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Desmacella austini sp. nov. from sponge reefs off the Pacific coast of Canada

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Abstract

A new species of a very thinly encrusting *Desmacella* (Porifera, Demospongiae, Poecilosclerida, Desmacellidae) is described from Queen Charlotte Basin and Georgia Basin, off the Canadian Pacific coast. It is compared with all known species of the genus, differing in the geometry and size of spicules, and the persistent epizoic growth.

Contents

Introduction

Siliceous sponge reefs had a wide distribution in prehistoric times and once constructed the largest reefs known on earth, reaching an acme in the Upper Jurassic when a deep-water reef belt on the northern Thetis shelf existed that was 7,000 km long (Krautter *et al*., 2001). In present times hexactinellid sponges of the order Hexactinosida have constructed reefs at several localities off the coast of British Columbia, Canada. The reefs occur on relict glaciated seafloor areas with a low sedimentation rate and a high dissolved silica concentration in the Queen Charlotte Basin and in Georgia Basin (Conway *et al*., 2004; Conway *et al*., 2005) and the reefs represent stable communities that have been growing for up to 9,000 years. The main framebuilders include the hexactinosidan species *Aphrocallistes vastus, Farrea occa* and *Heterochone calyx* in Queen Charlotte Basin, and *A. vastus* and *H. calyx* in Georgia Basin (Conway *et al*., 2004). The framework of these reefs is constructed through several processes of framebuilding, and the reef matrix is derived from trapping of suspended sediments (Krautter *et al*., 2001). Similar framebuilding processes are thought to have contributed to the formation of the ancient reefs (Krautter *et al*., 2006). Upwelling and downwelling oceanographic processes in a biologically productive coastal sea have contributed to the development of large reef complexes (Whitney *et al*., 2005). The reefs form as bioherms (mounds) and biostromes (beds or sheets) that may rise up to 21 m above the seafloor and they cover around 1000 km^2 on the continental shelf. Individual reef complexes may cover areas of more than 300 km^2 and occur in 90-240 m depth range (Conway *et al*., 2001; Conway *et al*., 2005). The three-dimensional framework structure of the reefs is comparable to coral reefs and provides habitat for a variety of sessile and motile organisms from different phyla. Among the sessile epifauna of the sponge reefs are sponges of the class Demospongiae, although the magnitude of epifaunal sponge (and other) species growing on the reef-framework is presently unknown. Only a relatively small number of epifaunal sponge species have been examined and of these one is undescribed.

It is the purpose of the present paper to describe this new species of the genus *Desmacella* and compare it with other known species.

Methods

Samples of hexactinosidan sponges with adhering epifaunal organisms were collected by KC and MK during a research cruise aboard CCGS *John P. Tully*, using Shipek and Van Veen grab samplers and also sampling using the submersible *Delta* in July 1999 and in June 2002 using an HD2+2 remote operated vehicle (ROV). Photo and video-documentation was made in situ during the dives. In October 2003 the ROV *ROPOS* was deployed from the research vessel CCGS *Vector* to survey, photograph and sample sponge reefs in Georgia Basin. Samples were stored in 95% ethanol or alternatively in 4% formalin/seawater after collection. For the identification of the sponges semi-thin sections parallel and perpendicular to the surface were made with a razor blade and embedded in Canada balsam. For spicule preparations small pieces of sponge were boiled in sodium hypochlorite solution, washed in distilled water and transferred into ethanol in several steps using a centrifuge to avoid loss of spicules. Ethanol-spicule suspension was pipetted on glass slides and spicules were embedded in Canada balsam after evaporation of the ethanol. SEM observations were made at the Institute for Zoology in Erlangen, Germany with a Hitachi S800 on gold sputtered spicules.

Systematic description

Class Demospongiae
Order Poecilosclerida
Family Desmacellidae Ridley and Dendy, 1886
Genus *Desmacella* Schmidt, 1870

***Desmacella austini* sp. nov.**

(Figs. 1-5)

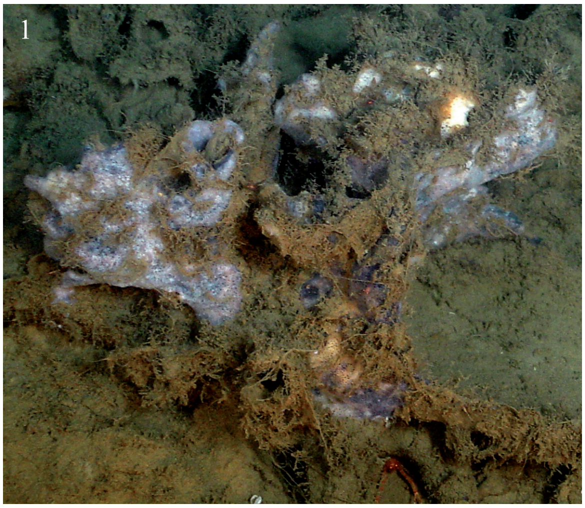
Material. Holotype. Originally labeled VEC0301. Type locality. Georgia Basin, Georgia Strait, coordinates: 49°36.76'N 123°07.19'W, 169 m, deposited at the Senckenberg Museum, Frankfurt am Main, Germany, registration number: SMF 9760. A schizotype is kept at the Zoological Museum Amsterdam, registration number: ZMA Por. 18340.

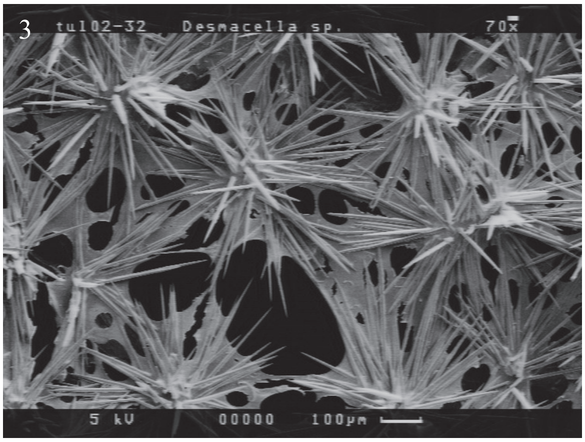
Additional material. Tul99A-17, Queen Charlotte Basin, Queen Charlotte Sound, 51°34.61'N 128°08.11'W, 205 m; Tul02-33A-56, Queen Charlotte Basin, N. Hecate Strait, 53°13.66'N 130°05.43'W, 165 m; Tul02-33A-57, Queen Charlotte Basin, N. Hecate Strait, 53°16.15'N W 130°04.24'W, 169 m; Tul02-52B, Queen Charlotte Basin, N. Hecate Strait, 53°17.3'N 130°04.4'W, 165 m; Tul02-46A, Tul02-46B, Queen Charlotte Basin, N. Hecate Strait, 53°09.63'N 130°04.84'W, 163 m.

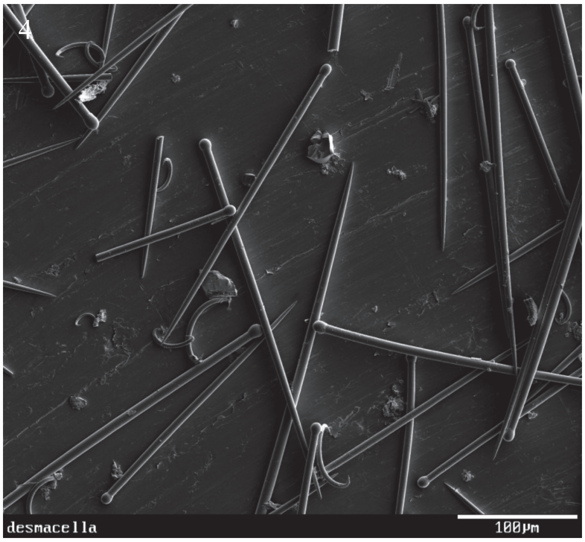
Description. Alive blue or yellow, thinly encrusting sponge (Figs. 1 and 2) on *Heterochone calyx*, light brown or greyish in preservative. Oscules not apparent. Surface hispid. The ectosome consists of densely spaced spicule brushes of tylostyles, points facing outwards forming bouquets (Fig. 3). In some specimens the spicule brushes are basally prolonged and from short polyspicular tracts. Occasionally these tracts are branching and lead to two spicule brushes. A direct connection of the polyspicular tracts or the ectosomal spicule brushes to the rigid hexactinellid skeleton could not be observed. The spicule tracts of the *Desmacella* seem to end between the spicules of the hexactinellid sponge. Strewn in between are the three categories of sigmas. The choanosome in thin specimens is situated where the rigid skeleton of *Heterochone* is still present and tylostyles are clearly more rare in this region, but sigmas are visible between the hexactinellid spicules. Tylostyles (Fig. 4) are 170-495 × 6-10 µm; large sigmas, 55-65 µm; medium size sigmas, 26-42 µm and small sigmas, 15-20 µm (Figs. 4 and 5).

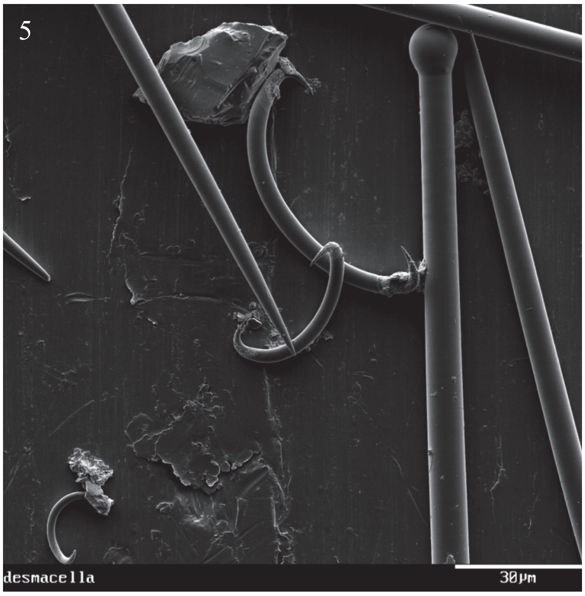
Remarks. This species seems to show specific adaptations for overgrowing *Heterochone calyx* and possibly other hexactinellid sponges. While it constructs a typical desmacellid skeleton near the surface, it produces mainly microscleres where it settles deeper in the rigid hexactinellid skeleton. There is also some evidence of a succession of species growing on the hexactinellid substratum. In several cases we observed *Halichondria disparilis* growing over *Desmacella austini* sp. nov. In all cases *D. austini* sp. nov. was growing directly on *Heterochone calyx*. If *Halichondria disparilis* was present it grew on the *Desmacella*. On living *Heterochone calyx* we found the yellow growth form of *Desmacella austini* sp. nov. while the blue *Desmacella* was growing on dead *Heterochone*. Living *Heterochone calyx* is coloured white or pale yellow.

The occurrence of *D. austini* sp. nov., growing specifically on hexactinosidan skeletons, within hexactinellid sponge reefs has implications for sponge reef ecology. The sponge is in competition for, or at least limits availability of, hard subtrate growing space for the reef forming hexactinellid









Figs. 1-5. Desmacella austini sp. nov. (1) In situ photograph, blue growth form on dead *Heterochone calyx* in Georgia Strait on Mc Call Bank, 169 m depth. (2) Yellow, growing among living, pale yellow *Heterochone calyx* in N. Hecate Strait at 165 m depth. (3) Surface spicule brushes. (4) Tylostyles and three categories of sigmas. (5) Three size categories of sigmas.

sponges. Considering that on sponge reefs the only available hard substrate is dead and macerated hexactinosidan skeletons (Conway *et al*., 1991, Krautter *et al*., 2001) this competition could potentially become a factor limiting reef growth or recovery. Many reef areas have been impacted by bottom trawling (Conway *et al*., 2001) and *in situ* observations suggest that *D. austini* sp. nov. where abundant, may limit the ability of hexactinosidan sponges to re-colonize reef areas that have been damaged by trawling by occupying the available substrate of sponge skeletons and skeletal fragments of the reef surface.

Table 1. Spicule categories, dimensions and distribution of *Desmacella.*

		Tylostyles I	**Tylostyles II**	**Other megascleres**	**Sigmas I**	**Sigmas II**	**Sigmas III**
Desmacella austini sp. n.		170-495 × 6-10 µm	none	none	55-65 µm	28-42 µm	15-20 µm
D. alba	(Wilson, 1904)	216-1275 × 6.5-36 µm	none	none	18.7-137 × 2-6.4 µm	none	none
D. ambigua	Bergquist and Fromont, 1988	390-530 × 10-13 µm	280-360 × 7.5-10 µm	tylostyles, 160-250 × 5-9 µm	none	none	none
D. annexa	Schmidt, 1870	size not given	none	none	14-over 100 µm	none	none
D. arenifibrosa	Hentschel, 1911	styles and subtylostyles, 160-344 × 3-6 µm	none	none	none	none	none
D. campechiana	Topsent, 1889 as *Tylodesma*	up to 1000 × 8 µm	up to 200 × 8 µm	none	55 µm	25 µm	7.5 µm
D. corrugata	(Bowerbank, 1866)	present, size not given	none	none	present, size not given	none	none
D. democratica	(Sollas, 1902)	180-560 × 2.5-6 µm	none	none	10-80 × 3 µm	none	none
D. dendyi	De Laubenfels, 1936	140-630 × 6-12 µm	none	none	10-44 µm	none	none
D. digitata	(Lévi, 1960)	180-270 × 1-2 µm	none	none	22-26 µm	14-18 µm	none
D. grimaldii	(Topsent, 1904)	390-1900 × 8-30 µm	none	none	28-45 µm	none	none
D. groenlandica	Fristedt, 1887	1200 µm	none	none	min. 7.5 µm	none	none
D. informis	Stephens, 1916	180-1300 × 8-27 µm	none	none	26-45 µm	none	none
D. inornata	(Bowerbank, 1866)	190-1000 × 6-18 µm	none	none	20-45 µm	none	none
D. ithystela	Hooper, 1984	135-222 × 4-10 µm	100-164 × 1-4 µm	none	12-20 × 0.5-2 µm	29-55 × 2.5-4 µm	96-192 × 5-10 µm
D. janiae	Verrill, 1907	styles and tylostyles, 220-250 µm	none	none	37-40 µm	none	none
D. lampra	De Laubenfels, 1936	250 × 2.5 µm	none	none	30-33	13	none
D. meliorata	Wiedenmayer, 1977	210-230 × 3.5-4.5 µm	none	none	37 × 2 µm	none	none
D. microstrongyla	(Hentschel, 1912)	style, 336-496 × 7-22 µm	none	none	9-10 µm	none	none
D. microsigma	(Lévi, 1964)	500-1000 × 15-25 µm	none	none	11-15 × 2 µm	none	none
D. peachi	sensu Ferrer-Hernandez, 1914	present, long and sinuous, size not given	none	none	none	none	none
D. polysigmata	Van Soest, 1984	styles to strongyles, 513-635 × 10-19 µm	none	none	30-42 µm	10-15 µm	none
D. pumilio	Schmidt, 1870	320-1400 × 9-17 µm	none	none	30-45 µm	none	none
D. suberea	(Schmidt, 1870) as *Desmacodes*	mainly oxeas and styles, tylostyles present, size not given	none	none	612.8 µm	none	none
D. suberitoides	(Burton, 1932) as *Sigmotylotella*	choanosomal, 1000 x 18 µm	ectosomal, 600 × 12 µm	none	28 µm	none	none
D. topsenti	(Burton, 1930)	250-730 × 5-10 µm	none	none	43 µm	none	none
D. toxophora	Lévi, 1993	300-600 × 10-12 µm	none	none	none	none	none
D. vagabunda	Schmidt, 1870	600 µm	none	none	14-over 100 µm	none	none
D. vestibularis	(Wilson, 1904)	240-630 × 8-16 µm	none	none	12-36 µm (after Lévi, 1964, 30-65 µm)	none	none
D. vicinia	Schmidt, 1870	600 × 12 µm	none	none	36 µm	12 µm	none

Rhaphide	Other spicules	Known distribution
20-30 µm, sometimes missing	none	British Columbia
none	none	Galapagos, Kerguelen
113-145 µm	none	New Zealand, intertidal
thin oxeas, size not given	none	Florida, 357 m
304+342 µm	toxa, 21-26 µm	Australia, 14-18 m
none	none	
none	none	N-Atlantic
none	none	Malaysia
none	none	New Zealand
none	none	E-African coast
none	none	Azores
250 µm and 75 µm	none	East coast of Greenland, 238 m
none	none	Ireland, Azores
none	none	Mediterranean, Shetlands, Norway
none	none	Australia
none	none	Bermudas
none	none	Marshall and Palau Islands
none	none	Bahamas
160-240 µm, in trichodragmata	microxeas, 40-60 µm; microstrongyles 12.5-14 × 4-6 µm	Arafura Sea
none	none	Philippines
present, thin and, curved size not given	none	
none	none	Barbados, 100 m
none	none	Florida, California
none	none	Atlantic
none	none	Tristan da Cunha, S-Atlantic
none	none	Azores
none	toxa, 90-140 µm	New Caledonia
none	none	California
none	none	Galapagos, Pacific, Antarctica Philippines
none	none	Florida

Discussion

As the distribution of deep-water species is not known very well we compared our new species with all known species of the genus (Table 1). Comparing the categories and sizes of spicules, *D. democratica* (Sollas, 1902) has the most similar set of spicules. Sollas (1902) did not report different size categories for the sigmas of *D. democratica* but the size range of 10-80 µm is within the size range of all size classes of our new species and it could be argued that Sollas overlooked their occurrence in distinct size-classes. Conspecifity nevertheless, seems unlikely as the tylostyles Sollas reported are longer and considerably thinner than in *D. austini* sp. nov. There are two other species of *Desmacella* which also have three size-categories of sigmas, *D. campechiana* (Topsent, 1889) and *D. ithystela* Hooper, 1984. *Desmacella campechiana* has two size-categories of tylostyles, the large category being much longer than styles in *D. austini* sp. nov. and the small category of sigmas being only half the size of the small sigmas in the species described in this publication. *Desmacella ithystela* from the Northwest Shelf, western Australia, differs in having again two size categories of tylostyles which are considerably smaller than in our new species and it differs also in the large category of sigmas which are two to three times larger than reported for *D. austini* sp. nov. All three species have very different distributions from *D. austini* sp. nov., the Caribbean, Australia and New Zealand respectively, which makes conspecifity again more unlikely from a biogeographic perspective. *Desmacella vestibularis* (Wilson, 1904) and *D. vagabunda* Schmidt, 1870 occur roughly sympatric on the American Pacific coast, though known only from Galapagos and California. However, these species differ clearly in spicule categories and sizes (see Table 1). Hentschel (1929) and Koltun (1959) transferred *Desmacella capillifera* Levinsen, 1887, *Desmacella hamifera* Lundbeck, 1909 and *Desmacella groenlandica* Fristedt, 1887 to *Biemna* as they found commata as microscleres. As both authors report the occurrence of commata it seems probable that the first authors of these species overlooked the commata and so we assume this transfer correct, and therefore do not include these species in Table 1. However, spicule categories and sizes differ clearly from our new species.

Etymology. Named after Dr W.C. (Bill) Austin in recognition of his contributions to the understanding of sponge biology and ecology.

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