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Phytoplankton analysis of Warwand reservoir of Daund tahsil of Maharashtra

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Abstract
Phytoplanktons are microscopic, floating and drifting organisms occurs in various water bodies and have photosynthesis ability. They are essential part of aquatic food web and also contribute to carbon cycling. The present work has been conducted on phytoplankton diversity in Warwand reservoir of Daund Tahsil of Maharashtra. The study has reported a total of 35 phytoplankton species belonging to 4 major groups namely Cyanophyta, Bacillariophyta, Chlorophyta and Xanthophyta. The highest species count of 16 was noticed of Chlorophyta followed by Bacillariophyta with 13 species, Cyanophyta with 5 species and Xanthophyta with a 1 species. Also winter season was reported to be more favorable for growth and showed highest count as compare to summer and monsoon.

Keywords: Phytoplankton, cyanophyta, bacillariophyta, chlorophyta, xanthophyta and seasonal variation, etc

Introduction

Phytoplanktons are microscopic, photosynthetic and floating or drifting organisms found in water bodies such as oceans, lakes and rivers. According to the tropical status, they are the main producers in aquatic food webs and helps in conversion of sunlight, carbon dioxide and nutrients into organic matter and oxygen through the process of photosynthesis (Jahan and Singh, 2023) [8]. Even though these are minute in size, they are said to have contributed almost half the amount of oxygen that is generated on the earth and had a major role in the cycling of carbon globally accounting for the photosynthetic fixation of around 50×10^{15} g Carbon annually (Marañón, 2019; Gui and Sun, 2024; Nam *et al*., 2024) [6].

The prevalent phytoplankton groups are green algae, diatoms, dinoflagellates and Cyanophyta. The structures and functional features of each group are also unique like the silica shells of diatoms or the flagella of dinoflagellates. Phytoplankton growth and distribution are influenced by a range of environmental factors such as the availability of light, water temperature and nutrients like nitrogen, phosphorus and silica levels, etc. They exhibit a good growth rate in nutrient-rich waters and sustain higher trophic levels such as zooplankton and fish (Vaghela *et al*., 2023) [23]. On the other, high concentrations of nutrients due to agricultural run-offs or sewage run-offs may cause eutrophication provoking the development of harmful algal blooms that include toxic phytoplankton species. Such blooms have the potential to cause destruction to the ecosystems by killing aquatic animals and being harmful to people (Dembowska *et al*., 2018) [1].

Monitoring of phytoplankton is necessary in the continuous assessment of water quality as phytoplankton may serve as a bioindicator and may be used to monitor a decrease or increase in abundance or species composition. These suggest the occurrence of ecologically disturbing events. The climatic change in water quality parameters like temperature, stratification and acidity will eventually affect phytoplankton dynamics which can change the global productivity patterns (Giripunje *et al*., 2013; Nigam, 2023) [5, 15]. Therefore, the phytoplankton not only supports the growth of aquatic animals, but also acts as a bioindicator of environmental change.

Although there are many reports are available on investigation of the phytoplankton diversity from Pune district, the Warwand reservoir has not been studied for its phytoplankton composition. The present work has been carried out with the similar aim to explore the phytoplankton diversity and variation.

Methodology

a. **Sample Collection:** The Warwand reservoir was selected as a study area for the present work. It is the largest and major fishery site from Daund Tahsil of Pune district built before independence and situated at 18°25'48"N & 74°24'37"E. The water samples were collected monthly from three different sites in the study area for a year by using plankton net of mesh size 64 µm. A total of 100 liter water was filtered through the plankton net followed by immediate preservation of sample using Lugol's Iodine. The samples were then brought to the laboratory for further investigation. The sample was subsequently subjected to centrifugation in the laboratory to accomplish total sedimentation, facilitating both quantitative and qualitative analysis of phytoplankton. The supernatant liquid was removed using a pipette and the sample was concentrated to a final volume of 15 ml.

b. **Sample analysis:** The samples were used for both quantitative and qualitative analysis. The qualitative analysis was performed using the Identification of phytoplankton was performed by using standard key literature keys (Edmondson, 1959; Prescott, 1962; Needham and Needham, 1962) [3, 14, 17].

The quantitative analysis of plankton was performed by using Sedgwick – Rafter counting chamber method. The Sedgwick Rafter Cell is a specialized counting chamber used in microscopy for analyzing water samples to

determine the number and types of planktons. The dimensions of cell are 50mm x 20 mm x 10 mm rectangular cavity that designed for holding a 1 ml sample. The cell was adjusted horizontally on the stage of microscope (Labomed LX400 model) and the planktonic species found in the field were counted. A series of replicate samples were counted to determine the plankton per liter. The final value was calculated using following formula (Mahajan and Harney, 2020) [12].

Plankton (Units/Lit.) = n x c /v

Where,

n = number of plankton in 1 ml.

c = volume of concentrate.

v = volume of sample in lit

The mean values of three samples of every month were taken into consideration for further analysis.

1. **Statistical data analysis:** The data analysis was performed by using the software PAST version 4.03.

Result and discussion

The present work has reported a total of 35 phytoplankton species from four groups namely- Cyanophyta, Bacillariophyta, Chlorophyta and Xanthophyta. The Cyanophyta were reported with a total of 5 species namely- *Chroococcus turgidus*, *Merismopedia elegans*, *Merismopedia glauca*, *Microcystis sps* and *Oscillatoria sps*. The Chlorophyta was represented by 16 species namely- *Chlamydomonas sps*, *Pediastrum simplex*, *Pediastrum duplex*, *Scenedesmus quadricauda*, *Scenedesmus obliquus*, *Scenedesmus bijugatus*, *Scenedesmus obtusus*, *Scenedesmus ellipticus*, *Tetraedron sps*., *Cosmarium nitidulum*, *Cosmarium granatum*, *Closterium leibleinii*, *Closterium cornu*, *Staurastrum sps*, *Zygnema sps.* and *Spirogyra sps*. The Bacillariophyta was reported by 13 species namely- *Fragilaria crotonensis*, *Fragilaria capucina*, *Synedra sps.*, *Cymbella tumidula*, *Cymbella affinis*, *Gomphonema sps*, *Navicula rostellata*, *Navicula menisculus*, *Navicula salinarum*, *Pinnularia sps.*, *Caloneis sps.*, *Nitzschia sps.* and *Surirella sps*. The Xanthophyta reported only one species namely *Tribonema sps.* (Table 1).

The abundance of phytoplankton reported significant impacts of seasonal changes. The highest count of phytoplankton was observed in November with a value of 2106/Lit, while the minimum total count was noticed in June with a value of 969/Lit.

There were also several phytoplankton species that were not observed during certain months of observation. *Merismopedia elegans* and *Merismopedia glauca* were not seen in June, July and September. *Microcystis sps*. had not been identified in May and *Scenedesmus quadricauda* had not been detected between April and July. *Scenedesmus bijugatus* was absent in October and *Scenedesmus obtusus* was absent between May and July. *Scenedesmus ellipticus* was missing in June to July. *Tetraedron sps*. had not been reported in February. *Closterium cornu* was absent between June and August, and *Zygnema sps*. was absent between April and June. *Synedra sps*. was not observed in June-September. *Cymbella tumidula* and *Cymbella affinis* were not found at any time during a longer interval between June and January. Also, *Gomphonema sps*. was not noticed in June, *Pinnularia sps*. in July and *Surirella sps*. in August (Table 1).

The summer season reported a range between 1022 to 1450/Lit with a higher count in March (1050/Lit) and a lower count in May (1022/Lit). The monsoon season reported a range between 1572.33 to 696/Lit with a higher count in September (1572.33/Lit) and a lower count in June (696/Lit). The winter season reported a range between 2106 to 1843.33/Lit with a higher count in November (2106/Lit) and a lower count in October (1843.33/Lit). The mean values of total count for summer, monsoon and winter were 1239.83/Lit, 1052.92/Lit and 1979.83/Lit, respectively. The order of dominance was found to be Winter > Summer > Monsoon (Table 1).

Table 1: Phytoplankton Analysis during February-2022 to January-2023 (All values are in/Lit)

Sr. No.	Species	February	March	April	May	June	July	August	September	October	November	December	January
1	*Chroococcus turgidus*	48.00	36.00	33.33	105.33	142.67	84.00	62.67	66.67	62.67	98.67	126.67	69.33
2	*Merismopedia elegans*	60.00	58.00	54.67	58.67	0.00	0.00	19.33	0.00	46.00	44.67	37.33	50.67
3	*Merismopedia glauca*	26.67	26.67	28.67	32.00	0.00	0.00	6.67	0.00	27.33	28.00	26.00	30.67
4	*Microcystis sps*	344.67	259.33	38.67	0.00	55.00	79.33	159.33	198.67	250.00	270.33	583.33	582.00
5	*Oscillatoria sps*	45.33	51.33	52.67	48.00	36.00	44.00	34.67	39.33	44.00	40.00	41.33	49.33
6	*Chlamydomonas sps*	31.33	40.00	21.00	8.67	17.33	19.00	34.00	64.67	66.33	76.33	49.33	65.67
7	*Pediastrum simplex*	12.33	15.00	18.00	14.67	11.33	10.33	9.00	8.67	7.33	11.00	10.33	10.67
8	*Pediastrum duplex*	13.00	15.00	19.00	16.33	14.00	10.67	10.67	12.33	9.33	7.33	10.33	12.33
9	*Scenedesmus quadricauda*	53.67	32.33	0.00	0.00	0.00	0.00	71.00	91.00	45.33	52.67	15.00	36.00
10	*Scenedesmus obliquus*	19.00	22.00	43.00	46.67	37.67	32.67	18.00	9.67	32.33	31.00	21.67	23.00
11	*Scenedesmus bijugatus*	38.67	22.33	25.67	53.33	20.33	41.67	24.33	14.67	0.00	67.33	63.00	35.00
12	*Scenedesmus obtusus*	53.33	80.00	19.00	0.00	0.00	0.00	99.67	125.67	139.67	160.00	35.67	42.00
13	*Scenedesmus ellipticus*	28.00	57.67	14.33	8.33	0.00	0.00	67.67	93.67	85.33	79.67	15.67	31.33
14	*Tetraedron sps.*	0.00	11.00	6.00	10.00	5.67	12.33	11.00	9.33	19.00	13.67	14.00	6.33
15	*Cosmarium nitidulum*	9.67	8.33	8.33	27.33	18.67	33.00	27.33	14.33	21.00	24.00	20.00	6.33
16	*Cosmarium granatum*	21.33	19.33	17.33	4.67	4.33	14.33	46.00	64.33	79.00	74.00	73.67	71.67
17	*Closterium leibleinii*	55.33	27.67	0.00	32.67	25.33	20.00	17.00	17.00	32.00	53.33	60.33	82.00
18	*Closterium cornu*	29.33	22.67	15.33	10.67	0.00	0.00	0.00	20.67	12.67	18.33	22.67	34.67
19	*Staurastrum sps*	41.67	63.33	58.67	9.67	9.00	9.33	9.00	9.67	8.00	26.00	35.00	58.67
20	*Zygnema sps*	25.00	10.67	0.00	0.00	0.00	11.00	65.67	125.33	205.00	183.67	103.67	71.00
21	*Spirogyra sps*	80.00	71.00	70.00	76.00	40.67	45.33	50.00	35.33	80.00	71.00	81.00	81.00
22	*Fragilaria crotonensis*	15.00	14.33	13.67	12.67	11.67	14.33	12.67	14.33	13.33	16.00	13.33	14.00
23	*Fragilaria capucina*	25.00	25.67	24.33	24.00	28.00	33.67	32.33	34.67	24.67	35.00	35.33	36.00
24	*Synedra sps*	10.67	13.00	10.33	15.67	0.00	0.00	0.00	0.00	13.67	13.33	11.00	10.00
25	*Cymbella tumidula*	23.00	62.00	52.00	59.67	16.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	*Cymbella affinis*	22.33	40.67	36.33	40.00	13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	*Gomphonema sps*	22.33	27.33	27.00	3.67	0.00	24.67	22.33	50.00	53.00	60.67	66.00	74.33
28	*Navicula rostellata*	50.33	54.67	86.33	84.67	51.67	64.33	62.33	90.00	86.00	83.67	82.33	88.67

29	*Navicula menisculus*	51.00	55.00	57.00	53.33	37.67	36.33	41.67	65.67	61.33	65.00	65.00	65.00
30	*Navicula salinarum*	35.00	41.33	39.67	42.00	35.33	30.00	29.00	43.33	44.00	42.33	45.00	43.33
31	*Pinnularia sps*	24.67	28.00	18.67	26.67	7.33	0.00	0.33	8.33	8.33	13.33	12.33	9.33
32	*Caloneis sps*	48.33	56.33	34.67	28.67	31.00	40.33	107.67	143.00	162.00	129.67	29.33	61.67
33	*Nitzschia sps*	26.00	28.33	27.00	23.67	14.67	15.67	14.00	28.00	23.67	22.67	26.00	26.67
34	*Surirella sps*	9.67	1.00	19.33	18.33	6.00	18.00	0.00	39.67	52.00	86.33	4.33	7.67
35	*Tribonema sps*	46.67	52.67	51.00	26.00	5.00	11.00	22.67	34.33	29.00	107.00	119.00	128.67
Total		1446.33	1450.00	1041.00	1022.00	696.00	755.33	1188.00	1572.33	1843.33	2106.00	1955.00	2015.00

There are few reports available on investigation of phytoplankton from different freshwater bodies of Pune district. A study on planktonic diversity from Junnar tahasil of Pune district reported a total of 344 phytoplankton species belonging to belonging to 112 genera (Tagad, 2016) [22]. The investigation on fresh water algae from the surrounding area of Baramati city in Pune district of Maharashtra reported a total of 25 species belonging to 23 genus (Dhumal *et al*., 2020) [2]. The Gupteshwar lake in Daund Tahsil have been evaluated for algal diversity and repoted a total of 44 algal species belonging to 31 genera (Jadhav and Deokule, 2016) [7]. Phytoplankton diversity of Nira left Bank canal region of Baramti tahsil of Pune district was also noticed a total of 19 species (Gantaloo, 2021) [4]. The Mula River at Pune City also reported a high count of phytoplankton diversity noticed 162 species from 75 genera (Kshirsagar *et al*., 2012) [11]. The Tarangwadi Perennial Lake of Indapur tahsil also reported a total of 15 species with a dominance of Chlorophyceae (Raut *et al*., 2025) [18]. The Valvan lake of Lonavala also investigated a total of 52 species of phytoplankton belonging to four taxonomical divisions namely Chlorophyta, Cyanophyta, Bacillariophyta and Euglenozoa with a dominance of Chlorophyta (Mahajan and Harney, 2020) [12]. The Khadakwasla Reservoir also studied for phytoplankton noticed a dominance of Chlorophyceae followed by Bacillariophyceae, Cyanophyceae and Euglenophyceae (Nigam *et al*., 2023) [15]. The Indrayani River at Moshi also reported for a totall of 62 species of phytoplanktons with the dominance of Chlorophyceae (Patil *et al*., 2017) [16]. The order of dominance was found to be similar as Khadakwasla Reservoir (Nigam *et al*., 2023) [15].

Also several studies have reported phytoplankton diversity from other part of Maharashtra state. Jadhav & Chavan (2009) [9] documented a total of 37 phytoplankton species from Yamai lake and 35 phytoplankton species from Kapurbao lake. Kadam *et al*. (2014) [10] recorded a total of 36 phytoplankton species found in Masooli reservoir and 32 in Yeldari reservoir. Sakhare and Chalak (2015) [19, 21] documented a total of 18 phytoplankton species from Gharni Reservoir of Latur district. Sakhare & Jetithor (2015) [19, 21] reported 21 phytoplankton species from Siddeshwar Reservoir of Hingoli District. Sakhare *et al*. (2022) [20] also recorded a total of 17 phytoplankton species from seasonal eutrophic wetland ecosystems of Ambajogai town region of Beed district. The present work also reported a total of 35 species belonging to 23 genera with the dominance of Chlorophyta.

Conclusion

The seasonal analysis revealed that the winter season is a more productive period for phytoplankton followed by the summer season. The monsoon season was found to be less productive. These indicate that the winter season has favorable environmental conditions for high growth, whereas the monsoon is less suitable. The dominance of Chlorophyta was observed.

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