

**DIVERSITY OF PLANKTONIC ALGAE OF SELECTED TEMPLE PONDS OF MAHE
(U.T. OF PUDUCHERRY), INDIA**

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ABSTRACT

A study was conducted to analyse the diversity of algal components of selected temple ponds of Mahe. Three representative ponds were selected from the three geographic locations of Mahe, viz. Mahe proper, Palloor and Pandakkal. 41 algal species were identified and Chlorophyceae was the dominant group in all the three ponds. The scanty prevalence of Cyanophyceae showed that there was no much pollution in these ponds.

KEY WORDS: diversity, Planktonic algae, temple ponds, water pollution

INTRODUCTION

Indigenous fresh water systems are the hot spot of diverse and rare algal components as a result of varying micro habitats. Diversity in these localities is determined by habitat modification, harvest of native species and accidental introduction of exotic species. Algae, the principle primary producers, are photosynthetic thallophytes, usually microscopic, unicellular, and colonial or multi cellular organisms which perform the maximum quantum of photosynthetic activity than any living organisms in this world. Many forms spread throughout the water body and cause turbidity of water and algal blooms. Ponds are the part of the lentic systems which also include pools, puddles, reservoirs, lakes and paddy fields. The ponds may contain different types of phyco components like free floating (planktons), benthos (attached to sediments), epiphytic (attached to plants and other objects) etc. The appearance of algae is most probably seasonal. Temple ponds are the inevitable part of the temples of Kerala and a holy dip is considered to be sacred and enough to wash off the accumulated sins. It is believed that bathing in sacred water cures the disease and ill feelings. They are also considered as protected areas and may be located either within the temple or outside. Northern Kerala has its unique temple construction methods and cultural patterns. The construction of temple and temple ponds is in harmony with available resources and climatic condition. Occasionally these ponds are polluted by discharge of domestic sewage, industrial effluents, agricultural run-off etc. Since there was no much study about the algal components of the temple ponds of Mahe region, this study has been conducted.

Mahe, Union Territory of Puducherry, is situated on the West Coast of the Indian Peninsula between 11° 42' and 11° 43' Northern Latitude and 75° 31' and 75° 33' Eastern Longitude, just between Vatakara and Thalassery, 65 kilometers from Kozhikode and 28 kilometers from Kannur in northern part of Kerala State. This former small French town, covering an area of 9 sq. Kilometers, is 650 kms away from its administrative Head Quarters, Puducherry. National Highway 17 (Mangalore – Edappally) and Mangalore-Shornur railway lines are passing through Mahe. The entire area, even though in three segments, is well connected through a network of paved roads.

The area enjoys tropical humid climate with summer from March to May and mild winter from December to February. The region receives South – West Monsoon (June to September), North – East Monsoon (October to December), winter rain (January to February) and summer rain (March – May). A review of the literature of Phycological studies of this region showed that only scanty information is available with Algae of Mahe even though its neighbouring areas in Kerala is well represented. M V N Panikkar is considered as the doyen in this field and he has studied most of the algal life forms of the state, especially that of Southern Kerala (1988). Girish kumar *et al.* (2010) have studied the algae associated with the rhizosphere of *Funaria hygrometrica* of Mahe region. Anand *et al.* (1987) have studied the Blue green algae in the rice fields of Kerala state. Sivadasan *et al.* (1995) have studied the benthic algae of Cochin estuary.

MATERIALS AND METHODS

Three representative temple ponds were selected based on the geographical location of Mahe. The three important locations in Mahe are Mahe proper, Palloor and Pandakkal. The selected pond from Mahe proper is Sree Krishna temple pond, Choodikkotta. The selected pond from Palloor is Koyyottu Puthanambalam temple pond and the selected pond from Pandakkal is Pandokkavu Ayyappa temple pond. The dimension of Sree Krishna temple pond is 7x7 metres and that of Koyyottu Puthanambalam temple is 9x8 metres and the area of Pandokkavu Ayappa temple is 4x3 metres. The pond at Mahe is situated nearly 9 metres away from the temple, pond at Palloor is about 10 metres away from the temple and the pond at Pandakkal is about 8 metres away from the temple. The ponds at Mahe and Palloor are more or less open receiving direct sun light and that of Pandakkal is situated in a shady condition. The pond at Mahe is of 8 feet depth and that of Palloor and Pandakkal are 13 feet depth at the centre. The pond at Mahe is more or less abandoned and not used for bathing. Other two temple ponds are still used for bathing and washing by local people.

The study was conducted from January to December, 2012 at the onset of summer season. Data were collected pertaining to the total number of temple ponds in Mahe and their locations and based on the study the three specified locations were selected. Physical features of the selected ponds were studied and with help of specific mesh net of size 10 micron, the algal components were filtered from the water. A sterilized bucket of 10 Litre volume was used and 20 buckets full of surface water from different locations of the ponds are filtered through the mesh net. The filtrate collected over the nylon cloth was immediately transferred to the sterilized sample bottle and sealed immediately along with the pond water. The bottled algal samples were centrifuged at 10000 rpm in a centrifuge and the upper centrifugate is discarded. The filtrate was sucked slowly with the help of dropper and kept on a neat sterilized glass slide and mounted in glycerin using cleaned cover slips. The photographs were taken and the dimensions of the algae were studied using micro meters. The algae were identified using pertinent standard algal keys like Desikachary (1958), Anand (1987), Fritsch (1945), Panikkar (1989), Prescott (1954) etc.

A part of the algal sample was cultured in Bold's Basal Medium. Three conical flasks of 500 ml volume were sterilized using autoclave and the algal samples were transferred into the sterilized conical flasks containing the culture medium in aseptic conditions of Laminar Air Flow. After 7 days the algae were filtered from the culture medium and brought under further taxonomic analysis.

RESULTS AND DISCUSSION

The analysis of water sample from the selected three locations showed the presence of following algal forms (**Table 1**)

IMPORTANT SALIENT FEATURES OF THE IDENTIFIED ALGAL SPECIES

(1) *Kirchneriella lunaris*: Colonies spherical to ellipsoid with a faint outer gelatinous envelope, 47.28-49.15 μm broad; cells 4 or 8, flattened, crescent shaped, strongly curved with pointed ends arranged irregularly, 8.56-13.43 μm long, 4.38-7.25 μm broad; chloroplast 1, nearly filling the cell; pyrenoid 1.

(2) *Scenedesmus bijuga*: Cells 2-4, arranged in a single row, cells oval to oblong, all similar in shape, rounded at both ends, compactly and lateral adjoined with smooth walls, cells 4-8 μm in diameter, 6-16 μm long

(3) *Chlorococcum humicola*: Cells spherical, 8.73-14.25 μm broad; wall smooth; cells of variable size; chloroplast parietal; completely filling; pyrenoid 1; multinucleate; contractile vacuoles absent; colonial mucilage thin and sometimes not evident.

(4) *Pinnularia viridis*: Valves linear; elliptic with tapering rounded ends, 94.15-97.95 μm long, 17.23- 21.62 μm broad raphe thick; axial area narrow, linear; central area rhomboid; striae slightly radial in middle and convergent at ends; 10-12 in 10 μm

(5) *Pediastrum boryanum*: Colonies circular to slightly oval, compact of 16 or 32 cells, 60.39- 82.9 μm broad; cells, 12.97-14.63 μm broad, with 10 cells in outer ring, 5 in innerside and 1 in centre or 15 cells in outer ring, 16 in inner side and 1 in centre, without intercellular space; inner cells polygonal with straight sides; marginal cells with two short spines in outer face, 4.31-6.25 μm long; wall smooth; chloroplast parietal; pyrenoids 4-6; multinucleate

- (6) *Pediastrum muticum*: Colonies circular to slightly oval or compact ;colonies 16 celled flat rounded without perforations, 40.72-47.49 μm broad; inner cells 4.23-5.89 μm long, 7.21-7.88 μm broad; outer face of peripheral cells straight or slightly concave, 8.46-9.23 μm long, 4.56-5.19 μm broad; outer wall emarginated with two projections; cell wall smooth; pyrenoid present
- (7) *Zygnema pectinatum*: Chloroplasts 2, definitely star-shaped, each containing a large, central pyrenoid; aquatic, filaments form green clumps and floating mats, but not the large masses in the water, filaments unbranched, cells 16-50 μm in diameter and 2-3 times long as broad
- (8) *Ankistrodesmus spiralis*: Colonies 4-8 or more cells; cells acicular to narrow by fusiform with the ends tapering to acute apices , usually spirally twisted around one another in the mid region, but free at the ends, 22.54-30.16 μm long, 2.17-3.20 μm broad; chloroplast 1' parietal, pyrenoids absent
- (9) *Coleochaete pulvinata*: Thallus an epiphytic cushion of dichotomously or irregularly branched filaments radiating from a common central group of cells; cells 10-20 μm in width, 1-4 times as long as broad; antheridia bluntly conical, produced in small clusters, rarely single, usually distal to oogonia, 8-10 μm long and 5-6.5 μm broad at lower end
- (10) *Amphora ovalis*: Cell broad, oval, inflated in the median region, with two sub-orbicular apices; Raphe inflexed, bi- arcuate; central area distinct; ventral margin slightly concave; dorsal side convex; ventral side comprises row of short striae and dorsal side with indistinct longitudinal line
- (11) *Pithospora mooreana*: Filaments highly branched, 112.23-116.43 μm long, 53.34-61.92 μm broad; chloroplast parietal; nucleus 6-8; pyrenoids 4-6; akinetes brownish green; cylindrical with rounded end; terminal and inter calary, 121.29-135.49 μm long and 78.24-88.17 μm broad
- (12) *Oscillatoria princeps*: Trichomes blue-green; bent; not constricted at cross walls, 29.32-34.52 μm broad; apices slightly attenuated; cells 3.65-5.53 μm long, 0.19-0.25 μm broad; end cell capitate with or without thickened membrane
- (13) *Dimorphococcus lunatus*: Cells appearing both reniform (bean-shaped) and ovoid in the same colony. It is abundant in soft-water lakes, cells with the concave side facing the inner side of the colony; cells of variable size; gregarious, in or on soil; chloroplast covering almost the entire wall
- (14) *Scenedesms armatus*: Colonies flat; cells oblong, ellipsoid with ends rounded, arranged in single linear series, cells 2.5-305 μm broad, 8-10 μm long, terminal cells with single curved spine at each pole, 8.28-10.39 μm long; chloroplast parietal; pyrenoid 1
- (15) *Pandorina morum*: Colony spheroidal or oval; cells crowded, somewhat pyriform, with the broad ends all directed outwardly. The flagella extend from the broad anterior ends of the pyriform cells in a more or less parallel fashion at first and then flare widely as they emerge from the colonial sheath
- (16) *Scenedesmus quadricauda*: Colonies 2-4 celled, 37.32-43.72 μm long and 2.14-3.23 μm broad; cells oblong-cylindrical with rounded ends, arranged in single linear series and closely attached to one another along lateral walls, pole terminals with slightly curved spines ;cell wall smooth; chloroplast parietal; pyrenoid 1
- (17) *Cosmarium tenue*: Cells 14.78-17.49 μm long; 11.12-14.06 μm broad; margin entire; constriction deep; isthmus 3.51-4.44 μm broad; sinus linear; wall smooth; chloroplast axile; pyrenoids 2
- (18) *Navicula gracilis*: Cells elongate, lanceolate with acute apices, raphe straight; central nodule short; axial area narrow and indistinct; polar nodules small; valve surface striate; striae surface robust; reaching to the raphe; median ones scarcely radiant; striae 12 in 1
- (19) *Scytonema cincinnatum*: Stratum caespitose, intricate, woolly, olivaceous; to brownish green, 18-30 μm broad, 3cm or more long, crisp; false branches mostly germinate, sometimes very sparsely false- branched, hyaline, rarely brownish: trichome 14-30 μm broad, green or brownish violet, distinctly or very little constricted at the cross walls ; heterocyst depressed or quadrate , short cylindrical, or elliptical, single or many
- (20) *Stigonema mesentericum*: Filaments prostrate, dense with short protuberant branches, 25-35 μm broad, coralloid- like; sheath thick, firm, lamellated, yellow- brown; trichome with 2-4 or seldom with many rows of cells, cells in the older parts of the filament with a special envelope; heterocysts lateral or intercalary, hormogonia not known
- (21) *Spirogyra biochromatophora*: Filaments of vegetative cells cylindrical, 153.64-160.93 μm long, 57.12-60.56 μm broad; septa plane; chloroplasts 2 in each cell with 4-5 turns; conjugation scalariform; conjugation tube formed by both gametangia; fertile cells cylindrical, 154.87-162.84 μm broad; zygospores ellipsoid, mesospore wall smooth, brown

- (22) *Microcystis flos-aquae*: Colonies blue- green, spherical' ellipsoidal or elongate with diffluent colonial mucilage; clathrate arranged, 4.56-5.23µm broad; gas-vacuoles present
- (23) *Nitzschia frustulum*: Valves linear, tapering to sub-acute apices; in girdle view frustules bacilliform; keel marginal; margin convex, lanceolate with carnal dots, 18.24-21.63µm long, 3.78-4.25µm broad; ends rounded; keel eccentric; striae 20-22 in 10µm
- (24) *Fragilaria capucina*: Frustules rectangular, attached together to form chain; valves linear ,narrow towards ends ,18.26-129.47µm long ,3.13-4.27µm broad; ends slightly constructed pseudo raphae linear lanceolate; central area not formed ; striae 16-18in 10µm
- (25) *Nostoc carneum*: Thallus tuberculate, leathery and irregularly expanded gelatinous brown; filaments loosely controlled, flexuous; sheath hyaline trichemes, 3.28-3.92 µm broad; cells cylindrical, 5.16-6.47µm long, 4.14-5.26µm broad; spores ellipsoidal, episore smooth and hyaline
- (26) *Oscillatoria limosa*:Thallus dark blue –green to brown; trichome more or less straight, dull blue green,brown or olive green,not constricted at the cross walls, or only slightly constricted ,11-20 (-22)µ,commonly 13-16µ broad; cells 113-116 as long as broad, 2-5 µ long cross walls frequently granulated; end cell flatly rounded with slightly thickened membrane
- (27) *Spondylosium incurvatum*: Cells attached to form long chains, cells linearly-ovate; 12 µ broad and 28-30 µ in length; apices slightly flat; concave sides facing each other, mucilage pads thin, chloroplast diffused; nucleus single
- (28) *Triploceras gracile*: Cells of this placoderm desmid are highly ornate, possessing whorls of spines. They are practically cylindrical in general shape but have slightly enlarged, lobed and spine-bearing apices. Like many other desmids. Triploceras occurs in acid or soft waters
- (29) *Oedogonium globosum*: Cells cylindrical, 16-26 µm in diameter , 49-120µm long ; basal cell tapering towards hold –fast; swollen at upper end; apical cell bluntly rounded,macrandrous, dioecious, chloroplast parietal, nucleus 1,pyrenoids 4-7, basal cell elongated
- (30) *Lyngbya spiralis*: Filaments forming a thin leathery thallus blue green or bluish black , 3-6µ broad, entirely or for major part or at the ends spirally coiled; sheath get coloured violet by chlor-zinc-iodide, smooth, firm, not lamellated, colourless; trichome in living and pale blue-green not attenuated
- (31) *Stigonema ocellatum*: Thallus cushion like, caespitose, wooly or tomentose, brownish; filaments prostrate or partly erect,about 3-8mm high,35-40µ broad,irregularly branched; branches as broad as or smaller than the main filament, at the ends with hormogones; sheath thick,mostly distintly lamellated,mostly yellow to brown,sometimes colorless in the young portions at the ends of filaments; cells in a single row or in two rows, often wider than long, 18-30µ broad ,with a colorless or brown individual envelopes; heterocysts mostly lateral,sparse; hormogones 50-65µ long and about 15µ broad
- (32) *Johannesbaptista pellucid*: Filaments blue- green or olivaceous, straight or curved, about 2.5mm long, cells discoid or sphaerico-discoid, round at the apex of the filaments, arranged in a single series, in a cylindrical hyaline mucilage, homogenous or granular
- (33) *Mougeotia recurva*: Vegetative cells cylindrical,151.17-179.21 µ long, 14.63-17.28 µ broad, chloroplast 1, axial plate, pyrenoids 5-7;arranged in series, scalariform conjugation, zygosporer globose; formed in conjugation tube, aplanospores globose, 25.15-29.26 µ broad
- (34) *Pleurotaenium trabecula*: Semi cell has half the cell wall undulate, slightly tapering towards the pole, cells cylindrical, 468.17-556.75 µ long,20.0-25.6 µ broad, semi cells with one basal inflation, lateral margins straight;apices rounded,tubercles absent;wall punctuate,chloroplast band shaped; pyrenoids 15-18
- (35) *Closterium rostratum*: Cells sickle shaped, strongly curved, apices bluntly pointed; 120.9-126.18 µ long, 13.15-21.00 µ broad; outer margin 125-130° arc, middle portion not tumid, wall smooth; chloroplasts 5-6 ridges; pyrenoids 7-8, in axial row; zygosporer rounded, smooth walled, 45.0-58.0 µ in diameter
- (36) *Ulothrix variabilis*: Cells quadrate to long-cylindric; chloroplast a broad, parietal band covering most of the cell wall, or a median band completely encircling the cell; without a wide gelatinous sheath; pyrenoids 6-7; cells 14.63-15.47 µ long and 4.56-6.18 µ broad
- (37) *Botryococcus protuberans*: Cells ovoid or cuneate, compactly arranged in semi-opaque mucilage which is brown or yellow and so obscures the cells; colonies frequently compounded by inter connecting strands of tough mucilage between clusters of cells
- (38) *Spirulina major*: Trichomes loosely or tightly coiled; cross wall between cells not clear; sheath absent; apex not attenuated; terminal cell rounded; calyptra absent, reproduction by fragmentation

(39) *Microspora amoena*: Filaments unbranched; cells cylindrical, slightly constricted at cross walls, 41.56-46.39 μ long; 22.49-24.13 μ broad, cell wall thick, 'H' shaped structure not prominent in the mid-region, lamellation absent; chloroplast parietal and perforated; completely covering the cell wall

(40) *Coscinodiscus sublineatus*: Frustules discoid, radially symmetrical; 9.38-12.47 μ broad; valve surface areolated, hexagonal, arranged tangential series, 11-12 in 10 μ ; margin striated; striae thin short radiating towards centre, 14-15 in 10 μ

(41) *Frustulia lewisiana*: Cells colonized in mucilage secretion; valves broadly clavate; central nodules about 7 μ and terminal nodules about 13-14 μ in length, siliceous ribs elevated on both sides of raphe, striae on the valves parallel, 24-30 in 10 μ ; striae at the apices parallel.

Table-1. List of Algae present in selected Temple ponds in Mahe

Sl. No.	SCIENTIFIC NAME	CLASS	STATION I MAHE PROPER	STATION II PALLOOR	STATION III PANDAKKAL
1.	<i>Kirchneriella lunaris</i>	Chlorophyceae	+	+	-
2	<i>Scenedesmus bijuga</i>	Chlorophyceae	+	-	-
3	<i>Chlorococum humicola</i>	Chlorophyceae	+	+	-
4	<i>Pinnularia borealis</i>	Bacillariophyceae	+	+	-
5	<i>Pediastrum boryanum</i>	Chlorophyceae	+	-	-
6	<i>Pediastrum muticum</i>	Chlorophyceae	+	-	-
7	<i>Zygnema pectinatum</i>	Chlorophyceae	+	-	+
8	<i>Ankistrodesmus spiralis</i>	Chlorophyceae	+	-	-
9	<i>Coleochaete pulvinata</i>	Chlorophyceae	+	-	-
10	<i>Amphora ovalis</i>	Bacillariophyceae	+	-	-
11	<i>Pithospora mooreana</i>	Chlorophyceae	+	-	-
12	<i>Oscillatoria princeps</i>	Cyanophyceae	+	-	-
13	<i>Dimorphococcus lunatus</i>	Chlorophyceae	-	+	+
14	<i>Scenedesmus armatus</i>	Chlorophyceae	-	+	-
15	<i>Pandorina morum</i>	Chlorophyceae	-	+	-
16	<i>Scenedesmus quadricauda</i>	Chlorophyceae	-	+	-
17	<i>Cosmarium tenui</i>	Chlorophyceae	-	+	-
18	<i>Navicula gracilis</i>	Bacillariophyceae	-	+	-
19	<i>Scytonema cincinnatum</i>	Cyanophyceae	-	+	-
20	<i>Stigonema mesentericum</i>	Cyanophyceae	-	+	-
21	<i>Spirogyra bichromatophora</i>	Chlorophyceae	-	+	-
22	<i>Microcystis flos-aquae</i>	Cyanophyceae	-	+	-
23	<i>Nitzschia frustulum</i>	Bacillariophyceae	-	+	-
24	<i>Fragilaria capucina</i>	Bacillariophyceae	-	+	-
25	<i>Nostoc carneum</i>	Cyanophyceae	-	+	-
26	<i>Oscillatoria limosa</i>	Cyanophyceae	-	+	+
27	<i>Spondylosium incurvatum</i>	Chlorophyceae	-	-	+
28	<i>Triploceras gracile</i>	Chlorophyceae	-	-	+
29	<i>Oedogonium globosum</i>	Chlorophyceae	-	-	+
30	<i>Lyngbya spiralis</i>	Cyanophyceae	-	-	+
31	<i>Stigonema ocellatum</i>	Cyanophyceae	-	-	+
32	<i>Johannesbaptista pellucida</i>	Cyanophyceae	-	-	+
33	<i>Mougeotia recurva</i>	Chlorophyceae	-	-	+
34	<i>Pleurotaenium trabecula</i>	Chlorophyceae	-	-	+
35	<i>Closterium rostratum</i>	Chlorophyceae	-	-	+
36	<i>Ulothrix variabilis</i>	Chlorophyceae	-	-	+
37	<i>Botryococcus protuberans</i>	Chlorophyceae	-	-	+
38	<i>Spirulina major</i>	Cyanophyceae	-	-	+
39	<i>Microspora amoena</i>	Chlorophyceae	-	-	+
40	<i>Coscinodiscus sublineatus</i>	Bacillariophyceae	-	-	+
41	<i>Frustulia lewisiana</i>	Bacillariophyceae	-	-	+

The study of the diversity of algae showed the presence of 41 algae altogether with Pandakkal pond showing maximum number (18) followed by Palloor pond with 17 and the least number was found in the Mahe proper pond (12). A few members are represented by both stations and no algal species was found common in all the three stations. The Mahe proper pond showed 1 Cyanophyceae, 10 Chlorophyceae and 1 Bacillariophyceae member. The Palloor pond showed 5 Cyanophyceae, 8 Chlorophyceae and 4 Bacillariophyceae members. The Pandakkal pond showed 5 Cyanophyceae, 11 Chlorophyceae and 2 Bacillariophyceae members. It is very much clear that Chlorophyceae was the most dominant class of Algae in all the three stations. This finding has substantiated the study by Gaunker and Kerkar (2004), who reported maximum number of chlorophyta in the temple ponds of Goa. Murugan (2008) has reported the same in the temple tanks of Kanchipuram. Less number of Cyanophyceae and Bacillariophyceae in all the 3 stations indicated that serious pollution has not happened in the selected sites.

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