Gymnodinium), most of them develop a conspicuous cell wall that often is sculptured and bears large spines and elaborate cell wall processes (*e.g. Ceratium, Peridinium*). In both naked and armoured types, the cell surfaces have transverse and longitudinal furrows that connect and contain the flagella. Movements of flagella create water current for weak locomotion disrupting the chemical gradients at the cell surface (Wetzel, 2001). Among the dinoflagellate one example *Ceratium* shows phytoplanktonic cyclomorphosis by lengthening cellular extensions or horns as temperature increases from spring to midsummer (Hutchinson, 1967), a characteristic mainly shown by zooplankton. These may have adaptive significance as it reduces the rate of sinking out of the photic zone and help in monitoring seasonal changes.

MATERIAL AND METHODS

The Din flagellates along the periphery of Yashwant lake were collected during each biweekly visit at the three stations namely YLA, YLB and YLC. Ten litres of water was filtered through the plankton net No. 25 of bolting silk with mesh size 64 micron. Net was washed with the water by inverting it to collect the plankton attached to the net and the volume of sample was made to 100 ml. The samples were taken in separate vials and fixed in the field with 1 ml of 4 % formalin and 1 ml of Lugol's Iodine at the collection site. 10 ml of sample from each station was further concentrated by centrifuging at 2000 RPM for 10 min. For quantitative estimation of plankton, one ml well mixed sample was taken on 'Sedgewick Rafter Cell'. To calculate density of plankton the averages of 5 to 10 counts were made for each sample and the results are expressed as numbers of organisms per litres of sample. Qualitative study of phytoplankton and zooplankton were carried out upto the genus/species level using the standard keys given by Edmondson (1963), Philipose (1967), Sarode and Kamat (1984), Battish (1992) and APHA (1998). Hence, species richness of Dinoflagellates is considered as number of species of Dinoflagellates observed per visit. The number of species present in a region may be considered as its 'species richness' a frequently used measure. Species richness can be correlated positively with some measures of ecological diversity (Hurlbert, 1971).

The data of the two years (from December-2006 to November-2008) was pooled and separated for three months and analysed for seasonal variations, with respect to winter (December, January, February), Summer (March, April, May), Monsoon (June, July, August) and Postmonsoon (September, October, November). Further, the Mean, Standard Error of Mean (SEM) and One-Way ANOVA with No post test for various parameters for four seasons was performed using Graph Pad Prism version 3.00 for Windows (Graph Pad Software, San Diego California USA). The correlation between the abiotic factors and the Dinoflagellate density was calculated. The Pearson correlation was calculated by keeping Dinoflagellate as dependent variable and other biotic factors as independent variables with the help of SPSS 7.5 for Windows.



Google satellite image of Yashwant Lake

RESULTS

Representation of Dinophyceae was poor at Yashwant lake. Its mean biannual percentage density varied around 8.62, 8.74 and 8.77 % at the three stations YLC, YLB and YLA respectively.

Maximum density of dinophyceae (Table 1) were recorded in summer with 468 ± 29 ind./L, 500 ± 55 ind./L and 511 ± 28 ind./L. A decrease was observed in monsoon and postmonsoon with small variations among the three stations. The density was 197.5 ± 24.41 ind./L and 142.8 ± 4.4 ind./L at YLA, 216.8 ± 35.63 ind./L and 162.8 ± 15.95 ind./L at YLB and 258 ± 37 ind./L and 182.5 ± 7.79 ind./L at YLC during monsoon and post monsoon respectively. Minimum densities of dinophyceae were recorded in winter with 96 ± 5 ind./L, 159 ± 43 ind./L and 129 ± 16 ind./L at YLA, YLB and YLC respectively with seasonal variation at the level $P < 0.0001$.

Species richness of Dinophyceae at Yashwant Lake was poor, and only 4 species belonging to two genera were recorded. Biannual percentages of species richness of Dinophyceae were 9.72, 8.34 and 8% at YLA, YLB and YLC respectively.

Maximum species richness of Dinophyceae were recorded in post monsoon with 3.66 ± 0.2, 3.3 ± 0.2 and 3.5 ± 0.2 at YLA, YLB and YLC (Table 1) respectively which decreased in winter to 2.3 ± 0.2, 2.16 ± 0.1 and 2.3 ± 0.2 and were minimum in summer with 1.5 ± 0.3, 1.16 ± 0.2 and 1.3 ± 0.2 species only. It increased nonsignificantly in monsoon to 1.8 ± 0.1, 2.0 ± 0.2 and 2.0 ± 0.0 at all the three stations.

Table: 1 Seasonal Variations in density and species richness of Dinophyceae (ind./L) at YLA, YLB and YLC of Yashwant Lake during December 2006 to November 2008

Parameters	Stations with F value	Winter	Summer	Monsoon	Postmonsoon
Density of Dinophyceae.	YLA $F_{3\ 20}$ 72.64	96.50 ± 5.07	468.7 ± 29.82	197.5 ± 24.41	142.8 ± 4.438
	YLB $F_{3\ 20}$ 16.47	159 ± 43.35	500.8 ± 55.04	216.8 ± 35.63	162.8 ± 15.99
	YLC $F_{3\ 20}$ 45.65	129.3 ± 16.07	511.2 ± 28.20	258 ± 37.29	182.5 ± 7.792
Species richness of Dinophyceae	YLA $F_{3\ 20}$ 15.56	2.33 ± 0.21	1.50 ± 0.34	1.83 ± 0.16	3.66 ± 0.21
	YLB $F_{3\ 20}$ 19.11	2.16 ± 0.16	1.16 ± 0.16	2.0 ± 0.25	3.33 ± 0.21
	YLC $F_{3\ 20}$ 23.67	2.33 ± 0.21	1.33 ± 0.21	2.0 ± 0.0	3.50 ± 0.22

Table: 2. Pearson correlation of Dinophyceae density with Biotic and Abiotic parameters of Yashwant Lake during December 2006 to November 2008

Sr. No.	Parameter	YLA	YLB	YLC
1	Ambient Temperature AT)	.775**	.542**	.806**
2	Water Temperature (WT)	.827**	.526**	.867**
3	Water Cover (WC)	-.801**	-.718**	-.780**
4	Total Solids (TS)	.645**	0.283	.682**
5	Total Suspended Solids (TSS)	0.093	-0.262	0.18
6	Total Dissolved Solids (TDS)	.765**	.615**	.736**
7	Transparency	-0.243	0.065	-.433*
8	Acidity	.774**	.695**	.742**
9	Alkalinity	.598**	.655**	.691**
10	Carbon Dioxide (CO_2)	.747**	.581**	.788**
11	Dissolved Oxygen (DO)	-.699**	-.584**	-.603**
12	Chloride	.802**	.667**	.731**
13	Total Hardness (TH)	.435*	.582**	0.271
14	pH	.892**	.640**	.842**
15	NO_2^-	.440*	-0.127	.416*
16	NO_3^-	-0.12	-.613**	-0.168
17	PO_4^{-3}	.579**	0.135	.603**
18	Total Density Of Zooplankton (TDZ)	.738**	.768**	.737**
19	Total Density of Mollusc (TDM)	0.09	-0.255	0.002
20	Total Density of Birds (TDB)	-.645**	-0.231	-.657**

** The pearson correlation is significant at the 0.01 level (two tailed)
*The pearson correlation is significant at the 0.05 level (two tailed)

DISCUSSION

Phytoplankton forms the basic link of food chain between abiotic and biotic factors in the aquatic ecosystem as the metabolic activities of these organisms depend on the physicochemical factors of the aquatic environment. The quality and quantity of phytoplankton and their seasonal succession patterns have been successfully utilized to assess the quality of water and its capacity to sustain heterotrophic communities. Virtually all the dynamic features of lakes such as colour, clarity, tropic state, and zooplankton and fish production depend to a large degree on the phytoplankton (Goldman and Horne, 1983).

The distribution of din flagellates in relation to major chemical characteristics shows that, while some species are widely tolerant and ubiquitous, especially among species of *Ceratium* and *Peridinium*, most din flagellate species have restricted ranges with respect to calcium, pH, dissolved organic matter and temperature (Taylor and Pollingher, 1987). These two genera of dinophyceae *Ceratium* and *Peridinium* were recorded at Yashwant Lake. Dinophyceae, a sub-dominant quantitative component of phytoplankton, was at fourth position in algal group abundance (Table 4A.1) with 8.62 % (at YLC), 8.74 % (at YLB) and 8.77 % (at YLA). Temperature plays an important role in the periodicity of dinoflagellate (Fritch, 1935). Here also the abundance of dinophyceae is positively correlated with temperature. Asexual resting stages or cysts are known to undergo considerable periods of diapauses in winter decreasing their density (Loeblich and Loeblich, 1984). For example in *Ceratium*, the autumn decline of summer populations in temperate regions, results in the production of overwintering cysts. Emergence from benthic cysts can result in an exponential increase in the planktonic cells in the ensuing spring and summer (Heaney *et al*., 1983; Pollingher *et al*., 1993). However, in tropics Zafar (1967); and Singh and Swaroop (1979) reported that the dianoflagellates are also abundant in winter. Hasle (1954) reported that the cells show diurnal vertical migration that concentrate in the uppermost 5 m belt but migrate further towards the surface during the day time, often collecting around 2 m depth. The dianoflagellates are also reported to move against water movement and show a negative reaction to light around noon (Blasco, 1978). This can be the reason for lower dinophyceae at Yashwant lake.

Dinophyceae of Yashwant lake observed at Toranmal in Satpura ranges during December 2006 to November 2008

1. **Peridinium spp 1**
2. **Peridinium spp 2**
3. **Ceratium hirudinella Schrank**
4. **Ceratium spp.**

CONCLUSION

High temperature, bright sunlight and rapid tropholytic activities accelerates multiplication of dinoflagellates during summer as it was observed at yashwant lake during study period. The dinoflagellates are also reported to move against water movement and show negative reaction to light around noon. This can be the reason for lower dinophyceae at Yashwant lake.

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