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PHYTOPLANKTON STUDIES OF HOKARSAR WETLAND, KASHMIR

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ABSTRACT

The present study on Hokarsar wetland was undertaken during 2008 for studying the ecological distribution of phytoplankton assemblages. A total of 23 genera of phytoplankton belonging to Chlorophyceae (10), Bacillariophyceae (08) and Cyanophyceae (05) were recorded at four different sites. Almost a clear dominance of Bacillariophyceae over Chlorophyceae and Cyanophyceae was observed throughout the study period. Phytoplankton displayed its maximum growth and development during the spring, followed by summer season. The number of common taxa recorded from all the sites were 18 while as genera like *Tabellaria*, *Pandorian* and *Cocconeis* were observed from sites I and II only. A perusal of data at different study sites revealed no apparent changes in species composition of phytoplankton at different study sites as supported by diversity and similarity index values.

Key words: Hokarsar, phytoplankton, wetland, Bacillariophyceae, relative density

INTRODUCTION

Wetland issues have become increasingly prominent as the effects of large-scale wetland losses are assessed (Mitsch and Gosselink, 2000). The effects of wetland losses and recognition of their societal value has led to the adoption of laws that attempt to protect wetlands. In recognition of the importance of this loss, appropriate identification, elineation, and management of remaining wetlands are needed to assess the effectiveness of wetland protection plans. However, our understanding of the fundamental components of wetlands (i.e., hydrology, soils, vegetation, and topography), and their interaction with each other, is often not sufficient to meet this goal (Hunt, 1996; Hunt *et al.*, 1998, 1999), especially for wetlands that are only seasonally wet.

Phytoplankton are the primary producers and good indicators of the trophic status of aquatic ecosystems. They convert solar energy to chemical energy and release oxygen to the water body and the surrounding terrestrial environment through photosynthesis. Half of the world's oxygen is produced via phytoplankton photosynthesis (Roach, 2004). Phytoplankton productivity and composition are influenced by the spatial and temporal dynamics of environmental factors. Their periodicity in temperate areas follows a typical seasonal pattern (Sommer, 1989; Reynolds, 1989) dominated by the solar energy cycle (Patterson and Wilson, 1995) but this pattern in the tropics is less apparent and is controlled mainly by weather and related changes.

The succession of different phytoplankton populations is dependent on the degree to which they can adapt to changes in the critical environmental factors such as nutrients, sedimentation, light and turbulance (Smayda, 1980). Numerous studies have been made on the species composition, population densities and their seasonal dynamics in phytoplankton communities of all kinds of water bodies throughout the country (Lakshminarayana, 1965; Vyas, 1968; Vyas and Kumar,1968; Munawar, 1970; Kant and Kachroo, 1973, 1974, 1977; Rao, 1975, 1977; Zutshi and Vass, 1977; Singh and Swarup, 1980; Rao *et al.*, 1982; Sharma *et al.*,1982; Uhlmann *et al.*, 1982; Zafar, 1986; Sarwar and Zutshi, 1987,1988; Zutshi and Wanganeo, 1984; Unni, 1993; Pandit, 2002; Bhat and Yousuf, 2002; Bhat and Pandit, 2003; Badr and Pandit, 2006). Taking above particulars into consideration it was thought worthwhile to make an attempt of taxonomic survey of phytoplankton of this particular wetland ecosystem which is called the "Queen wetland" of Kashmir.

STUDY AREA

Hokarsar is a permanent shallow wetland, designated recently as Ramsar site spread over an area of 10 sq.km situated to the southwest of Srinagar on Srinagar-Baramulla Highway. The famous wetland is fed by perennial Doodganga stream from the west. The wetland drains into river Jhelum on the northwest by a small stream near village Sozieth .The catchment of the wetland is comprised of flat arable land under intense paddy cultivation besides little cattle grazing .The wetland is surrounded by a thick canopy of willow (*Salix* sp.) trees besides some popular (*Populus* sp.) trees. The wetland is characterized by dense macro-vegetation both rooted floating type and emergent especially *Typha angustata*, *Phragmites australis*, *Nymphaea* sp. and *Trapa natans* besides providing ideal nesting and breeding ground for good number of residential birds and also for feeding ground for a host of migratory birds. Four study sites were selected for collection of phytoplankton samples from the wetland (Fig. 1).

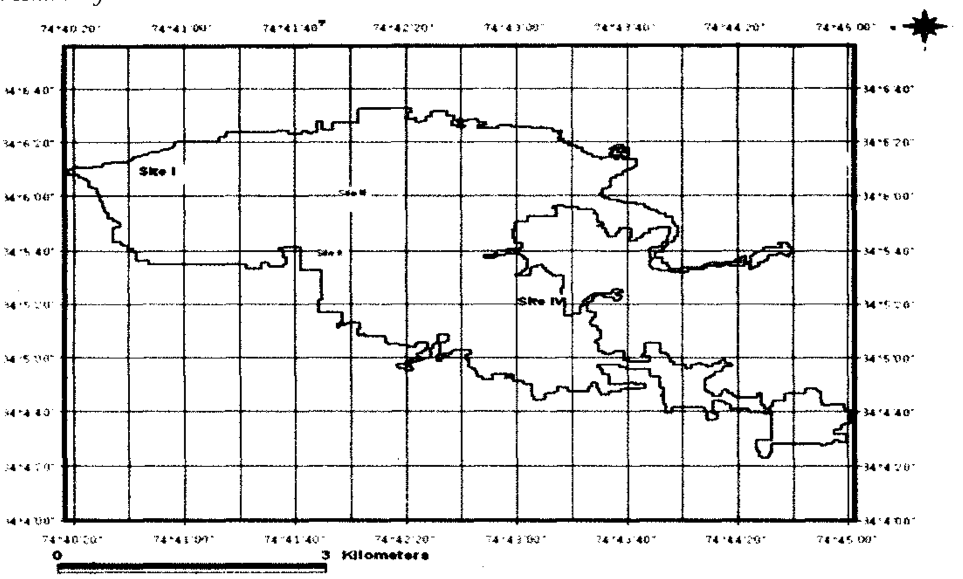

Fig. 1. Location of study sites in Hokarsar Wetland

Site – I

This is the only site at inlet where Dudhganga stream enters the Hokera wetland. It is situated near the village of Hajibagh at the entrance of the stream in the wetland.

Site – II

The second site is chosen inside the wetland having open water and is only few meters away from bird watching site.

Site – III

This site is also chosen inside the wetland; this site is far from bird watching site and is located in open water.

Site – IV

The site is located at the outlet near the village of Sozeith.

MATERIAL AND METHODS

For the estimation of phytoplankton composition and abundance, composite samples from four sampling sites were taken so as to represent the whole wetland. From the composite samples, 100 ml aliquots were removed and preserved with Lugol's iodine solution. The field study was carried out during the course of investigation from May to October 2008. Collection of samples was done by filtering 50 litres wetland water through plankton net of bolting silk (No 25, mesh size 55μm). The content collected in the plankton tube attached to the lower end of the net was transferred to the wide mouth plastic bottle. The samples were subsequently reduced to known volumes by centrifuging for about 20 minutes at 2000 rpm. The concentrated samples were used for both qualitative and quantitative analysis.

The cell number (cells/L) of the wetland water was calculated according to Hotzel and Croome (1999) and Wetzel and Likens (2000). The unicellular algae were counted as individuals, where as in the filamentous forms, each filament was taken as unit. On the other hand, for colonial forms like *Volvox* sp. etc. counting unit was the colony (Jumppanen, 1976). The plankton were expressed as units/litre. Both preserved and fresh samples taken with the help of phytoplankton net (55im mesh size) were used for the identification of major phytoplankton taxa using the standard identification keys (Prescott, 1939; Whitford and Schumacher, 1973; Pennak, 1978; Gasse, 1986; Komarek and Kling, 1991; Edmondson, 1992; Cox, 1996; APHA, 1998; Komarek and Anagnostidis, 2000; Cronber and Komarek, 2004).

RESULTS AND DISCUSSION

Phytoplankton in the present study exhibited a very little diversity in species number across different sampling sites of Hokarsar wetland. A total of 23 genera of phytoplankton belonging to Chlorophyceae (10), Bacillariophyceae (08) and Cyanophyceae (05), were recorded across four different sites during the period of investigation. The number of common species recorded from all the sites were 18 while as genera like *Tabellaria, Pandorian* and *Cocconeis* and were observed from only sites I and II only. Amongst 23 genera, the highest number of taxa (21), were registered at site II while as sites I, III and IV recorded 20 each. Comparative analysis revealed that Chlorophyceae, Bacillariophyceae and Cyanophyceae contributed 9, 7 and 4 genera at site I. At site II 9 genera belonged to Chlorophyceae, 7 to Bacillariophyceae, 5 to Cyanophyceae. However, a similar pattern in terms of contribution to algal taxa was observed for sites III and IV with 9 belonging to Chlorophyceae, 6 to Bacillariophyceae and 5 to Cyanophyceae. Qualitatively, Cholorophyceae was the most dominant algal class at all the sites as against Cyanophyceae which was least represented. The most numerically dominant genera found during the entire study period were *Ankistrodesmus* , *Cosmarium, Closterium, Cladophora Oedogonium, Pediastrum, Scenedesmus, Volvox and Chlorella* among Chlorophyceae; *Astronella,, Cymbella, Navicula, Pinnularia, Synedra, Melosira, and Tabellaria among* Bacillariophyceae and *Anabena, Nodularia, Oscillatoria, and Spirulina* among Cyanophyceae.

Chlorophyceae

Among the sites studied the population density of Chlorophyceae fluctuated from a minimum of 640 ind./l at site IV in autumn season to a maximum of 1544 ind./l at site III in spring. The highest density peak of Chlorophyceae was noticeable in summer. The life-forms which contributed their major share in the overall density of Chlorophyceae were *Cosmarium* and *Cladophora*. On the other hand, mean density values ranged from a minimum of 851 ind./L at site IV to a maximum of 1120 ind./L at site III (Table 1).

Table 1. Spatio-temporal variations in density (Ind./L) of phytoplankton at four different sites of Hokarsar wetland

	Site	Spring	Summer	Autumn	Mean
Chlorophyceae	I	924	1116	816	952
	II	1088	1120	778	995
	III	1544	1148	668	1120
	IV	920	992	640	851
Bacillariophyceae	I	1344	708	700	917
	II	1740	908	920	1189
	III	1628	1216	668	1171
	IV	1228	856	1104	1063
Cyanophyceae	I	512	340	212	355
	II	908	788	764	820
	III	916	932	628	825
	IV	308	492	400	400
Total		13060	10616	8298	10658

Bacillariophyceae

The population density of Bacillariophyceae varied from a low of 668 ind./l at site III in autumn to a high of 1740 ind./l at site II in spring. Pronounced population peak was noted in spring with values ranging from a minimum of 1228 ind./L (site IV) to a maximum of 1740 ind./L (site II). Different genera like *Cymbella*, *Navicula* and *Synedra*, were the major contributors to the overall population density at most of the sites. Besides, the highest mean density was recorded at site II (1189 ind./L), followed by site III (1104 ind./L), site IV (1063 ind./L) and declining to the lowest of 917 ind./L at site I (Table 1).

Cyanophyceae

The population density of Cyanophyceae reached its highest peak (932 ind./L) at Site III in summer while as the lowest population density (212 ind./L) was obtained at site I in autumn. Like other algal classes, the blue-greens also depicted their maximum population density in spring which ranged between 308 ind./L at site IV and 916 ind./L at site III. Genera like *Oscillatoria* and *Rivularia* were the most dominant species contributing the major portion to the overall density of cyanophycean group. Further, the highest mean density values was recorded at site II (893 ind./L) against the lowest (355 ind./L) being recorded at site I (Table 1).

Relative Density (Percentage Composition)

Bacillariophyceae dominated quantitatively (32-52%) in the overall phytoplankton production, at site I during summer and autumn, while at site II it dominated during spring. However, at site IV Bacillariophyceae again made decisive proportion in summer only. Bacillariophycea was closely followed by Chlorophyceae and ranked second (29-52%) in its overall dominance pattern which was conspicuous during spring at site I, in autumn at site II and again in spring at site III and IV. The percentage composition of Cyanophyceae was lesser as compared to other two taxonomic groups and, therefore, ranked third (12-32%) in the overall phytoplankton population. It was sparsely noticeable during the present study. On the basis of mean relative density values Chlorophyceae contributed highest (44 %) at site I and lowest (33%) at site II while as Bacillariophyceae exhibited its maximum proportion (46%) at site IV against the minimum (37 %) being recorded at site III. Cyanophyceae was however found to contribute a fairly major share (28%) each at site II and III against the minimum of 15 % at site I (Fig. 2).

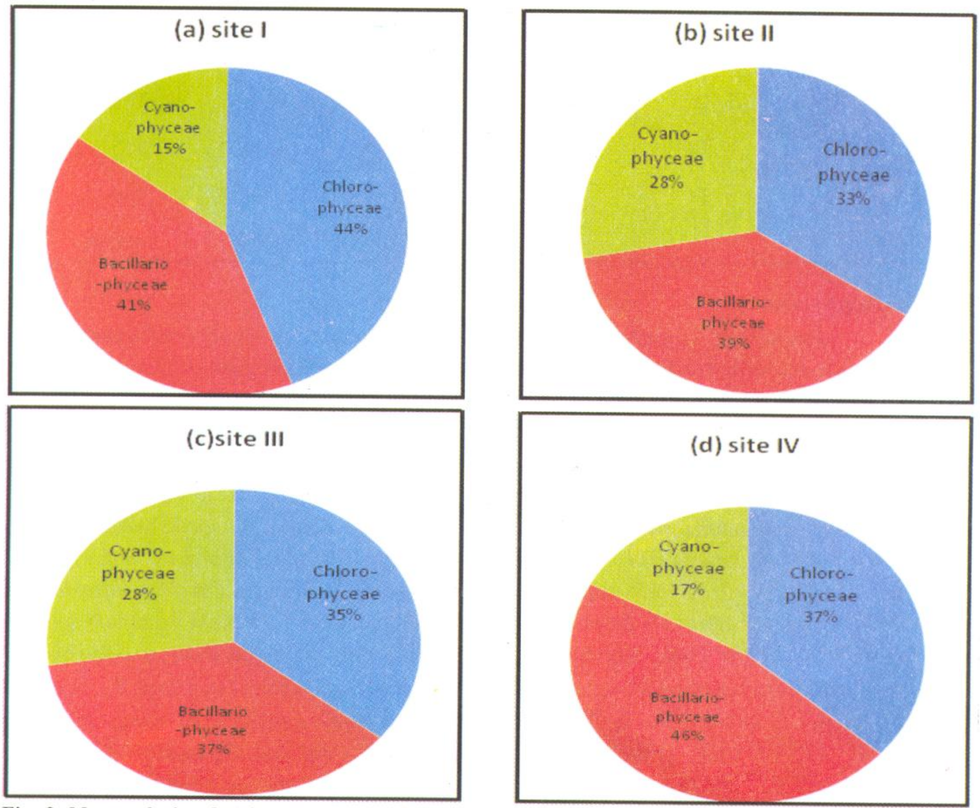

Fig. 2. Mean relative density of phytoplankton groups at different sites

Highest values of Shannon Weiner Index (Fig. 3) were found each at site I and III (2.76) agaist the lowest being obtained at site II (2.72). A close look on Sorensen's similarity coefficient indicated that all the sites were closely related as is also revealed from diversity index values (Table 2).

Table 2. Sorenson similarity coefficient (%) between different selected sites on the basis of phytoplankton

	Site II	Site III	Site IV
Site I	87.80	90.00	95.00
Site II		92.60	97.56
Site III			100.00

Fig. 3. Shannon Diversity index values at different sites

Phytoplankton compositions are affected by different environmental factors such as pH, light and temperature, nutrients (Buzzi, 2002). Increasing the input of phosphorus to a low nutrient water body generally results in a dramatic elevation of phytoplankton standing crop besides favouring certain species over others (Schindler and Fee, 1974; Schindler, 1977). The relative abundance of certain nutrients can also influence phytoplankton species composition and therefore species of phytoplankton can be useful indicators of water quality (Kitner and Poulickova, 2003; Rey *et al.*, 2004). The number of taxa recorded in the present study is very low in comparison of the previous records which is likely due to limited sampling and a period of study in the present investigation. Further, the representation of other algal classes apart from Chlorophyceae, Bacillariophyceae and Cyanophyceae is lacking on account of limitations in the sampling frequency. Seasonal phytoplankton dynamics in lakes involving multiple shifts of dominant algal species has been corroborated against a background of zooplankton abundance and nutrient dynamics (Melack, 1976). The same very reason can justify the seasonal decline in phytoplankton cell numbers as has been attributed to increased abundance of rotifer and copepod zooplankton grazers, which are important source of mortality for phytoplankton and thus bringing about seasonal changes in the abundance of phytoplankton (Reynolds, 1984). Phytoplankton seasonality in wetlands and lakes is influenced by external factors (e.g. biological) and periodic changes in the hydrographic structure of the water column (Talling, 1986; Reynolds, 1984), which is more influential in closed water bodies. Temporal patterns in phytoplankton with some environmental aspects observed by Harding (1963) and Iles (1960) indicated that highest abundance occurred in June-July (rainy) and the lowest in January-March (dry).However, in the present study depicted the phytoplankton peak growth was registered in spring season and the same has been also reported by Kaul *et al.* (1978) for wetlands of Kashmir.

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