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Family Irciniidae Gray, 1867

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Irciniidae Gray (Demospongiae, Dictyoceratida) consists of three valid genera, with approximately 72 species described worldwide. Irciniids are readily identified by the presence of very fine collagenous filaments with beaded ends in the mesohyl, which supplement the fibre skeleton. The abundance of these filaments varies between species, but this is not a significant diagnostic generic character. Genera are distinguished by the presence of a cortical armour, the degree of primary fibre fasciculation, and the presence of a foreign debris core within these fibres.
Keywords: Porifera; Demospongiae; Dictyoceratida; Irciniidae; *Ircinia*; *Sarcotragus*; *Psammocinia*.

DEFINITION, DIAGNOSIS, SCOPE

Synonymy

Hirciniadae Gray, 1867a. Hircinidae Lendenfeld, 1886a. Irciniidae Bergquist, 1995.

Definition

Dictyoceratida with fine collagenous filaments in the mesohyl in addition to the fibre skeleton.

Diagnosis

Irciniids are massive, or occasionally spreading, encrusting sponges, which display a wide range of forms across the three genera, including low and pad-like, large and cushion-like, caliculate to lamelliform, lobate and digitate. The surface is usually conulose, though in forms which have an organised sand armour, the surface can be micro-conulose, tuberculate or smooth. Genera of the Irciniidae possess pithed and concentrically laminated, primary and secondary fibres. Primary fibres may often incorporate a core of foreign material, and can form complex, often massive fascicles, particularly in species of *Ircinia*. Secondary fibres are usually uncored, though foreign inclusions may occur in some species. Unique to the Irciniidae are fine collagenous, terminally-enlarged spongin filaments that supplement the fibre skeleton. When present in sufficient quantities, these filaments make the sponges very difficult to tear. All genera have spherical to oval, diplodal choanocyte chambers, and the mesohyl is lightly to moderately infiltrated with collagen.

Scope

The family includes three valid genera, with 72 described species. A checklist of described irciniid species is available on the internet (Cook, 2001).

History and biology

Until approximately 20 years ago, the family Spongiidae incorporated most of the genera now comprising the Spongiidae, Irciniidae and Thorectidae. Irciniidae was established as Hirciniadae Gray, 1867a, used by Lendenfeld (1886a) as Hircinidae and was then absorbed back into Spongidae (now spelt as Spongiidae) by Lendenfeld (1888, 1889a). Thorectidae was erected by Bergquist (1978) to accommodate those sponges with distinctly laminated and pithed fibres, which included *Ircinia* and the other filamentose genera. Bergquist (1980b) revised the Dictyoceratida to include three families: Spongiidae, Thorectidae and Dysideidae. However, her inclusion of *Ircinia* in the Thorectidae contravened the rules of the International Code of Zoological Nomenclature (ICZN Art. 40) regarding the priority of Irciniidae Gray, 1867a over Thorectidae Bergquist, 1978. By including the genera *Ircinia* and *Thorecta* (type genera of Irciniidae and Thorectidae, respectively) within a single taxon, the name Irciniidae had seniority. This was corrected by Hooper & Wiedenmayer (1994), where they used Irciniidae in place of Thorectidae. Bergquist (1995) assigned the three filamentose genera, *Ircinia, Sarcotragus*, and *Psammocinia*, to the family Irciniidae, leaving all the non-filamentose dictyoceratids with laminated fibres and diplodal choanocyte chambers to Thorectidae.

Most irciniid species inhabit diving depths (0–60 m), though some specimens have been collected in excess of 400 m (e.g., Cook & Bergquist, 1999). Irciniids have been recorded from tropical to temperate regions, with one species recorded from subantarctic waters (Cook & Bergquist, 1999).

Remarks

Once a sponge has been identified as a member of the Irciniidae, essentially by the possession of fine collagenous filaments in the mesohyl, they are easily assigned to genera, though not always to species. The presence of an organised sand-armoured crust distinguishes *Psammocinia* from *Ircinia*, while the third genus, *Sarcotragus* is distinguished from both by the absence of a sand armour, the presence of fine interstitial filaments and lack of foreign coring in the fibres. It should be noted that while *Sarcotragus* is currently maintained as a valid taxon, its status is viewed as uncertain. The genus is due for future review, when better material from the Mediterranean and Australia becomes available.

Previous reviews

Bergquist, 1980b; Hooper & Wiedenmayer, 1994; Bergquist, 1995; Cook & Bergquist, 1998; Cook & Bergquist, 1999.

KEY TO GENERA

(1) Dermis unarmoured (although surface may be covered with sparse sand) 2
Dermis armoured (with a thick crustose layer of foreign debris) ..... ***Psammocinia***
(2) Primary fibres form massive fascicles, which are often cored with foreign debris ..... ***Ircinia***
Primary fibres fascicular, uncored, or with coring light and intermittent ..... ***Sarcotragus***

IRCINIA NARDO, 1833

Synonymy

Ircinia Nardo, 1833: 519; Vacelet, 1959: 89; Bergquist, 1980b: 468. *Hircinia* Nardo, 1834: 714. *Stematumenia* Bowerbank, 1845b: 406. *Filifera* Lieberkühn, 1859: 353; Schmidt, 1862: 30. *Polytherses* Duchassaing & Michelotti, 1864: 67. *Euricinia* Lendenfeld, 1889a: 554; Lendenfeld, 1889c: 58. *Hircinella* Lendenfeld, 1889a: 564.

Type species

Spongia fasciculata Pallas, 1766, *sensu* Schmidt, 1862 (by subsequent designation; de Laubenfels, 1948).

Definition

Unarmoured Irciniidae with massive fascicular primary fibres, cored with foreign debris.

Diagnosis

Species of *Ircinia* display a wide range of forms, with an unarmoured, conulose surface, and a skeleton of primary and secondary fibres, and filaments (Fig. 1C–D). Primary fibres are cored with foreign debris, and form massive fascicles. Secondary fibres are simple and uncored. The consistency of these sponges is soft to firm, though they are extremely tough, and are often difficult to cut or tear. Species of *Ircinia* also typically have a strong, pungent, sulphurous smell.

Previous reviews

De Laubenfels, 1948; Van Soest, 1978; Bergquist, 1980b; Hooper & Wiedenmayer, 1994; Cook & Bergquist, 1999.

Remarks

Ircinia is a large genus, the result of providing a catch-all for any unarmoured irciniid with cored fibres. The plastic nature of these species, in terms of overall morphology, has caused difficulty

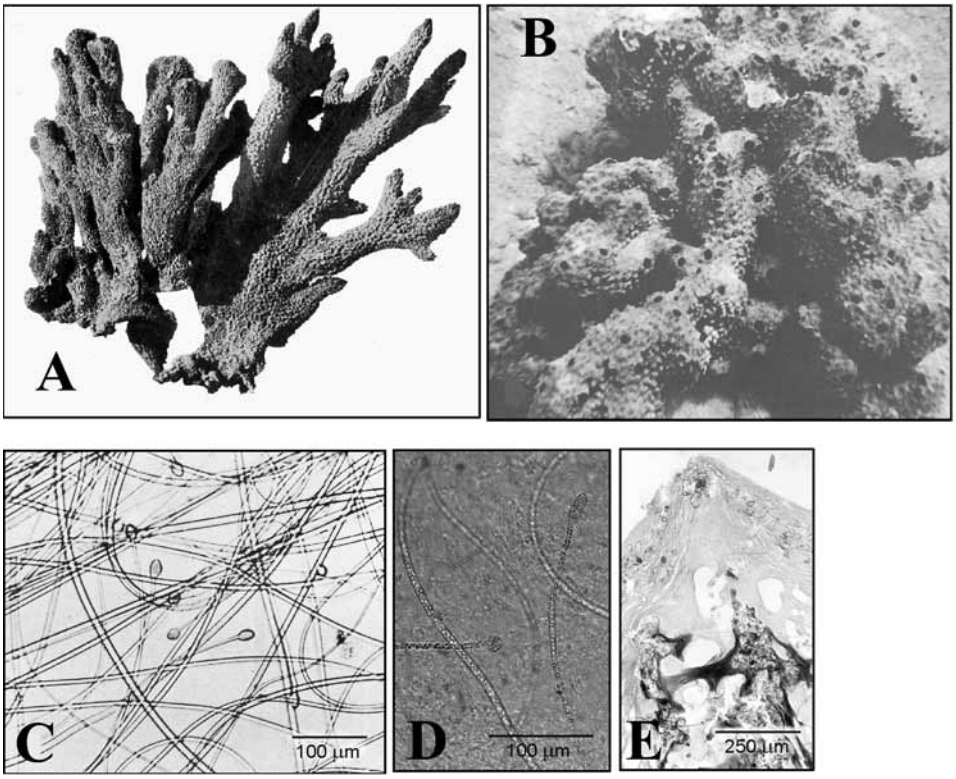

Fig. 1. *Ircinia*. A, *Ircinia ramosa* (left) and *I. fasciculata* (right) (from de Laubenfels, 1950). B, *I. felix* (from Wiedenmayer, 1977b). C, fine filaments unique to irciniids. D, filaments encrusted with lepidocrocite granules. E, *I. akaroa*, surface debris present but not forming an organised crust.

in separating species not only within a geographic region but also on a global scale.

Ircinia species are easily recognised by the presence of fine filaments in the mesohyl, strong primary fibre fascicles, the foreign coring in primary fibres and an unarmoured cortex (Fig. 1F). The interpretation of characters by different authors has led to the incorrect generic assignment of some species. For example, it has been shown that at least some *Ircinia* species should be reassigned to the closely related, but distinct genus *Psammocinia* (Cook & Bergquist, 1998). There are likely to be other species within *Ircinia* which do not belong to that genus, but the morphological evidence for correctly identifying them remains elusive. It is not easy to ascertain the structural organisation of these sponges, because of the irregularly disposed fibre skeleton, or to detect consistent differences in detail which easily distinguish species and possibly subgeneric and generic groups. The inherent ecomorphic variation associated with *Ircinia* is clearly also part of the problem. This is confounded by many poor descriptions of new species, not only historically, but in more recent work as well. Historical descriptions based on dry specimens are often insufficient as surface features change, and internal morphological detail cannot be determined when the sponges are dried. Also, in many parts of the world where *Ircinia* is a common genus, few species have been verified from living material since their original descriptions.

Ircinia was established by Nardo in 1833, with only a brief description. Nardo did not describe any species, but did include a list of names, all of which are considered *nomina nuda* (de Laubenfels, 1948). In 1834, Nardo changed the name *Ircinia* to *Hircinia*, which is classically more correct, but in contravention of standard nomenclatural practice. Unfortunately, most authors subsequently used this erroneous name. In 1934, Burton, still using *Hircinia*, designated Nardo's name, *I. spongiastrum*, as the generic type, but as it was *nomen nudum*, the designation was invalid.

The first species actually described as an *Ircinia* was the Mediterranean *Spongia fasciculata* Pallas, 1766, by reassignment to *Filifera (Hircinia)*, by Schmidt (1862). Schmidt indicated that it was his own new species, with *S. fasciculata* Esper in synonymy, but the description clearly comes from the re-description of Pallas's species by Esper (1794 [1791–1799]), and was hence, merely a transfer (Wiedenmayer, 1977b). Wiedenmayer notes that Esper's sponge is extant in Strasbourg, and was redescribed by Topsent (1920c, 1933). However, *S. fasciculata* Pallas is a *nomen dubium* as Pallas's Mediterranean types have been lost. Consequently, de Laubenfels (1948) designated *Ircinia fasciculata* (Pallas), *sensu* Schmidt (1862) as the type species, an action which is still regarded as valid.

In designating a neotype for *I. fasciculata*, however, de Laubenfels (1948) was remiss. He used a specimen from the Dry Tortugas, Florida, not from the type locality of the Mediterranean. This was in contravention of ICZN (1985) Art. 75d(v). This prompted Wiedenmayer (1977b) to declare the neotype invalid. At present no neotype for *I. fasciculata* has been designated. Clarification of this species would require a geographically wide-ranging study, at least in both the Mediterranean and the West Indies, to ascertain whether the Mediterranean and West Indies forms are conspecific or unique, and to designate a neotype, collected from the Mediterranean, which clearly represents Pallas' original description. Wiedenmayer (1977b) proposed that all West Indian records of *I. fasciculata* should be referred to *I. felix* (Duchassaing & Michelotti, 1864). This cannot easily be accepted as it implies that all records of *I. fasciculata* from the West Indies are based on correct identifications. Future study also needs to distinguish *I. fasciculata* clearly from *I. variabilis* (Schmidt, 1862), as historically this has undoubtedly been a source of confusion.

Ircinia is a large genus, with over 40 described species. Some species are recorded from all over the globe, but the suggested cosmopolitan distribution of any dictyoceratid species has so far proved dubious or unfounded. Given the relatively high number of species in the genus, it is possible that the group may require subdivision. This was explored by Cook & Bergquist (1999), but as yet no consistent character or characters have been identified which make this possible. Many more unplaced species of *Ircinia* exist in museum collections (Hooper, Bergquist, Cook, unpublished data).

Description of type species

Ircinia fasciculata (Pallas) (Fig. 1C).

Synonymy. *Spongia fasciculata* Pallas, 1766: 381; Esper, 1794 (1791–1799): 253, pl. 32. *Filifera (Hircinia) fasciculata* Schmidt, 1862: 34. *Hircinia (Polyfibrospongia) fasciculata* Lendenfeld, 1889a: 587. *Ircinia fasciculata* de Laubenfels, 1948: 66; Vacelet, 1959: 89; Bergquist, 1980b: 466.

Material examined. Type specimen currently unassigned (see remarks). Other material. Authors collections, including: SDCC/RF097 (*gigantea*); SDCC/RF100 (*irregularis*); SDCC/RF102 (*dendroides* var. *dura*).

Description. It is apparent that a full description of *Ircinia fasciculata* is unavailable, owing to the difficulty in clearly characterising this and similar species, and the lack of detail in older descriptions (see remarks). A highly variable species, having been reported as massive, irregular, and encrusting. This sponge is usually upright and digitate, with a conulose surface. The surface is often irregularly covered with sand, but this does not form a consistent crust as in *Psammocinia*. Colour is variable ranging from off-white to black, or tinged with red, brown or purple. Oscules are scattered irregularly over the sponge. This sponge is tough, and its consistency is firm. Primary fibres are always cored and fascicular, attaining 200–250 μm in diameter, and secondary fibres are uncored. The filaments are numerous and dense, and measure 2–8 μm in diameter. (Lendenfeld, 1889; Vacelet, 1959; Topsent, 1920c, 1933.)

Distribution

Mediterranean (type locality), Australasia, Indo-Pacific, West Indies.

SARCOTRAGUS SCHMIDT, 1862

Synonymy

Sarcotragus Schmidt, 1862: 35; Bergquist, 1980b: 466. *Dysidicinia* Lendenfeld, 1889a: 565. *Stenospongia* Burton, 1928a: 134.

Type species

Filifera (Sarcotragus) spinosulus Schmidt, 1862 (by subsequent designation; Vacelet, 1959).

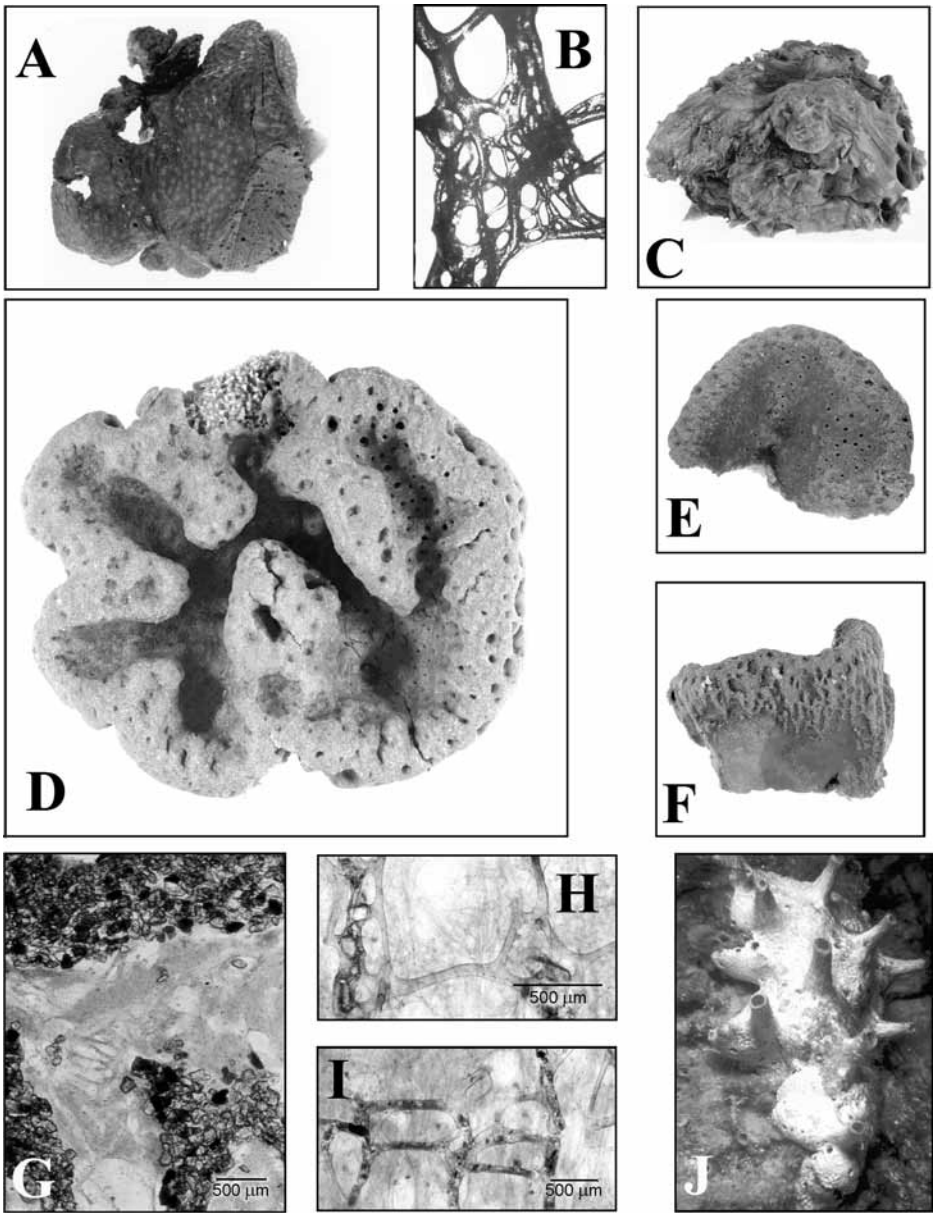

Fig. 2. *Sarcotragus* and *Psammocinia*. A–B, *Sarcotragus spinosulus*. A, SDCC/RF136. B, uncored primary fibre fascicle. C, *S. muscarum*, SDCC/RF135. D–G, *Psammocinia halmiformis*. D, AM Z4688, top view. E, AM Z4687, top view. F, AM Z4687, side view. G, AM Z414, fibre skeleton with armoured surface at top of image. H–I, *P. hawere*, fibre skeleton with primary fibre fascicles, SDCC/NZ032. I, fibre skeleton, SDCC/NZ013. J, *P. bulbosa, in situ*.

Definition

Unarmoured Irciniidae in which the primary fibres form fascicles, and are uncored or have only light, intermittent coring.

Diagnosis

Compact forms (Fig. 2A, C), with an unarmoured, conulose surface. The fibre skeleton comprises primary and secondary fibres, and very fine spongin filaments. Primary fibres are fasciculate and clear of foreign debris (Fig. 2B), or with only intermittent inclusions. Secondary fibres are uncored. The consistency is firm and compressible. These sponges are tough, reflecting the density of filaments within the mesohyl.

Previous reviews

Vacelet, 1959; Bergquist, 1980b; Hooper & Wiedenmayer, 1994.

Remarks

Previous authors (Vacelet, 1959; Bergquist, 1980b) have emphasised the very fine filaments as characteristic of *Sarcotragus*, but there are some recently described species of *Psammocinia* from New Zealand (Cook & Bergquist, 1998) and an undescribed species from the Great Barrier Reef (Bergquist, unpublished data), which also have very fine filaments. The emphasis is redirected to the fascicular primary fibres, and the uncored or only vaguely

cored fibres. The distinction between the massive fascicular primary fibres of *Ircinia* and the comparatively minor primary fibre fascicles of *Sarcotragus* is clear. Six species have been described.

Description of type species

Sarcotragus spinosulus (Schmidt) (Fig. 2A–B).

Synonymy. *Filifera (Sarcotragus) spinosulus* Schmidt, 1862: 35, pl. 3, fig. 18. *Hircinia spinosula* Schulze, 1879: 26, pl. 2, figs 1–2, pl. 3, fig. 4. *Hircinia (Sarcotragus) spinosula* Lendenfeld, 1889a: 574. *Ircinia spinulosa* de Laubenfels, 1948: 78. *Ircinia (Sarcotragus) spinosula* Vacelet, 1959: 92, pl. 3, fig. 21. *Ircinia spinosula* Pulitzer-Finali & Pronzato, 1977: 12, fig. 5; Pulitzer-Finali & Pronzato, 1981: 147. *Sarcotragus spinosulus* Bergquist, 1980b: 466, fig. 8f (incorrectly spelt as *S. spinulosus*).

Material Examined. Syntypes: LMJG 15428 (dry); LMJG 15429 (dry); LMJG 15430 (dry); LMJG 15482 (wet); LMJG 15431 (dry); BMNH 1867.7.26.76 (dry fragment of type); BMNH 1867.7.26.90 (dry fragment of type); BMNH 1877.5.21.319 (dry fragment of type); BMNH 1877.5.21.1225 (fragment of type); MZUS P0031 (dry). Other material. Authors collections, including SDCC/RF091 (*spinosulus*); SDCC/RF135 (*muscarum*); SDCC/RF136 (*spinosulus*).

Description (from Vacelet, 1959). These sponges are massive, and relatively regular, usually globular or lobose. The exterior colour varies from black to grey, and the interior is white. The surface is irregularly conulose, with conules around 1–2 mm high. Oscules are scattered haphazardly over the sponge surface. The moderately dense skeleton is composed of clearly laminated fibres. Primary fibres are 90–180 μm in diameter, without foreign coring, and are clearly pithed. Secondary fibres, 50–100 μm in diameter, are uncored and without pith. The filaments are fine, 0.7–2 μm in diameter, and dense. The consistency is firm and slightly compressible.

Distribution

Zlarin Island, Adriatic (type locality), Mediterranean, Australia, New Zealand.

PSAMMOCINIA LENDENFELD, 1889

Synonymy

Psammocinia Lendenfeld, 1889c: 59; 1889a: 579; Bergquist, 1980b: 468; Cook & Bergquist, 1998: 400.

Type species

Hircinia halmiformis Lendenfeld, 1888 (by subsequent designation; Bergquist, 1980b).

Definition

Armoured Irciniidae.

Diagnosis

Digitate, pedunculate, lamellate to caliculate, fistulose and low, compact or amorphous forms. *Psammocinia* species are characterised by their sand-armoured surface, that can be conulose, covered with rounded tubercles or pitted, and regular, reticular fibre skeleton. The distinction between primary and secondary fibres is not always clear as they are often of similar diameter (Fig. 2I). Primary fibres are usually cored and secondary fibres may be uncored to fully cored. Primary fibres may form fascicles (Fig. 2H), typically near the sponge surface, but can be obscured by heavy coring (Fig. 2G). Adjacent primary fibres may be connected by wide secondary fibre webs of spongin, which resemble stretched plastic. Consistency is firm. Sand and debris scattered throughout the mesohyl can render these sponges brittle, but when filaments are present in high densities, these sponges are tough to tear.

Previous reviews

Bergquist, 1980b; Hooper & Wiedenmayer, 1994; Cook & Bergquist, 1998.

Remarks

Psammocinia was originally erected as a subgenus of *Hircinia* (now *Ircinia*), by Lendenfeld (1889a). Species allocated to the subgenus *Psammocinia* were defined as displaying the same characters as *Ircinia*, with the addition of abundant sand and grit in the fibres and mesohyl, their primary fibres are often slender and fasciculated, and "abundant foreign bodies are contained in the skin". Lendenfeld had thought to include *Psammocinia* as a genus, but decided to retain it at a subgeneric level on the grounds that he recognised transitional forms belonging to other genera.

Despite some major studies on dictyoceratid systematics (de Laubenfels, 1948; Vacelet, 1959), later authors all but ignored *Psammocinia* until it was established as a genus by Bergquist (1980b). Wiedenmayer (1989), in a report on sponges from Bass Strait (Australia), argued that *Psammocinia* should be synonymised with *Ircinia*. He did not recognise the distinction between an organised armoured surface and an unarmoured surface, asserting that it was difficult to distinguish in some specimens. Many species of Dictyoceratida have foreign material incorporated into the mesohyl or the dermis. But this is distinct from the sand-armoured crust which diagnoses *Psammocinia* and, for example, *Thorectandra* (family Thorectidae).

In those species which are difficult to distinguish generically between *Ircinia* and *Psammocinia*, the presence and magnitude of fascicular primary fibres is a useful indicator. Members of the genus *Psammocinia* typically have simple primary fibres, sometimes with moderate fasciculation. In contrast, *Ircinia* species typically have massive, sometimes spectacular fascicular fibres. If a specimen has a significant amount of sand in its ectosome, but does not appear to form a distinct armoured crust, and has heavily fascicular fibres, it would be classified within the genus *Ircinia*. Using this method, Cook & Bergquist (1998) found it possible to place all specimens encountered within one genus or the other without difficulty.

Recently, researchers (Sim & Lee, 1999) reported observing filaments emerging from single pores on skeletal fibres. This has not been observed in any other *Psammocinia* species, but neither have they been looked for. This may prove to be another useful line of investigation.

Large quantities of foreign material distributed throughout the mesohyl of some species renders these sponges brittle, though this

is not a diagnostic character, as employed by some authors. Moderate to high densities of fine filaments make them tough to tear. *Psammocinia* is known mainly from Australia (Hooper & Wiedenmayer, 1994) and New Zealand (Cook & Bergquist, 1998), though this may reflect acceptance of the genus.

Description of type species

Psammocinia halmiformis (Lendenfeld) (Fig. 2D–G).

Synonymy. *Hircinia halmiformis* Lendenfeld, 1888: 183. *Hircinia (Psammocinia) halmiformis* Lendenfeld, 1889a: 586, pl. 27, fig. 9. *Ircinia halmiformis* de Laubenfels, 1948: 77. *Psammocinia halmiformis* Bergquist, 1980b: 468, fig. 9a; Hooper & Wiedenmayer, 1994: 236; Cook & Bergquist, 1998: 404, fig. 5.

Material Examined. Lectotype: AMG8885 (dry). Other material. AM Z414; AM Z4687; AM Z4688; AM Z4027; AM Z3146. Authors collections, including: SDCC/RF015 (*halmiformis*); SDCC/RF116 (*vesiculifera*); SDCC/RF120 (*halmiformis*); SDCC/RF126 (*halmiformis*).

Description. Thick lamellae, which may be crescentic, and/or cupped. Deep, discrete pits occur along the top ridge and upper sides, becoming broader and incomplete over the convex surface of the sponge. Fine pores (0.5–2.0 mm diameter) are scattered over one (concave) surface. This species is firm and incompressible, with a very thick sand armour. The skeleton comprises a relatively regular reticulum of primary (800 μm in diameter) and secondary (300 μm–500 μm in diameter) fibres, cored with loose columns of sand grains, 800 μm thick. Choanocyte chambers are diplodal, spherical to oval and are 23–34 μm in diameter. There is an ectosomal layer of collagen, underlying and extending through the surface armouring.

Distribution

Australia (type locality), New Zealand, New Caledonia, South Africa (undescribed), Korea, Atlantic Coast of the United States (Bahia).