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# Demospongiae *Incertae sedis: Myceliospongia* Vacelet & Perez, 1998

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*Myceliospongia* Vacelet & Perez (Demospongiae, *incertae sedis*), contains a single species which is most unusual amongst demosponges in its anatomy and cytology. The sponge shows (1) a remarkable uniformity of cell types, (2) a reduced aquiferous system, and (3) an unusual morphology and mode of growth (which occurs via extension of its filaments across the substratum), which is thought to facilitate both the external exchange surface and possibly the capture and ingestion of prey. This unique body organisation is adapted to living in a stable cave environment, but offers no clues as to its affinities with any known askeletal or skeletal demosponges.
**Keywords:** Porifera; Demospongiae *incertae sedis*; *Myceliospongia*

## *MYCELIOSPONGIA* VACELET & PEREZ, 1998

### Synonymy

*Myceliospongia* Vacelet & Perez, 1998: 13.

### Type species

*Myceliospongia araneosa* Vacelet & Perez, 1998, by original designation.

### Definition

Demospongiae *incertae sedis* without skeleton and without cortex.

### Diagnosis

Body encrusting, from which arises a reticulation of thin filaments covering the substratum. The sponge has a reduced canal system and a low number of choanocyte chambers. Exopinacocytes are non-flagellated, covered by a mucous sheet. Most of the cells contain granular inclusions and symbiotic bacteria.

### Description of type species

*Myceliospongia araneosa* Vacelet & Perez, 1998 (Fig. 1).

***Synonymy.*** *Myceliospongia araneosa* Vacelet & Perez, 1998: 13–20, figs 4–6.

***Material examined.*** Holotype: MNHN DJV 61 – La Ciotat, 3PP cave, Northwestern Mediterranean, 18 m depth. Paratype: MNHN DJV 62 – same locality.

***Description.*** Encrusting, with main 'body' up to 25 cm diameter and 1 mm thick, easily removed from substratum. 'Body' covers most of the surface of the substratum, and also with irregular lacunae and filaments. Filaments, which could be as thin as 5 μm diameter, form an extensive spider web-like network, bifurcating and anastomosing across the substratum, insinuating irregularities of the rock surface and growing over and under other marine life. White alive, surface smooth, with small oscules up to 1.2 mm diameter rare on the body, absent on filaments; ostia not seen. Subsurface canals, about 1 mm diameter, visible through the translucent ectosome of the body and filaments, with only one canal per filament. Consistency is soft and fragile.

Spicules and spongin fibres absent, and collagen fibrils do not form bundles or thick condensations. Ectosome thin, composed of a layer of t-shaped exopinacocytes and a thin cuticle, without any underlying special ectosome differentiation. Exopinacocytes lack a flagellum, with the cytoplasm containing dense granules (0.4–1.1 μm diameter), and without vacuole. The lateral expansions of exopinacocytes are often superimposed for a few micrometres and are linked without specialised cell junctions. The outer surface of the exopinacocytes on both the 'body' and filaments is covered by an extremely thin cuticle (0.12–0.25 μm thick), covered by a well organised fibrillar material similar to the 'glycocalyx' layer in *Hemimycale columella* described by Willenz (1981). The exopinacoderm is invaginated in places, 2–4 μm diameter (probably ostia), leading to small canals, and these canals are lined by pinacocytes with a similar 'glycocalyx' but are more ovoid in shape and with a nucleus 2.8–3 μm diameter. The undersurface of the sponge, in contact with the substratum, is composed of ovoid basopinacocytes which are lined by a cuticle similar to that of the exopinacoderm but appears to lack a 'glycocalyx' layer.

The choanosome is unusual, with canals and choanocyte chambers rare. Canals are lined by ovoid endopinacocytes with a nucleus 1.9–2.5 μm diameter, no flagellum, with dense granules similar to those of the exopinacoderm but lacking any apparent 'glycocalyx' layer. Most of the choanosomal cells consist of single, granular cell type, which are highly diverse in size and shape, containing a variable amount of dense inclusions and intracellular symbiotic bacteria. Spherulous cells absent. Granular cells up to 40 μm diameter when ovoid or spherical, with a frequently nucleolated nucleus, 2.4–4 μm diameter, and containing a variable amount of spherical inclusions 0.2–12 μm diameter. These inclusions contain a large mass of dense ovoid granules, 0.1 μm maximum diameter, surrounded by a membrane, and the mass is usually spherical but often deformed by a few lipid globules or irregular myelinic-like granules. The large granular cells also contain symbiotic bacteria included in vacuoles, the latter often occupying most of the cell volume. The shape of these granular cells varies importantly according to the zone of the mesohyl, from spherical to very elongate. Elongated cells have small and clearer granules, no bacteria, long pseudopodia, and are usually in parallel arrangement in tracts, especially in the filaments, suggesting an intense,

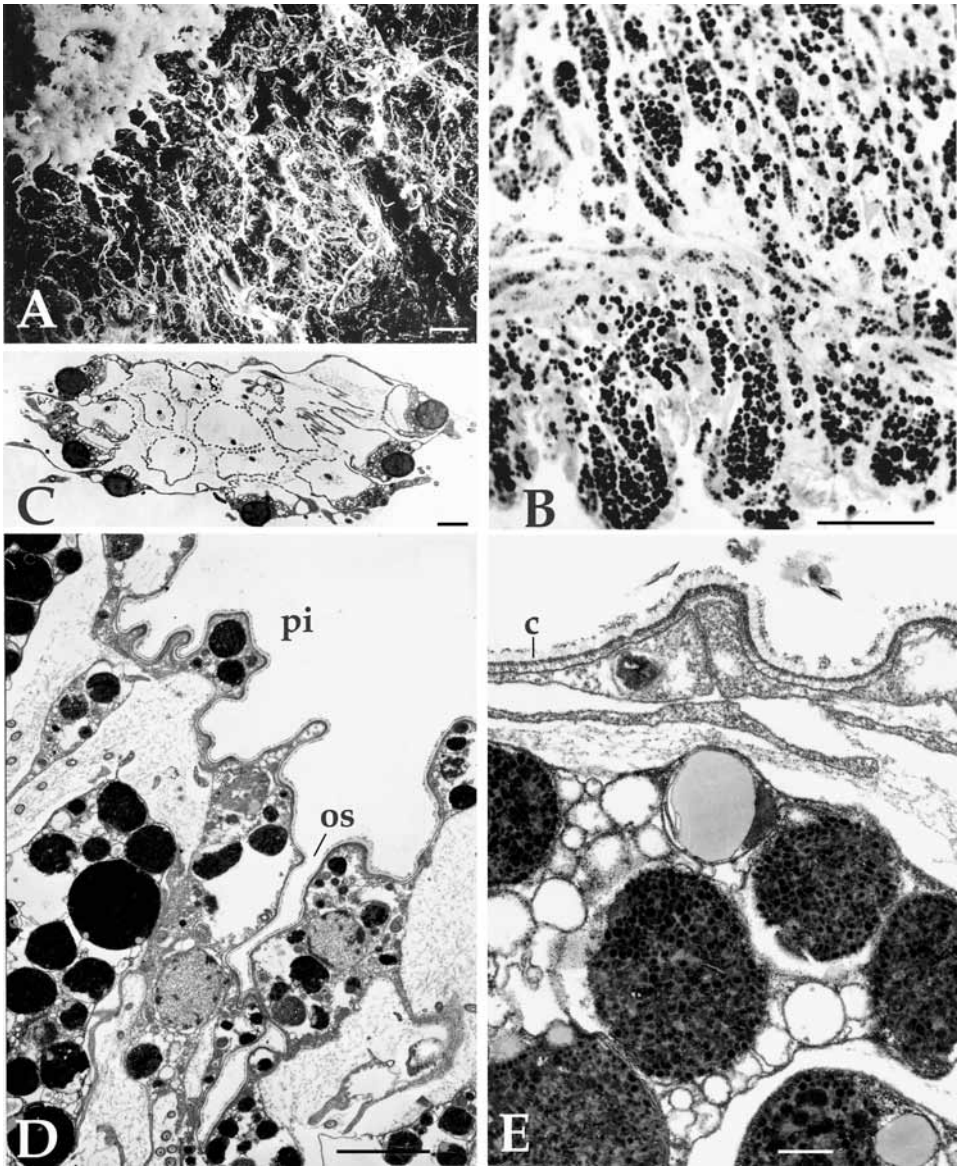


**Fig. 1.** *Myceliospongia araneosa*. A, specimen in situ (scale 13 mm). B, semi-thin section through the mesohyl near the undersurface (at bottom) (scale 22.5 μm). C, TEM of a choanocyte chamber, note the lateral expansions of the choanocytes (scale 1.3 μm). D, TEM of the sponge surface (pi, exopinacocyte; os, ? ostium) (scale 3.2 μm). E, TEM of the sponge surface showing the pinacocyte layer with a cell junction (arrow), the cuticle (c), the 'glycocalyx' layer, and a granular cell (scale 0.6 μm) (all figures from Vacelet & Perez, 1998).

orientated cell migration along trails with denser and polarized collagen fibrils. Intermediate stages between elongated cells and spherical cells are numerous.

Choanocyte chambers occur in low density, with the mesohyl surrounding them containing a few extracellular symbiotic bacteria and highly dispersed collagen fibrils. They are ovoid, approximately 7.5–15 × 20–24 μm. Choanocytes have a cylindrical or flattened body (2.5 μm maximum height), with a spherical anucleolate nucleus 1.6–1.8 μm diameter. Their base has lateral lamellipodia which attach to or cover the appendages of adjacent choanocytes, together forming a cellular sheet surrounding the entire choanocyte chamber. The cytoplasm contains numerous clear vacuoles and some metachromatic inclusions, and the collar is made up of 38–39 microvilli and surrounded by a 'glycocalyx' consisting of a reticulation of thin fibrils. The flagellum lacks a vane but has a sheet of fibrillar material similar to that outside the collar. No apopylar or cone cells found but their presence or absence is not yet certain.

Collagen fibrils with variable density make up the intercellular matrix, most often irregularly dispersed except in zones with elongated granular cells and beneath the pinacoderm where they form thin, poorly organised fascicles. Fibrils are 'rough' (Garrone, 1978), 18–19 nm in diameter, with a poorly defined striation of approximately 22 nm periodicity. The matrix contains dispersed extracellular bacteria but less morphologically diverse than the intracellular bacterial flora. Reproduction unknown.

***Ecology and distribution.*** Growing on vertical or overhanging walls in a cave, in a cool stable environment, 13–14.5°C. Known only from the type locality.

***Remarks.*** This demosponge *incertae sedis* is most unusual in its anatomy and cytology, showing a remarkable uniformity of cell types, a reduced aquiferous system, and an unusual morphology and mode of growth (which occurs via extension of its filaments across the substratum). These filaments produce an expansion of the body area over the substratum, greatly increasing the external exchange surface, thus accommodating a loss of choanocyte chambers without compromising survivorship in the stable cave environment. Vacelet & Perez (1998) also suggest that these filaments have a role in the capture and ingestion of particles, aided by the covering mucous sheet. These features are suggested to be 'normal' characteristics for this species. They are consistent year-around, and are not apparently related to reproductive condition (which can alter anatomy and cytology in some sponges, such as *Halisarca*; e.g., Bergquist, 1996), or to tissue regression (such as over-wintering or degenerative behaviour where there is a reduction or loss of the aquiferous system and dedifferentiation of most cell types into archaeocyte-like cells; Simpson, 1984). However, these features do not permit the allocation of *Myceliospongia* to any known family of Demospongiae in which non-skeletonised genera have been described. These genera include: (1) *Oscarella* and *Pseudocorticium* (Homoscleromorpha) (which have flagellated exo- and endopinacocytes, large choanocyte chambers, and a unique basement membrane underlying both pinacoderm and choanoderm); (2) *Chondrosia* (Chondrillidae) and *Hexadella* (Ianthellidae) (which have clearly distinct histology and anatomy); (3) *Thymosiopsis* (Chondrillidae) (which has a superficial cuticle and pore-sieves, and a marked cortex enriched with fibrillar collagen); or (4) Halisarcida (which has an organised ectosome of collagen fibrils and tubular, branched choanocyte chambers distinctive of the order Halisarcida).

Similarly, there are no obvious affinities to any of the demosponges with spicular and/or fibre skeletons. Several of the characters in *Myceliospongia* are found in other demosponges, but these are inconsistent and do not necessarily confer any close phylogenetic relationship. For example, the fibrillar layer covering the exopinacocytes resembles the 'glycocalyx' of the Hymedesmiidae poecilosclerid *Hemimycale columella* (Willenz, 1981); the absence of typical spherulous cells and the large number of inclusions similar to residual bodies in most cell types are shared with the Dysideidae dictyoceratid *Dysidea avara* (Uriz *et al*., 1996); and the rough nature of the collagen fibrils provides a weak indication of affiliation with Ceractinomorpha demosponges (Garrone, 1978).

Indications are, therefore, that *Myceliospongia* may form a new order and family of demosponges, but Vacelet & Perez (1998) rejected this action for the time being pending new evidence, particularly biochemical, reproductive and genetic data to assess its affinities.