Note

Species composition and diversity of diatoms in the intertidal sediments of Gopalpur coast, Bay of Bengal

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Abstract

The species composition, diversity and distribution of diatoms present in the intertidal sediments of Gopalpur (Lat.19°6'N & Long. 84° 56'E) along Orissa coast in India are presented. The diatom flora comprised of a mixture of benthic-pelagic components. Out of 124 species encountered, 70 belonged to the Order-Pennales and 54 to Order-Centrales. But, only 13 pennate and 9 centric species were found as common to all the 4 locations, and thus they may be considered as endemic. The population density also showed well-marked spatio-temporal variations. There was an unexpected dominancy (86-93%) of Asterionella glacialis, during March and April. The species diversity indices - richness (D), diversity (H') and evenness (J) showed visible changes with respect to space and time.

Diatoms (Class - Bacillariophyceae), the single celled microscopic algae having highly ornamented siliceous cell wall and contributing nearly 23% to the total primary production of the world, are ubiquitous in distribution. They occur in a wide range of moist habitats, more so in coastal areas. In the soft and mobile sedimentary environments, they constitute the most dominant flora mixed with a few species of dinoflagellates, Cyanophyceae and Chrysophyceae (Round, 1960). The diatom populations in the intertidal sandy beaches and mud-flats are highly diverse with respect to their taxonomic composition and substrata affinity (Koen et al., 2003). Perusal of literature (Elisa and Cao, 2003; Bulent, 1998) and the review made by Round (1971), suggest that benthic diatom taxonomy, biology and ecology, are less studied. The benthic diatom studies in Indian waters are quite scanty and mostly limited to their taxonomic evaluation (Desikachary, 1987). Although taxonomy and ecology of planktonic diatoms in near shore areas (Gouda and Panigrahy, 1996), surf waters (Choudhury and Panigrahy, 1989) and the meiofaunal distribution in intertidal beach sediments (Laxman Rao and Patnaik, 1986) have been studied earlier, no published reports are available on microphytobenthos occurring along this coast. The present paper calls attention to the species composition, change in biodiversity and distribution of diatoms in the intertidal sediments of Gopalpur, east coast of India, on a spatio- temporal scale.

Materials and methods

The study was undertaken at Gopalpur (Lat. 19°6'N & Long. 84°56'E), a known beach resort of the southern Orissa. Sediment samples were collected at monthly

intervals during low tide from February to June, 2004 from 4 stations covering the coastline between Hotel Palm Beach and the mouth of the Haripur creek (Fig.1). Only surficial sediments (0-5 cm depth) were collected using PVC tube of 10-cm diameter. The samples were brought to the laboratory in separate containers. Grain size distribution of sediment was done by sieve analysis after



Fig.1. Sampling stations at Gopalpur in Orissa

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Sediment type	Grain size (Ø value)	Feb.	Mar.	Apr.	May	Jun.
Coarse & medium sand	< 2 Ø	45.7-57.5	37.1-56.9	48.1-67.0	55.6-65.9	56.3-61.4
Fine sand	< 3 Ø	38.5-46.2	38.0-58.9	29.0-47.4	30.1-40.3	34.3-39.2
Silt & clay	< 5 Ø	3.9-8.0	4.0-5.3	3.9-5.3	3.8-4.1	4.1-5.1

Table 1. Range of percentage composition and sorting coefficient of sedimentary articles of intertidal beach sands at Gopalpur, during Feb.-Jun. 2004.

they were treated with 10% Hydrochloric acid and 30% Hydrogen peroxide. Qualitative and quantitative estimation of diatoms were made adopting the resuspension technique used by Aleem (1950) and Hopkins (1963). Identification of diatoms was made with the aid of the taxonomic works of Desikachary (1987) and Carmelo (1996). Three diversity indices, such as species richness (D), diversity (H²) and evenness (J) were computed following Shannon-Weaver (1963) and Pielou (1966).

Results and discussion

The beach configuration along the Gopalpur coast shows well-marked seasonal variation being influenced by the monsoonal and reverse monsoonal currents of the Bay of Bengal. Along with the changes in climatological features, the tides of this region also exhibit significant variations. The extreme high water spring of this coast has been measured at 5 m high above the MSL (Laxman Rao and Patnaik, 1986). The changes in beach morphology coupled with cyclic erosion and accretion processes strongly influence the sedimentary environment and thereby, their biota. The physico-chemical properties of the nearshore and surf waters also show significant seasonal variations influenced by monsoon effect (Sasmal et al, 1986; Choudhury and Panigrahy, 1991). During postwinter and summer months, the hydrographical features exhibit moderate fluctuations, while the nutrients, due to their rapid uptake by the bloom forming diatoms show visible loss. A rapid increase of oxygen in surf water in March could be due to photosynthetic activities of the bloom-forming diatom *Asterionella* in surf water. Blooming of this diatom in March/April is an annual event in this part of the Bay of Bengal (Gouda and Panigrahy, 1996; Choudhury and Panigrahy, 1989). Among the three nutrients analysed, only silicate showed more visible changes whose concentration ranged from 23.12 - 32.26 μ g at 1⁻¹. Out of these five months study, lowest values of nutrients were observed in March, in coincidence with the *Asterionella* bloom.

The granulometric properties of sediments play a key role in the colonization of benthic organisms. The grain size and sorting coefficient values of the intertidal sediments at Gopalpur in Wentworth scale are given in Table 1. Silt and clay fractions ($<5\emptyset$) contributed only <5% of the bulk sediment, while the sand ($<2\emptyset$) and fine sand ($<3\emptyset$) fractions accounted about 37-65% and 29-58% respectively.

The diatom flora in the beach sands of Gopalpur was represented by 124 species, 70 from order-Pennales and 54 from Centrales showing that both are almost equally rich. Benthic diatoms are mostly predominated by pinnate forms, consisting of some araphidineae, monoraphidineae or biraphidineae species. The large-scale contribution of centric species in the sediments of Gopalpur coast could be ascribed to the recruitment of some pelagic components from surf waters as was reported by Round (1960) from Massachusetts coast. Significant variation was observed in the floristic composition of diatoms at different locations and during different months. However, 22 spe-

Table 2. Diversity indices of diatoms occurring in the beach sands of Gopalpur, during Feb- Jun., 2004 (All stations pooled)

Month	Feb.	Mar.	Apr.	May	Jun.		
Species richness (D)	2.7	2.7	3.3	3.8	3.1		
Species diversity (H')	0.5	0.4	1.1	1.6	1.6		
Evenness (J)	0.1	0.1	0.5	0.5	0.3		

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Diversity of diatoms in the intertidal sediments of Gopalpur coast



Fig. 2. Population density and relative abundance of diatoms in intertidal beach sediments in Gopalpur

cies viz., Asterionella glacialis, Thalassiosira eccentrica, T. lineata, Thalassiothrix longissima, Rhaphoneis discoides, Guinardia flaccida, Biddulphia mobiliensis, Nitzschia sigma, N. longissima, N. panduriformis, Navicula lyra, Fragilaria sp., Cocconeis distans, Paralia sulcata, Plagiogramma obesum, Amphora binodis, Thalassionema nitzschioides, Trachyneis aspera, Coscinodiscus asteromphalus, Rhizosolenia stolterfothii, R. cochlea, R. styliformis were found commonly at all locations throughout the period of study. But, some other species like Amphora coffeaeformis, Chaetoceros furcellatus, Coscinodiscus rothii, Cymbella aspera, Diploneis cynthia, Nitzschia interruptestriata, N.plana, N.separanda and Pleurosigma carinatum were reported randomly in different locations and periods of collection.

The population density and relative abundance of benthic diatoms also showed distinct spatial as well as temporal variations (Fig. 2). The total population density ranged from $2.24 \times 10^3 - 53.10 \times 10^3$ cells g⁻¹ wet weight. Huge increase in population density at all locations was reported during March, when the diatom crop was dominated by *Asterionella glacialis*. This is a common bloom forming species along this coast. In March, an extraordinary situation was noticed, when the total population density showed overwhelming dominance by pinnate diatoms (>95%). This could happen due to the recruitment of the bloom forming *A. glacialis* cells into the benthic populations by their settlement onto the beach sediments washed ashore by the surf foam.

The diversity indices such as species richness (D), diversity (H') and evenness (J) showed well-pronounced monthly variations (Table 2). The diversity indices were found to be higher in April and May than February and March, which could be ascribed to the addition of new species during these months. Further, long duration studies may elucidate clearer picture about the species composition and diversity of benthic diatom along this region.

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