

## 2. MATERIALS AND METHODS.

### 2.1. Area of work.

Kerala with a coastline of about 600 km is endowed with numerous and extensive brackish water bodies, mostly running parallel to the coastline. Eight major estuarine systems along this coast, covering a distance of 500 km were investigated over a period of one year during 1978, namely Veli at Trivandrum, Neendakara at Quilon, Thottappilly near Alleppey, Cochin backwaters at Cochin, Korapusha, Kallai and Beypore at Calicut and Mahe near Tellicherry (Fig. 2).

#### Veli Lake:

The Veli lake is primarily a fresh water body and is one of the smallest of the lakes confined to the southern part of the Kerala State, situated 5 km north-west of Trivandrum. It is 1 km long and 0.3 km broad. A narrow strip of sand bar across the mouth of this lake during the dry season obstructs free exchange of marine and fresh water. The lake is very shallow, depth being 2 to 2.5 m. The bottom is sandy. Observations were made near the sand bar on the lake side.

Neendakara:

The estuary at Neendakara is situated about 9.6 km north of Quilon at  $9^{\circ}28'$  -  $8^{\circ}45'$ N lat. and  $76^{\circ}28'$  -  $77^{\circ}17'$ E long. This estuary is one of the foremost centres of marine fish landing along the southern Kerala coast. It is also known as Ashtamudi estuary. The point of observation was near the mouth and in this area, the water is always churned up by the propellers of fishing boats and tidal action. The depth at the area of observation is 4 m. The bottom is muddy sand.

Thottappilly Lake:

This lake is situated about 25 km south of Alleppey. There is a narrow strip of sand bar across the mouth of this lake. A barrage is constructed on the eastern side in the lake about 0.5 km away from the sand bar to prevent incursion of saline water into the hinterlands so as to enhance paddy cultivation. The spill ways are opened during the monsoon period. The samplings were made still further on the eastern side of the barrage.

Cochin backwaters:

The Cochin backwaters include a system of interconnected lagoons penetrating the main land and enclosing many islands in between, whose tidal area amounts to approximately 500 sq. km. The backwaters around Cochin is located along  $9^{\circ}58'N$ ,  $76^{\circ}15'E$ . It has a permanent connection with the Arabian Sea on the western side by a channel about 450 m wide which forms the entrance to the Cochin harbour. At the northern extremity it opens into the Arabian Sea at Ashikode and at the southern end it terminates into a large body of fresh water namely Vembanad lake.

The coastline is of an emergent type formed of a number of narrow sand bars running parallel to the coastline often in several rows (Darbishire, 1967). The sand bar and the harbour channel at Cochin are periodically dredged to accommodate the traffic of the port. The channel area around the mouth where observations were made is about 15 m deep. The depth of the estuary gradually reduces further upstream to about 2 m at Alleppey. The depth of the area north of the barmouth is uniformly shallow, being 2 to 4 m. The bottom of the estuary is generally muddy.

The major source of fresh water in the estuary are the two large rivers namely Pamba on the south and Periyar on the north. In addition to these, Meenachil and Muvattupuzha rivers and several small tributaries and irrigation channels join the backwaters.

The tidal effects of the estuary is maximum near the mouth, the amplitude of the tides being about 1 m at the harbour area decreasing towards the upper reaches. Incursion of sea water to the upper reaches oscillates depending on the fresh water efflux (Haridas et al., 1973).

#### Korapuzha estuary:

The Korapuzha estuary is shallow and 52 km long. Two rivers feed the estuary. The Elathur river joins the Korapuzha backwater system about 1 km away from the mouth. Another stream running from the foot of the high mountain range surrounding the Kodianadu Malai empties into it about 16 km from the river mouth. The depth of the estuary is 4 to 5 m and the bottom is sandy. During monsoon the silt laden fresh water run down the river suppressing the ebb tide almost completely.

Kallai estuary:

Kallai estuarine system has its origin as a small stream from Kunnammangalam and flows down through Kunnathupalam and Mankavu to Kallai town and then joins the Arabian Sea. It has a length of 30 km. All along the river banks there are large numbers of coir cottage industry units and considerable amount of coconut husks are dumped into the river for retting. These husks get sedimented at the bottom and due to organic decay of these, a black layer is formed on the substratum mixed with sand. Further, large number of logs are kept in this river for conditioning all through the year. These logs also foul the water. During the rainy season water level rises up by 2 to 4 m in this river. In fact torrential flow of fresh water from uplands cleans the river seasonally. Because of the small size of the river the tidal currents enter upstream into the river by about 18 to 20 km.

Boypore estuary:

Boypore estuary has its source principally in the Nilgiri Hills and flows down as a major river through Nilambur, Mambad, Arikkoḍ, Mavur, Kanniyamparamba, Feroke and Boypore and empties into the Arabian

Sea. The rivers Cherupuzha and Irinjipuzha open into this estuary at Kanniamparamba and Mavur respectively.

The river Chaliyar which receives the effluents from the Rayon factory at Mavur also joins this estuary. During monsoon the water level rises up by 4 to 5 m and the water becomes turbid. The bottom is sandy.

Mahe estuary:

River Mayyashi (Mahe) has its origin in the Western Ghats. The drainage basin has similar characteristics as those of other three rivers of north Kerala described earlier. It enters the Arabian Sea at Mahe, a small Union Territory and part of Pondicherry State. During the monsoon seasons the water level at the point of sampling rises by about 1.5 to 2 m. The bottom is muddy sand and has an average depth of 5 m. Stake net fishery operates here almost round the year. It has a small fishing harbour and is a landing centre for the green mussel Mytilus viridis collected by local divers. This river also has retting yards in it.

## 2.2. Methods.

All observations were conducted monthly in the year 1978. Observations were made at one station near the mouth at all the estuaries except Cochin backwaters. In the Cochin backwaters apart from collecting monthly information at a station fixed at the mouth, the distribution of zooplankton to the interior of the estuary was also studied. For this purpose zooplankton and environmental characters were observed from 6 more stations in four months, representing various seasons, viz. January (early premonsoon), April (peak saline period), July (monsoon) and November (postmonsoon). The stations were fixed to cover the entire backwaters from its mouth (at Cochin) to its head (Alleppey) (Fig. 3).

### 2.2.1. Sampling procedure:

Water samples were collected from the surface with a clean plastic bucket and from mid depth and bottom using a water sampler for the estimations of hydrographical parameters. The temperature was recorded immediately after sampling using a thermometer. Salinity

was estimated using Mohr-Knudsen titration method and oxygen by Winkler's technique. Zooplankton was collected by oblique hauls from the bottom to surface using an HF net (Heron-Tranter net, mouth area 0.25 m<sup>2</sup>, length 3 m, mesh size 300 micron).

A flow meter (Rigosa Model No.850) was attached to the mouth of the net to estimate the volume of the water filtered. The net was gradually drawn from the bottom to the surface, the duration of haul being 5 minutes. Zooplankton was preserved in 5% formaline.

The plankton samples were filtered, drained of excess water using absorbant paper and added to known volume of water to find out the displacement of volume. Subsamples were often taken for the analysis using a Folsom Plankton Splitter. Large organisms like hydro-medusae, ctenophores and chaetognaths were removed and counts taken for the whole sample. The subsample was then spread on a counting tray and counted to species level as far as possible. The whole sample was used for counting whenever the sample was small. The counts were then transformed into numbers per unit volume of water filtered using the flowmeter data.

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