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A PRELIMINARY REPORT ON BENTHIC FORAMINIFERAL ASSEMBLAGE IN THE ASHTAMUDI ESTUARY, KERALA

R. NAGENDRA, T. N. PRAKASH[1] K. JAYAMURUGAN, R. GAYATHRI and A.N. REDDY[2]

DEPARTMENT OF GEOLOGY, ANNA UNIVERSITY, CHENNAI-600025
[1]CENTER FOR EARTH SCIENCE STUDIES, AKKULUM, TRIVANDRUM-695031
[2]RGL, OIL AND NATURAL GAS CORPORATION, LTD, CHENNAI-600049
E-mail: geonag@annauniv.edu

ABSTRACT

The sediment samples of Ashtamudi estuary were studied for foraminiferal assemblages as no systematic records are available on the spatial distribution in the estuary. Out of 30 stations sampled, only 13 stations (A 3, A11, A14, A15, A16, A17, A19, A20, A22, A25, A26, A32 and A35) have yielded a good faunal control. Twenty-nine foraminiferal species belonging to seventeen genera have been recorded from the estuarine sediments. The spatial distribution of foraminifera analyzed by Q-mode cluster analysis has revealed four distinct biotopes. The low diversity and low frequency of foraminifera in eastern, western and southern parts of the estuary have been attributed to inhospitable microniches possibly contributed by coir husk retting activities.

Keywords: Benthic foraminifera, cluster analysis, Ashtamudi estuary, Kerala

INTRODUCTION

Of the many estuaries in Kerala, Ashtamudi estuary is the second largest, located between 8° 31'-9 ° 02' N and 76 ° 31' -76 ° 41'E. It is unique in its configuration and extent. The water body derives its name from the plannimetric shape with eight branches radiating from the central part extending from the north of Quilon (Kollam) town. It has a length of 16 Km and a total width of about 15 Km with each individual lobe having an average width of around 3 Km. Steep slopes of lateritic capping and escarpments are seen around the estuary. A few individual islets with very steep side slopes are also observed within the estuary. The major fresh water input to the estuary is from the Kallada River which is 121 Km long and is formed by the confluence of three tributaries viz., the Kulathupuzha, Chendurni and Kalthuruthy originating from the highlands of the western Ghats. During the monsoon season, the surface and bottom water temperatures are less. Light penetration in the estuary is reduced during May, June and December months (Nair *et al.*, 1977). The sediment characteristics are dominantly silt and clayey silt type in Ashtamudi estuary (Prakash *et al.*, 2001). Water quality parameters were measured and documented as the baseline information (Muraleedharan Nair *et al.*, 2001).

SEDIMENT SAMPLE LOCATIONS

Estuarine bottom sediment samples at 30 locations were collected from Ashtamudi estuary during March/April 2000 using a Van-Veen grab as a part of the development of Asthamudi development plan by Center for Earth Science Studies, Trivandrum (Black and Baba, 2001). The sediment samples were collected from different parts of the estuary representing five regions; Ashtamudi entrance, central kayal, southern kayal, western kayal and eastern kayal. These grab sediment samples were used for the study of distribution of benthic foraminiferal assemblages (Fig. 1a,b and Table 1).

The foraminifera were identified based on the published literature (Murray, 1971 and Boltovskoy *et al.*, 1980). Q-mode cluster analysis was carried out on the relative abundance of foraminiferal data of 29 species. The sample groups were identified using SPSS software. The benthic foraminiferal abundance was studied vis-a-vis the sample station within the estuary. The spatial-temporal distribution of the relative abundance of benthic foraminifera is tabulated in Table. 1.

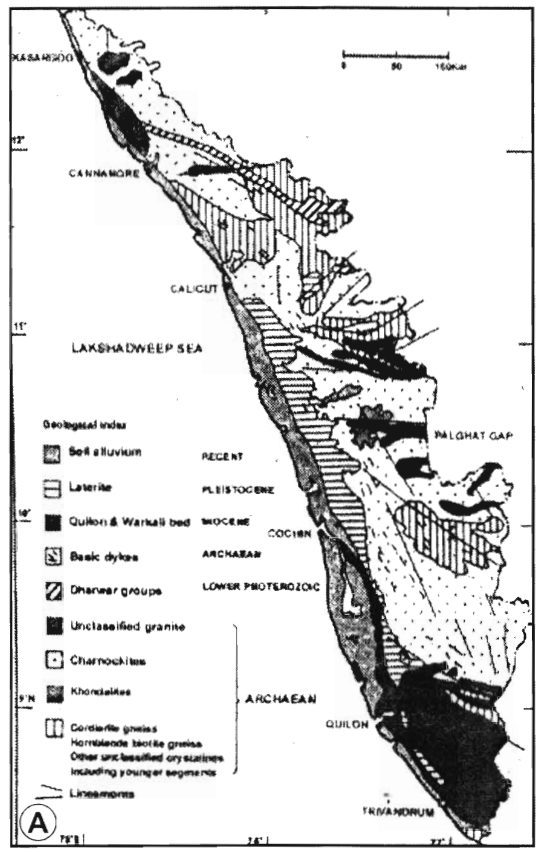
RESULTS AND DISCUSSION

The study attempts to quantitatively analyze the relationship of 29 recent benthic foraminifera in the estuarine sediments with different ecological parameters of Ashtamudi estuary. The multivariate study has been inspired from the results of the faunal abundance data of the estuary. The estuary has been iterated statistically using Q-mode Cluster analysis to understand the spatial distribution of foraminifer species among the various locations in the arms of Ashtamudi estuary (Table.2). Foraminiferal genus *Ammonia* is the dominant taxa in the Ashtamudi estuary, and hence, it is not considered for the cluster analysis. Q-mode cluster analysis has identified four distinct biotopes which reveal the distribution pattern of faunal assemblages in the estuarine sediments.

The cluster I, which represents the stations A 35, A38, A17, A32, A20, and A16 differentiates the biotope I. This biotope is dominated by *Brizalina striatula, Quinqueloculina seminula, Quinqueloculina boueana, Pararotalia nipponica, Nonion boueana, Caribbeanella polystoma* and *Textularia agglutinans.* The biotope II is differentiated by the Cluster-II covering the stations A 14, A 11, and A 15 respectively. Biotope II is dominated by *Brizalina striatula, Elphidium hispidulum, Elphidium excavatum, Nonion scaphum, and Nonion boueana.*

The cluster differentiated biotope III covers the stations A 19, A 21, A 3. Mostly, *Nonion boueana, Nonion scaphum* and *Brizalina striatula* and population of other species are dominated in this biotope. The cluster IV covers the stations A 25 only. *Rolshausenia rolshauseni, Nonion boueana, Nonion scaphum* and followed by planktic species *Globoratolia ungulata* are dominating the biotope IV (Fig. 2).

Twenty-nine benthic foraminiferal species represented by *Ammonia beccarii, Ammonia dentata, Bolivina earlandi, Bulimina*



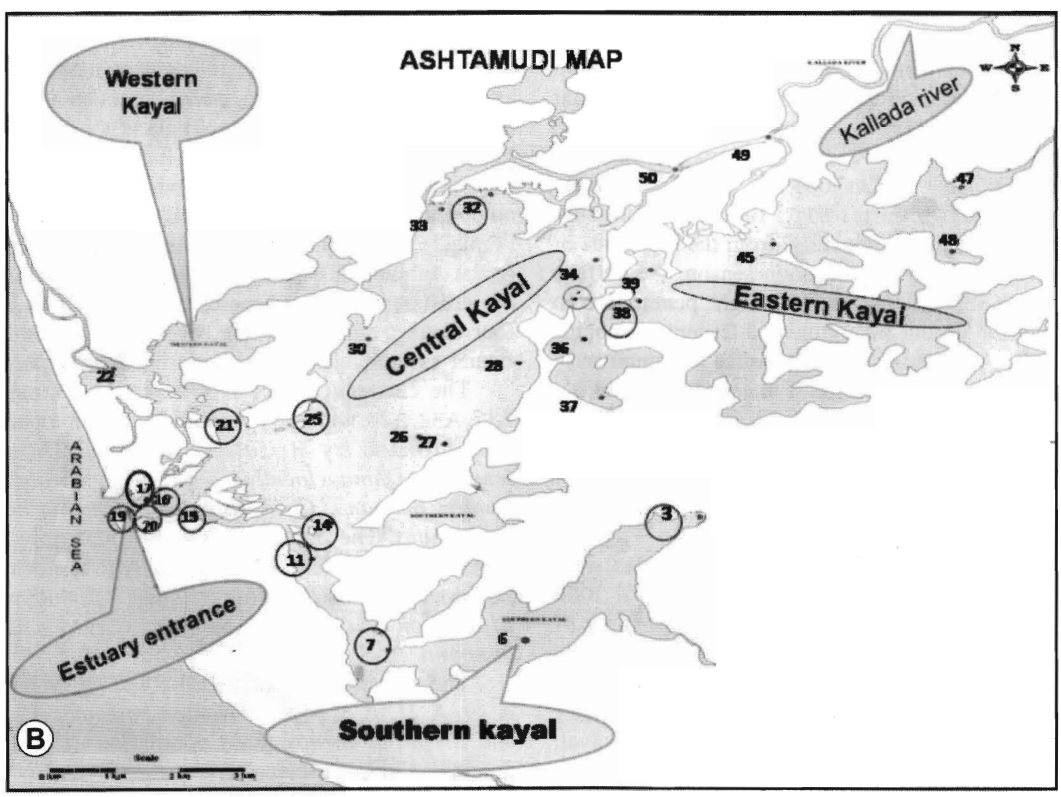


Fig. 1A. Geological map of Kerala (after GSI, 1976), B. Location map of the Ashtamudi Estuary with sediment sampling stations 1-50.

Table 1: Ashtamudi sediment sample coordinates.

Site	Location	Depth(m)	Sediment sample station no
Ashtamudi Entrance	8° 55' 54"N:76° 32' 17"E	7.0	A15,16,17,19,20
Western Kayal	8° 56' 55"N: 76° 33' 21"E	1.5	A21,22
Central Kayal	8° 57' 59": N:76 °36' 16"E	1.5	A25,26,27,28,30, 32,33,34,35
Southern Kayal	8° 54' 56":N :76° 34" 09"E	5.0	A3,6,7,11,14
Eastern Kayal	8° 58' 19" N :76° 36' 16"E	4.0	A36,37,38,39,45,47,48
Kallada River	9° 00' 20" N: 76° 37' 58"E	4.5	A49,50

marginata, Caribeanella polystoma, Cancris oblongus, Cibicides lobatulus, Dyocibicides sp., *Elphidium crispum, Elphidium excavatum, Elphidium discoidale, Elphidium hispidulum, Eponides repandus, Globulina gibba, Loxostomum lobatum, Nonion boueana, Nonion grateloupi, Nonion scaphum, Nonion* sp., *Pararotalia nipponica, Poroeponides lateralis, Quinqueloculina agglutinans, Quinqueloculina boueana, Quinqueloculina seminula, Rolshausenia rolshauseni, Virgulina riggii, Ammobaculites* sp., *Textularia agglutinans* and three planktics *Globigerina bulloides, Globigernoides ruber* and *Globorotalia ungulata* were identified from 30 fixed stations covering the entire Ashtamudi estuary. The identified foraminiferal species are illustrated in Plate I.

Out of 30 stations sampled, only 13 stations have yielded a good faunal control (Table 2). Ashtamudi entrance covering the stations A15, A16, A17, A19 and A20 have yielded a total 774 benthic foraminiferal tests; station no. A22 in western kayal yielded a total of 42 tests. Station nos. A25, A26, A32, A35 in the central kayal yielded a total of 109 faunal tests and the station nos. A3, A11, A14 of the southern kayal yielded a total of 93 foraminiferal tests. The western, southern and eastern kayals were used for coir husk retting. The process of coir retting releases hydrogen sulphide gas which has a propensity to reduce water pH. The H_2S also depletes dissolved oxygen at water-substrate interface producing low/anoxic oxygen conditions (Prakash *et al.*, 2001). The low frequency and low diversity of foraminifera in eastern, western and southern kayals can be attributed to coir husk retting in these parts of the estuary which appear to have contributed to the random distribution of ecological parameters and nutrients that control faunal distribution. Further studies are underway to understand seasonal distribution and ecology of foraminifera of Ashtamudi estuary.

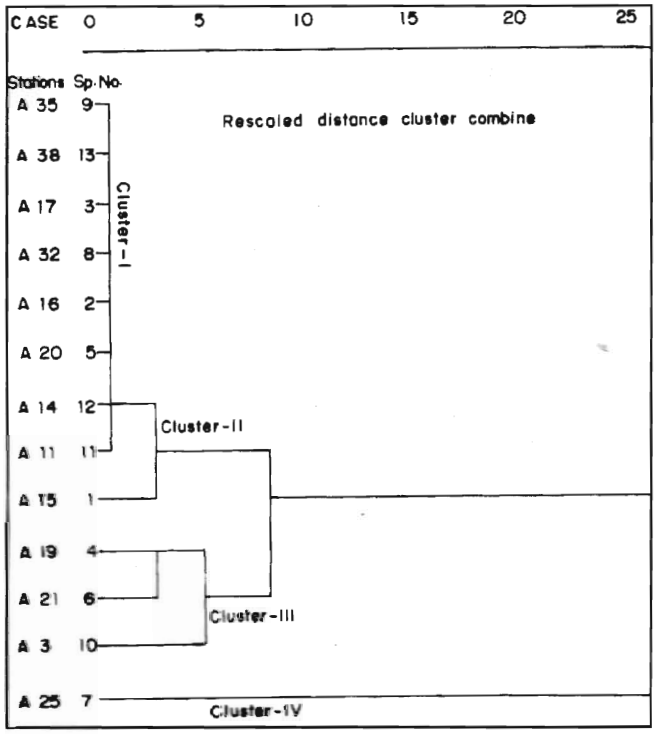


Fig. 2. Hierarchical cluster analysis-Q mode cluster analysis.

CONCLUSIONS

1. The Ashtamudi estuary has yielded a total of 29 benthic and 3 planktic foraminiferal species and Q- mode cluster analysis identified four distinct biotopes in the estuarine sediment samples.

2. The faunal frequency variation is suggestive of random distribution of ecological parameters and nutrients that control faunal distribution.

3. Low faunal frequency and diversity in eastern, western and southern kayals reveal the deterioration of ecological niches possibly by effluents released by coir retting process.

4. The process of coir retting releases hydrogen sulphide gas which has a propensity to reduce water pH. The H_2S also depletes dissolved oxygen at water-substrate interface producing low/anoxic oxygen conditions.

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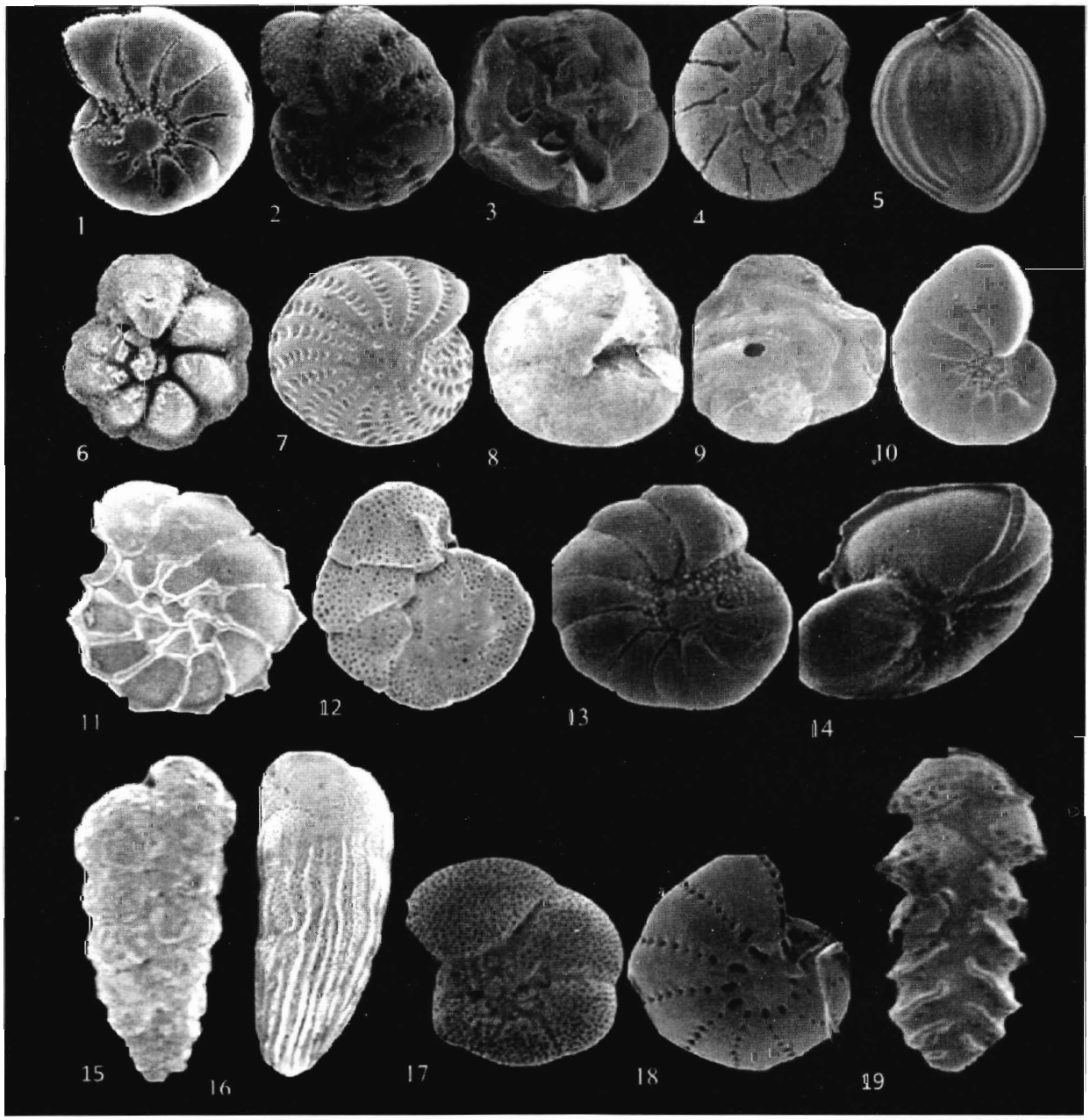
Table 2: Spatial distribution of Benthic foraminifera, Ashtamudi Estuary.

NAME OF SPECIES	ASHTAMUDI ENTRANCE					W.KAYAL	CENTRAL KAYAL			SOUTHERN KAYAL			E.KAYAL
	A 15	A 16	A 17	A 19	A 20	A 21	A 25	A 32	A 35	A 3	A 11	A 14	A 38
Ammonia beccarii (Linne', 1758)	31	469	24	40	95	0	0	3	33	32	3	0	20
Ammonia dentata (Parker and Jones, 1865)	0	50	0	0	0	0	0	0	0	0	0	0	0
Ammobaculites sp.	0	0	0	0	0	0	0	0	0	0	1	0	0
Bolivina earlandi Parr, 1950	0	0	0	0	0	0	2	0	0	0	0	0	0
Brizalina striatula (Cushman, 1922)	1	0	1	2	1	4	1	0	0	7	0	3	0
Bulimina marginata d' Orbigny ,1826	0	0	0	1	0	0	0	0	0	0	0	0	0
Caribeanella polystoma Bermudez, 1952	0	2	0	0	0	2	0	0	0	6	2	1	0
Cancris oblongus (Williamson, 1858)	0	0	0	1	0	1	0	0	0	0	0	0	0
Cibicides lobatulus (Walker and Jacob,1798)	0	0	0	0	0	0	1	0	0	0	0	0	0
Dyocibicides sp. Cushman and Valentine,1930	0	0	0	1	0	0	0	0	0	0	0	0	0
Elphidium crispum (Linnaeus, 1758)	0	0	0	2	0	0	0	0	0	0	0	0	0
Elphidium excavatum (Terquem,1875)	0	0	0	0	0	0	0	0	0	0	3	0	0
Elphidium discoidale (d' Orbigny,1839)	4	0	0	1	0	2	1	0	0	0	0	0	0
Elphidium hispidulum Cushman, 1936	4	0	0	0	0	0	1	0	0	0	1	3	0
Eponides repandus (Fichtel and Moll,1798)	0	0	0	0	0	0	1	0	0	0	0	0	0
Globigerina bulloides D' Orbigny,1826	0	0	0	0	2	3	6	0	0	1	1	0	0
Globorotalia ungulata Bermudez,1960	0	0	0	0	0	0	0	0	0	0	0	0	0
Globigerinoides ruber (d'Orbigny, 1839)	0	0	0	0	1	0	0	0	0	0	0	0	0
Globulina gibba (d'Orbigny,1826)	0	0	0	1	0	0	0	0	0	0	0	0	0
Loxostomum lobatum (Brady,1881)	0	0	0	0	0	0	1	0	0	0	0	0	0
Nonion boueana (d' Orbigny, 1846)	6	2	0	14	1	16	17	0	0	8	3	1	0
Nonion grateloupi (d' Orbigny,1839)	0	0	0	0	0	0	2	0	0	0	0	0	0
Nonion scaphum (Fichtel & Moll,1798)	6	0	0	3	1	10	17	0	0	12	3	2	0
Nonion sp.	0	0	0	0	0	0	1	0	0	0	0	0	0
Pararotalia nipponica (Asano,1936)	0	2	0	0	0	0	0	0	0	0	0	0	0
Poroeponides lateralis (Terquem,1878)	0	0	0	0	1	0	0	0	0	0	0	0	0
Quinqueloculina agglutinans d'Orbigny, 1839	0	0	0	0	0	3	0	0	0	4	0	0	0
Quinqueloculina boueana d'Orbigny,1846	0	0	0	0	1	0	0	0	0	0	0	0	0
Quinqueloculina Seminula (Linne', 1758)	0	0	0	0	2	0	0	0	0	0	0	0	0
Rolshausenia rolshauseni (Cushman and Bermudez,1952)	0	0	0	0	0	0	21	0	0	0	0	0	0
Textularia agglutinans d'Orbigny 1839	0	0	0	0	0	0	0	1	0	0	0	0	0
Virgulina riggii Boltovskoy, 1954	0	0	0	0	0	1	0	0	0	0	0	0	0

Plate I



EXPLANATION OF PLATE I

(Scale: Figures. 2, 3,5,13,14,17, 18 is 100μm. Figures. 1,6,10,15,16,19 is 200μm. Figures 4,7,8,11,12 is 300μm. Figure.9 is 500μm)

1. ***Nonion boueana*** (side view)
2. ***Elphidium incertum*** (side view)
3. ***Rolshausenia rolshauseni*** (dorsal view)
4. ***Ammonia beccarii*** (ventral view)
5. ***Quinqueloculina boueana*** (side view)
6. ***Pararotalia nipponica*** (ventral view)
7. ***Elphidium crispum*** (side view)
8. ***Eponides repandus*** (ventral view)
9. ***Dyocibides*** sp. (dorsal view)
10. ***Nonion grateloupi*** (side view)
11. ***Ammonia dentata*** (dorsal view)
12. ***Cibicides lobatulus*** (dorsal view)
13. ***Protoelphidium*** sp.(side view)
14. ***Nonion scaphum*** (side view)
15. ***Textularia agglutinans*** (side view)
16. ***Brizalina striatula*** (side view)
17. ***Caribeanella polystoma*** (dorsal view)
18. ***Elphidium discoidale*** (side view)
19. ***Loxostomum lobatum*** (side view)

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