

Recent Foraminifera from nearshore shelf, south of Visakhapatnam, east coast of India

R Kaladhar, S Kamalakaram, K U Varma & V Bhaskara Rao
Department of Geology, Andhra University, Waltair 530 003, India

Received 3 July 1989, revised 20 December 1989

Forty two species of Foraminifera are recognised from the sediments of inshore waters (3-10 m depth). Both living and dead individuals of Foraminifera have been studied. The assemblage is devoid of agglutinated forms.

Although some studies¹⁻⁷ have been made on Foraminifera present in different environs of Visakhapatnam, no information exists on this group in the nearshore region (< 20 m depth of water). This paper deals with the Recent Foraminifera from the inshore waters (3-10 m depth) between Yarada and Gangavaram, south of Visakhapatnam (Fig. 1).

Bottom sediment and water samples were obtained in February 1980 at sts 1-10 (Fig. 1). Sts 1-5 had depths of 8-10 m and sts 6-10 depths of 3 m. Phleger corer and Van Veen grab were used to obtain sediment samples. In either case, the top 1 cm thick sediment layer was removed by a constant volume sampler⁸ and preserved in formaldehyde for faunal analysis. Living Foraminifera were determined following Walton⁹.

Water and sediment characteristics — Spatial variations in bottom water characteristics are not significant⁷. Salinity ranges from $32.8-33.5 \times 10^{-3}$, temperature $26^{\circ}-26.4^{\circ}\text{C}$ and dissolved oxygen $3.1-3.7 \text{ ml.l}^{-1}$. The substrate consists of very fine sand with little silt and clay and is poor in organic matter (< 0.1%).

Foraminiferal abundance and species — Living foraminiferal number (LFN) per unit volume wet sediment (12 ml) ranges from 2-85 and total foraminiferal number (TFN) from 90-969. LFN/TFN ratios are very low, varying between 0.02 and 0.17 (Table 1). Diversity is expressed by species number (S), Shannon-Wiener information functions $H(S)$ and equitability (ϵ)¹⁰. S , $H(S)$ and ϵ respectively ranges from 1-14, 0-2.4 and 0.47-1 for living populations, and from 18-32, 2.09-3.0 and 0.3-0.91 for total populations (Fig. 2). S and $H(S)$ are higher for total populations whereas ϵ is higher for living populations. Living and total foraminiferal numbers are higher in the northern half of the area of study.

A total of 42 species of Foraminifera have been identified from the area (Table 1). They belong to 21 genera and 12 families. The assemblage includes 11 miliolids, 2 planktonic forms and 29 rotaliids and is devoid of agglutinated species. All miliolids with the exception of *Quinqueloculina seminulum*, the two planktonic forms and 17 of the 29 rotaliids are not represented by living specimens (Table 1). Individually, they are of common to scarce occurrence (< 5% of TFN) but their empty tests together generally account for up to 16% of TFN. Of the remaining 13 species represented by living individuals, 3 are less common (*Elphidium advenum*, *E. crispum* and *pseudorotalia schroeteriana*), while 10 are abundant (> 5% of LFN/TFN) and include *Quinqueloculina seminulum*, *Ammonia beccarii*, *A. beccarii tepida*, *Asterorotalia dentata*, *A. inflata*, *A. trispinosa*, *Cibicides lobatulus*, *Hanzawaia concentrica*, *Pararotalia nipponica* and *Pseudonion grateloupi*.

All the 42 species recognised from the shallower zone of the inner shelf also occur in the inner shelf (> 20 m depth) and in the seaward segments of the Gostani river⁵, and the Meghadri gedda⁶ and Balacheruvu stream⁷. However, the assemblage of the land-

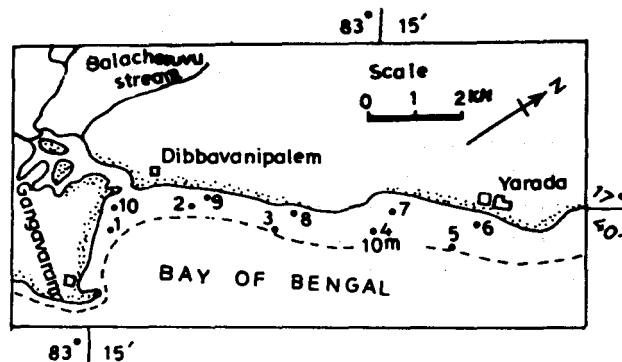


Fig. 1—Sample locations

Table 1—Foraminiferal populations
 [Values in parentheses indicate living individuals]

	Stations								
	1	2	3	4	5	6	7	8	9
Species not represented by living individuals									
<i>Asterorotalia multispinosa</i>			4	3			3	1	
<i>Bolivina striatula</i>						6	2		
<i>Bolivina</i> sp. cf. <i>amygdaleoformis</i>		2			2	3	1	2	
<i>Bolivina</i> sp.			4				1	4	
<i>Elphidium discoidale</i>	2	3		2	8	3	2		2
<i>E. hispidulum</i>			1		3	1			
<i>E. incertum</i>	2	2							
<i>E. Simplex</i>		5				1	1	3	
<i>E. somaense</i>	2	2	3	1	2	2	1	1	1
<i>Florilus asterizans</i>					3			3	
<i>F. incisus</i>	2	2	4			8	3	2	
<i>F. labradoricus</i>		3	2	1	7	5	2		2
<i>F. scaphus</i>			3	3	2				3
<i>Globigerina bulloides</i>	3		2		2	2	2		
<i>Globigerinoides rubra</i>	2					3			
<i>Loxostomum karrerianum</i>			4	2	6	6	6	8	3
<i>Quinqueloculina elongata</i>		1			3	2			
<i>Q. gualtieriana</i>					2		3	2	
<i>Q. lamarckiana</i>		4			4	5	4		
<i>Q. parkeri</i>		2						2	
<i>Q. subrotunda</i>	3	2	2	2		10		3	2
<i>Rosalina floridana</i>		2							2
<i>R. globularis</i>		3				3			
<i>Spiroloculina costifera</i>		1	7	1	2	5		2	2
<i>S. indica</i>						4		3	
<i>Triloculina rupertiana</i>		1				5			1
<i>T. tricarinata</i>			2			2		2	
<i>T. trigonula</i>			7			3	2		1
<i>Uvigerina proboscidea</i>				2	3			1	
Species represented by living individuals									
<i>Ammonia beccarii</i>	12(2)	5	25(8)	2	30(10)	11(i)	40(14)	2	6
<i>A. tepida</i>		4	18(3)		31(5)	8	1(2)	1	2
<i>Asterorotalia dentata</i>	28	12	60(10)	25(5)	123(21)	160(10)	101(20)	125(40)	42(2)
<i>A. inflata</i>	6(1)	7			10	25(5)	10(2)	4(1)	4
<i>A. trispinosa</i>	3(1)	10	35(5)	5	40(10)	215(16)	13(1)	17(2)	18
<i>Cibicides lobatulus</i>	4	11	19(4)	8	60(11)	124(14)	15(3)	10	17(2)
<i>Elphidium advenum</i>	2(1)	3	3(1)		6	4	2	3	3
<i>E. crispum</i>	3	5	4(1)	3	4	11(1)	5(1)	4	
<i>Hanzawaia concentrica</i>	5	10	25(5)	7	71(13)	155(6)	20(5)	10	18(2)
<i>Pararotalia nipponica</i>	12(2)	12(2)	33(3)	14(5)	53(13)	138(14)	8	36(6)	10(2)
<i>Pseudononion grateloupi</i>	4	3	13(3)	4		21(1)	16	4	3
<i>Pseudorotalia schroeteriana</i>		1	6(1)		12(2)	8		3	
<i>Quinqueloculina seminulum</i>	7(1)	10	6(2)	5	15	11	4		6
Total	102(8)	128(2)	292(46)	90(10)	504(85)	969(68)	284(48)	258(49)	148(8)
LFN/TFN	0.08	0.02	0.16	0.11	0.17	0.07	0.17	0.10	0.05
Species number(s)	18(6)	28(1)	24(12)	18(2)	16(8)	32(9)	26(8)	27(4)	21(4)

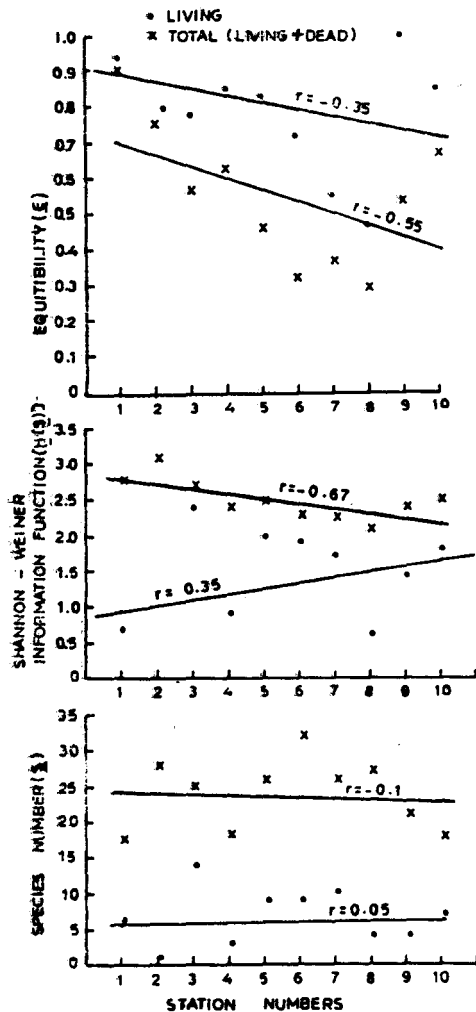


Fig. 2—Faunal diversity in relation to station numbers

ward zone of the inner shelf (3-10 m depth) differs in several ways from the deeper inner shelf (> 20 m depth) and estuarine environments of the adjacent coast: 1) diversity (S) in the area of study is lower than

in the areas under reference; 2) agglutinated forms are conspicuous by their total absence from the shallower inner shelf zone; and 3) neither those present in the deeper inner shelf (> 20 m depth) nor those present in the coastal estuaries⁵⁻⁷ are found here.

The nearshore shelf of the present study is affected by shoaling waves and longshore currents and thus there is a rigorous environment more inhospitable for Foraminifera than the deeper inner shelf. It is characterised by the total absence of agglutinated Foraminifera and living miliolids, and only a few living rotalids. On the basis of the thanatocoenosis, the nearshore fauna can be distinguished from the offshore fauna (> 20 m depth) by its lower species diversity and lack of agglutinated forms.

Thanks are due to Prof M Subba Rao and Dr T Y Naidu for helpful suggestions.

References

- 1 Ganapati P N & Satyavati P, *Andhra Univ Memoir Oceanogr*, 2 (1958) 100.
- 2 Subba Rao M & Vedantam D, *Bull Nat Inst Sci India*, 38 (1968) 491.
- 3 Subba Rao M, Vedantam D & Nageswara Rao J, *Palaeogeogr Palaeoclimatol Palaeoecol*, 27 (1979) 349.
- 4 Bhalla S N, *Bull Nat Inst Sci India*, B 38 (1967) 376.
- 5 Nageswara Rao J, *Studies on Foraminifera from the Gosthani estuary and the Visakhapatnam shelf sediments, east coast of India*, Ph.D. thesis Andhra University, 1979.
- 6 Chandrasekhara Rao D, *Foraminiferal ecology of the Visakhapatnam harbour complex, east coast of India*, Ph.D. thesis Andhra University, 1982.
- 7 Kaladhar R, *Recent Foraminiferida from the Balacheruvu stream, Tandava river estuary and Rishikonda rock pools, east coast of India*, Ph.D. thesis Andhra University, 1981.
- 8 Phleger F B, *Ecology and distribution of Recent Foraminifera*, (The Johns Hopkins Press, Baltimore) 1960, 297.
- 9 Walton W R, *Contr Cushman Found Foraminifera Res*, 3 (1952) 56.
- 10 Gibson L B & Buzas M A, *Bull Geol Soc Amer*, 84 (1973) 217.