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A Preliminary Study on the Algal Diversity of Selected Indigenous Ponds in Kannur, Kerala, India

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Abstract: ***Kannur district in Kerala state of India was famous for large number of traditional ponds associated with temples. This study has been undertaken to investigate the diversity of algae in freshwater pond ecosystems associated with the traditional ponds of two famous temples from Irikkur block (Thaliparamba taluk) of Kannur district of Kerala state in India. Sample collection was done in post monsoon and pre monsoon seasons in 2018-2019. Both ponds under investigation showed rich algal diversity and the water parameters showed slight variation. The study revealed 27 algal taxa belonging to groups such as Chlorophyceae, Bacillariophyceae, Dinophyceae and Myxophyceae.***

Keywords: pond, algal diversity, physico-chemical parameters

1. Introduction

Ponds are small fresh water ecosystems. Two artificially constructed but having much historical significant temple ponds were selected for the present study. For artificial pond, walls are built above or around the ground level, the retaining wall prevent the flow of surface water into the pond, otherwise surface water from land may flow into the pond after the rains. 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. According to Welch (1952) "ponds are very shallow bodies of quite standing water in which extensive occupancy by higher aquatic plant is a common characteristics''. This study was an attempt to know the algal diversity of such an important aquatic ecosystems namely ponds, associated with the two famous temples from Irikkur block (Thaliparamba taluk) of Kannur district. The microalgal population was enormous in ponds. Algae, the principle primary producers, are photosynthetic thallophytes, usually microscopic, unicellular and colonial or multicellular organisms which perform the maximum quantum of photosynthetic activity than any other living organisms in this world. Many forms spread throughout the water body and cause turbidity of water and algal blooms. The appearance of algae is most probably seasonal. Ponds usually associated with the centers of worship, such as temples having much significance in cultural, aesthetic and diversity aspects. The construction of temple and temple ponds is in harmony with available resources and climatic condition. The aquatic life may vary according to water parameters. Those properties can be physical chemical or biological. Occasionally these ponds were polluted by discharge of domestic sewage, industrial effluents, agricultural run-off *etc*.

2. Research Methodology

The diversity of aquatic algal groups and water parameters vary seasonally. The level of contamination is higher during pre-monsoon than post-monsoon, primarily due to water scarcity (Kannan and Joseph, 2009). For comparing the diversity in two ponds, data about some important physicochemical parameters are essential. Changes in algal flora distribution depended on local environment, size of pond, usage and water quality.

3. Study Area

Two ponds of Irikkur block, *Velam Sree Maha Ganapathi* temple and *Mamanikkunnu* temple were selected for the present study. Apart from serving as water harvesting device these ponds were found to facilitate the growth of a wide variety of algae. The two ponds selected were from two entirely different in size and architecture. Pond associated with *Velam Sree Maha Ganapathi* temple was well constructed. The water observed as green by microscopic algae. Renovation process is taking place in the *Velam Ganapathi* temple, where as in the case of *Mamanikkunnu* temple had no renovation for the last 5 years, only cleaning process were conducted. Thick films of filamentous algal bloom were observed here.

The *Velam Sree Maha Ganapathi* temple was one of the famous temples dedicated to lord Ganesha in the Malabar region. It was located in the Kayaralam Village, Mayyil in the district of Kannur. *Velam Maha Ganapthi* Temple was just 800 Meters from Mayyill township, located in 11°59'52" N and 75°26'48"E. The temple pond is near to the temple, it was about 240 feet nearly 1335.4626m^2.

The *Mamanikkunnu Mahadevi* temple is dedicated to *Shakt*i and is located in Irikkur block of Taliparamba . This Temple was situated on the eastern bank of Irikkur River. Temple pond was situated at East-North region of the *Mamanikkunnu Sri Mahadev*i temple. It was located in 11.9932 N and 75.54900 E, around 28kms from Taliparamba. Area of the pond is nearly 100m^2.

4. Collection and Analysis

Sampling was conducted seasonally, post monsoon season as well as pre monsoon season. The sample was collected in the morning hours. The algal samples were collected from all corners and from the centre by using plankton net with 20µm sieve size, and these sub samples were mixed in to polythene bottles of 100 ml. The fixation of sample was done with FAA and Lugol's solutions. Identification of algae done with the help of reference texts of authors, Fr. Jose John and Francis (2013) and Presscott (1964). Classification system followed was by Fritsch (1961).

For Physico-chemical parameters**,** the samples were collected in the morning hours. Few important physicochemical parameters were studied. Two liters of water was collected for further study of physicochemical parameters. Some important parameters such as pH, salinity, temperature, TDS, conductivity, seechi disc transparency were examined on time. pH and temperature calculated by using pH meter. The samples were then brought to the laboratory for analysis of various physico-chemical analysis.

5. Results and Discussion

A thick film of Algal bloom along with hydophytes was observed in *Mamanikkunnu Sree Maha devi* temple in post monsoon season and that was lesser in pre- monsoon season. Water was stagnant and water depth nearly 30cm, and the bottom of pond was clearly visible in pre monsoon. In the case of *Velam Sree Maha Ganapath*i temple no hydrophytes and algal blooms observed.

Algal diversity

The study revealed 27 algal taxa, belongs to Chlorophyceae, Bacillariophyceae, Dinophyceae and Myxophyceae. *Mamanikkunnu Mahadevi* temple had more algal diversity than *Velam Sree Maha Ganapathi* temple. Algal diversity also showed seasonal variation, more algal diversity in post monsoon season than pre monsoon season. The algae were easily distinguishable in post monsoon season, but clumps of many algae were observed in pre monsoon season but were not in distinguishable manner.

Table 1: Seasonal algal diversity of ponds

Class	Sl. No.	Algal Taxa	Distribution			
			Pond1: VMG*		Pond2: MSM*	
			Post Mon Soon	Pre Mon soon	Post Mon soon	Pre Mon soon
Chlorophyceae	1	***Selenastrum***	-	-	+	-
	2	***Ankistrodesmus***	-	-	+	-
	3	***Pediastrum***	-	-	+	-
	4	***Scenedesmus***	-	-	+	+
	5	***Oedogonium***	-	-	+	-
	6	***Spirogyra***	+	+	+	+
	7	***Mougeotia***	-	-	+	+
	8	***Zygnema***	-	-	+	-
	9	***Cosmarium***	+	-	+	-
	10	***Pleurotaenium***	-	-	+	-
	11	***Staurastrum***	+	-	-	-
	12	***Microsteria***	-	-	+	-
	13	***Eustrum***	+	-	+	-
	14	***Desmidium***	-	-	+	-
	15	***Bambusina***	-	-	+	-
Baccillariophyceae	16	***Fragilaria***	-	-	+	-
	17	***Eunotia***	-	-	-	+
	18	***Navicula***	-	-	+	+
	19	***Pinnularia***	-	-	+	+
Dinophyceae	20	***Glenodinium***	-	-	+	-
Myxophyceae	21	***Chroococcus***	+	+	+	-
	22	***Microcystis***	-	+	-	-
	23	***Aphanocapsa***	+	-	+	-
	24	***Merismopedia***	-	-	+	+
	25	***Oscillatoria***	-	-	+	-
	26	***Spirulina***	-	+	-	+
	7	***Gleotrichia***	+	-	-	-
	28		**7**	**4**	**22**	**8**

VMG-Velam Maha Ganapathi Temple - MSM*-Mamanikkunnu Sree Mahadevi Temple*

In Velam Ganapathi temple renovation process was recently taken place, people are continuously visiting there, they use the pond for swimming and various competitions. Where as in the case of *Mamanikkunnu* temple pond, anthropogenic interfering was very less. In both temple ponds entirely different traditions and conservation practices observed. The

two systems were best example for traditional practices of water conservation

Morphological Description of Algae

1) Selenastrum
CLASS: CHLOROPHYCEAE,
ORDER: CHLOROCOCCALES,
FAMILY: SELENASTRACEAE
Cells crescent to sickle-shaped with sharply pointed ends. Normally appear in colonies of 4,8,16 or more cells. Chloroplast is single, parietal and usually with a pyrenoid. Cells 5-8 µm broad, 16-38µm long

2) *Ankistrodesmus*
CLASS: CHLOROPHYCEAE,
ORDER: CHLOROCOCCALES,
FAMILY: SELENASTRACEAE
Cells curved or sigmoid, twisted around one another. Cells acicular with acute apices normally appear in colonies of usually 4,8,16 rarely two. Cells spirally twisted around one another in the median region, but free at the ends. Chloroplast single and without pyrenoid. Colonies 75-180 µm in size.

3) *Pediastrum*
CLASS: CHLOROPHYCEAE,
ORDER: CHLOROCOCCALES,
FAMILY: HYDRODYCTYACEAE
Colonies are found to be flat circular plates of 16-32-64 cells. Inner cells four cornered with a small lens-shaped perforation in front and another at the back. Marginal cells usually longer than broad and ending in short spines. Size ranges from 60-80 µm.33

4) *Scenedesmus*
CLASS: CHLOROPHYCEAE,
ORDER: CHLOROCOCCALES,
FAMILY: COELASTRACEAE
Colony a flat plate, cells joined side by side, rarely curved plate of usually 2,4,8 cells which are always in multiplex of two. Individual cells acicular, ellipsoid, ovoid or cylindrical. Cells arranged in one or two rows and in lateral contact. Cell wall was smooth.

5) *Oedogonium*
CLASS: CHLOROPHYCEAE,
ORDER: OEDOGONIALES,
FAMILY: OEDOGONIACEAE
Thallus filamentous unbranched and attached to substratum with the help of holdfast. Cells cylindrical, longer than broad and enlarged towards the anterior end. Chloroplast with parietal reticulum and numerous pyrenoids. Presence of ring like scars.

6) *Spirogyra*
CLASS: CHLOROPHYCEAE,
ORDER: CONJUGALES,
FAMILY: ZYGNEMACEAE
Thallus filamentous unbranched without any base apex differentiation. Cells longer than broad. Free floating. Chloroplast a parietal ribbon shaped, usually spirally twisted. Conjugating tubes appear between filaments. It form green colony of filaments.

7) *Mougeotia*
CLASS: CHLOROPHYCEAE,
ORDER: CONJUGALES,
FAMILY: ZYGNEMACEAE
Thallus filamentous unbranched. It consists of cylindrical cells. The cells are many times longer than broad with plane and distinct end walls. The chloroplast is a flat axial band like and is capable of shifting and rotating within the cell. Hence chloroplast seen as narrow band in the sides or as twisted plates. The pyrenoids are arranged in one or many rows.

8) *Zygnema*
CLASS: CHLOROPHYCEAE,
ORDER: CONJUGALES,
FAMILY: ZYGNEMACEAE
Filamentous unbranched thallus, cells longer than broad. Chloroplast in pair of two, definitely star shaped (stellate) per each cell. The filaments form a yellow –green to bright green in colour and are free floating.

9) *Cosmarium*
CLASS: CHLOROPHYCEAE,
ORDER: CONJUGALES,
FAMILY: DESMIDIACEAE
Cells were solitary, tiny to large with shallow to deep median construction called isthmus. Two Semi cells were rounded quadrate with undulate margin. Sub circular to elongate oval in apical view.

10) *Pleurotaenium*
CLASS: CHLOROPHYCEAE
ORDER: CONJUGALES,
FAMILY: DESMIDIACEAE
Cells usually solitary, cell contains two elongated semi cells with sub parallel margins. Apex smooth or with ring of round or conical warts, terminal vacuole containing granules around poles. Cell wall with undulate margins. Chloroplast usually narrow, parietal bands, several per semi cells, each with many pyrenoid. Nucleus seen in the isthmus.

11) *Staurastrum*
CLASS: CHLOROPHYCEAE,
ORDER: CONJUGALES,
FAMILY: DESMIDIACEAE
Cells solitary. Deep median constriction (isthmus) between semi cells. Semi cell walls overlap. The cell wall with decorations. The apex of semi cells extended into radiating arms or lobes which ends in spines. Chloroplast usually one per cell and were stellate in end view with axial pyrenoid.

12) *Microsteria*
CLASS: CHLOROPHYCEAE,
ORDER: CONJUGALES,
FAMILY: DESMIDIACEAE
Cells flat and nearly circular in proportion star like in view. Containing deep median incision. Semi cells deeply lobed.

13) *Euastrum*
CLASS: CHLOROPHYCEAE,

ORDER: CONJUGALES,
FAMILY: DESMIDIACEAE
Cells solitary, Cell body is long as wide and elongate pyramid –shaped. Isthmus wide. Deep narrow notch present in the apex of each semi cells. Isthmus 11-14µm wide. Usually one chloroplast. Cell wall smooth and with scattered pores.

14) ***Desmidium***
CLASS: CHLOROPHYCEAE,
ORDER: CONJUGALES,
FAMILY: DESMIDIACEAE
Filamentous desmid. Cells wider than long and are constricted in the middle or with slight median notch. Semi cells transversely sub-rectangular, lateral margins obliquely truncate. Filaments easily broken into individual cells.

15) ***Bambusina***
CLASS: CHLOROPHYCEAE
ORDER: CONJUGALES,
FAMILY: DESMIDIACEAE
Filamentous desmid. Cells in short or long filaments. Individual cells small, elongate, barrel shaped with shallow median constriction (isthmus). Cell in apical view bi radiate or tri radiate. Cell wall with transverse rows of desmid type pores and longitudinally plicate near cell ends. Chloroplast one per semi cells, stellate in end view with central pyrenoid.

16) ***Fragilaria***
CLASS: BACILLARIOPHYCEAE,
ORDER: PENNALES,
FAMILY: FRAGILARIOIDEAE
Thallus filamentous. Cells with numerous intercalary bands and rectangular cells joined by their valve faces to form a ribbon-like chain, Rectangular in girdle view. Elongate with finely punctate striations in the cells.

17) *Eunotia*
CLASS: BACILLARIOPHYCEAE,
ORDER: PENNALES,
FAMILY: EUNOTIOIDEAE
Frustules bend or curved in the apex, wavy or undulate on one margin as seen in valve view, transversely striate, no central nodules

18) *Pinnularia*
CLASS: BACILLARIOPHYCEAE,
ORDER: PENNALES,
Free floating solitary spindle shaped cells. Shape of Valves elongate elliptical Axial field usually broad, with relatively pronounced "costae" (thickened silica rows)

19) *Navicula*
CLASS: BACILLARIOPHYCEAE,
ORDER: PENNALES,
FAMILY: NAVICULOIDEAE
Solitary spindle shaped cells. Brown or golden colour. Usually free-floating, rhomboidal lanceolate with gently flatted rostrate ends, raphe thin, straight and median with central nodules. Terminal fissures curved. Axial area narrow, linear central area somewhat rectangular.

20) *Glenodinium*
CLASS : DINIPHYCEAE,
SUB-CLASS DINOKONTAE,
ORDER:DINOFLAGELLATA,
FAMILY: DINOCAPSACEAE
Cells round in shape. Thin evident cell plates, a transverse furrow completely encircling the cell.

21) *Chroococcus*
CLASS: MYXOPHYCEAE,
ORDER: CHROOCOCCALES,
FAMILY: CHROOCOCCACEAE
Cells spherical or sub spherical, hemispherical. Gelatinous mucous matrix is present. Sheath of individual cells distinct firm, generally lamellated, in some homogenous. Cells mostly two, seldom three or four together in group's bright blue green.

22) *Mirocystis*
CLASS: MYXOPHYCEAE, ORDER: CHROOCOCCALES, FAMILY: CHROOCOCCACEAE
Colony irregular to circular with numerous cells, mucilage distinct

23) *Merismopedia*
CLASS: MYXOPHYCEAE
ORDER: CHROOCOCCALES
FAMILY: MERISMOPEDIACEAE
Ovoid or spherical in shape and arranged in flat, forming rectangular colonies held together by mucilaginous matrix

24) *Aphanocapsa*
CLASS: MYXOPHYCEAE
ORDER: CHROOCOCCALES
FAMILY: MERISMOPEDIACEAE
Thallus colonial, olive green in colour, gelatinous, spherical mostly with a special envelope. Cells loosely arranged in a common mucilaginous envelope. Colony spherical in outline. Mucilage homogenous, colourless, cells often with a thin more or less gelatinized individual sheaths.

25) *Spirulina*
CLASS: MYXOPHYCEAE,
ORDER: NOSTOCALES,
FAMILY: OSCILLATORIACEAE
Road shaped spiral unicellular algae

26) *Oscillatoria*
CLASS: MYXOPHYCEAE,
ORDER: NOSTOCALES,
FAMILY: OSCILLATORIACEAE
Filamentous unbranched thallus. Trichome usually naked and have a thin poorly developed mucilaginous sheath. The wall usually smooth. Cells arranged into long flat thread like filaments. Usually found as colonies.

27) *Gleotrichia*
CLASS: MYXOPHYCEAE,
ORDER: NOSTOCALES,
FAMILY: RIVULARIACEAE
Thallus spherical colony of many filaments. Filaments tapered towards the distant end. Heterocysts single

spherical. Heterocyst and akinete present at the base. Filaments stratified and with brown sheath around it.

Results of some important physicochemical parameters

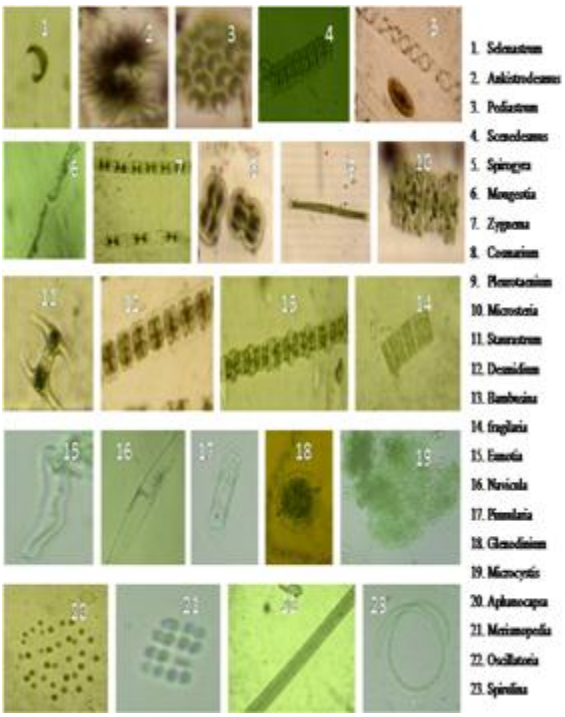
Table 2: Seasonal variation of some important physico-chemical parameters of ponds

In the case of chemical parameters salinity is increased in pre monsoon season, Alkalinity decreased. Hardness of water is also decreased.

Figure 1: Photographs of some algae

Sl. No.	Physico -chemical parameters	POND1: VMG*		POND 2: MSM*	
		Post mon soon	Pre Mon soon	Post Mon soon	Pre Mon soon
1	Appearance	Greenish	Greenish	Greenish	Greenish
2	Odour	None	None	None	None
3	Temperature (°C)	32.00	33.20	31.20	33.00
4	Seechi disc transparency (cm)	77	66	67	-
5	Electrical Conductivity (µS/cm)	50	211.584	120	12.4944
6	Total Dissolved Solids (ppm)	30	123.12	80	15.048
7	pH	6.8	6.5	6.2	6.0
8	Salinity	0	0.11	0	6.41
9	Alkalinity (mg/l)	12	1.4	12	2
10	Total hardness (mg/l)	15	1.1	22	27.95
11	Ca hardness (mg/l)	10	0.7	6	8.2
12	Mg hardness(mg/l)	5	0.4	16	19.75
13	Chloride (mg/l)	4.963	2.4	1.418	0

VMG*-Velam Maha Ganapathi Temple – MSM*-Mamanikkunnu Sree MahadeviTemple



6. Conclusion

The present study was a pioneer attempt in finding out algal diversity of traditional ponds of Kannur district. The occurrence of 27 algal taxa indicates richness of ponds in diversity. This also indicates the productivity of the system. These types of studies were significant in the present scenario of global warming and climate change as these planktons play a wonderful role in carbon capturing.

7. Future Scope

The correlation between physico -chemical parameters and occurrence of algae should also be studied. The productivity measurements and pollution status also need to be studied.

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