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Annual shifts in inter-tidal foraminiferal diversity in the west coast of India

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Environmental conditions are known to influence foraminiferal assemblages and their diversity. Seasonal fluctuations however, are not well studied in tropical intertidal habitats. The southern West Coast of India has narrow coastal plains bordered on the east by the Western Ghats, which rise to an average height of 900m above sea level. This generates monsoon precipitation from southwesterly winds that last for about four months beginning in the first week of June. Due to a steep gradient of the Western Ghats numerous swift-flowing rivers course through a highly productive region that includes the coastal plains and they traverse a distance of about 60 km before reaching the sea. They provide large inputs of various micro- and macro-nutrients. The monsoons thus considerably alter the hydrobiologic profile of the Arabian Sea. Thus the West Coast of India provides an interesting region for study of correlation of monsoon and foraminiferal diversity. It is all the more significant as paleomonsoon data are often interpreted from proxy foraminifera.

In the present investigation, seasonal variations in diversity and abundance of total foraminiferal populations (TFN) were studied at an estuarine (River Sal) and a non-estuarine site (Utorda) along the coast of Goa, India, between October 2004 to September 2005. The observations were correlated with various parameters such as sediment texture, organic matter, calcium carbonate, water temperature, salinity, dissolved oxygen, calcium, silicate and phosphate content. Quantitative analyses of all samples were carried out by following standard methods and biodiversity indices were calculated.

At the estuary, lesser diversity of foraminifera represented by 25 species (23 benthic and 2 planktonic species) belonging to 15 genera, 9 families and 2 sub-orders were found. In contrast, 55 foraminiferal species (51 benthic and 4 planktonic species) were recorded at a non-estuarine site. They belong to 25 genera, 11 families and 4 sub-orders. *Spiroloculina tricarinata*, *Quinqueloculina vulgaris* *Rotallidium annectans*, *Rotallinoides papillosus*, *Ammonia beccarii*, *A.dentata*, *Elphidium discoidale*, *Amphistegina radiata*,

and *Poroepionides lateralis* were found in abundance at both the locations but their TFN was higher at the non-estuarine site. *Lagena leavis*, *Cancris auriculus* and *Rosalina* sp. were found only at the non-estuarine site, though in lesser numbers. Planktonic forms-*Globigerina bulloides* and *Globigerinoides ruber*-were found at both sites. Well-marked seasonal variations of foraminifera were also observed at both sites. Lowest densities and diversities were observed during monsoon and highest densities and diversities of foraminifera were found during post-monsoon (winter). Highest TFN was recorded in January 05. The post-monsoon period is characterized by the presence of *R. annectans*, *R. papillosus* and *E. discoideale* in abundance.

Maximum rainfall was recorded during the month of July (1223.7 mm at estuarine and 1096.9 mm non-estuarine sites respectively). This also reflects the rainfall pattern in the plains and the Western Ghats. Foraminiferal data for monsoon and non-monsoon periods show a profound correlation with sedimentological and hydrological data. Species diversity and total foraminiferal number were higher at the non-estuarine site through all the seasons and deformed forms were scarce. Decreased salinity, and changes in other environmental parameters resulted in low species diversity and TFN at the estuarine region. Relict foraminifera were found predominantly during the monsoon. This is probably due to tidal transportation of benthic relicts. Observed morphological abnormalities are attributed to environmental stresses such as low salinity, low Ph and low calcium. The study reveals that a moderate increase in salinity, organic matter, calcium carbonate and dissolved oxygen are positively correlated with an increase in diversity and abundance of species following the monsoon.