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INTERTIDAL SEDIMENT CHARACTERISTICS OF VELLAR ESTUARY

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ABSTRACT

The seasonal changes of the intertidal sediments were studied for one year, at pairs of stations situated at either banks of the Vellar estuary. The difference in the nature of the slope and direction of flow of water in the estuary affects the deposition of silt and clay particles and therefore the median particle size. The largest quantity of silt and clay was deposited during monsoon.

Key-words: Sediment, particle size, Vellar estuary.

The particle size of beach sand has a profound effect on the fauna. In general, coarse intertidal sediments retain little water or organic matter and are, therefore, inhospitable habitats. On the other hand, fine sediments such as muds have poor water circulation and often low oxygen retention (Gray, 1981).

For the present study sampling was done at high, mid and low water marks at three pairs of stations, situated at either banks of the estuary representing the marine, gradient and tidal zones, extending upto about 7.4 km from the mouth of Vellar estuary (Fig.1). The Vellar river enters the Bay of Bengal near Porto Novo (11°29'N; 79°46'E) and has a mean tidal range of about one metre with the tidal influence upto a distance of 16 km from the river mouth (Fernando, 1981). The average depth of the estuary is around 2 m at low tide with the maximum depth of about 5 m. The water in the estuary is turbid only after heavy rains during monsoon.

Sediment samples were collected at monthly intervals over a period of one year (Aug. 1977-July 1978). Samples were dried at 105°C (Morgans, 1956) and subsamples of known weight were sieved through a series of graded sieves with mesh diameter of 1000, 500, 250, 125 and 64 µm. The results of these analyses are expressed as phi (ϕ) notations (where $\phi = -\log_2$ of the diameter of the grains in milimeters, McManus, 1963).

Median particle size: The stations M_1 and M_2 at the marine zone had an admixture of medium and fine sand and did not show much seasonal variation. At stations J_1 and J_2 at the gradient zone and stations R_1 and R_2 at the tidal zone, the median particle size ranged from medium to

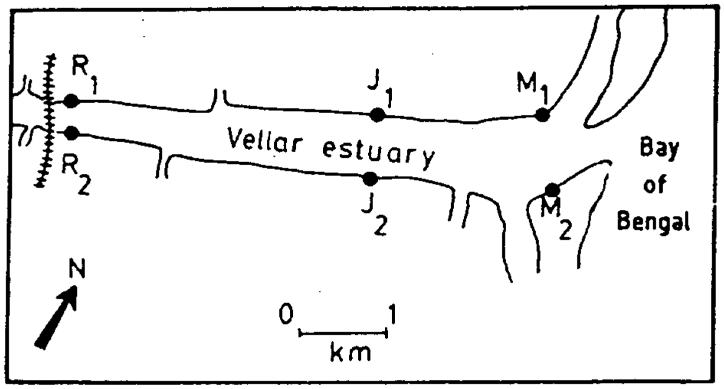

Fig.1. Map showing the study area and stations.

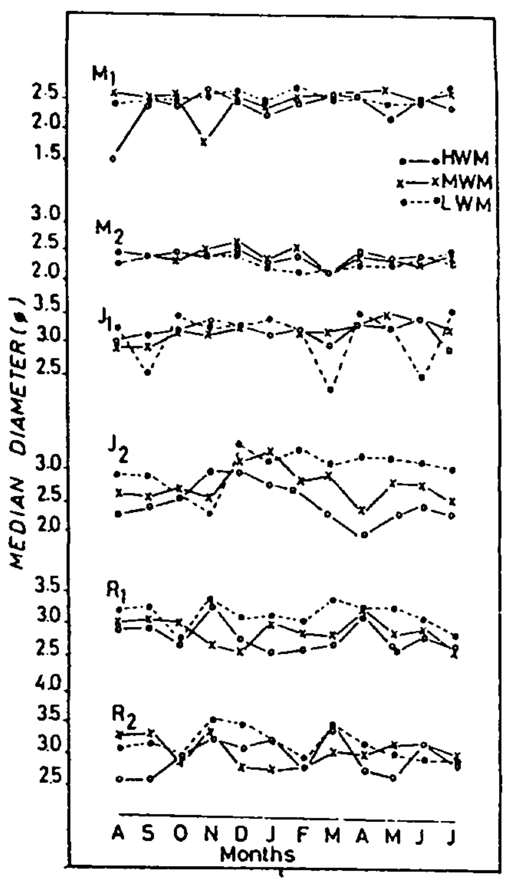

Fig.2. Monthly variation in Md ϕ

very fine sand (Fig.2). In general, an increase in the median phi was observed during monsoon months alone, showing a decrease in the particle size due to the deposition of silt and clay brought in by monsoon floods.

Silt and clay: The stations at the marine zone recorded the least quantity of silt and clay compared to the other stations. At station M_2 the deposition of silt and clay was negligible (≃ 1%) whereas at station M_1 it ranged between 0-8.6%. The other four stations recorded relatively greater quantities of silt and clay at the low water mark than at the other water marks, but during monsoon all water marks recorded similar increase in the quantities of silt and clay (Fig.3).

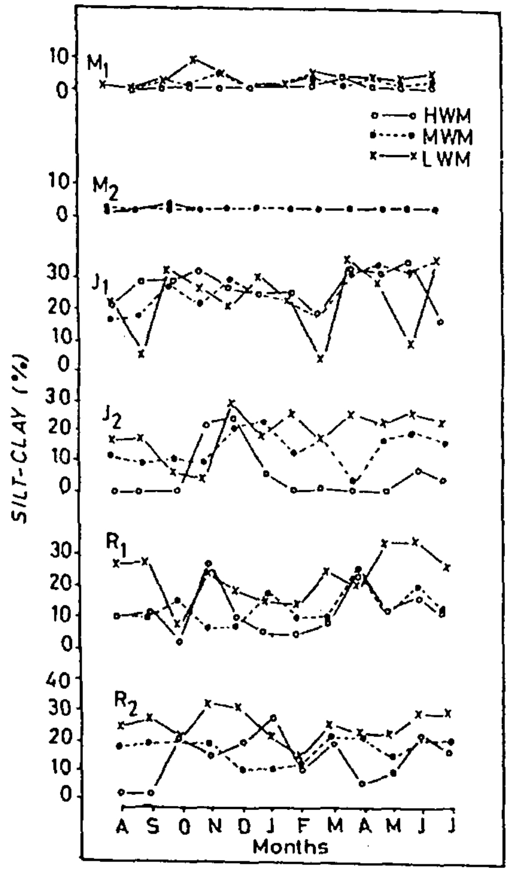

Fig.3. Monthly variation in % silt and clay.

Quartile deviation: The sediments showed a sorting coefficient ranging from very well sorted to moderately sorted particles. The substrate at station M_1 and M_2 were very well sorted or moderately well sorted, whereas at the other four stations moderately sorted substrate were also observed. This shows that the extent to which the grains vary from that of

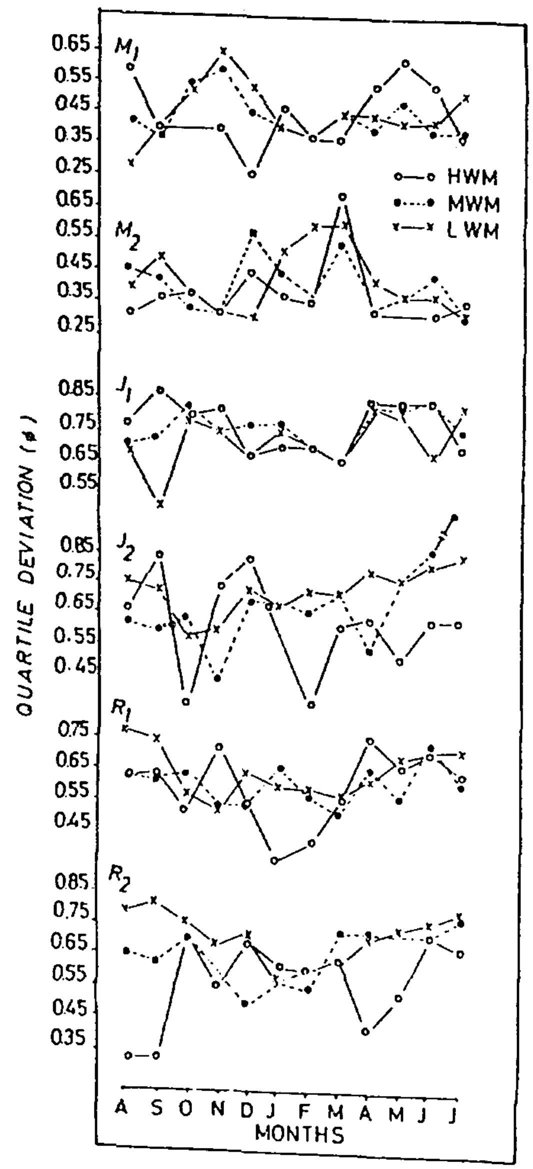

Fig.4. Monthly variation in Quartile deviation.

the median particle size, was greater at the stations situated at the gradient and tidal zone in comparison to the marine zone (Fig.4).

An increase in the percentage of fine particles towards high water mark has been observed by Kuenen (1950), Brown (1971), and Dye (1978). But in the present study large quantities of silt and clay particles were found to be deposited at the low water mark than at the other two levels. Similar observations have been made by Dwivedi, Rahim and Nair (1975) in the intertidal region of Mandovi estuary, Goa.

The median particle size of the substrate was observed to increase with the distance from the mouth of the estuary and the larger particles were observed at the marine zone compared to the other zones. Dye (1979) in his observations at the Mngazana estuary, South Africa, noticed that the substrate became progressively fine towards the middle and upper reaches where mud and silt predominate. Severe wave action is generally associated with steeply sloping beaches of coarse grains whereas broad flats of fine sand or mud usually occur in areas with little wave action (Brafield, 1978). In the present study, only station M_2 showed a comparatively steep slope. All the other stations recorded fine or very fine sand during most of the months and only occasionally medium sands were observed. Thus it could be learnt that there is very little wave action at these stations except at M_2 which is partially exposed.

Table I — Two way analysis of variance for comparison of different seasons.

Source of variation		df	High Tide Level		Mid Tide Level		Low Tide Level	
			MS	F	MS	F	MS	F
Md ϕ	A	5	0.0597	15.70*	0.1580	1.70	0.0639	17.60*
	B	3	1.3310	347.82*	1.5454	16.69*	1.4279	393.00*
	Error	15	0.0038		0.0925		0.0036	
% silt & clay	A	5	9.9439	14.60*	9.7100	27.77*	11.7555	21.63*
	B	3	3.8258	5.61*	3.7129	10.61*	5.0017	9.20*
	Error	15	0.6809		0.3496		0.5433	

$P_{.05}$ (3,15) = 3.29; $P_{.05}$ (5,15) = 2.9; A = Between stations; B = Between seasons; * Significant at $P_{.05}$

The median particle size and the quantity of silt and clay at each water mark did not show statistically significant monthly variations, though seasonal variations were significant (Table I). The median particle size of stations at either banks showed significant variations among themselves (Table II). But when stations of either banks were compared, it was seen that, though they differed significantly at the high and mid water marks, it did not do so at the low water mark. From Table II it could be seen that the silt and clay deposition varied greatly within the stations on the same bank as well as between the stations of the opposite bank. Hylleberg, Nateewathana and Chatananthawej (1985) from their studies near the west coast of Phuket Island suggested that the deposition and erosion of silt and clay depended on the monsoon and the direction and velocity of wind during monsoon. Similarly in the present study also, it was observed that the change in the sediment characteristics was mainly dependent on the monsoon. Such a high suspended load may be detrimental in a low energy habitat (Charuchinda and Hylleberg, 1984) which may not be the same in a high energy environment where the particles are prevented from settling. In the present observation, large quantities of detritus was found deposited at the stations of the gradient and tidal zones with a simultaneous decrease in the fauna (Fernando, 1981) during monsoons.

Table II – Comparison of median particle size (Anova) and percentage silt and clay (Anova) among the six stations.

Source of variation	df	Median particle size (Anova) F value			Percentage silt and clay (Anova) F value		
		HW	MW	LW	HW	MW	LW
Among groups (between 6 stations)	5	22.11*	27.57*	23.64*	40.08*	125.94*	84.63*
Between stations of the opposite bank	1	11.50*	08.00*	03.00	24.20*	15.62*	07.48*
Between M_1 & M_2	1	00.55	00.33	02.65	02.33	28.24*	31.04*
Between J_1 & J_2	1	54.42*	28.83*	00.60	60.05*	15.91*	00.0041
Between R_1 & R_2	1	00.50	00.83	00.46	00.57	06.03*	00.79
Between M_1, J_1 & R_1	2	35.22*	42.91*	24.55*	50.26*	114.73*	55.35*
Between M_1 & J_1	1	69.87*	85.11*	31.57*	97.80*	221.62*	82.82*
Between M_1 & R_1	1	23.17*	29.00*	41.29*	40.60*	97.73*	83.23*
Between J_1 & R_1	1	12.52*	14.50*	00.61	12.33*	25.00*	00.00
Between M_2, J_2 & R_2	2	14.22*	23.66*	33.11*	37.83*	192.24*	152.48*
Between M_2 & J_2	1	00.00	18.66*	42.40*	13.46*	262.84*	213.66*
Between M_2 & R_2	1	22.25*	46.13*	55.89*	75.07*	311.80*	242.86*
Between J_2 & R_2	1	20.43*	05.94*	00.88	24.95*	02.08	00.93

$P_{.05}(1,60) = 4.00$; $P_{.05}(2,60) = 3.15$; $P_{.05}(5,60) = 2.37$; *Significant at $P_{.05}$

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