

## **Planktonic diatoms of the Zuari estuary, Goa (West coast of India)**

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### **ABSTRACT**

During the studies on fouling diatoms in Zuari estuary the overlying surface diatoms were also studied for comparison. In all 66 spp. of planktonic diatoms have been recorded, belonging to 29 genera. Out of these, 36 species (16 genera) were Pennales and 30 (13 genera) Centrales. The common diatoms observed were *Chaetoceros borealis*, *C. decipiens*, *Biddulphia regia*, *B. sinensis*, *Coscinodiscus conscinnus*, *C. subtilis*, *C. grani*, *Navicula inflexa*, *N. oblonga*, *Amphora turgida*, *A. ovalis*, *Nitzschia sigma* var. *regidula*, *N. longissima* var. *closterium*, *Thalassiothrix nitzscheoides*, *Rhizosolenia stolterfothii* and *R. shrubsolei*. Pennales were dominant over Centrales both in diversity of genera and species. Minimum number of diatoms were recorded during monsoon and maximum during postmonsoon and premonsoon months. Solitary forms were found in abundant quantity, while colonial forms were few. Occasional blooms of *Chaetoceros* sp. were only observed. Interestingly most of the fouling diatoms were represented in plankton also.

### **Introduction**

The important work on planktonic diatoms from Indian waters has been done by Subrahmanyam (1946, 1958), Gonsalves (1947), Venkataraman (1957, 1958), Misra (1962), Chennubhotla (1969), Gopala krishnan (1972), Desikachary (1977) and Nair *et. al.* (1980). But from the study area i.e. Zuari estuary, there have been a few investigations : Primary production

(Bhattathiri *et. al.*, 1976; Devassy 1983; Devassy and Goes 1989) and phytoplankton pigment (Bhargava 1974; Bhargava and Dwivedi, 1976).

The Zuari estuary on the west coast (Goa) of India is a highly dynamic and variable environment with considerable tidal influence. The perennial connection of this estuary with the Arabian sea results in rhythmic ingress and egress of marine and estuarine plankton populations. Except

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during the monsoon months, Zuari estuary maintains well conditions (Qasim and Sengupta, 1981).

The present work was undertaken to find out the flora in ambient waters and whether any relation exists between the flora and the forms settling on the inert surfaces like glass slide panels of Dona Paula in Zuari estuary.

### Material and Methods

The Zuari estuary is located at lat. 15° 25'N and long. 73° 59'E on the central west coast of India. Dona Paula station was selected in the Zuari estuary for carrying out the present study. This station is located at the mouth of the estuary and depth of water is about 2.0 to 4.5 m. Surface water was collected with the help of bucket and 125 ml of the sample was

preserved in Lugoi's solution. This sample was used for evaluation of the diatom population in the ambient waters of this station. It was done by using the method described by Lund (1951). The sample was observed under phase contrast inverted microscope for enumeration of diatom population and quantitative studies. The results were estimated in terms of their numerical variations per litre of sea water. The environmental parameters studied were temperature, salinity, pH, dissolved oxygen nitrite, nitrate, phosphate and silicate.

### Results

In all 66 species of planktonic diatoms listed below were recorded and of which 36 belong to Pennales (16 genera) and 30 to Centrales (13 genera).

#### Centrales

1. *Coscinodiscus radiatus*
2. *C. subtilis*
3. *C. grani*
4. *C. excentricus*
5. *C. marginatus*
6. *C. conscinnus*
7. *C. centralis*
8. *C. gigas*
9. *Coscosira polychorda*
10. *Biddulphia obtusa*
11. *B. regia*
12. *B. mobiliensis*
13. *B. sinensis*
14. *Skeletonema costatum*
15. *Rhizosolenia stolterfothii*
16. *R. shrubsolei*
17. *R. setigera*
18. *R. styliformis*
19. *R. castracanei*
20. *Chaetoceros borealis*
21. *C. danicus*
22. *C. decipiens*

23. *C. gracilis*
24. *Ditylum brightwelli*
25. *Lauderia borealis*
26. *Melosira borneri*
27. *Thalassiosira sp*
28. *Planktoniella sol*
29. *Bacteriastrum varians*
30. *Hyalodiscus sp.*

#### Pennales

31. *Amphora ostrearia*
32. *A. ovalis*
33. *A. turgida*
34. *A. marina*
35. *A. spectabilis*
36. *Amphora sp.*
37. *Amphiprora sp.*
38. *Bacillaria paradoxa*
39. *Navicula inflexa*
40. *N. oblonga*
41. *N. nobilis*
42. *N. lata*
43. *N. borealis*

44. *N. gastrum*
45. *N. retusa*
46. *Nitzschia longissima*
47. *N. longissima var. closterium*
48. *N. sigmoidea*
49. *N. paradoxa*
50. *N. sigma var. regidula*
51. *N. obtusa var. nana*
52. *Pleurosigma angulatum*
53. *Cymbella gastroides*
54. *C. gastroides var. minor*
55. *Cocconeis littoris*
56. *Achnanthes longipes*
57. *Thalassiothrix nitzscheoides*
58. *T. frauenfeldii*
59. *Asterionella japonica*
60. *Campyloneis grevillei*
61. *Licmophora gracilis*
62. *L. paradoxa*
63. *L. juergensii*
64. *Gramatophora marina*
65. *G. serpentina*
66. *Raphoneis amphicerus*

Low number of diatoms was recorded during monsoon and maximum number during postmonsoon and premonsoon periods. During monsoon 1993, the total diatom cell number varied from 20 to 1460 / l with the minimum value being recorded in July and the maximum in September. The total diatom number ranged from 420 to 17100 / l during postmonsoon season. Minimum number of cells was recorded in the month of October and maximum in January. Variation in total diatom number during premonsoon season was from 840 to 11400 / l. Minimum number of cells was recorded in May and maximum in February. During monsoon 1994 the total diatom cell number varied from 20 to 1600 / l with the minimum value being recorded in July and maximum in August. Bloom of *Chaetoceros* was observed in the month of January 1994. The common species

of diatoms recorded were *Navicula inflexa*, *N. oblonga*, *Nitzschia sigma* var. *regidula*, *N. longissima* var. *closterium*, *Coscinodiscus conscinnus*, *C. subtilis*, *C. grant*, *Amphora turgida*, *A. ovalis*, *Biddulphia regia*, *B. sinensis*, *Thalassiothrix nitzscheoides*, *Chaetoceros borealis*, *C. decipiens*, *Rhizosolenia stolterfothii* and *R. shrubsolei*. It was observed that certain fouling diatoms though present in the surrounding waters were not found on the glass slides though exposed upto the period of 4 days. It was observed that environmental parameter like salinity influenced the abundance of diatoms and low number of diatom were recorded during monsoon when salinity was low and high number during increasing salinities i.e. during postmonsoon and premonsoon seasons.

The following diatoms were present in water but were not recorded on glass slide.

Month	Name of the Diatom Species
June 93	<i>Amphora ovalis</i> , <i>Coscinodiscus subtilis</i>
July 93	<i>Pleurosigma angulatum</i> , <i>Navicula oblonga</i> , <i>Nitzschia sigma</i> var. <i>regidula</i> , <i>Thalassiothrix nitzscheoides</i> , <i>Coscinodiscus subtilis</i> , <i>Ditylum brightwelli</i>
August 93	<i>Pleurosigma angulatum</i> , <i>Thalassiothrix nitzscheoides</i>
September 93	<i>Thalassiothrix frauenfeldii</i> , <i>Nitzschia longissima</i> var. <i>closterium</i>
October 93	<i>Coscosira polychorda</i> , <i>Coscinodiscus conscinnus</i> , <i>Thalassiothrix frauenfeldii</i> , <i>Planktoniella sol</i> , <i>Nitzschia longissima</i> var. <i>closterium</i> , <i>Rhizosolenia shrubsolei</i> , <i>Chaetoceros borealis</i>
November 93	<i>Rhizosolenia shrubsolei</i>
December 93	<i>Ditylum brightwelli</i> , <i>Coscosira polychorda</i> , <i>Rhizosolenia stolterfothii</i> , <i>Nitzschia longissima</i> var. <i>closterium</i> , <i>Planktoniella sol</i> , <i>Biddulphia regia</i>
January 94	<i>Biddulphia regia</i> , <i>Asterionella japonica</i> , <i>Chaetoceros borealis</i> , <i>Rhizosolenia stolterfothii</i> , <i>Synedra ulna</i> var. <i>longissima</i> , <i>Thalassiothrix nitzscheoides</i> , <i>Lauderia borealis</i>

Month		Name of the Diatom Species
February	94	<i>Coscinodiscus subtilis</i> , <i>Ditylum brightwelli</i> , <i>Skeletonema costatum</i> , <i>Rhizosolenia stolterfothii</i> , <i>Pleurosigma angulatum</i> , <i>Bacteriastrum varians</i> , <i>Asterionella japonica</i> , <i>Chaetoceros danicus</i>
March	94	<i>Bacillaria paradoxa</i> , <i>Chaetoceros borealis</i> , <i>Coscinodiscus subtilis</i> , <i>Thalassiothrix nitzscheoides</i> , <i>Ditylum brightwelli</i> , <i>Pleurosigma angulatum</i> , <i>Planktoniella sol</i> , <i>Rhizosolenia stolterfothii</i>
April	94	<i>Coscosira poly chorda</i> , <i>Coscinodiscus grani</i> , <i>Pleurosigma angulatum</i> , <i>Biddulphia regia</i> , <i>Bacteriastrum varians</i> , <i>Ditylum brightwelli</i>
May	94	<i>Coscosira polychorda</i>
June	94	<i>Skeletonema costatum</i> , <i>Ditylum brightwelli</i> , <i>Pleurosigma angulatum</i> , <i>Coscinodiscus grani</i> , <i>Coscosira polychorda</i>
July	94	<i>Coscosira polychorda</i>
August	94	<i>Coscosira polychorda</i> , <i>Thalassiothrix nitzscheoides</i> , <i>Nitzschia longissima var. closterium</i>
September	94	<i>Cocconeis littoris</i> , <i>Pleurosigma angulatum</i> , <i>Coscosira polychorda</i> , <i>Thalassiothrix nitzscheoides</i>
October	94	<i>Coscinodiscus conscinnus</i> , <i>Thalassiothrix nitzscheoides</i> , <i>Pleurosigma angulatum</i> , <i>Chaetoceros borealis</i> , <i>Skeletonema costatum</i> , <i>Bacteriastrum varians</i> , <i>Gramatophora marina</i>

## Discussion

Diatoms from subsurface waters were studied in order to find out the possible correlation between the subsurface planktonic forms and the fouling diatoms and also response to environmental parameters. Devassy and Goes (1988) have listed 63 diatoms species from Mandovi Zuari estuarine complex of Goa waters. In the present study, in all 66 species of planktonic diatoms were recorded. Majority of the forms were solitary and few colonial. Most of the fouling forms observed during the study period are represented in subsurface plankton also, while certain fouling forms though present in surrounding waters were observed not to settle on glass

slides even though exposed for 4 days period. The fouling nature or process of such diatoms needs further investigations.

The environmental parameters showed the following ranges: Temperature (25 to 32°C), Salinity (7.24 to 35.7 ‰), pH (7.3 to 8.3), Dissolved oxygen (4.2123 to 6.3280 ml/l), Nitrite (undetectable level to 4.7 µg/l), Nitrate (0.138 to 19.136 µg/l), Phosphate (undetectable level to 2.8 µg/l), Silicate (0.700 to 90.25 µg/l).

Of these salinity appears to directly influence the abundance of diatoms which showed less number in lower salinities but the number increased with increasing salinities (Table 1).

Table 1 Relationship of salinity and diatom abundance

Month		Average Salinity (ppt)	Average Diatom (Cells/l)
June	93	26.82	134
July	93	10.81	356
August	93	12.88	376
September	93	24.44	1133
October	93	29.01	1260
November	93	33.14	1532
December	93	32.80	3190
January	94	34.48	8180
February	94	34.21	7496
March	94	34.56	1427
April	94	34.72	2232
May	94	35.45	1344
June	94	20.41	488
July	94	7.88	110
August	94	14.07	608
September	94	27.57	270
October	94	27.60	2521

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### Literature cited

Bhargava, R.M.S. 1974. Diurnal variation in phytoplankton pigments in Zuari estuary. *Indian J. Mar. Sci.*, 5 : 142-145.

Bhargava, R. M. S. and N. Dwivedi 1976. Seasonal distribution of phytoplankton pigments in the estuarine system of Goa. *Indian J. Mar. Sci.*, 5 : 87-90.

Bhattathiri, P. M. A., V. P. Devassy and R.M.S. Bhargava 1976. Production at different trophic levels in the estuarine system of Goa. *Indian J. Mar. Sci.* 5: 83-86.

Chennubhotla, V.S.K. 1969 Distribution of phytoplankton in the Arabian sea between Cape Comorin and Cochin. *Indian J. Fish.*, 16(1/2) : 129-136

Desikachary, T.V. 1977. *First list of diatoms of the Indian Ocean Region*, A working paper, University of Botany Laboratory, Madra, India. 140pp.

Devassy, V.P. 1983. *Plankton ecology of some estuarine and marine regions of the west coast of India* Ph.D. thesis university of Kerala, Trivandrum.

Devassy, V.P. and J.I. Goes 1988. Phytoplankton community structure and succession in a tropical estuarine complex (Central west coast of India). *Estuarine Coastal Shelf Sci.*, 27 : 671-685.

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

Gonsalves, E. A. 1947. Variations in the seasonal compositions of the phytoplankton of the Bombay Harbour. *Curr. Sci.*, 16 : 304-305.

Gopalakrishnan, P. 1972. Studies on the marine plankton diatoms off Port Okha in the Gulf of Kutch. *Phykos*, 11(12) : 37-49.

Lund, J.W.G. 1951. A sedimentation technique for counting algae and other organisms. *Hydrobiologia*, 3(4): 39 - 94.

- Misra, J.N. 1962. A systematic account of some littoral marine diatoms from the west coast of India. *J. Bombay Nat. Hist. Soc.*, 53(4): 537-568.
- Nair Sreekumaran, S.R., C. T. Achuthankutty V.R. Nair and V.P. Devassy 1980 Plankton composition in the coastal waters between Jaigarh and Rajapur along west coast of India. *Mahasagar*, 13(4) : 343-352.
- Qasim, S. Z. and R. Sengupta 1981. Environmental characteristics of the Mandovi-Zuari estuarine system in Goa. *Estuarine Coastal Shelf. Sci.*, 13 : 557-578.
- Subrahmanyam, R. 1946. A systematic account of the marine plankton diatoms of the Madras coast. *Proc. Indian Acad. Sci*, 24 B: 85-197.
- Subrahmanyam, R 1958. Ecological studies on the marine phytoplankton on the west coast of India. *Mem. Indian Bot. Soc.*, 1: 145-151.
- Venkataraman, G.S. 1957. A contribution to the knowledge of the Diatomaceae of Kanyakumari (Cape Comorin), India I. *Proc. Nat. Inst. Sci, India* 23 B : 80-88.
- Venkataraman, G.S. 1958. A contribution to the knowledge of the diatomaceae of Kanyakumari (Cape Comorin), India EL *Proc. Nat. Inst. Sci. India.*, 24 B : 307-313.