Phycological Diversity of Temple Ponds from Pullur, Kasaragod District

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Abstract : The two ponds under investigation were associated with *Pullur Sree Vishnumoorthi temple* of Kasaragod district. The algal diversity and the physico-chemical parameters of the ponds were studied. The algal samples were collected by using plankton net from different parts for representing the whole pond. After a thorough microscopic investigation, the algae were identified with the help of standard literature. The taxonomic key was prepared based on morphological characteristics. Some important physico-chemical parameters were investigated according to standard procedure. Both ponds under investigation showed rich algal diversity and the water parameters showed slight variation. The study revealed 45 algal taxa belonging to groups such as *Chlorophyceae*, *Chrysophyceae*, *Bacillariophyceae*, *Dinophyceae* and *Myxophyceae*.

IndexTerms -Temple pond, algal diversity, key, physico-chemical parameters, post monsoon.

I. INTRODUCTION

Temple ponds are semi-natural ponds seen associated to majority of the Hindu temples in districts of Kerala. Among them some temples have more than one associated ponds. The use was different associated to the practices of the temple. The present study aims to investigate the features such as algal diversity and physico-chemical parameters of nearby located temple ponds. Anuja and Chandra (2012) suggested that the culture studies of temple ponds are very essential as it may result in the discovery of many new taxa in these water bodies. The study on ponds having significance in this scenario as pond can act as reservoir of water for future generations. The algae play an important role in maintaining aquatic ecosystem and form the base of food web. The diversity of algae depends on a variety of environmental factors in which the physico-chemical parameters play a significant role (Palanivel and Uma Rani, 2016).

II. RESEARCH METHODOLOGY

1.1. Study area

Sree Vishnu moorthi temple(Latitude 12.355134 & Longitude 75.092393) near pullur- veleswaram road on Pullur village, North-east of Hosdurg which is 4.1km away from Kanhangad town. Both ponds were larger enough and having open use. Ponds, one at northern side of temple (PMV NP) and another at eastern entrance (PMV EP) having size about 575±5 and 555±5 square meters respectively(Fig.1).

Fig.1 showing satellite image of ponds under study.

1.2. Algal sample collection

Samples were collected after the south-west monsoon season (post-monsoon). Algal samples were collected by using phytoplankton net. Samples collected from different parts of the pond (sub-samples) mixed together in 100ml transparent plastic containers and preserved. Through Microscopic investigation morphological key prepared. Identification of algae was done with the help of authenticated literatures such as Prescott (1964), Jose John and Francis (2013), Bellinger and David Singee (2010). Classification system followed was by Fritsh (1935).

1.3. Physico-chemical parameters

The physico-chemical parameters are to be estimated as described in the 'standard methods' (APHA, 1998).

III. RESULT AND DISCUSSION

Analysis of algal diversity of this two nearby located ponds resulted in identification of many freshwater algal taxa. The taxonomic key was prepared based on morphological characteristics (morphological key), which helps in the easy identification of algal taxa present in these two ponds.

3.1. Key to identification of algae

Based on preliminary observation the algae were categorized into different classes and then prepared dichotomous key based on readily identifiable morphological features.

I) Thallus unicellular motile to heterotrichous filaments, green algae.....**Class: Chlorohyceae**

1a) Cells grouped into filaments ……..…… **(2)**
1b) Cells not grouped into filament ...… ……..…… **(7)**

2a) Filaments branched ……..…….... **(3)**
2b) Filaments unbranched ……...…….... **(4)**

3a) Cells somewhat broader at the top than the base, characteristic colourless terminal hair with a swollen base (chaetae) arising from the top of the cell …...…… ***Bulbochaete***
3b) Cell quadrate to cylindrical, irregularly branched filaments to forms a cushion or disc ……..… ***Protoderma***

4a) Cells with a median constriction (isthmus) between semi cells, cells oval in shape, arranged in single row and connected to adjoining cells by flat apical face of the cells .....…… ***Desmidium***
4b) Cells without median construction…….... **(5)**

5a) Filament free floating……..……. **(6)**
5b) Filament attached with holdfast, cells rectangular longer than broad, slightly larger at anterior end, presence of transverse ring like scar (cap cells) ……..……...***Oedogonium***

6a) Cells quadrate with thick cell wall, end cells usually have characteristic H-shaped end…….…….. ***Microspora***
6b) Cells rectangular, longer than broad, chloroplast lengthwise sheet, distinct cell wall connection ….. ***Mougeotia***

7a) Thallus colonial …..……..……..… **(8)**
7b) Thallus solitary ……..……..……..….. **(15)**

8a) Individual cells clustered in colony, cells connected together……..…. ……..… **(9)**
8b) Individual cells clustered in colony, but cells not connected ……...……..... **(12)**

9a) Connected cells form flat shape..… …….. **(10)**
9b) Connected cells form spherical shape ……..……..…. **(11)**

10a) Cells forming circular plates, the marginal cells different in shape from those within …….…..….... ***Pediastrum***
10b) Cells forming filamentous by attaching side by side, usually contain four or multiple of four cells …… ***Scenedesmus***

11a) Colony covered with mucilage which extends beyond the cells at the edge, colony densely packed cells, and individual cells have flattened sides where they touch their neighbor cells, flagellate …..……. ***Pandorina***
11b) Colony covered with thin layer mucilage, hollow and many sided, closely joined cells arranged in a regular sphere ……..… ***Coelastrum***

12a) Arrangement of cells irregularly.. …….. **(13)**
12b) Arrangement of cells in a rectilinear series, are spherical to oval cells as groups of four, forming a plate of one cell thickness …….. ***Merismopedia***

13a) Cells enclosed in mucilage ……..... **(14)**
13b) Cells not enclosed in mucilage, slightly curved cells, loosely entangled about one another …... ***Ankistrodesmus***

14a) Shape of cells crescent, the ends almost touch although, arranged in small mucilaginous colonies……..... ***Kirchneriella***
14b) Shape of cells spherical and usually in groups of 4–8–16 surrounded by stratified or lamellate mucilage but may be solitary …… ***Glacocystis***

15a) Unicellular, Semicells present ...……..... **(16)**
15b) Unicellular, Semicells absent ... ……..…. **(20)**

16a) Semi cells with spines……...……...…. **(17)**

16b) Semi cells without spine…..……...…..… **(19)**

17a) The each semi cells processes less number of spines……..…….…… **(18)**

17b) The each semi cells with more number of spines as whorls of protuberance which bearing spines, poles of the cell forked…….....… ***Triplocerus***

18a) Cells with each semi cells with two opposing spines in ….……..….... ***Staurodesmus***

18b) Cells with each semi cells with three radiating arms which ends in two spine ……...…...…...… ***Staurastrum***

19a) Cells elongated, blunt ends, ring like thickening in the central area where semi cells join…..….. ***Pleurotaenium***

19b) Cells broad as long ……..…..……..... **(20)**

20a) Outline circular or rectangular, semi cells joined by clear isthmus, having prominent chloroplast, cell wall may be smooth or decorated by granules, teeth or scorbiculations ……..… ***Cosmarium***

This genus posses four species in the sampling site, in which (A) ***C. contractum* Krichner** is broad ellipsoid laterally circular with smoth cell wall, size 28 µm length,19 µm width and 6 µm wide isthmus (B) ***C. monoliformae* Ralf** ellipsoid laterally circular, cell wall dotted, size 30 µm length,23 µm width and 12 µm wide isthmus (C) ***C. angulosum Brebisson*** semi cells quadrate margin of the cell with small toothed decoration, size 31 µm length,22 µm width and 14 µm wide isthmus (D) ***C. margaritatum* (Lund)Roy** shape sub-rectangular, basal angle rounded, lateral margin convex, cell wall decorated by regular granules, size 79 µm length, 80 µm width and 24 µm wide isthmus.

20b) Outline angular, semi cells joined by isthmus, distinct apical and broader lateral lobes……...…….... ***Eustrum***

21a) Shape of cell lunate, cells many time longer than broad ……...… ***Closteriopsis***
21b) Shape of cell spherical, non-flagellate green unicells ……..…….. ***Chlorococcum***

II) Thallus unicellular motile to branched filamentous, golden brown algae, presence of a siliceous cyst ..... **Class: Chrysophyceae**

1a) Colonial, cells surrounded by a flask-shaped, branched or dendroid lorica emerging from the open neck of the old, cells within each lorica are biflagellate or cells may be naked..... ***Dinobryon***
1b) Colonial, the cells pear-shaped, covered with fine silica scales, closely packed into colony ……..... ***Synura***

III) Cells with a siliceous wall, unicellular or colonial, occur in two forms centrales and pennales, cell wall containing silica ……**Class: Bacillariophyceae**

1a) Cells arranged into filaments ……..…… **(2)**
1b) Cells usually solitary ……..…… **(4)**

2a) Filaments formed by central diatom, circular in valve view, cells joined together to form a continuous filament longer than wide, cell walls punctuated …….. ***Melosira***
2b) Filaments formed by pennales diatom ……..…….. **(3)**

3a) Rectangular cells joined by their valve faces to form a ribbon-like chain rectangular in girdle view..... ***Fragilaria***
3b) Rectangular or tabular in normal view, sometimes united to form zig-zag chain, also seen group of four cells, internal septa clearly visible ……..……..……..…… ***Tabellaria***

4a) Shape of cells elongate, linear .... ……..……..……..… **(5)**
4b) Shape of cells broadly elliptic or oval, incompletely septate ……..……..…..…. ***Cocconeis***

5a) Cells bilaterally Symmetric ……..……..……..... **(6)**

5b) Cells non symmetric ……..……..……..……..… **(8)**

6a) Individual cell with mucilage stalks, which helps in attachment to substrate, wedge shaped with a an enlarged head at the opposite end of the stalk ……..……..……..... ***Gomphonema***

6b) Individual cell without mucilage stalk ……..……..…. **(7)**

7a) Valves symmetrical in both views ……..……..……..… **(8)**

7b) Valves asymmetrical …..……..……..……..…… **(10)**

8a) Shape of Valves lanceolate cell ……..……..……..… **(9)**

8b) Shape of Valves elongate elliptical Axial field usually broad, with relatively pronounced "costae" (thickened silica rows), relatively large pennate diatom ……..……..……..... ***Pinnularia***

9a) Axial field narrow sometimes wide gradually or suddenly stauros shaped structure, transversely symmetrical, distinct central and polar nodules, curved terminal fissure……..……..…….. ***Stauroneis***

9b) Axial field usually narrow and linear, transverse ornamentation composed of puncta(dot like), genus include many freshwater species of varying shape and size, some aggregate within mucilage ……..…… ***Navicula***

10a) Opposing valves with more or less parallel sides……..…….. **(11)**

10b) Opposing valves not parallel, shapes of sides not similar, solitary or rarely fused, girdle view rectangular or curved particularly at centre……..……..……..….. ***Achanthes***

11a) Frustules 'S' shaped or sigmoid, in valve view the cells are linear and curve to a rounded point at each end opposite of each other, the raphe is generally in the middle of the cell with a central nodule … ……... ***Gyrostigma***

11b) Frustules bend or curved in the apex, wavy or undulate on one margin as seen in valve view, transversely striate, no central nodules …… ……..……..……..…… ***Enotia***

IV) Mostly unicellular flagellates, cells surrounded by a complex theca ..... **Class: Dinophyceae**

Cells round in shape, thin evident cell plates, a transverse furrow completely encircling the cell…….. ***Peridinium***

V) Thallus unicellular motile to branched filamentous, blue green algae, cells prokaryotic……**Class: Myxophyceae**
1a) Thallus filamentous ……..……..……..…….. **(3)**
1b) Thallus colonial ……..……..……..……... **(2)**

2a) Colony globular amorphous, circular cells spaced out within the mucilage …..…… ***Aphanocapsa***
2b) Colony formed by aggregate of cell in irregular spherical to more or less polygonal, sarcinoid shape……..……..……..……..…… ***Myxosarcina***

3a) Trichomes branched, mucilaginous sheath often stained yellow brown in colour, the main axis multiseriate with the side branch uniseriate ……..……..……..……. ***Stigonema***
3b) Trichome unbranched, ……..……..……..…. **(4)**

4a) Cells of trichome similar size……..……..……..…..... **(5)**
4b) Cells of trichome tapering to a fine point, basal heterocysts and an akinete immediately above, spherical colonies of radiating trichomes ……..……..……..... ***Gloeotrichia***

5a) Mucilage present are extensive firm around filament, the cells are spherical to barrel shaped……..….. ***Nostoc***
5b) Mucilage absent, the individual cells are rectangular broad……..……..… ***Oscillatoria***

3.2. Distribution of algal diversity

Distribution of freshwater algae in each pond was evaluated and identified as one pond (PMV EP) showing higher algal diversity than the other (PMV NP). The total algal diversity of temple ponds of *Pullur Sree Vishnumoorthi temple is* 42 genus in which *Cosmarium* is having 4 species which were ***C. contractum* Krichner**, ***C. monoliformae* Ralf**, ***C. angulosum* Brebisson**, ***C. margaritatum* (Lund) Roy.** The two sampling sites were situated only 20 Meter apart, and having this much differences in algal diversity.

Table1 showing distribution of algal diversity

Class	Taxa	Distribution	
		Pond 1:PMV NP*	Pond 2:PMV EP*
Chlorophyceae	1 ***Bulbochaete***	-	+
	2 ***Protoderma***	-	+
	3 ***Desmidium***	-	+
	4 ***Oedogonium***	-	+
	5.***Microspora***	+	+
	6.***Mougeotia***	-	+
	7 ***Merismopedia***	-	+
	8 ***Ankistrodesmus***	-	+
	9 ***Kirchneriella***	-	+
	10 ***Glaucocystis***	+	-
	11 ***Pediastrum***	+	-
	12 ***Scenedesmus***	+	+
	13 ***Pandorina***	-	+
	14 ***Coelastrum***	-	+
	15 ***Staurastrum***	-	+
	16 ***Staurodesmus***	-	+
	17 ***Triplocerus***	-	+
	18 ***Pleurotaenium***	+	-
	19 ***Cosmarium contractum***	-	+
	20 ***C. monoliformae***	-	+
	21 ***C. angulosum***	+	+
	22 ***C. margaritatum***	+	+
	23 ***Euastrum***	-	+
	24 ***Closteriopsis***	-	+
	25 ***Chlorococcum***	+	+
Chrysophyceae	1 ***Dinobryon***	+	-
	2 ***Synura***	-	+
Bacillariophyceae	1 ***Melosira***	+	-

	2 ***Fragilaria***	+	+
	3 ***Tabellaria***	+	+
	4 ***Cocconeis***	-	+
	5 ***Gomphonema***	-	+
	6 ***Pinnularia***	+	+
	7 ***Stauroneis***	-	+
	8 ***Navicula***	+	+
	9 ***Achanthes***	-	+
	10 ***Gyrostigma***	-	+
	11 ***Eunotia***	-	+
Dinophyceae	1 ***Peridinium***	-	+
Myxophyceae	1 ***Stigonema***	+	-
	2 ***Nostoc***	+	-
	3 ***Gloeotrichia***	+	-
	4 ***Oscillatoria***	-	+
	5 ***Aphanocapsa***	-	+
	6 ***Myxosarcina***	-	+
Total	**45**	**17**	**37**

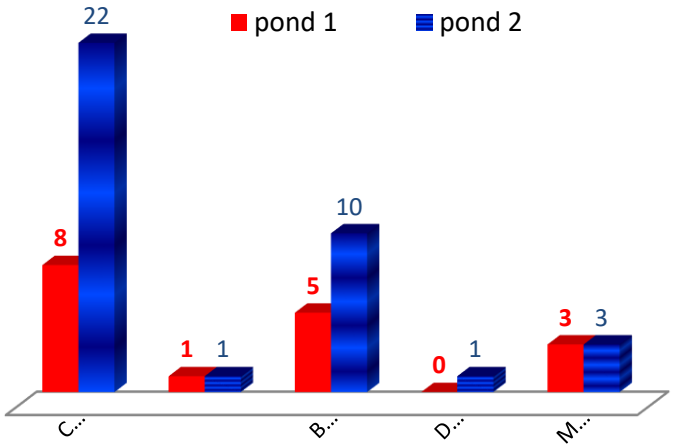

Figure2 showing algal diversity in each class

In both ponds algal diversity is dominated by members of class Chlorophyceae. The greater proportion among chlorophyceae inhabitants were desmids (10 algae), which belongs to the non filamentous green algae, constitute the family Desmidiaceae of the order Conjugales. Higher algal diversity observed in PMV EP (37 algae) while comparing to other PMV NP (17 algae). Only 9 algae were common in both ponds, others are specifically located to each pond.

3.3. Physico- chemical parameters

For identification of water quality status analysis of some important physical and chemical parameters are essential. Although hese ponds are very nearly located there were variations in the result of parameters.

Table 2 showing physico-chemical parameters of ponds

Parameters			Pond1: PMV NP*	Pond2: PMV EP*
Physical parameters	1	Appearence	Greenish	Greenish
	2	Odour	None	None
	3	Temperature	32.20	32.00
	4	Seechi disc transparency(cm)	78.5	194.5
	5	Electrical Conductivity(µS/cm)	70	60
	6	Total Dissolved Solids (ppm)	40	40
Chemical parameters	1	pH	5.8	5.8
	2	Salinity (ppt)	0	0
	3	Alkalinity(mg/l)	9	9
	4	Total hardness(mg/l)	10	14
	5	Ca hardness(mg/l)	5	5
	6	Mg hardness(mg/l)	1.22	2.2
	7	Chloride(mg/l)	7.8	9.93
	8	Phosphate (mg/l)	252.5	147.5
	9	Sulfate(mg/l)	1.5	0.25
	10	Nitrate (mg/l)	37.5	35
	11	Dissolved oxygen(ppm)	10.56	8.83
	12	Sodium(mg/l)	12.1	11.3
	13	Potassium(mg/l)	1.6	1.6

Physical parameters water temperature only slight variation and TDS showing same reading in both ponds. Seechi disc transparency is higher in PMV EP*, but the electrical conductivity is higher in the other pond PMV NP*. In case of chemical parameters pH, salinity, alkalinity, Ca hardness and potassium concentration are same in both sampling site.

IV. CONCLUSION

Total of 45 algae identified, among them only 9 algae were present in both ponds. Major algal groups include *chlorophyceae, chrysophyceae, bacillariophyceae, dinphyceae* and *myxophyceae.* Higher algal diversity observed in PMV EP (37 algae). These closely located ponds showing differences in algal diversity. Among studied 19 parameters, 10 parameters showed variation. Both the ponds were used for recreational activities but PMV EP, used mainly for temple related activities.

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