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OBSERVATIONS ON THE DISTRIBUTION OF BENTHIC FAUNA IN VELLAR ESTUARY, PORTO NOVO

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ABSTRACT

Occurrence, abundance and seasonal variation of the major groups of macro- and meiobenthic fauna from the Vellar estuary were studied from October 1978 to September 1979. Macrofauna were dominated by polychaetes and meiofauna by nematodes and harpacticoids. Environmental parameters such as temperature, salinity, oxygen and sediment were monitored at different stations and correlated with the abundance.

Key-words : Benthos, Vellar estuary.

INTRODUCTION

Estuaries often serve both as receiver and accumulator of organic matter at the bottom which in turn affects the fauna. Studies on the bottom communities of estuaries have great importance in view of their role in the trophic cycle. In India, many of the earlier studies on the estuarine bottom fauna were mostly concerned either on their taxonomy or on distribution and abundance based on short term observations. Although annual variation of the bottom fauna of estuaries of the west coast are known to some extent (Parulekar, Dhargalkar and Singbal, 1980) similar studies on the estuaries of the east coast are scanty. A preliminary survey on the bottom fauna of Vellar estuary made by Balasubrahmanyan (1960) is the first study in the area. Subsequently Ajmal Khan, Vivekanandan and Balasubrahmanyan (1975) studied the bottom fauna of the same estuary confirming their observations to the marine and gradient zones for three months. The present study is the first attempt to understand the annual variations in the composition, abundance and distribution of the macro- and meiobenthos of the Vellar estuary.

MATERIALS AND METHODS

Vellar estuary (lat. 11° 29′ N and long. 79° 47′ E) is comparatively shallow with an average depth of about 2 m. In terms of salinity characteristics, the Vellar estuary was demarcated and defined into four zones based on Rochford's (1951) classification of estuarine environment, viz. marine zone, gradient zone, tidal zone and freshwater zone (Ramamoorthi, 1954). Four stations (station 1 in marine zone, station 2 in gradient zone, station 3 in tidal zone and station 4 in freshwater zone) were selected for the study (Fig. 1). Monthly samples were taken from October 1978 to September 1979. At each station two hauls were made with a Peterson grab (area 736 cm^2, penetration 20 cm) and the material for macrobenthos were washed through a 0.5 mm mesh. From one

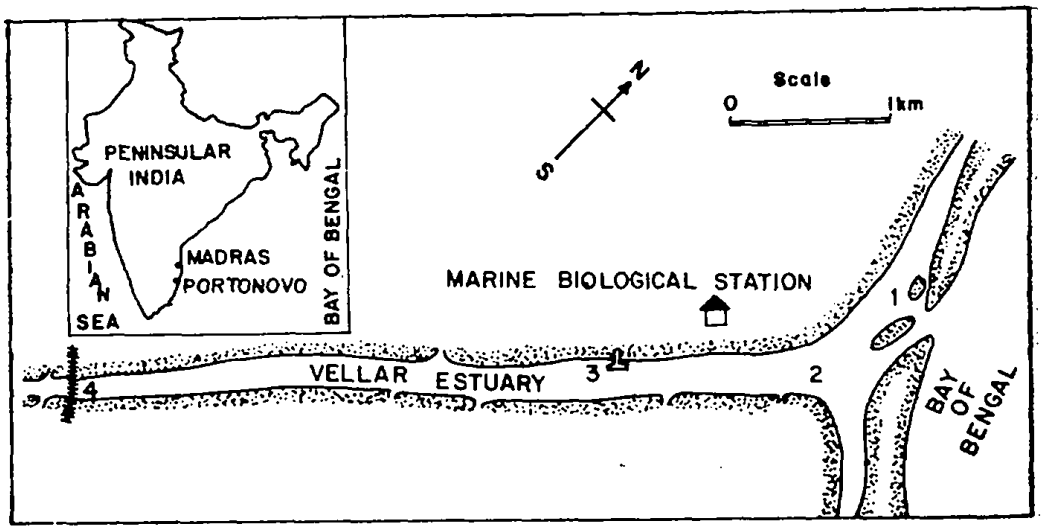

Fig. 1. Map of Vellar estuary showing sampling stations.

grab haul at each zone a meiobenthos core sample was taken using a Perspex tube of 3 cm internal diameter. The top 5 cm of the core was then pushed out below with a plunger and preserved in 5% formalin.

In the laboratory, the macrobenthic sample was washed and the organisms were counted and sorted into major taxa. For analysing meiobenthos samples, the core was washed through a 0.5 mm sieve and all the animals retained were recorded and returned to the appropriate macrobenthos samples. The filtrate was further washed through a 64 μ sieve and the residue on this was placed over-night in a dilute solution of rose-bengal for staining. It was later examined under a binocular microscope and all the stained organisms were counted and sorted into major taxa. For comparison of values the number of macrobenthos per haul were converted into values per m^2 and the number of meiobenthos per core into values per 10 cm^2. Salinity and dissolved oxygen of bottom water were estimated following Harvey (1955) and Winkler's method (Strickland and Parsons, 1968) respectively. Sediment samples were analysed following the pipette method outlined by Krumbein and Pettijohn (1938).

RESULTS AND DISCUSSION

Environmental factors

Bottom salinity ranged between 0 (Station 4) and 35‰ (station 1) and interestingly at station 4 in the freshwater zone, the salinity was high (range 26.3–34‰) during most part of the year except monsoon (Table I). This is not surprising because Ramamoorthi (1954) who demarcated the estuary into different zones commented that in tropical estuarine environment where most labile conditions prevail, field zonation concept is difficult to fit in.

Temperature also showed a similar trend of decrease during monsoon and increase during dry months with a range of 27.3 (station 4) to 31.2 °C (station 1). Dissolved oxygen values ranged from 2.8 to 8.3 ml/l, with maximum during monsoon and minimum during post-monsoon.

Sediment was sandy throughout the year at station 1 (Table II). At other stations sediment characteristics showed wide variation. From the sandy substrate at station 1, the estuarine bottom gradually changed to sandy loam at station 2, to a admixture of sand, silt and clay at station 3 and to silty clay at station 4.

Macrobenthos

The distribution of macrobenthos/m^2 is given in Table III. Macrobenthos was chiefly constituted by polychaetes, bivalves, crustaceans, gastropods and 'others' (sipunculids, virgularians, *Boleopthalmus* sp. and fish larvae). Polychaetes were the dominant group in the total macrobenthos.

Station 1 recorded the lowest density of the macrobenthos in which polychaetes were dominant (63.10%) followed by bivalves (13.90%), crustaceans (11.71%) and 'others' (9.63%). At station 2, the density of macrobenthos was found to be higher than that at station 1. Polychaetes constituted 71.35% followed by gastropods (16.39%) and bivalves (8.88%). Crustaceans and 'others' were poorly represented (2.87% and 0.51% respectively). The density of macrobenthos at station 3 was found to be lower than that of station 2, but higher than that of station 1. Polychaetes constituted 78.04% of the macrobenthos followed by bivalves (11.5%), crustaceans (5.5%), gastropods (4.22%) and 'others' (0.74%). Station 4 recorded the maximum density of the macrobenthos dominated by polychaetes (78.59%). Bivalves represented 15% while the remaining groups were less abundant.

Seasonally, summer recorded abundant macrofauna (mean for the season 122.52/m^2) while postmonsoon recorded the minimum (74.91/m^2). Monsoon (98.5/m^2) recorded more than the premonsoon (79.26/m^2) and postmonsoon. Polychaetes were more or less uniformly distributed during different seasons. Crustaceans were well represented during monsoon, postmonsoon and summer but poorly represented during premonsoon. Gastropods were high during summer and absent during premonsoon. Bivalves were also high during summer and less during monsoon. 'Others' were abundant during monsoon.

Meiobenthos

The distribution of meiobenthos/10 cm^2 is given in Table IV. Nematodes, harpacticoids, copepod nauplii and foraminiferans were abundant in the meiobenthos. Nematodes were the dominant group among the meiobenthos.

Station 1 recorded the highest abundance of meiobenthos. Nematodes dominated here (52.23%) followed by copepod nauplii (19.04%) and harpacticoids (16.51%). Meiofauna density at station 2 was only one-third of that

Table I. Environmental data at different stations in Vellar estuary.

Parameters	Oxygen (ml/l)				Temperature (°C)				Salinity ‰				Rain fall (mm)
Stations	1	2	3	4	1	2	3	4	1	2	3	4	
Months													
October 1978	6.1	6.0	6.3	7.1	29.0	28.5	28.5	28.3	18.4	16.1	7.9	4.6	210.0
November	7.1	7.2	7.3	8.0	28.0	27.8	27.5	27.5	14.5	8.5	6.6	3.3	435.0
December	7.3	7.8	8.1	8.3	28.5	27.4	27.8	27.3	7.1	6.2	2.5	0.0	503.9
January 1979	5.1	4.8	3.8	5.0	29.5	29.2	28.4	28.8	34.1	33.2	31.3	27.6	1.0
February	3.3	3.2	3.0	2.8	30.0	29.8	29.6	29.2	34.7	34.2	33.4	32.1	5.5
March	5.1	4.3	4.2	4.0	30.0	29.5	29.5	28.6	34.9	34.9	34.2	33.4	1.0
April	5.0	4.8	4.3	3.2	30.5	30.2	30.2	29.6	35.0	35.0	34.5	34.0	Nil
May	4.3	4.2	4.0	3.8	30.8	30.0	30.5	29.4	35.0	35.0	34.6	34.0	12.0
June	5.3	4.8	4.0	3.8	31.2	30.4	30.0	30.2	35.0	35.0	33.4	32.6	7.0
July	5.8	5.1	5.0	5.1	29.8	29.4	29.2	29.0	30.0	30.0	28.6	26.3	12.5
August	5.5	5.1	4.8	4.0	30.4	28.6	28.4	28.2	35.0	34.6	34.2	33.2	18.5
September	5.8	5.1	4.5	3.8	30.5	28.8	28.6	28.4	35.0	35.0	34.0	34.0	300.1

Table II. Bottom sediment characteristics of Vellar estuary (% values).

	Station 1			Station 2			Station 3			Station 4		
Months	Sand	Silt	Clay	Sand	Silt	Clay	Sand	Silt	Clay	Sand	Silt	Clay
October 1978	89.62	3.57	6.81	63.31	29.98	6.71	78.92	9.60	11.48	28.40	52.80	18.80
November	92.39	4.62	2.99	72.20	24.98	2.82	93.52	2.40	4.08	14.60	48.80	36.60
December	94.36	2.74	2.90	68.01	25.35	6.64	87.40	12.00	0.60	75.50	12.50	12.00
January 1979	96.20	0.26	3.53	59.40	39.27	1.33	92.00	4.80	3.20	48.70	36.80	14.50
February	92.62	5.31	2.07	39.75	38.77	21.48	92.00	2.40	5.60	25.22	28.80	45.98
March	96.71	2.72	0.57	38.77	54.28	6.95	80.50	8.80	10.70	24.08	26.42	49.50
April	98.38	0.27	1.35	45.28	48.72	8.10	78.08	16.80	5.12	12.00	24.80	63.20
May	95.83	0.22	3.95	59.90	18.07	22.03	68.90	19.20	11.90	17.58	64.92	17.50
June	93.96	2.60	3.35	57.77	36.12	6.31	64.79	8.20	27.01	4.50	48.80	45.70
July	95.34	1.02	3.64	60.56	31.97	7.47	64.20	15.20	20.60	4.86	32.00	63.14
August	91.26	0.87	7.87	54.00	36.92	9.08	60.20	24.80	15.00	3.72	16.00	80.28
September	93.74	1.32	4.94	51.39	41.63	6.98	51.40	24.00	24.60	2.50	26.10	71.40

Table III. Mean and percentage of macrobenthos (m^{-2}) at different stations and seasons during 1978-1979.

Macrobenthos	Stations								Seasons							
	1		2		3		4		Monsoon		Postmonsoon		Summer		premonsoon	
	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%
Polychaetes	49.17	63.10	70.33	71.35	67.83	78.04	87.72	78.59	76.67	27.87	60.75	22.09	69.92	25.41	67.75	24.63
Crustaceans	9.17	11.71	2.83	2.87	4.75	5.50	2.33	2.08	6.00	31.43	4.42	23.15	8.00	41.91	0.67	3.51
Gastropods	1.25	1.60	16.16	16.39	3.67	4.22	4.25	3.81	4.58	18.08	2.08	8.21	18.67	73.71	0.00	0.00
Bivalves	10.83	13.90	8.75	8.88	10.00	11.60	16.75	15.00	6.00	12.95	7.08	15.28	22.58	48.74	10.67	23.03
'Others'	7.50	9.63	0.50	0.51	0.67	0.74	0.58	0.58	5.25	56.76	0.58	6.27	3.25	35.14	0.17	1.83

Table IV. Mean and percentage of meiobenthos ($10\ cm^{-2}$) at different stations and seasons during 1978-1979.

Meiobenthos	Stations								Seasons							
	1		2		3		4		Monsoon		Postmonsoon		Summer		Premonsoon	
	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%
Foraminifera	15.25	7.14	14.41	20.07	2.58	7.78	3.33	8.41	6.58	18.49	—	—	29.0	81.51	—	—
Turbellaria	1.25	0.59	0.33	0.46	0.42	1.27	1.25	3.15	1.42	43.60	—	—	—	—	1.83	56.40
Nematoda	113.66	53.23	46.33	64.53	21.58	65.08	31.0	78.32	55.58	26.15	34.33	16.15	84.25	39.63	38.42	18.07
Bivalves	3.50	1.64	0.50	0.69	1.17	3.53	0.17	0.43	2.33	43.80	0.33	6.20	1.83	34.40	0.83	15.60
Polychaetes	3.40	1.59	1.41	1.96	1.58	4.76	1.83	4.62	1.67	20.22	3.67	44.43	1.00	12.11	1.92	23.24
Ostracods	0.16	0.07	0.33	0.46	0.08	0.24	—	—	0.08	13.79	0.08	13.79	0.25	43.10	0.17	29.32
Harpacticoids	35.25	16.51	7.50	10.45	4.58	13.81	1.58	3.99	19.25	39.35	4.92	10.06	18.08	36.96	6.67	13.63
Copepod Nauplii	40.60	19.04	0.66	0.92	1.00	3.02	0.25	0.63	0.00	0.00	2.75	6.46	38.5	90.42	1.33	3.12
'Others'	0.41	0.19	0.33	0.46	0.17	0.51	1.17	0.43	0.42	38.8	—	—	0.33	30.56	0.33	30.56

of station 1. Nematodes constituted 64.53%, foraminiferans 20.07% and harpacticoids 10.45%. Least abundance of meiofauna was recorded at station 3. Next to nematodes (65.08%) were harpacticoids (13.81%) and foraminiferans (7.78%). At station 4, abundance of meiofauna was more than that of station 3, but less than that of stations 1 and 2. Nematodes dominated the meiofauna with 78.32%. Other groups were far less than nematodes.

Seasonwise, the abundance of meiofauna was more during summer followed by monsoon, premonsoon and postmonsoon. Nematode was the dominant group during all the seasons and their abundance varied in the above order. Foraminiferans, ostracods and copepod nauplii were abundant during summer. Harpacticoids were slightly more in abundance during monsoon than in summer. Polychaetes, bivalves and turbellarians were abundant during postmonsoon, monsoon and premonsoon respectively.

Year round observations on the numerical abundance and distribution of benthos in Vellar estuary exhibited wide zonal and seasonal variations. Macrobenthos were more at station 4 and less at station 1. Seasonwise, high faunal abundance was observed during summer. Polychaetes followed generally by bivalves were the dominant groups among the macrobenthos at all the zones. Although polychaetes were followed by bivalves in their abundance in macrobenthos of Indian estuaries (Parulekar, Rajamanickam and Dwivedi, 1975), in certain regions they seem to alternate in their dominance with bivalves followed by polychaetes (Parulekar and Dwivedi, 1974) or polychaetes followed by crustaceans (Untawale and Parulekar, 1976). These variations in abundance were attributed either to a single or combined environmental factors such as salinity or sediment. Parulekar and Dwivedi (1974) and Parulekar, Rajamanickam and Dwivedi (1975) observed that in Mandovi and Zuari estuaries, bivalves, particularly, *Meretrix casta* were pre-dominant in sandy bottom with high salinity, whereas polychaetes were abundant in silty clayey, clayey and clayey silty bottoms with a lower range of salinity. In the present study, eventhough polychaetes were observed abundantly at all the stations, was mainly due to the substratum. Polychaetes and *M. casta* here generally their number was comparatively more at stations 2–4 than at station 1. This was mainly due to the substratum. Polychaetes and M. casta here generally occur more in muddy substratum of sandy loam type or sand with admixture of silt and clay type or silty clay type. Eventhough bivalve as a group was well represented at all the four stations, their composition varied between stations. At stations 2–4, *M. casta* was the dominant member and at station 1, it was absent and the bivalves were represented by *Tellina* sp. and others. Juveniles of *M. casta* were found more at station 4, especially during summer and it agrees with the previous observations of Sreenivasan (1980 a, b) who reported that *M. casta* spawns intensively during summer. The young ones also settle in calmer muddy substratum of types noticed at stations 2–4. Station 4 is situated in the upper reaches of the estuary and is relatively less disturbed than other stations and hence the settlement of young ones is more. *Tellina*

sp. was abundant at station 1. Parulekar, Rajamanickam and Dwivedi (1975) also observed *Tellina* sp. in the lower reaches. Regarding *M. casta*, the present study agrees with their on one aspect that it occur more in upper reaches of estuary and disagrees in that the *M. casta* prefers sandy substratum.

Gastropods were constituted by *Cerithidea fluviatilis* and *Natica marochiensis* of which the former was abundant. Both the species showed maximum density during summer. *C. fluviatilis* was abundant at the shallow depths of the station 2 while *N. marochiensis* at stations 2 and 3. At station 1, *C. fluviatilis* was absent throughout the year while *N. marochiensis* occurred only during monsoon.

Parulekar, Dhargalkar and Singbal (1980) observed that in Goa estuaries *C. fluviatilis* was found abundantly in the low saline, less agitated areas in the upper reaches where there is much scope for scavenging. But in the present study it was found in high saline middle and upper reaches of estuary.

Tanaids, prawn juveniles and hermit crabs constituted the macrobenthic crustacean and were abundant at station 1 especially during summer. Prawn juveniles enter into the estuary in large numbers during summer and this contributes to the abundance of crustaceans at this station (P. Subramanian — Personal Communication).

Eventhough crustaceans were present at all the stations, there seems to exist a preference for lower reaches of estuary as evidenced by their maximum abundance at station 1. Being mostly epifaunal, they do not have substratum specificity as already reported by Parulekar and Dwivedi (1974).

Meiobenthos consisted largely of nematodes, harpacticoids, copepod nauplii and foraminiferans. It is known that meiobenthos were generally abundant in muddy bottoms of the deep water (Mc Intyre, 1969). Ansari (1978) and Dalal (1980) also reported the same respectively from Karwar region and Goa estuaries. Interestingly in the present study, meiofauna was maximum in the sandy bottom of station 1. The average ratio of macro- to meiobenthos was in the order of 1:955.

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REFERENCES

Ajmal Khan, S., E. Vivekanandan and K. Balasubrahmanyan, 1975. Bottom fauna in two regions of the Vellar estuary. In: *Recent Researches in Estuarine Biology*, edited by R. Natarajan, Hindustan Publishing Corporation (I), Delhi, p. 255-272.

Ansari, Z.A., 1978. Meiobenthos from the Karwar Region. *Mahasagar—Bulletin of the National Institute of Oceanography*, 11: 163–168.

Balasubrahmanyan, K., 1960. Studies in the ecology of the Vellar estuary: 1. A preliminary survey of the estuarine bottom and its fauna conducted on 11-9-59. *Journal of the Zoological Society of India*, 12 : 209–215.

Dalal, S.G., 1980. Relationship between benthic foraminifera and sediment in the estuarine complex of Goa. *Mahasagar—Bulletin of the National Institute of Oceanography*, 13: 77–79.

Harvey, H.W. (Ed.), 1955. *The Chemistry and Fertility of Seawater*, (IInd Edition), Cambridge University Press, 240 pp.

Krumbein, W.C. and E.J. Pettijohn (Eds.), 1938. *Manual of Sedimentary Petrography*. Appleton-Century-Crofts, New York, 549 pp.

McIntyre, A.D., 1969. Ecology of marine meiobenthos. *Biological Review*, 44: 245–290.

Parulekar, A.H. and S.N. Dwivedi, 1974. Benthic studies in Goa estuaries: Part I–Standing crop and faunal composition in relation to bottom salinity distribution and substratum characteristics in the estuary of Mandovi river. *Indian Journal of Marine Sciences*, 9: 41–45.

Parulekar, A.H., V.K. Dhargalkar and S.Y.S. Singbal, 1980. Benthic studies in Goa estuaries: Part III–Annual cycle of Macrofaunal distribution, production and trophic relations. *Indian Journal of Marine Sciences*, 9: 189–200.

Parulekar, A.H., V. Rajamanickam and S.N. Dwivedi, 1975. Benthic studies in Goa estuaries: Biomass and faunal composition in Zuari estuary. *Indian Journal of Marine Sciences*, 4: 202–205.

Ramamoorthi, K., 1954. A preliminary study of the hydrology and fauna of Vellar estuary (South Arcot District). Proceedings of the 9th Indo-Pacific Fisheries Council, Bangkok, 27 (Abstract).

Rochford, D.J., 1951. Studies in Australian estuarine Hydrology. 1. Introductory and Comparative features. *Australian Journal of Marine and Freshwater Research*, 2: 1–116.

Sreenivasan, P.V., 1980a. Growth of the clam *Meretrix casta* (Chemnitz) transplanted in the Vellar estuary. (Abstract) *Symposium on Coastal Aquaculture* (Marine Biological Association of India).

Sreenivasan, P.V., 1980b. Distribution of the seed of the clam *Meretrix casta* (Chemnitz) in Vellar estuary. (Abstract) *Symposium on Coastal Aquaculture* (Marine Biological Association of India).

Strickland, J.D.H. and T.R. Parsons, 1968. A practical handbook of seawater analysis. *Journal of Fisheries Research of Canada*, 167: 311 pp.

Untawale, A.G. and A.H. Parulekar, 1976. Some observations on the ecology of an estuarine mangrove of Goa. *Mahasagar—National Institute of Oceanography*, 9: 57–62.