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Seasonal variations of cyanobacterial flora in the backwater of Kattumavadi (Palk strait), India

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Abstract

Availability and diversity of cyanobacteria varied seasonally in the backwater of Kattumavadi (Palk Strait) during the year 2002. Totally, twelve species of unicellular and filamentous species of cyanobacteria belonging to either Chroococcaceae or Oscillatoriaceae families were observed. *Phormidium fragile* was predominant throughout the year followed by *Oscillatoria curviceps*. *Lyngbya hieronymusii, Oscillatoria trichoides, O. salina, O. subbrevis, Phormidium tenue* and *Gloeocapsa magma* were observed in all seasons, however with less frequency. *Microcystis aeruginosa* and *Spirulina subsalsa* were observed in all seasons except in monsoon season, whereas, *Synechococcus* sp. was observed in premonsoon and postmonsoon seasons.

Keywords : back water, cyanobacteria, diversity, photosynthetic prokaryotes, physico-chemical parameters

INTRODUCTION

Cyanobacteria are the largest, most diverse and widely distributed group of photosynthetic prokaryotes (Stanier and Cohen-Bazire, 1977). Occurrence of cyanobacteria in marine as well as freshwater environments has been reported from all parts of the world (Whitton, 1968; Gonzalez and Parra, 1975; Potts, 1980). However, there are no reports on the distribution and diversity cyanobacterial flora on the backwaters of India except that of Thajuddin and Subramanian (1992). This paper reports the seasonal variations of cyanobacterial diversity in relation to the physicochemical parameters of the backwater of Kattumavadi, Palk Strait, South India.

MATERIALS AND METHODS

Seasonal variation of cyanobacterial occurrence and abundance were monitored monthly over a period of one year (2002) in Kattumavadi backwater area, south east of Tamilnadu, South India (Fig. 1). Samples were collected at monthly intervals in different locations using sterile translucent containers and transported to the laboratory. A part of each sample was separated and fixed in 5% formalin. The samples of cyanobacterial masses were separated and isolated under stereo microscope (Cannon, Japan). The cyanobacterial species were identified by referring to Desikachary (1959) and Biswas (1949). Water samples were collected from the backwaters and physicochemical parameters viz., pH, alkalinity, salinity, calcium, magnesium sodium, potassium, sulphate, chloride, carbonate, bicarbonate nitrate, nitrite and total phosphate were measured using standard methods (Strickland and Parsons, 1972., Wetzel and Likents, 1972., Parsons *et al.*, 1984). Species diversity (H'), Species Richness (SR) and species dominance(ä) were calculated using Shannon and Weaver index (1963) with the following formulae.

Shannon and Weaver Index (H^1) = Σ pi log pi;

Species Richness (SR) = S 1 / In N

Species dominance (ä) = $100 \times (n_1 + n_2) / N$

RESULTS

Totally, twelve species of cyanobacteria four species of Chroococcaceae and eight species of Oscillatoriaceae were found in the present study site (Table 1). It is interesting to note that *Phormidium fragile* and *Oscillatoria curviceps* were present throughout the year with *Phormidium fragile* being predominant *Gloeocapsa magma* was absent during summer, *Aphanocapsa koordersi* was about during the postmonsoon season and *Microcystis aeruginosa* and *Spirulina subsalsa* were present in all seasons except in monsoon. *Synechococcus* sp. was present in premonsoon and monsoon whereas absent in postmonsoon and summer. Eventhough species such as *Lyngbya hieronymusii, Oscillatotia trichoides, Oscillatoria salina, Phormidium ambiguum* were found in all seasons they were not predominant. Highest abundance of cyanobacterial species was recorded during the monsoon followed by summer, premonsoon and postmonsoon seasons.

The pH of the backwater of Kattumavadi ranged between 7.5 and 8.0 (14.12 ppt) and the maximum salinity (20.32 ppt) was recorded during summer and minimum value during monsoon during the present study period. Levels of calcium, magnesium, sodium, bicarbonate, carbonate and chloride were highest during summer and lowest during monsoon of 2002.

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Table 1. Seasonal variations of cyanobacterial population in Kattumavadi backwater area, South India

	CYANOBACTERIAL SPECIES												
Month of 2002	*Microcystis aeruginosa*	*Gloeocapsa magma*	*Aphanocapsa koordersi*	*Synechococcus*	*Spirulina subsalsa*	*Oscillatoria subbrevis*	*O. curviceps*	*O. trichoides*	*O. willei*	*Phormidium fragile*	*P. ambiguum*	*Lyngbya hieronymusii*	Seasons
JAN	+	-	-	-	+	-	+	+	-	+ + +	+	+ +	
FEB	+	+	-	-	+	+	+	-	+	+ +	+	+	Post Monsoon
MAR	+	+	-	-	+	-	+ +	+	+	+ +	-	+	
APR	+	-	+	-	+	-	+ +	+	+	+ + +	+ +	+ +	
MAY	-	-	-	-	+	+	+ +	+ +	-	+ +	-	-	Summer
JUN	+ +	-	+ +	-	+	-	+ +	+	+	+ +	+ +	+	
JUL	+ +	-	+	-	+	-	+ +	-	+	+ + +	+	-	
AUG	+	+	+	+	-	+	+	+ +	+ +	+ +	-	+	Premonsoon
SEP	+	-	-	+	-	+	+	+ +	+ +	+ +	+	+	
OCT	-	+	+	-	-	+ +	+ +	+ +	+ +	+ + +	+	-	
NOV	-	+	-	+	-	+ +	+	+ +	+ + +	+ +	-	+	Monsoon
DEC	-	-	-	+	-	+ + +	+	+ +	+ +	+ +	+	-	

+ = 1-10 cells x 10^4 ml^{-1} + + = 11-20 cells x 10^4 ml^{-1} + + + = > 20 cells x 10^4 ml^{-1} - = not present in the sample

Table 2: Physicochemical characteristics of Kattumavadi Backwater area, South India during different month of 2002

S. No	Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	pH	7.8	7.5	7.5	8.0	8.0	8.0	8.0	7.5	7.5	7.5	7.8	7.5
2	Salinity(ppt)	19.12	19.20	19.08	20.31	20.25	20.32	20.22	20.31	20.21	15.37	1412	15.24
3	Calcium (mg^{-1})	500	400	350	600	650	565	350	400	425	360	380	385
4	Magnesium(mg^{-1})	700	720	800	650	750	800	600	650	530	520	580	530
5	Sodium(mg^{-1})	4900	4950	5000	5680	5980	5850	5500	5600	5550	3910	4100	3900
6	Potassium(mg^{-1})	250	255	262	283	260	265	286	297	250	200	260	250
7	Bicarbonate (mg^{-1})	260	265	265	300	290	286	250	244	200	150	155	155
8	Carbonate(mg^{-1})	0.02	0.01	0.012	0.045	0.04	0.04	0.01	0.02	0.02	0.025	0.02	0.043
9	Sulphate(mg^{-1})	500	560	575	590	760	800	1900	1344	1400	650	650	650
10	Chloride(mg^{-1})	14900	14905	15092	15800	15900	15962	15900	15953	15800	12824	11500	12200
11	Nitrate(mg^{-1})	20	21	16	15	16	16	17	17	20	25	35	25
12	Alkalinity(mg^{-1})	226	221	221	256	246	242	206	200	156	106	111	111
13	Total phosphate(mg^{-1})	0.03	0.02	0.02	0.1	0.1	0.15	0.18	0.05	0.08	0.4	0.5	0.4
14	Nitrite (mg^{-1})	3.3	3.5	2.6	2.5	2.6	2.6	2.8	2.8	3.3	4.2	5.8	4.2

In contrast, maximum levels of nitrate, nitrite and total phosphate were recorded monsoon and minimum levels during summer. Sulphate level was highest in the premonsoon and lowest in the postmonsoon season (Table 2).

Highest species diversity (H^1) of cyanobacteria was obtained in summer followed by premonsoon, monsoon and postmonsoon (Table 3). The maximum Species Richness (SR) of cyanobacteria was in postmonsoon, followed by premonsoon, mosoon and summer. The species dominance (ä) of cyanobacteria was maximum in summer, followed by postmonsoon, monsoon and premonsoon (Table 3).

In the present study, both unicellular and filamentous cyanobacterial forms were recorded but not heterocystous forms. Filamentous forms of cyanobacteria belonging to the family Oscillatoriaceae dominated the unicellular species in all the seasons of the present study in the Kattumavadi backwater area, South India. Among the species, *P. fragile* predominanted followed by *O. curviceps*. Eventhough in this backwater environment, pH, salinity and dissolved inorganic nutrients varied among the seasons, these two species were predominantly observed in all the four seasons. This could be due to remarkable adaptability of *P. fragile* and *O. curviceps*.

Table 3. Cyanobacteria Species Diversity, Species Richness and Species Dominance at Kattumavadi, South India during different seasons of 2002

Population characteristics	Post Monsoon	Summer	Premonsoon	Monsoon
Species Diversity(H')	3.01	3.16	3.12	3.11
Species Richness(SR)	3.145	2.498	3.077	2.699
Species Dominance(□)	35.48	36.11	32.50	33.33

DISCUSSION

Abhaykumar *et al.*, (1995) observed an increased in pH level during summer in the intestinal regions of Bhavanagar Port, which might be due to water evaporation. Low salinity values contributed by the inflow of river water were recorded during monsoon in the Agridar estuary (Mohammed and Rahman, 1987). Similarly, inorganic nutrients were high in monsoon season (Oct-Dec) compared with other seasons in the coastal waters of Chennai (Mahadevan and Subramanian, 1999). Kurup *et al.* (1998) detected that freshwater cyanobacterial cells that enter the estuary are likely to be adversely affected by high salinity in summer and post monsoon. It was observed in the present study that species diversity and species dominance were high in summer. Similar results have been reported by Thajuddin and Subramanian (1992) in the backwaters of southeast coast of India.

In the present study, filamentous cyanobacterial species were abundant in Kattumavadi backwater region Cowell and Botts (1994) also observed abundance of the filamentous cyanobacteria in all sites of crystal river estuarine system of Cenral Florida. Selvakumar and Sundararaman (2001) observed unicellular and filamentous species of cyanobacteria harboured by mangrove forest in Muthupet estuary. This is in accordance with Steitz and Velimirov (1999) who suggested that cyanobacteria contribute substantially for the primary production in the backwater system and the adjoining aquatic systems of freshwater, estuary and marine. Kirschner *et al.*, (1999) also suggested that filamentous cyanobacterial species dominated the phytoplankton component in the eutrophic backwater of the River Danube. *Phormidium tenue* was the most versatile filamentous species occurred in open sea, stagnant sea water, backwater and salt pans. *P. tenue* was observed in Pichavaram mangroves and it has been adapted in various concentration of salinity (Thajuddin and Subramanian, 1992., Palaniselvam *et al.*, 1998).

Only few cyanobacterial species were recorded throughout the year in the Kattumavadi backwater region. This might be a reflection of various ranges of saline adaptability of different cyanobacterial species.

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