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A survey of algal blooms in the ponds of Pallippuram, Kerala, India

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ABSTRACT

A survey of ponds in the Pallippuam Panchayath of Cherthala taluk, Kerala was undertaken from October 2010 to May 2011. Out of the 873 ponds surveyed 66% are unused, while 33% are used for domestic purpose other than drinking and irrigation; 11 ponds are used as drinking water source. Among the unused ponds 48 had algal blooms comprising species of Cyanophyta and Charophyta. They were observed as scums or mat on the surface of the ponds.

Keywords: Pallippuram Panchayath, algal bloom, ponds, Cyanophyta, Charophyta.

1. Introduction

The algae and Cyanobacteria comprising the phytoplankton are the first link in the aquatic food web as primary producers. Their presence in the water is often unnoticed as they are tiny microscopic organisms. Under favorable environmental conditions such as elevated nutrient concentration, warm temperature, shallow and slow moving water, the algal growth is stimulated in the water bodies that will finally result in the formation of algal blooms (Wetzel, 2001). Anthropogenic inputs can alter the algal community such that the health of an ecosystem may be reflected in the algal community and diversity (Lowe and Pan, 1996). Though algal blooms are natural phenomenon, and have occurred throughout the recorded history, recent studies from around the world indicate that they have increased in frequency and geographic distribution over the past few decades (Rejmenkova et al., 2011, Winter et al., 2011).

The lakes have received much attention in ecological studies in relation to nutrient enrichment and algal blooms. However, the domestic land excavated ponds, though small in size, but large in numbers in certain regions are among the most human influenced systems, as well as most vulnerable. These ponds are important as water sources for drinking and irrigation in rural areas. The water quality of the domestic ponds is influenced by the land use practices in the immediate neighbourhood. According to Akasaka et al (2010) macrophyte diversity and water quality of 55 ponds in western Japan were related to land use and morphometric variables. Soni and Bhatt (2008) have described the degradation of an urban pond in Gujarath, India due to sewage disposal. The pond has become unfit for use due to proliferating algae, macrophyte and pathogens. Similar studies on changing water quality of ponds in India have been reported by many authors (Bhuiyan and Gupta, 2007, Upadhyay et al., 2010).

In Kerala state, located at the south west coast of India, village ponds had been the sole source of drinking water along the coastal regions a few decades ago. Continuous maintenance of these ponds through traditional methods ensured the water quality. As

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population increased and urbanization set in many of these ponds were reclaimed for alternate use. The rest of the ponds were neglected as and when public water supply became accessible. Considering that ponds are important freshwater ecosystems and abode of rich biodiversity, the need for their conservation is recognised. Therefore this study is undertaken in 'Pallippuram' a typical coastal village of Kerala which has high density of domestic ponds. The present investigation is part of a study on current state of the ponds, their scope of restoration and utilization. The results presented in this paper are that of the preliminary survey on the status of these ponds.

2. Materials and methods

2.1 Study area

The study area is Pallippuram Panchayath a village situated in the Alappuzha district of Kerala state located in the South West coast of India at $9^0 45' 20''$N and $76^0 21' 39''$ E. It is an administrative entity that is part of an island in the Vembanadu Estuary bounded in the east, west and south by the estuary. The northern side is contiguous with the rest of the island (Fig.1 and Fig.2). The region has tropical monsoon climate with a mean annual temperature of 26.5^0 C (minimum18^0 C in December; maximum 35^0 C in April) and mean annual precipitation of 2500mm. The Panchayath has a population of 27307 in an area of 25.53 km^2as per census of 2001. There are 6202 households. The predominant land use includes paddy fields, coconut gardens and residential. The drinking water source in the village was traditionally ponds. As the population increased and lifestyles changed, there occurred a shift to piped water supplies and wells. As a result, the once prevalent ponds were largely neglected or reclaimed. It is in this context that a survey of those existing ponds was undertaken to provide the primary data on the state of these ponds so as to devise steps to conserve them as clean freshwater sources.

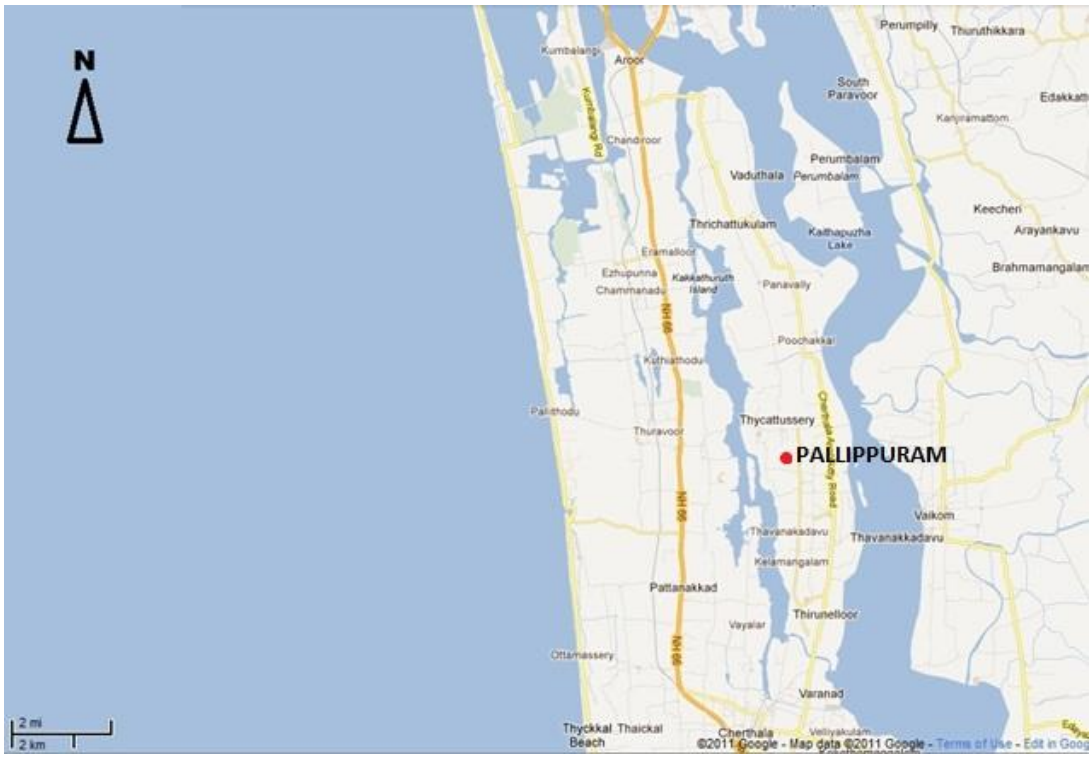


Figure 1: Google map of location of Pallippuram

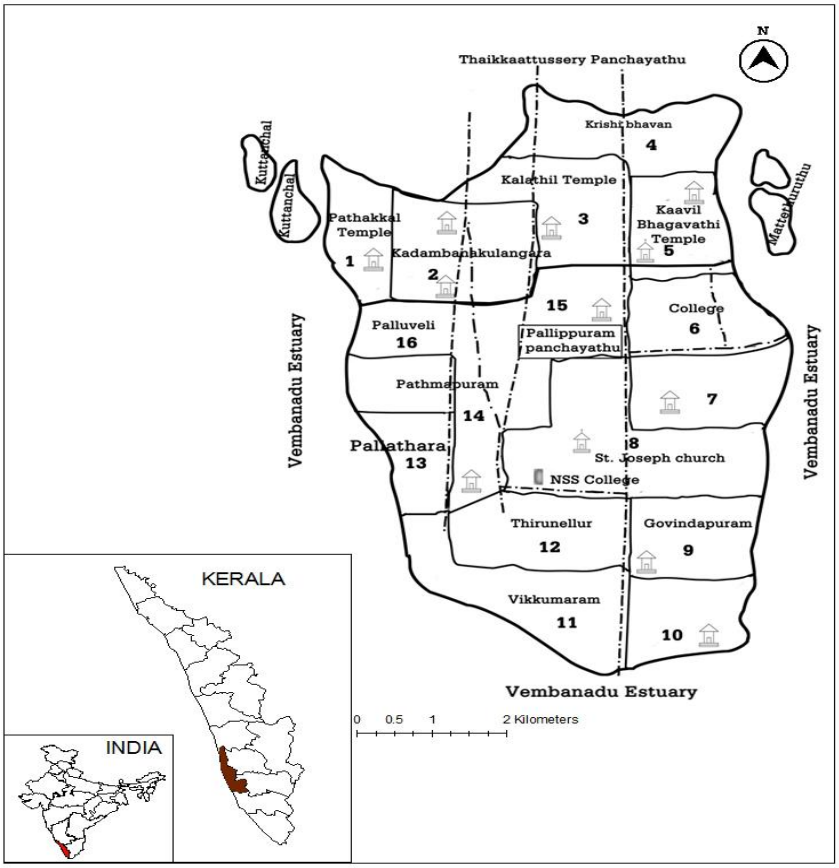


Figure 2: Map of Pallippuram Panchayath showing 17 wards (ward no. 17 is recently formed from ward no. 15 and 16)

2.2 Method of study

The Pallippuram Panchayath which is a local body of the civil administration is divided into17 wards or administrative units. The survey involved collecting data of ponds in each of these 17 wards separately and then compiling it. The period of survey was October 2010 to May 2011. The preliminary survey charted the total number of ponds in each ward, their area, type of use, occurrence of algal blooms, and other aquatic vegetation.

In the second stage of the survey, algal blooms were collected from 32 ponds selected at random; brought to the laboratory, and observed under microscope. The algal blooms were identified based on the existing literature (Desikachary , 1959 , Guiry and Guiry, 2011).

3. Results

A total number of 873 ponds were recorded in the Panchayath during this survey. The area of these ponds ranged from 12 m^2 to 300m^2. The detailed survey results for each ward are given in Table1. It is found that 66% of these ponds are out of use. Eleven ponds out of the fifty one in Ward1 are used for drinking purpose; 33% of all ponds in the Panchayath are used either for irrigation or other purpose such as bathing and washing clothes. Algal blooms were observed in 48 ponds. The blooms appeared as green or blue green turbidity, floating scum, or as thick blue-green floating mats. Submerged Aquatic Vegetation (SAV) occurred in 19 ponds. The SAV comprised of *Vallisneria sp., Hydrilla verticillata and Ceratophyllum*

submersum. Floating hydrophytes were *Lemna minor, Pistia stratiotes, Eichhornia crassipes, Salvinia molesta and Azolla pinnata* (Fig.3).

Table 1: Survey results of ponds in Pallippuram Panchayath

Ward No.	No. of ponds	Area(m^2)	Type of use			No of ponds with		
			Drinking	Irrigation and other uses*	Unused	Algal bloom	SAV*	Floating hydrophytes
1	51	15-176	11	12	28	1	1	33
2	48	19-153	Nil	19	29	2	2	35
3	120	28-153	Nil	50	70	13	8	84
4	94	19-176	Nil	31	63	7	2	76
5	41	38-300	Nil	12	29	2	-	17
6	57	12-153	Nil	22	35	3	2	35
7	40	19-132	Nil	7	33	3	-	25
8	27	19-132	Nil	6	21	2	-	20
9	46	19-176	Nil	14	32	1	1	37
10	60	12-176	Nil	28	32	-	1	45
11	50	12-176	Nil	17	33	3	-	36
12	20	12-153	Nil	8	12	1	-	14
13	39	19-176	Nil	9	30	1	-	33
14	32	19-176	Nil	8	24	1	-	16
15	82	12-176	Nil	25	57	4	1	53
16	41	12-176	Nil	12	29	2	1	24
17	25	38-153	Nil	6	19	2	-	15

* Irrigation, bathing and washing * Submerged Aquatic Vegetation

Figure 3: Images of ponds

(Fig.3.1 and3.2 pond with algal bloom, Fig.3.3 and3.4 Pond with floating and submerged vegetation, Fig.3.5 Pond covered completely with *Pistia*, Fig.3.6 A Clean pond under domestic use)

Out of the thirty two ponds sampled for algal bloom, six ponds had blooms of Charophyta, and the rest of the ponds had Cyanophyta. The blooms were mostly of filamentous algae that formed thick floating surface scum or mat (Table 2).

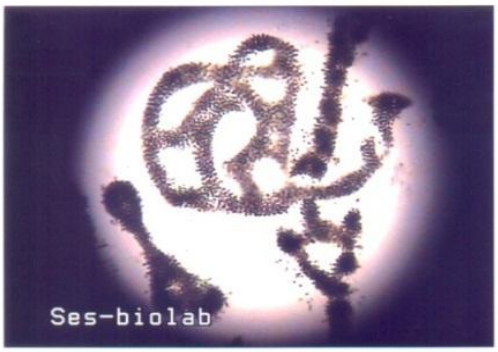
The Charophyta was represented by *Spirogyra* sp., *Klebsormidium* sp., and *Mougeotia scalaris*. *Spirogyra* bloom occurred in four ponds where as *Klebsormidium* and *Mougeotia* were present in one pond each. Blue-green algal bloom occurred in the rest of the twenty six ponds examined.

Oscillatoria occurred in nineteen ponds represented by two species. Blooms of *Microcystis aeruginosa* occurred in three ponds. The species spectrum of the bloom is presented in Fig.4 and 5. Co-existence of hydrophytes and algal bloom was observed in certain ponds.

Table 2: Algal blooms in ponds of Pallippuram Panchayath

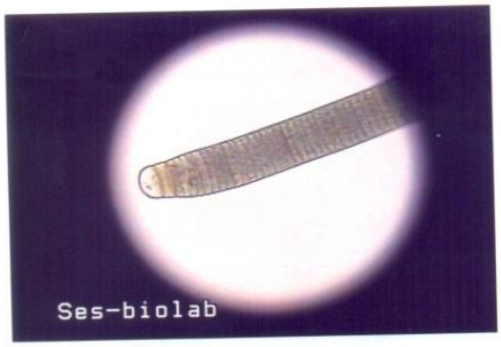
Ward No.	Pond No.	Algal species observed								
		1	2	3	4	5	6	7	8	9
3	1	-	+	-	-	-	-	-	-	-
	29	+	-	-	-	-	-	-	-	-
	38	-	-	-	-	-	-	+	-	-
	52	-	-	-	-	-	-	-	+	-
	56	-	+	-	-	-	-	-	-	-
	58	-	-	-	-	-	-	-	-	-
	65	+	-	-	-	-	-	-	-	-
	83	-	+	-	-	-	-	-	-	-
	106	-	-	-	-	-	-	+	-	-
	108	-	-	+	-	+	-	-	-	-
	112	-	+	-	-	-	-	-	-	-
	118	-	-	-	+	-	-	-	-	-
	120	-	-	+	-	-	-	-	-	-
4	10	-	-	-	-	-	-	-	-	+
	11	-	+	-	-	-	-	-	-	-
	26	-	+	-	-	-	-	-	-	-
	31	-	-	+	-	-	-	-	-	-
	33	-	+	-	-	-	-	-	-	-
	34	-	+	-	-	-	-	+	-	-
	35	-	-	-	-	-	+	-	-	-
	36	-	-	+	-	-	-	-	-	-
	49	-	+	-	-	-	-	-	-	-
	60	-	+	-	-	-	-	-	-	-
5	27	-	-	-	-	-	+	-	-	-
	39	-	+	-	-	-	-	-	-	-
6	25	-	-	-	-	-	-	-	-	-
	26	-	+	-	-	-	-	-	-	-
	27	-	-	+	-	-	-	-	-	-
	28	-	-	-	-	-	+	-	-	-
16	8	+	-	-	-	-	-	-	-	-
17	6	-	-	+	+	-	-	-	-	-
	12	+	+		-	-	-	-	-	-

(1.Spirogyra sp. 2. Oscillatoria princeps 3. Oscillatoria subbrevis 4. Phormidium tenue 5. Anabaena sp 6. Microcystis aeruginosa 7. Coelosphaerium kuetzingianum 8.Mougeotia scalaris 9.Klebsormidium sp.)

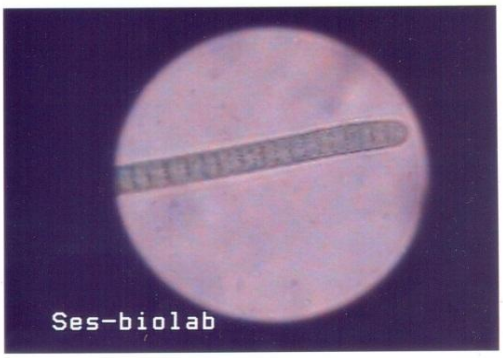


Microcystis aeruginosa-100x

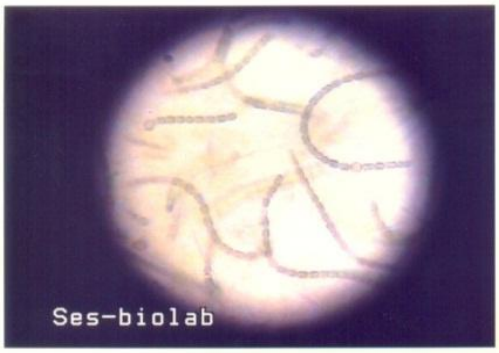
Coelosphaerium kuetzingianum -1000x



Oscillatoria princeps-400x



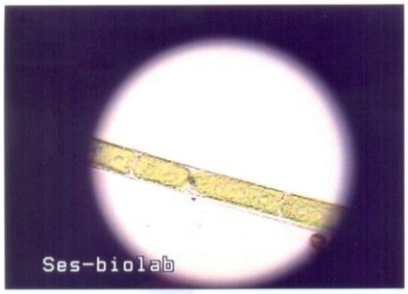
Oscillatoria subbrevis - 400x



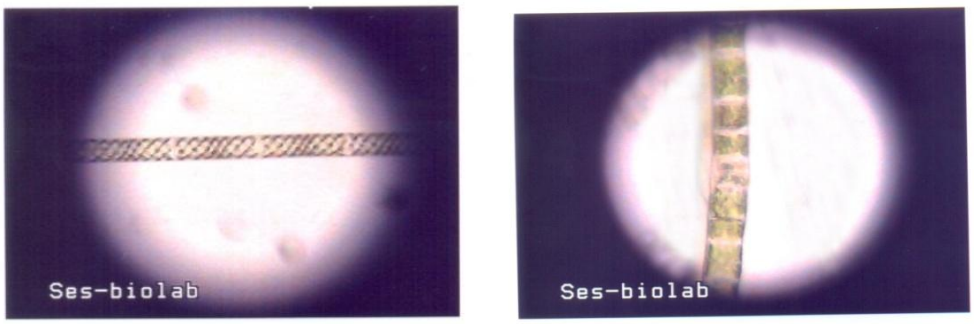
Anabaena sp. - 400x

Figure 4: Species spectrum of algae

Phormidium tenue - 1000 x



Mougeotia scalaris – 400 xs



Spirogyra s. - 100x *Klebsormidium sp.- 400x*

Figure 5: Species spectrum of algal bloom

4. Discussion and conclusion

The present survey has listed the number of ponds existing in the 'Pallippuram Panchayath', their status of use, and indirectly indicated the water quality. As 66% of the ponds are now unused, it is evident that they are not essential for the community from the utilitarian point of view, and therefore grossly neglected.

The ponds that are used for drinking purpose are maintained through traditional methods with the funds provided by the civil authority. The domestic use includes mainly washing of clothes. Therefore phosphates from detergents could be a strong reason for induction of algal blooms. The region has paddy fields; both cultivated and uncultivated which could be a source of fertilizer run off. Effluents from the residential areas and the faulty sanitation systems can likely contribute excess organic matter, and consequent nutrient enrichment in the ponds. According to Akasaka et al. (2010) the land use pattern around the pond has direct effect on water quality and aquatic vegetation. The emergence of *Microcystis aeruginosa* bloom in kandy lake, Srilanka has been explained in terms of N-enrichment mainly by ammonium-N, and high turnover rates of dissolved phosphorus(Silva, 2003). Ahmed et al. (2007) relates the periodic cyanobacteria blooms in an urban river to increased dissolved organic nutrients, long sunshine hours and favorable water temperature. Species of *Oscillatoria* are reported to produce hepatotoxic microcystins (Ahmed et al., 2010). Welker et al. (2005) detected microcystins in thirty nine ponds related to occurrence of *Microcystis, Planktothrix* and *Anabaena*. The observation of potentially toxic genera of *Microcystis* and *Oscillatoria* in the present study is of concern.

Dense growth of three species of Charophyta were observed in six ponds in this survey. Charophytes are generally recognized as indicators of clean water ecosystems and they prefer hard alkaline waters rich in calcium. However Charophytes may persists under moderate fertility and turbidity (Klosowski et al., 2006). The survey has revealed the need for conservation, and the scale of restoration to be undertaken.

5. Acknowledgement

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