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Svenzea, a new genus of Dictyonellidae (Porifera: Demospongiae) from tropical reef environments, with description of two new species

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Abstract

The new genus *Svenzea* is created to group three sponge species from tropical reef environments of the Caribbean Sea and Indonesia: *Pseudaxinella* (?) *zeai* Alvarez, Van Soest & Rützler, *Svenzea cristinae* n. sp. and *S. devoogdae* n. sp. The genus shows affinities with members of both Halichondrida and Haplosclerida but it is assigned to the family Dictyonellidae based on shared microanatomical and developmental features. The higher taxonomic position of *Svenzea* is a subject for future investigations.

Contents

Introduction

A very common sponge species found in the Caribbean and generally mis-identified as *Calyx podatypa* (De Laubenfels, 1934) in chemical literature (e.g. Carballeira *et al.*, 1998; Rodriguez *et al.*, 1997a) and in field guides (i.e. Humann, 1992) was described by Alvarez *et* al. (1998) as *Pseudaxinella* (?) *zeai*. The assignment of the species to *Pseudaxinella* (now *Dragmacidon* Alvarez & Hooper, 2002) of the family Axinellidae was doubtful at that time as the species shows a mixture of features of haplosclerid and halichondrid sponges. The skeleton of *P. zeai* is a nearly unispicular reticulation common in Haplosclerida and obscured by masses of granular cells, also present in *Scopalina* (Halichondrida: Dictyonellidae). The consistency is firm but crumbly as in some species of *Xestospongia* (Haplosclerida: Petrosiidae). The spicules that form the skeleton of *P. zeai* are styles with a small percentage of oxeas, such as in many axinellid species, and also in a similar size range, and unlike the spicule combination found in the order Haplosclerida.

The discovery of two additional species with similar skeletal structure and spicule composition justifies the erection of a new genus which, based on histological and development evidence (Rützler et al., in press) is assigned to the family Dictyonellidae of the order Halichondrida (*sensu* Van Soest et al., 1990).

Material examined in this work is deposited at the National Museum of Natural History, Washington D.C. (USNM), Zoological Museum of Amsterdam (ZMA), National Natural History Museum, Leiden (RMNH) and Museum and Art Gallery of the Northern Territory, Darwin (NTM). Thick sections, spicule slides, Transmission and Scanning Electron Microscopy (TEM, SEM) preparations were made using the methods described by Rützler (1978), Rützler et al. (in press), and Hooper (1996).

Systematics

Order Halichondrida Gray, 1867
Family Dictyonellidae Van Soest et al. 1990

Svenzea, new genus

Type species. – *Pseudaxinella zeai* Alvarez et al 1998: 20 (Fig. 1).
Diagnosis. – Massive or thickly encrusting. Surface smooth but microscopically hispid. Ectosomal skeleton specialization absent. Choanosomal skeleton formed by an uni- or paucispicular reticulation of megascleres with spongin cementing the spicules at the nodes. Internal structure on thick sections viewed in transmitted light obscured by numerous black-looking cells of 18-35 μm diameter, with 3 μm spherical or angular granules. All known species are bacteriosponges, with a substantial biomass contribution from unicellular bacteria and cyanobacteria in the mesohyl or inside vesicles of special cells (bacteriocytes). Megascleres are styles with a few oxeas or oxeote modifications. Microscleres are absent. Reproduction viviparous; large larvae, up to 6 mm, elongate ovoidal and uniformly flagellated.

Distribution. Central West Atlantic and Indonesia.

Etymology. After Sven Zea, first collector of the type species, in recognition of his contribution to the systematics of Caribbean sponges.

Svenzea zeai (Alvarez, Van Soest & Rützler, 1998)
Hymeniacidon amphilecta. – Pulitzer-Finali, 1986: 117 (not de Laubenfels, 1936: 137)
Calyx podatypa. – Humann, 1992: 33
Pseudaxinella sp. – Alvarez & Crisp, 1994: 119
Pseudaxinella zeai. – Erhardt & Moosleitner, 1995: 52[prematurely referring to Alvarez et al 1998]
Pseudaxinella (?) *zeai* Alvarez, Van Soest & Rützler, 1998: 20. – Díaz & Ward, 1997: 97-107 [production rates of dissolved inorganic nitrogen].

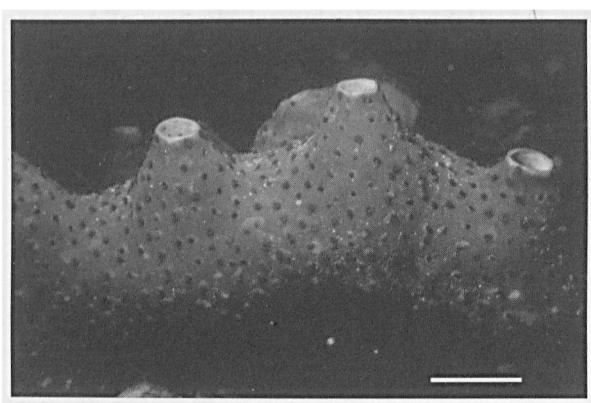

Fig 1. Svenzea zeai (Alvarez, Van Soest & Rützler, 1998) in situ, Santa Marta, Colombia (photo, S. Zea). Scale bar 20 mm.

Material examined. – Holotype USNM 39361 (Colombia, Isla Tesoro, 18 m, S. Zea coll.) NTM Z4152 (CBC97-BAG7), Carrie Bow Cay, Belize, 16°48'N, 88°05'W, 20 m, M.C. Díaz, 6 Aug 1997.

Description. – The material examined from Belize fits with the original description of the species. New observations allow us to shed some light on the nature of the granulous cells which characteristically obscure the skeleton of *S. zeai*, and which were described as pigment (?) grains by Alvarez et al. (1998). Prominent inclusion cells are of two kinds, bacteriocytes and granular cells (Rützler et al., in press) (Fig. 2).

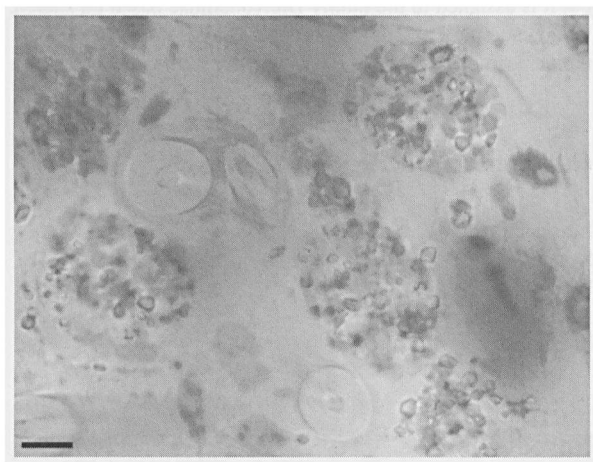

Fig. 2. Photomicrograph of characteristic granular cells found in *Svenzea zeai*; circular bodies are spicule cross-sections. (Scale: 10 μm.)

Both styles [length 205-270 (237.88 ± 16.8); width 7-12 μm (9.48 ± 1.5)] and oxeas [length 210-320 μm (276.4 ± 21.3); width 7-12 μm (9.36 ± 1.5)] in the specimen from Belize were of similar dimensions to those present in the material from St. Croix, Colombia and Tobago (Alvarez et al., 1998).
Reproduction. – The species is viviparous, with unusually large and conspicuous embryos present in most specimens year around. Embryos are yellow-

ish to cream, spherical, up to 4 mm in diameter. Larvae are ovoid with a thicker anterior pole, entirely and evenly flagellated, up to 6 mm long.
Ecology. – Cyanobacterial and bacterial endosymbionts in this species have been linked to the fixation of dissolved inorganic nitrogen (Díaz & Ward, 1997).
Distribution. – The species is widely distributed through the Caribbean area. It is been recorded from Florida to Puerto Rico, the Virgin Islands, Tobago, the Atlantic coast of Colombia, Curaçao and Belize, between 20 and 40 m depth.
Remarks. – *Svenzea zeai* was wrongly identified as *Calyx podatypa* by Humann (1992) in a field guide of reef organisms. After this publication a variety of novel fatty acids, cyclopropene sterols, calyxamines (a type of alkaloid) and calyxolanes (new 1,3-diphenylbutanoid metabolites) have been isolated from Caribbean sponges also identified as *Calyx podatypa* (Carballeira et al., 1998; Rodriguez et al., 1997a; Rodriguez et al., 1997b). We assume, that the target species of these chemical investigations was *Svenzea zeai* given that the species is widespread and common throughout the Caribbean and because the description of the external morphology given in these papers matches perfectly with the species. *Calyx podatypa* (De Laubenfels, 1934: 23) has no resemblance to *Svenzea zeai*. It is massive or ramose, brittle in consistency, pale drab in colour with characteristic oscules of various shapes: heart-shaped, Y-shaped, and some resembling human footprints. The ectosomal skeleton is thick and dense, formed by a tangential layer of spicules. The choanosomal skeleton is a subrectangular reticulation of spongin fibres cored by multispicular tracts and interstitial spicules in a vague isodictyal reticulation. The spicules are exclusively oxeas.

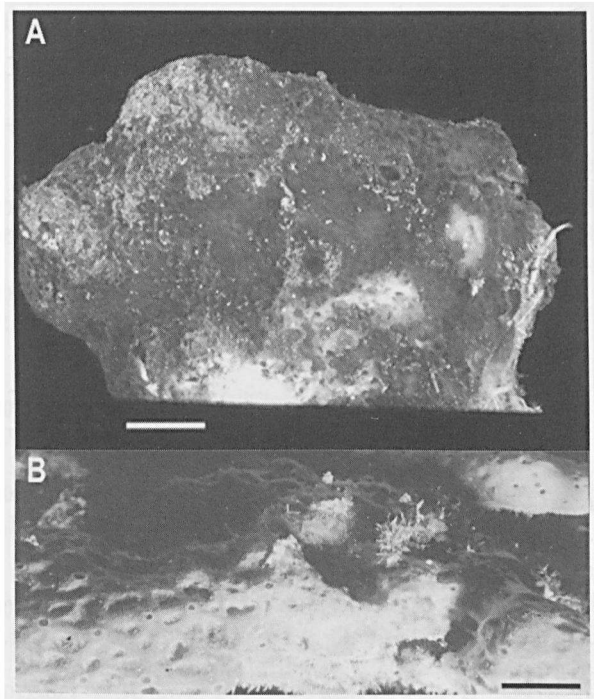

Fig. 3. Svenzea cristinae n. sp. A, holotype USNM 1006559 (CBC97-52). B, ZMA 16613 in situ, Discovery Bay, Jamaica (photo, H. Lehnert). Scales A-B 10 mm.

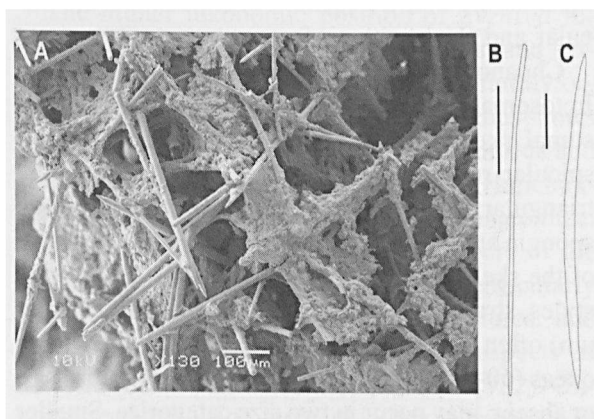

Fig. 4. Svenzea cristinae, NTM Z4154 (CBC97-BAG4). A, scanning electron micrograph (SEM) of the choanosomal skeleton. B, spicules. (scales B, 100 μm, C, 25)

Svenzea cristinae sp. nov. (Figs. 3-4, Table 1).

Material examined. – Holotype: USNM 1006559 (CBC97-52), Cat Cay lagoon, Pelican Cays, Belize, 16°39.8'N, 88° 11.5'W, Sven Zea coll. 3 Aug 1997. Paratypes: USNM 1006560 (KS96-92), Fisherman's Cay, Pelican Cays, Belize, 16°40.25'N, 88° 11.40'W, K. Smith coll. 24 Nov 1996; ZMA 17098 (CBC97-57), Cat Cay lagoon, Pelican Cays, Belize, 16°39.8'N, 88° 11.5'W, B.Alvarez coll. 3 Aug 1997; NTM Z4155 (CBC97-58), Cat Cay lagoon, Pelican Cays, 16°39.8'N, 88° 11.5'W, Belize, B. Alvarez coll. 3 Aug 1997. Other material: NTM Z4153 (CBC97-BAG3), Blue Ground Range, Belize, 16°48. 6'N, 88°08.9'W, on mangrove roots, B.Alvarez coll., 31 Jul 1997; NTM Z4154 (CBC97-BAG4), Blue Ground Range, Belize, 16°48.6'N, 88°08.9'W, on mangrove roots, B.Alvarez coll., 31 Jul 1997. ZMA 16613, Discovery Bay, Jamaica, H. Lehnert coll.

Description. – Thickly encrusting. Surface brown-yellowish with purple or brown-pinkish areas; smooth; pierced with minute pores less than 1mm diameter, aggregated in shallow depressions; with

Table 1. Spicule dimensions for *Svenzea* spp. Measurements (in µm) are ranges of 25 spicules or the number indicated in brackets, with means ± standard deviation in parenthesis.

Species	Styles	Oxeas
Svenzea zeai (Alvarez, Van Soest, Rützler)		
Colombia (Holotype)		
length	220-290 (270.4±17.7)	270-330 (301.6±15.5)
width	7.5-12.5 (11.1±1.5)	7.5-12.5 (10.4±1.2)
Belize (CRC97-BAG7)		
length	205-270(237.9±16.8)	210-320(276.4±21.3)
width	7-12(9.5±1.5)	7-12(9.4±1.)
Svenzea cristinae n. sp		
Belize (NTM Z4155)		
length	320-450(405.6±27.9)	60-200(131.6±42.3)
width	6.25-17.5(11.05±27)	3.75-10(6.17±2.1)
Jamaica (ZMA 16613)		
length	310-460(375.8±45.3)	120-340(212.5±102.4)[4]
width	4.25-11.25(7.97±1.5)	6.25-8.25(7.15±0.9)[5]
Svenzea devoogdae n. sp		
Sulawesi (ZMA 17097)		
length	160-270(218.4±25.1)	200-290(243.2±23.7)[14]
width	6.25-11.25(9.15±1.4)	7.5-12.5(9.7±1.4)[14]
Bali (RMNH Por.1363)		
length	130-270(221±38.8)	130-240(182.5±47.9)[4]
width	8.25-13.75(11.2±1.4)	7.5-12.5(10±2.0)[4]

meandering and transparent channels. Oscula circular and flush with surface.

Choanosome white. Consistency soft, crumbly. Ectosomal skeleton specialization absent. Choanosomal skeleton (Fig. 4A) is a disorganised unispicular reticulation with loose spicules forming triangular or polygonal like-meshes with very little spongin at the nodes; granular cells obscuring most of the skeleton. Spicules are (Fig. 4B-C, Table 1): styles, straight or slightly sinuous (320-460 × 4-11 µm) often with mammiform tips or with swellings; oxeas (60-340 × 4-10 µm), less frequent than styles or absent; may occur in two size categories. Smaller oxeas straight, curved, angulated or twisted. Large numbers of endosymbiotic bacteria present throughout the sponge.

Etymology. – The species is named after Maria Cristina Díaz in recognition to her contribution to the knowledge of the biology of the genus.
Distribution. – Belize, Jamaica; subtidal on mangroove roots, 0.5 m.
Remarks. – The species differs from *Svenzea zeai* mainly in shape and consistency. It has all the diagnostic characters of the genus, including the presence of granular cells and skeletal organisation. Other characters common to dictyonellids such as the dominance of styles and the spicules with variable endings are also present in this species.

Svenzea devoogdae sp. nov. (Figs. 5-6, Table 1).

Material examined. – Holotype, ZMA 17097, Indonesia, SW Sulawesi, Spermonde Shelf, Bone Lola, 05°03'145"S 119°21'207"E, 11 m, Nicole de Voogd, #NV/BL/080900/129, 8 Sep 2000.Other material: RMNH Por.1363, Indonesia, Bali, N side Nusa Penida, off Desa Ped, 08°40'28" S 115°30'50" E, 24 m, coll. Nicole de Voogd, NV/Bal.26/180401/217, 18 April 2001.

Description. – Massive with lobes and oscular mounds. Maroon-black externally, beige choanosome. Surface smooth, infested with small black zoanthids. Oscula up to 1 cm in diameter on top of lobes and mounds. Ectosomal skeleton specialization absent.

Choanosomal skeleton is a disorganised reticulation of uni-paucispicular spicule tracts connected at the nodes with very little spongin and obscured by granular cells (Fig. 6A). Spicules are styles and less frequent oxeas (Table 1, Fig. 6B). Styles are

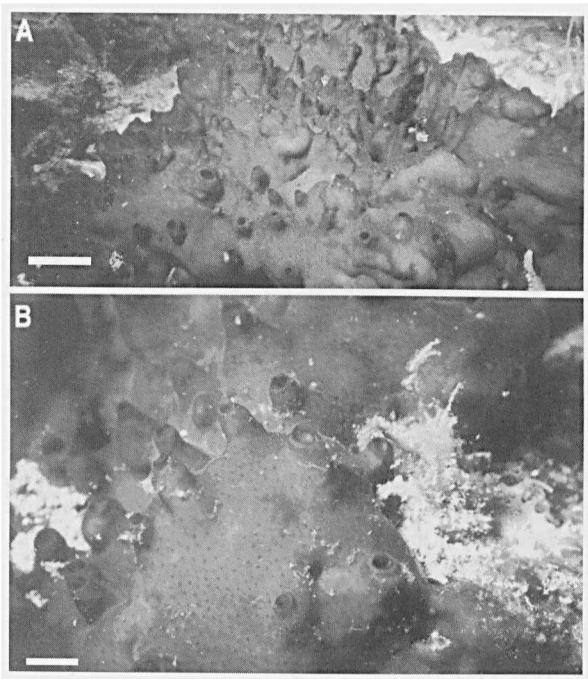

Fig. 5. Svenzea devoogdae n. sp. A-B, holotype ZMA 17097 (Sulawesi) in situ, Sulawesi, Indonesia. Scales A, 50 mm, B, 25 mm.

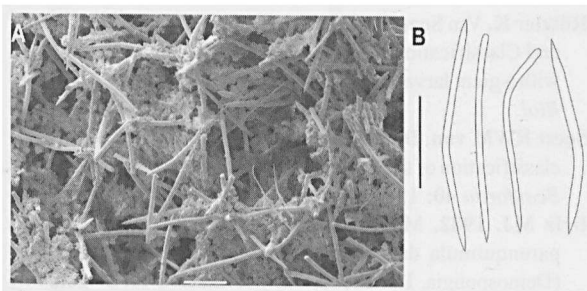

Fig. 6. Svenzea devoogdae n. sp. A, SEM of the choanosomal skeleton. B, spicules (scales 100 μm)

flexuous or straight some with bases slightly bent or reflexed (130-270 × 6-14 μm). Oxeas are straight or angulated, some with hastate points (130-290 × 8-13 μm). Sustantial numbers of endosymbiotic bacteria present.

Distribution. – Sulawesi, Bali, Indonesia; 11-20 m

Etymology. – The species is named after Nicole de Voogd, (University of Amsterdam / National Museum Naturalis, Leiden) who collected the specimens examined here.

Remarks. – Both megascleres appear in a wide size range (160-250 μm length) in the specimen from Bali; the smaller generally thicker than the larger ones. This feature was not so obvious in the specimen from Sulawesi and suggests that intraspecific variation of spicule size might be high. The species is remarkably similar to *Svenzea zeai* differing only in that spicules can be sinuous, rhabdose (styles) or angulated (oxeas). As in the Caribbean species, *S. devoogdae* is quite common within its known geographical range but with a patchy distribution (N. de Voogd personal communication)

Discussion

A possible fourth species of the new genus is *Pseudaxinella? flava* Lehnert & Van Soest, 1999 from 76 m on the fore reef off N Jamaica. It shares features with above described species, especially with *S. zeai* such as a reticulation of styles of 244-380 × 2-11 μm and lack of ectosomal specialization. However, the reticulation in this species is anisotropic, with multispicular ascending tracts, and more importantly, the characteristic granular cells and large embryos/larvae were not observed, precluding a definite assignment to *Svenzea*.

The higher taxonomic position of *Svenzea* remains unclear. Based merely on skeleton and spicules an unambiguous assignment to a family/order is not possible. In these features, the genus shows affinities with members of both Halichondrida and Haplosclerida. We assign the genus to Halichondrida: Dictyonellidae for it shares microanatomical and developmental features with members of the dictyonellid genus *Scopalina* Schmidt, particularly the granulous cells, certain spicule features, and larval development, morphology, and aspects of behaviour (Rützler et al., in press, Uriz 1982). Ongoing research using molecular data is expected to find independent evidence of the phylogenetic relationships for *Svenzea* and to help define its position in the higher classification. Recent results of that research using 28S rRNA (McCormack et al, in press) indicates already that *Svenzea zeai* is not closely related to haplosclerid species.

Acknowledgements

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