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Dynamics of micro algae in relation to water quality parameters of Pasupatheswarar Temple Pond, Annamalai Nagar, Tamil Nadu

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ABSTRACT

The current study deals with water quality variations and micro algal community structure in the highly eutrophic pond. Several water quality parameters were evaluated during the period from July 2014 to June 2015 from sampling station sited from Annamalai Nagar viz., Pasupatheswarar temple pond. The water quality parameters like Air and water temperature, turbidity, electrical conductivity, total dissolved solids, total alkalinity, pH, free carbon-dioxide, dissolved oxygen, biological oxygen demand (BOD), chemical oxygen demand (COD), calcium, magnesium, phosphate and nitrate were analysed. A total 29 species were observed during the study period of which 11 species from the class Cynophyceae, 9 species from the class Chlorophyceae, 6 species from the class Bacillariophyceae and 3 species from the class Euglenophyceae. Maximum species of the class Cyanophyceae were observed during study period. The *Microcystis aeruginosa* species observed in the pond indicates the signs of eutrophication of pond. The water quality parameters such as temperature, alkalinity, phosphate and nitrates are favourable for the growth of phytoplankton.

1. INTRODUCTION

Water is an important for the survival of life on earth. Water is one of the abundantly available substances in nature, which man has exploited more than any other resources for the sustenance of life. Water of good quality is required for living organisms. Ponds have been used since time immemorial as a traditional source of water supply in India. However, the water of the ponds, lakes and river are polluted mainly due to discharged waste water from residential areas, sewage outlets, solid wastes, detergents, automobile oil wastes, fishing facilities and agricultural pesticides from farmlands (Hasan *et al*., 2007; Elayaraj and Selvaraju 2014a).

The pond fertilization system also has an effect on the physico-chemical properties of phytoplankton and zooplankton communities (Ibrahim *et al*., 2003). Water quality assessment generally involves analysis of physico-chemical, biological and microbiological parameters and reflects on biotic and abiotic status of the ecosystem (Mulani *et al*., 2009). Physico-chemical factors are predictors of possible changes in the aquatic ecosystem and thus serve as important indicators for proper management of pond water resources. Changes in physico-chemical parameters may be caused by the production, composition and dynamics of phytoplankton (Descy, 1987).

Eutrophication is the process of water enrichment with nutrients (Istvanovics 2009; Karydis 2009) that change fauna, flora and water chemistry, food chains and nutrient cycles (Asaeda *et al*., 2001). Eutrophication can be natural, stems from natural processes such as climate variations (Vincent, 2009). The natural eutrophication occurs slowly over a period of many years through the lake aging process (Hill, 2010). Human activities increase nutrient loading and intensify this natural process (Khan and Ansari, 2005), which is called cultural eutrophication. The cultural eutrophication is the most important global water quality problem (Glibert *et al*., 2005).

Phytoplankton is a primary producer of the new particulate organic matter in pelagic systems. This organic matter pool transfer to higher trophic levels can be performed both through

the classic food chain - grazing algae by zooplankton - and by the way, of microbial food web. The planktonic study is a very useful tool for the assessment of water quality and productivity of any type of water body and also contributes to understanding of lentic water bodies (Pawar *et al*., 2006). When an aquatic ecosystem is considered, the planktons prove to be of great importance as the changes in the environment can portray an instantaneous response of the planktons (Thakur *et al*., 2013 and Malik *et al*., 2013). The plankton growth rate and development depends on various biotic as well as abiotic factors like, light, temperature, available nutrients, hydronamics, predation, oxygen concentration, pH, etc (Dhar *et al*., 2012).

The main objectives of the study were to determine microalgae diversity and water quality in the Pasupatheswarar temple pond of Annamalai Nagar.

2. MATERIALS AND METHODS

2.1. Study area

Pasupatheswarar temple pond is located in Annamalai Nagar, Chidambaram, Tamil Nadu (Fig. 1). The Latitude and Longitude of Pasupatheswarar temple pond is 11.39' N and 79.72' N respectively. It spreads about approximately 125m in length and 85m in width. The depth of the water ranges from 2 meters to 4 meters in different seasons.

Figure 1. Photograph of Pasupatheswarar temple pond, Annamalai Nagar, (TN)

2.2. Collection of water sample

The water samples for physico-chemical as well as phytoplankton analysis were collected at monthly interval for a year from July 2014 to June 2015 from a collection points taking randomly at the pond. The data thus generated were summed up as average data on the basis of seasons viz. pre monsoon (July to September), Monsoon (October to December), post monsoon (January to March) and summer (April to June).

2.3. Analysis of water sample

The temperature was recorded at the sample site. The pH of water sample was measured with the help of pH meter (Elico LI-1617) with a glass electrode. The pH meter was calibrated using buffer of pH 4.0 and 7.0. The total dissolved solids and conductance of water samples was measured using conductivity meter (Elico CM 183). Dissolved oxygen is determined by dissolved oxygen analyzer (Elico PE-135). Turbidity is determined with turbidity meter (Elico CL-52D). Rest of the physico-chemical properties like total alkalinity, free carbon dioxide, BOD, COD,

calcium, phosphate and nitrate were analyzed in laboratory following Trivedy and Goel (1986) and APHA (2012).

2.4. Analysis of Phytoplankton

Both surface and subsurface water samples of microalgae were collected by using mesh plankton net (mouth diameter 0.35 m) made up of bolting silk (no. 30; mesh size 20 μm) for half an hour and immediately preserved in 4 % formalin and Lugol's iodine solution. Identification was done by consulting standard literature and monographs of Desikachary (1959), Fritsch (1961) and Prescott (1975).

3. RESULT AND DISCUSSION

The outcomes on a few water quality parameters viz., Air and water temperature, turbidity, electrical conductivity, total dissolved solids, total alkalinity, pH, free carbon-dioxide, dissolved oxygen, Biological oxygen demand, chemical oxygen demand, calcium, magnesium, phosphate and nitrate are given in Table 1.

Table.1 Monthly variations of Water quality Parameters of Pasupatheswarar temple pond during July-2014 to June-2015

Sl. No.	Physico-chemical Parameters	Pre-monsoon			Monsoon			Post-monsoon			Summer		
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1.	Air temperature (° C)	34.7	32.8	31.9	32.2	29.5	28.0	28.4	29.6	31.6	34.9	33.8	37.2
2.	Water temperature (° C)	33.5	31.7	31.0	30.1	28.3	27.1	27.8	28.8	31.1	34.0	33.1	36.3
3.	Turbidity (NTU)	38.5	42.9	39.1	39.8	26.3	31.4	46.8	44.2	48.6	45.1	50.4	43.9
4.	Electrical conductivity (μS)	427.1	395.7	303.4	374.9	458.1	498.9	443.2	392.7	453.5	516.1	541.7	566.3
5.	Total dissolved solids (mg/L)	50.3	45.9	51.5	44.7	53.6	59.1	49.8	54.2	46.7	39.5	32.2	35.8
6.	Total alkalinity (mg/L)	142.1	126.7	119.2	105.6	96.2	112.8	103.4	114.9	133.1	167.4	202.9	182.5
7.	pH	8.64	8.37	8.29	7.72	7.06	7.83	8.09	8.58	8.42	8.59	8.74	8.87
8.	Free CO_2 (mg/L)	4.56	4.07	3.45	4.39	4.91	4.96	4.64	4.26	5.02	4.83	5.35	4.94
9.	Dissolved oxygen (mg/L)	5.24	5.99	6.56	5.31	5.85	6.8	6.31	5.97	6.09	5.9	5.72	5.16
10.	Biological Oxygen Demand (mg/L)	4.31	4.16	4.02	3.78	2.36	2.97	2.57	2.70	3.88	3.96	4.52	6.12
11.	Chemical Oxygen Demand (mg/L)	5.92	5.58	5.99	6.16	5.58	4.8	5.61	6.34	5.85	6.06	9.93	5.69
12.	Calcium (mg/L)	112.8	90.3	89.7	92.16	68.4	76.61	89.53	94.18	81.22	95.27	100.2	106.4
13.	Magnesium (mg/L)	27.54	24.72	21.36	16.53	12.24	16.48	18.47	21.89	28.92	33.75	45.8	39.0
14.	Phosphate (mg/L)	1.65	1.92	2.34	2.01	1.86	1.31	1.67	2.39	2.04	2.21	2.47	2.85
15.	Nitrate (mg/L)	3.31	2.02	1.94	1.78	1.62	0.95	0.87	1.15	1.11	1.85	1.78	1.82

Information on vital water quality parameters having an immediate bearing upon the dispersion and nature of different micro algal groups in the eutrophic pond water were gathered. Month to month variances of diverse micro algal gatherings are exhibited in Table 2. In the current study micro algal communities in the eutrophic pond water were represented by the members of Chlorophyceae, Cyanophyceae, Bacillariophyceae and Euglenophyceae. The microalgae members comprised of 29 species of which 11 belonging to Cyanophyceae, 9 to Chlorophyceae, 6 to Bacillariophyceae and 3 to Euglenophyceae.

Table 2. Monthly occurrence of micro algae during the year July-2014 to June-2015 on Pasupatheswarar temple pond

Sl. No.	Name of the Species	Pre-monsoon			Monsoon			Post-monsoon			Summer		
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
I.	**Cyanophyceae**												
01.	*Aphanocapsa grevillei* (Hass.) Rabenh	+	+	+	-	-	-	-	+	++	++	++	++
02.	*Nostoc pruniforme* Ag.	++	+	+	+	+	+	++	++	++	++	++	++
03	*Spirulina princeps* Gomont	++	+	+	+	+	+	++	++	++	++	++	++
04.	*Microcystis aeruginosa* (Wittr.) Kirchner	++	++	++	+	++	+	++	++	++	++	++	++
05.	*Chroococcus minor* (Kutz.) Nageli	+	+	+	+	+	+	+	+	++	++	++	+
06.	*Arthrospira platensis* (Nordst)	+	+	++	+	-	-	-	-	+	+	+	+
07.	*Oscillatoria curviceps* Ag. ex Gomont	++	+	+	+	+	+	++	++	++	++	++	+
08.	*Oscilltoria tenuis* Ag. ex Gomont	+	+	+	+	+	-	-	+	++	+	+	+
09.	*Lyngbya versicolor* (Vartm) Gom.	+	+	-	-	+	-	-	-	-	+	+	-
10.	*Lyngbya aestuari* Liebm Ex Gomont	-	-	-	-	-	-	+	+	+	++	+	+
11.	*Merismopedia glauca* (Ehr.) Nag.	-	+	+	-	-	+	+	-	-	-	+	-
II.	**Chlorophyceae**												
01.	*Chlorella pyrenoidosa* Chick	+	+	++	++	++	++	++	++	+	+	+	+
02.	*Scenedesmus quadricauda* (Turp.) Breb.	++	++	++	+	+	++	++	+	+	+	+	+
03.	*Chlamydomonas globosa* Snow.	+	+	+	+	++	++	++	+	+	+	+	+
04.	*Palmella miniata* Lieb.	-	+	-	+	+	+	-	+	-	+	-	-
05.	*Cladophora crispate* (Roth) Kutz.	-	-	-	+	++	++	+	+	+	+	-	+
06.	*Spirogyra* sps.	+	+	+	++	++	++	++	++	++	++	+	+
07.	*Pediastrum duplex* Meyen	-	+	-	-	-	+	+	-	-	-	-	-
08.	*Palmella miniata* Lieb.	+	-	+	-	++	-	+	+	+	-	-	+
09.	*Closterium purvulum* Nageli	-	-	-	-	+	++	++	+	+	-	-	-
III.	**Bacillariophyceae**												
01.	*Diatoma* sps.	+	+	+	+	++	+	+	++	++	++	+	+
02.	*Navicula acicularis* Kutz.	++	++	+	+	++	++	+	+	+	-	-	+
03.	*Cyclotella meneghiniana* Kutz.	-	-	++	+	++	++	++	-	-	+	-	+
04.	*Pinnularia borealis* Her.	++	+	-	-	+	++	+	+	-	-	-	-
05.	*Amphora ovalis* Kutz.	-	-	-	-	+	+	-	-	+	-	-	-
06.	*Nitzschia* sps.	+	+	-	-	+	-	-	+	-	-	-	-
IV.	**Euglenophyceae**												
01.	*Euglena viridis* Ehr.	++	+	++	++	++	++	+	-	-	+	-	++
02.	*Euglena deses* fo Klebsi	+	-	+	++	+	++	++	++	+	+	+	-
03.	*Phacus pleuronectes* Dujardin	+	+	+	+	++	+	++	++	++	+	+	+

(+) = Medium level present, (++) = High level present, (-) = Absent.

3.1. Cyanophyceae

Cyanophyceae (11 species) dominance has been attributed to eutrophic nature of the pond. These ponds are highly enriched with nutrients and productive water bodies. Maximum density of Cyanophycean members occurred from April to July during the study period. The density gradually decreased during winter and rainy seasons as their number was very low. The Cyanophyceae members are represented by the species like *Microcystis aeruginosa, Chroococcus minor, Oscillatoria curviceps, Nostoc pruniforme*, *Spirulina princeps, Aphanocapsa grevillei* and *Oscilltoria tenuis*. Physico-chemical parameters like pH, dissolved oxygen, phosphate, nitrate, total alkalinity, BOD and COD may have influenced the growth of Cyanophyceae (Elayaraj and Selvaraju, 2014a). High nutrients favoured the luxuriant growth of Cyanophyceae (Prescott, 1984). Naik *et al*., (2005) stated that maximum value of pH and nitrate supports the growth of cyanophyceae.

3.2. Chlorophyceae

Chlorophyceae is second dominant group. This group was represented by nine species and the maximum density of Chlorophyceae was observed in the month of November to March and minimum number was noticed in the month of May respectively. The dominant group among the chlorophyceae are *Chlorella pyrenoidosa, Scenedesmus quadricauda, Chlamydomonas globose* and *Spirogyra* species are recorded in appreciable number in the pond. Palmer (1980) and Mishra and Saksena (1993) have also reported these genera as the bio-indicator of organic pollution. Chlorophyceae members grow well in water that is rich in nutrients such as nitrate and phosphate (Philipose, 1967).

3.3. Bacillariophyceae

Bacillariophyceae or Diatoms were represented by six species out of which two species were recorded in all months. Maximum density of bacillariophyceae members occurred from November to December during the study period. The bacillariophyceae members are represented by the species like *Diatoma* species, *Navicula acicularis* and *Cyclotella meneghiniana.* Temperature, pH, calcium and nitrate will play key role in the distributions of diatoms and abundance of diatoms will be more in colder months (Elayaraj and Selvaraju, 2014b). Calcium and chloride is the most significant factors for controlling the growth of diatoms (Murugesan and Sivasubramanian, 2008). Diatoms are considered to be the best indicators of quality and tropic status of the water body (Callieri, 2008).

3.4. Euglenophyceae

In the present study Euglenophyceae comprises three species belonging to one species were recorded in all months in Pasupatheswarar temple pond. The maximum density of Euglenophyceae was observed in the month of September to January and minimum was noticed in the month of May. Results of these parameters in the present study show the favourable impact on the growth of euglenophyceae. Temperature above 25°C was favourable for the growth of euglenophyceae and high pH was favourable for the growth of euglenophyceae (Ashwani *et al*., 2012; Sedamkar and Tikke, 2011).

4. CONCLUSION

The present investigation of water quality parameters and micro algal community structure of Pasupatheswarar temple pond has revealed that the pond water is adversely affected by anthropogenic pollution and showed a trend of increasing eutrophication. The studied Pond water supports moderate levels of phytoplankton that constituted largely by Cyanophyceae (blue green algae). Deterioration of water quality and eutrophication are due to casual attitude of people. Thus, it can be concluded that these characteristics of water bodies are influenced by monthly variations. The distribution and population density of microalgae species depend upon the water quality parameters of the environment.

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References

[1] APHA, Standard Methods for examination of water and wastewater (22nd ed.), American Public Health Association, Washington DC, 2012, pp 1175.

[2] T. Asaeda, V.K. Trung, J. Manatunge, T. Van Bon, *Ecological Engineering* 16(3) (2001) 341-357.

[3] K. Ashwani, Dubey, Sandeep Kumar Shukla and Matadeen Bharti, *International Journal of Research in Pharmaceutical and Biomedical Sciences* 3 (2) (2012) 631-636.

[4] C. Callieri, *Freshwater Reviews* 1 (2008) 1-28.

[5] J.P. Descy, *Hydrobiologies* 78 (1987) 225-247.

[6] T.V. Desikachary, Cyanophyta. ICAR Monograph, New Delhi, India, 1959, pp 686.

[7] J. Dhar, Randhir Singh Baghel, Anuj Kumar Sharma, *Applied Mathematics and Computation* 218 (2012) 8925-8936.

[8] B.Elayaraj, M. Selvaraju, *International Letters of Natural Science* 16 (2014a) 145-156.

[9] B. Elayaraj, M. Selvaraju, *International Journal of Biological Research* 2 (2) (2014b) 90-95.

[10] F.E. Fritsch, The structure and the reproduction of the algae, University Press, Cambridge, 1961, Vol II. pp 791.

[11] P.M. Glibert, S. Seitzinger, C.A. Heil, J.M. Burkholder, M.W. Parrow, L.A. Codispoti, V. Kelly, *Oceanography* 18(2) (2005) 198-209.

[12] G.O. Hasan, Paul P. Mathisen, Don Pellegrino, *Journal of Environmental Biology* 28 (2007) 493-502.

[13] M.K. Hill, Understanding Environmental Pollution. Cambridge University Press, Cambridge, 1997-2010, pp 425.

[14] A.M. Ibrahim, N.F. Abd El-Hakim, Z.A. Nagdy, N.A. Ali, *Journal of Environmental Science* 7 (2003) 107-133.

[15] V. Istvanovics*, Lake ecosystem ecology* (2009) 47-55.

[16] M. Karydis, *Global NEST Journal* 11(4) (2009) 373-390.

[17] F.A. Khan, A.A. Ansari, *The botanical review* 71(4) (2005) 449-482.

[18] N. Malik, A.K. Biswas, C.B. Raju, *Bull Environ ContamToxicol* 90 (2013) 725-729.

[19] S.R. Mishra, D.N. Saksena, *Environment and Ecology* 11 (1993) 625-629.

[20] S.K. Mulani, M.B. Mule, S.U. Patil, *Journal of Environmental Biology* 30 (2009) 455-459.

[21] S. Murugesan, V. Sivasubramanian, *Indian Hydrobiology* 11(1) (2008) 149-154.

[22] U.G. Naik, S.H. Bhosale, J.L. Rathod, V.G. Bhat, Proceeding of Senior, Lecture University Grants Commission Haveri, 2005, pp 192-196.

[23] C.M. Palmer, Algae and Water Pollution. Castle House Publications Ltd. England, 1980, pp 123.

[24] S.K. Pawar, J.S. Pulle, K.M. Shendge, *Journal of Aquatic Biology* 21 (2006) 1-6.

[25] C.M.T. Philipose, Fresh water phytoplankton of inland fisheries Proc. Symp. Algology, ICAR New Delhi, 1967, pp 272-291.

[26] G.W. Prescott, *American Association of Advanced Science* 10 (1984) 65-78.

[27] G.W. Prescott, Algae of the Western Great Lake area. W Mc Brown company publishers, Iowa. Press, London, 1975, pp 977.

[28] E.B. Sedamkar, Mrs Jayashree Tikke, *World Journal of Science and Technology*, 1(1) (2011) 22-25.

[29] R.K. Thakur R. Jindal, UdayBhan Singh, A.S. Ahuwalia, *Environmental monitoring Assessment* 185 (2013) 8355-8373.

[30] R.K. Trivedy, P.K.Goel, Chemical and biological methods for water pollution studies. Environmental Publications, Karad, India. 1986, 248 pp.

[31] W.F. Vincent, *Lake Ecosystem Ecology* 463 (2009) 55-60.

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