

Influence of Estuaries on Shelf Foraminiferal Species

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Dabhol-Bhatkal stretch of the west coast of India is marked by a number of estuaries. *Cavarotalia annectens* is selected to monitor the influence of these estuaries on the inner shelf foraminiferal fauna. The percentage distribution of this species varies from 0 to 41% in total fauna from surface sediments. It is absent/rare near the river mouths. Study of the abundance of this species in samples from cores, collected from estuarine mouths, can probably be used to study paleomonsoons.

Estuaries act as filters between land and the oceans and they influence various processes on the adjoining continental shelf, thus creating a microenvironment near their mouths. The extent of the areas covered under these microenvironments depends upon the amount of fresh water discharge from the estuaries.

The central west coast of India (Dabhol to Bhatkal) is marked by a number of small estuaries. These estuaries are strongly influenced by the annual monsoons. Due to variations in annual monsoonal discharge the outer boundary of the microenvironment shifts seaward or landward. Study of shifts in this boundary, in part through indicator foraminiferal species in cores, can reveal variations in paleomonsoons, including cyclicity.

Based on previous studies¹⁻⁷ on the distribution of foraminifera from the Dabhol-Bhatkal sector of west coast of India, *Cavarotalia annectens* (Parker and Jones) was selected as the indicator species. In this paper, its distribution has been studied with reference to river input in coastal waters.

Materials and Methods

As part of an oceanographic survey under the project 'Distribution, ecology and significance of foraminiferal fauna on the western continental margins of India', 50 surficial sediment samples were collected from the inner shelf of Dabhol-Bhatkal sector at depths ranging from 12-58 m during the 17 [March 1977] and 30 [March 1978] cruises of *RV Gaveshani* (Fig. 1). Samples were collected with a La Fond Dietz snapper (area 100 m²). The top 1 cm layer was separated from each sample and washed over a 63 μ m sieve. On an average, 500 specimens of benthic foraminifera were picked from the + 63 μ m fraction

of sediments. Percentage occurrence of *C. annectens* was calculated for each sample.

Study Area

The continental shelf in this area is bordered landward by the Western Ghats⁸. The width of the coastal plain varies between 24 km in the northern part and 78 km in the southern. The main rivers flowing across the coastal plain are Vashishti, Shastri, Bhatia, Rajapuri, Vaghotan, Devgarh, Mandovi, Zuari, Kali, Gangavati and Tadri (Fig. 1). The average annual discharge⁹ (in m³.sec⁻¹) through Mandovi, Kali, and Gangavati rivers is respectively 42, 207 and 156.

The continental shelf has an average width of 80 km and the depth of shelf break varies between 90 and 120 km. The shelf is smooth and featureless up to 50 m. Beyond 50 m depth small scale prominences and undulations appear. The clayey silt forms a relatively narrow band confined to < 50 m water depth and within a distance of 25 to 35 km from the coast. Beyond this, there are sands. The Dabhol-Vengurla inner shelf is covered with clayey silt except near Vengurla, where it is silty clay¹⁰.

Organic matter content¹¹ in sediments of this region ranges from 1.1 to 6.1%. Low values (< 2%) of organic matter are associated with coarse sediments. The clayey substrate contains more organic matter (2 to 6.1%) than at river mouths (< 4%).

Results and Discussions

C. annectens constitutes 0-41% of the foraminiferal number in the region (Fig. 1). In general, it is rare (< 5%) to absent in areas adjacent to the coast and becomes more abundant (> 40%) in a seaward direction. Contours in Fig. 1 also show that the area of total absence of *C. annectens* is largest near Kali riv-

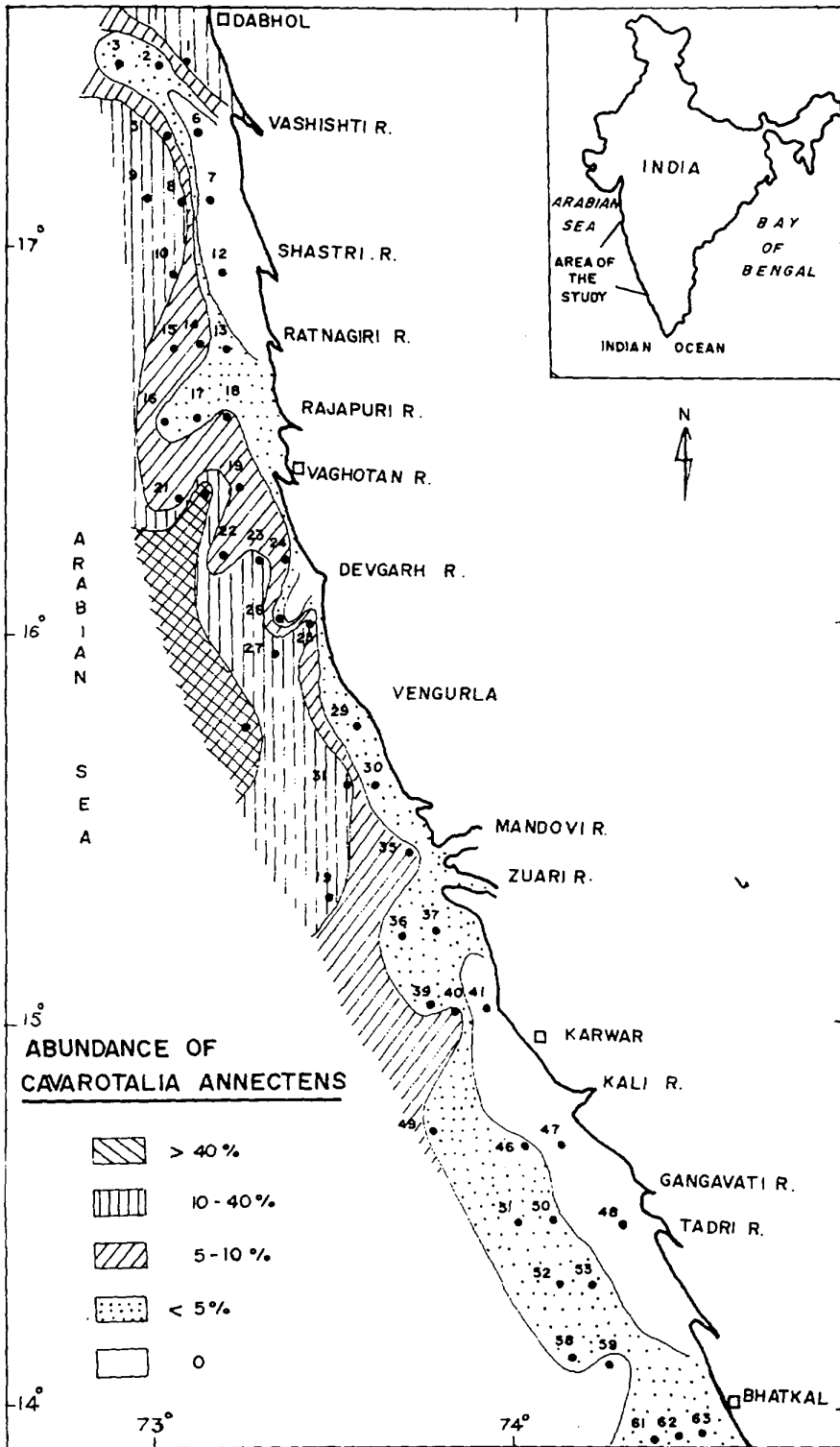


Fig. 1—Contours showing percentage distribution of *C. annectens*

er mouth as compared to the area near Vashishti and Shastri river mouths. These areas are dominated by species like *Ammobaculites* and *Trochammina*⁴⁻⁶ which are hyposalinal in nature^{12,13}. Therefore, it is apparent that fresh water has an adverse effect on *C. annectens* species and that average amount of fresh water discharge through rivers should be more in the area between Karwar and Bhatkal.

Distribution of foraminifera is also governed by nature of substrate, organic matter content, etc. But fresh water has been singled out because it is the runoff that affects and determines the substrate and its organic matter content. Nair and Hashimi¹⁴ have studied the influence of estuaries on shelf sediment of the south west coast of India and concluded, "where there are large number of estuaries, the inner shelf sediments are fine grained". The present study area is similar in that respect. The entire innershell of Dabhol-Bhatkal sector is carpeted by clayey substrate, except near Vengurla and south of Bhatkal where the sediments are silty. This is in agreement with the conclusions, based on distribution of *C. annectens*, that fresh water effect is relatively less near Vengurla and Bhatkal. Organic matter concentration is low in sandy substrate (few offshore samples off Bhatkal) and quite high (2 to 6.1%) in the entire study area. However, in coastal areas off river mouths, where runoff is expected to be high, it is < 4%. It is evident that it is the runoff which controls the sediment texture, organic matter and the benthic foraminiferal content in the nearshore regions. Therefore it is concluded that coastal areas, where *C. annectens* is absent, can be considered as the area most affected by fresh water discharge.

Recent studies evaluating the importance of fresh water runoff are mostly aimed at studying productivity and population dynamics of coastal marine eco-

systems¹⁵. Volume of fresh water discharge into the Arabian Sea from the western side of India is a function of monsoons. The present study indicates the possibility of using *C. annectens* as an indicator of the behaviour of monsoons of the past.

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