Foraminiferivory revisited: a preliminary investigation of holes in foraminifera

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Planktonic and benthonic foraminiferal tests from modern tropical-subtropical marine environments were investigated with regard to bioerosional traces. The traces found on the foraminiferal tests were grouped into 7 different categories. It is suggested that the different traces may be related to different unknown preda-tors of which at least one is planktonic.

Key words: Foraminiferivory, predation, planktonic foraminifera, borings.

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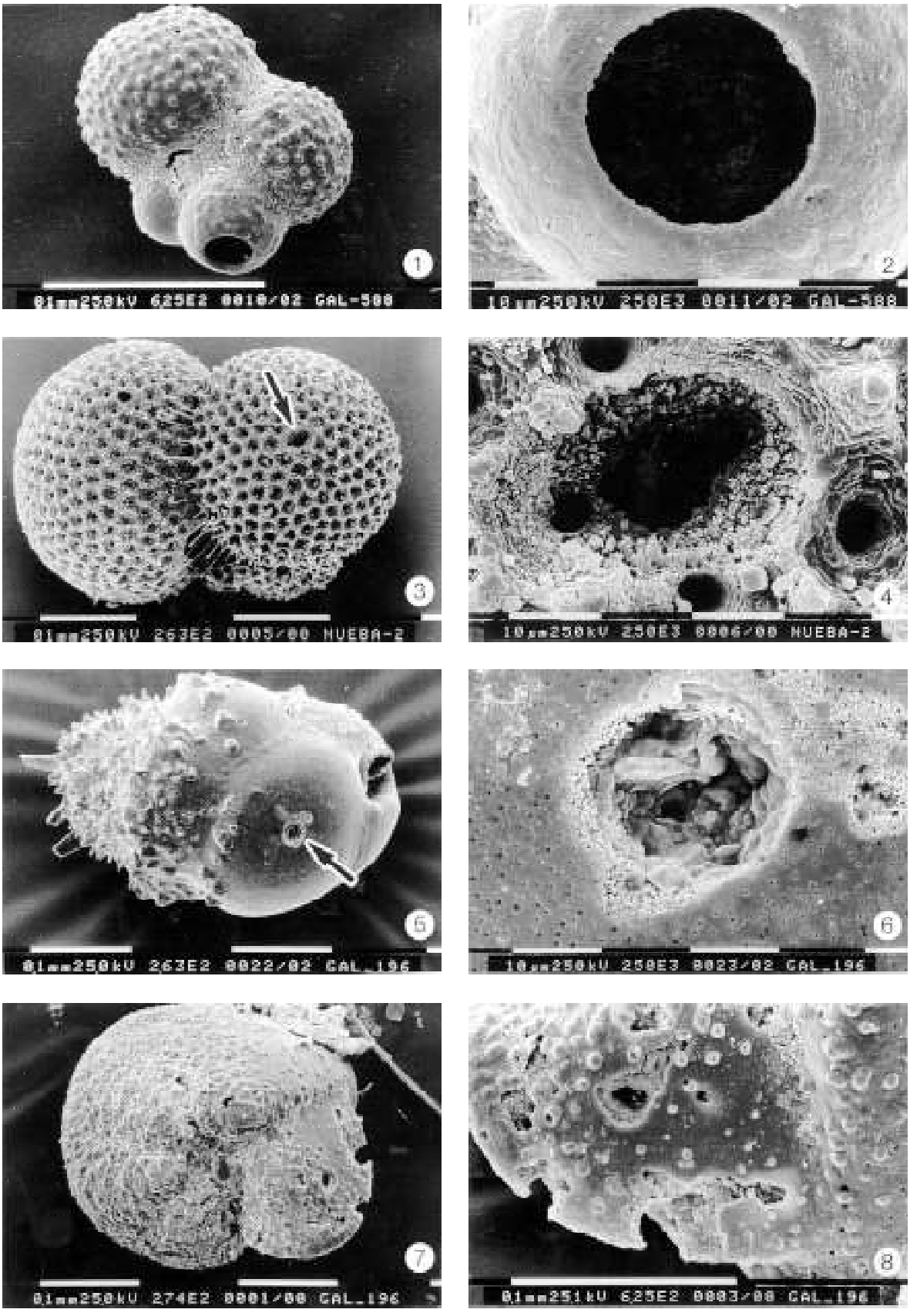
The term foraminiferivory was introduced by Hickman & Lipps in 1983 to cover the general phenomenon of ingestion of foraminifera. Little is known about the relationship between the predators and the foraminifera in modern communities. The problem is further complicated by the alleged uncertainties as to why foraminifera are eaten (Hickman and Lipps 1983, Walker 1971). Many fish (Daniels & Lipps 1987, Lipps 1988) and macro-invertebrates are known to ingest foraminifera (Arnold et al. 1985, Berger 1971, Boltoskoy & Zapata 1980, Brand & Lipps 1982, Buzas and Carle 1979, Hickman & Lipps 1983, Langer et al. 1995, Lipps et al. 1974, Mageau et al. 1975, Reyment 1966, Sliter 1971, and Walker 1971). All fish and most of the invertebrates do so incidentally. However, a few invertebrates (gastropods, nematodes and scaphopods) seem to prey selectively on benthonic foraminifera (Langer et al. 1995). Few of these animals leave traces on the foraminiferal tests and most tests are probably destroyed in the process of ingestion. In addition, a few reports exist on predaceous and parasitic foraminifera preying on other benthonic foraminifera (Banner 1971, Baumfalk et al. 1982, Cedhagen 1994, Freiwald & Schönfeld 1996, Hallock & Talge 1994, Plewes et al. 1993, Todd 1965, and Vénec-Peyre 1996).

Results

Holes in foraminiferal tests found in five samples from the Danish deep-sea expedition Galathea (1950–52) and two samples from the Gulf of Aqaba are here interpreted as predation of foraminifera through boring. Almost all hitherto described examples of foraminiferivory involve either ingestion of or borings in benthonic foraminiferal tests. Based on the morphology of the holes found in the planktonic foraminifera it is possible to establish seven different categories. *Group A:* Circular to sub-circular holes (Figs 1, 2), *Group B:* Oval to sub-oval holes (Figs 3, 4), *Group C:* Pits (Figs 5, 6), *Group D:* Bite traces (Figs 7, 8), *Group E:* Circular to oval holes that end in a floor with a minute perforation (Figs 9, 10), *Group F:* Cup-shaped holes (Figs 11, 12), *Group G:* Star-shaped holes (Figs 13, 14). None of the bored tests exceeds 350 μm in size and in tests containing more than one boring the additional borings occur in separate chambers. All hole categories, except for group G, were also found in benthonic foraminifera.

Discussion

It is assumed that most of the borings are the result of predation. Since the unknown predators seem to be size-selective relative to planktonic foraminifera, it is likely that the primary target for these predators is the cytoplasm in the foraminiferal test. The position of additional borings in separate chambers seems to support this suggestion. Bé & Spero (1981) described repair processes in planktonic foraminifera when subjected to experimental damage of the test. No such structure has been observed in association with the borings and it is assumed that the foraminifera died from the attack. Since planktonic and benthonic foraminifera inhabit different environments it is most


1
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5
01mm250kV 263E2 0022/02 CAL-196
6
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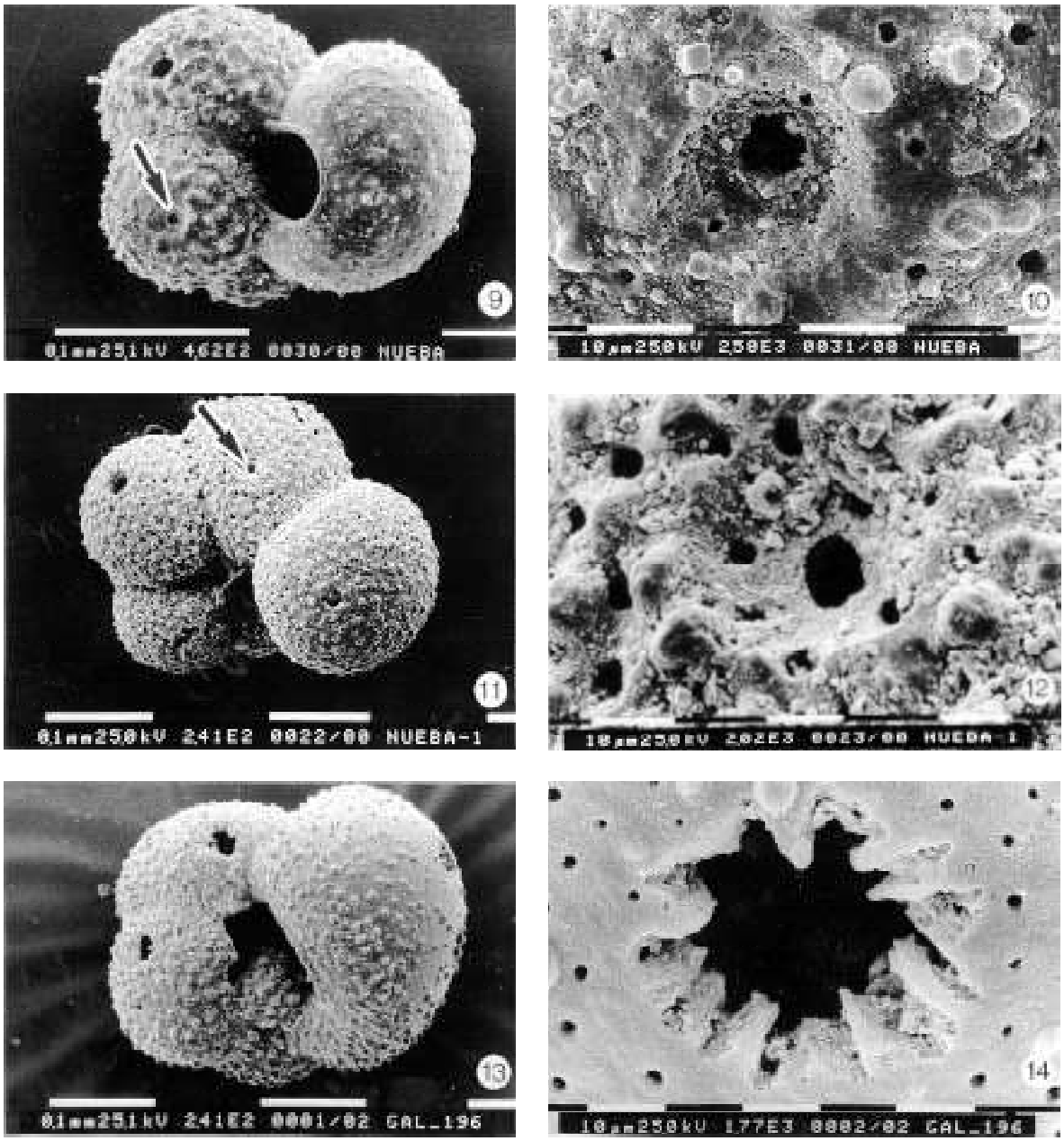

Figs 1–14. General and close-up views (see arrows). 1, 2: Group A. 3, 4: Group B. 5, 6: Group C. 7, 8: Group D. 9, 10: Group E. 11, 12: Group F. 13, 14: Group G. All figures except 5 and 6 are planktonic foraminifera. Scale at bottom of figures.

likely that at least two different predators are involved of which one is planktonic.

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Dansk sammendrag

Betegnelsen foraminiferivory blev i 1983 introduceret af Hickman & Lipps for at dække det generelle fænomen, at nogle marine dyregrupper og fugle fortærer foraminiferer. Tidligere undersøgelser synes at indikere, at foraminiferer ikke har været et primært fødeemne for de fleste af disse dyregrupper. Analyser af maveindholdet fra nogle arter af rovsnegle og søtænder viser dog, at kalkskallede bentoniske foraminiferer udgør en betragtelig del af disse makroinvertebraters diæt.

For størstedelen af de foraminiferer, som bliver spist, gælder det formodentlig, at deres kalkskaller enten bliver knust af dyrets munddele, bliver opløst under fordøjelsesprocessen eller passerer igennem dyrenes fordøjelsessystem uden at der efterlades spor på skallen, der vidner om, at foraminiferen er blevet fortæret.

Prøver fra den danske Galatheaekspedition (1950-1952) og fra Aqaba bugten blev undersøgt med henblik på at påvise spor på kalkskallerne efter prædation på nulevende arter af planktoniske foraminiferer. De fundne spor kan morfologisk inddeles i 7 kategorier (A-G). Sporene er her tolket som værende af biogen oprindelse og menes dannet ved prædationsadfærd af et eller flere planktoniske rovdyr.

Hypotesen synes understøttet af den omstændighed, at de ukendte spordannere udvælger planktoniske foraminiferer af en størrelse, der er mindre end 350 µm, og at hvis der forekommer mere end et spor i skallen, er disse placeret i forbindelse med nye skalkamre.

Da alle kategorier af spor undtagen gruppe G også er påvist på kalkskaller af bentoniske foraminiferer er det muligt, at der er mere end to forskellige spordannere og at en af dem er et planktonisk rovdyr.

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