



TAXONOMY AND DISTRIBUTION OF BENTHIC FORAMINIFERA FROM THE SEDIMENTS OFF PALK STRAIT, TAMIL NADU, EAST COAST OF INDIA

SURESH GANDHI, G.V. M, RAJAMANICKAM and R. NIGAM*

DEPARTMENT OF EARTH SCIENCES, TAMIL UNIVERSITY, THANJAVUR - 613 005.

* GEOLOGICAL OCEANOGRAPHY DIVISION, NATIONAL INSTITUTE OF OCEANOGRAPHY
DONA PAULA, GOA - 403 004.

E-mail: surgan@yahoo.co.uk; vrajamanickam@yahoo.com; nigam@csnio.res.nic.in

ABSTRACT

A systematic study of benthic foraminifera has been made based on 42 sediment samples collected between Mandapam and Kodiyakkara, off Palk Strait, Tamil Nadu. A total of 102 benthic foraminiferal species belonging to 52 genera, 38 families, 23 superfamilies and 5 suborders are identified. The above species were compared to inventories given by earlier workers on east and west coast faunas. The result shows the presence of 38 species for the first time in this Strait. All these 38 species are illustrated here and their taxonomical details are provided. The foraminiferal distribution shows the number of species to be higher in the south of Manalmelkudi as compared to the north.

Key words: Benthic Foraminifera, Systematic Palaeontology, Palk Strait, East Coast of India.

INTRODUCTION

The study of foraminiferal assemblages and assemblage variations, preserved within coastal and marine sediments, offers manifold opportunities for investigating the responses of coastal zones to changes during the Quaternary period. In Indian waters Chapman (1895), Hofker (1927, 1930) and Stubbings (1939) initiated the foraminiferal studies. Subsequently, foraminiferal distribution has been reported by many workers off Visakhapatnam (Vedantam and Rao 1970; Kaladhar *et al.*, 1990), off Pondicherry (Setty, 1978), off Portonovo (Ragothaman, 1974; Rasheed and Ragothaman 1978), off Rameshwaram (Ragothaman and Kumar, 1985, 1988), off Palk Bay (Kumar, 1988; Kumar *et al.*, 1996, 1998), and off Karikattukuppam (Rao, 1998) off Dhabol - Vengurla (Setty and Nigam, 1978) off Trivandrum (Rao *et al.* 1985), off Karwar (Nigam and Khare, 1992, 1994, 1995) off Vengurla-Mangalore (Henriques, 1993), off Mangalore-Cochin (Mayenkar, 1994), off Karwar (Khare, 1992). However, only few works are seen in the Palk Strait. Hamsa (1973) has reported 34 species from the beach sands of Palk Bay and Gulf of Mannar. Kumar (1988) have studied ecology and distribution of foraminifera at Rameshwaram, Palk Bay. Kumar *et al.* (1996) have explained the spatial and temporal

variations in foraminiferal abundances and their relation to substrate characteristics in the Palk Bay, off Rameswaram, Tamil Nadu. Mohan *et al.* (2000) have attempted the rate of sedimentation in Palk Strait using grain size and textural study along the coast between Vedaranyam to Rameshwaram.

Palk Strait is endangered to get closed due to heavy siltation. The danger of closure was shown by recent studies using remote sensing techniques (Loveson *et al.*, 1990); using foraminifera (Gandhi and Rajamanickam, 1996; 1997, 1998). But, no systematic study has so far been undertaken in this region. In this paper, an attempt has been made to identify the foraminiferal distribution and their systematics in that region.

STUDY AREA AND METHODS

The investigated area is located in the central coast of Tamil Nadu extending from Rameshwaram to Point Calimere (fig.1). The drainage pattern is represented by perennial river such as Vaigai and ephemeral streams such as Ambulliar, Vellar, Kottakkarai, Versuliar, Valavanar, Uppar, Koluvan and Koraiyar. The study area enjoys tropical climate and the SW and NE monsoons bringing copious rainfall. From Vedaraniyam to Rameshwaram, waves propagating from south generally do not enter the

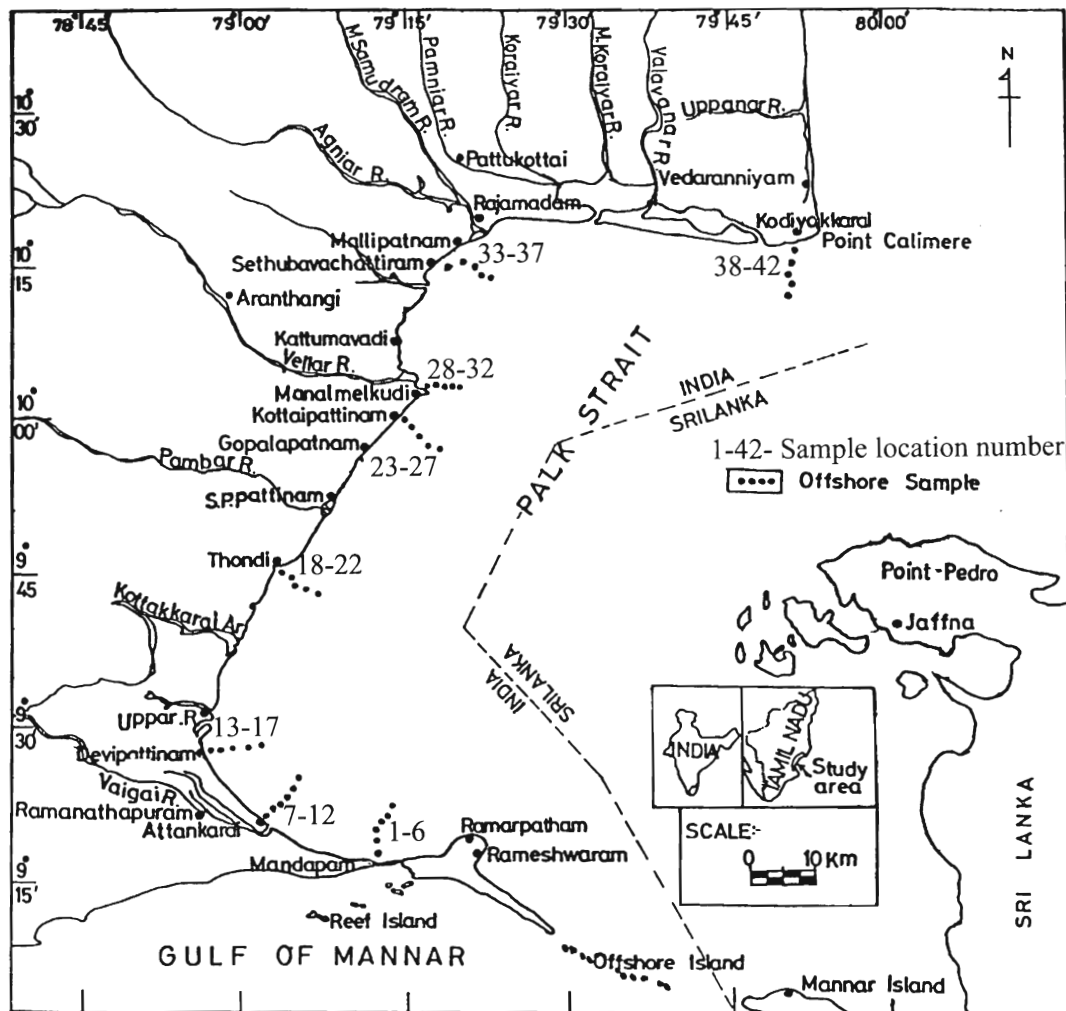


Fig. 1. Location map of the study area.

bay. But during NE monsoon, waves enter the bay through Pedro Channel and reach the coast between Puduvalasai and Gopalpattinam (Jena, 1997).

Fortytwo sediment samples were collected in the eight stations between Mandapam to Rameshwaram using a La fond Dietz snapper during April, 1996. The samples were preserved with 10% neutralised formalin. Simultaneously, rose bengal solution (1gm/lit) was applied to stain the tests (Walton, 1952) in the field itself. In the laboratory, the washed samples were passed through an 0.063 mm sieve and then dried. From the dried residues,

one gram sediment is taken out by cone and quartering. From that, foraminifera are hand picked, the remaining residues were again separated by CCl_4 method (Nigam, 1984). The picked out specimens were mounted and then counted.

In the study area, each station is divided into four depth zones for the convenience of sampling. The first depth zone is having a range of 0-2.5 m, while the second depth zone is in a depth range of 2.5-5 m, the third one of 5-7 m and the fourth is of more than 7 m. But, here in this paper as we are mainly dealing with only the taxonomy part, only

to record the presence or absence of species in the region, taking into account the occurrence in all depths the counting of species has been lumped to indicate the total number. The classification of foraminiferal genera proposed by Loeblich and Tappan (1988) has been followed in the present work. Scanning electron micrographs of different views of 38 foraminiferal species were obtained using a JEOL JM 350 Scanning Electron Microscope.

DISTRIBUTION

From the present study, 102 benthic foraminiferal species belonging to 52 genera, 38 families, 22 superfamilies and 5 suborders have been identified (table.1). The living foraminiferal specimens are rare and the present study is based on total fauna (living+dead). The 102 identified species are listed in table.2.

Table 1. Species composition of foraminiferal Suborders.

SUBORDER	SUPERFAMILY	FAMILY	GENUS	SPECIES (in %)
Textulariina	4	4	4	4.90
Miliolina	3	8	15	47.06
Lagenina	1	2	2	2.94
Globigerinina	1	1	1	0.98
Rotaliina	13	23	30	44.12
	22	38	52	

Table 2. List of Species in Palk Strait.

1. *Ammobaculites exiguus*
2. *Reophax* sp.
3. *Textularia agglutinans*
4. *T.porrecta*
5. *Ammopemphix* sp.
6. *Vertebralina striata*
7. *Edentostomina cultrata*
8. *Spiroloculina antillarum*
9. *S. communis*
10. *S. costifera*
11. *S. henbesti*
12. *S. indica*
13. *S. nitida*
14. *S. orbis*
15. *S. sp.*
16. *Adelosina leavigata*
17. *Quinqueloculina agglutinans*
18. *Q. costata*
19. *Q. elegans*
20. *Q. elongata*
21. *Q. boschiana* var. *malayensis*
22. *Q. granulocostata*
23. *Q. intricata*
24. *Q. lamarckiana*
25. *Q. parkeri*
26. *Q. poeyana*
27. *Q. polygona*
28. *Q. rhodionsis*
29. *Q. seminulum*
30. *Q. sidebottomi*
31. *Q. transversistriata*
32. *Q. tropicalis*
33. *Q. sp.*
34. *Massilina secans tropicalis*
35. *Pseudomassilina australis*
36. *Pseudomassilina macilinata*
37. *Miliolinella australis*
38. *M. circularis*
39. *M. labiosa*
40. *M. perplexa*
41. *M. pyrgoformis*
42. *M. sp.*
43. *Triloculina insignis*
44. *T. schreiberiana*
45. *T. terquemiana*
46. *T. tricarinata*
47. *T. trigonula*
48. *Rupertianella rupertiana*
49. *Articulina mayori*
50. *Spirolina arietinus*
51. *Sorites orbiculus*
52. *Monalysidium politum*
53. *Peneroplis planatus*
54. *Lagena perlucida*
55. *L. striata*
56. *Fissurina marginata*
57. *Globigerina bulloides*
58. *Bolivina durandi*
59. *B. lobata*
60. *B. nobilis*
61. *B. ordinaria*
62. *B. spathulata*
63. *B. striatula*

64. *Rectobolivina raphanus*
65. *Siphogenerina virgula*
66. *Hopkinsinella glabra*
67. *Loxostomina limbata*
68. *Bulimina. sp*
69. *Uvigerina. sp*
70. *Reussella simplex*
71. *Fursenkoina. sp*
72. *Sigmavirgulina tortuosa*
73. *Cancris auricula*
74. *Rosalina globularis*
75. *Rotorboides granulosum*
76. *Glabratella patelliformis*
77. *Discorbinella bertheloti*
78. *Cibicides lobatulus*
79. *Cymbaloporeta bradi*
80. *Cymbaloporella sp.*
81. *Acervulina inharens*
82. *Amphistegina radiata*
83. *Nonionoides boueanum*
84. *Nonion elongatum*
85. *Nonion sp.*
86. *Hanzawaia. sp*
87. *Ammonia beccarii*
88. *A. tepida*
89. *Asterorotalia dentata*
90. *A. trispinosa*
91. *A. inflata*
92. *Pseudorotalia schroeteriana*
93. *Pararotalia calcar*
94. *P. nipponica*
95. *Elphidium advenum*
96. *E. craticulatum*
97. *E. crispum*
98. *E. discoidale*
99. *E. incertum*
100. *Parrellina hispidula*
101. *Assilina ammonoides*
102. *Ossangularia venusta*

The overall distribution of the foraminiferal species is shown in fig. 2 station by station within the depth of 10 m. Mandapam records the highest diversity of 74 species without showing any variation at different depths, whereas there are 46 species in Attankarai, 57 species at Devipattinam, 39 species at Thondi, 44 species at Kottaipattinam, 18 species

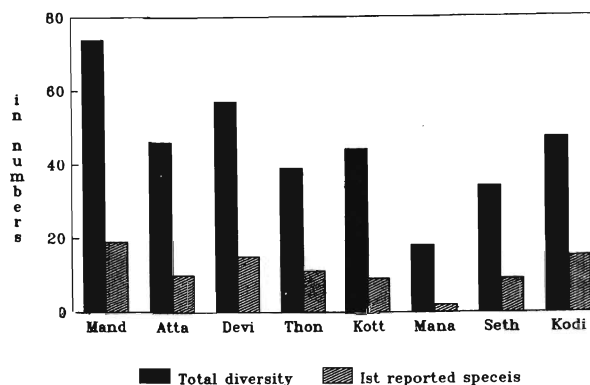


Fig. 2. Diversity of foraminiferal species in the study area.

at Manalmelkudi, 34 species at Sethubavachattiram and 47 species Kodyakkarai.

Out of 102 identified species from Strait, many species have already been reported from other areas by Nigam (1982) Khare (1992), Henriques (1993) and Mayankar (1994) in the west coast and Kumar (1988), Jayaraju (1993) and Rao (1998) in the east coast.

From a thorough review of the existing literature, it appears that the following six species have been recorded first time in the east coast of India namely, *T. porrecta*, *Q. bosciiana* var. *malayansis*, *Q. poeyana*, *Q. sidebottomi*, *Q. tranverse striata*, *Massilina secans tropicalis*. Among the species present, *A. beccarii*, *A. dentata*, *O. venusta*, *E. crispum*, *A. trispinosa*, *Q. seminulum* exhibit prolific abundance. Six species namely *S. communis*, *Q. lamarckiana*, *Q. seminulum*, *A. beccarii*, *E. crispum*, *E. discoidale* have shown a uniform distribution in more than six stations. Thirty eight species are recorded for the first time in this strait. Their distribution at eight different stations is given in table. 3. The identification is supported by illustrations (plates 1 and 2) and systematic inventory of species given below:

SYSTEMATIC PALAEOONTOLOGY

Order **Foraminiferida** Eichwald, 1830

Superfamily **Hormosinacea** Haeckel, 1894

Family **Textulariidae** Ehrenberg, 1838

Subfamily **Textulariinae** Ehrenberg, 1838

Genus **Textularia** de France, 1824

Table 3. Distribution of foraminiferal species in different stations.

Species Recorded for the first time in Palk Strait	MAN	ATT	DEV	THO	KOT	MMK	SBC	KOD
<i>Textularia porrecta</i>								x
<i>Spiroloculina antillarum</i>	x		x					
<i>S. henbesti</i>			x					
<i>S. indica</i>	x	x	x	x	x	x	x	x
<i>S. nitida</i>		x	x					
<i>Adelosina leavigata</i>		x						
<i>Quinqueloculina costata</i>		x						
<i>Q. elongata</i>			x					
<i>Q. elegans</i>							x	
<i>Q. boschiana</i> var. <i>malayensis</i>			x					
<i>Q. granulocostata</i>	x		x					
<i>Q. intricata</i>							x	
<i>Q. poeyana</i>	x				x			
<i>Q. rhodiensis</i>			x					
<i>Q. sidebottomi</i>	x							
<i>Q. transverse striata</i>	x							
<i>Q. tropicalis</i>	x	x	x	x	x		x	x
<i>Massilina secans tropicalis</i>			x	x	x			
<i>Miliolinella australis</i>				x			x	
<i>M. perplexa</i>				x				
<i>M. pyrgoformis</i>	x	x	x	x	x		x	x
<i>Lagena perlucida</i>	x		x	x				x
<i>Bolivina durandi</i>								x
<i>B. lobata</i>	x				x		x	x
<i>B. ordinaria</i>		x						x
<i>B. spathulata</i>								x
<i>Loxostomina limbata</i>					x		x	x
<i>Reussella simplex</i>	x							x
<i>Siphouvigerina virgula</i>		x						x
<i>Hopkinsinella glabra</i>	x							
<i>Cancris auricula</i>	x							
<i>Glabratella patelliformis</i>			x					
<i>Discorbinella bertheloti</i>	x			x			x	
<i>Amphistegina radiata</i>	x			x	x			x
<i>Nonion elongatum</i>	x							x
<i>Elphidium craticulatum</i>	x	x		x				
<i>Parrellina hispidula</i>	x	x	x	x	x	x	x	x
<i>Assilina ammonoides</i>	x		x					
Total species	19	10	15	11	9	2	9	15

Man: Mandapam
 Att: Attankarai
 Dev: Devipattinam
 Tho: Thondi

Kot: Kottaipattinam
 Mmk: Manalmelkudi
 Sbc: Sethubavachattiram
 Kod: Kodiyakkarai

Textularia porrecta (Brady)

(Pl. I, fig. 1)

Textularia agglutinans d'Orbigny var. *porrecta* Brady, 1884, Challenger Expedition Reports. Zoology, v.9, pts.2, p.304, p.43, figs.4a-b.

Textularia porrecta (Brady, 1884) - Yassini and Jones, 1995, p.76, pl.7, figs.104 - 110. - Rao, 1998, p.60, pl.6, figs.4-5.

Hypotype: Length - 0.25 mm Breadth - 0.12 mm

Remarks: This species is similar to those from Suddagudda estuary Rao and Rao (1974). Rare species (1.37%) occurring only at Kodiyakkarai station.

Repository of Type Material : IES, TU, Cat. No. MSG.1.

Superfamily **Miliolacea** Ehrenberg, 1839

Family **Spiroloculinidae** Wiesner, 1920

Subfamily **Spiroloculininae** Wiesner, 1920

Genus **Spiroloculina** d'Orbigny, 1826

Spiroloculina antillarum d'Orbigny

(Pl. I, fig. 2)

Spiroloculina antillarum d'Orbigny, 1839, p.166, pl.7, figs.3-4. - Rocha and Ubaldo, 1946b, p.647, pl.2, fig.6. - Ganapati and Satyavati, 1958, p.114, pl.2, fig.34. - Sethulakshmi Amma, 1958, p.3, pl.1, fig.2. - Antony, 1968, pp.34-35, pl.1, fig.7. - Bhalla, 1968, p.378, pl.1, figs.7a-b. - Rao, 1970a, p.592, pl.2, fig.20. - Setty and Nigam, 1984, p.432, pl.32, fig. 2. - Rao, et al., 1987, p.164, pl.1, figs.14-15. - Shareef and Venkatachalapathy, 1988, p.434, pl.1, fig.4. - Khare, 1992, pp.61-62, pl.2, fig.5. - Henriques, 1993, p.44, pl.2, figs.2a-b. - Mayankar, 1994, p.58, pl.1, figs.12a-b. - Rao, 1998, p.72, pl.9, fig.5.

Hypotype: Length - 0.29 mm Breadth - 0.15 mm.

Remarks: Out of total fauna it is 0.51 %, and 0.92 % respectively in Mandapam and Devipattinam.

Repository of Type Material: IES, TU, Cat. No. MSG.2.

Spiroloculina henbesti Petri

(Pl. I, fig. 3)

Spiroloculina henbesti Petri, 1955, vol.6, no.2, p.82, figs.4-6. - Jayaraju, 1993, p.92, pl.1, fig.6. - Rao, 1998, pp.74-759, pl.9, fig.12.

Hypotype: Length - 0.98 mm Breadth - 0.75 mm

Remarks: *Spiroloculina henbesti* closely resembles *S.communis* but differs in having broader and relatively short and stout chambers with rectangular depressions on the later formed chambers which occupy a major portion of the test (Jayaraju, 1993). It is found only at Devipattinam.

Repository of Type Material: IES, TU, Cat. No. MSG.3

Spiroloculina indica Cushman & Todd

(Pl. I, fig. 4)

Spiroloculina indica Cushman and Todd, 1944, p.71, pl.9, figs.32a-b. - Rocha and Ubaldo, 1964a, p.412, pl.2, fig.2; 1964b, p.647, pl.2, fig.9. - Bhatia, 1956, p.18, pl.2, fig.5. - Zobel, 1973, p.14, pl.1, figs.17,24. - Khare, 1992, pp.65, pl.2, fig.10. - Henriques, 1993, p.46, pl.2, figs.5a-b. - Mayankar, 1994, p.60, pl.21, figs.1a-b. - Rao, 1998, p.75, pl.10, fig.1.

Hypotype: Length - 0.31 mm Breadth - 0.10 mm

Remarks: The present species was first described from the Recent shore sand of Karachi (Cushman and Todd, 1944). It is also known to occur near Bombay and Bhogat in Saurashtra (Bhatia, 1956); Gogola, off the Kathiawar coast (Rocha and Ubaldo, 1964a); and in the beach sediments near Mandvi, Kutch (Jain and Bhatia, 1978). From the Palk Strait, it is noticed in all stations.

Repository of Type Material: IES, TU, Cat. No. MSG.4.

Spiroloculina nitida d'Orbigny

(Pl. I, fig. 5)

Spiroloculina nitida d'Orbigny, 1826, vol. 7, p.298. - Sidebottom, 1918, p.5, pl.1, fig.4. - Cushman and Todd, 1944, p.76. - Rasheed, 1967 - 68b, p.49, pl.16, figs.12-13.

Hypotype: Length - 0.90 mm Breadth - 0.75 mm

Remarks: Rare species, occurs (0.64 %) at Devipattinam. Ragothaman (1974) observed the presence of two teeth in the specimens from off Porto Novo.

Repository of Type Material: IES, TU, Cat. No. MSG.5.

Genus : **Adelosina** d'Orbigny, 1826

Adelosina leavigata d'Orbigny

(Pl. I, fig. 6)

Adelosina leavigata d'Orbigny, 1826, p.303. - Barker, 1960, p.6, pl.3, figs.10-11, 12a-c. - Yassini and Jones, 1995, p.80, figs.135-136.

Adelosina leavigata d'Orbigny, Rao, 1998, p.69, pl.8, figs.9-10.

Hypotype: Length - 0.54 mm Breadth - 0.50 mm

Remarks: This species is similar to *Quinqueloculina*. The test is rounded in shape without any striations and found only in Attankarai station.

Repository of Type Material : IES, TU, Cat. No. MSG.6.

Family **Hauerinidae** Schwager, 1876

Subfamily **Hauerininae** Schwager, 1876

Genus **Quinqueloculina** d'Orbigny, 1826

Quinqueloculina costata d'Orbigny

(Pl. I, fig. 7)

Quinqueloculina costata d'Orbigny, 1826, p.301, no.3. - Rao, 1974, p.63, fig.14. - Khare, 1992, p.69, pl.3, figs.4a-b. - Rao, 1998, p.82, pl.12, figs.3-4.

Hypotype: Length - 0.45 mm Breadth - 0.30 mm

Remarks: From *Q. bicostata*, the present species differs in shape and ornament around the periphery. The periphery in small specimen is seen with truncation and angular edges marked with one or two striations. It is seen only in Attankarai station.

Repository of Type Material: IES, TU, Cat. No.MSG.7.

Quinqueloculina elegans d'Orbigny

(Pl. I, fig. 8)

Quinqueloculina elegans d'Orbigny, 1826, p.301. - Daniels, 1970, p.73, pl.12, fig.13. - Haake, 1975, p.33, pl.3, figs.51-57. - Setty and Nigam, 1984, p.431, pl.32, fig.13. - Henriques, 1993, p.49, pl.3, figs.3a-c. - RAO, 1998, p.84, pl.13, fig.1.

Hypotype: Length - 0.40 mm Breadth - 0.28 mm

Remarks: Very rare species. It is 1.57% of total fauna at Sethubavachattiram only.

Repository of Type Material: IES, TU, Cat. No.MSG.8.

Quinqueloculina elongata Natland

(Pl. I, fig. 9)

Q. elongata Natland, 1938, vol.4, no.5, p.141, pl.4, fig.5.

Q. elongata (Natland) Matoba, 1970, pl.2, figs.8a-b. - Rao, 1998, pp. 84-85, pl.13, figs.2-3.

Hypotype: Length - 1.30 mm Breadth - 0.30 mm

Remarks: Only at Devipattinam station.

Repository of Type Material: IES, TU, Cat. No. MSG.9.

Quinqueloculina bosciana d'Orbigny var.
malayensis Rasheed

(Pl. I, fig. 10)

Quinqueloculina bosciana d'Orbigny var. *malayensis* nov. var. - Rasheed, 1968, v.37-38, p.65, pl.6, figs.3 a-c.

Hypotype: Length - 0.45 mm Breadth - 0.28 mm

Remarks: This species is similar to Rasheed's (1968) specimens. Rare species, occurs in Devipattinam station.

Repository of Type Material: IES, TU, Cat. No.MSG.10.

Quinqueloculina granulocostata Germeraad

(Pl. I, fig. 11)

Quinqueloculina granulocostata Germeraad, 1946, p.63, pl.7, fig.11, pl.8, fig.11. - Yassini and Jones, 1995, p.84, fig.155. - Germeraad, Rasheed, 1968, v.37-38, p.64, pl.3, figs.3a-c. - Haig, 1988, p.233, pl.6, figs.8-10.

Hypotype: Length - 0.55 mm Breadth - 0.35 mm

Remarks: Rare species occurs in Mandapam and Devipattinam stations. This species has been recorded from the inner and middle shelf of the southeast Australian coast (Yassini and Jones, 1995).

Repository of Type Material: IES, TU, Cat. No.MSG.11.

Quinqueloculina intricata Terquem

(Pl. I, fig. 12)

Quinqueloculina intricata Terquem, 1876, p.73, figs.16-21, tab.13. - Boltovskoy, 1954, p. 201, pl.21, figs.1a-b. - Barker, 1960, p.12, pl.6, figs.11-12. - Khare, 1992, pp.70-71, pl.3, figs.6a-c.

Miliolina bicernis (Walkar and Jacob), Brady, 1884, p.171, figs.11-12, tab.6.

Hypotype: Length - 0.50 mm Breadth - 0.30 mm

Remarks: Rare species. At Sethubavachattiram, obtained to the tune of 0.65 % out of total fauna.

Repository of Type Material : IES, TU, Cat. No. MSG.12.

Quinqueloculina poeyana d'Orbigny

(Pl. I, fig. 13)

Quinqueloculina poeyana d'Orbigny, 1839, p.191, pl.11, figs.25-27. - Sengupta and Schafer, 1973, p.360, pl.1, fig.7. - Haig, 1988, p.234, pl.7, figs.18-20. - Debenay, 1990, p. 255, pl. 2, fig. 6. - Yassini and Jones, 1995, p. 84, fig.158, 160, 163.

Hypotype: Length - 0.35 mm Breadth - 0.24 mm

Remarks: Occurs only at Mandapam station. It is most probably the first report of *Q. poeyana* from off the east coast.

Repository of Type Material: IES, TU, Cat. No.MSG.13.

Quinqueloculina rhodiensis Parker

(Pl. I, fig. 14)

Quinqueloculina rhodiensis Parker. Matoba, 1970, pl.2, figs.11a-b.

Hypotype: Length - 0.30 mm Breadth - 0.20 mm

Remarks: Found at Mandapam and Kottaipattinam stations. It is similar to the species of Matoba (1970).

Repository of Type Material: IES, TU, Cat. No.MSG.14.

Quinqueloculina sidebottomi (Rasheed)

(Pl. I, fig. 15)

Triloculina litorils Collins, 1958, p.369, pl.3, fig.12.

Triloculina sidebottomi Rasheed, 1971, p.38,39, pl.6, fig.4.

Quinqueloculina sidebottomi (Rasheed), Haig, 1988, p.234, pl.8, figs.10-14.

Hypotype: Length - 0.30 mm Breadth - 0.15 mm

Remarks: Rarely occurring at Mandapam and Devipattinam.

Repository of Type Material: IES, TU, Cat. No.MSG.15.

Quinqueloculina transversistriata Brady

(Pl. I, fig. 16-17)

Quinqueloculina transversistriata Brady, 1881, pl.8, figs. 22-24.

Miliolina transversistriata Brady, 1881, p.45, pl.4, fig.6.

Quinqueloculina transversistriata (Brady), Haig, 1988, p. 229, pl.8, figs.22-25.

Hypotype : Length - 0.20 mm Breadth - 0.14 mm

Remarks: Very rare only at Mandapam. So far it has not been recorded in the east coast of India. The striations are the typical characteristics of this species. This specimen is similar to the ones from Papuan lagoon, New Guinea, Haig (1988).

Repository of Type Material: IES, TU, Cat. No.MSG.16.

Quinqueloculina tropicalis Cushman

(Pl. I, fig. 18)

Miliolina gracilis (d'Orbigny). Brady, 1884, pl.5, fig.2.

Quinqueloculina tropicalis Cushman, 1924, p.63. - Bhatia and Bhalla, 1959, p. 78, pl. 1, figs. 2a-b. - Bhalla, 1968, p. 381, pl.1, figs. 4a-b. - Khare, 1992, p. 79-80, pl. 5, figs. 5a-b. - Rao, 1998, pp. 91-92, pl.15, fig.2. Carneg Inst. Wasington publ. 342, p. 63, pl. 23, figs. 9-10: pl. 9, fig. 6. - Yassini and Jones, 1995, p.85, figs. 170-171, 174-175.

Hypotype: Length - 0.28 mm Breadth - 0.26 mm

Remarks: Brady (1884) reported it from off Papua in the Pacific at a depth of 108 m. In Palk Strait, except Manalmelkudi it is found in all the stations.

Repository of Type Material: IES, TU, Cat. No.MSG.17.

Genus *Massilina* Schlumberger, 1893

Massilina secans tropicalis Collins

(Pl. I, fig. 19)

Massilina secans (d'Orbigny), Heron- Allen and Earland, 1915, p.582, pl.44, figs.24-27.

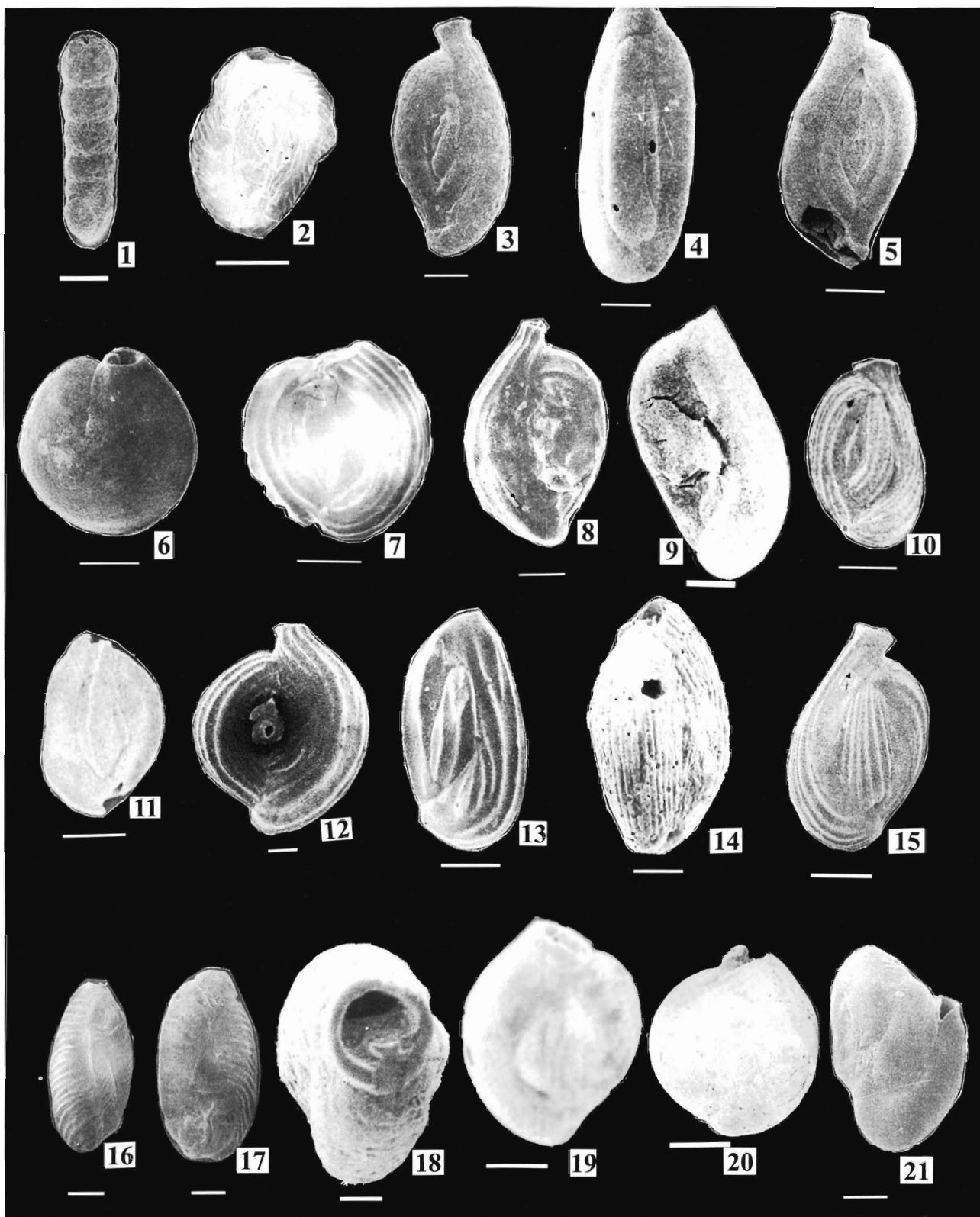
Massilina secans (d'Orbigny) var. *tropicalis* Collins, 1958, p.362, pl.2, figs.10a-c.

Hypotype: Length - 0.28 mm Breadth - 0.26 mm

Remarks: This species has wide geographical distribution and having been reported from the

EXPLANATION OF PLATE I

1. <i>Textularia porrecta</i> (Brady)	15KvX150	11. <i>Quinqueloculina granulocostata</i> Germeraad	10KvX200
2. <i>Spiroloculina antillarum</i> d'Orbigny	10KvX50	12. <i>Quinqueloculina intricata</i> Terquem	10KvX200
3. <i>Spiroloquolina henbesti</i> Petri	10KvX150	13. <i>Quinqueloculina poeyana</i> d'Orbigny	10KvX200
4. <i>Spiroloculina indica</i> Cushman and Todd	10KvX100	14. <i>Quinqueloculina rhodiensis</i> Parker	10KvX150
5. <i>Spiroloculina nitida</i> d'Orbigny	10KvX150	15. <i>Quinqueloculina sidebottomi</i> (Rasheed)	10KvX200
6. <i>Adelosina leavigata</i> d'Orbigny	15KvX200	16.17. <i>Quinqueloculina transversistriata</i> Brady	15KvX150, 15KvX200
7. <i>Quinqueloculina costata</i> d'Orbigny	10KvX200		
8. <i>Quinqueloculina elegans</i> d'Orbigny	10KvX150	18. <i>Quinqueloculina tropicalis</i> Cushman	15KvX350
9. <i>Quinqueloculina elongata</i> Natland	15KvX200	19. <i>Massilina secans tropicalis</i> Collins	10KvX100
10. <i>Quinqueloculina bosciiana</i> d'Orbigny	10KvX200	20. <i>Miliolinella australis</i> (Parr)	10KvX150
var. <i>malayensis</i> Rasheed	10KvX200	21. <i>Miliolinella perplexa</i> McCulloch	15KvX150



African coast to New south Wales (Albani, 1968).

Repository of Type Material : IES, TU, Cat. No. MSG.18.

Subfamily Miliolinellinae Vella, 1957

Genus Miliolinella Wiesner, 1931

Miliolinella australis (Parr)

(Pl. I, fig. 20)

Quinqueloculina australis Parr, 1932, pl.1, fig.8.

Miliolinella australis (Parr), Barker, 1960, pl.5, figs.10-11. - Nigam, 1982, p.97, pl.4, fig.1. - Khare, 1992, p.84, pl.6, figs.5a-c. - Henriques, 1993, p.57, pl.5, figs.2a-b. - Mayankar, 1994, p.70, pl.5, figs.1a-b. - Rao, 1998, p.95, pl.16, fig.5.

Hypotype: Length - 0.22 mm Breadth - 0.16 mm

Remarks: Rare species, it occurs only at Thondi and Sethubavachattiram stations. Brady (1884) recorded this species (as *M. subrotunda*) from the Pacific at depths between 70 and 73 m.

Repository of Type Material: IES, TU, Cat. No.MSG.19.

Miliolinella perplexa McCulloch

(Pl. I, fig. 21)

Pippinoides perplexa McCulloch, 1977, p.571.

Miliolina perplexa Loeblich and Tappan, 1988, p.340, pl.350, figs.13-15. - Rao, 1998, p.97, pl.17, fig.1.

Hypotype: Length - 0.32 mm Breadth - 0.42 mm

Remarks: It is a rare one, seen only in Thondi station. McCulloch (1977) considered *Pippinoides perplexa* as the type species for the genus *Pippinoides*, based on specimens from the outer Gorda Bank off Mexico in the east Pacific.

Repository of type material : IES, TU, Cat. No. MSG.20.

Miliolinella pyrgoformis Yassini & Jones

(Pl. II, figs. 1-2)

Miliolinella pyrgoformis Yassini and Jones, 1995, p.88, figs.240,243.

Hypotype: Length - 0.10 mm Breadth - 0.08 mm

Remarks: In this species the test is ovoid with inflated chambers, with a well rounded periphery. Its aperture is very narrow. It has a long opening at the end of the last chamber with a very narrow upper lip and very broad ventral flap. This species occurs

in all the stations, except Manalmelkudi.

Repository of Type Material: IES, TU, Cat. No.MSG.21.

Suborder Lagenina Delage & Herouard, 1896

Superfamily Nodosariacea Ehrenberg, 1838

Family Lagenidae Reuss, 1862

Genus Lagena Walker & Jacob, 1798

Lagena perlucida (Montagu)

(Pl. II, fig. 3)

Vermiculum perlucidum Montagu, 1803, p.525, pl.14, fig.3.

Lagena perlucida (Montagu) Cushman and Mocolloch, 1959, p.347, pl.46, figs.19-26. - Ganapati and Satyavati, 1958, p.108, pl.3, fig.74. - Sethulakshimi Amma, 1968, pp.55-56, pl.3, fig.22. - Rao, 1971b, p.158, fig.25. - Seibold, 1975, p.183, pl.1, fig.5. - Khare, 1992, p.98, pl.8, fig.12. - Rao, 1998, p.128, pl.25, fig.1.

Hypotype: Length - 1.16 mm Breadth - 0.10 mm

Remarks: Rare species, occurs in four stations. Flask shape with elongated neck is the characteristic feature of this species.

Repository of Type Material: IES, TU, Cat. No.MSG.22

Suborder Rotaliina Delage and Herouard, 1896

Superfamily Bolivinacea Glaessner, 1937

Family Bolivinidae Glaessner, 1937

Genus Bolivina d'Orbigny, 1839

Bolivina durandi Millett

(Pl. II, fig. 4)

Bolivina durandi Millett, 1900, p.544, pl.4, figs.7a-b. - Seibold, 1975, p.184, pl.1, fig.15. - Khare, 1992, pp.120-121, pl.11, figs.3a-b. - Henriques, 1993, p.100, pl.12, figs.3a-b. - Mayankar, 1994, p.110, pl.12, figs.3a-b.

Hypotype: Length - 0.22 mm Breadth - 0.11 mm

Remarks: Rare species, found in only one station (Kodiyakkarai).

Repository of Type Material: IES, TU, Cat. No.MSG.23.

Bolivina lobata Brady

(Pl. II, fig. 5)

Bolivina lobata Brady 1884, p. 425, pl. 53, figs. 22-23. - Rao and Rao,

1974, p. 416, pl. 2, fig. 2.- Seibold, 1975, p.186, pl.1, fig.18. - Khare, 1992, pp. 122-123, pl. 11, fig. 6.

Loxostomum lobatum (Brady), Sethulakshmi Amma, 1958, p. 47, pl. 2, fig.7. - Jayaraju, 1993, p. 131, pl. 5, fig. 15.

Patellina jugosa (Brady), Antony, 1968. p. 48, pl. 7, fig. 6.

Hypotype: Length - 0.20 mm Breadth - 0.10 mm

Remarks: This species seems to be very close to *Rectobolivina fimbriata* (Millet) (Hofker, 1951, p.91, figs.51a-h).

Repository of Type Material: IES, TU, Cat. No.MSG.24.

Bolivina ordinaria Phleger & Parker

(Pl. II, fig. 6)

Bolivina ordinaria Phleger and Parker, 1951, p.14, pl. 2, fig. 3. - Khare, 1992, p.123-124, pl.11, figs.7a-c.

Hypotype: Length - 0.18 mm Breadth - 0.10 mm

Remarks: Rare species, occurring in Attankarai and Kodyakkarai stations only. Repository of type material : IES, TU, Cat. No.MSG.25.

Bolivina spathulata (Williamson)

(Pl. II, fig. 7)

Textularia variables var. *spathulata* Williamson, 1858, p.76, figs.164-165, pl. 6.

Bolivina spathulata (Williamson) Cushman, 1937, p. 162, figs.20-24, tab.15. - Khare, 1992, p.125, pl. 11, fig. 9. - Mayankar, 1994, p.113, pl.12, fig.7.

Hypotype : Length - 0.30 mm Breadth - 0.12 mm

Remarks: Rare species occurring only at Kodyakkarai station.

Repository of Type Material : IES, TU, Cat. No. MSG.26.

Superfamily **Buliminacea** Jones, 1875

Family **Loxostomidea** Loeblich & Tappan, 1964

Genus **Loxostomina** Sellier de Cirvieux, 1969

Loxostomina limbata (Brady)

(Pl. II, fig. 8)

Bolivina limbata var *costulata* Cushman, 1922, p. 26, pl. 3, fig. 8.

Loxostma limbatum (Brady) var *costulatum* Cushman, 1937, p.187, pl.21, figs.30-31. - Rasheed, 1969-70c, p. 184, pl. 6, figs. 23-24.

Loxostomum limbatum Brady, Rocha and Ubaldo, 1964a, p. 414, pl. 2, fig. 9.

Hypotype: Length - 0.80 mm Breadth - 0.20 mm

Remarks: The only difference between this variety and *L.limbatum* (Brady) is that the former is ornamented with a few longitudinal costae which run parallel to the periphery. The same species was reported by Khare (1992) in the west coast of India, and by Rao (1998) off Karikattukkuppam near Madras.

Repository of Type Material: IES, TU, Cat. No. MSG.27.

Family **Siphogenerinoididae** Saidova, 1981

Subfamily **Tubulogenerininae** Saidova, 1981

Genus **Siphovigerina** Schlemberger, 1882

Siphovigerina virgula (Brady)

(Pl. II, fig. 9)

Sagrina virgula Brady, 1879, p. 275, pl. 8, figs. 20-21.

Siphovigerina virgula (Brady), Hofker, 1951, p. 93, figs.52a-b. - Sethulakshmi Amma, 1958, p. 51, pl. 2, fig. 77. - Antony, 1968, p. 81, pl. 5, fig. 14. - Seibold, 1975, p.189, pl. 2, figs. 2a-b. Khare, 1992, p.131, pl.12, fig.7. - Henriques, 1993, p.113, pl.15. figs.7a-b. - Mayankar, 1994, p. 124, pl. 13, figs.11a-b. - Rao, 1998, pp. 177-178, pl. 43, figs. 7-10.

Hypotype: Length - 0.36 mm Breadth - 0.04 mm

Remarks: Small-sized test, uniserially arranged chambers with rounded neck at the apertural are he characteristic features of this species. Same species was reported by Nigam and Khare (1994) in the west coast of India. It occurs only at Attankarai and Kodyakkarai stations.

Repository of Type Material: IES, TU, Cat. No.MSG.28

Genus **Hopkinsinella** Bermúdez & Fuenmayor, 1966

Hopkinsinella glabra (Millet)

(Pl. II, fig. 10)

Uvigerina auberiana d'Orbigny var. *glabra* Millett, 1903, p. 268, pl. 5, figs. 8-9.

Uvigerina glabra (Millet), Matoba, 1970, p. 63, pl. 3, figs. 35a-b.

Hopkinsina glabra (Millet), Lutze, 1974, p.22, p.22, pl.6, fig.107. - Seibold, 1975, p.188, pl. 3, fig.1.

Hopkinsinella glabra (Millet), Khare, 1992, pp.130-131, pl.12, fig.5.- Mayankar, 1994, p.123, pl.13, fig.9. - Rao, 1998, p.172, pl.41, figs.11-12.

Hypotype: Length - 1.10 mm Breadth - 0.16 mm

Remarks: It is found only at Mandapam Station. The test is covered by tiny tubercles which are irregularly distributed, but often arranged in fine striations which cannot be seen with smaller magnifications.

Repository of Type Material: IES, TU, Cat. No.MSG.29.

Family *Reussellidae* Cushman, 1933

Genus *Reussella* Galloway, 1933

Reussella simplex (Reuss)

(Pl. II, fig. 11)

Reussella simplex (Reuss), Cushman, 1942, p. 40, pl. 11, figs. 5-8. - Sethulakshmi Amma, 1958, p. 48, pl. 2, fig.73. - Antony, 1968, p. 83, pl. 5, fig.16. - Rao *et al.*, 1987, p.167, pl. 4, fig. 21.

Trimosina simplex Cushman, 1929, p. 158, figs. 2a-b.

Reussella simplex (Cushman) Seibold, 1975, p.187, pl.4, figs. 6a-c. - Khare, 1992, pl.141, p.13, fig.4. - Henriques, 1993, p.123, pl.17, figs.4a-c. - Mayankar, 1994, p.134, pl. 15, fig. 8.

Hypotype : Length - 0.28 mm Breadth - 0.14 mm

Remarks: Rare species, occurs in extreme stations Mandapam in the south and Kodiyakkarai in the north.

Repository of Type Material: IES, TU, Cat. No.MSG.30.

Superfamily *Discorbacea* Ehrenberg, 1838

Family *Bagginidae* Cushman, 1927

Subfamily *Baggininae* Cushman, 1927

Genus *Cancris* de Montfort, 1808

Cancris auricula (Fichtel & Moll)

(Pl. II, fig. 12)

Nautilis auricula Fichtel and Moll, 1978, p. 108, 110, pl. 20, fig. a-f.

Cancris auricula (Fichtel and Moll), Leroy, 1941, p.117, pl. 3, figs.7-9. - Antony, 1968, pp. 97-98, pl. 7, figs. 5a-b. - Zobel, 1973, p.16, pl.1. figs. 18-20.-Setty and Nigam, 1984, p. 434, pl.33, fig.22. - Shareef and Venkatachalapathy, 1988, p.435, pl.3, figs.9a-b.

Cancris auricula (Fichtel and Moll, 1798), Cushman, 1927, pl.5, fig. 10. - Bhatia, 1956, p. 23, pl.5, figs.5a-b. - Rao, 1971, p. 161, fig. 52. - Seibold, 1975, p. 190, pl. 4, figs.1a-b. - Bhalla and Nigam, 1979, p.239, pl.1.- Nigam and Theide, 1983, pp.148-149, pl.13, figs.10a-b. - Mayankar, 1994, p.138, pl.15. - Rao, 1998, p.192, pl.47, figs.5-6.

Hypotype : Length - 0.40 mm Breadth - 0.24 mm

Remarks : The same species has also been reported as *C.oblonga* by several workers as reported by Murray (1971). Occurs in Mandapam station only.

Repository of Type Material : IES, TU, Cat. No.MSG.31.

Superfamily *Glabratellacea* Loeblich & Tappan, 1964

Family *Glabratellidae* Loeblich & Tappan, 1964

Genus *Glabratella* Dorreen, 1948

Glabratella patelliformis (Brady)

(Pl. II, figs. 13-14)

Glabratella patelliformis Brady, 1884, p.647, pl.88, figs.3a-c. pl.89, figs.1a-c.

Discorbis patelliformis (Brady), Cushman *et al.*, 1954, p. 359, pl. 89, fig.7. - Sethulakshmi Amma, 1958, p. 65, pl. 3, figs. 99a-b.

Neoconorbina patelliformis (Brady), Todd, 1965, p.15, pl.1, fig.7.

Glabratella cf. *G. patelliformis* (Brady), Matoba, 1970, p.54, pl.5, figs.3a-c. - Shareef and Venkatachalapathy, 1988, p. 435, pl. 3, figs.11a-b.

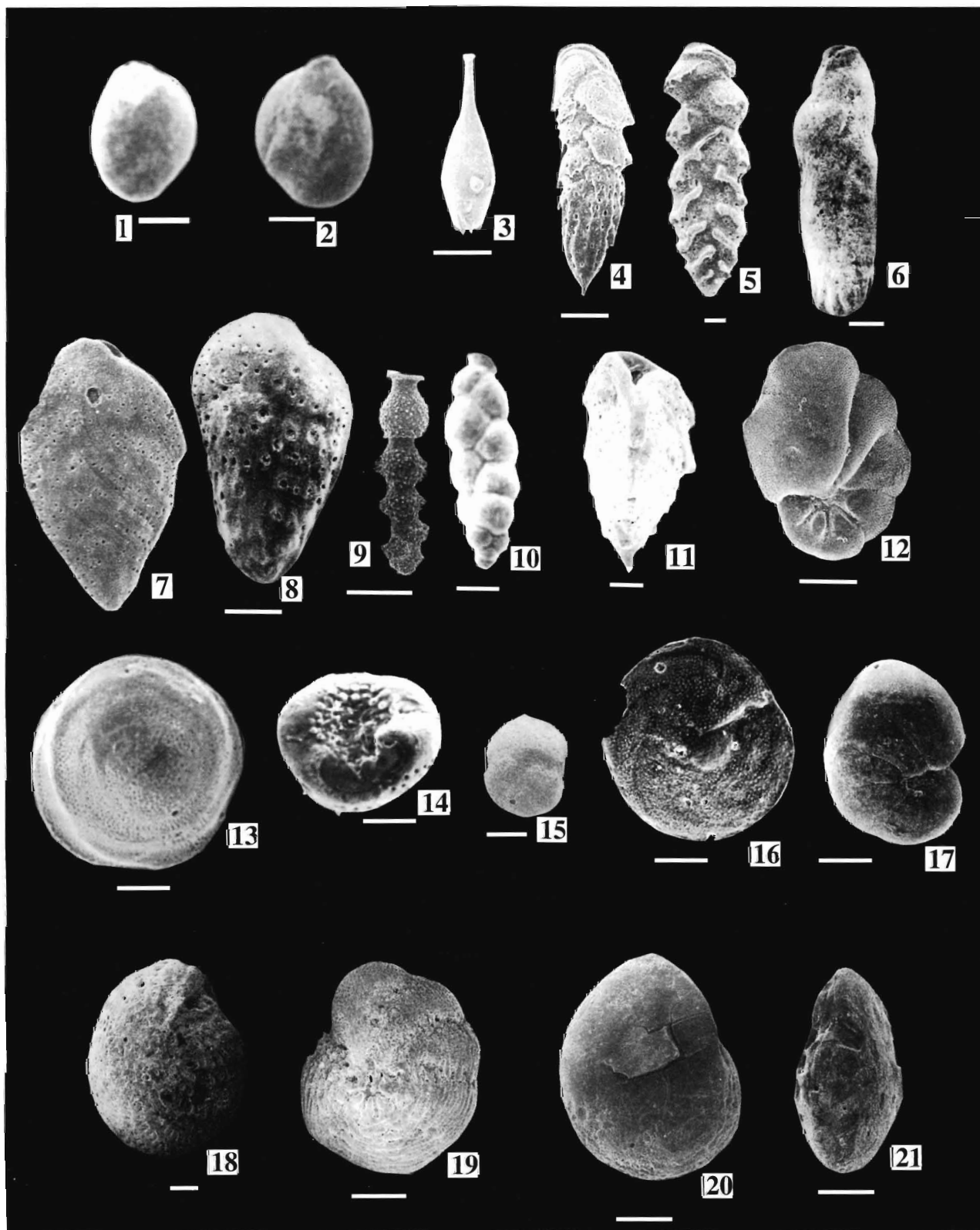
Glabratella. sp Bhalla, 1970, p.157, pl.20, figs.7a-b. - Bhalla and Gaur, 1987, p.124, pl.2, figs.4a-b. - Khare, 1992, p.153, pl.14, figs.6a-c.

Hypotype: Length - 0.40 mm Breadth - 0.24 mm

Remarks: Bhalla (1970) and Bhalla and Gaur

EXPLANATION OF PLATE II

1,2. <i>Miliolinella pyrgoformis</i> Yassini and Jones	15K v X 200, 15K v X 200	11. <i>Reussella simplex</i> (Reuss)	10K v X 200
3. <i>Lagena perlucida</i> (Montagu)	10K v X 200	12. <i>Cancris auricula</i> (Fichtel and Moll)	15K v X 200
4. <i>Bolivina durandi</i> Millett	15K v X 350	13,14. <i>Glabratella patelliformis</i> (Brady)	15K v X 500, 15K v X 150
5. <i>Bolivina lobata</i> Brady	10K v X 200	15. <i>Discorbinella bartheloti</i> (d'Orbigny)	15K v X 150
6. <i>Bolivina ordinaria</i> Phleger and Parker	10K v X 350	16. <i>Amphistegina radiata</i> (Fichtel and Moll)	10K v X 350
7. <i>Bolivina spathulata</i> (Williamson)	10K v X 350	17. <i>Nonion elongatum</i> (d'Orbigny)	10K v X 200
8. <i>Loxostomina limbata</i> (Brady)	10K v X 200	18. <i>Elphidium craticulatum</i> (Fichtel and Moll)	10K v X 100
9. <i>Siphouvigerina virgula</i> (Brady)	15K v X 200	19. <i>Parrallina hispidula</i> (Cushman)	10K v X 100
10. <i>Hopkinsinella glabra</i> (Millett)	10K v X 350	20,21. <i>Assilina ammonoides</i> (Gronovius)	15K v X 200, 15K v X 200



(1987) reported similar specimens as *Glabratella* sp. Our specimens are similar to Khare (1992) west coast of India. Found only at Devipattinam.

Repository of Type Material: IES, TU, Cat. No. MSG.32.

Superfamily Discorbinellacea Sigal, 1952

Family Discorbinellidae Sigal, 1952

Subfamily Discorbinellinae Sigal, 1952

Genus Discorbinella Cushman & Martin, 1935

Discorbinella bertheloti (d'Orbigny)

(Pl. II, fig. 15)

Rosalina bertheloti d'Orbigny, 1839, p.135, pl.1, figs.28-30.

Discorbinella bertheloti (d'Orbigny), Brady, 1884, p. 469, pl. 48, fig.10. - Rao, 1970b, p. 172, figs.66a-b.

Discorbinella bertheloti (d'Orbigny), Loeblich and Tappan, 1988, p.577, pl.630, figs. 4-6. - Mayankar, 1994, p. 143, l.17, figs. 3a-b. - Rao, 1998, p.102, pl.50, figs. 6-7.

Hypotype: Diameter 0.26 mm

Remarks: Rare species, the spiral side is convex nearly involute. Last-formed chamber is irregular and large.

Repository of Type Material: IES, TU, Cat. No. MSG.33.

Superfamily Asterigerinacea d'Orbigny, 1839

Family Amphisteginidae Cushman, 1927

Genus Amphistegina d'Orbigny, 1826

Amphistegina radiata (Fichtel & Moll)

(Pl. II, fig. 16)

Nautilus radiatus Fichtel and Moll, 1798, p. 58, pl. 8, figs. 9 b-d.

Amphistegina radiata (Fichtel and Moll), Chapman, 1895, p. 45, pl. 1, figs. 8-10. - Rocha and Ubaldo, 1964a, p. 417, pl. 4, figs. 1a-b. - Rao *et al.*, 1987, p. 170, pl. 7, fig. 9. Bhalla and Gaur, 1987, p. 125, figs. 8a-b. - Khare, 1992, p. 159, pl.15, fig.6. - Mayankar, 1994, p. 148, pl. 18, fig. 5. - Rao, 1998, pp. 207-208, pl. 52, fig. 2.

Hypotype: Length - 0.20 mm Breadth - 0.08 mm

Remarks: In comparison with Rasheed's (1969-1970c) from the Coral sea, I have found my specimen are in close similarity to them.

Repository of Type Material: IES, TU, Cat. No. MSG.34.

Superfamily Nonionacea Schultze, 1854

Family Nonionidae Schultze, 1854

Subfamily Nonioninae Schultze, 1854

Genus Nonion de Montfort, 1808

Nonion elongatum (d'Orbigny)

(Pl. II, fig. 17)

Nonion elongata d'Orbigny, 1826, p. 294.

Nonion elongatum (d'Orbigny), Cushman, 1939, p. 11, pl. 3, figs. 4-6. - Setty and Nigam, 1984, p. 434, pl. 33, fig. 21; 1985, p. 286. - Nigam, 1986, p. 424, tab.1. - Khare, 1992, p. 164, pl. 15, fig.10. - Nigam *et al.*, 1992b, p. 536, pl. 1. - Mayankar, 1994, p.152, pl. 20, figs.1a-b.

Florilus elongatus (d'Orbigny), Bhalla and Gaur, 1987, p. 125, pl. 1, fig.18.

Hypotype: Length - 0.18 mm Breadth - 0.06 mm

Remarks: Rare species, occurs only in two stations namely Mandapam and Kodyakkarai. Rao (1998) reported this species as *Nonionoides elongatum* at off Karikkattukuppam near Madras.

Repository of Type Material : IES, TU, Cat. No. MSG.35.

Family Elphididae Galloway, 1933

Subfamily Elphidiinae Galloway, 1933

Genus Elphidium de Montfort, 1808

Elphidium craticulatum (Fichtel & Moll)

(Pl. II, fig. 18)

Nautilus craticulus Fichtel and Moll, 1798, p. 51, pl.4, figs.h-k.

Elphidium craticulatum (Fichtel and Moll), Cushman, 1933b, p. 48, pl. 11, figs.5a-b. - Bhatia, 1956, p. 20, pl. 5, fig.10. - Ganapati and Satyavati, 1958, p. 108, pl. 3, figs. 87-88. - Rocha and Ubaldo, 1964a, p. 416, pl. 3, fig. 7; 1964b, p. 647, pl.1, fig. 3. - Antony, 1968, p. 61, pl. 4, fig.3. - Rao *et al.*, 1987, p. 169, pl. 6, figs. 3-4. - Khare, 1992, p.187, pl. 17, fig. 7. - Henriques, 1993, p.155, pl. 22, figs. 12. - Mayankar, 1994, p. 164, pl. 21, figs. 6. - Rao, 1998, p. 227, pl. 58, figs. 7-8.

Hypotype: Diameter 0.63 mm

Remarks: It is a typical Indo-Pacific species. Found in Mandapam, Attankarai and Thondi stations.

Repository of Type Material: IES, TU, Cat. No. MSG.36.

Subfamily Notorotaliinae, Hornibrook, 1961

Genus Parrellina Thalmann, 1951

Parrellina hispidula (Cushman)

(Pl. II, fig. 19)

Elphidium hispidulum Cushman, 1936, p.83. pl.14, fig 13 a-b

Parrellina hispidula (Cushman), Hotinger and Leutengger, 1980, pl.8, fig. 7-9.

Hypotype: Diameter 0.42 mm

Remarks: This species originally recorded from the Australian and Indonesian region.

Repository of Type Material: IES, TU, Cat. No. MSG.37.

Superfamily **Nummulitacea** de Blainville, 1827

Family **Nummulitidae** de Blainville, 1827

Genus **Assilina** d'Orbigny, 1839

Assilina ammonoides (Gronovius)

(Pl. II, figs. 20-21)

Nautilus ammonoides Gronovius, 1781, p. 282, pl. 19, figs. 5-6.

Operculina ammonoides (Gronovius), Carpenter *et al.*, 1862, p. 318. - Antony, 1968, p. 65, p. 14, fig. 8. - Setty and Nigam, 1984, p. 434, pl. 33, figs. 1-2, 4-8.

Nummulites ammonoides (Gronovius) - Khare, 1992, pp. 196-197, pl. 19, fig.6.

Hypotype: Diameter 0.38 mm

Remarks: This species is similar to Rao (1998) off Karikattukupam. Found in Mandapam and Devipattinam stations.

Repository of Type Material: IES, TU, Cat. No. MSG.38

SUMMARY

For the first time, a foraminiferal study has been undertaken in the offshore region of Palk Strait. The study of 42 samples highlights the presence of a cosmopolitan fauna of foraminifera. One hundred two benthic species (table 2) belonging to 38 families, 52 genera were identified from the 42 sediment samples. A comparison of the identified species with inventories made by earlier workers from this region reveals the presence of an additional 38 species, hitherto unknown, in this area. Out of these, six following taxa are recorded for the first time from the east coast of India: *Textularia porrecta*, *Quinqueloculina boschiana* var. *malayensis*, *Q. poeyana*, *Q. sidebottami*, *Q. transversestriata*, *Massilina secans tropicalis*. Species richness in the samples from the stations Mandapam, Attankarai and Devipattinam closest to the Gulf of Mannar is higher than at the other stations which are more remote from

the Mannar Gulf.

ACKNOWLEDGEMENTS

The authors are grateful to Dr.A.R.Gujar, Scientist, GOD, NIO, Goa, Dr. N.Khare, Antarctica Study Centre, Vasco, Goa, Mr.Subodh Kumar Chatruvedi and other scholars, NIO, Goa for their help in microscopic studies. Dr.A.S.R. Swamy and Dr.Yeruku Naidu, Dept. of Geology, Andhra University for taking SEM photographs. The help rendered by Dr.V. Kumar, Dept. of Geology, National College, Trichy, Dr.N. Rajeswara Rao, Dr.S.D.G. Sridhar, and Dr. Sk. Md. Hussain, Dept. of Geology, Madras University is gratefully acknowledged. Dr. N. Angusamy, Dr. P.M. Mohan and all other staff members of Dept. of Earth Sciences, Tamil University are thanked for their help in preparing this manuscript. Our thanks are due to Ms. R. Sivagama Sundari for typing this manuscript. The authors have immensely benefited from the helpful comments of Prof. L. Hottinger, Natural History Museum, Basel.

REFERENCES

- Albani, A.D. 1968. Recent foraminifera from Port Hacking, New Southwales. *Contrib. Cushman Found. Foramin. Res.* **19** : 85-119.
- Antony, A. 1968. Studies of the shelf water foraminifera of the Kerala coast. *Bull. Dept. Mar. Biol. Oceano. Univ. Kerala*, **4** : 11-154.
- Barker, R.W. 1960. *Taxonomic notes on the species figured by H.B.Brady in his report on the foraminifera dredged by HMS 'Challenger' during the year 1873-1876*. Soc. Econ. Paleont. Miner, Spec. Publ.
- Bhalla, S.N. 1968. Recent foraminifera from Visakhapatnam beach sands and its relation to the known foraminiferal provinces in the Indian ocean. *Bull. Nat. Inst. Sci. India*, **376-392**.
- Bhalla, S.N. 1970. Foraminifera from Marina beach sands of Madras and faunal provinces of the Indian ocean. *Contrib. Cushman Found. Foramin. Res.* **21** : 156-163.
- Bhalla, S.N. and Gaur, K.N. 1987. Recent foraminifera from Colva beach sands, Goa. *Jour. Pal. Soc. India*, **32** : 122-130.
- Bhalla, S.N. and Nigam, R. 1979. A note on Recent foraminifera from Calangute beach sands, Goa. *Bull. Ind. Geol. Assn.* **12(2)** : 239-240.
- Bhatia, S.B. 1956. Recent foraminifera from the shore sands of western India. *Contrib. Cushman Found. Foramin. Res.* **7** : 15-24.
- Bhatia, S.B. and Bhalla, S.N. 1959. Recent foraminifera from the beach sands at Puri, Orissa. *Jour. Pal. Soc. India*, **4**:78-81.
- Boltovskoy, E. 1954. Foraminiferos de la Bahia San Blas. *Revista del Instituto Nacional de Investigacion de las Ciencias Naturales. <Bernardino Rivadavia> (Sea Geologicas)*, **3** : 247-300.
- Brady, H.B. 1879. Notes on some Reticularian Rhizopoda of the 'Challenger' expedition. Part II. Additions to the knowledge of porcellanous and hyaline types. *Quart. Jour. Micro. Sci. (New Ser.)*

- 19 : 261-299.
- Brady, H.B.** 1884. Report of the foraminifera dredged by HMS Challenger during the years 1873-1876. Rept. Scientific results Explor. Voyage HMS Challenger. *Zoology*, **9** : 1-814.
- Carpenter, W.B. Parker, W. and Jones, T.** 1862. *Introduction to the study of the foraminifera*. Royal Society, London.
- Chapman, F.** 1895. On some foraminifera obtained by the Royal Indian Survey Ship SS 'Investigator' from the Arabian Sea. *Proc. Zoo. Soc. London*, 1-55.
- Collins, A.C.** 1958. Foraminifera. Great Barrier Reef Expedition (1928-29). *Scientific Report*, **6** : 335-437.
- Cushman, J.A.** 1922. Foraminifera of the Atlantic Ocean, part 3, Textulariidae. *Bull. US Nat. Mus.* **104** : 1-143.
- Cushman, J.A.** 1924. A new genus of Eocene foraminifera. *U.S. Nat. Mus. Proc.* **66** : 1-4.
- Cushman, J.A.** 1927. An outline of a re-classification of the foraminifera. *Contri. Cush. Lab. Foram. Res.* **3** : 1-105.
- Cushman, J.A.** 1929. The genus Trimosina and its relationship to other genera of the foraminifera. *Jour. Washington Acad. Sci.* **19** : 115-159.
- Cushman, J.A.** 1933. The foraminifera of the tropical pacific collections of the 'Albatross' (1899-1900). *U.S. Nat. Mus., Bull.* **161** : 1-79.
- Cushman, J.A.** 1936. Some new species of *Elphidium* and related genera. *Contri. Cush. Lab. Foram. Res.* **12** : 1-83.
- Cushman, J.A.** 1937. A Monograph of the subfamily virgulinae of the foraminiferal family Buliminidae. *Cush. Lab. Forma. Res. Spl. Publ.* no. **9** : 1-27.
- Cushman, J.A.** 1939. *A monograph of the foraminiferal family Nonionidae*. U.S. Geol. Surv. Prof. Paper No.191.
- Cushman, J.A.** 1942. The foraminifera of tropical pacific collections of the "Albatross" 1899-1900. *U.S. Nat. Mus. Bull.* **161** : (3) 1-67.
- Cushman, J.A. and Todd, R.** 1944. The genus *Spiroloculina* and its species. *Cush Lab. Foram. Res. Spl. Publ.* 1-82.
- Cushman, J.A., Todd, R. and Post, R.J.** 1954. Recent foraminifera of the Marshall Islands-Bikini and Nearby Atolls, Oceanography (Biologic). *U.S. Geol. Surv. Prof. Paper*, **260** : 319-384.
- Daniels, C.H.V.** 1970. Quantitative ökologische Analyse der zeitlichen und räumlichen Verteilung rezenter Foraminiferen im Limski kanal bei Rovinj (nordliche Adria). *Gottinger Arbeiten zur Geologie and Palaontologie*, **8** : 1-109.
- Debenay, J.P.** 1990. Recent foraminifera assemblages and their distribution relative to environmental stress in the paralic environment of West Africa (Cape Trimiris to Ebrie (Lagoon)). *Jour. Foram. Res.* **20** : 267-282.
- d'Orbigny, A.** 1826. Tableau methodique de la classe de cephalopodes. *Ann. Sci. Nat. Paris Ser.* **1-7** : 245-314.
- d'Orbigny, A.** 1839. Foraminifers in Ramon de al Sagara. *Historie Physique politique Nationale Cuba*. French (ed), **8** : 1-124.
- Fichtel, W.E.** 1970. Distribution and ecology of benthonic foraminifera in the sediments of the Andaman Sea. *Contri. Cush. Found. Foram. Res.* **21** : 123-147.
- Frerichs, W.E.** 1970. Distribution and ecology of benthonic foraminifera in the sediments of the Andaman Sea. *Contrib. Cushman Found. Foram. Res.* **21** : 123-147.
- Ganapathy, P.N. and Satyavati, P.** 1958. Report on the foraminifera in bottom sediments in the Bay of Bengal off the east coast of India. *Andhra Univ. Mem. Oceanogr. Ser.* **62** : 100-127.
- Gandhi, M.S. and Rajamanickam, G.V.** 1996. Benthic foraminifera and its relation to sedimentation in Palk Strait. *International Seminar on Quaternary Sea-Level Variation, Shoreline Displacement and Coastal Environment, Abs.*, p.18.
- Gandhi, M.S. and Rajamanickam, G.V.** 1997. Siltation in the Palk Strait — inference by benthic foraminifera. *Fifth Scientific Tamil Conference, Annamalai University, Abs.*, p.18.
- Gandhi, M.S. and Rajamanickam, G.V.** 1998. Nature of sediments and foraminiferal distribution along the Palk Strait, Tamil Nadu, India. *XVI Indian Coll. Micropal. Strati., NIO, Goa. Abs.* p.27.
- Germeraad, J.H.** 1946. Geology of Central Seran, p. 1-135. In : *Geological, Petrological and Paleontological results of Explorations carried out from September, 1917 till June 1919 in the Island of Ceram.* (Rutten, L. and Hotz., W.).
- Gronovius** 1781. Zoophylzcelii Gronoviani - Leyden theodorus. *Haak. Et Soc.* 241-380.
- Guptha, M.V.S.N.** 1973. A preliminary report on the foraminiferal assemblages from the lagoon sediment of Karavati Atoll (Laccadives). *Curr. Sci.* **42** : 781-782.
- Haake, F.W.** 1975. Millolinen (Foram.) in Oberflächensedimenten des Persischen Golfes. *"Meteor" Forschungs Ergebnisse (Ser C)*, **21** : 15-51.
- Haig, D.W.** 1988. Miliolid foraminifera from inner-neritic sand and mud facies of the Papuan lagoon, New Guinea. *Jour. Foram. Res.* **18** : 203-236.
- Hamsa, K.M.S.A.** 1973. Foraminifera of the Palk Bay and Gulf of Mannar. *Jour. Mar. Bio. Asso. India*, 418-423.
- Henriques, P.J.** 1993. Distribution of foraminifera in surface sediments off Central (Vengurla- Mangalore) west coast of India and its Paleoenvironmental significance. *Unpublished Ph.D.Thesis, Goa University.*
- Heron-Allen, E. and Earland, A.** 1915. The foraminifera of the Kerimba Archipelago (Portuguese East Africa). *Trans. Zool. Soc. London*, **20** : 543-704.
- Hofker, J.** 1927. Foraminifera of the Siboga Expedition, part 2. Siboga Expeditite. *Mon.* **IV**. (1) : 1-78.
- Hofker, J.** 1930. The foraminifera of the Siboga Expedition. Siboga Expeditite. *Mon.* **IV** : 79-170.
- Hofker, J.** 1932. Idem. III. Die foraminiferen fauna der Ammontatura. *Staz zoologische Napoli, Publ.* **12** : 61-144.
- Hofker, J.** 1951. The foraminifera of the Siboga Expedition. Part 3. (Ser E), Brill, Leiden, **12**: 1-513.
- Hottinger, L. and Leutengger, S.** 1980. The structure of calcareous foraminifera. *Schweiz. Palaeontol. Abhand.* **101** : 115-127.
- Jain, S.P. and Bhatia, S.P.** 1978. Recent benthonic foraminifera from Mandvi, Kutch. *Proc. VII Indian Coll. Micropal. Strati.* 153-174.
- Jayaraju, N.** 1993. Ecosystem and population dynamics of benthic foraminifera from coastal and estuaries sediments of Kovalam-Kanniyakumari-Tuticorin of South India, India. *Unpublished Ph.D. Thesis, S.V.University.*
- Jena, B.K.** 1997. Studies on littoral drift sources and sinks along the Indian Coast. *Unpublished Ph.D. Thesis, Berhampur University.*
- Kaladhar, R., Kamalakaran, S, Varma, K.U. and Bhaskara Rao, V.** 1990. Recent foraminifera from nearshore shelf, south of Visakhapatnam, east coast of India. *Ind. Jour. Mar. Sci.* **19** : 71-73.
- Khare, N.** 1992. A study of foraminifera in surface and subsurface sediments from the shelf region off Karwar and their paleoclimatic significance. *Unpublished Ph.D. Thesis, Goa University.*

- Kumar, V.** 1988. Ecology, Distribution and systematics of Recent Benthic foraminifera from the Palk Bay, off Rameswaram, TN. *Unpublished Ph.D Thesis Bharatidasan University, India.*
- Kumar, V., Manivanan, V. and Ragothaman, V.** 1996. Spatial and temporal variations in foraminiferal abundance and their relation to substrate characteristics in the Palk Bay, off Rameswaram, Tamil Nadu. *Proc. XV Indian Coll. Micropal. Strati.* 393-402.
- Kumar, V., Manivanan, V., and Priya, R.** 1998. Epiphytic foraminifera and its relation to algae in the Palk Bay off Rameswaram. *Proc. XVI Indian Coll. Micropal. Strati. NIO, Goa, Abs.* 74.
- Leroy, L.W.** 1941. Some small foraminifera from the type locality of Bautamien substage, Bodjong Beds, Bentam Residency, West Java, Netherlands, East Indies. *Col. Sch. Min. Quart.* 36 : 107-132.
- Loeblich, A.R. and Tappan, H.** 1964. Sarcodina, Chiefly "Thecamobians and foraminiferids, p. 1-900. In: *Treatise on Invertebrate Palaeontology* (Ed. Moore, R.C.), pt C, Protista 2. *Geol. Soc. Amer. and University of Kansas Press.*
- Loeblich, A.R. and Tappan, H.** 1988. *Foraminiferal genera and their classification.* Von Nostrand Reinhold, New York.
- Lovesson, V.J., Chandrasekar, N. and Rajamanickam, G.V.** 1990. Environmental impact of the micro-delta and swamp along the coast of Palk Bay, Tamilnadu, p. 159-178. In : *Sea Level variation and its Impact on coastal environment* (Ed.G.Victor Rajamanickam), Tamil University, Thanjavur, India.
- Lutze, G.F.** 1974. Benthische Foraminiferen in Oberflachen - Sedimenten des Persischen Golfes. *Teil I: Arte. Meteor. Forschungs Ergebnisse (Reihe C),* 17 : 1-66.
- Matoba, Y.** 1970. Distribution of Recent Shallow Water Foraminifera of Matsushima Bay, Miyagi Prefecture, Northeast Japan. *Science Reports of the Tohoku University, Sendai, (Ser 2),* 42 : 1-85.
- Mayenkar, P.J.** 1994. Distribution of Foraminifera off Mangalore-Cochin sector, West coast of India. *Unpublished Ph.D Thesis, Goa University.*
- McCulloch, I.** 1977 *Qualitative observations on Recent foraminiferal tests with Emphasis on the Eastern Pacific.* University of Southern California, Los Angeles, Parts 1-3.
- Millett, F.W.** 1900. Report on the Recent foraminifera of the Malay Archipelago collected by Durrand, A.. *FRMS. Jour. Roy. Microscop. Soc.* IX : 539-549.
- Millett, F.W.** 1903. Report on the recent foraminifera of the Malay Archipelago collected by Durrand, A.. *FRMS. Jour. Roy. Microscop. Soc.* XIV : 253-275.
- Mohan, P.M., Shephard, K., Angusamy, N., Suresh Gandhi, M. and Rajamanickam, G.V.** 2000. Evolution of Quaternary sediments along the coast between Vedaranyam and Rameshwaram Tamil Nadu. *Jour. Geol. Soc. India.* 56 : 271-283.
- Montagu, 1803.** *Testacez Britannica or natural History of British shells, marine, land and fresh water including the most minute.* J.S.Hollis, England.
- Narappa, K.V., Rao, M.S. and Rao, M.P.** 1981. Living foraminifera from the estuarine complex of the Goutami and Nelarevu distributaries of river Godavari - part I, living populations in relation to ecological factors. *Proc. IX Indian Coll. Micropal. Strati.* 49-68.
- Narappa, K.V., Rao, M.S. and Rao, M.P.** 1982. Comparison of foraminiferal assemblage from Godavari and Krishna river estuaries, *Ind. Jour. Mar. Sci.* II : 220-224.
- Natland, M.L.** 1938. New species of foraminifera from off the west coast of North America and from the later Tertiary of the Los Angeles basin. *Bull. Tehnol. Scripps Institute of Oceanography. (Ser 4) :* 137-164.
- Nigam, R.** 1982. A study of recent foraminifera from the sandy beaches of western India. *Unpublished Ph.D. Thesis, Aligarh Muslim University, Aligarh.*
- Nigam, R.** 1984. Living benthonic foraminifera in a tidal environment. Gulf of Khambhat (India). *Mar. Geol.* 58 : 415-425.
- Nigam, R.** 1986. Foraminiferal assemblages and their use as indicators of sediment movement: A study in the shelf region off Navapur, India. *Cont. Shelf Res.* 5 : 421-430.
- Nigam, R., Hashimi, N.H., Menezes, E.T. and Wagh, A.B.** 1992a. Fluctuating sea levels off Bombay (India) between 14,500 to 10,000 years. before present. *Curr. Sci.* 62 : 309-311.
- Nigam, R., and Khare, N.** 1992. Oceanographic evidences of the great floods on 2000 and 1500 BC documented in archaeological records. p. 517-522. In : *New Trends in Indian Art and Archaeology.* 2 : 517-522.
- Nigam, R. and Khare, N.** 1994. Effect of river discharge of the morphology of benthonic foraminifera test. *Jour. Geol. Soc. India,* 43 : pp.457-463.
- Nigam, R. and Khare, N.** 1995. Recent foraminifera along west coast of India. Retrospect, Prespect and Prospect. *Jour. Indian Acad. Geo. Sci.* 43 : 457-463.
- Petri, S.I.** 1955. Recent foraminifera from Sao Paulo, Brazil. *Contri. Cush. Found. Foram. Res.* 6 (2) :82-86.
- Phelger, F.B. and Parker, F.L.** 1951. Ecology of foraminifera. Northwest Gulf of Mexico: Paleocology and biostratigraphy. *Trans. Gulf Coast Assoc. Geol. Soc.* 22 : 267-287.
- Ragothaman, V.** 1974. The study of foraminifera off Porto Novo, Tamil Nadu State. *Unpublished Ph.D Thesis, University of Madras.*
- Ragothaman, V. and Kumar, V.** 1985. Recent foraminifera off the coast of Rameswaram, Palk Bay, Tamil Nadu. *Bull. Geol. Min. Met. Soc. India.* 97-121.
- Rao, D.C.S. Rao, M.S., Kaladhar, R. and Naidu, T.Y.** 1982. Living foraminifera associated with algae from rock pools near Visakhapatna, east coast of India. *Ind. Jour. Mar. Sci.* II : 212-219.
- Rao, K.K.** 1970a. Foraminifera of the Gulf of Cambay. *Jour. Bombay Nat. Hist. Soc.* 66 : 584-596.
- Rao, K.K.** 1970b. Foraminifera of the Gulf of Cambay. *Jour. Bombay Nat. Hist. Soc.* 67 : 259-273.
- Rao, K.K.** 1971. On some foraminifera from the north eastern part of the Arabian Sea. *Proc. Ind. Acad. Sci. LXXIII, (Sec.B) :* 155-178.
- Rao, K.K.** 1974. Ecology of Mandovi and Zuari Estuaries, Goa. Distribution of foraminiferal assemblages. *Ind. Jour. Mar. Sci.* 3 : 61-66.
- Rao, K.K., Sivasdas, P., Narayanan, B., Jayalakshmi, K.V. and Krishnan Kutty, M.** 1987. Distribution of foraminifera in the lagoons of certain islands of the Lakshadweep Archipelago. Arabian Sea. *Ind. Jour. Mar. Sci.* 16 : 161-178.
- Rao, N.R.** 1998. Recent foraminifera from innershelf sediments of the Bay of Bengal off Karikatukuppam, near Madras, South India. *Unpublished Ph.D Thesis, University of Madras.*
- Rao, M.S. and Vedantam, D.** 1968. Distribution of foraminifera in Visakhapatnam, India. *Nat. Inst. Sci. Bull.* 491-501.
- Rao, M.S. Vedantam, D. and Nageswara Rao, J.** 1979. Distribution and ecology of benthic foraminifera in the sediments of the Visakhapatnam shelf. *Paleogeogra. Palaeoclimatol. Palaeoecol.*

- 27 : 349-369.
- Rao, T.V. and Rao, M.S.** 1974. Recent foraminifera of Suddagadda estuary, east coast of India. *Micropal.* **20** : 398-419.
- Rasheed, D.A.** 1967-68a. Distribution of foraminifera in the coral sea, south of Papua, New Guinea. *Madras Univ. Jour. B*, **37-38** : 73-80.
- Rasheed, D.A.** 1967-68b. Some foraminifera belonging to Miliolidae and Ophthalimididae from the coral sea, south of Papua, New Guinea. *Madras Univ. Jour. B*, **37-38** : 19-68.
- Rasheed, D.A.** 1969-70a. Some Recent arenaceous foraminifera from the coral sea, south of Papua, New Guinea. *Madras Univ. Jour. B*, **39-40** : 41-58.
- Rasheed, D.A.** 1969-70b. Some recent calcareous foraminifera belonging to the families Peneroplidae, Alveolinellidae, Lagenidae and Polymorphinidae from the coral sea, south of Papua (New Guinea). *Madras Univ. Jour. B*, **39-40** : 77-110.
- Rasheed D.A.** 1969-70c. Some calcareous foraminifera belonging to the families Rotaliidae, Cymboloporidae, Anomalinidae, Calcarinidae, Globigerinidae and Bulinidae from the coral sea, south of Papua (New Guinea). *Madras Univ. Jour. B*, **39-40** : 150-201.
- Rasheed, D.A.** 1971. Some foraminifera belonging to Miliolidae and Ophthalimididae from the Coral Sea, south of Paupa (New Guinea). Part.2. *Madras University Jour. B*, **39-40** : 150-201.
- Rasheed, D.A. and Ragothaman, V.** 1978. Ecology and distribution of Recent foraminifera from the Bay of BHengal off Porto Novo, Tamil Nadu state, India. *Proc. VII Indian Coll. Micropal. Strat.*: 263-298.
- Rocha, A.T. and Ubaldo, M.L.** 1964a. Contribution for the study of Foraminifera from sands of Diu, Gogola and Simbor. *Garcia de orta (lisaboa)*, **2** : 409-419.
- Rocha, A.T. and Ubaldo, M.L.** 1964b. Nota Sobre of foraminifera recents das areias das praias dejampor (Damao) e de Baga Goa. *Garcia de orto (lisaboa)*, **12** : 645-650.
- Seibold, I.** 1975. Benthonic foraminifera from the coast and lagoon of Cochin (south India). *Rev. Espanola de Micropal.* **7** : 175-213.
- Sengupta, B.K. and Schafer, C.T.** 1973. Holocene benthonic foraminifera in leeward bays of St.Lucia, W.I. *Micropal.* **19**: 341-365.
- Sethulakshmiamma, J.** 1958. Foraminifera of the Travancore coast. *Bull. Centre. Res. Inst. Univ. Kerala, Ser. C* **6** : 1-97.
- Setty, M.G.A.P.** 1978. Shelf edge regime and foraminifera off Pondicherry, Bay of Bengal. *Ind. Jour. Mar. Sci.* **7** : 302-304.
- Setty, M.G.A.P.** 1984. Benthic foraminiferal biocoenoses in the estuarine regimes of Goa. *Rev. Ital. Paleontol. Stratigraph.* **89** : 437-445.
- Setty, M.G.A.P. and Nigam, R.** 1978. Microenvironment and anomalous benthic foraminiferal distribution with the neritic region of Dabhol - Vengurla sector of Arabian sea. *Indian Coll. Micropal. Strat., Abs. p.1.*
- Setty, M.G.A.P. and Nigam, R.** 1984. Benthic Foraminifera as pollution indices in the marine environment of West Coast of India. *Revi. Ital. Paleonto. Stratigraph.* **89** : 421-436.
- Setty, M.G.A.P. and Nigam, R.** 1985. Benthic foraminifers as indices of diversity and hyposalinity in a modern clastic shelf edge regime, off Bombay, India, p. 283-288. In : *Indian Ocean Biology of Benthic Marine Organisms* (Eds. Thomson, M.F., Sarojini, R. and Nagbhusanan, R.), Oxford and IBH Publishing Co., Bombay.
- Shareef, N.A. and Venkatachalapathy, V.** 1988. Foraminifera from the shore sands of Bhaktal and Devgad Islands, west coast of India. *Jour. Geol. Soc. India*, **31** : 432-441.
- Sidebottom, 1918.** Report on the Recent foraminifera dredged off the East coast of Australia. *Jour. Roy. Micr. Soc.* 1-25, 121 - 153, 246 - 264.
- Stubbings, H.G.** 1939. Stratification of biological remains in marine deposits. *John Murray Exped. Sci. Repts.* **3** : 158. (1933-1934).
- Terquem, O.** 1876. Les foraminifera et les Entomos traces-Ostracodes du Pliocene Superieur de l'Il de Rhodes. *Mem. de la Soc. Geologi. de France, (Ser. 2)*, **1** : 55-100.
- Tood, R.** 1965. A new *Rosalina* (Foraminifera) parasite on a bivalve. *Deep Sea Res.* **12**(6): 831-837.
- Vedantam, D. and Rao, M.S.** 1970. Recent foraminifera from off Pentakota, east coast of India. *Micropal.* **16** : 325-344.
- Walton, W.R.** 1952. Techniques for recognition of living foraminifera. *Contri. Cushman Found. Foram. Res.* **3** (2) : 56-60.
- Williamson, W.C.** 1858. *On the Recent foraminifera of Great Britain.* The Royal Society, London.
- Yassini, I and Jones, B.G.** 1995. *Recent foraminifera and Ostracoda from estuarine and shelf environments on the south eastern coast of Australia.* University of Wollongang Press, New South Wales, Wollongang.
- Zobel, B.** 1973. Biostratigraphische Untersuchungen an Sedimenten des indischpakistanischen Kontinentalrandes (Arabisches Meer). *Meteor. Forschungs Ergebnisse (Ser. C)*, **12** : 9-73.