



## Studies on fresh water algae in relation to chemical constituents of Thiruneermalai temple tank near Chennai, India-I

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### Abstract

A preliminary investigation was carried out for six months from Apr' 2007 to Sep' 2007 to access the status of algal biodiversity of Thiruneermalai Temple tank near Pallavaram (Chennai). The algae identified in this temple tank belong to the Classes, Cyanophyceae, Chlorophyceae, Bacillariophyceae and Euglenophyceae. Physical parameters such as light intensity, pH, humidity, water temperature, atmospheric temperature, odour, appearance, turbidity NTU, TDS, electrical conductivity, and chemical parameters such as total hardness, calcium, magnesium, sodium, potassium, manganese, free ammonia, nitrate, nitrite, chloride, sulphate, phosphate, silica, BOD were recorded. The biological indices of water quality of all the seasons were determined using appropriate statistical method to assess the trophic status of the temple tank.

**Key words:** fresh water algae, temple tank, aquatic ecosystem, phytoplankton

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### Introduction

Algae constitute a major part of primary producers in aquatic ecosystem and are ubiquitous components of the biosphere (Raj et al., 1981; Ahluwalia, 1993). They occur in a wide variety of habitats and play an important role in nature. The phytoplankton diversity and seasonal oscillations were reported earlier (Das, 2000; Sedamkar and Angadi, 2003; Sharma and Sarang, 2004). Temple tanks are prime source of water storage since ancient times. There are about 50 identifiable tanks in and around the city of Chennai. Most of them are neglected, disused or being used as a dump garbage, seepage of sewage. Prior work on biodiversity of a algae in temple tanks were carried out by Iyengar (1939), Ganapathi (1940), Jeeji Bai and Lakshmi (1999), Maya (2003), Subha and Chandra (2005), Subha (2005b), Kavitha et al. (2005). An attempt has been made in the present study to survey the algal flora of Thiruneermalai temple tank near Pallavaram, Chennai. This temple tank is of historical importance and the study is intended to capture the present scenario of the tanks and to record the algal biodiversity. Bathing and Washing

are the two main activities in this temple tank, in addition to the usage for spiritual activities.

### Material and Methods

#### Study area

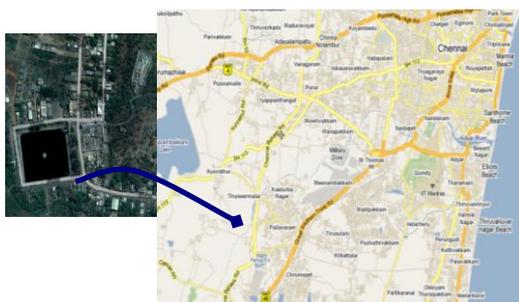
It is located at 12°57'44" north longitudes and 80°6'44" east latitudes (Fig. 1). It is situated 5 kms away from Pallavaram, in Chennai. The tank is rectangular in shape with twenty three well constructed steps. All the four sides are closed by alternately grided and cement walls. There is only one gate facing on the south side and one active well on the southeast direction. Total volume capacity of water is 63,786.301 cubic meter. Total area of the tank is 2.910 acre. 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). A digital elevation Model (DEM) is digital representation of ground surface topography or terrain. It is also widely known as a Digital Terrain Model (DTM).

#### Physico-chemical parameters

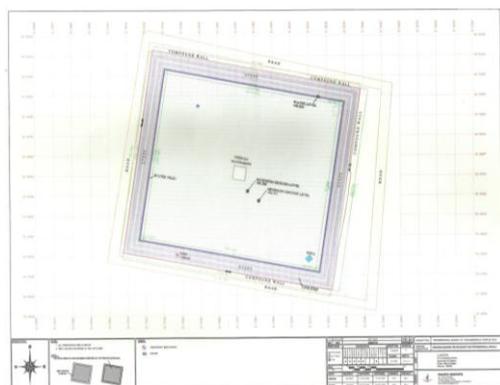
Physico-chemical parameters were observed

using standard methods (APHA, 1985) surface water temperature (Degree Celsius), light intensity (Lux), pH of water, biological oxygen demand mg/L, turbidity NTU, electrical conductivity (micro mho/cm), alkalinity total (as CaCO<sub>3</sub>) mg/L, total hardness (as CaCO<sub>3</sub>) mg/L, calcium (as Ca) mg/L, magnesium (as Mg) mg/L, sodium (as Na) mg/L, potassium (as K), iron (as Fe) mg/L, manganese (as Mn) mg/L, Free ammonia (as NH<sub>3</sub>) mg/L, nitrite (as NO<sub>2</sub>) mg/L, nitrate (as NO<sub>3</sub>) mg/L, chloride (as Cl) mg/L, fluoride (as F) mg/L, sulphate (as SO<sub>4</sub>) mg/L, phosphate (as PO<sub>4</sub>) mg/L, silica (as SiO<sub>2</sub>).

**Fig.1.** Map showing the study area



**Fig. 2.** Survey of the study area using (DTM)



#### Collection of samples

Monthly water samples were collected for the period of April 2007 to September 2007 samples were collected on six directions viz., North-West, North-East, South-West, South-East, Middle surface and Middle bottom. Planktons were collected using plankton net. During collection following were recorded water temperature Degree Celsius, Atmospheric temperature (Degree Celsius), Light intensity, humidity, Monthly average rainfall, Depth of water body and time of collection (Table 1). Routing chemical test analysis of various essentials nutrients were carried using standard procedures

described by APHA (1985) (Table 2). Algae were identified using standard manuals. Individual cell counts were made in the sample using haemocytometer. The tropic level of water of pond was analysed with the help of Nygaard's index (Krishnamurthy, 1990).

#### Results and Discussion

Monthly variation on physical and chemical characteristics during the study period is shown in Table 1. Well marked variation in surface water temperature which ranged from 20-34°C. The monthly average daily temperature of the atmosphere varied from minimum of 29°C to a maximum of 36°C. The humidity ranged from 40% to 82%. The monthly average rainfall ranged from 4-236 mm and depth of water ranged from 220-310 cms. Light intensity ranged from 2100 to 8100 lux which indicates hours of sunshine was high during the summer. As per haemocytometer cell count study, the maximum cell number was recorded in Cyanophyceae is *Microcystis* sp. 1,62,000/mL. Minimum cell no was recorded in *Cyclotella* sp. 300/mL (Table 4). Since BOD and essential nutrients are in appreciable amounts in the pond, it is very clear that is temple tank is undergoing eutrophication. The pH was alkaline throughout the period of study. There exists a closed relationship between pH and phytoplankton density (Sedamkar and Angadi, 2003). Various types of soaps, detergents, and other washable drugs might be helping to increase the alkalinity of water (Kadam, 1990).

The diversity index of boyd indicates the order of pollution of a water body. The resultant values indicate the pollution status of the water body. In the present investigation, the values lay between 3-2 (Table 5). The BOD of the study period ranged between 3.0 mg/L to 37.2 mg/L which indicated the level of organic pollution in this temple tank. Electrical Conductivity ranged from 576.0 to 811.3 (micromho/cm) also indicates the organic pollution level. Increase in the values of total hardness were found in this temple tank ranges from 81.0 to 141.8 mg/L. It may be due to high level of carbonated and bicarbonates in water.

Chloride levels fluctuated from 89.0-141.3 mg/L might be due to high degree of sewage discharge and human interferences (Arvind kumar, 1997). Levels of phosphate from 0.1 mg/L to 0.6 mg/L might be due to mattress washing by detergents. Along with these nitrates was also found to be increased from 6.2 mg/L to 8.8 mg/L. Water bodies polluted by organic matter exhibit higher values of nitrate (Kodarkar, 1995). The major sources of phosphate and nitrate were from domestic sewage, detergents and waste waters (Trivedy and Goel, 1984). There was an increase in calcium from 20.2 mg/L to 36.8 mg/L due to pollution. Along with this increase in the levels of sodium and magnesium were recorded. Increase in calcium, Sodium, Magnesium might be due to sewage and disposal of waster waters. No trace of heavy metals like lead, cadmium and nickel which were found absent in this temple tank. Increase in the number of diatom cells indicate the presence of fairly high amount of silica ranges from 3.4 to 40.2 mg/L. As per the results of Nygaards index, indicating the trophic level of water bodies the temple tank shows eutrophic state (Table 6). This is because of the presence of desmids *Staurastrum* sp, *Cosmarium undulatum* var. *crenulatum*, *Closterium* sp and several species of Cyanophyceae, genera like *Chroococcus* sp, *Oscillatoria* sp, *Aphanocapsa* sp., *Microcystis* sp, *Navicula* sp, *Synedra ulna*, *Cyclotella, meneghiniana* and *Nitzschia obtusa* were recorded

as pollution indicators. The diversity index of boyd (Table 5) indicates the order of pollution of a water body. The resultant values indicate the pollution status of the water body. In the present investigation, the values lay between 3-2 and it is moderately polluted. A similar instance had been noticed (Muhammed Ali et al., 2003; Sudeep et al., 2007).

In the present study, a total number of 61 species of fresh water algae have been recorded. Out of 61 species 18 of them belonged to Cyanophyceae, 27 species belonged to Chlorophyceae, 14 species belonged to Bacillariophyceae, and only 2 species belonged to Euglenophyceae. As per heamocytometer cell count study, the maximum number was recorded in Cyanophyceae i.e. *Microcystis aeruginosa* 3,26,700 /ml. Minimum cell number was recorded in *Chlorella* sp. and *Pleurosigma angulatum* 500/ml. Since the BOD and the essential nutrients are in appreciable amounts in the pond, it is very clear that this temple tank is undergoing eutrophication. As per the results of Nygaard's index indicating the trophic level of the water bodies the temple tank shows eutrophic state. This is because of the presence of desmids such as *Closterium* sp, *Cosmarium* sp and *Staurastrum* sp. in the tank. The abundance and biodiversity of the algal forms indicate the eutrophic nature of the water body.

**Table 1**

Meteorological parameters recorded during the study period

| Parameter \ Month            | April 2007 | May 2007 | June 2007 | July 2007 | August 2007 | September 2007 |
|------------------------------|------------|----------|-----------|-----------|-------------|----------------|
| Date                         | 6          | 24       | 29        | 26        | 28          | 27             |
| Time                         | 7.15 a.m   | 6.30 a.m | 7.15 a.m. | 7.20 a.m. | 8.50 a.m.   | 8.05 a.m.      |
| Atmospheric temperature (°C) | 36         | 36       | 29        | 32        | 33          | 30             |
| Water temperature (°C)       | 34         | 29       | 26        | 28        | 30          | 20             |
| Humidity (%)                 | 40         | 60       | 80        | 82        | 74          | 66             |
| Light intensity x10 (lux)    | 8100       | 5700     | 2100      | 3790      | 6400        | 6200           |
| Depth (cms)                  | 230        | 220      | 200       | 230       | 285         | 310            |
| Average Rainfall (mm)        | 10         | 4        | 112       | 179       | 236         | 155            |

**Table 2**

Physico-chemical parameters and their variation in the tank during the study period

| Sl. no     | Month and Year                                  | April    | May      | June     | July     | August   | September |
|------------|---|----------|----------|----------|----------|----------|-----------|
|            |   | 2007     | 2007     | 2007     | 2007     | 2007     | 2007      |
| Parameters |   |          |          |          |          |          |           |
| Physical   | 1 Appearance                                    | Greenish | Greenish | Greenish | Greenish | Greenish | Greenish  |
|            | 2 Odour   | None     | None     | None     | None     | None     | None      |
|            | 3 Turbidity NTU                                 | 22.9     | 24.9     | 24.7     | 20.6     | 18.1     | 24.6      |
|            | 4 Electrical Conductivity (micro mho/cm)        | 751.3    | 852.8    | 811.3    | 664.3    | 630.2    | 576.0     |
| Chemical   | 5 pH  | 7.6      | 8.4      | 7.4      | 8.0      | 7.9      | 7.8       |
|            | 6 Alkalinity total (as CaCO <sub>3</sub> ) mg/L | 182.3    | 184.0    | 153.8    | 146.0    | 145.2    | 166.0     |
|            | 7 Total hardness (as CaCO <sub>3</sub> ) mg/L   | 137.8    | 81.0     | 141.8    | 139.2    | 102.7    | 114.2     |
|            | 8 Calcium (as Ca) mg/L                          | 35.0     | 20.2     | 36.8     | 36.0     | 25.2     | 27.7      |
|            | 9 Magnesium (as Mg) mg/L                        | 11.8     | 7.3      | 11.8     | 11.5     | 9.3      | 10.5      |
|            | 10 Sodium (as Na) mg/L                          | 150.7    | 150.7    | 133.7    | 87.5     | 99.5     | 80.0      |
|            | 11 Potassium (as K)                             | 11.8     | 10.7     | 9.7      | 7.8      | 7.2      | 8.0       |
|            | 12 Iron (as Fe) mg/L                            | 2.8      | 0.7      | 1.2      | 1.0      | 1.6      | 1.4       |
|            | 13 Manganese (as Mn) mg/L                       | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0       |
|            | 14 Free ammonia (as NH <sub>3</sub> ) mg/L      | 1.9      | 1.7      | 2.0      | 1.1      | 0.4      | 0.8       |
|            | 15 Nitrite (as NO <sub>2</sub> ) mg/L           | 0.2      | 0.1      | 0.4      | 0.0      | 0.0      | 0.3       |
|            | 16 Nitrate (as NO <sub>3</sub> ) mg/L           | 8.7      | 8.8      | 8.3      | 6.2      | 6.8      | 6.2       |
|            | 17 Chloride (as Cl) mg/L                        | 139.7    | 140.3    | 141.3    | 103.7    | 89.0     | 90.8      |
|            | 18 Fluoride (as F) mg/L                         | 0.5      | 0.6      | 0.6      | 0.5      | 0.5      | 0.5       |
|            | 19 Sulphate (as SO <sub>4</sub> ) mg/L          | 21.2     | 28.7     | 37.0     | 16.5     | 14.8     | 6.3       |
|            | 20 Phosphate (as PO <sub>4</sub> ) mg/L         | 0.3      | 0.6      | 0.6      | 0.3      | 0.1      | 0.4       |
|            | 21 Silica (as SiO <sub>2</sub> )                | 3.4      | 6.0      | 40.2     | 5.1      | 7.9      | 10.8      |
|            | 22 BOD mg/L                                     | 37.2     | 36.5     | 22.3     | 22.5     | 27.7     | 3.0       |
|            | 23 Dissolved oxygen mg/L                        | 4.1      | 4.6      | 4.5      | 4.7      | 4.7      | 4.9       |

Table 3

List of algal species encountered in the study in different months

| Sl.no | Algal Species   | April | May  | June | July | August | September |
|-------|---|-------|------|------|------|--------|-----------|
|       |   | 2007  | 2007 | 2007 | 2007 | 2007   | 2007      |
|       | <b>Cyanophyceae</b>   |       |      |      |      |        |           |
| 1     | <i>Microcystis aeruginosa</i> Kutz. (c)   | +     | +    | +    | +    | +      | +         |
| 2     | <i>Chroococcus turgidus</i> (Kutz.) Nag. (c)  | +     | +    | +    | +    | +      | +         |
| 3     | <i>Chroococcus minutus</i> (Kutz.) Nag. (r)   | +     | -    | +    | -    | +      | -         |
| 4     | <i>Gloeocapsa punctata</i> Nag. (r)   | -     | -    | -    | -    | -      | +         |
| 5     | <i>Gloeothece palea</i> (Kutz.) Rabenh. (r)   | -     | -    | -    | -    | -      | +         |
| 6     | <i>Aphanocapsa rooseana</i> de Bary (r)   | +     | -    | -    | -    | -      | +         |
| 7     | <i>Gomphosphaeria aponina</i> Kutz. (r)   | +     | -    | -    | -    | -      | +         |
| 8     | <i>Merismopedia tenuissima</i> Lemm. (c)  | +     | -    | +    | +    | +      | +         |
| 9     | <i>Merismopedia elegans</i> A. Br. (r)  | -     | -    | -    | -    | -      | +         |
| 10    | <i>Chaemisiphon fuscus</i> (Rostaf.) Hansgirg (r)   | +     | -    | -    | -    | -      | -         |
| 11    | <i>Spirulina laxissima</i> West, G.S (c)  | +     | +    | +    | +    | +      | +         |
| 12    | <i>Spirulina major</i> Kuetz. ex.Gomont (r)   | -     | -    | -    | +    | +      | +         |
| 13    | <i>Oscillatoria subbrevis</i> Schmidle (c)  | +     | +    | +    | +    | +      | +         |
| 14    | <i>Phormidium tenue</i> (Menegh.) Gomont (r)  | +     | -    | -    | -    | -      | -         |
| 15    | <i>Lyngbya kuetzingii</i> Schmidle (r)  | -     | -    | -    | +    | -      | -         |
| 16    | <i>Anabaenopsis arnoldii</i> Aptekarj (c)   | +     | +    | -    | +    | +      | +         |
| 17    | <i>Nostoc</i> sp. (c)   | -     | +    | +    | +    | +      | +         |
| 18    | <i>Anabaena circinalis</i> Robenhost ex.Born.et Flah.(r)                                    | +     | -    | -    | -    | -      | +         |
|       | <b>Chlorophyceae</b>  |       |      |      |      |        |           |
| 19    | <i>Pandorina morum</i> (Mull.) Bory (r)   | +     | +    | -    | -    | +      | -         |
| 20    | <i>Eudorina elegans</i> Ehr. (r)  | +     | -    | -    | -    | +      | -         |
| 21    | <i>Pediastrum simplex</i> Meyen (c)   | +     | +    | +    | +    | +      | +         |
| 22    | <i>Pediastrum ovatum</i> (Ehr.) A. Braun. (r)   | -     | -    | +    | -    | -      | -         |
| 23    | <i>Pediastrum duplex</i> Meyen var. <i>reticulatum</i> Lagerheim (c)                        | +     | +    | +    | +    | +      | +         |
| 24    | <i>Pediastrum boryanum</i> (Turpin) Meneghini (c)   | +     | +    | +    | +    | +      | +         |
| 25    | <i>Closteridium bengalicum</i> Turner. (r)  | -     | -    | -    | -    | +      | +         |
| 26    | <i>Palmella</i> sp. (r)   | -     | -    | -    | -    | +      | +         |
| 27    | <i>Chlorella</i> sp. (c)  | +     | +    | -    | +    | +      | +         |
| 28    | <i>Dictyosphaerium ehrenbergianum</i> Naegeli (r)   | +     | +    | -    | -    | -      | -         |
| 29    | <i>Westella botryoides</i> (W.West) de Wilderman (r)  | +     | +    | -    | -    | -      | -         |
| 30    | <i>Ankistrodesmus falcatus</i> (Corda) Ralfs (c)  | +     | +    | +    | -    | +      | +         |
| 31    | <i>Selenastrum gracile</i> Reinsch (c)  | +     | +    | +    | +    | +      | +         |
| 32    | <i>Coelastrum microporum</i> Naegeli (r)  | -     | -    | -    | +    | +      | +         |
| 33    | <i>Scenedesmus dimorphus</i> (Turpin) Kuetzing (c)  | +     | +    | +    | +    | -      | +         |
| 34    | <i>Scenedesmus bijugatus</i> (Turpin) Kuetzing (c)  | +     | +    | +    | +    | +      | +         |
| 35    | <i>Scenedesmus abundans</i> (Kirchner) Chodat (r)   | +     | -    | -    | -    | -      | +         |
| 36    | <i>Scenedesmus bijugatus</i> (Turpin) Kuetzing var. <i>alternans</i> (Reinsch) Hansgirg (c) | +     | +    | +    | -    | +      | +         |
| 37    | <i>Scenedesmus quadricauda</i> (Turpin) Brebisson(c)  | +     | +    | +    | +    | -      | +         |
| 38    | <i>Ulothrix variabilis</i> Kuetzing (r)   | -     | +    | -    | -    | -      | -         |
| 39    | <i>Oedogonium</i> sp. (c)   | +     | +    | +    | +    | -      | +         |
| 40    | <i>Closterium intermedium</i> Ralfs (r)   | +     | -    | +    | +    | -      | +         |

| Sl.no | Algal Species   | April | May  | June | July | August | September |
|-------|---|-------|------|------|------|--------|-----------|
|       |   | 2007  | 2007 | 2007 | 2007 | 2007   | 2007      |
| 41    | <i>Cosmarium undulatum</i> Corda var. <i>crenulatum</i> (Nag.) Wittrock (c) | -     | +    | +    | +    | +      | +         |
| 42    | <i>Spondylosium</i> sp. (r)   | +     | -    | -    | -    | -      | -         |
| 43    | <i>Staurastrum</i> sp. (r)  | -     | -    | -    | +    | -      | -         |
|       | <b>Euglenophyceae</b>   |       |      |      |      |        |           |
| 44    | <i>Euglena</i> sp. (r)  | -     | -    | +    | +    | +      | +         |
| 45    | <i>Lepocinclis</i> sp. (r)  | -     | -    | +    | -    | +      | -         |
|       | <b>Bacillariophyceae</b>  |       |      |      |      |        |           |
| 46    | <i>Melosira granulata</i> (Ehr.) Ralfs (r)                                  | +     | +    | +    | +    | +      | +         |
| 47    | <i>Cyclotella meneghiniana</i> Kutz. (c)                                    | +     | +    | +    | +    | +      | +         |
| 48    | <i>Fragilaria intermedia</i> Grun.var. <i>robusta</i> var. nov.(r)          | -     | -    | -    | -    | -      | +         |
| 49    | <i>Synedra ulna</i> (Nitzsch) Ehr. (c)                                      | +     | +    | +    | +    | +      | +         |
| 50    | <i>Eunotia robusta</i> Ralfs var.tetraodon (Ehr.)Ralfs (r)                  | -     | -    | -    | -    | -      | +         |
| 51    | <i>Pleurosigma angulatum</i> (Quekett) W.Smith (r)                          | -     | -    | -    | +    | -      | +         |
| 52    | <i>Navicula cuspidata</i> Kutz.var. <i>ambigua</i> (Ehr.) Cleve (c)         | +     | +    | +    | +    | +      | +         |
| 53    | <i>Navicula protracta</i> Grun.(r)  | -     | -    | +    | -    | -      | -         |
| 54    | <i>Pinnularia interrupta</i> W.Smith f. <i>subcapitata</i> Fritsch (c)      | +     | +    | +    | +    | +      | +         |
| 55    | <i>Cymbella turgida</i> (Greg.) Cleve (r)                                   | -     | -    | -    | -    | -      | +         |
| 56    | <i>Gomphonema lanceolatum</i> Ehr. (c)                                      | +     | +    | +    | +    | +      | +         |
| 57    | <i>Nitzschia obtusa</i> W.Smith var. <i>scalpelliformis</i> Grun. (c)       | +     | +    | +    | +    | +      | +         |
| 58    | <i>Nitzschia closterium</i> (Ehr.) W.Smith (c)                              | +     | +    | +    | +    | +      | +         |
| 59    | <i>Hantzschia amphioxys</i> (Ehr.)Grun.var. <i>vivax</i> (Hantz.)Grun. (c)  | +     | +    | +    | +    | +      | +         |

+ Present , - Not seen, (c) Constant, (r) Rare,

TABLE 4

Individual cell count (cells/ml) - Monthly variation during the study period

| Sl. no                         | Cell count  | April        | May           | June         | July         | August        | September    |
|--------------------------------|---|--------------|---------------|--------------|--------------|---------------|--------------|
|                                |   | 2007         | 2007          | 2007         | 2007         | 2007          | 2007         |
| <b>Cyanophyceae</b>            |   |              |               |              |              |               |              |
| 1                              | <i>Microcystis aeruginosa</i> Kutz.                                     | 68000        | 162000        | 0            | 34700        | 34000         | 28000        |
| 2                              | <i>Chroococcus turgidus</i> (Kutz.) Nag.                                | 2000         | 8000          | 6500         | 2000         | 0             | 2000         |
| 3                              | <i>Chroococcus minutus</i> (Kutz.) Nag.                                 | 0            | 0             | 16000        | 0            | 16000         | 0            |
| 4                              | <i>Gomphosphaeria aponina</i> Kutz.                                     | 0            | 0             | 0            | 16000        | 0             | 0            |
| 5                              | <i>Merismopedia tenuissima</i> Lemm.                                    | 0            | 0             | 0            | 16000        | 32000         | 0            |
| 6                              | <i>Spirulina laxissima</i> West, G.S                                    | 0            | 0             | 1000         | 1000         | 0             | 0            |
| 7                              | <i>Oscillatoria subbrevis</i> Schmidle                                  | 14000        | 13000         | 20000        | 17000        | 23000         | 8000         |
| 8                              | <i>Anabaenopsis arnoldii</i> Aptekarj                                   | 0            | 500           | 0            | 0            | 0             | 0            |
| 9                              | <i>Nostoc</i> sp.   | 0            | 0             | 0            | 0            | 4000          | 0            |
| 10                             | <i>Anabaena circinalis</i> Robenhost ex.Born.et Flah.                   | 0            | 0             | 0            | 0            | 0             | 0            |
| <b>Cyanophyceae total</b>      |   | <b>84000</b> | <b>183500</b> | <b>43500</b> | <b>86700</b> | <b>109000</b> | <b>38000</b> |
| <b>Chlorophyceae</b>           |   |              |               |              |              |               |              |
| 11                             | <i>Eudorina elegans</i> Ehr.  | 0            | 0             | 0            | 0            | 5500          | 0            |
| 12                             | <i>Pediastrum simplex</i> Meyen   | 4000         | 13500         | 3500         | 0            | 0             | 0            |
| 13                             | <i>Pediastrum duplex</i> Meyen var. <i>reticulatum</i> Lagerheim        | 6000         | 7500          | 0            | 0            | 12500         | 1500         |
| 14                             | <i>Pediastrum boryanum</i> (Turpin) Meneghini                           | 4000         | 6000          | 0            | 0            | 4000          | 0            |
| 15                             | <i>Palmella</i> sp.   | 0            | 0             | 0            | 0            | 50000         | 0            |
| 16                             | <i>Chlorella</i> sp.  | 0            | 0             | 0            | 0            | 0             | 500          |
| 17                             | <i>Selenastrum gracile</i> Reinsch                                      | 500          | 1000          | 1500         | 4000         | 1500          | 0            |
| 18                             | <i>Coelastrum microporum</i> Naegeli                                    | 0            | 0             | 0            | 0            | 0             | 16000        |
| 19                             | <i>Coelastrum scabrum</i> Reinsch.                                      | 0            | 6000          | 0            | 0            | 0             | 0            |
| 20                             | <i>Scenedesmus dimorphus</i> (Turpin) Kuetzing                          | 0            | 0             | 0            | 1000         | 0             | 0            |
| 21                             | <i>Scenedesmus bijugatus</i> (Turpin) Kuetzing                          | 0            | 0             | 2000         | 0            | 0             | 6000         |
| 22                             | <i>Scenedesmus quadricauda</i> (Turpin) Brebisson                       | 6000         | 0             | 0            | 0            | 0             | 0            |
| 23                             | <i>Ulothrix variabilis</i> Kuetzing                                     | 0            | 0             | 0            | 0            | 3000          | 0            |
| 24                             | <i>Oedogonium</i> sp.   | 3000         | 0             | 0            | 0            | 0             | 1000         |
| 25                             | <i>Cosmarium undulatum</i> Corda var. <i>crenulatum</i> (Nag.) Wittrock | 1000         | 1000          | 1000         | 1000         | 1000          | 1000         |
| <b>Chlorophyceae total</b>     |   | <b>24500</b> | <b>35000</b>  | <b>8000</b>  | <b>6000</b>  | <b>77500</b>  | <b>26000</b> |
| <b>Euglenophyceae</b>          |   |              |               |              |              |               |              |
| 26                             | <i>Euglena</i> sp.  | 0            | 0             | 0            | 1500         | 1500          | 1000         |
| <b>Bacillariophyceae</b>       |   |              |               |              |              |               |              |
| 27                             | <i>Melosira granulata</i> (Ehr.) Ralfs                                  | 0            | 1500          | 0            | 0            | 0             | 0            |
| 28                             | <i>Cyclotella meneghiniana</i> Kutz.                                    | 300          | 750           | 2500         | 3000         | 4500          | 5000         |
| 29                             | <i>Fragilaria intermedia</i> Grun.var. <i>robusta</i> var. nov.         | 0            | 0             | 0            | 2000         | 0             | 0            |
| 30                             | <i>Synedra ulna</i> (Nitzsch) Ehr.                                      | 1000         | 1000          | 1000         | 500          | 0             | 1000         |
| 31                             | <i>Pleurosigma angulatum</i> (Quekett) W.Smith                          | 0            | 0             | 500          | 0            | 0             | 0            |
| 32                             | <i>Navicula cuspidata</i> Kutz.var. <i>ambigua</i> (Ehr.)               | 2500         | 500           | 2500         | 2500         | 0             | 2500         |
| 33                             | <i>Pinnularia interrupta</i> W.Smith f. <i>subcapitata</i> Fritsch      | 1500         | 500           | 500          | 1000         | 1000          | 1000         |
| 34                             | <i>Gomphonema lanceolatum</i> Ehr.                                      | 0            | 0             | 4500         | 1500         | 2000          | 2500         |
| 35                             | <i>Nitzschia obtusa</i> W.Smith var. <i>scalpelliformis</i>             | 1000         | 2500          | 1000         | 1000         | 500           | 1000         |
| 36                             | <i>Hantzschia amphioxys</i> (Ehr.)Grun.var. <i>vivax</i> (Hantz.)Grun.  | 500          | 2000          | 1500         | 500          | 1000          | 0            |
| <b>Bacillariophyceae Total</b> |   | <b>6800</b>  | <b>8750</b>   | <b>14000</b> | <b>12000</b> | <b>9000</b>   | <b>13000</b> |

Table 5

Pollution diversity index of Boyd (1981) for Thiruneermalai temple tank  
April to Sep 2007

| Month and Year | Number of Species (S) | S-1 | Total number of individuals (N) | ln(N)     | Boyd's index $H = \frac{S-1}{\ln(N)}$ | Order of Pollution  |
|----------------|-----------------------|-----|---------------------------------|-----------|---------------------------------------|---------------------|
| April 2007     | 39                    | 38  | 114300                          | 11.646582 | 3.26                                  | Moderately polluted |
| May 2007       | 31                    | 30  | 226250                          | 12.329396 | 2.43                                  | Moderately polluted |
| June 2007      | 32                    | 31  | 64500                           | 11.074421 | 2.80                                  | Moderately polluted |
| July 2007      | 33                    | 32  | 105200                          | 11.563619 | 2.77                                  | Moderately polluted |
| August 2007    | 34                    | 33  | 196000                          | 12.18587  | 2.71                                  | Moderately polluted |
| September 2007 | 45                    | 44  | 77000                           | 11.251561 | 3.91                                  | Moderately polluted |

**Legend**

4 - Clean water

3-2 Moderately polluted

Less than 1 - Heavily polluted

Table 6

Nygaard's phytoplankton quotients and water quality-criteria for indicating oligotrophic / eutrophic state April to September 2007

| Sl. no | Index          | April | May    | June  | July   | August | September |
|--------|----------------|-------|--------|-------|--------|--------|-----------|
|        |                | 2007  | 2007   | 2007  | 2007   | 2007   | 2007      |
| 1      | Myxophyceae    | 84    | 183.5  | 43.5  | 86.7   | 109    | 38        |
| 2      | Chlorophyceae  | 23.5  | 34     | 7     | 5      | 76.5   | 25        |
| 3      | Diatom         | 0.046 | 0.346  | 0.217 | 0.333  | 1.000  | 0.625     |
| 4      | Euglenophyceae | 0     | 0      | 0     | 0.0164 | 0.0081 | 0.0159    |
| 5      | Compound       | 107.8 | 219.75 | 53    | 96.2   | 191.5  | 69        |

**Conclusion**

Eutrophication generally leads to increase in algal population as there would be enrichment of nutrient in water and their enrichment could either be organic or inorganic enrichment. Improper maintenance of the pond must lead to this state. It is suggested that the culture studies of temple ponds is very essential as it may result in the discovery of many new taxa in these water bodies.

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