RESEARCH ARTICLE

Phytoplankton biodiversity in lakes of Nagpur city; A Bio-indicator of water quality

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Manuscript details:

Date of publication 18.10.2014

Available online on http://www.ijlsci.in

ISSN: 2320-964X (Online)
ISSN: 2320-7817 (Print)

Editor: Dr. Arvind Chavhan

Cite this article as:
Giripunje Manisha D, Fulke Abhay B and Meshram Pravin U (2014) Phytoplankton biodiversity in lakes of Nagpur city; A Bio-indicator of water quality, *Int. J. of Life Sciences,* Special issue, A2: 159-162.

Acknowledgment:
Authors are grateful to the Principal, Sevadal Mahila Mahavidyalaya, Nagpur for providing resources for successful conduct of this work.

ABSTRACT

The study of phytoplankton count and trend of algal diversity for seasonal changes was conducted at three study sites such as Futala, Gandhisagar and Ambazari lakes of Nagpur, Maharashtra, India. The study revealed that, phytoplankton population increased with increase in climatic temperature and nutrients. Overall fifty-two phytoplankton taxa were recorded in three lakes of the city. All three lakes predominantly consisted of chlorophyta, cyanophyta and bacillariophyta. However, in this study the Shannon Wiener diversity Index values for all three lakes indicated oligotropic water.

Keywords: Phytoplankton, Futala Lake, Gandhisagar Lake, Ambazari Lake, Shannon Wiener diversity Index

INTRODUCTION

The term 'plankton' refers to the group of organisms that float on the surface water. Most of the floating plankton in the major water-bodies is the unicellular microscopic algae collectively called phytoplankton (Ward and Whipple, 1966). Like plants on land all phytoplankton photosynthesize, but some get energy by consuming other organisms. Phytoplankton growth depends on the availability of carbon dioxide, sunlight, and nutrients. Like land plants, phytoplankton also requires nutrients such as nitrate, phosphate, silicate, and calcium. Some phytoplankton can fix nitrogen and can grow where nitrate concentrations are low. Phytoplankton need trace amount of iron for growth, which helps them adapt well in large areas of the ocean where the iron concentrations are low (Reynolds, 2006). Other factors influencing phytoplankton growth rates include temperature, salinity, depth, wind, and kinds of predators. There has been much interest in the processes influencing the development of phytoplankton communities, primarily in relation to physical-chemical factors (Akbay *et al*., 1999). Phytoplankton as fundamental indicators of ecosystem status is sensitive to environmental changes at small spatial scales. The phytoplankton in a reservoir is an important biological indicator of the water quality. Phytoplankton is primary producer, forming the basis of the food chain which exhibit excellent continuity through time and with varying water quality.

The current study was conducted to study the composition and diversity of phytoplankton in three lakes of Nagpur City like Futala lake, Gandhi sagar lake and Ambazari lake.

MATERIAL AND METHODS

Sampling Station: The study was conducted in three lakes in Nagpur city like Futala lake, Gandhi sagar lake and Ambazari lake (Fig.1). Futala lake (alias Telankhedi Lake) is located at latitude of 21'09'11.74'' north and longitude 79'02'32.77'' east, a century old and has historical importance. The catchment area of Futalalake is 0.40 km^2. Futalalake is used for fishing and immersion of idol and religious practices. Gandhi Sagarlake (alias Shukravari Talao/ Jumma Talao) is located at latitude of 21°8'44.82" north and longitude 79°5'59.50" east. The catchment area of Gandhi Sagarlake is 0.181 km^2. Gandhi Sagar lake a historic lake that is more than 275 years old and was traditionally a source of water supply during the regime of the king of Nagpur, the Chand Sultan. Gandhi Sagar lake is also used for fishing and for religious practices such as idol immersion. The Ambazari lake lies between latitude of 20'35'21.44'' north and longitude of 78'15'79.40'' east. Ambazari lake is the biggest lake in the city with an catchment area of 1.185 km^2. Ambazari lake supplies water for each drinking and irrigation purpose to the urban population of Nagpur.

Figure 1: A map showing Futala, Gandhisagar and Ambazari lakes, Nagpur, Maharashtra, India.

Sampling: Water samples and algal bloom biomass were collected in sterilized sampling bottles from Futala, Gandhi sagar and Ambazari lakes and immediately preserved with Lugol's iodine (APHA, 2005)

Community Compositions: The phytoplankton density is low in clean water while it is high in polluted water. Therefore, the sample from a clean water source needs to be concentrated before counting for accurate estimation. The water sample was concentrated by centrifugation at 250 rpm for 15 minutes. The supernatant water was decanted and the pellet of algal cells was suspended in 1 ml distilled water. The total count of phytoplankton population was enumerated by Lackey's drop count method (Lackey, 1938). The Lackey's drop count method is a reliable method for getting plankton counts especially with samples containing a dense plankton population. Briefly, 0.04 ml of concentrated water sample was placed on a glass slide and covered with an 18 millimeters glass cover slip (No. 1). Using an Olympus microscope BX51 (Olympus, Japan), under a magnification of 100X and 400X phytoplankton were observed and counted in at least 10 microscopic fields. The identification was confirmed by referring the keys (Prescott, 1978; Ward and Whipple,1966). A biological community, whose composition is influenced by environmental conditions and availability of required resources, may undergo changes for their number and types of species and their populations. A widely accepted ecological idea is that community with many species with high diversity will have stability and thus have the ability to resist adverse environment influences to a particular extent. Shannon Wiener diversity Index (SWI) is a measure of diversity of phytoplankton that accounts for total count and individual count of phytoplankton in water samples. SWI values in the range of 3 and above are considered to represent oligotropic indicating healthful condition of water. The SWI values between 1 and 3 considered as eutropic condition indicating partially poor productivity (Pielou,1966).

RESULTS AND DISCUSSION

Phytoplankton communities and count of Nagpur lakes like Futala lake, Gandhisagar lake and Ambazari lake during monsoon, winter and summer seasons consisted of 52 taxa belonging to six taxonomical divisions: Chlorophyta (*n=23*), Cyanobacteria (*n=13*), Cryptophyta (*n=1*), Bacillariophyta (*n=10*), Euglenozoa (*n=4*) and Pyrhhophyta (*n=1*) (Table 1 and Table 2). Green, blue-green and brown algae were present in the highest numbers throughout the three seasons and dominated predominantly by *Chlorella* sp., *Scenedesmus* sp., *Ankistrodesmus*sp., *Pediastrum*sp. (green algae); *Anacystis*sp., *Oscillotoria*sp., *Spirulina*sp., *Anabaena* sp. (blue-green algae); and *Navicula* sp., *Melosira* sp., *Synedra* sp. (brown algae). Excessive growth of some algal genera such as, *Scenedesmus*,

Anabaena, *Aphanizomenon*, *Anacystis*, *Oscillatoria*, *Pediastrum* and *Melosira*indicate nutrient enrichment of aquatic bodiescopiotrophic condition of water. Count ofphytoplankton in Futala lake, Gandhisagar lake and Ambazari lake varied from 1604 to 7872 phytoplanton/ml, 1340 to 9352 phytoplanton/ml and 1840 to 4984 phytoplanton/ml respectively spanning the three seasons (Figure 2 and 3). The phytoplankton abundance was observed to be highest during summer in all three lakes, this may be because of the increased salinity, pH, high-temperature and high-intensity of light penetration (Giripunje *et al*., 2013). The influence of nutrient and sunlight on phytoplankton abundance and diversity has also been reported from the southern part of Orissa at Gopalpur (Gouda, Panigrahy, 1996). In the monsoon season the storm water increased the volume of lake water, thereby resulting in dilution of organic pollution in lakes in comparison with winter and summer seasons. An abundance of phytoplankton indicates nutrient load. SWI values for all the three lakes spanning the three seasons wereranged from 3.010 to 3.850 (Table1).

Table1: Seasonal phytoplankton abundance and diversity in Futala, Gandhisagar and Ambazari lakes of Nagpur, India

Taxonomic divisions	Identified taxa
Cyanophyta (13)	*Anacystis, Microcystis, Gomphosphaeria, Chroothece, Chroococcus, Merismopedia, Dactylococcopsis, Aphanothece, Arthospira, Oscillotoria, Spirulina, Lyngbya, Anabaena*
Euglenozoea(4)	*Euglena, Phacus , Lepocindis, Gonyostomum*
Chlorophyta(23)	*Coleochaete, Chlorella, Actinastrum, Coelastrum, Ankistrodesmus, Elakatothrix, Pediastrum, Tetrastrum, Zygnema, Chlorococcum, Crucigenia, Chlamydomonas, Phacotus, Scenedesmus, Tetraedron, Gonium, Tetradesmus, Desmidium, Spondylomorum ,Closterium, Staurastrum, Cosmarium, Chloromonas*
Bacilleriophyta(10)	*Synedra, Coscinodiscus, Cyclotella, Hydrosera, Diatoma, Tabellaria, Rhoicosphenia, Navicula, Nitzschia, Fragillaria.*
Cryptophyta(1)	*Cryptomonas*
Pyrhhophyta(1)	*Urococcus*

Table2: Phytoplankton taxa observed in climatic seasons of Futala, Gandhisagar and Ambazari lakes of Nagpur, India

Lakes	Seasons*	Phytoplankton (No/ml)	Percentage composition of algal divisions						
			Cyanophyta	Euglenozoa	Chlorophyta	Bacillariophyta	Cryptophyta	Pyrhhophyta	SWI*
Futala	M	1604	15	2	66	15	1	1	3.02
	W	4592	19	1	37	40	3	-	3.07
	S	7872	22	2	18	55	2	1	3.43
Gandhi sagar	M	1340	46	1	33	12	8	-	3.09
	W	4984	52	1	28	15	4	-	3.01
	S	9352	58	1	21	14	6	-	3.42
Ambazari	M	1840	44	1	38	15	2	-	3.85
	W	3360	33	1	47	17	1	1	3.78
	S	4984	37	1	43	18	1	-	3.44

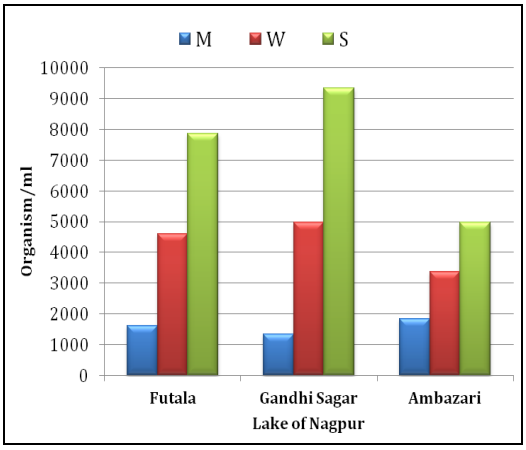

Figure 2: Seasonal trend of phytoplankton count in lakes of Nagpur

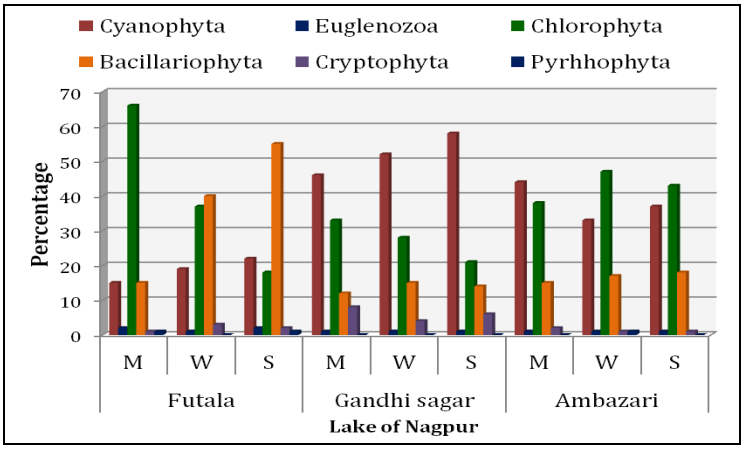

Figure 3: Seasonal trend of percentage composition of algal divisions in lakes of Nagpur

In an another study by Wilham in 1968 it was shown that the abundance and diversity of phytoplankton increased with increasing organic pollution in the lakes of United States (Wilham and Dorris, 1968). Excessive fishing, washing of cattles and heavy religious practices like idol immersion have been loading organic burden on the aquatic ecosystem. We believe suitable evaluation have to convalesce the health of Futala, Gandhisagar and Ambazari lakes of Nagpur, Maharashtra, India.

CONCLUSION

The study shows that the phytoplankton abundance and diversity was affected by the environmental conditions. The phytoplankton abundance and diversity was evaluated as an indicator of pollution that also affected by seasonal changes.

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