

Studies on fouling diatoms from the Zuari estuary, Goa (West coast of India)

P.D. REDEKAR¹ AND A.B. WAGH²

*MCMRD, National Institute of Oceanography, Dona Paula,
Goa - 403 004, India*

ABSTRACT

Very few studies are available in density of fouling diatoms from Zuari estuary. Hence this work was undertaken. In all 49 species of fouling diatoms belonging to 19 genera were recorded on glass slide as panels at 1 m depth in Zuari estuary. Of these 39 species (14 genera) belonged to Pennales and 10 (5 genera) to Centrales. The dominant genera were *Navicula*, *Nitzschia* and *Amphora*. Pennales were dominant over Centrales in diversity. The minima and maxima of number of cells showed an increasing trend from 1st day to 4th day of settlement. However, maximum number of diatoms was recorded on 1st and 3rd day and minimum on 4th day. The number of diatoms was found to be minimum, whenever there was settlement of hydroids on the slides. Seasonal abundance of fouling diatoms was also observed. Minimum number of genera and species during monsoon and high number during premonsoon and postmonsoon were observed. Solitary forms were normally abundant and colonial forms were few. No succession of species or genera was observed although blooms of *Nitzschia*, *Bacillaria*, *Amphora* and *Navicula* were observed.

Introduction

In coastal ecosystem, diatoms play an important role in the productivity. In biofouling process, they are dominant members of the primary film. Diatoms normally contribute the greatest percentage of microbial colonisation and are normally present in large numbers within a few days of immersion (Cuba and Blake, 1983) of test

panels. They also play a significant role in nutrient dynamics of the biofilm through syntrophic interactions.

Very little work has so far been done on the diatoms, both abroad and in India. In India, earlier works on fouling diatoms were mainly by Daniel (1955) from Madras waters; Karande (1968) from Vizhinjam Bay and Meenakumari and Nair (1984) from Cochin waters. Kelkar (1989) studied the fouling

¹ *College of Fisheries, Shirgaon, Ratnagiri - 415 629, Maharashtra*

² *Flat No. D-9, Kanchanganga Housing Society, Behind Mahatma Society,
Kothrud, Pune -411 029, Maharashtra*

diatoms from offshore waters of Bombay High area and from Goa coast. Bhosale *et. al.* (1990) worked on some biochemical aspects of fouling diatoms from Dona Paula. Pangu (1993) studied the fouling diatoms from Mandovi along Goa coast and Wagh (1995) (South Konkan) estuaries: Wagh (1995) studied the fouling diatoms from Dona Paula, Goa. However a detailed study on fouling diatoms has not so far been carried out from the Zuari estuary. The present work was therefore undertaken.

Materials and Methods

The Zuari estuary (Goa) is located at lat. 15°25' N and long. 73°59' E on the central west coast of India. Dona Paula was selected as a sampling station (Fig. 1) for the present study made during June 1993 to Oct. 1994. This station is located at the mouth of the estuary and the depth of water is about 2 to 4.5 m. Glass slides were used as test panels which were exposed from the jetty at this station.

Glass slides (7.6 x 2.2 cm) were fixed in wooden frame and were immersed in 1.0 m depth. Before exposure, the slides were cleaned using a commercial detergent, followed by washing in 2% Chromic acid and distilled water. The slides were then submerged in the subsurface water at 1 m depth. Sampling was done monthly. Every day two slides were removed and observed under phase contrast inverted, microscope for evaluation of diatom population. The diatom cells settled on both the surfaces of slides were counted and results expressed in terms of cells per dm².

The environmental parameters studied were temperature, salinity, pH, dissolved oxygen and nutrients such as nitrite, nitrate, phosphate and silicate. Standard methods of Strickland and Parsons (1968) and Parsons *et al.* (1984) were followed for determination of these environmental parameters.

Results

Among the fouling diatoms settled on glass slides, species belonging to Pennales were dominant over Centrales both in diversity of genera and species. In all 49 species. (Table, 1) were recorded and of these 39 species belonged (14 genera) to Pennales and 10 species (5 genera) to Centrales. Dominant genera observed are *Navicula*, *Nitzschia* and *Amphora*

The number of cells showed an increasing trend from 1st to 4th day of settlement. However, maximum number of diatoms was recorded on 1st and 3rd day and minimum on 4th day. Whenever there was settlement of hydroids on glass slides, minimum number of diatoms was recorded and this may be due to grazing by the hydroids. Seasonal abundance of diatoms was also observed. Minimum number and lesser diversity both in number of species and genera were recorded during monsoon when salinity was low. Solitary forms predominated and colonial forms were few. No succession of species or genera was observed although sporadic bloom of *Nitzschia*, *Bacillaria*, *Amphora*, *Navicula* were recorded. *Biddulphia* was invariably dominant during monsoon period

The ranges of environmental parameters are as follows: The temperature, salinity, pH, dissolved oxygen, nitrite, nitrate showed a range of 25 to 32°C, 7.24 to 35.7‰, 7.3 to 8.3, 4.2123 to 6.3280 ml/l, undetectable level to 4.7 µg/l, 0.138 to 19.136 µg/l respectively. The monthly average data on environmental parameters are given in Table 2 and 3.

The correlations between fouling diatoms with temperature, salinity, dissolved oxygen, nitrite, nitrate, phosphate and silicate are shown in Figures 2 to 8. It was observed that during low salinities, minimum

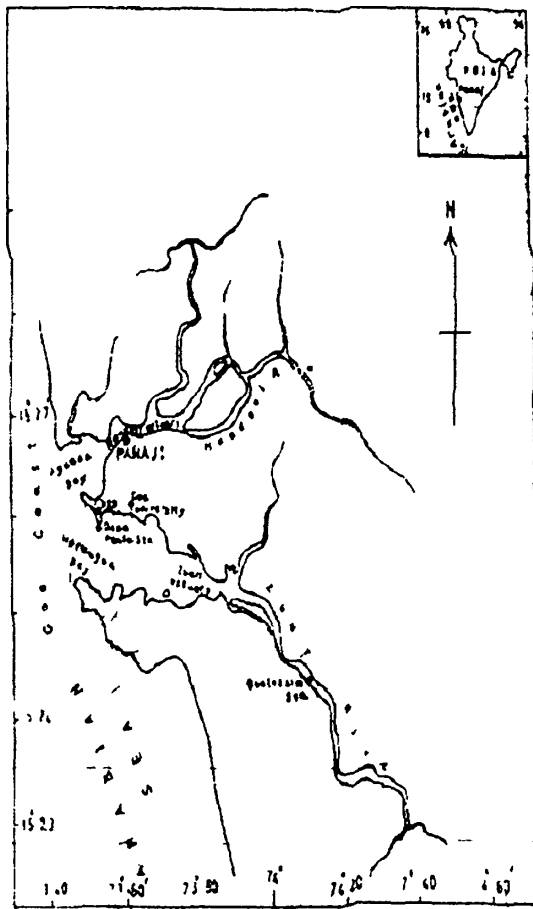


Fig 1 Map showing study area - Dona Paula

number of diatoms was recorded and maximum number during high salinities (Fig 3) Diatom abundance was also more moderate nitrate concentration (Fig 6)

Discussion

In the present studs an attempt was made for the first time to present both qualitative and quantitative aspects of fouling diatoms using glass test panels Dominance of Pennales over Centrales in fouling communities has also been observed by earlier workers (Wood 1967 Mathew and Nair 1981 Kelkar 1989 Pangu 1993) The nature of test panels may have a role in settlement of foulers Among the Indian works Kelkar (1989) Pangu (1993) and Wagh (1993) have studied fouling diatoms using different test panels

Kelkar (1989) studied fouling diatom from offshore waters of Bombay High area using aluminium panels and recorded 58 species of fouling diatoms Of these *Navicula* *Coscinodiscus* *Rhizosolenia* and *Chaetoceros* were found to be common The dominance of Centrales over Pennales in water column was observed The number of colonial forms were also more than the individual forms which is contrary to the present work

Table 1 Species of diatoms recorded from glass slides

S No	Diatoms Species	S No	Diatoms Species	S No	Diatoms Species
Centrales					
1	<i>Biddulphia obtusa</i>	6	<i>A. speclabilis</i>	23	<i>N borealis</i>
2	<i>B. mobiliensis</i>	7	<i>Amphora sp</i>	24	<i>N gastrum</i>
3	<i>B. sinensis</i>	8	<i>Bacillavia paradoxa</i>	25	<i>N retusa</i>
4	<i>B. regia</i>	9	<i>Cocconeis littoris</i>	26	<i>Nitzschia obtusa</i>
5	<i>Coscosira polychorda</i>	10	<i>Cymbella gastroides</i>	27	<i>N. paradoxa</i>
6	<i>Coscinodiscus subtilis</i>	11	<i>C gastoides var minor</i>	28	<i>N. sigma var regidula</i>
7	<i>C. grant</i>	12	<i>Fragillaria oceanica</i>	29	<i>N. longissima</i>
8	<i>C. conscinnus</i>	13	<i>Campyloneis grevillei</i>	30	<i>N. longissima var closterium</i>
9	<i>Ditylum brightwelli</i>	14	<i>Gramatophora marina</i>	31	<i>N sigmoidea</i>
10	<i>Melosira borneri</i>	15	<i>G. serpentina</i>	32	<i>Pleurosigma angulatum</i>
Pennales					
1	<i>Achnanthes longipes</i>	16	<i>Licmophora gracilis</i>	33	<i>P angulatum var major</i>
2	<i>Amphora marina</i>	17	<i>L. paradoxa</i>	34	<i>P angulatum var delicatulaum.</i>
3	<i>A. ovalis</i>	18	<i>L. juergensii</i>	35	<i>P elongatum</i>
4	<i>A. turgida</i>	19	<i>Navicula inflexa</i>	36	<i>P fasciola</i>
5	<i>A. ostrearia</i>	20	<i>N oblonga</i>	37	<i>Raphoneis amphiceros</i>
		21	<i>N nobilis</i>	38	<i>Thalassiothrix nitzscheoides</i>
		22	<i>N. lata</i>	39	<i>T.frauenfeldii</i>

Table 2. *Monthly data on environmental parameters*

Month	Temperature (°C)	Salinity (ppt)	pH	Dissolved Oxygen (ml/l)
June, 1993	30.0	26.82	7.54	4.3481
July	29.0	10.81	8.26	5.1102
August	26.2	12.88	7.70	4.9268
September	28.4	24.44	7.96	5.1584
October	27.2	29.01	7.72	4.5765
November	29.0	33.14	8.12	4.7183
December	26.4	32.80	8.20	5.1640
January, 1994	26.0	34.48	7.90	4.8364
February	26.6	34.21	8.00	5.0737
March	30.0	34.56	8.16	4.5313
April	31.0	34.72	8.14	4.7912
May	31.3	35.45	8.10	4.5426
June	27.8	20.41	8.00	5.9664
July	26.0	07.88	8.10	5.8929
August	25.6	14.07	8.08	5.7065
September	26.5	27.57	8.18	4.8703
October	28.4	27.60	8.18	5.2432

Table 3. *Monthly data on environmental parameters*

Month	Nitrite (µg/l)	Nitrate (µg/l)	Phosphate (µg/l)	Silicate (µg/l)
June, 1993	2.9080	14.9546	0.9894	10.4040
July	0.0840	07.0940	0.1224	69.3660
August	0.2180	07.3600	0.8360	38.1800
September	0.0300	00.9076	0.6750	06.2600
October	0.1940	02.5776	1.3100	07.6600
November	1.1240	10.2850	0.7400	06.1000
December	0.2400	01.0400	0.5700	01.5800
January, 1994	0.1400	01.9750	0.9800	08.1200
February	0.1280	01.3450	0.9400	02.4000
March	0.3640	02.2050	0.2900	03.0000
April	0.0480	00.2300	0.1400	14.4200
May	0.1360	00.4000	0.1900	14.8000
June	0.6500	03.1240	0.3750	18.4000
July	0.2250	06.2025	0.0500	60.0225
August	0.5380	02.2352	0.1200	66.7600
September	0.1920	00.5426	0.6250	43.6000
October	0.2480	00.7250	0.2062	15.1200

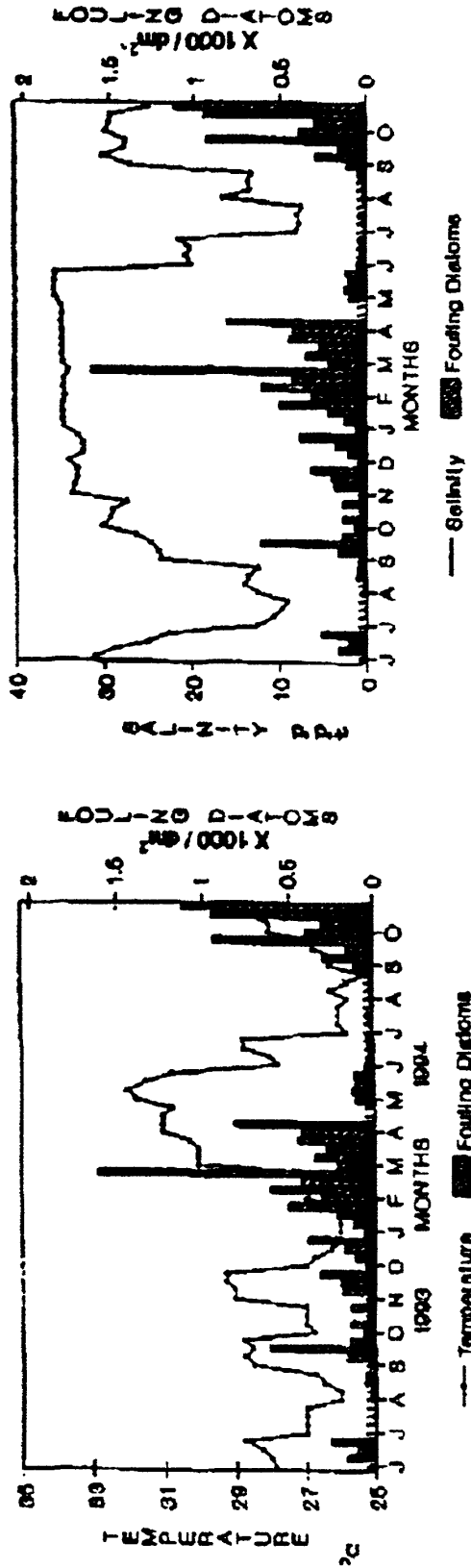


Fig. 2. Correlation of temperature and fouling diatoms

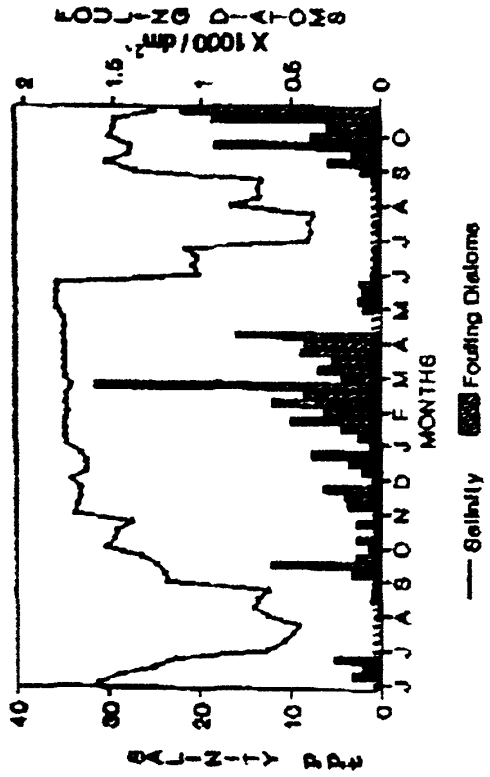


Fig. 3. Correlation of salinity and fouling diatoms

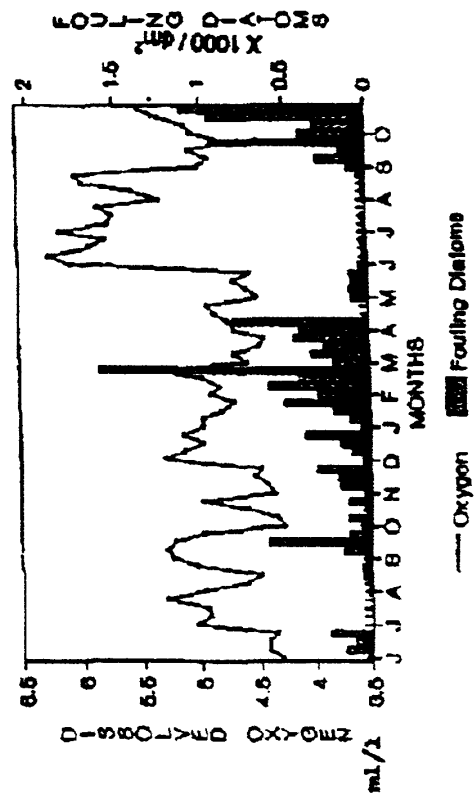


Fig. 4. Correlation of dissolved oxygen and fouling diatoms

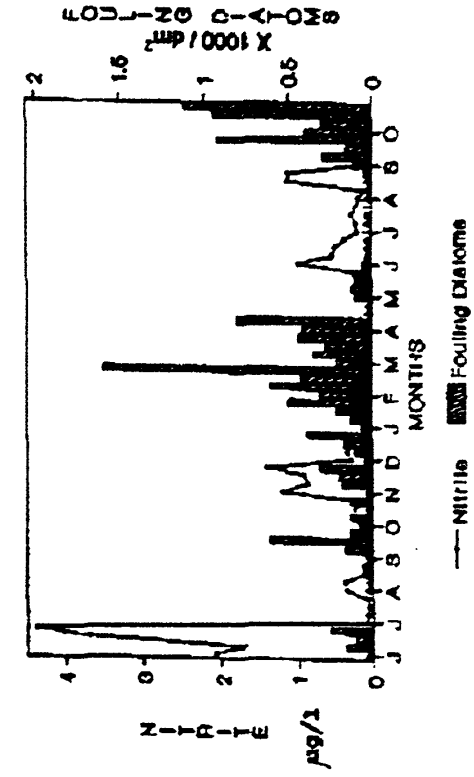


Fig. 5. Correlation of nitrite and fouling diatoms

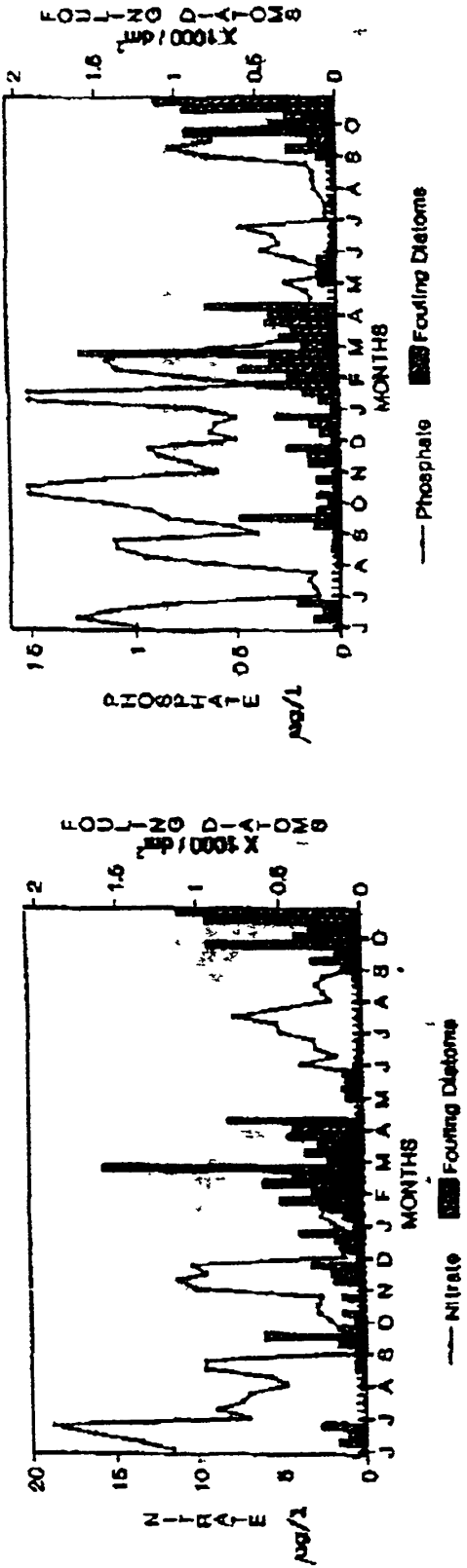


Fig 6 Relationship between nitrate and fouling

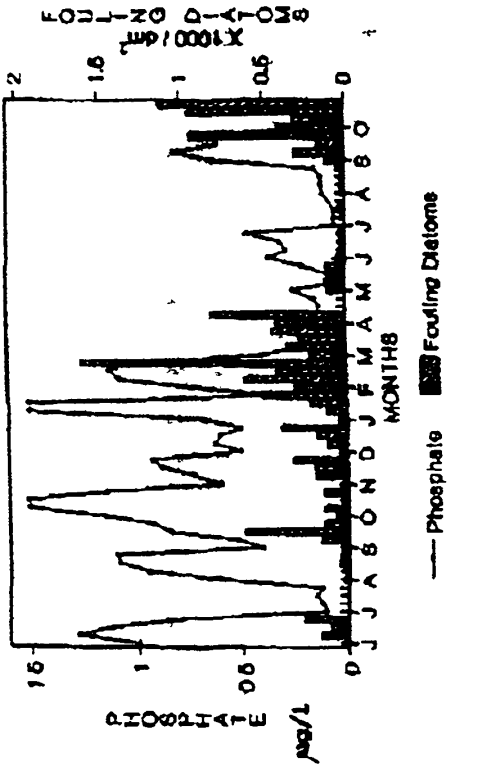


Fig 7 Relationship between phosphate and fouling diatoms

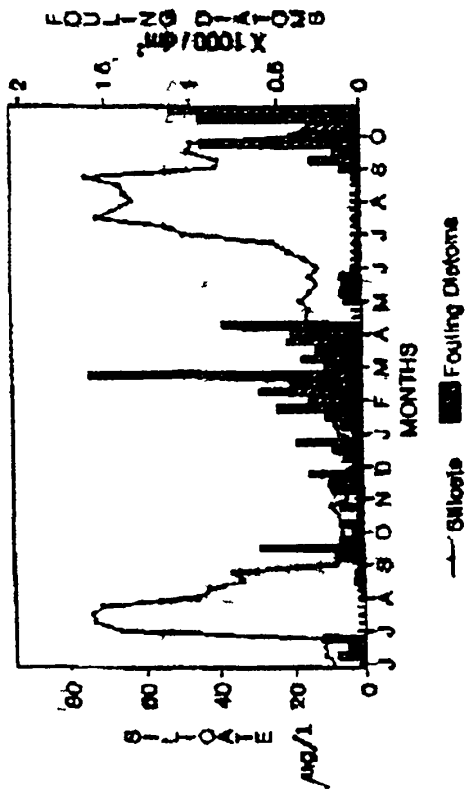


Fig 8 Relationship between silicate and fouling diatoms

Pangu (1993) used mild steel, aluminium, fiberglass and glass test panels and the immersion period of panels was long (1 month to 11 months) The fouling diatoms from Waghotana (South Konkan) and Mandovi estuary were studied. Panels in Waghotana estuary and man-made structures like barge, jetty etc. were used to study the fouling diatoms. Ninety two species from Waghotana estuary and 103 species from Mandovi estuary were recorded. The dominance of *Melosira borreri* on glass panels was observed. *Thalassiothrix frauenfeldi*, *Nitzschia* sp. and *Biddulphia* sp. were the common fouling diatoms on all the man-made structures. Wagh (1993) used glass panels in Zuari estuary (Dona Paula). The species encountered in the present study almost agree with those recorded by Wagh (1993). Though the total number recorded by Pangu (1993) is high i.e. 92 from Waghotana estuary and 103 from Mandovi, those recorded on glass panels were relatively lower (33) compared to the present work (50).

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