

## BENTHIC STUDIES IN SOUTH GUJARAT ESTUARIES

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### ABSTRACT

Benthic biomass and faunal composition in relation to various environmental conditions of the four South Gujarat estuaries namely the Auranga, Ambika, Purna and Mindola were studied and compared. Mean population density of benthos in Auranga, Ambika, Purna and Mindola were 318690, 54727, 122350 and 88368 m<sup>-2</sup> respectively. Mean benthic biomass (dry wt.) in Auranga, Ambika, Purna and Mindola were 7085, 411, 1814 and 1922 mg m<sup>-2</sup> respectively. Differential abundance of macro and meiofaunal groups was noticed among the four estuaries. The predominance of meiofauna both in terms of biomass and numerical abundance in the benthic productivity of the four estuaries, was clearly indicated. Foraminifera was the dominant group in all the four estuaries. All the four estuaries had the sandy bottom at their mouth and the percentage of silt and clay increased towards the upstream regions. On an average, the higher percentage of organic matter in the sediment was found associated with clayey silt. It was observed that wherever industrial pollution occurred benthos were badly affected.

*Key-words* : Benthos, biomass, estuary, Gujarat.

### INTRODUCTION

Studies on benthos in the estuaries and backwaters along the west coast of India were mostly confined to central (Parulekar and Dwivedi, 1973; Dwivedi, Bhargava, Parulekar, Selvakumar, Singbal and Sankaranarayanan, 1974; Parulekar and Dwivedi, 1974; Parulekar, Rajamanickam and Dwivedi, 1975 and Parulekar, Dhargalkar and Singbal, 1980) and southern parts (Desai and Krishnan Kutty, 1967a and b) and only little is known about northern part (Varshney, Govindan and Desai, 1981) of the west coast. The present communication deals with biomass and composition of benthos in 4 estuaries of South Gujarat namely Auranga, Ambika, Purna and Mindola (Fig. 1), with a view to understand the subtidal benthos in relation to the existing water quality of these estuaries. The riverine and estuarine region of Ambika and Mindola receive considerable amount of industrial and domestic wastes and thereby polluting the quality of water to a great extent (NIO, 1980b).

These estuaries are mostly navigable during flood tides. All the four estuaries receive considerable quantity of fresh water during south west monsoon. Freshwater discharges to these estuarine systems are considerably reduced during premonsoon. The tidal currents were strong at the mouth of these estuaries and gradually decreasing towards upstream. They have good flushing at ebb tide (NIO, 1980).

## MATERIALS AND METHODS

The studies were carried out during premonsoon (April/May) and early postmonsoon (late September/October) in 1979. Station 2 (Fig. 1) represents a location upto which the salinity intrudes considerably and the estuary is navigable. Benthic samples were collected using a Van-Veen grab of  $0.04 \text{ m}^{-2}$  area. Benthos samples were collected in duplicate from each station and the mean values were taken into account. The samples for meiobenthos were collected from the grab by pushing a plastic core (2 cm diameter and 15 cm length) and were preserved in buffered formalin Rose Bengal (1:500) solution.

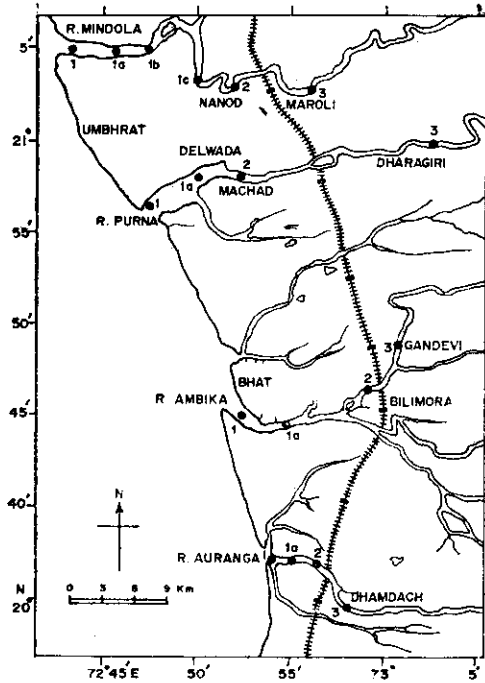


Fig. 1. Map showing the location of stations.

For macrobenthos fresh grab samples were taken. The details pertaining to the sieving and laboratory analysis of meio and macrobenthos have been reported earlier (Varshney, Govindan and Desai, 1981). Biomass is expressed on dry tissue weight basis. The sediment texture and percentage of organic matter in the sediment for 28 samples were also studied following method of Holme and McIntyre (1971) and EL Wakeel and Riley (1956) respectively.

## RESULTS AND DISCUSSION

*Environmental parameters*

The data obtained (NIO Report, 1980) on the physico-chemical parameters are presented in Table I. No appreciable change in the temperature for

the period of study, among the four estuarine systems was noticed. Salinity of the bottom waters fluctuated within a wide-range at the mouth of the four estuarine systems and their values were almost comparable. Salinity fluctuations at the upstream station 2 of Purna (0.43–26.95‰) and Ambika (0.12–16.39‰) estuaries were moderate. Among the four estuaries salinity at the upstream station 2 of Auranga (3.72–32.93‰) was comparatively higher. On the other hand, the salinity was very low (0.06–0.59‰) at the upstream station 2 of Mindola. Comparatively, high dissolved oxygen and low BOD were observed in Auranga and Purna. An increase in BOD and decrease in DO associated with considerable amounts of waste discharge were noticed during certain periods at the upstream station 2 of Mindola and Ambika (NIO, Report, 1980b). This clearly indicates the deteriorating conditions at the upper reaches of these two estuaries. In general, nutrient values varied and are not comparable among the four estuaries (Table I).

Four types of substrate were noticed in these estuaries viz. sandy, silty sand, sandy silt and clayey silt (Table II). All the four estuaries had a sandy bottom at their mouth. The Zuari (Parulekar, Rajamanickam and Dwivedi, 1975) and Narmada estuaries (Varshney, Govindan and Desai, 1981) also have the predominance of sandy bottom in their lower reaches. The percentage of silt and clay portions gradually increased towards upper reaches of these four estuaries.

The mean percentage of organic matter in sediment was poor in Mindola (0.44%) and Purna (0.75%) as compared to Auranga (1.32%) and Ambika (1.27%). Higher percentage of organic matter in sediment was found associated with clayey silt.

Table I. Ranges of hydrographic parameters and mean standing stock of benthos in Auranga, Purna, Mindola and Ambika estuaries during 1979.

St. No.	Temp. °C	Salinity ‰	DO mg/l	BOD mg/l	PO <sub>4</sub> -P µg-at/l	NO <sub>3</sub> -N µg-at/l	Benthos	
							Population No/m <sup>2</sup>	Biomass mg/m <sup>2</sup>
Auranga :								
1.	26.2–32.5	4.12–35.80	4.8– 9.2	0.7– 7.0	2.77–45.36	0.28–19.13	318690	7085
2.	27.7–32.5	3.72–32.93	3.4–10.8	1.8– 7.5	0.09– 7.19	0.64–16.42		
Ambika :								
1.	27.0–32.7	2.24–36.58	3.6– 7.3	1.5– 7.9	0.77–19.08	0.85–29.43	54727	411
2.	25.5–32.5	0.12–16.39	0.3– 6.8	1.7–32.6	0.06–5.26	0.14–16.70		
Purna :								
1.	29.0–33.0	1.46–32.89	1.3– 8.7	0.8– 5.9	1.55– 8.85	1.57–14.99	122350	1814
2.	26.0–34.2	0.43–26.95	2.9– 9.4	0.8– 4.2	1.32–11.07	0.99–33.34		
Mindola :								
1.	25.0–32.0	4.72–33.78	3.4–10.2	1.5–12.4	0.22–54.85	0.71–43.83	88368	1922
2.	27.0–32.5	0.06– 0.59	1.8– 8.3	1.8–14.2	0.67–62.27	0.07–24.63		

Table II. Population and biomass of benthos in relation to depth, sediment type and organic matter in Auranga, Ambika, Purna and Mindola estuaries during 1979.

St. No.	Depth (m)	Macrofauna		Meiofauna		Sediment Characteristic					Silt & Clay %	Texture	Organic matter (%)
		Population No/m <sup>2</sup>	Biomass mg/m <sup>2</sup>	Population No/m <sup>2</sup>	Biomass mg/m <sup>2</sup>	Sand (%)	1000 $\mu$	500 $\mu$	250 $\mu$	125 $\mu$			
<b>AURANGA :- MAY.</b>													
1	3.5	—	—	89600	1702	89	2	3	2	1	3	Sandy	0.39
1a	4.0	44	6	533400	6174	41	6	2	1	—	50	Silty Sand	1.25
2	1.5	880	46	274400	1848	—	—	—	2	2	95	Clayey Silt	1.77
<b>OCTOBER</b>													
1	4.5	22	3	89600	560	—	1	1	4	24	70	Sandy Silt	1.25
1a	4.0	88	11.5	840000	30912	29	7	7	1	2	54	Sandy Silt	0.85
2	2.5	110	4	84000	1142	—	—	—	1	2	97	Clayey Silt	2.45
<b>AMBIKA :- MAY</b>													
1	1.5	22	3	207200	1176	40	35	10	5	7	3	Sandy	0.32
1a	2.0	110	14	61600	123	18	40	20	6	9	7	Sandy	0.90
2	2.5	22	3	11200	784	6	10	4	25	20	35	Silty Sand	1.25
<b>OCTOBER</b>													
1	2.5	484	63	8400	17	58	28	7	2	3	2	Sandy	0.03
1a	2.0	44	6	16800	34	20	35	10	20	5	10	Sandy	1.77
2	1.0	88	201	22400	45	3	2	8	37	11	39	Silty Sand	3.39
<b>PURNA :- APRIL</b>													
1	3.5	—	—	263200	599	25	28	39	4	1	3	Sandy	0.31
1a	2.5	220	28	84000	1467	40	25	15	16	2	2	Sandy	0.60
2	3.0	—	—	268800	2688	—	—	1	26	65	8	Sandy	0.36
<b>SEPTEMBER</b>													
1	4.5	176	6	—	—	—	—	15	70	13	2	Sandy	0.06
1a	3.0	44	5	67200	3707	—	1	1	2	3	93	Clayey Silt	1.53
2	2.0	66	15	50400	2374	—	1	—	3	2	94	Clayey Silt	1.66
<b>MINDOLA :- APRIL</b>													
1	4.5	66	15	106400	812	15	22	20	3	—	40	Silty Sand	0.31
1a	4.0	154	54	80600	2646	—	—	—	2	6	92	Clayey Silt	1.69
1b	4.0	22	14	257600	3870	—	—	2	54	40	4	Sandy	0.28
1c	3.0	110	4	123200	1747	4	5	55	29	2	5	Sandy	0.34
2	2.5	88	57	61600	739	—	—	2	18	65	15	Silty Sand	0.23
<b>SEPTEMBER</b>													
1	4.5	110	31	—	—	3	3	25	51	11	7	Sandy	0.03
1a	3.5	22	14	22400	45	42	24	16	2	10	6	Sandy	0.30
1b	4.0	22	14	—	—	74	12	1	1	1	11	Sandy	0.22
1c	3.5	132	10	11200	22	—	—	—	5	77	17	Silty Sand	0.06
2	3.0	154	128	219800	8996	2	1	5	5	21	66	Sandy Silt	0.95

**Biomass:** The biomass distribution in the four estuaries is given in Table II. Mean macrobenthic biomass values for the four estuaries varied from  $9 \text{ mg m}^{-2}$  (Ambika) to  $48 \text{ mg m}^{-2}$  (Purna). In general, all the four estuaries contributed a poor macrofauna. Mean meiobenthic biomass values for the Auranga, Ambika, Purna and Mindola estuaries were 1056, 363, 1805 and 1888  $\text{mg m}^{-2}$  respectively. Contribution of meiobenthos to the total biomass significantly varied for the four estuaries. Table II clearly indicated the predominance of meiofauna both in terms of numerical abundance and biomass. Similar observation has been reported earlier for the Narmada estuary (Varshney, Govindan and Desai, 1981).

**Faunal Composition:** The macrofauna of the four estuaries consisted of polychaetes, crustaceans, gastropods and fishes with varying percentages (Fig. 2). The differential abundance of various macrofaunal groups was noticed. Polychaetes were the dominant macrofaunal group in Ambika and Purna whereas gastropods predominated the macrofauna in Auranga estuary. Crustaceans (35%), gastropods (32.5%) and polychaetes (30%) contributed almost

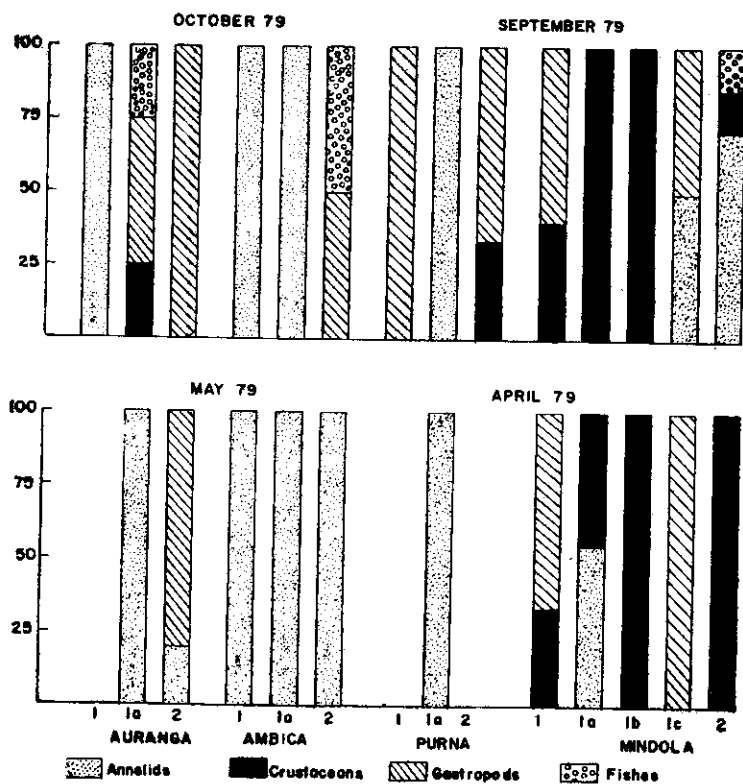


Fig. 2. Percentage composition of macrobenthos at different stations in the four estuaries.

equal percentage in Mindola estuary. Mean population density of macrobenthos for Auranga, Ambika, Purna and Mindola estuaries were 191, 128, 84 and 88  $m^{-2}$  respectively. Comparatively, a higher numerical abundance of macrofauna was noticed in Auranga than the other three estuaries. The numerical abundance of macrofauna of the four estuaries was found comparatively lower than that of Goa estuaries. (Parulekar Rajamanickam and Dwivedi, 1975).

Meiofauna was chiefly represented by foraminiferans, nematodes, polychaetes, crustaceans and gastropods (Fig. 3). Foraminifera was the dominant

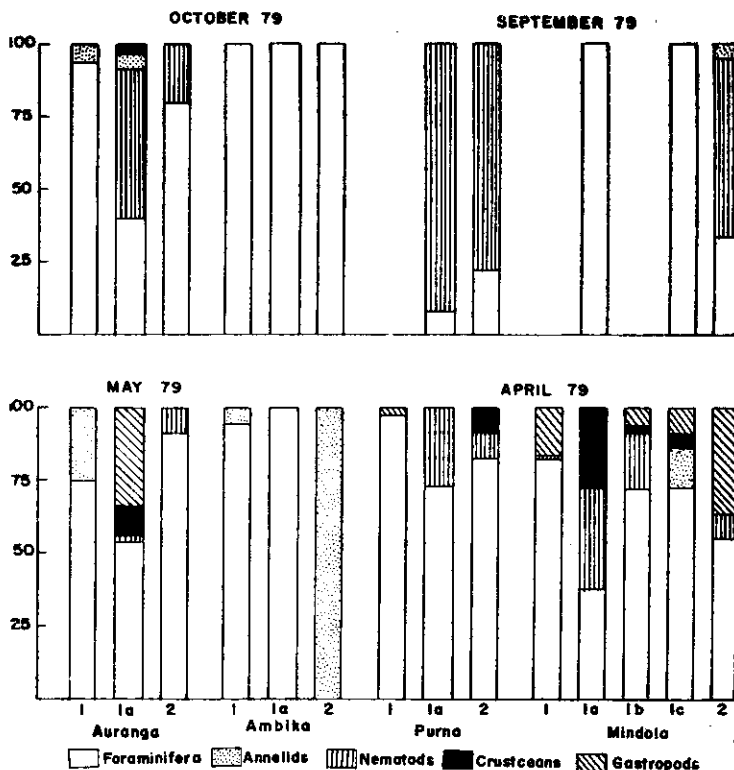


Fig. 3. Percentage composition of meiobenthos at different stations in the four estuaries.

group of the meiofauna in the four estuaries of which Ambika accounted for the higher percentage (93%) as compared to the other three estuaries (56 to 76%). Similar observation has been already reported for Narmada estuary (Varshney, Govindan and Desai, 1981). Nematodes were next to foraminiferans in abundance in these estuaries excepting Ambika where they were not recorded. The observed mean population of meiofauna for the Auranga, Ambika, Purna and Mindola estuaries were 318499, 54599, 122266 and 88280  $m^{-2}$  respectively.

From the foregoing account of the benthic studies it is concluded that Auranga which maintained good water quality and relatively a stable substratum contributes comparatively a higher population of biomass of benthos among the four estuaries (Tables I and II). Purna and Mindola contribute relatively a moderate benthic fauna in terms of biomass. Whereas the population of benthos is poor in Mindola as compared to Purna. This, perhaps, can be attributed to the pollution load at the upstream sections of the Mindola estuary (NIO Report, 1980). Ambika which is affected by industrial pollution as revealed from its water quality (NIO Report 1980) contributes poor benthos both in terms of numerical abundance and biomass of the four estuaries. In general, the upstream stations of the estuaries contributed comparatively a higher benthic biomass than the down stream stations excepting Ambika.

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