

Salinity intrusion into Muvattupuzha estuary (south west coast of India) during premonsoon season

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Changes in salinity distribution and stratification in Muvattupuzha estuary have been studied in relation to tides and fresh water discharge using field data on salinity, discharge and tidal fluctuations, collected during premonsoon periods of 1993 and 1994. Near the mouth of the estuary variations in salinity are in phase with tides. Salinity variations in the upstream of the estuary show less correlation with tidal fluctuations.

The physical characteristics of an estuary varies with respect to seasons of the year, phases of the tides, estuarine topography, fresh water discharge and meteorological forcing. In understanding the physical characteristics of an estuary, it is important to know the salinity patterns during different seasons'. The results of investigations on salinity intrusion in Muvattupuzha estuary during January, February, May and December 1993 and February 1994 (premonsoon season) are discussed in this paper.

Muvattupuzha estuary bifurcates into two branches, 'Ittipuzha' and 'Murinjapuzha', at Vettikattumukku. Constant flow is maintained in the estuary during non monsoon months also, due to the discharge of tail race water from Iddukki hydroelectric power station (Fig.1). The discharge through the estuary increases steadily since the onset of monsoon by the 1st week of June. A major irrigation project (Muvattupuzha Valley Irrigation Project) is nearing completion at Malankara, upstream of the study area (Fig. 1). Under this scheme it is proposed to divert a portion of fresh water flow coming from Iddukki tail race for irrigation purpose. In the present paper an attempt is made to study the magnitude of salinity intrusion in the estuary once water is diverted for irrigation.

At selected observation stations in the estuary continuous observations of salinity, velocity and

tidal fluctuations were carried out during premonsoon months of 1993 and 1994 (January, February, May, December 1993 and February 1994) for a complete tidal cycle. Electrical conductivity meters (Systronics conductivity meters with conductivity range $1-10^6$ micro mhos in six ranges and measuring frequency 1000 Hz on battery) were used for salinity observations and current meters (Cup type) for velocity measurements. Salinity was observed at thirty minutes interval and velocity at one hour interval at three depths 0.2 D, 0.6 D and 0.8 D where D is the total depth of the estuary at the mid section. Hourly water level variations were also monitored using simple tide staffs installed at fixed points near the observation stations which were connected to a common datum.

The average salinity values over a tidal cycle obtained for different discharge conditions are plotted for three stations in Fig. 2. Towards the mouth of the estuary salinity values show a good correlation with discharge conditions. It was observed that the salinity levels observed during a tidal cycle at monitoring stations located in the main stream vary within a narrow range of 0.03 to 0.06 ppt and no correlation was observed with tidal fluctuations (Fig. 3). The tidal average salinity value plotted against various discharge conditions at Manakkakadavu station in the main stream also show less correlation

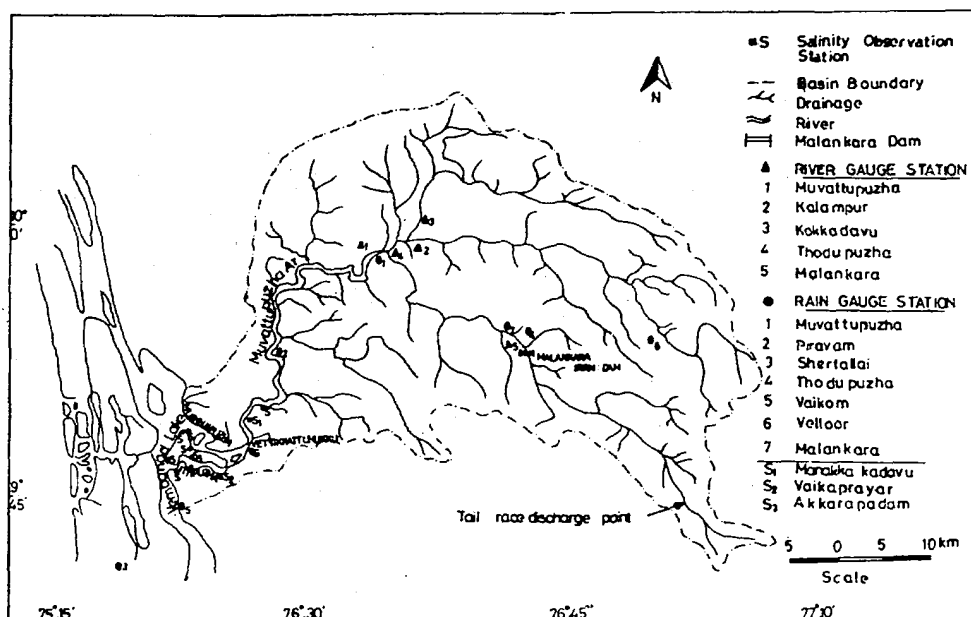


Fig. 1—Location map of the study area

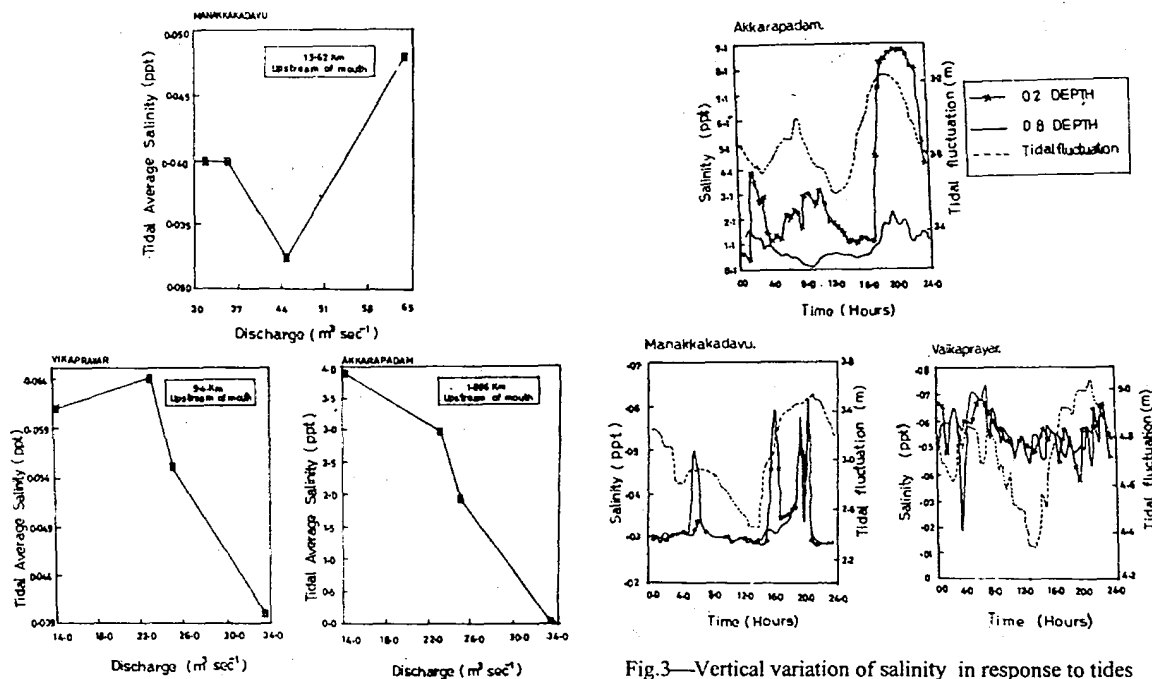


Fig. 2—Tidal average salinity values for various discharge conditions

Fig. 3—Vertical variation of salinity in response to tides

(Fig. 2). The effect of effluent released by the Hindustan Newsprint Ltd., 4 km upstream of Manakkakadavu station is not considered in the present analysis. The tidal fluctuations for various discharge conditions in the estuary at Vaikaprayer and Ittipuzha are shown in Fig. 4.

From the mean velocity profiles depth mean flows of 0.11 m sec^{-1} and 0.133 m sec^{-1} were found for the main stream and Ittipuzha branch respectively during the period under consideration. The depth mean has been subtracted from the net velocity for each depth as done by Bowden² in

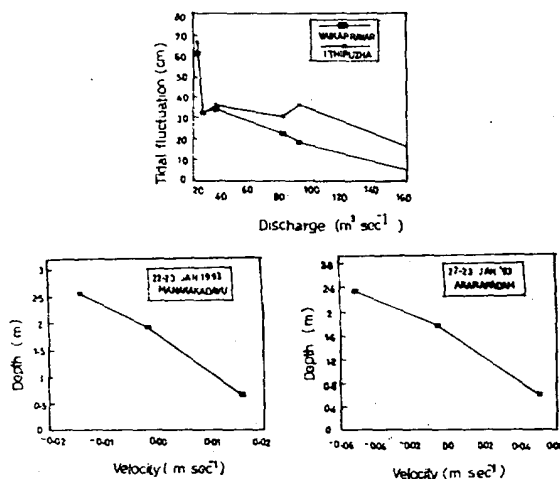


Fig.4—Tidal fluctuations and mean velocity profiles.

order to obtain the differential flows which are shown in Fig.4. The profiles show the variation in vertical gradient of velocity in the main stream and in the Ittipuzha branch³.

From the simultaneous observations made at different stations in Ittipuzha and Murinjapuzha branches of Muvattupuzha estuary, it is observed that salinity intrusion is more through Ittipuzha branch. The observed salinity values for three stations (Manakkakadavu, Vikarapuram and Akkarapadam) at 0.2 depth and 0.8 depth are plotted against time (Fig. 3). The fresh water discharge in the Muvattupuzha river can be considered constant over a tidal cycle and the variations in water level at various sections in the

estuary are due to the tidal intrusion. The tidal fluctuations at these stations are also shown in the figures.

Analysis of salinity data show that salinity increases with depth and also towards the mouth of the estuary. The observations in the upstream stations show a well mixed condition (Fig. 3). Near the mouth of the estuary variation in salinity shows a very close correlation with tidal fluctuations. Estuary is well mixed during the flood tide. As constant flow is maintained in the estuary the sharp increase in salinity lasts for only a short period near the surface than the sub surface sections and the salinity levels come down considerably at all sections and at all depths during ebb tide. The observed salinity data at Manakkakadavu and Vikarapuram stations show less correlation with tidal fluctuations and the salinity values show very less variation vertically (within 0.1 ppt) even during the flood tide of lean flow period.

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