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LIMNOLOGICAL STUDIES IN RELATION TO PHYTOPLANKTONS OF RIVER WARDHA NEAR EKONA, TALUKA WARORA, DISTRICT CHANDRAPUR, MAHARASHTRA STATE, INDIA

P.R. Makde[1] and M. C. Kale[2]

[1]Department of Botany, Arts, Commerce and Science College, Maregaon, Maharashtra

Email – mrprass11@gmail.com

[2]Department of Botany, Anand Niketan College, Anandwan, Warora, Maharashtra

Email address – mrunalkale24@gmail.com

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ABSTRACT

Over a one-year period, this study examined the whole impact of coal mines and power plants on entertained local phytoplankton community and physico-chemical characteristics of Wardha river near Ekona. These characteristics were studied for a period of 12 months from February 2022 – January 2023. In view of above, an attempt was made to study certain limnological parameters such as water temperature, conductivity, T.D.S., turbidity, pH, D.O., total alkalinity, B.O.D., free CO_2, chloride, phosphate and nitrate. For examination of above all mentioned parameters American Public Health Association (APHA - 1985), American Water Works Association was made. Present research work concludes that Wardha river near Ekona was basically for irrigation purpose is now polluted water body due to continuous discharge of coal mines and power plants.

INTRODUCTION

Water is elixir of life but water pollution is one of the most serious problems for living system on the Earth. The diversity as well as growth of phytoplanktons in the lotic ecosystem is influenced by several physico – chemical parameters. Phytoplanktons are the pioneer of lotic ecosystem and plays key role in aquatic food chain for all aquatic animals. Environmental pollution is the global concern of the day. The growth of industrial area is rapid and very fast thus related anthropogenic activities have also been increased like waste discharge from industries, transportation and domestic activities (Tambekar et al., 2012).

The impact of coal mining activity on the environment is of great concern, especially due to acidification of surface water bodies. Hence, mining requires complex planning that takes into account the specificity of techniques and characteristics of the affected environment (Kopezinski, 2000). Water reservoirs are not only a source of water storage but also provide valuable habitats to biological world (APHA 1985). Planktons are highly sensitive to environmental variation, as a result; change in their diversity, density or community composition indicates environmental change or disturbance (Dahegaokar, 2023). Water, the matrix of life is exposed to pollution, unhealthy environment, resulting in human affliction and diseases transmission due to rapid industrialization and population (Mohammad et al., 2015).

Wardha river near Ekona is the major river in Warora taluka, Chandrapur district, Maharashtara which is important for different aspects such as source of drinking water, irrigation, wild life and domestic life purposes and washing clothes. The present investigation has been carried out in order to determine the phytoplankton diversity of Wardha river in term of physico-chemical properties since no attempts have been noticed on the limnological aspects of this river.

MATERIAL AND METHODS

A) STUDY AREA: The study area comprised of part of Chandrapur and Yavatmal districts near Ekona village through which Wardha river flow. The Wardha river water quality gets contaminated due to effluents of power station, Coal mines and anthropogenic activity. Geographically study area is situated at latitude $20^0$25'45" N and longitude $78^0$90'57" E.

B) SAMPLING: River water samples were collected for physico – chemical and hydrobiological analysis from select location during Feb. 2022 to Jan. 2023 for one years as per the standard method (APHA 1985).The water sample for phytoplankton were collected by planktonic net (mesh size 25µm) using sterilized 100 mL borosil bottles and immediately preserved by adding Lugol's

iodine solution. The estimation of pH, dissolved oxygen, conductivity, TDS, turbidity was carried out onsite by water analysis kit. The remaining physico – chemical parameters were analyzed as per standard methods (APHA 1985). Identification and enumeration of phytoplankton were carried out by fresh water plankton keys (Prescott 1973, Philipose 1974, APHA 1985, Plaskitt 1997).

RESULT AND DISCUSSION

The results obtained by physico – chemical analysis of all samples are given in table no.1. The monthly variations in the physico – chemical parameters are discussed under following points. The water temperature varied from 23.5^{0}C to 34.2^{0}C in month of December and May. Electric conductivity was maximum in June, 645 µmhos/cm and minimum in July, 231µmhos/cm. The total dissolve solid value was ranges from 150 mg/L in month of July to 419 in month of June. The value of turbidity was high in September, 15.1 NTU and low in January, 1.07 NTU. The pH values falls within the alkaline range fluctuating within 8.13 to 8.63. Pearsall (1930) observed that the pH of the water appears to be dependent upon the relative quantities of calcium, carbonates and bicarbonates. The lower pH in winter may be due to short period and decreased photosynthetic activity (George, 1997). Saraf and Shenoy (1986) during their study on Wardha river near Ballarshah recorded similar observations. The dissolved oxygen concentration was minimum, 3.86 mg/L in May and maximum, 6.91mg/L in January. Shivanikar et al., (1999) reported increase in temperature of water in summer results in decrease of dissolved oxygen in Godavari River. High value of total alkalinity was recorded during summer and low during winter. Adebisi (1981) also reported maximum total alkalinity during summer. The B.O.D. values were ranges between 4.52 and 12.0 mg/L in winter and summer respectively. Minimum values of free CO_2 were recorded during winter (1.88 mg/L) and maximum during summer (5.71 mg/L). The minimum value of free CO_2 during winter months may be due to its utilization through photosynthetic activity by the aquatic microscopic life. However, the higher values of CO_2 can be attributed to the higher rate of decomposition of organic matter by microorganisms with consequent increased release of free CO_2, decrease in utilization in photosynthetic activity and high respiratory activity of benthos and microbes. The chloride in natural water bodies may also be contributed by sewage discharge and discharge of effluents from industries and irrigation drainage. Most of the rivers receive chloride by leaching through soils with which the water comes in contact. Chloride concentration was maximum in the month of July and minimum in month of September (26.6 to 48.4 mg/L). Phosphate concentration ranged from 0.44 mg/L in December to 1.05 mg/L in June. Reginna and Nabi (2003) recorded the lowest value 0.01 mg/L in the month of September and May and highest value 0.9 mg/L in the month of June. Ansari (1993) reported high values of soluble phosphates in summer due to enhanced rate of decomposition in river Godavari at Nanded. Nitrate was maximum in month of July, 1.48 mg/L and minimum in January 0.47 mg/L. The higher values of nitrates were due to the influx of nitrogen rich runoff water from catchment areas that bringing large quantity of concentrated sewage water. Arvind Kumar and Singh (2002) reported high values of nitrate during rainy season due to influx of nitrogen rich flood water that brings large amount of contaminated sewage water. Similar findings were recorded by Badge and Verma (1985), Sunder Raj (1988) in river Jhelum.

Biotic status

Phytoplanktons are regarded as the chief primary producers of any aquatic environment (Wetzel 1975). They were very useful by ecological point of view. Some develop contaminated water bodies, sometimes creating offensive tastes with bad odour or anoxic or toxic conditions due to noxius bloom, resulting in human illness and animal death, to those who consume this water (Hosseti, 2002). In the present investigation, 34 phytoplanktonic algal species were identified. Chlorophyceae was the dominant group among the phytoplankton represented by 17 genera among which Closterium, Zygnema and Spirogyra, were abundance at the sampling site. The Spirogyra spp. and Zygnema spp were recorded in appreciable number which could be indicated as pollution tolerant genera. Palmer (1980) has also reported these genera as the bioindicator of organic pollution. Myxophyceae is considered to be highly adaptive and colonized even in polluted water at higher temperature. They are more efficient in utilizing CO_2 at high pH level and low light availability under eutrophic condition (Shapiro, 1990). In present investigation 08 genera have been recorded among which genera like Rivularia, Microcystis and Spirulina are abundant. Bacillariophyceae was the most important group of algae even though most species are sessile and associated with littoral substrate (Wetzel 1983). The group Bacillariophyceae was represented by 07 genera among which the genera like Diatoma, Fragillaria and Mastogloia were found to be abundant. Lowe and Gale (1980) reported that diatoms are the most important colonizers of rivers and their species composition depend upon temperature, water quality, current pattern and substrate type. The density of diatoms is affected due to extra cellular products are released by Chlorophyceae after excessive growth (Somashekhar, 1988). Euglenophyceae was shown very poor distribution and represented by only two genera such as Euglena and Phacus. Euglenophyceae are the key species of biological indicator of organic pollution demonstrated by Palmar (1969). Euglena was dominant in this group.

CONCLUSION

In the present investigation, it can be conclude that there are clear variations in the physico – chemical parameters. 34 phytoplanktonic algal species were identified and were found in the following order of abundance Chlorophyceae > Myxophyceae > bacillariophyceae > Euglenophyceae. The evaluation of phytoplanktons show that the water quality of Wardha river is mildly polluted due to effluents of power stations, Coal mines and anthropogenic impact on water body. Present investigation would be useful for future assessment after interlinking. In Pearson correlation coefficient D.O. shows negative correlation with all the physico – chemical parameters as well as pH, Total alkalinity, B.O.D., Free CO_2, Chloride shows negative correlation with turbidity. Nitrate shows negative correlation with conductivity, T.D.S., pH, Total alkalinity and Turbidity also shows negative correlation with conductivity and T.D.S

Table no. 1: Table Shows Monthly Mean Values of Physico-Chemical Parameters in Wardha river near Ekona during February 2022 – January 2023

Months→ Parameters ↓	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
Water temp.	25.4	31.3	31.4	34.2	31.8	30.8	28.6	28.4	27.1	24.9	23.5	24.6
Conductivity	471	510	501	630	645	231	458	468	443	394	483	470
T.D.S	306	331	326	410	419	150	168	304	288	258	314	304
Turbidity	7.84	6.86	6.12	5.56	9.02	9.36	10.3	15.1	7.1	3.74	3.42	1.07
pH	8.31	8.4	8.43	8.49	8.63	8.17	8.18	8.21	8.13	8.26	8.42	8.35
D.O	5.56	5.25	4.24	3.86	4.56	4.32	5.41	5.68	5.91	6.18	6.88	6.91
Total alkalinity	208	225	204	196	236	130	142	138	152	130	224	206
B.O.D.	8.81	9.17	10.7	12	10.9	8.82	7.88	5.93	5.78	5.23	4.52	8.69
Free CO_2	5.48	4.98	5.66	5.71	4.29	4.21	3.12	2.46	2.49	1.88	3.32	3.96
Chloride	35.4	38.6	36.6	44.8	47.4	48.4	35.6	26.6	38.2	37.2	37.8	35.4
Phosphate	0.59	0.93	1.03	1.02	1.05	0.96	0.82	0.73	0.81	0.62	0.44	0.46
Nitrate	0.79	0.8	0.84	0.98	1.08	1.48	1.19	0.86	0.65	0.59	0.49	0.47

Unit of Water temperature is °C, Conductivity (µmhos/cm) pH Hydrogen ion conc. Turbidity (NTU) and mg/l is for T.D.S, Free CO2, Total alkalinity, Chloride, D.O, B.O.D, PO4 and NO3.

Table no.2: Seasonal average mean values of physico-chemical parameters of water in Wardha river near Ekona during February 2022 – January 2023

Year →		February 2022 - January 2023			
Parameters ↓		Summer	Monsoon	Winter	Annual
1	Water temp.	30.56 ± 3.71	29.91 ±1.675	25.01 ± 1.545	28.49 ± 2.31
2	Conductivity	528 ± 70.33	450.2 ±169.7	447.4 ± 39.49	475.20 ± 93.17
3	T.D.S	343.2 ± 45.51	260.3 ± 126.4	290.9 ± 24.4	298.13 ± 65.44
4	Turbidity	6.595 ± 0.986	10.96 ± 2.829	3.833 ± 2.482	7.13 ± 2.10
5	pH	8.406 ± 0.076	8.296 ± 0.221	8.286 ± 0.125	8.33 ± 0.14
6	D.O	4.727 ± 0.807	4.992 ± 0.654	6.473 ± 0.502	5.40 ± 0.65
7	Total alkalinity	208.5 ± 11.87	161.7 ± 50.06	178.1 ± 44.3	182.77 ± 35.41
8	B.O.D.	10.18 ± 1.482	8.39 ± 2.075	6.054 ± 1.83	8.21 ± 1.80
9	Free CO_2	5.46 ± 0.333	3.518 ± 0.888	2.911 ± 0.916	3.96 ± 0.71
10	Chloride	38.85 ± 4.181	39.5 ± 10.38	37.15 ± 1.237	38.50 ± 5.27
11	Phosphate	0.893 ± 0.209	0.891 ± 0.14	0.583 ± 0.173	0.79 ± 0.17
12	Nitrate	0.851 ± 0.087	1.151 ± 0.257	0.551 ± 0.085	0.85 ± 0.14

Unit of Water temperature is °C, Conductivity (µmhos/cm) pH Hydrogen ion conc. Turbidity (NTU) and mg/l is for T.D.S, Free CO_2, Total alkalinity, Chloride, D.O, B.O.D, PO_4 and NO_3.

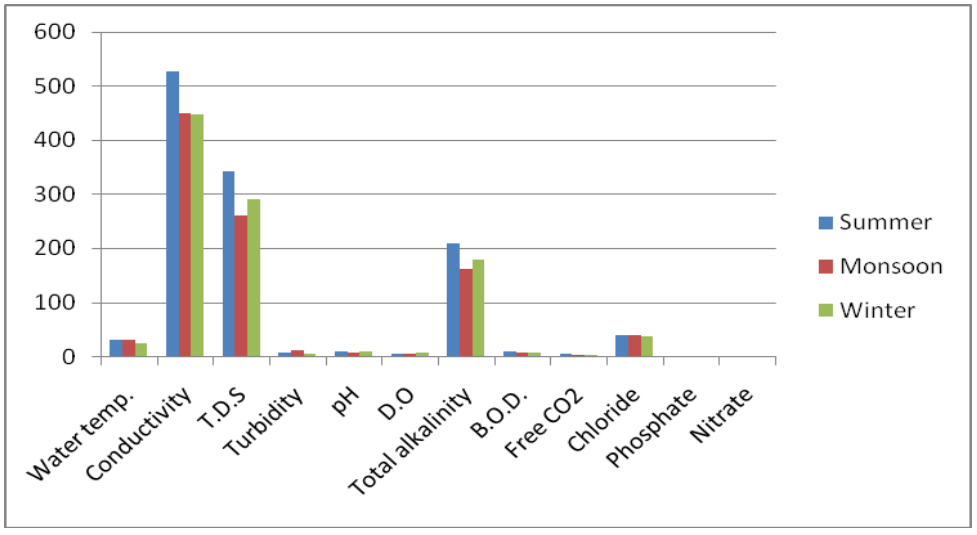

Table no. 3: Monthly variation of phytoplankton at station of Wardha river near Ekona during the year 2022 - 2023

Month→ Phytoplankton↓	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Total
Myxophyceae													
Nostoc spp.	8	7	5	12	7	2	0	1	4	6	13	8	73
Microcystis spp.	6	10	11	16	4	0	2	4	6	9	1	14	83
Rivularia spp.	5	13	12	14	2	0	1	6	8	10	9	18	98
Scytonema spp.	4	10	8	9	11	0	0	3	5	7	8	4	69
Anabaena spp.	8	9	7	10	7	0	0	1	6	3	7	9	67
Spirulina spp.	0	12	23	10	4	0	0	1	12	6	3	3	74
Anacystis spp.	3	2	10	11	4	1	0	1	0	10	5	1	48
Oscillatoria	5	14	8	7	4	0	1	0	2	2	5	7	55
Total	39	77	84	89	43	3	4	17	43	53	51	64	567
Bacillariophyceae													
Nitzchia spp.	2	2	1	0	0	0	0	1	6	8	4	10	34
Navicula spp.	1	1	20	10	7	1	0	14	17	16	21	24	132
Pinnularia spp.	2	9	8	18	7	0	1	10	14	13	27	32	141
Diatoma spp.	11	12	22	18	5	4	2	17	16	22	14	18	161
Mastogloia spp.	29	16	4	10	12	8	3	0	4	16	27	24	153
Fragilaria spp.	11	16	12	2	8	0	0	9	24	17	29	32	160
Gyrisigma spp.	1	10	4	9	1	0	0	7	10	13	8	0	63
Total	57	66	71	67	40	13	6	58	91	105	130	140	844
Chlorophyceae													
Volvox spp.	1	4	3	5	3	0	0	4	3	2	1	0	26
Pediastrum spp.	1	3	2	2	7	0	1	8	2	12	14	10	62
Chlorella spp.	2	7	4	8	6	0	2	4	12	19	17	14	95
Ulothrix spp.	4	5	2	0	0	0	0	4	10	8	11	0	44
Cladophora spp.	2	14	4	9	3	2	3	12	16	17	10	17	109
Oedogonium spp.	4	2	5	8	9	1	0	1	2	4	8	5	49

Spirogyra spp.	18	8	22	10	18	0	7	14	27	22	29	33	208
Zygnema spp.	9	7	8	7	14	0	0	22	48	35	44	52	246
Closterium spp.	38	10	1	14	9	0	3	10	22	54	35	70	266
Cosmarium spp.	2	1	0	0	0	4	3	4	10	8	9	5	46
Gloeocystis spp	10	0	0	0	3	1	0	2	3	2	5	9	35
Micrasterias spp.	1	0	0	0	0	0	0	0	4	2	2	1	10
Vaucheria spp.	10	12	6	3	2	0	0	3	9	15	11	8	79
Microspora spp.	0	0	0	0	0	0	0	0	2	1	1	2	6
Scenedesmus spp.	0	0	0	0	0	0	0	0	0	0	1	1	2
Chlorocloster spp.	19	5	7	1	3	2	0	0	0	10	16	20	83
Coelastrum spp.	0	0	0	0	2	2	1	1	5	6	5	1	23
Total	121	78	64	67	79	12	20	89	175	217	219	248	1389
Euglenophyceae													
Euglena spp.	5	7	6	9	2	0	0	0	1	1	2	3	36
Phacus spp.	1	0	0	0	0	0	0	1	2	4	2	1	11
Total	6	7	6	9	2	0	0	1	3	5	4	4	47

Table no. 4: Table shows Pearson's correlation coefficient of Physico - chemical parameter

Parameters	Water temp.	Conductivity	T.D.S	Turbidity	pH	D.O	Total alkalinity	B.O.D.	Free CO2	Chloride	Phosphate	Nitrate
Water temp.	1											
Conductivity	0.347	1										
T.D.S	0.295	0.883	1									
Turbidity	0.364	-0.079	-0.197	1								
pH	0.368	0.783	0.822	-0.301	1							
D.O	-0.928	-0.199	-0.175	-0.378	-0.293	1						
Total alkalinity	0.109	0.684	0.731	-0.396	0.843	-0.019	1					
B.O.D.	0.781	0.467	0.419	-0.001	0.585	-0.779	0.442	1				
Free CO2	0.550	0.374	0.413	-0.143	0.567	-0.607	0.631	0.846	1			
Chloride	0.506	0.043	0.109	-0.206	0.393	-0.553	0.205	0.515	0.373	1		
Phosphate	0.951	0.244	0.190	0.403	0.270	-0.925	0.016	0.690	0.434	0.536	1	
Nitrate	0.668	-0.219	-0.357	0.609	-0.099	-0.754	-0.309	0.467	0.246	0.514	0.697	1

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