



Polymastiidae and Suberitidae (Porifera: Demospongiae: Hadromerida) of the deep Weddell Sea, Antarctic*

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Abstract

The Antarctic deep-water fauna of Polymastiidae and Suberitidae is revised using recently collected material from the Weddell Sea. The former family appeared to be more abundant and diverse than the latter family in the studied area. Seven species within five polymastiid genera and three species within three suberitid genera are described. Relatively high sponge abundance at two stations deeper than 4700 m was mainly constituted by a polymastiid species *Radiella antarctica* sp. nov. Previously, representatives of *Radiella* have never been found in the Antarctic. An eurybathic species, *Polymastia invaginata*, well known from the Antarctic and subantarctic, appeared to be especially abundant at less than 1000 m depth. Another eurybathic polymastiid species, *Tentorium* cf. *semisuberites*, known for its bipolar distribution, was the third abundant species at the depths between 1000–2600 m, with the highest density found at the deeper stations. *Tentorium papillatum*, endemic of the Southern Hemisphere, was registered only at a depth of about 1000 m. Other species studied were less abundant. *Astrotylus astrotylus*, the representative of the endemic Antarctic genus, was found exclusively deeper than 4500 m, often together with *R. antarctica*. *Acanthopolymastia acanthoxa*, the endemic deep-water Antarctic species, was registered at 3000 m. The discovery of suberitid *Aaptos robustus* sp. nov. at about 2300 m is the first signalization of *Aaptos* in the Antarctic and at such a considerable depth. The finding of *Suberites topsenti* deeper than 4700 m is also remarkable. In general the results achieved confirm the high degree of geographical endemism of the Antarctic deep-water sponge fauna and the eurybathic distribution of many Antarctic sponge species.

Key words: Antarctic, deep sea, Polymastiidae, Suberitidae, new species

Introduction

Families Polymastiidae and Suberitidae include a number of quite common and abundant sponge species registered worldwide (Boury-Esnault 2002; van Soest 2002). Members of the latter family are found mainly in shallow waters, whereas several genera of the family Polymastiidae are typical of the deep-sea. Antarctic and subantarctic faunas of both families were initially described by Ridley and Dendy (1886, 1887), Kirkpatrick (1907, 1908), Thiele (1905), Hentschel (1914), Topsent (1915, 1917), Burton (1929) and Koltun (1964, 1976). The following authors only compiled old data without describing any new species (Boury-Esnault & van Beveren 1982; Sarà *et al.* 1992). Until recently, eight species of Polymastiidae belonging to five genera and 15 species of Suberitidae belonging to five genera have been reported from the Antarctic, but they have never been critically revised. Moreover, in contrast to the shelf and bathyal zone, the Antarctic abyssal sponge fauna is extremely poorly known. Within this context, rich sponge material recently collected by several interna-

tional Antarctic deep sea expeditions mainly from the Weddell Sea (Arntz & Brey 2001, 2003, 2005; Fütterer *et al.* 2003; Fahrbach 2006) merits detailed analysis. The principal aim of the present study is to revise Polymastiidae and Suberitidae of the deep Weddell Sea. Another aim is to estimate the endemism of the deep-water Antarctic sponge fauna with the example of these two families.

Material and methods

The sponges described herein were collected during the ANT XIX/4 (PS61) and ANT XXII/3 (PS67) cruises of the RV *Polarstern* carried out 28.02.–01.04.2002 and 21.01.–06.04.2005, respectively. These cruises were organized as parts of the research program ANtarctic benthic DEEP-sea biodiversity (ANDEEP II in 2002 and ANDEEP III in 2005). Altogether material from five stations of PS61 and ten stations of PS67 was studied (table 1, fig. 1). Studies at 13 stations were conducted with an Agassiz trawl, and at two, PS67/110-8 and PS67/133-2, an epibenthic sledge was employed. All sponges were collected by Dorte Janussen and deposited in the Senckenberg Naturmuseum, Frankfurt am Main (SMF). The specimens were initially fixed in 6 % formaldehyde and later preserved in 70 % ethanol. Their colour and texture were described after preservation except in a few cases specified in species descriptions below. Skeletal architecture was studied on manual or histological sections by light microscopy. Manual sections were prepared with a razor blade, dehydrated in ethanol, propanol and xylene, and mounted in Canada balsam on the slides. Histological sections were prepared following the technique of Vacelet (2006) which included dehydration in ethanol, propanol and acetone, embedding in epoxy resin, and cutting using a precise saw with a diamond wafering blade. The resulting 700–800 µm thick sections were mounted in resin on the slides. Dissociated spicules were prepared as generally accepted by dissolution of the soft tissue of sponge fragments in nitric acid, and were studied by light microscopy after mounting in Canada balsam on slides, and by SEM after sputtering on stubs. The measurements of spicules were made using a calibrated stage micrometer. In the descriptions of species the number of measured spicules are indicated specifically for each case; spicule dimensions are given as minimum-mean-maximum elsewhere.

TABLE 1. Stations of ANDEEP expeditions, where Polymastiidae and Suberitidae spp. were found.

Cruise/station no.	Date	Coordinates (start – stop)	Depth, m (start – stop)
PS61/132-3	06.03.02	65°17.88' S 53°22.88' W – 65°17.35' S 53°22.89' W	2087–2084
PS61/134-3	09.03.02	65°19.54' S 48°5.47' W – 65°19.47' S 48°4.27' W	4060.8–4065.1
PS61/135-3	10.03.02	64°59.12' S 43°0.43' W – 64°58.68' S 42°59.97' W	4679.5–4680.1
PS61/141-9	23.03.02	58°24.82' S 25°0.82' W – 58°24.38' S 25°0.21' W	2276–2292
PS61/143-2	25.03.02	58°44.35' S 25°10.48' W – 58°43.76' S 25°11.09' W	752.7–795
PS67/057-2	10.02.05	69°24.50' S 5°19.37' W – 69°24.62' S 5°19.68' W	1819–1822
PS67/074-7	20.02.05	71°18.48' S 13°58.55' W – 71°18.40' S 13°58.14' W	1055–1047
PS67/078-11	21.02.05	71°9.39' S 13°59.33' W – 71°9.35' S 13°58.81' W	2157–2147
PS67/080-6	22.02.05	70°40.23' S 14°43.78' W – 70°40.42' S 14°43.83' W	3006–2978
PS67/094-11	02.03.05	66°38.05' S 27°5.90' W – 66°38.10' S 27°5.46' W	4893–4894
PS67/102-11	06.03.05	65°35.40' S 36°29.00' W – 65°35.51' S 36°28.83' W	4794–4797
PS67/110-2	09.03.05	65°0.79' S 43°0.41' W – 65°0.85' S 43°0.25' W	4701–4704
PS67/110-8	10.03.05	65° 0.52' S 43° 2.09' W -65° 0.68' S 43° 2.16' W	4698–4696
PS67/121-7	14.03.05	63°34.92' S 50°41.97' W – 63°34.65' S 50°41.68' W	2616–2617
PS67/133-2	16.03.05	62°46.49' S 53°3.50' W – 62°46.38' S 53°3.98' W	1584–1579

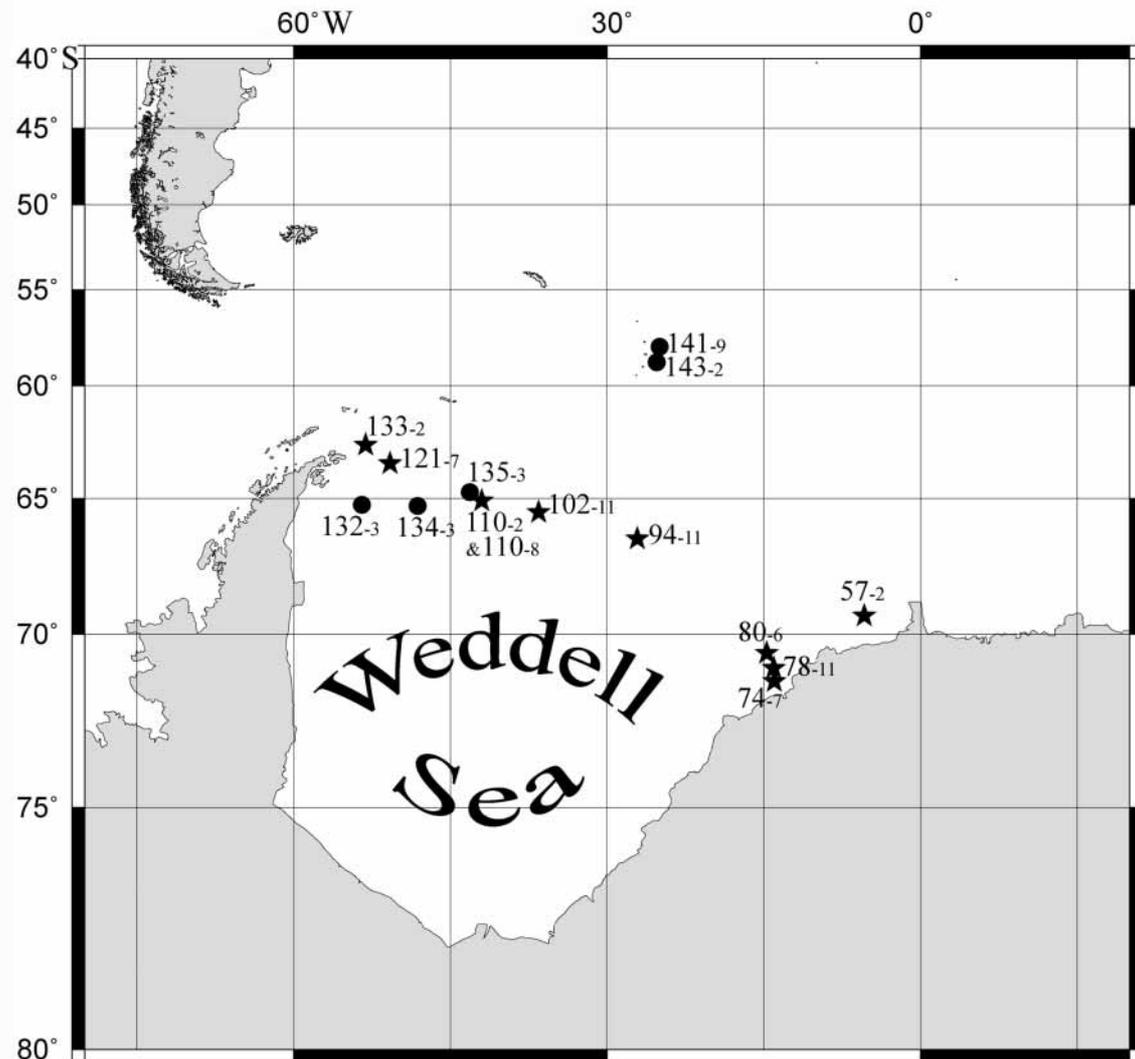


FIGURE 1. Map of stations, listed in table 1. Circles designate ANDEEP II, stars designate ANDEEP III.

Systematics

Phylum Porifera Grant, 1836

Class Demospongiae Sollas, 1885

Order Hadromerida Topsent, 1894

Family Polymastiidae

Diagnosis (emended from Boury-Esnault 2002): Sponges of massive, encrusting, globular, discoid or pedunculate growth form. Surface slightly velvety to very hispid. The choanosomal skeleton is constituted by radial megasclere tracts. To a greater or lesser degree a complex specialized cortical skeleton is developed. It is composed of at least a palisade of tylostyles, or oxeas and/or exotyles. Spicules comprise two or more size categories and include tylostyles, subtylostyles, strongyloxeas, styles or oxeas. Free spicules are always present in the choanosome; they may be intermediary or small tylostyles as well as various microscleres including smooth centrotylote microxeas, acanthose microxeas, raphides in trichodragmata and astrotylostyles. A fringe of long spicules is often present at the edge of the body at the contact with the substrata.

Emendations proposed: 1) A bark-like superficial region of the sponge body, reinforced by a special skeleton, is shared by all polymastiids and fits the definition of “cortex” given in the Thesaurus of Sponge Mor-

phology (Boury-Esnault & Rützler 1997) well. Therefore, here and elsewhere in the diagnoses of polymastiid genera, “ectosome” is substituted by “cortex” and subsequently “ectosomal skeleton” is replaced with “cortical skeleton”. 2) The number of spicule categories may exceed three in many polymastiid species. 3) Astrotylostyles, a newly described type of free choanosomal microscleres (Plotkin & Janussen 2007), is added.

Genus *Acanthopolymastia* Kelly-Borges & Bergquist, 1997

Diagnosis (emended from Boury-Esnault 2002): Sponges are cushion-shaped or discoid, with a single low oscular papilla. The edge of the body is very hispid whereas the other part of the surface is only minutely hispid. The choanosomal skeleton is composed by tracts of tylostyles, subtylostyles or styles which project beyond the surface making up the hispidation. The cortical skeleton includes a palisade of small tylostyles. Acanthose microxeas are very abundant both in cortex and choanosome.

Emendations proposed: 1) Spicules of the choanosomal tracts may be styles. 2) In all known *Acanthopolymastia* spp. the surface is hispid to a greater or lesser degree (see Kelly-Borges & Bergquist 1997). This hispidation is constituted by the choanosomal tracts projecting beyond the whole surface but not exclusively at the edge as given in Systema Porifera (Boury-Esnault 2002). Moreover, the excess edge hispidation shared by *A. acanthoxa* (Koltun, 1964) and *A. pisiformis* (Lévi, 1993) is not found in *A. bathamae* Kelly-Borges & Bergquist, 1997.

Type species: Atergia acanthoxa Koltun, 1964 (by original designation).

***Acanthopolymastia acanthoxa* (Koltun, 1964) (Fig. 2)**

Synonymy

Atergia acanthoxa—Koltun 1964: 27, fig. 3.

Acanthopolymastia acanthoxa—Kelly-Borges and Bergquist 1997: 396, fig. 27; Boury-Esnault 2002: 209, fig. 7.

Not *Atergia acanthoxa*—Lévi 1993: 26, fig. 7C, pl. II (9–12).

Material examined

SMF 10539 (1 specimen): PS67/080-6.

Description

External morphology. Slightly damaged, cushion-shaped sponge measuring about 13x13x5.5 mm and removed from substrate (fig. 2A). The upper surface of the sponge is mainly hispid, where not damaged. Its colour is greyish due to sediment particles, which soil the hispidation. Bare areas of the surface are paler. The basal surface is rather damaged. The marginal spicule fringe is well preserved and measures about 6 mm in width. A single exhalant papilla is pale and measures approximately 1 mm in length and 2 mm in diameter. The cortex is semi-transparent, hardly detachable, moderately firm and somewhat fragile. The choanosome is soft, crumbly and whitish in colour.

Skeleton. The main choanosomal skeleton consists of the radial tracts of principal spicules measuring in the basal choanosome 100–300 µm in thickness, penetrating the cortex and making up a surface hispidation of 650 µm in thickness (fig. 2B). The additional choanosomal skeleton is composed of free-scattered, abundant, acanthose, centrotylote microxeas (fig. 2C). The cortex, measuring 340–1140 µm in thickness, consists of two layers—the external palisade of small tylostyles and the internal unordered mass of centrotylote acanthoxeas. The marginal fringe is made of extremely long and thin spicules.

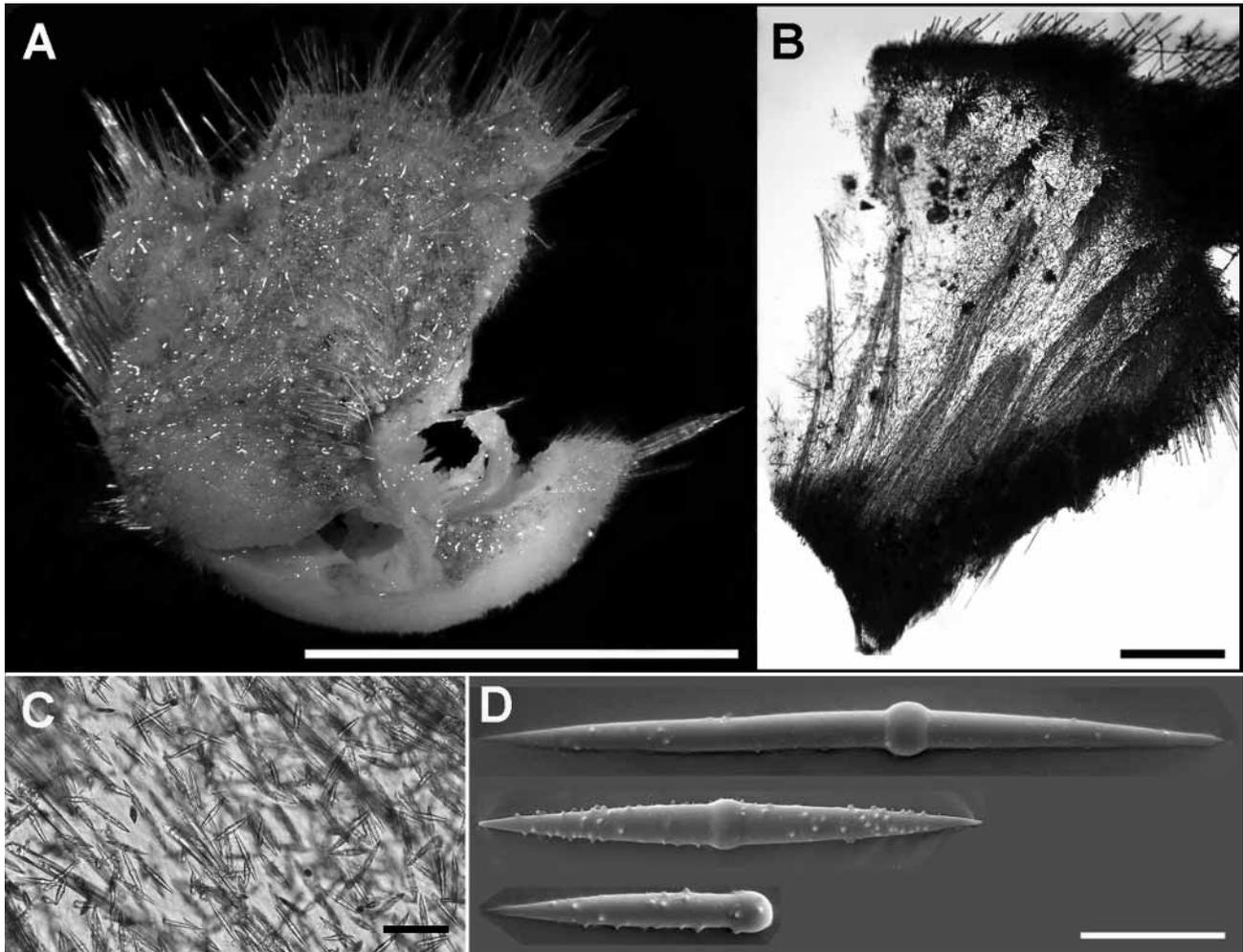


FIGURE 2. *Acanthopolymastia acanthoxa*. A—specimen SMF 10539. B—histological section of idem, general view. C—the same as B, detail of choanosome with acanthose centrotyle microxeas. D—microxeas at SEM. Scale bars: A 10 mm; B 1 mm; C 0.1 mm; D 0.03 mm.

Spicules. There are three main categories of spicules including acanthoxeas. We measured 20 spicules of each category. An additional category is constituted by the extra-long spicules of the marginal fringe. Very few of them were measured, because most were broken on the slides.

Principal spicules vary from styles to tylostyles. They are straight, slender and slightly fusiform and measure: length 1525-2123-2693 μm , maximal diameter 11-14.7-17 μm . Small cortical tylostyles are straight and slender. They measure: length 257-369-549 μm , maximal diameter 9-10.3-12 μm . Acanthose, centrotyle microxeas measure: length 89-113-158 μm , diameter of central tyle 5-5.9-8 μm (fig. 2D). Extra-long spicules of the marginal fringe vary from styles to subtylostyles. They are slightly curved and slender. We estimate that their maximal length exceeds 5900 μm , while the maximal diameter can be more than 30 μm .

Type locality: Antarctic: Northern Ross Sea, 3200–3400 m.

Distribution (other than type locality): Antarctic: NE Weddell Sea, ca. 3000 m (present study).

Remarks. This is the second finding of *A. acanthoxa* since Koltun (1964) described it from the northern Ross Sea. Both specimens have come from approximately 3000 m and demonstrate no sufficient difference in external morphology, skeletal arrangement, spicule shape and size. The comprehensive comparison of *A. acanthoxa* with its congeners has been completed by Kelly-Borges and Bergquist (1997).

Genus *Astrotylus* Plotkin & Janussen, 2007

Diagnosis: Cushion-shaped encrusting sponges with hispid surface. Choanosomal skeleton consists of radial tracts of principal megascleres, between which numerous microscleres and rare small megascleres are freely scattered. Cortical skeleton formed by the main tracts arising from the choanosome, diverging into bouquets, reinforced by the irregular palisade of small megascleres and echinating the surface. Megascleres are tylostyles, microscleres are astrotylostyles.

Type species: *Astrotylus astrotylus* Plotkin & Janussen, 2007 (by original designation).

Astrotylus astrotylus Plotkin & Janussen, 2007 (Fig. 3)

Synonymy

Astrotylus astrotylus—Plotkin and Janussen 2007: 1395, figs. 1–3.

Material examined

Holotype: SMF 10518 (1 specimen): PS67/102-11.

Paratypes: SMF 10517 (1 specimen): PS67/094-11; SMF 10519 (1 specimen): PS67/102-11; SMF 10516 (1 specimen): PS67/110-2.

Description (emended from Plotkin & Janussen 2007)

External morphology. Sponges are small cushion-shaped encrustations on pebbles measuring up to 21x18x4 mm (fig. 3A). Surface is uniformly or irregularly hispid, brownish or greyish in colour due to the covering sediments. A single exhalant papilla is very small or the sponges may lack a papilla. The cortex is greyish, hardly detachable and rather resilient. The choanosome is beige to greyish, soft but rather dense.

Skeleton. The main choanosomal skeleton is constituted by the radial tracts of principal tylostyles (fig. 3B). The thickness of these tracts in the basal choanosome measures 150–290 μm . The tracts branch, cross the cortex, where they diverge into bouquets, and make up the surface hispidation. The cortical bouquets of principal tylostyles are reinforced by an irregular palisade of small tylostyles. The cortex is 200–550 μm thick and the thickness of the surface hispidation is 570–2000 μm including the external area of dense sediment cover which measures 170–1200 μm . The aquiferous cavities, measuring 80–130 μm in diameter, are visible in the upper part of the cortex, among the cortical bouquets. The additional choanosomal skeleton is composed of freely scattered small tylostyles and microscleres—astrotylostyles. The tylostyles are very rare. Numerous astrotylostyles are uniformly distributed between the main tracts; their mean density is about 300–500 per 1 mm^2 of the section. We were unable to study the aquiferous system and skeleton architecture of the papillae because of their extremely weak development.

Spicules. Two size categories of tylostyles are well distinguished, and astrotylostyles constitute a third category (see frequency distributions in Plotkin & Janussen 2007). Altogether, 120 spicules of each category were measured (30 spicules in each specimen; see particular results of measurements for each specimen *ibidem*).

Megascleres are exclusively tylostyles with well-developed, terminally located, spherical or oval tyles. Principal tylostyles are usually straight and slender (figs. 3C–D). Their dimensions are: length 914–1814–5414 μm , tyle diameter 11–17.2–28 μm , diameter of the shaft underneath the tyle 5–11.2–20 μm , maximal diameter of the shaft 8–16.7–24 μm . Small tylostyles are straight or rarely slightly curved, fusiform, with well-developed, terminal spherical tyles (fig. 3E). They measure: length 217–396–750 μm , tyle diameter 10–13.2–18 μm , diameter of the shaft underneath the tyle 3–7.6–12 μm , maximal diameter of the shaft 5–13.3–19 μm .

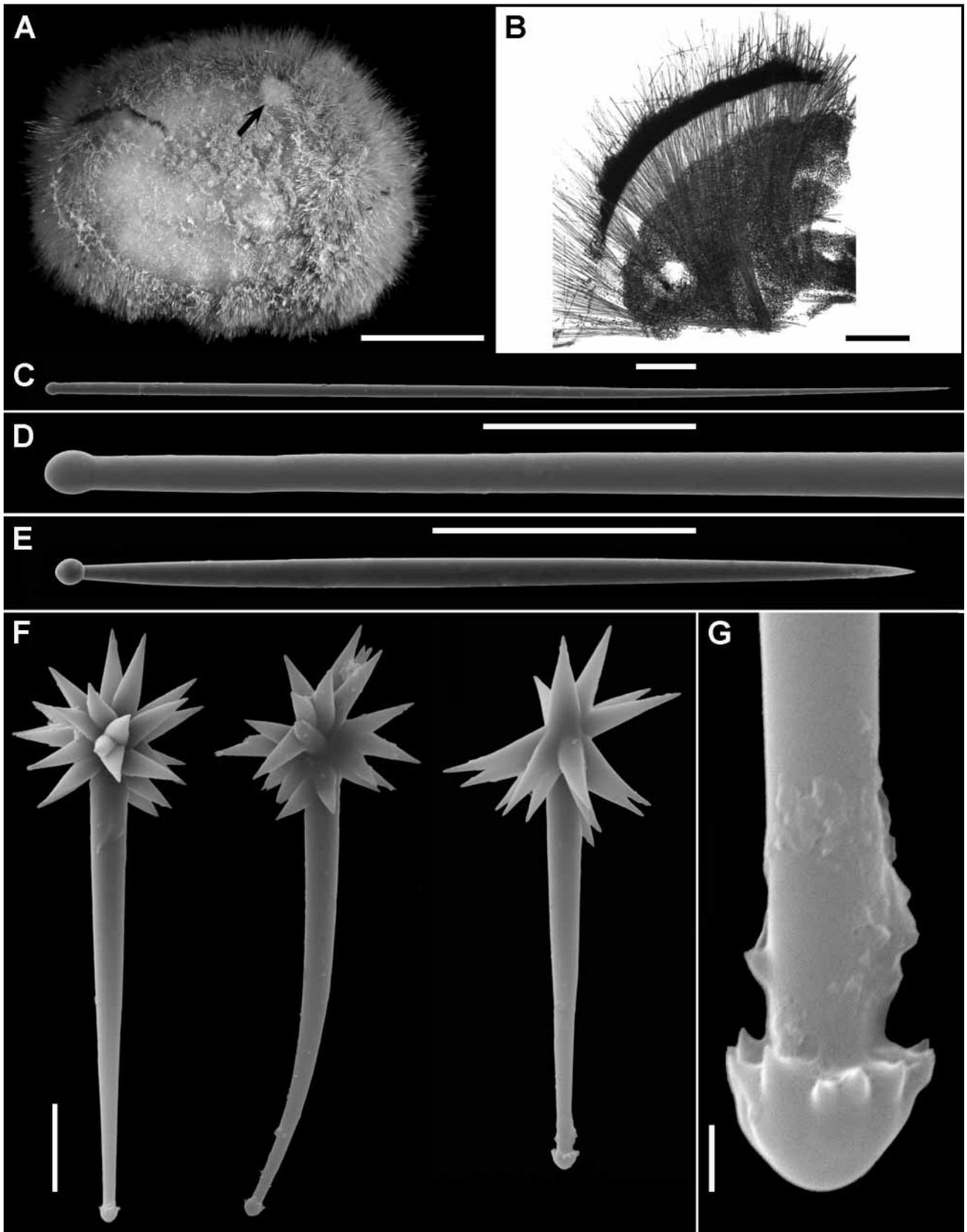


FIGURE 3. *Astrotylus astrotylus*. A—holotype SMF 10518, an arrow indicates a papilla. B—histological section of idem. C—principal tylostyle, general view. D—proximal end of idem. E—small tylostyle. F—astrotylestyles, general view. G—detail of fungiform serrated tyle. Scale bars: A 5 mm; B 1 mm; C–E 0.1 mm; F 0.01 mm; G 0.001 mm.

Astrotylostyles are straight or curved (fig. 3F). Each spicule consists of a shaft with a small fungiform serrated tyle at one end (fig. 3G), the other end bearing a multi-rayed star-like structure resembling an asterose spicule. The latter structure varies in regularity, its one ray being always a prolongation of the main spicule shaft. The dimensions of astrotylostyles are: length 50-71.0-93 μm , diameter of tyle 1-2.8-5 μm , diameter of the shaft underneath the tyle 1-1.6-3 μm , diameter of the shaft underneath the star-like formation 2-4.7-7 μm , diameter of the star-like formation 8-20.7-35 μm .

Type locality: Antarctic: Northern Weddell Sea, ca. 4700–4900 m (known only from type locality).

Remarks. The affinities of *A. astrotylus* with allied polymastiid species have been discussed by Plotkin and Janussen (2007).

Genus *Polymastia* Bowerbank, 1864

Diagnosis (emended from Boury-Esnault 2002): Thickly encrusting sponges of spherical, hemispherical or cushion shape, always with papillae. Choanosomal skeleton is composed by radial tracts of principal spicules between which free spicules are scattered. Cortical skeleton constituted by at least two layers, the superficial palisade of small tylostyles and the lower layer made of intermediary spicules, lying tangential to the surface. The principal spicules can be tylostyles, subtylostyles, styles, and stronglyloxeas, intermediary spicules are most often tylostyles, and cortical spicules are always tylostyles.

Remarks to diagnosis: At the moment 73 from 117 accepted polymastiid species are placed in *Polymastia* (van Soest *et al.* 2005), and some of them demonstrate noticeable discrepancies with the currently accepted diagnosis of the genus (see, e.g. Kelly-Borges & Bergquist 1997), that calls for its considerable re-evaluation. Since we did not aim to revise *Polymastia* in the present study, the emendations of the diagnosis given in *Systema Porifera* (Boury-Esnault 2002) are minimized. Meanwhile, two Antarctic species, *P. invaginata* Kirkpatrick, 1907 and *P. zitteli* (Lendenfeld, 1888), concerned below, bear the features which somehow contradict the accepted diagnosis of *Polymastia*, the contradiction has not been previously emphasized. The dissimilarities include a single-layered cortex of the former species and the reticulated choanosomal skeleton of the latter. However, as the species in question share some other diagnostic features of *Polymastia*, we retain them as is, until the revision of the whole genus can be completed.

Type species: *Spongia mamillaris* Müller, 1806 (by monotypy).

Polymastia invaginata Kirkpatrick, 1907 (Figs. 4–5, Tables 2–3)

Synonymy

Polymastia invaginata—Kirkpatrick 1907: 271; 1908: pp. 15–16, pl. XII(1b), pl. XIV (5–15a); Burton 1929: 446; 1932: 338; Koltun 1964: 26, pl. IV(10–14); 1976: 168; Boury-Esnault and van Beveren 1982: 36–37, pl. IV (13–14), figs. 9d, e, f.

Polymastia invaginata var. *gaussi*—Hentschel 1914: 49, Taf. V, Fig. 4.

Material examined

SMF 10540–10541 (2 specimens): PS61/132-3; SMF 10542 (4 specimens): PS61/134-3; SMF 10543 (1 specimen): PS61/141-9; SMF 10544–10545 (2 specimens) and 10546 (19 specimens): PS61/143-2; SMF 10547 (1 specimen): PS67/057-2; SMF 10548–10551 (4 specimens): PS67/074-7; SMF 10552 (1 specimen): PS67/078-11; SMF 10553 (4 specimens) and 10554 (2 specimens): PS67/102-11; SMF 10555 (1 specimen) and 10556 (4 specimens): PS67/121-7.

Description

External morphology. Sponges are cushion-shaped or hemispherical, always attached to the substrata (figs. 4A–C). Their diameter may reach 3.7 cm and thickness is up to 2.9 cm. The surface is usually densely hispid, its colour varies from dark brown to dark grey due to the sediment particles incorporated between protruding spicules. The upper surface bears one or very rarely few papillae, light brown or grey coloured and measuring 2–13 mm in length and 2–8 mm in diameter. Papillae are usually slightly sunken below the surface hispidation, occasionally being located inside a small pit within which the surface is smooth and pale. Oscula are opened at the papillae summits and ostia are scattered over the walls of the papillae. No ostia can be seen on the surface. The cortex is pale grey to whitish, hardly detachable and rather resilient. The choanosome is grey to beige, heterogeneous in consistency.

Skeleton. The main choanosomal skeleton is constituted by the radial tracts of principal spicules running from the sponge base to the surface, entering the cortex and diverging into bouquets (figs. 4D, E). The additional choanosomal skeleton is composed of small spicules scattered between the main tracts. These small spicules lie singly or grouped in stellate bundles (fig. 4F). Concentration of the scattered spicules under the cortex is higher than in the lower choanosome. The cortex, measuring 600–1560 μm in thickness, consists of the palisade of small spicules overlapped by the bouquets of the main tracts (fig. 4G). The latter are reinforced by extra-long spicules making up a surface hispidation, the thickness of which is 100–2700 μm . In the cortical bouquets of some sponges we also observed a few remarkable sceptre-like spicules, which were probably modified tylostyles (fig. 4H).

Spicules. Altogether 1267 spicules from 16 specimens were measured. Frequency distribution of length revealed three main categories of monactins, corresponding to extra-long spicules of the hispidation, principal spicules of the main tracts, and small spicules forming the additional choanosomal skeleton and the cortical palisade (fig. 5A). The fourth category was constituted by the infrequent sceptre-like spicules. Summarizing results of spicule measurements are given in the main text below, indicating the total number of spicules measured for each category (n). Particular results of spicule measurements for each specimen (sceptre-like spicules excluded) are given in table 2.

Principal spicules vary from styles to tylostyles (fig. 5B). They are mainly straight, often fusiform and measure: length 1026–1568–2186, proximal diameter 5–10.5–18 μm , central maximal diameter 8–18.5–32 μm ($n=264$). Their tyles, if present, are spherical, terminally located and measure 8–14.5–24 μm in diameter ($n=228$).

Small spicules are usually straight or rarely slightly curved, stout and fusiform tylostyles with spherical, well-developed, terminally located tyles (fig. 5C). About 11% of these are subtylostyles and nearly 3% are styles. Altogether they measure: length 60–383–988 μm , tyle diameter 2–9.4–22 μm , diameter of the shaft underneath the tyle 1–5.8–19 μm , maximal diameter of the shaft 2–9.4–30 μm ($n=860$).

Extra-long spicules vary from styles to tylostyles (figs. 5D, E). They are straight, very slender and sharply pointed. Their dimensions are: length 2200–2753–4771 μm , proximal diameter 2–11.8–24 μm , central maximal diameter 5–24.6–41 μm ($n=135$). The tyles of the extra-long spicules, if present, may be spherical or oval, terminally located and measure 4–14.5–26 μm in diameter ($n=111$).

Sceptre-like spicules are considerably stout and either nearly isodiametric or its diameter increases from the proximal to the distal end, the former bearing a tyle and the latter being rounded (fig. 5F). The spherical tyles may be well or weakly developed, terminally located or slightly displaced. Sceptre-like spicules measure: length 145–482–1080 μm , tyle diameter 30–47.0–94 μm , proximal diameter 23–42.3–91 μm , central diameter 27–59.0–97 μm , distal diameter 25–60.0–103 μm ($n=8$).

Type locality: Antarctic: Southern Ross Sea: near Winter Quarters, 18–55 m and off Erebus volcano, 910 m.

Distribution: Antarctic near-continent sectors (Koltun 1964; Sarà *et al.* 1992): NN 2–5 including the Western Ross Sea and NN 8–9 including the Weddell Sea (present study as well) and the South Shetland Islands. Depth: 18–1080 m (Koltun 1964); ca. 1050–4800 m in the Northern Weddell Sea (present study).

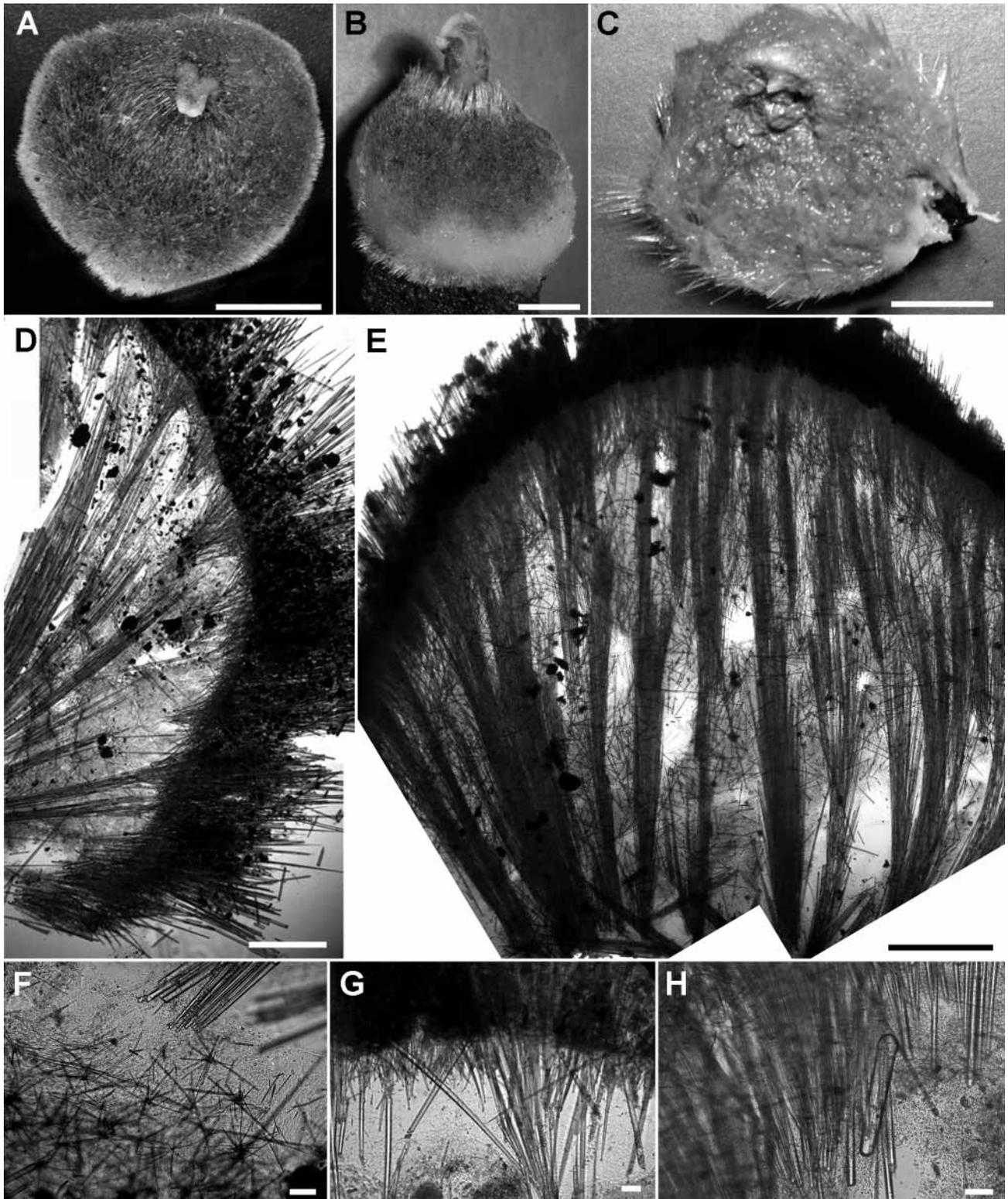


FIGURE 4. *Polymastia invaginata*: external morphology and skeleton architecture. A—specimen SMF 10543. B—a specimen from series SMF 10546. C—a specimen from series SMF 10554. D—histological section of SMF 10543, general view. E—histological section of SMF 10546, general view. F—histological section of SMF 10548, detail of choanosome with stellate bundles of small spicules. G—histological section of SMF 10547, detail of cortex. H—histological section of SMF 10543, detail of cortex with a sceptre-like spicule. Scale bars: A–C 10 mm; D–E 1 mm; F–H 0.1 mm.

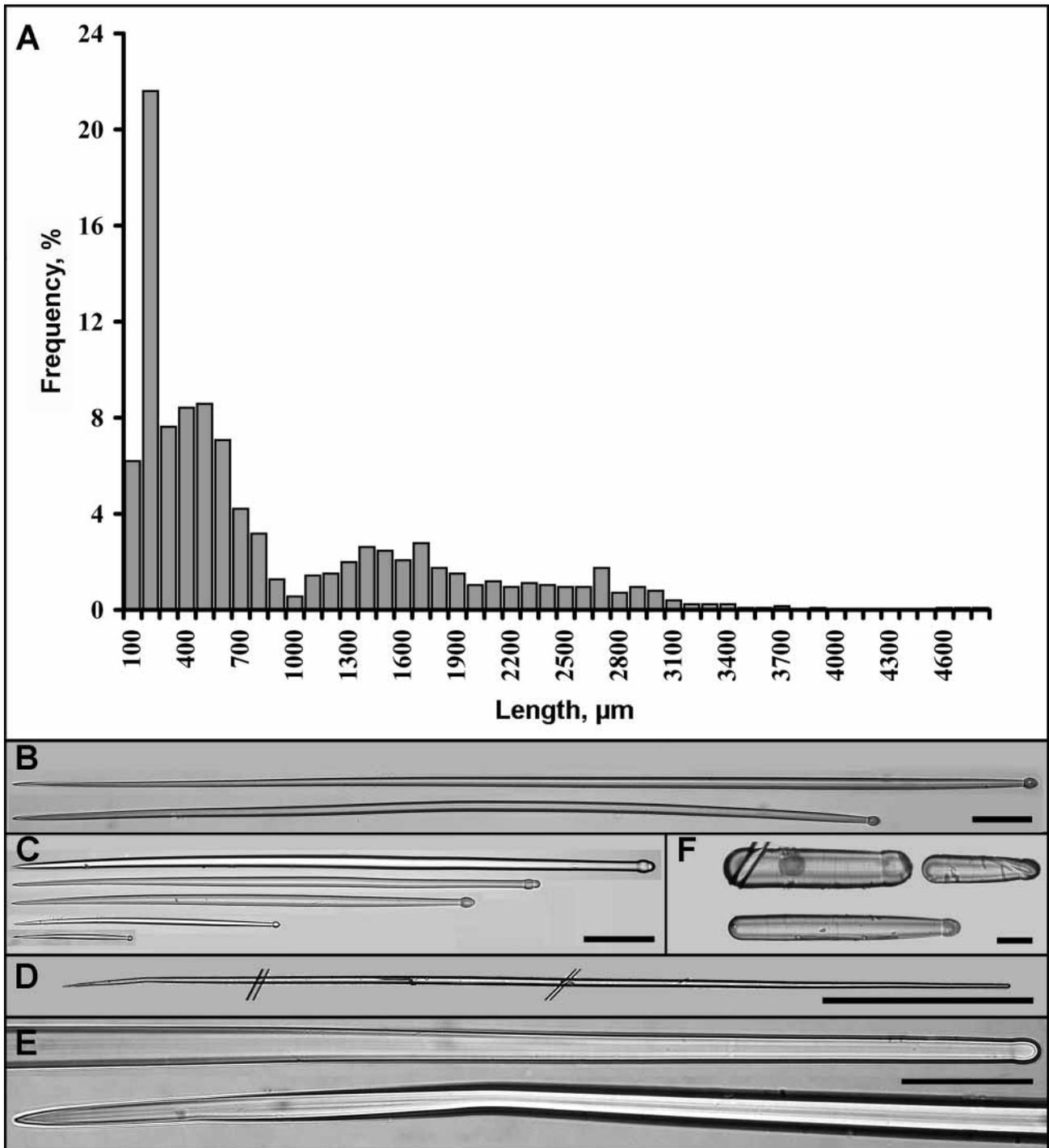


FIGURE 5. *Polymastia invaginata*: spicules. A–frequency distribution of length (sceptre-like spicules excluded). B–principal spicules. C–small spicules. D–extra-long spicule, general view. E–the same as D, details of proximal and distal ends. F–sceptre-like spicules. Scale bars: B–C 0.1mm; D 1 mm; E–F 0.1 mm.

SW Atlantic: South Georgia and South Orkney Islands (Koltun 1964; Sarà *et al.* 1992); South Sandwich Islands, ca. 750–2300 (present study).

SE Pacific: Magellan area of Chile (Desqueyroux & Moyano 1987).

Southern Indian Ocean: Kerguelen, 245–346 m and Heard, 750 m (Boury-Esnault & van Beveren 1982).

TABLE 2. *Polymastia invaginata*: Results of spicule measurements.

Measurements are given in μm . Each measurement is given as minimum-mean-maximum. Upper row represents length. Middle row represents tyle diameter / diameter of the shaft underneath the tyle. Lower row represents maximal diameter of the shaft and the number of measured spicules (in brackets).

Specimen no.	Small spicules	Principal spicules	Extra-long spicules
SMF 10540	60-218-445	1140-1326-1634	No extra-long spicules were observed
	3-11.2-21 / 2-7.7-13	10-11.7-16 / 8-10.1-13	
	2-12.5-22 ($n=46$)	16-19-22 ($n=17$)	
SMF 10541	180-433-720	1482-1943-2090	2204-2344-2508
	4-8.6-13 / 5-6.7-10	8-13.6-16 / 6-10.6-13	13-15.5-17 / 11-12.9-14
	5-9.8-18 ($n=41$)	10-18.4-21 ($n=7$)	18-21.9-27 ($n=13$)
SMF 10542 (specimen 1)	240-397-650	1140-1451-1710	No extra-long spicules were observed
	8-9.6-13 / 2-4.4-8	8-13.3-16 / 6-9.2-11	
	4-7.5-11 ($n=83$)	11-16.7-19 ($n=40$)	
SMF 10543	155-403-780	1520-1870-2090	2242-2402-2622
	5-9.3-16 / 2-5.3-11	14-17.5-21 / 10-11.8-18	16-18.9-24 / 10-12.2-16
	3-9.2-18 ($n=44$)	18-25.6-30 ($n=10$)	26-30.6-38 ($n=10$)
SMF 10544	165-281-950	1102-1495-2166	2356-2356-2356
	5-10.1-13 / 2-5.6-10	9-13.5-18 / 5-9.9-13	18-17.6-18 / 13-12.8-13
	4-8.8-18 ($n=41$)	8-17.6-22 ($n=18$)	16-16-16 ($n=1$)
SMF 10545	135-417-929	1286-1707-2129	2286-3011-4771
	5-8.8-16 / 3-5.6-11	14-15.5-18 / 9-12.8-16	15-18.5-26 / 14-17-24
	4-9.3-16 ($n=60$)	19-24.3-30 ($n=2$)	27-33.3-41 ($n=29$)
SMF 10546 (specimen 1)	429-575-943	1029-1579-2086	No extra-long spicules were observed
	11-13.1-15 / 5-7.4-11	12-16.9-24 / 8-10.7-14	
	11-13.9-16 ($n=24$)	14-19.4-27 ($n=36$)	
SMF 10547	140-429-988	1026-1259-2052	2470-2786-3724
	3-9.5-17 / 2-5.4-13	11-13.7-19 / 6-8.4-13	5-6.8-16 / 2-4.2-11
	3-9.6-18 ($n=59$)	13-16.2-28 ($n=8$)	5-11.7-30 ($n=13$)
SMF 10548	135-374-943	1029-1505-2186	2200-2791-3400
	3-7.3-16 / 1-6.3-15	9-13.1-19 / 8-12.2-18	15-17.1-19 / 14-16.3-19
	3-8.6-27 ($n=60$)	16-21.3-32 ($n=40$)	27-34.9-41 ($n=20$)
SMF 10549	105-244-450	No principal spicules were observed	2318-2970-3534
	5-7.7-13 / 2-4.2-8		4-5.3-6 / 3-4.5-6
	5-7.3-16 ($n=47$)		8-10.3-11 ($n=20$)
SMF 10550	100-323-988	1026-1462-2014	No extra-long spicules were observed
	2-6.8-13 / 2-5-12	8-11.9-14 / 6-10.1-13	
	3-6.7-13 ($n=45$)	13-18.2-24 ($n=17$)	
SMF 10552	150-375-880	1444-1858-2166	2204-2625-3610
	4-8.9-18 / 2-5.1-13	8-13.3-16 / 5-8.7-11	8-15.9-21 / 5-11.2-14
	3-8.4-19 ($n=125$)	8-14.6-24 ($n=9$)	8-23.7-34 ($n=29$)
SMF 10553 (specimen 1)	160-482-790	1292-1636-2014	No extra-long spicules were observed
	6-8.7-13 / 3-5.4-8	10-14.5-19 / 7-11-16	
	6-8.8-13 ($n=43$)	11-15.3-19 ($n=20$)	

..... continued

TABLE 2 (continued)

Specimen no.	Small spicules	Principal spicules	Extra-long spicules
SMF 10554 (specimen 1)	145-318-530 4-7-10 / 3-4.5-6 6-7.1-11 (<i>n</i> =41)	1330-1697-2090 10-14.2-18 / 8-10.7-13 13-18-22 (<i>n</i> =20)	No extra-long spicules were observed
SMF 10555	360-608-850 8-11.6-14 / 3-5.8-8 6-12-16 (<i>n</i> =42)	1558-1767-2014 13-17.5-21 / 10-10.8-14 14-18.4-22 (<i>n</i> =20)	No extra-long spicules were observed
SMF 10556	111-345-914 5-12.8-22 / 3-9.7-19 5-15-30 (<i>n</i> =59)	No principal spicules were observed	No extra-long spicules were observed

Remarks

The external and spicule morphology of *P. invaginata* varies greatly, that caused some discrepancy between the descriptions of different authors (table 3). Kirkpatrick (1907) noticed a sole exhalant papilla, completely invaginated in the thick surface hispidation, and a basal fleshy pad (the latter structure having never been mentioned by the following authors). A year later (Kirkpatrick 1908) a sponge with two papillae was discovered. Kirkpatrick recognized two categories of spicules – principal styles, or stronglyloxeas, of the main tracts, and small tylostyles including the slenderer ones of the stellate bundles in the choanosome and the fusiform ones making up the cortical palisade. In 1914 Hentschel established a new variety, *P. invaginata* var. *gaussi*, which he distinguished from Kirkpatrick’s sponges by the principal spicules being subtylostyles of smaller size. Koltun (1964) emphasized that the principal spicules could vary greatly in shape from styles to subtylostyles and in size. Both Hentschel (1914) and Koltun (1964) found no differences in shape between the choanosomal and cortical small tylostyles, though Koltun pointed out that the latter could be slightly larger. All authors mentioned above dealt with Antarctic sponges. Meanwhile Boury-Esnault and van Beveren (1982), who studied the material from the Southern Indian Ocean (Kerguelen and Heard), described the specimens with papillae being only partially sunk in the surface hispidation. These authors recognized three spicule categories – principal tylostyles of the main tracts being considerably smaller than those described by the previous authors, small tylostyles of the choanosomal stellate groups and the cortical palisade, and long, sharply pointed tylostyles reinforcing the cortical bouquets of principal spicules and making up the surface hispidation. The latter echinating tylostyles of Boury-Esnault and van Beveren had dimensions similar to those of the principal spicules described by the previous authors.

The sponges examined by us share most of the morphological features with *P. invaginata* described by other authors. The presence of up to four papillae in a few ANDEEP specimens is not surprising if keeping in mind the note of Kirkpatrick (1908). The minor invagination of papillae and the sufficient variety of principal spicules from tylostyles to styles might be also expected. In the meantime we observed the cortex reinforced by sharply pointed monactins morphologically similar to those described by Boury-Esnault and van Beveren (1982), but on average twice as long as any spicules previously registered in *P. invaginata*. The other feature distinguishing some of our sponges is the presence of cortical sceptre-like spicules. Principal spicules of our sponges fit well the dimension range given by Kirkpatrick (1907, 1908), Hentschel (1914) and Koltun (1964). Small spicules are also similar to the previous descriptions though their length maximum is relatively higher. This may be explained either by the insufficiently distinct discrimination between small and principal spicules or by the existence of intermediary size category being hidden because of insufficient sample size. We were unable to ascertain if there was any difference between the choanosomal and cortical small spicules.

TABLE 3. *Polymastia invaginata*: comparison of characters given by different authors.

All dimensions are given in μm as either a mean value or minimum-maximum or minimum-mean-maximum. In spicule dimensions the upper row represents length; the lower row represents central diameter of the shaft.

Characters	Kirkpatrick, 1907; 1908	Hentschel, 1914	Koltun, 1964	Boury-Esnault & van Beveren, 1982	Present study
<i>Number of papillae</i>	1-2	1	1	1	1-4
<i>Invagination of papillae</i>	Complete	Partial	Complete	Partial	Partial or none
<i>Basal fleshy pad</i>	Recorded	Not recorded	Not recorded	Not recorded	Not recorded
<i>Spicules of choanosomal tracts</i>	Slightly curved styles or strongyloxeas 2240 40	Slender, fusiform subtylostyles 816-1792 15-20	Styles or subtylostyles 816-2240 15-40	Fusiform tylostyles 227-590-890 10-22.1-32	Fusiform, straight styles (subtylostyles, tylostyles) 1026-1568-2186 8-18.5-32
<i>Spicules of choanosomal stellate bundles</i>	Slender, slightly curved tylostyles 200 15	Stout, fusiform tylostyles 120-600 10-25	Fusiform tylostyles 70-600 6-25	Fusiform tylostyles 71-166-312 5-6.5-9	Fusiform, straight or slightly curved tylostyles (subtylostyles, styles) 60-383-988 2-9.4-30
<i>Thickness of cortex</i>	500-1250	400	400	1500	600-1560
<i>Spicules of cortical palisade</i>	Fusiform, straight tylostyles 140-350 12-19	Stout, fusiform tylostyles 120-600 10-25	Fusiform tylostyles 70-600 6-25	Fusiform tylostyles 71-166-312 5-6.5-9	1) Fusiform, straight or slightly curved tylostyles (subtylostyles, styles) 60-383-988 2-9.4-30 2) Infrequent scepter-like spicules 145-482-1080 27-59.0-97
<i>Spicules forming surface hispidation</i>	Bouquets of choanosomal tracts	Bouquets of choanosomal tracts	Bouquets of choanosomal tracts	Bouquets of choanosomal tracts reinforced by slender, slightly curved, sharply pointed tylostyles 923-1697.3-2106 13-23.9-32	Bouquets of choanosomal tracts reinforced by slender, straight, sharply pointed tylostyles or styles 2200-2753-4771 5-24.6-41
<i>Spicules of basal skeleton</i>	Irregularly located spicules of various size	Not recorded	Not recorded	Not recorded	Not recorded

The considerable polymorphism of *P. invaginata* described above may be due to the environmental distinctions between different localities, e.g., between the Antarctic and Southern Indian Ocean. Nevertheless the existence of a species complex also cannot be excluded. In any case, all described specimens of *P. invaginata* share the possession of a single or at least very few exhalant papillae, a densely hispid surface and a single spicule layer in the cortex. *P. hispidissima* Koltun, 1966 from the NW Pacific and *P. villosa* Desqueyroux-Faúndez & van Soest, 1997 from the SE Pacific are also characterized by the single papilla and the thick surface hispidation formed by extra-long spicules. However, these two species differ from *P. invaginata* by two spicule layers in the cortex. Meanwhile, a single-layered cortex is shared by *P. kurilensis* Koltun, 1962 from the NW Pacific and *P. atlanticus* Samaai & Gibbons, 2005 from the SE Atlantic. The latter species also possesses the choanosomal clews of small spicules similar to the stellate bundles of *P. invaginata*. But other features of both *P. atlanticus* and *P. kurilensis*, including smooth surface, numerous wart-like papillae as well as spicule shape and size, distinguish them considerably from *P. invaginata*.

***Polymastia zitteli* (Lendenfeld, 1888) (Fig. 6)**

Synonymy

Sideroderma zitteli—Lendenfeld 1888: 211.

Polymastia zitteli—Hallmann 1914: 400–402, pl. XV (fig. 6).

Material examined

SMF 10557 (1 specimen): PS61/132-3.

Description

External morphology. Sponge is cushion-shaped, removed from substrate (fig. 6A). It measures approximately 33x27x5 mm. Surface is macroscopically smooth, grey coloured. The cortex is firm, transparent and easily detachable (fig. 6E). It is perforated by numerous small ostia which are not visible by a naked eye. There are several exhalant papillae of conical or tubular shape measuring 2–7 mm in length and 2–4 mm in diameter. The colour of papillae does not differ from that of the surface. Oscula measuring 0.5 mm in diameter are opened at the papillae summits. The choanosome is grey and rather friable.

Skeleton. The main choanosomal skeleton represents a very loose reticulation formed by the tracts of principal spicules, which branch and anastomose (fig. 6B). Freely scattered intermediary spicules make up the additional choanosomal skeleton. The cortex, measuring 250–540 µm in thickness, consists of two layers (figs. 6C, D). The external palisade is made of the bouquets of small spicules. Its internal area is overlapped by the layer of intermediary spicules regularly arranged tangentially to the surface.

Spicules. Three size categories of spicules are well distinguished. Thirty spicules of each category were measured.

Principal and intermediary spicules are usually straight and fusiform styles, rarely stronglyloxeas or subtylostyles (fig. 6F). Principal spicules measure: length 812–908–1315 µm, proximal diameter 6–7.5–10 µm, central maximal diameter 13–16.0–21 µm. Intermediary spicules measure: length 340–395–598 µm, proximal diameter 6–8.3–10 µm, central maximal diameter 8–9.1–11 µm. Small spicules are subtylostyles with slightly subterminal tyles which are only feebly developed (fig. 6G). These subtylostyles are very slender, often slightly curved and measure: length 247–287–333 µm, proximal diameter 2–2.8–4 µm, central maximal diameter 3–4.0–4 µm.

Type locality: SW Pacific: Eastern Australian Coast: Port Jackson, depth unknown.

Distribution (other than type locality): Antarctic: NW Weddell Sea, ca. 2080 m (present data).

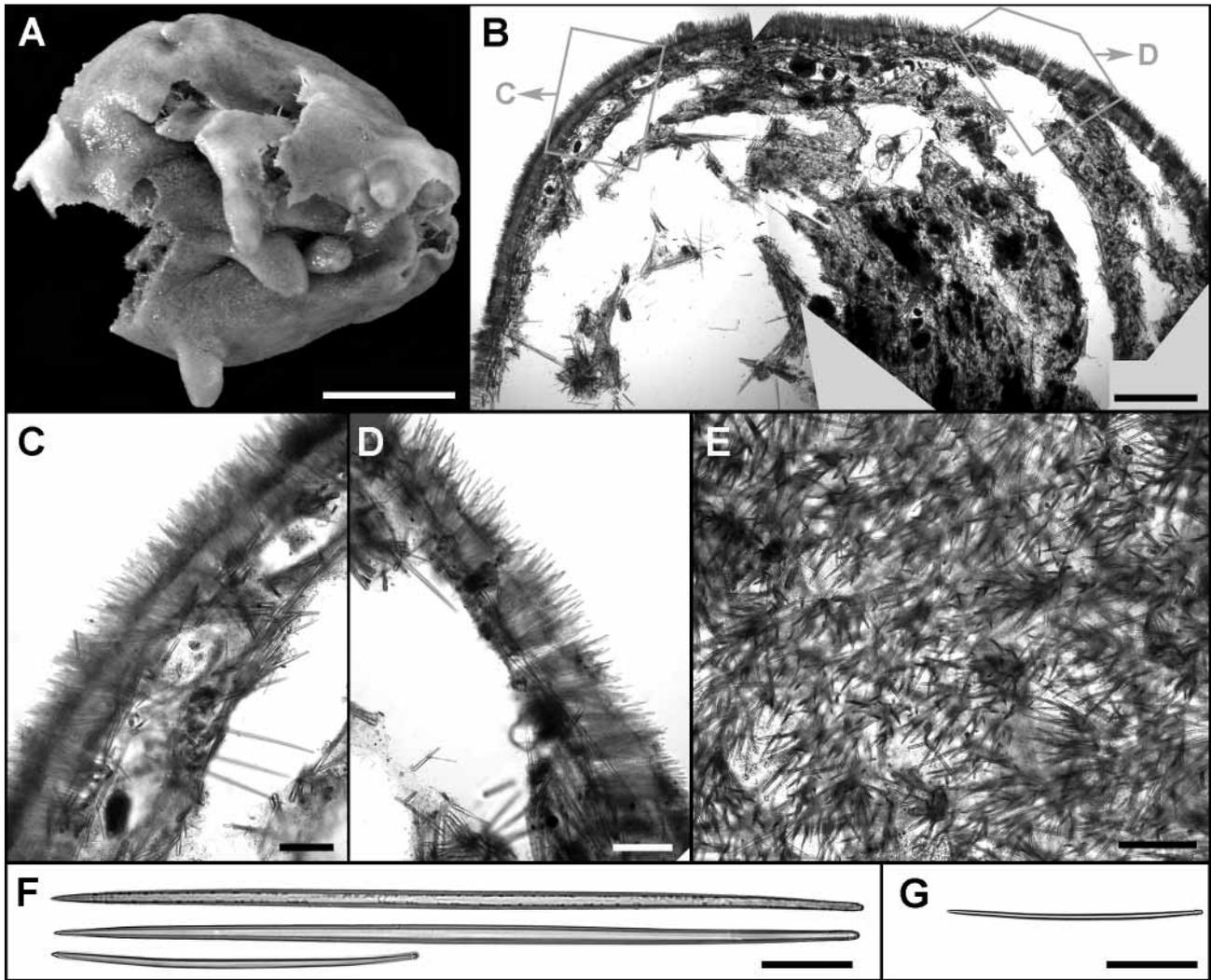


FIGURE 6. *Polymastia zitteli*. A—specimen SMF 10557. B—histological section of idem, general view. C, D—the same as B, details of cortex. E—surface view of detached cortex of idem. F—principal and intermediary spicules. G—small spicules. Scale bars: A 10 mm; B 1 mm; C–E 0.2 mm; F–G 0.1 mm.

Remarks. This is the second finding of *P. zitteli* since Lendenfeld (1888) described it from Eastern Australia. Our sponge fits well the original description as well as the re-description by Hallmann (1914). The latter author clarified the misinterpretations made by Lendenfeld, namely so called trichites, making the cortical palisade, which were in fact very slender subtylostyles, chelae scattered within the palisade, which were evidently foreign, and oxeas found in the choanosomal tracts and in the internal cortical layer, which were obviously extremely fusiform styles or strongyloxeas. *P. zitteli* shares the reticulated choanosomal skeleton with two shallow-water species, *P. boletiformis* (Lamarck, 1813) from the North Atlantic and *P. croceus* Kelly-Borges & Bergquist, 1997 from New Zealand. *P. croceus* and *P. zitteli* also share three spicule categories, which are typical of most other *Polymastia* spp., and the small cortical subtylostyles with faintly-developed tyles, which distinguish these species from other congeners. Conversely, *P. boletiformis* is distinguished by the absence of the intermediary spicule category, but its cortical tylostyles possess well-developed tyles, which are quite typical of the genus.

Genus *Radiella* Schmidt, 1870

Diagnosis (emended from Boury-Esnault 2002): Sponges are circular, lenticular or hemispherical. The inhalant and exhalant apertures are grouped on papillae. The choanosomal skeleton is composed of diverging tracts of principal spicules emanating from a central nucleus at the sponge base and by groups of fusiform tylostyles. The skeleton of the lower surface is constituted by an envelope of principal subtylostyles or styles covered by a thin palisade of cortical tylostyles. The upper surface is composed of one or two layers of tylostyles. A fringe of additional spicules is observed at the border between the upper and the lower surface.

Emendation: The presence of a marginal fringe is added.

Type species: *Radiella sol* Schmidt, 1870 (by subsequent designation).

Radiella antarctica sp. nov. (Figs. 7–9, Table 4)

Material examined

Holotype: SMF 10558: PS67/110-2.

Paratypes: SMF 10559 (2 specimens): PS61/132-3; SMF 10560 (10 specimens), 10561 (7 specimens) and 10562 (1 specimen): PS61/135-3; SMF 10563 (66 specimens) and 10564 (1 specimen): PS67/102-11; SMF 10566 (62 specimens), 10567 (42 specimens) and 10568 (2 specimens): PS67/110-2; 10565 (1 specimen), 10569 (1 specimen) and 10570 (1 specimen): PS67/110-8.

Description

External morphology. The holotype is a lenticular, slightly irregular sponge measuring approximately 9 mm in diameter and 2 mm in thickness, without any substrate (fig. 7A). The central area of the upper surface is gently rough and has a pale colour in alcohol, with a single very low exhalant papilla of 1 mm in diameter. The periphery of the upper surface is hispid and covered with greyish sediment particles. The basal surface is nearly smooth and pale coloured. A spicule fringe of 0.7 mm in width is in the margin between the upper and basal surfaces. The cortex is hardly detachable, whitish in colour and moderately firm in consistency. The choanosome is whitish, firm but crumbly.

All paratypes share the presence of solitary exhalant papillae and the marginal fringes with the holotype. The colour of their upper surfaces is mainly determined by the hispidation pattern and the subsequent density of the soiling sediment particles. The basal surface, if present, is usually pale, and the papillae are of the same colour. The cortex is hardly detachable, whitish to grey in colour and moderately firm or slightly resilient in consistency. The choanosome is whitish to pale beige. Other external features of the paratypes vary much more. The paratype SMF 10564 is a lenticular, slightly irregular sponge without any substrate (fig. 7B). The paratype SMF 10565 is a discoid sponge attached to a very small sediment particle by the central area of its basal surface (fig. 7C). Both specimens SMF 10564 and 10565 possess uniformly hispid upper surface covered with sediments and a smooth basal surface. Another paratype SMF 10562 (fig. 7D) has a discoid upper surface with a smooth pale central area and a hispid periphery, and a conical, smooth basal surface without substrate.

Most other studied sponges are attached by the basal surface to various hard substrata including pebbles, rock pieces and volcanic concretions (fig. 7E). The shape varies from discoid to hemispherical and cushion-like. The diameter is up to 30 mm while the thickness may reach 8 mm. The upper surface is mainly smooth, velvet or gently rough though its peripheral area close to the marginal fringe may be hispid. The length of the papillae varies from 0.5 to 4 mm; the diameter is 1–2 mm.

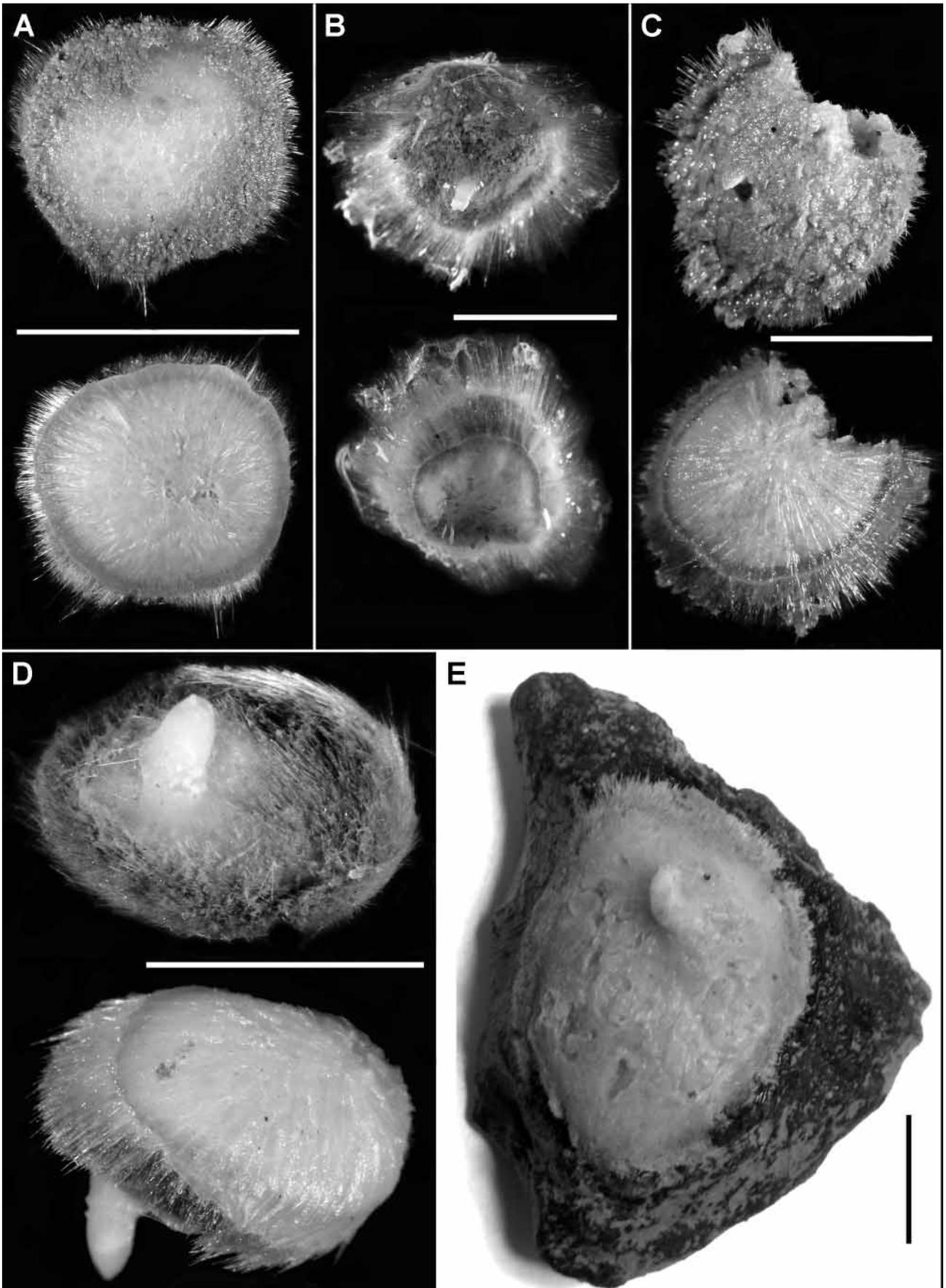


FIGURE 7. *Radiella antarctica* sp. nov.: external morphology. A–holotype SMF 10558. B–paratype SMF 10564. C–paratype SMF 10565. D–paratype SMF 10562. E–a paratype from series SMF 10563 on a rock piece. Scale bars: 10 mm.

Skeleton. The main choanosomal skeleton is constituted by the tracts of principal tylostyles radially running from the central basal area (fig. 8). The thickness of the radial tracts is 110–330 μm in the holotype and 100–280 μm in other specimens. In sponges free of substrate, or with a small substrate, the radial tracts form a smooth envelope of the basal surface (figs. 8A, B). In specimens attached to larger substrata, such an enveloping is less visible (figs. 8C, D). The additional choanosomal skeleton is composed of the variously positioned principal and small tylostyles lying singly or gathered in the thin bundles. In the upper surface the main choanosomal tracts enter the cortex, diverge into bouquets and make up the surface hispidation developed mainly in the periphery. The cortical bouquets are reinforced by the palisade of small tylostyles. Ostia are located between the bouquets. The thickness of the cortex is 250–680 μm in the holotype and 210–800 μm in other specimens. The thickness of the surface hispidation is 120–630 μm in the holotype and 260–410 μm in other specimens. The marginal fringe is made of the additional extra-long tylostyles which may also reinforce the peripheral hispidation. Papilla skeleton is constituted by the ascending main tracts surrounding the exhalant canal of 540 μm in diameter. The skeleton of each papilla possesses ascending main tracts surrounding the exhalant canal, the latter measuring 540 μm in diameter (fig. 8C).

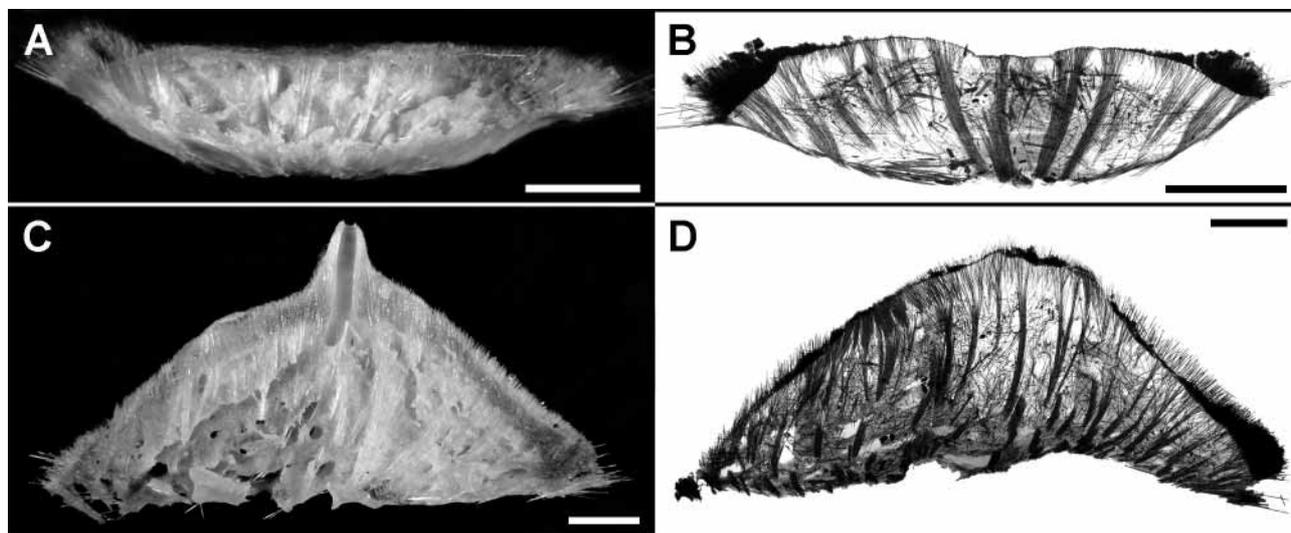


FIGURE 8. *Radiella antarctica* sp. nov.: skeleton architecture. A—holotype SMF 10558, manual section. B—the same as A, histological section. C—a paratype from series SMF 10563, manual section. D—the same as C, histological section. Scale bars: 2 mm.

Spicules. Altogether 1307 spicules from 15 specimens were measured. Two main size categories of tylostyles are well distinguished and no intermediary class can be marked out (fig. 9A). Extra-long tylostyles of the fringe undoubtedly constituted an additional size category. But the measurements of them were very few, because most of these spicules became broken on the slides. Summarizing results of spicule measurements are given in the main text below, indicating the total number of spicules measured for each category (n). Particular results of spicule measurements for each specimen (extra-long tylostyles excluded) are given in table 4.

Principal tylostyles are usually straight or rarely slightly curved, slender (fig. 9B). Most of them possess terminally located, spherical tyles. More than 60% of principal spicules have well-developed tyles and about 35% of them have weakly-developed tyles. Very infrequently, principal spicules have slightly displaced, weakly-developed tyles or even lack any tyles. In general the principal tylostyles measure: length 957–1599–2686 μm , tyle diameter 8–15.0–27 μm , diameter of the shaft underneath the tyle 5–11.8–26 μm , maximal diameter of the shaft 8–17.6–27 μm ($n=412$).

Small tylostyles are mainly straight or rarely slightly curved and most of them are slightly fusiform (fig. 9C). The majority of small spicules have terminally located, well-developed spherical tyles. About 11% of

small tylostyles are with weakly-developed tyles. The slight displacement of tyle and its absence are observed very rarely. In general the small tylostyles measure: length 125-636-1271 μm , tyle diameter 4-10.0-21 μm , diameter of the shaft underneath the tyle 2-6.0-19 μm , maximal diameter of the shaft 3-11.0-24 μm ($n=895$). It should be mentioned that in three specimens (SMF 10559 and 10564), the small spicules are significantly shorter than in other sponges—125-290-829 μm ($n=209$).

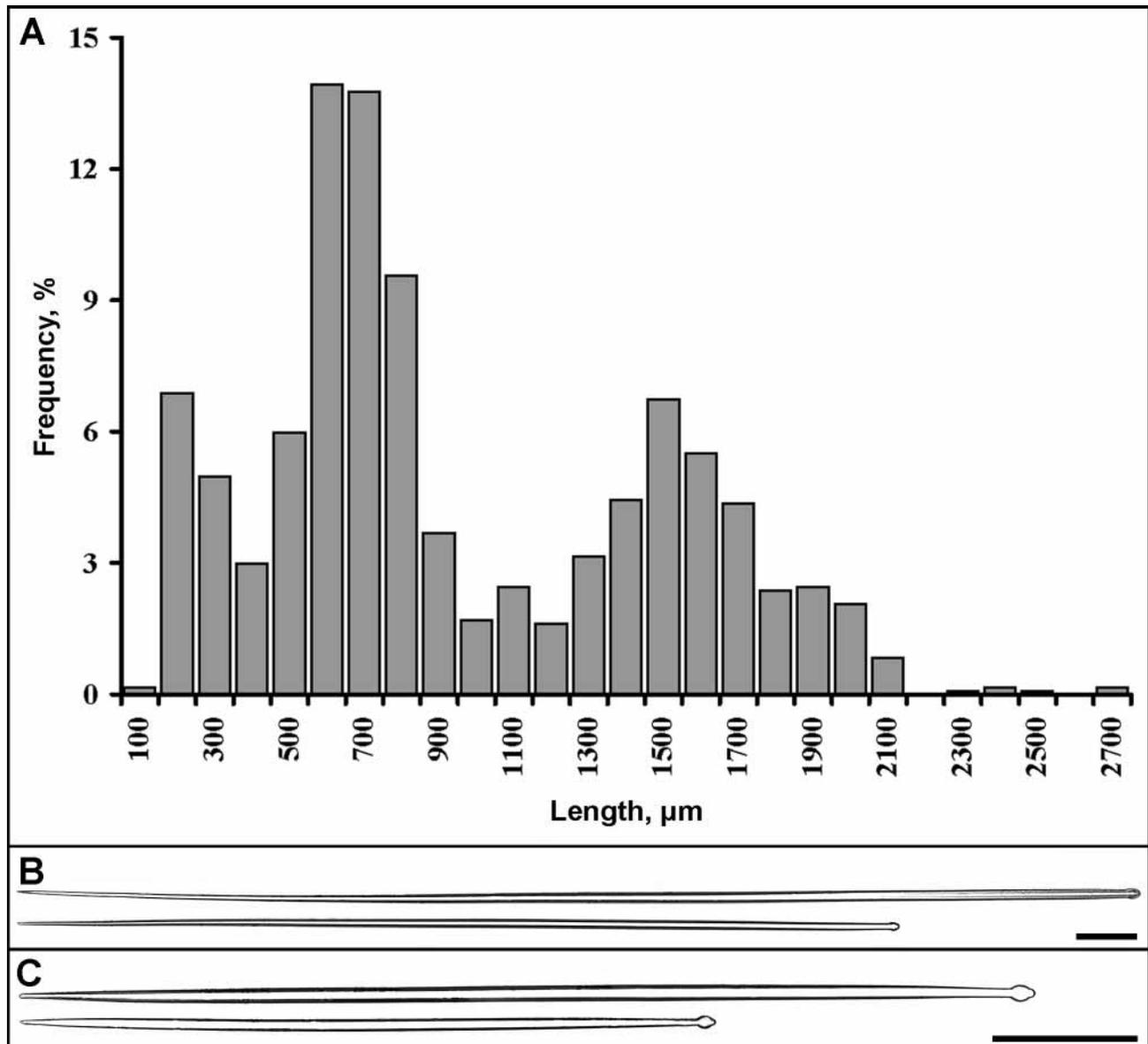


FIGURE 9. *Radiella antarctica* sp. nov.: spicules. A—frequency distribution of length (extra-long spicules of the fringe excluded). B—principal tylostyles. C—small tylostyles. Scale bars for B–C: 0.1 mm.

Extra-long tylostyles of the fringe are very slender as their diameters are similar to those of the principal tylostyles. Their minimal length is about 2500 μm while the maximal one exceeds 5600 μm . No remarkable differences in tyle location and development have been found between the fringe and principal tylostyles.

Type locality: Antarctic: Northern Weddell Sea, ca. 2080–4800 m.

Etymology: The name arises from the type locality.

TABLE 4. *Radiella antarctica* sp. nov.: Results of spicule measurements. Measurements are given as in table 2.

Specimen no.	Large tylostyles	Small tylostyles
SMF 10558 (holotype)	1330-1571-1710	490-676-810
	12.8-14.4-16 / 9.6-10.6-12	8-10.1-11.2 / 4-5.1-7.2
	12.8-16-17.6 (<i>n</i> =21)	8-10.8-14.4 (<i>n</i> =39)
SMF 10559 (specimen 1)	1014-1690-2686	155-275-829
	9.6-15.4-23 / 4.8-11-16.2	4.1-10.6-18.9 / 2.4-6.2-11.2
	8.1-19.9-27 (<i>n</i> =49)	4.8-10.1-16.2 (<i>n</i> =104)
SMF 10559 (specimen 2)	1064-1400-1710	170-320-660
	12.8-14.5-17.6 / 6.4-10.4-12.8	5.6-10.2-17.6 / 2.4-5.5-12.8
	16-18.8-22.4 (<i>n</i> =19)	4-9.7-20.8 (<i>n</i> =48)
SMF 10561 (specimen 1)	1343-1744-2086	557-872-1271
	10.8-14-17.6 / 8.1-11.7-16.2	8.1-11.7-16.2 / 4.1-6-9.5
	13.5-18.3-21.6 (<i>n</i> =19)	8.1-12.1-20.3 (<i>n</i> =41)
SMF 10562	1064-1401-1710	460-702-930
	8.8-10.8-13.6 / 6.4-9.3-12.8	5.6-8.7-12.8 / 2.4-6.1-9.6
	12.8-15.3-17.6 (<i>n</i> =60)	4.8-11.4-16 (<i>n</i> =121)
SMF 10563 (specimen 1)	1386-1523-1686	571-845-1114
	13.5-16.9-21.6 / 10.8-14.1-16.2	8.1-12.3-16.2 / 4.1-7.2-13.5
	16.2-19-21.6 (<i>n</i> =28)	8.1-14.3-24.3 (<i>n</i> =32)
SMF 10563 (specimen 2)	1486-1796-2086	600-785-1271
	9.5-13-17.6 / 8.1-11-16.2	6.8-9.5-12.2 / 4.1-6.1-8.1
	13.5-17.5-20.3 (<i>n</i> =30)	8.1-11.7-16.2 (<i>n</i> =60)
SMF 10564	1543-1864-2543	125-291-520
	10.8-15-18.9 / 8.1-12.2-14.9	6.4-9.2-13.5 / 3.2-5.2-8.1
	12.8-16.7-27 (<i>n</i> =29)	5.4-8.3-13.5 (<i>n</i> =57)
SMF 10565	957-1567-2671	400-591-871
	12.2-15.1-18.9 / 8.1-10.8-13.5	8.1-10-13.5 / 2.7-5.8-8.1
	13.5-18.7-24.3 (<i>n</i> =36)	8.1-11.4-16.2 (<i>n</i> =54)
SMF 10566 (specimen 1)	1286-1712-2057	510-796-1178
	8-13.6-27 / 6.8-11.8-25.7	6.4-8.7-20.3 / 3.2-5.5-18.9
	12.8-16.9-25.7 (<i>n</i> =43)	5.4-11.1-21.6 (<i>n</i> =84)
SMF 10567 (specimen 1)	1102-1606-2090	480-684-940
	11.2-14.4-17.6 / 6.4-10.4-14.4	6.4-9.9-12.8 / 2.4-5.7-8.8
	12.8-15.3-18.4 (<i>n</i> =20)	8-11.6-17.6 (<i>n</i> =40)
SMF 10568 (specimen 1)	1216-1525-1748	470-663-870
	12.8-15.2-22.4 / 9.6-12.8-16	8-10.8-12.8 / 4.8-5.9-8
	12.8-17.6-22.4 (<i>n</i> =21)	8-10-12.8 (<i>n</i> =43)
SMF 10568 (specimen 2)	1330-1594-2014	490-707-900
	13.6-15.8-17.6 / 10.4-12.2-14.4	8-10.2-12.8 / 4.8-6.1-8
	14.4-16.6-19.2 (<i>n</i> =20)	7.2-10-12.8 (<i>n</i> =40)
SMF 10569	1330-1568-1786	460-649-850
	14.4-17.7-22.4 / 12.8-14.1-17.6	6.4-10.1-14.4 / 1.6-5.4-8
	16-18.4-22.4 (<i>n</i> =26)	4-10.2-16 (<i>n</i> =41)
SMF 10570	1026-1429-1634	420-641-950
	12.8-19.1-22.4 / 6.4-14.8-17.6	6.4-9.2-12.8 / 2.4-5.4-9.6
	16-19.3-20.8 (<i>n</i> =28)	3.2-9.4-16 (<i>n</i> =54)

Remarks. No species of *Radiella* has previously been reported from the Antarctic, although two species were described from other regions of the Southern Hemisphere, namely *R. irregularis* (Ridley & Dendy, 1886) from the Chilean Coast, and *R. sarsi* (Ridley & Dendy, 1886) from Australia. Both species are from the deep sea. In contrast to the Antarctic sponges, the choanosomal skeleton of *R. irregularis* and *R. sarsi* consists of a confused mass of small tylostyles, while the upper cortical skeleton is formed by intermediary spicules, and long spicules constitute the basal envelope and the marginal fringe. *Radiella irregularis* is also distinguished by the presence of several papillae. The status of *R. sarsi* is somewhat controversial because its type locality simultaneously includes Australia and the Azores. Meanwhile later findings of this species have been made exclusively in the Northern Hemisphere (Boury-Esnault *et al.* 1994; Plotkin 2004). Another similar deep-water species, *R. straticulata* (Wilson, 1925) from the Philippines, is distinguished from other *Radiella* spp. by the three-layered cortex.

The status of *R. sol* Schmidt, 1870, the type species of the genus, is rather confused. Schmidt (1870) described it from Cuba. His illustration of the sponge habit resembles *R. sarsi* and also some of our Antarctic sponges, but the description is very brief and gives no information about the skeleton architecture. Boury-Esnault (2002) discovered a specimen collected by the 'Blake' expedition 1878–1879 from the Western Central Atlantic deep waters and identified by Schmidt as *R. sol*. She considered this specimen as the holotype but made a question mark and emphasized that the discovered specimen differs from the original illustration of Schmidt (1870). The differences are not listed but the comparison of Schmidt's drawing and Boury-Esnault's description and photo reveals that the former sponge had a single papilla and a hispid upper surface whereas the latter specimen possessed 15 papillae and a velvety surface. Additionally, Schmidt's drawing indicates a very long marginal fringe whereas Boury-Esnault's photo shows a considerably damaged or probably just weakly-developed fringe; although in her description the fringe is alleged to be very long. Meanwhile, the possession of several papillae, the smooth or velvety upper surface and the moderately-developed fringe are typical of *R. hemisphaerica* (Sars, 1872), widely distributed in the North Atlantic and Arctic deep and shallow waters (Koltun 1966; Plotkin 2004). Boury-Esnault writes (2002, p.213): "...Presently it is impossible to ascertain if this specimen from the West central Atlantic is a synonym of '*hemisphaericum*' from the Arctic and North Atlantic..."

Albeit a detailed revision of *Radiella* being necessary, it appears quite clear that the materials dealt with here belong to a new species. We should just mark out high variability of external morphology of *R. antarctica* sp. nov. Sponges free of substrate, or attached to very small substrata, have lenticular or discoid shape with a prominent basal surface enveloped by main spicule tracts, which is typical of other *Radiella* spp. On the contrary, specimens attached to larger substrata are hemispherical or cushion-shaped and the enveloping of their basal surface is reduced. However, in both cases a marginal fringe of additional spicules is developed to a greater or lesser extent.

Genus *Tentorium* Schmidt, 1870

Diagnosis (emended from Boury-Esnault 2002):

Sponges are columnar or globular, protected by a dense cylindrical sheath of longitudinally placed principal spicules which form a solid imperforate layer. The cortical skeleton contains bundles of smaller spicules arranged in a palisade and is limited to the upper surface of the cylinder. Ostia are present on the upper surface. The oscula are at the tops of small papillae located on the upper surface. Spicules are subtylostyles and tylostyles.

Type species: Thecophora semisuberites Schmidt, 1870 (by original designation).

***Tentorium papillatum* (Kirkpatrick, 1908)** (Figs. 10–11)

Synonymy

Suberites caminatus var. *papillatus*—Kirkpatrick 1908: 20–21, pl. XV (16), pl. XVI (11–14).

Suberites papillatus—Burton 1929: 445; 1932: 336.

Suberites caminatus—Koltun 1964 (partly): 25, pl. IV (15–18).

Tentorium caminatus—Koltun 1976 (partly): 168.

Tentorium papillatum—Topsent 1917: 36, pl. IV(2); Boury-Esnault and van Beveren, 1982: 38–39, pl. V(17–18), figs. 8c, d, e.

Material examined

SMF 10571 (7 specimens): PS67/074-7.

Description

External morphology. Sponges are mostly hemispherical or rarely more pillar-like, detached from substrata (figs. 10A, B). Their diameter may reach 16 mm. Surface is smooth or slightly granulated. From 1 to 4 exhalant papillae and numerous small protuberances are located on the upper surface whereas the lateral surface lacks these structures. The papillae measure 2.5–8 mm in height and 1.5–2.3 mm in diameter. They are cylindrical or slightly conical, getting thinner at the summit, where oscula of 0.5–2 mm in diameter are opened. Ostia are located exclusively at the tips of the small protuberances. The colour of the papillae, protuberances and the surface between them is more or less the same pale beige to whitish. Occasionally slight sediment dust makes the surface more greyish. The cortex is hardly detachable, nearly white in colour, rather dense and resilient in consistency. The choanosome is of similar colour, less dense but not very crumbly.

Skeleton. The choanosomal skeleton is constituted by the longitudinal tracts of principal spicules (fig. 10C). These tracts, initially measuring 150–220 µm in thickness, rise from the sponge base and branch into 2–3 thinner tracts, which enter the cortex within the protuberances and diverge into bouquets. The cortical bouquets do not penetrate the surface which is therefore smooth. The cortex, measuring 420–440 µm in thickness, consists of a single palisade of small tylostyles (fig. 10D). This palisade is more or less regular over the whole surface. Within the protuberances it is intermingled with the principal bouquets and split by ostia. The palisade also continues to the lateral cortex, where the tylostyles do not change their polarity, staying perpendicular to the upper surface and tangentially to the lateral one. Skeleton of papillae is constituted by the ascending choanosomal tracts.

Spicules. Altogether 133 spicules from 2 specimens were measured. Two size categories are well marked (fig. 11A). The number of measured spicules of each category is given below, separately for each specimen (*n*₁, *n*₂).

Principal spicules are styles or subtylostyles with slightly subterminal, oval tyles which are only feebly developed (fig. 11B). They are usually straight, slender and slightly fusiform. Their dimensions are: length 814–1068–1743 µm, tyle diameter 8–12.9–18 µm, proximal diameter 5–12.2–19 µm, central maximal diameter 11–17.2–22 µm (*n*₁=30, *n*₂=20). Small tylostyles are usually straight, rather fusiform, with well-developed terminal spherical tyles (fig. 11C). They measure: length 145–348–671 µm, tyle diameter 6–12.9–18, proximal diameter 3–8.7–14 µm, central maximal diameter 5–15.0–26 µm (*n*₁=30, *n*₂=53).

Type locality: Antarctic: Pacific sector: to the West of Balleny Islands, 462 m.

Distribution. Antarctic near-continent sectors (Koltun 1964; Sarà *et al.* 1992): N 5 including the Western Ross Sea and NN 8–9 including the Weddell Sea (present study as well). Depth: 90–1080 m (Koltun 1964); ca. 1050 m in the NE Weddell Sea (present study).

SW Atlantic: South Georgia (Koltun 1964; Sarà *et al.* 1992).

Southern Indian Ocean: Kerguelen, 177–315 m (Boury-Esnault & van Beveren 1982).

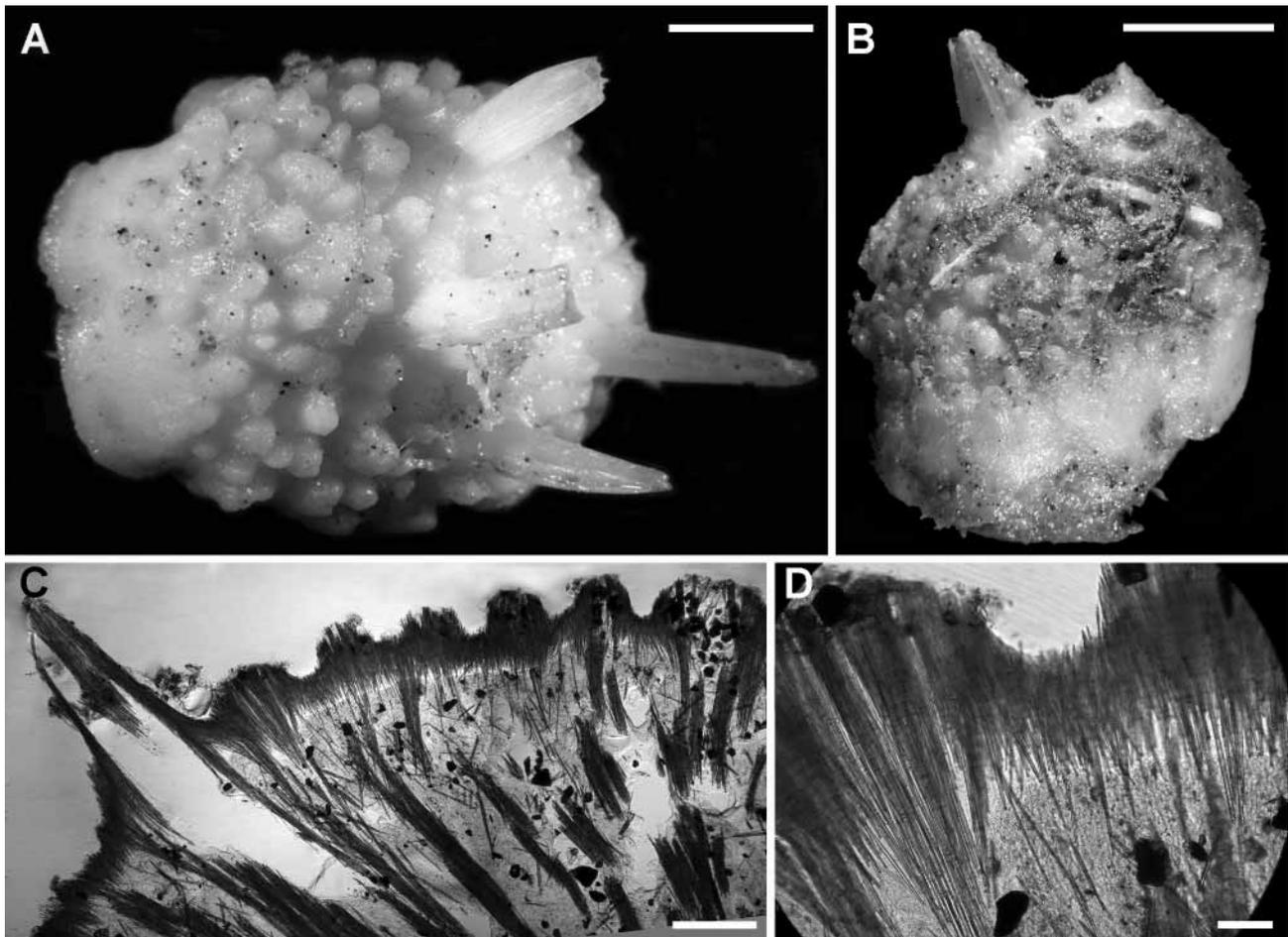


FIGURE 10. *Tentorium papillatum*: external morphology and skeleton architecture. A–B—specimens from series SMF 10571. C—histological section of the specimen showed on A, general view. D—the same as C, detail of cortex. Scale bars: A–B 5 mm; C 1 mm; D 0.1 mm.

Remarks

The classification of *Tentorium papillatum* has been a matter of considerable debate. In 1886 Ridley and Dendy established a new species *Suberites caminatus*. A year later they erected a new species, *S. microstomus* Ridley & Dendy, 1887, out of one syntype of *S. caminatus*. Kirkpatrick (1908) established new varieties for the species of Ridley and Dendy, *S. caminatus* var. *papillatus* differing from the typical morphs by the locality of ostia exclusively on the tops of small surface raisings and *S. microstomus* var. *stellatus* differing from the typical morphs by the stellate shape of the surface ostial areas and by the thicker and denser cortical tylostyles. Topsent (1917) raised the variety *papillatus* to species level and placed it in *Tentorium*, as *T. papillatum*. Burton (1929) agreed with validity of this species but kept it in *Suberites*, as *S. papillatus*. Koltun (1964) synonymized *S. papillatus* with *S. caminatus* and *S. microstomus* and gave the name of the senior synonym, *S. caminatus*. Later he transferred *caminatus* to *Tentorium* without any comments (Koltun 1976). Boury-Esnault and van Beveren (1982) advocated the validity of *S. microstomus* and also followed Topsent (1917), maintaining *papillatus* in *Tentorium*.

Herein, we follow Topsent and Boury-Esnault & van Beveren considering *papillatum* a valid species of *Tentorium*; its regular radial skeleton and presence of papillae do not correspond with the accepted definition of *Suberites* (see van Soest 2002). Furthermore, the location of exhalant papillae and ostia exclusively on the upper surface, the single-layered cortex and only two tylostyle categories are typical of *Tentorium*. Nevertheless, *T. papillatum* considerably differs from the type species, *T. semisuberites*, and also from the recently

described *T. levantinum* Ilan, Gugel, Galil & Janussen, 2003 in lacking a dense, solid, lateral sheath made of principal spicules placed longitudinally. Thus, the taxonomic position of *T. papillatum* remains uncertain.

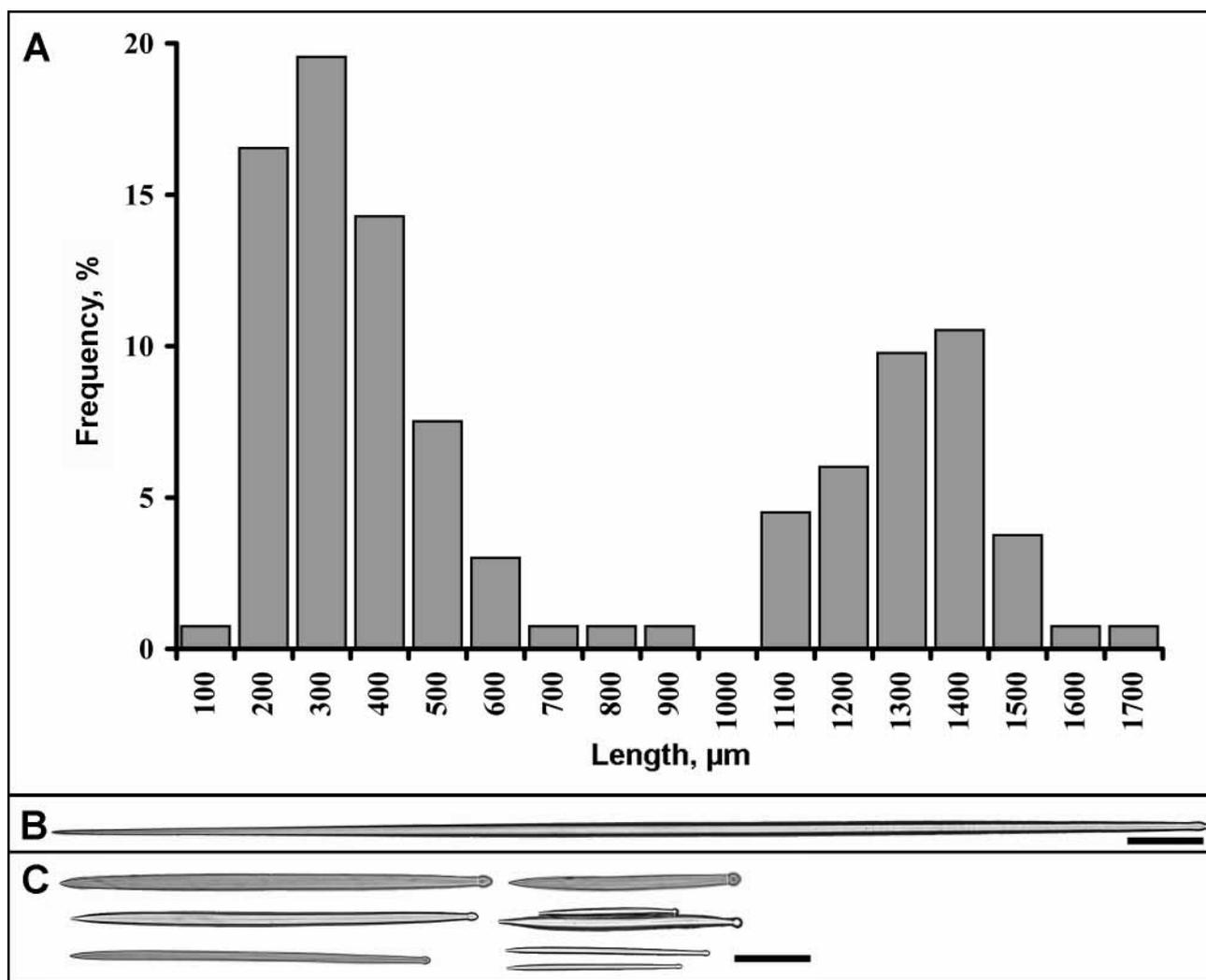


FIGURE 11. *Tentorium papillatum*: spicules. A—frequency distribution of length. B—principal spicule. C—small tylostyles. Scale bars for B–C: 0.1 mm.

***Tentorium cf. semisuberites* (Schmidt, 1870) (Figs. 12–13, Table 5)**

Synonymy

Northern Hemisphere:

Thecophora semisuberites—Schmidt 1870: 50, Taf. VI (Fig. 2); Hansen 1885: 8–9.

Tentorium semisuberites—Vosmaer 1885: 18; Brøndsted 1914: 522–523; Ferrer-Hernández 1914: 19; Stephens 1915: 29–30; Hentschel 1929: 868–869; Koltun 1966: 85–86, text-fig. 57, pl. XIX (figs. 4–8), pl. XXXI (fig. 12); Boury-Esnault 2002: 215–216, fig. 12; Plotkin 2004: 544, figs. 1j, 2j.

Southern Hemisphere:

Ridley and Dendy 1886: 489; 1887: 221–222; Boury-Esnault and van Beveren 1982: 37–38, pl. V (19), figs. 8f, g.

Material examined

SMF 10572 (1 specimen) and 10573 (2 specimens): PS61/132-3; SMF 10574 (1 specimen): PS67/074-7; SMF 10575 (8 specimens), 10576 (4 specimens) and 10577 (2 specimens): PS67/121-7; SMF 10578 (1 specimen): PS67/133-2.

Description

External morphology. Sponges are cylindrical or columnar, measuring 0.4–1.2 cm in diameter and 0.2–1.6 cm in height (figs. 12A, C, E). The upper surface is nearly hemispherical in shape, minutely rough in texture and brownish to greyish in colour. It is perforated by numerous ostia and bears one or few exhalant papillae which measure 0.6–2.6 mm in height and 0.6–1.6 mm in diameter with oscula of 0.2–1.5 mm in diameter. The cortex is restricted to the upper surface. It is hardly detachable, the consistency is firm, and the colour is nearly white. The lateral surface is smooth, firm, imperforate and always paler in colour in comparison with the upper surface. The choanosome is slightly darker than the cortex, its consistency may be resilient or firm and crumbly.

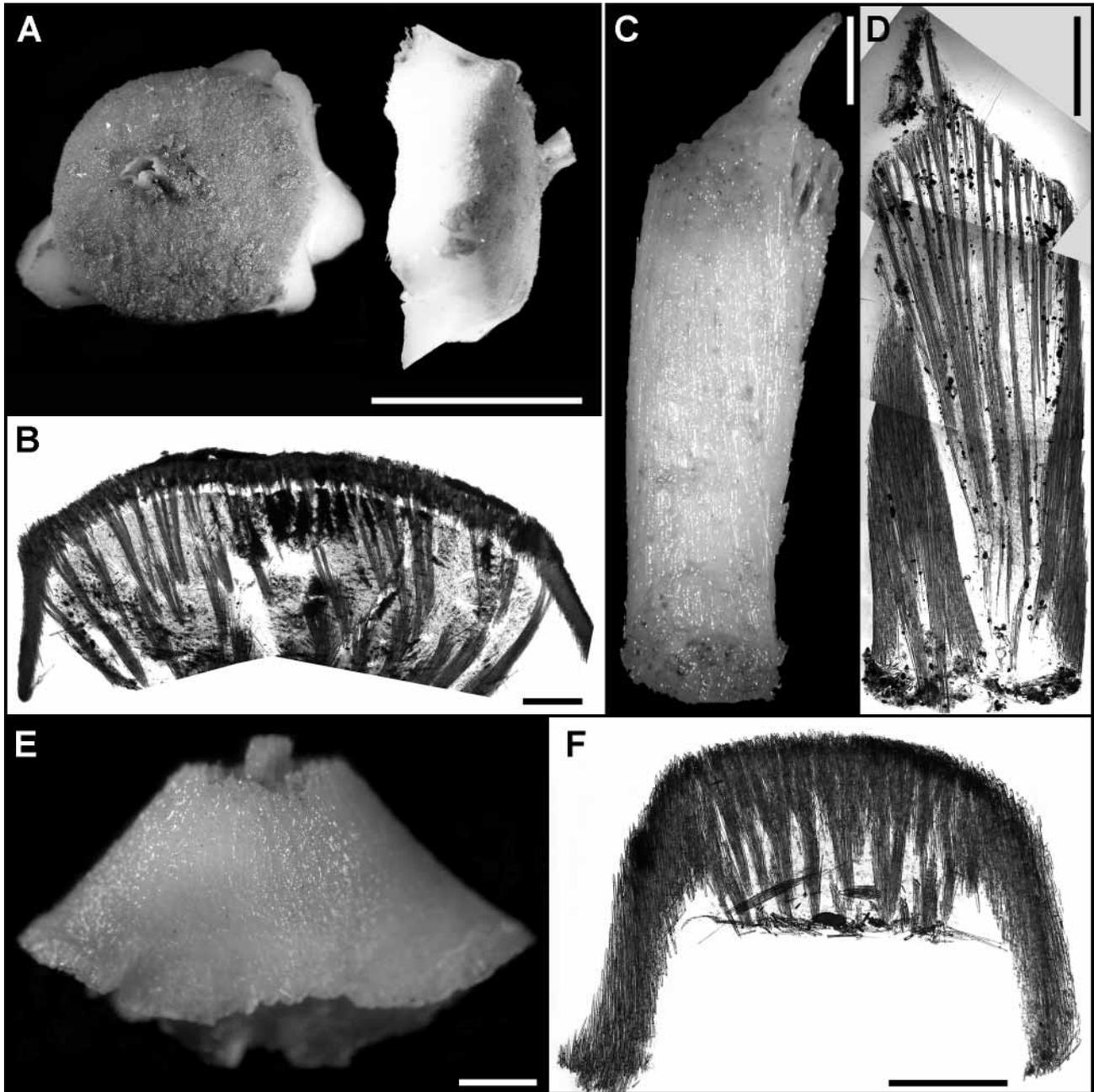


FIGURE 12. *Tentorium* cf. *semisuberites*: external morphology and skeleton architecture. A—a specimen from series SMF 10575. B—histological section of idem. C—specimen SMF 10574. D—histological section of idem. E—a specimen from series SMF 10577. F—histological section of idem. Scale bars: A 10 mm; B 1 mm; C–D 2 mm; E–F 1 mm.

Skeleton. The choanosomal skeleton is constituted by the longitudinal tracts of principal spicules running from the base to the surface (figs. 12B, D). The internal tracts measuring 70–240 μm in thickness enter the cortex and diverge into bouquets. The peripheral tracts form a solid imperforate lateral sheath (fig. 12E). The cortex measuring 550–650 μm in thickness is reinforced by the bouquets of small spicules. In the sponge base, at the level of attachment to the substrate, small spicules form a pad where they lie tangentially to the substrate. Skeleton of papillae is constituted by the ascending longitudinal tracts (fig. 12D).

Spicules. Altogether 503 spicules from 7 specimens were measured. Two main size categories of tylostyles are well distinguished (fig. 13A). Summarizing results of spicule measurements are given in the main text below, indicating the total number of spicules measured for each category (n). Particular results of spicule measurements for each specimen are given in table 5.

Principal spicules are mainly tylostyles, rarely subtylostyles or styles (fig. 13B). They may be very fusiform or slender, often with blunt distal ends and measure: length 800–1064–1529 μm , proximal diameter 2–13.7–35 μm , central maximal diameter 3–21.4–51 μm ($n=168$). Their tyles, if present, are spherical and measure 9–17.8–41 μm in diameter ($n=141$).

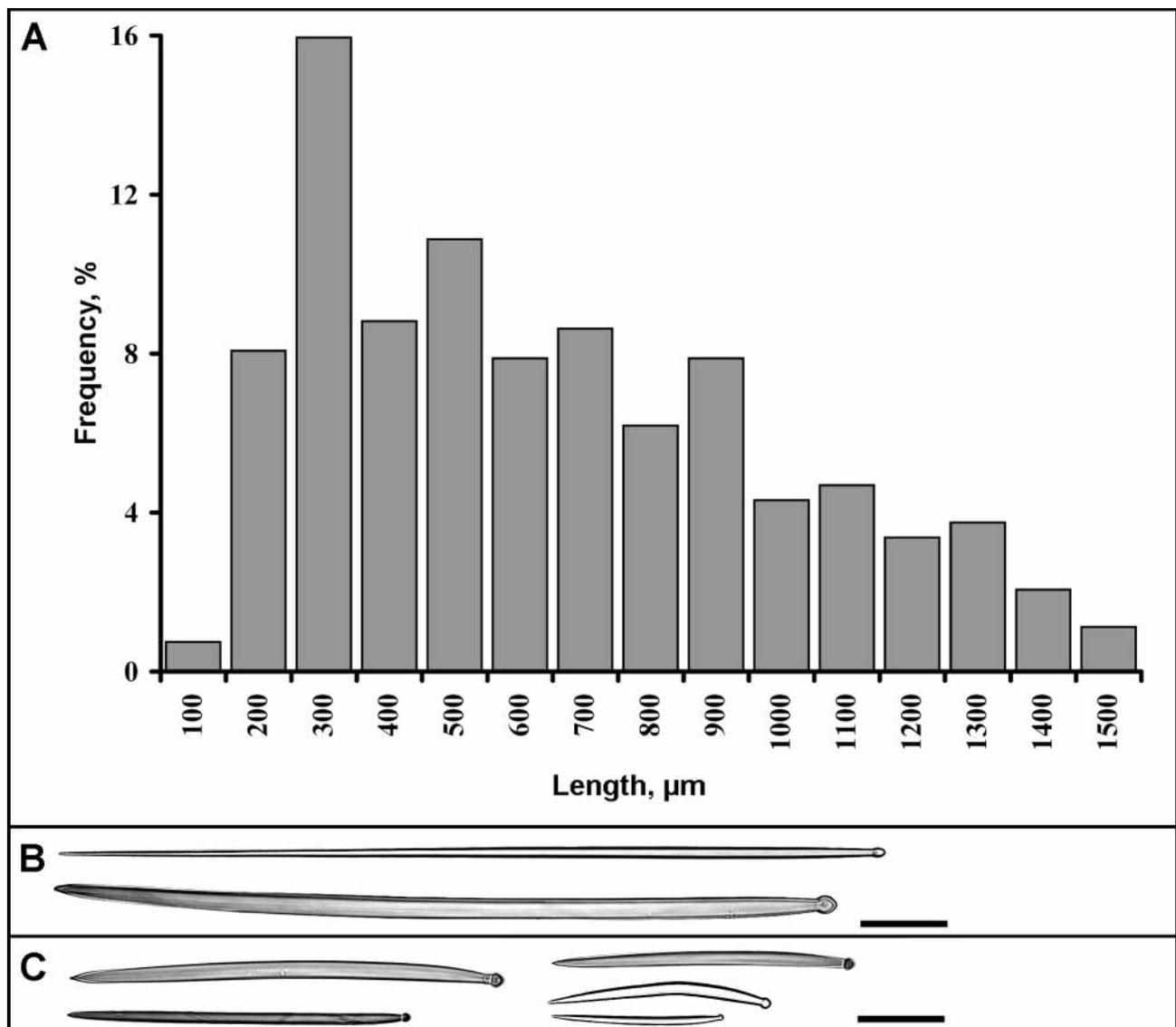


FIGURE 13. *Tentorium cf. semisuberites*: spicules. frequency distribution of length. B—principal spicule. C—small tylostyles. Scale bars for B–C: 0.1 mm.

Small spicules are tylostyles or subtylostyles (fig. 13C). They are usually stout, fusiform, with spherical tyles, sometimes with blunt distal ends. Their dimensions are: length 105-446-790 μm , tyle diameter 5-12.8-32 μm , proximal diameter 3-8.9-30 μm , central maximal diameter 5-15.1-32 μm ($n=335$).

Type locality: Arctic Ocean: Ubekendl, depth unknown.

Distribution: Northern Hemisphere: Arctic and North Atlantic (various localities, see Koltun 1966; Boury-Esnault 2002). Depth: 26–2800 m (Koltun 1966); deeper in temperate waters, shallower in high latitudes (Boury-Esnault 2002).

Southern Hemisphere: Southern Indian Ocean: Kerguelen, 70–245 m (Boury-Esnault & van Beveren 1982). South Atlantic: Inaccessible Island, 109–164 m (Ridley & Dendy 1887), South Georgia (Sarà *et al.* 1992). Antarctic near-continent sectors (Sarà *et al.* 1992): NN 2–5 including the Western Ross Sea and N 9 including the Weddell Sea (present study as well). Depth: ca. 1050–2620 m in the Northern Weddell Sea (present study).

Remarks

This species is well known from the North Atlantic and Arctic, mainly from deep waters, except from high latitudes where it may be collected in the subtidal zone (Boury-Esnault 2002). The Southern Hemisphere specimens reported by Ridley and Dendy (1886, 1887) and Boury-Esnault and van Beveren (1982), as well as the specimens examined by us, do not considerably differ from the northern sponges. However, such a discontinuous distribution may testify for the existence of two sibling species within *T. semisuberites*.

TABLE 5. *Tentorium cf. semisuberites*: Results of spicule measurements. Measurements are given as in tables 2 and 4.

Specimen no.	Principal spicules	Small spicules
SMF 10572	860-1210-1482	280-532-760
	10-12.7-16 / 6-9.7-13	9-10.4-14 / 3-6-10
	14-18.9-26 ($n=23$)	9-12.7-18 ($n=43$)
SMF 10573 (specimen 1)	810-895-990	215-440-790
	10-16.2-24 / 6-10-16	10-13.8-19 / 5-8.9-11
	13-19.7-26 ($n=15$)	11-17.7-26 ($n=48$)
SMF 10574	814-1082-1500	400-618-729
	15-32.4-41 / 11-26.5-35	14-23-32 / 11-18.9-30
	16-36.9-51 ($n=21$)	16-24.9-32 ($n=9$)
SMF 10575 (specimen 1)	857-1146-1529	162-502-771
	11-16.9-27 / 7-13.9-22	8-16.6-22 / 7-13.2-19
	14-21.2-35 ($n=42$)	8-21.1-28 ($n=22$)
SMF 10576 (specimen 1)	800-836-920	105-421-790
	10-16-21 / 6-12.3-16	5-12.2-19 / 4-8.8-16
	10-21.4-29 ($n=14$)	5-14.4-27 ($n=108$)
SMF 10577 (specimen 1)	836-959-1178	190-395-700
	9-15.4-19 / 2-10.3-14	10-14-19 / 5-9.6-13
	3-18.8-27 ($n=21$)	10-16-22 ($n=47$)
SMF 10578	800-1085-1371	200-429-786
	9-12.8-15 / 8-12.3-16	5-9.5-16 / 4-7.7-11
	11-15.9-19 ($n=32$)	5-11.6-19 ($n=58$)

Family Suberitidae

Diagnosis (sensu van Soest 2002):

Sponges are globular, ramose, stipitate, massive or encrusting. Megascleres are usually tylostyles, occasionally styles, strongyloxeas or centrotylote oxeas. Microscleres are usually absent, when present confined to microrhabds and trichodragmas. In cross section, megascleres are usually arranged in bouquets at the surface, in more massive species becoming progressively confusedly arranged towards the interior, but overall structure may also be strictly radial or show a strong axial orientation. In one genus the spicules at the surface are arranged tangentially. There is no recognizable cortex. In thinly encrusting species spicule orientation is either parallel or perpendicular to the substratum. Modifications of shape and position of the tylostyle heads are common; they can be lobate, pear-shaped, drop-shaped or subterminal.

Genus *Aptos* Gray, 1867

Diagnosis (sensu van Soest 2002):

Sponges are lobate, spherical, subspherical or globular often consisting of confluent globular or lobate units. Surface smooth or tuberculate-papillate, usually rough to the touch. Some species show a distinct colour change when taken out of the water. In cross section, the outer region is often fibrous and may be considered as a cortex which grades into the choanosome. Skeleton strictly radial, with tracts and single spicules issuing from the centre of the lobe or globular body. At the surface the tracts fan out and form a dense palisade consisting of smaller spicules intermingled between the ends of the larger spicules. Spicules are strongyloxeas, in three overlapping size categories; the intermediate and smaller spicules are occasionally oxeas, styles or tylostyles.

Type species: Ancorina adriatica Gray, 1867 (by original designation) = *Aptos aptos* (Schmidt, 1864).

Aptos robustus sp. nov. (Fig. 14)

Material examined

Holotype: SMF 10579: PS61/141-9.

Description

External morphology. The holotype is a cushion-shaped sponge originally attached to a stone but detached from it on the deck (figs. 14A, B). The dimensions are approximately 55x26x7 mm. Surface is smooth, slightly rough to the touch, with numerous gentle elevations at the tops of which small oscula are opened. Surface colour was light brown in life and has become pale yellow in alcohol, the elevations have remained darker. The cortex is pale yellow to white, very hard and firm in consistency, and cannot be detached from the choanosome. The latter is also hard but crumbly, its colour pale yellow. Numerous aquiferous cavities are located under the cortex and in the internal choanosome.

Skeleton. The choanosomal skeleton is constituted by the radial tracts of principal strongyloxeas running from sponge base to the surface and measuring 150–500 µm in thickness (fig. 14C). Cortical skeleton made of a layer of small and intermediary tylostyles which are mainly arranged perpendicularly to the surface but also sometimes obliquely to it (fig. 14D). The cortex measuring 1–1.2 mm in thickness is perforated by rare, small ostia (fig. 14E).

Spicules. Three size categories of spicules are well distinguished. Thirty spicules of each category were measured.

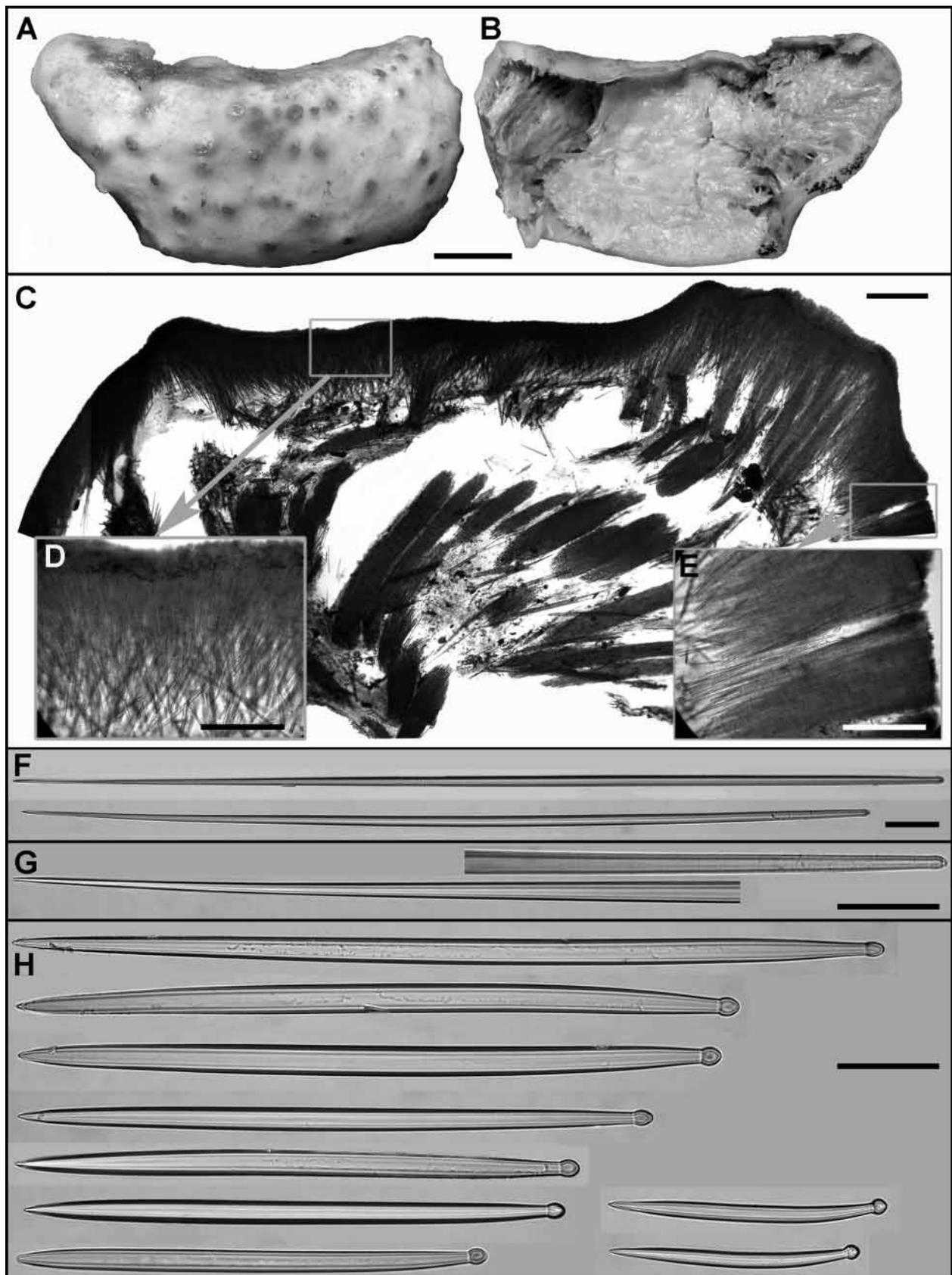


FIGURE 14. *Aptos robustus* sp. nov. A—holotype SMF 10562, upper surface. B—the same as A, basal surface after detaching from substrate. C—histological section of idem, general view. D—the same as C, detail of cortex with perpendicular and tangentially lying tylostyles. E—the same as C, detail of cortex with ostia. F—principal strongyloxeas, general view. G—details of proximal and distal ends of a strongyloxea. H—intermediary and small tylostyles. Scale bars: A–B 10 mm; C 1 mm; D–E 0.5 mm; F–H 0.1 mm.

Principal strongyloxeas are mainly straight, rarely slightly curved (figs. 14F, G) and measure: length 1378-1647-1780 μm , proximal diameter 10-11.3-12 μm , central maximal diameter 14-16.3-21 μm . Small and intermediary tylostyles are always stout and fusiform, with well-developed, terminally located, spherical or oval tyles (fig. 14H). Intermediary tylostyles are mainly straight and measure: length 470-618-830 μm , diameter of the tyle 13-15.5-18 μm , diameter of the shaft underneath the tyle 9-10.8-12 μm , maximal diameter of the shaft 20-23.3-28 μm . Small tylostyles are often slightly curved. Their dimensions are: length 250-259-300 μm , diameter of the tyle 14-14.6-16 μm , diameter of the shaft underneath the tyle 9-9.9-11 μm , maximal diameter of the shaft 14-14.9-16 μm .

Type locality

SE Atlantic: to the East of the South Sandwich Islands, ca. 2300 m.

Etymology

The name refers to the hard consistency of the cortex (Latin *robustus*=hard, robust).

Remarks

No species of *Aaptos* has previously been registered in the Antarctic and deeper than 1000 m either, although Sarà *et al.* (1992) included *A. unispiculus* (Carter, 1880) in the Antarctic faunistic complex. In the meantime, the taxonomy and geography of this species are rather confused. *Hymeraphia unispiculum* described by Carter (1880) from the Gulf of Manaar, tropical Indian Ocean, was a thinly encrusting, hispid sponge with long rhabdostyles echinating the surface. De Laubenfels (1936) proposed transferring *H. unispiculum* to *Aaptos* without examination of any material and in spite of evident disparities. Later de Laubenfels (1954) recorded *A. unispiculus* from the Marshall Islands, tropical North Pacific, probably from shallow waters. His specimen really shared some features with *Aaptos* spp., at least it possessed a surface palisade of styles, but any resemblance to Carter's description could hardly be observed. Following the actions of de Laubenfels, Desqueyroux (1972) and Desqueyroux & Moyano (1987) reported *A. unispiculus* as deep as 200–400 m, from the SE Pacific, off Juan Fernandez Islands and in the Magellan area of the Chilean Coast, respectively. Subsequently the latter record was taken into account by Sarà *et al.* (1992). The SE Pacific sponges were thickly encrusting, hard and hispid. Their confused choanosomal skeleton was made of styles and microxeas, and the distinct dense cortex contained the styles oriented either tangentially or perpendicularly to the surface. Thus, the placement of *H. unispiculum* in *Aaptos* is hardly justified. Currently, the species in question is accepted as *Eurypon unispiculum*, both *Eurypon* and *Hymeraphia* belong to the family Raspailiidae Hentschel, 1923. Subsequently, the sponges recorded as *A. unispiculus* from the tropical and subantarctic Pacific, belong in fact to some other species, which, probably but not for certain, may belong to *Aaptos*. There is at least no doubt that these species share very few features with *A. robustus* sp. nov. described herein.

Meanwhile, seven valid species of *Aaptos* are currently known from the temperate shallow waters of the Southern Hemisphere – four New Zealand species, *A. confertus*, *A. globosum*, *A. rosacea* and *A. tentum*, all described by Kelly-Borges and Bergquist (1994); one South Australian species, *A. horrida* (Carter, 1886); and two South African species, *A. nuda* (Kirkpatrick, 1903) and *A. alphiensis* Samaai & Gibbons, 2005. The latter six species share a globular or (sub)spherical body and a strictly radial choanosomal skeleton composed of the main spicule tracts which issue from the body center. Conversely, *A. robustus* sp. nov. described herein is characterized by a cushion-shaped body and a choanosomal skeleton constituted by the tracts starting from sponge base. Our new species probably has the growth pattern similar to that of *A. confertus*. The body of the latter is said to result from the confluence of several strictly globular or spherical units, and subsequently its skeleton is considered as a compilation of several strictly radial subskeletons (Kelly-Borges & Bergquist 1994). We suppose that *A. robustus* sp. nov. demonstrates even more complete confluence of the units than *A. confertus*, so that these units can hardly be recognized.

Concerning the skeletal arrangement and spicule composition, our new species shares the main choanosomal tracts made of principal strongyloxeas, and the cortex constituted by a single palisade of smaller spicules with *A. confertus*, *A. globosum*, *A. rosacea*, *A. tentum* and *A. horrida*, whereas *A. nuda* lacks any cortical or even ectosomal skeleton, and *A. alphiensis* is distinguished by the principal spicules being subtylostyles and by the under-palisade layer of densely packed, tangentially oriented spicules. The cortical palisade of *Aaptos* spp. is often composed of two categories of spicules (Kelly-Borges & Bergquist 1994). In *A. robustus* sp. nov. and *A. confertus* these categories are distinguished only by size and presented by fusiform, straight tylostyles in the former species and by slender, curved and/or bent styles in the latter species. In *A. globosum*, *A. rosacea* and *A. tentum* these are small, fusiform tylostyles and larger, slender subtylostyles or styles, and in *A. alphiensis* they include small tylostyles and larger styles.

Thus, the principal spicules and two size classes of the cortical spicules constitute altogether three spicule categories of *A. robustus* sp. nov., and no other spicules were observed in this species. Conversely, most other *Aaptos* spp. possess a fourth category of spicules being intermediary in size between the longer spicules of the palisade and the principal megascleres, and embedded in the fanning main tracts protruding the cortex. In *A. confertus*, *A. rosacea* and *A. alphiensis*, such an intermediary category is constituted by styles or subtylostyles, and these are also abundantly scattered in the choanosome between the main tracts. In *A. tentum* and *A. globosum* the intermediary spicules do not differ from the principal strongyloxeas in shape and are rarely found (in the former species) or absent (in the latter species) in the choanosome.

Genus *Rhizaxinella* Keller, 1880

Diagnosis (sensu van Soest 2002):

Pedunculate sponges, with spherical, ovoid or cylindrical body carried on a simple or ramified stalk, normally attached to the substrate by a root system; usually an apical oscule. Body with a more-or-less radial skeleton and with brushes of spicules at the surface, skeleton of the stalk a tightly packed mass of aligned megascleres, bound by spongin. Megascleres are tylostyles of different sizes with raphides in trichodragmas.

Type species: Rhizaxinella clavigera Keller, 1880 (by monotypy) = junior synonym of *Alcyonium pyriferum* delle Chiaje, 1828.

Rhizaxinella cf. *nuda* Wilson, 1925 (Fig. 15)

Synonymy

Rhizaxinella nuda—Wilson 1925: 352–353, pl. 38 (fig. 5).

Material examined

SMF 10580 (1 specimen) and 10597 (2 specimens): PS61/132-3; SMF 10581 (1 specimen) and SMF 10588 (1 specimen): PS67/121-7.

Description

External morphology. Small club-shaped sponges with rather damaged stalks (figs. 15A–E). Their height varies from 0.6 to 2.1 cm. The surface is velvety, greyish. Consistency is rather soft. A contracted osculum is located slightly eccentrically on the top of main body.

Skeleton. The choanosomal skeleton is constituted by the principal tylostyles arranged more or less radially and grouped in tracts or bundles (fig. 15F). The ectosomal skeleton is formed by the bouquets of small tylostyles, densely packed and intermingled. Skeleton of the stalk not observed because of considerable damage of the latter.

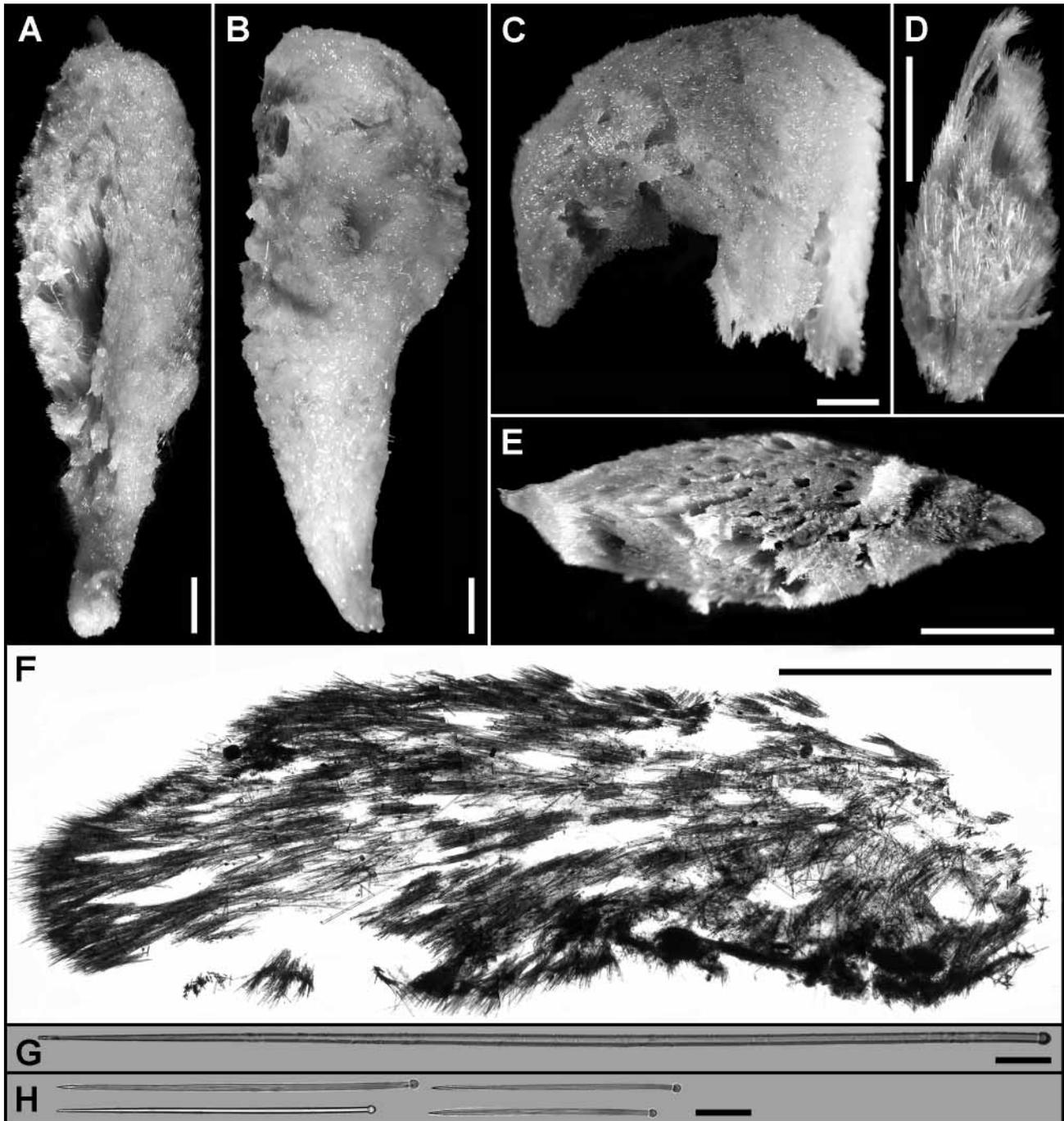


FIGURE 15. *Rhizaxinella* cf. *nuda*. A—one specimen SMF 10597. B—the other specimen SMF 10597. C—specimen SMF 10588. D—specimen SMF 10581. E—specimen SMF 10580. F—histological section of idem. G—long choanosomal spicules. H—small ectosomal spicules. Scale bars: A–F 2 mm; G–H 0.1 mm.

Spicules. Altogether 120 spicules from 2 specimens were measured. Two size categories are well distinguished. The number of measured spicules of each category is given below, separately for each specimen (*n1*, *n2*).

Both principal and ectosomal spicules possess well-developed spherical tyles. Principal tylostyles are slightly fusiform and straight (fig. 15G). Their dimensions are: length 1150-1759-2318 μ m, tyle diameter 17-18.9-21 μ m, diameter of the shaft underneath the tyle 13-14.3-15 μ m, maximal diameter of the shaft 13-16.2-

21 μm ($n1=30$, $n2=30$). Ectosomal tylostyles are isodiametric, straight or slightly curved (fig. 15H). They measure: length 450-551-690 μm , tyle diameter 9-13.7-18 μm , diameter of the shaft underneath the tyle 7-9.0-11 μm , maximal diameter of the shaft 8-10.1-13 μm ($n1=30$, $n2=30$). Spicules of the stalk were not observed.

Type locality: NW Pacific: Philippines: Mindanau Island: Iligan Bay, 814 m.

Distribution (other than type locality): NW Pacific: Philippines: E. Cebu, 710 m (Lévi 1964).

Antarctic: Northern Weddell Sea, 2080–2620 m (present study).

Remarks

We allocated the specimens studied to *R. nuda* due to the similarities of main body shape and skeleton architecture. However, it was done with some doubt because our sponges have smaller ectosomal tylostyles and thinner principal tylostyles than those described by Wilson (1925) and also we did not observe the stalk skeleton. On the other hand, our specimens differ quite noticeably from the Southern Hemisphere species *R. australiensis* Hentschel, 1909. The latter is characterized by the branching, anastomosing body and smaller sizes of both principal and ectosomal spicules than those of the specimens described herein.

Genus *Suberites* Nardo, 1833

Diagnosis (sensu van Soest 2002):

Sponges are massive, compact, usually with velvety smooth surface, caused by dense ectosomal arrangement of tylostyles oriented perpendicularly to the sponge surface, pointing outward; peripheral choanosomal skeleton consists of closely packed strands of tylostyles distinctly larger than ectosomal ones, with interior skeleton of densely packed unordered tylostyles. Centrotylote, minutely spined microstrongyles may be present in a few species and if so are concentrated at the surface.

Type species: *Alcyonium domuncula* Olivi, 1792 (by original designation).

Suberites topsenti (Burton, 1929) (Figs. 16, 17)

Synonymy

Suberella topsenti—Burton 1929: 446, pl. IV (fig. 5).

Laxosuberella topsenti—Burton 1930: 675.

Suberites montiniger—Topsent 1915: 39–40; Koltun 1964: 25–26; 1976: 169.

Suberites topsenti—van Soest 2002: 242.

Material examined

SMF 10582 (1 specimen): PS67/078-11; SMF 10583–10584 (2 specimens): PS67/110-2.

Description

External morphology. Sponges are compact, massive, irregularly shaped (figs. 16A–C). The dimensions may reach 35x15x11 mm. Surface is minutely hispid or velvety, grey-coloured, with a single osculum of 0.4–1 mm in diameter. Consistency is dense and compressible.

Skeleton. The choanosomal skeleton is dense, confusedly reticulate, constituted by long spicules (fig. 16D). The ectosomal skeleton is made of the smaller spicules arranged in bouquets (fig. 16E).

Spicules. Altogether 130 spicules from 2 specimens were measured. Two size categories are well distinguished (fig. 17A). The number of measured spicules of each category is given below, separately for each specimen ($n1$, $n2$).

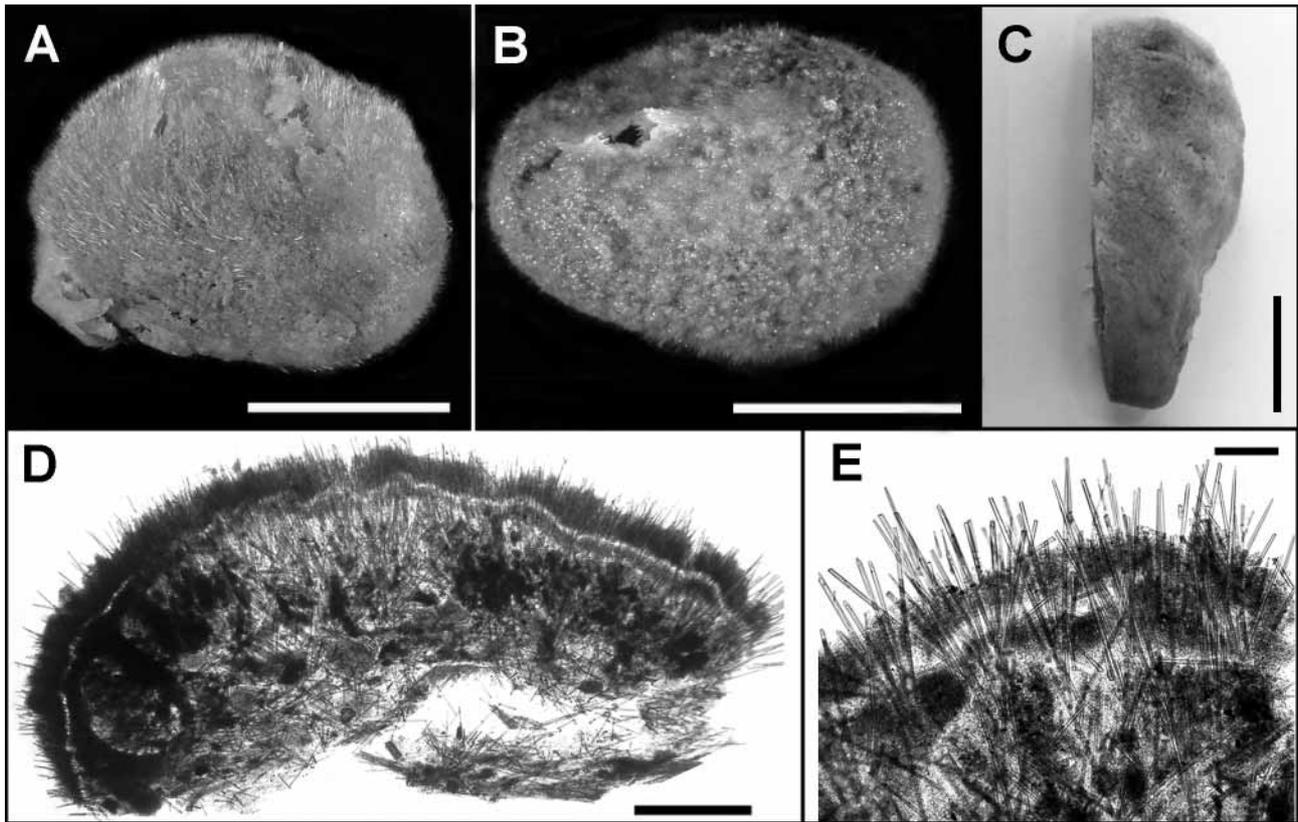


FIGURE 16. *Suberites topsenti*: external morphology and skeleton architecture. A—specimen SMF 10584. B—specimen SMF 10583. C—specimen SMF 10582. D—histological section of SMF 10583, general view. E—the same as D, detail of ectosome. Scale bars: A–C 10 mm; D 1 mm; E 0.1 mm.

Both long and small spicules vary from tylostyles to subtylostyles. They are straight, more or less slender, with terminal lobate tyles (figs. 17B–E). The long spicules measure: length 857–1092–1368 μm , tyle diameter 14–18.8–22 μm , diameter of the shaft underneath the tyle 8–13.0–18 μm , maximal diameter of the shaft 8–14.0–19 μm ($n_1=40$, $n_2=30$). The dimensions of the small spicules are: length 300–479–743 μm , tyle diameter 14–17.0–27 μm , diameter of the shaft underneath the tyle 8–12.4–19 μm , maximal diameter of the shaft 11–13.4–22 μm ($n_1=30$, $n_2=30$).

Type locality: Antarctic: Ross Sea: McMurdo Sound, depth unknown.

Distribution: Antarctic: Antarctic near-continent sectors (as *S. montiniger*: Koltun 1964; Sarà *et al.* 1992): NN 3 and 5 including the Western Ross Sea, as deep as 700 m. Northern Weddell Sea, ca. 2150–4700 m (present study).

SW Atlantic: Burdwood Bank, 102 m (as *S. montiniger*: Topsent 1915); Magellan area, Falkland Islands (as *S. montiniger*: Sarà *et al.*, 1992).

Remarks

In 1929 Burton erected a genus *Suberella* for a new species, *S. topsenti* described by him from McMurdo Sound, Antarctica. He also allocated the Antarctic specimens, previously identified by Topsent (1915) as *Suberites montiniger* Carter, 1880, to *Suberella topsenti*. In fact, *S. montiniger* had been originally described from the Arctic (Carter 1880). Burton (1929) considered *Suberella* to be an evolutionary step between *Suberites* and *Pseudosuberites*. Belatedly, Burton (1930) discovered that *Suberella* had been preoccupied by Thiele (1905), and erected *Laxosuberella* with type species *L. topsenti* as a replacement of *Suberella topsenti*. Koltun

(1964; 1976) disagreed with Burton and reverted *S. montiniger* again. Herein we follow van Soest (2002) who recently advocated the validity of *topsenti* as a species, but placed it in *Suberites*. The taxonomic history of *S. topsenti* is described in detail by the latter author. We should only emphasize the lobate tyles of the subtylostyles in our sponges which have not been previously mentioned by any author, and the larger size of the choanosomal spicules in comparison with those observed by Koltun (1964) who did not distinguish two spicule categories either.

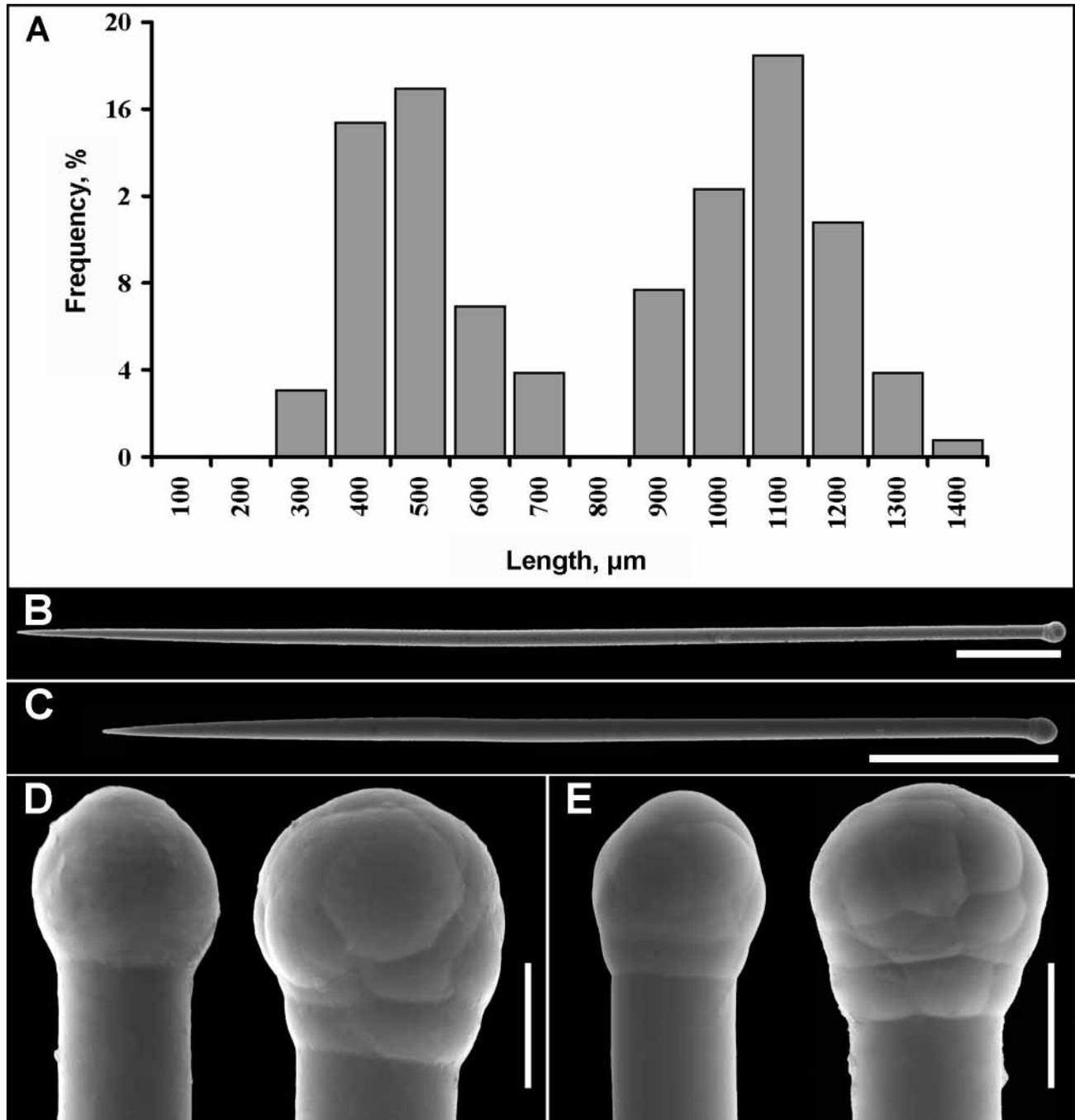


FIGURE 17. *Suberites topsenti*: spicules. A—frequency distribution of length. B—long spicule, general view. C—small spicule, general view. D—the tyles of long spicules. E—the tyles of small spicules. Scale bars: B–C 0.1 mm; D–E 0.01 mm.

Discussion

Polymastiidae prevails over Suberitidae in abundance and species diversity within the studied area of the deep Weddell Sea. Altogether, we registered seven species of Polymastiidae belonging to five genera, and three species of Suberitidae belonging to three genera (table 6). The three most abundant species, *Polymastia invaginata*, *Radiella antarctica* sp. nov. and *Tentorium* cf. *semisuberites*, display three different patterns of distribution. *P. invaginata* was recorded from most localities and from a large depth range. However, the highest abundance of this species was registered at about 800 m, whereas it was much scantier at the deeper sites. Conversely, *R. antarctica* sp. nov. was found exclusively deeper than 2000 m and displayed the most conspicuous abundance as deep as 4700 m. *T.* cf. *semisuberites* was recorded from 1000–2600 m, being relatively more numerous at the deeper sites but on the whole yielding to *P. invaginata* and *R. antarctica* in abundance. Other studied species were much lesser abundant.

TABLE 6. Number of specimens of Polymastiidae and Suberitidae spp. according to the stations.

Species: I—*Acanthopolymastia acanthoxa*, II—*Astrotylus astrotylus*, III—*Polymastia invaginata*, IV—*Polymastia ziteli*, V—*Radiella antarctica* sp. nov., VI—*Tentorium papillatum*, VII—*Tentorium* cf. *semisuberites*, VIII—*Aptos robustus* sp. nov., IX—*Rhizaxinella* cf. *nuda*, X—*Suberites topsenti*.

Cruise/station no.	Species									
	I	II	III	IV	V	VI	VII	VIII	IX	X
PS61/132-3			2	1	2		3		3	
PS61/134-3			4							
PS61/135-3					18					
PS61/141-9			1					1		
PS61/143-2			21							
PS67/057-2			1							
PS67/074-7			4			7	1			
PS67/078-11			1							1
PS67/080-6	1									
PS67/094-11		1								
PS67/102-11		2	6		67					
PS67/110-2		1			107					2
PS67/110-8					3					
PS67/121-7			5				14		2	
PS67/133-2							1			

The described regularities of Polymastiidae and Suberitidae distribution in the deep Weddell Sea correspond well with the data on other deep sea areas of the World Ocean. Listing sponge species which inhabit deeper than 2000 m, Lévi (1964) recorded 11 species of the order Hadromerida altogether. These were three species of Suberitidae including two Atlantic and one Pacific species, one Atlantic species of Clionidae and six species of Polymastiidae including three Atlantic species, *Polymastia corticata* Ridley & Dendy, 1886, *Rhaphidorus setosus* Topsent, 1898 (now accepted as *Spinularia spinularia* (Bowerbank, 1866), see Boury-Esnault 2002) and *T. semisuberites*, one Pacific species, *Trichostemma irregularis* (now accepted as *Radiella irregularis*, see Boury-Esnault 2002), one species from the Indian Ocean, *P. disclera* Lévi, 1964 as well as an alleged cosmopolitan, *T. sarsi* (now accepted as *R. sarsi*, see Boury-Esnault 2002). Describing the sponge

fauna of the deep NW Pacific, Koltun (1970) reported three species of Polymastiidae and none from other hadromerid families. *Polymastia sol pacifica* Koltun, 1966, the most abundant species among the polymastiids, was reported as deep as 6065 m. In fact, this species is morphologically very close to *Radiella*. Two other polymastiid species were *Sphaerotylus exotylotus* Koltun, 1970 and *S. sceptrum* Koltun, 1970. Dealing with the deep water sponges of New Caledonia (SW Pacific), Lévi (1993) listed eight hadromerid species, namely two suberitids, one tethyid and five polymastiids. The latter included *Atergia acanthoxa* (now accepted as *Acanthopolymastia pisiformis* Kelly-Borges & Bergquist, 1997), *Sphaerotylus exospinosus* Lévi, 1993, *Spinularia australis* Lévi, 1993, *Tyloxocladus hispidus* Lévi, 1993 and *T. sarsi* (now accepted as *R. sarsi*, see Boury-Esnault 2002). Exploring the sponge associations of the abyssal Norwegian-Greenland Sea, Barthel and Tendal (1993) reported two polymastiids, *T. sol* (now accepted as *R. sol*, see Boury-Esnault 2002) and *T. semisuberites*, and no other hadromerid species.

Thus, we can conclude that in various deep sea regions Polymastiidae prevails over other hadromerid families, and *Radiella* prevails over other polymastiid genera. These sponges are well adapted to the existence on a muddy bottom with a deficit of hard substrata. The marginal fringe of *Radiella* prevents a sponge from sinking in the sediments, and its growth does not much depend on the substrate size, although the latter may determine the structure of the basal surface, such as that we observed on *R. antarctica*. On the whole the habit, skeleton architecture and spicule shape of many *Radiella* spp. from different deep water regions are very similar, that has resulted in numerous reports of *R. sarsi* and *R. sol* all over the world (see above Remarks after the description of *R. antarctica*). Moreover, the Arctic representatives of *R. sarsi* are reported from a wide depth range, known as shallow as the upper continental slope (Plotkin 2004). Undoubtedly, the taxonomic relationships within *Radiella* need re-evaluation using an approach other than morphological one.

It should be also noted that three more genera, *Acanthopolymastia*, *Atergia* Stephens, 1915 and *Spinularia* Gray, 1867 share the presence of the marginal fringe, which allows survival on soft sediments in the deep sea. Besides that, the latter genus resembles *Radiella* in growth pattern, shape and skeleton architecture but is distinguished by the presence of the choanosomal raphids in trichodragmata. Conversely, *Acanthopolymastia* and *Atergia* differ more from *Radiella* in shape, skeleton and spicules.

Tentorium displays another morphological adaptation to the deep-sea environment, a columnar growth shape, which allows the functioning of oscula and ostia at a certain distance above from the sediments. The problem of the alleged bipolarity of *T. semisuberites* is concerned above. Both northern and southern representatives are distributed in a wide depth range, coming as shallow as the upper sublittoral in the Arctic (Koltun 1966), in the Southern Indian Ocean (Boury-Esnault & van Beveren 1982) and in the South Atlantic (Ridley & Dendy 1887), but never being registered in the Antarctic shallow waters.

A stalked growth shape, shared by two polymastiid genera *Quasillina* Norman, 1869 and *Ridleia* Dendy, 1888 and by a suberitid *Rhizaxinella*, can be also considered as an adaptation to the substrate deficit. The first two genera are unknown from the Antarctic, whereas *Rhizaxinella* is presented by two species, *R. australiensis* and *R. cf. nuda*, in the region in question. Meanwhile, we are the first who signalize the latter species in the Southern Hemisphere, and the relationships between our specimens and typical *R. cf. nuda* from the Philippines should be further re-evaluated.

Other polymastiids and suberitids, reported from the deep sea, demonstrate no evident morphological adaptations for living on a soft bottom, and all of them need at least hard substrata of more or less gross size for growing. Meanwhile, large amounts of hard substrata are usually concentrated in the shelf and the upper continental slope rather than in the deeper zones. Therefore the spread of the typically shelf sponge species down to the abyssal is considered to be possible exclusively in a few regions, where the considerable amounts of hard substrata are dispersed both on the shelf and in the deep waters (e.g. in the NW Pacific as stated by Koltun 1970). Currently we do not have the granulometric data on ANDEEP stations in our disposal, but we can imagine that the reasons of the eurybathic distribution of such Antarctic species as *P. invaginata*, *T. papillatum* and *S. topsenti* are similar to those described above. However, this supposition does not explain the ori-

gin of *A. astrotylus* and *Proteleia burtoni* Koltun, 1964 (the latter species was absent in our samples). These two species together with *R. antarctica* and *A. acanthoxa* are endemics of the Antarctic abyssal. But in contrast to *Radiella* and *Acanthopolymastia*, *Astrotylus* and *Proteleia* display no visible adaptations to the soft bottom. The origin of *A. robustus* sp. nov. also remains completely unclear because *Aaptos* spp. have been previously reported neither from the shelf nor from the deep waters of the Antarctic.

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