

## PHYTOPLANKTON DISTRIBUTION IN THE COASTAL WATERS OFF PORBANDAR (SAURASHTRA)

M. JIYALAL RAM, S.N.GAJBHIYE AND DESAI\*

National Institute of Oceanography, Regional Centre,  
Bombay - 400 061.

### ABSTRACT

Phytoplankton population ( $3.37 - 56.09 \times 10^4$  cells/l) and pigments (chl.  $a$   $1.10 - 26.8 \text{ mg/m}^3$ ) in the waters off Porbandar indicated wide variations. Higher cell counts and lower diversity of species were encountered in the nearshore waters as compared to the waters of the seaward side. The concentration of dissolve oxygen was correlated to the phytoplankton population and pigments. 71 species belonging to 28 genera of algae were recorded. Species of *Nitzschia* were dominant almost at all stations. Species of *Chaetoceros* were very common along the middle and western transects.

### INTRODUCTION

Though a number of literature on phytoplakton of the west coast of India are available (Qasim and Reddy, 1967; Prakash and Serma, 1969; Shah, 1967; Bhattathiri and Devassy, 1977, Abidi *et al*; 1981, Jiyalal *et al*, 1984), the present paper deals with a detailed investigation on the distribution pattern of phytoplankton along the coastal waters off Porbandar in the north west coast of India. The sea off Porbandar receives sewage from the nearby urban region and industrial influents from Saurashtra Chemicals, a chemical complex which manufactures soda ash and related products.

### MATERIAL AND METHODS

Surface samples were collected with the help of a clean plastic bucket from three transects - Eastern (E), Middle (M) and Western (W) consisting of 9 stations of 3 in each transect. Stations  $E_1$ ,  $M_1$  and  $W_1$  were close to the shore. Stations  $E_3$ ,  $M_3$  and  $W_3$  were

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\* Present Address : National Institute of Oceanography, Dona Paula, Goa - 403 004.

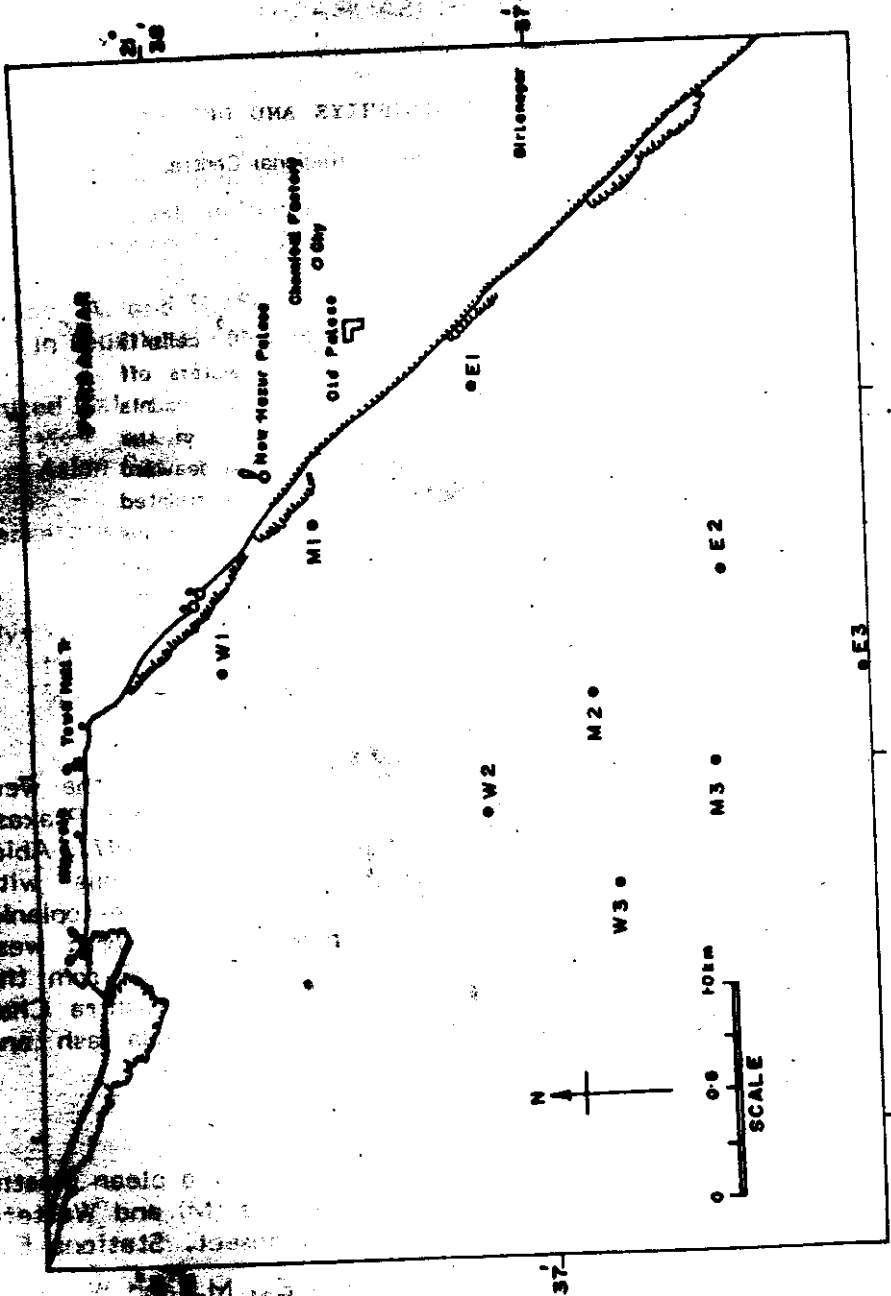


Fig. 1 : Map showing location of stations of Porbandar.

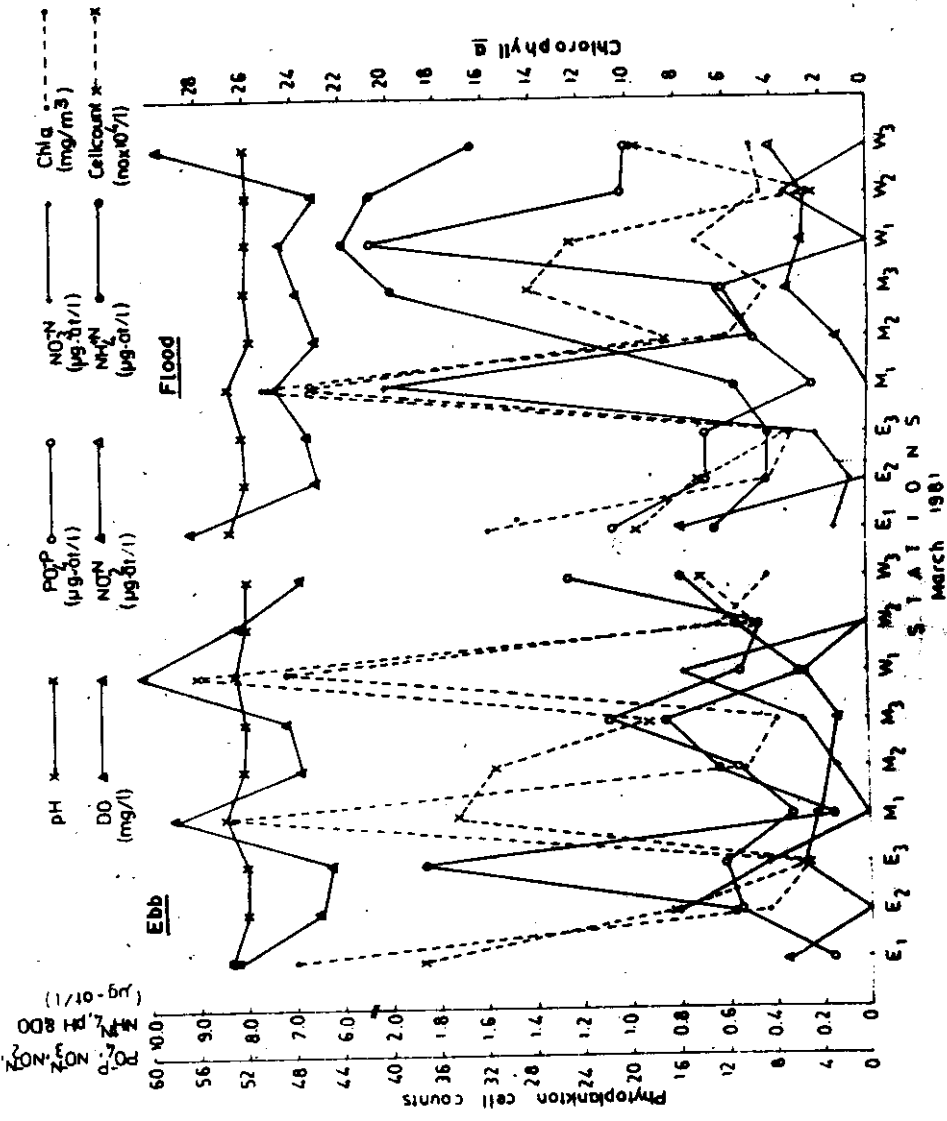


Fig.2 : Distribution of physico-chemical parameters phytoplankton cell counts and chlorophyll a at different stations during ebb and flood tides in March 1981.

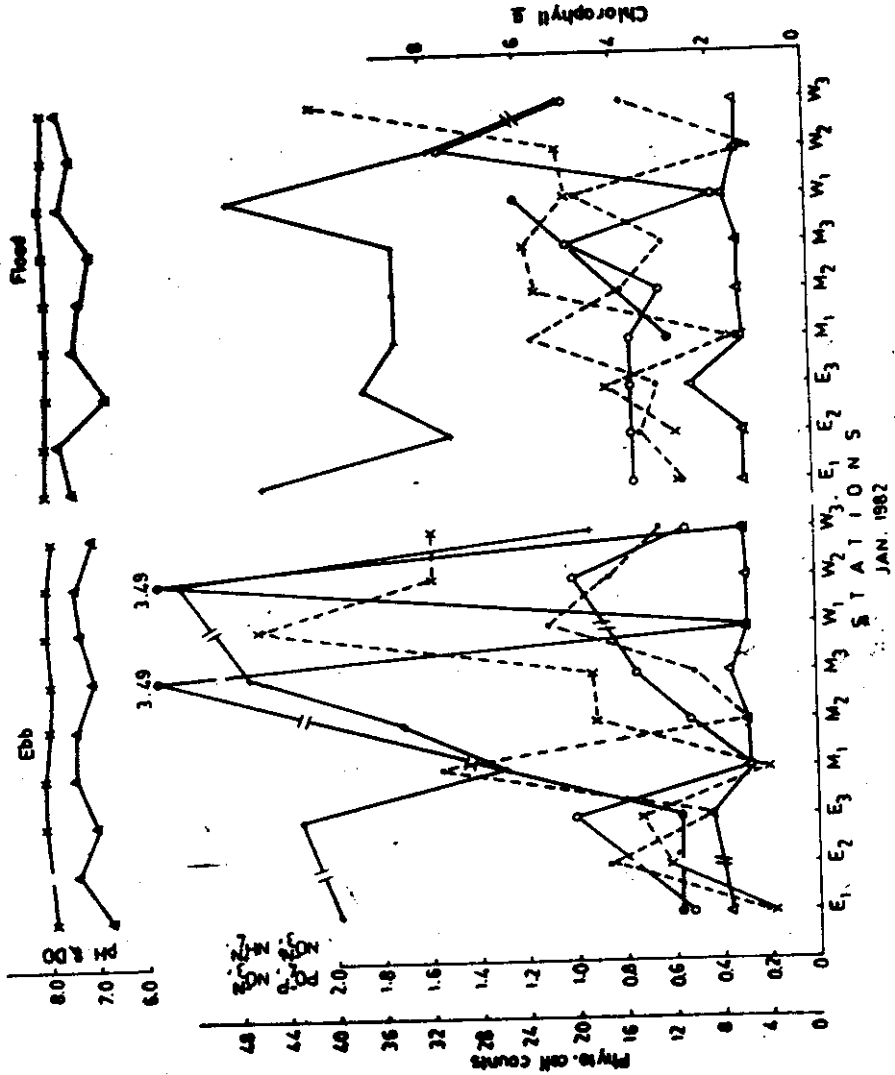


Fig.3 : Distribution of physico-chemical parameters, phytoplankton cell counts and chlorophyll a at different stations in both ebb and flood tides in January 1982.

around 2.5 km away from the shore towards the sea (Fig.1). The present study was carried out during March, 1981 and January, 1982.

Phytoplankton samples were preserved in Lugole's solution and analysed as per the standard methods (APHA, 1980). The samples for phytoplankton pigment analysis were collected in 500 ml. plastic bottles and were determined following the methods described by Strickland and Parsons (1971). Chlorophyll *a*, *b*, *c*, and carotenoid were estimated separately. Some of the physico-chemical parameters obtained from the NIO RC Report, 1982 are presented in Figs. 2 and 3.

## RESULTS AND DISCUSSION

The results of the present study have revealed that the distribution pattern of phytoplankton population and pigments was associated with the physico-chemical parameters. Variations in the physico-chemical parameters at different stations and different tides were noticed.

Temperature varied from 21.2-24.0°C in January and from 24.2 - 27.2°C in March. Salinity varied in the narrow range of 34.32 - 35.84‰. Salinity values were lower during the period of the low tide than during the high tide which could be due to the freshwater discharge in the region. pH was in the expected range (7.85 - 8.45) for natural seawater. In general, higher pH was observed during ebb than during flood and also towards near-shore than offshore, which could be attributed to the industrial discharges. The concentration of dissolved oxygen was recorded to be higher during ebb tide than during flood tide.

Appreciable fluctuations in the concentration of phytoplankton pigments and population were noticed from station to station and tide to tide. Phytoplankton pigments and cell counts were always higher at the nearshore stations than in the seaward stations (Figs. 2 & 3), which could be due to the fact that the coastal regions are generally more productive. Higher concentration of dissolved oxygen was associated with highest phytoplankton population at  $M_1$  and  $W_1$  during March, which indicates intense photosynthetic process by phytoplankton at these stations during March. Fairly high concentration of phytoplankton production was associated with increase in temperature during March. High temperature is reported to enhance the regeneration rate of nutrients which accelerate the growth of phytoplankton (Wood, 1964).

In an experimental study on phytoplankton organisms from Cochin backwaters, it has been shown that many algal forms have adopted to changing conditions of salinity, light and nutrients

Table 1: Percentage Composition of phytoplankton during March, 1981

	Ebb			Flood			Ebb			Flood			Ebb			Flood		
	E <sub>1</sub>	E <sub>2</sub>	E <sub>3</sub>	E <sub>1</sub>	E <sub>2</sub>	E <sub>3</sub>	M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>	M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>	W <sub>1</sub>	W <sub>2</sub>	W <sub>3</sub>	W <sub>1</sub>	W <sub>2</sub>	W <sub>3</sub>
<i>Nitzschia</i> sp	68.7	89.7	60.8	94.3	84.8	81.6	55.1	44.6	65.8	37.9	73.8	84.9	61.8	73.4	88.1	88.9	44.9	2.5
<i>Chaetoceros</i> sp	28.3	7.1	15.5	-	-	12.2	-	-	-	4.3	-	-	34.3	12.8	3.0	5.1	59.6	89.7
<i>Coccinodiscus</i> sp	-	-	6.2	-	-	-	5.6	-	-	-	-	-	-	-	-	-	-	-
<i>Pleurosigma</i> sp	-	-	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Oscillatoria</i> sp	-	-	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Synedra</i> sp	-	-	3.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Thalassiosira</i> sp	-	-	-	-	10.7	-	20.3	41.4	14.4	48.1	15.6	9.3	-	-	-	-	-	-
<i>Biddulphia</i> sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.7	-	-
<i>Rhizosolenia</i> sp	-	-	-	-	-	-	3.5	-	-	-	-	-	-	-	-	-	-	3.1
<i>Thalassiothrix</i> sp	-	-	-	-	-	-	3.5	6.0	-	-	-	-	-	-	-	-	-	-
Miscellaneous sp	2.9	3.2	-	5.6	4.5	6.1	12.0	7.9	19.8	9.6	10.5	5.7	3.8	10.0	8.8	5.9	12.3	7.7

Table 2 : Percentage composition of phytoplankton during January, 1982

	Ebb			Flood			Ebb			Flood			Ebb			Flood		
	E <sub>1</sub>	E <sub>2</sub>	E <sub>3</sub>	E <sub>1</sub>	E <sub>2</sub>	E <sub>3</sub>	M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>	M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>	W <sub>1</sub>	W <sub>2</sub>	W <sub>3</sub>	W <sub>1</sub>	W <sub>2</sub>	W <sub>3</sub>
<i>Nitzschia</i> sp	45.3	23.2	29.5	6.4	37.4	11.0	15.9	16.0	3.77	55.3	38.0	36.8	30.8	48.9	14.8	22.9	14.52	12.7
<i>Chaetoceros</i> sp	36.6	27.8	7.9	49.2	60.7	82.0	58.2	63.5	83.8	17.4	48.2	31.9	51.3	32.6	56.1	61.6	58.0	54.3
<i>Navicula</i> sp	4.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.0
<i>Thalassiosira</i> sp	6.8	-	-	-	-	-	-	-	-	-	-	-	-	-	6.8	-	9.8	-
<i>Coscinodiscus</i> sp	-	43.9	40.7	44.0	-	-	5.0	3.3	-	15.7	-	8.9	-	-	-	-	-	-
<i>Biddulphia</i> sp	-	-	8.2	-	-	-	12.6	-	-	-	-	-	5.6	5.1	-	5.1	-	3.6
<i>Rhizosolenia</i> sp	-	-	-	-	-	-	-	3.3	-	3.3	-	9.6	6.4	-	4.8	-	7.2	-
<i>Stauroneis</i> sp	-	-	-	-	-	-	-	3.3	-	-	-	-	-	-	-	-	-	-
<i>Gyrodinium</i> sp	-	-	-	-	-	-	-	-	-	3.2	-	-	-	-	-	-	-	12.1
<i>Tropidoneis</i> sp	-	-	-	-	-	-	-	-	-	3.2	-	6.4	-	-	-	-	-	-
<i>Ditylum</i> sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.2	-	-	-
<i>Pleurosigma</i> sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.3	-	4.8	6.0
<i>Thalassionema</i> sp	-	-	-	-	-	-	-	-	-	-	-	-	8.0	4.7	-	-	-	-
<i>Thalassiothrix</i> sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	6.2	5.9	13.5	0.2	1.8	6.9	8.1	10.5	12.4	4.9	4.1	9.5	4.1	8.6	7.9	10.2	5.4	5.0

(Qasim, 1980). The present study indicated high phytoplankton population at the time of low salinity. Decline in the concentration of salinity associated with high phytoplankton production was also reported by Bhargava and Dwivedi (1976) in the estuarine system of Goa and Rajagopal (1980) in Mandovi and Zuari estuaries.

Higher concentration of pigments and cell counts towards nearshore stations could be attributed to the effect of large amount of effluent discharged into the coastal environment. But occasionally higher level of phytoplankton production associated with comparatively lower concentration of nutrients recorded at some stations as also noticed by Ganpati and Raman (1979), indicated probably utilization of the entire nutrients, leading to high phytoplankton growth.

The present study reveals that the coastal water is very productive during the month of March. The coastal areas in the tropics are generally productive. The main cause for high production of phytoplankton in shallow areas is rapid regeneration of nutriently high temperature, accelerating all bacterial processes (Thomas and Owen, 1971).

The ratios of chl. *a*:*b* were always more than 1 but ratios of chl. *a*:*c* were very often less than 1 suggesting higher concentration of chl. *c* than chl. *a*, which was in accordance with the observation of Ketchum *et al.*; (1958), Anita *et al.* (1962) and Vernon and Seely (1966). Higher ratios of chl. *a*:*c* may also be due to the fact that chlorophyll *c* is more stable than chl. *a* when cells are disintegrating. This would give higher apparent values for chl. *c* in water samples than those actually present in the organisms (Vernon and Seely, 1966).

Chl. *c* was also observed to be less than Chl. *a* on certain occasions and this observation is similar to the findings of Parsons (1960), Bhargava and Dwivedi (1976) and Jiyalal *et al.* (1984). However the ratios of chl. *a* to chl. *b*, chl. *a* to chl. *c* and chl. *a* to carotenoids were varying considerably. Varying ratios of these pigments were also recorded by Bhargava and Dwivedi (1976) and Jiyalal *et al.* (1984). The ratios of chl. *a* to carotenoids varied considerably, being particularly sensitive to changes in cellular nitrogen (McAllister *et al.*; 1964; Jiyalal *et al.*; 1984).

There were 71 species of algae belonging to 28 genera recorded during the period of the study. The species belonging to the class Cyanophyceae and Pyrrophyceae were very few in number whereas the species of Bacillariophyceae (diatom) were recorded to be dominant (Tables 1&2). Of these *Nitzschia* sp; *N. closterium*, *N. seriata*, *N. bilobata*, *Stauroneis membranacea*, *Biddulphia sinensis*,



*B. mobeliensis*, *Chaetoceros* sp, *C. difficilis*, *thalassiosira gravida*, *T. condensata* and *Thalassionema* sp were in abundance during the ebb period. The species of *Nitzschia* and *Chaetoceros* were reported by Palmer (1980) and Jiyalal (1985) as characteristics of organically enriched areas. During the period of flood, *Pleurosigma angulatum*, *P. directum*, *P. elongatum*, *Coscinodiscus vursus*, *C. granii*, *C. lineatus*, *C. excentricus*, *Gyrosigma balticum*, *G. fasciola*, *Rhizosolenia setigera* and *Tropidoneis* sp were found in higher abundance. This indicated that these species were characteristic of offshore Phytoplankton distribution in the area was not uniform and varied depending on the preference of individual species to varying environmental conditions.

Tidal effect on the phytoplankton population was well defined with higher concentration during low tide and lower counts during high tide. This could be attributed to effluent discharge in the region.

The coastal waters off Porbandar were observed to be highly productive. Remarkably high phytoplankton crop recorded during the month of March could be due to optimum environmental conditions.

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