BEAUFORTIA

INSTITUTE FOR SYSTEMATICS AND POPULATION BIOLOGY
UNIVERSITY OF AMSTERDAM

Vol. 45, no. 1 March 2, 1995

MYCALE ESCARLATEI N.SP. AND *MYCALE UNGUIFERA* N.SP. (DEMOSPONGIAE) FROM THE TROPICAL-WESTERN ATLANTIC

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Key words: Porifera, Poecilosclerida, Mycalidae, Tropical-western Atlantic, Phylogeny

ABSTRACT

Mycale escarlatei n.sp. is described from the coasts of Bahia and Rio de Janeiro in Brazil and from the Santa Marta area in Colombia. It belongs to the subgenus *Aegogropila* and is distinguished from other congeners in the area, by slender anisochelae-II and possession of micracanthoxeas. *Mycale unguifera* n.sp. is found in the Islas del Rosario and Santa Marta area in Colombia. It belongs to the subgenus *Grapelia* and is distinguished within this taxon, by its large and abundant sigmas. The specimen described by Carter (1886) as *Pseudoesperia enigmatica*, is here proposed as neotype of *Grapelia australis*. Furthermore, we provide a phylogenetic discussion of centrally-thickened, centrotylote-like toxas, micracanthoxeas, absence of an ectosomal skeleton and anisochelae-III with a basal spur-like projection.

INTRODUCTION

Eighteen species of *Mycale* are currently known from the tropical-western Atlantic (Hajdu & Desqueyroux-Faúndez, 1994; Hajdu & Rützler, in prep., key included). Of these, seven occur along the Brazilian coast (three endemics), and six along the Colombian Caribbean coast (one endemic). Our article describes two additional species, both occurring along the Colombian

Caribbean coast, and only one along the Brazilian coast, thus raising to eight the number of species known from each of both subareas quoted above.

The frequent finding of new species of *Mycale* in areas like the Caribbean (e.g. Van Soest, 1984; Hajdu & Rützler, in prep.; present article), where the acquisition of knowledge relative to the marine life has been a priority for a long time, is indicative that the diversity of the genus may be markedly underestimated worldwide. This is corroborated by the observation of several unpublished species in the Natural History Museum of London, and the Zoölogisch Museum in Amsterdam. Furthermore, Hooper & Lévi (1994) observed enormous amounts of unpublished / unidentified material in museums all over Australia, which is also bound to contain new species of *Mycale*.

New species of sponges are still being found in the poorly studied Southern Caribbean and Brazilian areas where the geological history and environmental conditions differ markedly from those of the oceanic Antillean arc, source of most of the monographed faunal collections from the Central Atlantic area. The rocky and coral reefs, and associated ecosystems located in the continental coast of Colombia in the Southern Caribbean, for example, are scattered among the mouths of the Atrato and Magdalena, the greatest rivers that open into the Caribbean basin. Moreover, the Santa Marta area in NE Colombia is the scenario of an upwelling of relatively cold waters (ca. 21° C), seasonally alternated with outwelling of continental runoff (Zea, 1993). These ecological conditions, together with the relatively recent connection to the Eastern Pacific before the rise of the Panama isthmus, make the Southern Caribbean a likely source of new faunal elements.

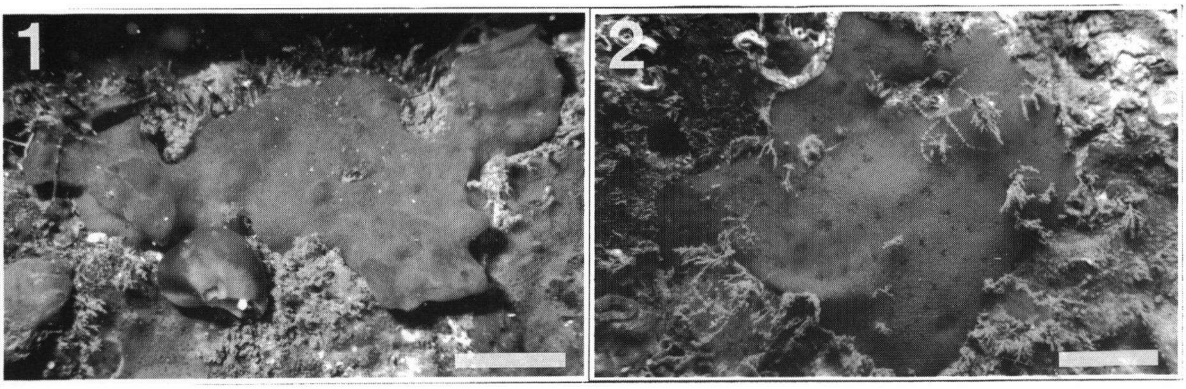
This situation is evident along the extensive Brazilian coastline, where tropical coral-reef ecosystems, like those in the Caribbean, are gradually replaced as we move south by a system of alternating bays and sandy beaches in open coastline, interrupted here and there by a few rocky pontoons or mouths of rivers. The bays have a tropical affinity ["oasis coralliennes", Laborel (1969)], while the open coastline is frequently washed by either the cold Falkland Current or by local upwelling waters (e.g. Valentin, 1984; Matsuura, 1986), which bring a subtropical component to its marine fauna and flora (= Patagonian affinity, sensu Mothes et al., 1993). This complex scenario is suggestive of the existence of an, as yet poorly known diverse fauna of Porifera. Extensive collections of mostly unidentified material, including numerous new species, are housed in several Universities in Brazil, such as those in Rio de Janeiro, Salvador, Recife and João Pessoa.

MATERIALS AND METHODS

Brazilian specimens of *Mycale* were collected by EH in Angra dos Reis (Rio de Janeiro), and by SP during ecological and systematic studies of the sponges of Salvador (Bahia). The Colombian specimens were collected by MK and SZ in course of ecological and systematic studies of Colombian sponges. Specimens were all collected by SCUBA, except for the Bahian one which was found by wading at low tide. Preparation techniques followed those outlined by Rützler (1978), with additions by Hajdu & Rützler (in prep.).

Abbreviations used are:

AMS	(Australian Museum, Sidney),
BMNH	(Natural History Museum, London),
DES	(Department of Earth Sciences, University of Cambridge),
INV-POR	(INVEMAR, Porifera collection),
ISP-UvA	(Institute of Systematics and Population Biology, University of Amsterdam),
MCN	(Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre),
NMV	(Museum of Victoria, Melbourne),
NNM	(Nationaal Natuurhistorisch Museum, Leiden),
SME	(Station Marine d'Endoume, Marseille),
SMF	(Senckenberg Museum, Frankfurt),



Figs. 1-2. *Mycale (Aegogropila) escarlatei* n.sp. 1. holotype (UFRJPOR 4451), in situ, Ilha do Bomfim, Angra dos Reis, Rio de Janeiro State, Brazil. 2. *Mycale (Aegogropila) escarlatei* n.sp., paratype (INV-POR 448), in situ, Punta de Betín, Bahía de Santa Marta, Colombia. Scale = 1 cm.

UFBaPOR	(Universidade Federal da Bahia, Porifera collection),
UFRJPOR	(Universidade Federal do Rio de Janeiro, Porifera collection),
UMZC	(University Museum of Zoology, Cambridge),
USNM	(National Museum of Natural History, Smithsonian Institution, Washington D.C.),
ZMA POR	(Zoölogisch Museum, University of Amsterdam, Porifera collection),
ZMH	(Zoologisch Museum Hamburg) and
ZRC	(Zoological Reference Collection, Department of Zoology, National University of Singapore).

SYSTEMATIC DESCRIPTIONS

Class Demospongiae Sollas
Order Poecilosclerida Topsent
Family Mycalidae Lundbeck
Genus *Mycale* Gray
Subgenus *Aegogropila* Gray, 1867

Diagnosis: *Mycale* with an, often regular, tangential, ectosomal skeleton of spicule bundles which often easily peels off, and no serrated sigmas. Anisochelae palmate. Type species: *Aegogropila varians* Gray, 1867.

Mycale (Aegogropila) escarlatei n.sp.

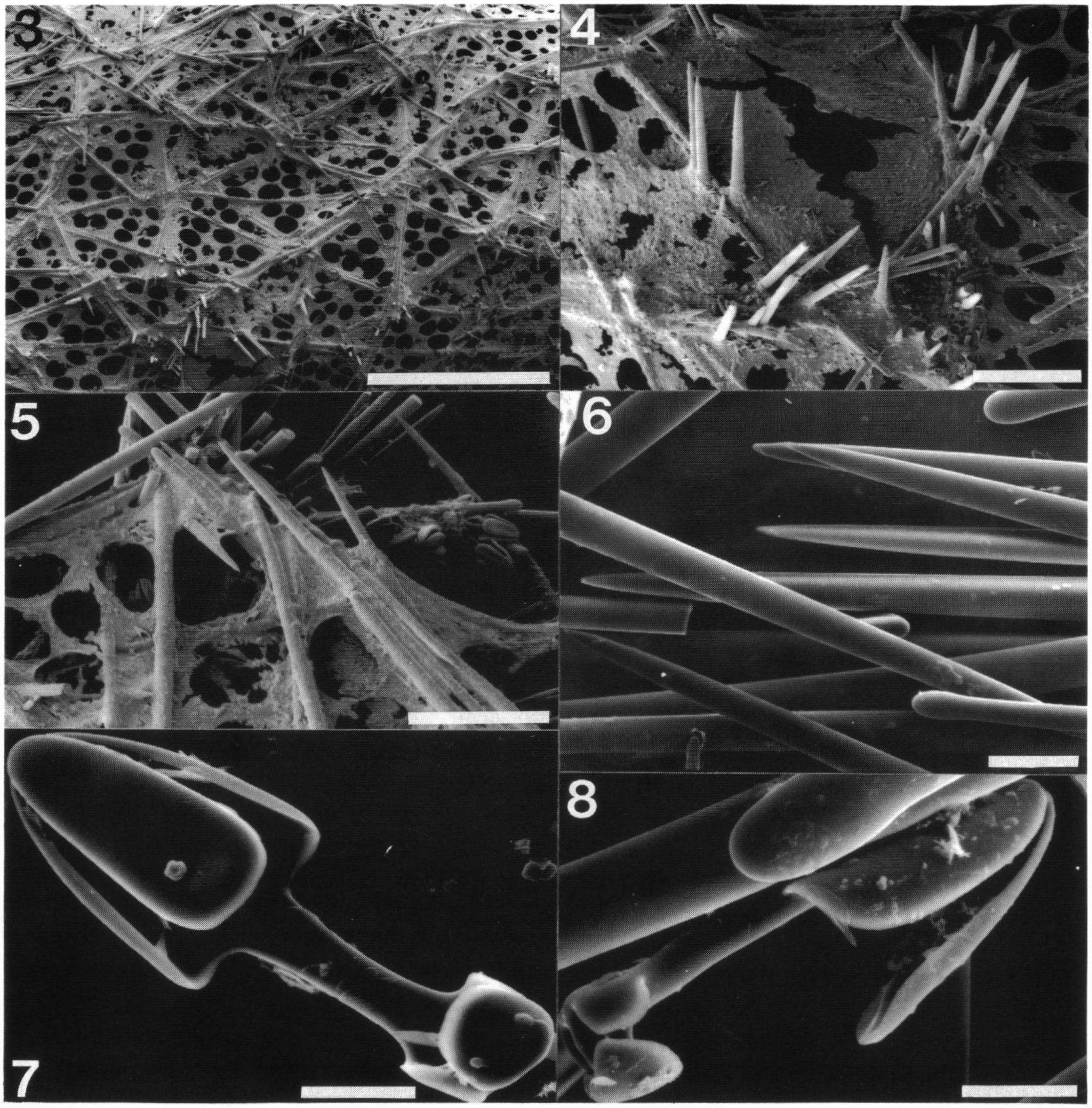
Figs. 1-17, Table 1.

Material studied. Holotype: UFRJPOR 4451, Ilha do Bomfim (Angra dos Reis, Rio de Janeiro State, Brazil), coll. E. Hajdu, 16.X.1992, ca. 2 m deep, under boulder in community dominated by *Sargassum*. Paratypes: MCN 2829, Itapoã (Salvador, Bahia State, Brazil), coll. S. Peixinho, 5.XI.1991, intertidal; INV-POR 448, Punta de Betín (Bahía de Santa Marta, Colombia), coll. S. Zea, 12.XII. 1983, 3 m deep, under metamorphic boulder; INV-POR 449, El Morro (Bahía de Santa Marta, Colombia), coll. S. Zea, 14.IV. 1989, 15 m deep, on dead coral on fringing reef. Schizotype from holotype deposited under ZMA POR 10710.

Diagnosis: *Mycale (A.) escarlatei* n.sp possesses very slender anisochelae-II, with head 75% of the shaft's length (Figs. 9, 15-17); with micracanthoxeas.

DESCRIPTION

External morphology. Specimens small (ca. 4 by 4 cm in area), encrusting (≤ 5 mm thick), slightly tuberculate (Figs. 1-2). Surface reticulated to the naked-eye (Figs. 1-2), microhispid; consistency firm but compressible. Colour of live material dull-pinkish-red, bright-orangy-red, or yellow. No subectosomal channels of the aquiferous system visible. Few, scattered oscula 1-2 mm in diameter. Both specimens from Angra dos Reis (UFRJPOR 4451, holotype) and from Punta de



Figs. 3-8. *Mycale (Aegogropila) escarlatei* n.sp., holotype (UFRJPOR 4451). 3. Tangential view of surface showing reticulation composed partly by bundles of subtylostyles, partly by single subtylostyles. Pores of variable sizes are clearly visible in the meshes. 4. Enlarged central lower portion (rotated upside-down) of figure 3, showing protruding terminations of a few subectosomal brushes of subtylostyles. Abundant anisochelae-IV, and a few anisochelae-II can be seen lying tangentially to the surface membrane. 5. Detail of surface showing rosettes of anisochelae-I ocurring immediately below the surface. 6. Terminations of megascleres. 7. Face view of anisochelae-I. 8. Profile view of anisochelae-I. Scales: 3 = 500 µm, 4-5 = 100 µm, 6 = 20 µm, 7-8 = 10 µm.

Betín (INV POR 448) inhabited by single small ophiuroid.

Skeleton. Ectosomal skeleton, tangential reticulation of paucispicular bundles of subtylostyles (3-10 spicules across, up to 70 µm thick, Fig. 3). Meshes very irregular, up to 350 µm wide. Rosettes of anisochelae-I (up to 140 µm in diameter) scattered in nodes of the reticulation (Fig. 5), or, more rarely, around bundles (like a whorl). Sigmas-I rare, visible around bundles, with hooks directed to the bundle or away from it. Anisochelae-II, and -IV scattered in the meshes, the latter predominantly among the pores (≤ 50 µm in diameter) on the surface membrane (Fig. 4).

Choanosomal skeleton, plumo-reticulated architecture with much divergence and little anastomosing of tracts (≤ 100 µm thick). Tracts run perpendicularly to surface, diverging in a profusion of acute-angled brushes in the subectosomal area. The latter support the tangential ectosomal skeleton, only slightly piercing it (≤ 100 µm, Fig. 4). Rosettes of anisochelae-I occur as deep as 500 µm in the choanosome.

Spicules (measurements in Table 1). Megascleres: subtylostyles (Fig. 6), fusiform, straight, slightly bent, or slightly sinuous, thicker at middle portion, ellyptical head, apex narrowing gradually. Microscleres: anisochelae-I (Figs. 7-8), head about 50% of total length of the shaft, shaft almost straight on profile view, frontal ala of foot markedly bent forward (ca. 30° angle with shaft on profile view); anisochelae-II (Figs, 9, 15-17), head about 75% of total length of the shaft, shaft gently curved all over on profile view, general aspect on profile and face views very narrow, on face view microsclere wider on top portion of head [like a duck's bill, sensu Thomas (1968)]; anisochelae-IV (Fig. 10), head about 55% of total length of the shaft, shaft gently curved all over on profile view, foot with markedly reduced alae, the frontal one extends on top in a long, thin digitiform process; sigmas-I, stout, hooks abruptly bent and sharp; sigmas-II (Figs. 11-12), slender, hooks markedly bent and sharp; toxas-I (Fig. 12), slender, markedly curved inward centrally, gently curved outward on both prolongations, gradually sharpened terminations; toxas-II (Fig. 13), stouter than -I, centrally-thickened, centrotylote-like, markedly curved centrally, straight prolongations, sharp terminations; micracanthoxeas (Figs. 11, 13-14), straight, large spines, ca. 20 spines per spicule.

Etymology. The species is named after Sergio Escarlate (formerly with Colégio Santo Inácio de Loyola, Rio de Janeiro) who introduced EH to marine biology, and also because specimens can be scarlet-red.

REMARKS

Mycale escarlatei is easily distinguished from other species from the tropical-western Atlantic by its possession of both very slender, "duck's bill" like, anisochelae-II with a head long 75% of the length of the shaft, and micracanthoxeas. Species from other biogeographic realms may possess one or the other character.

Mycale (Carmia) micracanthoxea Buizer & Van Soest, 1977 (NE Atlantic), and *M. (Aegogropila) bamfieldense* Reiswig & Kaiser, 1989 (NE Pacific) possess micracanthoxeas, but differ from *M. escarlatei* by a collection of features. *M. micracanthoxea* does not have a third category of anisochelae, and both its sigmas-I and micracanthoxeas are larger. Additionally the colour in life varies from orange-yellow to brownish-grey, according to type of substrate and time of the year (Buizer & Van Soest, 1977), never reaching the intense bright colours of the new species. *M. bamfieldense* differs from *M. escarlatei* in the absence of a second category of toxas. Its greyish-yellow colour in life also sets it apart. Both northern species possess sigmas-II which are considerably smaller (14-25 µm) than those found in the new species (20-39 µm). Their smaller toxas were not reported as centrally-thickened, and none of them possess anisochelae-II of the peculiarly narrow shape found in *M. (A.) escarlatei* sp.n.

Comparison with over 60 species and varieties of *Mycale* occurring in the Indo-west Pacific (data derived from database by Van Soest; Van Soest, 1994) revealed two species which are likely to be related to *M. escarlatei*, viz. *M. (A.) sulevoidea* (Sol-

Table 1. Spicular micrometric data on the holotype and paratypes of *Mycale (Aegogropila) escarlatei* sp.n, two species of *Mycale* for which micracanthoxeas were reported, viz. *M. (Carmia) micracanthoxea* Buizer & Van Soest, 1977, and *M (A.) bamfieldense* Reiswig & Kaiser, 1989, and two species which possess similarly shaped "duck's bill" (sensu Thomas, 1968) anisochelae-II, viz. *M. (A.) sulevoidea* (Sollas, 1902) and *M. (A.) cavernosa* Bergquist, 1965. Unless stated otherwise, N = 20 for the holotype and other species studied, and N = 10 for the paratypes.

	subtylostyles length by width of head by width of shaft	anisochelae	sigmas	toxas	micracanthoxeas
escarlatei sp.n. holotype UFRJPOR 4451	254-*318.3*-350 by 5-*7.1*-8 by 8-*9.2*-11	I: 34-*42.8*-46 II: 24-*29.5*-32 IV: 13-*13.5*-14	I: 63-*70.2*-77 II: 20-*27.0*-31	I: 74-77 (N = 2) II: 9-*15.9*-22	3-4
escarlatei sp.n. paratype MCN 2829	249-*275.1*-292 by 4-*5.9*-7 by 4-*6.9*-8	I: 35-*38.3*-42 II: 28-*29.5*-32 IV: 11-*11.3*-13	I: 65-*67.7*-70 (N = 8) II: 33-*36.2*-39 (52 ?)	I: 55-*61.4*-69 II: 15-*17.4*-20	n. found
escarlatei sp.n. paratype INV POR 448	271-*286.9*-309 by 3-*4.8*-6 by 3-*6.0*-11	I: 35-*38.0*-41 II: 25-*29.2*-33 IV: 11-*12.7*-14	I: 61-*66.4*-75 II: 25-*27.9*-30	I: 60-*70.7*-86 II: 6-*11.2*-18	n. found
escarlatei sp.n. paratype INV POR 449	266-*307.8*-342 by 3-*5.8*-7 by 4-*7.5*-10	I: 37-*39.3*-43 II: 28-*29.6*-32 IV: 11-13.8 (N = 4)	I: 57-*65.3*-73 (N = 8) II: 27-30 (N = 2)	I: 71-92 (N = 5) II: 15-23 (N = 5)	3-*3.4*-4 (N = 8)
micracanthoxea Buizer & Van Soest	256-*270*-285 by 7-7.5	I: 20-*23*-32 II: 13-*16*-20	I: 58-*73*-89 II: 19-*22*-24	I: 100-*110*-120 II: 13-*16*-20	7-8.5
bamfieldense Reiswig & Kaiser	247-*273*-297 by 3-*7.6*-12	I: 28-*36.2*-42 II: 16-*20.4*-24 III: 9-*12.8*-17	I: 35-*68*-75 II: 14-*18.9*-25	I: 19-*38.3*-70	3-*4.2*-7
sulevoidea (Sollas)	360 by 6-12	I: 50-60 II: 33 III: n. rep. IV: 12	I: 60-80 by 6 II: n. rep	I: 50 (?) - 140 II: n. rep	
holotype remeasured	321-*345.0*-387 by 4-*7.8*-9 by 8-*11.9*-14	I: 48-*56.8*-62 II: 32-*34.7*-39 III: not found IV: 12-*13.9*-15	I: 72-*77.8*-83 by 3-*6.7*-8 II: not found	I: 73-*94.3*-127 (N = 10) II: 11-*14.9*-19 (N = 4)	
sulevoidea (Sollas) sensu Hentschel[1]	392-576 by 15-17	I: 49-54 II: 21-35 III: n. rep. IV: 12-14	I: 83-104 II: 25-30	I: 120-136 II: n. rep.	

Table 1. continued.

	subtylostyles length by width of head by width of shaft	anisochelae	sigmas	toxas	micracanthoxeas
SMF 1031 remeasured	398-*417.6*-435 by 6.6-*7.5*-9.4 by 8.8-*9.4*-11	I: 55-*55.5*-56 (N = 8) II: 30-*33.9*-37 (N = 14) III: 21-*22.6*-24 (N = 11) IV: 11-*13.4*-18 (N = 75)	I: 90-*96.0*-102 by 6.1-8.3 (N = 7) II: 21-*28.9*-36	I: 55-*82.2*-127 II: N.Found	
cavernosa Bergquist	262-*306*-351 by 0.8-*4.2*-8	I: 29-*33*-40 II: 11-*13.5*-15	I: 92-*97.5*-105 by 1.5-*3.6*-5 II: 19-*23*-26.5		
holotype remeasured	278-*303.6*-316 by 3.9-*4.3*-5.5 by 3.3-*5.1*-6.6	I: 34-*36.8*-39 II: 28-*28.9*-31 III: 12-*13.1*-14	I: 88-*93.2*-99 by 2.2-*3.2*-4.4 II: 21-*23.1*-28		

[1] Perhaps new species.

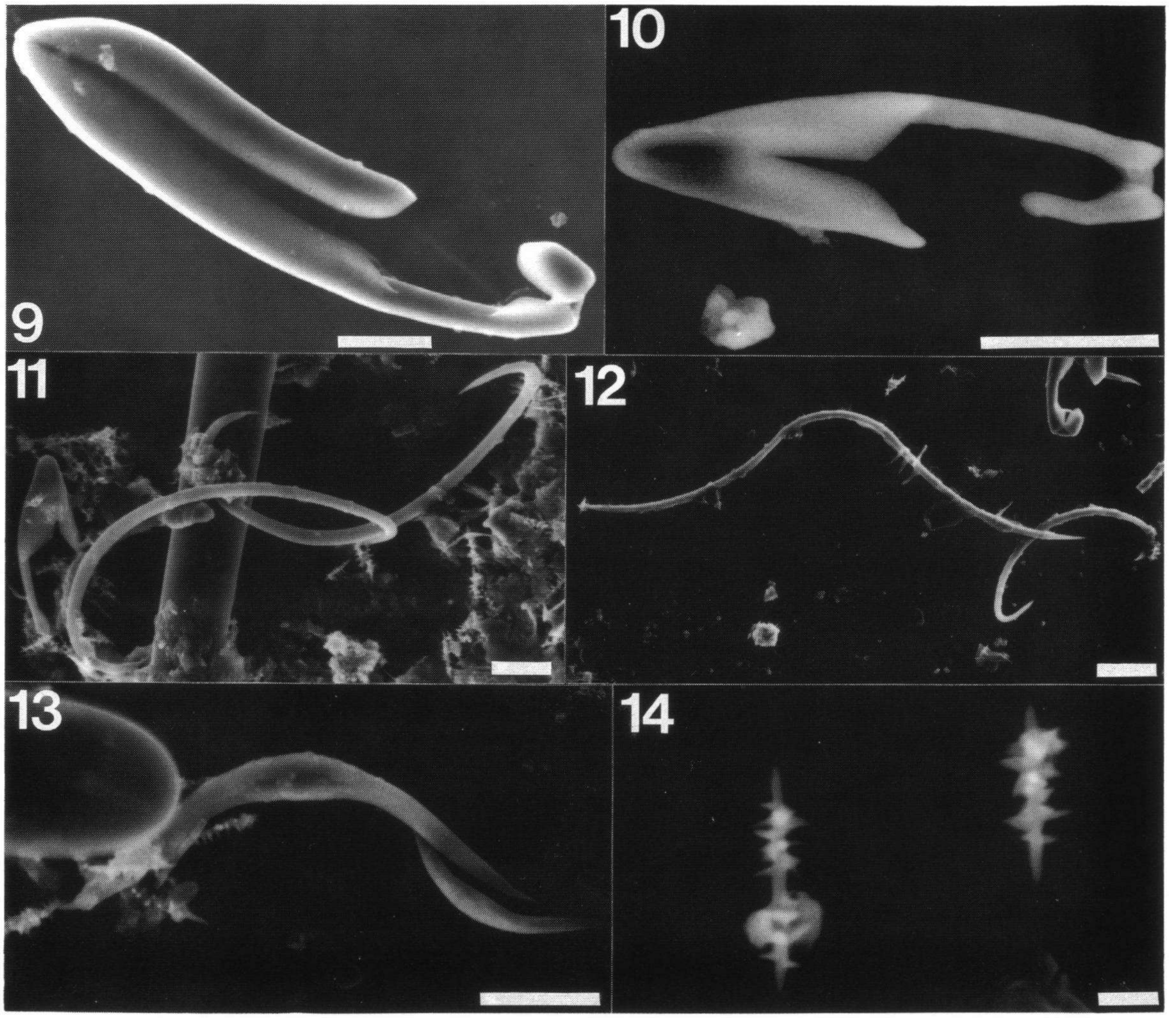
las, 1902) and *M. (A.) cavernosa* Bergquist, 1965. Both species possess anisochelae-II of comparable dimensions, which on face view resemble a duck's bill, and also a reticulated ectosomal skeleton. Nevertheless, detailed scrutiny under SEM failed to reveal the occurrence of micracanthoxeas in either species.

Mycale sulevoidea (holotype studied, UMZC Reg. Nov.30.1899) is distinct from *M. escarlatei* by its slightly larger megascleres, anisochelae-I and -IV, and toxas-I; and absence of sigmas-II (Table 1). Another five specimens originally assigned to *M. sulevoidea* were studied for comparative reasons, two identified by Hentschel (1912, viz. SMF 1031 and 1032), and three identified by Burton (ZMA 1612 and 1613, from the 'Siboga' Exp., unpubl. res; BMNH 1930.8.13.75a, Great Barrier Reef Exp.). Only Hentschel's SMF 1031, from the Strait of Malacca, actually resembles the holotype, although possessing larger megascleres, a fourth category of anisochelae, second category of sigmas and only one category of toxas, which sets it apart (Table 1). It may be a new species. Other specimens differed in several respects to the type of *M. sulevoidea,* and from the new species described here.

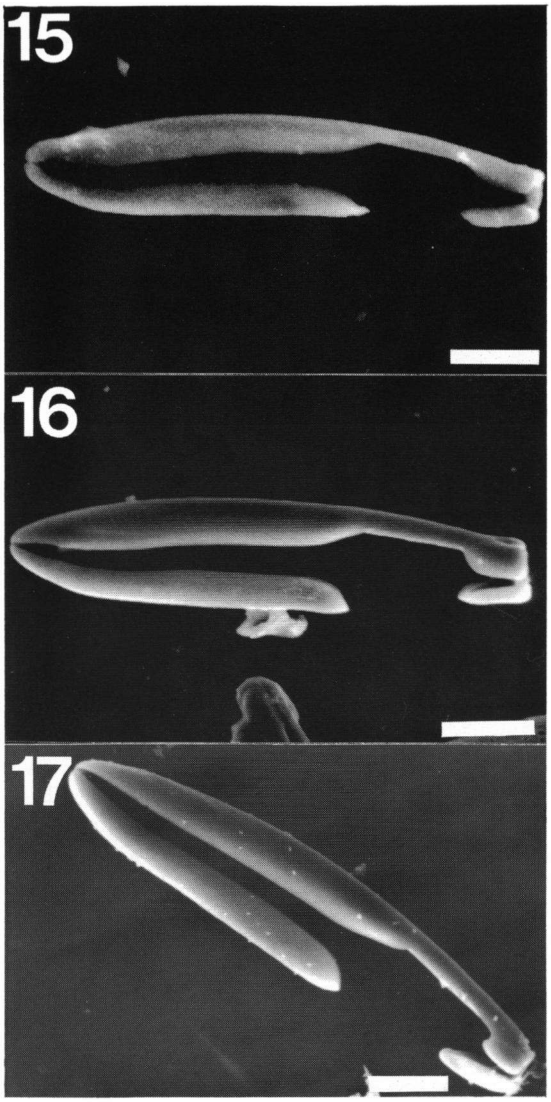
We studied the holotype of *M. cavernosa* (USNM 23703) and found it to possess three categories of anisochelae (anisochelae-I being quite rare), instead of two as originally reported (Bergquist, 1965). This aspect agrees with *M. escarlatei* but *M. cavernosa* differs by its possession of thinner megascleres and larger sigmas-I (Table 1), absence of toxas (a single toxa, 26 µm long was seen, but its autochtonous nature is uncertain) and erect shape.

Subgenus *Grapelia* Gray, 1867

Diagnosis: *Mycale* with three categories of anisochelae. Categories-I and -II markedly curved on profile view and organized in rosettes. Anisochelae-I mostly unguiferate. Anisochelae-II acanthose, frequently bipocilla-like. Anisochelae-III palmate with basal spur-like projection. Type species: *Grapelia australis* Gray, 1867.



Figs. 9-14. *Mycale (Aegogropila) escarlatei* n.sp., holotype (UFRJPOR 4451). 9. Profile-view of anisochelae-II. 10. Profile-view of anisochelae-IV. 11. Sigmas-II. Note anisochelae-IV on the left, and abundant micracanthoxeas all over the picture. 12. Toxa-I (smooth, the preparation is dirty) and sigma-II. 13. Toxas-II with a thickened (centrotylote-like) central portion. Note micracanthoxeas on the left. 14. Micracanthoxeas. Scales: 9-11, 13 = 5 µm, 12 = 10 µm, 14 = 1 µm.



Figs. 15-17. *Mycale (Aegogropila) escarlatei* n.sp. Profile view of anisochelae-II. 15. Paratype (MCN 2829). 16. Paratype (INV-POR 448). 17. Paratype (INV-POR 449). Scales = 5 µm.

REMARKS

(Including the naming of a neotype for *Grapelia australis.)*

The type-specimens of *Grapelia* and its possible junior synonym *Pseudoesperia* Carter, 1885 are both assumed to be lost (Valentine, *in litt.*). *Grapelia australis* is known from the hand-drawing of a single spicule by Bowerbank (1864, Fig. 135; out of a specimen from Fremantle, SW Australia), while *Pseudoesperia* is known from Carter's (1885) original description of *Esperia parasitica* Carter, 1885 [the type species, improperly renamed *P. enigmatica* by Carter (1886)]. Although the type specimen of *Pseudoesperia* is lost too, there is a specimen identified by Carter (1886) as conspecific with it, which also originates from S Australia, viz. Port Phillip Heads (Melbourne). This is BMNH 1886.12.15.467 (as *P. enigmatica*), which is a large dried specimen. As it is absolutely impossible to be sure of the validity of both *G. australis* [sensu Gray (1867), = *Mycale (G.) australis*] and *E. parasitica* [sensu Carter (1885), = *M. (G.) parasitica; P. enigmatica* = junior synonym], we opt here for their conspecificity, and formally propose to consider BMNH 1886.12.15.467 the neotype of the oldest available name, viz. *G. australis.* The other two names must, accordingly, be considered junior synonyms.

Mycale australis Hentschel, 1911 (as *M. macilenta* var. *a.*) is a junior homonym of *M. (Grapelia) australis.* We refrain from renaming it until its status as a valid species is confirmed.

Mycale (Grapelia) unguifera n.sp.

Figs. 18-30, Table 2.

Material studied. Holotype: INV-POR 450, Islas del Rosario (Colombia), coll. S. Zea, 31.I.1983, 6 m deep, yellow-orange, on dead bottom parts of the coral *Porites porites.* Paratypes: INV.POR 429, Chengue Bay (11°20'N-74°08'W, Santa Marta, Colombia), coll. M. Kielman, 4.VII.1991, 10 m deep, blue, rocky substrate; INV.POR 430, Chengue Bay (11°20'N-74°08'W, Santa Marta, Colombia), coll. M. Kielman, 28.V.1990, 10 m deep, blue, rocky substrate. Schizotype and slides from the holotype deposited under ZMA 10884 and UFRJPOR 4465.

Comparative material: *Mycale (G.) australis,* neotype, BMNH 1886.12.15.467 (as *Pseudoesperia enigmatica*); *P. enigmatica* [sensu Dendy (1896)], NMV-F65700, NMV-F65701, NMV-F65702, NMV-F65703, NMV-F65704; *Esperella ancorina* Whitelegge, 1906, type is lost, AMS-Z1440; *M. parasitica* var. *arenosa* Hentschel, 1911, holotype, ZMH-S1666; *P. carteri* Dendy & Frederick, 1924, holotype, BMNH 1925.11.1.280; *P. trichophora* Dendy & Frederick, 1924, holotype, BMNH 1925.11.1.1303 (original microscopic slides only); *M. (G.) parasitica* (sensu Vacelet et al., 1976), MNHN D.VVL 149 and 150; *M. parasitica* (det. Burton, Durban, S. Africa, unpublished), BMNH 1934.11.20.94 (microscopic slide only); *M. (G.)* sp. (det. Van Soest, Sey-

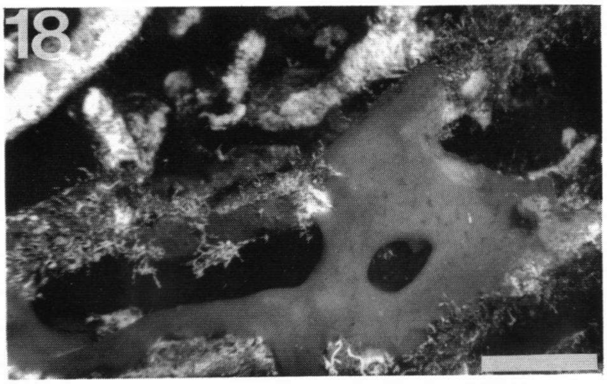
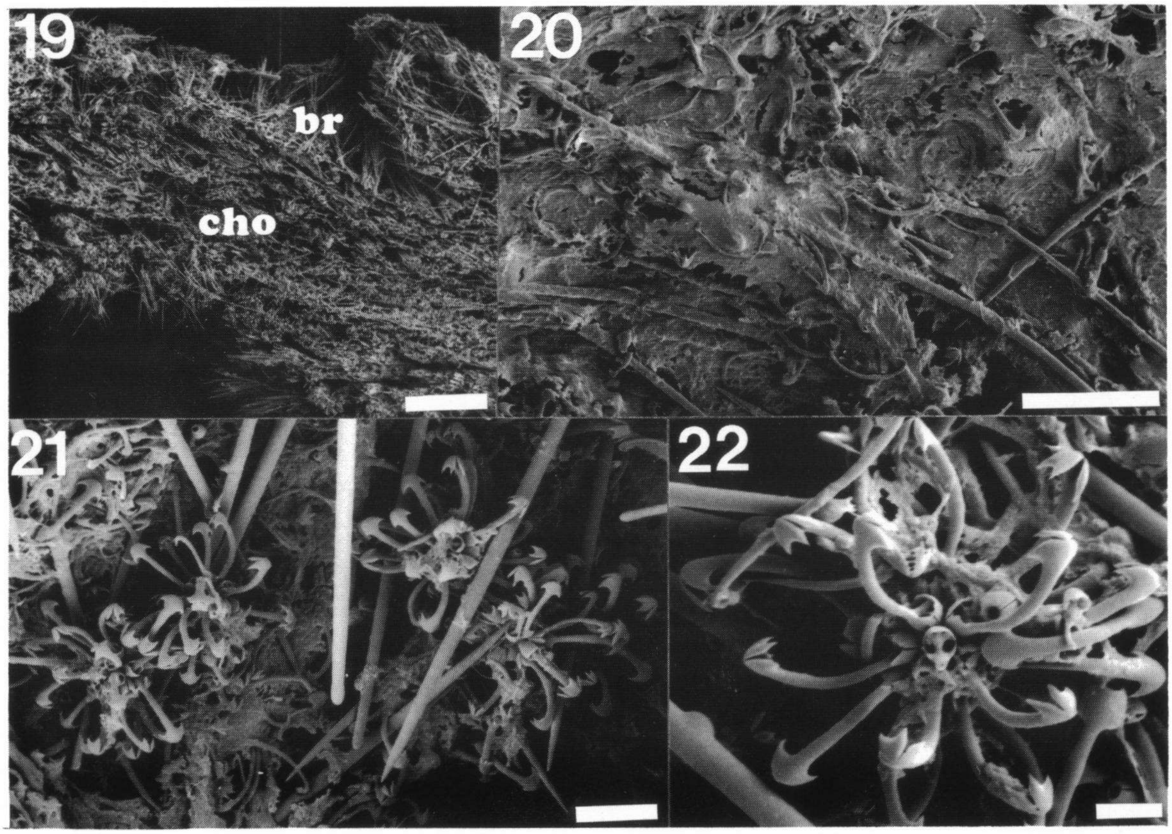


Fig. 18. *Mycale (Grapelia) unguifera* n.sp., holotype (INV-POR 450), in situ. Scale = 1 cm.



Figs. 19-22. *Mycale (Grapelia) unguifera* n.sp., holotype (INV-POR 450). 19. Transverse section showing general architecture, with very dense and confused choanosomal skeleton (cho), and abundant subectosomal divergent brushes (br). 20. Tangential view of surface showing low density of subtylostyles strewn at random, and abundant anisochelae-I and sigmas. 21. Subectosomal area showing abundance of rosettes of anisochelae-I and patches of sigmas. 22. Detail of rosette of anisochelae-I. Scales: 19 = 500 μm, 20 = 100 μm, 21 = 50 μm, 22 = 20 μm.

Table 2. Spicular micrometric data on the holotype and paratypes of *Mycale (Grapelia) unguifera* sp.n.. N = 20.

	subtylostyles length by width of head by width of shaft	anisochelae	sigmas length by width
INV-POR 450	339-*405.5*-445	I: 45-*49.3*-53	54-*61.0*-69
Islas del Rosario	by 6-*6.4*-8	II: 21-*23.1*-25	by 2-*2.5*-3
	by 7-8.3-11	III: 15-17.0-20	
INV-POR 429	339-*372.6*-392	I: 30-*35.1*-42	50-*53.6*-61
Santa Marta	by 3-*5.1*-7	II: 17-*18.2*-20	by 2-2.1-3
	by 4-*6.0*-9	III: 13-*14.2*-15	
INV-POR 430	334-*372.9*-392	I: 34-*36.7*-39	51-5*4.8*-59
Santa Marta	by 4-*5.5*-8	II: 16-*17.1*-19	by 1-*1.9*-3
	by 5-*6.0*-9	III: 13-*14.5*-17	

chelles, unpublished), ZMA 10711; *M. parasitica* (det. Carpay, Tasmania, unpublished), ZMA 10712.

Diagnosis: *Mycale (Grapelia) unguifera* n.sp. possesses sigmas longer than 50 µm, anisochelae-II markedly larger than anisochelae-III; megascleres with mean length over 350 µm.

DESCRIPTION

Holotype fragile, slimy crust, with smooth surface (Fig. 18). Colour in life yellow-orange. Paratypes blue in life. INV-POR 429 like a bulgy bladder, composed of two main fragments (ca. 15 by 9 by 4 and 4 by 4 by 2 mm). INV-POR 430 composed of four main fragments, the largest 4 by 4 by 2 mm. Both are firm, but compressible.

Ectosomal skeleton a thin tangential layer of subtylostyles intermingled with abundant anisochelae-I (single or in rosettes, ca. 105 µm in diameter, 15-25 anisochelae each) and sigmas (Fig. 20).

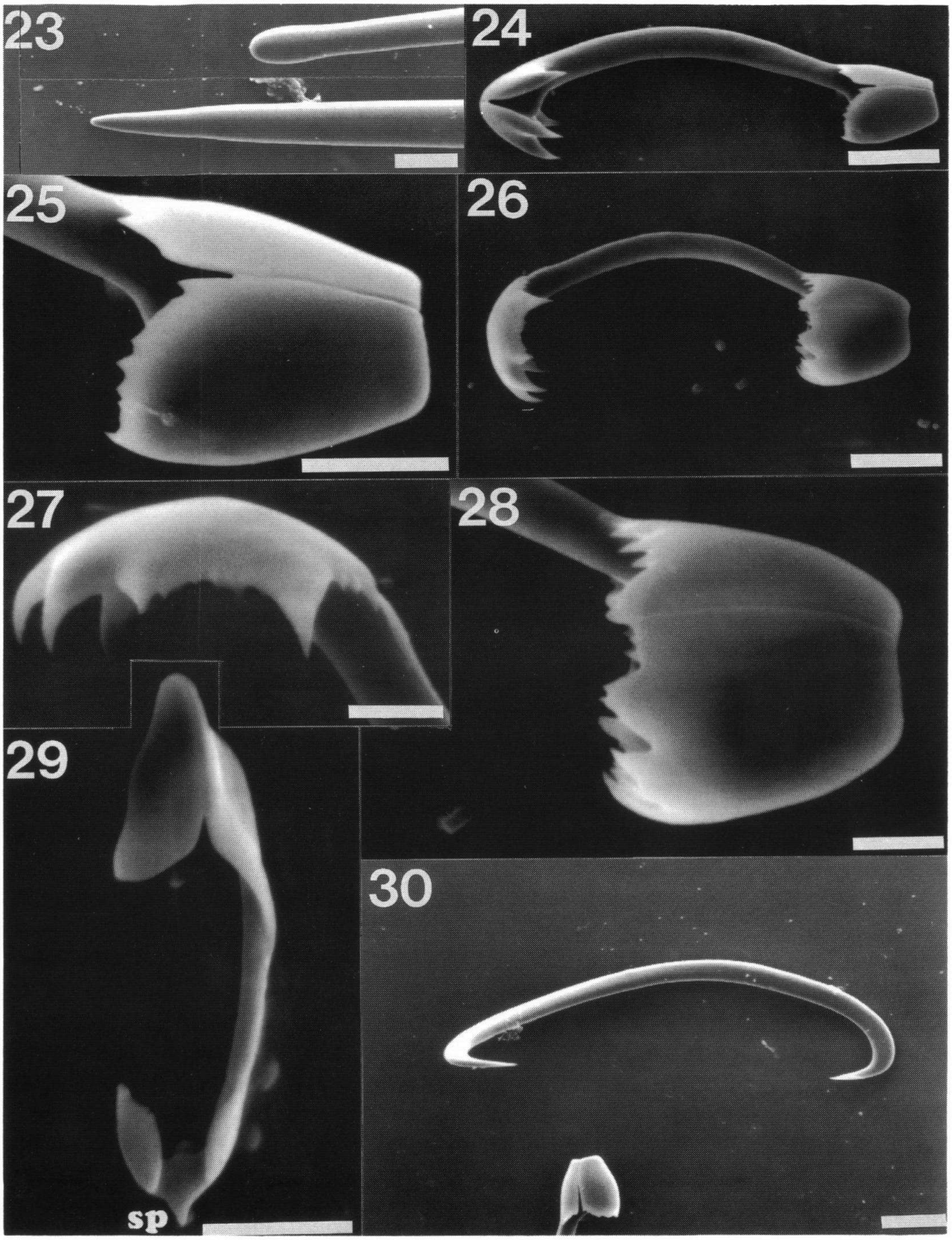
Choanosomal skeleton markedly confused, with dense spiculation and tracts of megascleres not easily discernible (Fig. 19). Anisochelae-I, strewn at random or organized in rosettes, and sigmas abound in subectosomal area (Figs. 21-22) among brushes of subtylostyles, perpendicular to, and slightly piercing the surface. Rosettes of anisochelae-II (ca. 60 µm in diameter, 15-20 anisochelae each) are very rare.

Spicules (Measurements in Table 2). Megascleres: subtylostyles (Fig. 23), fusiform, thicker at central portion, elliptic head, apex sharpening gradually . Microscleres: anisochelae-I (Figs. 24-25), unguiferate head < 20% of shaft's total length, lateral alae of head very narrow and sharp, biphid frontal ala, with deep notch between two narrow and sharp projections, shaft markedly curved on profile view, palmate foot with spines on top of alae; anisochelae-II (Figs. 26-28), acanthose head ca. 15% of shaft's total length, alae of head not recognizable, head with larger and smaller spines, slender shaft markedly curved on profile view, palmate foot with large spines on top of alae; anisochelae-III (Fig. 29), head 40% of shaft's total length, lateral alae of head longer than frontal one, slender shaft slightly curved on profile view, foot with reduced alae and large basal spur-like projection; sigmas (Fig. 30), stout, bent at middle portion, markedly bent on hooks, sharp hooks.

Etymology. The species is named after the unguiferate shape of its anisochelae-I.

REMARKS

The occurrence of slightly larger and thicker



Figs. 23-30. *Mycale (Grapelia) unguifera* n.sp., holotype (INV-POR 450). 23. Terminations of subtylostyles. 24. Profile view of anisochela-I with a curved shaft, unguiferate head, and base which is microspined on its top portion. 25. Detail of base of the anisochela-I of Fig. 24 showing spines on its top portion. 26. Profile view of anisochela-II with a curved shaft, unguiferate head, and base which is acanthose on its top portion. 27. Detail of unguiferate head of the anisochela-II of Fig. 26 showing larger-spines (= alae?), with smaller ones in between. 29. Detail of spined base of the anisochela-II of Fig. 26. Note size-variation of spines. Profile view of palmate anisochela-III, with reduced base and basal spur-like projection (sp). 30. Sigma. Scales: 23-24, 30 = 10 µm, 25-26, 29 = 5 µm, 27-28 = 2 µm.

spicules in the holotype from the Islas del Rosario on the southern Colombian coast, as compared to both paratypes from the Santa Marta area, conforms to the pattern described by Zea & Van Soest (1986), and Zea (1987). According to these authors more than 50% of the sponge species occurring on the southern Colombian Caribbean coast possess stouter siliceous spicules when compared to specimens from other more northerly localities along the Colombian coast, and the Caribbean in general.

Of the comparative material of *Grapelia* studied here, only *M. (G) carteri* (Dendy & Frederick, 1924), the specimen described by Vacelet et al. (1976), as *M. (G.) parasitica,* and two undescribed specimens from the western Indian Ocean, from Durban (South Africa) and from the Seychelles, possess sigmas. These are generally smaller (26-45 µm long, partly new micrometries; Hajdu, in prep.) than the ones reported here for *M. (G.) unguifera* n.sp. (50-69 µm long). The specimen from the Seychelles was blue alive, and has sigmas which are 45-53 µm long, thus coming closer to the new species (both paratypes were blue alive). Nevertheless, it shows at least two additional distinctive characters. The first, a trait shared with some other specimens from the Indo-west Pacific-anisochelae-III which are larger than the anisochelae-II. The second, anisochelae-I almost two times as long as those in *M. (G.) unguifera* n.sp.. The new species is thus considered well distinguished from other congeners.

PHYLOGENETIC DISCUSSION

The phylogenetic significance of centrally-thickened, centrotylote-like toxas and micracanthoxeas as found here in *M. escarlatei* is uncertain. Hajdu (1994) described centrotylote-sigmas from *Hamacantha popana* (De Laubenfels, 1935), but these are probably only analogous to the centrally-thickened toxas reported here, since both spicule-types (sigmas and toxas) diverged very early. These spicules are synapomorphic for Haplosclerida and Poecilosclerida (e.g. Van Soest, 1991; Hajdu et al., 1994b). This fact, coupled with the rarity of centrotylote-sigmas and /or -toxas in the Poecilosclerida makes it likely that the scattered occurrence of this character is independently achieved, thus constituting several distinct apomorphies.

Small micracanthoxeas with disproportionately large spines as found in the, as yet, few species of *Mycale* discussed above also seem unrelated to other similar microscleres occurring in the Poecilosclerida. Some Cladorhizidae De Laubenfels, 1936 may possess microspined (sub)(tylo)styles (see Lundbeck, 1905), which are larger and generally contorted. These are markedly distinct in overall shape, and function (they form a surface crust), from the micracanthoxeas of *Mycale*. The genera of uncertain affinities *Phlyctaenopora* Topsent, 1904 [synonym *Barbozia* Dendy, 1922; sensu Lévi & Lévi (1983)], and *Discorhabdella* Dendy, 1924 may possess aster-like microxea with two semiterminal whorls of large spines, very much unlike the pattern observed in *Mycale*. *Neofibularia* Hechtel, 1965 possesses microspined microxea, but these are larger, and spines are smaller. The well known onychaetes of *Tedania* Gray, 1867 also differ markedly from the micracanthoxeas reported here because of their much larger size, smaller spines, and occasional centrotylote shape.

Despite the lack of affinities to other known microspined microscleres mentioned above, the occurrence of micracanthoxeas in *Mycale* could be uniquely derived, although probably on a more inclusive level of universality. This occurrence could be an underlying synapomorphy for distinct subgenera or species-groups, rather than be interpreted as suggestive of the close affinities of the three species possessing them alone. Indeed, despite their likely artificial assignment to distinct subgenera, *M. micracanthoxea* and *M. bamfieldense* seem very close with respect to anatomical characters other than their ectosomal skeletons (Table 1). On the other hand, *M. escarlatei* seems far from these species as suggested by anatomical characters other than the micracanthoxeas. The assessment of the true level of universality of the occurrence of micracanthoxeas will ultimately depend on a taxonomic revision of known species of *Mycale*, since it is quite possible that the character has been overlooked in the past.

The observation that *M. micracanthoxea* and *M. bamfieldense,* despite distinct with respect to the pattern of their ectosomal skeletons (the first without, the latter with), do share a comparable set of spicules is suggestive of further pitfalls in the use of ectosomal patterns as the sole diagnostic character for *Mycale* subgenera. Supporting evidence comes from Hajdu & Desqueyroux-Faúndez (1994) who noted that although agreeing in most characters to sponges assigned to subgenus *Mycale, M. (M. ?) lapidiformis* (Ridley & Dendy, 1886) did not possess the characteristic tangential confused ectosomal skeleton of other species assigned to the subgenus (sensu Van Soest, 1984). Additionally, *M. (A. ?)* n. sp. (Hajdu & Rützler, in prep.) is described with an unstable tangential ectosomal reticulation of spicule bundles - 50% of reported specimens had it (2 out of 4), the others did not (being *Carmia*-like). All these observations when taken in conjunction are interpreted here as suggestive that patterns of the ectosomal skeleton may have been often lost. This points towards the unnatural status of *Carmia* as an artificial assemblage of several convergent evolutionary lines. Begle (1991) stated that absences (such as the ectosomal skeletal pattern of *Carmia*) are as useful as characters as presences. However, such features are, according to him, even more dependent of an overall phylogenetic analysis before they can be evaluated as synapomorphic, since their 'astructural' nature prevents the formulation of any hypothesis concerning primary homology (Pinna, 1991).

Anisochelae-III with a basal spur-like projection as found here in *M. unguifera,* occur in other species of *Mycale,* subgenera *Mycale* and *Grapelia* (Hajdu & Boury-Esnault, 1991; Hajdu & Desqueyroux-Faúndez, 1994). They are also characteristic of *Iophon* Gray, 1867, *Phlyctaenopora* and *Acanthorhabdus* Burton, 1929. As far as morphological similarity goes, hardly any distinction can be made between these anisochelae, except perhaps that those in *Phlyctaenopora* seem stouter, and those in *Iophon,* more regular. But this view could be biased by our greater familiarity with the ones occurring in *Mycale. Phlyctaenopora* is a genus of uncertain affinities, for the moment considered best assigned to the Mycalidae (Van Soest & Stentoft, 1988). To make the appearance of anisochelae with a basal spur-like projection a single event in mycalid evolution would imply accepting a close relationship of *Phlyctaenopora* to subgenera *Mycale* and *Grapelia.* The halichondroid choanosomal pattern and the ectosomal specialization in the form of a second category of diactinal megascleres make it very unlikely that *Phlyctaenopora* could be so closely related to *Mycale.* It seems pointless to say that *Iophon* and *Acanthorhabdus* also do not share additional features with *Mycale,* other than the shape of their anisochelae. The conclusion that follows from the rationale above is that despite their morphological similarity [primary homology, Pinna (1991)], distinct occurrences of anisochelae with a basal spur-like projection may well constitute several independent achievements by variably distantly related poecilosclerid lineages.

ACKNOWLEDGEMENTS

This article benefited from the comments of N. Boury-Esnault (SME), K. Rützler (USNM), R.W.M. van Soest and F.R. Schram (ISP-UvA). Authors are thankful to L.B. Holthuis (NNM) for clarifying doubts concerning the status of *Grapelia* and *Pseudoesperia,* and to P.B. Berents (AMS), M. Dzwillo (ZMH), M. Grasshoff (SMF), K. Joysey (UMZC), Y.C. Man (ZRC), T. Stranks (NMV), C. Valentine (BMNH) and R. Wood (DES) for the loan of, and/or search for specimens. EH is thankful to G. Muricy and S. Bonnecker (UFRJ) for providing laboratory facilities during field activities in Brazil which led to the collection of the holotype of *M. (A.) escarlatei* sp.n., and to Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, Brazil) for providing a fellowship in support of his PhD studies in the University of Amsterdam, and funding of field activities in Brazil in 1992. INVEMAR provided field and laboratory facilities to SZ and MK. COLCIENCIAS (Colombia) and WOTRO (The Netherlands) funded, respectively, the research of SZ and MK.

REFERENCES

BEGLE, D.P., 1991. Relationships of the osmeroid fishes and the use of reductive characters in phylogenetic analysis. Syst. Zool., **40** (1): 33-53.

BERGQUIST, P.R., 1965. The sponges of Micronesia, Part 1. The Palau Archipelago. Pacific Sci., **19** (2): 123-204.

BOWERBANK, J.S., 1864. A monograph of the British Spongiadae. Vol I. Ray Society, London. i-xx, 1-290, pls. I-XXXVII.

BUIZER, B. & R.W.M. VAN SOEST, 1977. *Mycale micracanthoxea* nov. spec. (Porifera, Poecilosclerida) from the Netherlands. Neth. J. Sea Res., **11** (3/4): 297-304.

BURTON, M., 1929. Porifera. Part 2. Antarctic sponges. Nat. Hist. Repts. British Antarctic 'Terra Nova' Exped. **6** (4): 393-458.

CARTER, H.J., 1885. Descriptions of sponges from the neighbourhood of Port Phillip Heads, S. Australia. Ann. Mag. nat. Hist., (5) **15** (X): 107-117, pl. IV.

CARTER, H.J., 1886. Supplement to the descriptions of Mr. J. Bracebridge Wilson's Australian sponges. Ann. Mag. nat. Hist., (5) **18** (XLII): 445-466, pl. X.

DENDY, A., 1896. Catalogue of non-calcareous sponges collected by J. Bracebridge Wilson, Esq., M.A., in the neighbourhood of Port Phillip Heads. Part 2. Proc. roy. Soc. Vic., (n.s.), **9**: 230-259.

DENDY, A., 1922. Report on the Sigmatotetraxonida collected by H.M.S. Sealark in the Indian Ocean. In: Reports of the Percy Sladen Trust Expedition to the Indian Ocean in 1905. Vol. 7. Trans. Linn. Soc. Lond., Zool., **18**: 1-164, pls. 1-18.

DENDY, A., 1924. Porifera. I. Non-Antarctic sponges. Brit. Antarctic ('Terra Nova') Exped. 1910. Nat. Hist. Repts., Zool., **6** (3): 269-392, pls.

DENDY, A. & L.M. FREDERICK, 1924. On a collection of sponges from Abrolhos Islands, western Australia. J. Linn. Soc. (Zool.), **35**: 477-519, pls. 25-26.

GRAY, J.E., 1867. Notes on the arrangement of sponges, with the description of some new genera. Proc. zool. Soc. Lond., 1867: 492-558, pls. XXVII-XXVIII.

HAJDU, E., 1994. A phylogenetic interpretation of hamacanthids (Demospongiae, Porifera), with the redescription of *Hamacantha popana*. J. Zool., **232**: 61-77.

HAJDU, E. & N. BOURY-ESNAULT, 1991. Marine Porifera of Cabo Frio (Rio de Janeiro - Brazil). The family Mycalidae Lundbeck, 1905, with the description of a new species. Revta. Brasil. Biol., **51** (3): 503-513.

HAJDU, E. & R. DESQUEYROUX-FAÚNDEZ, 1994. A synopsis of South American *Mycale (Mycale)* (Poecilosclerida, Demospongiae), with the description of three new species and a cladistic analysis of Mycalidae. Rev. suisse Zool., **101** (3): 563-600.

HAJDU, E. & K. RÜTZLER, in prep.. Sponges, Genus *Mycale* (Poecilosclerida) from a Caribbean mangrove and critique of subgeneric classification.

HAJDU, E., SOEST, R.W.M. VAN & J.N.A. HOOPER, 1994. Proposal for a phylogenetic subordinal classification of poecilosclerid sponges (Demospongiae, Porifera). In: R.W.M. van Soest, Th.M.G. van Kempen & J.C. Braekman (eds.), Sponges in time and space, Proc. 4th int. Porifera Congr.: 123-139. Balkema, Rotterdam. 515 pp.

HAJDU, E., WEERDT, W.H. DE & R.W.M. VAN SOEST, 1994. Affinities of the "Mermaid's Glove" sponge *Isodictya palmata* with a discussion on the synapomorphic value of chelae microscleres. In: R.W.M. van Soest, Th.M.G. van Kempen & J.C. Braekman (eds.), Sponges in time and space, Proc. 4th int. Porifera Congr.: 141-150. Balkema, Rotterdam. 515 pp.

HALLMANN, E.F., 1914. A revision of the monaxonid species described as new in Lendenfeld's "Catalogue of the sponges in the Australian Museum." Part III. Proc. Linn. Soc. N.S.W., **39**: 398-446.

HECHTEL, G., 1965. A systematic study of the sponges of Port Royal, Jamaica. Bull. Peabody Mus. nat. Hist., **20**: i-iv, 1-103.

HENTSCHEL, E., 1911. Tetraxonida. 2 Teil. In: W. Michaelsen & R. Hartmeyer (eds.), Die Fauna Südwest-Australiens, **3** (10): 277-393. Gustav Fischer, Jena.

HENTSCHEL, E., 1912. Kiesel- und Hornschwämme der Aru und Kei-Inseln. Abh. senckenb. naturforsch. Ges., **1912**: 295-448.

HOOPER, J.N.A. & C. LÉVI, 1994. Biogeography of Indo-west Pacific sponges: Microcionidae, Raspailiidae, Axinellidae. In: R.W.M. van Soest, Th.M.G. van Kempen & J.C. Braekman (eds.), Sponges in time and space, Proc. 4th int. Porifera Congr.: 191-212. Balkema, Rotterdam. 515 pp.

LABOREL, J., 1969. Les peuplements de madréporaires des côtes tropicales du Brésil. Ann. Univ. Abidjan, (E), **2** (3): 1-260.

LAUBENFELS, M.W. DE, 1935. Some sponges of lower California (Mexico). Am. Mus. Novit., **779**: 1-14.

LAUBENFELS, M.W. DE, 1936 A discussion of the sponge fauna of the Dry Tortugas in particular and the West Indies in general, with material for a revision of the families and orders of the Porifera. Pap. Tortugas Lab., **30**: 1-225.

LÉVI, C. & P. LÉVI, 1983. Démosponges bathyales récoltées par le N/O 'Vauban' au sud de la Nouvelle-Calédonie. Bull. Mus. natn. Hist. nat. Paris, (4) **5** (A, 4): 931-997.

LUNDBECK, W., 1905. Porifera (Part 2). Desmacidonidae. Dan. Ingolf Exped. **6**: 1-219.

MATSUURA, Y., 1986. Contribuição ao estudo da estrutura oceanográfica da Região Sudeste entre Cabo Frio (RJ) e Cabo de Santa Marta Grande (SC). Ciência e Cultura, **38** (8): 1439-1450.

MOTHES, B., SOEST, R.W.M. VAN & G.S. CARVALHO, 1993. Biogeography of Brazilian marine sponges (Porifera, Demospongiae). In Book of Abstracts. 4th Int. Porifera Congr. University of Amsterdam, Amsterdam.

PINNA, M.C.C. DE, 1991. Concepts and tests of homology in the cladistic paradigm. Cladistics, **7**: 367-394.

REISWIG, H.M. & H. KAISER, 1989. Description of *Mycale bamfieldense* n.sp. (Porifera, Demospongiae, Poecilosclerida) from Vancouver Island, British Columbia. Can J. Zool., **67**: 674-677.

RIDLEY, S.O. & A. DENDY, 1886. Preliminary report on the Monaxonida collected by H.M.S. 'Challenger'. Ann. Mag. nat. Hist., (5) **18**: 325-351, 470-493.

RÜTZLER, K., 1978. Sponges in coral reefs. In: D.R. Stoddart & R.E. Johannes (eds.), Coral reefs: research methods. Monogr. oceanogr. Meth. (UNESCO), **5**: 299-313.

SOEST, R.W.M. VAN, 1984. Marine sponges from Curaçao and other Caribbean localities. Part III. Poecilosclerida. Stud. Fauna Curaçao Caribb. Isls., **66** (199): 1-160.

SOEST, R.W.M. VAN, 1991. Demosponge higher taxa classification re-examined. In: J. Reitner & H. Keupp (eds.), Fossil and recent sponges: 54-71. Springer-Verlag, Berlin and Heidelberg. 595 pp.

SOEST, R.W.M. VAN, 1994. Demosponge distribution patterns. In: R.W.M. van Soest, Th.M.G. van Kempen & J.C. Braekman (eds.), Sponges in time and space, Proc. 4th int. Porifera Congr.: 213-223. Balkema, Rotterdam. 515 pp.

SOEST, R.W.M. VAN & N. STENTOFT, 1988. Barbados deep-water sponges. Stud. Fauna Curaçao Caribb. Isls., **70** (215): 1-175.

SOLLAS, I.B.J., 1902. On the sponges collected during the "Skeat Expedition" to the Malay Peninsula, 1899-1900. Proc. zool. Soc. London, **11**: 210-221, pls. 14-15.

THOMAS, P.A., 1968. Studies on Indian sponges - III. Two species of silicious sponges of the family Ophlitaspongiidae De Laubenfels (Class: Demospongiae Sollas, Order: Poecilosclerida Topsent). J. mar. biol. Ass. India, **10** (2): 255-259.

TOPSENT, E., 1904. Spongiaires des Açores. Résult. Camp. scient. Prince Albert I, **25**: 1-280, pls. I-XVIII, [281-316].

VACELET, J., P. VASSEUR & C. LÉVI, 1976. Spongiaires de la pente externe des récifs coralliens de Tuléar (sud-ouest de Madagascar). Mém. Mus. natn. Hist. nat. Paris, (A, Zool.) **99**: 1-116, pls. I-X.

VALENTIN, J.L., 1984. Analyse des paramétres hydrobiologiques dans la remontée de Cabo Frio, Brésil. Mar. Biol., **82**: 259-276.

WHITELEGGE, T., 1906. Sponges. Part I. In: Scientific Results of the Trawling Expedition of H.M.C.S. "Thetis" off the coast of New South Wales in February and March 1898. Mem. Austral. Mus. **IV** (9): 453-484, pls. XLIII-XLIV.

ZEA, S., 1987. Esponjas del Caribe Colombiano. Catálogo Científico, Bogotá: 1-286.

ZEA, S., 1993. Cover of sponges and other sessile organisms in rocky and coral reef habitats of Santa Marta, Colombian Caribbean Sea. Car. J. Sci., **29** (1/2): 75-88.

ZEA, S. & R.W.M. VAN SOEST, 1986. Three new species of sponges from the Colombian Caribbean. Bull. mar. Sci., **38** (2): 355-365.

Received: September, 1994.