ORIGINAL RESEARCH PAPER

Zoology

Evaluation of Phytoplankton multiplicity and Correlation of it with Pollution indicator species at Ravivar Peth Lake, Ambajogai, Beed Marathwada Region, India

KEY WORDS: phytoplankton, pollution indicator species, Ravivar Peth Lake

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ABSTRACT

The present study is apprehensive with monthly and seasonal variations of phytoplankton during January to December 2004 in the Ravivar Peth Lake, Ambajogai Dist Beed India.Which is situated in the geographical coordination 18° 45' N and 76° 10' E. The present analysis was undertaken to study the plankton diversity of the lake as the water of the lake wasused for drinking purpose up to 1985 and afterwards it was not used for this purpose to find the cause of the question. During the present work total of 31 genera were recorded of which 11 were *Chlorophyceae, 10 Cyanophyceae, 9 Bacillariophyceae and 1 Euglenophyceae.* Results showed population density of phytoplankton *of Bacillariophyceae* dominated in summer and winter season over all other three groups. In the monsoon Chlorophyceae dominated other rest of the three groups. Out of the recorded phytoplankton species 14 species were found to be pollution indicator.

1] Introduction :-

Planktons are very sensitive to the environment they live in any alteration in the environment leads to the change in the plankton communities in terms of tolerance, abundance, diversity and dominance in the habitat. Therefore, plankton population observation may be used as a reliable tool for biomonitoring studies to assess the pollution status of aquatic bodies (Mathivanan and Jayakumar, 1995). The study of plankton as an index of water quality with respect to industrial, municipal and domestic pollution has been reported earlier (Acharjee et al., 1995 ; Jha et al., 1997). Phytoplankton are photosynthesizing microscopic organisms that inhabit the upper sunlit layer of almost all oceans and bodies of fresh water on Earth.

Phytoplankton, also known as microalgae, are similar to terrestrial plants in that they contain chlorophyll and require sunlight in order to live and grow. Most phytoplankton are buoyant and float in the upper part of the ocean, where sunlight penetrates the water. Phytoplankton also require inorganic nutrients such as nitrates, phosphates, and sulfur which they convert into proteins, fats, and carbohydrates.

They are agents for "primary production," the creation of organic compounds from carbon dioxide dissolved in the water, a process that sustains the aquatic food web *Ghosal; et.al .,2011.* Phytoplankton obtain energy through the process of photosynthesis and must therefore live in the well-lit surface layer (termed the euphotic zone) of an ocean, sea, lake, or other body of water. Phytoplankton account for about half of all photosynthetic activity on Earth.(NASA Satellite Detects 2009 ., NASA. *2 March 2005. Retrieved 9 June 2014.* and Their cumulative energy fixation in carbon compounds (primary production) is the basis for the vast majority of oceanic and also many freshwater food webs (chemosynthesis is a notable exception).

Phytoplankton converts solar radiant energy into biological energy through photosynthesis as primary production. It plays an important role in conditioning the microclimate, helps in regulating the atmospheric level of O_2 and CO_2; vital gases for life. The phytoplankton production depends upon a variety of factors like sunlight, certain inorganic nutrient substances, CO_2, temperature, salinity and pH etc. They are biological indicators of water quality in pollution studies. The blue green component of phytoplankton blooms, nutrient rich waters accelerates the rate of eutrophication, rendering the water useless.

Algae are an ecologically important group in most aquatic ecosystems and have been an important component of biological monitoring programs. Algae are ideally suited for water quality assessment because they have rapid reproduction rates and very short life cycles, making them valuable indicators of short-term impacts. Algal assemblages are typically species rich, and algal species exhibit wider distributions among ecosystems and geographical regions. As primary producers, algae are most directly affected by physical and chemical factors. Algal assemblages are sensitive to some pollutants and they readily accumulate pollutants, and algal metabolism is also sensitive to the variation of environmental and natural disturbances. Algae are easily cultured in the laboratory and sampling is easy, inexpensive and creates minimal impact on resident biota; relatively standard methods exist for the evaluation of functional and non-taxonomic structural characteristics of algal communities (Stevenson & Lowe 1986; Rott 1991; Round 1991; Stevenson & Pan 1999

They serve as food for fishes directly or indirectly. For any scientific utilization of resources a prior knowledge of the phytoplankton is always helpful Chandhary *et. al.,* (1987).The work on seasonal variations of phytoplankton in water has been carried out by Singh (1990), Pandey *et al.,* (1993). Much work has been carried out in India on the phytoplankton of fresh water habitats (Jawale and Kumawat, 2000; Sahat *et al.,* 2001; Das *et al.*, 2002, More and Nandan, 2003; Sirsat *et al.,* 2004; Pawar and Pulle, 2005; Pawar *et al.,* 2006.

Biological indicators show the degree of ecological imbalance that has been caused and chemical methods measure the concentration of pollutants responsible. The majority of lake systems of biological assessment have been devised mainly to deal with conditions arising out of organic pollution. Chemically the effects to measure all the organic pollution are rather difficult to monitor.

Keeping this view in mind present study has been undertaken to assess phytoplankton diversity in Ravivar Peth Lake at Ambajogai District Beed, India.

1.1 Objective of Research

The different objectives of the investigation are as:-

1] To study the Phytoplankton diversity of the Lake.

2] To study the abundance of the phytoplankton in different season and
correlate this aspect with the pollution status of the lake. .

3] To find out the quantitative and qualitativedata of the phytoplankton abundance.

4] To find out the pollution indicator species from different orders of hytoplankton and correlate those with pollution indicator species mentioned by Palmer (1969) for pollution status.

1.2 Need behind the goal

1] From many years this lake needs the attention of society for its reuse and rehabilitation. 2] From many years Ambajogai residents are suffering from scarcity of water.3] To help to solve this problem of society with the help of Municipal corporation, Govt officials and NGOs etc.

MATERIALS AND METHODS

In the present study phytoplankton sampling was taken for one year from January to December 2004 during summer (February, March, April and May), Monsoon (June, July, August and September) and winter (October, November, December and January). The geographical coordination is 18° 45' N and 76° 10' E at Ravivar Peth Lake from three stations selected for water collection.

Station 'A':- Gaothana Site
Station 'B':- Domestic Site
Station 'C':- Temple Site

Plankton Analysis

Plankton net [mesh size 25 µm] was swept on surface water [Secchi's disc transparency zone] and plankton collected through the net was easily transferred in to separate plastic bottle/container. 100 liters of surface water was sieved through plankton net to obtain phytoplankton.

These were fixed and preserved in 4% formalin. The formalin fixed plankton samples were centrifuged at 1500-2000 rpm for 10-12 min. The phytoplankton were settled at bottom, diluted to a desirable concentration in such a way that they could be easily counted individually, under compound binocular microscope and phytoplankton were measured and multiplied with the dilution factors, using Sedgwick Rafter cell Edmonson, (1963); Battish, (1992) and APHA, (2005).

Results and Discussion

Detailed microscopic examination of revealed phytoplankton there were 4 groups consisting of 31 genera of phytoplankton in orders of Chlorophyceae (11 genera), Cyanophyceae (10 genera), Bacillariophyceae (9 genera) and Euglenophyceae (1 genera). The species observed were of *Volvox Sp., Chlorella Sp., Pediastrum Sp., Closterium Sp., Cosmarium Sp., Tetraspora Sp. Hydrodictyon Sp., Staurastrum Sp., Chladyomonas Sp., Botryoccoccus Sp.,* and *Scenedesmus Sp.* (**Chlorophyceae**); *Oscillatoria Sp., Spirulina Sp., Microcystis Sp., Phormidium Sp., Merismopodia Sp., Nostoc Sp., Anabaena Sp., Arthrospira Sp., Pleurococcus Sp.* and *Gleocapsa Sp.* (**Cyanophyceae**); *Stephanodiscus.Sp., Astroinella Sp., Gomphonema Sp., Nitzschia Sp., Cymbella Sp., Acanthadium Sp., Tabellaria Sp., Navicula Sp.,* and *Suriella Sp.* (**Bacillariophyceae**); *Euglena Sp.* (**Euglenophyceae**).

In the present study during January to December 2004 the Phytoplankton cell count /ml ranged 536 cell count /ml to 1406 cell count /ml. The minimum quantity 536 cell count /ml was recorded at station A in October 2004 while maximum quantity 1406 no. cell count /ml was recorded at station C in May. Among Phytoplankton groups Chlorophyceae population ranged, 102 cell count/ml to 704 cell count /ml. The minimum quantity 102 cell count /ml was recorded at station A in November 2004 and maximum quantity 704 cell count /ml was recorded at Station C in September 2004. In Phytoplankton groups, Cyanophyceae population ranged 102 cell count/ml to 305 cell count /ml. The minimum quantity 102 cell count /ml was recorded at station A in June 2004 and maximum quantity 305 cell count /ml was recorded at Station C in Jan. 2004. In Phytoplankton groups Bacillariophyceae [Diatoms] population ranged, 181 cell count/ml to 765 cell count /ml. The minimum quantity 181 cell count /ml was recorded at station C in November 2004 and maximum quantity 765 cell count /ml was recorded at Station C in May 2004. In relation to Phytoplankton groups Euglenophyceae population ranged, 0 cell count/ml to 68 cell count /ml. The minimum quantity 0 / nil cell count /ml was recorded at different stations as A in May and August 2004, Station B in May to July and station C in May and June 2004 while maximum quantity 68 cell count /ml was recorded at station C in January2004. In case of total Phytoplankton count the quantity ranged from 256 cell count /ml /year to 5959 cell count /ml/year. The minimum quantity 256 / cell count /ml/year was recorded by group Euglenophyceae in 2004, while the maximum quantity 5959/cell count /ml/year was represented by Bacillariophyceae at station C in 2004. The seasonal magnitude of Phytoplankton population showed variations. During the study period lowest mean 274.33 cell count /ml /year was represented by the group Euglenophyceae in year 2004.While the highest 4606 cell count /ml /year was represented by the Chlorophyceae in 2004.The monthly distribution of phytoplankton count and mean seasonal data of Phytoplankton count /ml/year (Table No.1-2 and fig. No. 3-5) and Monthly phytoplankton count per ml is graphically represented in the Fig.1 to Fig.no.3.

Different types of Phytoplankton were present in lake showed the following seasonal variations during study period 2004.

January to December 2004.

Summer:-Bacellariophyceae>Chlorophyceae>Cynophyceae> Euglenophyceae.

Mansoon:-Chlorophyceae>Bacellariophyceae>Cynophyceae> Euglenophyceae.

Winter:-Bacellariophyceae>Cynophyceae>Chlorophyceae> Euglenophyceae.

Table No. 1. Monthly distribution of different groups of Phytoplankton with respect to the number of genera and their concentration at different station. (Year Jan to Dec-2004)

Station	Groups	Jan	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
A	Chlorophyceae	8/250	9/340	9/360	9/390	8/402	9/503	9/560	9/600	10/690	5/125	5/102	5/119
	Cyanophyceae	10/260	9/220	9/190	9/202	9/250	7/125	6/102	6/115	9/269	8/180	8/180	9/200
	Bacillariophyceae	1/590	8/635	8/660	8/602	8/725	6/360	6/375	6/308	6/205	6/219	6/225	7/500
	Englenophyceae	1/60	1/25	1/30	1/20	1/0	1/31	1/20	1/0	1/30	1/12	1/35	1/54
B	Chlorophyceae	7/290	9/355	8/373	8/378	9/425	9/560	9/591	9/625	10/720	5/139	5/130	5/141
	Cyanophyceae	9/281	9/265	9/181	9/230	9/211	7/103	6/128	6/139	9/275	8/192	8/207	9/251
	Bacillariophyceae	7/620	8/670	8/687	8/691	8/743	6/320	6/402	6/300	6/209	6/200	6/195	7/530
	Englenophyceae	1/66	1/21	1/27	1/18	1/0	1/0	1/0	1/18	1/22	1/25	1/28	1/31
C	Chlorophyceae	8/300	9/372	9/401	9/435	8/400	9/605	9/620	9/588	10/704	5/190	5/175	5/160
	Cyanophyceae	10/305	9/290	9/205	9/256	9/241	7/142	6/157	6/162	9/291	8/208	8/225	9/271
	Bacillariophyceae	7/692	8/702	8/735	8/705	8/765	6/310	7/399	6/308	6/265	6/220	6/181	7/677
	Englenophyceae	1/68	1/15	1/23	1/21	1/0	1/0	1/10	1/18	1/45	1/20	1/20	1/10

Table No. 2. MEAN PHYTOPLANKTON COUNT / ml. 2004.

Seasons	W	Summer				Monsoon				Winter			Total
Months	Jan	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
Chlorophyceae	280.00	355.67	378.00	401.00	409.00	556.00	590.33	604.33	704.67	151.33	135.67	140.00	4706.00
Cyanophyceae	282.00	258.33	192.00	229.33	234.00	123.33	129.00	138.67	278.33	193.33	207.33	240.67	2506.33
Bacillariophyceae	634.00	669.00	694.00	666.00	744.33	330.00	392.00	305.33	226.33	213.00	200.33	569.00	5643.33
Englenophyceae	64.67	20.33	26.67	19.67	0.00	10.33	10.00	12.00	32.33	19.00	27.67	31.67	274.33
Total	1260.67	1303.33	1290.67	1316.00	1387.33	1019.67	1121.33	1060.33	1241.67	576.67	571.00	981.33	

Table No. 3. Monthly Variations of Phytoplankton Count per ml at Station 'A' during 2004

Station A	Jan	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Chlorophyceae	250	340	360	390	402	503	560	600	690	125	102	119	4441
Cyanophyceae	260	220	190	202	250	125	102	115	269	180	190	200	2303
Bacillariophyceae	590	635	660	602	725	360	375	308	205	219	225	500	5404
Euglenophyceae	60	25	30	20	0	31	20	0	30	12	35	54	317
Total	1160	1220	1240	1214	1377	1019	1057	1023	1094	536	552	873	

Table No. 4. Monthly Variations of Phytoplankton Count per ml at Station 'B' during 2004.

Station B	Jan	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Chlorophyceae	290	355	373	378	425	560	591	625	720	139	130	141	4727
Cyanophyceae	281	265	181	230	211	103	128	139	275	192	207	251	2463
Bacillariophyceae	620	670	687	691	743	320	402	300	209	200	195	530	5567
Euglenophyceae	66	21	27	18	0	0	0	18	22	25	28	31	256
Total	1257	1311	1268	1317	1379	983	1121	1082	1226	556	560	953	13013

Table No. 5. Monthly Variations of Phytoplankton Count per ml at Station 'C' during 2004.

Station C	Jan	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Chlorophyceae	300	372	401	435	400	605	620	588	704	190	175	160	4950
Cyanophyceae	305	290	205	256	241	142	157	162	291	208	225	271	2753
Bacillariophyceae	692	702	735	705	765	310	399	308	265	220	181	677	5959
Euglenophyceae	68	15	23	21	0	0	10	18	45	20	20	10	250
Total	1365	1379	1364	1417	1406	1057	1186	1076	1305	638	601	1118	13912

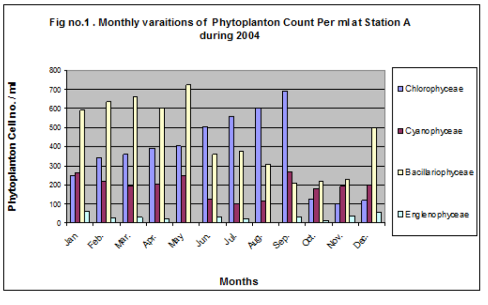

Fig no.1 . Monthly varaitions of Phytoplanton Count Per ml at Station A during 2004

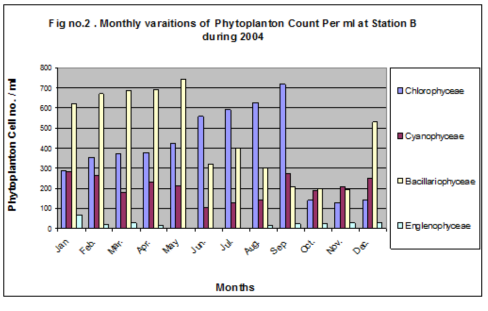

Fig no.2 . Monthly varaitions of Phytoplanton Count Per ml at Station B during 2004

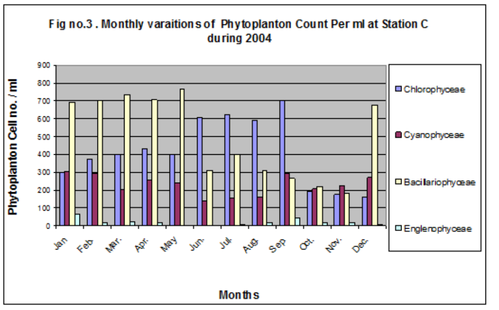

Fig no.3 . Monthly varaitions of Phytoplanton Count Per ml at Station C during 2004

In conclusion, Bacillariophyceae were the dominant Phytoplankton group in the study period.

The all data is tabulated in Table no.1 to Table no.5 ,Pollution indicators species with specificity of occurance in table no.6 and graphically represented in Fig.no.1 to 3 .

The presence of a species will depend on its environmental tolerance, but the resources available to it will determine its abundance. If competition or predation is reducing or the food supply or suitable habitat increase, the species will become more abundant. In present study basic information of the phytoplankton distribution and abundance would form a useful tool for further ecological assessment and monitoring of ecosystems at Ravivar Peth Lake. Algae have been recommended as an indicator of water pollution, hence are considered as useful tool in pollution monitoring studies; Patrik (1949), Palmer (1969),Venkateshwaralu and Sheshadri (1981). Kamat (1981), More and Nandan (2000, Kumawat and Jawale (2003), Nandan and Aher (2005).

Conclusion

1. It can be concluded that Bacillariophyceae were the dominant Phytoplankton group in the study period.
2. The presence of a species depends on its environmental tolerance, but the resources available to it will determine its abundance. If competition or predation is reducing or the food supply or suitable habitat increase, the species will become more abundant.
3. In present study basic information of the phytoplankton distribution and abundance would form a useful tool for further ecological assessment and monitoring of ecosystems at Ravivar Peth Lake.
4. From the present study it can be concluded that the Ravivar Peth Lake at Ambajogai District Beed, India. Shows the presence of pollution indicator species from Palmer (1969), *Chlorophyceae; as Chlorella sp., Hydrodictyon Sp.,Pediastrum sp., Scenedesmus Sp.,Closterium sp., Cosmarium sp , Cyanophyceae as Oscillatoria sp, Spirulina sp, Microcistis sp., Bacillariophyceae as Nitzschia sp., Navicula sp, Gomphonema sp., Suriella sp, and only Euglena sp.* and *Euglenophyceae.*
5. In all out of 31 genera, 14 pollution indicator species were recorded as 6 from order *Chlorophyceae*, 3 from order *Cyanophyceae*, 4 from order *Bacillariophyceae* and 1 from order *Euglenophyceae*.
6. So it can be concluded that Ravivar Peth Lake water is polluted and needs the rehabilitation.
7. The continuous biomonitering of Ravivar Peth Lake is badly needed, as it affects the flora and fauna of the lake.

Table.no 6 Phytoplankton species with specificity of pollution indication.

Sr. No	Phytoplankton Group	List of the species included	Occurrence and Degree of Pollution
1	*Chlorophyceae*	*1]Chlorella sp.*	@#***
		2]Pediastrum sp.,	**
		3]Closterium sp.,	W%
		4]Cosmarium sp	
		5]Scenedesmus Sp.	00=
		6]Hydrodictyon Sp.	00=
2	*Cyanophyceae*	*7]Oscillatoria sp,*	++

		8]Spirulina sp,	***** ++
		9]Microcistis sp.,	ϕ ******
3	*Bacillariophyceae*	*10]Nitzschia sp.,*	Ø↑
		11]Navicula sp,	Ø↑
		12]Gomphonema sp.,	**
		13]Suriella sp,	*
4	*Euglenophyceae.*	*14]Euglena sp*	Ø↑

Pollution frequency: - 1] Nil pollution status * 2] Pollution tolerent ** 3] Organic pollution Indicator, excessive addition of organic matter, nitrates or phosphates.@# *** 4] Highest degree of pollution status with phosphate and nitrates. Produces toxic substances that are harmful to fishes and aquatic animals. ϕ***** 5] Organically polluted water indicator species Ø↑6] Indicator of Lead (Pb) pollution ++ 7] High pollution tolerant species ** 8] Organic pollution indicator 00= 9] Indicator of waste and heavy metals w%

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