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Survey of Cyanobacterial flora from Samuthiram Lake of Thanjavur, Tamil Nadu, India

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ABSTRACT:-

Survey of cyanobacterial flora were monitored along with physico-chemical parameters such as dissolved oxygen, pH, carbonate, bicarbonate, nitrite, nitrate, total phosphorus and inorganic phosphorus of water from 10 different sites on samuthiram lake of Thanjavur, were analyzed. Samples were collected periodically from June 2011 to May 2012. Nitrate and phosphate were generally low throughout the studied, while dissolved oxygen remainder near saturation and pH minimum 6.4 to maximum 7.3. Totally 46 species of 12 genera of cyanobacteria were record. *Oscillatoria* 15 was dominant genus which was Followed by *Phormidium* and *Lyngbya* with 9 species each *Synechococcus*, *Anabaena*, *Microcystis, Spirulina* with two species. *Chroocococcus, Gleocapsa, Merismopedia, Nostoc* and *Calothrix* with single species each. *Osillatoria laete-virens* and *Phormidium corium* were recorded in all seasons.

Key words: Biodiversity, ecosystem, cyanobacteria, physico-chemical parameters

INTRODUCTION:-

The total life of the world depends on water and hence the hydrobiological study is a pre-requisite in any aquatic system for the assessment of its potentialities and to understand the realities between its different trophic levels and food webs. Further, the environmental condition such as topography, water movement, salinity, oxygen, temperature and nutrients characterizing particular water mass also determine the composition of its biota. Thus, the nature and distribution of the flora and fauna in the aquatic system are mainly controlled by the fluctuations in the physico-chemical characteristics of the water body.

Information on algal diversity is important for the study of primary productivity, to understand the factors influencing rise, fall and change in algal population, interactions algae with other organisms and study the effect of anthropogenic pressure upon aquatic habitats (Goldman and Home, 1983; Kumar, 1990). The importance of algal dynamics, particularly cyanobacteria as the enormous potential organisms for the pollution free environment. During the recent past, studies on cyanobacteria have emphasized their important role in ecosystems. They grow at any place and in any environment where moisture and sunlight are available. However, specific algae grown in specific environment and therefore their distribution pattern, ecology, periodicity, quality and quantitative occurrence differ widely.

Beside their ecological significances, Cyanobacteria are one of the potential organisms, which are useful to mankind in various ways. Cyanobacteria constitute a vast potential resource in varied applications such as mariculture, food, feed, fuel, fertilizer, medicine, industry and in combating pollution (Prabhakaran and Subramanian,1995 ; Sundararaman *et al.,* 1996). The present work was carried out to understand the diversity of cyanobacteria from Samuthiram lake of Thanjavur District, Tamil nadu as an initiative study for exploiting their innate potentials.

MATERIALS AND METHODS

Samuthiram lake located at Thanjavur in the centre east of Tamil Nadu, India (lat.10^{o}27’ N; long.79^{o}15’ E) which is one of the most important rice growing areas in Tamil Nadu. There are several natural and artificial freshwater lakes are distributed.

Samples (both water and cyanobacteria) were collected from (June 2011-May 2012) from different site in

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freshwater lake. Water sample and cyanobacteria were collected in large sterilized containers and polythene bags respectively. Physico-chemical characteristics of freshwaters were carried out according to standard methods (APHA, 2000). Standard microbiological methods were followed for the isolation of cyanobacteria. Algal sample were microscopically examined and plated on soild agar medium. The inoculated plates were incubated in culture room maintained at 25±2°C fitted with cool white fluorescent tube emitting 2500Lu for 18hrs a day. The isolated cyanobacteria were identified with the help of classical manuals (Geiter, 1932; Anagnostidis and Komárek, 1988, 1990; Cronberg and Komárek, (2004); Desikachary, 1959; Iyengar and Desikachary, 1981; Komárek, 2005; Komárek and Anagnostidis, 1986, 1989; Komárek and Fott, 1983; Kant and Gupta, 1998; and Ramanathan, 1964) and subcultured in BG11 medium Rippka *et al.*, 1979 under the above said culture conditions.

RESULTS:-

PHYSICO-CHEMICAL OBSERVATIONS:

The water temperature ranged between 24°C to 32°C the maximum temperature was recorded in the month of May 2012 and a Minimum temperature value was recorded in the month of January 2012(Fig.1) The pH ranged from 6.4 mg/liter to 8.3mg/liter (Fig.2) and maximum D.O. value was 3.9mg/liter in the month of December, (Fig7) minimum was 1.2mg/liter in the month of July. But the free carbon dioxide varied between 120mg/liter to 170mg/liter (Fig.3) The total hardness value was 230 mg/liter to 280 mg/liter (Fig.4) BOD varied from minimum 130 mg/liter to 190 minimum value (Fig.5).COD varied from minimum 426 mg/liter to maximum 547 mg/liter in the month of October 2011 (Fig.6) Nitrate 120 mg/liter to 162 mg/liter in the month of January (Fig.8) Nitrite content range from 96 mg/liter to 132 mg/liter. In the month of June the nitrite content was minimum and in the month of December 2011 the nitrite contents maximum (Fig.9) Ammonia varied from minimum 138 mg/liter to 183 mg/liter in the month of January.2012 (Fig.10). Total phosphorus content in samuthiram lake range from 72 mg/liter to 106mg/liter (Fig.11). Inorganic phosphate varied from minimum 36 mg/liter to maximum 56 mg/liter.(Fig.12). Organic phosphate varied from minimum 33 mg/liter to maximum 54 mg/liter.(Fig.13) Calcium varied from minimum 72 mg/liter to maximum 114 mg/liter.(Fig.14). Magnesium varied from minimum 58 mg/liter to maximum 82 mg/liter.(Fig.15) organic phosphate varied from minimum 156.9 mg/liter to maximum 189.9 mg/liter.(Fig.16).

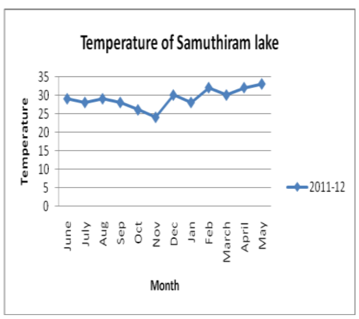
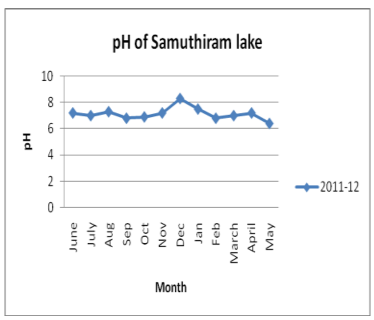


Fig1



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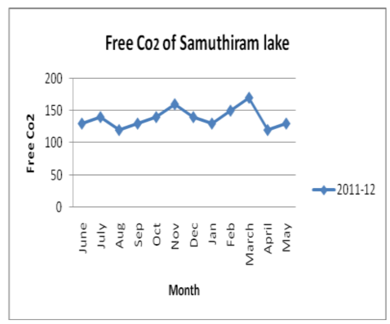

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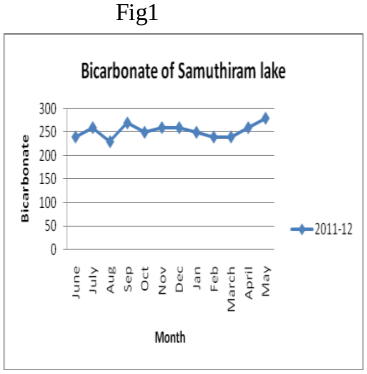

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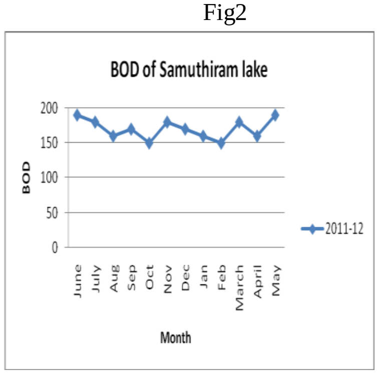

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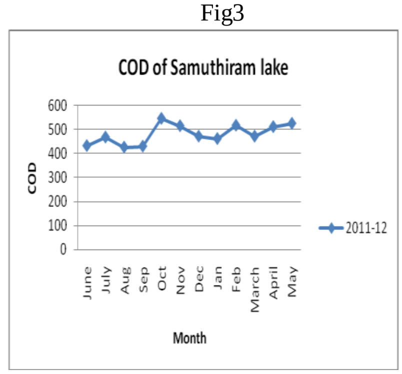

Fig6

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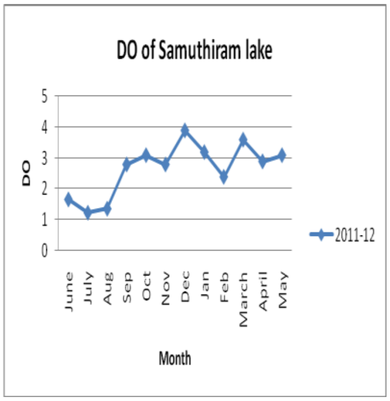
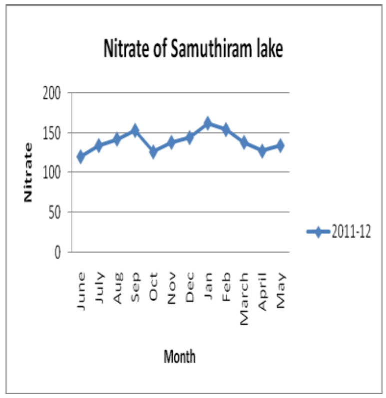


Fig7



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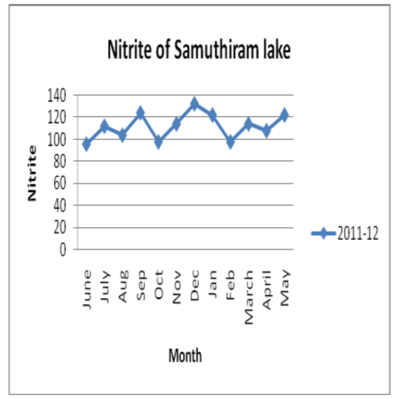

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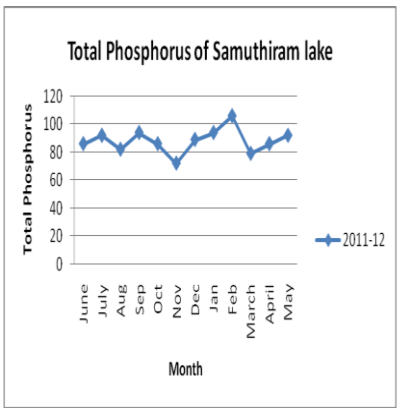

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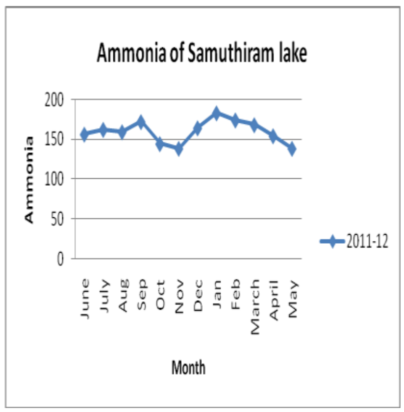

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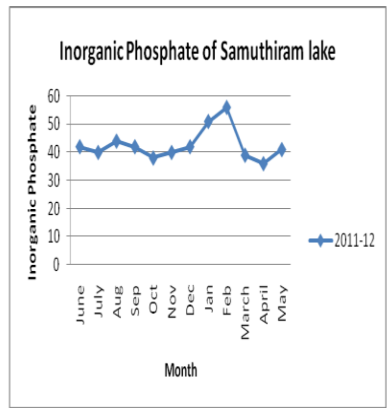

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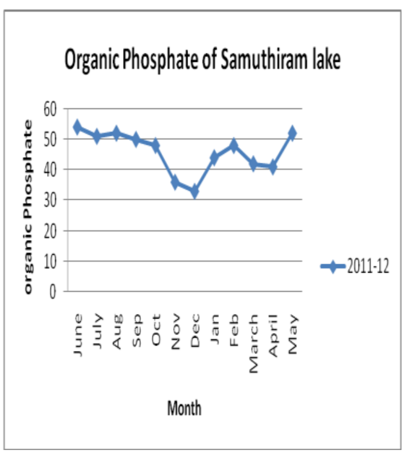
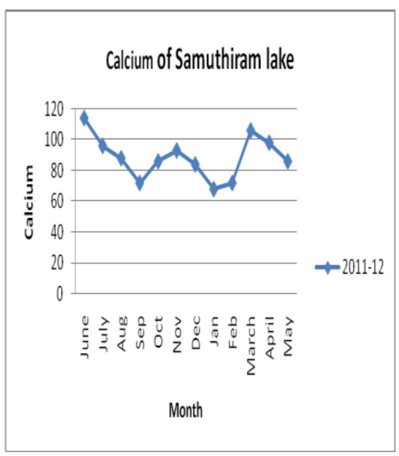


Fig13



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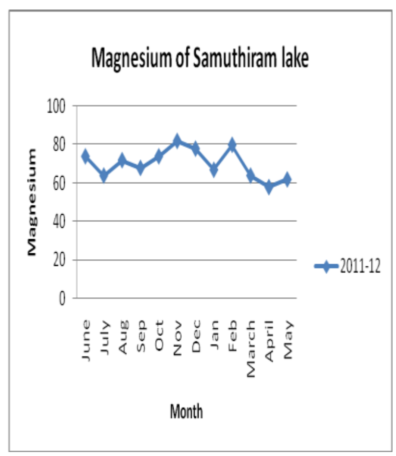

Fig15

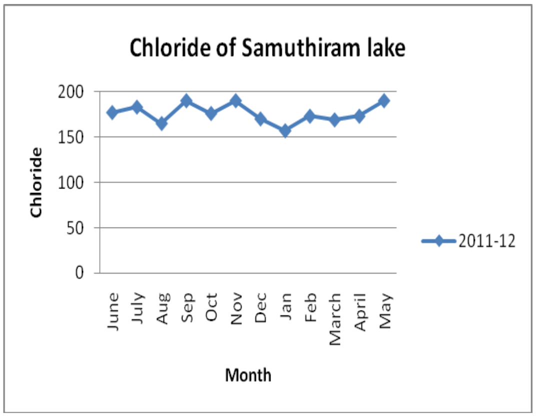

Fig16

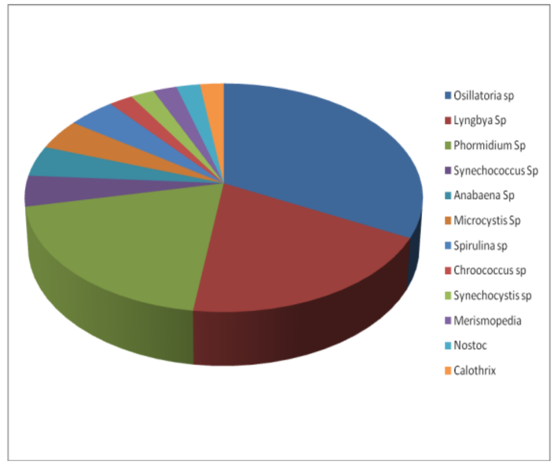

Fig .17 Generic contribution of cyanobacteria to Morphotypic DiversityIn Some Fresh Water Bodies of Samuthiram Lake

Totally 46 species belongs to 12 genera of cyanobacteria were recorded in samuthiram lake Thanjavur (Table.1, Fig 17). These genera following under 7 families of these 46 species followed by Microcystaceae and Nostocaceae with three species, each Chroococcaceae, Merismopediaceae and Rivulariaceae with one species. Among the genera *Oscillatoria* with 15 species was found dominant genus followed *Phormidium* and *Lyngbya* with 9 Species. Each *Synechococcus, Anabaena, Microcystis, Spirulina* with two species. *Chroocococcus, Gleocapsa, Merismopedia, Nostoc* and *Calothrix* with single species. Of the species 4 were heterocystous and the remaining non heterocystous. Among of 9 species were unicellular and rest were filamentous form of the total 46 species. Of the cyanobacteria identified *Oscillatoria cortiana* was record only during summer, *Synechocystis pevalekii*, *Anabaena torulosa*, *Oscillatoria curviceps*, *Spirulina subtilissima* were recorded only rainy and winter season not is summer

Altogether (Table.1) found in all the examined. Among the species identified *Osillatoria laete-virens* and *Phormidium corium* were dominant with 100% recorded in all 12months were the percentage occurrence *Osillatoria salina, O.willei and Lyngbya truncicola* were more than 75% while least percentage occurrence was observed with *Anabaena torulosa, Osillatoria curviceps*. The correlation co-efficient analysis of physic-chemical properties of water samples and total cyanobacterial species (TCS) revealed that the significant positive correlation between total Cyanobacterial Species (TCS) and dissolved oxygen (r = -0.111: P< 0.01), TCS and Bicarbonate r=0.677; p<0.05). (Table -2)

DISCUSSION:

In any ecosystem, not a single species grows independently and indefinitely, because all the species are interlinked and has cyclic transformation of nutrients. The physicochemical changes in the environment may affect particular species and induce the growth and abundance of other species, which leads to the succession of several species in a course of time.

The abundance of cyanobacteria is attributed to favorable contents of oxidizable organic matter and less dissolved oxygen and observation(Fig:7) which support (Venkateshwarlu,1969b; Boominathan,2005; Vijayakumar *et al.*, 2007; Kannan, 2006; Muthukumar *et al.*, 2007. Gomathy *et al.*,(2011) suggest that cyanophyce*ae* grow luxuriansly with great variety and abundance rich in calcium in possibly one of the factors. Besides calcium, high amount of oxdisable organic mater, taces of dissolve oxygen, considerable amount of nitrate and phosphate were the favouring the growth of cyanobacteria as suggested by (Anand, 1998; Boominathan,2005; Murugesan and Sivasubramanian, 2005; Vijayakumar *et al* 2005; & Senthil *et al*.,2011).

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Table -1 CYANOBACTERIA ISOLATED FROM SAMUTHIRAM LAKE (June 2011-May 2012)

S.no	Name of the Cyanobacteria	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	April	May	Percentage
	Chroococcaceae													
1.	*Chroococcus minor* (Kutz.) Nag.	+	+	+	+	+	+	+	+	+	+	+	-	91
	Microcystaceae													
2	*Synechocystis pevalekii* (Carm) Kutz.	-	-	-	+	+	+	+	+	+	-	-	-	50
3	*Microcystis aeruginosa* Kutz.	-	+	+	+	+	+	-	+	+	+	-	+	75
4	*Microcystis viridis* (Wittr.) kirchner	-	-	-	+	+	-	-	+	+	-	-	+	41
	Merismopediaceae													
5	*Merismopedia aeruginea* Breb.	+	+	+	+	-	-	-	+	+	-	-	-	50
	Nostocaceae													
6	*Anabaena fertilissima* Rao,C.B	+	+	-	-	-	-	-	+	+	-	-	-	41
7	*A.torulosa lagerh.* ex Born et Flah	-	-	-	-	-	+	+	+	-	-	-	-	25
8	*Nostoc paludosum* Kutz. ex Born et Flah	+	+	+	-	-	-	+	+	-	-	-	-	41
	Synechococcaceae													
9	*Synechococcus aeruginosus* Nag	-	-	-	+	+	-	+	-	+	+	+	+	58
10	*S.elongates* Nag	+	+	+	+	-	-	-	+	+	-	+	+	66
	Osillatoriaceae													
11	*Osillatoria brevis* (Kutz.) Gomont.	-	-	-	-	+	+	+	+	-	-	-	+	41
12	*O.chalybea* (Mert.) Gomont.	+	+	+	+	-	-	+	+	-	+	+	-	66
13	*O.curviceps* Ag.ex Gomont	-	-	-	-	-	+	+	+	-	-	-	-	25
14	*O.claricentrosa* f.bigranulata Rao,C.B	+	+	+	+	-	-	-	-	-	-	+	+	50
15	*O.cortiana* Menegh ex Gomont	+	+	-	-	-	-	+	-	-	+	+	-	41
16	*O.earlei* Gardner	+	+	+	+	+	-	-	+	-	-	-	+	58
17	*O. foreaui* Fremy	-	-	-	+	-	-	-	+	+	-	-	+	33
18	*O. laete-virens* (Grouan) Gomont	+	+	+	+	+	+	+	+	+	+	+	+	100
19	*O.princeps* Vaucher	+	+	+	+	-	-	+	+	+	-	+	-	66
20	*O. pseudogeminata* G.Schmid	+	+	-	+	-	+	+	+	+	+	+	+	83
21	*O. salina* Biswas	+	+	+	-	-	+	+	+	+	+	+	-	75
22	*O. splendida* Grev ex Gomont	+	+	+	-	-	-	-	+	+	+	+	-	58

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23	*O. subbrevis* Schmidle	+	+	-	-	+	+	+	-	-	+	+	-	**58**
24	*O. willei* Gardner	+	+	+	+	+	+	+	+	+	-	-	-	**75**
25	*O. tenuis* Ag.ex Gomont	+	+	-	+	-	+	+	+	+	+	+	+	**83**
26	*Lyngbya aestuarii* Liebm. Ex Gomont	+	-	-	-	+	+	-	+	+	+	-	-	**50**
27	*L.borgerti* Lemmermann	-	-	+	+	+	-	-	-	+	+	-	+	**50**
28	*L.connectens* Bruhl et Biswas	+	-	-	-	-	+	+	+	-	-	+	+	**50**
29	*L.martensiana* Menegh ex Gomont	+	+	+	+	+	+	+	-	-	+	+	+	**83**
30	*L.majuscula* Harvey ex Gomont	+	-	-	-	+	+	+	-	-	+	+	-	**50**
31	*L.polysiphoniea* Fremy	+	+	+	-	-	-	+	+	+	-	-	-	**50**
32	*L.semiplena* (C.Ag.)J.Ag. ex Gomont	+	-	-	-	+	+	+	-	-	+	-	-	**41**
33	*L.spirulinoides* Gomont	+	+	+	+	-	-	+	-	+	+	+	+	**66**
34	*L.truncicola* Ghose	+	+	+	+	+	+	-	-	-	+	+	+	**75**
35	*Phormidium ambiguum* Gomont	-	-	+	+	-	-	-	+	+	+	+	-	**50**
36	*P. corium* Ag. Gomont	+	+	+	+	+	+	+	+	+	+	+	+	**100**
37	*P. calcicola* Gardner	+	+	-	-	-	+	-	-	+	+	-	+	**50**
38	*P. fragile (*Menegh) Gom.	+	+	+	+	+	+	-	-	+	+	-	-	**66**
39	*P. jadinianum* Gomont	+	+	-	-	-	+	+	-	-	-	-	+	**41**
40	*P. lucidum* Kutz. Ex Gomont.	-	-	-	+	+	-	-	+	-	+	-	+	**41**
41	*P. mucicola* Hub.-Pestalozzi et Naumann	+	+	+	-	-	-	-	+	+	+	-	-	**50**
42	*P. tenue* Menegh ex Gomont	+	+	+	-	-	+	+	-	+	+	-	-	**66**
43	*P. uncinatum* Ag. Gomont	-	-	-	+	+	+	-	-	-	-	+	+	**41**
44	*Spirulina subsalsa* (Nordst.) Geitler	-	-	+	+	+	+	-	-	-	+	+	-	**50**
45	*S. subtilissima* Kutz. ex Gomont.	-	-	-	-	+	+	+	+	-	-	-	-	**33**
	Rivulariaceae													
46	*Calothrix brevissima* West ,G.S.	+	+	+	+	-	-	-	-	-	-	-	-	**33**

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Table – 2 **Pearson Correlation of (r) value for meteorological, physico-chemical parameter and cyanobacterial population at samuthiram lake**

	TNC	Ph	TEMP	FCO	C	B	BOD	COD	DO	NITRA	NITRI	AMMO	TP	IP	OP	CA	MA	TCS
TNC	1																	
pH	0.146	1																
TEMP	-0.283	-0.169	1															
FCO	0.420	-0.055	-0.274	1														
C	0.0[a]	0.0[a]	0.0[a]	0.0[a]	0.0[a]													
B	-0.202	-0.222	0.090	-0.138	0.0[a]	1												
BOD	0.152	-0.138	0.025	0.168	0.0[a]	0.358	1											
COD	-0.246	-0.314	0.065	0.294	0.0[a]	0.315	-0.247	1										
DO	0.012	0.246	0.108	0.339	0.0[a]	0.346	-0.098	0.396	1									
NITRA	0.419	0.164	0.013	0.075	0.0[a]	-0.012	-0.377	-0.229	0.230	1								
NITRI	0.027	0.350	0.055	0.021	0.0[a]	0.633*	0.277	-0.156	0.564	0.468	1							
AMMO	0.514	0.284	0.173	-0.010	0.0[a]	0.344	0.344	0.529	0.032	0.716**	0.182	1						
TP	0.235	-0.199	0.517	-0.268	0.0[a]	0.113	-0.351	0.030	-0.070	0.468	0.005	0.539	1					
IP	0.572	0.027	0.198	0.023	0.0[a]	-0.342	-0.389	-0.110	-0.102	0.733**	-0.087	0.619*	0.677*	1				
OP	-0.073	-0.648*	0.184	-0.426	0.0[a]	-0.138	0.115	-0.272	-0.680*	-0.179	-0.479	0.003	0.360	0.146	1			
CA	-0.133	-0.002	-0.009	0.176	0.0[a]	-0.225	0.579*	-0.102	-0.253	-0.834**	-0.367	-0.426	-0.605*	-0.627*	0.055	1		
MA	0.411	0.326	-0.452	0.356	0.0[a]	-0.325	-0.194	0.068	-0.017	0.171	-0.196	-0.065	-0.056	0.394	-0.262	-0.177	1	
TCS	-0.118	-0.536	-0.158	0.125	0.0[a]	0.677*	0.506	0.240	-0.111	-0.307	0.103	-0.586*	-0.097	-0.388	0.167	0.121	0.028	1

a Cannot be computed because at least one of the variables is constant0.

*. Correlation is significant at the 00.05 level (2-tailed)0.

** Correlation is significant at the 00.01 level (2-tailed)0.

Murugasan, (2005) and Gomathi et al., (2011) reported that high value of BOD and COD, Phosphate and Nitrates with low DO favored the growth of the cyanibacteria than any other algae. Their finding supported by the observation of Kannan, (2006) and Vijayakumar et al.,(2012). In the present study freshwater showed considerable amount of nitrates and phosphates with increased level of BOD and COD along with Low DO. This could be reason the furnishing the growth of cyanobacteria. However (Fogg *et al*., 1973; and Murugesan, 2005), inferred that the correlation between abundance of planktonic cyanobacteria and high concentration of dissolved organic matter may due to the depletion oxygen.

Heterocystorus cyanobacteria and as *Anabaene fertilissima* and *Nostoc muscorum* were observed. (Muthukumar *et al.*,2007; Hoyslew and Person 1979; and Oren and Shilo, 1979) reported that the high levels of sulfide content anaerobic conditions was believed to exclude the forms. High levels of nitrogen source in the environment are also eliminating heterocystous forms, since nitrogen free media is commonly used for the isolation and purification of heterocystous cyanobacteria. Forms the foregoing discussion, it is concluded that Physico-chemical characters together with biological monitoring provided converging lines of evidences for evaluation freshwater habitats in this case as in same as in some other studies (Cairns and Dickson, 1971; and Jame and Evison, 1979;).

Gomathi *et al*. (2011) and Vijayakumar *et al.,* (2012) reported that the genus *Oscillatoria* has been found to be very tolerant to pollution which frequently inhabits the polluted water. Vijayakumar *et al* (2007) and Muthukumar *et al*., (2007) found *Oscillatoria*, *Phormidium* were the most dominant genera in industrial effluent and ponds respectively, Present study also confirmed their observation as *Oscillatoria, Phormidium* along with *Lyngbya* were found dominating all the seasons were studied

The crucial role of the physico-chemical parameters in the ecosystem on the distribution of algal community has been extensively analyzed in tropical and temperate freshwater ecosystems (Lund, 1965; Reynolds, 1984; Köhler, 1994). Chellappa et al. (2004) reported the collective dominance by the species of cyanobacteria was due to their capacity to grow in turbid water and low light intensity to maintain buoyancy and the capacity to grow exponentially in wet period in which nitrogenous nutrients were high. The daily water level fluctuations attributed to increase and decrease in phytoplankton species diversity. Pingale and Deshmukh, (2005) identified 87 algal species belonging to 43 genera from Kalsubai-Ratangal, Ahmednagar. Subha and Chandra (2005) studied the algal flora from temple tanks in and around the city of Chennai and reported 17 species of algae belonging to Cyanophyceae, Chlorophyceae,Bacillariophyceae and Euglenophyceae. Of the 39 species of cyanobacteria recorded in the present study, only 5 heterocystous cyanobacteria such as *Calothrix brevissima*, *Calothrix* sp., *Scytonema* sp., *Anabaena* sp. and *Nostoc carneum* were recorded. Hoyslew and Pearson, (1979) and Oren and Shilo, (1979) reported that the high levels of sulfide content, and anaerobic conditions was believed to exclude the heterocystous forms. High levels of nitrogen source in the environment is also eliminating heterocystous forms, since nitrogen free media is commonly used for the isolation and purification of heterocystous cyanobacteria.

The significant positive correlation between the cyanobacterial diversity and Micronutrients was observed and also reported by Govindasamy and Azaraiah 1999. Total Cyanobacterial Species (TCS) and dissolved oxygen ($r = -0.111$: $P< 0.01$), TCS and Bicarbonate $r=0.677$; $p<0.05$). Hence the present study concluded in spite of the fact that the cyanobacteria are ubiquitous, their population dynamics are often influenced by the available nutrients and the physico-chemical condition of the ecosystem

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References

APHA. 2000. Standard Method For The Examination Of Water And Wastewater, 20th Ed. American Water Work Association And Water Environment Federation, Washington D.C.

ANAGNOSTIDIS K. AND J. KOMÁREK, 1988. Modern approach to classification system of cyanophytes. 3. Oscillatoriales. *Arch. Hydrobiol., Algol. Studs*. 50-53: 327- 472.

ANAND, N. -1998- Indian Freshwater Microalgae. Bishen Singh Mahendra Pal Singh. Dehra Dun. pp.1-94.

BOOMINATHAN, M. -2005- Bioremediation Studies On Dairy Effluent Using Cyanobacteria.Ph.D. Thesis. Bharathidasan University. Tiruchirapalli. Tamil Nadu. India.

BAILEY, K.M. AND F.B. TAUB -1980- Effects of hydroxamate siderophores (strong Fe (III) chelators) on the growth of algae. *Journal of Phycology* 16: 334-339.

CAIRNS, J. J.R. AND K.L. DICKSON -1971- A simple method for the biological assessment of the effects of waste discharge on aquatic bottom dwelling organisms. *J. Wat. Poll. Control Fed.* 43: 722-725.

DESIKACHARY. T.V. 1959. Cyanophyta. I. C. A. R. Monograph on Algae. New Delhi. PP. 686.

FERREIRA, F. AND N.A. STRAUS -1994- Iron deprivation in cyanobacteria. *Journal of Applied Phycology* 6: 199-210.

FOGG, G.E., W.D.P. STEWART, P. FAY AND A.E. WALSBY -1973- The Blue-green Algae. Academic Press Inc. (London) Ltd.. London.

GOVINDASAMY, C. AND J. AZARIAH -1999- Seasonal variation of heavy metals in coastal water of the Coromandel Coast, Bay of Bengal, India, *Indian Journal of Marine Science* 28: 249-256.

GEITLER, L. -1932- Cyanophaceae. In: Rabenhorst's Kryptogamen flora. Akademische Verlagsgesellschaft Lepzig.1196 pp.

GOMATHY, R., DEEPA, P., JEYACHANDRAN, S., MANOHARAN, C AND VIJAYAKUMAR, S., 2011. Biodiversity of Cyanobacteria from different freshwater ponds, Thiruvarur. *Indian Hydrobiology*, 8: 12-17.

HOWSLEY, R. AND H.W. PEARSONS -1979- pH dependent sulfide toxicity to oxygenic photosynthesis in cyanobacteria. *FEMS Microbioogy Lette*, 6: 287 293.

IYENGAR M.O.P. AND DESIKACHARY T.V. 1981. Volvocales. I.C.A.R. Monograph. New Delhi, Pp. 525.

JAMES, A. AND L.EYISON (eds.) 1979.Biological indicators of water quality john willey and sons Newyork.

KANNAN, S. -2006- Biodiversity Of Cyanobacteria In Freshwater Ponds Of Poondi. Thanjavur. M.Phil. dissertation. Bharathidasan University. Tiruchirapalli.

KANT, S. AND P. GUPTA, 1998. Algal Flora Of Ladakh. Scientific Publication, Jodhpur, India, Pp. 341.

KOMÁREK J. 2005. Studies On The Cyanophytes (Cyanobacteria, Cyanoprokaryota) Of Cuba 11. Freshwater *Anabaena* Species. *Preslia, Praha* 77: 211 – 234.

KOMÁREK J. AND K. ANAGNOSTIDIS, 1986. Modern Approach To Classification System To Cyanophytes. 2. Chroococcales. *Arch. Hydrobiol., Algol. Studs*. 43: 157 - 226.

KOMÁREK J. AND K. ANAGNOSTIDIS, 1989. Modern Approach To Classification System To Cyanophytes. 4. Nostocales. *Arch. Hydrobiol., Algol. Studs*. 56: 247 – 345.

KOMÁREK J. AND B. FOTT, 1983. Chlorophyceae, Ordung: Chlorocccales. In; Das Phytoplankton des Süßwassers, Teil: 7/1, Ed. Huber-Pestalozzi G., E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, pp. 1044.

KÖHLER, J. -1994- Origin and succession of phytoplankton in a river-lake (Spree, Germany). *Hydrobiologia* 289: 73 - 83.

LUND, J.W.G. -1965- The ecology of freshwater phytoplankton. Biological Reviews 40: 231 - 293.

MURUGESAN, S. AND V. SIVASUBRAMANIAN-2005- Cyanobacteria Of Porur Lake. Chennai. Tamilnadu. *Indian Hydrobiology* 8(1): 49-54.

MUTHUKUMAR, C., MURALITHARAN.G., VIJAYAKUMAR, R., PANNEERSELVAM, A., AND TAJUDDIN, N., 2009 Cyanobacterial biodiversity from different freshwater ponds of Thanjavur, Tamilnadu, India, *Acta Botanica Malacitana*, 32: 17-25.

ISSN: 2229- 6905

OREN, A. AND M. SHILO -1979- Anaerobic heterotropic dark metabolism in the cyanobacterium *Oscillatoria limnetica* sulfur respiration and lactate fermentation. *Archives Microbiology* 122: 77 - 84.

PINGALE, S.D. & B.S. DESHMUKH -2005- Some fresh water algae from Amphitheatre of Wilson Dam. Indian Hydrobiology 7: 97-100.

PRABHAKARAN, D. AND SUBRAMANIAN, G., Hydrogen photoproduction by marine cyanobacteria *Dicothrix bauriana* BDU 40481. *Physiol. Mol. Biol. Plants*, 1995, I, 45–57.

RAMANATHAN K.R. 1964. Ulotrichales. I.C.A.R. Monograph, New Delhi, Pp. 183.

RANI, G., K. INDHUMATHY AND K. SOFIA REVATHI -2005- Water characterization and fresh water algae of Chitlapakkam. *Indian Hydrobiology* 7: 143-146.

RIPPKA R., J. DERUELLES, J. B. WATERBURY, M. HERDMAN AND R. Y. STANIER, 1979. Generic assignments, strain histories and properties of pure cultures of cyanobacteria. *J. Gen. Microbiol*. 111: 1 – 61.

SCARSBROOK, M.R. -2002- Persistence and stability of lotic invertebrate communities in New Zeland. *Freshwater Biology* 47: 417-431.

SOININEN, J. AND P. ELORANTA -2004- Seasonal persistence and stability of diatom communities in rivers: are there habitat specific differences. *European Journal of Phycology* 39: 153-160.

SUNDARARAMAN, M., SUBRAMANIAN, G., AVERAL, H. I. AND AKBHARSHA, M. A., Evaluation of the bioactivity of marine cyanobacteria on some biochemical parameters of rat serum. *Phytotherapy. Res*., 1996, **10**, 9–12.

SUBHA, T.S. AND S. CHANDRA -2005- Temple tanks, their status and algal biodiversity. *Indian Hydrobiology* 7: 123-127

SENTHIL, P., JEYACHANDREN, S., MANOHARAN, C., AND VIJAYAKUMAR S., 2011 Biodiversity of cyanobacteria in industrial effluent. J. Adva.Biotech, 10(10): 157-159.

VENKATESHWARLU, V. -1969b- An Ecological Study Of The Algae Of The River Moosi. Hyderabad (India) With Special Reference To Water Pollution. Ii. Factors Influencing The Distribution Of Algae. *Hydrobiologia* 34: 352-362.

VIJAYAKUMAR,S., THAJUDDIN, N. AND MANOHARAN, C., 2005. Role of cyanobacteria in the treatment of dye industry effluent, *Poll. Res*., 24(1):79-84.

VIJAYAKUMAR, S.,THAJUDDIN,N. AND MANOHARAN, C., 2007. Biodiversity of Cyanobacteria in Industiral effluents, *Acta Botanica malacitana*, 32: 27-34.

VIJAYAKUMAR S, JEYACHANDREN S AND MANOHARAN C., 2012. Studies on cyanobacterial population in industrial effluents. *J of algal biomass and utilization*.3(1):39-45.