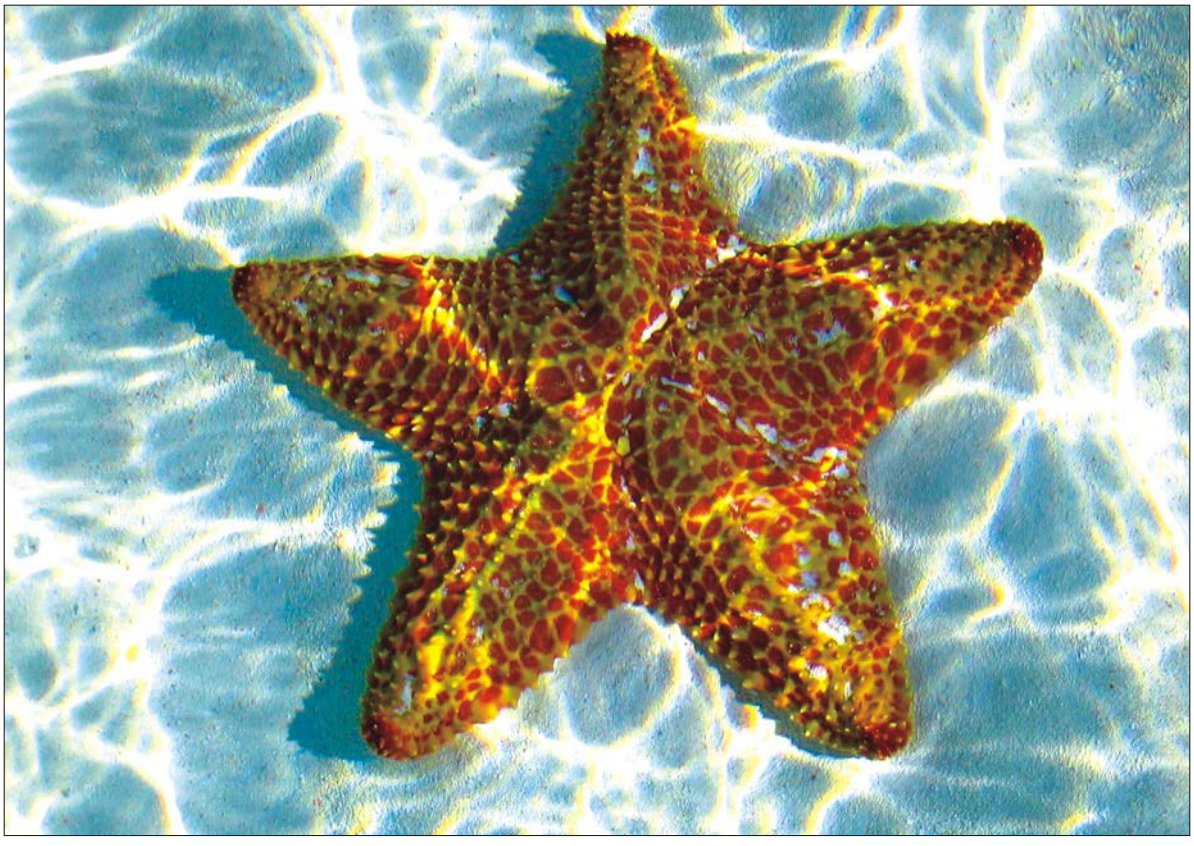

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Species Composition, Abundance and Distribution of Phytoplankton in the Harbour Areas and Coastal Waters of Port Blair, South Andaman

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ABSTRACT

Species composition, abundance and distribution of phytoplankton were studied from harbour and coastal waters during February and March, 2009. A total of 49 genera with 65 species of phytoplankton were recorded in this study. Among these 40 genera was represented by 46 species of diatoms and 9 genera with 19 species of dinoflagellates. There were 40 species of diatoms, 15 species of dinoflagellates in the harbour areas and 36 species of diatoms, 16 species of dinoflagellates in the coastal waters were recorded during February. Whereas 33 species of diatoms, 15 species of dinoflagellates in the harbour areas and 37 species of diatoms, 13 species of dinoflagellates in the coastal waters were recorded in March. The study indicated higher phytoplankton densities and low diversity in harbour areas compared to coastal waters.

Key words: Phytoplankton, harbour areas, coastal waters, species composition, abundance, distribution

INTRODUCTION

Phytoplankton forms the vital source of energy in the marine environment. They initiate the marine food chain, by serving as food to primary consumers, which include zooplankton, shellfish, finfish and others (Ananthan *et al*., 2004; Tas and Gonulol, 2007). Generally, Phytoplankton in coastal waters receive sewage wastes; increases in standing crop or productivity or both, have been described by Taslakian and Hardy (1976), Duedall *et al*. (1977) and Malone (1977). Moreover, the pollution on harbour areas is highly publicized but its effects on plankton have received less attention. Environmental disturbances from such as pollutants are known to induce changes to the structure and function of biological systems (Odiete, 1999). Literature is available on the distribution of phytoplankton in coastal waters around Andaman Islands are limited (Devassy and Bhattathiri, 1981; Sarojini and Sarma, 2001; Madhav and Kondalarao, 2004). Information about the phytoplankton on moderately polluted harbour area is lacking. Hence, an attempt has been made to study the species composition, abundance and distribution of phytoplankton in the harbour areas and coastal waters.

MATERIALS AND METHODS

Phytoplankton sampling was carried out for a period of month during February and March 2009. The study area was divided in to two categorize viz., (1) harbour areas and (2) coastal waters.

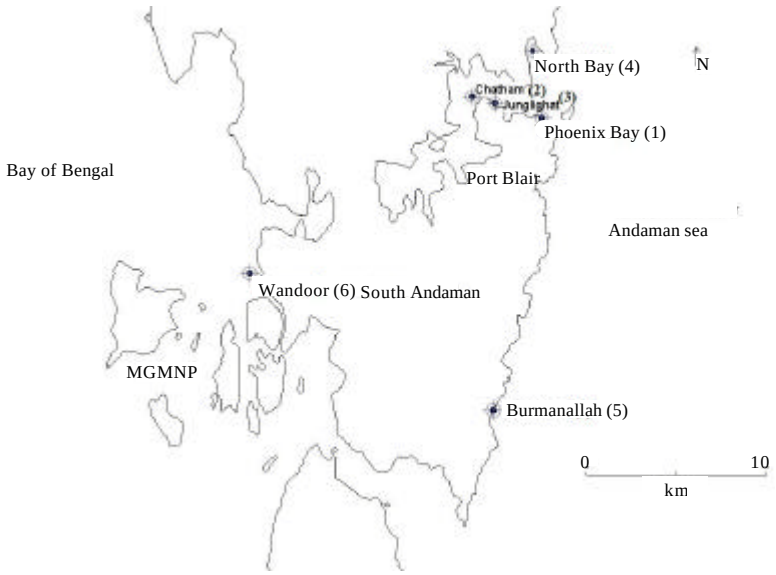

Fig. 1: The study area and location of the sampling sites

St. (1, 2 and 3) are harbour areas and remaining (St. 4, 5 and 6) are coastal waters (Fig. 1). Water samples were collected for the measurement of air and seawater temperature, salinity and pH. Water samples for phytoplankton count were collected in 250 mL bottles by filtering 50 L of water, using phytoplankton scoop net. For phytoplankton taxonomy and cell counts, 500 mL water samples were fixed with a few drops of Lugol's iodine, preserved in 4% formalin. The samples were concentrated and stored in the dark for a couple of days until complete sedimentation was achieved. The phytoplankton cells were counted using a Sedgewick-Rafter counting chamber and examined under the microscope.

RESULTS

In the study area, water temperature in the range of 30.5 to 31.6°C at all stations. Salinity ranged from 29 to 31‰ and it was recorded high during February at all the stations. The pH values of harbour areas were ranged from 7.3 to 8.1 whereas in coastal waters were 7.1 to 7.4.

A total 49 genera with 65 species were identified from the samples collected in the surface layer during the survey. Diatom was found to be the most dominant group in terms of a number of species followed by dinoflagellates. Phytoplankton consisted of 40 genera with 46 species of diatoms and 9 genera with 19 species of dinoflagellates (Table 1). During February, diatoms and dinoflagellates were recorded more in harbour areas while March they found more in coastal waters. Diatoms were represented by *Chaetoceros* (3 species) *Ceratium* (5 species) and *Protoperidinium* (5 species). *Coscinodiscus* sp., *Guinardia flaccida* and *Pleurosigma* spp. were found to be common at all stations. The maximum cell count was found at St. 3 and minimum cell count was found at St. 6 during February. Whereas during March maximum density was found at St. 1 and minimum was at St. 5 (Table 2).

Table 1: List of phytoplankton species occurred in harbour areas and coastal waters

	February						March					
	Harbour area			Coastal waters			Harbour area			Coastal waters		
Phytoplankton species	1	2	3	4	5	6	1	2	3	4	5	6
Diatoms												
Actinoptychus senarius		*		*						*		*
Amphiprora sp.		*										
Amphora sp.			*	*					*	*	*	*
Asterionellopsis sp.	*				*			*			*	
Bacillaria paradoxa	*	*					*					
Bacteriastrum hyalinum				*				*		*		
Biddulphia bidduliana			*		*			*	*		*	*
Campylodiscus sp.		*	*			*			*	*		*
Cerataulina pelagica	*				*		*				*	*
Chaetoceros atlanticus	*			*								
Chaetoceros sp.		*		*		*			*	*	*	
Chaetoceros decipiens			*			*						*
Climacodium frauenfeldianum			*			*	*					
Coscinodiscus sp.		*	*	*	*	*	*	*	*	*	*	*
Cyclostephanos dubius									*			*
Cylindrotheca closterium			*		*			*			*	*
Cymbella sp.		*				*					*	
Diploneis sp.			*				*		*			
Fragilaria sp.						*				*		*
Grammatophora sp.	*				*		*	*			*	
Guinardia flaccida	*		*		*	*	*		*	*	*	*
Gyrosigma sp.		*	*						*			
Hemiaulus sp.										*	*	
Isthmia ernervis			*	*	*				*		*	
Leptocylindrus danicus	*	*	*					*	*	*		
Licmophora sp.				*	*	*	*	*			*	*
Melosira nummuloides		*		*	*			*				*
Melosira sulcata	*	*					*				*	
Navicula marginata	*				*	*	*		*		*	
Navicula sp.	*	*			*						*	
Nitzschia longissima			*	*		*			*		*	
Odontella sp.		*		*	*		*	*			*	
Pinnularia sp.	*		*					*	*	*		
Plagiotropis sp.				*								
Planktoniella sol		*				*		*		*		*
Pleurosigma angulatum			*	*	*		*	*	*	*		
Pleurosigma sp.		*			*	*	*	*	*	*	*	*
Pseudo-nitzschia sp.			*	*	*					*		
Rhabonema arcuatum		*		*		*				*		
Rhizosolenia calcar-avis	*			*	*			*		*	*	*
Rhizosolenia sp.	*	*		*			*	*	*			
Skeletonema costatum	*		*									*
Striatella sp.						*			*		*	
Surirella sp.	*	*			*		*					

Table 1: Continued

	February						March					
	Harbour area			Coastal waters			Harbour area			Coastal waters		
Phytoplankton species	1	2	3	4	5	6	1	2	3	4	5	6
Thalassiosira polychorda		*		*		*						*
Triceratium sp.		*		*		*		*		*		
Dinoflagellates												
Ceratium furca		*					*	*		*		
Ceratium fusus					*	*		*		*	*	*
Ceratium sp.	*	*							*	*		
Ceratium sp.			*		*	*					*	
Ceratium tripos		*		*		*		*				*
Cochlodinium sp.					*							
Dinophysis caudata	*	*		*			*	*		*		
Diplopsalis sp.			*			*	*	*				
Gymnodinium sp.					*				*			
Mesoporos perforatus	*			*	*				*	*		*
Peridinium aciculiferum	*		*		*			*			*	
Peridinium oceanicum		*	*			*	*					
Peridinium sp.					*	*					*	
Prorocentrum sp.	*	*		*					*	*		
Protoperidinium divergens		*		*		*		*	*	*		
Protoperidinium granii		*	*			*	*	*				*
Protoperidinium leonis	*											
Protoperidinium sp.			*			*		*				
Protoperidinium steinii		*		*		*		*	*			*

*: Species found

Table 2: Dominant species in harbour area and coastal waters

Month	Area	Station	Total (cells L^{-1})	Dominant species
Feb.	HA	1	13,091	*Guinardia flaccida*
		2	10,545	*Dinophysis caudata*
		3	17,091	*Guinardia flaccida*
	CW	4	12,000	*Mesoporos perforatus*
		5	11,636	*Peridinium aciculiferum*
		6	6545	*Thalassiosira polychorda*
Mar.	HA	1	12,000	*Pleurosigma angulatum*
		2	11,273	*Melosira nummuloides*
		3	8000	*Leptocylindrus danicus*
	CW	4	9091	*Amphora* sp.
		5	7636	*Biddulphia bidduliana*
		6	9818	*Skeletonema costatum*

HA: Harbour areas, CW: Coastal waters

DISCUSSION

Variations in physico-chemical parameters showed an affect on phytoplankton abundance and distribution (Rajkumar *et al*., 2009; Nowrouzi and Valavi, 2011; Fathi *et al*., 2009). The surface water temperature ranged from 27 to 30°C and it was low in March as compared to February at

all stations. The maximum temperature (30°C) was recorded at St. 1 and 6 and minimum temperature (27°C) was recorded at St. 5. Variation in the water temperature may be due to the difference in sampling time and the effect of a season (Jayaraman *et al.*, 2003; Tiwari *et al.*, 2004). Salinity is the main physical parameter that can be attributed to the plankton diversity which acts as a limiting factor that influences the distribution of planktonic community (Kouwenberg, 1994; Ramaiah and Nair, 1997; Mohan and Sreenivas, 1998; Balasubramanian and Kannan, 2005; Sridhar *et al.*, 2006). Salinity values were found maximum during February as compared to March at all stations. The St. (2 and 5) showed maximum salinity of 31‰, whereas the minimum salinity of 29‰ was recorded at St. (1 and 6). Maximum phytoplankton density was recorded at St. 1 and 3 where salinity was high as observed in this study was also reported earlier from Bay of Bengal (Rajkumar *et al.*, 2009). The pH values were showed high as compared to coastal waters in our study.

Increase in phytoplankton standing crop was found in harbour area compared to other coastal waters could be due to the discharge of domestic and industrial effluents (Braarud, 1945, 1969; Goodbody, 1970; Turner and Hopkins, 1974). Such wastes have been a major cause for the nutrient enrichment resulting in a decrease in diversity and an increase in biomass promoting some opportunistic algal species to dominate (Dederen, 1992; Kimor, 1991). Tiwari and Nair (1998), Ramaiah *et al.* (1998), Gopinathan *et al.* (2001), Gowda *et al.* (2001), Jalal *et al.* (2011) and Onyema (2008) reported that diatoms were found to be dominant as observed in this study, which could be due to the fact that diatoms can tolerate the widely changing hydrographical conditions (Rajasegar *et al.*, 2000; Gowda *et al.*, 2001; Senthilkumar *et al.*, 2002). *Guinardia flaccida* was dominated at the St. (1 and 3) during February and *Skeletonema costatum* dominated at St. 6 during March. These two dominant species appear to be confined to coastal waters yet fail to form resting spores (Smayda, 1958). Though the composition of dominant species varied with the different season and with increasing salinity, *Skeletonema costatum* was always prominent. The occurrence of *Skeletonema costatum* as an indicator of eutrophication was reported by Smayda, (1965). The presence of *Cerataulina pelagica* at St. (1, 5 and 6) also as indicators of eutrophication (Dorgham, 1987). *Planktoniella sol* is a circumtropical diatom and found principally in oceanic regions (Smayda, 1958) and this species was observed in the St. (2, 4 and 6) in this study. The dominance of any species in the polluted water may be considered as indicator species (Dorgham, 1987). *Bacteriastrum hyalinum* and *Chaetoceros* spp. prefer relatively higher nutrient regions and these species were recorded in most of the stations indicating nutrient enriched areas which needs further investigation. *Thalassiosira polychorda* was observed more in St. (2, 4 and 6). The demand for Si by diatoms as observed in this study appears to differ with species and such inter-species differences in silica requirements may be one reason for the observed differences in the distribution of *Thalassiosira* sp. (Paul *et al.*, 2008). *Rhizosolenia* sp. was observed in good numbers in both harbour and coastal waters could be due to the reason that this species undergo vertical migration in search of nitrate and then come to the surface for photosynthesis (Singler and Villareal, 2005). *Coscinodiscus* sp. and *Navicula* sp. has been found at most of the stations from both harbour and coastal waters during February and March could be due to the tolerance of wide temperature variations (Horner, 2002). Maximum phytoplankton density was found at the harbour areas where species diversity low as a result of high light and nutrient availability (Tabinda *et al.*, 2003; Bahaar and Bhat, 2011; Periyanayagi *et al.*, 2007) whereas in other coastal waters low phytoplankton density and high species diversity were observed. As similar to earlier study (Dorgham, 1987) some species were shown decreased in abundance at harbour areas may reflect

the tolerance to the domestic wastes and some were increased in abundance may indicate their susceptibility to the municipal wastes.

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