

## DISTRIBUTION AND SPECIES DIVERSITY OF RECENT FORAMINIFERA FROM THE THAMIRABARANI RIVER ESTUARY, PUNNAIKKAYAL, TAMIL NADU

V.KUMAR<sup>1</sup>, V. MANIVANNAN<sup>2</sup> AND V. RAGOTHAMAN.<sup>3</sup>

DEPARTMENT OF GEOLOGY, NATIONAL COLLEGE, TIRUCHY - 620 001. <sup>2</sup>DEPARTMENT OF GEOLOGY, GOVT. ARTS COLLEGE, SALEM - 636 007. <sup>3</sup>DEPARTMENT OF GEOLOGY, UNIVERSITY OF MADRAS, MADRAS - 600 025.

### ABSTRACT

A total of twenty six foraminiferal species was identified from sixteen sediment samples collected from the Thamirabarani river estuary, among which 4 are arenaceous (agglutinated), 5 are calcareous imperforate and the rest 17 are calcareous perforate species. The distribution of the fauna reveals that the population size is gradually decreasing in the samples collected away from the mouth and are related to the decreasing salinity value, depth and silt & clay particles of the substrate. The species diversity value (V) is also found to be maximum in the stations near the mouth and minimum at the farthest station from the mouth.

### INTRODUCTION

The river Thamirabarani rises in the Western Ghats and flows eastward for about 120 kilometers before debouching into the Gulf of Mannar, through three small distributaries, at and around Punnaikkayal, 20 kilometers south of Tuticorin, Tamil Nadu. The coast in immediate vicinity of the estuary is characterised by the occurrence of a number of small sand bars. Thamirabarani river estuary, lies between latitudes 78° 4' and 78° and longitudes 8°40' which forms a part of toposheet No. 58 L/2, Survey of India.

This estuary is a tropical oligomictic estuary, which floods during winter and scanty flows during summer. 16 sediment samples were collected from the Thamirabarani river estuary (fig. 1) in the month of January 1988. The length of the estuary is about 9 kilometers. The maximum depth of the estuary is about 1 meter

at the northern entrance, and is about 2.5 meters at the middle and the southern entrances. The water depth gradually decreases in the upstream direction.

### SUBSTRATE AND SALINITY

The substrate of the southern and middle distributaries are found to have comparatively a higher percentage of silt and clay. The substrate at the upstream end of the estuary (Station 16) is pure sand.

	Sand %	Silt %	Clay %
Middle estuary (Station 5)	35.40	40.46	24.12
Southern estuary (Station 6)	25.25	36.40	38.34
Northern estuary (Station 1)	55.25	33.80	10.95
Farthest station from the mouth (Station 16)	99.54	0.46	-

The salinity value of the bottom water sample taken near the mouth in the northern distributary is 26 ppt; in the middle and southern distributaries it is 30 ppt. This value is found to be a minimum (5 ppt) in sample collected in the farthest station from the mouth. The higher salinity values found in the middle and southern distributaries may be attributed to the lesser flow of fresh water, due to the sand bars.

Sixteen sediment samples were collected starting from the mouth of the estuary (fig. 1). For the study of foraminiferal population, 50 gms of dry sediment from each sample was taken after coning and quartering.

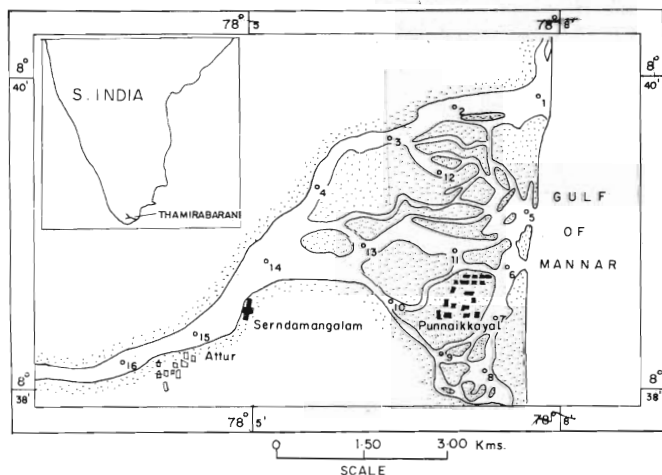


Fig. 1. Location of the sampling stations in the Thamirabarani Estuary.

Photomicrographs were taken to illustrate the various views of the 26 species described.

#### SPECIFIC COMPOSITION OF THE FORAMINIFERAL FAUNA

Foraminiferal studies from the substrate of the Thamirabarani river estuary has led to the recognition of 26 species belonging to 20 genera, 15 families and 7 superfamilies (fig. 2).

Families Miliolidae and Rotaliidae are best represented with 4 species each. Out of the 26 foraminiferal species, 4 are arenaceous agglutinated forms, 5 are calcareous imperforate and the rest 17 are calcareous perforate.

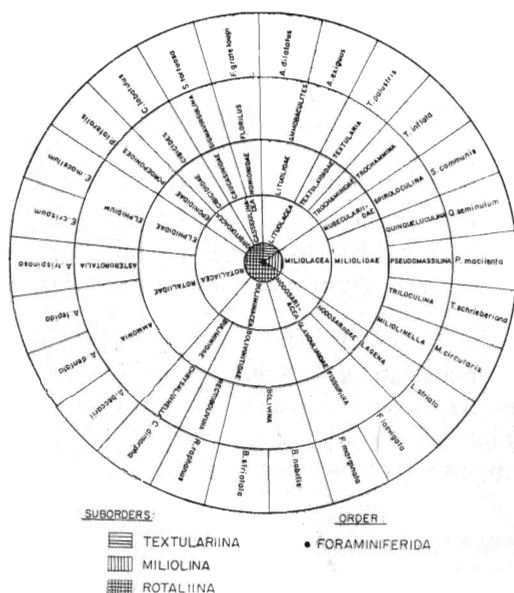


Fig. 2. Taxonomic chart of the foraminifera of the Thamirabarani Estuary.

#### FORAMINIFERAL POPULATION AND THEIR DISTRIBUTION

Foraminiferal population size ranges between 8 and 1127, with the maximum at station 5 and the minimum at the station 16 (Table 1). From the distribution of sampling stations (fig 1) and from the foraminiferal population size of the respective samples, it is seen that i. though the sampling station 1,5 and 6 are near the mouth, station 1 is less populated because of the lesser salinity and comparatively sandy nature of the substrate, ii. the population size is comparatively lesser in the samples collected from the northern distributary and iii. the population size gradually decreases in the samples collected away from the mouth, irrespective of the distributaries.

Out of the 26 species, *Ammonia tepida* and *Quinqueloculina seminulum* are found to occur in all the 16 samples collected and studied; while *Florilus grate-*

*loui* in 15 samples. The species which shows a poor representation in this area is *Ammobaculites dilatatus* as it is found only in 3 samples.

#### SPECIES DIVERSITY

From a study of the species diversity, we can compare the sediment samples in terms of the number of species they contain and the distribution of their abundance (in their respective sampling stations). According to Walton (1964), faunal variability also called faunal diversity is "the number of ranked species of a counted or estimated foraminiferal population whose cumulative percentage constitutes 95% of the total population". This characteristic is obtained by ranking the percentage occurrence of each benthonic species, cumulating the percentages, and plotting a curve of numbers of species against cumulative percents. The variability value (V) is calculated from the curve by taking the difference between the number of species as the one-hundred percentile ( $NS_{100}$ ) and at the five percentile ( $NS_5$ ) (Table. 2). These values have the same environmental significance as the total number of species but are not affected by those occurrence of rare species that constitute fractional percentages of the total populations.

In the present study, the per cent distribution of the foraminiferal assemblage in terms of genera for 16 sampling stations were calculated (Table 2). The diversity curves relating the number of species with cumulative percentage of genera for the 16 stations are presented in the Fig. 3.

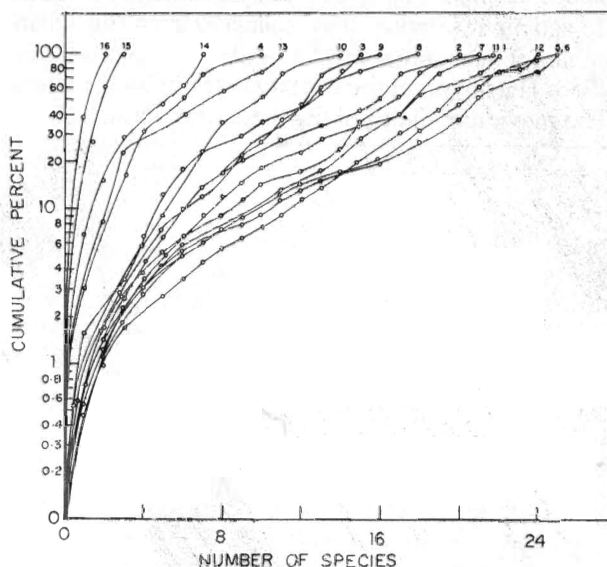


Fig. 3. Diversity curves relating number of species with average cumulative percentage of genera.

Table 1. Distribution of the Benthonic Foraminifera in actual numbers of specimens in the Thamirabarani river estuary.

Sl. No.	Name of species	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
01.	<i>Ammobaculites dilatatus</i>	—	—	—	—	4	8	6	—	—	—	—	—	—	—	—	—
02.	<i>A. exiguus</i>	—	—	—	—	12	16	18	10	24	12	14	8	—	—	—	—
03.	<i>Ammonia beccarii</i>	34	48	21	28	108	92	50	39	34	19	97	84	15	—	—	—
04.	<i>A. dentata</i>	9	17	9	6	12	14	10	21	9	11	13	6	8	—	—	—
05.	<i>A. tepida</i>	79	88	55	38	124	123	138	66	105	74	116	92	33	17	10	3
06.	<i>Asterorotalia trispinosa</i>	32	21	12	—	18	13	18	29	—	—	16	12	—	—	—	—
07.	<i>Bolivina nobilis</i>	27	24	46	35	98	44	37	63	39	34	74	68	39	8	—	—
08.	<i>B. striatula</i>	12	19	24	17	48	25	21	27	18	23	41	33	18	—	—	—
09.	<i>Chrysalidina dimorpha</i>	16	4	—	—	14	8	12	8	—	—	12	21	—	—	—	—
10.	<i>Cibicides lobatulus</i>	21	19	—	—	21	13	10	—	—	—	—	8	—	—	—	—
11.	<i>Elphidium crispum</i>	9	17	4	—	15	11	—	12	—	—	14	19	—	—	—	—
12.	<i>E. macellum</i>	26	22	—	—	30	24	15	19	—	—	34	32	—	—	—	—
13.	<i>Fissurina laevigata</i>	10	14	12	16	38	34	27	18	12	15	32	35	20	3	—	—
14.	<i>E. marginata</i>	18	26	20	18	98	72	80	23	39	34	66	74	36	12	—	—
15.	<i>Florilus grateloupi</i>	84	64	43	39	157	133	92	36	77	49	140	155	48	14	8	—
16.	<i>Lagena striata</i>	4	—	—	—	12	14	—	—	—	—	—	12	—	—	—	—
17.	<i>Miliolinella circularis</i>	5	4	—	—	—	9	—	—	—	—	12	10	—	—	—	—
18.	<i>Poroepionides lateralis</i>	8	11	6	—	10	—	8	—	—	—	7	5	—	—	—	—
19.	<i>Pseudomassilina macilenta</i>	4	7	—	—	7	8	—	—	—	—	—	—	—	—	—	—
20.	<i>Quinqueloculina seminulum</i>	134	116	74	57	216	245	182	88	123	84	213	205	82	36	12	5
21.	<i>Rectobolovina raphanus</i>	9	—	6	—	12	7	—	—	—	—	—	8	—	—	—	—
22.	<i>Sigmavirgulina tortuosa</i>	8	12	8	—	22	14	8	17	5	—	18	10	—	—	—	—
23.	<i>Spiroloculina communis</i>	16	20	14	8	16	19	16	29	11	13	19	21	16	6	—	—
24.	<i>Textularia palustris</i>	—	—	—	—	6	8	4	—	3	2	5	4	—	—	—	—
25.	<i>Triloculina schroeberiana</i>	14	19	12	—	11	7	—	27	6	—	6	7	9	—	—	—
26.	<i>Trochammina inflata</i>	—	—	—	—	18	12	9	—	11	7	9	—	—	—	—	—
		579	572	366	262	1127	973	761	532	516	377	958	929	324	96	30	8

Table 2. Percentage distribution of Foraminifera in terms of genera in the Thamirabarani river estuary.

Sl. No.	Name of Genera	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
01.	<i>Ammobaculites</i>	—	—	—	—	1.42	2.46	3.16	1.88	4.65	3.18	0.86	—	—	—	—	—
02.	<i>Ammonia</i>	21.07	26.74	23.23	27.48	21.65	23.54	26.01	23.69	28.68	27.59	23.60	19.59	17.28	17.71	33.33	37.5
03.	<i>Asterorotalia</i>	5.53	3.67	3.28	—	1.60	1.34	2.37	5.45	—	—	1.67	1.29	—	—	—	—
04.	<i>Bolivina</i>	6.73	7.52	19.13	19.85	12.96	7.09	7.62	16.92	11.05	15.12	12.01	10.87	17.60	8.33	—	—
05.	<i>Chrysalidina</i>	2.76	0.70	—	—	1.24	0.82	1.58	1.50	—	—	1.25	2.26	—	—	—	—
06.	<i>Cibicides</i>	3.63	3.32	—	—	1.86	1.34	1.31	—	—	—	—	0.86	—	—	—	—
07.	<i>Elphidium</i>	6.05	6.82	1.09	—	3.99	3.60	1.97	5.82	—	—	5.01	5.49	—	—	—	—
08.	<i>Fissurina</i>	4.84	7.00	8.74	12.98	12.07	10.89	14.06	7.70	9.89	13.00	10.23	11.74	17.28	15.63	—	—
09.	<i>Florilus</i>	14.51	11.19	11.75	14.88	13.93	13.67	122.09	6.77	14.92	13.00	14.61	16.68	14.81	14.58	26.67	—
10.	<i>Lagena</i>	0.69	—	—	—	1.06	1.44	—	—	—	—	—	1.29	—	—	—	—
11.	<i>Miliolinella</i>	0.86	0.70	—	—	—	0.93	—	—	—	—	1.25	1.08	—	—	—	—
12.	<i>Poroepionides</i>	1.38	1.92	1.64	—	0.89	—	1.05	—	—	—	0.73	0.54	—	—	—	—
13.	<i>Pseudomassilina</i>	0.69	1.22	—	—	0.62	0.82	—	—	—	—	—	—	—	—	—	—
14.	<i>Quinqueloculina</i>	23.14	20.88	20.22	21.76	19.17	25.18	23.92	16.54	23.84	22.28	22.23	22.07	25.31	37.50	40.00	62.5
15.	<i>Rectobolovina</i>	1.56	—	1.64	—	1.06	0.72	—	—	—	—	—	0.86	—	—	—	—
16.	<i>Sigmavirgulina</i>	1.38	2.10	2.19	—	1.95	1.44	1.05	3.20	0.97	—	1.88	1.08	—	—	—	—
17.	<i>Spiroloculina</i>	2.76	3.50	3.81	3.05	1.42	1.95	2.10	5.45	2.13	3.45	1.98	2.26	4.94	6.25	—	—
18.	<i>Textularia</i>	—	—	—	—	0.53	0.82	0.53	—	0.58	0.53	0.52	0.43	—	—	—	—
19.	<i>Triloculina</i>	2.42	3.32	3.28	—	0.98	0.72	—	5.08	1.16	—	0.63	0.75	2.78	—	—	—
20.	<i>Trochammina</i>	—	—	—	—	1.60	1.23	1.18	—	2.13	1.85	0.94	—	—	—	—	—
		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Diversity Value		17	16	13	9	20	19	17	15	12	11	17	17	10	7	3	2

The curves of the farthest stations ie 14, 15 and 16 are nearly straight, while they become more inclined for the stations towards the mouth.

The diversity values of the assemblage in the present area show a range from 2 to 20, the maximum near the mouth (Station 5) and the minimum at the farthest station (Station 16).

Though the stations, 1, 5 and 6 are near the mouth, station 1 has comparatively lesser diversity value. In all the three distributaries, this value is found to be gradually decreasing in the samples collected away from the mouth. In the present area, the lesser diversity value may be attributed to the lesser salinity, lesser depth and lesser fines (clay & silt) of the substrate.

#### CONCLUSION

Out of the 26 foraminiferal species indentified, 4 are arenaceous, 5 are vitreous and the rest 17 are porcellaneous species. The highly tolerant species *Ammonia tepida* and *Quinqueloculina seminulum* are found to occur in all the 16 sediment samples collected and studied.

The foraminiferal population size is found to be lesser in the samples collected in the northern distributary. In all three distributaries, the population size is gradually decreasing in the samples collected away from the mouth. Physical parameters such as salinity, depth and fines of the substrate are seen to have positive effect on the population.

The species diversity value (V) is also found to be maximum in the samples collected near the mouth and minimum at the farthest station.

#### ACKNOWLEDGEMENT

The authors are thankful to Dr. K.C. Rajasekaran, Professor and Head in-Charge, Department of Geology, University of Madras, and Sri K. Ramamoorthy, Head of the Department, Department of Geology,

National College, Tiruchy, Government Arts College, Salem, for their constant encouragement throughout the work.

#### REFERENCES (Consulted)

- BOCK, W.D., LYNTS, G.W., SMITH, S., WRIGHT, R., HAY, W.W. & JONES, J.I. 1971. A symposium of Recent South Florida foraminifera. *Miami Geol. Soc.* **1**: 1-245.
- BRASIER, M.D. 1975a, Ecology of recent sediment-dwelling and phytal foraminifera from the lagoons of Barbuda, West Indies. *Jour. Foram. Res.* **5**(1):42-62.
- BRASIER, M.D. 1975b, The ecology and distribution of Recent foraminifera from the reefs and shoals around Barbuda, West Indies. *Jour. Foram. Res.* **5**(3):193-210.
- BUZAS, M.A. SMITH, R.K. & BEEM, K.A. 1977 Ecology and systematics of foraminifera in *Thalassia* Habitats, Jamaica, West Indies. *Smithsonian Centr. Paleobio.* **31**:1-139.
- KOHL, B. 1985 Early Pliocene benthonic foraminifera from the Salina Basin, southeastern Mexico. *Bull. Amer. Pal.* **88**(322):1-173.
- KUMAR, V. 1989 Ecology, Distribution and Systematics of Recent Benthic Foraminifera from the Palk Bay, off Rameswaram, Tamil Ndu. Bharathidasan University *Ph.D thesis* (Unpublished):1-246.
- LOEBLICH, A.R. Jr., & TAPPAN, H. 1964 Sarcodina, Chiefly "Thecamoebians" and Foraminifera. IN: Moore, R.C. Ed. *Treat. Invert. Pal.*, New York. *Geol. Soc. Amer., Part. C, Protista*. **2** (142):1-900.
- RAMANATHAN, RM. 1969 Seasonal variations in foraminiferal abundance and their relation to the substrate in Vellar Estuary, Madras. *Jour. Geol. Soc. India* **10**(2):188-200.
- RASHEED, D.A. & RAGOTHAMAN, V. 1978 Ecology and distribution of Recent foraminifera from the Bay of Bengal, Off Porto Novo, Tamil Nadu Stat, India. *Proc. VII Indian Colloq. Micropal. & Strat.*:263-289.
- REDDY, K.R. & JAGADISWARA RAO, J. 1983 Diversity and dominance of living and total foraminifera from the Pennar estuary, Andhra Pradesh. *Jour. Geol. Soc. India.* **24**(11):594-603.
- VENKATA RAO, T. & SUBBA RAO, M. 1974. Recent foraminifera of Suddagedda estuary, east coast of India. *Micropal.* **20**(4):38-419.
- WALTON, W.R. 1964 Recent foraminiferal ecology and Palaeoecology. IN: J. Imbrie and M. Newell (Eds). *Approches to Palaeoecology* John Wiley and Sons. Inc. 151-237.

#### EXPLANATION OF PLATES

##### PLATE I

- |   |  |      |
|---|--|------|
| 1 | <i>Ammobaculites dilatatus</i> Cushman & Bronniman<br>L - 0.50 m.m, B - 0.15 m.m.<br>Side view | X100 |
| 2 | <i>Ammobaculites exiguus</i> Cushman & Bronniman<br>L - 0.38 m.m., B - 0.15 m.m.<br>Side View  | X75  |
| 3 | <i>Textularia palustris</i> Warren<br>L - 0.43 m.m., B - 0.15 m.m.<br>Side View                | X130 |
| 4 | <i>Trochammina inflata</i> (Montagu)<br>D - 0.45 m.m.<br>Doral View                            | X70  |

5	<i>Spiroloculina communis</i> Cushman & Todd L - 0.85 m.m., B - 0.35 m.m., T - 0.25 m.m. Side View	X55
6	<i>Quinqueloculina seminulum</i> (Linne) L - 0.39 m.m., B - 0.25 m.m. Side View	X135
7-8	<i>Pseudomassilina macilenta</i> (Brady) L - 0.92 m.m., B - 0.54 m.m. 7 Apertural View 8 Side View	X60 X55
9-10	<i>Triloculina scheriberiana</i> d'Orbigny L - 0.45 m.m., B - 0.56 m.m., T - 0.30 m.m. Side Views	X65
11	<i>Miliolinella circularis</i> (Bornemann) L - 0.45 m.m., B - 0.41 m.m., T - 0.16 m.m. Side view	X60
12	<i>Lagena laevis</i> (Montagu) L - 0.45 m.m., B - 0.12 m.m. Side view	X70
13	<i>Fissurina laevigata</i> Reuss L - 0.21 m.m., B - 0.13 m.m. Side view	X100
14	<i>Fissurina marginata</i> (Montagu) L - 0.23 m.m., B - 0.19 m.m. Side view	X70
15	<i>Bolivina nobilis</i> Hantken L - 0.42 m.m., B - 0.14 m.m. Side view	X70
16	<i>Bolivina striatula</i> (Cushman) L - 0.35 m.m., B - 0.12 m.m. Side view	X90
17	<i>Chryslidinella dimorpha</i> Brady L - 0.92 m.m., W - 0.38 m.m. Side view	X30
18	<i>Rectobolivina raphanus</i> (Parker & Jones) L - 1.04 m.m., B - 0.23 m.m. Side view	X60

## PLATE II

1-2	<i>Ammonia beccarii</i> (Linne) D - 0.76 m.m. 1: Dorsal side 2: Ventral side	X55 X70
3-4	<i>Ammonia dentata</i> (Parker & Jones) D - 0.81 m.m. Fig. 3: Ventral side Fig. 4: Dorsal side	X50 X50
5-6	<i>Ammonia tepida</i> (Linne) D - 0.66 m.m. Fig. 5: Ventral side Fig. 6: Dorsal side	X45 X40
7	<i>Asterorotalia trispinosa</i> (Thalmann) L - 0.63 m.m. Dorsal side	X40
8-9	<i>Cibicides lobatulus</i> (Walker & Jacob) L - 0.36 m.m., B - 0.29 m.m., T - 0.15 m.m. 8: Ventral side 9: Dorsal side	X75 X65
10	<i>Elphidium crispum</i> (Linne) D - 0.58 m.m., T - 0.12 m.m. Side view	X80

- |       |   |      |
|-------|---|------|
| 11    | <i>Elphidium macellum</i> (Fichtel & Moll)  |      |
|       | D - 0.48 m.m.                               |      |
|       | Side view                                   | X50  |
| 12    | <i>Sigmovirgulina tortuosa</i> (Brady)      |      |
|       | L - 0.45 m.m., B - 0.22 m.m.                |      |
|       | Side view                                   | X105 |
| 13    | <i>Florilus grateloupi</i> (d'Orbigny)      |      |
|       | L - 0.45 m.m., B - 0.27 m.m., T - 0.16 m.m. |      |
|       | Side view                                   | X115 |
| 14-15 | <i>Poroeponides lateralis</i> (Terquem)     |      |
|       | L - 0.80 m.m., B - 0.68 m.m.                |      |
|       | 14: Ventral side                            | X40  |
|       | 15: Dorsal side                             | X35  |



