

to handle several samples simultaneously, and (iii) works both as an extractor as well as desalter, this technique is recommended for the free amino acid analysis of marine algae.

Authors wish to express their sincere thanks to Dr D. J. Metha, Scientist-in-Charge, for permitting them to publish the results.

# References

1. BLOCK, R. J., DURRUM, E. L. & ZWEIG, G., *A manual of paper chromatography and paper electrophoresis* (Academic Press Inc., New York), 1958, 710.
2. HUNTER, I. R., HOUSTON, D. F. & KESTER, E. B., *Anal. Chem.*, **27** (1955), 965.
3. SMITH, I., *Chromatographic and electrophoretic techniques* (Interscience Publishers, New York), 1960.
4. STEWARD, F. C., *Pl. Physiol.*, **4** (1965), 379.
5. THOMPSON, J. F., HONDA, S. I., HUNT, G. E., KRUPKA, R. N., MORRIS, C. J., POWEL (Jr), A. L. E. & SILVERSTEIN, O., *Bot. Rev.*, **25** (1959), 263.
6. LEWIS, E. J. & GONZALVES, E. A., *Ann. Bot. N.S.*, **26** (1962), 301.
7. STEWARD, F. C., *Ann. Bot. N.S.*, **27** (1963), 691.
8. LEWIS, E. J., *Phykos*, (1973), (in press).
9. HAMILTON, P. H. & SIMPSON, S. G., *Adv. Chromatogr.*, **2** (1966), 3.

## *Musculus strigatus* (Hanley) (Mollusca: Bivalvia) Associated with Littoral Algae at Visakhapatnam

A. L. N. SARMA & P. N. GANAPATI

Department of Zoology, Andhra University, Waltair

Received 16 June 1973; revised received 6 August 1973

Density distribution pattern of *M. strigatus* among 13 physiognomically different local littoral algae is given. The morphology of the weed, its tidal level and the amount of protection offered against wave action and insolation appear to be the chief factors governing the distribution and abundance of *M. strigatus*. The worldwide distribution of the species and its range as recorded so far is also given.

WHILE engaged in studies on the phytal faunal communities of littoral algae of Visakhapatnam coast, several rusty-brown bivalves ranging in size from 1.5 to 7.0 mm were observed crawling with a slender strap-shaped foot on the fronds of the algae. These specimens have now been identified as *Musculus* (= *Modiolaria*) *strigatus* (Hanley).

The shells are small, heavily built, iridescent, ovately elongated and inflated at the umbonal region (Fig. 1). The shell walls are radially sculptured externally with raised ridges both posteriorly and anteriorly; the intervening portion of the surface is smooth. There is considerable colour variation in the shell valves with the growth of the animal. The aged shells are greenish brown on the thick dorsolateral portions and light greenish yellow on the ventral margin. The young specimens are iridescent and lustrous with a reddish hue.

Earlier, 2 species of *Musculus*, *M. cumingianus* (Dunker) and *M. nanus* (Dunker) have been reported from the Krusadai Island<sup>1</sup>. *M. strigatus* is recorded and reported for the first time from peninsular India.

*M. strigatus* is found to be an important member of the phytal faunal societies of the local foreshore and its abundance on 13 species of algae is shown in Table 1. Of all the algae investigated the tufted, shrub-like *Spongomorpha indica* was found to be the most congenial ecological niche, where *M. strigatus* nestles among the slender, hair-like fronds of the weed adhering to it by its byssal threads. The axils of the bipinnate erect fronds of *Caulerpa taxifolia* are the next important favourable ecological niches. The mat-like encrusting calcareous *Amphiroa fragilissima* with thick, dense fronds and with several interstices which offer protection against wave action and insolation, is yet another favourable site for *M. strigatus*. Coarser shrub-like *Sargassum* sp., cushion-like *Gracilaria corticata*, stoloniferous *Caulerpa racemosa* appearing like a bunch of grapes and shrub-like *Hypnea musciformis* form favourable substrata in the order of their suitability for colonization of *M. strigatus*. Among the rest of the algae the foliaceous *Ulva fasciata*, the filamentous *Chaetomorpha antennina* and the broad leathery fan-like *Padina tetrastrum* harboured more than 41 individuals/100 g algae. String-like mucus forming *Liagora erecta*, band-like *Dictyota dichotoma* supported only small numbers of *M. strigatus* which were altogether absent on the slippery membranous blades of *Porphyra vietnamensis*.

The distribution of *M. strigatus* seems to be governed by the morphological nature of the weed, its tidal level and the amount of protection it could

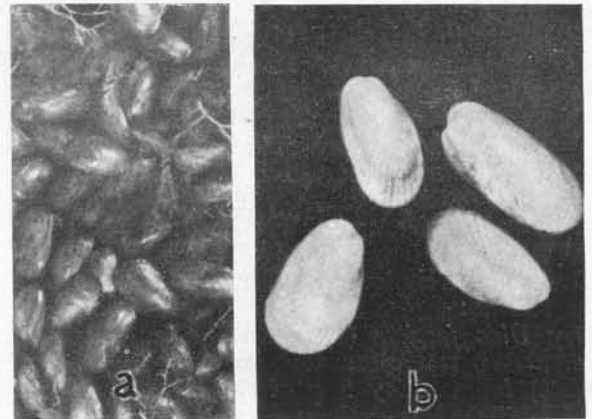


Fig. 1 — *M. strigatus* (a) among *Spongomorpha indica* and (b) the external sculpture of the shell walls

TABLE 1 — AVERAGE DENSITY DISTRIBUTION OF *M. strigatus* ON 13 SPECIES OF LITTORAL ALGAE

| Alga                         | Number/<br>100 g<br>wet alga | Alga                          | Number/<br>100 g<br>wet alga |
|------------------------------|------------------------------|-------------------------------|------------------------------|
| <i>Spongomorpha indica</i>   | 12500                        | <i>Ulva fasciata</i>          | 100                          |
| <i>Caulerpa taxifolia</i>    | 2400                         | <i>Chaetomorpha antennina</i> | 50                           |
| <i>Amphiroa fragilissima</i> | 1550                         | <i>Padina tetrastrum</i>      | 41                           |
| <i>Sargassum</i> sp.         | 1450                         | <i>Liagora erecta</i>         | 11                           |
| <i>Gracilaria corticata</i>  | 1400                         | <i>Dictyota dichotoma</i>     | 4                            |
| <i>Caulerpa racemosa</i>     | 1200                         | <i>Porphyra vietnamensis</i>  | —                            |
| <i>Hypnea musciformis</i>    | 600                          |                               |                              |

afford against wave action and insolation. Thus *M. strigatus* is found in abundance on shrub-like algae collected in the infralittoral fringe and in low numbers on the algae (*U. fasciata*, *C. antennina*) collected in the midlittoral.

*M. strigatus* has been previously reported from Madagascar and Sumatra Islands<sup>2</sup>. With the present record, the distribution of *M. strigatus* ranges from Madagascar, South east coast of India to Sumatra in Malaysian Archipelago. A more intensive search may perhaps reveal that the species has a wider distribution than at present known.

Glynn<sup>3</sup> observed a mean absolute abundance of 450 individuals of *M. pygmaeus*/g dry weight of the red alga *Endocladia muricata* at the Hopkins Marine Station in Monterey Bay, California. It is found that at both California and at the local foreshore, *Musculus* forms an important faunal element of the phytal system.

From the foregoing account it seems reasonable to assume that the bivalves form an important component of the phytal fauna, all over the world.

The authors are indebted to Dr (Miss) Ruth Turner, Harvard Museum of Comparative Zoology, for identifying the pelecypod. One of the authors (A.L.N.S.) is grateful to the Council of Scientific & Industrial Research, New Delhi and the University Grants Commission, New Delhi, for the award of research fellowship during the tenure of which the present work was carried out.

#### References

1. SATYAMURTI, S. T., *Bull. Madras Govt Mus.*, 1 (1956), 1.
2. LAMY, E., *C.r. Congr. Soc. sav. Paris*, (1931), 149.
3. GLYNN, P. W., *Veliger*, 7 (1964), 121.

### Planktonic Foraminifera from the Sediments off Cochin

M. V. SHANKARANARAYANA GUPTHA

National Institute of Oceanography, Panaji

Received 24 March 1973; revised received 4 June 1973

Sediment samples at a depth range of 27-212 m from shelf region off Cochin coast yielded about 24 species of planktonic Foraminifera. In the innershelf region the fauna was very sporadic whereas in the outershelf it was rich; species belonging to the genera *Globigerina* and *Globigerinoides* formed the bulk of the fauna. The fauna in the outershelf region was found to be a mixture of recent and relict fauna.

**E**ARLIEST attempts to study the Foraminifera from the west coast of India were those of Chapman<sup>1</sup> and Stubbings<sup>2</sup>. Be and McIntyre<sup>3</sup> reported a sub-species *Globorotalia menardii flexuosa* (Koch) from the eastern Arabian Sea, and Rao<sup>4-6</sup> identified about 22 species from the sediments of north-west coast of India. Guptha<sup>7</sup> studied the distributional pattern of the planktonic Foraminifera from the slope sediments off Bombay and described the systematics of about 26 species. In the central west coast of India, Setty and Guptha<sup>8</sup> reported the quantitative distribution of planktonic Foraminifera from the sediments off Karwar and Mangalore regions. Relatively, a little work was done on the

distribution of Foraminifera of the south-eastern Arabian Sea. However, some regional studies<sup>9,10</sup> give an account of only a few planktonic forms. Studies made by Setty<sup>11</sup> were based on a single sample collected from the outershelf region off Alleppey.

During the experimental seismic cruise conducted in February 1965, in which I.N.S. *Kistna* and I.N.S. *Konkan* participated, surficial sediment samples have been collected from the continental shelf region along a section normal to the coast off Cochin Harbour. These samples have been studied for their planktonic foraminiferal content and the results obtained are presented in this paper.

Five sediment samples were collected (Table 1) by means of La Fond-Dietz snapper. About 20 g of oven dried sample was dispersed with sodium hexametaphosphate and kept overnight, later it was wet sieved through 230 ASTM mesh sieve to separate the silt and clay from the sand. Then the sand fraction was floated with the carbon tetrachloride to obtain the foraminiferal concentration for further study under the stereo-binocular microscope.

Previous work on the sediment distribution by Nair and Pylee<sup>12</sup> from this region has revealed that the innershelf up to a depth of about 40 m is floored with greenish black poorly sorted silty clays. These sediments are largely terrigenous, being deposited by the present day rivers, but further seaward starts a zone of fine and medium sand exhibiting better sorting and moderate amounts of clay size material.

The sediment samples have shown 24 species of planktonic Foraminifera and their frequency of occurrence at the stations covered is given in Table 2.

Analysis of 5 sediment samples revealed that the fauna below 73 m depth (stations 201, 204 and 207) was sparsely distributed and it gradually increased with the increase in depth. Enrichment of the fauna at stations 203 in the outermost shelf region was distinctly marked, there was also an increase in species abundance. More than half of the bulk fauna was constituted by 2 major genera *Globigerina* and *Globigerinoides* followed by *Globoquadrina*, *Globorotalia*, *Pulleniatina*, *Globigerinella*, *Globigerinita*, *Sphaeriodinella* and *Orbulina* in the decreasing order. The difference in the faunal abundance in the nearshore and offshore regions clearly indicate that the planktonic foraminifera prefer open sea environments and they are greater in the outershelf regions.

While examining the outershelf sediment samples (station 203) it was noticed that some of the

TABLE 1 — STATION NUMBERS, DEPTH IN METERS AND LOCATIONS

| Station No. | Depth m | Longitude E | Latitude N |
|-------------|---------|-------------|------------|
| 201         | 31      | 75°58'      | 10°11'     |
| 203         | 212     | 75°32'      | 10°00'     |
| 204         | 73      | 75°41'      | 10°00'     |
| 205 }       | 60      | 75°47'      | 10°00'     |
| 206 }       |         |             |            |
| 207         | 27      | 75°52'      | 9°50'      |