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Protozoa Xenophyophorea Granuloreticulosa : *Psammina zonaria* sp. nov. from the West Pacific and some aspects of the growth of xenophyophores

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ABSTRACT

Psammina zonaria sp. nov. is the first member of this genus described from bathyal depths of the West Pacific. It is characterized by strong compartmentalization of the interior space and strictly directional growth. It appears to live attached to hard substrates, with the stiff but fragile test sticking up in the near-bottom water layer.

RÉSUMÉ

Protozoa, Xenophyophorea Granuloreticulosa : *Psammina zonaria* sp. nov. du Pacifique ouest. Considérations sur quelques aspects de la croissance des xenophyophores

Psammina zonaria sp. nov. est la première espèce du genre *Psammina* décrite des profondeurs bathyales du Pacifique Ouest. Elle se caractérise par un fort compartimentage de l'espace intérieur et une croissance strictement directionnelle. Elle semble vivre fixée à des substrats durs, avec son test, rigide mais fragile, dressé dans la couche d'eau se trouvant près du fond.

INTRODUCTION

Xenophyophores are macro- and megafauna-sized agglutinating rhizopods, mainly found in the deep sea (TENDAL, 1972, 1989). Although the present class Xenophyophorea was erected as an order, Xenophyophorida, of the Rhizopodea early in the century (SCHULZE, 1912), it is only over the last two decades that its wide geographical occurrence and ecological significance have become acknowledged beyond a narrow circle of deep-sea workers. The generalities, including terminology, are now accessible in larger textbooks (MARSHALL, 1979;

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PAGE, 1982; TENDAL, 1989; GAGE & TYLER, 1991; GOODAY & TENDAL, *in press*). The ecology of the group has attracted special interest in recent years (GOODAY *et al.*, 1993; LEVIN, 1991; LEVIN & THOMAS, 1988; LEVIN & GOODAY, 1992; RIEMANN *et al.*, 1993; TENDAL, 1985).

About 50 species of xenophyophores are formally named, and quite a few await formal description. Because most species are known from just a few records, and many only as fragments, any new find has the potential to bring substantial new information about the group.

The material secured during the MUSORSTOM 7 Expedition was collected from bathyal depths on the flat top of a seamount in the central West Pacific, north of the Fiji Islands, between the Combe and the Bayonnaise banks (RICHER DE FORGES & MENOU, 1993); this is the first record of a xenophyophore from that region. It also adds to our knowledge of the growth pattern of xenophyophores in general and the basic organization of members of the genus *Psammina* in particular.

METHODS

The samples were preserved in alcohol shortly after recovery.

Analysis of chemical constituents (Ba and S) was performed with an energy-dispersive X-ray spectrographic analyzer (EDS) connected to a scanning electron microscope (CamScan), which was run at 15 kV.

The holotype and one paratype are in the Muséum national d'Histoire naturelle, Paris, and two paratypes are in the Zoological Museum, University of Copenhagen.

SYSTEMATICS

Family PSAMMINIDAE Haeckel, 1889

Genus ***PSAMMINA*** Haeckel, 1889

Psammina zonaria sp. nov.

Fig. 1-2

MATERIAL EXAMINED. — **Wallis and Futuna Islands**. MUSORSTOM 7 : st. DW 620, 12°34.4'S, 178°11.0'W, 1280 m, clay, 28 May 1992, Warén dredge : Fourteen specimens and large fragments.

DIAGNOSIS. — A flat, elongate and spatulate *Psammina* with even increase in width from narrow to broad end. Up to 3 mm thick. Inner test space conspicuously compartmentalized by bars running across the whole width of the test. Colour white, consistency hard and brittle. Xenophyae planktonic foraminiferal shells of all sizes.

TYPE MATERIAL. — Two fragments in the sample fit together and form a large entire specimen selected as the holotype (Fig.1) and deposited in the Muséum national d'Histoire naturelle, Paris (registration number MNHN-489UV). It is spatulate in form, 26 mm (16 + 10 mm) long, 13 mm wide at one end and 4 mm at the other. A paratype is also deposited there (MNHN-490UV). Two paratypes in the Zoological Museum, University of Copenhagen, are without registration number.

DESCRIPTION. — There are three other nearly complete specimens in the sample, measuring in length, and greatest and smallest width, 15, 11, and 4 mm, 12, 9, and 4 mm and 10, 7, and 5 mm, respectively. The thickness is 2-3 mm.

Test : The tubular part is in all cases broken at the narrow end. As the tubular end gradually widens, the test becomes flattened and platelike, attaining the characteristic *Psammina* organization of two parallel plates of xenophyae with a space in between.

Both outer surfaces appear smooth apart from protruding xenophyae, but when examined more closely in oblique light it is seen that they are both slightly undulating, with about 3 mm from one crest to the next. The crests of the two test sides are arranged symmetrically. The test edges are rounded. Both test surfaces and the edges have numerous small openings, < 0.1 mm in diameter, which are probably the passages for pseudopodia, although some of them may be places where small xenophyae have fallen out. A number of larger holes, 0.5-1 mm in diameter, to the interior are merely damages. Granellare and stercomare branches are visible in some cases along the broad end, protruding among the xenophyae; they are not seen along the sides.

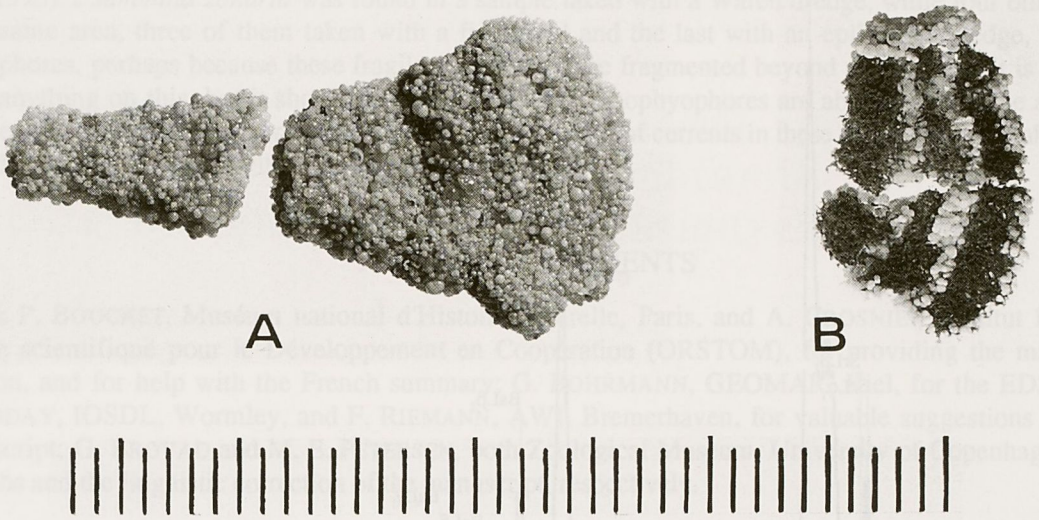

FIG. 1. — **A** : The holotype of *Psammina zonaria* sp. nov. — **B** : A fragment of *Psammina zonaria* sp. nov. One side is dissected away to show the interior compartmentalization. Scale in mm.

Xenophyae are planktonic foraminifer shells of all sizes, packed with the smaller ones well cemented as an infilling around the large ones.

The space between the plates, is 0.5-1 mm wide. The inner sides of the plates are connected by long solid, well cemented bars of xenophyae running across the whole width of the test and subdividing the interior space into long narrow, 1-2 mm wide compartments (Fig. 1 B). The bars are 0.5-1 mm wide, and the xenophyae are of the same kind as in the plates. The bars lack larger openings, but are occasionally crossed by branches of granellare and stercomare passing through small spaces between the xenophyae.

Granellare : The strings of granellare are sparsely developed and seem mostly to occur in the widest end, immediately under the test plates. The dichotomously dividing yellow-white branches are 100-120 µm in diameter; anastomoses are not seen. The plasma contains enormous numbers of granellae, up to 5 µm long. Their size, form, colour and distribution are as in other xenophyophores, and that the main constituent is $BaSO_4$ is confirmed by EDS analysis (Fig. 2).

Stercomare : The strings of stercomare are very strongly developed and fill the compartments completely (Fig. 1 B). The dark brown or black branches are 100-200 µm in diameter and anastomose in a tight network with open spaces about 0.1 mm in diameter. The covering membrane is thin but solid and slightly shiny. Rounded xanthosomes up to 12 µm in diameter are commonly seen among the masses of stercomata.

DISCUSSION

REMARKS ON TAXONOMY. — Because of the basic test construction, (two well defined plates of xenophyae connected by pillars or bars) the species is placed in the genus *Psammina* Haeckel, 1889. Six other species are presently referred to the genus. Superficially, a broken specimen of *P. zonaria* can be mistaken for *P. globigerina*

Haeckel, 1889, or maybe *P. plakina* Haeckel, 1889, a poorly known species (TENDAL, 1972 : 33), but the pronounced compartmentalization of the inner test space is a clear difference from these species. Large specimens of *P. globigerina* may have irregularly distributed bar-like pillars between the plates, but these do not compartmentalize the interior space. The only other known species with well defined bars is *P. sabulosa* Gooday & Tendal, 1988, but here the bars are regularly perforated by large openings, and the xenophyae are well sorted sandgrains.

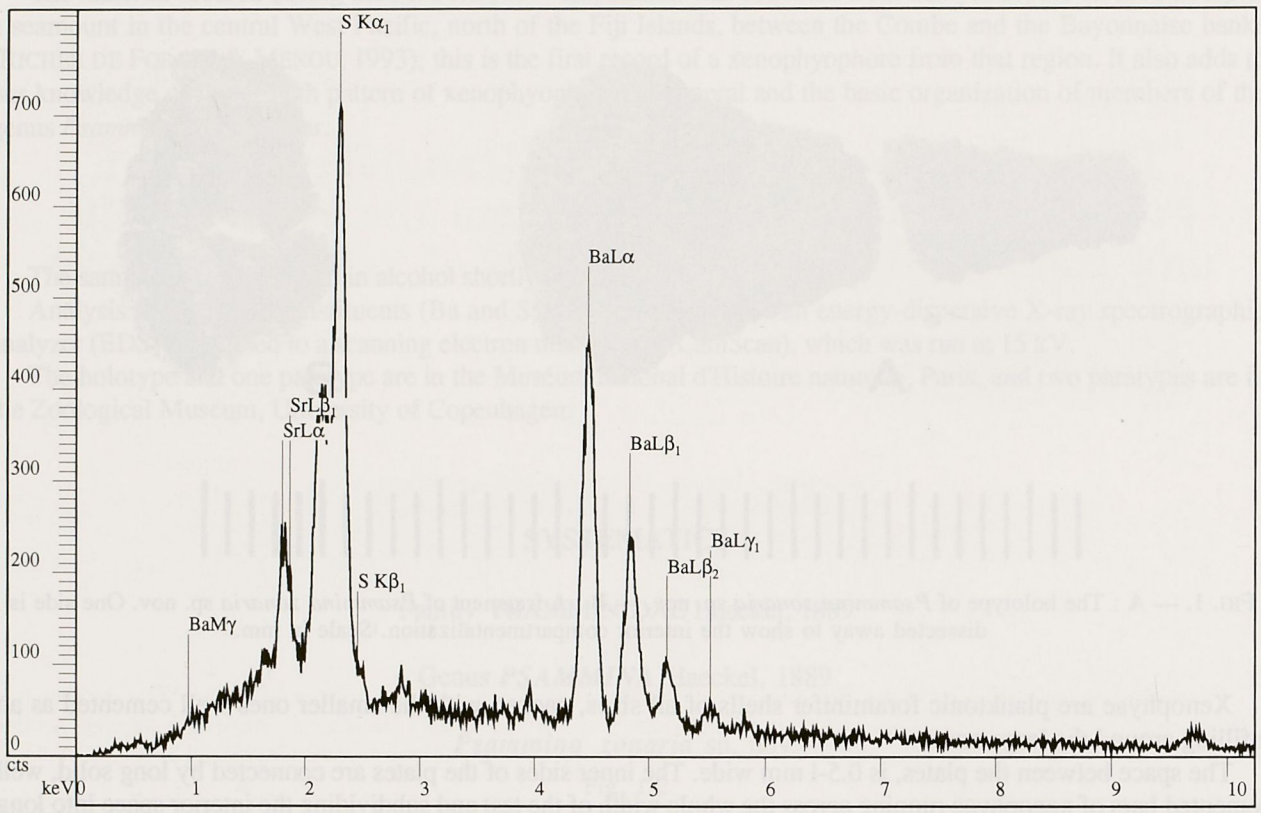

FIG. 2. — EDS elemental analysis of a single crystal in dried plasma of *Psammina zonaria* sp. nov. The peaks show the main constituents to be barium (Ba) and sulphur (S), with a trace of strontium (Sr).

GROWTH. — The compartmentalization reflects a distinct growth pattern showing a striking resemblance to that of a number of other xenophyophore species, viz *Psammina sabulosa* Gooday & Tendal, 1988, *Stannophyllum zonarium* Haeckel, 1889, *S. globigerinum* Haeckel, 1889, *S. granularium* Tendal, 1972, *S. fragilis* Tendal, 1972 and *S. flustraceum* Haeckel, 1889. The explanation might be found in the very important phenomenon of episodic growth recently discovered in the xenophyophore *Reticulammina labyrinthica* from the Madeira abyssal plain in the Atlantic (GOODAY *et. al.*, 1993).

P. zonaria has directed growth, the narrow part being the oldest, the wide part the youngest. This can be seen from the distribution of granellare which are only present in the youngest part of the test. The tubular oldest part can be considered a juvenile stage; thus, *P. zonaria* is a new example within the xenophyophores of young specimens having another body form than the older ones (TENDAL, 1972 : 80). The existence of strong morphological differences between two parts of the same specimen implies the risk that an isolated fragment is attributed a wrong taxonomic placement, a phenomenon also evident in other xenophyophores (GOODAY, 1991 : 210).

LIFE POSITION. — Some *Psammina* species have been found on the surface in box cores, on soft sediment (LEVIN & THOMAS, 1988); they may initially have started to grow on some small hard object. Further, there are many photographs from deep-sea bottoms showing supposed *Psammina* specimens on the sediment surface,

sometimes among or maybe on manganese nodules (TILOT, 1992, and unpubl.; TENDAL, unpubl.). Accordingly, the main part of the body of at least some *Psammina* species protrudes into the water above the bottom. In *P. zonaria* all the tubular parts are open at one end, have the same dimensions, and are still filled with stercomare. This suggests that they do not represent an area that gradually dies off and decomposes; it is more likely that they were originally fixed to a hard substrate, the brittle test breaking at the weakest point, probably just above the base. All evidence taken together thus suggests that *P. zonaria* lives upright on some solid substrate.

GENERAL ECOLOGY. — The sampling locality lies close to the summit of a seamount (RICHER DE FORGES & MENOU, 1993). *Psammina zonaria* was found in a sample taken with a Warén dredge, while four other samples from the same area, three of them taken with a fish trawl and the last with an epibenthic sledge, yielded no xenophyophores, perhaps because these fragile organisms were fragmented beyond recognition. It is difficult to conclude anything on this, but it should be pointed out that xenophyophores are abundant near the summits of many eastern Pacific seamounts, probably because intensification of currents in these places leads to enhanced flux of suspended food particles (LEVIN & THOMAS, 1988).

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