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Phytoplankton Dynamics of Fresh Water Lake Varhala in Thane District, Maharashtra

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I. Introduction

Aquatic organisms especially plankton forms the most sensitive component of the ecosystem and signal environmental disturbance. The knowledge on the abundance, composition and seasonal succession of the same is a prerequisite for the successful management of an aquatic ecosystem. Apart from primary production, phytoplankton plays an important role as food for herbivorous animal and act as biological indicator of water quality in pollution studies. The communities of phytoplankton especially the different species of diatoms are also used as an indicator of water pollution *(Mishra S. R. 1996)*. The biological continuum of the lentic fresh water bodies is multidimensional and phytoplankton is used for bio-monitoring the ecological disturbance caused by a number of physico-chemical factors, sewage pollutants and other anthropogenic factors. Phytoplankton study provides a relevant and convenient point of eutrophication and its adverse impact on an aquatic ecosystem *(Meshram and Dhande 2000).*Although, voluminous literature is available on the phytoplankton population of freshwater habitats, scanty literature is available on VarhalaLake. Therefore, the present work was undertaken to know the species composition, abundance and distribution of phytoplanktonto cover the existing gap in the knowledge about the lake.

II. Study Area

The Varhala Devi Lake is situated in the southern part of the Bhiwandi city, amidst some of the densely populated areas. Geographically this lake is located in between 19° 16.800' N latitude and 73° 3.671' E longitude. It is primarily a rain fed lake, without any natural springs or reservoirs. The area witnesses an annual rainfall of 2000 to 3000 mm. The Morphometric Features of Varhala Devi Lake is shown in Table 1.

Table 1: Morphometric Features of Varhala Devi Lake

Location	Bhiwandi
District	Thane
State	Maharashtra
Purpose	Multipurpose
Mean Depth	3.68 meter
Height of Dam (waste weir)	4.05 meters
Total area of the lake	135 Hectares
protected water body (Perimeter-3144 meter)	50 hectares
Water holding capacity	1.65 million cubic meter
Catchment area of the Lake	35 Hectares
Total influence area of the lake	70 Hectare
Area of the lake (summer)	25 Hectares

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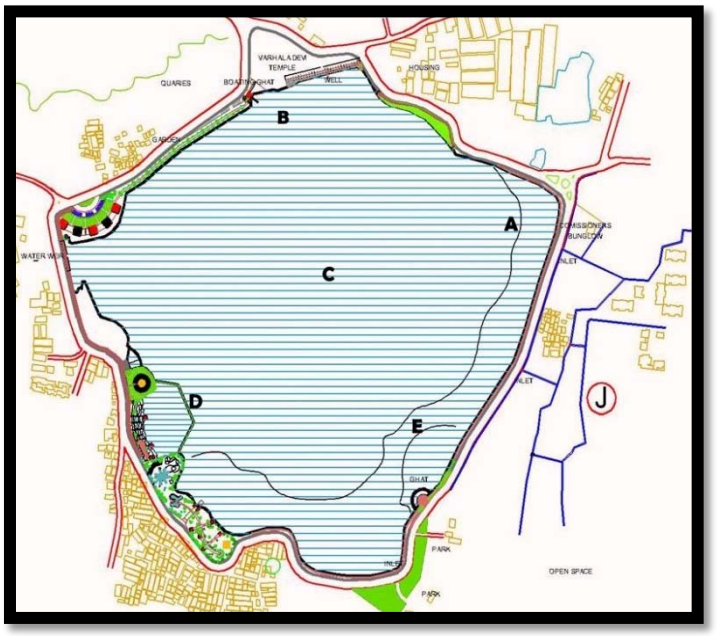


Fig. 1: Map showing sampling stations at Varhala Devi Lake

The stations selected are
Station A:Ayuctaya Bungalow
Station B:Varhala Devi Ghat
Station C: Centre of the Lake
Station D:Varhala Devi Mangal Bhawan
Station E:FeneGhat

III. Materials and Methods

The sampling was carried on monthly basis from February 2015 to January 2016 at the selected site. In order to study species composition and abundance of phytoplankton aspects of Varhala Devi Lake, five Sampling Stations viz. Station – A, Station – B, Station – C, Station – D and Station – E were selected based on topographical dissimilarities. These sampling stations are shown in an outline map Figure1.

Phytoplankton samples were collected from the site by filtering 10 liters of water through a standard plankton sieve net of bottling silk with mesh size 120 μm.

The sieved residue, collected in the tube attached at the end of the net, was properly transferred into a well-labelled vial and transported to lab under dark conditions. The bottles were thoroughly cleansed and rinsed with distilled water before collection. Samples were preserved by adding Lugol's solution and 4% formalin *(APHA 2005).* Quantitative analysis of phytoplankton was done by drop count method. The results were obtained by recording the number of organisms per liter. Phytoplankton Identification was done with the help of standard works by *APHA (2005),* and different online keys which included:
http://www.algaebase.org/[10]
http://www.nhm.ac.uk/botany/algaevision[17]
http://craticula.ncl.ac.uk/EADiatomKey/html/index.html[12]

IV. Result and Discussion

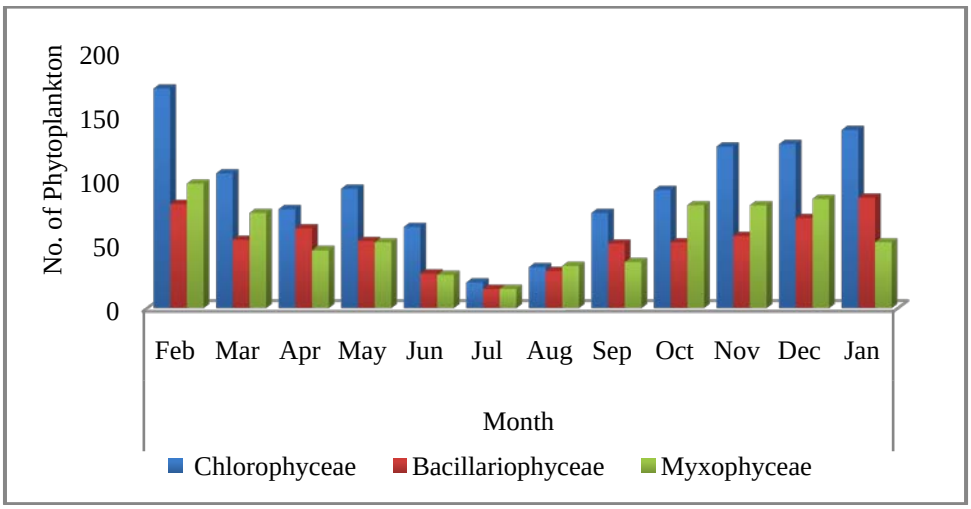
Diversity, distribution, abundance and variation in the biotic factors provide information of energy turnover in the aquatic systems*(Forsberg C. 1982).* Phytoplankton communities do not respond only to natural changes into the lakes, but may also present variations because of human interventions affecting the water body, either directly or through activities carried on in the basin as a whole.

In the present study, a total of 20 genera presenting 3 major classes were documented which indicate diverse nature of phytoplankton in the lake. Among 20 genera of phytoplankton, 10 belonged to Chlorophyceae, 05 to Bacillariophyceae and 05toMyxophyceae (Table 2).

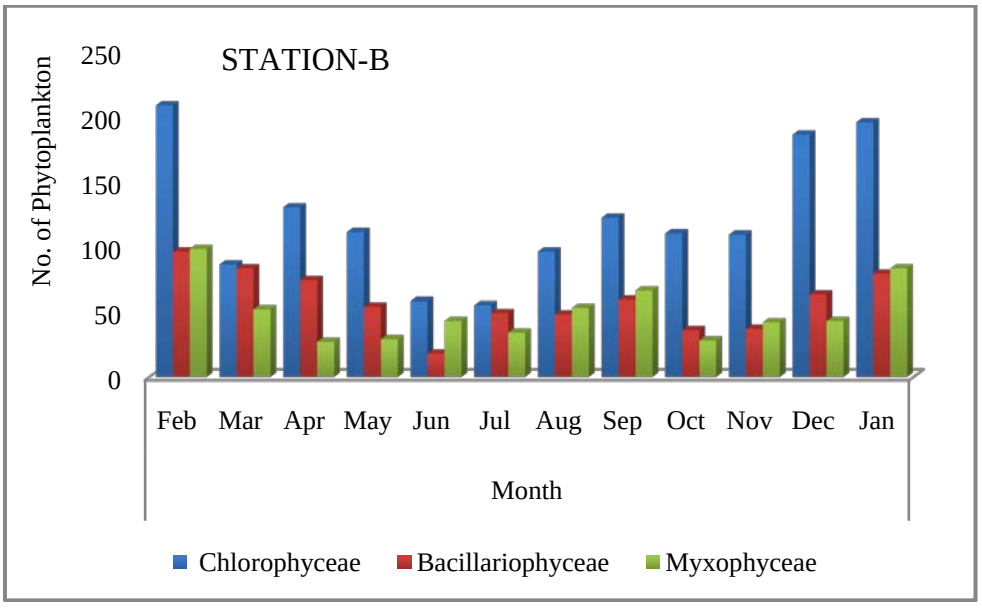
Table 2: Species composition of different algal classes at Varhala Lake

Chlorophyceae	Bacillariophyceae	Myxophyceae
Ankistrodesmus sp.	Diatoma sp.	Anabaena sp.
Closterium sp.	Gyrosigma sp.	Microcystis sp.
Desmidium sp.	Melosira sp.	Nostoc sp.
Hydrodictyon sp.	Navicula sp.	Oscillatoria sp.
Microspora sp.	Nitzschia sp.	Spirulina sp.
Oedogonium sp.		
Pediastrum sp.		
Spirogyra sp.		
Ulothrix sp.		
Zygnema sp.		

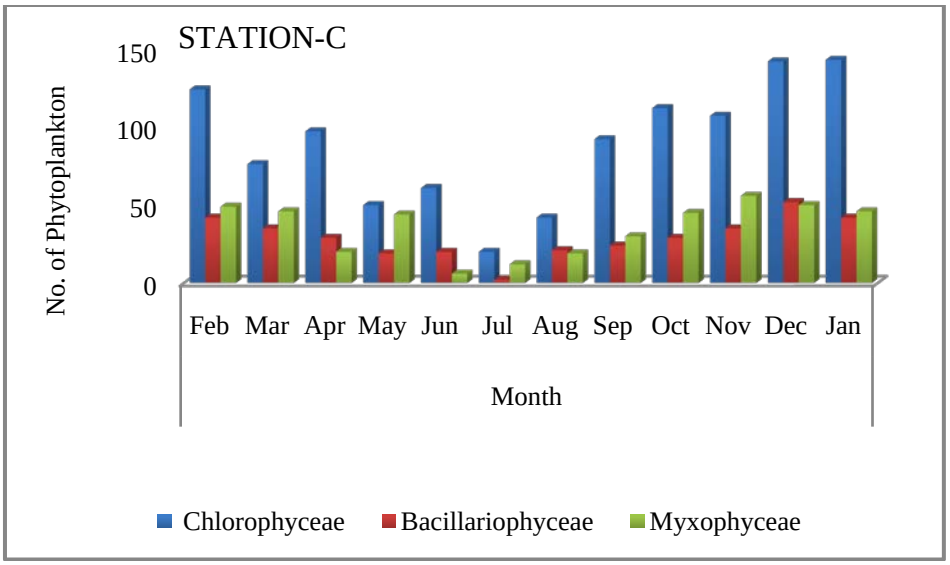
In general, with minor variations, the total phytoplankton showed nearly similar pattern of fluctuations throughout the study period with little exceptions in general at all stations as shown in Graph 1-5.



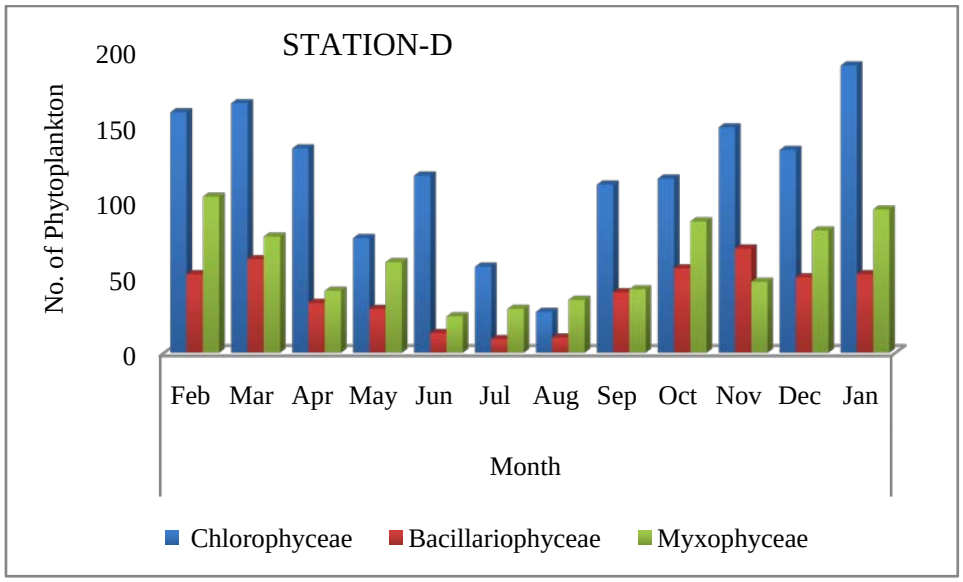
Graph 1: Phytoplankton composition and abundance at station A



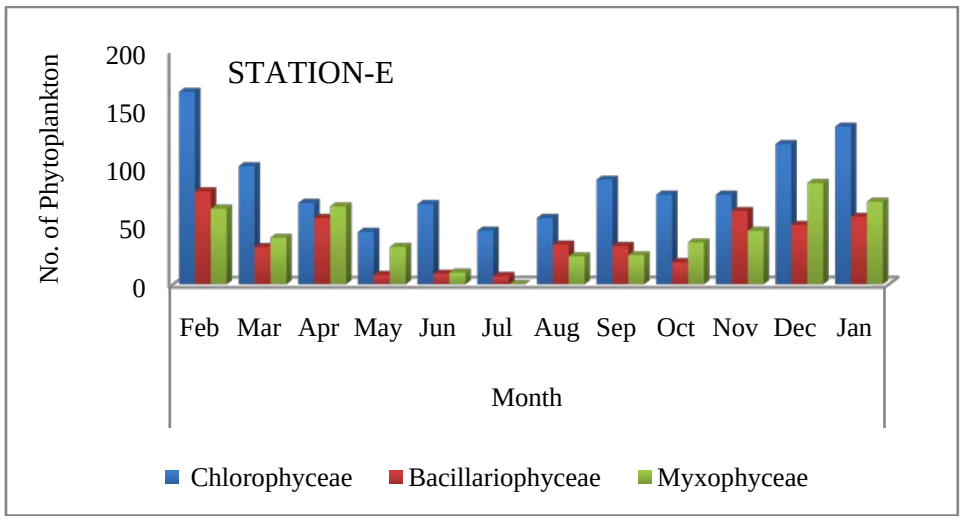
Graph 2: Phytoplankton composition and abundance at station B



Graph 3: Phytoplankton composition and abundance at station C



Graph 4: Phytoplankton composition and abundance at station D



Graph 5: Phytoplankton composition and abundance at station E

Chlorophyceae:

Chlorophyceae formed the most dominant group of phytoplankton in terms of diversity as well as density. It constituted 53% of total phytoplankton abundance(Table 3).The population density of chlorophyceae varied from a minimum of 20 units/l during July at Station 'A' and Station 'C'to a maximum of 208 units/l in February at Station 'B'.Among Chlorophyceae,numerical superiority was found in case of *Spirogyra sp., Zygnema sp., Oedogonium sp.* and *Pediastrum sp.*

Myxophyceae:

Myxophyceae are the most efficient in utilizing CO_2 at high pH and thus their abundance indicates the eutrophic nature of the water. Myxophyceaen members are considered as highly tolerant to polluted water at higher temperature. In the present investigation 5 species have been recorded among which *Anabaena* and *Microcystis* species were found to be dominant. Myxophyceae formed 25% of the total phytoplankton abundance and it placed 2nd in position among phytoplankton abundance (Table 3).The highest density of Myxophyceae was recorded as 103units/lat Station 'D'and it was lowest (6 units/l) at Station 'C' whereas it was absent at station 'E' in the month of July. The highest population of Myxophyceaeat Station 'D' may be due to variation in nutrient and other favorable conditions of water during plankton production.

Bacillariophyceae:

Bacillariophyceae was the least dominant group and it constituted 22% of total phytoplankton abundance (Table 3). The highest abundance of Bacillariophyceae (96 units/l) was found at Station 'B' and lowest (2 units/l) at Station C.*Melosira and Navicula* was found to be abundant among Bacillariophyceae.

Table 3: Percentage density of Phytoplanktons at different stations

Class	Station-A	Station-B	Station-C	Station-D	Station-E
Chlorophyceae	46%	53%	58%	55%	52%
Bacillariophyceae	26%	25%	19%	18%	23%
Myxophyceae	28%	22%	23%	27%	25%

Seasonal variations in quantity of plankton are associated with the changes in environmental conditions. *Davis (1974)*pointed out that a number of physical, chemical and biological factors acting simultaneously must be taken into consideration in understanding the fluctuation of plankton population. Distribution and seasonal fluctuation of plankton population in lakes determines the ecological status of the lake and helps in understanding the aquaculture prospective also.

During the first year of investigation, the maxima was noted in post-monsoon season with 950 units/L whereas minima was noted in monsoon season (467 unit/L).

However, when we compare mean of the said factor maximum number of phytoplankton was noted in the month of February (318 units/l). The high productivity rate during February i.e. in early summer was due to increase in temperature and transparency. Such parameters speed up the photosynthetic activity of phytoplankton. Water quality and other biotic communities of that water body control the phytoplankton diversity and density. The maximum growth of phytoplankton during post-monsoon period is due to rich nutrient received through rainwater *Sreenivasan(1974). Mathew and Nair (1981)*considered low temperature as the main factor responsible for the abundance of phytoplankton during post-monsoon period. Some worker has suggested that the total population of algae reached their high density during winter *Bhoyar and Tamloorka (2015).* The minimum density was recorded in July as74 units/l. The low density during peak monsoon may be due to high turbidity, cloudy weather and more water coverage with rains. Various authors such as *Harris* and *Silvey (1940), Chandler (1942) and Green and Andrew (1964)* have studied the effect of turbidity on phytoplankton production; they studied the variation of phytoplankton in relation to turbidity value during pre-monsoon and monsoon period.

Low phytoplankton density was observed in pre-monsoon as compared to post-monsoon. These findings are coincides with low DO concentrations. Similar observations had also made by *Dehadray (1982)* in Varhala Devi Lake, Bhiwandi.

It is also observed that at all the Sampling Stations the crop of phytoplankton was clearly dominated by Chlorophyceae group, followed by Myxophyceae and Bacillariophyceae.

Out of five sampling Stations studied, Sampling Station 'B' showed a distinctly higher abundance of total plankton as compared to other Sampling Stations. This may be due to the muddy bottom, which enhances the growth of aquatic vegetation and availability of more nutrients at this Station.

V. Conclusion

- 20 generabelonged to three major classes were identified.10 belonged to Chlorophyceae, 05

belonged to Bacillariophyceae and 05 belonged to Myxophyceae.

- Total phytoplankton showed similar pattern of fluctuations throughout the study period
- Chlorophyceae was the most abundant group of phytoplankton in terms of diversity as well as density. It constituted 53% of total phytoplankton abundance.
- Myxophyceae formed 25% of the total phytoplankton abundance
- Bacillariophyceae was the least found group and constituted 22% of total phytoplankton abundance.
- Of the 5 sampling Stations, Sampling Station 'B' showed a distinctly higher abundance of total plankton as compared to other Sampling Stations.

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