Indian J. Applied & Pure Bio. Vol. 37(1), 29-37 (2022). **ISSN: 0970-2091**
A web of Science Journal

Studies on Phytoplankton using Quantitative Method in Relation with Some Physicochemical Parameters of Manar Reservoir, Nanded

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Abstract

Phytoplanktons are a vital part of aquatic flora. They provide the primary source of food for several organisms in the water typically fishes and play a crucial role in managing perfect balance into biotic and abiotic parts of the water ecosystem. This study reports understanding the phytoplankton assemblage and their diversity for physicochemical parameters. Physico-chemical parameters such as water temperature, pH, Dissolve oxygen which impact the diversity and production of phytoplankton were studied. The period of study was from January 2018 to December 2018 covering all three seasons. In the study, 10 species of phytoplankton were recorded of which, 3 species come under Chlorophyceae, 2 species to Cyanophyceae, 2 species to Bascillariphyceae, 2 species to Zygnematophyceae and 1 species to Euglenophyceae. The study showed the influence of temperature, pH and DO on the phytoplankton distribution. This study also showed seasonal abundance and percent composition of different species.

Water contamination is one of humankind's most critical issues today. Since algae are natural habitats of water, they play an important environmental role and are frequently used as indicators of water pollution. The aquatic ecosystem is home to a wide variety of communities that define the characteristics and function of the ecosystem in terms of production and food chain maintenance[17].

Primary production in aquatic systems is regulated by the phytoplankton, which serves as food for primary consumers[15].

Physico-chemical parameters are important factors in the study of nutrients status in the freshwater environment[7].

Seasonal changes in Physico-chemical characteristics regulate phytoplankton diversity

and generally, phytoplanktons are important in an aquatic ecosystem as they are a basic part of the productivity pyramid[13].

Sudden change can contribute to a disturbance in the food web in the aquatic ecosystem. In general, these fluctuations are caused by Physico-chemical elements in the water as well as seasonal variations. Therefore, the aim of the present research study is to examine the differences in community structure and species composition due to varying seasonal influence on physicochemical parameters in the Manar reservoir.

Study area :

Manar reservoir is situated on Manar river at village Barul near Kandhar, Nanded district in the state of Maharashtra. There are three locations were selected for the study as Site S_1, Site S_2, and Site S_3.

Manar reservoir is an earth-fill type of dam, As it is a cluster of fauna and flora, it is considered a reproductive reservoir and one of the most biologically diverse lakes. It is a freshwater reservoir that provides a fresh supply of water into agricultural fields to make it more fertile, small-scale fishing, and for other purposes of the locals throughout the entire year.

Three locations were selected to collect the water samples. Sampling was performed during the summer, winter and monsoon seasons of Jan. 2018 to Dec. 2018 respectively. The collection of the water sample has been done from the different sampling stations by the application of a standard water sampler and was poured in pre-rinsed sampling bottles immediately. These samples were collected during the study period at the three selected sites. Water temperature, pH and (DO),[5,10].

The water temperature was recorded with the help of a degree centigrade (– 10 to 100 °C) Thermometer. A pH meter has been used to measure the pH level in the water.

Fig. 1. Google Earth image showing location of Manar Reservoir at Barul village of Kandhar Taluka in Nanded district of Maharashtra.

The dissolved oxygen in the water sample of all sites was estimated by Winkler's titrimetric method in the laboratory.

The qualitative and quantitative study of the samples :

The phytoplankton community was quantitatively studied by the drop count method and a qualitative study was done by identifying the species under a microscope. In both methods, analysis was carried out as described by Adoni *et al.*,[1]. For the quantitative procedure, one liter of water sample was taken in a glass bottle after filtering through a phytoplankton net. Then 10 ml of Lugol's Iodine was added and allowed to stand for at least 24 hrs to ensure complete sedimentation. After removing the supernatant, one drop of the concentrated sample was taken on a clean micro slide and the whole drop was covered with a coverslip. This slide was kept under a research microscope at 10 x, 40 x 100x and the number of phytoplankton was studied species-wise.

The formula to calculate the phytoplankton density is as follows,

Total number of organisms/L=A x 1/L x n/v

Where,

A is the total no. of organism or drop,

V is theone drop volume,

N is theconcentrated sample volume,

L is theoriginal sample volume.

Table-1. Physico-chemical parameters from all three sites of Manar reservoir during Jan 2018 - Dec 2018 (Seasonal).

Study Period		S_1			S_2			S_3		
		Temp ℃	pH	DO (mg/L)	Temp ℃	pH	DO (mg/L)	Temp ℃	pH	DO (mg/L)
Summer	Feb. 2018	24	8.3	3.50	24	8.4	3.57	26	8.5	3.57
	Mar.2018	24	8.4	3.36	26	8.5	3.57	24	8.5	3.64
	Apr.2018	28	8.4	3.57	28	8.6	3.50	28	8.6	3.50
	May2018	26	8.5	3.64	28	8.4	3.71	26	8.8	3.78
Monsoon	Jun.2018	24	8.2	4.06	24	8.3	4.48	24	8.3	4.62
	July.2018	22	8.1	4.20	22	8.3	4.55	23	8.3	4.76
	Aug.2018	23	8.1	4.34	21	8.2	4.62	22	8.2	4.90
	Sep.2018	23	8.3	4.48	22	8.3	4.76	24	8.4	4.83
Winter	Oct.2018	22	8.2	4.62	20	8.3	4.69	22	8.4	4.76
	Nov.2018	16	8.3	4.76	19	8.3	4.69	22	8.5	5.04
	Dec.2018	18	8.4	4.83	18	8.5	4.83	20	8.4	4.90
	Jan.2018	21	8.3	4.90	20	8.4	4.97	21	8.5	5.18

Table-2. Seasonal abundance (no/L) of different groups of Phytoplankton study at S_1 of Manar reservoir during Jan 2018 - Dec 2018.

Group wise name of the species 2018	Number of organisms /L Location of S_1											
	Summer				Monsoon				Winter			
	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan
Chlorophyceae												
Volvox	50	100	75	62.5	50	25	75	62.5	62.5	62.5	50	75
Oedogonium	62.5	87.5	87.5	75.0	37.5	25	50	25	100	87.5	62.5	50
Chlamydomonas	62.5	100	75	50	25	12.5	37.5	37.5	50.0	52.5	75.0	50.0
Cyanophyceae												
Anabaena	37.5	87.5	62.5	50.0	25.0	25.0	50.0	50.0	37.5	37.5	62.5	62.5
Nostoc commune	50	62.5	62.5	50.0	12.5	25.0	37.5	50.0	62.5	50.0	50.0	25.0
Bacillariophyceae												
Frustulia	37.5	62.5	75	62.5	25	25	50	37.5	50	62.5	37.5	50
Navicula	50	62.5	75	37.5	25	37.2	37.5	25	25	50	37.5	50
Zygnematophyceae												
Closterium	62.5	37.5	50	37.5	37.5	25.0	12.5	25.0	12.5	37.5	37.5	25.0
Cosmarium	50.0	75.0	62.5	50.0	37.5	25.0	25.0	37.5	87.5	62.5	50.0	37.5
Euglenophyceae												
Euglena	50.0	62.5	62.5	50.0	37.5	25.0	37.5	25.0	62.5	50.0	25.0	37.5

A total of 10 species belonging to 5 taxonomic class groups were recorded from the Manar reservoir. The highest number of phytoplankton were from the Chlorophyceae group with 3 different species and the lowest was from the Euglenophyceae group with only 1 species.

Seasonal abundance of different groups of phytoplankton was done and the details of which are given in table 2-4. Variations of different phytoplanktons concerning each season are also done and are shown in table 5. The percentage composition of each group along with the number of species present in each taxonomic class was determined and shown in tabl-6.

Three species of Chlorophyceae were found namely *Volvox, Oedogonium* and *Chlamydomonas*. Two species of Cyanophyceae were found namely *Anabaena and Nostoc commune.* Two species of Bacillariophyceaewere found namely *Frustulia* and *Navicula.* Two species of Zygnematophyceae namely *Closterium* and *Cosmarium* and one species of Euglenophyceae namely *Euglena* were found. The seasonal abundance, percent composition, and seasonal variation of each species are given in the table 2-4 below.

Table-3. Seasonal abundance (no/L) of different groups of Phytoplankton study at S_2 of Manar reservoir during Jan 2018 - Dec 2018.

Group wise name of the species 2018	Number of organisms /L Location of S_2											
	Summer				Monsoon				Winter			
	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan
Chlorophyceae												
Volvox	75	87.5	87.5	50	37.5	50	62.5	50	75	62.5	75	62.5
Oedogonium	25.0	62.5	37.5	62.5	50.0	37.5	25.0	37.5	37.5	62.5	50.0	25.0
Chlamydomonas	87.5	75.0	100.0	75.0	62.5	75.0	62.5	50.0	87.5	100	75.0	62.5
Cyanophyceae												
Anabaena	50.0	87.5	75.0	62.5	50.0	37.5	25.0	37.5	62.5	75.0	75.0	62.5
Nostoc commune	62.5	87.5	50.0	75.0	62.5	50.0	37.5	37.5	62.5	75.0	37.5	50.0
Bacillariophyceae												
Frustulia	75	87.5	50.0	37.5	12.5	37.5	50.0	37.5	50.0	62.5	50.0	37.5
Navicula	62.5	75.0	62.5	50.0	25.0	50.0	62.5	37.5	87.5	50.0	62.5	50.0
Zygnematophyceae												
Closterium	50.0	87.5	100.0	87.5	62.5	50.0	25.0	12.5	37.5	50.0	62.5	50.0
Cosmarium	62.5	50.0	37.5	12.5	37.5	50.0	37.5	12.5	37.5	75.0	50.0	62.5
Euglenophyceae												
Euglena	50	75	62.5	75	25	37.5	50	62.5	62.5	50	75	62.5

Table-4. Seasonal abundance (no/L) of different groups of Phytoplankton study at S_3 of Manar reservoir during Jan 2018 - Dec 2018.

Group wise name of the species 2018	Number of organisms /L Location of S_3											
	Summer				Monsoon				Winter			
	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan
Chlorophyceae												
Volvox	75	125	100	87.5	37.5	87.5	75	50	112.5	100	87.5	62.5
Oedogonium	62.5	137.5	112.5	87.5	62.5	50.0	25.0	25.0	37.5	50.0	62.5	75.0
Chlamydomonas	75	125	137.5	100	50	62.5	75	62.5	100	75	87.5	87.5

Cyanophyceae												
Anabaena	50.0	100.0	62.5	75.0	50.0	62.5	37.5	50.0	37.5	50.0	62.5	50.0
Nostoc commune	62.5	112.5	87.5	87.5	37.5	37.5	50	62.5	50	25	62.5	75
Bacillariophyceae												
Frustulia	50.0	100.0	87.5	62.5	50.0	37.5	25.0	12.5	37.5	50.0	37.5	25.0
Navicula	50.0	75.0	87.5	75.0	62.5	50.0	75.0	62.5	62.5	75.0	62.5	50.0
Zygnematophyceae												
Closterium	75.0	87.5	75.0	62.5	50.0	37.5	25.0	25.0	50.0	62.5	50.0	37.5
Cosmarium	50.0	75.0	100.0	37.5	25.0	62.5	75.0	50.0	37.5	25.0	50.0	50.0
Euglenophyceae												
Euglena	50	100	87.5	75	50	37.5	25	62.5	50	62.5	62.5	75

Table-5. Seasonally presence and absence of Phytoplankton species in the Manar reservoir during research work.

Seasons	Summer			Monsoon			Winter		
Group									
Chlorophyceae	**S_1**	**S_2**	**S_3**	**S_1**	**S_2**	**S_3**	**S_1**	**S_2**	**S_3**
Volvox	+	+	+	+	+	+	+	+	+
Oedogonium	+	+	+	+	+	+	+	+	+
Chlamydomonas	+	+	+	+	+	+	+	+	+
Cyanophyceae	**S_1**	**S_2**	**S_3**	**S_1**	**S_2**	**S_3**	**S_1**	**S_2**	**S_3**
Anabaena	+	+	+	+	+	+	+	+	+
Nostoc commune	+	+	+	+	+	+	+	+	+
Bacillariophyceae	**S_1**	**S_2**	**S_3**	**S_1**	**S_2**	**S_3**	**S_1**	**S_2**	**S_3**
Frustulia	+	+	+	+	+	+	+	+	+
Navicula	+	+	+	+	+	+	+	+	+
Zygnematophyceae	**S_1**	**S_2**	**S_3**	**S_1**	**S_2**	**S_3**	**S_1**	**S_2**	**S_3**
Closterium	+	+	+	+	+	+	+	+	+
Cosmarium	+	+	+	+	+	+	+	+	+
Euglenophyceae	**S_1**	**S_2**	**S_3**	**S_1**	**S_2**	**S_3**	**S_1**	**S_2**	**S_3**
Euglena	+	+	+	+	+	+	+	+	+

Table-6. Indication of Phytoplankton number in each group and species percentage composition

Group	Each group species	% Composition
Chlorophyceae	3	30
Cyanophyceae	2	20
Bascillariophyceae	2	20
Zygnematophyceae	2	20
Euglenophyceae	1	10

As per observation and analysis of abiotic variables, the level of different indicators was largely or completely related to the environmental condition of the river. Also, temperature, pH, and DO have a direct effect on the growth of biological communities[8].

Seasonal changes in Physico-chemical characteristics are shown in Table-1. From table-1, it is clear that for site 1, site 3 in summer temperature was highest in April months, and site 2 was rich in April and May. While in November temperature was the lowest at site 1 and in December it was the lowest in second and third sites. Santhanam and Perumal[14] and Chaurasia and Pandey[3] made a similar observation the highest water temperature in summer is mainly due to the high intensity of solar radiation.

Das *et al*.,[4] studied that the temperature of water increases and decreases depending on the ambient temperature.

Temperature is the common factor in an aquatic ecosystem, which affects the Physico-chemical properties as well as the existence of organisms[16].

Manar reservoir shows slight alkalinity throughout the year. Higher pH was observed during summer. Pawar and Shembekar[12] studied that the availability and lack of free carbon dioxide and carbonate, as well as planktonic densities, cause fluctuations in pH over time.

The pH was highest in the first and third sites in summer May whereas the second site was rich in April. Similarly, pH at site 1 was lowest in monsoon July and August, while site 2 and site 3 were the lowest pH in August. An alkaline pH is generally regarded to be favorable for encouraging higher primary productivity[9].

Among all three sites, DO was highest in January during the winter. Whereas, the second and third sites had the lowest in April and the first site had the lowest in the month of March. A minimum concentration of

Dissolved oxygen in this study was observed during summer and the maximum was in winter. The amount of dissolved oxygen indicates the environmental health of the water body[2].

DO decreases in summer may be associated with the high metabolic rate of organisms in summer, and it is higher in winter due to lower ambient temperature[11].

In the current study microflora community in the Manar reservoir was diversified, 10 species totally under 5 algal classes with Chlorophyceae as the maximum contribution followed by *Cyanophyceae, Bacillariophyceae, Zygnematophyceae* and *Euglenophyceae*.

With overall study, it showed that the aquatic flora and its density observed during the entire year were influenced by various Physico-chemical parameters like pH, temperature, and DO. Hence, it was the extensive study carried on the phytoplankton of this reservoir that was a significant member of the food chain.

The first author is thankful to the Indian Council of Social Sciences Research (ICSSR), New Delhi, for financial support to this research work. Authors are very much thankful to the Director, School of Earth Sciences, Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra, India for providing laboratory and library facilities.

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