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ABUNDANCE AND DISTRIBUTION OF FORAMINIFERA FROM THE OFF KONKAN COAST, INDIA

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ABSTRACT

Foraminifera has been successful inhabitants of all the marine environment. In order to know their distribution in different offshore habitats, the present study has been undertaken from off Konkan coast, wherein 3 bottom sediment samples were collected at different depth. Faunal analysis of fossil foraminifera from surface sediments collected during the 340th cruise of ORV Sagar Kanya is used to know the bathymetric distribution of the foraminifera in the off Konkan coast, the western continental margin of India. From the present study, based on widely used Loeblich and Tappan's classification, 26 benthic and 6 planktonic foraminiferal species are identified and counted belonging to 16 benthic genera and 5 planktonic genera, 15 families of benthic foraminifera, and 2 families of planktonic foraminifera. Benthic foraminifera in which Rotaliida (75%) occupies the dominant place followed by Miliolida (20%) and Lagenida (5%). In light of this work, it is inferred that changes in the distribution of foraminifera are basically constrained by physiochemical parameters and geomorphology.

Keywords: Foraminifera, Diversity, Distribution, West coast of India

INTRODUCTION

Studies of foraminifera from marine sediments in the inshore region can provide the environmental condition, because marine organisms are susceptible to environmental changes **[1]**. Environmental changes such as low dissolved oxygen amount in the marine ecosystem influence the distribution of foraminiferal diversity.

Foraminifera are very sensitive to environmental changes and, therefore, commonly used for temporal and spatial environmental reconstructions **[2]**. Therefore, the environmental data recovered from foraminifera are useful to infer paleoecology. The marine sediments off the 1,400 km coastline of the west coast of India contain productive and diverse microfossils **[3]**. Prior work on foraminiferal diversity from the nearshore region off the west bank of India have been disperse **[4-7]** and from Lakshadweep islands **[8]**. Similarly, the east coast of India especially in along the Tamil Nadu coast has been carried out by sampling surface sediments from various marine environment for understanding recent foraminiferal assemblages and taxonomic classification **[8-11]** and environmental monitoring **[12]**. These sediments have received the notice of marine geologists resulting in the accumulation of huge literature on these sediments. Nevertheless, limited attention has been paid to the foraminifera from the continental shelf, slope, and marginal region, in surface sediments of western continental margin Indian. The knowledge of abundance, diversity, and distribution of foraminifera in these regions is still incomplete. Therefore, continental shelf, slope, and marginal sediments have been considered for their foraminiferal content. Earlier workers strongly suggested that emphasis should not be placed on single species for any interpretive purposes **[4]**. Although the fauna is identified up to species level, this study focuses on the quantitative distribution pattern in surface sediments of coarse taxonomic groups. Many studies on foraminiferal diversity from the onshore and offshore along thewest coast of India of India have been published **[4, 13]**. But no systematic study has so far been undertaken in this region. In this paper, an attempt has been made to know the foraminiferal distribution and their abundance, and their response to the marine environment has been investigated in detail.

Study Area

The continental shelf, off Maharashtra, is bordered by the coastal mountain range known as the Western Ghats, consisting of Dharwarian metamorphosed rocks of gneisses, schists, phyllites, quartzite and chlorite schists **[14]**. This area receives seasonal heavy rainfall during the south-west monsoon (June-September) which is discharged through two main rivers, the Narmada and Tapi. The approximate length of these river are 1,163 and 724 km and the annual average discharges are 5,170 and 1,941 cubic meter per second respectively **[15]**. Previous studies carried out in this area reveal that salinity decreases and

turbulence level increases dramatically during monsoon periods. The terregious sediment consists predominantly of river born clays and the aeolian fraction is negligible. In the present study, ecology and distribution of planktic and benthic foraminifera and their response to marine environment have been explore in detail.

MATERIALS AND METHODS

In order to carry out the present study, three grab samples (Station. 1: 16°12'N, 73°0'E, depth ~67 m, Station.2: 16°12' N, 72°35' E depth ~115 m, Station. 3: 16°10'N, 72°20.5' E, depth ~700 m) have been collected from the shelf, slope and marginal region off Maharashtra, central west coast of India bordering the eastern Arabian Sea **(Figure 1)**. The samples have been collected during the 340th cruise of ORV **(Figure 1)**. All samples were washed through a 63 μm sieve and an oven dried. About 300 foraminifera were picked from a weighted sample which includes benthic as well as planktonic foraminifera. The species level identification is done.

RESULT AND DISCUSSION

From this detailed study we have identified 32 species of foraminifera. In those 26 species are benthic **(Figure 2)** and 6 species are planktonic foraminifera **(Figure 3)**. Amongst various classification of foraminifera, the one proposed by **[16]** has been followed in the present study. All the specimens have been deposited in the Repository of the Department of Marine Science, Bharathidasan University, Tiruchirappalli.

Among the 26 benthic foraminifera species 9 (*Ammonia beccarii, Bolivina spathulata, Buliminam arginata, Cancris oblongus, Cibicides wuellerstorfi, Hyalinea palthica, Nonian scapum, Quinqueloculina seminulum, Uvigerina asperula*) are most dominated in the all three depths. However, when it comes to planktic foraminifera 5 of the 6 species (*Globigerina bulloides, Globigerinoides ruber, Globigerinoides sacculifer, Globorotalia menardii, Neoglobo quadrinadutertrei)* are present in all the depths except *Orbulina universa* **(Figure 2)**. The high abundance of benthic foraminifera *Bolivina spathulata* in continental margin and slope indicate the prevailing oxygen-poor and organic carbon-enriched environment (Planktonic foraminifera species such as *Globigerinoides ruber, Neogloboquadrina dutertrei, Globigerina bulloides, and N.dutertrei* have a higher abundance. *G.sacculifer, G.menardii, a*re comparatively lesser abundance than the other species, and *O.universa* are present only in station 3 **(Figure 3)**.

The high abundance of benthic foraminifera *Ammonia beccarii* indicates a euryhaline and shallow sea environment

[17]. A severe understanding dependent on the known present-day circulation of A. beccarii would limit the species to the upper shoreface climate **[18]**. The maximum percentage of these species shows 4.13 % in station number 1 and a minimum percentage of 0.94% at station 2 was noticed respectively **(Figure 2)**. Benthic foraminifera *Bolivinaspathulata*is an indicator of an oxygen-poor and high organic carbon environment with a deep oxygen minimum zone in the strong upwelling region **[19]**. Given this, very high content of *B. spathulata* in sediments upwelling and high productivity in the Eastern Arabian Sea, we also recorded the same in all stations 3 (50.75%), 2 (42.20%), and 1 (41.13%) **(Figure 2)**, The suboxic indicator species of benthic foraminifera *Buliminamarginata* is an indicator of oligotrophic conditions, a pulsed food supply. This species has been reported in shallow water depths (25–350 m) and suggested as a dominant species in the nutrient-rich environment. The present study shows this species is abundant in a maximum of 10 % at station 1 and less value in station 2 (4.74%). Benthic foraminifera *Cancris oblongus* has been considered as a type of well-oxygenated bottom water. The moderate values of *C. oblongus* indicate tolerance to mesotrophic-eutrophic conditions. The maximum percentage of this species is 13.79 % at station 3 and the minimum percentage of 3.16 at station 1 and there are species not available in station number 4 **(Figure 3)**.

Benthic foraminifera species *Cibicideswuellerstorfi* has been recommended as epibenthic foraminifera that prefers to live on raised objects above the sediment-water interface in a high-energy environment **[20, 21, 26, 27]**. The distribution pattern of this species shows the highest percentage 7.51 % at station 3 and the minimum percentage (2.41 %) at station number 1. This species is likewise a suspension feeder happening in districts of low food supply and low natural carbon transition **[20]**. Shallow infaunal species *Hyalinea balthica* is depicted in the lower part of the Arabian Sea though less oxygen and food supply are moderate **[22]**. *H. balthica* shows a maximum percentage of 7.91 % at station 2 and a minimum percentage of 1.03 % at station 1. This species indicates little ecological stress and its maximum abundance is reported in samples with the highest diversity **[23]**.

The planktonic foraminiferal species *Globigerina bulloides*is dominant in the upwelling area and monsoon season of the Arabian Sea **[24-27]**. This species is dominant in stations 1 and 3 percent respectively 23.56 % followed by 21.86 % and minimum percentage at station 2 (6.29

%) **(Figure 3)**. when we look at *G. ruber* abundance we could see higher fluctuation in the western Arabian Sea during SW monsoon as a result of upwelling. This species is shallow-dwelling, most abundant in the mixed layer. This species is less abundant in the upwelling region and it lives in the low-nutrient water column **[27]**. *G. ruber* is abundant in all stations compared to other species. Maximum percentage at station 2 (55.24 %), station 2 (48.82%) and station 3 shows 39.87 % **(Figure 3)**. *Globigerina sacculifera* shows the minimum percent in station 1 and maximum in station 3. Thermocline-dwelling below mixed layer planktonic foraminifera *Neogloboquadrina dutertrei*is a non-spinose it's abundant in tropical to mid-latitude regions **[28]**. In this present study, *N. dutertrei species* show a maximum percentage (23.77 %) at station 1 followed by station 2 shows 23.56 %, and the minimum percentage shows 16.72 % at station 3 **(Figure 3)**.

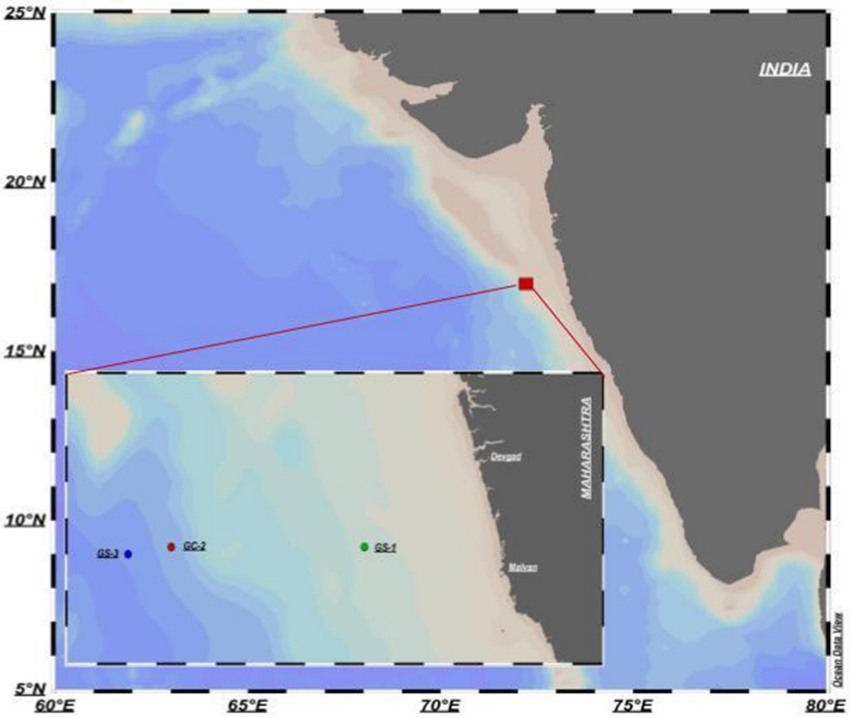

Figure 1: Locations map of the study area. Sampling location and water depth are represented in different colors

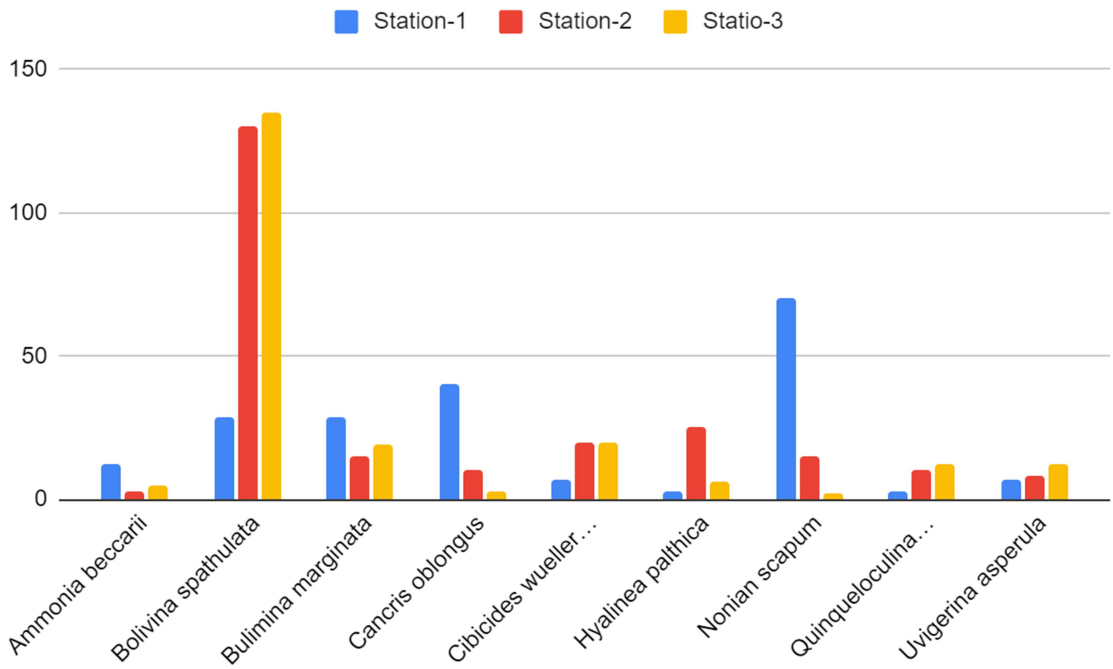

Figure 2: Relative abundance of benthic foraminiferal species

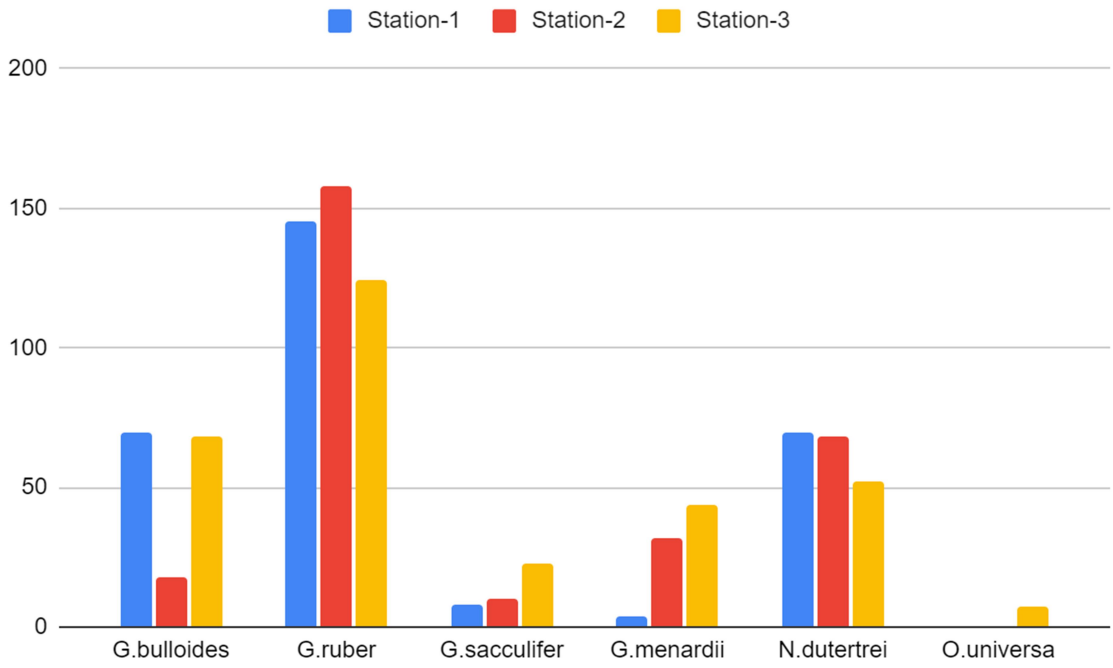

Figure 3: Relative abundance of planktonic foraminiferal species

CONCLUSION From the present study, based on widely

used Loeblich and Tappan's classification, 26 benthic and 6 planktonic foraminiferal species are identified and counted belonging to 16 benthic genera and 5 planktonic genera, 15 families of benthic foraminifera, and 2 families of planktonic foraminifera. Benthic foraminifera in which Rotaliida (75%) occupies the dominant place followed by Miliolida (20%) and Lagenida (5%). Our results show that there is no uniform pattern of paleo monsoonal variability from the Eastern Arabian Sea. *Globigerina bulloides*increase their abundances in stations 1 and 3 and *Globigerinoides ruber* increase their abundances occurred during all stations. Benthic foraminifera *Bolivina spathulata* have the highest percentage followed by *Uvigerina peregrina* results show low oxygen and high organic carbon in the study area location. From the organization of both benthic and planktonic foraminiferal proxy data, we also conclude that precipitation is more in the eastern Arabian Sea. The organization of foraminifera in this region is, therefore, managed by the layout of coastal morphology, wave dynamics, bathymetry, and the nature of the substrate.

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