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Research Article

DIATOMS AND THEIR CORRELATION WITH PHYSICOCHEMICAL PARAMETERS AND SEASIONAL VARIATIONS OF BUDKI M.I.TANK, SHIRPUR (M.S.) INDIA.

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ABSTRACT

Seasonal variations of diatom density and species richness of Budki medium irrigation tank (Dam) was studied. This revealed that the density of diatoms was maximum in summer, while it was minimum in monsoon and moderate in winter season. Maximum species richness of diatoms was recorded in summer, while minimum species richness was recorded in monsoon. The diatom structure depends on a variety of environmental factors that include biological parameters as well as various physico-chemical factors. The Pearson correlation was calculated by keeping diatoms as dependent variable and other abiotic factors as an independent variables.

Key Words: Diatoms, Correlation, Seasonal variations Budki dam

INTRODUCTION

The word plankton comes from an ancient greek word which means “floating,” or “drifting (Hensen, 1987) and Thurman,(1997). Plankton are the microscopic and aquatic forms of plants and animals that freely float in aquatic environment. Diatoms are the community which is made up of tiny plates, these organisms float through water bodies both fresh and salty around the globe. Some plankton plays an important role to maintain food chain as nutrient in the aquatic ecosystem. Their absence in the water body indicates an aquatic disproportion. In the present investigation of Budki Medium Irrigation Tank that receives the southwest monsoon. It is the first attempt to find out the effect of season on phytoplankton community and water quality assessment.

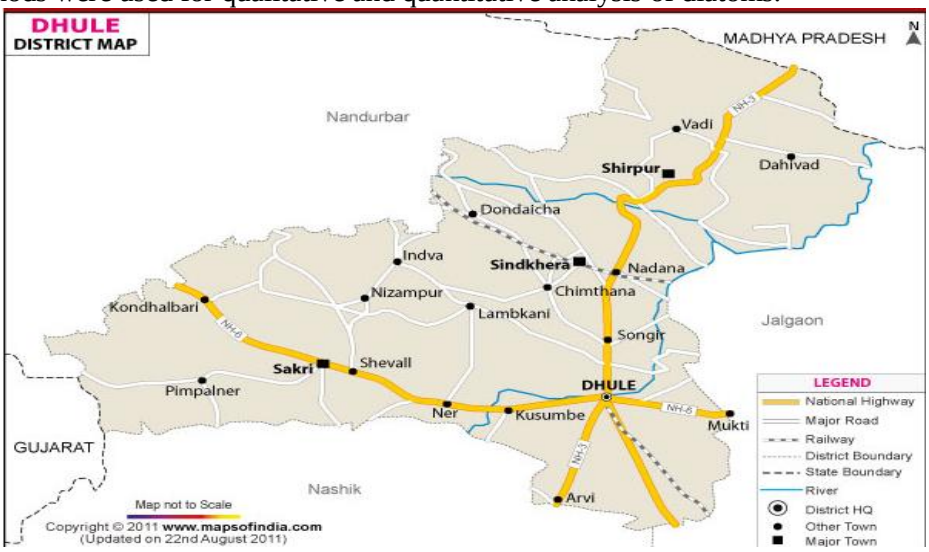
The diatoms comprise about 1600 species grouped under about 200 genera. Bacillariophyceae constitute an important part of the fresh and marine water plankton, which form the basic food of the aquatic animals and possess Chlorophyll A and C. This group of phytoplankton found at BMIT is the most important group of algae. Most species of Diatoms are sessile and associated with littoral substrata. Their primary characteristics are presence of silicified cell walls. Both unicellular and colonial forms are common among the diatoms. The group is commonly divided into the centric diatoms (Centrals), which have radial symmetry and the pennate diatoms (Pennates) that exhibit essentially bilateral symmetry. The Pennate diatoms are differentiated into four major groups: that are 1) the Araphidineae which posses a pseudoraphe (*e.g. Asterionella, Fragillaria*) 2) Raphidioidineae, in which a rudimentary raphe occurs at the cell ends *e.g. Actinelia and Eunotia* 3) The Monoraphidineae, which have a raphe on one valve and a pseudoraphe on the other *e.g. Achnanthes* and *Cocconeis* and 4) Biraphidineae in which the raphe occurs on both the valves *e.g. Amphora, Cymbella, Gomphonema, Nevicula, Nitzschia* and *Surirella.* These divisions are of more than taxonomic interest since distinct nutritional requirements favor the growth of one group over another Wetzel, (2001). The diatoms in Littoral zone are important contributors of the primary production in shallow aquatic ecosystems Wetzel, (1990). Some of the genera of diatoms are pollution tolerant. Palmer (1980) stated that *Synedra acus, Gomphonema sp., Cyclotella sp.* and *Melosira sp.* are found in organically rich water and play an important role in water quality assessment and trophic structure. Diatoms are important in Paleolimnological studies to reconstruct the past eutrophication of lakes on basis of paleolimnological evidences Taylor *et al*., (yr)

MATERIALS AND METHODS

Study Area

The Ambad nallah is a medium size irrigation tank, constructed at the junction of Ambad and Sossniya nallah near village Budki at a distance of about 1Km to the north of village Budki Taluka – Shirpur, Dist Dhule, Maharashtra. It was constructed in 1977; it is situated at 21°-32′36 latitude and 74°-51′41 longitudes. The catchments area of the project is 38.85 sq. Km. The water from the tank is perennial and is utilized for irrigation and drinking purpose as well as for pisciculture. A large number of major and minor carps are cultured by tender owners. However the basic data on the water quality of the tank is not available.

The study site was visited at an interval of a month from January, 2009 to December, 2010. Surface water samples were collected from three stations of Budki M.I.tank (BMIT) namely BMIT-A, BMIT-B and BMIT-C between 8 a.m. to 10 a.m. For each parameter studied the average of these stations were taken. Standard methods were used for qualitative and quantitative analysis of diatoms.



Map Location ***(Courtesy:*** *www.mapsofindia.com)*

Google Satellite image of Budki Medium Irrigation Tank (21^{0}32’36N 74^{0}51’41E) ***(Courtesy: Google Earth)***

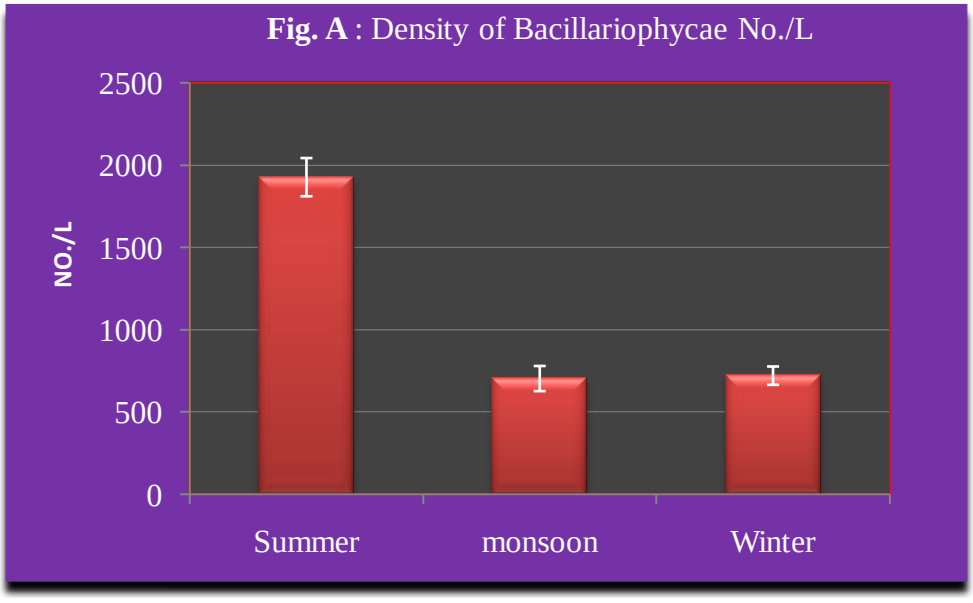
Ten liters of water was filtered through the plankton net No. 25 of bolting silk. Net was washed with the water by inverting it to collect the plankton attached to the net and the final volume of sample was made to 100 ml. The samples were taken in separate vials and fixed with 1 ml of 4 % formalin and 1 ml of Lugol's Iodine at the collection sites. Only 10 ml of well mixed sample from each station was further concentrated by centrifuging at 2000 RPM for 10 min. For quantitative estimation of plankton, one ml well mixed sample was taken on 'Sedgewick Rafter Cell'. To calculate density of plankton the averages of 5 to 10 counts were made for each sample and the results were expressed as numbers of organisms per liter of sample. Qualitative study of phytoplankton was carried out up to the genus/species level using the standard keys given by Edmondson (1963).

Statistical Analysis

The data collected during January, 2009 to December, 2010 was pooled for four months and three seasons and analyzed for seasonal changes, with respect to summer (January, February, March, and April), Monsoon (May, June, July and August), Winter (September, October, November and December). Further, the Mean, Standard Error of Mean (SEM) was calculated for each season and One-Way ANOVA with no post test .The Pearson correlation between the abiotic factors and the plankton density was calculated.

RESULTS

In the present study Bacillariophyceae (Diatoms) was the most dominant family in the Total Phytoplankton abundance with an average biannual percentage 42.65%. (Table 1) Maximum density of diatoms was recorded in summer with (1926 ± 116.4 No/L), and the minimum density was recorded in monsoon with (703.5±76.29 No/L) while moderate in winter season (721.0±55.70 No/L) at BMIT study site (Table1, Fig. A). Total thirty (30) species of diatoms (Annexure) were recorded in the BMIT, which showed significant seasonal variations ($P < 0.0001$, $F_{2\ 21}$ 172.8) with 48% of average (Table 1, Fig. B). Maximum species of diatoms were also recorded in summer (15.83 ± 0.262) but minimum in monsoon (8.37 ± 0.37), while it was (6.12± 0.44) in winter (Table 2). However, in the present study the diatom density is positively correlated (Table.2) with the AT, WT, TDS, CO_2, Cl, TH and Ca while negatively significantly correlated with WC, TSS and DO both at 0.01 level (2 tailed) at the BMIT.



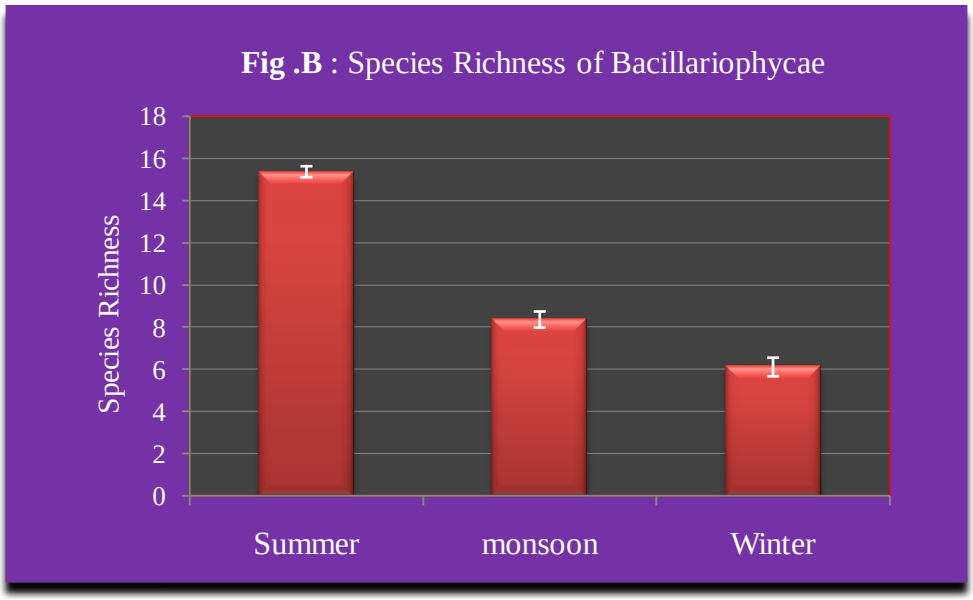


Table 1. Seasonal Variations in density (No. /L) and species richness of Diatoms at Budki M.I.Tank during January2009 to December 2010

Parameters	F value ($F_{2\ 21}$)	Summer	Monsoon	Winter	Two year %
Densityof Diatoms	$F_{2\ 21}$65.56	1926 ± 116.4	703.5 ± 76.29	721.0 ± 55.70	42.65
Species Richnessof Diatoms	$F_{2\ 21}$172.8	15.38 ± 0.26	8.37 ± 0.37	6.12 ± 0.44	48

Table 2. Pearson correlation of total Phytoplankton density along with individual group with physico-chemical parameters of Budki M.I.Tank during January2009 to December 2010

Sr.No	Parameters	Density of Diatoms	Species Richness of Diatoms
1	Atmospheric Temp.(AT °C)	.588**	.680**
2	Water Temp.(WT ^{0}C)	.528**	.659**
3	Water Cover (%)	-.753**	-.649**
4	Total Solids (TS) mg/L	.371	.543**
5	Total Dissolved Solids mg/L	.664**	.741**
6	Total Suspended Solids (TSS) mg/L	-.183**	.062
7	Transparency (Trans) Cm.	.013	-236
8	pH	.542**	.383
9	Dissolved Oxygen (DO)	-.665**	-.844**

10	Free Carbon dioxide (CO_2)	.609**	.751**
11	Total Hardness (TH)	.710**	.622**
12	Calcium (Ca)	.685**	.676**
13	Magnesium (Mg)	.583**	.505*
14	Chloride (Cl)	.603**	.674**
15	Nitrates (NO3) mg /L	.013	.259
16	Phosphate (PO4)mg /L	.022	.233
17	Sulfates (SO4) mg/L	-.272	.027

*** Correlation is significant at the 0.01 level (2-tailed)*
** Correlation is significant at the 0.05 level (2-tailed)*

DISCUSSION

The diatoms constitute an important component of the fresh water or marine plankton, the environmental factor such as physico-chemical and biological factors influence the abundance and species richness of diatoms, which is reflected in their seasonal variations. According to Pearsall (1923); Schorder (1940); PatricR.(1971) and Mahajan (2001),the temperature is the most important factor which affects the growth of diatoms. Maximum diatom density was recorded in summer at BMIT as was also reported by Sabata and Nayar (1987); Hujare (2005); Hafsa and Gupta (2009) and Jawale and Patil (2009); Ekhande(2010). According to Sing and Swarup (1979) the high temperature, phosphates, nitrate and calcium are the favorable parameters for the diatoms population in Suraha lake. The population of diatoms was considerably increased with increase in the concentration of phosphates (Sing, 1960; Zaffar, 1964; Hergenrader, 1980 and Pendse, et .al., 2000). The highest number of Bacillariophyceae recorded during the period of highest temperature (Abbas, 1984). In addition the water quality in terms of concentration of organic matter, DO, pH, and other physical factor play an important role in the distribution of diatoms. Diatoms are reported to absorb phosphates in large quantities than their requirements (Rutner, 1963 and Munawar, 1970). Philipose (1960) has reported direct relation of phosphates with diatoms. In the present study, minimum to moderate phosphates were recorded in winter and summer respectively when the diatom populations were moderate to maximum. In additions Nitrates have also been given the prime importance in diatom ecology (Rao, 1955). Nitrates are also considered as the main controlling parameter in the periodicity of diatoms, this was tallied with the observation of Ganpati (1943); Zaffar (1964) and Nandan and Patel (1986). However, in the present study the diatom density was positively correlated with the nitrate at the BMIT.

According to Nandan and Magar (2007) and Sharma (2009), the greater numbers of diatoms were observed in summer and winter in their annual studies. The similar result was found at BMIT. However, in the present seasonal study a steady increase from winter to summer has been recorded at BMIT. The effect of rains in distributing the plankton in general and resulting decline in their density stands true for diatoms too. Dissolved silica has a specific role in diatom growth and adequate silica supply is essential for Bacillariophyceae in general. Dissolved silica is supplied to the lake by drainage water Kobbia et al., (1992); Gad, (1992) and is also generated by remineralization within the lake. The relative importance of these processes is not yet known. In the present investigation the silica is not estimated, but high density of diatoms is indicative of sufficient silica content of BMIT.

In the investigation at BMIT the total 30 Bacillariophyceae species were recorded belonging to 17 genera (Annexure) which dominated in density for three seasons. This indicates availability of their distinct nutritional requirements at BMIT. According to Patrick (1973) many species of diatoms can tolerate various temperature ranges. The study of BMIT indicates that this group of species is found abundantly when water temperature fluctuated between winter and summer.

Accordance to Palmer, (1969) has listed the taxa emphasis with reference to pollution index. In the present study, some of these pollution tolerant species were also observed in BMIT these are: *Navicula*, *Melosira*, *Gomphonema*, *Fragilaria*, *Surirella*, *Cymbella*, Similar taxa was also recorded by Nandan and Mahajan, (2007) at Suki Dam, Maharashtra. It is general observation that *Cymbella*, *Fragilaria species*, *Gomphonema* are commonly found in organically rich waters and the clean water diatom species were *Amphora ovalis*, C*ymbella sp.*, *Pinnularia sp.* were also found in the waters of BMIT. This indicates that though not yet polluted, if the care is not taken may get polluted in future as it is having potential for deterioration and eutrophication under the influence of pollution and anthropogenic activities.

Annexure

1. *Mestoglia baltica* Grun.
2. *Melosira islandica* (O. Muell)
3. *Synedra affinis* Kuetz.
4. *Synedra acus* (Kuetz)
5. *Asterionella spp*
6. *Frustulina spp*
7. *Gyrosigma accuminatum* Kuetz
8. *Navicula cuspidate* Kuetz.
9. *Navicula papula* Kuetz
10. *Navicula rhynchocephala* Kuetz
11. *Navicula viridula*Kuetz

12 *Amphora ovalis*. Kuetz

13. *Pinnularia interrupta* W. Smith
14. *Pinnularia vidarbhensis* Sarode Kamat
15. *Rhopalodia gibba* Her O. Muell
16. *Nedium longiceps* Grey A. Cl. V.
17. *Stauroneis obtuse* Lagerst. V.
18. *Surirella capronii* Breb.
19. *Surirella robusta* Ehr.
20. *Surirella sabsalsa*W. Smith

22 . *Cymbella aspersa*(Her.) Cleve

22. *Cymbella gracilis* (Rabh) Cleve
23. *Cymbella ventricosa* Kuetz
24. *Gomphonema gracile*Ehr.
25. *Gomphonema intricatum* Kuetz
26. *Fragilaria construens* Ehr. Grun
27. *Fragilaria zafarii* Sarode Kamat

28 .*Fragilaria rumpens*Kuetz Carl.

29.*Nitzschia jalgaonesis* sarode et. Kamat
30.*Nitzschia maharastrensisis* sarode et. Kamat

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