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The study of Phytoplankton and Zooplankton in Freshwater Tulsi Lake, Mandangad, Ratnagiri, Maharashtra, India

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Abstract: *Aquatic microorganism mainly phytoplankton play an important role in the aquatic ecosystem. They serve as a food and shelter of other aquatic organism especially zooplankton. Phytoplankton acts as a biological indicator of water pollution. Tulsi Lake located at latitude 17.9686°N and longitude 73.2202°E. The Plankton sample were collected in once from all three sites of Tulsi Lake in monthly interval from January 2021 to December, 2021.The plankton sample were collected in sterile plastic bottles with the help of plankton net of mesh size 25 and diameter of pore 60µ. Phytoplankton material was preserved in 4% formalin solution at the site of collection. In the present research investigation, water body show variety of algal genera. Algal genera belong to groups Chlorophyta, Bascilariophyta and Myxophyta. Out of 19 Genera of Phytoplanktons 8 belongs to Chlorophyta, 5 belong to Bascilariophyta and 5 belong to Myxophyta. Algal study very essential for assessment of the good or bad condition of the fresh water lake/pond ecosystem. In all three sites of the lake, the results found to be average and more or less similar. So, it indicated that the lake not shown much eutrophic due to less presents of Pollutants and this is supported with the results of physicochemical parameters the lake water.*

Keywords: Tulsi Lake, Phytoplanktons, Zooplanktons, etc.

I. INTRODUCTION

Freshwater biology is the study of the biological characteristic and interaction of organism of freshwaters. The freshwater quality in pond, rivers, streams and dams may vary depending on the geological morphology, vegetation, and land use in the catchment. Industries, agriculture and urban settlements produce nutrients (sewage effluent and fertilizers) and toxic substances such as organic and inorganic pollutants and other chemicals including heavy metals. Water pollution occurs when these substances degrade the water quality of dams, rivers, ponds etc., enter the water way and alter their natural function. Due to increased human population, industrialization, the use of fertilizers in the agriculture and man-made activity, it is highly polluted with different harmful contaminants. Therefore, it is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from varying of water borne diseases.

Mandangad tahsil is a hilly coastal zone of Ratnagiri district of Maharashtra state, India. Arabian Sea is Just 40 km away from Mandangad so throughout the year climate always remain humid. Average rainfall in tahsil is 3996 mm per year. Mandangad is diversity rich site of Western Ghat (UNESCO World Heritage site and is one of the eight "hottest hot-spots" of biological diversity in the world). Tulsi Lake is situated 10 km away from the Mandangad city. Aquatic microorganism mainly phytoplankton play an important role in the aquatic ecosystem. They serve as a food and shelter of other aquatic organism especially zooplankton. They also play an essential role in the aquatic ecosystem to absorbs nutrients, heavy metals, toxic things and convert it into simplest form. Phytoplankton acts as a biological indicator of water pollution.

The communities of phytoplankton mainly different species of diatoms are also used as an indicator of water pollution (Mishra, 1996). Seasonal changes in quantity of plankton are associated with the switches in environmental condition Sumaiya and Singh, (2017). Tulsi Lake, Plankton study is carried out during the period of January 2021 to December2021 in all three sites of the Tulsi Lake, Mandangad, Maharashtra, India.

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II. Materials And Methods

1. Study Area:

Tulsi Lake is situated 10 km away from the Mandangad city and 1.5 Km away from the Tulsi Village. It is located at latitude 17.9686°N and longitude 73.2202°E. Study Area Shown in fig. 1, 2 and 3. This Lake is very important for local people which are used water for drinking and other domestic purpose.

Figure 1: Tulsi Lake

Figure 2: Satellite View of Tulsi Lake

Figure 3: View of Tulsi Lake

2. Water Sample Collection:

The Plankton sample were collected in once from all three sites of Tulsi Lake in monthly interval from January 2021 to December, 2021.The plankton sample were collected in sterile plastic bottles with the help of plankton net of mesh size 25 and diameter of pore 60µ. Phytoplankton material was preserved in 4% formalin solution at the site of collection. The Phytoplanktons were identified by staining with 1% Ligol's Iodine solution and examine under compound microscopes. Quantitative analysis of phytoplankton was done by drop count method. Phytoplankton identification was done with the help of standards works by (APHA, 2005) and different standards books and monographs Prescott (1969), Chapman & Chapman (1975). Ward and Whipple (1959) and also the available literature of Smith, (1950). The obtained results were recorded the number of organisms per Liter.

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III. Results And Discussion

The biological characteristics of lake with respect to phytoplankton mentioned in Table 3.1 and 3.2. Phytoplankton or algae are the major inhabitant of fresh water body Patil et.al; (2015). In fresh water ecosystem Phytoplanktons are the primary producer which absorbs the radiant energy and convert it into chemical energy. They also play an important role in aquatic food chain. Phytoplanktons communities do not respond only to natural changes into the lake, but may also present variation because of human variation because of human activities affecting the water bodies Sumaiya & Singh, (2017).

In the present research investigation, water body show variety of algal genera. Algal genera belong to groups Chlorophyta, Bascilariophyta and Myxophyta. Out of 19 Genera of Phytoplanktons 8 belongs to Chlorophyta, 5 belong to Bascilariophyta and 5 belong to Myxophyta which is mentioned in Table 3.1. With minor variation in distribution pattern of phytoplankton nearly similar fluctuation throughout the year in all three sites of the lake which is shown in Table 3. 2 and Graph 3.1, 3.2 and 3.3.

Chlorophyta members found to be most dominant group of Phytoplanktons with respect to diversity and density. Among total phytoplankton population Chlorophyta contribute 43.41% (Table -3.3) population density of Chlorophyta found maximum 140 unit/l in the month of January at site- 3. Whereas minimum 31 unit/l during the month of August at site - 1 and 2. Among the Chlorophyta, Closterium, Oedogonium and Pediastrum Species shown their abundance throughout the research. Bascilariophyta was contributed 35% of total phytoplankton population and acquired 2nd position which was shown in Table 3. The highest population of Bascilariophyta (117 unit/l) was found at site 3 and lowest population was found at site- 2 (33 unit/l). which is shown in Graph 3.1, 3.2 and 3.3. Among these members Diatoms and Melosira were found to be most abundance in site -1 and 3 during the period of study. Abundance of Diatoms was found from January to May as there is a significant amount of silica. These results were correlated with the findings of Patil et.al; (2015). Diatoms population also maximum in October in Site 1 and 3, it is due to heat and bright sunlight. As the summer advanced and temperature increased the diatoms become dominant. These findings also correlate with the findings of Moosa & Yeragi, (2013).

Myxophyta algal population is the most efficient in utilizing of CO_2 at high pH and thus their abundance indicates the Eutrophic nature of the water. These members considered as highly tolerant to polluted water at high temperature Sumaiya & Singh, (2017). In the present study 5 genera have been found. Myxophyta members contributed 25% of total phytoplankton Population which was shown in Table 3.3. The highest density of Myxophyta was recorded as 82 unit/l at site -2 at the month of July and lowest population was 30unit/l at site 3 in the month of September which is shown in Graph 3.1, 3.2 and 3.3. Among the Myxophyta algal members, Microcystis and Spirulina sp.were dominated. Microcystis was started in April and which become slightly thick in the month of June (74unit/l) in site -2 it is because small amount of pollutant mixed with rain water as well as washing of domestic animals these findings also correlated with the findings of Ramakrishna (2000), Patil et.al (2015) and Moosa and Yeragi, (2013). Seasonal variation in population of Phytoplankton depends on the changes in climatic condition. Davis (1947), reported that a number of physical, chemical and biological factors responsible for fluctuation of plankton population. Phytoplankton and its seasonal succession can be better predictor of long-term environment change in the aquatic system than the more usual descriptor of biomass and productivity indices Dhamak et.al;(2013).

In Twelve-month, investigation, the maxima of phytoplankton population noted in post-monsoon season with 863 unit/l whereas minimum population recorded in monsoon season (430 unit/l). The highest productivity rate found during the month of Pre-summer seasons that is in February this is because increased temperature, bright light, clear water and good transparency due to which sunlight penetrate well inside water which speed up the photosynthetic activity of phytoplankton. Water quality and other biotic community of that water body control the plankton diversity and density Sumaiya and Singh, (2017), Ramakrishna (2000) Dhamak et.al; (2013). The development of algal boom requires appropriate condition in water body like low flow of water still environment, good light penetration and rich nutrient supply and low zooplankton density Donnelly et.al; (1997).

The maximum growth of phytoplankton during post monsoon period is due to rich nutrient received through surface rain water which brings humus and other nutrients Sreenivasan (1974). In the present study, the minimum density of phytoplankton was recorded in August (36.22 unit/l). The lowest density during peak monsoon may be due to high turbidity, cloudy weather and more water with rains. Ramakrishna (2000), Patil et.al (2015), Moosa and Yeragi,(2013),

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Sumaiya & Singh, (2017), Green and Andrew (1964) & Dwivedi B.K and Pandey G.C.(2002), reported that, the effect of turbidity on phytoplankton production. They also studied the variation of Phytoplankton in relation to turbidity value during pre-monsoon and mid-monsoon period. Dissolved oxygen also impacts on population density of phytoplankton and similar observation hade also made by Patil, et.al; (2015) in Venna Lake, Mahabaleshwar. During the study, it was observed that, at the entire sampling sites the population of phytoplankton was dominated by Chlorophyta, then Bascilariophyta and Myxophyta. Out of three sampling Sites, Site-3 distinctly higher abundance of Chlorophyta, Bascilariophyta. Due to muddy bottom, clear and still water with high penetration of light. Whereas Site-2 shown abundant population of Myxophyta due to slightly mixing of pollutant, increased CO2 concentration.

Zooplanktons:
In Tulsi Lake zooplanktons population also found and these are members of Protozoan, Rotifera and Cladocera.

Protozoa: Among the protozoa, the member of the Mastigophora, Rhizopoda and Ciliata mostly present in the small patches among the senescent and rotting vegetation while Rhizopoda are present in open water. Some species of protozoan Tulsi Lake are Euglena, Diflugia, Paramoecium and Vorticella mostly found in post winter seasons.

Rotifera: The four species of rotifera are found during the investigation period from the lake of which Brachyonus sp. was dominated. Among rotifers the species are of Filinea, Brachyonus and Keratella are prominently founds.

Cladocera: Among the zooplanktons, Cladocera are found during summer months. They are mostly occurring from January to pre-monsoon period. Daiphanosoma and Ceriodaphnia sp. Found throughout the investigation period. But the population decreased during the month of July to September. The members of Cladocera are Diaphdnasoma sp., Ceriodephnia sp., Ceriodaphnia sp. Chydorus and Moina spp. mostly found during the study period

Table 3.1: Total Species Composition various algal groups at Tulsi Lake

Chlorophyta	Bascilariophyta	Myxophyta
Scendesmus sp.	Nitzschia	Anabaena
Ankistrodesmus sp.	Navicula	Microcystis
Closterium	Diatoms	Nostoc
Pediastrum	Fragilaria	Spirulina
Ulothrix	Melosira	Oscillatoria
Oedogonium		
Zygnema		
Hydrodyctyon		

Table 3.2: Phytoplankton Distribution table Jan2021 to December 2021

Phytoplankton (Class)	Sites	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept.	Oct	Nov	Dec	Mean
Chlorophyta	S-1	122	130	100	87	83	75	50	37	70	90	120	127	90.91
	S-2	118	125	96	83	79	63	47	31	48	77	85	98	79.16
	S-3	140	137	112	92	90	82	59	46	63	98	132	130	98.41
Bascilariophyta	S-1	74	80	72	86	105	69	47	38	53	100	92	86	75.16
	S-2	68	75	69	79	89	60	41	33	49	67	87	81	66.5
	S-3	83	96	88	76	117	73	62	57	64	103	89	97	84.58
Myxophyta	S-1	62	74	68	55	47	39	35	28	37	58	64	73	53.33
	S-2	65	60	69	73	68	82	40	37	33	66	71	65	60.75
	S-3	57	64	69	43	39	31	35	25	30	50	61	70	47.58

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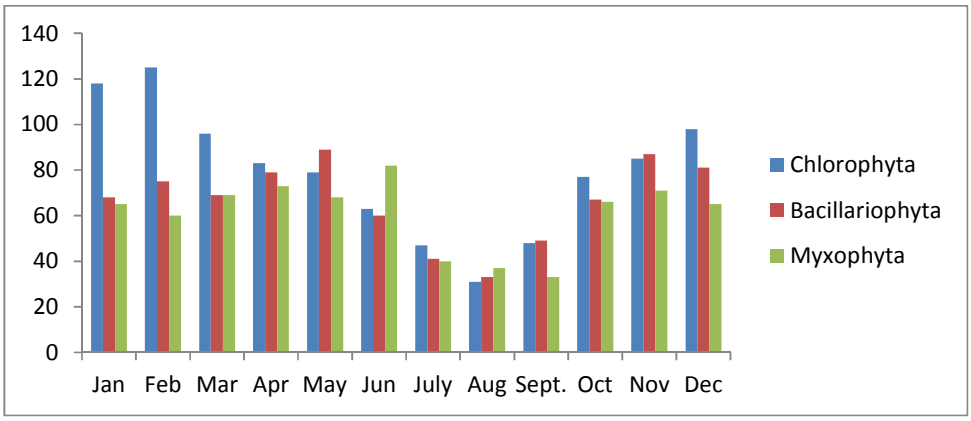
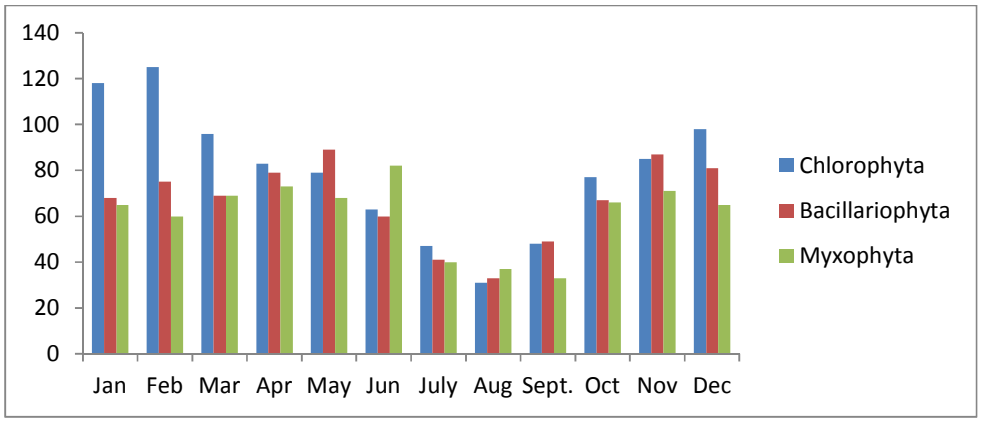
Table 3.3: Percent (%) Density of Phytoplanktons at all three sites of Tulsi Lake

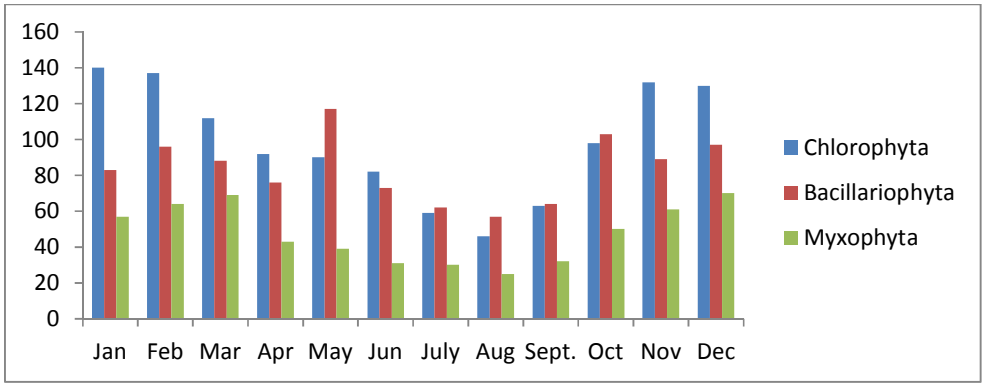
Class	Site-1	Site-2	Site-3
Chlorophyta	42.00	39.15	43.41
Bascilariophyta	32.43	31.65	35.57
Myxophyta	24.89	29.18	20.49



Graph 3.1: Phytoplanktons distribution at Site- 1



Graph 3.2: Phytoplanktons distribution in Site-2



Graph 3.3: Phytoplanktons distribution in Site-3

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IV. CONCLUSION

The present research study has been focused onto limnological study of Tulsi Lake with respect to Plankton population diversity and Density. The lake had a diversified algal flora in which Chlorophyta members were dominant in all three sites than Bascilariophyta and Myxophyta. Algal study very essential for assessment of the good or bad condition of the fresh water lake/pond ecosystem. The results in all three sites of the lake, found to be average and more or less similar. So, it's indicated that the lake not shown much eutrophic due to less presents of Pollutants. In future, it is also need to study the microbial biota of this lake.

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