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Seasonal Variation of Phytoplankton Community in the river Deorania at Bareilly district of Uttar Pradesh, India

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ABSTRACT

The river Deorania is a good source of irrigation in Bareilly district but today this river is in much worse condition in this region. During extreme months of summer, winter and rainy seasons the qualitative and quantitative analysis of the phytoplankton community of river water Deorania were carried out for three sampling stations. The investigation was carried out during 2005-2006 and 2019-2020 at three different sampling sites. Phytoplankton are prominent primary producers in water bodies. They constitute the main food for zooplankton as well as the majority of fish. Four major groups viz. chlorophyceae, cyanophyceae, euglenophyceae and bacillariophyceae are reported in this water body. In the river deorania, a total of 12 phytoplanktonic genera were identified in the present study. Chlorophyceae include 7 genera, Basillariophyceae include 2 genera, Cyanophyceae include 2 genera and Euglenophyceae include 1 genus.

Key words: Phytoplankton, Deorania river, population density, seasonal variation

1) INTRODUCTION

Alternaria For all living beings, water is an important natural resource and is essential for the biological activities and existence of life. Organisms depend on water for their survival, we too depend on water for irrigation, industry, domestic needs, for sanitation and disposal of waste. A major part of the earth is occupied by water in the form of bodies such as sea, rivers, ponds, lakes, streams, oceans etc. These bodies become polluted due to urbanization, industrial growth, and other man-made problems. Bareilly is the part of Rohilkhand division which lies on the north-west of Uttar Pradesh. It is located approximately between latitudes 28”35’N to 79”60’E. The elevation ranges between 160m-200m above sea level. Bareilly district occupies a sound position among the industrial cities of Uttar Pradesh. About 90 big industries and 1094 small scale industries are operating in the district Bareilly. The river Deorania is a main tributary of river Ram Ganga which is also a main tributary of holy river Ganga. About 8km of its stretch passes through the thickly populated area of Bareilly city [1] and joins river Ram Ganga near Uncha Gaon.

Phytoplanktons are involved in water pollution in a number of important ways. Haque [2], while studying the quality of river water found significant reduction in the plankton population at points where effluents are being discharged into it. In a study carried out by Khan et al. [3] with the river Sankha at Bareilly which receives effluents from industries found that there was a significant change in the composition of fauna and reported that the polluted water of this river also affected the germination of seeds of some leguminous plants.

Phytoplankton is a major component of aquatic ecosystems, not only in terms of biological diversity, but also because it contributes to primary productivity. The phytoplanktons have contributed significantly to producing the oxygen level to sustain the life cycles of all biotic communities of river ecosystem [4]. The phytoplanktons are the main primary producers and are the base of food chains in any water body. Phytoplankton are autotrophs and belong to first trophic level. Plankton communities exhibit an essential role in the biomass production and energy transfer in aquatic environments by including organisms of different trophic levels from the base (phytoplankton) to consumers of high levels (zooplankton) of food web [5].

Phytoplankton is the primary producer which plays an important role in the material circulation and energy flow in the aquatic ecosystem. Its presence often controls the growth, reproduction capacity, and population characteristics of other aquatic organisms [6]. Some phytoplankton species are also often used as good indicators of water quality including pollution described by Rajashree [7]. Phytoplankton through photosynthesis converts solar radiant energy into biological energy as primary production. It plays an important role in conditioning the microclimate, helps in regulating the atmospheric level of O_2 and CO_2, vital gases for life. The

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Phytoplankton study provides a relevant and convenient point of focus for research on the mechanism of eutrophication and its adverse impact on an aquatic ecosystem. The present study focused on productivity of phytoplankton which is the most sensitive floating community. Any undesirable change in riverine ecosystem affects diversity as well as biomass of this community.

2) MATERIALS AND METHODS

Three Sampling stations were selected along the water course of river Deorania. In which Site A was control site and Site B and C are polluted site respectively (Figure 1).

Site A (Control): It is the outer part of river which supports typical fauna & flora of lotic habitat. It is near Thana Bhojipura where Bareilly Nainital Road crosses the river.

Site B (Polluted): This site is located near the city Shamshan Bhoomi, about 50 meters away from that point where major drains of city discharge their contents into it.

Site C (Polluted): This site is near village Sarai Tulphi, about 3 km away from the region where the last drain is connected with the river. Study of water of river at this site will help in studying the ability of river microbes in reducing the degree of pollution.

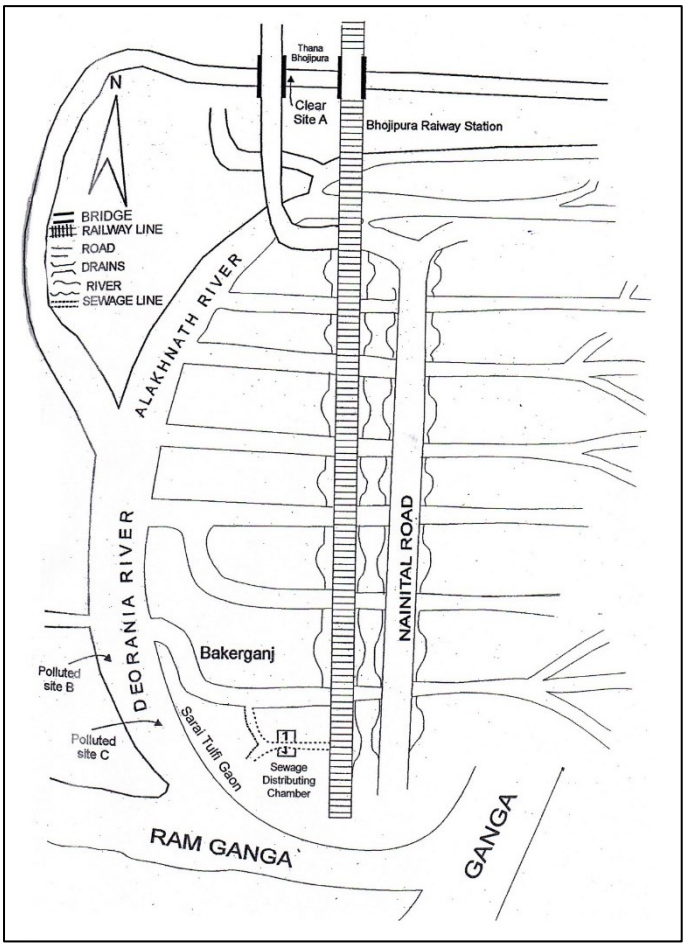


Figure 1: Map Showing all Sampling Station (Source: Municipal corporation Bareilly, U.P.)

For qualitative and quantitative analysis of phytoplankton water samples were collected from above selected three sites in extreme months of winter, summer and rainy season (2005-2006 and 2019-2020), sampling was done fortnightly. Phytoplankton are floating microscopic autotrophs, the larger phytoplankton were collected by filtering a known amount of water through a plankton not made of bolting silk (No. 25 i.e. mesh size 55µm), as through this net only micro and macro phytoplankton can pass out resulting in underestimation of population, this method was considered quite useful in the course of study water sample was taken in a wide mouthed sterilized bottle, to this was added Lugol's iodine solution. For long term preservation sample was preserved in 4% formaldehyde solution. Sample was allowed to stand for 24-30 hours to ensure complete sedimentation of phytoplankton. The clear supernatant was removed with the help of pipette this was examined under stereoscopic binocular microscope. Counting of the plankton was done by a Sedgewickrafter cell.

3) RESULTS AND DISCUSSION

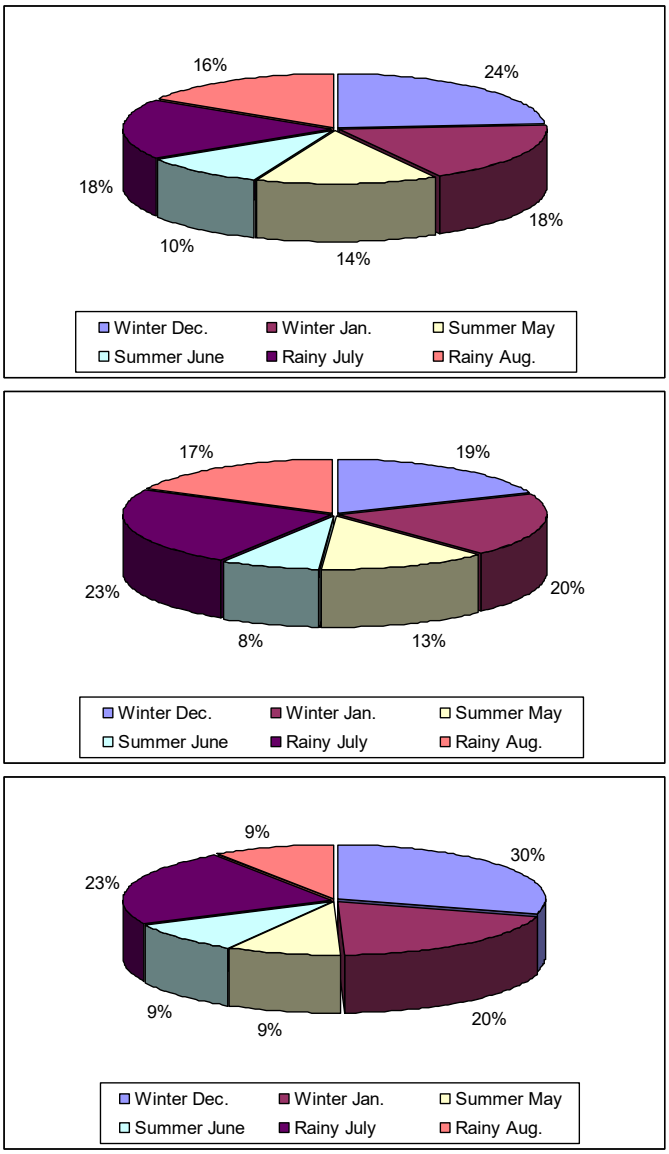
The four major groups of phytoplankton were recorded viz., chlorophyceae, Bacillariophyceae, cyanophyceae and Euglenophyceae. A Total of 12 phytoplanktonic genera were identified in the present study. Chlorophyceae include 7 genera, Bacillariophyceae include 2 genera, cyanophyceae include 2 genera and and Euglenophyceae include 1 genera. The results of phytoplankton diversity are given in table 1 and fig 1. Total numbers of 12 genera of phytoplankton were recorded during the study. Major share of phytoplankton diversity is accounted by Chlorophyceae (green algae) represented by 7 genera (Spirogyra, Ulothrix, Cosmarium, Tetraspora, Selenestrum, Ankistrodesmus and Scenedesmus) followed by Bacillariophyceae (diatoms) which is brown algae, second major group in terms of contribution in phytoplanktonic diversity, represented by 2 genera (Nitzschia and Navicula) followed by the blue green algae (Cyanophyceae) which constituted only 02 genera (Nostoc and Microsystis).followed by Euglenophyceae which constituted only 01 genera (Phacus). During our observations the maximum diversity was recorded during the winter months Similar pattern was observed by Joshi et al. [8] have observed that bacillariophycae were dominant over Chlorophyceae and Cyanophyceae in Ganga River Zooplankton makes a significant link in food web operating in aquatic ecosystems. Euglenophyceae showed tolerance to organic pollution and species belonging to this group could be used as biological indication of organic pollution [9].

Seasonal qualitative composition of phytoplankton diversity at three sampling sites (Thana Bhojipura, City Shamsan Bhoomi and Village Sarai Tulphi K) in the deorania river during the study period (January 2018 to December, 2018) has been depicted in Table-1. The maximum genera of phytoplankton were recorded in the winter months and minimum was in the monsoon months. The Chlorophyceae were dominant over bacillariophycae and Cyanophyceae. In freshwater ecosystems the planktons form a major community. The detailed examination of this community structure in river water Deorania includes the collection counting and identification of planktons on the basis of their quantitative and qualitative analysis. Phytoplanktons in temperate

regions usually grows in a series of blooms which is based on rapid vegetative reproduction with slow process of sexual reproduction occurring only under unfavorable environmental conditions. There is often a marked difference in the phytoplankton population in different seasons of the year, however in temperate regions due to light intensity and temperature in summer and dry seasons there is always an increase in algal population. During winter there is usually a minimum of algal activity caused by physical factors, mainly low light and temperature. The parameters like water, temperature, wind velocity, transparency and salinity widely affect the density of plankton in water [10, 11]. During the present findings, on the basis of qualitative and quantitative analysis of phytoplankton and the total population density has been worked out at three sites in different seasons. A brief consideration of the periodicity of different species of planktons throughout the period of investigation has been described along with their relative importance. Since there were seasonal fluctuations of phytoplankton was reported in river water Deorania. The population density is calculated from the selected sites A, B and C of river water. The abundance of phytoplankton is described for the important species only, which contribute more than 1% in terms of total population density. The seasonal variations in the density of the planktonic species are presented in table (1 and 2) The maximum total population density of phytoplankton 18.500 x 103 units/l at site A was recorded during winter in the month of December 2020. While minimum density of phytoplankton was 1.333 x 103 units/l at site C during summer in the month of May 2005. The seasonal variation in the population density of photoplanktons shows remarkable changes of river water Deorania between control and experimental sites (since experimental site B, and C are heavily polluted thus variation in density of phytoplanktons are obvious). Peelan [12], Mahadevan et al [13] and Bhave and Borse [14] revealed direct relationship of dissolved oxygen and planktons i.e., when dissolved oxygen was maximum the optical density of pigment extract and plankton population were also maximum. The results of the present investigations also support this view.

Table 1: Total population density of phytoplanktons (X x10^3 units/l) from surface -500 cm depth in river water Deorania at sites-A, B and C in different extreme months of winter, summer and rainy seasons during the year 2005-2006.

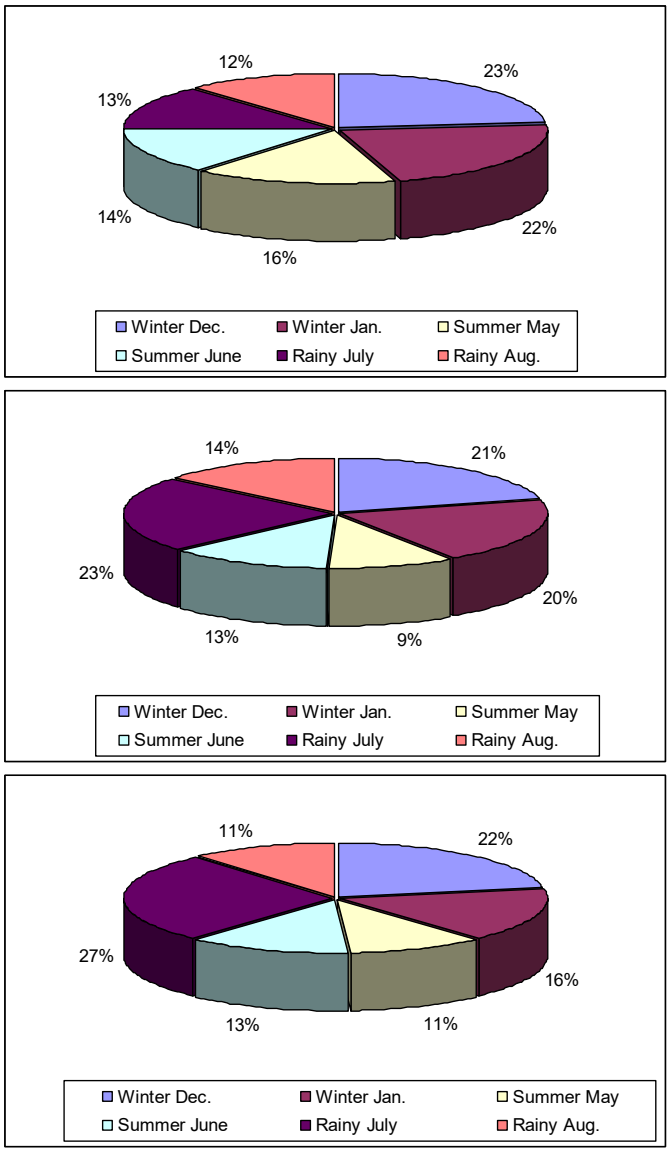
Season	Month	Total population density of phytoplankton		
		Site-A	Site-B	Site-C
Winter	Dec	15.916 x 10^3	4.500 x 10^3	4.417 x 10^3
	Jan.	12.116 x 10^3	4.750 x 10^3	3.000 x 10^3
Summer	May	9.5 x 10^3	3.167 x 10^3	1.333 x 10^3
	June	6.500 x 10^3	1.916 x 10^3	1.416 x 10^3
Rainy	July	12.250 x 10^3	5.741 x 10^3	3.416 x 10^3
	Aug.	10.500 x 10^3	4.250 x 10^3	1.416 x 10^3



Total population density of phytoplanktons (X x10^3 units/l) from surface -500 cm. depth in river water Deorania at sites-A, B and C in different extreme months of winter, summer and rainy seasons during the year 2005-2006.

Table 2: Total population density of phytoplanktons (X x10^3 units/l) from surface -500 cm depth in river water Deorania at sites-A, B and C in different extreme months of winter, summer and rainy seasons during the year 2019-2020.

Season	Month	Total population density of phytoplankton		
		Site-A	Site-B	Site-C
Winter	Dec	18.500 x 10^3	6.500 x 10^3	5.167 x 10^3
	Jan.	17.416 x 10^3	6.167 x 10^3	3.750 x 10^3
Summer	May	12.667 x 10^3	2.925 x 10^3	2.500 x 10^3
	June	10.917 x 10^3	4.000 x 10^3	3.000 x 10^3
Rainy	July	10.667 x 10^3	7.000 x 10^3	6.250 x 10^3
	Aug.	9.167 x 10^3	4.333 x 10^3	2.667 x 10^3



Total population density of phytoplanktons (Xx10^3 units/l) from surface -500 cm depth in river water Deorania at sites-A, B and C in different extreme months of winter, summer and rainy season sduring the year 2019-2020

4) CONCLUSION

Planktonic diversity exhibits a very important component of aquatic reservoir. Human and animal waste discharged directly into the river not only imparts the quality of water but also affects the health of the aquatic flora and fauna. The urban runoff and continuous dumping of waste materials are affecting the water quality of river Deorania. We conclude that there are several reasons for the deterioration of the plankton diversity especially at Deorania river. These findings will help in future studies for bio monitoring of the Deorania river. Therefore, it has been suggested to regularly monitor the water quality of rivers so as to take immediate action for better management of river water.

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Table A: Qualitative and quantitative analysis of phytoplanktons from surface to 500 cm. depth in river water Deorania at sites-A, B and C in different extreme months of winter, summer and rainy seasons during the year 2005-2006.

	Pytoplankton	Winter						Summer						Rainy					
		Site-A		Site-B		Site-C		Site-A		Site-B		Site-C		Site-A		Site-B		Site-C	
		Dec.	Jan.	Dec.	Jan.	Dec.	Jan.	May	June	May	June	May	June	July	Aug	July	Aug	July	Aug
1.	Nostoc sp.	22	12	-	-	-	-	14	17	02	06	-	08	42	33	36	11	22	-
2.	Phacus sp.	18	21	05	08	03	-	16	08	09	03	04	-	08	19	-	-	-	-
3.	Spirogyra sp.	13	06	18	22	17	14	06	-	05	04	02	-	-	-	-	-	-	-
4.	Ulothrix sp.	11	05	07	04	04	03	05	-	03	-	03	-	07	04	-	-	03	01
5.	Cosmerium sp.	16	22	12	09	03	05	08	02	04	-	03	02	04	02	01	05	02	-
6.	Tetraspora sp.	11	06	-	-	-	-	06	06	03	-	02	-	04	17	04	13	02	10
7.	Selenestrum sp.	34	21	08	06	02	-	21	10	04	04	-	03	26	09	-	02	03	04
8.	Microcystis sp.	19	12	04	06	16	14	10	12	-	04	-	02	05	-	-	-	-	-
9.	Ankistrodesmus sp.	36	21	-	-	04	-	14	11	06	02	02	-	20	12	16	10	04	02
10.	Scenedesmus sp.	14	08	-	-	-	-	08	05	02	-	-	02	24	19	12	06	04	-
11.	Nitzchia sp.	16	02	-	-	-	-	06	04	-	-	-	-	-	05	-	-	-	-
12.	Navicula sp.	21	10	-	02	04	-	10	03	-	-	-	-	-	06	-	04	01	-

Table B: Qualitative and quantitative analysis of phytoplanktons surface to 500 cm. depth in river water Deorania at sites-A, B and C in different extreme months of winter, summer and rainy seasons during the year 2019-2020.

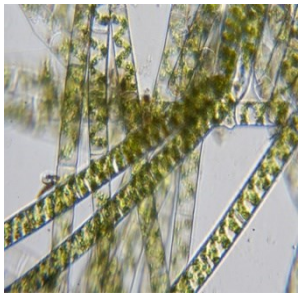
	Pytoplankton	Winter						Summer						Rainy					
		Site-A		Site-B		Site-C		Site-A		Site-B		Site-C		Site-A		Site-B		Site-C	
		Dec.	Jan.	Dec.	Jan.	Dec.	Jan.	May	June	May	June	May	June	July	Aug	July	Aug	July	Aug
1.	Nostoc sp.	28	26	05	05	02	-	12	14	06	08	07	-	22	24	23	02	07	11
2.	Phacus sp.	22	23	07	07	13	05	26	17	05	02	-	02	18	05	-	07	03	-
3.	Spirogyra sp.	21	16	11	-	10	03	22	05	03	-	02	03	-	-	03	02	05	03
4.	Ulothrix sp.	26	22	-	08	07	02	09	04	-	07	03	05	04	-	02	01	03	-
5.	Cosmerium sp.	18	23	15	09	06	11	11	03	02	-	4	7	05	07	11	-	-	-
6.	Tetraspora sp.	13	19	-	12	11	03	08	03	-	02	03	05	16	19	05	10	15	09
7.	Selenestrum sp.	16	22	11	09	02	-	25	17	05	06	-	03	06	03	-	-	-	-
8.	Microcystis sp.	21	05	-	07	-	06	11	09	-	03	-	02	12	03	02	-	-	04
9.	Ankistrodesmus sp.	12	09	07	05	-	-	-	15	15	09	06	09	16	23	11	12	14	02
10.	Scenedesmus sp.	09	21	03	02	-	-	13	14	07	08	03	-	18	21	19	10	13	03
11.	Nitzchia sp.	20	16	14	10	07	12	-	17	02	-	-	-	-	03	03	06	11	-
12.	Navicula sp.	16	07	05	-	04	03	15	13	-	03	02	-	11	02	05	02	03	-



Nostoc



Phacus



Spirogyra



Ulothrix



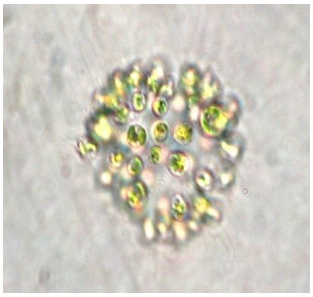
Cosmerium



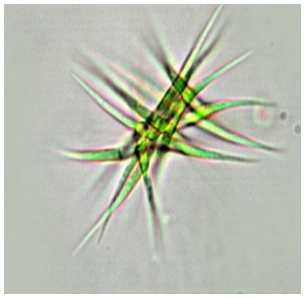
Tetraspora



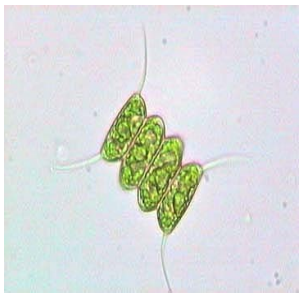
Selenestrum



Microcystis



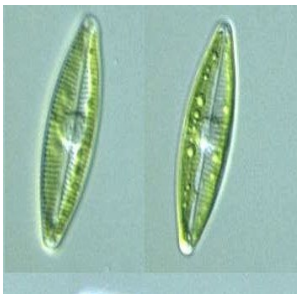
Ankistrodesmus



Scenedesmus



Nitzchia



Navicula

Figure 2: Showing all phytoplankton species found in river Deorania 1. *Nostoc,* 2. *Phacus*, 3. *Spirogyra,* 4. *Ulothrix,* 5. *Cosmerium*, 6. *Tetraspora*, 7. *Selenestrum*, 8. Microcystis, 9. *Ankistrodesmus,* 10. Scenedesmus, 11. Nitzchia, 12. Navicula