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A STUDY ON PHYTOPLANKTON DIVERSITY IN RIVER GANGA AT ALLAHABAD, UTTAR PRADESH (INDIA)

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Abstract

Presence of microscopic algae can cause taste and odour problems, water discoloration, or form large mats that can interfere with boating, swimming, and fishing. The present study was conducted to assess the phytoplankton assemblages which in turn can serve as a suitable method to assess the quality of river ecosystem. Diversity of phytoplankton in river Ganga in Allahabad at five sampling stations was conducted from March to April 2014. Plankton identified in the river mainly composed of the members of Bacillariophyceae, Chlorophyceae and Cyanophyceae families. The Palmer pollution index values were calculated to know the level of organic pollution and to support the data. On the basis of quantitative and qualitative estimates 15 significant algal species were identified which can tolerate high degree of pollution. The abundance of phytoplanktons in april was greater than in march. Abundance of phytoplanktons and algal bloom was maximum at Chhatnag ghat whereas at Sangam low phytoplankton diversity was found. In general, moderate temperature, low current velocity and high transparency of water appear to be better the conditions for algal growth in the river Ganga. These findings highlighted the deterioration of water quality of the river due to industrial, commercial and anthropogenic activities. The status of phytoplankton diversity of river Ganga was quite low indicating that the river is highly polluted.

Keywords: Algal bloom, Palmer pollution index, Phytoplankton, Phytoplankton diversity, bioaccumulate.

INTRODUCTION

Rivers have always been the most important freshwater resources and their water finds multiple uses in every sector of development like agriculture, industry, transportation, aquaculture, public water supply etc. The Ganga is a major river in the Indian subcontinent flowing east through the plains of northern India into Bangladesh. The 2,510 km (1,557 mi) long river begins at the Gangotri Glacier in the Indian state of Uttarakhand in the central Himalayas and drains into the Bay of Bengal through its vast delta in the Sunder bans. It is worshipped in its personified form as the goddess Ganga.

Study area

Allahabad

Allahabad is a metropolitan city in the north Indian state of Uttar Pradesh, IndiaThe city's original name – Prayaga or "place of offerings" comes from its position at the sacred union of the rivers Ganges, Yamuna and Saraswati.The river Yamuna merges into the Ganga at this point and the Ganga continues on until it meets the sea at the Bay of Bengal. Allahabad hosts the largest religious gathering in the world known as Maha Kumbh Mela which is celebrated every twelve years and Ardh (half) Kumbh Mela is celebrated every six years. Crores of people take holy dip in the sacred waters of Ganga on the particular day during the Maha Kumbh.

Sampling sites

Sampling sites were selected on the basis of human activities like washing clothes by laundries, bathing and disposal of sewage, cremation activities being done at the bank of Ganga. Other sources of pollution at this site are cattle wallowing, agricultural run-off, flower offerings etc. The sampling sites are given below-

1. Sangam Ghat, 2. Dashashwamedh Ghat, 3.Shivkuti Ghat, 4.Phaphamau Ghat, 5.Chhatnag Ghat

METHODOLOGY

Water samples were taken from five sampling stations of the rivers every month during the course of study. Monthly collections of phytoplanktons were made from five sampling stations using planktonic net of 20 micrometer (lm) mesh size and were preserved in 4% formalin for future use. The plankton identification was carried out with help of literatures and books[(2) and (3)].

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RESULTS

The results of samples collected at five locations in the study area are given in **Table 1** to **Table 4**. The seasonal variation observed in the analyzed parameter at five locations of the river from the entry point in Phaphamau to the exit point Chhatnag is discussed in the following write up.

The results obtained in march and april shows diversity of phytoplankton at Allahabd sites. The abundance of phytoplanktons in april is greater than in march. Chlorella is absent at Phaphamau and Chhatnag sites in the month of march while observed at all sites in april.Spirogyra was observed at all sites except at sangam in march and it was in gigher number in the april at Chhatnag ghat. The population of the genus Chlorella was very common throughout the study period. A single moderate peak, however, occurred during April. Genus Hydrodictyon was present in month of April at almost all the sampling stations studied. The variations in these phytoplanktonic communities indicate the natural management of primary production throughout the year. Most of the chlorophycean members forming prominent peak in the month of March and April. Genus of Microcystis and Pandorina were found throughout the study period at all sampling stations. Higher population of Scendesmus species was observed during the period of April than March and observed at all sites, during which the water level declined gradually from March to April.

Table 1: Variation of phytoplankton community in river Ganga at Allahabad sites in the month of March 2014

S.N.	Algae	Sangam Ghat	Dashashwamedh Ghat	Shivkuti Ghat	Phaphamau Ghat	Chhatnag Ghat
1.	Chlorella	++	++	++	-	-
2.	Chlamydomonas	+++	++	+	+	++
3.	Spirogyra	-	+	+++	++	++
4.	Hydrodictyon	-	++	+++	+++	+++
5.	Cladophora	++	+	-	-	-
6.	Scenedesmus	+	+	++	++	++
7.	Volvox	-	-	++	++	++
8.	Pandorina	+++	+++	++	++	++
9.	Navicula	-	-	+	+	++
10.	Synedra	++	++	-	-	-
11.	Fragilaria	++	++	++	++	+++
12.	Nostoc	-	-	-	-	-
13.	Anabaena	-	-	-	-	-
14.	Oscillatoria	-	-	+	++	++
15.	Microcystis	++	++	++	++	+++

(+)= Present, (++) = Common, (+++) = Abundant, (-) = Absent

Table 2: Vaiation of phytoplankton community in river Ganga at Allahabad sites in the month of April 2014

S.N.	Algae	Sangam Ghat	Dashashwamedh Ghat	Shivkuti Ghat	Phaphamau Ghat	Chhatnag Ghat
1.	Chlorella	+	++	++	++	++
2.	Chlamydomonas	++	++	-	-	++
3.	Spirogyra	+	++	+++	+++	+++
4.	Hydrodictyon	++	+++	+++	+++	+++
5.	Cladophora	+	++	-	-	-
6.	Scenedesmus	+++	++	++	++	++
7.	Volvox	+	+	++	+	+
8.	Pandorina	+	++	++	++	+
9.	Navicula	-	+	++	++	++
10.	Synedra	++	++	++	++	++
11.	Fragilaria	++	++	+++	++	+++
12.	Nostoc	++	+	++	+++	++
13.	Anabaena	+	-	-	++	-
14.	Oscillatoria	-	+	++	-	++
15.	Microcystis	++	++	++	++	+++

(+)= Present, (++) = Common, (+++) = Abundant, (-) = Absent

Chhatnag ghat has observed maximum abundance of phytoplankton and algal bloom also seen their due to very low water velocity and organic pollution whereas at Sangam diversity of phytoplanktons were observed less due to very fast water current and dilution with river Yamuna during the study period. In general, moderate temperature, low current velocity and high transparency of water appears to be better conditions for algal growth in the river Ganga.

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Palmer Pollution Index

Palmer[16] reviewed a composite rating of algae, tolerating organic pollution and developed an index to establish the status of the aquatic body. In this method to determine the level of organic pollution by studying the algae present in a sample of water. A pollution index factor of 1 through 5 has been assigned to each of the 20 types of algae that are most tolerant to organic pollution. Types of algae most tolerant of organic pollution were assigned a factor of 5. Less tolerant types were assigned a lower number. If the pollution index score is 20 or more, the score is evidence of high organic pollution. A score of 15-19 indicates probable organic pollution. Lower scores usually indicate less organic pollution, but they may also occur if something is interfering with algae growth.

Table 3: Palmer Pollution Index of river Ganga at Allahabad sites in March 2014

Genus	Pollution Index	Sangam Ghat	Dashashwamedh Ghat	Shivkuti Ghat	Phaphamau Ghat	Chhatnag Ghat
Microcystis	1	1	1	1	1	1
Ankistrodesmus	2	-	-	-	-	-
Chlamydomonas	4	4	4	4	4	4
Chlorella	3	3	3	3	-	-
Closterium	1	-	-	-	-	-
Cyclotella	1	-	-	-	-	-
Euglena	5	-	-	-	-	-
Gomphonema	1	-	-	-	-	-
Lepocinclis	1	-	-	-	-	-
Melosira	1	-	-	-	-	-
Micractinium	1	-	-	-	-	-
Navicula	3	-	-	3	3	3
Nitzschia	3	-	-	-	-	-
Oscillatoria	5	-	-	5	5	5
Pandorina	1	1	1	1	1	1
Phacus	2	-	-	-	-	-
Phormidium	1	-	-	-	-	-
Secnedesmus	4	4	4	4	4	4
Stigeoclonium	2	-	-	-	-	-
Synedra	2	2	2	-	-	-
Palmer Index Values		15	15	21	18	18

Table 4: Palmer Pollution Index of river Ganga at Allahabad sites in April 2014

Genus	Pollution Index	Sangam Ghat	Dashashwamedh Ghat	Shivkuti Ghat	Phaphamau Ghat	Chhatnag Ghat
Microcystis	1	1	1	1	1	1
Ankistrodesmus	2	-	-	-	-	-
Chlamydomonas	4	4	4	-	-	4
Chlorella	3	3	3	3	3	3
Closterium	1	-	-	-	-	-
Cyclotella	1	-	-	-	-	-
Euglena	5	-	-	-	-	-
Gomphonema	1	-	-	-	-	-
Lepocinclis	1	-	-	-	-	-
Melosira	1	-	-	-	-	-
Micractinium	1	-	-	-	-	-
Navicula	3	-	3	3	3	3
Nitzschia	3	-	-	-	-	-
Oscillatoria	5	-	5	5	5	5
Pandorina	1	1	1	1	1	1
Phacus	2	-	-	-	-	-
Phormidium	1	-	-	-	-	-
Secnedesmus	4	4	4	4	4	4
Stigeoclonium	2	-	-	-	-	-
Synedra	2	2	2	2	2	2
Palmer Index Values		15	23	19	19	23

In present study, in the month of March Shivkuti site has pollution index score of 21 it indicates high organic pollution while at Sangam and Dashashwamedh sites this value is 15 in March and Phaphamau, Chhatnag have 18 palmer index values in March shows

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probable organic pollution. While in April Dashashwamedh and Chhatnag sites show very high organic pollution with palmer index value of 23 whereas Shivkuti and Phaphamau have palmer index value of 19 shows probable organic pollution.

CONCLUSION

Algal diversities are natural occurrences, and may occur with regularity depending on weather and water conditions of the river. The excessive occurrences of phytoplanktons are harmful for water body and also for the organisms depending on it .Excessive algal growth and pollution can turn a holy river into dead water body. Also, there are some algae which secrets toxins which may be fatal to other organisms. It also spoils the aesthetic value of the water body. As these toxic substances do not degrade, they remain persistent in the environment, and also have the ability to bioaccumulate in the food chain, which might pose potential hazards in long run. If all the necessary measures were taken by Government and non-Government simultaneously and seriously can go a long way in alleviating and abating further deterioration of both the rivers with a view to restore its natural unpolluted and healthy ecosystem.

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