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RESEARCH ARTICLE

BIODIVERSITY OF PHYTOPLANKTON AND PHYSICO-CHEMICAL WATER ANALYSIS IN FORT LAKE OF BELGAUM (KARNATAKA)

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ABSTRACT

A study on biodiversity of phytoplankton in Fort Lake revealed a total of 35 species belonging to five classes in which Chlorophyceae-19 species, Bacillariophyceae-10 species, Cyanophyceae-3 species, Dinophyceae-2 species and 1 species of Euglenophyceae. Species of Bacillariophyceae were abundant and dominated by *Nitzschia sp., Navicula sp.,* and *Synedra sp.,* which are considered as indicators of organic pollution and bad quality of water. Algal pollution index revealed a score of 28 indicating that Fort Lake is organically polluted. Physico- chemical parameters of Fort Lake revealed that the pH ranges from 7.8 to 9.2, electrical conductivity ranges from 395 µS/cm to 570 µS/cm, dissolved oxygen 2.9 to 6.9 mg/L, total hardness 149 mg/L to 200 mg/L, calcium hardness 69 mg/L to 90 mg/L, Temperature 21^0C to 25^0C, Iron 0.1 mg/L to 0.3 mg/L, phosphate 0.0 mg/L to 0.5 mg/L, nitrite 0.0 mg/L, nitrate 0.1 mg/L to 5 mg/L, chloride 60 mg/L to 120 mg/L, residual chlorine 0.0 mg/L to 0.2 mg/L ,ammonium 0.1 mg/L to 5 mg/L, fluoride 0.0 mg/L, turbidity 24.00 cm to 38.100 cm and total alkalinity 105 mg/L to155 mg/L. Based on the investigation we conclude that Fort Lake is polluted by organic waste and is unfit for drinking but can be utilized for fish rearing and recreational activities.

INTRODUCTION

Belgaum city is nested in the foothills of the Western Ghats and it is in the northern part of karnataka. Fort Lake is in Belgaum city is famous for its recreational activity and fish rearing. Algae play an important role in Food chain of aquatic life. Any change in growth of algae affects the other organism's depended on it (Palmer, 1980). Urbanization and human activity have led to disposal of sewage wastes, industrial effluents and agriculture water runoff in lake has caused undesirable change in chemical composition and species diversity (Harper, 1992). Physical and chemical change in water affects the diversity of phytoplanktons. The qualitative and quantitative studies on phytoplankton are used to assess the quality of water. Phytoplankton is used as a biological indicator of water pollution (Rana and Palria, 1998). The growth of phytoplankton is regulated by various physical and chemical factors **(**Komarav and Hejzlar, 1996).The phytoplankton biomass, diversity, composition and primary production are mainly influenced by seasonal changes. By studying the physico-chemical parameters and the phytoplankton diversity we can assess the quality of water, severity of pollution and thereby safeguard the lakes from being polluted in future. Not much work is done on biological conditions and physiocochemical parameters on the Fort Lake and hence the present study.

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MATERIALS AND METHODS

Study Area

The Fort Lake is situated in the midst of Belgaum city at latitude of $15^0$51' N, Longitude $74^0$31'E, elevation of 750 m above MSL and approximate depth of water is 20 ft with an area of 1.99 km (Fig. 1).

Collection of Samples

Water samples were collected early in the morning from three different locations of lake during various seasons of the year. 100 liters of surface water was collected and filtered through plankton net no 25 and the volume was reduced to 100 ml. Later it was preserved in 4% formalin, kept for 24 to 48 hrs and the final volume was reduced to 30 ml (Ramchandra and Malvikaa, 2007). Surface water sample was collected in the plastic bottles and subjected for further analysis.

Biological Analysis

Phytoplanktons were studied under microscope and identified using standard monographs (Fritsch 1965; Desikachary 1959;

Trivedi *et al*., 1986). Quantitative and qualitative analysis of phytoplanktons were done by drop count method (Hegde, 2002).

Physico-chemical Analysis

Dissolved oxygen, tubidity and temperature were determined on the spot. Turbidity of water was measured by sacchi disc, temperature was measured by thermometer and electric conductivity was measured by using conductivitymeter. Other Physico-chemical parameters like pH, total hardness, calcium hardness, total alkalinity, chloride, residual chlorine, fluoride, phosphate, iron, nitrate, nitrite, ammonium and coliform bacteria test were estimated and tested in the laboratory by using NICE kits and standard methods prescribed by (APHA, 1998).

RESULTS AND DISCUSSION

The present study reveals a total number of 35 species of phytoplanktons (Table 1) which belonging to five classes such as Chlorophyceae - 19 species, Bacillariophyceae - 10 species, Cyanophyceae - 3 species, Dinophyceae - 2 species and 1 species of Euglenophyceae. Only 29 species were reported by Giriyappanavar B.S (Giriyappanavar and Patil, 2013). Based on the quantitative percentage (Fig.3) composition, it is recorded that Bacillariophyceae (55%), Chlorophyceae (34%), Cyanophyceae (7%), Dinophyceae (3%) and Euglenophyceae (1%). Species of Bacillariophyceae were abundant and dominated by *Nitzschia sp., Navicula sp.* and *synedra sp.,* which are considered as indicators of organic pollution and bad quality of water (Kavitha *et al* 2005; Verma 2002).

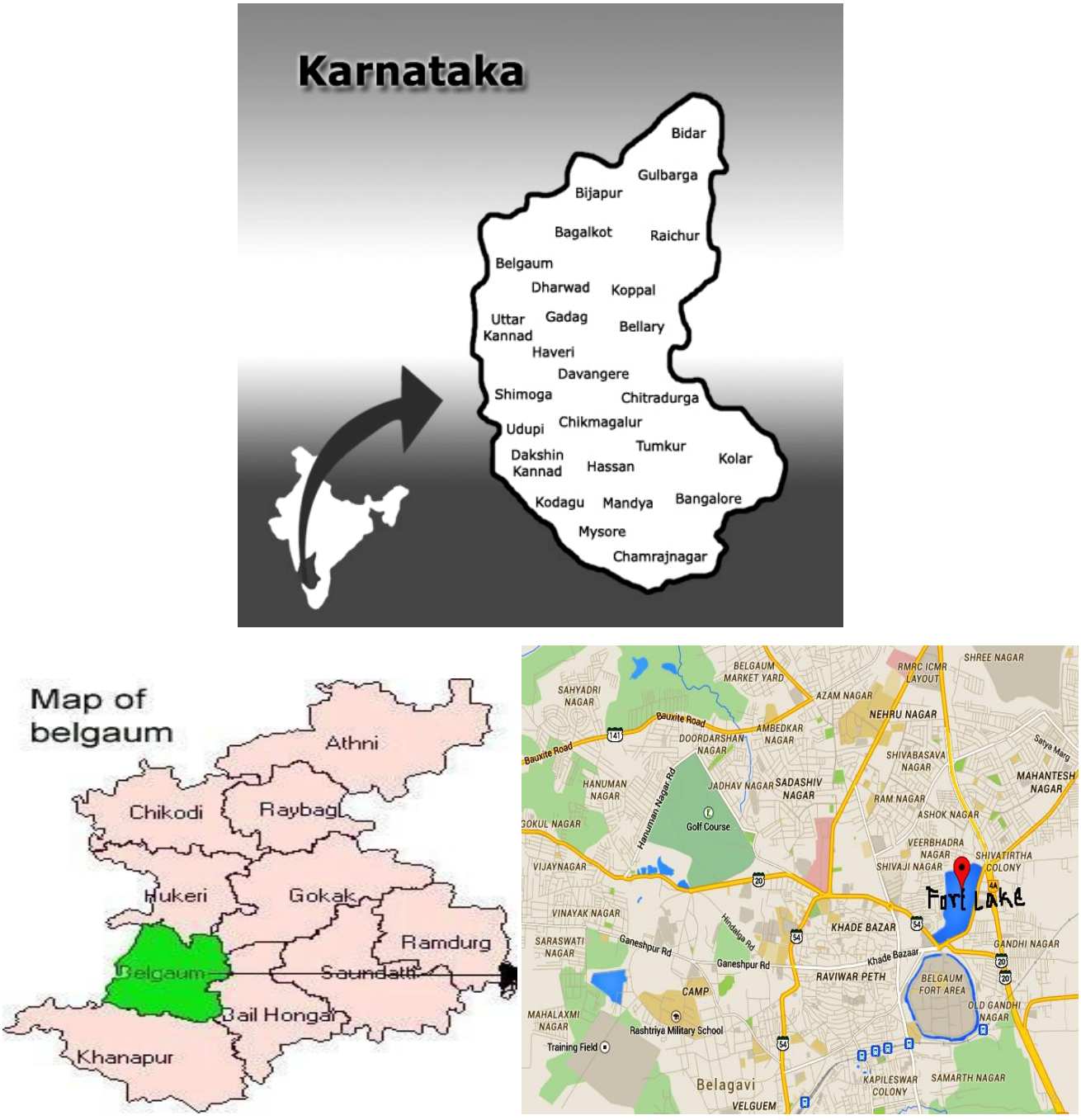

Fig.1. Location of Fort Lake in map of Belgaum city

Table 1. Diversity and Quantitative analysis of Phytoplankton in Fort Lake

Class	Species name	Plankton count/drop	Plankton count/liter
Chlorophyceae	Pediastrum simplex	3	23
	Pediastrum tetras	1	8
	Pediastrum duplex.	1	8
	Scenedesmus quadricada	1	8
	Scenedesmus obliqus	1	8
	Scenedesmus armatus.	1	8
	Draparnaldiopsis sp.	1	8
	Chlorella sp.	1	8
	Spirogyra punctata.	1	8
	Mougeotia sp.	1	8
	Monoraphidium contortum.	3	23
	Merismopedia glauca.	2	15
	Cosmarium circulare.	3	23
	Closteridium sp.	2	15
	Tetrastrum heterocenthum.	2	15
	Arthrodesmus incus.	2	15
	Ankistrodesmus falcatus	1	8
	Ankistrodesmus gracilis.	2	8
	Staurastrum crenulatum.	1	8
Bacillariophyceae	Navicula rhynchocephalia	10	75
	Navicula major.	2	15
	Navicula radiosa.	1	8
	Navicula sp.	16	120
	Nitzschia palea.	12	90
	Pinnularia major.	3	23
	Gomphonema intricatum.	1	8
	Gomphonema sp.	1	8
	Cymbella tumida.	1	8
	Synedra ulna.	2	15
Cyanophyceae	Anabaena sp.	2	15
	Oscillatoria limosa.	1	8
	Microcystis sp., aeruginosa	2	15
Dinophyceae	Perinidium limbatum.	2	15
	Ceratium hirudinella.	1	8
Euglenophyceae	Euglena viridis.	1	8
	Total count/drop	88	
	Total count/Liter		660

Occurrence of *Anabaena sp., Ocillatoria sp., Microcysts sp.,* and E*uglena sp.,* are also the indicators of organic pollution (Sanap *et al.*, 2008). Algal genus pollution index (Fig. 2) revealed a score of 28 indicating organic pollution (Palmer, 1969) which is the main cause for the disposal of sewage waste in Fort Lake. The Physico-chemical parameters of the fort lake is represented in Table 2 revealed that, the color of water is green due to eutrophication. pH is one of the important factors for the biological activity. During the present investigation, pH of water range from 7.8 to 9.2, highest in summer season due to high content of organic matter, high biological activity and also due to occurrence of high photosynthetic activity (Das *et al.,* 1997; Subramanian and Mahadevan, 1999). If the pH of water ranges from 6.5 to 7.5, it is good for agriculture and not for drinking. Turbidity varied from 24.00 cm to 38.100 cm, higest during monsoon due to surface runoff of water but for aquatic plant growth turbidity generally greater than 91.400 cm, Dissolved oxygen level range from 2.9 to 6.9 mg/L, high during winter (6.9 mg/L) and monsoon (5.6 mg/L) due to heavy rainfall which favours the solubility of oxygen in the water and least in summer due to faster rate of organic matter decomposition. The maximum concentration of dissolved oxygen in clean lakes is more than 7.5 mg/L (Shankar and Mruthunjaya, 2013).

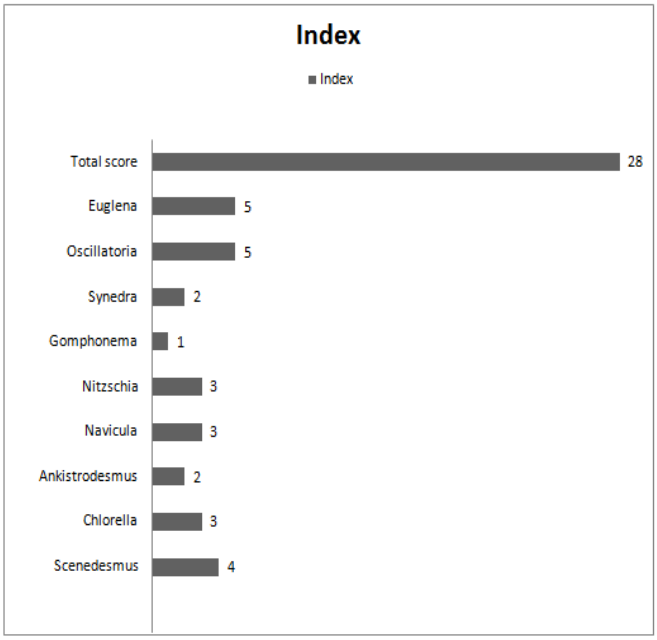

Fig. 2. Algal Genus Pollution Index (Palmer index)

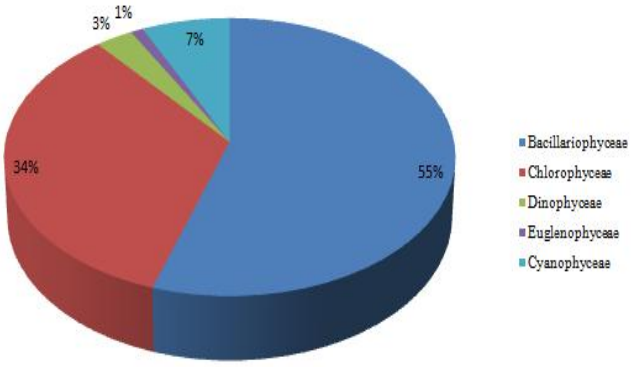

Fig. 3. The Pie Diagram Showing Abundance of Algae in Percentage

Temperature is an important factor which regulates the biogeochemical activities in the aquatic environment. Water temperature influences aquatic weeds and algal blooms (Zafar, 1968) and surrounding air temperature (Gupta and Sharma, 1993). In the present investigation, the temperature of water recorded varied from 21^0C to 25^0C high during summer ($25\ ^0$C) and low during winter (21^0C).

Total hardness recorded ranged from 149 mg/L to 200 mg/L high in winter (200 mg/L) and monsoon (184 mg/L) due to surface runoff of rain water, calcium hardness ranges from 69 mg/L to 92 mg/L high in winter (90 mg/L) due to surface runoff, unusual heavy rain noticed during winter (November month), iron ranged from 0.1 mg/L to 0.3 mg/L except during winter the concentration of iron was constant ie 0.3 mg/L,

Table 2. Physico-chemical Parameters of Fort Lake

Parameters	Summer season		Monsoon season		Winter season	
	April	May	August	September	November	December
Odor	Unpleasant	Unpleasant	Unpleasant	Unpleasant	Unpleasant	Unpleasant
Color	Green	Green	Light green	Light green	Light green	Light green
Turbidity	24.00 cm	30.480 cm	37.420 cm	38.100 cm	35.560 cm	33.020 cm
pH	9.2	9.0	7.8	8.0	8.5	8.8
Temperature	25^0C	25 ^{0}C	24^0C	24^0C	23^0C	21^0C
Conductivity	520 µS/cm	570 µS/cm	435µS/cm	410 µS/cm	395 µS/cm	450 µS/cm
Total alkalinity	105 mg/L	109 mg/L	123 mg/L	120 mg/L	155mg/L	150 mg/L
Total hardness	150 mg/L	149 mg/L	184 mg/L	180 mg/L	200 mg/L	195 mg/L
Calcium hardness	74 mg/L	69mg/L	83 mg/L	80 mg/L	90 mg/L	87 mg/L
Dissolved oxygen	2.9 mg/L	3mg/L	5.6 mg/L	5.5 mg/L	6.5 mg/L	6.9 mg/L
Iron	0.3 mg/L	0.3 mg/L	0.3 mg/L	0.3 mg/L	0.1 mg/L	0.1 mg/L
Phosphate	0.5 mg/L	0.5 mg/L	0.2 mg/L	0.2 mg/L	0.0 mg/L	0.0 mg/L
Nitrite	0.0 mg/L	0.0mg/L	0.0 mg/L	0.0 mg/L	0.0 mg/L	0.0 mg/L
Nitrate	0.1 mg/L	0.2mg/L	5 mg/L	5 mg/L	0.3 mg/L	0.2 mg/L
Ammonium	0.4 mg/L	0.5 mg/L	0.2 mg/L	0.1 mg/L	0.3 mg/L	0.3 mg/L
Chloride	110 mg/L	120 mg/L	75 mg/L	70 mg/L	60 mg/L	62 mg/L
Residual chlorine	0.2 mg/L	0.2 mg/L	0.0 mg/L	0.0 mg/L	0.2 mg/L	0.2 mg/L
Fluoride	0.0 mg/L	0.0 mg/L	0.0 mg/L	0.0 mg/L	0.0 mg/L	0.0 mg/L
Coli form test	Pathogenic bacteria present	Pathogenic bacteria present	Pathogenic bacteria present	Pathogenic bacteria present	Pathogenic bacteria present	Pathogenic bacteria present

phosphate ranged from 0.0 mg/L to 0.5 mg/L high during summer (0.5 mg/L) and monsoon (0.2) due to sewage disposal, wind surface runoff and runoff by rain (Vollenweider, 1945). Nitrate ranges from 0.1 mg/L to 5 mg/L higest in Monsoon due to surface runoff of water, nitrite and fluoride is 0.0 mg/L, chloride ranged from 60 mg/L to 120 mg/L high in summer (120 mg/L) and low in winter (60 mg/L), residual chlorine ranged from 0.0 mg/L to 0.2 mg/L, ammonium from 0.1 mg/L to 0.5 mg/L high level during summer (5mg/L) due to decomposition of organic nutrients.

The total alkalinity recorded during the present investigation ranged from 105 mg/L to 155 mg/L higest durig winter (155 mg/L) and least in summer(105 mg/L) reveals increased growth of Bacillariophyceae, which is in conformity with the earlier work of (Patric, 1973). According to Klein, Srivastava and Patil, the alkalinity is directly related to the abundance of phytoplankton since they dissociates bicarbonate into carbonates and carbon dioxide which leads to increase in alkalinity. Electric conductivity of water ranged from 395 µS/cm to 570µS/cm and is said to be a good indicator of the overall water quality, present investigation revealed 570µS/cm conductance of water is good for irrigation. Test for Coli form bacteria revealed that the Fort lake water is infected by pathogenic bacteria at all seasons and is unfit for drinking.

Conclusions

The study revealed that the water is unfit for drinking due to disposal of sewage waste and has resulted in organic pollution, eutrophication and infected by pathogenic bacteria. Due to dumping of municipal sewage and domestic waste of Belgaum city, their aquatic system got polluted resulting in water unfit for drinking purposes. If the dissolved oxygen level is decreased to 2 mg/L then even fish rearing is not possible. To protect this ecosystem, there should be proper management and planning of disposal of the municipal sewage for a healthy hygienic and sustainable environment. The water can be used for recreational activities and rearing of fishes.

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