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Phytoplankton as biological indicators in lentic hydrosphere from Gadhinglaj

S. S. Sakhare and N. A. Kamble

Department Of Zoology, Shivaji University, Kolhapur- 416 004, India.

E-mail : seemasakhare24@rediffmail.com , drknitinkumar@yahoo.in

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Abstract

The species composition, distribution and abundance of phytoplankton, in water body, found depend upon the chemical and physical properties of water. In aquatic organisms, planktons were most sensitive component of the ecosystem and signal of environmental disturbances. Apart from primary production, phytoplankton plays an important role in food web of herbivorous animals and act as biological indicators for water quality. Two lentic systems Nool pond and Yenechiwandi lake from Gadhinglaj tahsil were assessed for seasonal variations of Phytoplankton population and physico-chemical parameters such as pH, Temperature, Dissolved Oxygen, Free Carbon dioxide, Hardness, Chloride, Alkalinity, Nitrate, Phosphate with base level contamination of heavy metals Physico-chemical parameters and heavy metal contamination which has impact over the animal diversity in study region. Attempt was made to compare the water quality of aquatic habitats for pollution status.

Key words : Physico-chemical parameters, Phytoplankton, Pollution status.

INTRODUCTION

In recent years, India is facing a serious problem of scarcity of natural resources, especially that of water in view of population growth and industrial development. Water is a prime natural resource, a basic human need and a precious national asset and hence its use needs appropriate planning, development and management. Aquatic biodiversity is threatened primarily by human abuse and mismanagement of both living resources and the ecosystems that support them. Most of the ponds are getting polluted due to domestic waste, sewage, industrial and agricultural effluents. The requirement of water from micro-organisms to man, became serious problem today because of unplanned urbanization and industrialization in a restricted area. Water quality assessment generally involves analysis of physico-chemical, biological and microbiological parameters and reflects on abiotic and biotic status of the ecosystem [1]. Ecologically, phytoplanktons are one of the most important biotic components influencing all the functional aspects of an aquatic ecosystem, as food chains, food webs, energy flow and cycling of matter [2, 3, 4]. The distribution of planktonic community depends on several factors as, change of climatic conditions, physical and chemical parameters with covered vegetation. Most of the species of planktonic organisms were cosmopolitan in distribution [5]. According to [2-3] the plankton played an integral role and served as bio indicators and found well-suited tool for understanding water pollution status [6-7]. Major work have been carried out on ecological condition of freshwater bodies in various parts of India [4-8], but the ecological conditions of freshwater body found to be unfocused [9]. However, information on relationship between physico-chemical parameters and planktonic fauna seems to be limited [10-11] Phytoplankton, being the primary producer, forms the lowest trophic level in the food chain of fresh water ecosystem, moreover, number and species of phytoplankton serves to determine the quality of the water body [12] Phytoplankton study provides a relevant and convenient focus in research related to the mechanism of eutrophication and its adverse impact on an aquatic eco-system. Considering the conditions, present study designed to study planktonic richness, diversity and its relationship between physico-chemical parameters from two reservoirs of Gadhinglaj tahsil district, Kolhapur, which remained unfocused in relevant literature.

MATERIALS AND METHODS

A) Study area: Gadhinglaj Tahsil from Kolhapur District, Maharashtra, geographically situated at latitude 16º 13' 26” N and longitude 74º 26' 9” E. Total area of tahsil covered 35-40 small and large aquatic bodies.

B) Sampling: Water sample was collected from two different aquatic bodies, Nool pond and Yenechiwandi lake (Map 1). Samples were used for the assessment of physicochemical parameters and phytoplankton diversity. Physicochemical parameters were analyzed as per standard methods prescribed by [13] shown in Table No. I and II. Results were interpreted for the comparative assessment of phytoplankton diversity and pollution status in two aquatic bodies.

C) Phytoplankton assessment: Phytoplankton's from each water bodies were collected by planktonic net (mesh size 25 µm). Plastic bottles were used to store the samples. All the samples were carried to the laboratory, preserved in 4% formalin. After settlement, the samples were diluted up to desirable concentration. Analysis of phytoplanktons in respective aquatic bodies was carried by standard methods. The systematic identification of plankton was made by using standard keys of [14, 1, 15, 16]. The qualitative analysis of plankton was carried out using Sedgewick Rafter's plankton counting chamber.

RESULT

During the assessment, both water bodies were showed major effect of civilization as well as planktonic growth. The results obtained were as follows-

Physico-chemical Analysis:

Physico-chemical observations revealed that, nutrient level in aquatic bodies has important role in regulating the growth, succession and distribution of biomass. Average range of temperature recorded in summer season was 24.5±1.92, in rainy

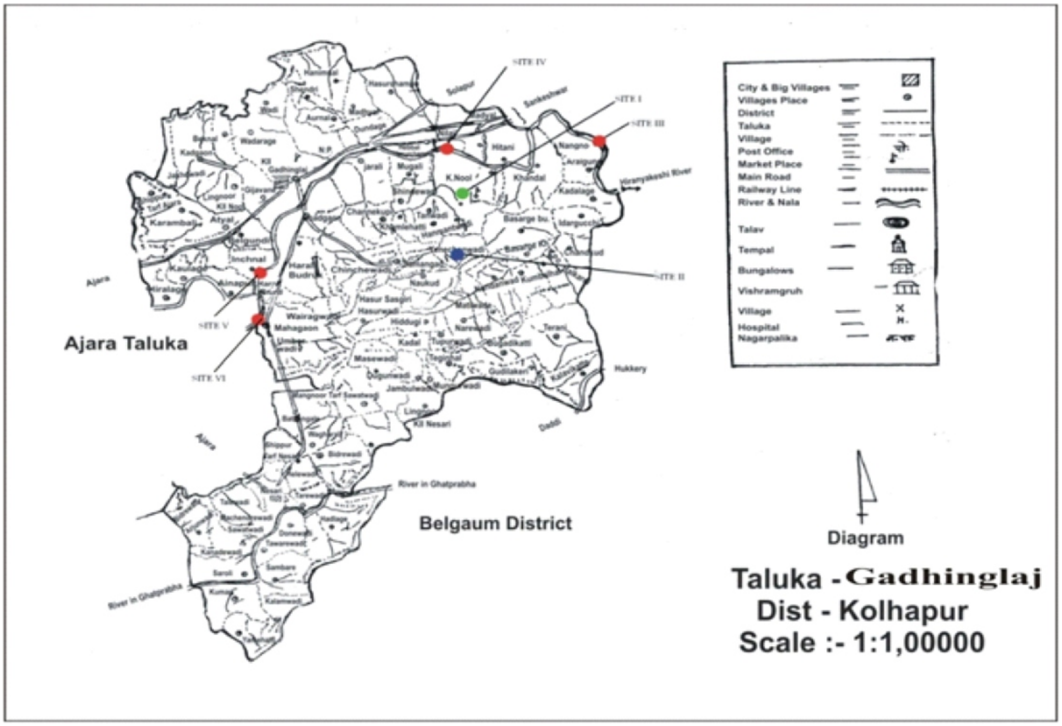

Table 1 : Seasonal variation in physico-chemical parameters of site I

Parameter	Summer	Rainy	Winter
Temperature-^{0}C	24.5±1.92	22.2±0.5	24.2±2.06
pH	7.73±1.05	8.38±0.63	7.97±1.23
DO(mg/l)	21.35±23.03	6±2.70	33.5±40.60
Free CO_2(mg/l)	55.77±45.57	19.25±8.30	12.65±5.19
TH(mg/l)	195.5±37.54	84.75±7.08	136±56.66
Alkalinity(mg/l)	128.75±18.42	77.5±74.50	106.75±59.68
Chlorides(mg/l)	242.07±121.22	69.55±39.54	112.85±58.26
Nitrate (mg/l)	0.1915±0.0643	0.051±0.037184	0.127±0.03718
Phosphate(mg/l)	2.945±0.130	1.8625±1.6171	2.6975±0.1466
Sodium(mg/l)	91.5±27.44	57.64±38.19	68.5±11.81
Potassium(mg/l)	53.75±35.71	72.5±0.58	52.5±33.36

22.2±0.5 and winter season showed 24.2±2.06 respectively at site I. Site II showed 24.75±1.25 in summer, 23±1.41 in rainy and 24.5±2.38 in winter. Increased temperature has enhanced the rate of decomposition by which water enriched by nutrient. Temperature considered as the most important factor for determining the composition and fluctuations of planktonic growth. The pH values of water bodies were not showed marked fluctuation and remained alkaline throughout all the seasons. pH range was found in between 5-9 and became suitable for growth of plankton. Variations in DO content could be due to one or more factors, as the temperature, light intensity, turbity, photosynthetic and respiratory activities. The importance of nitrate and phosphate content present in water bodies showed direct relationship with growth of phytoplankton. Chloride, nitrate and phosphate concentration was increased during summer and winter by which plankton population was increased. Higher alkalinity reflected pollution of water bodies, in which during summer season alkalinity was increased at sites I and site II as 128.75±18.42 and 79.75±60.07 because of physico-chemical alterations respectively. Numerical data of both water bodies were documented in table No. I and II and was supported by graphical presentation (Fig. 1 and 2).

Phytoplankton study

Seasonal changes has influenced planktonic population, most of the species was absent in the period June-September (rainy

Table 2 : Seasonal variation in physico-chemical parameters of site II

Parameter	Summer	Rainy	Winter
Temperature-^{0}C	24.75±1.25	23±1.41	24.5±2.38
pH	7.54±1.13	8.27±0.30	8.23±0.92
DO(mg/l)	17.05±9.39	5±2.44	33.25±27.36
Free CO_2(mg/l)	58.65±27.96	12.1±2.84	11.05±4.43
TH(mg/l)	119.5±66.66	93. ±44.85	94.5±24.83
Alkalinity(mg/l)	79.75±60.07	74.25±1.5	45.5±39.84
Chlorides(mg/l)	93.42±45.93	67.44±15.78	82.87±25.94
Nitrate (mg/l)	0.233±0.278	0.091±0.0038	0.106±0.01986
Phosphate(mg/l)	0.49±0.2340	0.3725±0.27944	0.3545±0.264
Sodium(mg/l)	42.75±1.5	38±3.74	39±8.71
Potassium(mg/l)	5.5±2.12	2.5±1.29	3±1.73

Table 3 : Phytoplankton diversity on seasonal variation at sites I

Phytoplankton orders	Summer	Rainy	Winter
I. Cyanophyta			
Anabaena	++++	++	++
Anacystis	++++	++	++
Epithemia zebra	+++	ND	++
Gomphosphaeria aponina	+++	+++	+++
Cylindrospemum minimum	++++	+++	+++
II. Chlorophyta			
Actinastrum gracillimum	+++	ND	++
Actinastrum hantzschii	++++	++	+++
Ankistrodesmus fulcatus	+++	++	+++
Chlorella	+++	+++	++
Eunotia faba	++++	++	+++
Palmella	++++	++	++++
Microspora	+++	+++	+++
Botricoccus	++++	ND	++
Pinnularia interrupta	+++	++	+++
Spirogyra	++++	+++	+++
III. Bacillariophyta			
Diatoma	+++	+++	++++
Cyclotella meneghiniana	+++	ND	++++
Gomphonema olivaceum	++	+++	++++
Gomphonema parvulum	++	+++	++++

Gomphonema sphaerophorum	− + +	+ + + +	+ + + +
Gomphonema spiculoides	− + +	+ + +	+ + +
Gomphonema subapicatum	− + +	+ + + +	+ + + +
Navicula cryptocephala	− + +	+ + +	+ + +
Navicula mutica	− + +	+ + + +	+ + + +
Navicula protracta	− + +	+ +	+ + + +
Navicula pupala	− + +	+ + + +	+ + + +
Navicula rodisa	− + +	+ + +	+ +
Cymbella turgidula	− + +	+ +	+ + + +
Cymbella ventricosa	− + +	+ + + +	+ + + +
Fragilaria constrains	− + +	+ +	+ + + +
Fragilaria pinnata	− + +	+ + +	+ + +
Stauroneis phoenicenteron	− + +	+ + + +	+ + + +
IV. Euglenophyta			
Euglena species	− + +	+ +	+ +
Trachelomonas	− + +	+ +	+ + +

Table 4 : Phytoplankton diversity on seasonal variation at sites II

Phytoplankton orders	Summer	Rainy	Winter
I. Cyanophyta			
Anabaena	+ + + +	+ +	+ + +
Anacystis	+ + + +	+ +	+ + +
Epithemia zebra	+ ++ +	+ +	+ ++
Gomphosphaeria aponina	+ + +	ND	+ + +
Cylindrospemum minimum	+ + + +	+ +	+ + +
II. Chlorophyta			
Actinastrum gracillimum	+ + +	+ +	+ + + +
Actinastrum hantzschii	+ + +	ND	+ +
Ankistrodesmus fulcatus	+ + +	+ +	+ + +
Spirogyra	+ + +	+ + +	+ +
Chlorella	+ + +	+ + +	+ + +
Eunotia faba	+ + +	+ +	+ + +
Palmella	+ + +	+ +	+ + + +
Microspora	+ +	ND	+ + +
Botricoccus	+ + + +	+ + + +	+ +
Pinnularia interrupta	+ + +	+ + +	+ + +
III. Bacillariophyta			
Diatoma	+ + +	+ + +	+ + + +

Cyclotella meneghiniana	+ + +	+ +	+ + + +
Gomphonema olivaceum	+ + +	+ + +	+ + + +
Gomphonema parvulum	+ + + +	+ + +	+ + + +
Gomphonema sphaerophorum	+ + +	+ + +	+ + + +
Gomphonema spiculoides	+ + +	+ + +	+ + + +
Gomphonema subapicatum	+ + +	+ + +	+ + + +
Navicula cryptocephala	+ + +	+ + +	+ + + +
Navicula mutica	+ + +	+ + +	+ + + +
Navicula protracta	+ + +	+ +	+ + + +
Navicula pupala	+ + +	+ + +	+ + + +
Navicula rodisa	+ + +	+ + +	+ + + +
Cymbella turgidula	+ + +	+ + +	+ + + +
Cymbella ventricosa	+ + +	+ + +	+ + + +
Fragilaria constrains	+ + +	+ + + +	+ + +
Fragilaria pinnata	+ + +	+ + +	+ + + +
Stauroneis phoenicenteron	+ + +	+ + +	+ + + +
IV. Euglenophyta			
Euglena species	+ + +	+ +	+ + +
Trachelomonas	+ + +	+	+ +

+ + + + High% population, + + + Moderate% population,
+ + Average % population, ND: Not detected.

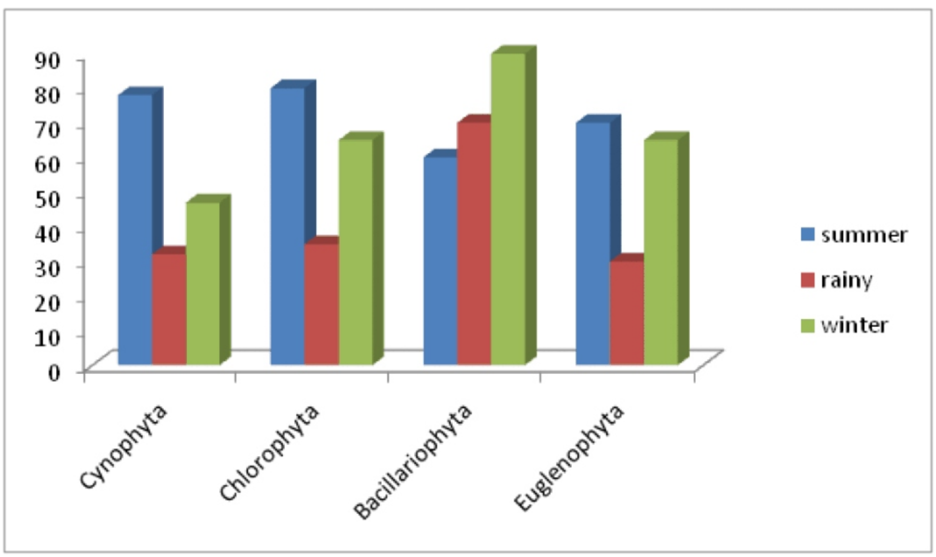

Fig. 1 Percentage composition of phytoplankton from site I

season) viz. *Epithemia zebra, Actinastrum gracillimum and Cyclotella meneghiniana.* Phytoplankton population was found maximum in summer because of favourable conditions and enriched nutrients with increased intensity of light during day time. Result indicated that, both lentic water bodies showed presence of major groups of phytoplanktons as *Cyanophyta, Chlorophyta, Bacillariophyta and Euglenophyta*. Comparative data related to abundance of species showed that, members of *Bacillariophyta* were dominated, among *Diatoma, Cyclotella meneghiniana, Gomphonema olivaceum, Gomphonema parvulum, Gomphonema sphaerophorum, Gomphonema spiculoides, Navicula mutica, Navicula rodisa, Cymbella ventricosa, Fragilaria pinnata.* Population of Diatoma's was found increasing from month of August and has peak in the December. Quantified data of phytoplanktonic members of *Euglenophyta* was less in comparision to other group. As per the population of phytoplanktonic study indicated that site I and site II were polluted marked by planktonic population. (Table No. III and IV). Comparatively planktonic population was more during summer season indicating major pollution of aquatic bodies and

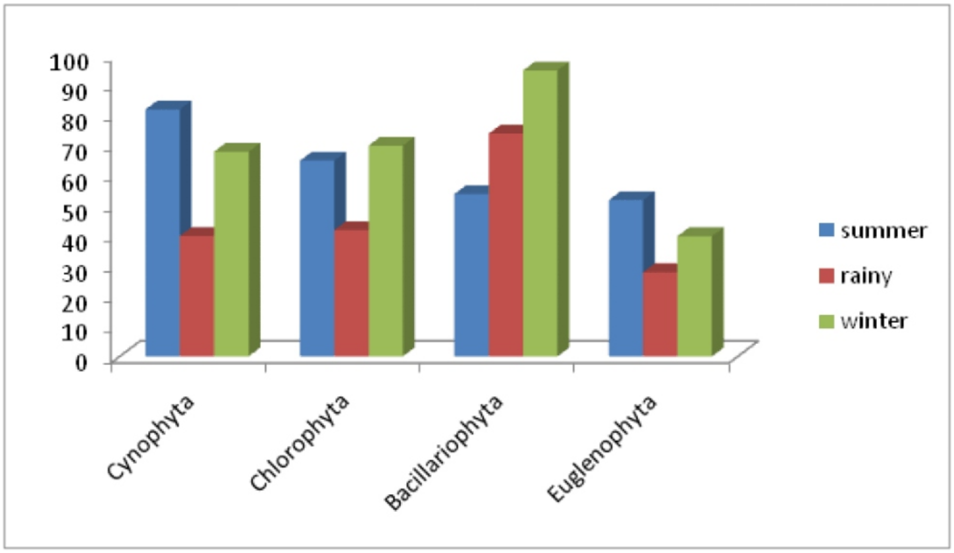

Fig. 2 Percentage composition of phytoplankton from site II

was not suitable for drinking purpose.

DISCUSSION

Singh *et al.,* [8] have recorded that, expansion of urban areas in relation to its socioeconomic growth has continuously modified physico-chemical and biological composition of water bodies. Krishnaram *et al.,* [18] reported altered physico-chemical parameters of water bodies which has affected the biotic and abiotic factors related to number and diversity. Increased in Dissolved Oxygen (DO) content during early summer was due to higher photosynthetic activity of algae, while during winter was clearly due to low temperature which has enhanced the oxygen dissolving capacity of water [19]. The photosynthetic activity of phytoplankton was also affected due to high turbidity causing "Blanketing affect" of suspended materials [19]. Content of nitrate and phosphate also favored good growth of blue green algae. Some of the parameters were also act as indicators of sewage pollution such as chloride, phosphate and nitrate [20]. Our results coincides with the above as seasonal changes showed variation in planktonic population, most of the species was found to be absent in the period of rainy season viz. *Epithemia zebra, Actinastrum gracillimum and Cyclotella meneghiniana* documented by number of scientists in their planktonic analysis [8]. Hutchinson, [21] found that, growth of phytoplankton was more in premansoon because of favourable environmental conditions. Further investigation in relation to pollution status of aquatic bodies is in progress.

CONCLUSION

Decreased content of planktons during rainy season was due to high current and turbidity of water, which has flushed the biota. Temperature has increased during February and March became more favourable for the growth of phytoplanktons. We found that, variations in physico-chemical parameters were responsible for the fluctuations in the quality and quantity of the plankton and related biota. Findings of phytoplanktonic diversity showed that, water bodies under study was heavily polluted with contamination of phytoplankton and needs major action to avoid further contamination for the development and survival of aquatic flora and fauna taking part in nutrient cycle of sustained ecosystem.

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