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Research article

STUDY OF PLANKTON DIVERSITY IN RECREATIONAL LAKE TILYAR, ROHTAK (HARYANA) INDIA

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ABSTRACT-The plankton diversity of Tilyar Lake (Lat 76°38' E and 28° 88' W Long), Rohtak was monitored fortnightly from April 2009 to September 2009. During the study period 55 taxa (33 taxa of phytoplankton and 22 taxa of zooplankton) were recorded. Among phytoplankton maximum phytoplankton taxa were observed for Chlorophyceae (15) followed by Cynophyceae (14) and Bacillariophyceae were represented by 4 taxa only. Zooplankton community comprised of Protozoans (2 taxa), Rotifers (10 taxa), Brachipods (5 taxa), Copepods (4 taxa) and Ostracopods were represented by single taxa.

Keywords: Lake Tilyar, Phytoplankton, Zooplankton, Species Diversity and Dominance.

INTRODUCTION

Aquatic ecosystem harbors variety of plants and animals viz., phytoplankton, zooplankton, small fishes, aquatic insects and amphibians (Zutshi, 1981). Plankton including phytoplankton and zooplankton forms the base of food chain in aquatic ecosystems and thus playing a vital role in fisheries (Wozniak and Marshall, 2009). The spatial and temporal variation of plankton community is regulated by major environmental factors and contaminations of water bodies might lead to change in their trophic status and render them unsuitable for aquaculture. Zooplankton is an important constituent of pelagic ecosystems. Zooplankton feed on the phytoplankton, bacteria, microorganism and all fresh water fishes feed on zooplankton at some stages in their life history (Mors 1988, Lampert *et al.*, 2005). In India attempts have been made by workers like Arora (1961), Islam and Nahar (1967), Misra *et al.* (1976), Zutshi (1981), Mathew (1989), Anil and Chawla (2012) and Chopra *et al.* (2013) to study the dynamics of planktonic community. The measurement of plankton productivity both at primary and secondary level is of great importance for ecosystem oriented approach of reservoir management (Boyd and Tucker, 1998). Tilyar Lake (Rohtak) is a tourist complex and has varied facilities such as guest house, bar, restaurant, gift shop, fast food center and lawns. The Lake is facing anthropogenic pressure such as disposal of Plastic bottles, plastic wrappers, polybegs and other waste materials left over by the visitors are the source of pollution in the lake. These waste products /pollutants get deposited in the lake and possibly alter the water quality and habitat of the inhabitants. The present study was planned to assess the plankton diversity of Tilyar lake.

STUDY AREA

The present study was carried out to investigate plankton diversity of Tilyar Lake, Rohtak (132 acre) (latitude 76°38' east and longitude 28° 88' west). Its area has large number of trees, jungles with bushes around and it is among the major tourist complex in Haryana which came in to existence in 1976 for the recreational purposes. Morphological features of the lake are given in the Table A.

MATERIALS AND METHODS

Depending upon lake morphology and anthropogenic activities three sampling stations (S-1, S-2, and S-3) were selected at the Tilyar Lake. The sampling was done between late morning and early evening. For the collection of plankton samples, 50L of water was filtered through plankton net of mess size 50μm (with attached collecting tube)..

Samples were preserved in 5% formaldehyde solution and then stored in dark and cool conditions until the time of analysis. Prior to microscopic examination, samples were concentrated to 5-10 ml. The water samples were collected fortnightly from each sampling station at the depth of 0.5m in plastic bottles and brought to laboratory for further analysis.

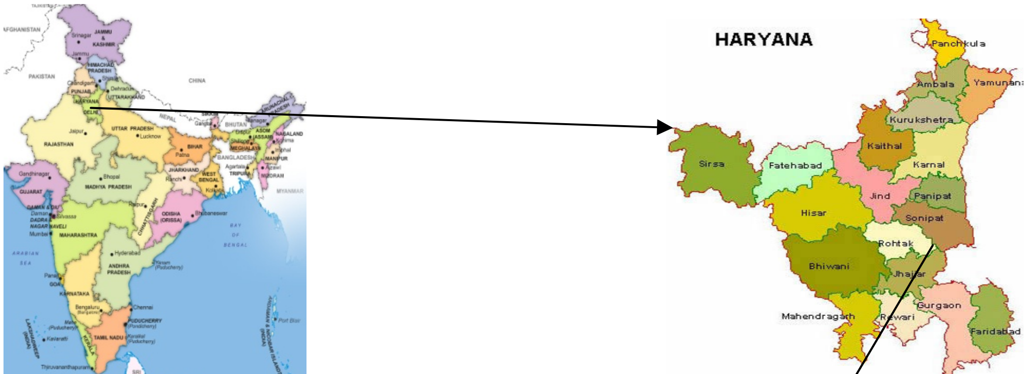

Table A.

Morphological Features	
Total area	18-20 acres
Max. Depth	12 feets
Primary inflows	Canal water
Primary outflows	Nil
Anthropogenic activities	
Boating, Angling (occasionally)	

Figure-1 Geographical map showing the study site.

Identification of Plankton

Plankton were identified up to genus level and counted using binocular compound microscope by using following references (Ward and Whipple, 1959; Prescott, 1954; Needham and Needham, 1962; Anantani and Marathe, 1972; Gupta, 1972; Pandey *et al.*, 1993; Kumar and Singh 1995; APHA 1998; Garg *et al*. 2002; Battish 1992). Shannon and Weaver diversity index (H) and Simpson index (D) were used to describe temporal changes in diversity and dominance during the study period (Shannon and Weaver 1963; Simpson, 1949).

RESULTS

During the study period 55 genera (33 phytoplankton and 22 zooplankton) were identified. The study revealed that Cynophyceae and Chlorophyceae were the major contributors among phytoplankton where as Bacillariophyceae contributed by four taxa only (Table-1). Zooplankton dominated by Rotifers (10 genera), Branchipods (5 genera), Copepods (4 genera). Maximum Species richness (taxa /month) was recorded in the month of June (51taxa, 31 taxa of phytoplankton and 20 taxa of zooplankton) and minimum (18 taxa, 11 taxa of phytoplankton and 7 taxa of zooplankton) was recorded in the month of September (Table-3). As far as plankton density is concerned, it was recorded maximum 284.9 x10^3 (individual/L) in the month of august and minimum 10.1 x10^3 individual/L in the month of April (Table -3). Phytoplankton density ranged from 3.1x10^3 to 277 x 10^3 individual/L. Members of Chlorophyceae and Cynophyceae were maximum in May at (S-1) in term of number of genera and abundance while Bacillariophyceae were represented by four genera. Cynophyceae were represented by varieties of colonial species. The dominant Cynophycea members included *Chrococcus* sp., *Synechocystis* sp., *Synechococcus* sp. *and Microcystis* sp. In Chlorophyceae the most numerously represented were *Tetraspora sp., Eudorina sp., Chlorella sp., Volvox sp., Chlorochytium sp.* and *Crucigenia sp.*

Table 1: List of Phytoplankton in the preserved samples from Tilyar Lake.

S.No.	CYNOPHYCEAE	CHLOROPHYCEAE	BACILLARIOPHYCEAE
1	*Chrococcus* sp.	*Tetraspora* sp.	*Cyclotella* sp.
2	*Synechocystis* sp.	*Eudorina* sp.	*Cymbella* sp.
3	*Synechococcus* sp.	*Chlorella* sp.	*Navicula* sp.
4	*Microcystis* sp.	*Volvox* sp.	*Pinnularia* sp.
5	*Gomphospheria* sp.	*Chlorochytium* sp.	
6	*Oscillatoria* sp.	*Crucigenia* sp.	
7	*Phormidium* sp.	*Oocystis* sp.	
8	*Aulosira* sp.	*Closteriopsis* sp.	
9	*Rivularia* sp.	*Microspora* sp.	
10	*Nodularia* sp	*Cladophora* sp.	
11	*Entophylais* sp.	*Ulothrix* sp.	
12	*Lyngbya* sp.	*Stigeoclonium* sp.	
13	*Phytoconis* sp.	*Oedogonium* sp.	
14	*Merismopedia* sp.	*Zygenema* sp.	
15		*Spirogyra* sp.	

Table 2: List of Zooplankton in the preserved samples from Tilyar Lake.

S.No.	PROTOZOANS	COPEPODS	OSTRACOPODS	BRANCHIPODS	ROTIFERS
1	*Vorticella sp.*	*Sida sp.*	*Cypris sp.*	*Daphnia sp.*	*Branchionus sp.*
2	*Glenodinum sp.*	*Nauplius sp.*		*Moina sp.*	*Filinia sp.*
3		*Cyclops sp.*		*Leydigia sp.*	*Keratella sp.*
4		*Diaptomus sp.*		*Chydorus sp.*	*Philodina sp.*
5				*Cerodaphnia sp.*	*Anuraeopsis sp.*
6					*Mytilina sp.*
7					*Lepidella sp.*
8					*Lacena sp.*
9					*Monostyla sp.*
10					*Trichocera* sp.

Table 3: Generic richness and total plankton density of the three sampling stations, *viz.*, S-1, S-2 and S-3.

Generic richness and total plankton density of S-1						
Parameters	**April**	**May**	**June**	**July**	**August**	**September**
Generic Richness (Phyto/Zoo)	20(6/14)	48(30/18)	50(31/20)	43(28/15)	29(16/13)	18(11/7)
Total Plankton Density	$58.9x10^3$	$93.4\ x10^3$	$114.8\ x10^3$	$185.9\ x10^3$	$143.3\ x10^3$	$119\ x10^3$
Phytoplankton Density	$38.2\ x10^3$	$70.1\ x10^3$	$98.4\ x10^3$	$168.6\ x10^3$	$138\ x10^3$	$107\ x10^3$
Zooplankton Density	$18.7\ x10^3$	$23\ x10^3$	$16.3\ x10^3$	$17.3\ x10^3$	$5.1\ x10^3$	$10.1\ x10^3$
Generic richness and total plankton density of S-2						
GenericRichness (Phyto/Zoo)	20(6/14)	46(30/160	46(30/16)	46(28/18)	33(16/17)	22(11/11)
Total Plankton Density	$32.8\ x10^3$	$90.3\ x10^3$	$96.7\ x10^3$	$100\ x10^3$	$132.2\ x10^3$	$112.7\ x10^3$
Phytoplankton Density	$15\ x10^3$	$73.2\ x10^3$	$77.1\ x10^3$	$86.1\ x10^3$	$119.9\ x10^3$	$101.6\ x10^3$
Zooplankton Density	$17.8\ x10^3$	$17.1\ x10^3$	$19.7\ x10^3$	$14.8\ x10^3$	$12.3\ x10^3$	$11.1\ x10^3$
Generic richness and total plankton density of S-3						
Generic Richness (Phyto/Zoo)	12(5/7)	36(22/14)	40(21/19)	30(19/11)	30(18/12)	25(14/11)
Total Plankton Density	$10.1\ x10^3$	$130.9\ x10^3$	$138.3\ x10^3$	$169.7\ x10^3$	$284.9\ x10^3$	$162\ x10^3$
Phytoplankton Density	$3.1\ x10^3$	$120\ x10^3$	$126.4\ x10^3$	$162.9\ x10^3$	$277.4\ x10^3$	$155.9\ x10^3$
Zooplankton Density	$7.4\ x10^3$	$10.1\ x10^3$	$11.7\ x10^3$	$6.8\ x10^3$	$7.1\ x10^3$	$6.6\ x10^3$

Rotifers were represented by *Branchionus sp., Filinia* sp., *Keratella sp., Philodina sp., Anuraeopsis sp., Mytilina sp., Lepidella sp., Lacena sp., Monostyla* sp., and *Trichocera species.* Out of these species of Rotifers, *Branchionus sp. and Filinia sp.* were found to be dominant followed by *Anuraeopsis sp.* and *Philodina sp.* Copepods were dominated by two genera *Nauplius sp.* and *Cyclops sp.* followed by *Diaptomus sp.,* and *Sida sp.* In Branchipods most numerously represented genera were *Daphnia sp., Moina sp., Leydigia sp., Chydorus sp.* while Protozoans and Ostracopods were particularly scarce during sampling period (Table-2).

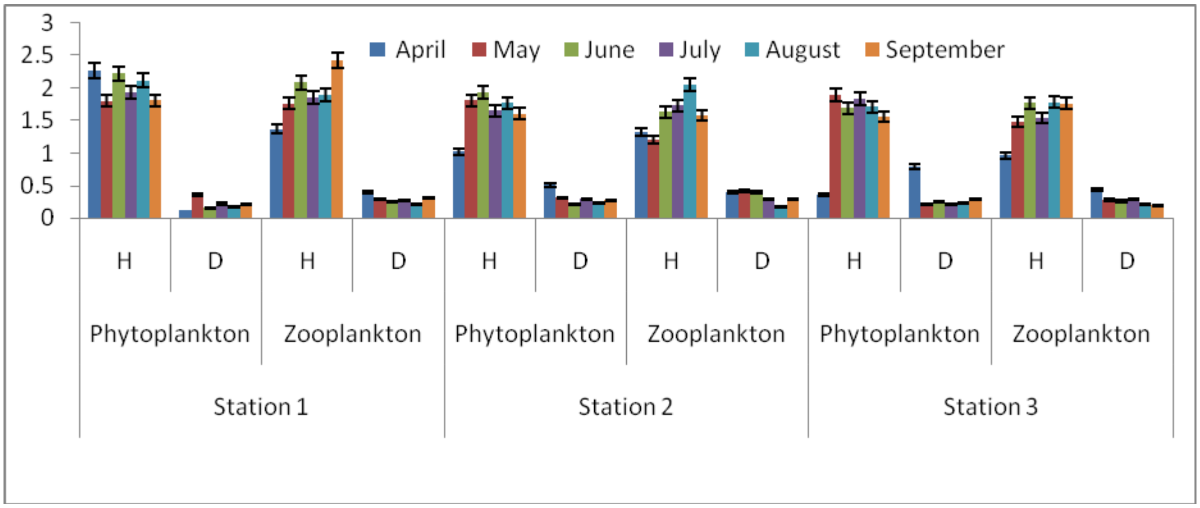

Figure-2 Graph showing monthly variation in diversity index of phytoplankton and zooplankton.

DISCUSSION

Fundamental characteristics of standing water (a lentic ecosystem) or flowing water (a lotic system), the dynamics of its interaction with adjacent land and vegetation, and seasonal fluctuations in water conditions determine characteristics biological assemblages. Coexistence of a number of phytoplankton species is a conspicuous characteristic of standing water or lentic system (Pejler, 1965; Islam and Nahar, 1967; Gautam, 1990 and Boyd and Tucker, 1998). In the present study at the sampling stations S-1 and S-2, in the month of May and June, the presence of diatoms were relatively higher which could be due to higher concentrations of pH and alkalinity. According to Barberi *et al.* (1999) in the monsoon months diatoms flourish at maximum rate due to alkalinity and mixing of nutrition due to rain. Turbidity too play important role as suspended matters blocks whatever sunlight is available during monsoon thus giving it status of lethal factor (Roy, 1955). The present study also revealed higher turbidity during monsoon and hence plankton density was maximum during June and July months at S-2 and S-3 (Table-3). Some other studies also reported higher plankton density during monsoon season (Anil and Chawla, 2012; and Chopra *et al.*, 2013). High variations in plankton diversity and density (phytoplankton) in the months of May to August may be attributed to longer photoperiods and favorable temperature for the metabolism and reproduction of plants and animals. High values of planktonic population are indicative of the eutrophic nature of the lakes (Jayangauder, 1964.; Arora, 1966; Islam and Nahar, 1967; Gautam, 1990). The highest phytoplankton density was recorded in S-3 followed by S-1 and S-2. The order of dominance of different phytoplankton groups at all the three sampling stations was as Cynophyceae > Chlorophyceae > Bacillariophyceae. The dominance of Cynophyceae revealed euthrophic nature of the lake (Prescott, 1939; Rawson, 1956; Wetzel, 1975). Some parameters like high temperature, pH, alkalinity and hardness may be responsible for this trend of algal dominance (Chada, 1999). Cloudy weather during monsoon, along with surface runoff may be responsible for the poor growth of photosynthetic algae in the absence of sufficient sun light, and increased nutrient level by the surface runoff in the monsoon provides food to the members of Cynophyceae (*Cymbella sp.* and *Cyclotella sp.*). The present study also goes in confirmation that diversity and density of Cynophyceae were higher in percentage during monsoon months. Zooplankton density was observed maximum during May and June at all the sampling stations. At S-1 greatest zooplankton density ($23x10^3$) was observed which was followed by S-2 and S-3. The order of dominance of different zooplankton groups as recorded in Tilyar Lake was rotifers > copepods > branchipods > protozoans > ostracopods.

Rotifers were dominated by *Brachionus sp.* and *Filinia sp.*, whereas copepods were dominated by *Diaptomus sp.* and *Cyclops sp.* in all three sampling stations. Dominance of rotifers further confirmed the euthrophic nature of the lake (Pejler, 1965; Arora, 1961, 1966; Sampath *et al.*, 1979; Unni, 1985; Sharma, 1987; Kaushik and Saksena, 1955; Dadhich, 1996). Some species of *Brachionus* were considered as indicators of mesotrophic and eutrophic conditions in several Central Indian waters by Unni (1985) and Kaushik and Saksena (1995, a & b). Planktonic blooms are one of the causes of turbidity in a water body and show inverse correlation with light penetration (Iqbal *et al.*, 2004). The present study also confirmed that planktonic density was significant positive correlation with turbidity. At the same time high D.O. in a habitat with higher planktonic density and longer photoperiods, may be due to the dominance of the photosynthetic activities over respiration. A continuous monitoring programme of the Tilyar Lake will be helpful in providing useful knowledge for environmental management.

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