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Seasonal variations in diatom richness, diversity and density of Chandraprabha river within sanctuary

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Abstract

The present investigation was undertaken for the first time on the water of Chandraprabha river with in Sanctuary to the study the diatom diversity, density and distribution during different season and their correlation with physico-chemical properties of water. The diatoms are broadly categorized as centrales, fragiliroides, raphidioids and biraphids of which the share of the biraphids is largest (more than 60%). Epilithic samples (24 nos) were obtained between April 2011 to March 2012 by scraping an area of 3x3 cm from cobbles. In all 224 diatom taxa (species, varieties and forms) belonging 43 genera were identified, along with some unidentified forms. Genus *Navicula* (35), *Cymbella* (23), *Nitzschia* (22), *Gomphonema* (19), *Achnanthidium* (14), *Amphora* (10) and *Synedra* (8) were recorded with the maximum number of species. Shannon-Weiner diversity index (H′) value (3.4) and Evenness (J′) value (0.92) were found to be highest during winter while Margalef index (32.2) was highest in summer. Maximum density of diatoms were recorded in winter (629 ± 29.25 /m^2) and minimum in monsoon (284.8 ± 11.91 /m^2), while it was (413 ± 32.81 /m^2) in summer. Present study revealed that the diatom species richness, diversity and density attain maximum growth during summer and winter months and gradually decline during monsoon.

Keywords: Chandraprabha river, diatom diversity, *Nacicula, Cymbella, Nitzschia.*

Introduction

Wetlands are dynamic ecosystems, continually undergoing natural changes due to infilling with sediments and nutrient subsidence and a rise in water levels due to heavy floods. They sustain all life forms and perform some useful functions in the maintenance of overall balance of nature. Rapid urbanization, burgeoning human population and their anthropogenic activities have contributed to the decline of the quality and quantity of these wetlands. The main anthropogenic factors that have contributed to wetland changes are: change in area (habitat loss), change in water regime and water quality, unsustainable exploitation of wetland resources, and interaction of alien species (Piyankarage *et al.* 2004).

Epilithic diatoms are important primary producers and key food source for benthic organisms (Beltrones & Romero 2004) in shallow aquatic environments. Seasonality and water quality alterations have been linked to changes in aquatic biota and each species of diatom has a specific distribution range and tolerance for environmental variables. Diatoms have proven potential for diversity and abundance in freshwater ecosystem (Nautiyal *et al.* 1996). The present investigation deals with the seasonal fluctuations of the diatom abundance and distribution of flora with reference to changes in physico-chemical parameters in wetland habitat of Chandraprabha sanctuary. Within this protected area (PA) the Chandraprabha River has been impounded thus creating a reservoir (wetland). Below the dam, the river flows and forms some beautiful waterfalls.

Materials and Methods

Chandraprabha was declared a wildlife sanctuary in 1957 by Uttar Pradesh Government on account of its rich bio-diversity. The Chandraprabha wildlife sanctuary, which spreads across 78 sq. kms (area 20845 ha) lies on

Naugarh and Vijaigarh hillocks in the Vindhya range of dense forests and green grasslands in Varanasi district (Fig. 1). It lies between north latitude 24^0 55' 38" - 24^0 56' 48" and East Longitude 83^0 10' 08" - 83^0 10' 33". The climate is usually hot round the year with an average rainfall of 800-1000 mm. Maximum temperatures during the long dry season in summer soars to 44° Celsius while winters are usually mild. Almost 13% of the land is covered with forests, dominated by thorny species such as *Zyzyphus glabarrima*, *Dicrostachys cinerea*, *Randia dumetorum* and *Carissa spinarum* while other plant species include Bamboo, *Pterocarpus*, *Anogeissus*, and *Buchanania*.

The studies were carried out at seasonally from April 2011 to March 2012 at Chandraprabha Sanctuary. The season were defined as summer, monsoon and winter. Water samples for physico-chemical analysis were collected from two stations in polythene cans. Temperature and conductivity, pH, salinity, total dissolved solids were determined at site itself using portable Hanna meter and chemical features were measured in the laboratory following the Standard Methods (APHA *et al.* 2000).

Figure 1: Satelite Map showing the study area i.e. Chandraprabha sanctuary.

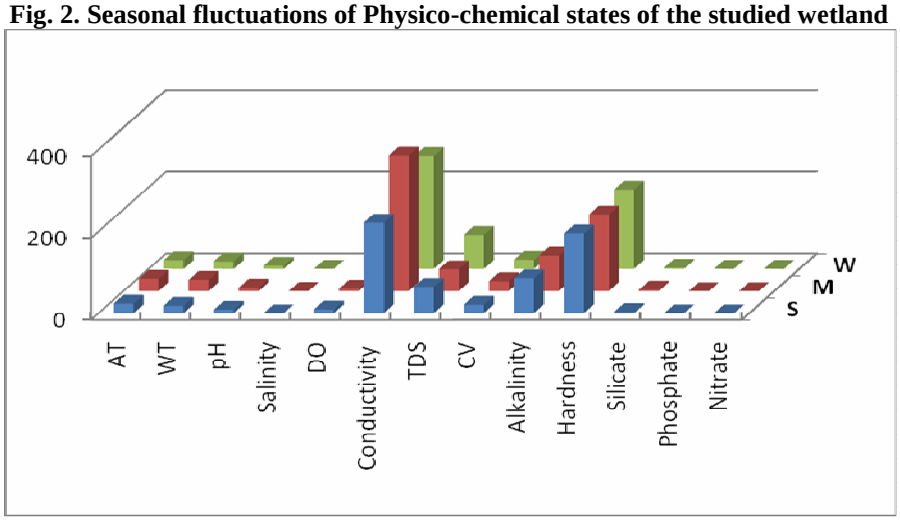
The epilithic samples were collected during summer, monsoon and winter. Diatoms were prepared by acid oxidation with concentrated sulphuric acid and potassium dychromate. Permanent slides were mounted using Naphrax (r.i. 1.74). At least 400 valves were counted on each slide on random transects with a light microscope using phase-contrast and Nomarski differential interference contrast optics at a magnification of 1000x. The identification

mainly followed Krammer & Lange-Bertalot, (1986–1991). The abundance, total density (indiv. m^{-2}) and species diversity (Shannon 1960 at Log_e base) were computed from counts with the help of PAST software.

Result and Discussion

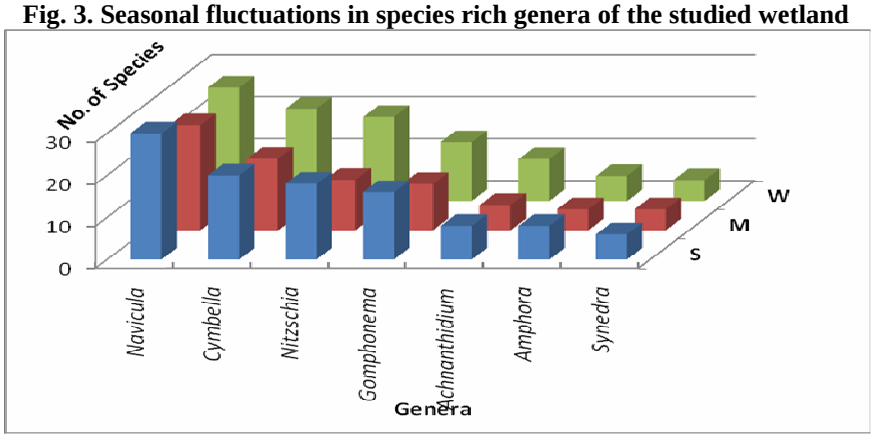
The range values of physico-chemical characteristics clearly show the seasonal differences. The range values of air, water temperature, pH, Salinity, Silicate, Nitrate and Phosphte were similar for both the sites. The Dissolved Oxygen (DO), Specific conductivity, Total Dissolve solids (TDS) and Current Velocity (CV) varied on both the sampling sites (Fig. 2).

Fig. 2. Seasonal fluctuations of Physico-chemical states of the studied wetland



Overall, 224 diatom taxa were observed with 43 genera., out of which, biraphid diatoms accounted with maximum taxa as compared to monoraphid, araphid and raphid. However 5 centrale were observed. The highest number of diatoms were recorded during summer (202), followed by winter (193) and least was recorded in monsoon season (178) (Table 1). Genus *Navicula* (35), *Cymbella* (23), *Nitzschia* (22), *Gomphonema* (19), *Achnanthidium* (14), *Amphora* (10) and *Synedra* (8) were found with the maximum number of species (Fig. 3). The maximum number of species of *Navicula*, *Gomphonema Synedra* and *Amphora* were observed in summer while *Cymbella*, *Nitzschia* and *Achnanthidium* in winter season. However minimum number of species were identified during monsoon season.

Fig. 3. Seasonal fluctuations in species rich genera of the studied wetland



Maximum density of diatoms were recorded in winter (629 ± 29.25 /m^2) and minimum in monsoon (284.8 ± 11.91 /m^2), while it was moderate (413 ± 32.81 /m^2) in summer. Shannon-Weiner diversity index (H') value (3.4) and Evenness (J') value (0.92) were found to be highest during winter while Margalef index (32.2) was highest in summer (Table 1).

Table 1. Seasonal fluctuations in different indices of diatoms in the studied wetland.

Indices	S	M	W
Taxa_S	202	178	193
Individuals	502	442	521
Dominance_D	0.01	0.01	0.01
Shannon_H	3.2	2.8	3.4
Simpson_1-D	0.99	0.99	0.99
Evenness_e^H/S	0.89	0.79	0.92
Menhinick	8.32	8.12	8.81
Margalef	32.2	27.4	31
Equitability_J	1.07	1.01	1.09
Fisher_alpha	108	101	120

Diatoms attain maximum density and size during winter months which are good indicators of water pollution (Singh *et al.* 2010). During the study period, the diatom density showed maximum peak during winter (January-February) and was recorded minimum in monsoon season as previously studied by Nautiyal *et al*. (1996). The prominent seasonal variations in diatom diversity was observed, clearly depicting highest number of diatoms in summer (202), followed during winter (193) and least was recorded in monsoon season (Table 1). Similar observations have already been made by Dubey & Boswal (2009).

In Nepalese rivers of the Kathmandu Valley, Arun Valley and Likhu Khola *Fragilaria* and *Achnanthidium* were dominant at higher altitude while the *Navicula, Nitzschia* at lower altitude (Ormerod *et al.* 1994). Similarly the stalked *Synedra* spp. and the prostrate *Achnanthidium* spp. occur in steeper streams as they are strongly attached to substratum and tolerant to fast currents. Majority of the forms were solitary and few colonial. Particularly, centric diatoms like *Melosira granulata* and *Cyclotella menenghiana* were most abundant during summer only whereas distinct numbers of dominant genera of pennate diatoms like *Nitzschia, Navicula, Gomphonema, Cymbella, Synedra* etc were dominant in all the seasons.

Conclusion

Present investigation revealed a positive relationship between diatom densities and TDS, EC and BOD. Hence, these variables were the important factors governing the abundance of diatoms in Chandraprabha sanctuary. The specific conductivity, TDS, CV and DO accounted for variations in diatom richness and density in the Chandraprabha sanctuary. This study calls for some drastic regulations to be made and remedial measures to be taken immediately to save this sanctuary as it supports a vast variety of diatoms acting as bioindicators of the aquatic environment.

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