Systema Porifera: A Guide to the Classification of Sponges, Edited by John N.A. Hooper and Rob W.M. Van Soest

Suborder Petrosina Boury-Esnault & Van Beveren, 1982

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Petrosina Boury-Esnault & Van Beveren (Porifera, Demospongiae) are here defined in new content following earlier proposals for a subdivision of Haplosclerida at the ordinal level suggested by Bergquist (1980a). In the present concept, Petrosina Boury-Esnault & Van Beveren, 1982 are marine Haplosclerida characterized by the possession of an isotropic skeleton, in which spicule tracts or fibres lack orientation. In this respect they differ from the suborder Haplosclerina, which has the skeleton organized in primary ascending and secondary interconnecting tracts or fibres. Spicules are frequently (but not exclusively) smooth oxeas and/or strongyles, in several size categories (Haplosclerina have only a single size category). A further difference which appears to be valid is demonstration of oviparous reproduction (Haplosclerina are probably all viviparous). Petrosina differ from freshwater sponges, here united in the suborder Spongillina Manconi & Pronzato, in having a tangential ectosomal skeleton which frequently takes the form of a crust of intercrossing spicules or a reticulation of spicules of smaller size than those of the choanosomal skeleton. Petrosina differ also from Spongillina in lacking gemmules and special microscleres protecting these asexual resting bodies. Also, spicules in Spongillina are frequently spined. Three families are recognised: Calcifibrospongiidae, Petrosiidae and Phloeodictyidae, differing in their habit and in the organization of the skeleton. Calcifibrospongiidae contains a single species of coralline sponges with a unique aragonitic limestone basal skeleton and a loose skeleton of thin strongyles. Petrosiidae include sponges with an alveolar choanosomal skeleton made by usually thick spicule tracts. Phloeodictyidae have a choanosomal reticulation of single spicules strengthened by independent thick and long tracts of spicules.
Keywords: Porifera; Demospongiae; Haplosclerida; Petrosina; Calcifibrospongiidae; Petrosiidae; Phloeodictyidae.

DEFINITION, DIAGNOSIS, SCOPE

Synonymy

Nepheliospongida Bergquist, 1980a; Petrosida Boury-Esnault & Van Beveren, 1982; Hartman, 1982.

Definition

Marine Haplosclerida with an isotropic choanosomal skeleton lacking differentiation in primary and secondary fibres or tracts; spicules smooth oxeas and/or strongyles in a single, or up to five size categories.

Diagnosis

Sponges with thickly encrusting, cushion-shaped, massive repent-ramose, erectly ramose, vase-shaped, tubular, lamellate, fan-shaped or turnip-shaped with main body buried in the substrate and often long fistules sticking out above the sediment. One genus has a basal limestone skeleton, and two (?) genera are excavating, with often long epilithic papillae or tubes. Consistency usually hard or firm, barely compressible, but crumbly, brittle and fragile sponges are not uncommon. Surface usually smooth, but may be ridged or honeycombed occasionally. Ectosomal skeleton uni- or polyspicular, crust-like, (lacking a well-organized triangular reticulation of single spicules or neat polygonal meshes, such as found in Haplosclerina). The choanosomal skeleton is isotropic, which means there is no orientation of the reticulation, with pauci- or multispicular primary or ascending fibres or tracts forming square, rounded or irregular polygonal meshes. In some petrosines, an irregular, vague anisotropic arrangement appears to be superimposed on the isotropic reticulation. Alveolar skeletons (i.e., rounded meshes made by thick spicule tracts), are especially common in some petrosiid genera. In phloeodictyids, the choanosomal skeleton consisting of an isodictyal uni- or paucispicular reticulation is strengthened by apparently independent long and thick spicule tracts forming their own anastomosing system, or remain clear of other such spicule tracts over large distances. These spicule tracts also run subdermally in fistules as an independent supporting structure. Spicules consist of smooth diactinal megascleres (oxeas or strongyles), and an erratic and presumably vestigial presence of microscleres, usually sigmas and/or toxas. In this suborder, microxeas or microstrongyles are recognized as a special microsclere, although they may in fact be part of a series of increasingly smaller megasclere categories.

Scope

In the concept of Petrosina presented here, three families are included: Calcifibrospongiidae Hartman, 1979, Petrosiidae Van Soest, 1980 and Phloeodictyidae Carter, 1882. Together these comprise a complement of sponges occurring all over the world in all marine habitats. Calcifibrospongiidae are monotypical, the other two families are speciose. Tropical shallow-water marine habitats such as reefs harbour the majority of petrosine sponges, but phloeodictyids especially are also frequently observed in sediment-rich environments, including cold- and deep-water habitats.

TAXONOMIC HISTORY

For a more extensive history of Haplosclerina we refer to the chapter on the order Petrosina (Van Soest & Hooper, this volume). In summary, two types of skeletal structure have emerged ('renierids' and 'chalinids') from the diffuse earlier classifications of sponges

now classed in Haplosclerida. These are now formalized at the subordinal level, with Petrosina largely comprising the former 'renierids'. Since *Reniera* is a subgenus of *Haliclona* (see contribution in this volume on Chalinidae by De Weerdt), any reference to this in the name of the present suborder needs to be avoided. Bergquist (1980a), on the basis of assumed ovipary and distinct chemistry, distinguished a restricted order Nepheliospongida, covering more-or-less the same groups. It was demonstrated subsequently that the fossil sponge *Nepheliospongia*, which formed the basis for the order Nepheliospongida, lacked spicules and could not be grouped together with the recent genera *Petrosia* and *Calyx*, originally assigned to this order. Boury-Esnault & Van Beveren (1982), and independently Hartman (1982), proposed to rename the order Petrosida to avoid confusion with *Nepheliospongia*. Since Hartman (1982) excluded Phloeodictyidae (as Oceanapiidae) from Petrosida, authorship for the present concept of Petrosina is given to Boury-Esnault & Van Beveren (1982).

REMARKS

Synapomorphies

The ovipary of Petrosina was upheld in a recent study (Fromont & Bergquist, 1994), but the chemical distinctness (possession of sterols with a cyclic sidebranch) could not be confirmed, since many species appear to lack them and several non-petrosines possess structurally similar molecules (e.g., Fromont *et al*., 1994; Van Soest & Braekman, 1999). Ovipary is shared with many tetractinomorph families and with verongids, and thus this makes a poor synapomorphy. The known chemistry so far provides evidence of the existence of genus markers (e.g., for *Petrosia*) but Petrosina-wide occurrence of the same compound family has not (yet) been demonstrated.

The anisotropic skeletal arrangement seen in haplosclerines, and in the periphery (e.g., tops of tubes, tips of branches) of some petrosins may be part of the radiate-accretive (*sensu* Wiedenmayer, 1977a) growth pattern, which in petrosins may be secondarily (derived) obscured by further silicification, resulting in the isotropic pattern. Alternatively, the isotropic choanosomal skeleton may be derived from a more widespread anisotropic skeletal arrangement, evidenced by its vaguely detected presence in species of *Neopetrosia*.

The ectosomal skeleton according to De Weerdt (1989) is usually crust-like with tangential spicules intercrossing. It is rather difficult to define the ectosomal skeleton of petrosine sponges due to the large variation observed. The neatly meshed ectosomal skeletons of haplosclerine sponges do not occur in petrosines, but this is not operational as a distinct synapomorphy.

The occurrence of several distinct size categories of megascleres in various genera of this suborder is unique among the Haplosclerida, but unfortunately it is not of general occurrence as many petrosine genera possess only a single category (e.g., *Neopetrosia, Xestospongia, Aka*, many species of *Oceanapia*).

Microscleres have the same haphazard distribution in individual species as found in Haplosclerina. They are considered to be remnants from an ancestral broad parentage including poecilosclerids, and their occurrence does not make them useful markers for taxa above the species level.

In spite of the paucity of genuine synapomorphies, De Weerdt's (1989) character analysis of the five families of marine Haplosclerida (Spongillina were excluded) suggested that two distinct clades exist, one comprising Chalinidae, Callyspongiidae and Niphatidae, the other Petrosiidae and Phloeodictyidae. Thus, a division of the order Haplosclerida into suborders Haplosclerina and Petrosina, as proposed here, is supported by a formal character analysis but the morphological synapomorphies that support these clades remain vague and partially elusive.

Previous reviews

Bergquist, 1980a; Van Soest, 1980; Desqueyroux-Faúndez, 1987; De Weerdt, 1985, 1989; Fromont, 1991; Fromont *et al*., 1994.

KEY TO FAMILIES

(1) Coralline sponge with basal limestone skeleton and a reticulation of thin strongyles ..... **Calcifibrospongiidae**
No basal limestone skeleton 2

(2) Choanosomal skeleton an isotropic unispicular skeleton, causing a 'pulpy' macroscopical texture, strengthened by long and thick spicule tracts running independently through the choanosome and forming an anastomosing subdermal supporting system ..... **Phloeodictyidae**
Choanosomal skeleton an isotropic reticulation of pauci- or multispicular tracts or fibres making squarish or rounded meshes and lacking a differentiation in primary ascending and secondary interconnecting tracts ..... **Petrosiidae**