

Original Research Article

Seasonal variation in phytoplankton density of Bhagirathi River at Uttarkashi (Uttarakhand) India



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ABSTRACT

Phytoplanktonic study is very important because they act as primary producers, food for variety of aquatic organisms and an efficient bio-indicator for water quality. Large population of phytoplankton is thriving in this wetland which enhances its productivity. A Total of 36 phytoplanktonic genera were identified in the present study. Bacillariophyceae include 15 genera, chlorophyceae include 10 genera, myxophyceae include 7 genera and desmidiaceae include 4 genera. In River Bhagirathi the overall total density fluctuates from 4.0 ± 1.41 Unit l^{-1} (October) to 179.0 ± 26.87 Unit l^{-1} (November). Seasonal total density ranged from minimum 77.67 ± 6.81 Unit l^{-1} (monsoon) at site S_1 to maximum 168.6 ± 53.29 Unit l^{-1} (winter) at site S_2 .

KEYWORDS

Phytoplanktons | Seasonal density | Diversity | River Bhagirathi

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Introduction

Phytoplankton are minute, chlorophyll bearing organism, occupies the lowest level in aquatic food chain pyramid system. They form the base of a grazing food chain and work as primary producers by trapping solar energy in the aquatic ecosystems. These are the major source of dissolved oxygen in the water bodies and are a good indicator of water quality (Wetzel 1975, 2001; Lynch 1980; Pathani *et al.*, 2002). Presence of plankton in any aquatic media directly affects the productivity of that aquatic system. Phytoplankton are very sensitive to changes in these environment and affects dissolved oxygen levels, nutrient concentrations, light levels, and zooplankton biomass. Plankton composition and diversity estimation have often been utilized to evaluate the overall health of riverine ecosystem.

Materials and methods

Two sampling sites (S_1 and S_2) were selected on the river Bhagirathi. The sampling site S_1 is after tailrace water meet with Original River at Joshiyara which is 16 km. from Maneri and site S_2 is before meeting point of tailrace water at Ujaly a distance from 14 km. from Maneri. The Maneri dam is fifteen kilometer from the Uttarkashi

district headquarter and about 165 Km. for from Rishikesh railway station. The Powerhouse of the dam is situated on right bank of river Bhagirathi in Tiloth, which is 1Km. away from the district head quarter. The water of the Maneri Dam tunnel then again meets with the original river Bhagirathi at Tiloth. Phytoplankton samples were collected by filtering 100 liter of water through phytoplankton net of 20 μm size and preserved using 4% formalin. Phytoplankton was identified up to the lowest recognizable taxonomic unit mostly genus following keys by Needham and Needham (1962), Ward and Whipple (1959) and Sarode and Kamat (1984). Phytoplankton was enumerated using Sedgwick-Rafter Cell Counter and number of phytoplankton ml^{-1} of water was calculated according to Welch (1952).

Results

The four major groups of phytoplankton were recorded viz. Bacillariophyceae, chlorophyceae, desmidiaceae and myxophyceae. A Total of 36 phytoplanktonic genera were identified in the present study. Bacillariophyceae include 15 genera, chlorophyceae include 10 genera, myxophyceae include 7 genera and desmidiaceae include 4 genera.

Months	Bacillariophyceae		Chlorophyceae		Desmidiaceae		Myxophyceae	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
November	82.05	77.34	4.69	8.59	5.64	7.81	6.15	6.25
December	64.56	71.26	17.09	13.79	12.03	6.90	6.33	8.05
January	58.93	64.8	17.86	15.20	16.96	14.4	6.25	5.60
February	68.12	66.46	10.87	16.77	13.77	7.45	7.25	9.32
March	72.91	69.23	11.33	12.31	8.37	9.23	7.39	9.23
April	46.15	49.5	23.08	22.77	23.08	17.82	7.69	9.90
May	45.24	53.44	27.38	20.61	17.86	16.79	9.52	9.16
June	47.62	58.39	19.05	21.9	23.81	13.87	9.52	5.84
July	50.00	51.61	18.75	21.51	25.0	16.13	6.25	10.75
August	53.01	59.09	24.1	20.00	13.25	7.27	9.64	13.64
September	42.86	49.06	34.29	26.42	8.57	9.43	14.29	15.09
October	61.67	81.10	11.02	12.6	8.33	2.36	6.67	3.94

Table1: Percentage fluctuation of Phytoplankton of River Bhagirathi during November 2007 to October 2008.

Bacillariophyceae (diatoms) contributed 41.67%, chlorophyceae (green algae) contributed 27.78%, desmidiaceae (desmids) contributed 11.11% and myxophyceae (blue green algae) contributed 19.44% of total population. The diversity of bacillariophyceae biomass was dominating the river Bhagirathi. The Bacillariophyceae had the maximum contribution 82.05% (November) at S₁

to minimum 42.86% (September) at S₁. The chlorophyceae contributes maximum of 34.29% (September) at S₁ to minimum 4.69% (November) at S₁. The desmidiaceae contributes maximum of 2.36% (October) at S₂ to minimum 17.82% (April) at S₂ and myxophyceae contributes maximum of 15.09% (September) at S₂ to minimum 3.94% (October) at S₂ (Table 1)

Months	Bacillariophyceae	Chlorophyceae	Desmidiaceae	Myxophyceae
November	179.0 ± 26.87	17.0 ± 7.07	15.5 ± 6.36	14.0 ± 2.83
December	113.0 ± 15.56	25.5 ± 2.12	15.5 ± 4.95	12.0 ± 2.83
January	73.5 ± 10.61	19.5 ± 0.71	18.5 ± 0.71	7.0 ± 0.00
February	100.5 ± 9.19	21.0 ± 8.49	15.5 ± 4.95	12.5 ± 13.54
March	119.0 ± 41.01	19.5 ± 4.95	14.5 ± 3.54	13.5 ± 2.12
April	40.0 ± 14.14	19.0 ± 5.66	16.5 ± 2.12	7.5 ± 3.54
May	54.0 ± 22.63	25.0 ± 2.83	18.5 ± 4.95	10.0 ± 2.83
June	65.0 ± 21.21	25.0 ± 7.07	22.0 ± 4.24	9.0 ± 1.41
July	44.0 ± 5.66	17.5 ± 3.54	17.5 ± 3.54	7.5 ± 3.54
August	54.5 ± 14.85	21.0 ± 1.41	9.5 ± 2.12	11.5 ± 4.95
September	41.0 ± 15.56	26.0 ± 2.83	8.0 ± 2.83	13.0 ± 4.24
October	70.0 ± 46.67	15.0 ± 1.41	4.0 ± 1.41	4.5 ± 0.71

Table 2: Class wise Mean ± SE total density of Phytoplankton of River Bhagirathi during November 2007 to October 2008.

Month		Winter	Summer	Monsoon
Bacillariophyceae	S1	91.8± 45.90	66.6± 54.95	38.0± 7.21
	S2	122.6 ± 44.85	72.5 ± 17.08	55.0± 8.89
Chlorophyceae	S1	17.6 ± 6.02	20.25± 3.77	19.67± 4.51
	S2	21.6± 4.27	24.0 ± 6.06	23.33 ± 4.16
Desmidiaceae	S1	14.6 ± 6.39	18.0± 4.76	12.33± 7.09
	S2	13.0 ± 6.63	17.75±4.19	11.0± 3.61
Myxophyceae	S1	8.6 ± 3.13	9.5 ± 4.20	7.67 ± 2.52
	S2	11.4 ± 5.03	10.5± 1.91	13.67± 3.21
Total Density	S1	132.6 ± 50.65	114.25± 61.38	77.67± 6.81
	S2	168.6 ± 53.29	124.75± 16.13	103.0± 8.89

Table 3: Seasonally Mean ± SE of density of Phytoplankton in River Bhagirathi during November 2007 to October 2008.

Quantitative fluctuation in the phytoplankton density of River Bhagirathi during the study period has been depicted in Table 2. In River Bhagirathi the overall total density fluctuates from 4.0 ± 1.41 Unit l^{-1} (October) to 179.0 ± 26.87 Unit l^{-1} (November). The diatoms (bacillariophyceae) had the largest contribution followed by green algae (chlorophyceae), than followed by desmidiaceae (desmids) and myxophyceae. (Fig.1). The total density of bacillariophyceae ranged from 40.0 ± 14.14 Unit l^{-1} (April) to 179.0 ± 26.87 Unit l^{-1} (November). The total density of chlorophyceae was minimum 15.0 ± 1.41 (October) to maximum 26.0 ± 2.93 (September). The total density of desmidiaceae ranged from 4.0

± 1.41 Unit l^{-1} (October) to 22.0 ± 4.24 Unit l^{-1} (June). The total density of myxophyceae varied from 4.5 ± 0.71 Unit l^{-1} (October) to 14.0 ± 2.83 (November). Seasonal density of bacillariophyceae ranged from minimum 38.0 ± 7.21 Unit l^{-1} (monsoon) at site S_1 to maximum 122.6 ± 44.85 Unit l^{-1} (winter) at site S_2 . Seasonal density of chlorophyceae ranged from minimum 19.67 ± 4.51 Unit l^{-1} (monsoon) at site S_1 to maximum 24.0 ± 0.06 Unit l^{-1} (summer) at site S_2 . Seasonal density of desmidiaceae ranged from minimum 11.0 ± 3.61 Unit l^{-1} (monsoon) at site S_2 to maximum 18.0 ± 4.76 Unit l^{-1} (summer) at site S_1 .

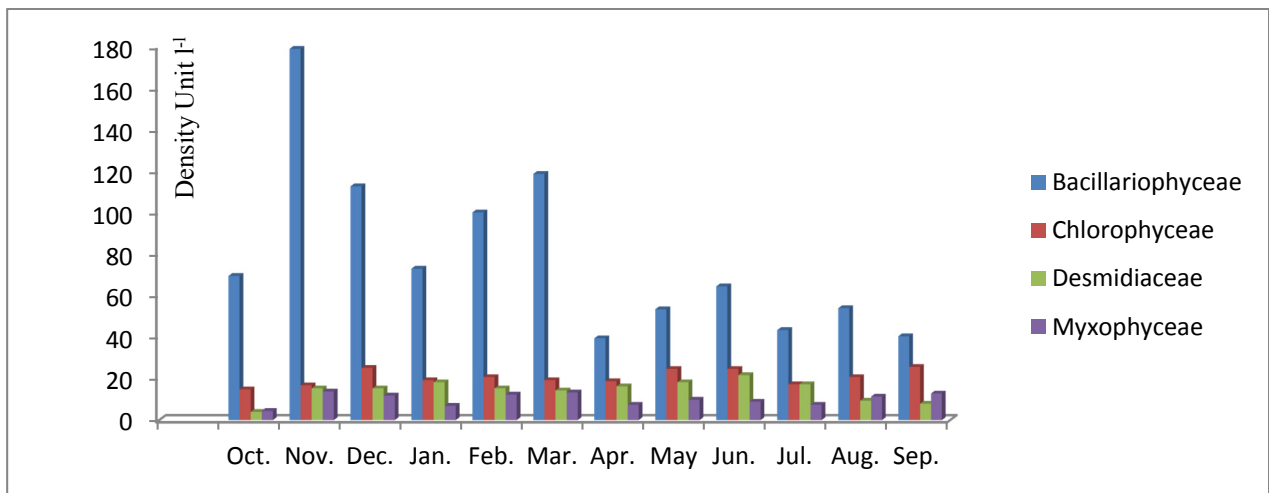


Fig. 1: Graph showing fluctuation in total density of phytoplankton during November 2007-October

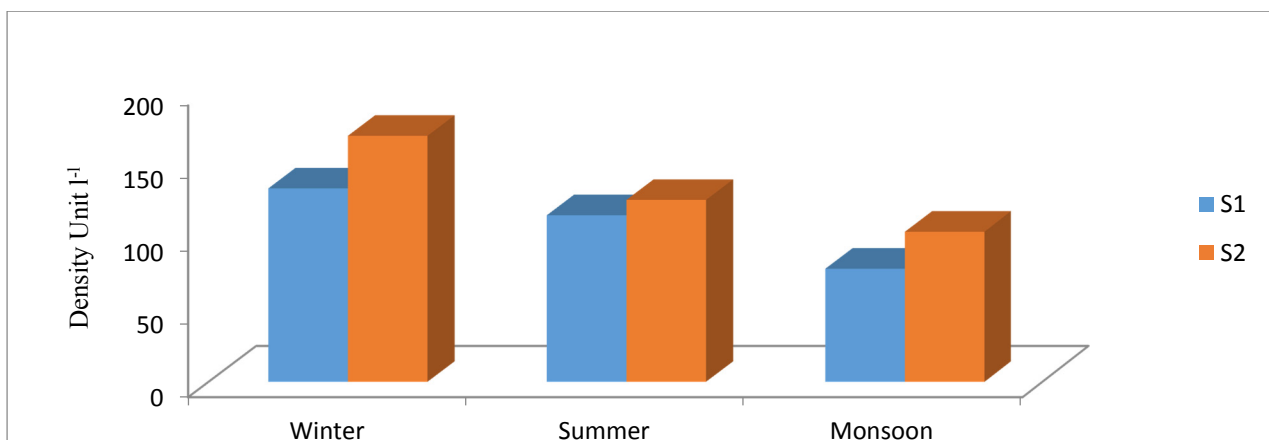


Fig. 2: Graph showing fluctuation in seasonal density of phytoplankton during November 2007-October, 2008.

Seasonal density myxophyceae ranged from minimum 7.67 ± 2.52 Unit l^{-1} (monsoon) at site S_1 to maximum 11.4 ± 5.03 Unit l^{-1} (winter) at site S_2 . Total density ranged from minimum 77.67 ± 6.81 Unit l^{-1} (monsoon) at site S_1 to maximum 168.6 ± 53.29 Unit l^{-1} (winter) at site S_2 (Table 3 & Figure 2).

Discussion

During the study on phytoplankton production in the snow-fed river Bhagirathi in the Garhwal Himalaya. Joshi *et al.* (1996b) observed planktonic density of Ganga canal at Jawalapur (Haridwar) and reported that the plankton density was maximum during winter and it decreased due to increased turbidity during rainy season. Joshi *et al.* (1996a) studied selected tributaries of river Ganga and recorded highest population of plankton during winter season with maximum plankton recorded from December to February and lowest population during monsoon months. Datta and Banik (1997) concluded that during monsoon, growth of periphyton (mainly constituted by the green and blue green algae and diatoms) was less, which was due to change in physico-chemical environment in the eco-system and also due to the effect of water flow, turbulence and increased depth of water. Agarwal and Thapliyal (2005) carried out hydrobiological studied on Bhilangana river and concluded that the maxima fauna density in winter and minima in monsoon season may be due to water temperature, water velocity, and turbidity been lower in winter months and these provide favourable environment for the growth of plankton and other biotic communities. Similar observations were made during the present investigation. Farzaneh *et al.* (2006) have studied the phytoplankton diversity and nutrients at the Jajerood River in Iran and recorded a total of 53 taxa, belonging to four algae classes: Bacillariophyceae, chlorophyceae, cyanophyceae, and dinophyceae. Bacillariophyceae appeared to be dominant group in terms of total genus number during the study

period. They also stated that number of phytoplankton genus was high in summer and quite low in winter. In the present study maximum number of phytoplankton was reported during the winter months whereas maximum density of phytoplankton genus was reported as bacillariophyceae.

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