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Original Research Paper

A Checklist of Benthic Foraminifera of Kudankulam Coast, Gulf of Mannar

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ABSTRACT

A total of 15 sediment samples were analysed for benthic foraminiferan contents from the region off Kudankulam coast, Gulf Mannar during November 2006. The study revealed 60 benthic foraminiferan species belonging to 30 genera, 21 families, 10 super families and 4 suborders. Genus *Quinqueloculina* was most represented by 10 species. *Ammonia beccarii* and *A. dentata* were the most abundant species found in the coast. The study has highlighted that the species diversity of foraminiferans in this coast is rich and these organisms could be used as effective environmental health indicators. The report regarding foraminiferans from this region is the first of its kind which can serve as a baseline data for any environment monitoring study in this coast in future.

INTRODUCTION

Marine ecosystem is one of the richest ecosystems. Industrialization and developmental activities in coastal zones have placed enormous stress on marine habitats. For the better management of natural marine systems, observational and experimental studies monitoring the diversity of various life forms and the ecosystem functioning are inevitable. In many marine areas, foraminiferans are a dominant meiofaunal group in terms of both numerical abundance and biomass. Foraminifers dwell in various types of environments such as open seas, oceans, bays, gulfs, saline lakes, lagoons, creeks, inlets, rock pools, mangrove swamps, tidal flats, estuaries and even some freshwater wells (Jones 1956).

The occurrence of foraminiferans in particular environment is mainly determined by several ecological factors like temperature, amount of light, turbidity and chemical factors of water, availability and character of food supply. Foraminiferans are very sensitive to abnormal changes in the ambient environment which may be caused due to several anthropogenic activities. The foraminiferal assemblages in a particular coastal region and the presence of morphological abnormalities in the foraminiferal test can be used as indicators of pollution (Alve 1995, Yanko et al. 1999, Samir & El-Din 2001). Therefore, foraminifera can be applied as part of integrated programme of pollution monitoring, including chemical analysis of the contaminants, long-term surveillance programmes, hazard assessment at discharge sites and in monitoring the effectiveness of remedial actions.

Being very sensitive to even subtle environmental changes and due to their good preservation potential foraminifera has been used to monitor marine pollution in coastal areas. In India, a number of researchers have published their reports regarding the utility of foraminifera in pollution studies (Naidu et al. 1985, Jayaraju & Reddi 1996, Nigam & Chaturvedi 2000). Limited work has been carried out on foraminiferans from the Kudankulam coast. Study of biological diversity of Kudankulam

waters is of great importance due to the upcoming nuclear power project. This ecosystem was therefore, selected for the present investigation and the study was aimed to prepare a checklist of benthic foraminiferans at various depths up to 30 m and up to 10 km off the coast of Kudankulam Nuclear Power Project (KKNPP) site.

MATERIALS AND METHODS

Description of the study area: Kudankulam (8°9'52" N and 77°42'42" E) is located in the southern side of peninsular India in the distal end of GoMBRE (Gulf of Mannar Biosphere Reserve). Kudankulam is a marine province which maintains a high diversity of flora and fauna. The place is endowed with a rich variety of marine organisms because its biosphere includes the ecosystem of coral reefs, marine plants, rocky shores, sandy beaches and muddy flats. A mega nuclear power station with Russian collaboration is under construction here.

Sampling stations: Sampling was made during November 2006 and sampling locations were fixed with Global Positioning System (GPS). Three sampling stations were fixed on the shore, one being the Kudankulam site, and others Panchal and Vijayapathi, 1 km on either side of the project site. From each point towards the sea, five sampling stations were fixed at 1 km, 3 km, 5 km, 7 km and 10 km distance (Table 1).

Collection and processing of sediment samples: One sediment sample was collected from each sampling site using Van Veen Grab sampler. The collected samples were packed in polythene bags, brought to the laboratory and preserved in 4% formalin solution to which calcium chloride was added to achieve neutrality. The preserved samples were then washed over an ASTM 230 mesh to remove the finer particles, and subsequently dried at 60°C in a hot air oven. Foraminiferan tests were separated by manual hand picking using stereo zoom microscope with the aid of 000 sable haired brush and by standard flotation technique using carbon tetrachloride (CCl_4).

Mounting and identification of Foraminiferans: The separated foraminiferal test specimens were picked from the samples and spread over a picking tray. Each foraminiferal test was mounted on 24-chambered micropaleontological slide over a thin layer of tragacanth gum and identified. Specimens were identified based on the classification proposed by Loeblich and Tappan (1987).

RESULTS AND DISCUSSION

Results of the present study revealed wide distribution pattern and greater diversity of benthic foraminiferans in the Kudankulam coast. Examining all the sediment samples, a total of 60 species belonging 30 genera, 21 families, 10 super families, and 4 suborders were identified (Table 2). Among the 30 genera, the genus *Quinqueloculina* was best represented by 10 species followed by *Triloculina* by 7 species and *Elphidium* with 5 species. Genera *Ammonia*, *Spiroloculina* and *Textularia* were represented by 3 species each. Two species belonging to genera *Fissurina, Amphistegina, Nonionoides, Pararotalia, Eponides* were recorded. All other genera were represented by a single species each.

Four suborders were represented in the Kudankulam region. Suborder *Rotaliina* was best represented by 27 species, closely followed by *Miliolina* encompassing 25 taxa. Other suborders, *Textulariina* and *Lagenina* were represented by 4 species and *Globigerinina* by 3 species respectively. Most abundant species in the region were *Ammonia beccarii* and *Ammonia dentata*. *Elphidium advenum, Asterorotalia inflata, Hanzawia concentrica, Nonionoides elongatum, Eponides criborepandus, Quinqueloculina seminulum, Textularia agglutinans, Textularia bocki* were more

Table 1: Global Positioning System (GPS) coordinates of sampling stations.

Station	1 km	3 km	5 km	7 km	10 km
Vijayapathi	N 08'10.579	N 08'09.524	N 08'08.262	N 08'07.328	N 08'04.223
	E 077'45.302	E 077'45.573	E 077'45.581	E 077'45.581	E 077'41.131
KK site	N 08'09.532	N 08'09.524	N 08.'07.382	N 08'06.316	N 08'04.750
	E 077'42'840	E 077'45.573	E 077'42.879	E 077'43.000	E 077'43.255
Panchal	N 08'08.991	N 08'07.943	N 08'08.835	N 08'05.677	N 08'04.868
	E 077'40.185	E 077'40.229	E 077'40.871	E 077'40.48	E 077'45.428

Table 2: Check list of foraminiferans identified.

1	*Textularia agglutinans*	31	*Lagena striata*
2	*Textularia bocki*	32	*Fissurina cucculata*
3	*Textularia porrecta*	33	*Fissurina laevigata*
4	*Karrerotextularia albatrossi*	34	*Brizalina spathulata*
5	*Adelosina laevigata*	35	*Chrysalidinella dimorpha*
6	*Spiroloculina antillarum*	36	*Sigmavirgulina tortuosa*
7	*Spiroloculina communis*	37	*Baggina philippinensis*
8	*Spiriloculina henbesti*	38	*Eponides criborepandus*
9	*Cycloforina semiplicata*	39	*Eponides repandus*
10	*Quinqueloculina agglutinans*	40	*Poroeponides lateralis*
11	*Quinqueloculina costata*	41	*Rosalina globularis*
12	*Quinqueloculina echinata*	42	*Cibicides lobatulus*
13	*Quinqueloculina ferusacci*	43	*Cymbaloporetta plana*
14	*Quinqueloculina karimbatica*	44	*Amphistegina lessonii*
15	*Quinqueloculina lamarckiana*	45	*Amphistegina radiate*
16	*Quinqueloculina oblonga*	46	*Nonionoides boueanum*
17	*Quinqueloculina polygona*	47	*Nonionoides elongatum*
18	*Quinqueloculina seminulum*	48	*Heterolepa subhaidingerii*
19	*Quinqueloculina undulose costata*	49	*Hanzawia concentrica*
20	*Flintina bradyana*	50	*Pararotalia calcar*
21	*Pyrgo denticulata*	51	*Pararotalia nipponica*
22	*Triloculina insignis*	52	*Ammonia beccarii*
23	*Triloculina oblonga*	53	*Ammonia dentata*
24	*Triloculina rotunda*	54	*Ammonia tepida*
25	*Triloculina schreiberiana*	55	*Asterorotalia inflata*
26	*Triloculina striatotrigonula*	56	*Elphidium advenum*
27	*Triloculina terquemina*	57	*Elphidium craticulatum*
28	*Triloculina tricarinata*	58	*Eliphidium crispum*
29	*Rupertianella rupertiana*	59	*Elphidium discoidale*
30	*Nodosaria catesbyi*	60	*Elphidium norvangi*

commonly noticed. Species like *Karrerotextularia albatrossi, Cycloforina semiplicata, Quinqueloculina ferusacci, Flintina bradyana, Pyrgo denticulata, Triloculina striatotrigonula, Rupertianella rupertiana, Chrysalidinella dimorpha, Nodosaria catesbyi, Globigerinoides rubber* were relatively rarely noticed.

Some species like *Pyrgo denticulata, Triloculina rotunda, Globigerinoides rubber, Sigmavirgulina tortuosa, Ammonia tepida, Eliphidium crispum* and *E. discoidale* recorded from this region are usually noticed in the shallow waters all over the world (Collins 1958, Brooks 1973). Previous studies report the entire east coast of India is species rich regarding foraminiferans (Kalaiselvan 1986, Rao et al. 1990 & 2000, Gandhi et al. 2002). Among the total of 42 species identified from the

nearshore shelf, Visakhapatanam, East Coast of India by Kaladhar et al. (1990), *Quinqueloculina seminulum, Q. lamarckiana, Rosalina globularis, Triloculina tricarinata, Ammonia beccarii, A. tepida, Asterorotalia inflata, Cibicides lobatulus, Eliphidium crispum, E. advenum, Hanzawia concentrica, Pararotalia nipponica* were recorded in the study.

Amphistegina radiata, A. lessonii, Triloculina oblonga and *Textularia agglutinans,* found abundant in the sediments of Lakshadweep Archipelago, Arabian Sea by Rao et al. (1987), were found rare in Kudankulam coast. Foraminiferal study from Kharo creek, Gujarat, north west coast of India (Nigam & Chaturvedi 2000) revealed the presence of 47 species of which 44 were benthic. Similar to other coasts, species diversity of foraminiferans is high in the Kudankulam coast also.

From a thorough review of earlier works, it appears that most species recorded from the Kudankulam region were recorded from the entire east and west coasts of India and they exhibit a wide pattern of distribution similar to other coasts.

Benthic foraminifera are increasingly used as environmental bioindicators, especially in polluted environments, where their sensitivity to pollutants can be attributed to peculiar foraminiferal features including variation in the abundance of foraminiferan species, species diversity and abnormal tests due to the circumstantial presence of pollutants at that site. The abnormalities of tests included stunted growth, abraded margins and dissolved ornamentations (Setty & Nigam 1984). The advantage of application of foraminifers over chemical and biological techniques for pollution monitoring lies in the potentiality of these organisms to depict temporal, spatial and numerical variations due to type and concentration of various pollutants at any site even in the absence of pre-pollution studies, based on the recovery of foraminifers from the sediment core samples (Nigam 2005).

The study contributes in identifying the patterns in diversity and abundance of Foraminiferans, a bioindicator of the Kudankulam coast for the first time. Comparison with similar such studies in the future will enable better understanding of changes in the marine ecosystem. Results of the present study may be useful to the power plant authorities and environmentalists to plan and take appropriate conservation strategies for the proper management of the ecosystem once the power plant gets established and start functioning. The present study can provide a baseline data to assess the particular environment by comparing these preliminary data with a post data taken after a few years.

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