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Studies of Seasonal variations of Phytoplankton diversity and their Correlation with Physicochemical Parameters of Susari dam of Shahada Taluka District Nandurbar (M.S.) India.

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ABSTRACT

The productivity of an aquatic environment is directly correlated with the density of phytoplankton. In the present investigation's accounts of phytoplankton diversity seasonal variations of phytoplankton density and species richness was studied of Susari dam. In the present study surface water sample were collected at an interval of a month from June 2012 to May 2014. This revealed that the density of phytoplankton was maximum in summer while it was minimum in monsoon. Maximum species richness of phytoplankton was recorded in summer, while minimum species richness was recorded in monsoon. The phytoplankton structure depends on a variety of environmental factors that include various physicochemical factors. The Pearson correlation was calculated by keeping phytoplanktons as dependent variable and other abiotic factors as independent variables. During the period of investigation 51 species of phytoplankton representing four taxonomic groups namely Cyanophyceae, Chlorophyceae, Bacillariophyceae and Euglenophyceae. It accounted for a contribution of 42.30% Bacillariophyceae, 32% Chlorophyceae, 21.78% Cyanophyceae and 3.90% Euglenophyceae. Cyanophyceae and Chlorophyceae found to be Maximum in winter, Bacillariophyceae maximum in summer and Euglenophyceae in monsoon.

Keywords: Susari dam, Phytoplankton, Biodiversity, Seasonal variation, density and correlation.

INTRODUCTION

Biodiversity is one of the important life supporting system on earth. "Biodiversity is the variety and variability among living organism and ecological complexes in which they occur". It is an index of Nations wealth and the basis of human survival. The Phytoplankton of the open water ponds, lakes and large streams consist of a diverse assemblage of microscopic autotrophs. Phytoplanktons are chlorophyll bearing suspended microscopic organism consisting mainly of algae. Phytoplanktons are the basic member of aquatic ecosystem and hence change in phytoplankton population has a direct link with the change of water quality in any aquatic medium. The number and species of phytoplankton serves to determine the quality of water body

(Bahura, 1991). Phytoplankton which includes Cyanophyceae, Chlorophyceae, Bacillariophyceae and Euglenophyceae, etc is important among aquatic flora. The phytoplankton diversity and density are controlled by water quality and other biotic communities in a water body (Reid and Wood, 1976). Phytoplankton functions as the primary producers in the aquatic Biotopes. Hence the quality and quantity of phytoplankton population bear much influence on the production potential of an aquatic ecosystem. Phytoplanktons are ecologically significant as they form the basic link in the food chain of all aquatic animals (Misra, 2001). When they are in large numbers, they make the water greenish.

Study area:

A Susari minor project lies at 21^0 35' North Latitude and74^0 29' East Longitude. A Susari reservoir is the minor project which is built up during the decade of 2006. The catchment area of Susari minor project is 96.94 Sq.Km. The nature of catchment area is hilly and well developed for the collection of water. The dam receives the water by rainfall only. The project is located near Navalpur village for about 500M away and 7Km from Shahada. It is perennial dam and used for irrigation and drinking purposes as well as Pisciculture.

MATERIALS AND METHODS:

Surface water samples were collected from three stations of the dam at monthly intervals for two years during June, 2012 to May, 2014. Water samples were analyzed in the laboratory for the important physico-chemical parameters like temperature (AT and WT), Water cover (WC), Transparency (Trans), Total Solids (TS), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), pH, DO, CO_2, TH, Cl^-, NO_3^-, PO_4^{-3}, SO_4. Mg^{+2} and Ca^{+2} were estimated using standard methods of analysis as per APHA (1998) and Michal (1984).

Ten liters of water was filtered using plankton net No. 25 of bolting silk with mesh size 64 µm and concentrated to 100ml and preserved in separate vials by adding 1ml of 4% formalin, 1ml of Lugol's iodine was added to it for further qualitative and quantitative studies for quantitative estimation of plankton, 1ml well mixed sample was taken on 'Sedgewick Rafter cell'. The average of 5-8 counts was made for each sample. Qualitative study of phytoplankton were carried out with the help of key's given by Edmonson (1963), Sarode and Kamat (1984) and Battish (1992).

Fig. 1: Satellite image and Panoramic view of Susari dam.

RESULTS AND DISCUSSION

The Physico-chemical analysis of Susari dam water has been in (Table- 1 & 2). The phytoplankton communities of the study period total 51 species belong to 4 groups recorded in the Susari dam. These four groups, Cyanophyceae, Chlorophyceae, Bacillariophyceae and Euglenophyceae (Table- 4).

Cyanophyceae:

Cyanophyceae, a rich plankton community with well-marked serial succession is the hallmark of Indian reservoirs. It mainly occurs in clean or polluted water body generally exhibits a characteristic cyclic growth. Cyanophyceae possess a high potential of adaptation to diverse environments (Garcia, Pichel *et al.,* 2001). Cyanophyceae has been reported to dominate phytoplankton communities under reduced light environment (An and Jones, 2000). At the study site Susari dam Cyanophyceae were third dominant quantitative group of total phytoplankton with an average of two years contribution of 21.78% to the total phytoplankton population. In the present study seasonal variation of Cyanophyceae shows maximum density was observed in winter (685± 51.16 No/L) and minimum during monsoon period (270.6±27.43 No/L) (Table- 3 Fig-1). Similar results were reported by various workers, B. Suresh *et al.,* 2013, Agale 2015, Sonule and Mulani (2017).

In the present study seasonal variation of Cyanophyceae maximum density was observed in winter (685± 51.16 No/L) and minimum during monsoon period (270.6±27.43 No/L) (Table- 3, Fig-1). In the present study Cyanophyceae are the positively significantly correlation with Trans at 0.01 level, pH, DO and Mg^{+2} at 0.05 level while negatively significant correlation with AT, WT, TS, TDS, TSS, NO_3^-, PO_4^{-3}, CO^2 and SO^4 at 0.01 level. (Table- 5).

Table: - 1 Seasonal variation in physical parameters of Susari dam over the period of two years from June 2012 to May 2014(Mean ± SEM)

Sr. No	Parameters	Monsoon	Winter	Summer	F value
1.	AT^{0}C	26.13±0.39	22.5±0.62	27.63±0.88	$F_{2\ 21}$ 15.6
2.	WT^{0}C	22.38±0.26	20±0.46	23.75±0.61	$F_{2\ 21}$ 16.18
3.	Water cover%	81.25±5.72	80±2.83	58.13±2.79	$F_{2\ 21}$ 10.21
4.	Transparency(Trans) cm	75±4.62	80±2.83	58.13±2.97	$F_{2\ 21}$ 10.28
5.	Total solids (TS) mg/L	216.8±6.39	160±4.15	206.8±5.63	$F_{2\ 21}$ 29.79
6.	Total Dissolved Solids (TDS) mg/L	148.3±4.81	128.4±3.04	165.8±3.83	$F_{2\ 21}$ 22.3
7.	Total Suspended Solids (TSS) mg/L	68.5±5.34	32.38±2.06	41±1.85	$F_{2\ 21}$ 29.43

Table: - 2 Seasonal Variations in Chemical Parameters of Susari Dam Over the period of two years from June 2012 to May 2014 (Mean ± SEM)

Sr. No	Parameters	Monsoon	Winter	Summer	F value
1.	pH	7.15±0.05	7.63±0.05	7.91±0.11	$F_{2\ 21}$ 23.92
2.	Dissolved Oxygen (DO) mg/L	5.33±0.27	7.11±0.21	4.05±0.22	$F_{2\ 21}$ 41.01
3.	Free Carbon-dioxide (CO_2) mg/L	2.83±0.11	1.73±0.36	3.71±0.17	$F_{2\ 21}$ 16.92
4.	Total Hardness (TH) mg/L	123.5±3.46	139.5±2.39	166.5±6.64	$F_{2\ 21}$ 22.88
5.	Chloride (Cl) mg/L	55.13±3.18	40.88±1.14	64.13±3.75	$F_{2\ 21}$ 16.14
6.	Nitrates (NO_3) mg/L	0.41±0.02	0.22±0.025	0.29±0.02	$F_{2\ 21}$ 15.64
7.	Phosphates (PO_4^{-3}) mg/L	0.66±0.03	0.27±0.04	0.43±0.03	$F_{2\ 21}$ 29.1
8.	Sulphates (SO_4) mg/L	7.42±0.33	4.25±0.37	5.33±0.34	$F_{2\ 21}$ 20.81
9.	Magnesium (Mg) mg/L	6.73±0.99	12.04±1.24	16.13±1.27	$F_{2\ 21}$ 15.93
10.	Calcium (Ca) mg/L	8.07±0.46	12.19±0.82	18.39±1.1	$F_{2\ 21}$ 38.49

Table:- 3 Seasonal variations in density of different groups of phytoplanktons (No/L) with two years mean percentage density at Susari Dam during June 2012 to May 2014.

Parameters	F value	Monsoon	Winter	Summer	Two years %
Total Phyto.	$F_{2\ 21}$ 38.02	1414±80.19	2477±13.9	2655±98.83	
Cyano.	$F_{2\ 21}$ 35.81	270.6±27.43	685±51.16	470±15.09	21.78%
Chloro.	F_{221} 40.89	405±43.67	1045±69.59	646.3±30.23	32.00%
Bacilli.	$F_{2\ 21}$ 39.11	586.9±47.87	701.4±49.84	1479±115.3	42.30%
Eugleno.	$F_{2\ 21}$ 22.87	151.9±19.59	45.38±5.15	60.38±5.05	3.90%

Table: - 4 Diversity of Phytoplankton in Susari dam.

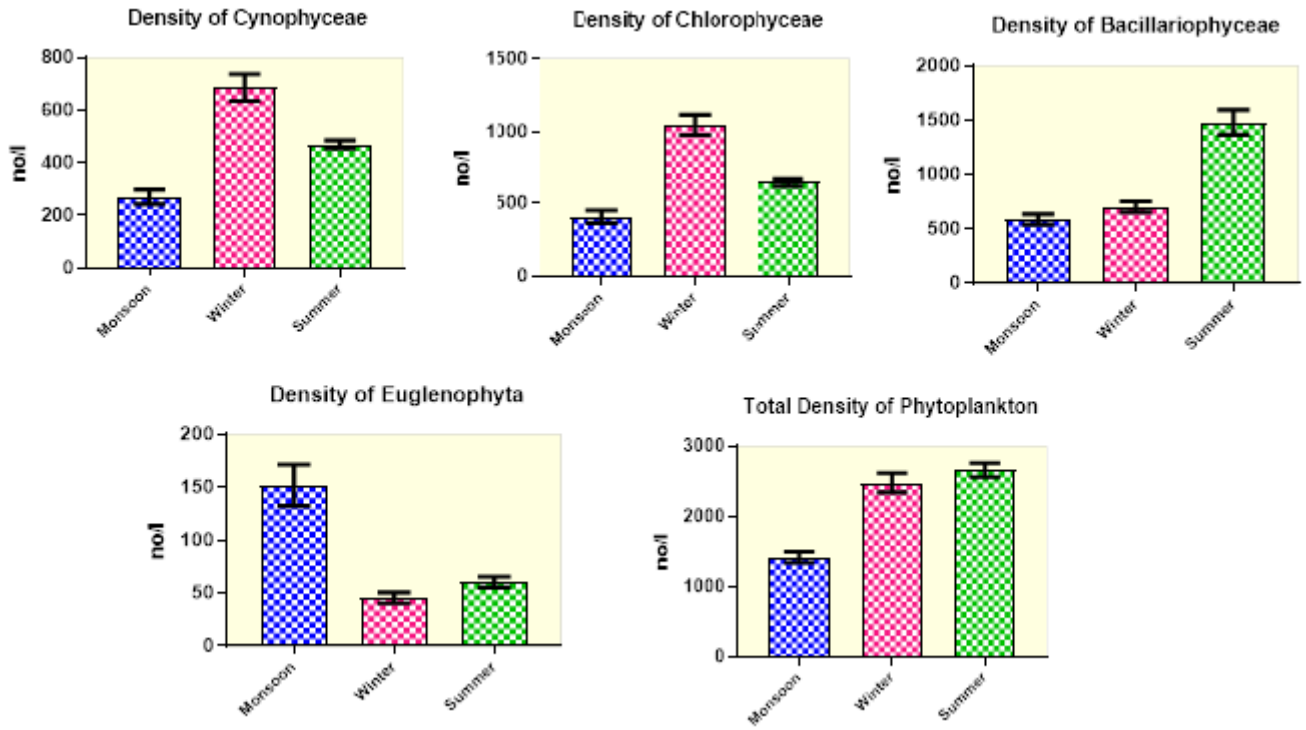
Cyanophyceae	Chlorophyceae	Bacillariophyceae	Euglenophyceae
1. *Microcystis viridis A.Br. Lemm* 2. *Merismopedia convoluta Breb.* 3. *Oscillatoria limosa (Ag)* 4. *Oscillatoria brevis (Kuetz) Gomont* 5. *Phormidium ambigum Gomont* 6. *Phormidium mucosum Gandhi* 7. *Lyngbya limnetica (Lemm)* 8. *Lyngbya aestivani Liemb ex.Gomont* 9. *Anabaena spiroides Klebnn*	1. *Volvox sp.* 2. *Ulothrix fibriate Bold* 3. *Microspora indica Radhwa* 4. *Microspora subsetece (Kuetzing) De. Toni* 5. *Closterium acerosum (Schr.) Ehr.* 6. *Closterium microporum Nageli* 7. *Pediastrum duplex Meyen* 8. *Pediastrum simplex (Meyen)* 9. *Cosmerium subsucumis Cooke.* 10. *Staurastrum spp* 11. *Eudorina spp* 12. *Spirogyra hyalina (Cleve)* 13. *Spirogyra biformis Jao* 14. *Merismopedia convoluta Breb.*	1. *Mastoglia baltica Grun.* 2. *Melosira islandica (O. Muell)* 3. *Synedra affinis Kuetz* 4. *Synedra acus (Kuetz)* 5. *Asterionella spp* 6. *Frustulina spp* 7. *Gyrosigma accuminatum Kuetz* 8. *Navicula papula Kuetz.* 9. *Navicula cuspidate Kuetz.* 10. *Amphora ovalis. Kuetz* 11. *Pinnularia vidarbhensis Sarode et. Kamat* 12. *Pinnularia maharastrensis Sarode et. Kamat* 13. *Rhopalodia gibba Her O. Muell* 14. *Nedium longiceps Grey A. Cl. V.* 15. *Surirella capronii Breb.* 16. *Surirella sabsalsa W. Smith* 17. *Cymbella gracilis (Rabh.) Cleve* 18. *Gomphonema gracile Ehr.* 19. *Gomphonema intricatum Kuetz* 20. *Gomphonema lanceolatum Ehr.* 21. *Fragilaria construens Ehr. Grun* 22. *Fragilaria zafarii Sarode Kamat* 23. *Fragilariarupens Grun.* 24. *Nitzschia jalgaonesis Sarode et. Kamat*	1. *Euglena spirogyra Her.* 2. *Euglena acus Ehrenb.* 3. *Euglena caudata Haben.* 4. *Phacus longicauda Her Duj*

Table: - 5 Pearson correlation of total phytoplankton density along with individual group with Abiotic parameters of Susari Dam during June- 2012 to May- 2014.

	Den.Bacil	Den.Chlor	Den.Cyano	Den.Eugle	Tot.Den
AT	.471*	-.662**	-.568**	.234	-.132
CA	.816**	.195	.284	-.552**	.719**
CL	.604**	-.608**	-.490*	.160	.007
CO2	.565**	-.634**	-.531**	.164	-.046
DO	-.623**	.637**	.507*	-.120	.002
MG	.651**	.321	.460*	-.594**	.712**
NO3	-.175	-.803**	-.759**	.788**	-.674**
PH	.766**	.337	.432*	-.630**	.790**
Den.Bacil	1.000	-.019	.106	-.399	.708**
Den.Chlor	-.019	1.000	.948**	-.796**	.686**
Den.Cyano	.106	.948**	1.000	-.823**	.765**
Den.Eugle	-.399	-.796**	-.823**	1.000	-.832**
Tot.Den	.708**	.686**	.765**	-.832**	1.000
PO4	-.206	-.923**	-.929**	.849**	-.800**
SO4	-.280	-.899**	-.916**	.881**	-.836**
TDS	.715**	-.557**	-.426*	.038	.120
TH	.770**	.156	.283	-.503*	.672**
TRAN	.007	.944**	.942**	-.810**	.675**
TS	.265	-.914**	-.836**	.631**	-.448*
TSS	-.319	-.870**	-.882**	.957**	-.832**
WC	-.740**	.020	-.137	.430*	-.527**
WT	.541**	-.674**	-.558**	.285	-.079

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).



(SD)

Figure 1: Seasonal variation in density of different groups of Phytoplankton (No/L) at Susari Dam during June 2012 to May 2014.

Chlorophyceae:

Chlorophyceae are free living phytoplankton is mostly found in shallow water and found on attached to the submerged plants or moist soil (Huisman, H. *et al.,* 2005). The Chlorophyceae are an extremely large and morphologically diverse group of algae that were more or less distributed in freshwater environment. During the investigation period the Chlorophyceae was second dominant quantitative component of algal composition of Susari dam. The average two years percentage was calculated 32.00%. This group included 14 species and 10 genera. The Chlorophyceae of Susari dam includes *Volvox sp., Ulothrix fibriate Bold ,Microspora indica Radhwa ,Microspora subsetece (Kuetzing) De. Toni ,Closterium acerosum (Schr.) Ehr. ,Closterium microporum Nageli ,Pediastrum duplex Meyen ,Pediastrum simplex (Meyen) ,Cosmerium subsucumis Cooke. ,Staurastrum spp ,Eudorina spp ,Spirogyra hyalina (Cleve) ,Spirogyra biformis Jao ,Merismopedia convoluta Breb.* In the present study seasonal variation of Chlorophyceae showed maximum density was reported in winter (1045± 69.59 No/L) and minimum (405±43.67 No/L) in monsoon period. (Table- 3). In the present study Chlorophyceae are the positively significant correlation with DO and Trans at 0.01 level and negatively significant correlation with AT, Cl, CO_2, NO_3^-, PO_4^{-3}, SO_4, TS, TDS, TSS and WT at 0.01 levels (Table- 5)

Bacillariophyceae (Diatoms):

The Bacillariophyceae constituted an important component of the freshwater or marine. Basically they are autotrophs can also utilize organic substance as nutrients. The diatoms are also being used increasingly as indicators of environmental changes including studies of past climatic changes (Smol and Cumming 2000; Wim *et al.,* 2007). The environmental factor such as physico- chemical and biological factors influence the abundance and species richness of Bacillariophyceae. Maximum density of Bacillariophyceae was recorded in summer (14.79± 115.3 No/L) and minimum in monsoon (586.9± 47.87 No/L) season. (Table- 3, Fig-1). The maximum density of diatoms in summer is also reported by Hafsa and Gupta (2009), Ekhande *et al.,* 2013, Sukla *et al.,* 2013. In the present study Bacillariophyceae are the positively significant correlation with AT, WT, TDS, pH, CO_2, TH, Cl^-, Mg^{+2} and Ca^{+2} at 0.01 level and negatively significant correlation with WC and DO (Table- 5). In the investigation at Susari dam, the total 24 species were recorded belonging to 16 genera (Table- 4).

Euglenophyceae:

Euglenophyceae are commonly found in small water bodies having rich organic matter (Palmar 1969) demonstrated that Euglenophyceae are the key species of biological indicator of organic pollution. Euglenophyceae occupied last position in the phytoplankton diversity. Euglenophyceae was the group represented in the lowest percentage density in the Susari dam water with annual average percentage density of only 3.90% when it's seasonal variations are considered higher density of Euglenophyceae were recorded in Susari dam maximum in monsoon (151.9± 19.59 No/L) and minimum in winter (45.38± 5.15) season (Table- 3, Fig-1). The similar results were reported by Pendase *et al.,* 2000. The Euglenophyceae group included 04 species and 02 genera (Table- 4). In the present investigation in Susari dam the density of Euglenophyceae showed positively significant correlation with TS, TSS, NO_3^-, PO_4^{-3} and SO_4^- at 0.01 levels, while negatively significant correlation with Trans, pH, Mg^{+2}, Ca^{+2} at 0.01 level (Table-5). Presence of *Phacus* species is a direct indication of beginning of pollution

Conflicts of interest: The authors stated that no conflicts of interest.

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