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Research Paper

POLLUTION INDICATOR ALGAE OF RIVER GANGA AT KANPUR

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ABSTRACT

In view of increasing pollution and subsequent algal growth in Ganga waters a detailed study of algal flora of river Ganga at Kanpur has been conducted during present investigation. Physicochemical characteristics of water samples from river Ganga at Kanpur have revealed varying levels of pollution. Quantitative and qualitative estimates have been made on monthly basis and as many as 36 significant algal species have been identified which can tolerate high degree of pollution. Their role as possible indicators of pollution has been discussed. Principal groups of algae constitute Cyanobacteria, Chlorophyceae and Chrysophyceae. The most significant finding being that apart from 4 species of Euglena and 3 species of Scenedesmus which perhaps are the best adapted species of polluted waters,

the members of Cyanobacteria like Oscillatoria, Merismopedia, Chroococcus and Spirulina etc. are the major pollution indicating species. The other dominant group is the diatoms with the genera like Nitzschia, Navicula, Synendra Gomphonema and Fragilaria etc. Species of Microcystis, Nostoc, Anabaena, Cladophora, Spirogyra, Closterium, Pediastrum, Hydrodictyon are abundantly found during present investigation.

Key Words: River Ganga, Phytoplankton, Water Pollution, Density, Pollution Index.

1. INTRODUTION

Algae are an ecologically important group of organisms in most aquatic ecosystems but often ignored as indicators of disturbance and conditions of aquatic ecosystem. Because of their nutritional needs and their position at the base of food chain, algal indicators provides relatively unique information concerning ecosystem conditions in comparison to commonly used animals and bacterial indicators. Algae, in general, and phytoplankton as specific group, respond rapidly and predictably to a wide range of pollutants and thus provide potentially early signal of the deteriorating condition of waters and possible causes. Algal assemblage provides one of the few benchmarks or establishing the required water quality conditions and for characterizing the minimally impacted biological conditions of many disturbing ecosystems.

Algae represent a conspicuous and significant group in their continuously changing population on a stream. The variation in algal population of different sampling sites or under different ecological conditions or different pollutional constituents of these one indices applied to any desired location in stream to determine the presence or absence of domestic, industrial wastes or other putrescrible wastes or to measure the degree of recovery form pollution with these wastes. The river receives domestic and industrial wastes and water shows high degree of pollution.

Kanpur is situated at 26.80 N latitude and 80.340 E longitudes at an elevation of 410 meters from sea level on the bank of river Ganga. There are few reports on algal pollution (Fogg, 1960; Reimer, 1965; Vankateswarlu, 1969; Palmer, 1969, 1983; Hosmani and Bharti 1980; Prasad and Singh, 1980; Kant, 1983; Whitton, 1975; Shubert, 1984; Joy and Joseph, 1995; Sudhkar et. al. 1994; Saha et.al. 2000; Dwivedi and Pandey 2002; Mahadev and Hosmani, 2005 Pramila et. al. 2008).

The present investigation has been based on the data generated from June 2009 to May 2010 of river Ganga between Bithoor to Jajmau and numbers of algal species have been identified at Kanpur which are useful indicator of pollution in river.

2. MATERIALS AND METHODS

Surveys of different sites of Ganga from Bithoor to Jajmau were made and five sampling stations (Bithoorghat, Ranighat, Sarsaiyaghat, Golaghat and Jajmaughat) were carefully chosen on the basis of their significance in pollution input and capability of the river or assimilation and self purification. The water and algal samples were collected from different sampling stations in each month since June 2009 to May 2010 to analyze the presence of algal species. The collected samples were brought to the laboratory and simultaneously preserved in 5% formalin. The samples were examined through microscope and Camera Lucida diagrams also prepared for the measurement. On the basis of structure and measurement algae were identified using standard text i.e. Desikachary 1959; Chapman 1962; Bold and Wynne 1978 and Prescott 1962 and numbers of algal species have been identified. The density of algae in a sample was estimated by adapting Drop Count Method (Trainor, 1978).

$$\text{Number of Algal Units per ml.} = N \times A_{cg} \times D / A_{strip}$$

Where N=Average count of algae per strip
A cg = Area of cover glass
D = Number of drops per ml.
N= Area of strip

3. RESULTS

Algae are one of the most rapid detectors of water pollution. This is because of their quick response to toxic

and other substances. They are primary producers in aquatic ecosystems. Algae are especially significant because those algae which accumulate toxic materials may intoxicate the entire food chain. Pollution stress reduces the number of algal species with a concurrent increase in the number of their individuals. In this manner the complex organization of community gets actually simplified pollution pressure (Patrick, 1949). A large number of algae have been collected from various sampling stations of river Ganga at Kanpur during June 2009 to May 2010 and about 21 genera spread over 36 species have been identified as indicator of water quality. Beside these major pollution indicating algae many other algae such as Cladophora, Spirogyra, Ulothrix, Pediastrum and Hydrodictyon have been abundantly observed in Ganga water at Kanpur between Bithoor to Jajmau during present investigation.

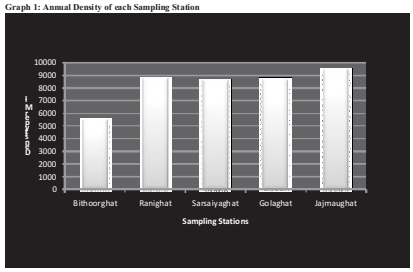
3.1. Phytoplankon Density of Sampling Stations: The phytoplankton density of each sampling station during June 2009 to May 2010 has been calculated. An average of annual density has also been estimated for each sampling station as well as Entire River from Bithoor to Jajmau (Table 1 and Graph 1). Table 1 indicates that the minimum density has been recorded during the month of July and August, whereas, maximum density has been observed in the month of May and June. The Bithoorghat shows less algal pollution then other Ghats because this Ghat situated at place where the river enters to the city, so this Ghat get minimum domestic and industrial wastes. Annual average density of each sampling station has been shown in Graph 1 which is also indicating maximum density in the month of June 2009 and May 2010. The minimum density (471.17 cells/ml.) has been observed from Bithoorghat and maximum (14294.10 cells/ml.) from Jajmaughat. The comparative monthly density of each sampling station has been shown in Graph 2 and monthly average density of river Ganga has been shown in Graph 3.

3.2. The occurrence of Algal genera in each sampling station: We have observed overall 21 genera spread over 36 species from all sampling stations. We have notified that 14 genera from each Bithoorghat and Ranighat; 17 genera from each Sarsaiyaghat and Golaghat while from Jajmaughat we have recorded maximum 20 genera (Table:2). Out of these 36 species, 8 species belongs to Chlorophyceae (Ankistrodesmus falcatus, Chlorella vulgaris, Closterium acerosum, Stigeoclonium sp., Scenedesmus quadricauda, S. obliquus, S. dimorphus, S. acuminatus), 4 species to Euglenophyceae (Euglena viridis, E. gracilis, E. acus, E.elongata), 12 species to Cyanobacteria (Anabaena fertilissima, A. flos-aquae, Chroococcus turgidus, Merismopedia tenuissima, Microcystis aeruginosa, M. flos-aquae, Oscillatoria princeps, O. formosa, O. limosa, O. pseudogeminata, Nostoc linckia, Spirulina major) and 12 species to Bacillariophyceae (Cyclotella sp., Cymbella affinis, C. cymbiformis, Gomphonema sphaerophorum, G. montanum, Fragilaria crotonensis, Melosira varians, Navicula cryptocephala, N. anceps, Nitzschia palea, N. obtusa, Synedra ulna).

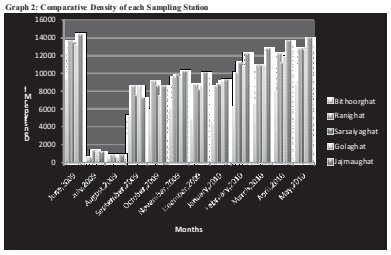
Table 1: Phytoplankton density/ml. of each sampling station for each month

Sampling Stations/Months	Bithoorghat	Ranighat	Sarsaiyaghat	Golaghat	Jajmaughat	Monthly Average density
June,2009	9206.45	13537.04	13293.5	13124.68	14294.10	**12691.15**
July,2009	471.17	539.9	1281.17	1037.64	1037.64	**873.50**
August,2009	487.05	772.94	487.05	539.99	772.94	**611.99**
September, 2009	5119.4	8454.69	7406.45	8470.57	7120.57	**7314.34**
October,2009	5765.28	9063.52	8470.57	7406.45	8470.57	**7835.27**
November, 2009	5939.9	9481.75	9741.16	9481.75	10117.04	**8952.31**
Deamber,2009	4695.87	8677.04	8052.34	8454.69	9968.81	**7969.75**
January,2010	4346.46	8470.57	8677.04	9063.52	9206.45	**7952.81**
February, 2010	6135.87	9968.8	11091.16	10704.69	12181.74	**10016.45**
March,2010	6479.9	10842.34	10704.69	10842.34	12705.86	**10315.03**
April,2010	7872.34	12181.74	11091.16	11779.39	13537.04	**11364.33**
May,2010	8677.04	12705.86	12679.39	12531.16	13897.04	**12098.10**
Annual Density of each Ghat	**5433.06**	**8724.68**	**8581.30**	**8619.74**	**9442.48**	

Graph 1: Annual Density of each Sampling Station



Graph 2: Comparative Density of each Sampling Station



Graph 3: Monthly Average Density of Entire River

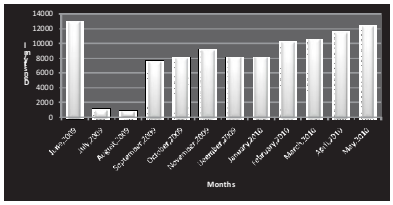


Table 2: Presence and absence each genus at different Sampling Stations and their Pollution Index

S.No.	Genus	Bithoorghat		Ranighat		Sarsaiyaghat		Golaghat		Jajmaughat	
		P/A	PPI	P/A	PPI	P/A	PPI	P/A	PPI	P/A	PPI
1	*Ankistrodesmus*	++	2	--		++	2	++	2	++	2
2	*Chlorella*	++	3	++	3	--		++	3	++	3
3	*Closterium*	++	1	--		++	1	++	1	++	1
4	*Stigeoclonium*	++	2	++	2	++	2	–		++	2
5	*Scenedesmus*	--		++	4	++	4	++	4	++	4
6	*Euglena*	--		--		++	5	++	5	++	5
7	*Anabaena*	++		++		--		++		++	
8	*Chroococcus*	++		++		++		++		–	
9	*Merismopatia*	--		--		++		++		++	
10	*Microcystis*	--		++		++		++		++	
11	*Oscillatoria*	--		++	5	++	5	++	5	++	5
12	*Nostoc*	++		++		++		–		++	
13	*Spirulina*	++		--		++		++		++	
14	*Cyclotella*	++	1	++	1	--		++	1	++	1
15	*Cymbella*	--		++		++		++		++	
16	*Gomphonema*	++		++	1	++	1	++	1	++	1
17	*Fragilaria*	++		--		++		++		++	
18	*Melosira*	--	1	++		--		++	1	++	1
19	*Navicula*	++	3	--		++	3	++	3	++	3
20	*Nitzschia*	++	3	++	3	++	3	–		++	3
21	*Synedra*	++	2	++	2	++	2	++	2	++	2
	PPI		**18**		**21**		**28**		**28**		**33**

P= Presence; A= Absence; ++= Present; -= Absent; PPI= Palmer's Pollution Index.

DISCUSSION AND CONCLUSSION

All sampling stations showed the dominance of Cyanobacteria and Diatoms over to Chlorophyceae. The species of Oscillatoria, Euglena, Scenedesmus, Chlorella, Navicula, Nitzschia, Stigeoclonium, Ankistrodesmus, Closterium, Cyclotella, Gomphonema, Melosira etc. algae are most adapted to the polluted waters and can be effectively utilized as indicators of various labels of organic pollution (Hosmani and Bharti, 1980, 82; Gunale and Balakrishnan, 1981). Oscillatoria, Euglena, Chlorella and Ankistrodesmus are typical inhabitant to most polluted waters (Ratnasabapathy, 1975). According to Patrick (1965) the species of Euglena and Oscillatoria most tolerant to highly polluted water and significant indicator of eutrophication. In present study same genera with high grade points of Palmer's scale such as Euglena viridis, E. gracilis, E. acus, E. elongata, Oscillatoria princeps. O. formosa, O. limosa, O. pseudogeminata were observed. It has already been known that Species of Stigeoclonium tolerant to polluted water and also tolerant to heavy metals (Mclean, 1974).

The algal flora of polluted sites of Ganga at Kanpur showed the dominance of Cyanobacteria and Diatoms such as Anabaena, Chroococcus, Merismopedia, Microcystis, Oscillatoria, Nostoc, Spirulina, Cyclotella, Cymbella, Gomphonema, Fragilaria, Melosira, Navicula, Nitzschia and Synedra.

By the application of Palmer's (1969) Algal Genus Index for Pollution, it has been observed that as many as 9 genera from Bithoorghat with the score of 18, 9 genera from Ranighat with the score of 22, 10 genera from Sarsaiyaghat with the score of 28, 11 genera from Golaghat with 28 score and 13 genera from Jajmaughat with their Pollution Index Score 33 were present. The present investigation indicates that all sampling stations between Bithoor to Jajmau Ganga at Kanpur are suffering from high organic pollution.

Thus, it can be concluded from the above results that there are a large number of pollution indicating algae (21 genera and 36 species) observed which can tolerate various degrees of organic pollution. Therefore, they can be significantly applied as indicators of organic pollution and can be used for the bio-monitoring and control of organic pollution in river Ganges.

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