Pollution Indicating Algae of Thiruneermalai Temple Tank, Pallavaram, Chennai

Anuja. J[1] and Chandra S.[2]

[1] Department of Botany, PSG College of Arts & Science, Coimbatore-641 014, Tamil Nadu, India
[2] L.N. Government Arts College, Ponneri, Thiruvallur, 601 204, Tamil Nadu, Tamil Nadu, India
Corresponding Author: anuja.phd@gmail.com

ABSTRACT

A research was carried out to access the status of water body through algal diversity in the present study. The algae identified in the chosen water tank were found to belong to the class Cyanophyceae, Chlorophyceae, Bacillariophyceae and Euglenophyceae. Some pollution indicating algal species were noticed as *Ankistrodesmus falcatus*, *Chlamydomonas*, *Oscillatoria*, *Phormidium*, *Pandorina morum*, *Chlorella*, *Euglena*, *Phacus Gomphonema*, *Navicula*, *Nitzschia*, *Cyclotella meneghiniana*, *Synedra ulna* and *Melosira granulata*. The Biological indices of water quality of all the seasons were determined using appropriate statistical methods to assess the trophic status of the temple water tank. Pollution status of the temple tank was determined using Boyd's index (1981) and organic pollution indictor by Palmer's Pollution Index (1969). The trophic status of the water body was calculated by Nygaard trophic status (1969). The survey of the temple tank was also taken using Digital Terrain Model (DTM). The temple tank, acts as water conservation structures, apart from their traditional purpose. By limiting the exposure, this aesthetic tank can be used properly for generations.

Key words: Pollution, Temple tank, Eutrophic, Bio-indicators, planktonic forms.

INTRODUCTION

Rivers of South India are only rain fed. Non availability of river water and consequent failure of rainfall led to the water harvesting and storage systems including percolation ponds, natural lakes, artificial reservoirs and temple ponds or temple tanks into highly polluted water resources. Temple tanks are one of the prime sources of water storage in India. Traditionally temple tanks seem to have played three hydraulic roles; as a storage which acted as insurance against low rainfall periods and also the recharge of ground water in the surrounding area, as a flood control measure, preventing soil erosion and prevention of wastage of runoff waters during the period of heavy rain fall, and as a device which was crucial to the overall ecosystems [1]. An attempt has been made in the present study to survey the algal flora hereby indicating the current pollution status of Thiruneermalai Temple tank, Pallavaram near Chennai.

MATERIALS AND METHODS

History of Thiruneermalai Temple Tank

Thiruneermalai temple was built during the 7th century A.D. in the land donated by a Chola king and is included as one of 108 Divya desams and as a Mukthi Sthala. In earlier days, the purity of water in such ponds was important and the quality was well maintained as this water was used by the people for bathing and other purposes.

Current Status of the Tank

Thiruneermalai temple tank is located at $12^o57'44''$ north longitudes and $80^o6'44''$ east latitudes. The tank is massive, situated outside the temple on the western side with well constructed steps and walls. There is a neerazhi mandapam situated in the middle of the tank (Fig.1).

There are also four deep wells in the tank floor to provide spring water. The tank has both an inlet and an outlet. Till a decade ago, the tank was full of water. The people in the locale began to use the tank for bathing, washing clothes and everything else, besides dumping garbage. As a result, it is heavily polluted in the current scenario. Out of the 4 wells, only one well is active today. The level of purity and quality of the water is badly changed. Natural springs and rainwater are the sources for recharging the water in the tank. Bathing and washing are two main activities in this tank. There are no hydrophytes. There are a few trees outside the tank. Fishes, crabs, prawns, frogs and snakes contribute to the aquatic fauna. The survey of the temple tank was taken once during the study period, using Digital Terrain Model (DTM) (Fig. 2).

Domestic Usage of Water - Washing and Bathing

Fig 1. A View of Temple on the Hill and Temple Tank with Neerazhi Mandapam
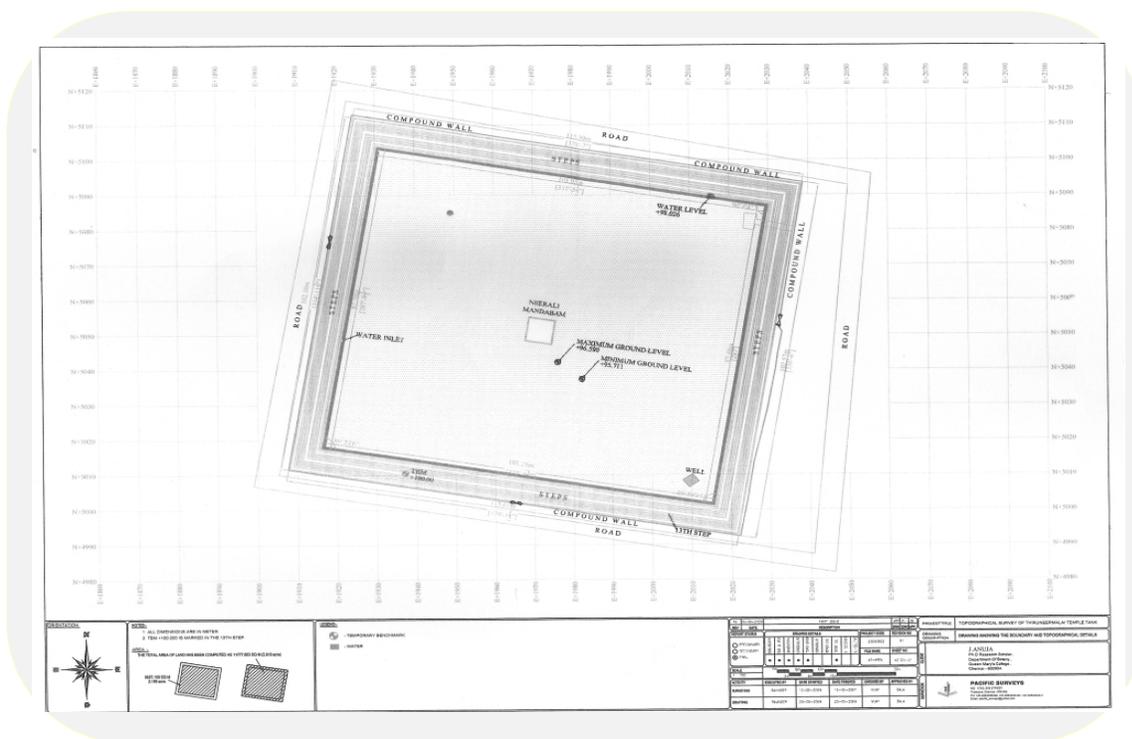
Fig.2 Survey of the study area using Digital Terrain Model (DTM)

Collection of phytoplankton

Samples were collected at monthly interval during the study period of two years (April 2007-March 2009) between 7.00 a.m. and 8.30 a.m. at all the sites (six collection points). Algal species that indicate pollution were collected using plankton net, a known volume of (5 litres) of water was allowed to pass through the plankton filter, made up of bolting silk no.25 mesh size, 60μm. Collected samples were preserved by standard methods. The cell count of algae was determined using Haemocytometer (no. of cells/ml). Nygaard's compound Quotient [2] indicates the trophic status of a water body. The diversity index of Boyd [3] indicates the order of pollution of a water body. Apart from the nature of water, floral diversity can also be calculated by Shannon-Wiener index (1949) and Species richness index [4] (Menhinick 1964) were used to calculate the total number species and the total number of individuals (total biomass), but not relative abundance of the individual species[5].

RESULTS AND DISCUSSION

Thiruneermalai temple tank has many other living communities, apart from algae such as zooplankton, frogs, fishes, crabs, prawn, beetles and snakes which indicate that the tank is rich in diversity and a well established ecosystem was seen. A systematic account of 78 species of algae belonging to 23 species of Cyanophyceae, 37 species of Chlorophyceae, 15 species of Bacillariophyceae and 3 species of Euglenophyceae was observed during the study.

From this account only a few species has been reported as indicators of pollution. They are *Chlamydomonas, Microcystis aeruginosa, Oscillatoria, Phormidium, Chlorella, Pandorina, Closterium, Ankistrodesmus, Scenedesmus Euglena, Phacus, Cyclotella, Gomphonema, Navicula, Nitzschia, Melosira* and *Synedra.*

Palmer (1969) [6] specified the range of organic pollution by the tolerance capacity of the algal species and expressed them numerically. Palmer's genus index was used during the study and the values were summed in the tabular column (Table 1). When the values are greater than fifteen then the organic pollution is absent, if it is between 15 and 20 then there is a possibility of organic pollution or greater than 20, then it is the indication of high level organic pollution. In the present investigation Palmer's genus index shows high level of organic pollution. According to Nygaard, if the compound quotient is below 1, the water is probably oligotrophic; the higher the quotient, the richer the assimilable nutrition. In the present study all the trophic indices showed the eutrophic values (Table.2), except Euglenophycean index which showed a slight tendency and transition from oligotrophic to eutrophication. The limits of Nygaard's phytoplankton quotient[2] given in literature pertain to temperate water bodies; therefore the index given in literature may not apply to tropical water bodies. This is seen clearly from the results obtained in the study. Even the diversity index of Boyd's indicates that the tank is moderately polluted (Table 3). According to flora diversity index and species richness index the tank has a higher diversified algal flora. Overall indices show that the Thiruneermalai temple tank has rich amount of organic pollution which may be due to the eutrophic nature of the water body. The water body is moderately polluted because of human interference which again has been reflected in the values of Boyd's index [3].

CONCLUSION

From the overall study it can be concluded that the Thiruneermalai temple tank, Pallavaram, Chennai is undergoing high level organic pollution and presently in the eutrophic status. If the anthropogenic disturbances as mentioned above is continued in this temple tank, near future the tank might be highly polluted and unfit for usage. Therefore, there is a necessity to manage the tank. The study also reveals that management of temple ponds should take into consideration not only the disturbances within the pond but also the disturbances in their catchment areas. This study has also reveals that the temple tank, acts as water conservation structures, apart from their traditional purpose. By limiting the exposure, this aesthetic tank can be used properly for generations.

Table 1. Palmer Pollution rating of Organic Pollution Indicator Algal Genera for Palmer Genus index.

| S.No.	Name of the pollution indicating algal species	Pollution rating
1.	*Chlamydomonas*	1
2.	*Microcystis aeruginosa*	5
3.	*Oscillatoria*	5
4.	*Phormidium*	1
5.	*Chlorella*	3
6.	*Pandorina*	1
7.	*Closterium*	1
8.	*Ankistrodesmus*	2
9.	*Scenedesmus*	4
10.	*Euglena*	5
11.	*Phacus*	2
12.	*Cyclotella*	1
13.	*Gomphonema*	1
14.	*Navicula*	3
15.	*Nitzschia*	3
16.	*Melosira*	1
17.	*Synedra*	2
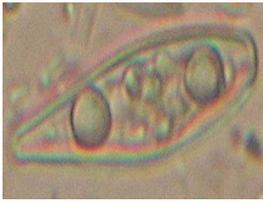
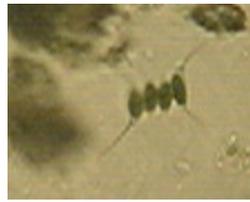**Gomphonema** **Euglena** **Navicula** **Cyclotella meneghiniana** **Closterium moniliferum**
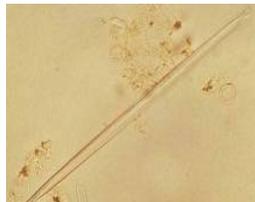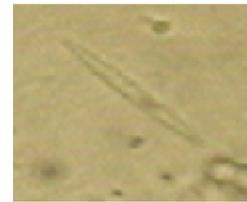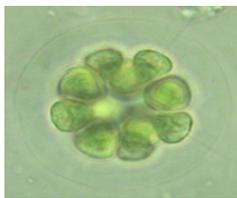
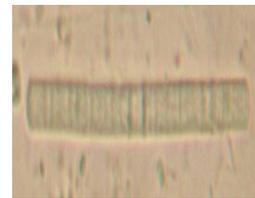**Ankistrodesmus falcatus** **Synedra ulna** **Scenedesmus quadricauda** **Nitzschia palae** **Scenedesmus dimorphus**

Pandorina morum **Microcystis aeruginosa** **Oscillatoria**

Fig.3. Algal species as water pollution indicators

Table 2

Nygaard's phytoplankton quotients and water quality-criteria for indicating

Oligotropic state 2007-2009

Year		Mysophycean	Chlorophycean	Diatom	Eugenophycean	Compound
April	2007	84	23.5	0.046	0	107.8
	2008	38	77	0.727	0	122
May	2007	183.5	34	0.346	0	219.8
	2008	60.4	6.4	0.150	0	67.4
June	2007	43.5	7	0.217	0	53
	2008	50.35	28.5	0.375	0	8035
July	2007	86.7	5	0.333	0.0164	96.2
	2008	60.75	37.5	0.500	0	100
August	2007	109	76.5	1.000	0.0081	191.5
	2008	51	24	0.889	0	79
September	2007	38	25	0.625	0.0159	69
	2008	82.8	27.6	0.375	0	112.8
October	2007	3.25	14	0.500	0	18.25
	2008	110.5	63.5	0.552	0	182
November	2007	76	14.5	2.000	0	92.5
	2008	87.5	21.25	1.200	0	111.8
December	2007	30.25	10.05	1.455	0	41.9
	2008	46.25	19.75	0.467	0.0076	70
January	2008	34.5	116	1.667	0	155.5
	2009	547.5	102.5	0.385	0.0015	653.5
February	2008	36	24.25	0.833	0	62.75
	2009	343.5	53	0.700	0	400
March	2008	87	44	0.500	0	135
	2009	1245	17.5	0.500	0.0035	1465

Calculation of Nygaard's Indices [2]

S. No.		Index	Oligotropic	Eutropic
1	Mysophycean	Myxophycean/Demidiaceae	0.0 – 0.0	0.1 – 3
2	Chlorophycean	Chlorococcales/Deamidiacceae	0.0 – 0.7	0.2 – 9
3	Diatom	Centric diatom/Pennate Diatom	0.0 – 0.3	0.0 – 1.75
4	Eugenophycean	Euglenophyceae/Myxophyceae + Chlorococcales	0.0 – 0.2	0.0 – 1.0
5	Compound	Myxophycean + Chlorococcales Centric diatom + Euglenophyceae /Demidiaceae	0.0 – 1.0	1.25 - 25

Table 3
Pollution diversity index of Boyd (1981) for Thiruneermalai temple tank
April 2007 – March 2009

Month and Year	Number of Species (S)	S -1	Total number of individuals (N)	In (N)	Boyd's Index H = S-1/Ln(N)	Order of Pollution
April 2007	39	38	114300	11.6466	3.26	Moderately Polluted
May 2007	31	30	226250	12.3294	2.43	Moderately Polluted
June 2007	32	31	64500	11.0744	2.80	Moderately Polluted
July 2007	33	32	105200	11.5636	2.77	Moderately Polluted
August 2007	34	33	196000	12.1859	2.71	Moderately Polluted
September 2007	45	44	77000	11.2516	3.91	Moderately Polluted
October 2007	38	37	81000	11.3022	3.27	Moderately Polluted
November 2007	23	22	93500	11.4457	1.92	Moderately Polluted
December 2007	27	26	86000	11.3621	2.29	Moderately Polluted
January 2008	40	39	158500	11.9735	3.26	Moderately Polluted
February 2008	30	29	131500	11.7868	2.46	Moderately Polluted
March 2008	36	35	143000	11.8706	2.95	Moderately Polluted
April 2008	39	38	131500	11.7868	3.22	Moderately Polluted
May 2008	34	33	178500	12.0923	2.73	Moderately Polluted
June 2008	26	25	84350	11.3427	2.20	Moderately Polluted
July 2008	32	31	207000	12.2405	2.53	Moderately Polluted
August 2008	30	29	84350	11.3326	2.56	Moderately Polluted
September 2008	41	40	298000	12.6048	3.17	Moderately Polluted
October 2008	41	40	393000	12.8816	3.11	Moderately Polluted
November 2008	25	24	228500	12.3393	1.95	Moderately Polluted
December 2008	30	29	155000	11.9512	2.43	Moderately Polluted
January 2009	38	37	132000	11.7906	3.14	Moderately Polluted
February 2009	23	22	81000	11.3022	1.95	Moderately Polluted
March 2009	27	26	30900	10.3385	2.51	Moderately Polluted

REFERENCES

1. Madhavi Ganesan, 2009. The temple tanks of Madras, India: rehabilitation of an ancient technique for multipurpose water. *Indian Journal of Science and Technology* 1(6):1-8.

2. Nygaard G., 1969. Hydrobiological studies on some Danish ponds and lakes. Part I: The quotient hypothesis and some new or little known phytoplankton organisms. *Kgl.Danske.Videnskselsk Bio. Skrifter.*7:1-293.

3. Boyd CE., 1981. Water quality in warm water fish ponds. *Craftmaster printers*, Alabama. Craftmaster Printers, Inc Inc. Opelika, Alabama.p.354.

4. Menhinick, 1964. A Comparison of Some Species-Individuals Diversity Indices Applied to Samples of Field Insects. Ecology 45:859–861.

5. Anuja. J and Chandra.S., 2014. Studies on fresh water algae in relation to chemical constituents of Thiruneermalai temple tank near Chennai, India-I.Int.J.Curr.Sci.4:21-29.

6. Palmer, C.M., 1969. A composite rating algae tolerating organic pollution. J.phycol., 5:1-2