

SEASONAL VARIATION AND SPECIES COMPOSITION OF PHYTOPLANKTON IN GANGA RIVER AND ITS TRIBUTARY AT GARHWAL REGION, UTTARAKHAND, INDIA

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ABSTRACT

The present investigation has been carried out from March, 2005 to Feb., 2007 in order to determine the seasonal variation of phytoplankton from Ganga river and its tributaries. Samples were collected from four different stations. Three phytoplankton samples were collected from stream and one sample from Ganga river. Plankton samples were taken using 25 μ m mesh plankton net and, after fixing in 4% formaldehyde and identified in the laboratory. A total of 53 genera belonging to 5 groups viz. *Chlorophyceae*, *Bacillariophyceae*, *Cyanophyceae*, *Xanthophyceae* and *Euglenophyceae* were recorded with maximum number of genera from green algae, *Chlorophyceae* (26) followed by *Bacillariophyceae* (12), *Cyanophyceae* (10), *Euglenophyceae* (4) and *Xanthophyceae* (1). The maximum diversity of phytoplankton was recorded maximum at site I (upstream) followed by site II (midstream) while it was recorded minimum at site IV (Ganga river).

KEYWORDS: Phytoplankton, chlorophyceae, synedra, Hinval stream, Ganga River

INTRODUCTION

Phytoplankton as primary producer plays a pivotal role in fixation of solar energy and makes it available to the higher level. It also forms an important link between the abiotic and biotic in the aquatic ecosystem. Phytoplankton consists of diverse assemblage of algae in the streams having different physiological requirements in response to physical and chemical parameters such as light, temperature and nutrients.

In the riverine system, the current velocity allows the planktonic components to establish at any given location, thus becoming a primary limiting factor. Temperature and CO₂, along with light intensity are reported to be the prime factors controlling the algal succession in natural waters and differentiates clearly the growth of two groups, Chlorophyta and Cyanophyta (King, 1970; Young and King, 1973).

Allan (1995) pointed out that instability of physical chemical characteristics of running water makes rivers unique and challenging ecosystems for biological communities dwelling in various habitats. Although several investigations have been carried out on the phytoplankton diversity and their relation

with abiotic factors on Ganga River and its tributaries (Ray et al, 1966 ; Bhatt et al, 1984 ; Nautiyal, 1986, 1990; Singh et al., 1994, Joshi et al, 1996a). There is no previous detailed ecological study on the Hival freshwater stream.

The present work has been carried out in Hival stream, is a small tributary of river Ganga, originating from Surkanda hills (2900MSL) in the Greater Himalayan zone and finally merges into the Ganga River at Shivpuri. The present investigation was carried out to determine seasonal species composition of phytoplankton in the Hival freshwater stream, and Ganga river water to compared the status of phytoplankton communities in the two different water bodies.

MATERIAL AND METHOD

Plankton samples were collected from the four selected sites viz., site I (upstream), site II (Midstream), site III (Down stream) and site- IV (Ganga river) on the monthly basis from March, 2005 to February, 2007 by using sterilized, one-litre wide mouth plastic container at each site (APHA 1998) and immediately fixed in 4% formalin solution. Identification and enumeration was done by freshwater plankton keys by Kadiri, 1993), Ward and Whipple, 1992, APHA 1998 and Kemdirim, 2001.

RESULTS

Species composition and seasonal variation in phytoplankton is documented in Table (1-4). A total of 53 genera belonging to 5 classes viz. *Chlorophyceae*, *Bacillariophyceae*, *Cyanophyceae*, *Xanthophyceae* and *Euglenophyceae* were recorded with maximum number of genera from green algae, *Chlorophyceae* (26) followed by *Bacillariophyceae* (12), *Cyanophyceae* (10), *Euglenophyceae* (4) and *Xanthophyceae* (1).

Although, *Chlorophyceae* exhibited maximum generic diversity, generic density was reported maximum in case of *Bacillariophyceae* at all the sites. The maximum diversity of phytoplankton was recorded maximum at site I (upstream) followed by site II (midstream) while it was recorded minimum at site IV (Ganga river). Among *Chlorophyceae*, *Chlorella*, *Chlorococcum*, *Ankistrodesmus*, *Spirogyra*, *Microspora* and *Actinastrum* were found to be dominant while *Cladophora*, *Tetraspora*, *Zygnema*, *Oedogonium*, *Draparnaldia*, *Miicrothamnion* and *Audouinella* were reported abundant. *Hydrodictyon*, *Botryococcus*, *Tribonema*, *Staurastrum*, *Vaucheria*, *Dichotomosiphon*, *Crucigenia*, *Pithopora* and *Mougeotia* were just recorded.

In case of diatoms belonging to *Bacillariophyceae*, *Diatoma*, *Synedra*, *Gomphonema*, *Cymbella*, *Nitzschia* and *Tabellaria* were dominant. *Navicula* and *Cyclotella* were found to be abundant while *Fragillaria*, *Stauroneis*, *Cocconeis* and *Achnanthes* were recorded occasionally.

Among blue-green algae (*Cyanophyceae*), *Anabena*, *Spirulina* and *Anacystis* were found to be the dominant genera while *Gomphosphaerium* was abundant. *Merismopedia*, *Oscillatoria*, *Chaemisiphon*, *Aphanizomenon*, *Gloecocapsa* and *Nodularia* were recorded rarely.

As far as *Euglenophyceae* (flagellated algae) is concerned, *Euglena*, *Chlorogonium*, *Peridium* and *Volvox* were recorded at some places. Similar was the case with the *Botrydium* sp. belonging to the *Xanthophyceae*.

In case of *Chlorophyceae*, maximum diversity of phytoplanktons was observed in the months of summer, while diatoms belonging to the order *Bacillariophyceae* were observed maximum in the pre-monsoon and winter months. Blue-green algae (*Cyanophyceae*) were observed more in the months of summer, however, members of *Xanthophyceae* and *Euglenophyceae* were observed rarely.

In case of site II, green algae (*Chlorophyceae*) were dominant during pre- and post-monsoon months. Similar trend was observed in case of diatoms and blue-green algae, however, diatoms were recorded almost throughout the year. Member of *Euglenophyceae* were recorded occasionally.

At site III, *Chlorophyceae* were maximum during winter followed by summer seasons. Diatoms were observed throughout the year at this site also, but reported maximum during pre-monsoon and winter seasons. Blue-green algae were dominant during summer season. Members of *Euglenophyceae* were reported very rarely, however, *Xanthophyceae* were not recorded at all.

At site IV (Ganga River), although green algae were recorded in summer and winter months, they were not recorded during the months of monsoon due to high turbidity. Diatoms were also recorded maximum during the months of winter and pre-monsoon months. While members of *Xanthophyceae* were not recorded, blue-green algae and *Euglenophyceae* were recorded very rarely.

As maximum diversity of phytoplankton was observed during pre- and post-monsoon months at all the sites, it may be inferred that with the decrease in the water temperature, planktonic growth is increased. During these months, values of dissolved oxygen were observed maximum at all the sites, thus promoting the planktonic population. A regular pattern in the values of total hardness at all the sites was observed, where maximum values were reported during winter months when planktonic growth was maximum. Similar trend was observed in case of alkalinity.

Thus it can be inferred from the above findings that water temperature, dissolved oxygen, total hardness and alkalinity has a direct influence on the planktonic growth while pH, free CO₂, TDS, Chlorides, Phosphates and Nitrates have no link with the planktonic growth.

DISCUSSIONS

During the study on phytoplankton production in the snow-fed river, Bhagirathi in the Garhwal Himalaya, Joshi et al. (1993) found the planktonic production was maximum during December- February and minimum in July- August.

Joshi et al, (1996b) observed planktonic density of Ganga canal at Jawalapur(Hardwar) and reported that the plankton density was maximum during winter and it decreased due to increased turbidity during rainy season.

Badoni et al. (1997) observed during the study on the variation in the epilithic diatoms community in the Ganga river water that the diatom density begins to decline with the increase in water temperature, current velocity and turbidity. Similar observations were made during the present investigation. Pandey *et al.* (1995) observed that group chlorophyceae and myxophyceae were abundant in summers whereas diatoms and euglenophyceae were mostly present in winter seasons.

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.

Pande and Mishra, 2000) studied the water quality of freshwater bodies of Dehradun and collected the members from group chlorophyceae, bacillariophyceae, rhodophyceae and cyanophyceae from Sahatradhara stream while members from chlorophyceae, bacillariophyceae and cyanophyceae from Mussoorie Lake.

Kutty et al., (2001) have reported a total 81 genus which is consist of 135 species of Bacillariophyta, Chlorophyta, Cyanophyta, Euglenophyta and Pyrrophyta division. They stated that chlorophyta was quantitatively and qualitatively the most dominant division, which was dominated by genus *Staurastrum* spp., *Cosmarium* spp, and *Ankistrodesmus falcatus*. During the present investigations maximum diversity of phytoplankton was belongs to genus Bacillariophyta.

Atici, 2002, reported during the study on phytoplanktons from Sariyar Dam reservoir, Turkey, one species from Cyanobacteria, 14 from Chlorophyta, 3 from Euglenophyta and one from Heterokontophyta.

Dutta et al, 2004) studied the ecology of plankton of Jammu and reported a total of 19 genera of phytoplankton. Out of which the dominance was shown by bacillariophyceae (8 genera), followed by Cyanophyceae (6 genera) and Chlorophyceae (5 genera).

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.

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 where as maximum diversity of phytoplankton genus was reported as Bacillariophyceae.

Negi et al, 2007 reported a total of 38 genera of phytoplanktons from three streams of District Nainital where *Bacsillariophyceae* was the dominant group with 21 genera followed by *Chlorophyceae* (13 genera), *Xanthophyceae* (2 genera), *Crysophyceae* (1 genus) and *Cryptophyceae* (1 genus).

Hossain *et al.*, (2008) have studied the comparison on water quality and plankton production between perennial and non perennial ponds in Bangladesh and state that total phytoplankton and zooplankton were also greater in perennial pond than of non-perennial ponds.

Laskar and Gupta, 2009) investigated Barak Valley of Assam and studied the phytoplankton diversity, density and distribution in different seasons and their correlations with physico-chemical properties of water and maximum number of species during pre-monsoon (29 species) and lowest in winter (23 species). Members of chlorophyceae were recorded in reasonable number throughout the year while being most abundant in pre-monsoon and monsoon.

According to Adirondack Ecologists (2010) abundance and species composition of algae can have significant implication with regards to both water clarity and quality of any given body of water.

Nowrouzi and Valavi (2011) has concluded that, increase of water temperature and nutrients in spring are both essential factors, which cause increasing of phytoplankton abundance and diversity. In summer, despite increasing water temperature, nutrients consumption by phytoplankton and also grazing by zooplankton causes decrease in phytoplankton abundance and diversity. In the present investigations maximum diversity of phytoplankton was recorded during the winter months where the water temperature was low as compared to summer and spring seasons.

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