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Relationship Analysis between Phytoplankton Diversity and Water Quality of Lower Lake of Bhopal

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Abstract: Quantitative evaluation of phytoplankton was carried out in different sites of lower lake of Bhopal (M.P.) during study period. The *Chlorophyceae* is dominant among *Cyanophyceae*, *Bacillariophyceae*, *Euglenophyceae* and *Dinophyceae*. The Boyd's index indicates that lower lake is moderately polluted throughout the year except in the month of May and June in which lake is heavily polluted. Some species which indicated eutrophic status included *Microcystis aeruginosa, Chlorococcus* sp., *Scenedesmus* sp. and *Chlorella* sp. The relationship between quantitative analysis of phytoplankton and water quality of lower lake of Bhopal has been discussed.

Key words: Boyd's index, eutrophication, *Microcystis aeruginosa, Chlorococcus* sp.

Introduction

Freshwater resources provide essential services to society and the most important of these services is supply of fresh drinking water around the world. In the present scenario the fresh water resources serve as a sink for many pollutants. In natural fresh water resources the greatest amount of biological production is done by phytoplanktons where algae are found in diverse form and are an important component of biological monitoring programmes for evaluating water quality (Mahadik and Jadhav, 2014; Bruun, 2012). Presence of some algal indicators along with water quality parameters indicates the pollution status of the fresh water bodies (Bordoloi and Baruah, 2014).

The plankton study is very useful tool for the assessment of biotic potential and contributes to overall estimation of basic nature and general economic potential of water body (Pawar et al., 2006). The relevance of algae to the current debate on global biodiversity is assessed and is considered at the levels of richness of species and of higher taxonomic ranks and as the variety of habitats algae dominate and their functional importance in the processes they mediate (Norton et al., 1996). The present study illustrates the order of pollution of lower Lake of Bhopal M.P. in terms of Boyd's index.

Material and Method

Sampling Station and Sampling Site

The Bhopal city has a panoramic view as it is situated on the frame of two main water bodies, the upper lake (Bara Tal) and the lower lake (Chhota Tal), along with a few other smaller water bodies. Hence, it justifies its popular name Lake City or City of Lakes and Ponds (Acharya, 2011).

Lower lake of Bhopal is almost fully surrounded by built up area and its water is highly eutrophicated and abhorrently polluted by continuous inflow of

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large amount of sewage that is badly affecting aquatic life. The lower lake is located at 23°14′30″-23°15′30″ North latitude and 77°24′-77°26′ East longitude. The lower lake represents with catchment area 9.6 km^2, submergence area 1.287 km^2, maximum depth 9.4 m and storage capacity of 3.5 M cum. Thus Lower Lake is identified as a sampling station and area near Hamidia College is identified as sampling site from where surface samples were collected.

Phytoplankton Analysis

Surface water sample were collected in ordinary glass bottles of 2 litre capacity. The 100 ml of sampled water was transferred in 200 ml conical flask and preserved by adding 4% formaldehyde allowed for sedimentation. After 24 hrs the supernatant was discarded without disturbing the sediment. The sediment was finally concentrated to 25 ml. The quantitative analysis of phytoplankton was done by Lackey's drop method (APHA, 1980).

The order of pollution in water body is calculated by Boyd's index (1981) by using mathematical formula

$$H = S - 1/\ln N$$

where S = Number of genera of the phytoplankton

N = Total number of phytoplankton

ln = Natural logarithm

Resultant value of Boyd's index indicates the pollution status of water body (i.e. >4 = non-polluted clean water; <1 = heavily polluted; and value between 3-2 = moderately polluted).

Result and Discussion

Microalgae have great potential for monitoring and evolving the water quality of water bodies (Venkataraman et al., 1994). Phytoplankton analysis, which includes species count and biomass determination, could be used as an indicator of water quality (Reynolds et al., 2000). In the present findings the Chlorophyceae is dominant over all other classes of phytoplankton throughout the year (Table 1). Extensive and rapid growth of planktonic algae, caused by an increased input of nutrients is a common problem in lakes. The present study, relevant with the findings of Medupin (2011) that the assemblages of phytoplankton in Hollingworth Lake were indicative of the lake's richness, based on species' abundance and diversity indicates that lake falls within the mesotrophic-eutrophic status. In the present study the Boyd's index in month of May and June is very low which results in heavy water pollution and eutrophication (Table 2, Figure 1). Eutrophication reduces water clarity, inhibits growth of aquatic plants, extensive oxygen depletion, accumulation of unsightly, decaying of organic matter, unpleasant odours, and killing of fishes (Verma et al., 2014).

The present results indicate that the high frequency of some species like *Nitzschia* sp., *Chlorella* sp., *Cyclotella* sp., *Peridimum* sp., and *Ulothrix* sp. indicates nutrient

Table 1: Quantitative analysis of phytoplanktons by Lackey's drop method

Months	*Algal classes*					*Total no. of phytoplanktons (N)*	*Total no. of genera (S)*
	Chlorophyceae	*Cyanophyceae*	*Bacillariophyceae*	*Euglenophyceae*	*Dinophyceae*		
Jan.	12155	3364	14680	3572	1109	34880	38
Feb.	12211	3545	15400	3886	1876	36918	41
Mar.	14000	3689	15000	3886	2586	39161	43
Apr.	15200	4300	16200	4324	2409	42433	43
May	10400	2235	1806	2360	NIL	16801	11
Jun.	10145	2039	1771	2367	NIL	16322	10
Jul.	16200	5360	17460	Nil	2380	41400	40
Aug.	16210	4780	18000	Nil	2159	41149	38
Sept.	15800	4260	18110	2600	2832	43602	36
Oct.	12600	Nil	17600	2868	3865	36933	30
Nov.	12600	Nil	16960	3216	2200	34976	32
Dec.	12240	Nil	16112	3400	2134	33886	32

Table 2: Boyd's index for water quality of Lower Lake of Bhopal

S.no.	*Months*	*Total no. of genera (S)*	*Total no. of phytoplanktons (N)*	*In N*	*Boyd's index H = S–1/ln N*	*Order of pollution*
1	Jan.	38	34880	10.45	3.54	Moderately polluted
2	Feb.	41	36918	10.51	3.80	Moderately polluted
3	Mar.	43	39161	10.57	3.97	Moderately polluted
4	Apr.	43	42433	10.65	3.94	Moderately polluted
5	May	11	16801	9.72	1.02	Heavily polluted
6	Jun.	10	16322	9.70	0.92	Heavily polluted
7	Jul.	40	41400	10.63	3.66	Moderately polluted
8	Aug.	38	41149	10.62	3.48	Moderately polluted
9	Sept.	36	43602	10.68	3.27	Moderately polluted
10	Oct.	30	36933	10.51	2.75	Moderately polluted
11	Nov.	32	34976	10.46	2.96	Moderately polluted
12	Dec.	32	33886	10.43	2.97	Moderately polluted

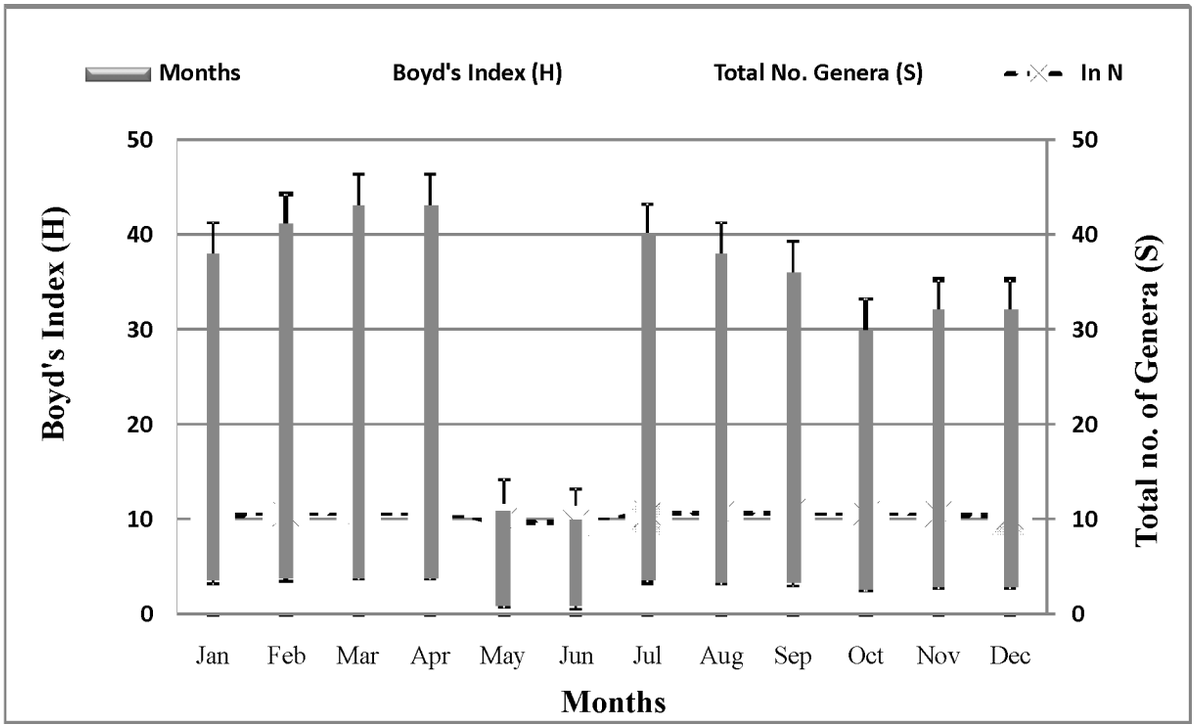

Figure 1: Relationship analysis between total number of genera and Boyd's index.

eutrophication. *Microcystis* sp. and *Chlorella* sp. abundance are indicators of water pollution. According to Gerrath (1993) and Sorayya et al. (2011), *Cosmarium, Closterium* and *Pediastrum* (demids species) and some micro-green algae *Scenedesmus*, *Chlamydomonas* and *Chlorella* are generally common and diverse in oligotrophic lakes and ponds; thus are considered as indicator species for oligotrophic systems (Gerrath, 1993). According to present finding, relevant with the studies of Coesel (1983, 2001) and Fonge et al. (2012), *Microcystis* sp., *Anacystis* sp., *Chlorococcus* sp. and *Peridinum* sp. are highly sensitive to changes in environmental parameters and as such are considered as bio-indicators for monitoring pollution status.

Conclusion

The species found indicate the trophic status of lower lake throughout the year and being eutrophic while the recent are oligotrophic. The physico-chemical properties of the wetland and water quality were greatly affected by the population of the different species.

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