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Qualitative and quantitative analysis of phytoplankton in Ramala Lake

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Abstract

Plankton are important biotic component of aquatic habitat. They do determine the trophic status and quality of water. The phytoplankton is the base of most of the lake food web. It forms a bulk of food for zooplankton, fishes and other aquatic organisms. The biodiversity of phytoplankton and zooplankton in any water body shows a correlation with reference to their occurrences and physic-chemical factors. The present paper is an attempt to enumerate the phytoplanktonic diversity of the Ramala Lake, Chandrapur, and Maharashtra. Data is collected during the different seasons from November 2006 to October 2007. The plankton community showed the seasonal fluctuations. The phytoplankton population of Ramala Lake was found to be composed of four major groups namely Chlorophyceae (48.40%), Bacillariophyceae (24.81%), Myxophyceae (22.44%) and Euglenophyceae (4.32%). The class Chlorophyceae represented by 11 species stood first quantitatively and qualitatively, Bailloriophyceae by 7 species, Myxophyceae by 5 and Euglenophyceae by only 2 species.

Key words: Phytoplankton, Zooplankton, diversity, productivity, biological indicator.

Introduction

Phytoplankton is a base of most of freshwater and (marine) food web. Phytoplankton, which includes blue-green algae, green algae, diatoms, desmids, euglenoid etc. are very important among aquatic flora. They are ecologically important as they form the basic link in the food chain of aquatic ecosystem. Phytoplankton is the pioneer of an aquatic environment food chain. The productivity of an aquatic environment is directly correlated with the density of phytoplankton. Number and species of phytoplankton serves to determine the quality of water body. The maintenance of healthy aquatic ecosystem depends on abiotic properties of water and biological diversity of ecosystem (Krishnan *et al.,* 1999). The planktonic study is very useful tool for assessment of water quality. Among the biotic communities phytoplankton constitute the first stage in tropic level by virtue of their transduction capacity of environmental radiant energy into the biological energy through photosynthesis. Also referred to as primary productivity, the magnitude of photosynthesis energy fixation depends upon diversity and biomass of phytoplankton. Phytoplankton also plays important role as food for herbivorous animals. They also are the biological indicators of water quality. The present phytoplankton study was undertaken in local fresh water body of Chandrapur city which is influenced by several anthropogenic activities like discharge of effluents, domestic washing, sewage, idol immersion and commercial fishery. Ramala Lake is a historical impoundment and main embankment of lake is a part of fort wall built up around Chandrapur city by Gond king (Raja). Lake harbors a wide variety of plant and animal species and plays an important role in conservation of nature. It is sole recreational water body situated in the heart of city. It is the only reminisce of greenery in the most polluted and populated city.

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Material and Methods

Samples for phytoplankton studies were, collected from three sampling stations monthly at regular interval between the study periods November 2005 to October 2006. The samples were collected between 7.00 a.m. to 9.00 a.m. 50 liters of water sample was filtered through plankton net made of

bolting silk (number 25) with mesh size 64µm. The collected samples were allowed to settle by adding Lugol's iodine. Normally sedimentation requires 24 hrs. After which supernatant was removed and concentrate was made up to 20ml with 4% formalin. The identification of phytoplankton was done with the keys Sehgal (1983), Adoni (1985), Presscot (1954) and APHA (1985).

Result and discussion

Phytoplankton, being the basic producer of food chain, is governed by the interrelation of a number of physico-chemical and biological conditions of water body. They are basically chlorophyll bearing suspended particles represented by four main groups like Chlorophyceae, Bacillariophyceae, Myxophyceae and Euglenophyceae.The water from three different sites of Ramala Lake was analyzed for quantitative and qualitative study of plankton in each month for the period of one year.

Qualitative analysis of phytoplankton

Water samples collected from three different sites were observed microscopically to analyze the plankton. Observation revealed the phytoplankton belonging to four major groups viz Chlorophyceae.

Total 25 species of phytoplankton were found and identified during study period. The group Chlorophyceae was dominating group represented by II species belonging to five orders. The members included, *Chlamydomonas, Volvox, Chlorella, Pediastrum, Hydrodyctyon, Scenedesmus, Tetradon, Spirogyra, Zygnema, Closterium* and *Cosmarium sp.*At all the three stations Chlorophyceae were maximum in number in winter months followed by summer.Some of the members from this group viz. *Volvox* and *Chlorella* found throughout the year during study period at all the three sampling stations. *Spirogyra* and *Pediastrum* were dominant among these members.The group Bacillariophyceae forms observed were 7 species viz. *Cymbella, Navicula, Nitzchia*, *Fragilaria, Pinnularia. Gomphonema* and *Synendra.* The members of this group were almost found distributed throughout the lake. The pollution indicator species like *Cymbella, Navicula* and *Nitzchia* found at station II. The group Myxophyceae was represented by 5 species. The group was found in second dominant position at station II regarding numerical abundance. The species identified from this group were *Microcystis, Spirulina, Nostoc, Anabena, Oscillatoria; Spirulina* was the dominant member present almost throughout the study period. *Microcystis* and *Nostoc* were also found in major proportion. Only two species were recorded from the group Euglenophyceae viz. *Euglena* and *Phacus.* Regarding numerical density, group Chlorophyceae emerged as a dominant group (48.40%). Group Bacillariophyceae (24.81%) as second dominant, followed by Myxophyceae (22.4%) and Euglenophyceae (4.32%). Number and species of phytoplankton serves to determine the quality of water body. Phytoplankton forms a bulk of food for zooplankton, fishes and other aquatic organisms. The planktonic study is very useful tool for assessment of water quality. The phytoplankton composition of Ramala Lake was recorded in the range from 467 units/L to 1385 units/L. The highest numerical density of phytoplankton was recorded in the month of May, June, December and January. Minimum density was found in August and September. Kalyani *et al.,* (1999) have recorded bimodal peak of phytoplankton population i.e. summer peak in April and winter peak in December. Similar peak in phytoplankton population were observed by Das and Shrivastava (1959). The effect of temperature on phytoplankton cannot be separated from the effect of light since both the factors are interrelated in photosynthesis. The enhanced growth of phytoplankton in summer could be attributed to increased temperature and light during summer.Enormous anthropogenic activities and heavy discharge of sewage, resulted in enrichment of nutrients, proliferation of algal species takes place which in turn enhances trophic status of Lake. Phytoplankton population of Ramala lake was composed of four major groups namely Chlorophyceae (48.40%), Bacillariophyceae (24.81%), Myxophyceae (22.44%) and Euglenophyceae (4.32%). Meshram and Dhande (2000) and Pailwan (2005) have recorded almost similar species composition of phytoplankton in Wadali Lake, Amaravati. Maximum density of Chlorophyceae was recorded in winter followed by summer. Monsoon months showed minimum density of Chlorophyceae. Chlorophyceae was represented by 11 different species.

Table 1. Phytoplankton species recorded from Ramala Lake during study period November 2005 – October 2007

Sr. No.	Species	Station I	Station II	Station III
	Chlorphyceae			
1	*Spirogyra sp.*	+	+	-
2	*Costerium sp.*	+	+	-
3	*Cosmarium sp.*	+	+	-
4	*Pediastrum sp.*	+	+	+
5	*Chlorella sp.*	+	+	+
6	*Hydrodictyon sp.*	+	+	+
7	*Dedogonium sp.*	-	+	-
8	*Scenedesmus sp.*	+	+	+
9	*Zygnema sp.*	-	+	-
10	*Volvox*	-	+	+
11	*Chlamydomonas*	+	+	+
	Bacillariophyceae			
1	*Navicula sp.*	-	+	+
2	*Nitzchia sp.**	+	+	+
3	*Cymbella sp.**	+	+	+
4	*Fragillaria sp*.*	-	+	-
5	*Gomphonema sp.*	+	-	+
6	*Pinhullaria sp.*	+	+	+
7	*Synedra sp.*	+	+	+
	Myxophyceae			
1	*Microcystis sp.**	+	+	-
2	*Anabena sp.*	+	+	+
3	*Nostoc sp.*	+	+	+
4	*Oscillatoria sp.**	+	+	-
5	*Spirulina sp.*	+	+	+
	Euglenophyceae			
1	*Euglena sp.*	+	+	-
2	*Phacus sp.*	+	+	+

Table 2. Quantitative analysis of total Phytoplankton from November 2005 to October 2006

MONTH	Station I	Station II	Station III
Nov. 2005	985	974	948
Dec. 2005	1069	1081	999
Jan.2006	1146	1119	1094
Feb. 2006	1121	1162	996
Mar-06	1070	1152	1027
Apr-06	1201	1188	1108
May.2006	1355	1302	1190
Jun-06	1374	1322	1186
Jul-06	881	679	550
Aug-06	751	676	521
Sept. 06	585	627	518
Oct. 06	1040	1069	1011

Table 3. Quantitative analysis of total Phytoplankton from November 2005 to October 2006

MONTH	Station I	Station II	Station III
Nov. 2006	1165	943	928
Dec. 2006	1209	1052	989
Jan.2007	1121	1007	965
Feb. 2007	1199	997	1039
Mar-07	1231	1002	1048
Apr-07	1306	1078	1131
May.2007	1385	1111	1187
Jun-07	1361	1200	1161
Jul-07	667	653	615
Aug-07	697	592	513
Sept. 07	803	573	467
Oct. 07	1172	977	1036

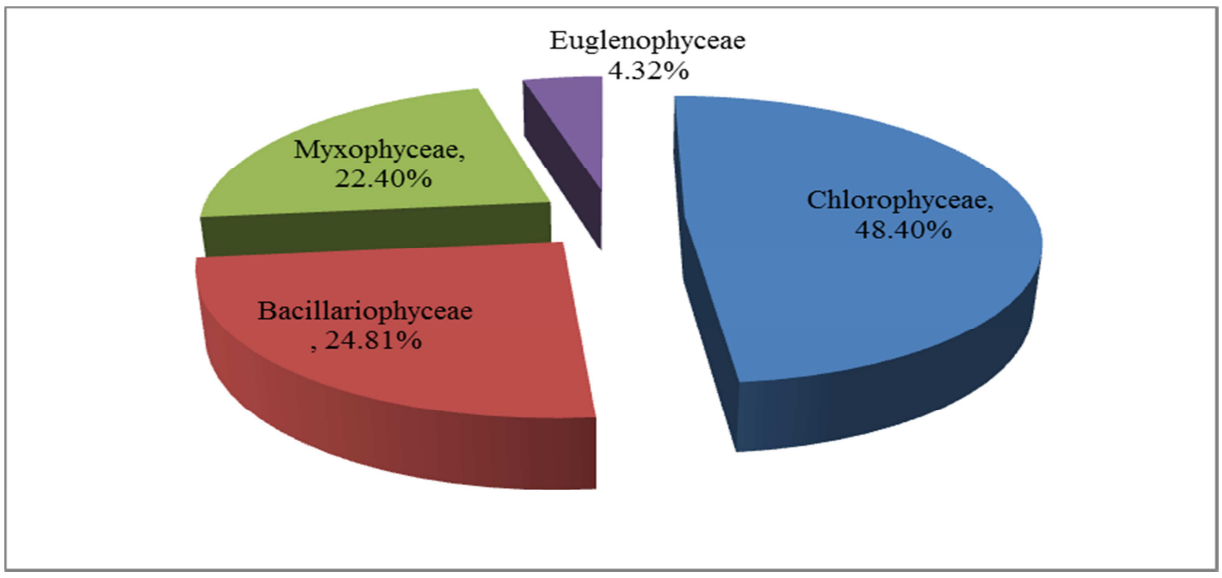

Fig 1.Percentage composition of Phytoplankton in Ramala Lake

Seasonal data revealed that maximum Chlorophyceae members were present in winter. The members from this group which dominated throughout the study period were Hydrodictyon, Pediastrum, *Dedogonium* and *Chlorella*. *Spirogyra, Closterium* and *Scenedesmus* were found predominantly at station II and in some months within study period indicating pollution (Meshram and Dhande, 2000). The dominance of this group during winter (November-December) coinciding with low temperature and high dissolved oxygen content has been reported by Venkateshwarlu (1969). Green algae prefer water with comparatively higher concentration of dissolved oxygen. The temperature is considered to be an important factor in the periodicity of the Chlorococcales population. The enhanced growth of green algae in winter, followed by summer may be due to high dissolved oxygen content in winter, maximum transparency and optimum pH.

The members of Bacillariophyceae dominated the lake and were found distributed throughout the lake. The group was represented by 7 species. Although few species of diatoms in the present investigation have been recorded, they differ both in quality and quantity in the study lake. Seasonal abundance of this group occurred in summer. *Pinnularia, Fragillaria and Navicula* were constantly encountered from this group. *Nitzehia, Navicula* and *Cymbella* which are known as pollution indicator species were observed predominantly in summer along with other phytoplankton species. *Navicula* and *Nitzchia* are commonly found in moderately polluted water. These were observed throughout the study period, but higher number was observed in summer (February - May). Dominance of this group indicates moderate pollution status of these tanks. Similar results have been reported by Shashikant (1979). Members of Myxophyceae are ubiquitous in natural water and many times forms temporary or permanent blooms in the polluted water body. The Myxophyceae was represented by five species, *Microcystis, Anabena, Nostoc, Oscillatoria* and *Spirulina*.

Microcystis species were present throughout the monsoon. The occurrence of *Microcystis,* the toxin producing blue green in blooms is a significant feature of tropical water (Wetzel, 1975). The blue green algae are frequently involved in contamination of water body. Various physical, chemical and biological circumstances must be taken into consideration for understanding plankton population. Parmasivan and Sreenivasan (1981) have reported that the polluted water bodies exhibit heavy growth of blue green algae which also dominate over Chlorophyceae and Bacillariophyceae. Myxophyceae found as a second dominant group only at station II might be due to pollution because of several anthropogenic activities. Euglenophyceae were represented by only two members, *Euglena* and *Phacus*. Seasonal data revealed maximum density of Euglenophyceae in winter followed by summer. Minimum density was found during monsoon months at all the three stations. The Euglenophyceae are in greater number at organically polluted water bodies. Palmer (1969) showed that the Euglenophyceae are the biological indicators of organic pollution. In the present study, *Euglena* and *Phacus* were found occasionally in winter and summer months and that too in very less quantity. The group as a whole is facultatively heterotrophic and generally abundant in water rich in organic matter (Hutchinson, 1957).

Conclusion

The studies of Biological Characteristics include the study of phytoplankton, zooplankton and primary productivity. Plankton due to its key role in ecosystem is directly related to fish potential. Any change in the physio-chemical environment has got its effect on biotic communities due to the fact that different species of flora and fauna exhibit variation in their responses to the altered water quality. Phytoplankton were represented by four groups, Bailloriophyceae (24.81%) ,Chlorophyceae (48.40%), Myxophyceae (22.4%) and Euglenophyceae (4.32%), phytoplankton exhibited a bimodal pattern of seasonal fluctuations, as such two peaks were recorded, one in May, June and other in winter. Total phytoplankton showed a positive correlation with temperature, pH, alkalinity, nutrient groups, phosphates, nitrates and chloride. Phosphate and nitrate play a vital role in governing the presence of aquatic system. Phosphate is an important nutrient required for the growth of phytoplankton in fresh water body. Phosphate is the major nutrient that triggers eutrophication. In natural water, phosphates are

present in small amount. The water receiving untreated domestic sewage can indicate presence of phosphate. The range of phosphates in the present investigation was found to be 0.5 mg/L to 2.1 mg/L, showing maximum concentration in summer. It can be attributed to the addition of detergents and also due to release of phosphates from dead and decayed plankton and macroinvertebrates. Thus positive correlation was seen in phosphate content and number of phytoplankton. The winter months showed higher phytoplankton density followed by summer and rainy months. The lower densities during rainy months may be due to high turbidity, low light intensity, cloudy weather and more water coverage with rains.

Various physical, chemical and biological circumstances must be taken into consideration for understanding plankton population. Temperature and light are most important factors affecting growth of phytoplankton and both factors are interrelated in photosynthesis. Enhanced growth of phytoplankton in summer could be attributed to increased temperature and light. Some pollution indicator species such as Nitzchia, Navicula and Cymbella are observed predominantly in summer. Navicula and Nitzchia are commonly found in moderately polluted water. Therefore it can be concluded that the lake under study is moderately polluted and in future care should be taken for conservation of water body.

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