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

Family Spongiidae Gray, 1867

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Spongiidae Gray (Demospongiae, Dictyoceratida) consists of six valid genera, one of which, *Spongia*, includes three subgenera. There are 91 nominal species. Spongiids are characterised by their homogeneous skeletal fibres and dense fibre skeleton. Within the family, the most important characters used to distinguish genera are surface armouring, skeletal morphology, and the development of sub-dermal or internal lacunae. Choanocyte chambers are diplodal, and the amount of collagen reinforcing within the matrix is variable.
Keywords: Porifera; Demospongiae; Dictyoceratida; Spongiidae; *Spongia*; *Spongia (Spongia)*; *Spongia (Australospongia)*; *Spongia (Heterofibria)*; *Hippospongia*; *Coscinoderma*; *Hyattella*; *Leiosella*; *Rhopaloeides*.

DEFINITION, DIAGNOSIS, SCOPE

Synonymy

Spongiidae Gray, 1867a; Bergquist, 1980b.

Definition

Dictyoceratida with homogeneous skeletal fibres, without distinct laminations, typically dominated by sub-primary skeletal fibres, and with diplodal choanocyte chambers.

Diagnosis

The six genera of the Spongiidae present a wide variety of forms, from low and encrusting to upright and massive. They all have a well-developed skeleton of primary and secondary fibres, and in a group of species from Australasia, distinct fine secondary or pseudo-tertiary fibres. Some species of *Hyattella* and *Spongia* may also have a superficial fibre net supporting the pinacoderm. All fibres are unpithed and are homogeneous, i.e., they show little or no sign of disjunct concentric laminations within the fibres, unlike members of the Thorectidae, Irciniidae and Dysideidae. However, it is possible to mistake stress marks within fibres, particularly at fibre intersections or corners, for laminations or lines of disjunction. Primary fibres may be sparse and are rare in one genus. Most characteristic of spongiids is the dense, secondary-fibre reticulum that dominates the skeleton. The surface may be heavily armoured with an organised dermal crust of sand, foreign spicules and detritus. Unarmoured genera usually have a conulose surface. The texture of the interior is rough to the touch, reflecting the density of spongin skeleton in relation to that of soft tissue. The whole body is compressible and resilient except where the surface is heavily sand-encrusted. Choanocyte chambers of spongiids are diplodal, and spherical to oval in shape. In some species, the mesohyl and ectosome are supported by heavy deposits of collagen, though this can vary, even between species within the same genus.

Scope

Spongiidae contains six valid genera, *Spongia, Hippospongia, Coscinoderma, Hyattella, Leiosella*, and *Rhopaloeides*. The genus *Spongia* is divided into three subgenera, and the family includes 91 nominal species. A checklist of described spongiid species is available on the internet (Cook, 2001).

History and biology

Until about 20 years ago, the family Spongiidae incorporated most of the genera now comprising the families Spongiidae, Irciniidae and Thorectidae. Bergquist (1980b) revised the Dictyoceratida and restructured the higher family level taxa to include three families: Spongiidae, Thorectidae and Dysideidae, and later (Bergquist, 1995) assigned the three filamentose genera to the family Irciniidae, leaving all dictyoceratids with homogeneous fibres and diplodal choanocyte chambers to Spongiidae.

The difficulty in assigning some species to either thorectid or spongiid genera is a matter of published record (Bergquist *et al*., 1988, Bergquist *et al*., 1999). This has resulted in four genera formerly considered as spongiids being reassigned to the family Thorectidae (Bergquist *et al*., 1988), and later placed together under the subfamily Phyllospongiinae (Bergquist *et al*., 1999). Spongiids occur in a wide range of habitats, and have been recorded from subantarctic to tropical latitudes.

Remarks

The above diagnosis includes minor deviations from the traditional definition of the Spongiidae (Bergquist, 1980b), in that some species are known to show moderately high development of collagen, and dermal skeletal support is present in some genera. As more species are discovered, and old taxa revisited, the concept of a perfectly homogeneous fibre is becoming less clear-cut. There are a number of taxa within the Spongiidae which appear to have very lightly laminated fibres, but which in all other respects are typical spongiids. The distinction between faint, adherent fibre laminae and strong, often disjunct laminae can be drawn. Further research needs to be focussed on this issue.

Work by Pronzato (unpublished), using scanning electron micrography, has revealed patterns of fine striations on the skeletal fibres of some *Spongia* and *Hippospongia* species. It would be interesting to determine whether this feature is exclusive to, and consistent within specific genera, or more widespread through Spongiidae, the Dictyoceratida or other Porifera.

Two genera of non-dictyoceratid, spiculose sponges, *Chalinopsilla* and *Dactylia* (here united under the name *Dactylia*

in Callyspongiidae), may easily be mistaken for Spongiidae, for example Lendenfeld (1889a). Both of these genera have irregular fibre skeletons, comprising primary, secondary and tertiary elements, without the normal complement of spicules. *Dactylia* also has cored primary fibres. These genera have smooth surfaces, unlike the sculptured or armoured dictyoceratids, a tangential surface fibre skeleton, and *Dactylia* is sticky when touched in the field (Bergquist, 1978: pl. 5b; Bergquist & Warne, 1980: pls 16f, 17a–f).

Previous reviews

Bergquist, 1980b; Cook & Bergquist, 2001.

KEY TO GENERA

(1) Surface armoured 2
Surface unarmoured 3
(2) Dense secondary skeleton of thick, branching secondary fibres ..... ***Leiosella***
Dense secondary skeleton of very fine, intertwined secondary fibres ..... ***Coscinoderma***
(3) Sponge body or ectoderm lacunose 4
Sponge not lacunose 5
(4) Primary fibres common ..... ***Hyattella***
Primary fibres uncommon to rare ..... ***Hippospongia***
(5) Primary fibres form long, simple fascicles ..... ***Rhopaloeides***
Primary fibres are simple, not forming fascicles ..... ***Spongia***

SPONGIA LINNAEUS, 1759

Synonymy

Spongia Linnaeus, 1759: 1119; Schmidt, 1862: 19; de Laubenfels, 1948: 4; Vacelet, 1959: 73; Bergquist, 1980b: 450; Hooper & Wiedenmayer, 1994: 391; Cook & Bergquist, 2001: 34. *Euspongia* Bronn, 1859: 12; Schulze, 1879: 613; Lendenfeld, 1886b: 483; 1889a: 222. *Ditela* Schmidt, 1862: 24.

Type species

Spongia (Spongia) officinalis Linnaeus, 1759 (by subsequent designation; Bowerbank, 1862a).

Definition

Unarmoured spongiids, not heavily lacunose, with simple primary fibres.

Diagnosis

The form of the sponge is variable, but it is usually massive spherical, lamellate, caliculate, or low and spreading. Sponges of the genus *Spongia* are unarmoured, and covered with low, evenly-disposed conules. The surface may be sand encrusted but never heavily or as an organised armour. The consistency is springy and very compressible, supple and elastic. The skeletal network is composed of a reduced number of cored, primary fibres and highly developed, uncored secondary fibres, which gives these sponges their flexibility, water retentive properties. Primaries are usually most obvious near the surface, where they may pierce the pinacoderm and support surface conules. Conules may also be supported by tufts of emergent primary fibres. The anastomosing of secondary fibres produces the skeletal reticulum, that creates a mesh-work of fibres. This mesh is created by the intersection and joining of fibres, and each fibre intersection always has three fibres leading away from it. A number of authors have referred to *Spongia* species as having reduced primary fibres. Evidence of this was observed in specimens of *S. nitens*, but it was not consistent enough within *Spongia* species to qualify as a useful generic character.

Previous reviews

Burton, 1934a; de Laubenfels, 1948; Vacelet, 1959; Bergquist, 1980b; Cook & Bergquist, 2001.

Description of type species

Spongia (Spongia) officinalis Linnaeus (Fig. 1A–C).

Synonymy. *Spongia officinalis* Linnaeus, 1759: 1348; Bowerbank, 1862b: 1119; Burton, 1934a: 576; de Laubenfels, 1948: 4, pl. 1 figs 1–2; Vacelet, 1959: 76, fig. 12; Bergquist, 1965: 127, 1980b: 452, fig. 1d; Cook & Bergquist, 2001: 35. *Spongia adriatica* Schmidt, 1862: 20, pl. 2 fig. 1; 1864: 24; *Euspongia officinalis* var. *adriatica* Schulze, 1879: 619, pl. 34 figs 1–4, pl. 35 fig. 3, pl. 36 figs 5–7, pl. 37 figs 1, 8, pl. 38 figs. 1–7; Lendenfeld, 1889a: 267, pl. 21 figs 6–7, pl. 22 figs 10, 16; *Euspongia officinalis* Schulze, 1879: 616; Lendenfeld, 1889a: 262, pl. 12 fig. 2, pl. 22 figs 6–7, 14. *Spongia officinalis matamata* de Laubenfels, 1954: 4. *Spongia (Spongia) officinalis* Cook & Bergquist, 2001: 35, fig. 1A.

Material examined. Neotype: BMNH 1883.12.4.28 (BMNH 1937.6.10.1–7, slides). Other material. Authors collections, including: SDCC/RF001 (*officinalis*); SDCC/RF006 (*reticulata*); SDCC/ RF044 (*officinalis*); SDCC/RF045 (*nitens*); SDCC/RF046 (*irregularis*); SDCC/RF062 (*zimocca*); SDCC/RF079 (*officinalis*); SDCC/RF080 (*agaricina*); SDCC/RF081 (*officinalis adriatica*); SDCC/RF084 (*nitens*); SDCC/RF089 (*nitens*), SDCC/RF101 (*irregularis jacksonia*); SDCC/RF108 (*officinalis adriatica*); SDCC/RF109 (*zimocca*); SDCC/RF110 (*officinalis adriatica*); SDCC/RF111 (*agaricina*); SDCC/ RF112 (*officinalis mollissima*); SDCC/RF114 (*zimocca*); SDCC/ RF140 (*officinalis adriatica*); SDCC/RF149 (*irregularis* var. *silicata*); SDCC/RF151 (*nitens*?); SDCC/RF153 (*illawarra*); SDCC/RF154 (*illawarra*); SDCC/ RF158 (*officinalis adriatica*).

Description (from Vacelet, 1959, and Castritsi-Catharios, 1998). *Spongia (Spongia) officinalis* is a variable species. The typical variety, *S. (Spongia) officinalis adriatica* Schmidt, which is a common sponge, also displays a wide variety of forms. Vacelet

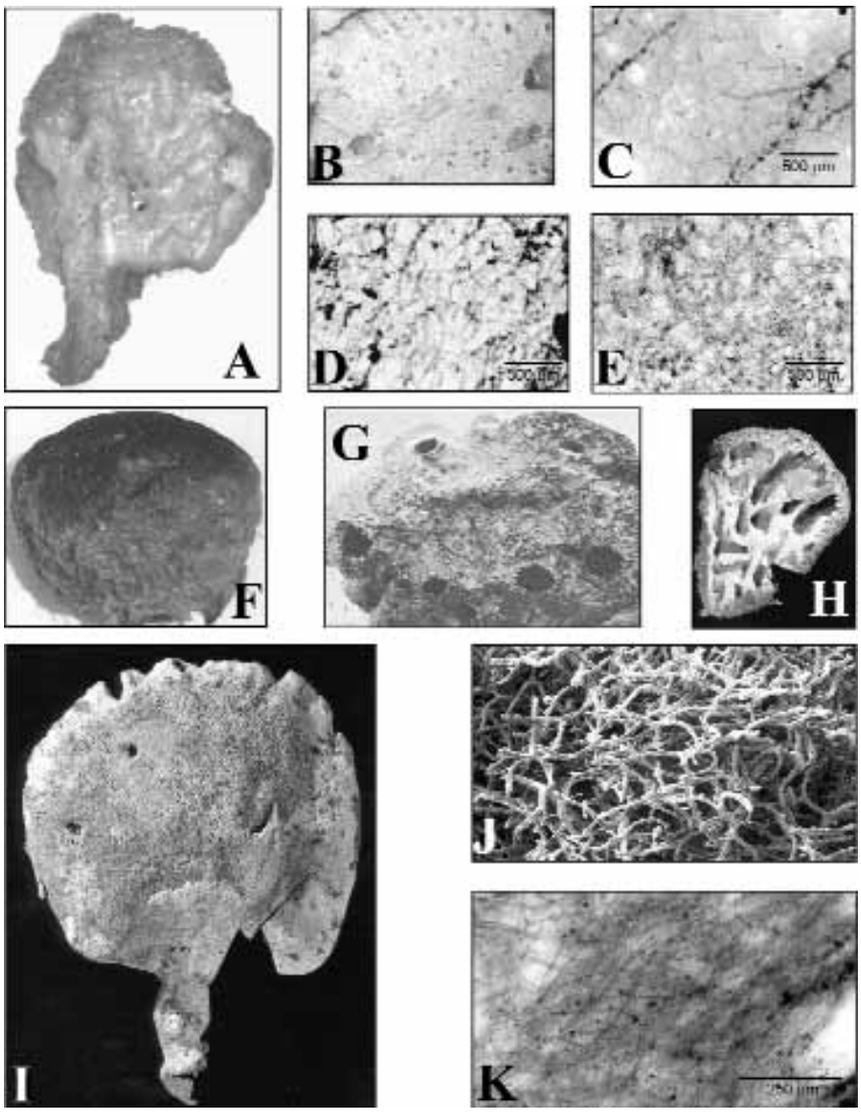

Fig. 1. A–C, *Spongia officinalis*, type of subgenus *Spongia*. A, neotype BMNH 1883.12.4.28. B, internal cross-section. C, skeleton. D, *Spongia (Australospongia) gracilis*, type of subgenus *Australospongia*, skeleton. E, *Spongia (Heterofibria) cristate*, type of subgenus *Heterofibria*, skeleton. F–H, *Hippospongia communis*. F, from Castritsi, 1998. G, from Rützler, 1975. H, internal cross-section, BMNH 1899.5.2.2. I–J, *Coscinoderma lanuginosum*. I, lectotype BMNH 1877.5.21.710. J, lectotype, fibre skeleton. K, *C. mathewsi*, fibre skeleton (from Bergquist, 1995).

(1959), after examining a great number of specimens, found it was impossible to classify these different forms. The most common form appears to be compact and rounded. External colouration ranges from black, through all possible shades of grey, to creamy white. Specimens exposed to light are the darkest in colour. The interior is cream or white, though is often the colour of rust. The consistency is very elastic and supple, with a characteristic velvet texture. The surface is generally smooth, and very finely conulose. Oscules, usually 1–10 per sponge, are irregularly scattered over the sponge, often raised on low turrets. There is sometimes a single large apical oscule up to 1 cm in diameter. Most oscules range from 3–10 mm in diameter. Primary fibres are cored, of irregular diameter (25–45 μm), and often anastomose distally with secondary fibres, giving the impression that primary fibres are produced by coalescing secondary fibres. Secondary fibres are uncored, and 20–35 μm in diameter. Choanocyte chambers are spherical, and 20–30 μm in diameter.

Remarks. The archetypal sponge, *Spongia officinalis*, the first named in the Linnaean classification, has records dating back to ancient Greece. These are also the sponges of commerce, harvested in the Mediterranean, West Indies and the Pacific, to provide natural bath sponges.

Spongia has the greatest number of recorded species of any genus of Dictyoceratida, although the validity of some of these is doubtful. Many of these sponges are variable in form, and are notoriously difficult to characterise uniquely. However, it is clear that there are some skeletal characters which are consistent within groups of species, that may be employed as taxonomic characters. In order to highlight these characters, two subgenera, in addition to the nominal subgenus, have been employed (Cook & Bergquist, 2001).

The genus *Spongia* was formally diagnosed by Linnaeus in 1759. Over the following 100 years or so authors proceeded to assign all species of sponge to *Spongia*. Most of those newly described species are no longer represented by extant specimens, and remain

unrecognisable (de Laubenfels, 1936a). The all-encompassing group was slowly divided into different genera. Bronn (1859) proposed the new name *Euspongia* to replace *Spongia*, giving no reason for the change. Many authors followed this change (e.g., Schulze, 1879; Lendenfeld, 1889; Whitelegge, 1901; Dendy, 1905), until the name *Spongia* was revived by Burton (1934a), as Bronn's action was "contrary to accepted procedure" (Burton, 1934a).

Spongia species are characterised by an unarmoured surface and a fibre skeleton dominated by the secondary fibre reticulum. The fibres making up this reticulum are homogeneous, in contrast to the concentrically laminated fibres of thorectid sponges, and of consistent average diameter, as illustrated here (Fig. 1C) and by other authors (e.g., Bergquist, 1980b: fig. 1d; Gaino & Pronzato, 1989: fig. 3).

The type species is *Spongia officinalis* Linnaeus, 1759. Burton (1934a) selected a specimen (BMNH 1883.12.4.28) of *S. officinalis* var. *adriatica* (Schmidt, 1862) as the neotype of *S. officinalis* and lectotype of *S. officinalis* var. *adriatica*. This rendered var. *adriatica* (now recognised at subspecific rank, as per ICZN Art. 45g) the typical variety of *S. officinalis* as none had been previously designated. This specimen may not have been the ideal choice for the neotype of *S. officinalis* because this variant was not collected from the original type locality (Anon., 1999). For this reason, Hooper & Wiedenmayer consider this neotype designation is unjustified.

Spongia species are very difficult, if not impossible, to distinguish solely on skeletal morphology. However, there are some skeletal characteristics which are consistent across groups of species. The species described from New Zealand (Cook & Bergquist, 2001) all have an unarmoured surface and a skeleton which is dominated by its secondary fibre reticulum, characters which are consistent with *Spongia*. However, within the dominant sub-primary fibre network of most of these species, there are fibres which are distinctly finer than the secondary fibres. These could be considered tertiary fibres, but they are not as fine as those seen in genera characterised by the presence of tertiary fibres, e.g., the thorectid *Luffariella*. Tertiary fibres are recognised as fibres of very small diameter in relation to the secondary fibres, which form a fine mesh-work within the meshes formed by the secondary fibre reticulum. Within the dominant fibre reticulum of most of the New Zealand species, larger diameter fibres are referred to as secondary fibres and the smaller diameter fibres as pseudo-tertiary fibres. The pseudo-tertiary fibres are not restricted to the meshes of the secondary fibre reticulum, nor are they particularly fine in relation to secondary fibre diameter. Fifty four species are known worldwide, although probably not all of these are valid. An assessment of the validity of these taxa would require other (e.g., non-morphometric) evidence.

Distribution

Mediterranean (type locality), Australia, Indo-Pacific, West Indies, Japan, New Zealand, Red Sea, Scandinavia, South Africa, Subantarctic region.

KEY TO SUBGENERA

(1) Sub-primary fibres of uniform diameter 2
Sub-primary fibres display a clear size dichotomy, into secondary and pseudo-tertiary elements ..... ***Heterofibria***
(2) Regular sub-primary fibre skeleton, with regular polygonal skeletal meshes ..... ***Spongia***
Irregular sub-primary fibre skeleton, with more angular skeletal meshes ..... ***Australospongia***

SUBGENUS *SPONGIA* LINNAEUS, 1759

Synonymy

Spongia (Spongia) Linnaeus, 1759: 1119.

Type species

Spongia (Spongia) officinalis Linnaeus, 1759 (by subsequent designation; Bowerbank, 1862b).

Definition

Spongia species characterised clearly by *S. officinalis*, which has a relatively regular secondary fibre reticulum.

Diagnosis

The fibres are of uniform diameter, and the meshes formed by the reticulum are relatively regular, polygonal and similar in size. Primary fibres are of similar diameter to secondary fibres.

Description of type species

Spongia (Spongia) officinalis Linnaeus (Fig. 1A–C).
Synonymy. As for genus *Spongia*.
Material examined. As for genus *Spongia*.
Description. As for genus *Spongia*.
Remarks. Forty seven species have been described.

Distribution

As for genus *Spongia*.

SUBGENUS *AUSTRALOSPONGIA* COOK & BERGQUIST, 2001

Synonymy

Spongia (Australospongia) Cook & Bergquist, 2001.

Type species

Spongia (Australospongia) gracilis Cook & Bergquist, 2001 (by original designation).

Definition

Spongia species characterised by their relatively dense, irregular secondary fibre skeleton, which does not form the clean, regular, polygonal meshes seen in the subgenus *Spongia*.

Diagnosis

The primary fibres in sponges of this subgenus, may also be significantly larger in diameter than the secondary fibres. Secondary fibres are uniform in diameter, in contrast to those of the subgenus *Heterofibria*.

Description of type species

Spongia (Australospongia) gracilis Cook & Bergquist (Fig. 1D).

Synonymy. *Spongia (Australospongia) gracilis* Cook & Bergquist, 2001: 35, figs 1B, 2, 9C.

Material examined. Holotype: SDCC/NZ115 – NIWA Oceanographic Collection, Wellington.

Description. This species is long, thin, and ramose, with some branches interlocking. Branches are roughly cylindrical, and 5–10 mm in diameter, tapering distally. The sponge surface is dusted with sand and debris, and is finely and abundantly conulose, with fine fibres protruding slightly from the tip of each conule. Oscules are 1–2 mm in diameter, occasionally on low, turret-like structures, or simply on a slightly raised area of the sponge surface, capped by the oscule opening. Very fine pores, <1 mm in diameter, are scattered irregularly over the sponge surface. The sponge is moderately firm, and compressible. The holotype is in four pieces, all of which are damaged and in poor condition. The longest intact branch is 315 mm long. Primary fibres, 78–243 μm in diameter, radiate through the mesohyl to emerge at the surface in fine conules. Primary fibres are cored, though coring is intermittent, and coring material may be much larger than the fibre diameter, resembling a beaded necklace. The skeleton is dominated by a relatively dense tangle of secondary fibres, 8–34 μm in diameter, but does not form the regular, consistently polygonal-shaped skeletal meshes seen in *S. (S.) officinalis*. There are also occasional thin, undivided fibres winding through the otherwise anastomosing skeleton.

Remarks. The thin, branching, ramose form of this sponge is unique amongst known *Spongia* worldwide. The sub-primary fibre skeletal reticulum is clearly denser and more irregular than the more open and relatively regular, polygonal secondary fibre reticulum of *S. (S.) officinalis*. One species is known so far.

Distribution

Chatham Rise (type locality).

SUBGENUS *HETEROFIBRIA* COOK & BERGQUIST, 2001

Synonymy

Spongia (Heterofibria) Cook & Bergquist, 2001.

Type species

Spongia (Heterofibria) cristata Cook & Bergquist, 2001 (by original designation).

Definition

Spongia species distinguished by a distinct size dichotomy between the elements of the sub-primary fibre skeleton.

Diagnosis

Spongia species in which the dominant sub-primary fibre reticulum is clearly divisible into two different size classes, the smaller approximately 40–50% less in diameter than the larger. The meshes formed by the fibre skeleton are usually polygonal, though irregular in size and shape, and less angular than those seen in the subgenus *Spongia*.

Description of type species

Spongia (Heterofibria) cristata Cook & Bergquist (Fig. 1E).

Synonymy. *Spongia (Heterofibria) cristata* Cook & Bergquist, 2001: 37, figs 1C, 3, 9D.

Material examined. Holotype: NMNZ Por.438. Paratypes: SDCC/NZ029; SDCC/NZ040.

Description (from Cook & Bergquist, 2001). Irregular, low and encrusting to massive forms, consisting of upright lobes and conical turrets. The pinacoderm is translucent, giving the sponge a slightly glossy sheen like smooth wet rubber, and stretches between emergent fibre tufts. Low turrets occur irregularly over the sponge surface, with terminal oscules 3–5 mm in diameter. Other pores, 2–3 mm in diameter, are scattered over the whole sponge surface. The consistency is moderately firm, compressible and rather rubbery. This sponge is easily torn, almost brittle, and there is a slight odour when it is cut or damaged. Colour is translucent pale khaki-grey externally and pale grey-brown internally, in both alcohol and in life. Sand is lightly scattered throughout the mesohyl, with a slight dermal concentration of fine sand and spicule debris. The holotype is 85 mm long × 35–55 mm wide × 20–40 mm high. The skeleton consists of homogeneous primary, secondary and pseudo-tertiary fibres. Primary fibres are sparse, and are irregularly cored with foreign material. Secondary and pseudo-tertiary fibres are uncored and dominate the skeleton. The fibre network increases in density as the fibres converge towards the surface and form primary fibres, that often branch before they emerge through the surface of the sponge. The meshes of the secondary fibre reticulum are irregular in size, and are irregularly polygonal. Pseudo-tertiary fibres are not restricted to forming networks within single meshes of the secondary fibre reticulum, as seen in *Luffariella*, but interconnect with adjacent secondary fibres. Primary fibres are 29–78 μm in diameter, secondary fibres are 17–42 μm in diameter and pseudo-tertiary fibres are 4–17 μm in diameter. If secondary and pseudo-tertiary fibres are considered together, the fibres have an average diameter of 21 μm. There are significant collagen deposits within the mesohyl surrounding groups of canals, but only minor deposits of collagen at the surface. Choanocyte chambers are diplodal, spherical in shape, and 26–39 μm in diameter.

Remarks. Six species are known.

Distribution

Leigh (type locality), Northland, New Zealand.

HIPPOSPONGIA SCHULZE, 1879

Synonymy

[*Ceratodendron*] Marshall, 1877: 187. *Hippospongia* Schulze, 1879: 614; Lendenfeld, 1889: 280; Bergquist, 1980b: 452; Hooper & Wiedenmayer 1994: 381; Cook & Bergquist, 2001: 53, fig. 11A–C. *Aphrodite* Lendenfeld, 1886a: 306. [*Hippiospongia*] de Laubenfels,

1936a: 11; 1948: 25 (unnecessary replacement name; see Hooper & Wiedenmayer, 1994: 381).

Type species

Spongia equina Schmidt, 1862 (by monotypy).

Definition

These unarmoured spongiids are characteristically lacunose. Primary fibres are uncommon to rare, and surface conules are usually produced by a tuft of emergent fibres. They are elastic and compressible.

Diagnosis

Spongiidae with a highly-developed fibre network characterised by the almost complete absence of primary fibres, which occur only superficially, and may be lightly cored. The tangled network of uncored secondary fibres forms the skeleton, which is supple and elastic. Species of *Hippospongia* are characterised by cavernous construction throughout (Fig. 1H), formed by numerous surface lacunae covered by pinacoderm and large diameter oscules (Fig. 1G) which maintain their diameter into the body of the sponge. The surface is conulose, each conule formed by one to several emergent fibres, forming a tuft or brush. When the skeleton is macerated and dried, the sponges appear coarsely hirsute, in contrast to the finely conulose surface of *Spongia* species. These sponges are dark-pigmented, and are never armoured.

Previous reviews

Vacelet, 1959; Cook & Bergquist, 2001.

Description of type species

Hippospongia communis (Lamarck) (Fig. 1F–H).

Synonymy. *Spongia communis* Lamarck, 1814: 370. *Spongia equina* Schmidt, 1862: 23, pl. 3 fig. 5. *Euspongia equina* Schmidt, 1868: 4. *Hippospongia equina* Lendenfeld, 1889: 302. *Hippiospongia communis* de Laubenfels, 1948: 30. *Hippospongia communis* Vacelet, 1959: 80–81; Bergquist, 1980b: 452, fig. 5b. *Hippospongia kerion* de Laubenfels & Storr, 1958: 116, figs 3–4.

Material examined. Holotype: Unknown. Other material. *H. communis* – BMNH 1899.5.2.2. Authors collections, including: SDCC/RF085 (*communis*); SDCC/RF113 (*communis*).

Description (from Vacelet, 1959 and Castritsi-Catharios, 1998). Massive, compact, and usually roughly spherical, though their shape may be influenced by water currents. Occasional specimens may have oscules grouped at the apex of a turret. These sponges are on average 15–25 cm in diameter. The colour is blackish grey, becoming paler where shaded, and the interior is cream-coloured or off-white. Vacelet (1959) recorded some rust-coloured specimens. This colouration has been observed by the authors in other members of the Dictyoceratida, and does not appear to be restricted to the Spongiidae, or for that matter, to particular species. It is due to the occurrence of lepidocrocite granules, as commonly seen in some New Zealand irciniids (Cook & Bergquist, 1999), the amount of which is highly variable according to environmental conditions and possibly the age of the sponge (Vacelet *et al*., 1988). The surface is normally coarsely conulose, but sometimes conules may be rare, localised around the oscules, or even absent. Oscules are numerous and of large, but variable diameter, either distributed haphazardly over the sponge, or arranged in groups of five or six. The consistency is firm and elastic. When macerated, its surface appears very irregular and furrowed with deep depressions and lacunae. The body of the sponge is also traversed with large circular canals, often attaining more than 2 cm in diameter. Primary fibres are rare, cored with foreign debris, and terminate in surface conules. They range in diameter from 60–100 μm, anastomosing with secondary fibres away from the sponge surface. Secondary fibres measure 20–30 μm in diameter, and form a very dense network.

Remarks. This genus contains 'classic' members of the Spongiidae, used as commercial bath sponges. Unfortunately this genus has been misinterpreted by a number of authors (e.g., Lendenfeld, 1889), such that *Hippospongia* came to represent a range of species which were only subdermally lacunose, rather than the combination of surface lacunae and large diameter oscular canals, which characterise the type species *H. communis*. As recently revised (Cook & Bergquist, 2001), *Hippospongia* comprises only three species, *H. communis* from the Mediterranean, and *H. gossypina* (Duchassaing & Michelotti, 1864) and *H. lachne* (de Laubenfels, 1936a), from the West Indies. The generic assignment of species other than the three valid species of *Hippospongia*, remains undetermined.

Species of *Hippospongia* are often confused with those of *Hyattella*. The latter genus has a coarse texture and abundant primary fibres, whereas *Hippospongia* is elastic and compressible with very few primary fibres.

Distribution

Mediterranean (type locality), West Indies.

COSCINODERMA CARTER, 1883

Synonymy

Coscinoderma Carter, 1883b: 309; Bergquist, 1980b: 458; Hooper & Wiedenmayer 1994: 380.

Type species

Coscinoderma lanuginosum Carter, 1883b (by monotypy).

Definition

Armoured spongiid, with characteristic very fine secondary fibres.

Diagnosis

Flabellate, pyriform, massive, or pedunculate sponges, with apical or marginal oscules. The surface armour is thin, very fine and even, so that these sponges remain soft, elastic and compressible. The fibre skeleton comprises simple, cored primary fibres, and a dense secondary reticulum, comprising very fine, intertwined secondary fibres (Fig. 1K).

Previous reviews

Bergquist, 1980b; Hooper & Wiedenmayer, 1994.

Description of type species

Coscinoderma pesleonis (Lamarck). (Fig. 1I–J).

Synonymy. *Spongia pesleonis* Lamarck, 1814: 379. *Coscinoderma lanuginosum* Carter, 1883b: 309; Lendenfeld, 1889a: 332, pl. 12 fig. 11, pl. 20 fig. 11. *Spongelia incerta* Hyatt, 1877: 533, pl. 16 fig. 32. *Coscinoderma pyriforme* Lendenfeld, 1889c: 334; 1889a: 334. *Coscinoderma pyriformis* Lendenfeld, 1889c: 38. *Coscinoderma pesleonis* Topsent, 1930: 33, fig. 3, pl. 1 fig. 6; Bergquist, 1980b: 456, figs 6e–f; Wiedenmayer, 1989: 128, 130, pl. 14 figs 7, 9, figs 85–88. *Phyllospongia lanuginosum* de Laubenfels, 1948: 127. *Phyllospongia pesleonis* de Laubenfels, 1948: 22.

Material examined. Lectotype: BMNH Bowerbank collection 710 (*lanuginosum*). Holotype of *S. pesleonis*: MNHN LBIM DT 540. Authors collections, including: SDCC/RF048 (*mathewsi*); SDCC/RF077 (*mathewsi*); SDCC/RF078 (*mathewsi*); SDCC/RF152 (*pesleonis*).

Description (from Carter, 1883b, and Wiedenmayer, 1989). This species is stalked or compressed-pedunculate, distally globular, pyriform, or thickly flabellate. The surface is smooth, visibly sandy in life, and pale coloured. Oscules are commonly elevated, forming apical and lateral crests, and are also scattered on the sides of the sponge. Primary fibres are regularly-spaced, cored with foreign debris, and are 55–80 μm in diameter. Secondary fibres are uncored, long and tangled, occasionally anastomosing with other secondary fibres, giving rise to Carter's (1883b) reference to their "wool-like character", and are around 32 μm in diameter. The consistency is soft and compressible.

Remarks. Four species are described, all of which have spongin fibre of commercial quality ('bath sponges').

Distribution

Australia (type locality), Hawaii, New Caledonia, West Indies (the West Indian record, for *C. lanuga* de Laubenfels, is likely to be a *Spongia* species, although this is unverified).

HYATTELLA LENDENFELD, 1888

Synonymy

Hyattella Lendenfeld, 1888: 233; de Laubenfels, 1948: 36; Bergquist, 1980b: 452; Hooper & Wiedenmayer 1994: 384. *Luffariospongia* Burton, 1937: 41. *Trypespongia* de Laubenfels, 1936a: 13.

Type species

Hircinia clathrata Carter, 1881b (by monotypy).

Definition

Unarmoured spongiid, with a lacunose body. Primary fibres are common, and there is a surface fibre network. These sponges are elastic and compressible.

Diagnosis

These sponges produce upright, tubular or low, spreading forms. Some species are buried in the substratum, with oscule bearing fistules protruding from the sediment. The surface is unarmoured and conulose. The whole sponge is often very lacunose, both through the sponge body and across the surface (Fig. 2A–C). The fibre skeleton comprises regularly spaced, cored primary fibres and a dense, regular network of uncored secondary fibres (Fig. 2D). There is also a fine-meshed, tangential, dermal fibre reticulum. The consistency is firm and compressible, with a coarse texture. Typically pale yellow to orange-brown.

Previous reviews

Bergquist, 1980b; Hooper & Wiedenmayer, 1994.

Description of type species

Hyattella intestinalis (Lamarck) (Fig. 2A).

Synonymy. *Spongia intestinalis* Lamarck, 1814: 439. *Hircinia clathrata* Carter, 1881b: 366. *Hippospongia anomala* Poléjaeff, 1884: 54: pl. 6 fig. 2, pl. 7. *Hyattella clathrata* Lendenfeld, 1888: 233; 1889c: 21; 1889a: 115, pl. 12 figs 15–16, pl. 20 fig. 4; Bergquist, 1980b: 452, fig. 5c. *Hyattella intestinalis* Lendenfeld, 1889a: 116, pl. 20 fig. 6; de Laubenfels, 1948: 41; Bergquist, 1980b: 452, 454, figs 4d–e, 5c. *Hyattella murrayi* Lendenfeld, 1889a: 120. *Hyattella tubaria* Lendenfeld, 1889c: 21; 1889a: 117, pl.15 fig. 3. *Stelospongia kingii* Lendenfeld, 1889c: 52; 1889a: 494.

Material examined. Holotype of *S. intestinalis*: MHNH LBIM DT 584. Other material. *H. intestinalis* BMNH 1883.2.22.19; *H. clathrata* BMNH 1930.8.13.158; *H. sinuosa* BMNH 1882.10.17.29. Authors collections, including: SDCC/RF056 (*sinuosa*).

Description (from Lendenfeld, 1888). The sponge appears in the form of a massive encrustation, from the upper surface of which short and thick processes arise. These may remain isolated and ramose or coalesce in many places, thus forming an irregular reticulation, or lamellae, producing a cup. These sponges are generally higher than broad, and extend distally, in caliculate forms, producing an irregular margin, and a cup which is always deeper than broad. The digitate branches of ramose forms are 15–20 mm in diameter, and the wall of the cup in caliculate specimens are of similar diameter. The surface is finely conulose. The dry skeleton is very hard, and only slightly compressible. This species is known to reach 200 mm high, and 180 mm across. The fibre skeleton consists of a very dense network. The primary fibres are 100 μm in diameter, and contain very little coring. Secondary fibres are 42 μm in diameter, producing polygonal or roughly circular meshes.

Remarks. Seven species are known.

Distribution

Indian Ocean (type locality), Australia, Indo-West Pacific, Sri Lanka, Japan, Red Sea, West Indies.

LEIOSELLA LENDENFELD, 1888

Synonymy

Leiosella Lendenfeld, 1888: 120; 1889a: 201; de Laubenfels, 1948: 59; Bergquist, 1980b: 458; Hooper & Wiedenmayer, 1994: 386.

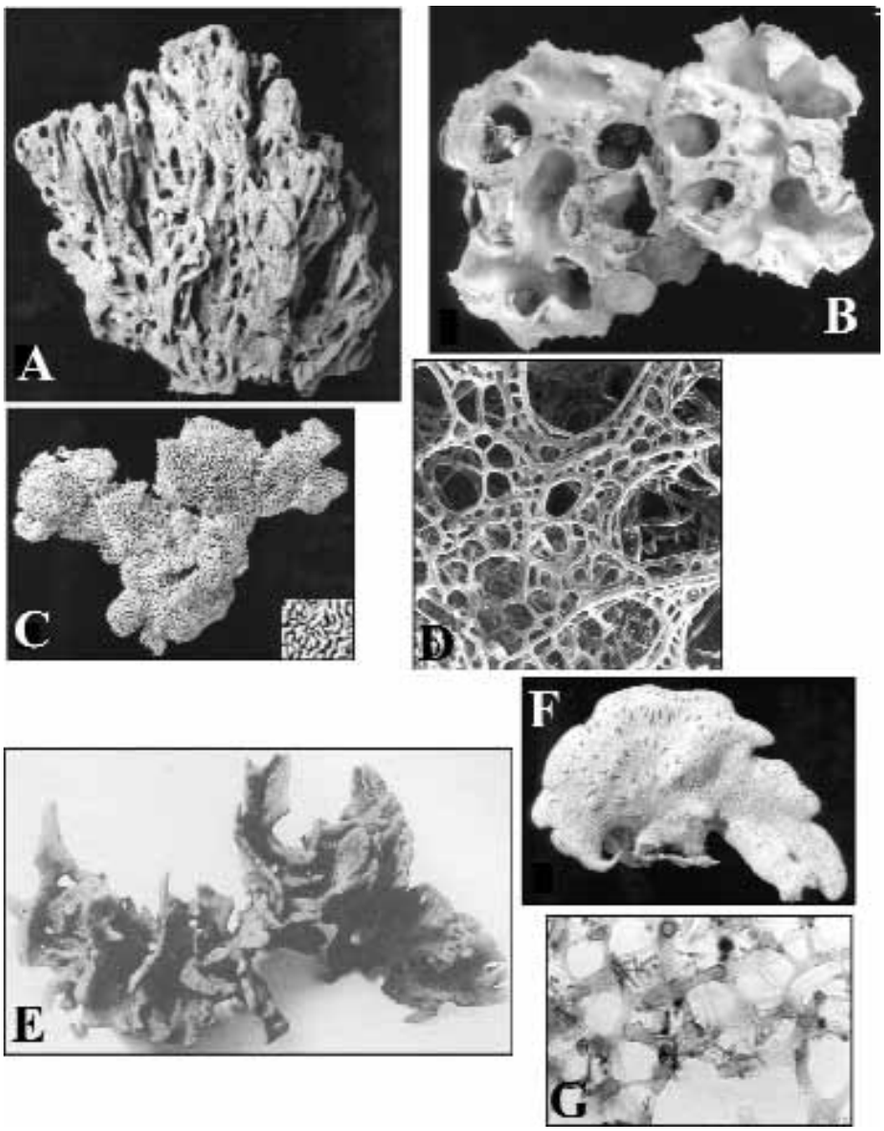

Fig. 2. A–D, *Hyattella*. A, *Hyattella intestinalis*, BMNH 1883.2.22.19. B, *H. clathrata*, internal view, BMNH 1930.8.13.158. C, *H. sinuosa*, BMNH 1882.10.17.29, inset of surface detail. D, fibre skeleton, BMNH 1882.10.17.29. E–G, *Leiosella levis*. E, from Lendenfeld, 1889. F, BMNH 1925.11.1.633. G, fibre skeleton, BMNH 1886.8.27.319.

Type species

Euspongia levis Lendenfeld, 1886b (by subsequent designation; Hooper & Wiedenmayer, 1994).

Definition

Lightly armoured spongiids, with a dense secondary skeleton of characteristically thick fibres.

Diagnosis

Caliculate, lobed, flabellate or ramose sponges, with a thin, regular sand armour. Primary and secondary fibres make up the fibre skeleton. Primary fibres are usually lightly cored and may be fascicular where they form out of the secondary skeleton, or just below the sponge surface. The fibre skeleton is dominated by the characteristic dense secondary reticulum of thick fibres (Fig. 2G). The consistency of these sponges is firm and compressible.

Previous reviews

Bergquist, 1980b; Hooper & Wiedenmayer, 1994; Bergquist, 1995.

Description of type species

Leiosella levis (Lendenfeld) (Fig. 2E–G).

Synonymy. *Euspongia levis* Lendenfeld, 1886b: 536, pl. 36 fig. 2; *Leiosella levis* 1888: 121; 1889a: 213, pl. 12 fig. 14, pl. 15 fig. 6, pls 20, 14; Bergquist, 1980b: 458, fig. 7a–c; Hooper & Wiedenmayer, 1994: 387.

Material examined. Lectotype: BMNH 1886.8.27.319 (slide AM G3702). Other material. Specimen BMNH

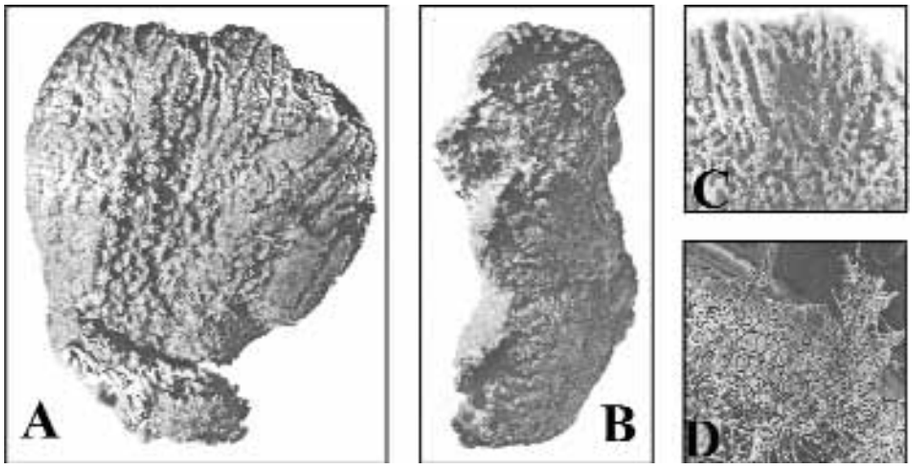

Fig. 3. A–D, *Rhopaloeides odorabile*. A, holotype, AM Z4965. B, apical view showing oscular arrangement. C, surface of dry specimen showing fasciculate primary fibre tufts and prominent exhalant canals. D, SEM of surface skeleton with primary fibre fascicules in relation to secondary fibre skeleton (from Thompson *et al*., 1987).

1925.11.1.633. Authors collections, including: SDCC/RF043 (*levis*); SDCC/RF064 (*levis*); SDCC/RF075 (*levis*).

Description (from Lendenfeld, 1888). Very irregular, ramose, horizontally extending sponges, which are composed of numerous compressed, irregularly curved fronds or lamellae, the free margins of which are rounded and divided by broad incisions into lobose or digitate parts. These lamellae grow out from an extended base attached at several points. The sponge attains a length of 200 mm, a breadth of 120 mm, and a height of 70 mm. Lamellae are uniformly 8–10 mm thick. The surface is smooth. Slightly elevated oscules are situated mainly on the free margins, where they form an irregular row; a few also occur on the lamellae faces. The living sponge is dirty greyish brown. The fibre skeleton is an irregular reticulum of primary and secondary fibres. Primary fibres are joined to a surface network of irregularly cored fibres. They are 70 μm in diameter, and are irregularly cored with foreign debris. Secondary fibres are 18–27 μm in diameter and uncored.

Remarks. *Leiosella elegans* Lendenfeld, 1889 was designated as type species by de Laubenfels (1936a). This was unfortunate and is considered invalid as a subsequent designation because *L. elegans* was described a year later than the genus *Leiosella* Lendenfeld, 1888. Consequently, Hooper & Wiedenmayer (1994) designated *L. levis* Lendenfeld, 1888 as the type species. In any case, the genus is better typified by *L. levis*, as indicated by Bergquist (1980b). Eight species are known.

Distribution

New South Wales (type locality), Australia, East Pacific, South Africa.

RHOPALOEIDES THOMPSON, MURPHY, BERGQUIST & EVANS, 1987

Synonymy

Rhopaloeides Thompson, Murphy, Bergquist & Evans, 1987: 595; Hooper & Wiedenmayer, 1994: 390.

Type species

Rhopaloeides odorabile Thompson, Murphy, Bergquist & Evans, 1987 (by monotypy).

Definition

Spongiidae with the texture and fibre quality of *Spongia* in which the cored primary fibres form simple fascicles.

Previous reviews

Thompson *et al*., 1987; Hooper & Wiedenmayer, 1994.

Diagnosis

Massive, upright sponges, with thick tuberculate conules on an unarmoured surface. These sponges could easily be mistaken for *Spongia* species, but are distinguished by the presence of fasicular primary fibres, particular near the sponge surface.

Description of type species

Rhopaloeides odorabile Thompson, Murphy, Bergquist & Evans (Fig. 3A–D).

Synonymy. *Rhopaloeides odorabile* Thompson, Murphy, Bergquist & Evans, 1987: 595–606, figs 2–6.

Material examined. Holotype: AM Z4965.

Description. The sponge is massive, erect in the form of thick, broad-based lamellae or of multiple, fused, thick clubs, up to 35 cm high. The surface conules are thick, tuberculate rather than pointed, and simple as in species of *Spongia*, each one is supported by several fibre tracts. Oscules have a prominent oscular membrane. This membrane, and the pinacoderm immediately inside the oscules, is dark brown to black. The general exterior is beige through reddish brown to pale or dark grey. The surface is clear of detritus and not armoured by development of a sand cortex. The presence of primary fibre fascicles is evident throughout the sponge but is most pronounced near and at the surface where the fasciculate fibre whorls dominate as skeletal elements

and support prominent surface conules (Fig. 3D). The secondary skeleton is comparable to that of *Spongia* but is more compact. Fasciculate primary fibres display an erratic distribution through the sponge, and are typically 50–100 μm across. Choanoctye chambers are spherical, and 15–25 μm in diameter.

Remarks. Monospecific.

Distribution

Great Barrier Reef (type locality), Australia.