Seasonal Variations and Diversity of Marine Diatoms of Jegathapattinam and Kattumavadi, South East Coast of India

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Abstract— The present study entitled on Seasonal variations and diversity of plantonic marine diatoms of Jegathapattinam (Lat. 09º 95 N: Long. 79º 18 E) and Kattumavadi (Lat. 10º 13 N; Long.79º 22 E) South East Coast of India was carried out for a period of one year (from June 2011 to May2012).The study focuses attention on the survey, systematics of marine diatom diversity and the influence of physico-chemical factors on their seasonal distribution. A total of 52 species belonging to 38 genera of marine diatoms were recorded from both stations. The most common genera were Actinocyclus, Amphora, Bacteriastrum, Biddulphia, Chaetoceros, Coscinodiscus, Cyclotella, Diploneis, Gyrosigma, Licmophora, Melosira, Navicula, Nitzschia, Pleurosigma and Tropidoneis were present in the two stations. Higher values of diatom population density were found during summer at both stations. The seasonal distribution and abundance are discussed in relation to physico- chemical parameters.

Key words: Diversity,Marine Diatoms,Physico-Chemical parameters, India

I. INTRODUCTION

Diatoms (Division: Bacillariophyta) are one of the largest group of microorganism. Diatom is among the most successful group of photosynthetic eukaryotes. Microorganisms on earth and are probably well in excess of 100, 000 species (Mann 1999.) Ocean represented a habitat of living environment which are continuous with the past. Diatoms, the micro algae that are found in all aquatic and moist environments, first appeared more than 180 million years ago (Bradbury, 2004). Diatom plays a vital role in establishing food chain relationship between different organisms in marine and estuarine ecosystem (Heald and Odum, 1970). These diatoms occur abundantly and fix significant fraction of their organic carbon to support the ecosystem (Admiraal, 1984). Diatoms are an important indicator of environmental changes where individual species respond directly or indirectly and sensitively to changes in chemical, physical parameters. Such as temperature, light, pH, nutrients, silicate, phosphorous, and nitrogen (Stevenson and Pan, 1999).The fact that each diatom species has a specific optimum and tolerance for some environmental parameters including pH, salinity, temperature, nutrients and light availability, makes them particularly useful indicators for biodiversity (Lim et al.,2001). Hence the present work was undertaken to study the seasonal variation and diversity of planktonic diatoms and hydrographical parameters in Jegathapattinam and Kattumavadi of Pudukkotai District, South east Coast of India.

II. MATERIALS AND METHODS

The planktonic marine diatoms were collected by towing plankton net (mouth diameter 0.35m) made of bolting silk cloth (No.35 meshsize 48 m) for 20 minutes., from the surface of water during themonthly intervals for a period of one year (from June 2011 to May 2012) at two stations in Jegathapattinam (Lat. 09º 95 N: Long. 79º 18 E) and Kattumavadi in (Lat. 10º 13 N; Long.79º 22 E) Pudukkotai District. The Water samples were preserved in 4 % neutralizedformalin and used for nutrient analysis, qualitative analysis of diatoms, the settling method described by Sukhanova (1978).Cleaning of diatom sample by Nitric acid Method (Hendey,1964). Identification of diatoms by Standard Manuals (Boyer, 1926 ;) Hustedt (1930);Subrahmanyan (1946);Cleve-Euler (1951-1955);Hendey(1964).

III. RESULTS AND DISCUSSION

A. Environmental Parameters and their Influence

For this study monthly variation in meteorological and physico-chemical parameters, rainfall, air, surface water temperature, salinity, pH, dissolved oxygen, reactive silicate, inorganic phosphate, organic phosphate, nitrate and nitrite were recorded for a period of one year from June 2011 to May 2012. The total annual rainfall recorded from the study area(S I and S II) varied from 1.0 mm to 413.6 mm. Minimum 1.0 mm rainfall was recorded during February 2012 at station I and II. Maximum 413.6 mm rainfall was recorded during November 2012 at station I and II. The Physicochemical parameters are subjected to wide spatial temporal variations. Rainfall is the most important cyclic phenomenon in tropical countries as it brings about important changes in the physical and chemical characteristics of the coastal and estuarine systems.Similar observation was reported by Kaliyaperumal, (1992) and Mathevan (1994).

Temperature is another important factor in the coastal and estuarine environments, which influences the physico- chemical characters. In general, air and water temperatures were recorded during the summer months during the study period varied from 23 to 36ºC. The minimum (23ºC) was recorded during the month of November 2011 at station II and maximum was recorded (36oC) during the month of May2012 at station I and II. The surface water temperature varied from 23 to 34ºC. The minimum surface temperature was recorded (23oC) was recorded during July and November 2011 at station I and maximum was recorded during May 2011 at station II. In general the two stations showed similar monthly changes. Similar observations were reported by RamalingamManikannanet al., (2011) from Vedaranyam

Swamp of the Point Calimere, South-east coast of India, Sushanth and Rajashekhar (2012) from the coastal ecosystem.

Salinity is one of the key factor that determines the distributions of diatoms. In the present study, salinity range varied from 28 to 37ppt. The low value (28ppt) during November 2011 at stations II and high value (37ppt) during the month of July and May2011 and 2012 at station I. This couldbe due to the continues evaporation of water from the all study area especially during the summer seasons as observed by Palpandi (2011) from Vellar estuary, South east coast of India by many workers Similar trend in the salinity values were also observed from various parts in southeast coast of India (Seenivasan, 1998;Palanichamy and Rajendran, 2000;Sulochana and Muniyandi, 2005; Prabuetal., 2008; Soundarapandianet al., 2009;Damotharan et al., 2010). In all the above studies the salinity was found fluctuating widely which was mainly due to the influence of rainfall and influx of the freshwater into the study areas.

The hydrogen ion concentration (pH) of water may influence many biological and chemical characteristics of marine waters (Saad, 1978). In general hydrogen ion concentrations fluctuated in all the stations during the study period and the temperatureas suggested by several authors (Zingdeetal1985; Tiwari and vijayalakshmi 1993; Soundarapandianet al., 2009; Sushanth and Rajashekhar, 2012; Medudhulaet al., 2012). Similar trend in pH was reported by Seenivasan (1998) from the Vellar estuarinesystem, Palanichamy and Rajendran (2000) from Palk Bay, Prabuet al., (2008) from Pichavaram mangroves, Damotharanet al.,(2010) from Point Calimere coastal water.RamalingamManikannanet al., (2011) from Great Vedaranyam Swamp of the Point Calimere Wildlife Sanctuary, South-east coast of India.

Dissolved oxygen showed a wide range of Variations throughout the study period at both stations. In general, the maximum values recorded during the monsoon month and minimum during the summer month. This is attributed to the variations in freshwater inflow and tidal ingress (Eswari and RamaniBai 2002). This was effected by low salinity, air and surface water temperature values. The earlier findings confirmed works that high concentrations of dissolved oxygen in low saline water coupled with low temperature during monsoon. It was noted that in the study area, the standing crop of diatoms were more during summer months (when dissolved oxygen concentrations was low due to cessation of freshwater flow) as reported by Jeyachandran (1989) in Pitchavram mangroves.

S. NO	**Name of the Diatoms**	S. NO	**Name of the Diatoms**
1.	Actinocyclusehrenbergii var.ralfsii (W.Smith)	27.	MelosiranummuloidesAgardh
2.	Achnantheshauckiana Grun.	28.	NaviculaarabicaGrun
3.	Amphora coffeaeformis(Ag.)Kutz	29.	N. clementisvar. linearis Brander ex Hustedt
4.	A. marina (W.Sm.)V.H	30.	Navicula granulate (Bailey)
5.	A. ovalis(Kutz) (Kutz)	31.	N. lyraHer
6.	Bacteriastrumfurcatum Shadbolt	32.	N. rhynchocephalaKützing
7.	Biddulphiamobiliensis Bailey	33.	N. salinarumGrunow
8.	Caloneispermagna(Bailey) Cleve	34.	Nitzschiaclosterium(Ehrenberg)W-Smith
9.	Chaetoceroslorenzianus Grun	35.	N.flexaSchumann
10.	CocconeiscostataGreg	36.	N.granulateGrun
11.	Coscinodiscuscentralis Her	37.	N. insignisGreg
12.	C. kutzingiiA.Schmidt	38.	N. punctate (Wm.Smith) Grun
13.	C. normaniiGregory in Greville	39.	Pinnulariaviridis(Nitzsch) Ehrenberg
14.	Cyclotellastriata(Kutz) Grun	40.	Planktoniellasol (wallich) Schutt
15.	Diplomenoracocconeiforma A & S Plaze	41.	Pleurosigmaaestuarii(Debreb.)W.Smith
16.	Diploneisbombus(Ehr.) Her	42.	Rhabdonemamirificoom w.smith
17.	D. crabro Her	43.	RhopalodiagibberulaKutz
18.	D. weissflogii(A.Schmidt) Cleve	44.	Skeletonemacostatum(Greville) Cleve
19.	Grammatophora marina (Lyngb.) Kutz	45.	SurirellaminutaBrébissonin Kützing
20.	Gyrosigmaattenuatum (Kutz.) Rabh	46.	SynedraformosaHantzsch
21.	G.balticum(Ehr).Cleve	47.	Thalassionemanitzschioides Grunow
22.	G. distortumvar. parkeri (M.B.Harrison)	48.	ThalassiothrixfrauenfeldiiGrunow
23.	G. scalproides(Rabh.) Cleve.	49.	Thalassiosiradecipiens(Grunow)
24.	LauderiaannulataCleve	50.	TriceratiumdubiumBrightwell
25.	Licmophora abbreviate Agardh	51.	TriceratiumfavusEhrenberg
26.	Licmophora abbreviate Agardh	52.	Tropidoneis Lepidoptera (Gregory) Cleve

Table 1: List of isolated of Diatoms

Station	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Fep	Mar	Apr	May
I	5462	5633	5645	5861	3942	3740	4123	5864	7210	11138	10915	10613
II	5612	6232	6095	6245	5368	3367	3175	4123	4790	9896	12183	14211

Table 2: Diatom population Density (cell numbers/ ml) during 2011-2012

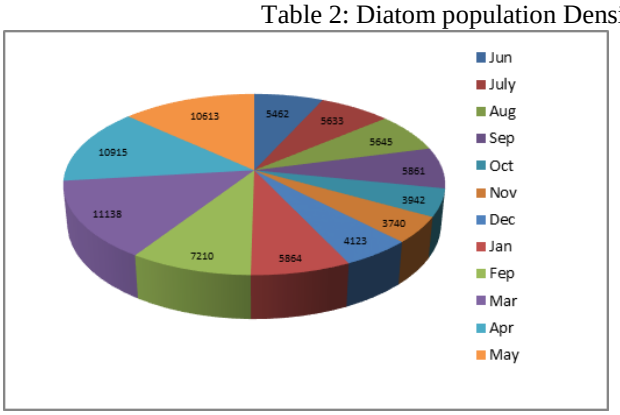

Fig. 1: Diatom population Density (cell numbers/ ml) during 2011-2012

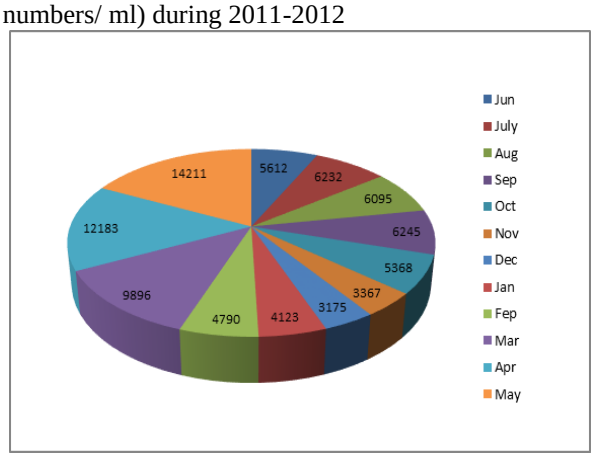

Fig. 2: Diatom Population Density (cell numbers/ ml) during 2011-2012

S. No.	Parameters	Pre Monsoon			Monsoon			Post Monsoon			Summer		
		JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
1.	Rainfall	29.9	73.7	91.1	74.6	262.0	413.6	56.1	4.5	1.0	22.3	9.3	3.4
2.	Air Temperature	26	26	29	27	25	23	33	30	29	28	33	36
3.	Water temperature	24	23	30	26	24	23	30	28	27	26	31	32
4.	Salinity	35	37	34	35	31	27	30	34	36	33	34	37
5.	pH	7.4	7	6.8	6	7.1	6.5	7.8	7.5	8.0	7.6	8.3	8.5
6.	Dissolved oxygen	3	2.5	3.4	2.1	3.2	6.3	5.2	5	2.1	3.2	2.2	2.1
7.	Reactive Silicate	10	11	12	11	46	48	39	33	25	20	17	12
8.	Inorganic Phosphate	3.1	4.0	4.4	4.1	5.6	5.7	4.3	3.0	2.5	2.5	2.0	2.2
9.	Organic Phosphate	6.5	7.5	7.5	7.0	12.3	15.4	7.1	4.7	4	3.1	3.0	2.5
10.	Nitrate	7	8.1	8.5	7.3	10.2	11.3	7.8	4.1	3.5	6.5	2.7	2.4
11.	Nitrite	3.1	3.4	7.1	3.4	10.8	12.2	4.1	4.0	3	3.4	3.1	3
12.	Diatom Population	5462	5633	5645	5861	3942	3740	4123	5864	7210	11138	10915	10613

Table.3: Environmental parameters -2011-2012 (Station I)

S. No.	Parameters	Pre Monsoon			Monsoon			Post Monsoon			Summer		
		JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
1.	Rainfall	29.9	73.7	91.1	74.6	262.0	413.6	56.1	4.5	1.0	22.3	9.3	3.4
2.	Air Temperature	31	34	36	33	27	28	29	28	28	29	33	36
3.	Water temperature	30	32	33	31	26	27	27	29	27	28	31	34
4.	Salinity	35	33	34	35	31	28	32	33	32	34	35	36
5.	pH	8.9	8.3	7.5	7.6	6.9	6.5	7.0	7.5	8.3	8.1	8.2	8.5
6.	Dissolved oxygen	9.2	1.2	3.5	2.5	4.5	6.5	4.6	4.1	3.6	2.5	2.2	1.5
7.	Reactive Silicate	12	14	16	13	41	47	44	30	25	19	15	9
8.	Inorganic Phosphate	4.1	4.3	4.5	4.2	4.5	5.1	4.2	3.6	3.5	3.1	3.2	2.5
9.	Organic Phosphate	7	10	12	8.9	12	10.9	7.5	3.5	3.2	3.1	2.8	2.4
10.	Nitrate	2.5	2.7	3.9	4.3	5.5	5.3	5.1	4.2	3.8	3.5	3.1	2.5
11.	Nitrite	2.4	4.5	4.9	4.6	4.5	5.4	4.9	4.8	4.2	4.3	4.5	3.5
12.	Diatom Population	5612	6232	6095	6245	5368	3367	3175	4123	4790	9896	12183	14211

Table 4: Environmental parameters -2011-2012 (Station II)

S.No	Name of the Diatoms	Station	
1.	Actinocyclus	1	-
2	Achnanthes		1
3.	Amphora	2	-
4.	Bacteriastrum	-	2
5.	Biddulphia	1	1
6.	Caloneis	2	1
7.	Chaetoceros	1	-
8.	Cocconeis	2	1
9.	Coscinodiscus	2	1
10.	Cyclotella	1	1
11.	Diplomenora	1	-
12.	Diploneis	2	1
13.	Grammatophoa	1	-

14.	Gyrosigma	1	-
15.	Lauderia	-	2
16.	Licmophora	1	-
17.	Melosira	1	2
18.	Navicula	-	1
19.	Nitzschia	2	1
20.	Pinnularia	1	1
26.	Planktoniella	1	-
27.	Pleurosigma	-	2
28.	Rhabdonema	1	-
29.	Rhopalodia	2	1
31.	Skeletonema	1	1
32.	Surirella	1	-
33.	Synedra	1	2
34.	Thalassionema	1	1
35.	Thalassiothrix	-	1
36.	Thalassiosira	1	-
37.	Triceratium	1	2
38.	Tropidoneis	1	-
	Total	33	26

Table 5: Distribution of Diatoms in Genera During June 2011 To May 2012

Higher dissolved oxygen concentration observed during monsoon season may be due to the cumulative effect of higher wind velocity joined with heavy rainfall and the resultant freshwater mixing (Daset al., 1997; Vijayakumaret al., 2000; Prabuet al., 2008; Damotharanet al., 2010).Nutrients concentrations showed distinct seasonal variations. High reactive silicate present at the bottom sediments might go into upper surface layers when the bottom region is agitated by wind action during the monsoonal floods. Low values of silicate recorded during the summer may be due to the abundant planktonic diatoms for their biological activity (Gouda and Panigrahy, 1992). In addition to planktonic diatom uptake, some related processes like absorption and co precipitation of soluble silicon might also govern the distribution of dissolved silicate in the marine environment (Sivakumar, 1982; Gouda and Panigrahy, 1992 and Sushanth and Rajashekhar, 2012).

Inorganic phosphate concentration ranged from 2.0 to 5.7µmL-1. Minimum concentration was observed during the month of Apr 2012 at station I and maximum (5.7µmL -1) during the month of November 2011 at station I. Similar observations have been made by Senthilkumaret al., (2002); RamalingamManikannanet al., (2011). Organic phosphate concentration value varied between 2.4 and 15.4µm L -1. The lowest value was recorded during the month of May 2012 at station II and peak value was recorded in the month of Nov 2011 at station I. The same result was obtained by various authors Gowda and Panigrahy, (1992). Nitrate concentration ranged from 2.4 to 11.3µm L -1.The minimum value recorded was 2.4µm L-1 during the month of May2012 at stations I. The maximum value recorded was 11.3µm L -1 during the month of November 2011 at station I. The same was recorded by Mathevan (1994) from Cuddalore Uppanar estuary, Satpathy (1996) from coastal waters of Kalpakkam.Daset al., (1997); Govindasamyet al., 2000; Medudhulaet al., (2012).

B. Diatom Population Density

Diatom population density ranged between 3740 and 11138 cells/ml. Minimum population density was observed during the month of November 2011 and maximum was recorded in the month of March 2012 (Table- II & Fig.-1-2). In minimum population was reported from station I (3740 cells/ml). Planktonic diatoms totalling 52 species belonging to 38 genera were collected from the both stations in the study area (Table- I & V).In station I 33 species belonging to 26 genera, at station II 26 species 20 genera (Table- V). Similar observations were made by many workers (Nagasathya and Thajuddin, 2008; Ya-hui,Lianget al.,2011).

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