

## BIOLOGICAL OBSERVATIONS OFF SUTRAPADA, VERAVAL (GUJARAT)

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### ABSTRACT

Biological production potential off Veraval was evaluated based on the contribution of phytoplankton, zooplankton and benthos. The study was made along three transects covering four months during 1984-85. The mean phytoplankton count, zooplankton biomass and macrobenthic biomass were respectively  $1.66 \times 10^4$ /litre, 74.76 ml/100 m<sup>3</sup> and 65.71 g/m<sup>2</sup>. Phytoplankton maintained an almost steady population. The area was not very rich in zooplankton even though the composition indicated a diverse faunal assemblage. The subtidal macrofaunal population density indicated the high fertility of the region. The importance of similar collective investigations to characterise an area particularly for environmental monitoring studies has been emphasised.

### INTRODUCTION

Majority of the investigations on biological characteristics of an area usually cover a specific level of productivity of a group of organism or a species. It is true that such reports provide authentic detailed information on the aspect covered with limited emphasis on the production potential of the area. Very often an overall study of a variety of biological aspects is also found to be essential in obtaining a comprehensive account of the entire system for predicting the state of equilibrium. Biological productivity at different levels is one such comprehensive investigation to be considered for evaluating the production potential of an area. This approach has more recently become an important part of all the environmental monitoring studies. As a case study, detailed investigations were made off Veraval, for four months spread over to different monsoon periods. It is anticipated that the studies made on phytoplankton, zooplankton and benthos and fishery of the area will give a fair picture on the existing production potential of Gujarat coast which is considered to be well known for its fishery resources.

### MATERIALS AND METHODS

Nine stations were selected in the sea off Sutrapada (Fig.1). The location of stations were fixed at 5, 15 and 25 m depth contours along three transects namely the eastern transect off Sutrapada village ('S' transect), the central transect ('M' transect) and western transect off Kadwar village ('K' transect). Samples were collected in May, October, November 1984 and February 1985. Water samples were collected from all stations from surface and bottom for estimating phytoplankton pigments and counts. Due to some technical problems pigments could not be estimated for May. Zooplankton samples were collected by oblique hauls using an HT net (mesh size 0.3 mm; mouth area 0.25 m<sup>2</sup>) with an attached TSK flow

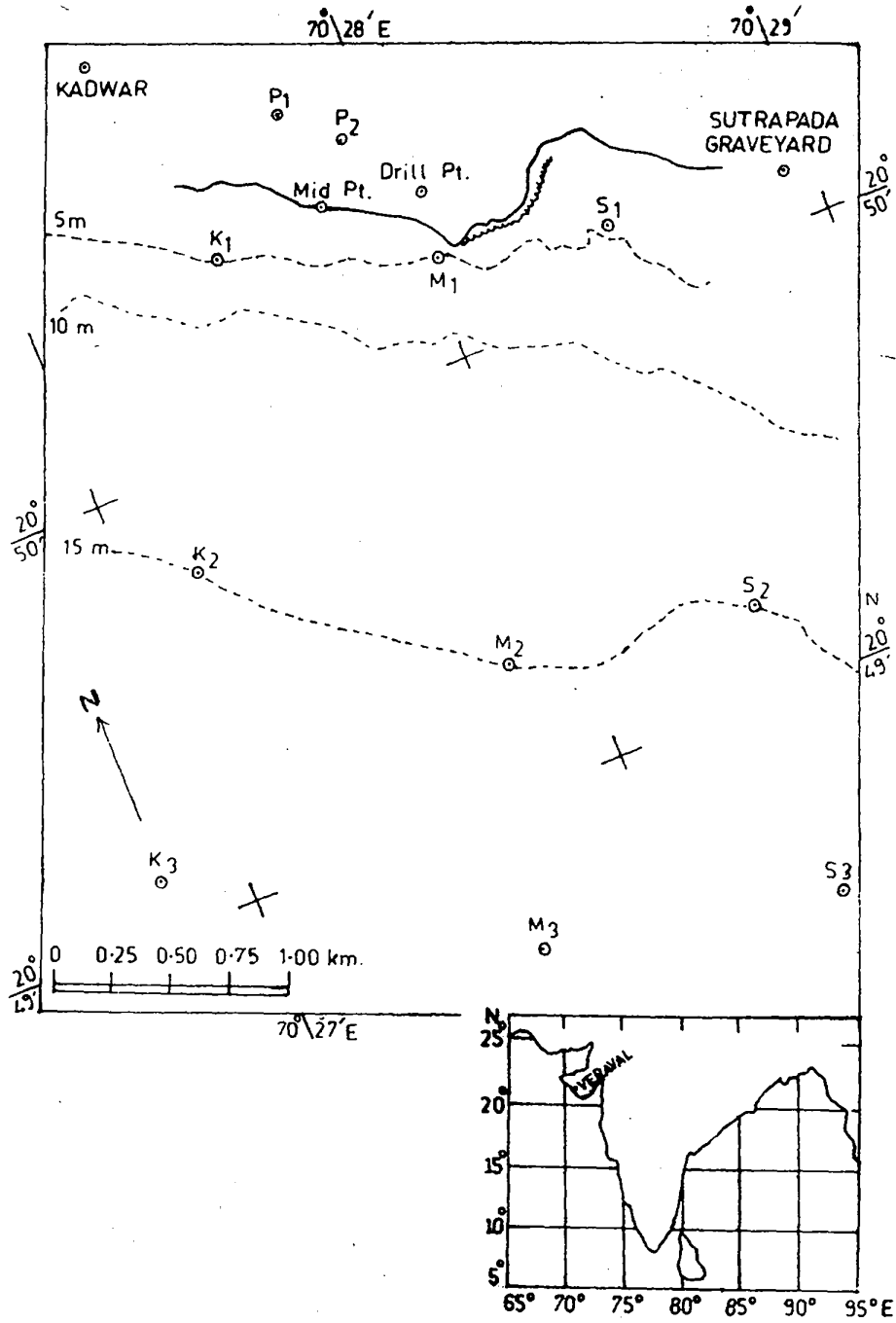


Fig. 1. Location of stations

meter. Sediment samples were obtained using a van-Veen grab of 0.04 m<sup>2</sup> area. The sample was sieved through a 0.5 mm mesh size and the animals retained were preserved in 5% buffered formalin. Benthic biomass was calculated on wet weight basis. Water samples were collected for estimating salinity, pH, and nutrients and were analysed as per standard dissolved oxygen procedure. Bottom trawling off Sutrapada was done in February 1984 using a 48 ft mechanised trawler to evaluate the fishery potential of the area. The catch was identified in different species.

## RESULTS AND DISCUSSION

### Environmental Conditions

The period of study covers only the premonsoon and postmonsoon months. For most of the physico-chemical parameters studies there was limited variation between the stations. The data on environmental parameters are presented in Table I. The average pH value for sea water varied from 7.76-8.16. The pH range is quite wide and appears to be due to the influence of limestone deposits which alter the pH of sea water. In general, the coastal waters off Sutrapada had low suspended matter. During May salinity showed a range of 35.45-37.38‰ which came down to 32.16-35.9‰ during the postmonsoon months. Dissolved oxygen level in May was frequently low (3.0-4.0) while during October - November and January the values were normal. The nutrients showed a sharp increase in value during the postmonsoon period and this was more conspicuous for nitrate. Relatively higher values of ammonical nitrogen were observed for the month of May than the postmonsoon period.

### Phytoplankton Pigments and Cell Counts

In October, chlorophyll *a* values were quite high (av. 1.4 mg/m<sup>3</sup>) compared to the month of November (av. 0.08 mg/m<sup>3</sup>). Very often the values of chlorophyll from the bottom waters were higher than that obtained for the surface. The values of phaeophytin often exceeded that of chlorophyll *a* and the respective average values for the two parameters were 0.87 and 0.74 mg/m<sup>3</sup>. Among the three transects surveyed the S transect showed higher values of chlorophyll *a* than the other two (Tables II & III).

The phytoplankton count was almost steady during the period of investigation (Tables IV-VI). The average values of cell counts for May, November and February were respectively 1.48, 1.88 and 1.64x10<sup>4</sup> per litre. Contrary to the findings observed for chlorophyll phytoplankton cell counts gradually increased from transects S to K. *Coscinodiscus* was the most abundant genus during the entire period of collection. *Navicula*, *Nitzschia* and *Thalassiothrix* were very common in November and February; *Pinnularia* and *Rhizosolenia* were more common in May.

### Zooplankton

During May, zooplankton standing stock and population density varied from 2.8 to 8.3 ml/100m<sup>3</sup> (av. 5.55 ml/100m<sup>3</sup>) and 2633-17267/100m<sup>3</sup> (av. 8053/100m<sup>3</sup>) respectively. In general, zooplankton biomass at all stations were comparable (Tables IV-VI). There was no regular pattern in the distribution showing either an increase towards the offshore area

TABLE I Variations in some physico-chemical parameters at different stations (Values given in brackets are averages)

Station	Temperature °C	pH	Suspended solids (mg/l)	Salinity ‰	Dissolved oxygen (mg/l)	Reactive phosphorus (µg. at/l)			Nitrate- nitrogen (µg.at/l)	Nitrite- nitrogen (µg.at/l)	Ammonia- nitrogen (µg.at/l)	Organic matter in sediment (%)
						phosphorus	phosphorus	phosphorus				
May 1984												
1	26.7-28.2 (27.23)	7.73-7.86 (7.80)	11-52 (21)	36.28-37.38 (36.81)	3.3-4.4 (3.95)	0.61-1.35 (0.83)	1.79-4.64 (3.19)	0.57-0.86 (0.70)	0.43-3.5 (1.5)	—	—	—
2	27.5-29 (28.32)	7.81-7.86 (7.83)	10-18 (14.6)	35.45-37.2 (36.55)	3.0-5.9 (4.28)	0.29-1.06 (0.78)	1.21-7 (3.73)	0.07-0.86 (0.63)	0.21-4.21 (1.43)	1.84-2.27 (2.06)	—	—
3	27.5-29 (27.96)	7.80-7.86 (7.83)	10-14 (11.5)	36.19-36.83 (36.54)	4.0-5.1 (4.5)	0.45-0.9 (0.68)	2.21-4.5 (3.04)	0.57-0.86 (0.75)	0.07-2.86 (1.11)	1.53-2.76 (2.17)	—	—
October 1984												
1	28.0-29.0 (28.66)	7.80-8.15 (7.94)	6-34 (21.2)	32.16-34.98 (33.55)	4.2-6.7 (5.71)	0.61-2.09 (1.09)	4.86-17.79 (11.88)	0.1-1.5 (0.86)	0.1-3.6 (0.59)	—	—	—
2	27.0-29.0 (28.59)	7.78-8.06 (7.93)	18-38 (26.5)	32.16-35.15 (33.83)	4.1-6.8 (5.93)	0.29-1.35 (0.89)	3-15.79 (10.68)	0.14-1.29 (0.78)	0-1 (0.46)	—	—	—
3	27.8-29.0 (28.59)	7.89-8.87 (8.06)	15-47 (26.5)	32.50-35.90 (34.58)	4.1-7.1 (6.04)	0.61-1.48 (0.92)	5.86-13.36 (10.37)	0.0-0.79 (0.24)	0.21-1 (0.53)	2.52-3.13 (2.89)	—	—
November 1984												
1	25.8-26.3 (26)	7.71-7.79 (7.77)	22-41 (32.78)	34.75-35.9 (35.25)	4.6-5.7 (5.39)	0.68-5.10 (1.49)	7.07-16.71 (12.30)	0.57-1.43 (1.06)	0.07-0.5 (0.25)	—	—	—
2	25.6-26.3 (25.98)	7.71-7.80 (7.77)	18-44 (31.44)	34.73-35.54 (35.05)	3.3-6.0 (5.14)	1.06-1.65 (1.32)	11.71-18.71 (15.13)	0.79-1.07 (0.90)	0.07-0.64 (0.27)	—	—	—
3	25.6-26.3 (25.97)	7.59-7.81 (7.76)	19-51 (32.5)	32.65-35.36 (34.75)	3.8-6.0 (5.13)	1-1.87 (1.33)	11.64-15.64 (13.70)	0.71-1.29 (0.83)	0-0.64 (0.28)	3.01-3.38 (3.21)	—	—
January 1985												
1	23.9-26.1 (24.54)	8.10-8.20 (8.14)	24-36 (30.33)	33.31-34.30 (33.91)	6.1-7.5 (6.78)	1.06-1.61 (1.33)	27.64-30.27 (28.64)	0.86-1.21 (1.0)	0.14-0.28 (0.21)	—	—	—
2	23.5-26.0 (24.5)	8.10-8.21 (8.16)	23-33 (27.11)	33.31-34.48 (34.04)	6.6-7.7 (6.97)	1.26-1.39 (1.30)	21.07-24 (22.83)	0.79-1.29 (1.02)	0.07-0.14 (0.12)	—	—	—
3	23.0-25.6 (24.38)	8.10-8.20 (8.16)	24-46 (31.33)	33.12-34.65 (34.06)	6.0-7.6 (6.87)	1-1.26 (1.17)	26.43-27.71 (26.86)	0.86-1.5 (1.14)	0.14-0.28 (0.24)	—	—	—

TABLE II Variations in the distribution of chlorophyll and phaeophytin at various stations on 16-10-84

Station	Time	Depth	Chlorophyll <i>a</i> (mg/m <sup>3</sup> )	Phaeophytin (mg/m <sup>3</sup> )
S <sub>1</sub>	1500	S	3.20	2.08
S <sub>1</sub>	1500	B	3.74	2.62
S <sub>2</sub>	1530	S	1.60	2.14
S <sub>2</sub>	1530	B	0.53	1.34
S <sub>3</sub>	1600	S	1.60	0.27
S <sub>3</sub>	1600	B	2.46	0.53
M <sub>1</sub>	1730	S	0.53	2.46
M <sub>1</sub>	1730	B	0.53	1.71
M <sub>2</sub>	1700	S	0.48	0.27
M <sub>2</sub>	1700	B	1.60	0.85
M <sub>3</sub>	1630	S	0.53	2.83
M <sub>3</sub>	1630	B	0.53	2.84
K <sub>1</sub>	1800	S	0.53	1.71
K <sub>1</sub>	1800	B	0.53	0.05
K <sub>2</sub>	1830	S	2.14	0.48
K <sub>2</sub>	1830	B	0.53	0.16
K <sub>3</sub>	1900	S	2.67	1.07
K <sub>3</sub>	1900	B	1.60	3.38

(st. 3 of all transects) or higher values towards the nearshore waters. The period of study was characterised by the dominance of crustaceans as the major constituent of the zooplankton community. At station 1 of all transects, chaetognaths and decapods contributed almost equal percentage while at other stations, percentage incidence of chaetognaths was generally more (Fig. 2). Fish eggs were very common at station 3.

Zooplankton volume and population for the month of October showed a fluctuation of 27.2 to 734.5 ml/100m<sup>3</sup> (av. 28375 ml/100m<sup>3</sup>) and 2333 to 25802/100 m<sup>3</sup> (av. 18042/100m<sup>3</sup>) respectively. The recorded biomass, quite unusual for any oceanic environment, was due to the congregations of salps, *Pegea confoederata* (Fig. 2). The collection included free swimming solitary forms as well as aggregate forms, some forming chains. Eventhough numerically copepods became dominant, on rare occasions, invariably salps contributed more than 90% of the total standing stock of zooplankton. The population density of salps

TABLE III Variation in the distribution of chlorophyll *a* and phaeophytin at various stations on 18-11-84

Station	Time	Depth	Chlorophyll <i>a</i> (mg/m <sup>3</sup> )	Phaeophytin (mg/m <sup>3</sup> )
S <sub>1</sub>	1000	S	0.53	0.21
S <sub>1</sub>	1000	B	0.02	0.04
S <sub>2</sub>	1030	S	0.07	0.14
S <sub>2</sub>	1030	B	0.03	0.05
S <sub>3</sub>	1100	S	0.03	0.04
S <sub>3</sub>	1100	B	0.10	0.02
M <sub>1</sub>	1230	S	0.10	0.01
M <sub>1</sub>	1230	B	0.03	0.06
M <sub>2</sub>	1200	S	0.04	0.91
M <sub>2</sub>	1200	B	0.03	0.01
M <sub>3</sub>	1130	S	0.14	0.13
M <sub>3</sub>	1130	B	0.03	0.02
K <sub>1</sub>	1300	S	0.03	0.06
K <sub>1</sub>	1300	B	0.03	0.04
K <sub>2</sub>	1330	S	0.02	0.08
K <sub>2</sub>	1330	B	0.02	0.01
K <sub>3</sub>	1400	S	0.17	0.04
K <sub>3</sub>	1400	B	0.17	0.70

reached its peak during October. To evaluate their distribution in the vertical realm, samples were collected by vertical hauls. The results indicated their uniform distribution in the entire water column. Offshore sampling from a depth range of 35-40 m was also done to confirm that the entire area was covered by these gelatinous organisms. These organisms were quite big and many of them reached a size of 5-7 cm long weighing about 5.5 to 6 g. The contribution of salps was relatively more towards the nearshore stations.

In November, the standing stock of zooplankton (4.88-29.27 ml/100 m<sup>3</sup>) showed an increasing trend towards offshore and copepods became the dominant group. The average biomass and population were respectively 12.19 ml/ 100m<sup>3</sup> and 25217/ 100m<sup>3</sup>. The entire population of salp disappeared from stations 1 and 2 of all transects with marginal representation of the group along the offshore stations (St. 3).

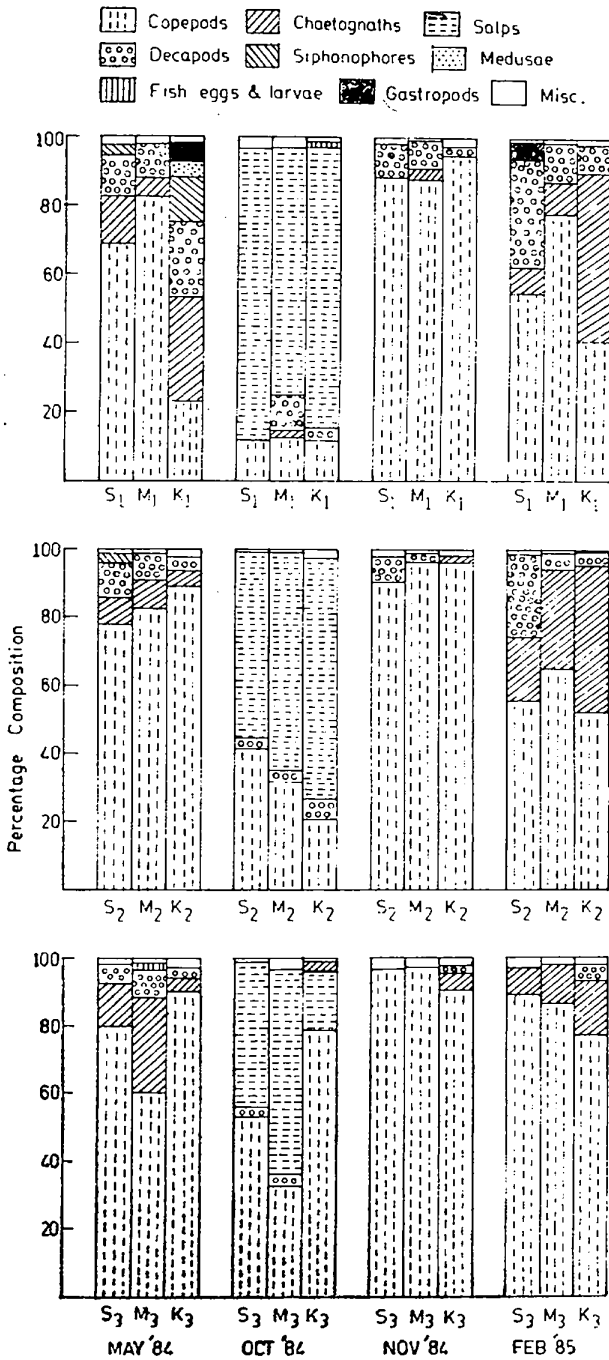


Fig. 2. Percentage composition of different groups of zooplankton along the three transects

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TABLE IV Quantitative distribution of phytoplankton, zooplankton and benthos at Sutrapada transect during 1984 - 85

Station	Phytoplankton Population (no x 10 <sup>4</sup> /l)	Zooplankton		Benthos	
		Biomass (ml/100 m <sup>3</sup> )	Population (no/100 m <sup>2</sup> )	Biomass (g/m <sup>2</sup> )	Population (no/m <sup>2</sup> )
<b>MAY 1984</b>					
S <sub>1</sub>	1.00	6.94	10533	—	—
S <sub>2</sub>	1.80	4.17	7444	3.597	6480
S <sub>3</sub>	1.52	4.17	4781	2.647	6492
<b>OCTOBER 1984</b>					
S <sub>1</sub>	—	480.52	22325	—	—
S <sub>2</sub>	—	697.88	36528	—	—
S <sub>3</sub>	—	439.68	19206	1.834	5112
<b>NOVEMBER 1984</b>					
S <sub>1</sub>	1.60	9.76	17015	—	—
S <sub>2</sub>	1.20	14.63	31507	33.347	14976
S <sub>3</sub>	1.72	17.07	39532	9.189	8712
<b>FEBRUARY 1985</b>					
S <sub>1</sub>	1.16	4.21	7840	—	—
S <sub>2</sub>	1.28	4.45	11764	1.553	2664
S <sub>3</sub>	1.28	7.84	96945	23.863	10464

Zooplankton biomass was low during February (2.91–11.34 ml/100 m<sup>3</sup>, av. 6.04 ml/100 m<sup>3</sup>) and the pattern of distribution became irregular along the three transects. On the otherhand, zooplankton population density was quite high (av. 44214/100m<sup>3</sup>) and copepods formed the major constituent of zooplankton community during this period. Then contribution of chaetognaths became high and the percentage incidence varied from 7 to 49.6.

The standing stock of zooplankton did not indicate a very rich potential of the area. The reported zooplankton biomass values are higher than that reported off Veraval (IOBC, 1968) but comparable with the available data for the coastal waters of Gujarat (Nair *et al.*, 1978). The trend in the pattern of distribution of zooplankton along the three transects is comparable. Eventhough biomass of zooplankton was more during October, the observed population maxima were in February. The swarming of, gelatinous organisms during October could be a recurring phenomenon. For confirming this a series of collections were made during the first week of September 1985 and it was found that the entire area had been dominated by salps.



TABLE V Quantitative distribution of phytoplankton, zooplankton and benthos at the middle transect during 1984 - 85

Station	Phytoplankton population (no. x 10 <sup>4</sup> /l)	Zooplankton		Benthos	
		Biomass (ml/100 m <sup>3</sup> )	Population (no/100 m <sup>3</sup> )	Biomass (g/m <sup>2</sup> )	Population (no/m <sup>2</sup> )
<b>MAY 1984</b>					
M <sub>1</sub>	1.64	2.78	4550	—	—
M <sub>2</sub>	0.96	3.47	6944	—	—
M <sub>3</sub>	1.48	5.56	4694	3.983	8450
<b>OCTOBER 1984</b>					
M <sub>1</sub>	—	76.01	2452	—	—
M <sub>2</sub>	—	212.63	13104	—	—
M <sub>3</sub>	—	220.74	8005	8.367	23844
<b>NOVEMBER 1984</b>					
M <sub>1</sub>	1.64	7.32	26727	—	—
M <sub>2</sub>	1.68	9.76	34961	0.539	2112
M <sub>3</sub>	2.09	9.79	33732	7.966	13920
<b>FEBRUARY 1985</b>					
M <sub>1</sub>	2.36	3.06	16506	—	—
M <sub>2</sub>	1.28	11.34	90614	13.622	14995
M <sub>3</sub>	1.84	8.57	72488	220.288	11208

### Substratum

The substratum was almost rocky at a depth of 8 to 10 m at stations S<sub>1</sub>, M<sub>1</sub> and K<sub>1</sub>. At stations S<sub>2</sub>, M<sub>2</sub> and K<sub>2</sub> mostly a rocky bottom with an intermittent clayey silt deposit was encountered at a depth of 15 to 18 m. Invariably a clayey silt bottom prevailed at all the transects at depths beyond 22 m (stations S<sub>3</sub>, M<sub>3</sub> and K<sub>3</sub>).

### Organic matter in sediment

The mean percentage of organic matter in sediment showed an increasing trend from May (2.12%) to November (3.21%) indicating a significant rise during postmonsoon (Table I). The mean percentages of organic matter for the transects S, M and K, were 2.60, 2.96 and 2.76 respectively. The observed mean percentage of organic matter for the area studied was 2.77. The results are comparable with available data on the organic content in the nearshore coastal sediments of the North-west coast of India (Parulekar *et al.*, 1976, Varshney, 1982).

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TABLE VI Quantitative distribution of phytoplankton, zooplankton and benthos at Kadwar transect during 1984 - 85

Station	Phytoplankton population (no $\times 10^4/l$ )	Zooplankton		Benthos	
		Biomass (ml/100 $m^3$ )	Population (no/10 0 $m^3$ )	Biomass (g/ $m^2$ )	Population (no/ $m^2$ )
<b>MAY 1984</b>					
K <sub>1</sub>	2.00	4.86	2633	—	—
K <sub>2</sub>	1.36	8.33	17267	6.568	14232
K <sub>3</sub>	1.52	3.47	13633	4.721	7752
<b>OCTOBER 1984</b>					
K <sub>1</sub>	—	65.54	6880	—	—
K <sub>2</sub>	—	182.47	6504	—	—
K <sub>3</sub>	—	107.77	10444	12.837	39816
<b>NOVEMBER 1984</b>					
K <sub>1</sub>	2.40	4.88	7093	—	—
K <sub>2</sub>	3.60	7.32	17078	0.567	1176
K <sub>3</sub>	1.00	29.27	19312	5.328	20232
<b>FEBRUARY 1985</b>					
K <sub>1</sub>	1.56	6.49	29735	—	—
K <sub>2</sub>	2.00	2.91	24509	861.632	10772
K <sub>3</sub>	1.96	4.55	37527	91.726	25752

**Subtidal macrofaunal population and biomass**

*Sutrapada transect (stations S<sub>2</sub> & S<sub>3</sub>):* Generally, the faunal counts and biomass of the stations S<sub>2</sub> and S<sub>3</sub> were comparable (Tables IV-VI, Fig. 3). Relatively higher population counts and biomass were observed during November at station S<sub>2</sub>, whereas the same were noticed during February at station S<sub>3</sub>. Mean population density of 7867/ $m_2$  and biomass of 11.1 g/ $m_2$  were recorded at this transect.

*Middle transect (stations M<sub>2</sub> & M<sub>3</sub>):* Station M<sub>3</sub> sustained higher population and biomass than station M<sub>2</sub>. At station M<sub>3</sub>, the highest population count was encountered during October whereas the highest biomass was obtained during February. At station M<sub>2</sub> the peak population density and biomass were recorded during February. On an average, the middle transect recorded a population of 11455/ $m_2$  and biomass of 33.6 g/ $m_2$  of subtidal macrobenthos. As compared to Sutrapada transect, the middle transect

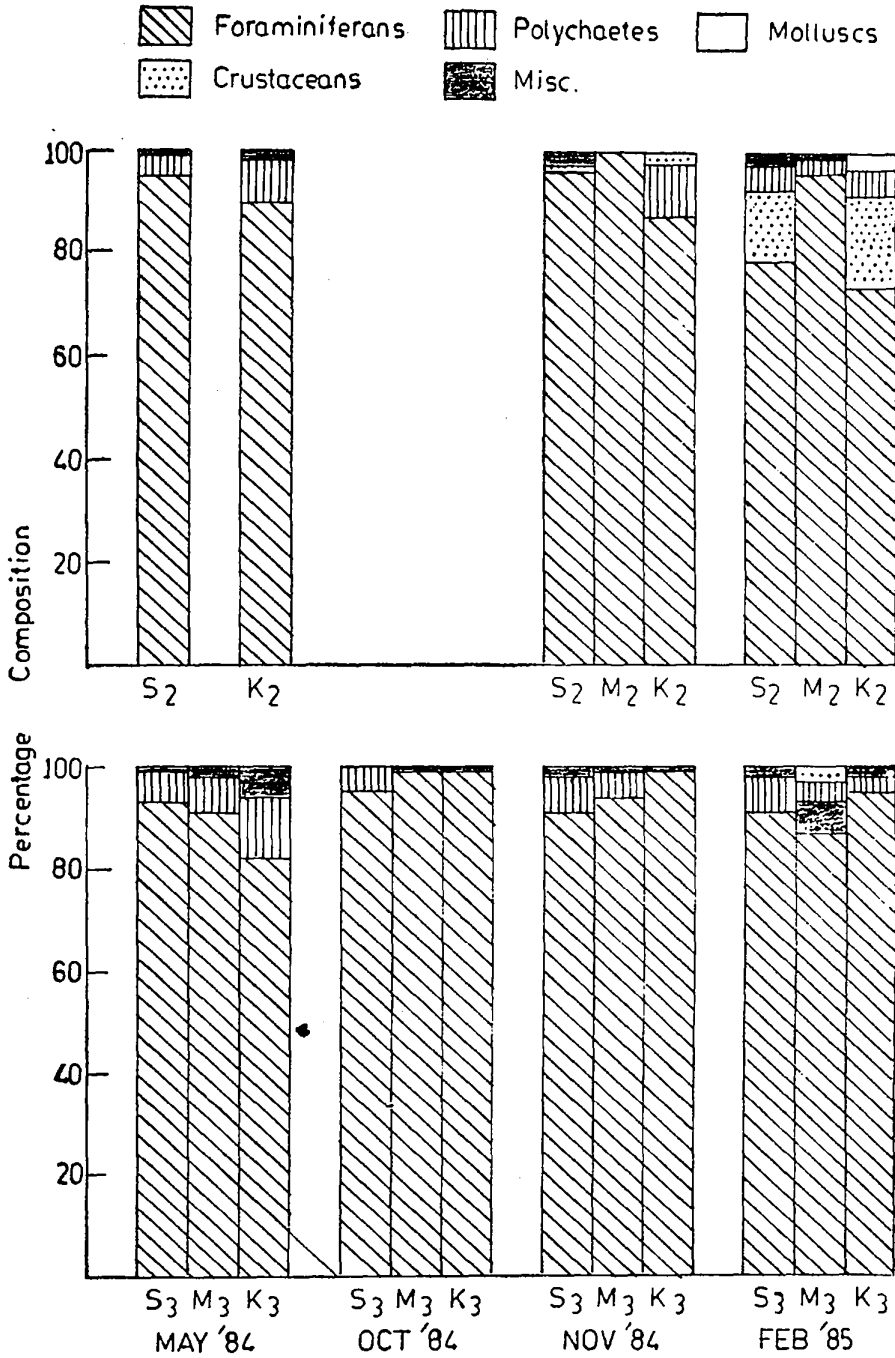


Fig. 3. Percentage composition of different groups of macrobenthos at various stations

sustained higher macrofaunal density and biomass of the order of 1.5 and 3 times more than the former respectively.

*Kadwar transect (stations K<sub>2</sub> & K<sub>3</sub>):* At station K<sub>3</sub>, the highest population count was recorded during October whereas the same was observed during May at station K<sub>2</sub>. But the highest biomass for both stations were obtained during February. However, the recorded mean biomass value was much higher for station K<sub>2</sub> than station K<sub>3</sub> although the latter sustained the highest mean population. The obtained mean population and biomass for this transect were 18239/m<sup>2</sup> and 159.1 g/m<sup>2</sup> respectively. In general, the Kadwar transect sustained higher biomass of the order of 14 and 4 times more than the Sutrapada and Middle transects respectively. Similarly, in terms of population density it sustained of the order of 2 and 1.5 times more counts than the transects S and M respectively.

The highest mean population and biomass of subtidal macrobenthos for the study area were noticed during October and February respectively. Similarly, the lowest mean population and biomass were obtained during May. In general, the area sustained a rich subtidal macrofauna in terms of population density (mean: 13609/m<sup>3</sup>) and biomass (mean: 55.9 g/m<sup>2</sup>).

#### **Faunal composition**

The different subtidal macrofaunal groups encountered in the order of abundance at the study area were foraminiferans, polychaetes, crustaceans, molluscs, sipunculids, echinuroids and miscellaneous groups. The last mentioned group chiefly consisted of echinoderms, turbellarians, nemertines, polyzoans and fish larvae. The details of the above mentioned faunal groups are as follows:

*Foraminiferans:* Foraminiferans formed a single large group in terms of numerical abundance (92.45%) of the subtidal macrofauna. They prevailed 100% in samples collected from various stations during different periods. Transect wise, an increasing trend in their abundance in terms of population as well as biomass was noticed from Sutrapada to Kadwar transect. The highest mean population (19834/m<sup>3</sup>) and biomass (4.8 g/m<sup>2</sup>) were encountered at Kadwar transect.

*Polychaetes:* Polychaetes formed the second largest group in terms of numerical abundance. Their percentage of prevalence was 100. They accounted for 4.72% of the total macrofauna studied. In general, polychaetes contributed 456/m<sup>2</sup> and 1.1 g/m<sup>2</sup> in terms of mean population and biomass of the total subtidal macrofauna respectively. Transect-wise polychaetes were relatively higher in number at Kadwar transect as compared to Sutrapada and Middle transects.

*Crustaceans:* The distribution of crustaceans in terms of station wise as well as month wise was discontinuous. Their percentage of prevalence was 75. Crustaceans were more frequently recorded at Sutrapada transect as compared to the rest of the transects.

*Molluscs:* Like crustaceans molluscs also revealed discontinuous distribution in the area of study. They were mostly encountered at Sutrapada and Kadwar transects. In general,

Kadwar transect recorded higher mean population counts and biomass of the three transects. Overall, molluscs contributed a mean percentage of 1.58% of the total subtidal macrofauna in the area studied.

*Sipunculids*: Sipunculids prevailed in 100% of the samples. They were numerically more abundant during premonsoon as compared to postmonsoon period. They varied from 0.08 to 1.80% (av. 0.67%) of the total macrofauna.

*Echiuroids*: Echiuroids were encountered in the samples only during February. They were recorded from all the three transects. Middle transect accounted for higher mean population count (608/m<sup>2</sup>) and biomass (112.3 g/m<sup>2</sup>) than the other two transects.

*Miscellaneous group*: The miscellaneous group accounted for a mean percentage of 0.32 of the total subtidal macrofauna. They contributed a population count of 9 to 168/m<sup>2</sup> and biomass of 0.3 to 4.1 g/m<sup>2</sup>.

The substratum plays a major role in deciding the faunal distribution in different environments (Parulekar, 1973). The difference in benthic biomass and population values between various transects can be attributed to the difference in the substratum rather than the observed physico-chemical parameters (Table I). The findings agree with biomass values and macrofaunal composition of the earlier report along the nearshore regions off Southern Saurashtra (Parulekar & Wagh, 1975). Since the type of substratum plays a major role in the distribution of benthic fauna, the difference in depth at an order of 5 to 10 m did not indicate any consistent relationship either with biomass or population count.

*Fishery*: Bottom trawling was done off Sutrapada using a fish and shrimp trawl. Trawling gave a catch rate of 30 kg/h. Prawns the single major catch (35%) followed by crabs (11.7%), sole (10%), sciaenids (10%), and lobsters (6.7%), Squilla (5%), squids (5%), ribbonfish (2.5%), eels, perch, anchovy were also present (14%).

The Gujarat coast is well known for its fishery for Bombay duck, prawns, pomfrets and sciaenids. Gujarat ranks fourth in marine fish landing among all the states and the total contribution amounts to 2, 90, 708 tonnes/year for the period 1984-85. Prawns in the present trawl catch belonged to *Metapenaeus affinis*, *M. monoceros* and *Parapenaeopsis stylifera*. Lobster was represented by *Panulirus homarus*. *Cynoglossus macrolepidotus*, *Jonius dussumieri*, *Otolithus argenteus*, *Trichiurus savala*, *Lactarius lactarius*, *Coilia dussumieri*, *Polynemus heptadactylus* and *Muraenesox talabonoides* were the common fishes found in the region.

In the overall analysis, the distribution of benthic biomass and phytoplankton count showed an increasing trend from Sutrapada to Kadwar village. In a similar way no such clear cut relationship could be brought out between benthos and zooplankton. An earlier finding (Humphrey, 1972) established a correlation between the higher benthic biomass and higher primary production in the coastal waters along the Northwest coast of India.

The phytoplankton maintained an almost steady population during the different periods of investigation. The area harbours diverse zooplankton fauna except during October when the gelatinous organisms completely dominated the environment and this

coincides with the peak fishing season. The rich subtidal macrofaunal population also suggests the high fertility of the coastal areas off Sutrapada. Eventhough the fishery data obtained was for the lean period, the information showed the incidence of economically important species of prawns, sciaenids and clupeids, suggesting the good biological production potential of the area. The present study on the biological characteristics off Sutrapada will serve as a baseline information for the future environmental monitoring and coastal management programmes of this region. Any industrial establishment coming along the coast of Veraval should take necessary measures to maintain the ecosystem without much disturbance.

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