

DIEL CHANGES IN PHYTOPLANKTON POPULATION IN THE MANDOVI AND ZUARI ESTUARIES OF GOA

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ABSTRACT

Diel changes in surface phytoplankton were studied in Mandovi and Zuari estuaries during pre- and post-monsoon seasons at two stations in each estuary— one near the mouth and other in mid-reaches. Phytoplankton cell counts indicated an overall greater value in the Mandovi. Mean counts for the whole day (24 hrs) at the mouth of Mandovi and at mid-reaches were 13,600 and 15,200 cells/l respectively in the premonsoon. In the post-monsoon period the counts were 55,800 and 37,600 cells/l. The corresponding figures for the Zuari were 10,100 and 17,200 cells/l in the premonsoon and 2,100 and 2,000 cells/l in the post-monsoon. In general, higher concentrations of phytoplankton were noticed in the morning hours during premonsoon in the Mandovi and during post-monsoon in the Zuari indicating seasonal changes in the two estuaries. The two estuaries, thus exhibit a contrasting picture during the two seasons.

Observations were made at two stations in the Mandovi estuary in December 1971 and May 1972 and in the Zuari estuary in February and April 1972 (Fig. 1). Sampling was done at 3 hourly interval. Phytoplankton samples preserved in Lugol's iodine and 3%

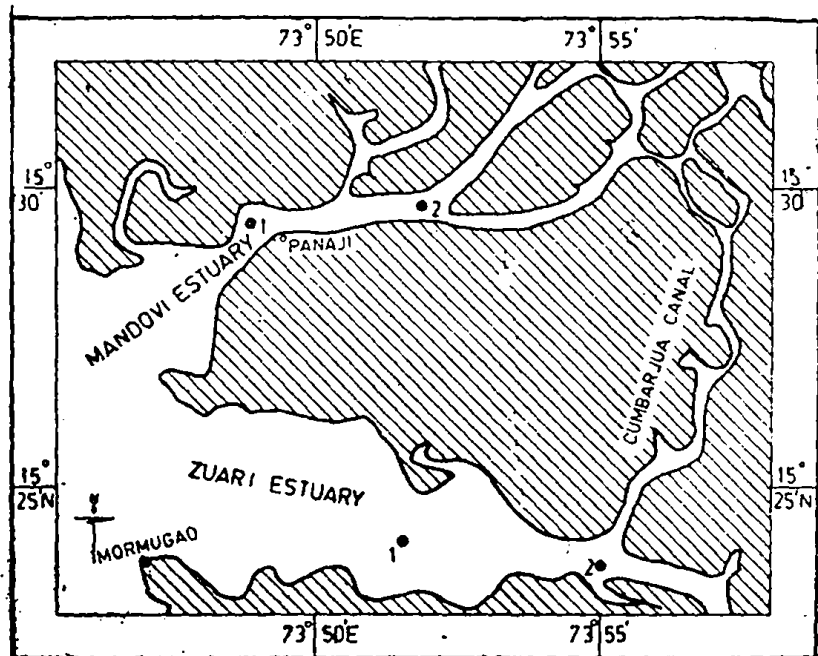


Fig. 1. Location of the sampling stations in the two estuaries.

Table I. Diel variations in phytoplankton populations in the Mandovi estuary during the pre- and post-monsoon seasons

Time in hours	Post-monsoon																
	Station 1					Station 2											
	Dia-toms	Dino-flagel-lates	Other algae	Total phyto-plankton	Time in hours	Di-atoms	Dino-flagel-lates	Other algae	Total phyto-plankton	Other phyto-algae	Total phyto-plankton	Dino-flagel-lates	Other algae	Total phyto-plankton			
0800	37900	800	600	39300	15000	400	7000	22400	0700	35900	600	1600	37100	31600	1800	—	33400
1100	11600	200	200	12000	13200	—	200	13400	1000	9400	400	800	10600	2000	—	—	2000
1400	7800	600	400	8800	10800	400	—	11200	1300	10100	—	400	1400	900	100	—	1000
1700	1600	200	—	1800	37000	200	200	37400	1630	39600	3000	2400	45000	36000	1400	—	37400
2000	7900	—	100	8000	6800	—	100	6900	1900	76000	4300	—	80300	52600	—	—	52600
2300	6400	200	200	6800	3600	—	—	3600	2200	80000	2600	3600	95200	70400	3200	—	73600
0200	3800	200	—	4000	11600	400	—	12000	0100	109200	4000	—	113200	70500	700	4400	75600
0500	20500	400	400	21300	13800	400	800	15000	0400	93400	8600	—	102000	49200	1400	—	50600
0800	21500	—	—	21500	No ob-servation	—	—	—	0700	23400	600	3600	27600	15000	1400	2400	18800

Table II. Diel variations in phytoplankton populations in the Zuari estuary during the pre- and post-monsoon seasons.

0830	13500	—	—	13500	10440	40	160	10640	1300	1600	100	—	1700	1100	200	—	1300
1130	7800	200	—	8000	15500	200	100	15800	1600	1500	100	—	1600	3400	600	—	4000
1430	4300	—	100	4400	9900	—	200	10100	1900	1600	—	—	1600	1000	300	—	1300
1730	7900	100	300	8300	24600	100	800	25500	2200	1000	100	—	1100	1800	300	100	2200
2030	2800	—	200	3000	5800	—	300	6100	0110	1600	200	200	2000	900	300	—	1200
2330	10600	—	400	11000	17300	100	400	17800	0400	1800	—	—	1800	500	300	—	800
0230	11400	100	200	11700	14200	—	100	14300	0700	900	800	—	1700	3400	200	200	3800
0530	13700	100	300	14100	26300	—	200	26500	1000	2700	—	—	2700	1600	300	—	1900
0830	16800	—	100	16900	27400	—	—	27400	1300	4500	300	—	4800	1500	300	100	1900

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formalin, were allowed to settle and then cell counts were made. Standard Mohr's method was used for estimating salinity. Other algae, as mentioned in the text, denote mainly flagellates and a few green algae.

The Mandovi estuary

Table I shows the diel variations in phytoplankton populations in the Mandovi estuary during pre- and post-monsoon seasons at the two stations.

Postmonsoon: The two stations selected in the estuary were about 7 km apart (Fig. 1). Salinity at station 1 varied from 28.17 to 34.4‰ and at station 2, from 20.08 to 33.28‰.

Diatoms dominated in the phytoplankton followed by dinoflagellates and other algae. At station 1, *Chaetoceros* (15,000 cells/l) dominated among diatoms, followed by *Planktoniella*, *Navicula*, *Melosira*, *Cyclotella*, *Biddulphia*, *Skeletonema*, *Triceratium*, *Bacteriastrum*, *Ditylum*, *Amphora*, *Asterionella*, *Rhizosolenia*, *Streptotheca*, *Corethron*, *Pleurosigma* and *Hemidiscus*. Maximum concentration of diatoms was noticed at 0100 hrs (109,200 cells/l) and minimum at 1300 hrs (1,000 cells/l). Dinoflagellates were comprised of *Ceratium*, *Peridinium*, *Dinophysis* and *Prorocentrum* in the order of abundance. Maximum number of dinoflagellates was observed at 0400 hrs.

At station 2, some of the neritic diatoms like *Chaetoceros* and *Skeletonema* were sparse unlike station 1. The diatom *Stephanopyxis* (8,800 cells/l at 1900 hrs during flooding) was dominant and followed by *Biddulphia*, *Coscinodiscus*, *Planktoniella*, *Cyclotella*, *Bacillaria*, *Ditylum*, *Rhizosolenia*, *Melosira*, *Streptotheca*, *Nitzschia*, *Diploneis*, *Pleurosigma*, *Navicula* and *Triceratium*. Maximum concentration of diatoms (70,500 cells/l) was observed at 0100 hrs (high tide). Dinoflagellates were mainly contributed by *Ceratium*, *Peridinium*, *Gymnodinium*, *Dinophysis*, *Noctiluca* and *Prorocentrum*. Their maximum was found again during high tide at 2200 hrs (3200 cells/l).

Premonsoon: Observations were made on 17/18 May 1972 at the same locations. Station 1 had more marine influence than station 2 and salinity varied from 33.25 to 35.35‰. At station 2, though the highest value was almost similar, the lower value declined to 30.1‰ during the low tide.

Phytoplankton was dominated by diatoms at both the stations. At station 1 *Coscinodiscus* (24,400 cells/l) was maximum at 0800 hrs during the low tide followed by *Navicula*, *Pleurosigma*, *Thalassiothrix* and a few other diatoms. Peak value of total phytoplankton was obtained during low tide at 0800 hrs (39,300 cells/l), where diatoms alone contributed 37,900 cells/l. Highest number of dinoflagellates (800 cells/l) was recorded at 0800 hrs (low tide). *Noctiluca*, *Peridinium*, *Dinophysis*, *Ceratium* and *Ornithocercus* were the main dinoflagellates.

At station 2 also the trend of diatom population remained more or less similar and the dominant forms were *Coscinodiscus*, *Navicula*, *Pleurosigma*, *Streptotheca*, *Cyclotella* and *Thalassiothrix*. Other algae were maximum at 0800 hours (7,000 cells/l). Phytoplankton population was greater at station 2 during this season coinciding with the

plant pigment values observed by Bhargava (1973). During the night a decline in phytoplankton concentration was noticed at both the stations. The peak, however, coincided with the low tide and low salinity.

The Zuari estuary

Table II shows the diel variations in phytoplankton populations in the Zuari estuary during the premonsoon and the postmonsoon seasons at the two stations.

Postmonsoon: Observations were made on 3/4 February 1972. Salinity at station 1 varied from 31.2 to 32.6‰ and at station 2 from 31.02 to 32.37‰.

Phytoplankton population was low at station 1. Pigment studies made by Bhargava and Dwivedi (1974) revealed low values. Maximum phytoplankton was recorded at 1300 hrs (4,800 cells/l). *Navicula*, *Coscinodiscus*, *Melosira*, *Nitzschia* and *Surirella* were the dominant diatoms. Dinoflagellates were represented by *Dinophysis*, *Peridinium* and *Ceratium* and their maximum was observed at 0700 hrs (800 cells/l).

At station 2 also the condition was almost similar but the maximum cell count observed was only 4,000/l at 1600 hrs.

Premonsoon: Samples were collected on 28/29 April 1972 from the stations located about 6 km apart. During this period salinity values remained more or less stable. Maximum phytoplankton was observed at 0830 hrs (16,900 cells/l) at station 1 and *Surirella*, *Coscinodiscus*, *Streptotheca* and *Navicula* were the dominant diatoms. Dinoflagellates and other algae were sparse.

At station 2 phytoplankton organisms were maximum at 0830 hrs (27,400 cells/l) and *Streptotheca* (13,700 cells/l) was the most dominant diatom.

A comparison of the two estuaries would reveal certain interesting features. The overall algal crop showed a greater concentration in the Mandovi estuary as compared to Zuari. It is difficult at present to attribute a specific reason for this. However, earlier observations have shown that Zuari is far more turbid than the Mandovi (Bhargava and Dwivedi, 1976). Probably the estuarine conditions prevailing in the Mandovi estuary may be one of the factors for the higher abundance of phytoplankton. Similar results have been obtained from the Cochin Backwaters also (Qasim, Bhattathiri and Devassy, 1972; Devassy and Bhattathiri, 1974). In the Mandovi during post-monsoon period when 38 genera of diatoms were encountered at station 1, there were 41 genera at station 2. But during the pre-monsoon period, diatoms were less than half of the post-monsoon population. On the contrary, in Zuari while premonsoon studies revealed a high diatom crop, the post-monsoon observations showed a population several times less. Pigments showed positive correlation with phytoplankton in the Mandovi. This estuarine system revealed the dominance of diatoms throughout the post and premonsoon seasons whereas in Cochin Backwaters dinoflagellate dominated during premonsoon (Devassy and Bhattathiri, 1974).

The difference in phytoplankton populations of the two estuaries as noticed in this study may be due to the different tide and turbidity conditions in the two seasons. Also the inter-mixing of these two estuarine waters through Cumbajua Canal makes this

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system an unique environment and detailed investigations would further elucidate the ecology of phytoplankton.

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REFERENCES

- Bhargava, R. M. S., 1973. Diurnal variation in phytoplankton pigment of Mandovi Estuary, Goa. *Indian Journal of Marine Sciences*, 2: 27-31.
- Bhargava, R. M. S. and S. N. Dwivedi, 1974. Diurnal variation in phytoplankton pigments in Zuari Estuary, Goa. *Indian Journal of Marine Sciences*, 3: 142-145.
- Bhargava, R. M. S. and S. N. Dwivedi, 1976. Seasonal distribution of phytoplankton pigments in the estuarine system of Goa. *Indian Journal of Marine Sciences*, 5: 87-90.
- Devassy, V. P. and P. M. A. Bhattathiri, 1974. Phytoplankton ecology of the Cochin Backwater. *Indian Journal of Marine Sciences*, 3: 46-50. ✓
- Qasim, S. Z., P. M. A. Bhattathiri and V. P. Devassy, 1972. The influence of salinity on the rate of photosynthesis and abundance of some tropical phytoplankton. *Marine Biology*, 12: 200-206.