

Influence of environmental parameters on the phytoplankton distribution in clambeds in atropical estuary

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ABSTRACT : Influence of environmental parameters on the phytoplankton distribution in clambeds in atropical estuary was studied from August, 2007 to July, 2008 in Mulki estuary. Hydrographical parameters exhibited a significant effect on the distribution of phytoplankton in the clambeds. The total phytoplankton numbers varied from 5,62,518 no./m³ to 16,22,660no./m³. Sixteen different species of diatoms, 15 species of green algae and 4 species of dinoflagellates were reported from the study area. Diatoms formed the bulk of the phytoplankters with a maximum of 3243025 no./m³.

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Estuary is a semi enclosed water body along the coast where freshwater from rivers and streams meets and mixes with the salt water of sea. Estuaries and back waters in India occupy 1.44 million hectares water spread area (Anonymous, 2006). No two estuaries are similar and they are different in their geography, morphology, topography, fresh water influx and tidal amplitude. mainly due to river inflow tidal ingress and basin topography. Estuary being dynamic nature offers a good habitat for many aquatic organisms. The change in the water level and the water quality offers a dynamic environment for the organism to thrive. The productivity of these estuaries is determined by factors like abundant nutrients; conservative retention and efficient recycling of nutrients, inter dependence of phytoplankton, zooplankton, benthos, benthic micro-and macroalgae, sea grasses, mangrooves etc.

Phytoplankton is the microscopic plant matter which does not have independent locomotive capability but they drift by the

mercy of wind, currents and tides (Kudela and Peterson, 2009). Phytoplankton community is in general used as indicators of estuarine water quality (Paerl *et al.*, 2007). Phytoplankton determines the primary productivity of the water body which forms a primary source of energy for the higher organisms in the foodweb. There are numerous factors affecting the production and distribution of phytoplankton in the estuarine environment such as salinity, temperature, tidal activity, nutrient levels etc. Studies on the phytoplankton distribution in estuarine waters are available in the works of George *et al.* (2012) in Tapi estuary, Gulf of Khambhat; Devassy and Goes (1989); Perumal *et al.* (2009) in Kaduviyar estuary, Nagapattinam, South east coast of India.

EXPERIMENTAL METHODOLOGY

The Mulki and Pavanje rivers flows towards west and makes a confluence just

before joining with the Arabian sea leading to formation of Mulki estuary. The Mulki estuary (lat. 13° 4' N and long. 74° 17' E) is situated at about 45 km north of Mangalore. The estuary is connected to the Arabian sea throughout the year and is subjected to tidal influence to a length of 6.0 km in Mulki river and 6.6 km in Pavanje river (Reddy and Gopala, 1982). The water samples were collected during the low tide period for determination of various physical and chemical parameters. The water quality parameters like temperature, pH, salinity, ammonical nitrogen and suspended solids were analysed and the phytoplankton samples were collected by filtering 100 liters of water every time through a nylon plankton net having 60 µm pore size. Three aliquots of phytoplankton sample were selected from which 1.0 ml was drawn for qualitative analysis. The phytoplankton cells present were identified counted and recorded employing sedwickrafter type of cell and a compound

microscope fitted with closed circuit television camera (CCTV camera). Phytoplankton cells were identified up to generic level and expressed in terms of number of cells/m³ of water.

EXPERIMENTAL FINDINGS AND DISCUSSION

The results of the present investigation are given in Table 1 to 4.

The water temperature ranged from 29.54 to 30.11°C during the entire study period and the maximum and minimum values were reported in the months of May and August, respectively. Cooler condition prevailed during the monsoon season and warmer conditions during the pre-monsoon season. pH values ranged from 7.84 to 8.10 with high values during the post and pre-monsoon and relatively lower values during the monsoon season. Clear cut seasonal variations were observed in the salinity

Table 1: Hydrographical and phytoplankton numbers observed in Mulki estuary

Parameter	Mean	Standard deviation
Water temperature(°C)	29.84	±1.84
Water pH	7.98	±0.56
Salinity (‰)	22.57	±14.76
Dissolved oxygen (ml/lit)	4.62	±0.57
Ammonia-nitrogen (µg atom/lit)	6.67	±4.59
Chlorophyll a (mg/lit)	0.37	±0.20
Total plankton (units/m ³)	12317x10 ⁻³	±26030 x10 ⁻³

Table 2 : Correlation co-efficients of phytoplankton in relation to different physico- chemical parameters in Mulki estuary

Parameters	Water temp.	pH	Salinity	Dissolved oxygen	Ammonia	Chlorophyll a	Plankton
Water temp.	1						
pH	0.621	1					
Salinity	0.310	0.815	1				
DO	0.598	0.991	0.823	1			
Ammonia	-0.578	-0.771	-0.560	-0.742	1		
Chlorophyll	0.166	0.433	0.617	0.432	-0.365	1	
Plankton	0.502	0.296	0.367	0.272	-0.320	0.344	1

Table 3: Monthly Percentage contribution of phytoplankton groups and total phytoplankton (no./m³) in Mulki estuary

Group	Monsoon		Post-monsoon			Pre-monsoon				Monsoon		
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.
Cyanophyceae (%)	7.633	5.676	1.330	2.106	0.000	0.000	0.138	0.029	0.000	0.000	16.728	11.567
Chlorophyceae(%)	36.816	23.515	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	26.993	46.084
Bacillariophyceae(%)	19.408	31.505	51.344	78.237	69.539	58.364	68.916	62.826	55.746	72.153	20.637	6.460
Dinophyceae(%)	36.143	39.304	47.326	19.658	30.461	41.636	30.946	37.145	44.254	27.847	35.642	35.889
Total phytoplankton (no./m ³)	14480	20411.2	12822.2	6292.7	72474.2	108095	2875697	1204115	175589.3	811329.3	61365.2	32317.2

of water with higher saline conditions during the post and pre-monsoon season and during the peak monsoon season, the minimum value of 0.08 per cent was reported during later part of August. The salinity concentration reduced rapidly due to copious amount of fresh water running into the sea and low saline condition was observed throughout the monsoon period. Dissolved oxygen of water varied from to minimum of 3.10 mg/lit to 6.10 mg/lit with mean values ranging from 4.59 ± 0.52 to 4.68 ± 0.70 mg/lit. The suspended solids varied from 50.42 to 59.65 mg/lit during the entire study period. Ammonia nitrogen content varied between 6.12 and 7.11 $\mu\text{g-at/lit}$ and the fluctuations encountered throughout the period of investigation which can be attributed to the conversion of ammonia into other forms of nitrogen, sea water influence and utilization by plankters. Nitrate - nitrogen values varied from 1.83 to 46.31 $\mu\text{g-at./lit}$ with the mean values ranging from 11.76 to 14.16 ± 13.54 $\mu\text{g-at./lit}$. The values of nitrate declined from August reduced and remained uniformly in low concentrations till March 2008. Analysis of variance indicated a significant variation with respect to all the physical and chemical parameters spatially and seasonally.

The total phytoplankton numbers varied from 5,62,518 no./m³ to 16,22,660 no./m³ with maximum numbers reporting during post monsoon and minimum during monsoon months. The estuary was dominated by

freshwater during monsoon months and during the onset of post-monsoon, due to enhanced wind velocity and water mixing the water gets mixed up and which will improve the salinity in the estuary with good nutrient load resulting in enhanced phytoplankton production in post-monsoon season (Palleyi *et al.*, 2008). *Cyanophyceae*, *Chlorophyceae*, *Bacillariophyceae* and *Dinophyceae* groups were reported with Diatoms forming the bulk of the phytoplankters and dominated throughout the period of study with numbers varying from zero to 3243025 no./m³. About sixteen genera of diatoms were reported, of which the commonly observed forms are *Bidulphia* spp., *Chaetoceras* sp., *Coscinodiscus* spp., *Gyrosigma* sp., *Leptocylindricus* sp., *Nitzschia* spp., *Pleurosigma* sp., and *Rhizosolenia* spp. Diatoms were dominant during early pre-monsoon with least numbers in monsoon period. Green algae ranged from 4779 to 16563 no./m³, showing maximum production during monsoon months. 15 species of chlorophycea were reported with maximum representation from *Anthyrodesmus* sp., *Closterium* spp., *Cosmarium* sp., *Desmidium* sp., *Docidium* sp., *Microspora* sp., *Micrasterias* sp., *Mougeotia* sp., *Pondorina* sp., *Pediastrum* spp., *Sphaerososma* sp., *Spirogyra* sp., *Triploceras* sp. and *Zygnema* sp. Four species of dinoflagellates were reported with the numbers ranging from 1236 to 1407148 no./m³ with maximum occurrence during premonsoon period at all the stations.

Table 4 : Distribution of different groups of phytoplankton (thousand no./m³) at different stations in Mulki estuary

Stations	Groups	Monsoon		Post-monsoon				Pre-monsoon			Monsoon		Mean	SDV	
		Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.			Jul
S ₁	Cynophyceae	539	752	432	0	0	0	10774	1020	0	0	7044	3011	1964	3445
	Chlorophyceae	3668	3836	0	0	0	0	0	0	0	0	21559	14083	3595	6981
	Bacillariophyceae	1267	2106	1562	1160	104622	82135	2236792	1150272	87289	1165086	5452	48	403149	723551
	Dinophyceae	0	370	522	110	87	1280	2510	10331	3850	0	0	0	1588	3010
S ₂	Cynophyceae	830	522	250	70	0	0	0	370	0	0	10395	8204	1720	3580
	Chlorophyceae	5166	6087	0	0	0	0	0	0	0	0	27980	18255	4791	9068
	Bacillariophyceae	1567	4231	4900	840	60444	120523	2298873	1205443	77146	558044	5670	0	361473	707465
	Dinophyceae	7562	10840	8151	980	61828	124071	2298873	1213361	78505	583646	44044	26458	371526	705149
S ₃	Cynophyceae	1359	2742	0	230	0	0	2247	0	0	0	12127	1497	1683	3434
	Chlorophyceae	9099	5682	0	0	0	0	0	0	0	0	10757	13757	3275	5147
	Bacillariophyceae	2915	3265	2086	2677	24960	31141	3243075	483388	64782	287781	20398	4681	347595	923944
	Dinophyceae	13372	13739	3100	2927	25190	33495	3245322	497112	124975	297297	43282	19935	359979	921098
S ₄	Cynophyceae	1693	618	0	230	0	0	2869	0	0	0	11495	2241	1595	3277
	Chlorophyceae	3391	3594	0	0	0	0	0	0	0	0	5961	13477	2202	4083
	Bacillariophyceae	5492	16120	17786	15016	11565	18557	148553	186878	162318	330688	19137	3622	77977	105061
	Dinophyceae	0	7141	12500	931	1201	21178	81890	68283	103492	22775	160	0	26629	36614

Ceratium spp., *Dinophysis* sp. were the commonly occurred species at all the stations with *Ceratium* being the dominant sp. Total number of blue-green algae during the period of study ranged from 130 to 10264 no. /m³ with *Oscillatoria* sp., *Anabaena* and *Nostoc* occurring majorly. The maximum production was found to be in monsoon and pre-monsoon months. Naik *et al.* (2009) reported 63 species of diatoms, 8 species of dinoflagellates and 6 species of bluegreen algae in Mahanadi estuary. Phytoplankton exhibited a positive correlation with all the hydrographical parameters in the estuary and exhibited a significant difference spatially and seasonally.

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REFERENCES

Anonymous (2006). *Handbook of aquaculture and fisheries*. (Ed). S. Ayyappan, ICAR, NEW DELHI, INDIA.

Devassy, V.P. and Goes, J.I. (1989). Seasonal patterns of phytoplankton biomass and productivity in a tropical estuarine complex (west coast of India). *Proc. Plant Sci.*, **99** (5):485-501.

George, Basil, Kumar, Nirmal J.I. and Kumar, Rita N. (2012). Study on the influence of hydro-chemical parameters on phytoplankton distribution along Tapi estuarine area of Gulf of Khambhat, India. *Egyptian J. Aq. Res.*, **38** (3) : 157-170.

Mani, P. (1992). Natural phytoplankton communities in Pichavaram Mangroves. *Indian J. Mar. Sci.*, **12** : 278-280.

Naik, S., Acharya, B.C. and Mohapatra, A. (2009). Seasonal

variations of phytoplankton in Mahanadi estuary, east coast of India. *Indian J. Mar. Sci.*, **38**(2): 184-190.

Paerl, H.W., Lexia, M. V., Alan R. J. and Valerie, W. (2007). Phytoplankton indicators of ecological change in the eutrophying Pamlico sound system, North Carolina. *Ecol. Appl.*, **17**: 88-101.

Palleyi, S., Kar, R.N. and Panda, C.R. (2008). Seasonal variability of phytoplankton population in the brahmani Estuary of Orissa, India. *J. Appl. Sci. Environ. Mgmt.*, **12**(3):19-23.

Perumal, N.V., Rajkumar, M., Perumal, P. and Rajasekar, K.T. (2009). Seasonal variation of phytoplankton diversity in the Kaduviyar estuary, Nagapattinam, South east coast of India. *J. Environ. Biol.*, **30** : 1035-1046.

Qasim, S.Z. (2010). Role of estuaries in sustainability of coastal environment. *J. Coast. Environ.*, **1**(2): 105-114.

Rajasegar, M., Srinivasan, M. and Rajaram, R. (2000). Phytoplankton diversity associated with the shrimp farm development in Vellar estuary, South India. *Seaweed Res. Util.*, **22** : 125 - 130.

Selvaraj, C.S.D., Thomas, V.J. and Khambadkar, R. (2003). Seasonal variation of phytoplankton and productivity in the surf zone and backwater at Cochin. *J. Mar. Biol. Ass. India*, **45** (1) : 9-19.

Sukumaran, M., Kothandapani, S. and Muthukumarravel, K. (2014). Studies on the diversity of phytoplankton in the Muthupet estuary south east coast of India. *Internat. J. Adv. Doctoral Res.*, **3** (1) : 28-30.

Vengadesh, Perumal, M., Rajkumar, Perumal, M.P. and Thillai Rajasekar, K. (2009). Seasonal variations of plankton diversity in the Kaduviyar estuary, Nagapattinam, South east coast of India. *J. Environ. Biol.*, **30** (6): 1035-1046.

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