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Phytoplankton Composition of Mandohol Reservoir and Its Implications for Fish Culture in Ahmednagar District, Maharashtra, India

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ABSTRACT

The systematic inquiry on phytoplankton from Mandohol Dam was done. Taking into account all 31 generic taxa (20 species of Chlorophyceae, 18 species of Bacillariophyceae, 7 species of Cyanophyceae, and 1 species of Euglenophyceae). Bacillariophyceae were determined to be the most prevalent and year-round present group among the examined species. The mean annual population density of phytoplankton was found to be 6.10 l^{-1}. The summer months saw the most extreme phytoplankton density (7.61 l^{-1}), while the wet season saw the lowest. (5.17 l^{-1}). ANOVA was applied and observed no significant statistical difference in plankton density between the observed three sites. ($f = 2.16$. $df = 2$, $p = 0.1307$). Shannon diversity, Evenness, and Simpson's Diversity Index were calculated (3.59, 0.94, and 0.97), Together these indices suggest a highly diverse and balanced ecosystem with equal distribution and a rich variety of species. The community is complex and stable. Almost all species from Bacillariophyceae show high algal diversity in the winter. The phytoplankton abundance indicates a high food potential, creating a suitable environment for a thriving population of zooplankton and fish.

Figures : 02 References : 27 Tables : 02
KEY WORDS : Density, Diversity, Fish culture, Phytoplankton, Zooplankton

Introduction

Together with global fish production, the per capita fish consumption has also risen by approximately 1.5 percent annually over the past 57 years[6]. India ranks as the world's second-largest aquaculture and third-largest fish-producing country, accounting for about 7% of all fish produced worldwide. The total amount of fish produced in 2020–21 was 14.73 million metric tons [4,19].

According to the first water bodies census of the Government of India, the nation has 2,424,540 water bodies. These water bodies, characterized by their considerable biological production potential, are emerging as crucial resources for fishery development.

Maharashtra's inland fishing resources comprise 3,77,905 hectares of ponds and reservoirs and 19,456 km of rivers and canals[1].

With a population of 1.486 billion, India has become the most populous country globally. This population growth, coupled with increased demand for freshwater and the discharge of liquid/solid wastes, is altering the diversity, quality, and quantity of aquatic ecosystems[17].

Conducting physicochemical and hydrobiological studies is crucial for the effective utilization and scientific fisheries development. Various physicochemical and biological factors serve as stressors, influencing fish growth and reproduction negatively[9,21].

Phytoplankton studies are essential for water management and developing fish culture. Understanding diversity and seasonal variation is important in assessing the status and potential of various aquatic resources for scientific fishery development[22].

Sufficient volumes of phytoplankton are usually introduced into the pond prior to fish spawning. They support the rapid growth of fish, zooplankton, and other aquatic life by serving as a supply of energy (food) [16].

Understanding the mechanisms regulating the variety, distribution, development, and growth patterns of phytoplankton and other organisms has piqued the interest of researchers. Initial investigations on phytoplankton diversity in lakes have been conducted by many researchers [13, 23,27].

The Mandohol dam, chosen for the study, was originally constructed for drinking water and irrigation

TABLE-1. Occurrence of various phytoplankton species in Mandohol Dam during the study period

A) Chlorophyceae:

1. *Ankistrodesmus falcatus*
2. *Coelastrum microporum*
3. *Cosmarium contractum*
4. *Cosmarium granatum*
5. *Cosmarium margaritatum*
6. *Cosmarium sp.*
7. *Desmidium swartazii*
8. *Euastrum pulchellum*
9. *Euastrum spinulosum*
10. *Hyalotheca dissiliens*
11. *Mougeotia indica*
12. *Mougeotia scalaris*
13. *Oocystis nägeli*
14. *Pandorina morum*
15. *Pediastrum duplex*
16. *Pediastrum simplex*
17. *Pediastrum simplex* var. duodenarium
18. *Scenedesmus bijugatus*
19. *Spirogyra sp*
20. *Tetraëdron trigonum*

B) Bacillariophyceae:

1. *Cymbella aspera*
2. *Cymbella bharatensis*
3. *Cymbella bengalensis*
4. *Cymbella tumidula*
5. *Diatoma* Sp
6. *Gomphonema gracile*
7. *Gyrosigma attenuatum*
8. *Licmophora gracilis*
9. *Melosira islandica*
10. *Navicula cuspidata* var. ambigua
11. *Navicula halophila*
12. *Navicula minuscula*
13. *Nitzschia amphibia*
14. *Nitzschia leave*
15. *Pinnularia dolosa*
16. *Pinnularia* sp.
17. *Synedra acus* var. *acula*
18. *Synedra ulna*

C) Cyanophyceae :

1. *Anabena sp*
2. *Chroococcus turgidus*
3. *Merismopedia punctata*
4. *Microcystis aeruginosa*
5. *Nostoc commune*
6. *Oscillatoria tenuis*
7. *Spirulina major*

D) Euglenophyceae

1. *Euglena viridis*

purposes. However, it is now also utilized for fishery activities by local communities, presenting ample opportunities for scientific fishery development. Recognizing the significance of this water body, particularly for fish culture, the study aimed to investigate spatial and temporal variations in phytoplankton diversity. This investigation is expected to contribute to developing fish culture programs and provide a scientific baseline record for future researchers.

Materials and Methods

The Mandohol reservoir (19°11’56"N 74°18’28" E), chosen for this study, is a permanent earth-fill dam located in Karjule Hareshwar village in Parner taluka, Ahmednagar district, Maharashtra, that spans a tributary of the Mula River. It is situated in a rugged, mountainous region and serves as a significant water source for fishing, farming, and drinking.

Monthly morning samples of phytoplankton subsurface were obtained from three distinct locations between September 2020 and August 2021. The plankton samples were collected and concentrated in 100 milliliters of water after being filtered through a

TABLE- 2: Population composition and monthly fluctuation of phytoplankton (No/l) during study

Sr. No.	Season	Month	Phytoplankton group- Average no of cells/lit				Total
			Chlorophy-ceae	Cyanophy-ceae	Bacillariophy-ceae	Euglenophy-ceae	
1.	Post Mansoon	October	2.13	4.95	8.11	4	19.19
2.		November	2.60	7.43	9.22	6.66	25.91
3.	Winter	December	1.73	7.43	4.89	6.66	20.71
4.		January	2.73	6.95	10.89	5.33	25.9
5.		February	4.0	7.05	7.67	8	26.72
6.	Summer	March	4.33	7.24	9.11	8	28.68
7.		April	5.0	7.24	7.03	14.66	33.93
8.		May	5.27	8.57	6.92	8	28.76
9.	Mansoon	Jun	1.67	5.90	3.67	9.33	20.57
10.		July	1.87	4.76	5.66	8	20.29
11.		August	1.80	5.14	4.56	4	15.5
12.		September	2.93	7.05	7.11	9.33	26.42
		Mean	**3.01**	**6.64**	**7.07**	**7.66**	**24.38**

plankton net (silk net No. 25, aperture size 64 µ) for 100 litters of water. After adding Modified Lugol's solution and letting them settle for a full day, they were concentrated into 20 milliliters and kept in 4% formaldehyde solution. Using a microscope, photomicrograph, and identification based on accepted literature, phytoplankton was examined [3, 5, 18, 20] and also confirmed by experts. The quantitative analysis of phytoplankton was carried out by drop count method[14] in a bright line hemocytometer and expressed as No/l. This reservoir's physiochemical study and biological fauna were also accessed during the study.

Results and Discussion

The study examined the phytoplankton composition of Mandohol Dam and its implications for fish culture in Ahmednagar District, Maharashtra. A list of record of phytoplankton was collected and identified from the present study (Table-1).

46 species in all were identified, with 20 species belonging to the Chlorophyceae family, 18 to the Bacillariophyceae family, 7 to the Cyanophyceae family, and 1 to the Euglenophyceae family of phytoplankton. The most varied group, Chlorophyceae, had lower density

The phytoplankton species encountered, and their month-wise distribution are presented in Table 2. The density of the phytoplankton population density of Chlorophyceae (05.27 l^{-1}), Cyanophyceae (8.57 l^{-1}), Bacillariophyceae (10.89 l^{-1}), and Euglenophyeae (14.66 l^{-1}) was observed in March to May. (March, April and May respectively). Chlorophyceae show varying densities throughout the year, with higher numbers during

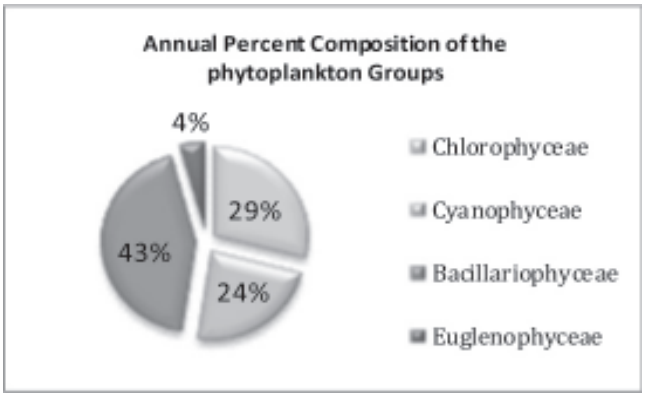

Fig. 1: Annual mean percentage composition of phytoplankton in Mandohol dam during the study period.

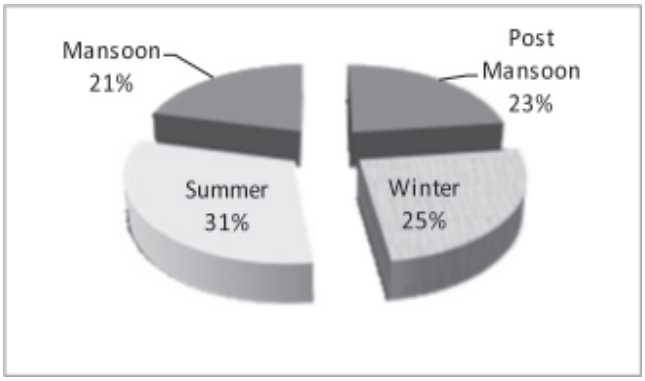

Fig. 2: Seasonal variation of phytoplankton population (No/l) in Mandohol dam during the study period.

the summer months (March to May) may be due to their preference for atmospheric temperature as has been found by other studies [2,8,26]. Summer productivity was at its peak because of ample solar radiation and nutrient enrichment of the water. The high density of Diatoms indicates nutrient-rich conditions and organic pollution. Their density is high in summer due to increased sunlight and warmer temperatures as observed[5].

Cyanophyceae numbers are relatively steady throughout the year, with slight peaks in January and April. Bacillariophyceae populations seem to peak in April, with generally stable numbers throughout the year. Euglenophyceae populations also show a peak in April, with fluctuations across the other months.

The mean values suggest that the peak average density of phytoplankton cells per liter is observed from winter to summer months, while the lowest occurs during the monsoon months.

The Table provides valuable insights into the seasonal variations in phytoplankton populations, which are crucial for understanding aquatic ecosystem dynamics and nutrient cycling. Chlorophyceae was the most abundant group from January to May, which may be due to their preference for temperature as has been found by other studies [7,26].

The highest phytoplankton population density (33.93 l^{-1}) was recorded in April, and the lowest (155.51 l^{-1}) in August. It was found that the mean annual population density of phytoplankton was 24.38 l^{-1} .

Considering the yearly average percentage composition of various phytoplankton groups (Fig. 1), the Bacillariophyceae group (43%) was dominant followed by Chlorophyceae (19.73%), Cyanophyceae (24%) and Euglenophyceae (4%) in the lake. The lower density of Cyanophyceae as compared to Chlorophyceae and Euglenophyceae indicated organic pollution of water bodies [24].

Fig. 2 shows the seasonal mean makeup of various phytoplankton groups. Phytoplankton was found to have a maximum density throughout the summer (30.46 l^{-1}), and a minimum during the monsoon (20.70 l^{-1}). The density during post-season was moderate (22.55 l^{-1}). The phytoplankton count was higher during the winter season, (24.764 l^{-1}). might be due to low temperature.

The ANOVA ($f = 2.16$. $df = 2$, $p = 0.1307$) results suggest, no statistically significant differences in the means of the sampling sites regarding the density variable.

The Shannon Diversity Index (3.59), Evenness (0.94), and Simpson's Diversity Index (0.97) together indicate that the phytoplankton community in Mandohol dam is highly diverse, with species evenly distributed and a low probability of any one species dominating the community.

These results imply a healthy and balanced phytoplankton community in the dam, which is beneficial for the overall ecosystem health, supporting higher trophic levels such as zooplankton and fish

Generally, *Cosmarium, Euastrum* and *Staurastrum* were recorded when the DO level was high[15]. *Cosmarium* and *Closterium* indicate the mesotrophic nature of water[11]. The presence of diverse and high individuals of Bacillariophyceae is highly diverse and sensitive unicellular green algae that serve as biological indicators of the health of water bodies [25].

Conclusion

The three main factors influencing phytoplankton production were temperature, turbidity, and nutrients. In the current study, increased turbidity during Monsoon reduced phytoplankton density, which is associated with rising zooplankton density.

Therefore, the current study offers some helpful advice for creating management plans that would increase fish output in these types of water bodies. A high population of naturally occurring food for fish and zooplankton is supported by the quantitative and qualitative abundance of phytoplankton. Planktophagus and predatory fish populations are mostly supported by phytoplankton, either directly or indirectly[10] . Therefore, a combined organization strategy uniting a catch and culture fishery in the reservoir might be used to greatly increase fish output based on the monthly change of the phytoplankton population.

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