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## Diversity of sponges (Porifera) from cryptic habitats on the Belize barrier reef near Carrie Bow Cay

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## Table of contents

Abstract	7
Introduction	7
Study sites and methods	8
Systematics	13
Class Homoscleromorpha	13
Order Homosclerophorida	13
Family Plakinidae	13
Genus <i>Corticium</i> Schmidt, 1862	13
<i>Corticium quadripartitum</i> Topsent, 1923	13
Genus <i>Plakinastrella</i> Schulze, 1880	13
<i>Plakinastrella onkodes</i> Uliczka, 1929	13
<i>Plakortis angulospiculatus</i> (Carter, 1882)	16
<i>Plakortis zyggompha</i> (de Laubenfels, 1934)	16
Genus <i>Tetralophophora</i> new genus	16
<i>Tetralophophora mesoamericana</i> new species	17
Class Demospongiae	18
Order Spirophorida	18
Family Tetillidae	18
Genus <i>Cinachyrella</i> Wilson, 1925	18
<i>Cinachyrella kuekenthali</i> (Uliczka, 1929)	18
Genus <i>Tetilla</i> Schmidt, 1868	19
<i>Tetilla laminaris</i> George and Wilson, 1919	19
Family Samidae	19
Genus <i>Samus</i> Gray, 1867	19
<i>Samus anonymus</i> Gray, 1867	19
Order Astrophorida	20
Family Ancorinidae	20
Genus <i>Stelletta</i> Schmidt, 1862	20
<i>Stelletta solidissima</i> (Wilson, 1902)	20
Genus <i>Cryptosyringa</i> Vacelet, 1979	22
<i>Cryptosyringa membranophila</i> Vacelet, 1979	22
Genus <i>Jaspis</i> Gray, 1867	22
<i>Jaspis</i> sp.	22
Family Geodiidae	23
Genus <i>Erylus</i> Gray, 1867	23
<i>Erylus formosus</i> Sollas, 1886	23
Genus <i>Geodia</i> Lamarck, 1815	23
<i>Geodia cribrata</i> new species	23
<i>Geodia gibberosa</i> Lamarck, 1815	25
Order Hadromerida	25
Family Alecetonidae	26
Genus <i>Spiroxya</i> Topsent, 1896	26
<i>Spiroxya spiralis</i> (Johnson, 1899)	26
Family Clionaidae	27
Genus <i>Cliona</i> Grant, 1826	27
<i>Cliona amplicavata</i> Rützler, 1974	27
<i>Cliona flavifodina</i> Rützler, 1974	27
<i>Cliona</i> cf. <i>mucronata</i> Sollas, 1878	28
<i>Cliona schmidti</i> (Ridley, 1881)	29
<i>Cliona varians</i> (Duchassaing & Michelotti, 1864)	30
<i>Cliona</i> sp.	31
Genus <i>Pione</i> Gray, 1867	31
<i>Pione vastifica</i> (Hancock, 1849)	31
Genus <i>Spheciospongia</i> Marshall, 1892	32
<i>Spheciospongia vesparium</i> (Lamarck, 1815)	32
Family Placospongiidae	32
Genus <i>Placosphaerastra</i> van Soest, 2009	32
<i>Placosphaerastra antillensis</i> van Soest, 2009	32
Genus <i>Placospongia</i> Gray, 1867	34
<i>Placospongia caribica</i> new species	34
Family Spirastrellidae	36
Genus <i>Diplastrella</i> Topsent, 1918	36

<i>Diplastrella megastellata</i> Hechtel, 1965	36
Genus <i>Spirastrella</i> Schmidt, 1868	37
<i>Spirastrella coccinea</i> (Duchassaing & Michelotti, 1864)	37
<i>Spirastrella mollis</i> Verrill, 1907	38
Family Suberitidae	40
Genus <i>Aptos</i> Gray 1867	40
<i>Aptos pernucleata</i> (Carter, 1870)	40
Genus <i>Prosuberites</i> Topsent, 1893	41
<i>Prosuberites carriehowensis</i> new species	41
<i>Terpios fugax</i> Duchassaing & Michelotti, 1864	44
Family Tethyidae	45
Genus <i>Lamarck</i> , 1814	45
<i>Tethya maza</i> Selenka, 1879	45
Family Timeidae	45
Genus <i>Timea</i> Gray, 1867	45
<i>Timea diplasterina</i> new species	45
<i>Timea oxyasterina</i> new species	48
<i>Timea stenosclera</i> Hechtel, 1969	49
<i>Timea</i> cf. <i>unistellata</i> (Topsent, 1892)	49
Family Trachycladidae	51
Genus <i>Rhaphidhistia</i> Carter, 1879	51
<i>Rhaphidhistia belizensis</i> new species	51
Order Chondrosida	53
Family Chondrillidae	53
Genus <i>Chondrilla</i> Schmidt, 1862	53
<i>Chondrilla caribensis</i> Rützler, Duran & Piantoni, 2007	53
Order 'Lithistida'	53
Family Siphonidiidae	53
Genus <i>Gastrophanella</i> Schmidt, 1879	53
<i>Gastrophanella cavernicola</i> Muricy & Minervino, 2000	53
Family Phymaraphiniidae	54
Genus <i>Kaliapsis</i> Bowerbank, 1869	54
<i>Kaliapsis</i> cf. <i>cidaris</i> Bowerbank, 1869	54
Order Poecilosclerida	55
Suborder Microcionina	55
Family Acarnidae	55
Genus <i>Acarnus</i> Gray, 1867	55
<i>Acarnus</i> cf. <i>nicoleae</i> van Soest, Hooper & Hiemstra, 1991	55
Genus <i>Cornulum</i> Carter, 1876	56
<i>Cornulum johnstoni</i> (de Laubenfels, 1934)	56
Genus <i>Wigginsia</i> de Laubenfels, 1953a	57
<i>Wigginsia curlewensis</i> new species	57
Family Microcionidae	59
Genus <i>Clathria</i> Schmidt, 1862	59
Subgenus <i>Microciona</i> Bowerbank, 1862	59
<i>Clathria (Microciona) bulbotoxa</i> van Soest, 1984	59
<i>Clathria (Microciona) campecheae</i> Hooper, 1996	60
<i>Clathria (Microciona)</i> cf. <i>echinata</i> (Alcolado, 1984)	61
Subgenus <i>Thalysias</i> Duchassaing and Michelotti, 1864	61
<i>Clathria (Thalysias) curacaoensis</i> Arndt, 1927	61
<i>Clathria (Thalysias) venosa</i> (Alcolado, 1984)	62
<i>Clathria (Thalysias) virgultosa</i> (Lamarck, 1814)	63
Family Raspailiidae	63
Genus <i>Ectyoplasia</i> Topsent, 1931	63
<i>Ectyoplasia ferox</i> (Duchassaing & Michelotti, 1864)	63
Suborder Myxillina	64
Family Chondropsidae	64
Genus <i>Strongylacidon</i> von Lendenfeld, 1897	64
<i>Strongylacidon rubrum</i> van Soest, 1984	64
Family Crambeidae	64
Genus <i>Monanchora</i> Carter, 1883a	64
<i>Monanchora arbuscula</i> (Duchassaing & Michelotti, 1864)	64
Family Hymedesmiidae	65
Genus/subgenus <i>Hymedesmia</i> Bowerbank, 1864	65

<i>Hymedesmia (Hymedesmia) agariciicola</i> van Soest, 1984	65
<i>Hymedesmia (Hymedesmia) curacaoensis</i> van Soest, 1984	65
Genus <i>Phorbas</i> Duchassaing & Michelotti, 1864	66
<i>Phorbas aurantiacus</i> new species	66
Family Iotrochotidae	66
Genus <i>Iotrochota</i> Ridley, 1884	66
<i>Iotrochota birotulata</i> (Higgin, 1877)	66
Suborder Mycalina	68
Family Desmacellidae	68
Genus <i>Desmacella</i> Schmidt, 1870	68
<i>Desmacella polysigmata</i> van Soest, 1984	68
Family Mycalidae	68
Genus <i>Mycale</i> Gray, 1867	68
Subgenus <i>Carmia</i> Gray, 1867	68
<i>Mycale (Carmia) microsigmata</i> Arndt, 1827	68
Subgenus <i>Grapelia</i> Gray, 1867	69
<i>Mycale (Grapelia) unguifera</i> Hajdu, Zea, Kielman & Peixinho, 1995	69
Subgenus <i>Mycale</i> Gray, 1867	69
<i>Mycale (Mycale) laevis</i> (Carter, 1882)	69
Family Merliidae	70
Genus <i>Merlia</i> Kirkpatrick, 1908	70
<i>Merlia deficiens</i> Vacelet, 1980	70
<i>Merlia normani</i> Kirkpatrick, 1908	70
Order Halichondrida	70
Family Axinellidae	70
Genus <i>Dragmacidon</i> Hallmann, 1917	70
<i>Dragmacidon reticulatum</i> (Ridley & Dendy, 1886)	70
Genus <i>Dragmaxia</i> Hallmann, 1916	71
<i>Dragmaxia undata</i> Alvarez, van Soest & Rützler, 1998	71
Genus <i>Ptilocaulis</i> Carter, 1883b	71
<i>Ptilocaulis walpersii</i> (Duchassaing & Michelotti, 1864)	71
Family Heteroxyidae	72
Genus <i>Myrmekioderma</i> Ehlers, 1870	72
<i>Myrmekioderma laminatum</i> new species	72
<i>Myrmekioderma rea</i> (de Laubenfels, 1934)	72
Family Dictyonellidae	74
Genus <i>Scopalina</i> Schmidt, 1862	74
<i>Scopalina ruetzleri</i> (Wiedenmayer, 1977)	74
Family Halichondriidae	74
Genus <i>Amorphinopsis</i> Carter, 1887	74
<i>Amorphinopsis</i> sp.	74
Genus <i>Hymeniacidon</i> Bowerbank, 1858	75
<i>Hymeniacidon caerulea</i> Pulitzer-Finali, 1986	75
Genus <i>Topsentia</i> Berg, 1899	75
<i>Topsentia bahamensis</i> Diaz, Pomponi & van Soest, 1993	75
<i>Topsentia ophiraphidites</i> (de Laubenfels, 1934)	76
Order Agelasida	76
Family Agelasidae	76
Genus <i>Agelas</i> Duchassaing & Michelotti, 1864	76
<i>Agelas citrina</i> Gotera & Alcolado, 1987	76
<i>Agelas dispar</i> Duchassaing & Michelotti, 1864	77
<i>Agelas schmidti</i> Wilson, 1902	77
<i>Agelas sventres</i> Lehnert & van Soest, 1996	78
<i>Agelas wiedenmayeri</i> Alcolado, 1984	78
Family Astroscleridae	78
Genus <i>Goreauiella</i> Hartman, 1969	78
<i>Goreauiella auriculata</i> Hartman, 1969	78
Genus <i>Hispidopetra</i> Hartman, 1969	79
<i>Hispidopetra miniana</i> Hartman, 1969	79
Order Haplosclerida	80
Family Chalinidae	80
Genus <i>Haliclona</i> Grant, 1835	80
Subgenus <i>Halichocona</i> de Laubenfels, 1932	80
<i>Haliclona (Halichocona) stoneae</i> de Weerdt, 2000	80

<i>Haliclona (Halichoclona) vansoesti</i> de Weerdt, de Kluijver & Gomez, 1999	80
<i>Haliclona (Halichoclona)</i> sp.	80
Subgenus <i>Reniera</i> Schmidt, 1862	81
<i>Haliclona (Reniera) implexiformis</i> (Hechtel, 1965)	81
<i>Haliclona (Reniera) manglaris</i> Alcolado, 1984	81
<i>Haliclona (Reniera) mucifibrosa</i> de Weerdt, Rützler & Smith, 1991	81
Subgenus <i>Soestella</i> de Weerdt, 2000	82
<i>Haliclona (Soestella) lehnerti</i> de Weerdt, 2000	82
<i>Haliclona (Soestella) luciensis</i> de Weerdt, 2000	82
<i>Haliclona (Soestella)</i> sp.	83
Family Niphatidae	83
Genus <i>Amphimedon</i> Duchassaing & Michelotti, 1864	83
<i>Amphimedon erina</i> (de Laubenfels, 1936)	83
Genus <i>Cribrochalina</i> Schmidt, 1870	83
<i>Cribrochalina vasculum</i> (Lamarck, 1814)	83
Genus <i>Niphates</i> Duchassaing and Michelotti, 1864	84
<i>Niphates alba</i> van Soest, 1980	84
<i>Niphates amorpha</i> Wiedenmayer, 1977	84
<i>Niphates arenata</i> new species	85
<i>Niphates erecta</i> Duchassaing & Michelotti, 1864	86
Suborder Petrosina	86
Family Phloeodictyidae	86
Genus <i>Calyx</i> Vosmaer, 1885	86
<i>Calyx podatypa</i> (de Laubenfels, 1934)	86
Genus <i>Siphonodictyon</i> Bergquist, 1965	87
<i>Siphonodictyon coralliphagum</i> Rützler, 1971	87
<i>Siphonodictyon occultum</i> new species	87
<i>Siphonodictyon ruetzleri</i> (Calcinai, Cerrano & Bavestrello, 2007)	88
<i>Siphonodictyon xamaycaense</i> Pulitzer-Finali, 1986	89
Genus <i>Oceanapia</i> Norman, 1869	89
<i>Oceanapia bartschi</i> (de Laubenfels, 1934)	89
Family Petrosiidae	90
Genus <i>Petrosia</i> Vosmaer, 1885	90
Subgenus <i>Petrosia</i> Vosmaer, 1885	90
<i>Petrosia (Petrosia) weinbergi</i> van Soest, 1980	90
<i>Petrosia (Petrosia)</i> sp.	90
Genus <i>Xestospongia</i> de Laubenfels, 1932	91
<i>Xestospongia arenosa</i> van Soest & de Weerdt, 2001	91
<i>Xestospongia deweerdae</i> Lehnert & van Soest, 1999	91
<i>Xestospongia purpurea</i> new species	92
<i>Xestospongia rampa</i> (de Laubenfels, 1934)	93
Order Dictyoceratida	93
Family Irciniidae	93
Genus <i>Ircinia</i> Nardo, 1833	93
<i>Ircinia felix</i> (Duchassaing & Michelotti, 1864)	93
<i>Ircinia strobilina</i> (Lamarck, 1816)	94
Family Thorectidae	94
Genus <i>Smenospongia</i> Wiedenmayer, 1977	94
<i>Smenospongia cerebriformis</i> (Duchassaing & Michelotti, 1864)	94
<i>Smenospongia</i> cf. <i>echina</i> (de Laubenfels, 1934)	94
Family Dysideidae	96
Genus <i>Dysidea</i> Johnston, 1842	96
<i>Dysidea etheria</i> de Laubenfels, 1936	96
Order Dendroceratida	96
Family Dictyodendrillidae	96
Genus <i>Igernella</i> Topsent, 1905	96
<i>Igernella notabilis</i> (Duchassaing & Michelotti, 1864)	96
Order Verongida	97
Family Aplysinidae	97
Genus <i>Aplysina</i> Nardo, 1834	97
<i>Aplysina cauliformis</i> (Carter, 1882)	97
<i>Aplysina fistularis</i> (Pallas, 1766)	97
<i>Aplysina fulva</i> (Pallas, 1766)	98
<i>Aplysina ocracea</i> Alcolado, 1984	98

<i>Aplysina sciophila</i> new species .....	98
Family Aplysinellidae .....	100
Genus <i>Suberea</i> Bergquist, 1995 .....	100
<i>Suberea? flavolivescens</i> (Hofman & Kielman, 1992) .....	100
Class Calcarea .....	101
Order Clathrinida .....	101
Family Clathrinidae .....	101
Genus <i>Clathrina</i> Gray, 1867 .....	101
<i>Clathrina hondurensis</i> Klautau & Valentine, 2003 .....	101
<i>Clathrina</i> cf. <i>panis</i> (Haeckel, 1872) .....	101
Family Leucettidae .....	102
Genus <i>Leucetta</i> Haeckel, 1872 .....	102
<i>Leucetta floridana</i> (Haeckel, 1872) .....	102
Order Leucosolenida .....	102
Family Sycettidae .....	102
Genus <i>Sycon</i> Risso, 1827 .....	102
<i>Sycon</i> sp. ....	102
Conclusions .....	103
Acknowledgments .....	103
References .....	123

## Abstract

The Caribbean barrier reef near Carrie Bow Cay, Belize, has been a focus of Smithsonian Institution (Washington) reef and mangrove investigations since the early 1970s. Systematics and biology of sponges (Porifera) were addressed by several researchers but none of the studies dealt with cryptic habitats, such as the shaded undersides of coral rubble, reef crevices, and caves, although a high species diversity was recognized and samples were taken for future reference and study. This paper is the result of processing samples taken between 1972 and 2012. In all, 122 species were identified, 14 of them new (including one new genus). The new species are *Tetralophophora* (new genus) *mesoamericana*, *Geodia cribrata*, *Placospongia caribica*, *Prosuberites carriebowensis*, *Timea diplasterina*, *Timea oxyasterina*, *Rhaphidhistia belizensis*, *Wigginsia curlewensis*, *Phorbas aurantiacus*, *Myrmekioderma laminatum*, *Niphates arenata*, *Siphonodictyon occultum*, *Xestospongia purpurea*, and *Aplysina sciophila*. We determined that about 75 of the 122 cryptic sponge species studied (61%) are exclusive members of the sciophilic community, 47 (39 %) occur in both, light-exposed and shaded or dark habitats. Since we estimate the previously known sponge population of Carrie Bow reefs and mangroves at about 200 species, the cryptic fauna makes up 38 % of total diversity.

**Key words:** Taxonomy, morphology, distribution, Caribbean, submarine caves, coral rubble, mangrove, new species, associations

## Introduction

The principal objective of this contribution is a sponge diversity assessment in cryptic habitats of the Atlantic barrier reef ecosystem near Carrie Bow Cay, Belize. This islet has been the site of the Smithsonian Marine Field Station for more than four decades, which has supported numerous systematic, ecological, life-history, and geological studies (Rützler, 2009). Sponges (Porifera) received a lot of attention from international collaborators, owing to their high diversity, biomass, and ecological importance in most reef, seagrass, and mangrove communities (Diaz & Rützler, 2001; Rützler, 2012).

We were intrigued by the sponge fauna in cryptic spaces early on—from lower surfaces and interstices of coral rubble to marine caves—because we could tell that many sponge species were different from those on the open, fully light-exposed surfaces of reefs, on lagoon bottoms covered by turtle grass, and on mangrove prop roots. Because sampling in cryptic spaces is difficult and time consuming and often resulted only in small specimen fragments, we were hesitant to describe our findings until more material was available. Only in recent years could we refocus our attention on cryptic environments as we had become well acquainted with most open-space species.

Reefs are rather porous, with cavities ranging in size from micrometers (pores in limestone skeletons of calcareous algae, foraminiferans and invertebrates) to meters (reef-framework caves), even kilometers in case of

some drowned karst caves and grottoes; it has been estimated that the volume of cavities may reach 50–90% of the framework volume (Ginsburg, 1983). Many of the framework caves are inaccessible by divers but are still densely populated if there is sufficient water exchange to bring in food for suspension feeders and flush out waste. Although not able to directly collect, researchers have been able to measure such remote cavities, observe their occupants by means of endoscopic video, and monitor several environmental parameters (e.g., Wunsch & Richter, 1998; Scheffers *et al.*, 2003). The principal sessile organisms (excluding microbes) that occupy these shaded spaces are coralline algae, foraminifers, sponges, ahermatypic corals, serpulid worms, brachiopods, bryozoans, bivalves, and tunicates. Furthermore, it was demonstrated that cryptic reef habitats occupied by sponges are major sinks of dissolved organic matter, thus contributing to the energy requirements of these ecosystems (de Goeij & van Duyl, 2007, de Goeij *et al.*, 2013),

Sponges have long been acknowledged as quantitatively important and highly diverse coelobites in tropical and subtropical caves worldwide and the subjects of exciting discoveries such as “living-fossil” calcareous and silico-calcareous (“coralline”) taxa, and lithistids and hexactinellids previously only known from the deep sea (see summaries in Rützler, 2004; Gerovasileiou & Voultsiadou, 2012).

In the Caribbean, pioneering work on cave sponges started out in Jamaica where the first coralline sponges were discovered in roofed-over surge channels (Hartman and Goreau, 1970). The first record of sponges from of a large karst cave in Belize lists 11 species from its dark ceiling dome, some 20 m from the sinkhole entrance (Macintyre *et al.*, 1982). Subsequent studies took place in reef caves of Bermuda where sponge species were recorded but not described (Logan *et al.*, 1984). A comprehensive, annotated list of cave sponges from reefs in the Netherlands Antilles comments on 92 species and includes detailed depth distribution records (Kobluk & van Soest, 1989). This was followed by an analysis of cryptic sponges and other taxa found under rubble in the same geographic location (Meesters *et al.*, 1991) and of under-rubble coelobites collected from 5 transects on the barrier reef and Glover’s Reef Atoll of Belize (Gischler & Ginsburg (1996).

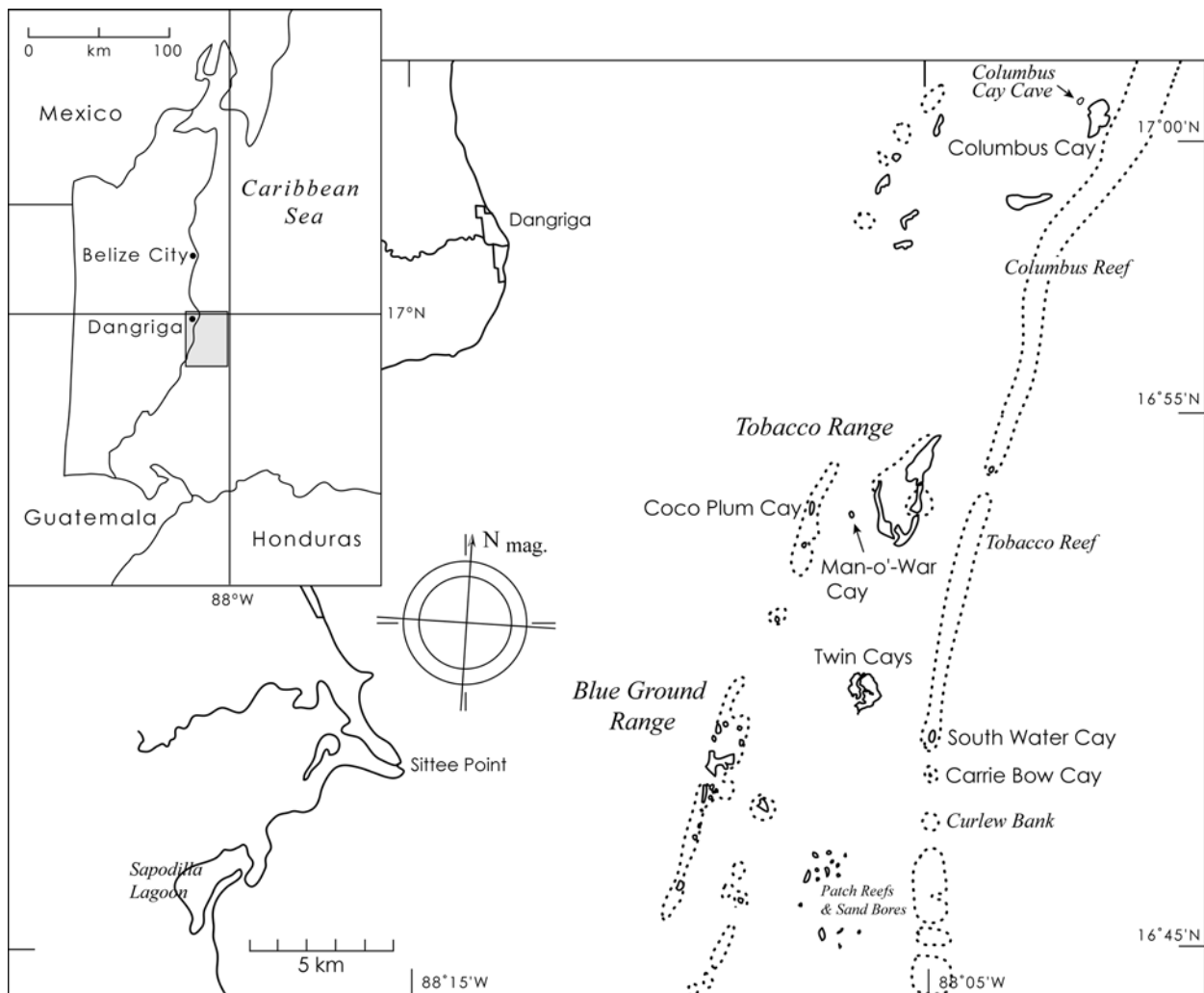
This study is based on material collected by us near Carrie Bow Cay, from interstitial spaces and undersides of reef rubble, including minireefs that occur among turtlegrass in the shallow lagoon, caverns formed by coalescing corals on patch reefs, coral overhangs and framework caves of the forereef, a drowned karst cave near Columbus Cay, and from undercut peat banks in the mangrove, mainly at Twin Cays.

## Study sites and methods

Carrie Bow Cay, base of our research, is a small coral islet situated on top of the Belize barrier reef (16°48.1'N, 88°04.9'W), about 25 km southeast of the town of Dangriga (Figure 1). The research area has been described in detail by Rützler & Macintyre (1982) and Rützler *et al.* (2000). Most sampling was done on the forereef between Carrie Bow Cay and Curlew Bank (the remains of Curlew Cay, eroded by hurricane), 5–35 m depth, and on the shallow reefs surrounding Carrie Bow, in 0.3–2 m. Additional collections came from mangrove peat caves at Twin Cays, 4 km to the northwest (1–3 m) (Rützler *et al.*, 2004) and minipatch reefs in the nearby lagoon (2 m), and from Columbus Cay cave, 24 km due north (18–21 m) (Macintyre *et al.*, 1982).

Typical cryptic reef habitats sampled by us are shown in Figure 2. They included the interstices of coral rubble (10–30 milliliter volume) and the lower surfaces of platy, live or dead corals (for instance, *Acropora palmata* (Lamarck), *Agaricia agaricites* (L.)) if supported and stabilized above the bottom sediment (up to 2 liter). A similar, common but generally neglected mini-cave habitat around Belizean cays is the interior of queen conch shells (*Strombus gigas* L.) discarded in great numbers by fishermen after harvesting the animals. To remove the soft parts, fishermen use a machete to hack a notch near the conch’s apex (through which the adductor muscle can be cut) which serves as a vent, allowing water flow through these small caves. Furthermore, we sampled crevices between sheet-like corals, coral overhangs, and walls and ceilings of framework caves (5–1,200 liter; cave bottoms were usually covered by fine sediment and only protruding rock ridges support some species). Sponges previously collected in a drowned karst cave (“blue hole”) near Columbus Cay (Macintyre *et al.*, 1982) were reexamined and reidentified in light of more recent taxonomic knowledge. Finally, we studied mangrove caves at Twin Cays, which are peat-bank undercuts in shallow (1–3 m) water, 1–4 m in horizontal depth; their ceilings and upper back wall, away from suspended fine sediments, are habitat for sponges.

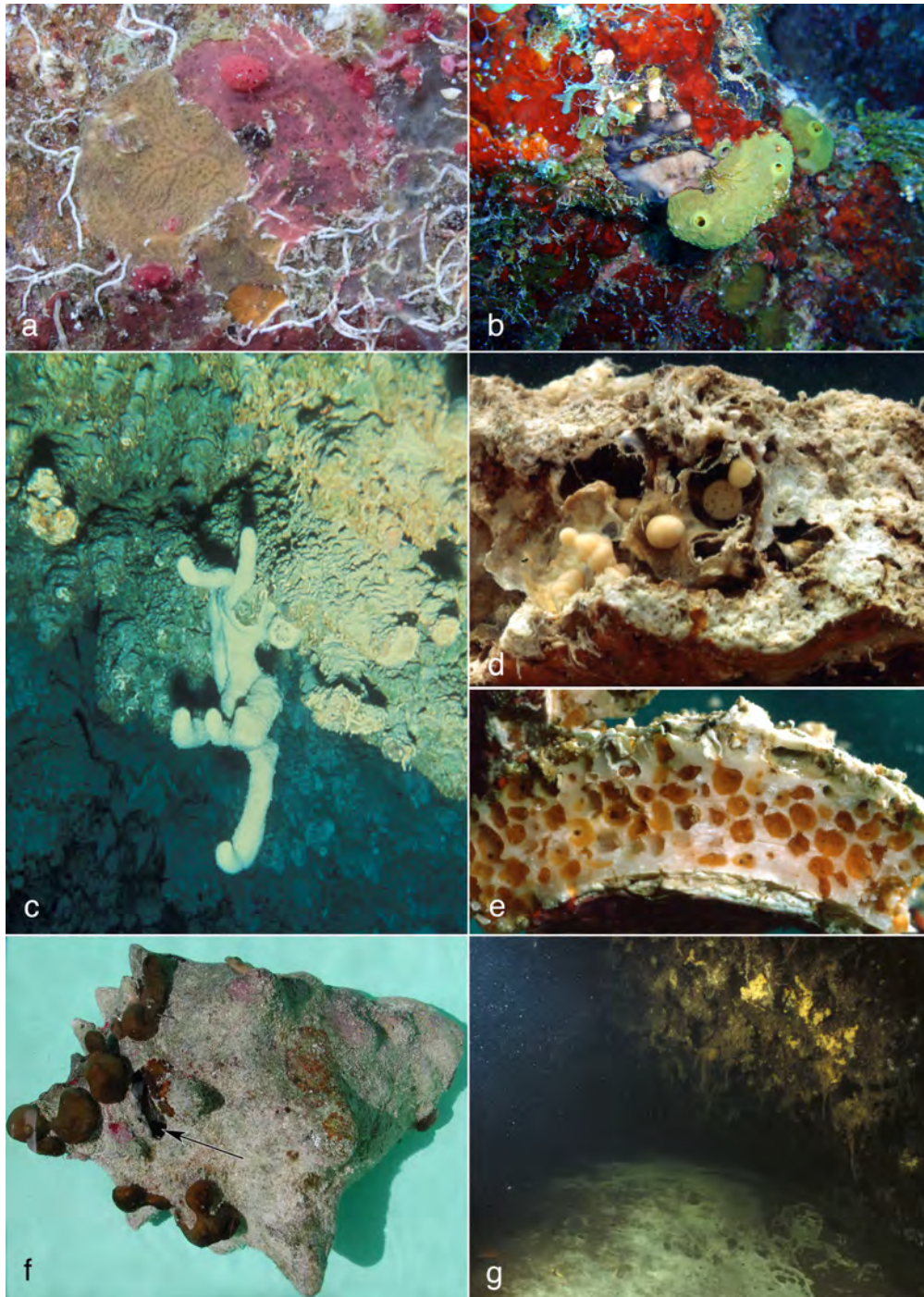




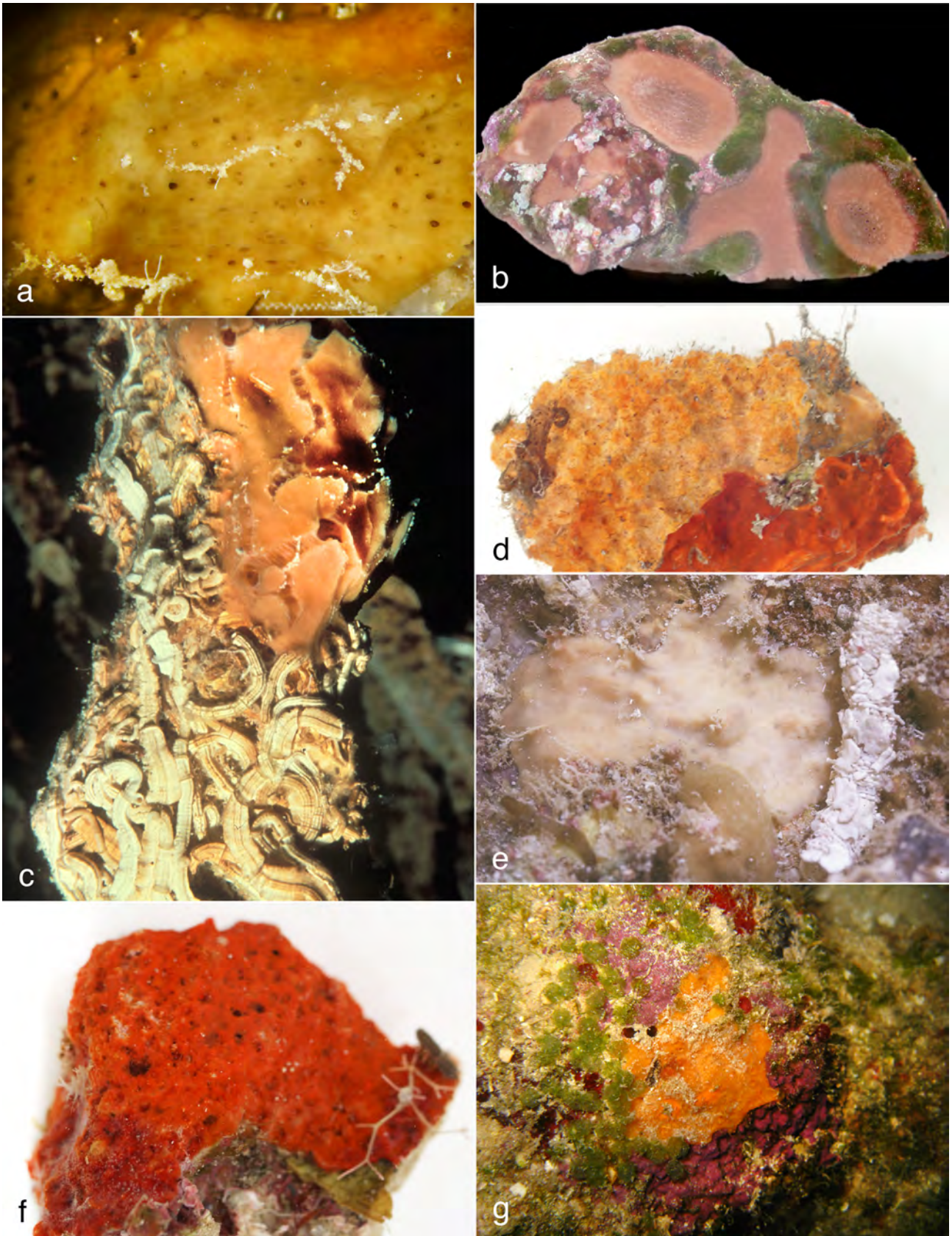
**FIGURE 1.** Map of Carrie Bow Cay (Belize) research area showing investigated locations: Carrie Bow Cay and Curlew bank, sites of shallow, platy coral rubble and forereef framework caves, Twin Cays mangrove island with undercut beat banks, and Columbus Cay, location of a drowned karst cave with sinkhole entrance (“blue hole.”)

Water movement in the various sampling locations varies with winds and tides but only periodically well-flushed habitats showed a dense population of sponges. Light levels were measured with a water-proofed photographic light meter at noon. Under shallow rocks they were 20–45 % of sea-surface illumination, in reef caves 0.1–5%, in mangrove peat caves 10–30%. Salinity and temperature regimes were those of the surrounding seawater, with fairly strong fluctuations on the shallow reef and in the mangrove, modest in the lagoon and on the deeper forereef; none of the habitats were directly exposed to mainland runoffs.

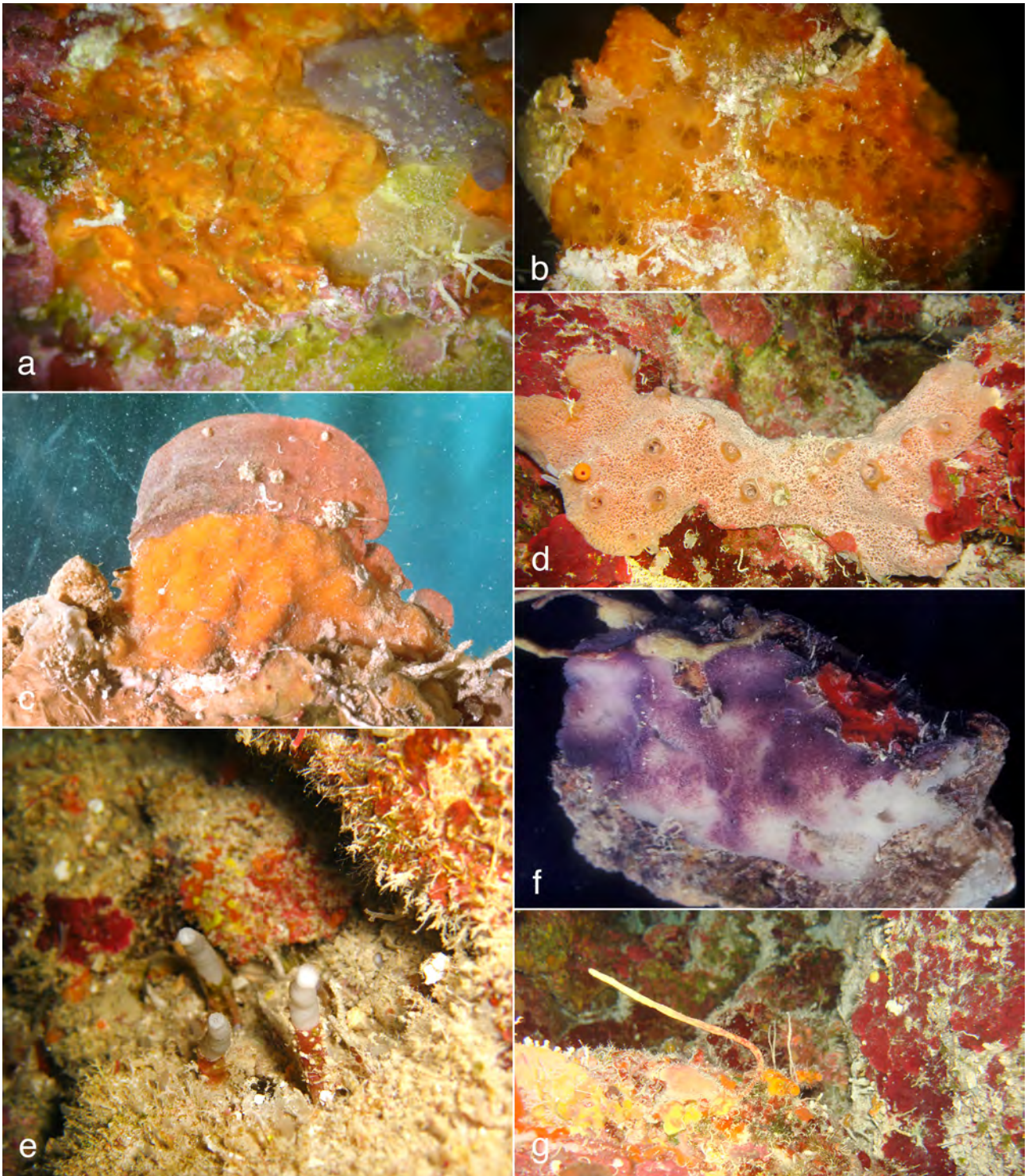
Material was collected by free and scuba diving, mostly using rock hammer and chisel or dive knife. Excavating sponges were only counted as cryptic if their surface papillae or fistules were in the cave environment. Whenever possible, pictures were taken with a digital camera, before and (or) after collection. Fixation for most specimens was in 10% formalin-seawater followed by preservation in 80% ethanol; a few recently collected specimens or duplicates were fixed and preserved in 95% ethanol. Spicules were cleaned in boiling nitric acid followed by water rinse and dehydration in alcohol, then dried on a microscope slide or circular 12 mm cover slip for SEM (scanning electron microscopy). SEM mounts were gold-coated and viewed using either a Leica Stereoscan 440 LaB6 or a Zeiss EVO MA15 LaB6 microscope at 500x, 600x, 800x, 2500x, and 4000x primary magnification. Spicule measurements (20 for each type, unless otherwise noted) were made by light microscopy and from SEM image prints. All measurements are ranges of maximum diameters (of aster-like spicules) or length by width of perpendicular axes (for elongate forms, including spines, if present). Calculated means (in italics) were rounded to the next full micrometer, except in some cases where it was deemed useful to state fractions of a  $\mu\text{m}$ , such as for very small dimensions ( $<1 \mu\text{m}$ ).



**FIGURE 2.** The most common cryptic habitats studied in the Carrie Bow Cay vicinity (measurements in parentheses are picture widths): a, lower surface of platy coral rock showing the characteristic red foraminiferan *Homotrema rubrum*, calcareous serpulid polychaete tubes, and two encrusting sponges, *Clathria (Thalysias) venosa* (left) and *Clathria (Thalysias) curacaoensis* (10 cm); b, wall inside a forereef framework cave, showing the massive *Smenospongia cf. echina* (yellow) and *Topsentia bahamensis*, and encrusting *Clathria (Microciona) bulbotoxa* (17 cm); c, ceiling of the drowned karst cave in the barrier reef lagoon near Columbus Cay, about 20 m away from the entrance (“blue hole”), showing cemented (mostly dead) serpulid tubes, a branching form of *Geodia gibberosa* (center) and a few knobby specimens of *Gastrophanella cavernicola* (far left and right; 20 cm); d, broken-up rock from a forereef cave bottom, showing deserted polychaete borings that are colonized by *Cryptosyringa membranophila* specimens (6 cm); e, broken-up coral rock showing chambers of excavating sponge *Cliona cf. mucronata* (7 cm); f, Queen conch (*Strombus gigas*) shell discarded by local fishermen are a common cryptic habitat on the shallow reef (the slot cut by machete near the apex (arrow) to remove the conch assures good ventilation inside the shell); this shell is colonized outside by *Chondrilla caribensis*, which occurs fully light exposed as well as in darkness (20 cm); g, peat cave (undercut) in the Twin Cays mangrove, the wall covered by *Scopalina ruetzleri* (80 cm).



**FIGURE 3.** In-situ photographs of new sponge species reported in this contribution (measurements in parentheses are picture widths): a, *Tetralophophora mesoamericana* (3 cm); b, *Geodia cribrata* (12 cm); c, *Placospongia caribica* on “pseudostalactite” made up by calcareous serpulid tubes (5 cm); d, *Prosuberites carriebowensis* (adjacent to *Monanchora arbuscula* to the lower right) (4 cm); e, *Timea diplasterina* (8 cm); f, *Timea oxyasterina* (4cm); g, *Rhaphidhistia belizensis* (14 cm).



**FIGURE 4.** In-situ photographs of new sponge species reported in this contribution (measurements in parentheses are picture widths): a, *Wigginsia curlewensis* (8 cm); b, *Phorbas aurantiacus* (10 cm); c, *Myrmekioderma laminatum* (12 cm); d, *Niphates arenata* (10 cm); e, *Siphonodictyon occultum* (10 cm); f, *Xestospongia purpurea* (8 cm); g, *Aplysina sciophila* (20 cm).

Synonymies and references in the paper were restricted to the most recent, authoritative papers containing descriptions and, possibly, illustrations that served to identify species or clarify genus assignments. Some species, based on morphological characteristics, have a wider distribution than the tropical Atlantic and may be invasive, but in the absence of genetic evaluation we continue to use the names originally assigned to them.

For our species illustrations (Figures 3–43), we included all new taxa, as well as those that were not previously illustrated, or whose morphological or anatomical features deviated from available documentation. Catalog

numbers are those of the National Museum of Natural History, Smithsonian Institution, Washington, D. C. (formerly United States National Museum), USNM.

## Systematics

For the following taxonomic treatment we adopted the classification established in the *Systema Porifera* (Hooper & van Soest, 2002) and later updates (see van Soest *et al.*, 2013b)

### Class Homoscleromorpha

### Order Homosclerophorida

### Family Plakinidae

### Genus *Corticium* Schmidt, 1862

#### *Corticium quadripartitum* Topsent, 1923

(Figure 5)

Synonymy and references. *Corticium quadripartitum* Topsent, 1923: 14, fig. 3B.

**Material.** USNM 1228889, Carrie Bow Cay back reef near reef crest, underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974.

**External morphology.** A thin cushion covering about 16 cm<sup>2</sup>, 3–5 mm thick. Surface rough, cork-like to the touch, bumpy, with small (1 mm) oscula slightly elevated, pores in small depressed areas in between. Greenish-olive color in life, darker brownish on the oscular bumps.

**Skeleton structure.** Spicules are condensed in a cortex at the surface and along the canals where they contain a large percentage of candelabras. Throughout the interior of the sponge, spicules are distributed in less dense fashion and are dominated by calthrops, mainly lophocalthrops.

**Spicules.** Basic calthrops (equiangular tetraxons with equal rays): 50–70 (57) µm; lophocalthrops (one or more of the rays branch into two, three, or four spines, the latter of which led to the species' name): 21–60 (44) µm; candelabras (lophocalthrops with branching, microspined rays): 26–33 (30) µm; spheres, rare: 4–6 (5, n=5).

**Ecology.** Only one specimen found under coral rock in a high-energy habitat behind the reef crest, 0.3 m.

**Distribution.** Previously known only from St. Vincent, in the Grenadine (Windward) Islands; now presumed to be Caribbean-wide.

**Comments.** The siliceous spheres seen in our SEM micrographs were not part of the original species description but they are easily overlooked by light microscopy.

### Genus *Plakinastrella* Schulze, 1880

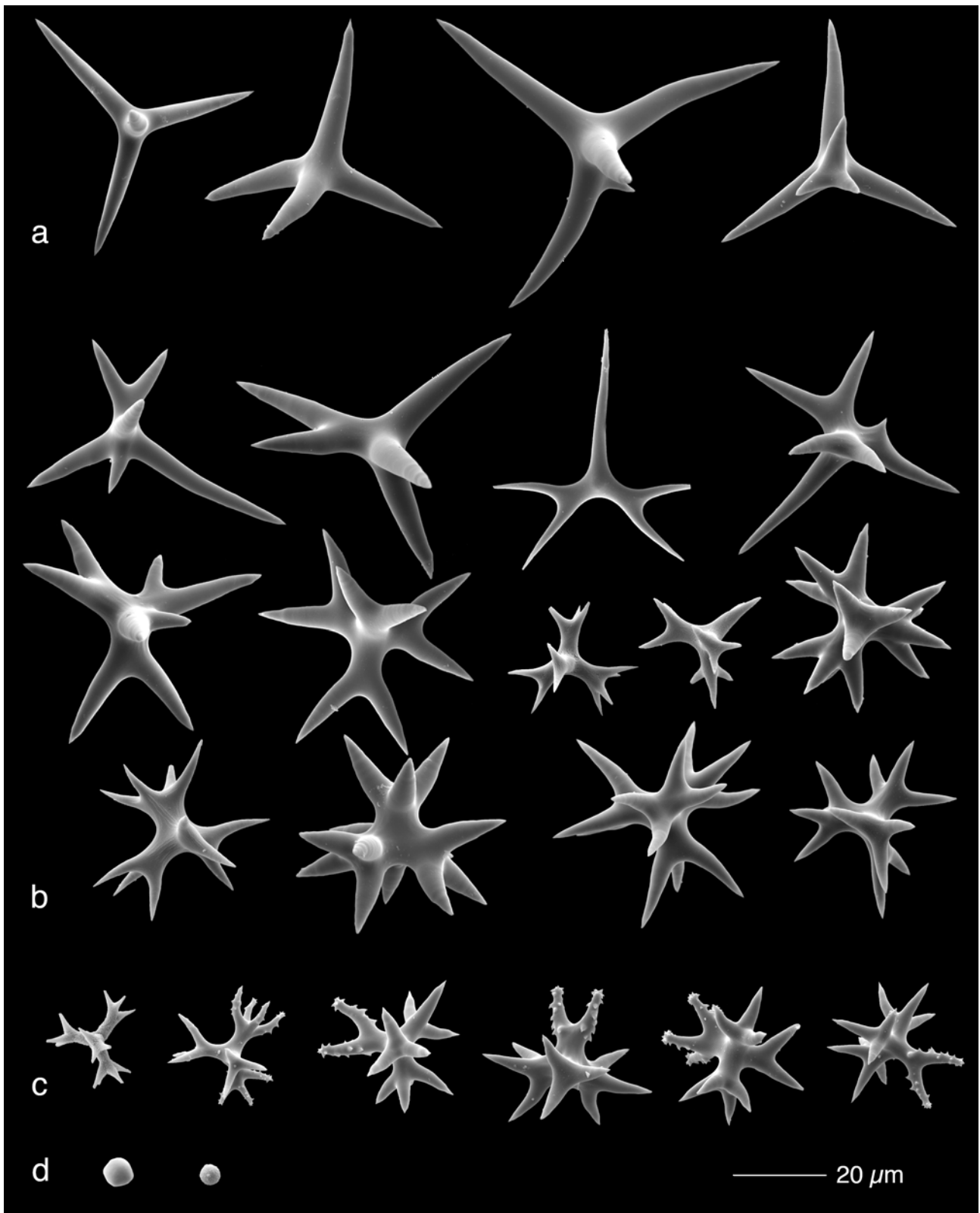
#### *Plakinastrella onkodes* Uliczka, 1929

(Figure 6)

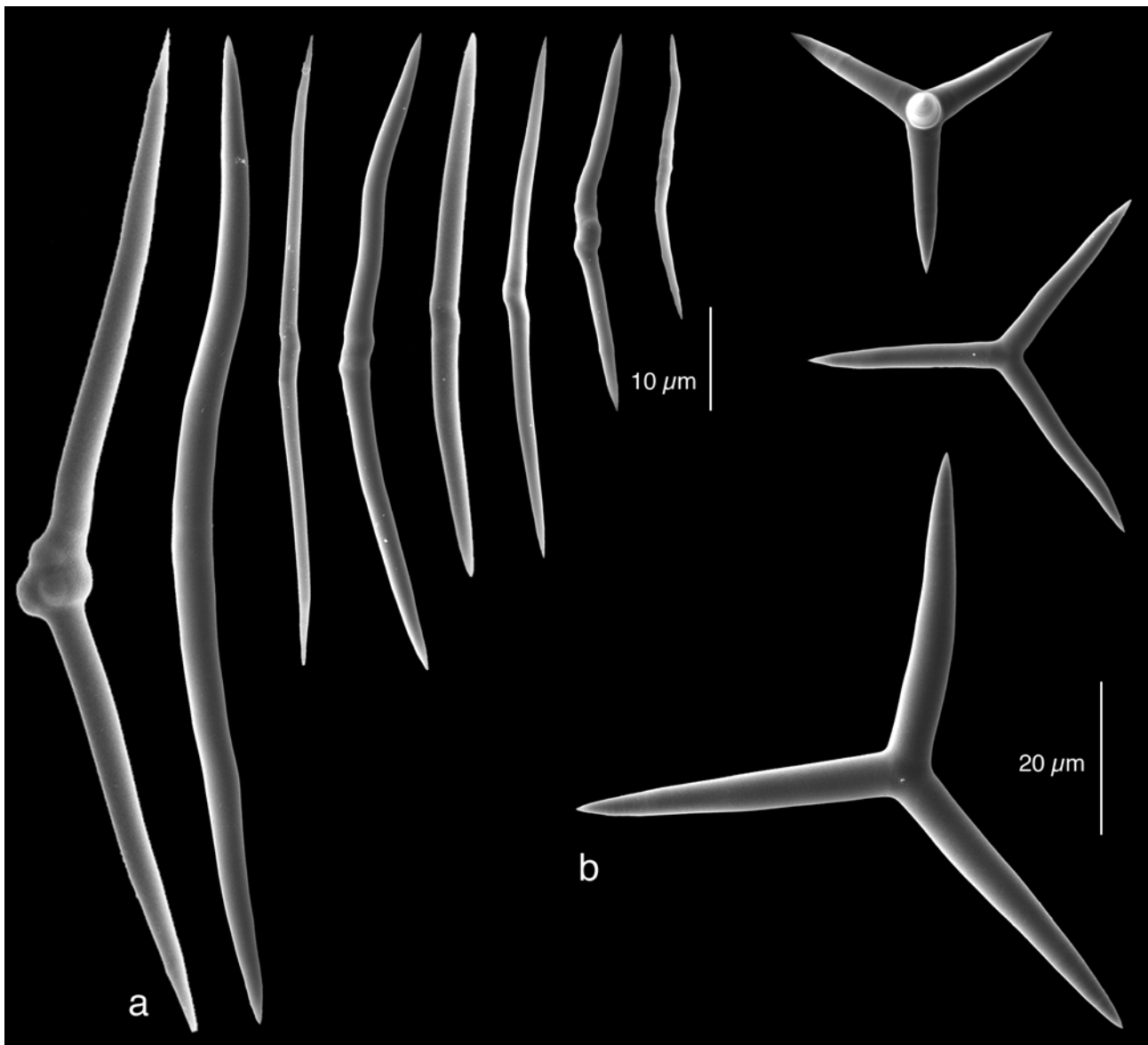
Synonymy and references. *Plakinastrella onkodes* Uliczka, 1929: Zea (1987): 227, fig. 83, pl. 13: 9.

**Material.** USNM 1228890, Carrie Bow Cay, back reef near reef crest, underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1228891, Carrie Bow Cay reef flat, under *Porites porites* and *Acropora cervicornis* coral rubble, 0.5 m; K. Ruetzler col. 29 Jan 1986. USNM 1228892, 1228893 Curlew Bank, forereef cave, 20 m; C. Piantoni col. 29 Jun 2007. USNM 1228894 Curlew Bank, forereef cave, 20 m; C. Piantoni col. 2 Jul 2007. USNM 1228895, Carrie Bow Cay South, back reef, lower surface of rock slab, 1 m; K. Ruetzler

col. 13 Mar 09. USNM 1228896 Curlew Bank, forereef slope framework cave, 20 m; C. Piantoni & M. Parrish, col. 22 Aug 2012. USNM 1228897 Curlew Bank, forereef slope framework cave, 18 m; C. Piantoni & M. Parrish, col. 23 Aug 2012.



**FIGURE 5.** *Corticium quadripartitum*, spicules (SEM): a, calthrops; b, lophocalthrops; c, candelabras; d, spheres.



**FIGURE 6.** *Plakinastrella onkodes*, spicules (SEM): a, diods; b, triods; c, calthrops.

**External morphology.** Encrusting, 4–20 mm thick, with a few oscula (up to 2 mm diameter) irregularly dispersed, some elevated on cone-shaped lobes. Horizontal spread to about 30 cm<sup>2</sup>; parts of the body may be covered by crustose coralline algae. Surface slightly rough to the touch, consistency tough elastic. Color cream, orange, bluish or blackish brown; no dark exudates upon preservation.

**Skeleton structure.** The ectosome shows a dense reticulation of small diactines (diods), some protruding brush-like from the surface. The choanosome is also very dense with spicules, some in mesh-like formation, many without specific orientation.

**Spicules.** Diods occur in a great size range, most with the characteristic (for the group) kinks or swellings at or near the center: 20–175 x <1–8 (92 x 5) μm. They are accompanied by delicate triods and more robust calthrops; triods: 35–75 (57) μm; calthrops: 35–75 (51) μm. Despite similar overall size and lengths of rays, the bases of rays average 4.8 μm in triods, 6.2 μm in calthrops.

**Ecology.** On the lower surfaces of back-reef coral plates and rubble and inside forereef caves, 0.3–20 m.

**Distribution.** Common throughout the Caribbean region.

### ***Plakortis angulospiculatus* (Carter, 1882)**

Synonymy and references. *Plakortis angulospiculatus* (Carter, 1879): Zea (1987): 222, fig. 81, pl. 13: 6, 7.

**Material.** USNM 1228898, Carrie Bow Cay, back reef near reef crest, underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1228899, 1228900 Curlew Bank, forereef cave, 20 m; C. Piantoni col. 28 Jun 2007. USNM 1228901, Carrie Bow Cay forereef cave, 26 m; M. C. Diaz col. 8 Sep 2009.

**External morphology.** Crustose to cushion-shaped (1–12 mm thick), covering up to 120 cm<sup>2</sup> substratum; with a few small (2 mm), elevated oscula. Surface rough, may be completely covered by another sponge; consistency firm but brittle. Color pale orange to grayish brown and medium-dark brown.

**Skeleton structure.** Reticulate spicule tracts in the ectosome, densely packed spicules without orientation in the choanosome.

**Spicules.** Straight, bent, and flexuous diods: 38–300 x 1–10 (165 x 6) µm; triods generally common, many deformed, with one ray smaller than the others or in odd angles (such as Y-shaped): 53–130 (84) µm.

**Ecology.** Under coral plates in the back reef and inside forereef caves, 0.3–26 m. Tends to be overgrown by other sponges, for instance, *Xestospongia deweerdtiae* (see the description there).

**Distribution.** Gulf of Mexico and throughout the Caribbean.

**Comments.** The spicule size range in our specimens is larger than that reported by Zea (1987), close to that given by this author for *Plakortis halichondroides* (Wilson), but the latter species is black in color and without triactines. However, recent molecular analyses (cox 1, 100% similarity) suggest that these two morphotypes of *Plakortis* are conspecific (Ereskovsky *et al.*, 2013). *P. zygompha* (described below) can be distinguished in the field by greenish-brown color and it has considerably smaller spicules. Three new species of *Plakortis* recently described from cave habitats in Jamaica (Ereskovsky *et al.*, 2013; Table 2) differ clearly in color and spicule characteristics and dimensions; none of them occurred in our samples.

### ***Plakortis zygompha* (de Laubenfels, 1934)**

Synonymy and references. *Plakortis zygompha* (de Laubenfels, 1934): Diaz & van Soest (1994): 104.

**Material.** USNM 1228902, 1228903, 1228904, Carrie Bow Cay, back reef near reef crest, underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1228905, Carrie Bow Cay south back reef, lower surface of coral rock, 1m; K. Ruetzler col. 13 Mar 09.

**External morphology.** Small crusts or cushions (to 5 mm thick), covering up to 5 cm<sup>2</sup>. Small (1 mm) oscula, located on the thicker lobes. Smooth surface, firm-elastic consistency. Color cream to olive, brown, and blackish brown.

**Skeleton structure.** Spicules densely packed throughout.

**Spicules.** Diods, small but of considerable size range: 18–138 x 3–8 (85 x 5) µm; triods, common: 38–110 (55) µm.

**Ecology.** Under platy coral rubble in the back reef, 0.3–1 m, reported from below 100 m.

**Distribution.** Gulf of Mexico and Caribbean.

### **Genus *Tetralophophora* new genus**

**Diagnosis.** Plakinidae (Muricy and Díaz, 2002) with leuconoid aquiferous system, diplodal choanocyte chambers, and one size class of calthrops dispersed evenly throughout ectosome and choanosome. The genus name reflects the characterizing type of spicule, tetralophose calthrops.

**Type species:** *Tetralophophora mesoamericana* new species.



### *Tetralophophora mesoamericana* new species

(Figures 3a, 7, 8)

**Material.** Holotype: USNM 1228906, Curlew Bank forereef cave, 18 m; C. Piantoni and M. Parrish, col. 25 Aug 2012.

**Diagnosis.** Encrusting to cushion-shaped, yellow-ochre plakinid with small but numerous aquiferous openings evenly distributed over the surface, and with tetralophose calthrops (51  $\mu\text{m}$  mean diameter) scattered across the ectosome and choanosome.

**External morphology.** The holotype is encrusting another sponge (*Agelas schmidtii*), 1–6 mm thick, and covering about 15 cm<sup>2</sup> of surface area. The surface is smooth but sprinkled by circular oscular and ostial openings, 0.2–0.5  $\mu\text{m}$  in diameter. Consistency is firm but compressible, color yellowish ochre.

**Skeleton structure and histology.** Spicules are densely and about evenly distributed throughout the ectosome and choanosome. Embryos are common and in various stages of development, averaging 250  $\mu\text{m}$  in diameter. Diplodal choanocyte chambers are abundant and measure 25–38  $\mu\text{m}$  in cross sections.

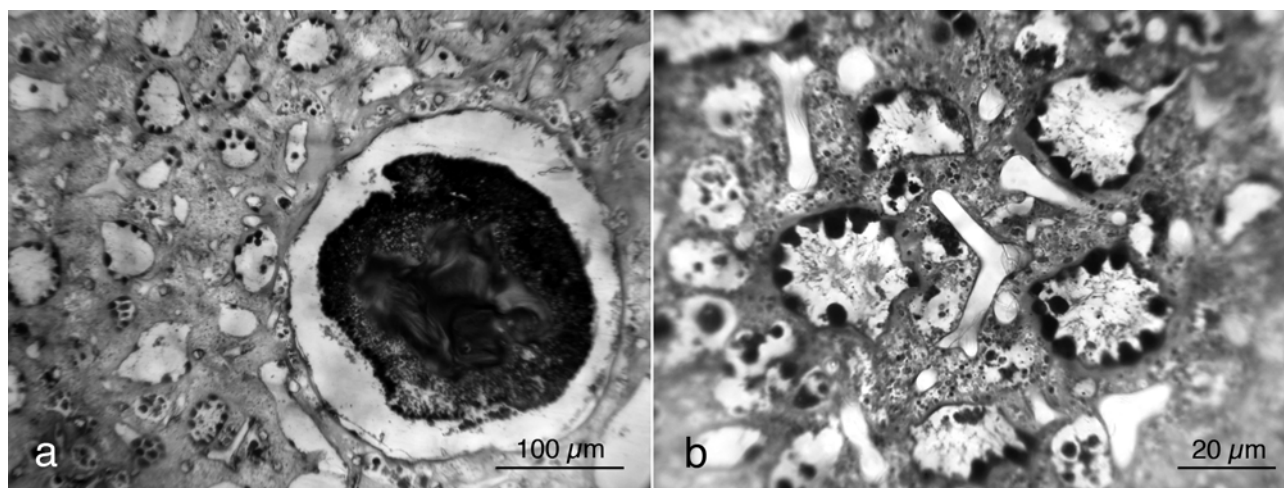
**Spicules.** All are tetralophose calthrops with diameters of 33–61 (51)  $\mu\text{m}$ . Typical rays (including distal spines) measure 18–33 x 4–8 (28 x 6)  $\mu\text{m}$ . Most rays have 2–5 apical spines, which may have points adorned by two or three spines, some have one or two spines halfway along their length, a few are furcated half way, then ending in spined points.

**Ecology.** Discovered in a forereef cave in 18 m; overgrowing coral rock and a specimen of another sponge, *Agelas schmidtii*.

**Distribution.** Belize.

**Etymology.** Named for the location of its discovery, the Mesoamerican Barrier Reef.

**Comments.** We introduce a new genus with hesitation but the latest review of the family (Muricy and Díaz, 2002) does not provide for a suitable allocation among established taxa. According to this review, the genus *Placinolopha* Topsent is closely related to our *Tetralophophora* by sharing the tetralophose calthrops, but it also includes diactinolophose and triactinolophose and, in some species, non-lophose spicules. Presence of diplodal choanocyte chambers and absence of candelabras make it impossible to include our species in the current definitions of *Plakina* or *Corticium*.



**FIGURE 7.** *Tetralophophora mesoamericana*, histology (holotype USNM 1228906; light microscopy): a, embryo (right) and choanocyte chambers; b, choanocyte chambers enlarged among fragments of calthrops.

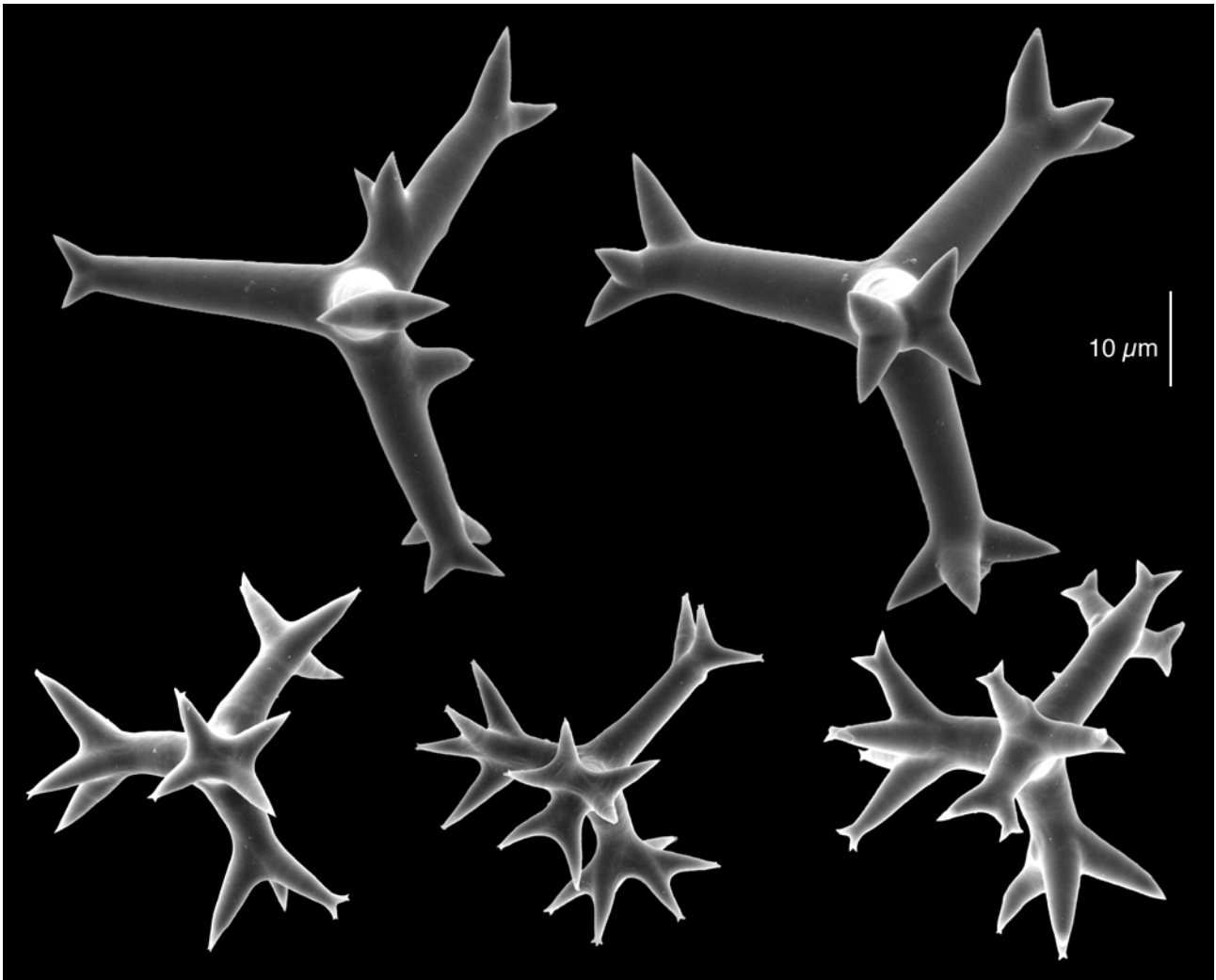


FIGURE 8. *Tetralophophora mesoamericana*, spicules (holotype USNM 1228906; SEM): tetralophose calthrops.

**Class Demospongiae**

**Order Spirophorida**

**Family Tetillidae**

**Genus *Cinachyrella* Wilson, 1925**

***Cinachyrella kuekenthali* (Uliczka, 1929)**

Synonymy and references. *Cinachyrella kuekenthali* (Uliczka, 1929): Rützler & Smith (1992): 154, figs. 4, 5.

**Material.** USNM 1228907, Curlew Bank forereef cave, 20 m; C. Piantoni col. 29 Jun 2007. USNM 1228908, Curlew Bank forereef cave, 20 m; C. Piantoni col. 2 Jul 2007. USNM 1228909, Curlew Bank, forereef slope (wall), 50-150 cm inside framework cave, ceiling, 20 m; C. Piantoni and M. Parrish, col. 22 Aug 2012.

**External morphology.** Bright yellow balls, 24–26 mm in diameter, almost entirely encrusted by thin, leaf-like layers of bright red crustose coralline algae. A few irregularly dispersed porocalices are on top of the specimens, 1.5–3 mm in diameter.

**Skeleton structure.** Spicules are arranged radially; there is no cortex.

**Spicules.** There are oxeas in three size classes, averaging 3,200 x 35 µm, 2200 x 8 µm, and 160 x 3 µm, the smallest one finely spinose; protriaenes and -diaenes in one size class (3800 x 11 µm rhabds, 50 µm clads), less common anatriaenes (3,700 x 6 µm rhabds, 39 µm clads), and relatively (to other species in the genus) large, microspined sigmaspires (17 µm). Because most spicules are broken on the slide, measurements (except for the small, microspined oxeas and the sigmaspires) are estimates from fragments; they are however within the ranges given in Rützler & Smith (1992).

**Ecology.** Typically an open, shallow-reef species, less common in caves, 20 m; also dredged from 100 m.

**Distribution.** From North Carolina to Florida, the Bahamas, Gulf of Mexico, Caribbean, and Northeastern Brazil.

**Comments.** This is a rare record of the species from a semi-dark cave, where it was attached to the ceiling.

## Genus *Tetilla* Schmidt, 1868

### *Tetilla laminaris* George and Wilson, 1919

Synonymy and references. *Tetilla laminaris* George and Wilson, 1919: 142, pl. 58: 14, 59: 17, 66: 54a-h.

**Material.** USNM 1228910, Carrie Bow Cay, back reef near crest, inside and underside of *Acorpora palmata* coral rubble, 0.3 m. K. Ruetzler, col. 23 Apr 1974.

**External morphology.** A crust and thin cushion spreading over about 30 cm are, also penetrating cavities in the substratum; up to 10 mm thick. Smooth surface, scattered oscula of 1 mm diameter or less, firm consistency. Live color grayish brown, which stays about the same in alcohol.

**Skeleton structure.** Radial brushes of megascleres, including many protriaenes, in the ectosome. Spicule tracts in the choanosome, many arching toward the surface; loose megascleres scattered throughout.

**Spicules.** Two kinds of oxeas, one is symmetrically ended, the other has one sharp and one dull point. Oxeas I: 820–2050 x 5–25 (1446 x 16) µm; oxeas II: 900–1800 x 5–23 (1170 x 11) µm. Protriaenes (rhabdomes mostly broken): 1050–2000 x 2–10 (1511 x 6) µm, with clad length 40–130 (91) µm. Anatriaenes (very common): 1300–2018 x 3–6 (1662 x 5) µm, clad length 20–50 (38) µm. Sigmaspires: 10–15 (13) µm.

**Ecology.** Cryptic on coral rubble, elsewhere on rocky bottom, <1m.

**Distribution.** First described from North Carolina, now extended into the Caribbean (Belize).

**Comments.** This species is difficult to identify with confidence because of great variation of spicule types and sizes, many broken during preparation, and accumulation of varied foreign spicules. Study of additional specimens would be desirable. Color, shape (in part), and spicule types, however, agree well with description of the type from North Carolina.

## Family Samidae

### Genus *Samus* Gray, 1867

#### *Samus anonymus* Gray, 1867

(Figure 9)

Synonymy and references. *Samus anonymus* Gray, 1867: van Soest and Hooper (2002): 100, fig.1.

**Material.** USNM 1228911, Columbus Cay cave, 18–25 m; G. Hendler, I. Macintyre, P. Kier, T. Rath & C. Clark col. 21 Mar 1979.

**External morphology.** Excavating and filling crevices in and between vacated serpulid worm tubes (“pseudostalactites”). Color in life yellowish tan.

**Skeleton structure.** Megascleres (triaenes) and microscleres (sigmaspires) dispersed throughout the tissue, without organization. Abundance of foreign spicules accumulated from the sediment.

**Spicules.** The megascleres are essentially variants of short-shafted amphitriaenes, some symmetrical, others

asymmetrical in branching patterns (dichotomous or trichotomous); smaller (possibly developing) spicules are microspined: 44–117 x 35–103 (71 x 65)  $\mu\text{m}$ ; sigmaspires with few but long, hook-like spines: 9–13 (11)  $\mu\text{m}$ .

**Ecology.** Common but inconspicuous in many cryptic habitats, to 25 m or more.

**Distribution.** First described from off Brazil, the species is reported worldwide, primarily from tropical and subtropical locations. Previous reports of this species do not mention microspined amphitriaenes, but the spination may have been overlooked or can be attributed to developmental stages of these spicules.

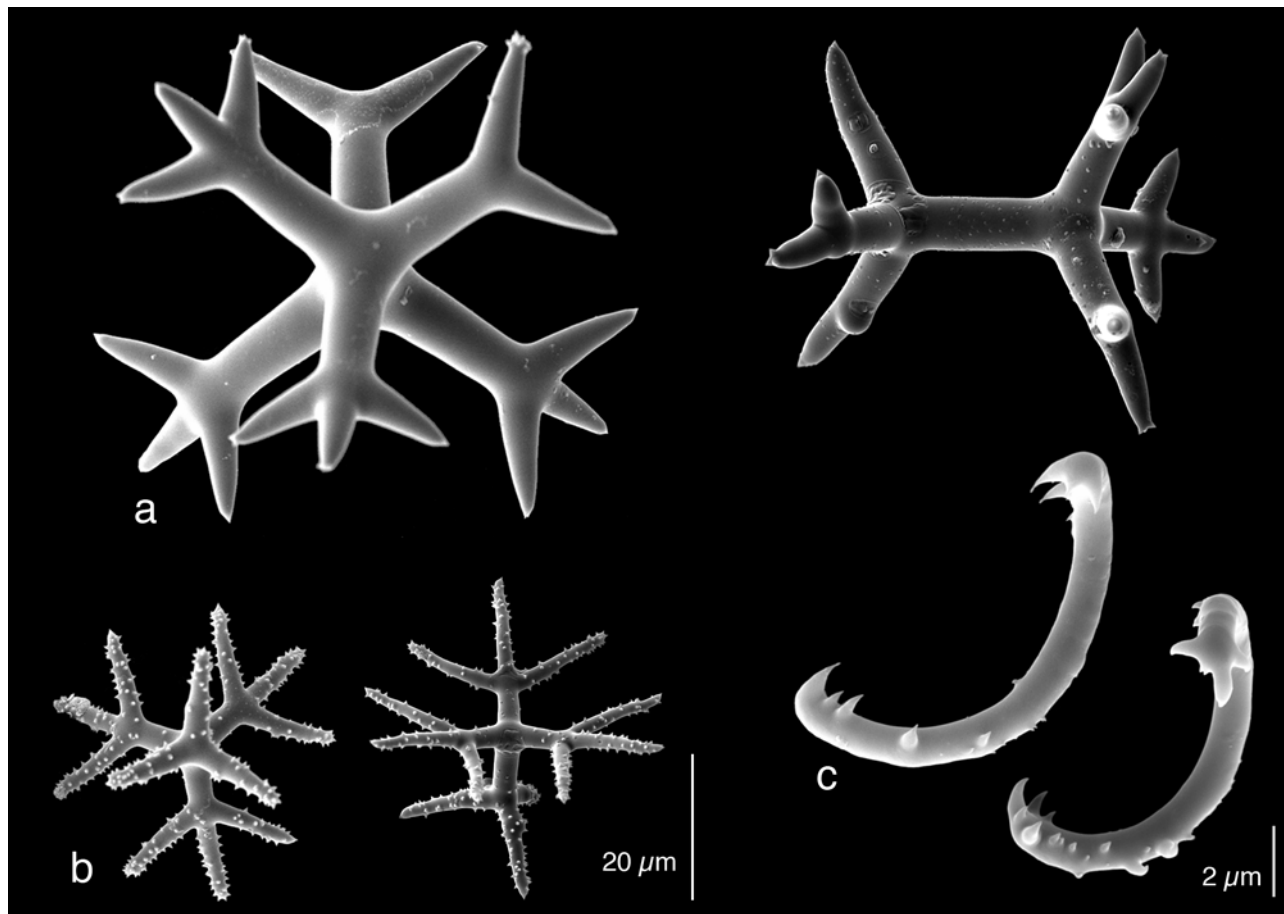


FIGURE 9. *Samus anonymous*, spicules (SEM): a, smooth amphitriaenes; b, microspined amphitriaenes; c, spined sigmaspires.

## Order Astrophorida

### Family Ancorinidae

#### Genus *Stelletta* Schmidt, 1862

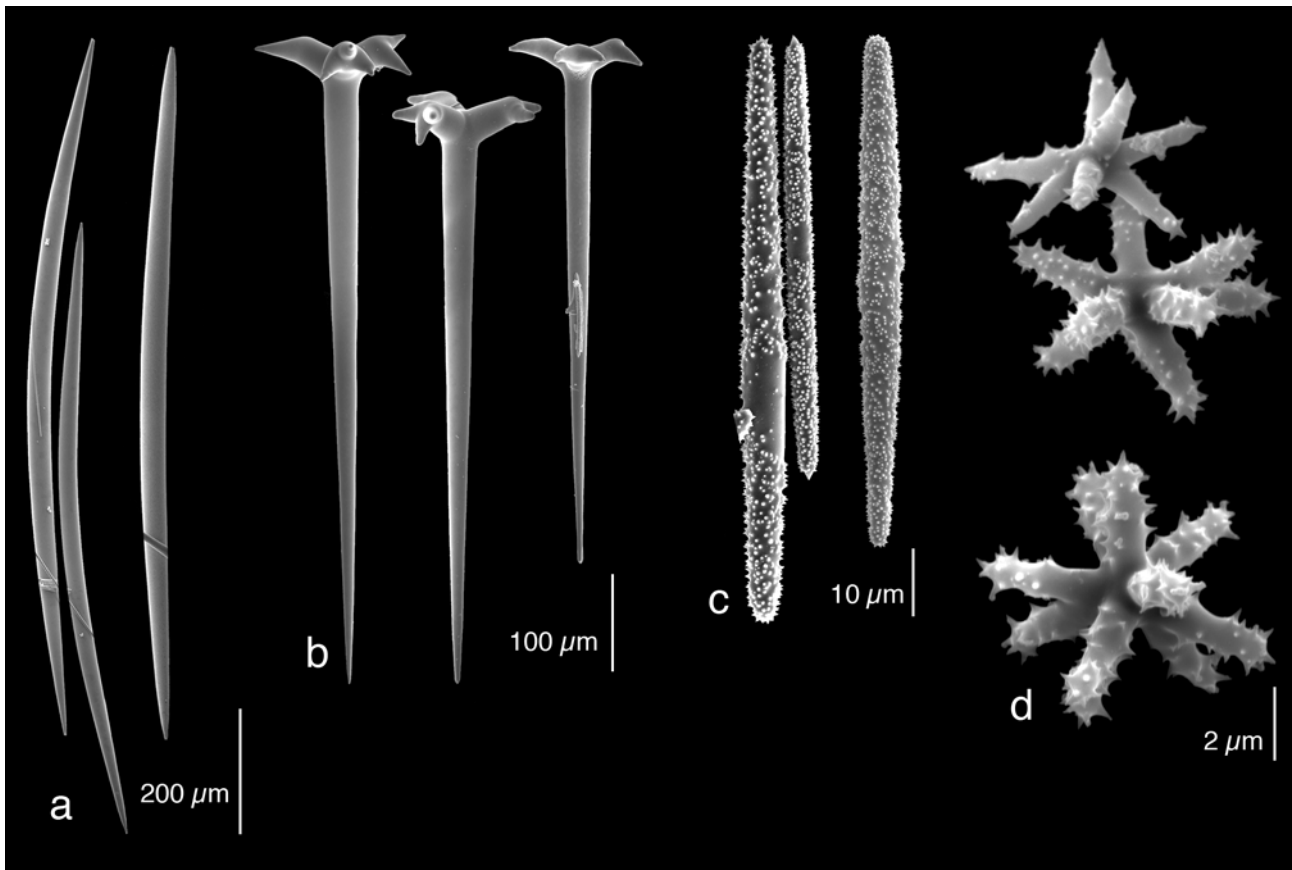
##### *Stelletta solidissima* (Wilson, 1902)

(Figure 10)

Synonymy and references. *Coppatias solidissima* Wilson, 1902: 387. *Stelletta* Schmidt, 1862: Uriz (2002a): 110, fig 1.

**Material.** USNM 1228912, Carrie Bow Cay forereef slope, underside of coral rock, 30 m; K. Ruetzler col. 26 Apr 1974. USNM 1228913, Carrie Bow Cay North channel, under coral rock, 6 m; K. Ruetzler col. 23 May 1979. USNM 1228914, Carrie Bow Cay South reef, *Acropora palmata* coral plates in exposed zone behind reef crest, 1 m; K. Ruetzler col. 6 Mar 2006.

Additional Material Examined: USNM 7659 (holotype) *Coppatias solidissima* Wilson, 1902: Coral bottom, Sail Rock, off St. Thomas (U. S. Virgin Islands), 36–41 m.



**FIGURE 10.** *Stelletta solidissima*, spicules (SEM): a, oxeas; b, triaenes; c, microspined microxeas; microspined strongylasters and oxyasters.

**External morphology.** Thin cushions covering up to 70 cm<sup>2</sup>, up to 6 mm thick. Firm consistency, smooth-looking surface but rough to the touch; oscula (1–3.5 mm), irregularly dispersed, alternating with groups of small pores (ostia). Color light to medium gray.

**Skeleton structure.** Large oxeas in radial position near the surface (including some very rare triaenes), some disorganized, particularly deeper in the choanosome. Asters are concentrated in the ectosome, microxeas dispersed throughout the body.

**Spicules.** Large oxeas, curved and with sharp tips, a few are stronglyloxeote modifications. Smaller oxeas (but not in a different size class) may be double-bent in opposite directions. Oxea sizes: 630–1450 x 8–49 (1104 x 37) µm; rare pro- and orthotriaenes (only found in specimen USNM 1228913): 540–700 x 80–158 µm (overall length x width), 23–79 µm, length of clads (n=6); microxeas, stout, thickest in the center and with rounded points, some approaching strongyles; microspined, except some have smooth center portion (about 15–20% of the length may be smooth): 55–90 x 3–5 (73 x 6) µm; microspined strongylasters, with small center and stout, spiny rays: 8–10 (8) µm; microspined oxyasters, with slender, pointed rays: 4–8 (7) µm.

**Ecology.** Cryptic, on the lower surface of coral rock, 1–30 m; the holotype of this species was dredged from coral bottom, 36–41 m.

**Distribution.** Caribbean (so far only from U. S. Virgin Islands and Belize).

**Comments.** Uriz (2002a) and the World Porifera Database (van Soest *et al.*, 2013b) consider this species to belong to *Stelletta*, based on the original describer’s observation that triaenic spicules were seen among the cortical oxeas. Upon reexamination of Wilson’s type material we could not detect triaenes, nor were any found in the present specimens except in one (USNM 1228913), indicating that this spicule type is rare in the species. Nevertheless, the genus transfer seems appropriate. The original description mentions “smooth” microxeas, but we could determine that they were microspined, just like the ones in our specimens. A similar species, *Melophlus hajdii*, was described by Moraes (2011) from oceanic islands off Brazil; it seems to lack triaenes (hence, assignment to *Melophlus*) and differs by the shorter and thinner oxeas and by microxeas that are evenly microspined over their entire lengths.

It is possible that, owing to the presence of microspined rhabds, this species needs to be transferred to *Ecionemia* or *Stellettinopsis* (see Kelly & Sim-Smith, 2012). However, we prefer to reserve this action for a more comprehensive revision because earlier work, lacking access to SEM, may not have been able to discern the various degrees of microspination in relevant species.

## Genus *Cryptosyringa* Vacelet, 1979

### *Cryptosyringa membranophila* Vacelet, 1979

(Figure 2d)

Synonymy and references. *Cryptosyringa membranophila* Vacelet, 1979: 33, figs. 1, 2; pl. I. Uriz (2002a): 111, figs. 2, 3.

**Material.** USNM 1191345, Forereef cave rock just east of Carrie Bow Cay, 26 m; K. Ruetzler coll. 22 May 1975.

**External morphology.** The tiny pyriform, off-white specimens (4.5 x 3 mm maximum dimensions), are attached to and penetrate leathery membranes at their thicker end. The membranes, which coat burrows in coral rock, are presumed to be remnants of boring polychaetes. The incurrent and exhalant openings are at opposite ends of the longer axis. Longitudinal inhalant-exhalant canals extend from the narrow end, where the ostia are located, to the sieve-like base that serves as the osculum.

**Skeleton structure.** Dichotriaenes are at the periphery, with a tangential cladome and the rhabdome directed inward. Tyloles/strongyles and oxeas are arranged in longitudinal and radial directions. Microscleres are concentrated in the ectosome (tylasters) and near the base (oscular region) of the sponge (oxyasters).

**Spicules.** Dichotriaenes with clads and rhabdome ending in rounded points or asymmetrical knobs. The overall diameter of the cladome is 240–360 (323)  $\mu\text{m}$ , protoclads measure 40–50 (44)  $\mu\text{m}$ , deuteroclads 90–180 (129)  $\mu\text{m}$ , the rhabdome 590–820 (693)  $\mu\text{m}$  in length; thickest diameters are 8–10 (9)  $\mu\text{m}$ . Most diactines are strongyles, thickest in the center, but many have terminal swelling (tylostyles; some quadrilobate), and a few are modified to pointed ends (oxeas): 530–880 x 5–10 (703 x 8)  $\mu\text{m}$ . Among the microscleres there are tiny tylasters, 8–10 (9)  $\mu\text{m}$  and larger oxyasters, 23–36 (30)  $\mu\text{m}$  in diameter; the latter with a center that takes up 20–30% of the total diameter.

**Ecology.** Approximately 10 specimens were retrieved from burrows in dead, platy coral (*Montastraea annularis*) in a small cave in 26 m depth. The sponges are attached to chitinous membranes presumed to have been secreted by eunicid polychaetes that produced the burrows.

**Distribution.** Only known from the type locality (Jamaica) and the present record (Belize).

**Comments.** It is still unknown what causes the attraction of these sponges to the organic bore-hole coatings presumably secreted by polychaetes. Finding this species in Belize under the same conditions and in the same kind of habitat as the type material in Jamaica indicates that there is a still enigmatic ecophysiological process involved.

## Genus *Jaspis* Gray, 1867

### *Jaspis* sp.

Synonymy and references. *Stellettinopsis* sp.: Macintyre *et al.* (1982): 134; *Jaspis* Gray, 1867: Uriz (2002a): 114, fig. 7.

**Material.** USNM 32861 Columbus Cay cave, ceiling, 10–15 m from entrance, 18–21 m depth; I. Macintyre col. 26 Apr 1979.

**External morphology.** Thinly coating and permeating dead serpulid polychaete worm tubes that are cemented together as “pseudostalactites” (Macintyre *et al.*, 1982). Color whitish, both live and preserved.

**Skeleton structure.** Larger oxeas in disorganized arrangement in the choanosome, smaller oxeas more or less tangential in the ectosome, microscleres (oxyasters) throughout the tissue.

**Spicules.** Oxeas I, slightly bent, some double-bent, with sharp points: 450–780 x 10–14 (643 x 12)  $\mu\text{m}$ ; oxeas II, gently bent, many are kinked twice, in same or opposite directions, sharp points: 55–120 x 2–4 (86 x 3)  $\mu\text{m}$ ; oxyasters, with very small center and microspined, pointed rays: 10–18 (13)  $\mu\text{m}$ .

**Ecology.** Encrusting and permeating one sample of serpulid tubes (“pseudostalactites”) protruding from the roof of a submersed karst cave, 12 m distant from the sink-hole entrance; 21 m water depth.

**Distribution.** Belize.

**Comments.** This is probably an undescribed species but the small amount of material of a single specimen makes it impossible to confirm this. Similar species from the region are *Jaspis salvadori* Boury-Esnault, 1973 from Brazil and *Stelletinopsis* (sic) (= *Jaspis*) *velezi* Wintermann-Kilian and Kilian, 1984 from Colombia. However, *J. salvadori* is black, has blunt microxeas, and very small oxyasters (<7 µm); *J. velezi* is yellow and the oxyasters occur in two size groups, the larger one ranging 36–46 µm.

## Family Geodiidae

### Genus *Erylus* Gray, 1867

#### *Erylus formosus* Sollas, 1886

Synonymy and references. *Erylus formosus* Sollas, 1886: Wiedenmayer (1977): 181, fig. 174, pl. 39: 4, 40: 1, 2, 4, 5; Cardenas *et al.* (2009): 25, fig. 13.

**Material.** USNM 1228916, Carrie Bow Cay, forereef slope, coral rock underside, 30 m; K. Ruetzler col. 26 Apr 1974.

**External morphology.** A 10–15 mm thick crust covering about 60 cm<sup>2</sup> of the rock. Surface smooth, except for a few serpulid worm tubes and small bryozoans crusts, but bumpy, with scattered, elevated oscula (2–3mm) and numerous single pores (<0.2 mm). Live color was light bluish gray.

**Skeleton structure.** There is a cortex of aspidasters and microrhabds, followed underneath by radially arranged triaenes and bundles of oxeas. In the choanosome below, there are more oxeas, more or less tangential or without orientation, along with microspined tylasters and more microrhabds

**Spicules.** The megascleres are oxeas, slightly bent and with sharp points, a few modified to styloids: 900–1100 x 20–30 (992 x 28) µm; and plagiotriaenes, many grading into orthotriaenes: 330–600 x 15–35 (496 x 20) µm for rhabds, 180–270 x 10–16 (227 x 12) µm for clads. Microscleres include aspidasters, rod- to oval-shaped: 190–220 x 40–100 (206 x 78) µm; microrhabds, which are centrotylote and vary from oxeate to strongyloxeate, 55–100 x 4–7 (71 x 5) µm; and microspined tylaster, a few grading to oxyasters: 15–38 (30) µm.

**Ecology.** A common shallow-reef species in 3–6 m, also found in cryptic habitats to 30 m.

**Distribution.** Caribbean and Brazil.

**Comments.** The color of this species when found in full light exposure is purplish gray to brown or nearly black.

### Genus *Geodia* Lamarck, 1815

#### *Geodia cribrata* new species

(Figures 3b, 11)

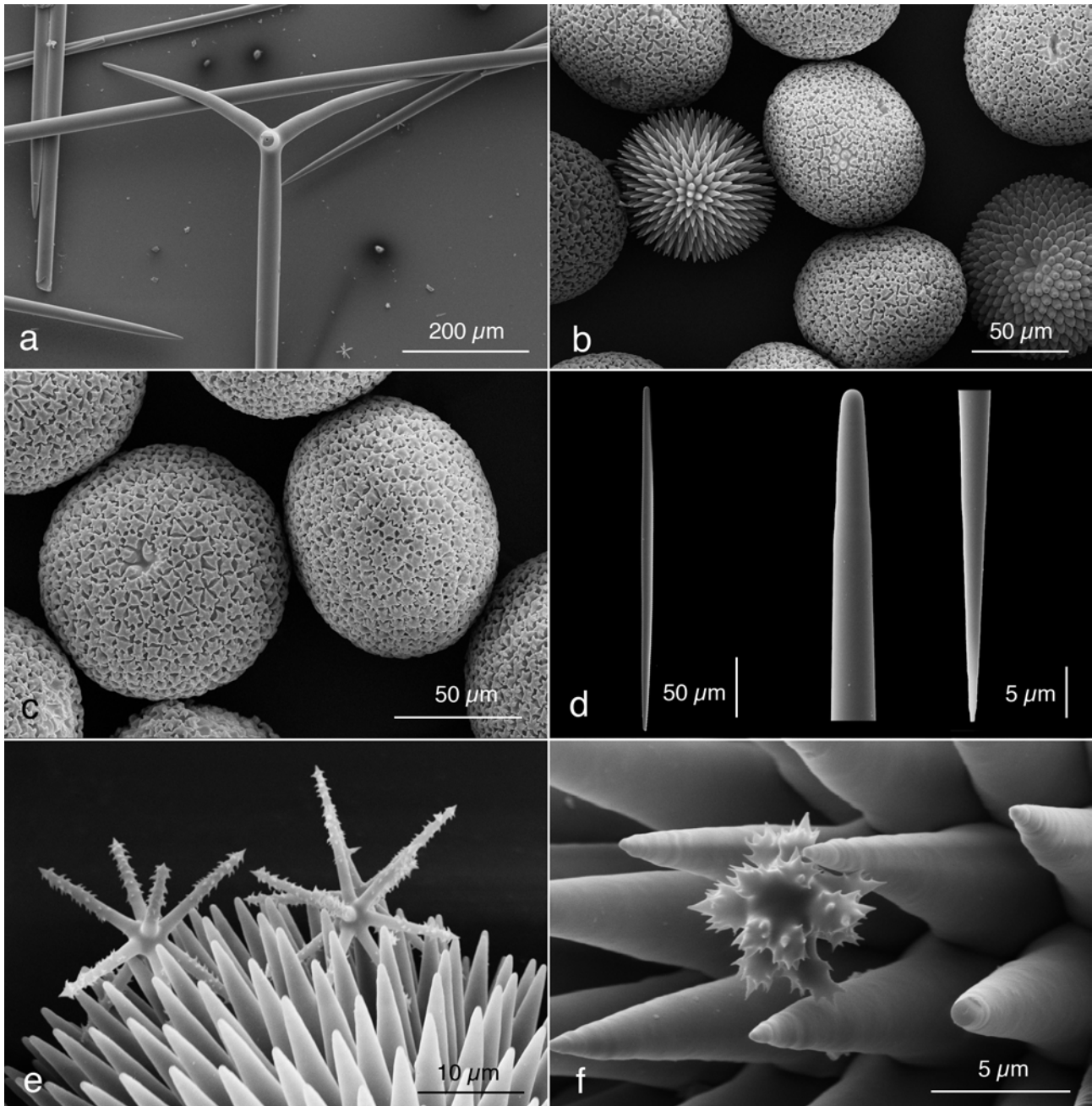
**Material.** Holotype: USNM 1228917, Curlew Bank South, framework cave, 29 m; K. Koltjes and J. Tschirky col. 31 Jul 2001. In addition, we have an in situ photograph (courtesy D. Fenner) of a specimen from a nearby cave that was not collected.

**Diagnosis.** Thickly encrusting, pinkish red *Geodia* without typical oscula, with pore sieves as the only morphological features dedicated to water exchange. With thick, non-detachable cortex built up by large (mean diameter: 110 µm) sterrasters. With additional spiculation of large oxeas, small (cortical) strongyloxeas, ortho- and plagiotriaenes, and microspined oxyasters and sphaerostongylasters.

**External morphology.** The holotype is a cushion-like piece measuring 12 x 8 cm, 6 cm thick but a photograph taken earlier of another specimen in the same habitat (not collected) shows a size of nearly double that, covering about 150 cm<sup>2</sup> of cave wall. The corrugate surface is interrupted by smooth, circular or oval depressions, 2.5 x 2.5

cm to 4 x 4 cm, dotted by numerous inhalant or exhalant, 0.2–1 mm diameter openings (pore sieves); some irregular, also smooth and depressed areas are without visible openings. There are two pore sieves on the type specimen, seven on the in-situ-photographed sponge. The elevated ridges and wrinkles, including those surrounding the pore sieves, are rough to the touch and encrusted by some encrusting coralline algae. The color of the ridges is brown to gray-brown, with some red from fouling corallines, or green from associated cyanobacteria. The smooth, depressed areas, including the pore sieves, are free of epizoans and of clear pinkish-red color in life, proper to the sponge.

**Skeleton structure.** A thick cortex (1.5–4 mm) cannot be separated (pulled apart) from the rest of the body. It contains packed sterrasters as the main structural crust and other asteroid microscleres, as well as cortical anisoxeas. Triaenes and derivatives occur in radial orientation below, with cladomes outward against the cortex, as well as large oxeas. The pulp of the choanosome includes oxeas, oriented radially or not at all, and oxyasters.



**FIGURE 11.** *Geodia cribrata*, spicules (holotype USNM 1228917, SEM): a, large oxeas and triaenes (both partial); b, sterrasters, including a developmental stage (left); c, sterrasters, enlarged; d, cortical strongyloxeas; e, microspined oxyasters attached to an immature sterraster; f, microspined strongylaster, also attached to spines of an immature sterraster.



**Spicules.** Large oxeas, slightly curved and acerate, 1400–2010 x 13–28 (1650 x 21)  $\mu\text{m}$ ; orthotriaenes and plagiotriaenes, some reduced to asymmetrical diaenes, but all in the same size class: 1010–5100 x 12–45 (2671 x 26)  $\mu\text{m}$ , clads: 20–420 (202)  $\mu\text{m}$ ; sterrasters, spherical or slightly ovoid: 90–120 (110)  $\mu\text{m}$ ; cortical strongyloxeas: 110–410 x 7–10 (295 x 9)  $\mu\text{m}$ ; microspined oxyasters: 18–29 (22)  $\mu\text{m}$ ; microspined strongylasters: 5–8 (7).

**Ecology.** Both, the type and the photographed specimen were found inside forereef caves, in 25–30 m depth.

**Distribution.** Belize.

**Etymology.** Named for the prominent pore sieves (Latin cribrum, sieve).

**Comments.** Based on spiculation, this species is close to the two other *Geodia* species commonly found on Carrie Bow reefs, *G. gibberosa* (see below) and *G. neptuni* (Sollas), the latter of which we did not find in caves. *G. cribrata* can be distinguished from both by having only pore sieves as aquiferous systems, no oscula, and by the pinkish red color. Furthermore, its sterrasters are considerably larger, 110  $\mu\text{m}$  mean diameter versus 67  $\mu\text{m}$  in *G. gibberosa* and 45  $\mu\text{m}$  in *G. neptuni* (the latter value re-measured from the holotype by Hajdu *et al.*, 1992; in some of our Belize reef material we calculated a mean value of 70  $\mu\text{m}$ ).

### ***Geodia gibberosa* Lamarck, 1815**

(Figure 2c)

Synonymy and references. *Geodia* (*Geodia*) *gibberosa* Lamarck, 1815: Wiedenmayer (1977): 178, fig. 172, pl. 38: 2, 3. *Geodia gibberosa* Lamarck, 1815: Uriz (2002b): 138, fig. 6.

**Material.** USNM 32872 Columbus Cay cave, 18–25 m; G. Hendler, I. Macintyre, P. Kier, T. Rath and C. Clark col. 21 Mar 1979. USNM 1228918, Columbus Cay Cave, 21 m deep, 7 m from sinkhole entrance; I. Macintyre col. 6 Mar 1987. USNM 1228919, 1228920, Curlew Bank, forereef cave, 20 m; C. Piantoni col. 2 Jul 2007.

**External morphology.** Irregularly massive (10 cm diameter), cone shaped (hanging from cave ceiling, point down: 14 cm height, 6 cm diameter at base), or cluster of branches (also hanging from cave ceiling, 2–11 cm length, 1.5–2.5 cm thickness). Surface rugose but smooth, oscula in groups (cribiporal, 2–4 cm), with individual oscula 1–4 mm in diameter. Tiny ostia (<0.5 mm) cribiporal and scattered. Color white, more or less brownish with increasing habitat exposure to light.

**Skeleton structure.** There is a cortex, about 1 mm thick, mainly composed of sterrasters, accompanied in places by small cortical oxeas; tiny strongylasters occur in the outermost layer, just below the pinacoderm. Megascleres (oxeas, triaenes) are arranged in bundles, radially oriented near the periphery, with oxeas often protruding beyond the surface, triaenes with cladomes positioned at the inner cortex; in the inner choanosome, oxeas occur without orientation, along with asteroid microscleres.

**Spicules.** Principal oxeas, straight or curved, sharply pointed at both ends, except for some rare styloid modifications where one end is rounded: 1000–1690 x 10–35 (1324 x 26)  $\mu\text{m}$ ; triaenes (ortho- or plagiotriaenes), length x width: 900–1300 x 18–50 (1104 x 41)  $\mu\text{m}$ , clad length: 70–215 (136)  $\mu\text{m}$ ; cortical oxeas, with one end tapering but rounded (strongyloxeas): 160–300 x 3–5 (238 x 4)  $\mu\text{m}$ ; sterrasters, spherical to slightly depressed (not including developmental (spherasteroid) stages: 58–90 (67)  $\mu\text{m}$ ; oxyasters with microspined rays: 15–30 (20)  $\mu\text{m}$ ; microspined strongylasters: 5–8 (6)  $\mu\text{m}$ .

**Ecology.** A shallow-water species found in reef habitats, oftentimes obscured by epizoans; also in caves, to 25 m. One study reports it from 100 m depth off Barbados (van Soest and Stentoft, 1988).

**Distribution.** Tropical West Africa, Bermuda, South Carolina, Florida, Bahamas, the entire Caribbean region, Guiana, and Brazil.

**Comments.** As already reported by Pulitzer-Finali (1986) from specimens in shallow coastal habitats in Puerto Rico and by Cárdenas *et al.* (2009) who redescribed the type specimen, our material too has cortical oxeas with one rounded end (strongyloxeas), a feature not mentioned by other authors describing Caribbean *G. gibberosa*. We examined this characteristic in other museum specimens, from Bermuda, off Georgia, Florida (Gulf of Mexico), Bahamas, Virgin Islands, and Belize and found that all had more or less modified strongyloxeas. None, however, had distinct cortical styles, as described and illustrated for *G. corticostylifera* Hajdu *et al.* (1992) from Brazil.

**Order Hadromerida**

**Family Alectonidae**

**Genus *Spiroxya* Topsent, 1896**

***Spiroxya spiralis* (Johnson, 1899)**

(Figure 12)

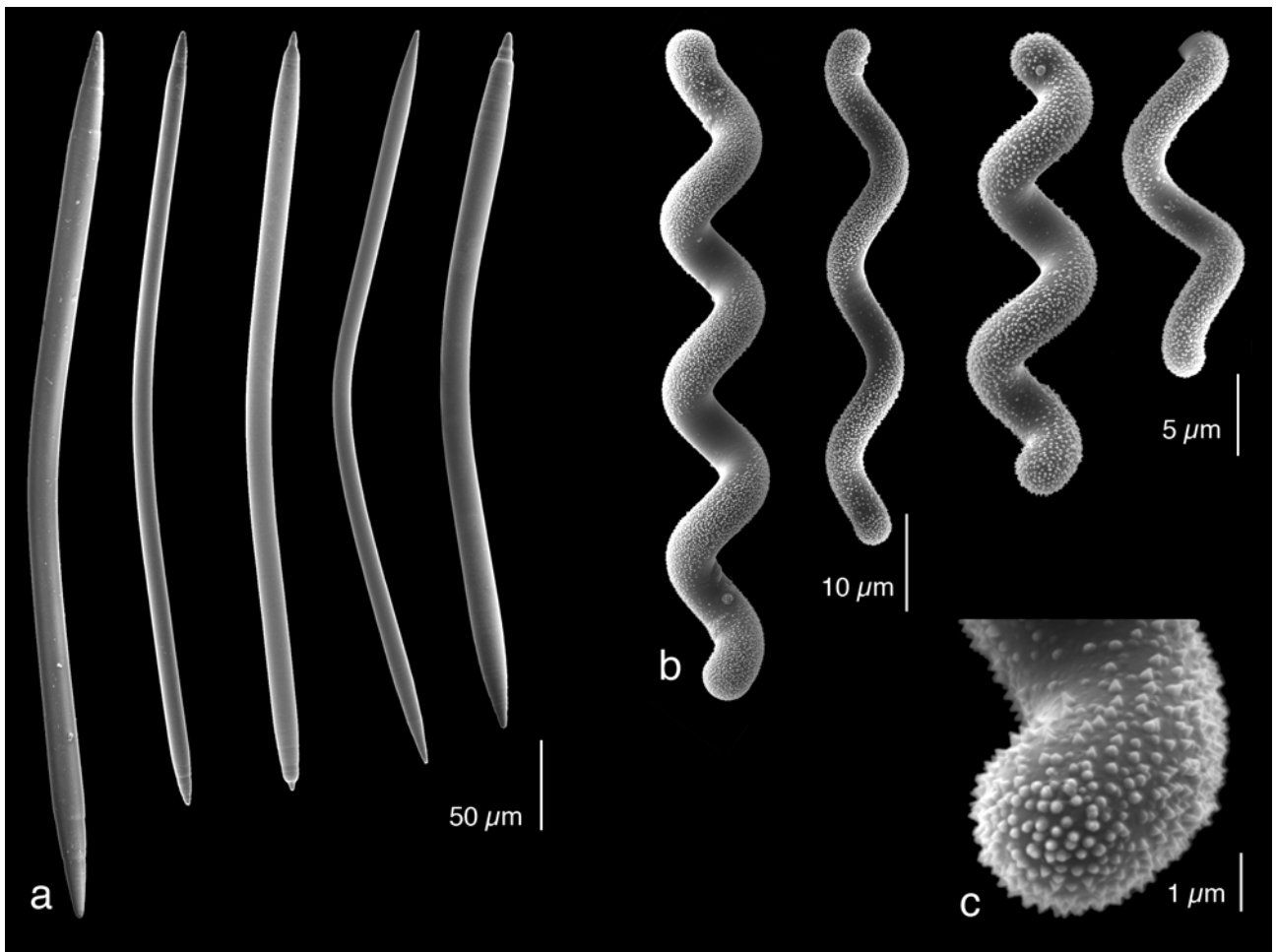
Synonymy and References. *Scantilla spiralis* Johnson, 1899: 462, pl. 6: 5, 5a.

**Material.** USNM 1228921, Carrie Bow Cay East, outer reef ridge cave, in *Agaricia* coral rubble, 12 m; K. Ruetzler col. 12 May 1975.

Examined in the field (not preserved, 12-24B): Curlew Bank, forereef slope (wall), 50-150 cm inside framework cave, ceiling, 20 m; C. Piantoni & M. Parrish, col. 22 Aug 2012.

**External morphology.** No papillar structures were observed on the substratum surface, only ovoid chambers filled with tissue, measuring 1.5–5 mm in diameter but may be confluent, following the porous structure of the substratum. Soft consistency, tan color (live as well as in alcohol).

**Skeleton structure.** Oxeas throughout the choanosome, some in bundles but most without orientation, accompanied by numerous spiral microscleres. Abundant tylostyles are foreign, apparently incorporated from other, neighboring clionoids.



**FIGURE 12.** *Spiroxya spiralis*, spicules (SEM): a, oxeas; b, spirasters, one of the ends enlarged to show details of microspination.

**Spicules.** Oxeas are rather thick and blunt, a few have one rounded (styloid) end, many are bent sharply in the center: 380–520 x 15–28 (471 x 22)  $\mu\text{m}$ ; microscleres are microspined spirasters (spines only detectable by SEM, measuring about 0.2  $\mu\text{m}$  at the base and in height), with spination mainly on the convex sides and at the end of the spirals: 23–80 x 2–7 (47 x 3)  $\mu\text{m}$  (length by thickness of axis), 7–11  $\mu\text{m}$  overall width, and 4–7 turns.

**Ecology.** Found in various calcareous substrata (oyster shells, coral rubble) to about 30 m depth.

**Distribution.** Eastern Atlantic, off West Africa (Madeira, Canary Islands, Azores); now Caribbean (Belize).

**Comments.** We did not examine the type specimen but the oxeas described by the original author (Johnson, 1899) seem to be more slender and acerate than ours and occur in two size classes. More material and study will be needed to confirm conspecificity.

*Spiroxya spiralis* was synonymized with *S. levispira* (Topsent) by Rosell & Uriz (1997) and van Soest & Beglinger (2009), who assumed that Johnson's description was incomplete as it does not mention acanthomicrohabds. However, absence of spiny, amphiaser-like rhabds in our material seems to confirm the original description.

## Family Clionaidae

### Genus *Cliona* Grant, 1826

#### *Cliona amplicavata* Rützler, 1974

Synonymy and references. *Cliona amplicavata* Rützler, 1974: 26, figs. 21–23.

**Material.** USNM 1228922, Carrie Bow Cay, South of boat dock, inside dead conch shell, 1 m; K. Ruetzler col. 26 Apr 1974. USNM 1228923, Carrie Bow Cay, South reef, inside dead conch shell, 1 m; K. Ruetzler col. 4 Aug 2001. USNM 1228924, 1228925 Carrie Bow Cay, back reef and reef flat, inside dead conch shell, 0.5–1 m; K. Ruetzler and C. Piantoni col. 23 Feb 2006.

**External morphology.** Fairly large, circular papillae, 1–4 mm in diameter, unevenly spaced. Large excavation chambers, 6–12 mm, many confluent, thus reaching up to 10 x 30 mm, filled with soft, slightly mucous tissue. Live color of both papillae and choanosome deep yolk yellow.

**Skeleton structure.** Spicules in the ectosome (papillae) tend to be packed radially, with points toward and penetrating the surface, in the choanosome they are without orientation.

**Spicules.** Tylostyles, with raphids as only microscleres. Tylostyles are slightly bent midway their length, have a sharp point and a spherical head that tends to be slightly subterminal, making it drop-shaped. Most heads seem to enclose a small bubble (in transmitted light), a remnant of the axial canal which, in some spicules, is seen extending through most of the length of the shaft; dimensions: 270–350 x 8–12 (310 x 10)  $\mu\text{m}$ . Raphids: 90–160 (107)  $\mu\text{m}$  long, >1  $\mu\text{m}$  thick.

**Ecology.** In this survey only found inside dead conch shells, 0.5–1 m; observed also on the reef, to 30 m.

**Distribution.** Bermuda, Netherlands Antilles (Kobluk and van Soest, 1989), and Belize, probably throughout the entire Caribbean region.

**Comments.** In the field, without a microscope, this sponge is easily confused with *Cliona flavifodina* Rützler because color and papillae size and distribution, and chambers are very similar. The tissue of the latter, however, feels “dry” (not mucous, soft) when touched.

#### *Cliona flavifodina* Rützler, 1974

Synonymy and references. *Cliona flavifodina* Rützler, 1974: 9, figs. 5–7; Hofman & Kielman (1992): 212, fig. 10, pl. 2C.

**Material.** USNM 1228926, Carrie Bow Cay reef flat, under coral rubble, 0.5 m; K. Ruetzler col. 29 Jan 1986. USNM 1228927, Carrie Bow Cay, South reef, lower surface of rock slab, 1 m; K. Ruetzler col. 13 Mar 09.

**External morphology.** Circular papillae, 2–3 mm in diameter, some penetrating coralline algal crusts. Large, irregular, ragged in outline, and confluent chambers, 5–29 mm. Chamber walls coated with non-mucous tissue. Color of the live sponge is ochre in the papillae, bright yellow in the chambers.

**Skeleton structure.** Tylostyles are without orientation throughout the tissue, radiating outward in the papillae. Spirasters occur mainly in the papillae (ectosome).

**Spicules.** Tylostyles are straight to slightly bent, in the upper third; the head is generally ovoid, stretched out in direction of the shaft; overall dimensions: 260–360 x 7–16 (305 x 12)  $\mu\text{m}$ . Spirasters have a thin shaft, generally bent two or three times and beset with long, slender spines: 23–47 x 7–16 (36 x 13)  $\mu\text{m}$ .

**Ecology.** Specimens were collected from the lower surfaces of coral rubble on the shallow reef (<1 m) but also noted in cave habitats on the forereef, to 15 m.

**Distribution.** Bermuda, Colombia, and Belize.

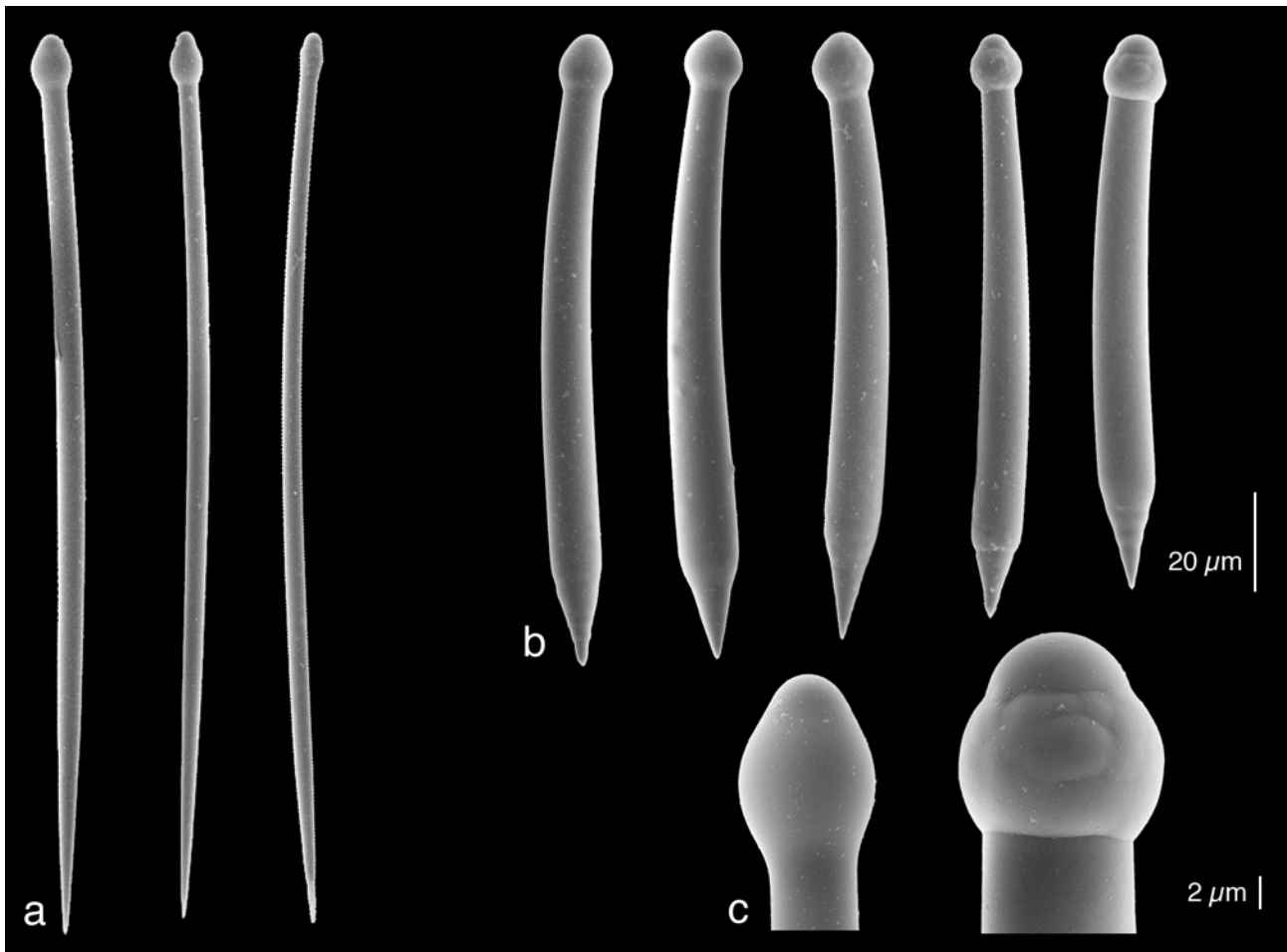
***Cliona cf. mucronata* Sollas, 1878**

(Figures 2e, 13)

Synonymy and references. *Cliona mucronata* Sollas, 1878: Thomas (1972): 347, pl. 1: 8, 8A–D.

**Material.** USNM 1228928, Carrie Bow Cay forereef slope, coral rock underside, 30 m; K. Ruetzler col. 26 Apr 1974. USNM 1228929, 1228930, Carrie Bow Cay forereef, spur and groove zone, *Agaricia* coral base, 8–10 m; K. Ruetzler col. 11 May 1975.

**External morphology.** Small, circular and well-separated papillae (1–3 mm), fairly large, densely spaced chambers (up to 5 mm), rounded or angular in outline. The color in life of the papillae and chambers is grayish to dull yellow or orange yellow.



**FIGURE 13.** *Cliona cf. mucronata*, spicules (SEM): a, tylostyles I; b, tylostyles II; c, enlarged heads of tylostyles I (top) and II (bottom).

**Skeleton structure.** Slim tylostyles are arranged brush-like in the papillae. In the chambers they are without orientation and are accompanied by a second, stout type of mucronate tylostyles.

**Spicules.** Tylostyles I are slender, acerate, with a small spherical but usually subterminal head, sharply pointed at the opposite end: 170–290 x 3–11 (208 x 8)  $\mu\text{m}$ . Tylostyles II are short, stout, and mucronate, with a pear-shaped to spherical head that is generally slightly subterminal, with a shaft widening until it almost reaches the opposite end (where it is the thickest, thicker than the head), then narrowing abruptly to a sharp point (mucron): 110–190 x 9–18 (132 x 12)  $\mu\text{m}$  (the head diameter averages 12  $\mu\text{m}$ ).

**Ecology.** Cryptic in coral rock on the forereef, 8–30 m.

**Distribution.** Previously known only from the Indian Ocean, now also in the Caribbean.

**Comments.** The combination of regular and mucronate spicules is quite unique and seems to justify our identification until more detailed studies of Indian Ocean and tropical Atlantic populations are available. The species' author (Sollas, 1878) described the presence of small spirasters but Thomas (1972) could not find these in his material from India. Presence/absence of spirasters is not unusual in clionoids. Delicate spirasters found by us in our slide preparations are foreign, attributed to a neighboring specimen (excavating stage) of *Sphaciospongia vesparium*.

### *Cliona schmidtii* (Ridley, 1881)

(Figure 14)

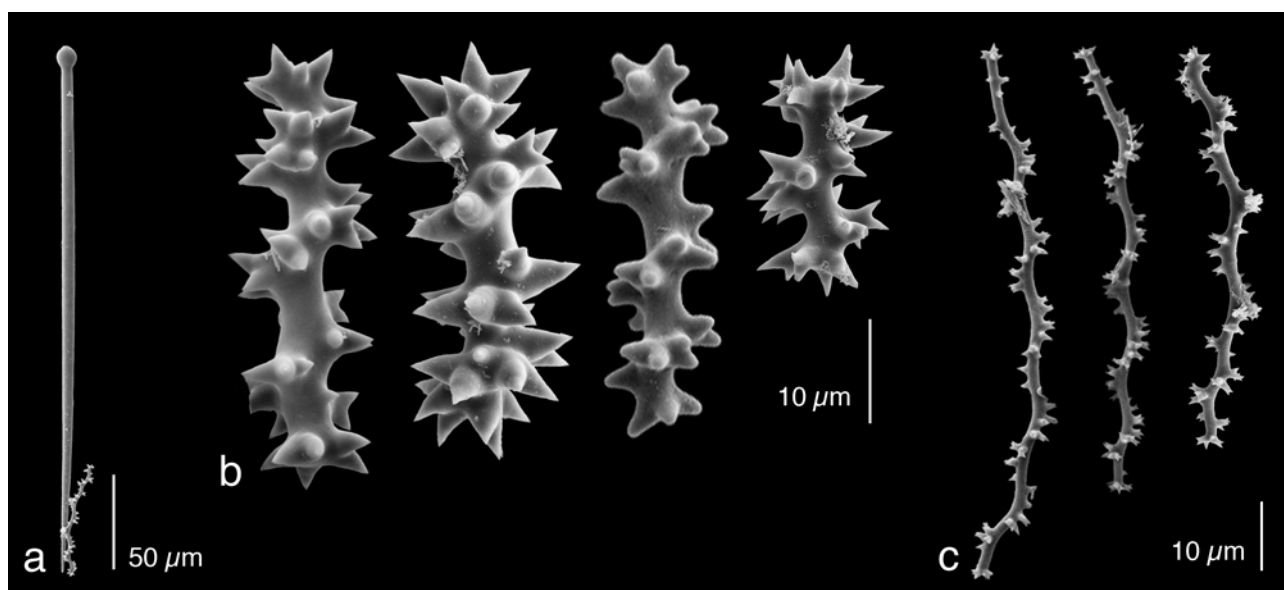
Synonymy and references. *Cliona schmidtii* (Ridley, 1881): Rützler (1973): 631, fig. 5. Cruz (2002): 114, fig. (unnumbered).

**Material.** USNM 1228931, Carrie Bow forereef slope, coral rock underside, 30 m; K. Ruetzler col. 26 Apr 1974. USNM 1228932, Carrie Bow forereef slope, coral rock underside, 26 m; K. Ruetzler col. 14 May 1975.-

**External morphology.** Circular, separated papillae of <1–3 mm diameter, small (1–2 mm), closely spaced chambers. Color purplish red, darker in the papillae than in the freshly exposed chambers; staying unchanged after preservation in alcohol.

**Skeleton structure.** Tylostyles in brushes in the papillae, without orientation in the chambers. Short, stout spirasters and amphisters occur mainly in the papillae, long, thin spirasters in the chambers.

**Spicules.** Tylostyles straight or slightly bent, with spherical head, some heads are subterminal (mucronate): 170–350 x 11–15 (274 x 12)  $\mu\text{m}$ . Short, stout spirasters I, densely covered by thick spines, with 2–4 bends, some modified with straight shaft to amphisters: 25–50 x 10–20 (40 x 14)  $\mu\text{m}$ ; long, slim spirasters II, with delicate, ornate spines mainly on the convex sides of the 5–8 turns: 50–75 x 4–8 (63 x 5)  $\mu\text{m}$ .



**FIGURE 14.** *Cliona schmidtii*, spicules (SEM): a, tylostyle; b, spirasters I; c, spirasters II.

**Ecology.** Known as a sciophilous species, 1–30 m.

**Distribution.** Mediterranean Sea, North and South Atlantic, now extended to the Caribbean region.

**Comments.** Tylostyles in our material are somewhat thicker and longer than in the described Mediterranean and Atlantic specimens but the stable color and microsclere complement are good indicators for this species.

***Cliona varians* (Duchassaing & Michelotti, 1864)**

(Figure 15)

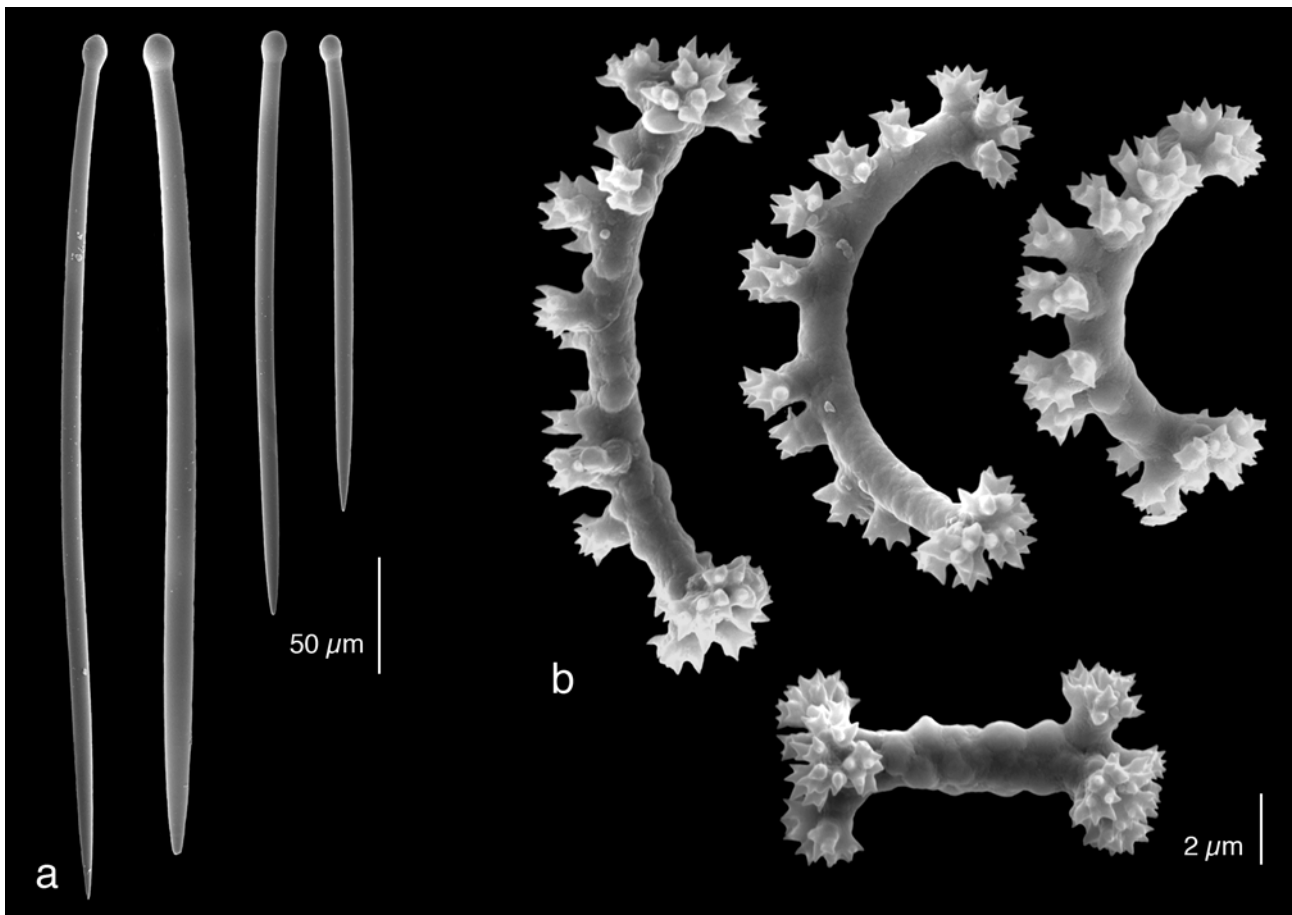
Synonymy and references. *Anthosigmella varians* (Duchassaing & Michelotti, 1864): Wiedenmayer (1977): 165; fig. 165, pl. 35: 1 (forma *incrustans*).

**Material.** USNM 1228933, Curlew Bank, forereef slope cave, 20 m; C. Piantoni col. 29 Jun 2007. USNM 1228934, Curlew Bank, forereef slope cave, 20 m; C. Piantoni col. 2 Jul 2007

**External morphology.** Fleishy crust, 2–5 mm thick, covering 120–500 cm<sup>2</sup> area and excavating and permeating the substratum to a depth of about 8 mm. Due to the porosity of the substratum, excavation chambers are not clearly visible but the few that are range 1–3 mm in diameter. Oscula, 2–4 mm in diameter, are conspicuous, raised on volcano-like elevations and lighter in pigmentation than the rest of the sponge. Color in life is deep greenish brown to light gray, depending on density of symbiotic dinophyceans (zooxanthellae) in the tissue (Rützler, 1990). The surface of many specimens is densely covered by symbiotic *Parazoanthus parasiticus* (Duchassaing & Michelotti) (Zoanthidea).

**Skeleton structure.** In the choanosome, megascleres are densely interwoven, without orientation; in the ectosome they form brushes toward and beyond the surface.

**Spicules.** Tylostyles straight or slightly curved, with distinct spherical or ovoid heads: 190–390 x 10–15 (319 x 13) µm; “anthosigma”-type spirasters: 10–24 (17) µm long; rare amphiasters: 10–13 (12) µm.



**FIGURE 15.** *Cliona varians*, spicules (SEM): a, tylostyles; b, spirasters and one amphiaster.

**Ecology.** Coating rock at the bottom of semi-obscure caves, to 20 m.

**Distribution.** Common off Florida, in the Bahamas, Gulf of Mexico, the Caribbean, and off Brazil.

**Comments.** This sponge is more common and larger in coverage on fully light-exposed, shallow-reef substrata.

***Cliona* sp.**

(Figure 16)

**Material.** USNM 1228935, Carrie Bow forereef ridge at drop-off, under coral plate, 12 m; K. Ruetzler col. 12 May 1975.

**External morphology.** Circular papillae of <1–2 mm diameter, small (1–2 mm), confluent chambers, or tunnels following the coral-substratum porosity. Color is purplish red, just like *Cliona schmidti*, but turns whitish tan in alcohol.

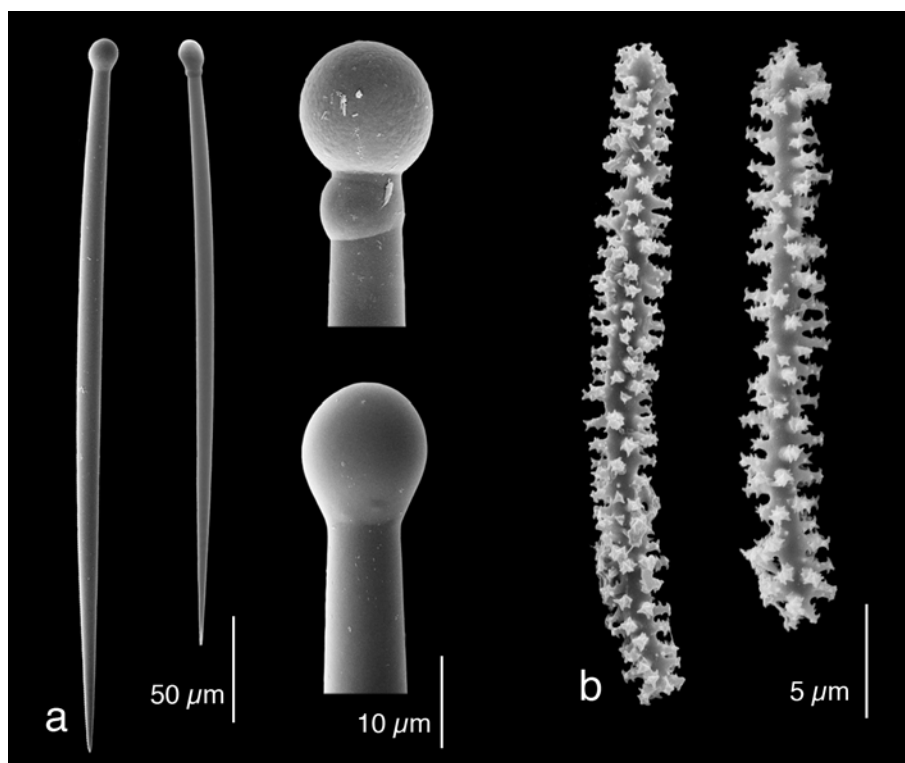
**Skeleton structure.** Tylostyles arranged in brushes, points outward, in the papillae, unorganized in the chambers. No microscleres in the papillae, only one kind, spiny microrhabds, in the chambers.

**Spicules.** Tylostyles, mostly straight, with spherical or slightly elongate head: 270–370 x 8–14 (340 x 14)  $\mu\text{m}$ . Microrhabds, straight or a bit curved, covered by complex, microspined spines: 23–33 x 3–4 (26 x 4)  $\mu\text{m}$ .

**Ecology.** Cryptic on the forereef, 12 m.

**Distribution.** Belize.

**Comments.** Because of the similar color, this sponge was initially (in the field) confused with *Cliona schmidti*. However, the color is not stable when exposed to alcohol and the spiculation is quite unique. Lack of sufficient material does not allow us to establish a new species.



**FIGURE 16.** *Cliona* sp., spicules (SEM): a, tylostyles, head shapes enlarged; b, microspined microrhabds.

**Genus *Pione* Gray, 1867**

***Pione vastifica* (Hancock, 1849)**

Synonymy and references. *Cliona lampa* de Laubenfels, 1950, forma *occulta*: Rützler (1974): 23, fig. 17d, 20d. *Cliona vastifica* Hancock, 1849: Rützler & Stone (1986): 667, fig. 6c, d.

**Material.** USNM 1228936, Carrie Bow Cay back reef, inside dead conch shell, 1 m; K. Ruetzler & C. Piantoni col. 23 Feb 2006. As foreign spicules in *Mycale (Carmia) microsigmatosa*. USNM 1228937, Carrie Bow Cay, south back reef, lower surface of platy coral rubble, 1 m; K. Ruetzler col. 17 Aug 2012.

**External morphology.** A 15 cm<sup>2</sup> area of the internal surface of the conch-shell substratum is punctured by the tiny (0.5–2 mm diameter) incurrent and oscular papillae of the sponge; the excavated chambers too are small (1–2 mm) and penetrated 4–6 mm into the substratum. Color of the live sponge is deep red, lighter in the endolithic chambers.

**Skeleton structure.** Microrhabds are concentrated in the ectosome of the papillae where some tylostyles form brushes. Most tylostyles and microxeas occur in the choanosome, without orientation.

**Spicules.** Tylostyles, mostly straight and with spherical or ovoid head: 160–340 x 4–7 (289 x 5) µm; microxeas, slightly bent, tapering to sharp points; microspined: 50–90 x 3–6 (75 x 4) µm; microrhabds, strongly and heavily microspined: 7–20 x 2–3 (12 x 2) µm.

**Ecology.** Abundant on shallow reef substrata, 1 m.

**Distribution.** Throughout the North Atlantic, including the Caribbean, Mediterranean, and Black seas.

**Comments.** Because of its small papillae, this species is inconspicuous and easily overlooked; even on fully illuminated substrata the papillae are hidden among algal turf. A closely related species (based on spicule morphology), *Pione lampa* (de Laubenfels), first described from Bermuda (as *Cliona*), is encrusting (as well as excavating), bright vermilion in color, and only grows in full sunlight; it has not yet been reported from Belize.

## Genus *Spheciospongia* Marshall, 1892

### *Spheciospongia vesparium* (Lamarck, 1815)

Synonymy and references. de Laubenfels, 1950: Rützler (1974): 29, figs. 24–26; *Spheciospongia vesparium* (Lamarck, 1815): Vicente *et al.* (1991): 215, figs. 2a, 3a.

**Material.** USNM 1228938, 1228939, Carrie Bow Cay back reef, near crest, inside and underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1228940, 1228941, Carrie Bow Cay foreereef slope, coral-rock underside, 30 m; K. Ruetzler col. 26 Apr 1974.

**External morphology.** Only some low, hollow cushions, 10 x 10 mm, with 2–5 mm oscula, were visible at the substratum surface. A narrow tunnel leads into 8–14 mm cavities inside the substratum, some apparently excavated, some taken over from previous occupants. The exposed ectosomal tissue is blackish, the choanosome filling the endolithic cavities is grayish yellow.

**Skeleton structure.** Megascleres (tylostyles) are scattered throughout the tissue, partly bundled in tracts, particularly in the ectosome where they tend to run perpendicularly to the surface. Microscleres (spirasters) are tiny and scattered throughout.

**Spicules.** Tylostyles are straight or bent about one third of their length below the head; tylostyles are spherical, in a few spicules they are reduced to oval swellings: 240–340 x 10–15 (304 x 12) µm. Spirasters are very delicate, with thin shafts making 2–5 turns and clusters of spines prominent at either end and on the convex parts of the turns; some are amphiasters and transitions between the two forms: 10–18 (14) µm in length (the overall width does not exceed 10 µm).

**Ecology.** Massive and early-stage excavating specimens are found on shallow reef and lagoon rock pavements, the latter also cryptic on the foreereef; 0.3–20 m.

**Distribution.** Bermuda, United States Atlantic coast, Bahamas, Gulf of Mexico, and the Caribbean.

## Family Placospongiidae

### Genus *Placosphaera* van Soest, 2009



***Placosphaera antillensis* van Soest, 2009**

(Figure 17)

Synonymy and references. *Placosphaera antillensis* van Soest, 2009: 6, figs. 2A–E, 3A, B.

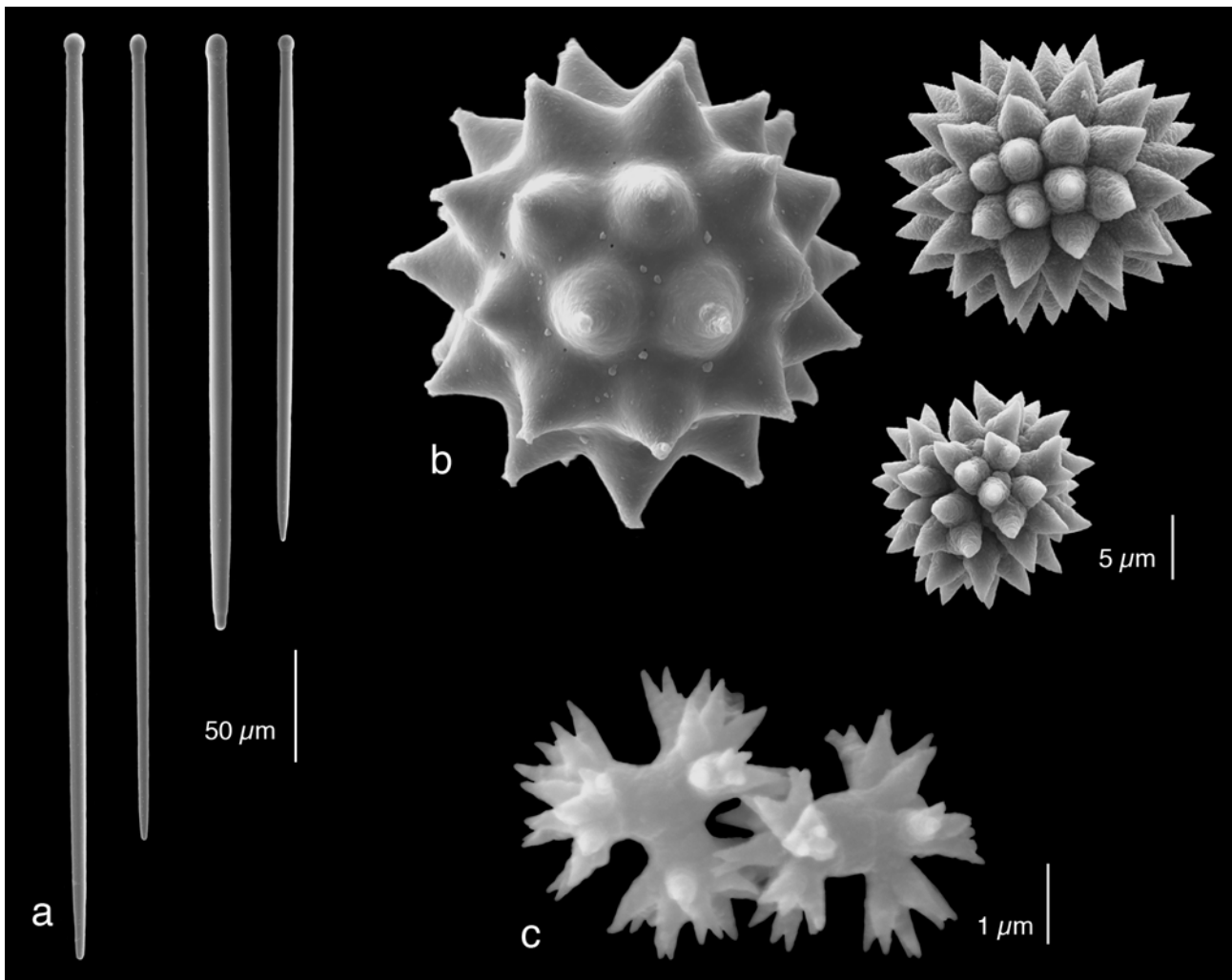
**Material.** USNM 1228942, Curlew Bank forereef cave, 20 m. C. Piantoni col. 29 Jun 2007. USNM 1228943, 1228944, Curlew Bank forereef cave, 20 m; C. Piantoni col. 2 July 2007.

**External morphology.** An encrustation covering about 35 cm<sup>2</sup>, 2–5 mm thick. Cortical plates at the surface are indicated by polygonal ridges that open as pore grooves when the sponge is alive and active. Consistency is hard, the surface rough, color in life is bright orange at the surface, brownish orange inside.

**Skeleton structure.** A cortex is made up by a dense layer of spherasters cemented into polygonal plates. Tracts of tylostyles run from the sponge base toward the cortex, points outward. Various astrose microscleres form a layer below the cortex and are dispersed throughout the tissue.

**Spicules.** Straight tylostyles, most with spherical tyles of about the same width as the center of the shaft, with pointed end rounded; considerable size range without clear separation into classes: 218–720 x 7–18 (299 x 12) μm; spherasters with large center (about 75% of diameter), with broad-based rays that, in young stages, have a crenulated surface, in mature spicules are microspined near their points: 15–50 (32) μm; diplasters, with long, slim rays emerging in clusters from two or three positions on the short shaft: 13–20 (17) μm; micro-amphiasters and –spirasters, possibly developmental stages of the diplasters: 3–5 (4) μm.

**Ecology.** Under reef rubble and in caves, 20–25 m.



**FIGURE 17.** *Placosphaera antillensis*, spicules (SEM): a, tylostyles; b, spherasters; c, spirasters/diplasters.

**Distribution.** First described from the Southeastern Caribbean, this record from Belize indicates a Caribbean-wide **Distribution.**

**Comments.** Some spicule dimensions are larger than those given in the original description (van Soest, 2009) but most morphological details agree well. One curious exception is the microspination surrounding the conical rays of the spherasters (shown in van Soest's fig. 2C, D), which is always at the tip of the rays in our specimen (Figure 17b).

## Genus *Placospongia* Gray, 1867

### *Placospongia caribica* new species

(Figures 3c, 18)

Synonymy. *Placospongia carinata* Bowerbank, 1858: Macintyre *et al.* (1982): 134, fig. 82a.

**Material.** Holotype: USNM 32873 Columbus Cay cave, 23 m; G. Hendler, I. Macintyre, P. Kier, T. Rath and C. Clark col. 21 Mar 1979.

Paratype: USNM 1228945, Columbus Cay cave, 20 m; I. G. Macintyre and G. Hendler col. 26 Apr 1979.

Additional material examined: USNM 22201, *Placospongia intermedia* Sollas, Panama City, Panama (Pacific coast), intertidal rock and coral; de Laubenfels col. 23 July 1933. USNM 22233, *Placospongia intermedia* Sollas, Ft. Randolph, Panama (Atlantic coast), intertidal rock and coral; de Laubenfels col. 28 Jul 1933. USNM 33178, Carrie Bow Cay East lagoon, 1 m; R. Larson col. 19 Apr 1972.

**Diagnosis.** *Placospongia* with two categories tylostyles, small (<60  $\mu\text{m}$  average) selenasters, spherasters, spirasters (some approaching amphiasters), oxyasters, and spiny microrhabds.

**External morphology.** Encrusting clusters of deserted serpulid polychaete tubes ("pseudostalactites"), up to 50  $\text{cm}^2$  area, 1–5 mm thick. Surface composed of polygonal cortical plates, defined by and surrounded by pore grooves (when specimens are alive and active), a characteristic of the family. Fully open pore grooves can be as much as 4 mm wide. Consistency is hard, due to the cortex, color is ochre to deep orange brown.

**Skeleton structure.** Ectosomal cortex plates are made up by selenasters, cemented together and accompanied by a small category of tylostyles and by small amphiasters, spirasters, oxyasters, and spiny microrhabds. The plates are supported along their edges by tracts of large-category tylostyles that rise from the substratum, points outward. Small tylostyles and more microscleres are dispersed throughout the choanosome.

**Spicules.** Tylostyles in two size classes, many with pronounced tyles and rounded points, but also (among the larger class) with subterminal tyles or with styloid and even strongylote modifications; tylostyles I: 480–870  $\times$  10–15 (641  $\times$  14)  $\mu\text{m}$ ; tylostyles II: 182–440  $\times$  8–11 (275  $\times$  9)  $\mu\text{m}$ ; selenasters, ovoid to bean-shaped (disregarding developmental stages showing free spines): 53–70  $\times$  30–58 (59  $\times$  43)  $\mu\text{m}$ ; spherasters with large centers (90% of total diameter): 10–28 (18)  $\mu\text{m}$ ; spirasters, with twisted shaft (1–3 turns), rays of equal length or up to double the diameter of the shaft, some approaching amphiasters by having spines concentrated at the ends of shafts; most are more or less microspined: 13–35  $\times$  6–13 (26  $\times$  11)  $\mu\text{m}$ ; oxyasters, with small center and about six microspined rays: 10–18 (13)  $\mu\text{m}$ ; spiny microrhabds, with straight or slightly bent axis densely beset by short, simple spines or clusters of thick, microspined rays: 5–15  $\times$  1–9 (9  $\times$  6)  $\mu\text{m}$ .

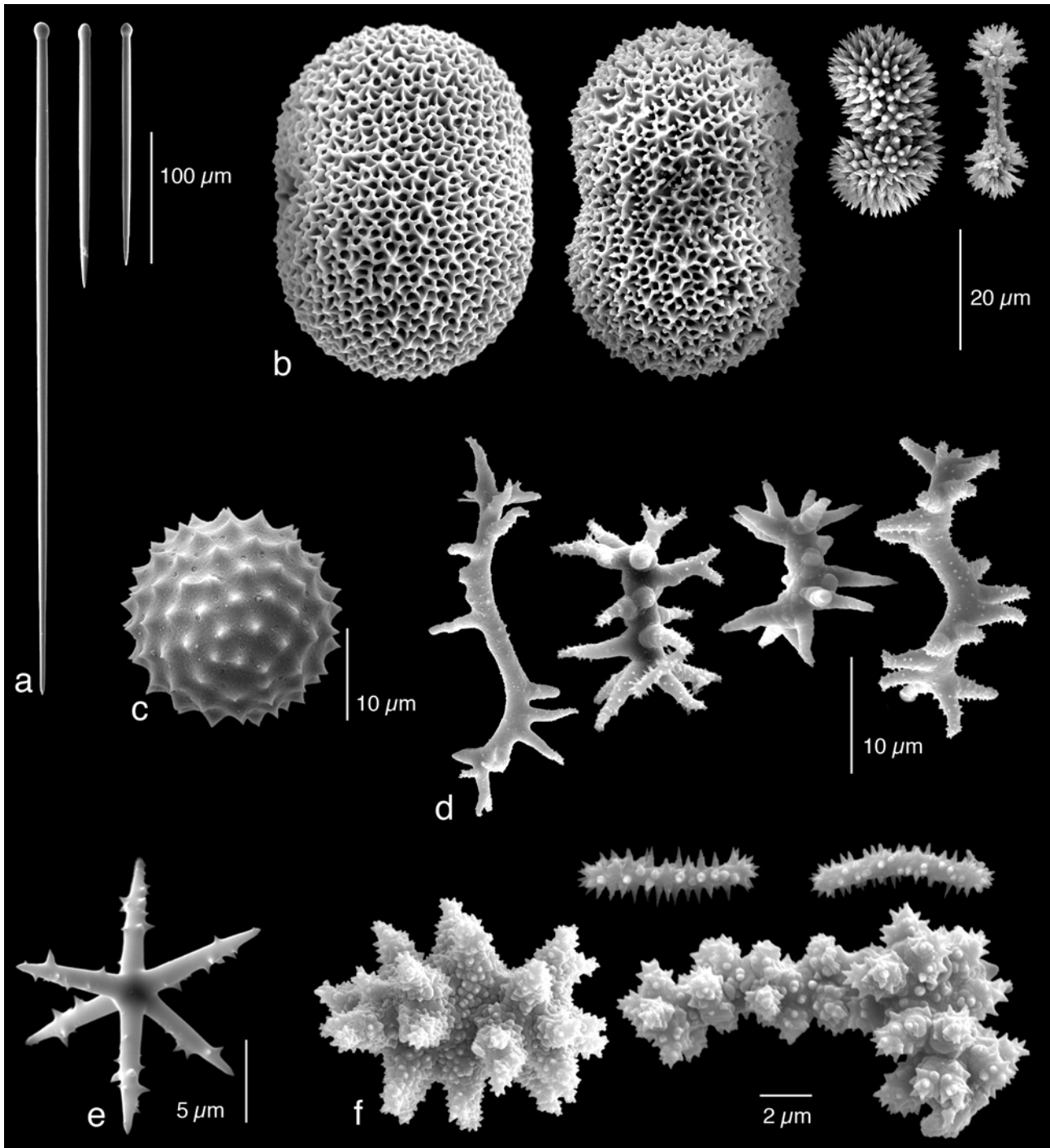
**Ecology.** Inhabits the dark ceiling of a lagoonal karst cave, 10–15 m from the sinkhole entrance, 20–23 m depth.

**Distribution.** Belize.

**Etymology.** Named after the Caribbean Sea, locality of its discovery.

**Comments.** Due to the diligent analyses by van Soest (2009) and Becking (2013) we have excellent information about type material and synonymies of *Placospongia* species. Five species are known that include among their microscleres spherasters with short, broad-based spines, about 20  $\mu\text{m}$  in diameter, termed "golf balls" by van Soest (2009). These spherasters co-occur (in addition to the always present selenasters) with short, stout, spirasters ("anthosigmas") in *P. anthosigma* (Tanita & Hoshino, 1989; as *Geodinella*), with minute (ca. 2  $\mu\text{m}$ ), microspined spherules in *P. melobesioides* Gray, 1867 (the genotype), or with long-rayed streptasters and microacanthose microrhabds in *P. mixta* Thiele, 1900 (SEM images in Becking, 2013); in addition, they occur without other (non-selenastrose) microscleres in *P. cristata* Boury-Esnault, 1973, and with smooth or microspined

microstrongyles (with some transitions to spirasters) in *P. intermedia* Sollas, 1888. All these species containing spherasters are from the Indo-Pacific or (the latter species) the eastern Pacific, except for *P. cristata*, which was first reported from off Recife, Brazil. *P. intermedia*, originally collected at the Pacific coast of Costa Rica (“Punta Arenas, Central America”), was subsequently described from both the Pacific and Atlantic sides of Panama (de Laubenfels, 1936a). These records were since considered doubtful (van Soest, 2009), mainly because de Laubenfels’ measurements of selenasters and spherasters were considerably smaller than those listed by the original describer (Sollas, 1888). However, we re-measured spicules on de Laubenfels’ original slide preparations and found selenaster means of  $66 \times 52 \mu\text{m}$ , spheraster means of  $20 \mu\text{m}$ , agreeing closely with Sollas’  $64 \times 58 \mu\text{m}$  (selenasters) and  $20 \mu\text{m}$  (spherasters); we could also confirm that there are no significant differences between the specimen on the Pacific (USNM 22201) and the one on the Atlantic side of the Panama isthmus (USNM 22233).



**FIGURE 18.** *Placospongia caribica*, spicules (holotype USNM 32873, SEM): a, tylostyles; b, selenasters, including developing forms; c, spherasters; d, spirasters, most are microspined; e, microspined oxyasters; f, microspined microrhabds.

Our material of *Placospongia caribica* has characteristics closest to those of *P. intermedia*, but is distinguished by orange-brown (as opposed to chocolate brown) live color, larger tylostyles, larger and abundant spirasters, and presence of oxyasters. Spirasters (amphiasters) in our species are in a (larger) size category, distinct from the astrose derivatives of the microstrongyles in *P. intermedia*. We also compared it with a non-cryptic specimen of *Placospongia* collected in the barrier-reef lagoon close to Carrie Bow Cay (USNM 33178), which turned out to have spherasters as well but lacked spirasters and related spicule forms and could therefore be assigned to *P. cristata*.

## Family Spirastrellidae

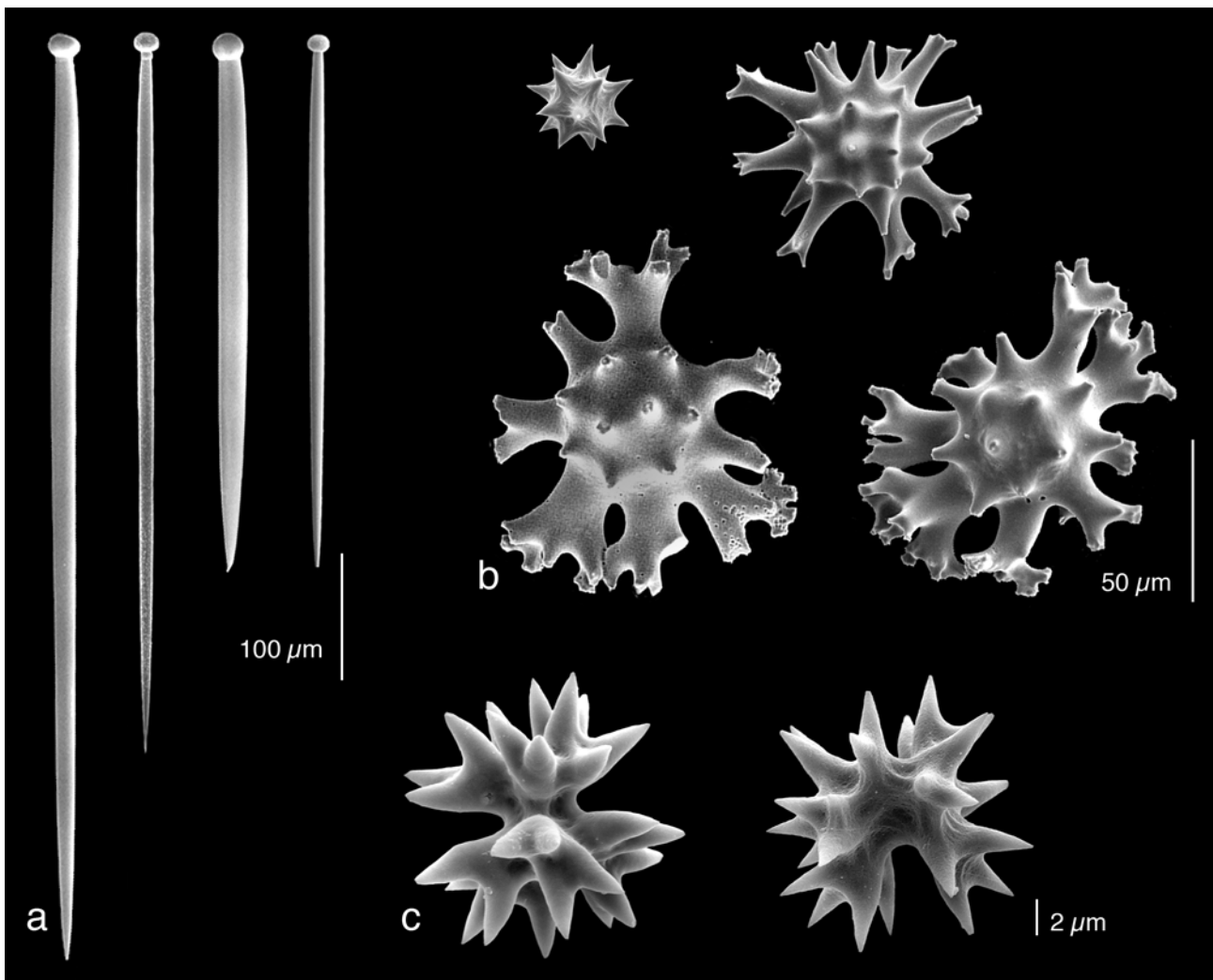
### Genus *Diplastrella* Topsent, 1918

#### *Diplastrella megastellata* Hechtel, 1965

(Figure 19)

Synonymy and references. *Diplastrella megastellata* Hechtel, 1965: 58, fig. 12, pl. 7: 2.

**Material.** USNM 1228946, 1228947, 1228948, Carrie Bow Cay, back reef near crest, inside and underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1228949, 1228950, Carrie Bow Cay south back reef, lower surface of rock slab, 1m; K. Ruetzler col. 13 Mar 2009. USNM 1228946, 1228946, Curlew Bank forereef slope cave, 20 m; C. Piantoni and M. Parrish col. 23 Aug 2012.



**FIGURE 19.** *Diplastrella megastellata*, spicules (SEM): a, tylostyles; b, spherasters with complex rays; c, spirasters/diplasters.

**External morphology.** Thin crusts spreading over 100 cm<sup>2</sup> and more, 1 mm thick. Surface slightly rough to the touch, with exhalant canals meandering vein-like toward small, slightly raised oscula (all contract strongly upon collecting). Color ranges from bright orange to grayish and brownish olive, subsurface canals and oscula are more yellowish.

**Skeleton structure.** Asterose microscleres occur throughout but form dense layers near the surface and at the base of the sponge. Megascleres (tylostyles) are embedded in the choanosome, more or less perpendicular to the substratum, some protruding from the surface.

**Spicules.** Tylostyles are robust and a bit curved, some are thickest near the center of the shaft or one third of the length from the point. Most tyloses are slightly depressed, appearing sub-spherical or ovoid. The spicules have a large size range: 284–1100 x 8–35 (576 x 19) µm; head width is 15–29 (22) µm. Large spherasters, which inspired the species' name, are present in great variety, the smaller ones with simple rays, larger ones increasingly complex, with rays of unequal lengths and branching to various degrees: 26–120 (75) µm; small spirasters and diplasters: 13–60 (20) µm.

**Ecology.** A cryptic, shallow reef species, 0.3–27 m.

**Distribution.** Caribbean.

**Comments.** Spicules in our material are on average larger than those of the holotype but all other characteristics agree well with the original description.

## Genus *Spirastrella* Schmidt, 1868

### *Spirastrella coccinea* (Duchassaing & Michelotti, 1864)

(Figure 20)

Synonymy and references. *Spirastrella coccinea* (Duchassaing & Michelotti, 1864): Wiedenmayer (1977): 163, fig. 162, pl. 33: 4–7.

**Material.** USNM 32863, USNM 32868, Columbus Cay, Belize, karst cave wall, 18–21 m; G. Hendler, I. Macintyre, P. Kier, T. Rath, C. Clark col. 26 Apr 1979. USNM 1228953, Carrie Bow Cay, forereef cave, 18 m; K. Ruetzler col. 19 May 1979. USNM 1228954, Carrie Bow Cay, reef flat, under *Porites porites* and *Acropora cervicornis* coral rubble, 0.5 m; K. Ruetzler col. 29 Jan 1986. USNM 1228955, Curlew Bank, lower surface of *Agaricia* coral plate outside caves, 21 m; C. Piantoni col. 28 Jun 2007. USNM 1228956, Curlew Bank, forereef cave, 20 m; C. Piantoni, col. 29 Jun 2007. USNM 1228957, Carrie Bow Cay forereef, cryptic in crevice, 25 m; M. C. Diaz col. 8 Sep 2009. USNM 1228958, Carrie Bow Cay, lagoon patch reef, inside of dead conch shell, 3 m; C. Piantoni, col. 18 Aug 2012. USNM 1228959, 1228960, Curlew Bank forereef slope, small cave, 20 m; C. Piantoni and M. Parrish col. 23 Aug 2012. USNM 1228961, 1228962, Curlew Bank forereef slope, framework cave, 18 m; C. Piantoni and M. Parrish col. 23 Aug 2012.

**External morphology.** Thin crusts, up to 5 mm, covering areas of 20–50 cm<sup>2</sup>. Smooth surface; small oscules (1–3 mm), slightly elevated. Live color bright vermillion to orange red, in some specimens with whitish mottled areas, particularly around the oscules; brownish orange below the ectosome.

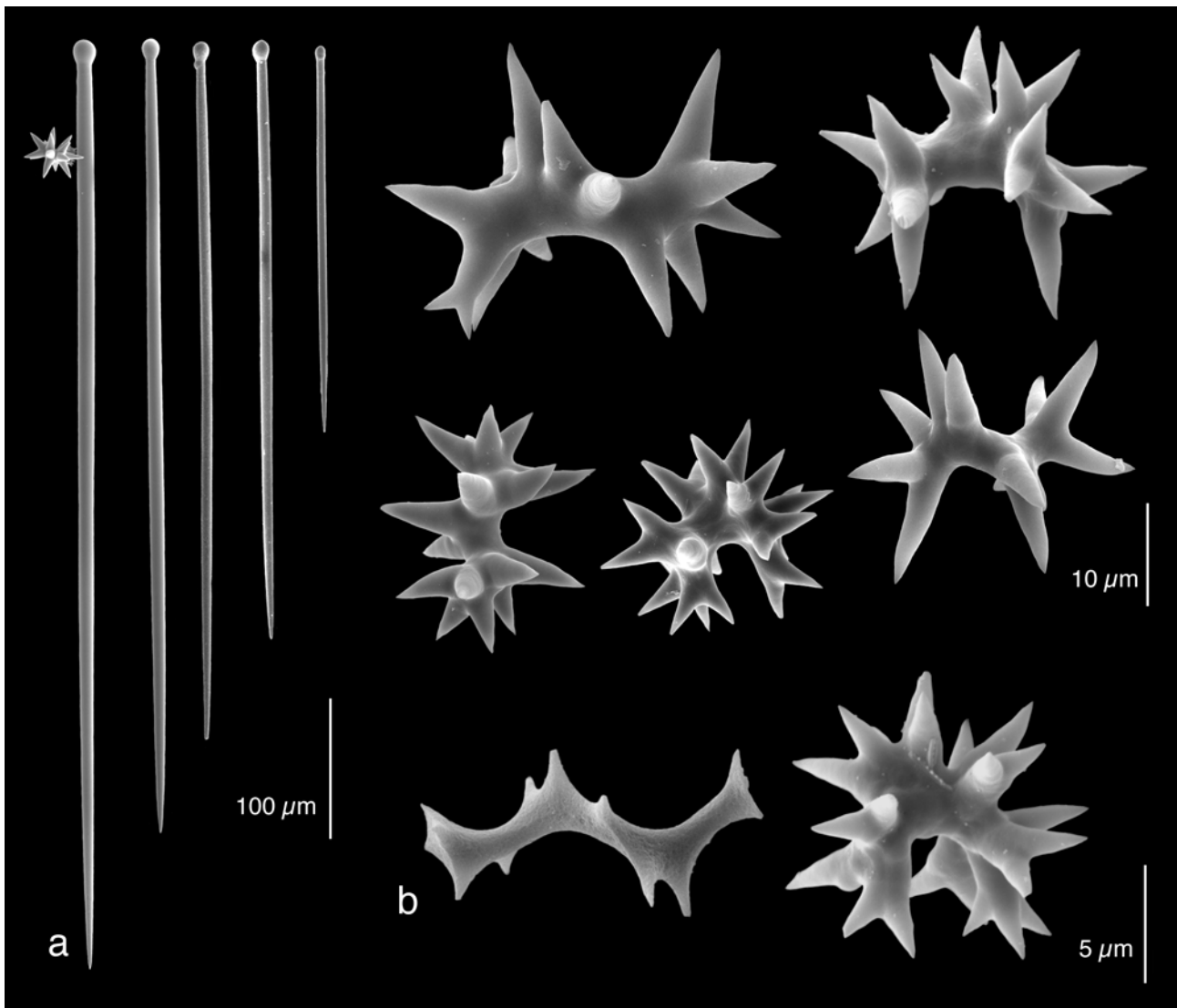
**Skeleton structure.** A layer of spirasters forms a cortex, but the entire cross section of the sponge is almost as dense with these microscleres, obscuring the ascending tracts of tylostyles. This is in contrast with the following species, *S. mollis*, where microscleres are mainly concentrated in the cortex and near the base, loosely strewn in between.

**Spicules.** Straight tylostyles with spherical or slightly elongate heads: 146–680 x 5–18 (426 x 11) µm; spirasters I, axis generally bent twice and with robust spines at either end and on the convex surfaces: 29–61 (46) µm; spirasters II, smaller versions of spirasters I and many with only one bend: 10–38 (23) µm.

**Ecology.** Very common in shaded and dark habitats, lower surfaces of coral rubble and walls and ceilings of caves, 0.5–21 m.

**Distribution.** Tropical western Atlantic.

**Comments.** The brilliant red color of the live sponge, uniform shape of the large and small spirasters (I & II), common occurrence of amphiasters, and simple (not branching) spines distinguish this species from the next, *S. mollis*.



**FIGURE 20.** *Spirastrella coccinea*, spicules (SEM): a, tylostyles; b, spirasters, with transitions to amphiasters.

***Spirastrella mollis* Verrill, 1907**

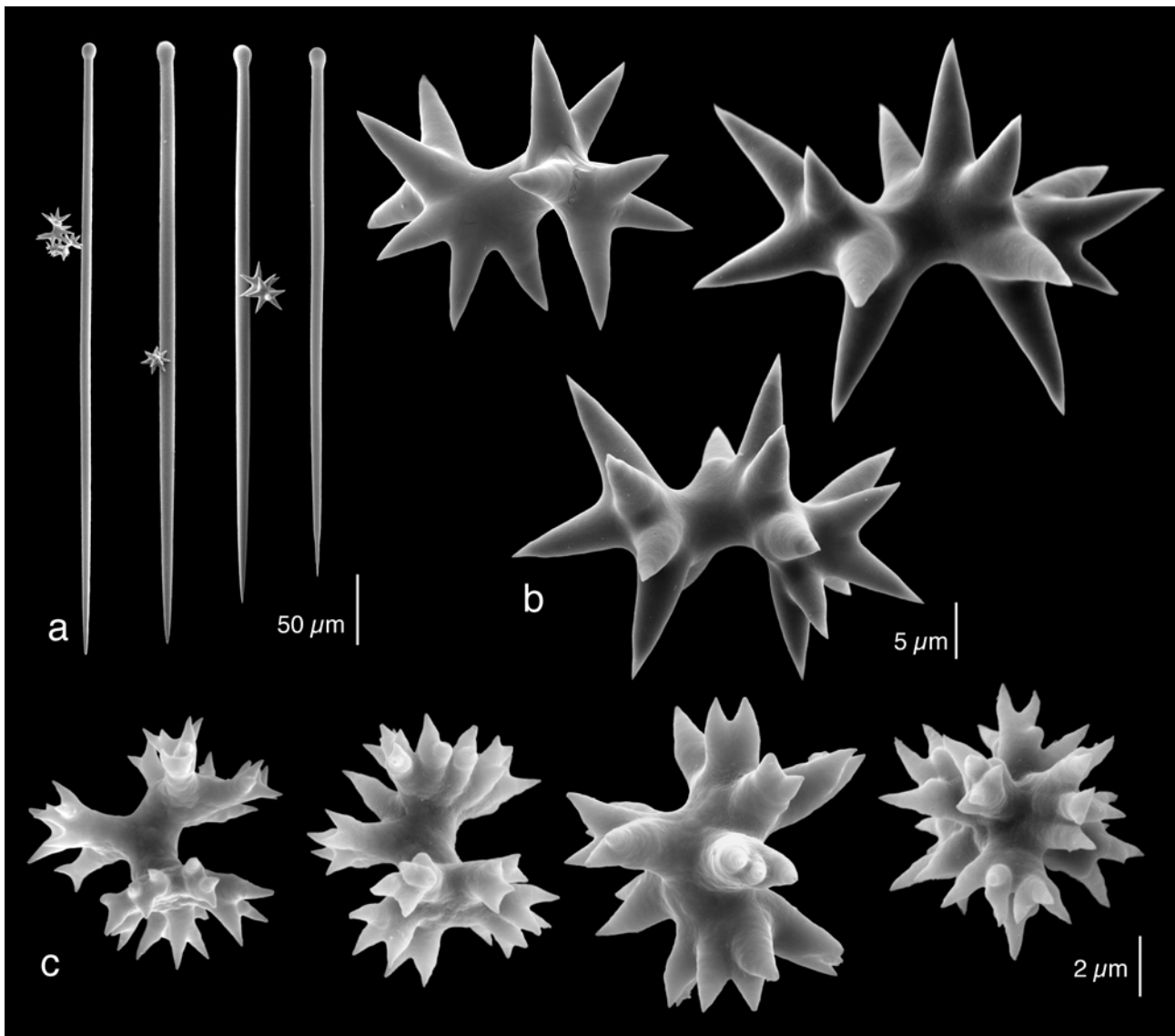
(Figure 21)

Synonymy and references. *Spirastrella cunctatrix* Schmidt, 1868: Wiedenmayer (1977): 162, fig. 161, pl 33: 8; *Spirastrella mollis* Verrill, 1907: Rützler (1986): 122, pl. 33, color pl. 4.14. *Spirastrella hartmani* Boury-Esnault, Klautau, Bézac, Wulff & Solé-Cava, 1999: 48, figs. 2A, 4A, B, E.

**Material.** USNM 1228963, Carrie Bow Cay back reef, near reef rest, underside of *Acropora palmata* coral rubble. 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1228964, Carrie Bow Cay South reef, *Acropora palmata* coral plates in exposed zone behind reef crest, 1 m; K. Ruetzler col. 6 Mar 2006. USNM 1228965, 1228966, Carrie Bow Cay South reef, *Acropora palmata* coral plates in behind reef crest, 1 m; K. Ruetzler col. 13 Mar 09. USNM 1228967, Carrie Bow Cay West, under concrete dock, 0.5 m; K. Ruetzler col. 18 Aug 2012.

Comparative material examined: USNM 30487 *Spirastrella mollis* Verrill, Little Bay cave, Harrington Sound, Bermuda, 5 m; W. Sterrer col. 24 Jan 1980; USNM 31914 *Spirastrella mollis* Verrill, Burchalls Cove cave, Bermuda, 17 m; C. Cardellina col. Jun 1981.

Additional material (examined in the field (09-17), not preserved: Twin Cays, Sponge Haven, undercut on mangrove peat, 1 m; M. C. Diaz col. 8 Sep 2009.



**FIGURE 21.** *Spirastrella mollis*, spicules (SEM): a, tylostyles; b, spirasters I; c, spirasters II/amphiasters.

**External morphology.** Fleishy crusts, up to 10 mm thick, covering 5–40 cm<sup>2</sup> of the substratum. The surface is rough to the touch and, under water when undisturbed, shows vein-like swellings of exhalant canals leading toward the elevated oscula. Oscula, 1–4 mm diameter. Color in life salmon, pinkish red to ochre, to dull reddish brown.

**Skeleton structure.** Tracts of tylostyles lead from the substratum to the sponge surface where they may protrude in brushes. Spirasters are forming a cortex as well as a dense layer at the base; in the choanosome in between they are loosely scattered.

**Spicules.** Tylostyles straight, most with slightly oblong, ovoid heads, some heads subterminal: 235–520 x 4–15 (396 x 11) µm; spirasters I, with an axis bent once or twice, with strong spines at the ends and on the convex side of the bends: 20–50 (39) µm; spirasters II, small structures with generally just one axial bend, with bifid (branched) and multifid spines at either end and on the convex side of the axis, a few amphiasters or transitions toward that state: 5–11 (9) µm.

**Ecology.** Common on the lower surfaces of platy coral rubble, in crevices and caves of the forereef, and on ceilings of mangrove-peat undercuts; 0.3–25 m.

**Distribution.** Bermuda, Bahamas, and Caribbean.

**Comments.** From its outside color and morphology, and its ecology, this sponge resembles (and was oftentimes confused with) *Spirastrella cunctatrix*, a Mediterranean species. However, Boury-Esnault *et al.* (1999) recognized, in addition to biogeographical distance, differences in spiculation, mainly the absence of complex

spination on the smallest spirasters present in *S. mollis*; therefore, these authors introduced a new species, *S. hartmani*, mainly because they did not have access to sufficient material of *S. mollis* from the type locality, Bermuda.

## Family Suberitidae

### Genus *Aptos* Gray 1867

#### *Aptos pernucleata* (Carter, 1870)

(Figure 22)

Synonymy and references. *Aptos aptos* (Schmidt, 1864): Wilson (1902): 338; Storr (1964): 42, tab. 9; Kelly-Borges and Bergquist (1994): 304, fig. 2, pl. 1a; van Soest (2002a): 228, fig.1 (including synonymy). *Trachya pernucleata* Carter (1870): Kelly-Borges & Bergquist (1994): 316: fig. 7.

**Material.** USNM 1191320, Reef flat East of Carrie Bow Cay, 0.5 m, underside of corrugated roofing tile; K. Ruetzler, col. 1 May 1974. USNM 1228969, 1228970, Curlew Bank, forereef slope (wall), 50-150 cm inside framework cave, ceiling, 20 m; C. Piantoni & M. Parrish, col. 22 Aug 2012. USNM 1228971, Curlew Bank, forereef slope (wall), framework cave, 18 m; C. Piantoni & M. Parrish, col. 25 Aug 2012.

Comparative material from the subtropical-tropical western Atlantic (Table 1).

**External morphology.** Encrusting to irregularly cushion-shaped with orange-yellow, blueish gray, to brownish surface, whitish, yellow, to ochre choanosome. Some overgrown in part by other encrusting sponges (for instance, *Plakinastrrella onkodes*). Surface smooth to warty and hispid, interior porous, consistency firm but elastic (stone hard when dry).

**Skeleton structure.** Larger spicules (strongyloxeas) radiate in bundles from the interior toward the surface where they end brush-like. Ectosome solidified by palisades of smaller styles that fill the space between the brushes of the larger spicules.

**Spicules.** There are three size classes of monactines (for measurements see Table 1). Large strongyloxeas (I), robust, slightly curved, thickest in the middle and tapering toward one pointed and one thinly rounded end; medium-size strongyloxeas (II), many modified to typical styles but widest in the center or lower third (toward pointed end); a third (ectosomal) spicule type are small styles (III), some modified to subtylostyles, straight or curved.

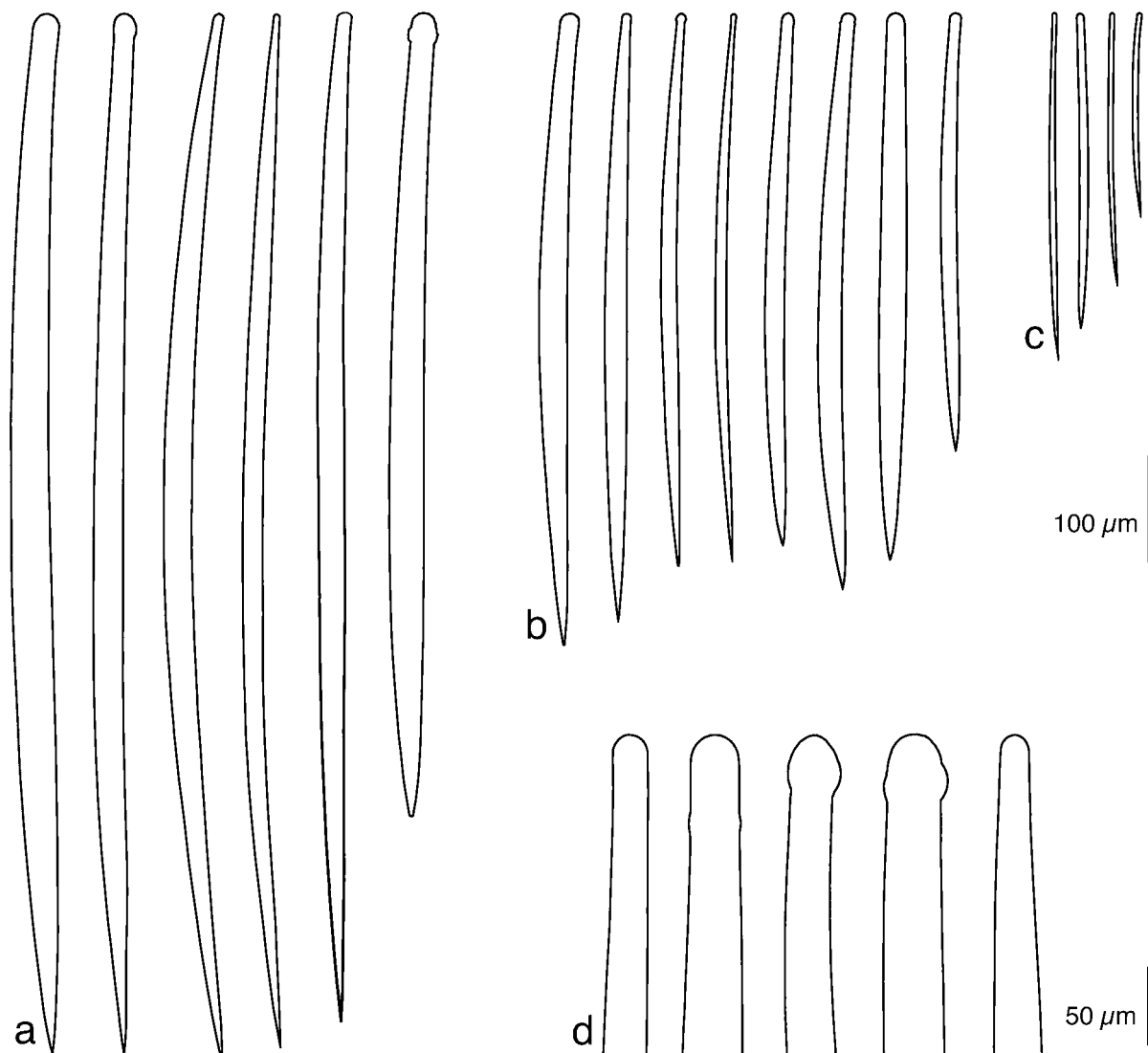
**Ecology.** Found near Carrie Bow Cay on the lower surfaces of platy coral rock and similar substrates in the subtidal zone (0.5 m) of the reef flat and in small caves to 20m on the forereef slope; partially encrusted by other sponges, for instance, *Phorbas amaranthus*, *Plakinastrrella onkodes*. Elsewhere (Gulf of Mexico, in particular) the species was also collected in shallow reef caves and in dredge hauls from 30 to over 50 m depth.

**Distribution.** The material reviewed for this study suggests a distribution ranging from East off Georgia and Florida to western Florida and the entire Gulf of Mexico and Caribbean Sea. Specimens, in addition to the present material from Belize and the eastern Gulf of Mexico, were reported from the upper (northern) Florida Keys (Storr, 1964), Puerto Rico (Wilson, 1902) and Bonaire, Netherlands Antilles (Kobluk & van Soest, 1989), and of course the type locality, Veracruz, Mexico (Carter, 1870).

**Comments.** Based on external appearance and spicule types (large strongyloxeas, medium-sized strongyloxeas and styles, and small styles and subtylostyles), this species seems close to the Mediterranean *Aptos aptos*. Dimensions of the strongyloxeas, however, allow us to separate three species that occur in the subtropical-tropical western Atlantic (Table 1). *A. pernucleata* stands out with the most distinctive strongyloxea shape, thick center and slim rounded end, very similar to those of *A. aptos* but only about 70% of their mean length (roughly 1100 versus 1500  $\mu\text{m}$ , on average). *A. bergmanni* de Laubenfels (1950), described from Bermuda and also found in the upper Florida Keys (Storr, 1964) and a cave in the Bahamas, has much shorter and slimmer (about half the diameter) strongyloxea than *A. pernucleata* and transitions to styles are more common. *A. lithophaga* (Wiedenmayer, 1977), found in the Bahamas and in one cave in Bermuda, was synonymized with *A. pernucleata* by van Soest *et al.* (2013b) but from our review it seems closer to *A. bergmanni*, except for the longer type I strongyloxeas. A possible fourth species in the region, *A. duchassaingi* (Topsent, 1889) from the Banc de



Campêche, needs to be reexamined because only the maximum dimensions of its spicules were reported (800 x 25  $\mu\text{m}$ ), not enough to assign it to or separate it from any of the other species. More material, live observations, and molecular methods will be needed to further clarify the taxonomy of *Aptos* in the western central Atlantic.



**FIGURE 22.** *Aptos pernucleata*, spicules (drawn from light and scanning electron micrographs): a, strongyloxeas/styloids I; b, strongyloxeas/styloids II; c, styles/subtylostyles (III); d, magnified rounded ends of styles/subtylostyles III.

### Genus *Prosuberites* Topsent, 1893

#### *Prosuberites carriehowensis* new species

(Figures 3d, 23)

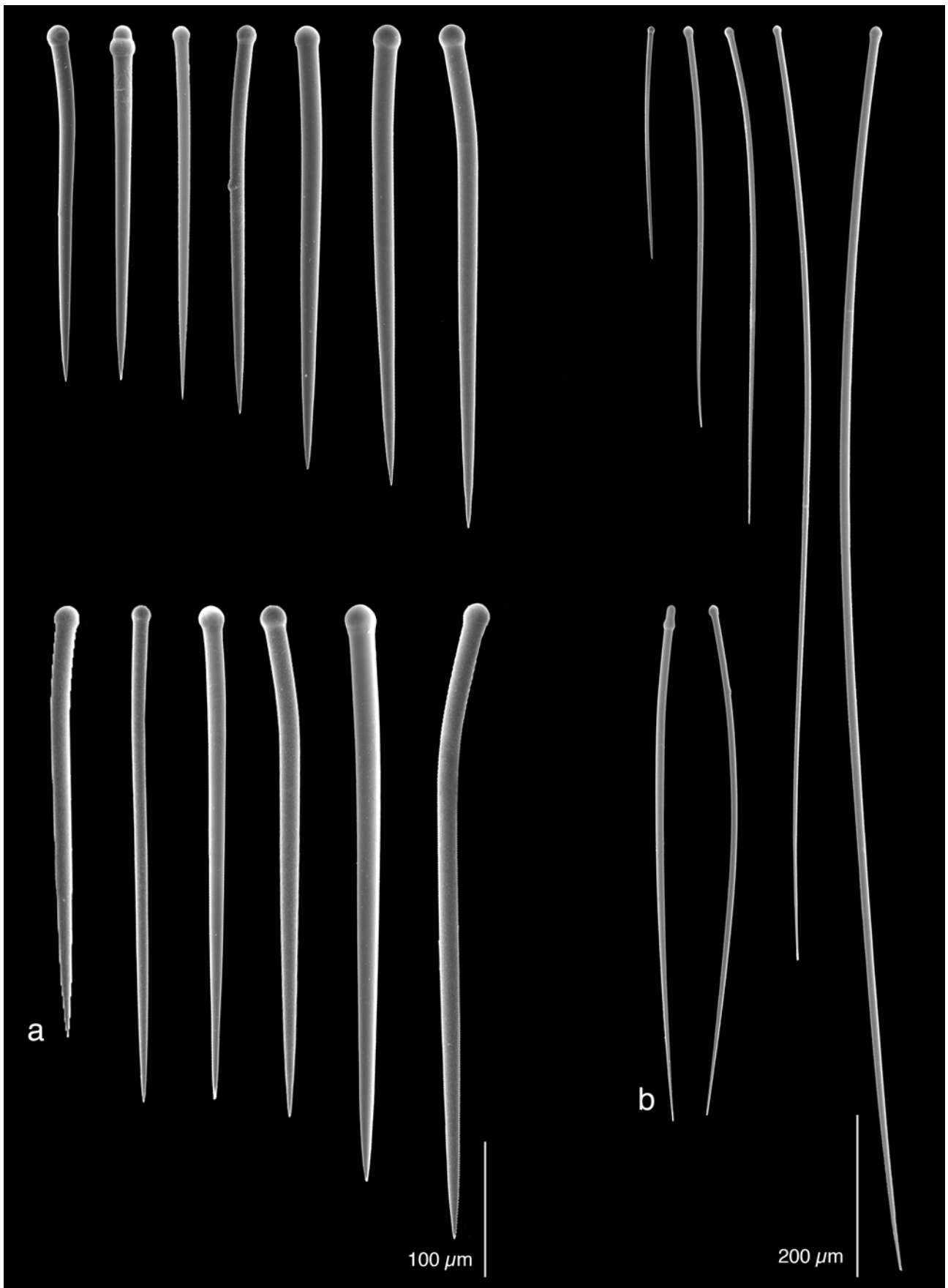
**Material.** Holotype: USNM 1228972, Curlew Bank forereef cave, 20 m; C. Piantoni col. 28 Jun 2007.

Paratypes: USNM 1228973, Curlew Bank forereef cave, 20 m; C. Piantoni col. 29 Jun 2007. USNM 1228974, Curlew Bank, forereef slope, 50-150 cm inside framework cave, ceiling, 20 m; C. Piantoni and M. Parrish, col. 22 Aug 2012. USNM 1228975, Curlew Bank, forereef cave, 20 m; C. Piantoni and M. Parrish col. 23 Aug 2012. USNM 1228976, Curlew Bank, forereef cave, 20 m; C. Piantoni and M. Parrish col. 23 Aug 2012.

**TABLE 1.** Tropical western Atlantic *Aaptos* spicule measurements, length x width ( $\mu\text{m}$ ) separated into three size categories (I–III) (ranges, means in italics in parentheses; n=20).

Species, Location	Catalog Number	I: Strongyloxeas	II: Strongyloxeas/styles	III: Styles/subtylostyles
<i>Aaptos aaptos</i> (Schmidt), holotype; Algeria <sup>I</sup>	BM 1910.1.1.866	1053–1911 x 12–31 ( <i>1502 x 29</i> )	490–955 x 10–23 ( <i>705 x 16</i> )	364–509 x 5–8 ( <i>388 x 7</i> )
<i>Trachya</i> (= <i>Aaptos pernucleata</i> (Carter), holotype; Veracruz, Gulf of Mexico <sup>I</sup> )	BM 54.12.21.18	735–1372 x 18–42 ( <i>1118 x 35</i> )	333–551 x 16–21 ( <i>470 x 18</i> )	i: 187–270 ( <i>231 x 2–8</i> ) ii: 312–416 ( <i>332 x 13–16</i> )
<i>A. bergmanni</i> de Laubenfels, holotype; Bermuda	BM 1948.8.6.43 (USNM 31642) USNM 33579	650–980 x 10–16 ( <i>793 x 13</i> )	280–750 x 4–12 ( <i>530 x 8</i> )	180–260 x 2–4 ( <i>227 x 3</i> )
<i>A. bergmanni</i> de Laubenfels; Bahama cave	USNM 24479	470–1005 x 10–20 ( <i>762 x 15</i> )	300–600 x 5–13 ( <i>500 x 9</i> )	250–340 x 1–5 ( <i>304 x 3</i> )
<i>Epipolasis</i> (= <i>Aaptos lithophaga</i> Wiedenmayer, holotype; Bahamas)	USNM 30488	800–1420 x 14–22 ( <i>1096 x 17</i> )	330–980 x 4–10 ( <i>598 x 9</i> )	150–340 x 2–5 ( <i>268 x 4</i> )
<i>Aaptos lithophaga</i> (Wiedenmayer); Bermuda cave	USNM 48393	940–1250 x 13–23 ( <i>1063 x 18</i> )	380–860 x 3–10 ( <i>640 x 7</i> )	119–220 x 3–6 ( <i>207 x 4</i> )
<i>Aaptos pernucleata</i> (Carter); Florida Gulf coast	USNM 1191320	800–1280 x 17–23 ( <i>1070 x 20</i> )	580–800 x 10–17 ( <i>722 x 14</i> )	190–280 x 2–5 ( <i>238 x 4</i> )
<i>Aaptos pernucleata</i> (Carter); Belize	Not provided	400–1200 x 15–50 ( <i>867 x 27</i> )	300–650 x 13–20 ( <i>479 x 15</i> )	200–380 x 3–8 ( <i>258 x 6</i> )
<i>Tuberella aaptos</i> (Schmidt), Puerto Rico <sup>II</sup>	Not provided	1500 x 40 (no range/means given)	(„about same“ as I; no range/means given)	300 x 7 (no range/means given)
<i>Aaptos</i> cf. <i>aaptos</i> (Schmidt), Curaçao cave <sup>III</sup>	USNM 41637	800–1300 x 20 (no means given)	300–600 x 15–25 (no means given)	200–220 x 3–4 (no means given)
<i>Aaptos pernucleata</i> (Carter); Florida Gulf coast	USNM 41963	930–1780 x 11–47 ( <i>1342 x 30</i> )	320–680 x 11–18 ( <i>553 x 14</i> )	200–320 x 2–7 ( <i>274 x 4</i> )
<i>Aaptos pernucleata</i> (Carter); Florida Gulf coast	USNM 41964	740–1450 x 25–38 ( <i>1092 x 33</i> )	540–560 x 13–14 ( <i>550 x 14</i> )	270–410 x 7–10 ( <i>320 x 8</i> )
<i>Aaptos pernucleata</i> (Carter); Florida Gulf coast	USNM 41967	870–1570 x 20–35 ( <i>1154 x 31</i> )	410–680 x 13–20 ( <i>574 x 16</i> )	190–430 x 5–10 ( <i>338 x 8</i> )
<i>Aaptos pernucleata</i> (Carter); Florida Gulf coast	USNM 48012	930–1290 x 19–31 ( <i>1115 x 25</i> )	640–950 x 12–19 ( <i>780 x 16</i> )	290–380 x 3–6 ( <i>343 x 4</i> )
<i>Aaptos pernucleata</i> (Carter); Florida Gulf coast	USNM 49547	800–1170 x 20–28 ( <i>935 x 24</i> )	310–650 x 8–20 ( <i>449 x 13</i> )	200–290 x 3–8 ( <i>250 x 6</i> )
<i>Aaptos pernucleata</i> (Carter); Florida Gulf coast	USNM 49562	810–1100 x 20–25 ( <i>965 x 22</i> )	420–710 x 8–14 ( <i>565 x 10</i> )	180–400 x 3–6
<i>Aaptos pernucleata</i> (Carter); Florida Gulf coast		800–1300 x 17–30 ( <i>989 x 23</i> )	500–600 x 10–14 ( <i>540 x 12</i> )	190–400 x 4–6 ( <i>256 x 5</i> )

I From Kelly-Borges & Bergquist (1994); II From Wilson (1902); III From Kobluk & van Soest (1989).



**FIGURE 23.** *Prosuberites carriebowensis*, spicules (holotype USNM 1228972, SEM): a, tylostyles I; b, tylostyles II.

**Diagnosis.** *Prosuberites*, thinly encrusting but with warty surface structure caused by folds of the basal spongin layer. Tylostyles of great size range (230–1520 x 9–30 µm), separable in two shapes, that is, short and stout, with neck almost as thick as the head, and long and slim, with head well offset from the neck. Color bright orange, overlaid with a whitish ectosomal membrane containing crystalline inclusions.

**External morphology.** Thin crusts, to 5 mm thick, extending 4–60 cm<sup>2</sup> or more. Surface slightly rugose and warty, bristly from protruding spicules. Oscula irregularly dispersed, slightly elevated, 1–4 mm diameter. Pores in small groups (cribiporal), each about 0.2 mm when open. Live color orange, overlaid by a whitish, very thin ectosomal membrane that blends in with the orange base color as soon as the sponge is touched or removed from the water.

**Skeleton structure.** Tylostyles, single and in bunches, stand erect, embedded with their heads in the basal spongin plate. Folds in the spongin causes elevations of spicule tracts and bumps on the sponge surface. All sizes of tylostyles are mixed together, without specific localizations.

**Spicules.** Tylostyles are straight or gently curved, and can be separated into two types, even though they overlap in dimensions (measurements of holotype). The more common type I is relatively thick and stout, the shaft widest at the neck, right below the spherical head, and tapering gradually to a sharp point: 240–840 x 15–30 (568 x 23) µm; type II is long and thin, with the small head more clearly set off, the shaft very gently tapering to a point: 230–1550 x 9–25 (963 x 15) µm. In a few of either type of tylostyle, heads can be subterminal, although this condition is rare.

**Ecology.** A reef species incrusting coral rock and cave walls and ceilings, 7–35 m. Oftentimes found overgrown by other crustose sponges, such as *Desmacella polysigmata* and *Monanchora arbuscula*.

**Distribution.** So far only known from the Mesoamerican Barrier Reef of Belize.

**Etymology.** Named after the type locality, Carrie Bow Cay, Belize.

**Comments.** This species shows similarities in color and ecology with *Prosuberites psammophilus* (Pulitzer-Finali, 1986: 89, figs. 17, 18) from the Dominican Republic and Puerto Rico, and with *P. laughlini* (Diaz, Alvarez & van Soest, 1987: 33, fig. 2; as *Eurypon*) from Venezuela and The Netherlands Antilles. However, the former species is distinguished by its incorporation of large quantities of sand and much thinner tylostyles with well set-off heads, the latter by visible subsurface canals that radiate toward the oscula and tylostyles with poorly developed heads, approaching the shape of styles. Neither species seems to have the bumpy surface or the whitish ectosomal membrane with pore sieves.

We examined a peel of the ectosomal membrane by compound light microscope, using both transmitted and polarized light, and found that the reflective white appearance is caused by calcareous crystals, unlike any particles seen in nearby reef sediments. Our colleague Jeffrey Post (Department of Mineralogy, National Museum of Natural History) confirmed this observation by analytical SEM (personal communication) and showed that the euhedral calcium carbonate crystals (assumed to be aragonite) are accompanied by smaller crystals of calcium sulfate (perhaps gypsum). We suspect that these crystals are the product of endosymbiotic calcifying bacteria, similar to those discovered in species of *Hemimycale* (Uriz *et al.*, 2012), along with artifacts from histological fixation (M. J. Uriz, Centre d'Estudis Avançat, Spain, personal communication). We hope to clarify this process using new material.

### ***Terpios fugax* Duchassaing & Michelotti, 1864**

Synonymy and References. *Terpios fugax* Duchassaing & Michelotti, 1864: Rützler & Smith (1993): 384, figs. 1, 9.

**Material.** USNM 1228977, 1228978, Carrie Bow Cay forereef, low spur and groove zone, underside of *Agaricia* coral rubble, 8–9 m; K. Ruetzler col. 7 May 1973. USNM 43146, Carrie Bow Cay reef flat, lower sides of coral rubble, 0.5 m; K. Ruetzler col. 32 Jan 1986.

**External morphology.** Small (1–4 cm<sup>2</sup>) and thin (1 mm) crusts, with smooth, microporous surface, soft, of ultramarine blue or bluegreen color due to symbiotic, blue-pigmented bacteria

**Skeleton structure.** Spicule bundles running in simple, rarely branched tracts from the base to the surface, loose spicules throughout.

**Spicules.** Straight tylostyles, in one size class, with depressed (flattened), lobed tyloles: 170–360 x 4–8 (310 x 7) µm (the shaft averages 5 µm in width).

**Ecology.** Undersides of shallow reef rubble, 0.5–9 m.

**Distribution.** Bermuda, throughout the tropical western Atlantic.

## Family Tethyidae

### Genus Lamarck, 1814

#### *Tethya maza* Selenka, 1879

(Figure 24)

Synonymy and references. *Tethya maza* Selenka, 1879: Ribeiro & Muricy (2011): 1513, fig. 1.

**Material.** USNM 33170, Carrie Bow Cay, under coral rubble on reef flat near shore, 0.2 m; R. J. Larson col. 27 Apr 1972. USNM 1228979, Carrie Bow Cay, back reef near crest, inside and underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1228980, 1228981, 1228982, 1228983, Carrie Bow Cay East, reef flat, underside of platy coral rubble, 0.5 m; K. Ruetzler col. 1 May 1974. USNM 1228984, Carrie Bow Cay West, under concrete dock; 0.5 m; K. Ruetzler col. 14 May 1988. USNM 1228985, Carrie Bow Cay back reef, inside dead conch shell, 0.5 m; K. Ruetzler & C. Piantoni, col. 23 Feb 2006.

Examined in the field (CBC 07-11, red) but not preserved: Carrie Bow Cay forereef, lower surface of *Agaricia* coral plate, 21 m; C. Piantoni col. 28 Jun 2007.

**External morphology.** Subspherical shape, with verrucose surface. Tough elastic consistency; yellow, orange yellow, red-orange, red, or green in live color, all with yellow interior.

**Skeleton structure.** Bundles of megascleres radiating from the center of the sponge toward the surface. Microscleres concentrated in the tough, contractile cortex.

**Spicules.** Megascleres, principal strongyloxeas: 1010–1820 x 10–26 (1380 x 17)  $\mu\text{m}$ ; auxiliary strongyloxeas: 370–830 x 4–11 (617 x 8). Microscleres, spherasters: 25–63 (49)  $\mu\text{m}$ ; strongylasters with small centers and up to 9 microspined rays, some of them branched (“strongylasters type 1,” according to Ribeiro and Muricy, 2011): 25–48 (36)  $\mu\text{m}$ ; tylasters with up to 9 cylindrical rays terminated by a microspined tyle (“tylasters type 1”): 10–15 (13)  $\mu\text{m}$ ; oxyasters with small center and microspined, pointed rays (“oxyasters 1,” rare, n=5): 37–46 (43)  $\mu\text{m}$ ; oxyasters with large center and smooth but somewhat crooked rays (“oxyasters 2,” rare, n=5): 7–10 (9)  $\mu\text{m}$ .

**Ecology.** Cryptic (under coral rubble, inside dead conch shells), 0.2–20 m.

**Distribution.** Caribbean and Brazil.

**Comments.** We compared our SEM images with the detailed, SEM-illustrated analysis of *Tethya maza* by Ribeiro & Muricy (2011) and found our specimens in full agreement, except that some of our mean measurements differ slightly, some being larger, others smaller.

## Family Timeidae

### Genus *Timea* Gray, 1867

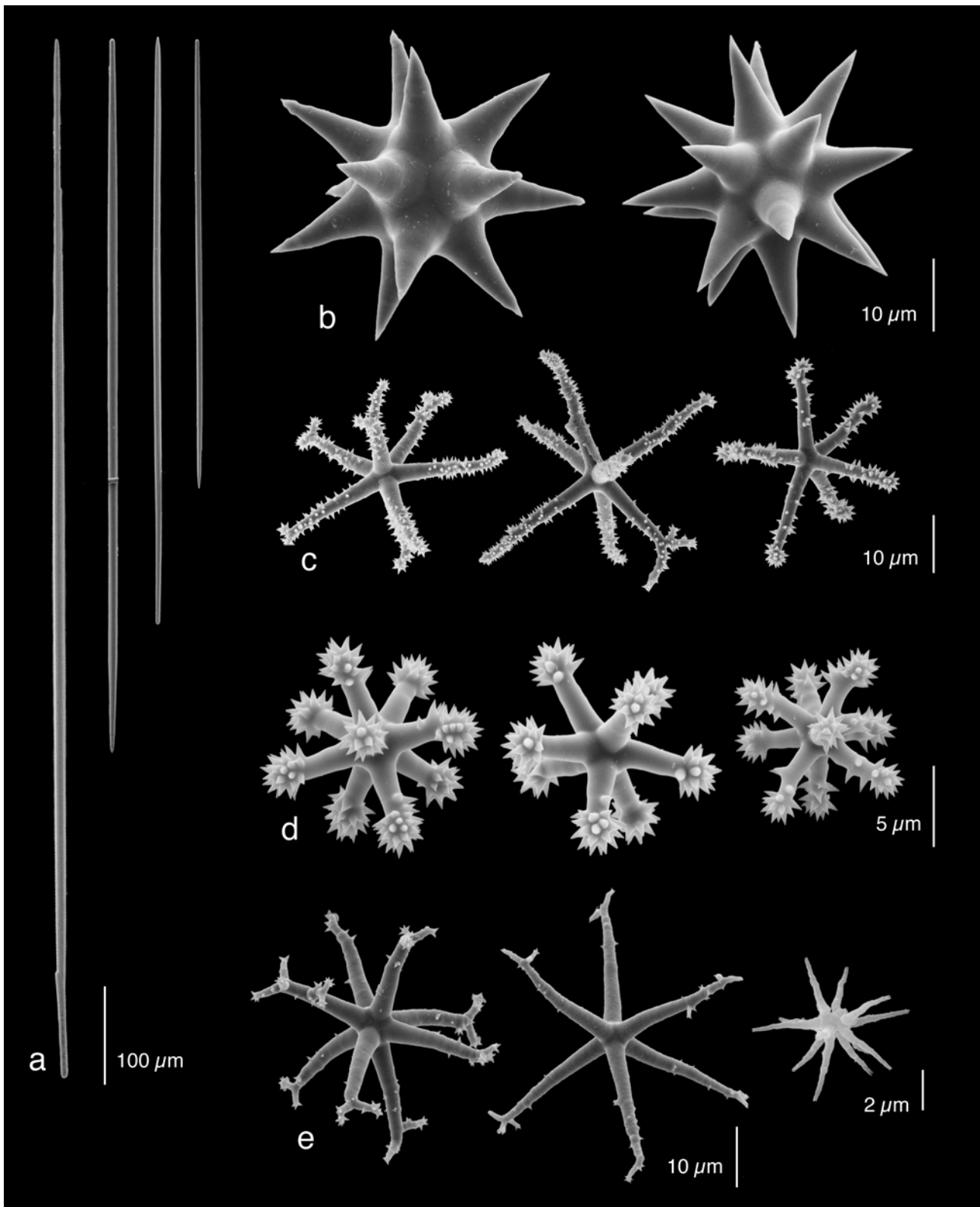
#### *Timea diplasterina* new species

(Figures 3e, 25)

**Material.** Holotype: USNM 1228986, Carrie Bow Cay back reef, near crest, underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler coll. 23 Apr 1974.

**Diagnosis.** *Timea* with two size classes each of tylostyles and spheroxyasters, with diplasters of one size class added to the microsclere complement.

**External morphology.** The holotype was originally a thin (0.2–3 mm), lumpy crust covering about 30 cm<sup>2</sup> of the rock surface. There were a few small (>1 mm), irregularly dispersed openings (oscula). Surface rough to the touch (from protruding spicule brushes), consistency firm, live color ranging from drab to dull orange brown.



**FIGURE 24.** *Tethya maza*, spicules (SEM): a, strongyloxeas; b, spherasters; c, strongylasters; d, tylasters; e, oxyaster.

**Skeleton structure.** Spicule bundles (bouquets) rising from the base to and beyond the surface, points directed outward. Microscleres, all types mixed, occur throughout the tissue but are densest near the base and in the ectosome.

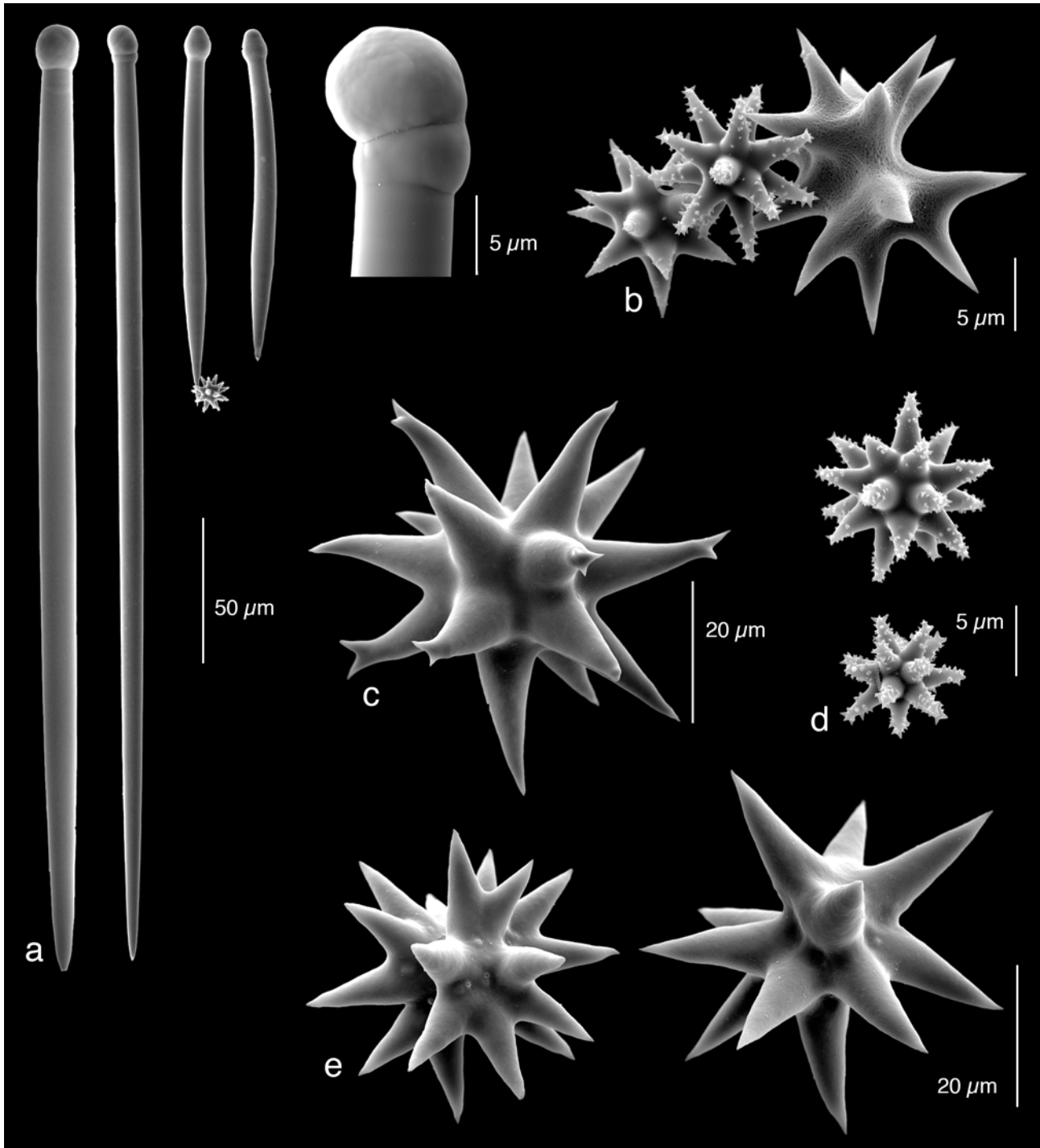
**Spicules.** Tylostyles straight or slightly bent, with spherical head that may be subterminal, slightly bent sideways, or show an extra swelling at the base, with pointed ends often dull or rounded; two size categories, I:

325–700 x 14–23 (555 x 17)  $\mu\text{m}$ ; II: 129–350 x 5–13 (272 x 10)  $\mu\text{m}$ . Spheroxyasters (center diameters: 37–42 % of total diameters), also in two size classes, the larger one (I) has smooth rays which, however, may be branched near the points: 38–59 (48)  $\mu\text{m}$ ; spheroxyasters II have microspined rays: 8–30 (17)  $\mu\text{m}$ ; diplasters, with smooth rays, some appearing like transition stages to spirasters: 13–27 (20)  $\mu\text{m}$ .

**Ecology.** Found only once, cryptic under coral rock, 0.3 m.

**Distribution.** Belize.

**Etymology.** Named for the addition of diplasters to the euasters typical of the genus.



**FIGURE 25.** *Timea diplasterina*, spicules (holotype USNM 1228986, SEM): a, tylostyles in two size classes, one deformed tyle magnified; b, two oxyasters (left) and one diplaster (approaching the shape of a spiraster); c, spheroxyaster I, with smooth rays, some branched; d, spheroxyasters II, with microspined rays; e, diplasters.

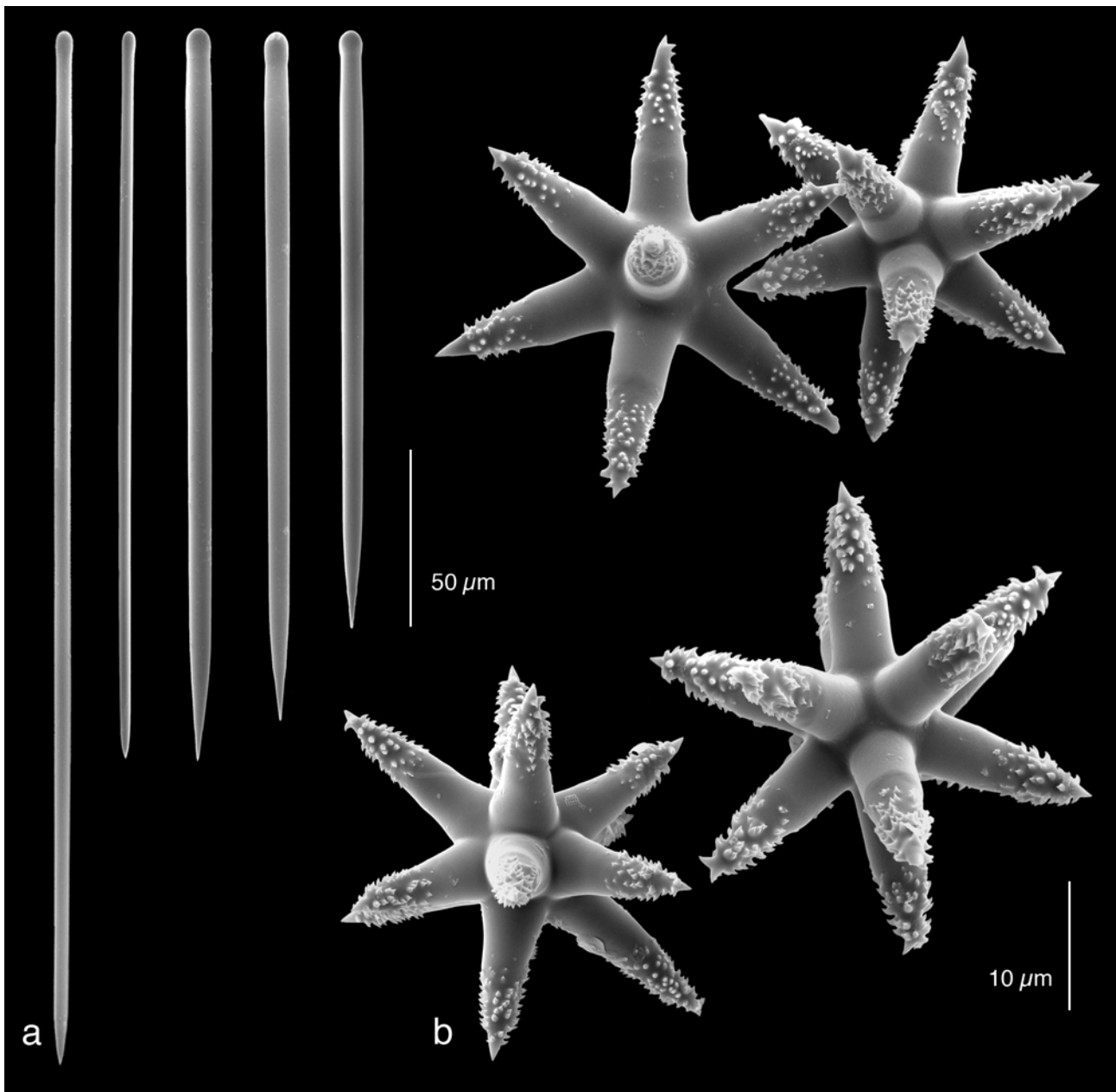
**Comments.** This species is quite similar in microsclere composition to *Timea bioxyasterina* Mothes, Santos and Campos (Mothes *et al.*, 2004: 3, fig. 3; larger oxyasters with smooth rays, smaller ones with microspined rays) except that euasters are spheroxyasters (with centers  $>1/3$  of total diameter) instead of oxyasters (center  $<1/3$  diameter) and that there is the addition of diplasters. Discovery of a species of *Timea* with diplasters and transitional spirasters among its microscleres demonstrates the closeness of the family Timeidae to Spirastrellidae (see discussions in Rützler (2002)).

***Timea oxyasterina* new species**

(Figures 3f, 26)

**Material.** Holotype: USNM 1228987, Curlew Bank forereef cave, 20 m; C. Piantoni col. 28 Jun 2007.

**Diagnosis.** *Timea* with one kind of oxyasters as only microscleres (center  $<1/3$  of total diameter), with slim, smooth rays, microspined only along the distal half of their lengths.



**FIGURE 26.** *Timea oxyasterina*, spicules (holotype USNM 1228987, SEM): a, tylostyles and styloid modifications; b, oxyasters, microspined along the distal parts of the rays.



**External morphology.** The holotype is a 1–4 mm thick crust extending over nearly 10 cm<sup>2</sup>, part of a much larger specimen. The surface is smooth but rugose and shows numerous circular aquiferous openings of 0.2–0.8 mm diameter. Consistency firm, compressible, live color deep red.

**Skeleton structure.** Tylostyle brushes and single spicules extend from the base layer of microscleres to the ectosome, points outward, some protruding from the surface. Only few of the oxyastrose microscleres occur in the ectosome but instead are crowded at the base of the crust and are densely populating tissue that fills, and possibly excavates, small cavities in the substratum.

**Spicules.** Tylostyles in one size class but of large range in length, straight or gently bent, with heads that may be barely thicker than the shaft, missing in some (styloid modifications), or is subterminal (mucronate) in a few: 152–320 x 3–11 (232 x 6) µm; oxyasters (center diameters: 21–31 % of total diameters), with slim, cylindrical rays and rounded point, smooth around the center, microspined along the distal half: 25–37 (32) µm.

**Ecology.** Found on the wall of a forereef cave, closely associated with the astrosclerid (“sclerosponge”) *Goreauella auriculata*, whose base skeleton it at least partly overgrows; 20 m.

**Distribution.** Belize.

**Etymology.** Named for the simple oxyasterine microscleres.

**Comments.** This is the second known central West Atlantic *Timea* with just one type and size category of euaster, the other is *T. unistellata* sensu Pulitzer-Finali (1986; see description there). In short, the principal difference is that *T. unistellata* has small (14 µm, in our material) spheroxyasters with conical, microspined rays, *T. oxyasterina* has larger (32 µm) oxyasters with cylindrical, microspined rays.

### ***Timea stenosclera* Hechtel, 1969**

(Figure 27)

Synonymy and references. *Timea stenosclera* Hechtel, 1969: 28, fig. 5.

**Material.** USNM 1228988, Carrie Bow Cay East, reef flat, underside of platy coral rubble, 0.5 m; K. Ruetzler col. 29 Jan 1986. USNM 1228989, 1228990, Carrie Bow Cay South reef, lower surface of rock slab, 1 m; K. Ruetzler col. 13 Mar 09.

**External morphology.** Very thinly encrusting (<1 mm), covering areas of up to 12 cm<sup>2</sup>. Smooth surface where meandering exhalant canals, leading toward tiny (<1 mm) oscula, are forming star-like patterns. Soft consistency, yellow-orange to ochre live color.

**Skeleton structure.** Bundles of tylostyles radiate from the substratum toward the ectosome, where many protrude beyond the surface. Euasters occur throughout the tissue, packed a bit more densely in the ectosome.

**Spicules.** Tylostyles, straight and slender, with small, mostly spherical heads: 176–310 x 2–7 (287 x 5) µm; spheroxyasters (with centrum larger than 33%, up to 50% of total diameter), with microspined rays that are either pointed or dull (strongylasters): 19–25 (22) µm; and rarer spheroxyasters with smooth, sharply pointed rays: 15–18 (17) µm.

**Ecology.** Cryptic (under coral rubble, inside dead conch shells), 0.2–20 m.

**Distribution.** Caribbean and Brazil.

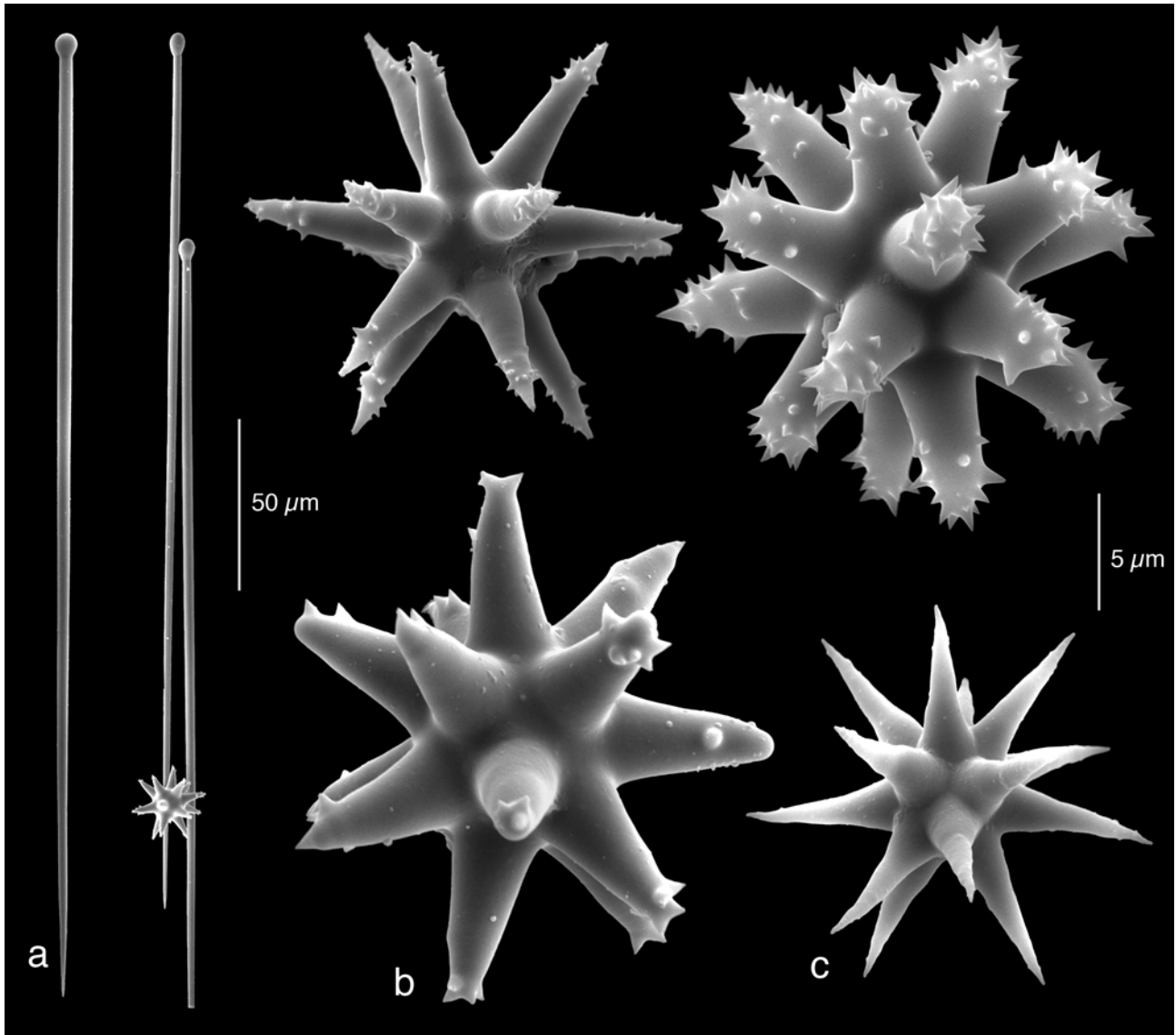
**Comments.** Hechtel’s (1969) measurements of the smaller category of euasters average much less than ours (means=9.2 µm) but all other characteristics and spicule dimensions agree well, prompting us to assign our species to his.

### ***Timea* cf. *unistellata* (Topsent, 1892)**

(Figure 28)

Synonymy and references. *Timea unistellata* (Topsent, 1892): Pulitzer-Finali (1986): 101, fig. 26; Cruz (2002): 116 (with two unnumbered figures).

**Material.** USNM 1228991, Carrie Bow Cay East, reef crest, underside of platy coral rubble, 0.5 m; K. Ruetzler col. 26 Apr 1974.



**FIGURE 27.** *Timea stenosclera*, spicules (SEM): a, tylostyles; b, oxyasters and strongylaster with microspines rays; c, oxyaster with smooth rays.

**External morphology.** Thin, small crust (2 cm<sup>2</sup>) without apparent openings. Firm consistency, dull orange color in life, grayish brown in alcohol.

**Skeleton structure.** Tylostyles in bundles, erect on the substratum, some of the points protruding beyond the surface. Euasters packed in the ectosome.

**Spicules.** Slim tylostyles, straight, with small, rounded heads: 240–557 x 4–8 (423 x 7) μm; spheroxyasters with broad-based, microspined rays (centrum 40–50% of total diameter): 9–18 (14) μm.

**Ecology.** Cryptic, under coral rubble, 1 m.

**Distribution.** Mediterranean, Northeast Atlantic, Canary Islands.

**Comments.** Although Pulitzer-Finali (1986) describes *Timea unistellata* from the Dominican Republic, we believe that his as well as our records of this Mediterranean-East Atlantic species are of a different albeit quite similar taxon. More material will have to be studied to determine useful morphological details for taxonomic characterization.

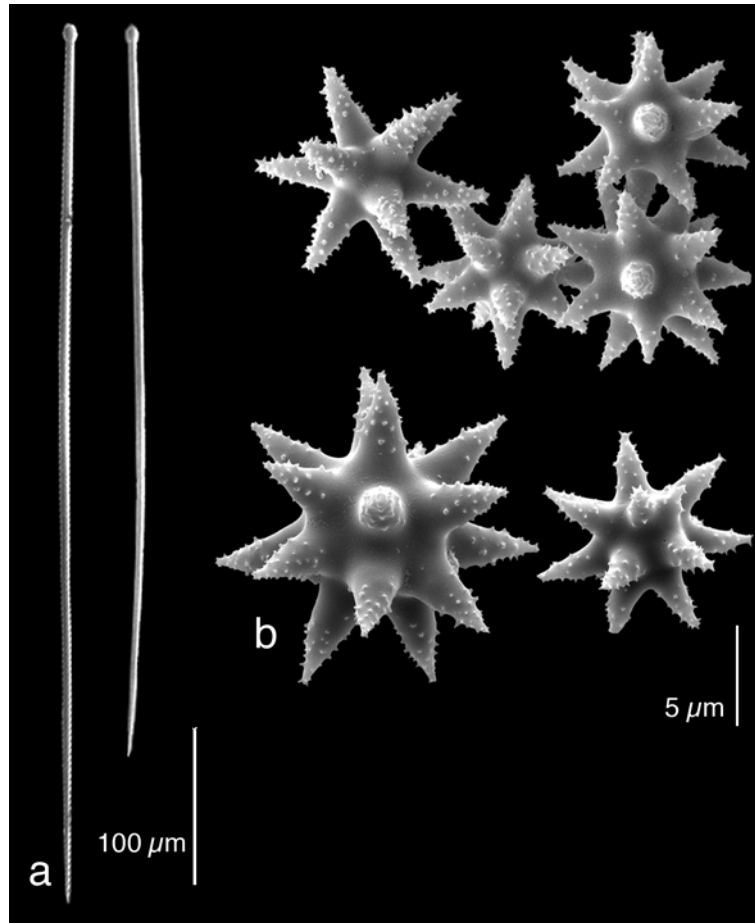


FIGURE 28. *Timea* cf. *unistellata*, spicules (SEM): a, tylostyles; b, spheroxyasters with microspined rays.

## Family Trachycladidae

### Genus *Rhaphidhistia* Carter, 1879

#### *Rhaphidhistia belizensis* new species

(Figures 3g, 29)

**Material.** Holotype: USNM 1228992, Carrie Bow Cay forereef slope, coral rock underside, 30 m; K. Ruetzler col. 26 Apr 1974.

Paratypes: USNM 1228993, 1228994, Curlew Cay, frame-work cave in forereef wall (1.5 m from entrance), 20 m; C. Piantoni and M. Parrish col. 22 Aug 2012. USNM 1228995, Curlew Cay, frame-work cave in forereef wall (1.5 m from entrance), 20 m; C. Piantoni and M. Parrish col. 23 Aug 2012.

**Diagnosis.** Thinly encrusting, orange-colored *Rhaphidhistia* with large oxeas (247–860 x 5–18 µm) and three size classes of spirasters (28–48 x 8–15 µm; 23–35 x 4–6; 7–18 x 3–9 µm) spread densely throughout the body. Largest spirasters with straight shaft and regularly spaced spiral spination by equal-sized rays (spinispires); smallest are microspined.

**External morphology.** Very thin (0.5–2 mm) crusts mirroring the structure of the coral substratum, covering 2–50 cm<sup>2</sup>. Groups of tiny pores but no obvious distinctions of oscula or ostia. Surface smooth, consistency firm, color vivid orange to light orange red.

**Skeleton structure.** Oxeas without much orientation (criss-cross), a few in the choanosome in ill-defined tracts, some in the ectosome parallel to the surface. Spirasters occur in abundance throughout the tissue.

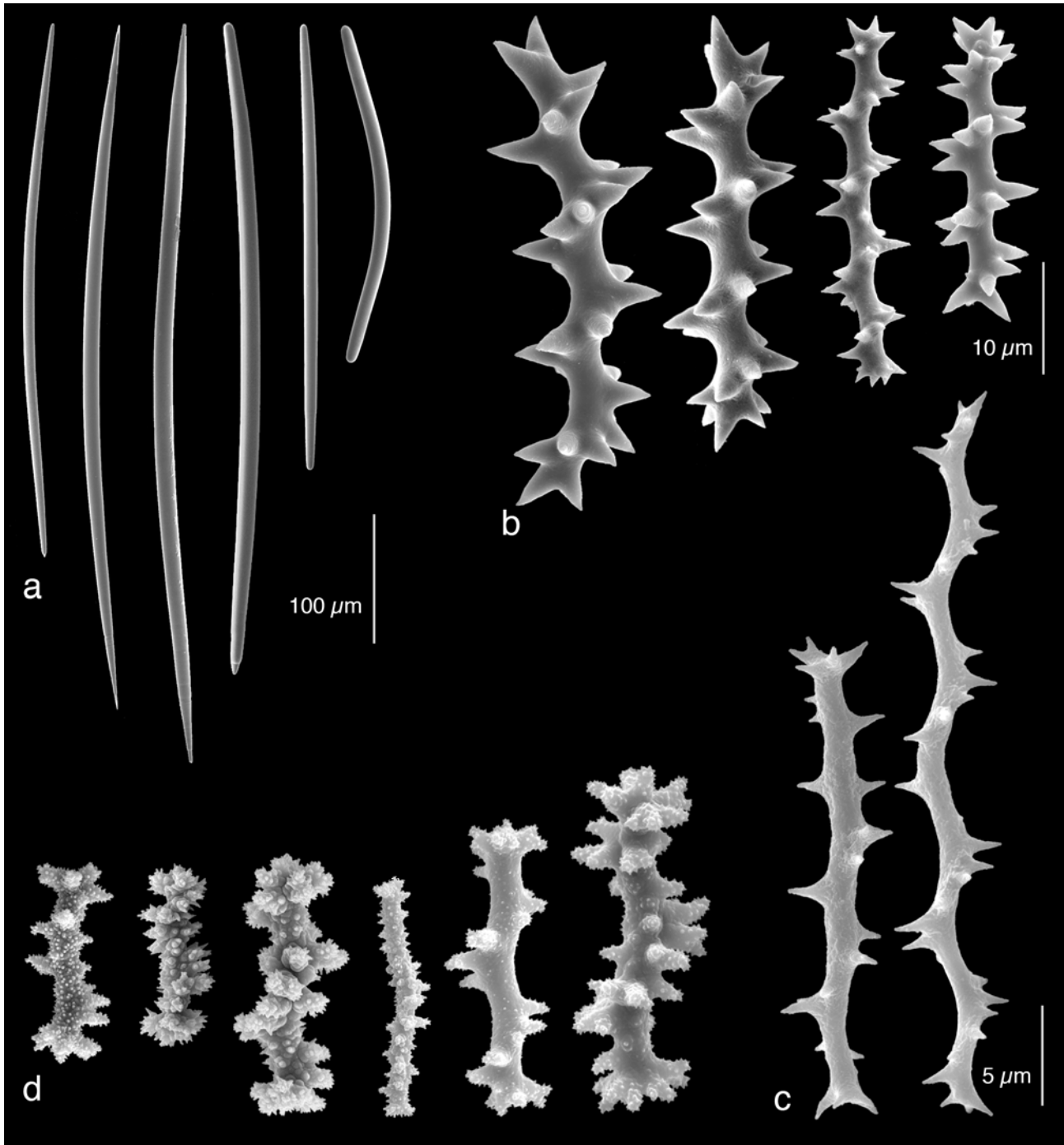
**Spicules.** Oxeas, straight or slightly bent, thickest in the center of the shaft, gradually tapering to sharp points;

a few show styloid or strongylote modifications: 247–860 x 5–18 (535 x 12)  $\mu\text{m}$ ; spirasters I, straight shafts (averaging 30 % of total spicule width) surrounded by a regular spiral of equal-sized rays: 28–48 x 8–15 (39 x 12)  $\mu\text{m}$ ; spirasters II, short and thin and less regular in spination than spirasters I: 23–35 x 4–6 (29 x 5)  $\mu\text{m}$ ; spirasters III, microspined or rugose: 7–18 x 3–9 (12 x 6)  $\mu\text{m}$ .

**Ecology.** Under forereef coral rock and in caves, 20–30 m.

**Distribution.** Belize (Caribbean).

**Etymology.** Named after Belize, the Caribbean nation where it was first discovered.



**FIGURE 29.** *Rhaphidhistia belizensis*, spicules (holotype USNM 1228992, SEM): a, oxeas, with styloid and strongylote modifications; b, spirasters I; c, spirasters II; d, spirasters III.

**Comments.** Morphological properties of our species agree well with the redescription of the type species of *Rhaphidhistia*, *R. spectabilis* Carter, 1879 (Hooper & van Soest, 2002, fig. 3A–C), particularly the thinly

encrusting habit, disorganized arrangement of oxeas, abundance of spirasters throughout, and mostly straight and very regular spirasters (spinispirae). The main differences are the fewer twists of spines (up to six versus up to ten) and the second, smaller size class of spirasters in our material, and of course the geographical separation Belize versus Mauritius.

In course of writing this chapter, colleagues from Colombia introduced a new species of *Rhaphidhistia*, *R. guajiraensis*, discovered in 50 m on a soft bottom off Dibulla, Colombian Caribbean (Díaz & Zea, 2013). This species is similar to ours but is thickly encrusting, as well as incorporating and agglutinating substratum particles (color in life is not known), and, like the type species (*R. spectabilis*), it lacks a small class of microspined spirasters (as was confirmed by S. Zea, personal communication).

## Order Chondrosida

### Family Chondrillidae

#### Genus *Chondrilla* Schmidt, 1862

##### *Chondrilla caribensis* Rützler, Duran & Piantoni, 2007

(Figure 2f)

Synonymy and references. *Chondrilla caribensis* Rützler, Duran & Piantoni (2007): 100, tab. 3, figs. 4–7; *Chondrilla nucula* (Schmidt, 1862): Macintyre *et al.* (1982): 134.

**Material.** USNM 1191346, Carrie Bow Cay, under concrete dock, 0.5–1; K. Ruetzler, col. 12 May 1978. USNM 32862 Columbus Cay cave, Belize, 18–21 m; I. G. Macintyre & G. Hendler, col. 26 Apr 1979. USNM 1191347, Carrie Bow reef flat, inside dead conch shells, 1 m; K. Ruetzler and C. Piantoni col. 23 Feb 2006.

**External morphology.** Lobed cushions, about 1 cm thick, covering up to 85 cm<sup>2</sup> of substrate. Smooth and slippery-feeling surface, with small (1–2 mm) oscula elevated on lobes; cartilaginous consistency (a common name is chicken-liver sponge). Color olive, light brown to white, depending on habitat illumination which controls density of symbiotic cyanobacteria.

**Skeleton structure.** Astrose spicules dispersed throughout the body but concentrated near the outer surface and along the canals of the aquiferous system.

**Spicules.** These are spherasters and spheroxyasters, measuring 20–36 (29) µm in total diameter, about two thirds taken up by the solid center; there are about 25 rays on average.

**Ecology.** Occurs in a wide range of habitats, from full light exposure on subtidal mangrove roots to dark caves, at least to 30 m depth.

**Distribution.** Tropical and subtropical western Atlantic, from Bermuda to Brazil.

**Comments.** This symbiotic species is tolerant of the full range of ambient light conditions but loses all pigmentation, including symbiotic cyanobacteria, when growing in the dark.

## Order ‘Lithistida’

### Family Siphonidiidae

#### Genus *Gastrophanella* Schmidt, 1879

##### *Gastrophanella cavernicola* Muricy & Minervino, 2000

(Figure 2c)

Synonymy and references. *Gastrophanella implexa* Schmidt, 1879: sensu Macintyre *et al.*, 1982: 134, fig. 83b; *Gastrophanella cavernicola* Muricy & Minervino, 2000: 600, figs. 2–5.

**Material.** USNM 32868, Columbus Cay cave, Belize, 20 m, ceiling, 20 m from entrance; I. G. Macintyre col. 26 Apr 1979. USNM 32871, Columbus Cay cave, Belize, 18–21 m, ceiling; B. Lester col. 24 Apr 1979. USNM 32875, Columbus Cay cave, Belize, 30 m, wall; C. Feller col. 25 Jun 1983.

**External morphology.** Massive, lobate, up to 20 mm thick and 50 mm in diameter. Single oscula on top, up to 3 mm in diameter, with radiating vein-like canals just below the surface; small patches of ostia in surface depressions and along the sides of specimens. Surface finely rough, consistency hard, color in life cream.

**Skeleton structure.** In the choanosome there is a dense reticulation of fused desmas, with tylostrongyles mixed in and also radiating toward the surface where they form a disorganized palisade with tylostrongyles outward (Muricy & Minervino, 2000, fig 3).

**Spicules.** Monocrepid desmas, 220–360 (280)  $\mu\text{m}$  in diameter; tylostrongyles, 250–480 x 2.5–11.4 (358 x 6.4)  $\mu\text{m}$  (measurements from Muricy & Minervino, 2000, tab. 1, figs 4, 5).

**Ecology.** In dark areas of caves, 3–30 m.

**Distribution.** Northeast Brazil and Belize.

**Comments.** The “Blue Hole” record from Lighthouse Reef atoll, Belize (Muricy & Minervino, 2000) is erroneous, due to a misunderstanding. Columbus Cay cave is a drowned karst cave, just like the famous “Blue Hole” of Lighthouse Reef some 60 km east-northeast, but its entrance tunnel on the lagoon floor (see Macintyre *et al.*, 1982) is more like a black crack although local fishermen refer to it as “blue hole.” In Belize, *Gastrophanella cavernicola* has so far only been recorded from Columbus Cay cave.

## Family Phymaraphiniidae

### Genus *Kaliapsis* Bowerbank, 1869

#### *Kaliapsis* cf. *cidaris* Bowerbank, 1869

(Figure 30)

Synonymy and references. *Kaliapsis cidaris* Bowerbank, 1869: Pisera & Lévi (2002): 381, fig. 1.

**Material.** USNM 1228998, Carrie Bow Cay South reef, underside of coral-rubble plates in exposed zone behind reef crest, 0.5 m; K. Ruetzler col. 6 Mar. 2006. USNM 1228999, Carrie Bow Cay South reef, underside of coral-rubble plates in exposed zone behind reef crest, 0.5 m; K. Ruetzler col. 13 Mar. 2009.

**External morphology.** A thin crust (1–2 mm thick) covering 20–30 cm<sup>2</sup> area. Surface smooth but with fine, star-like canal patterns leading toward minute openings (oscula); slightly rough to the touch. Color grayish white.

**Skeleton structure.** Discotriaenes support the ectosome, desmas occur throughout the choanosome and are accompanied by microxeas.

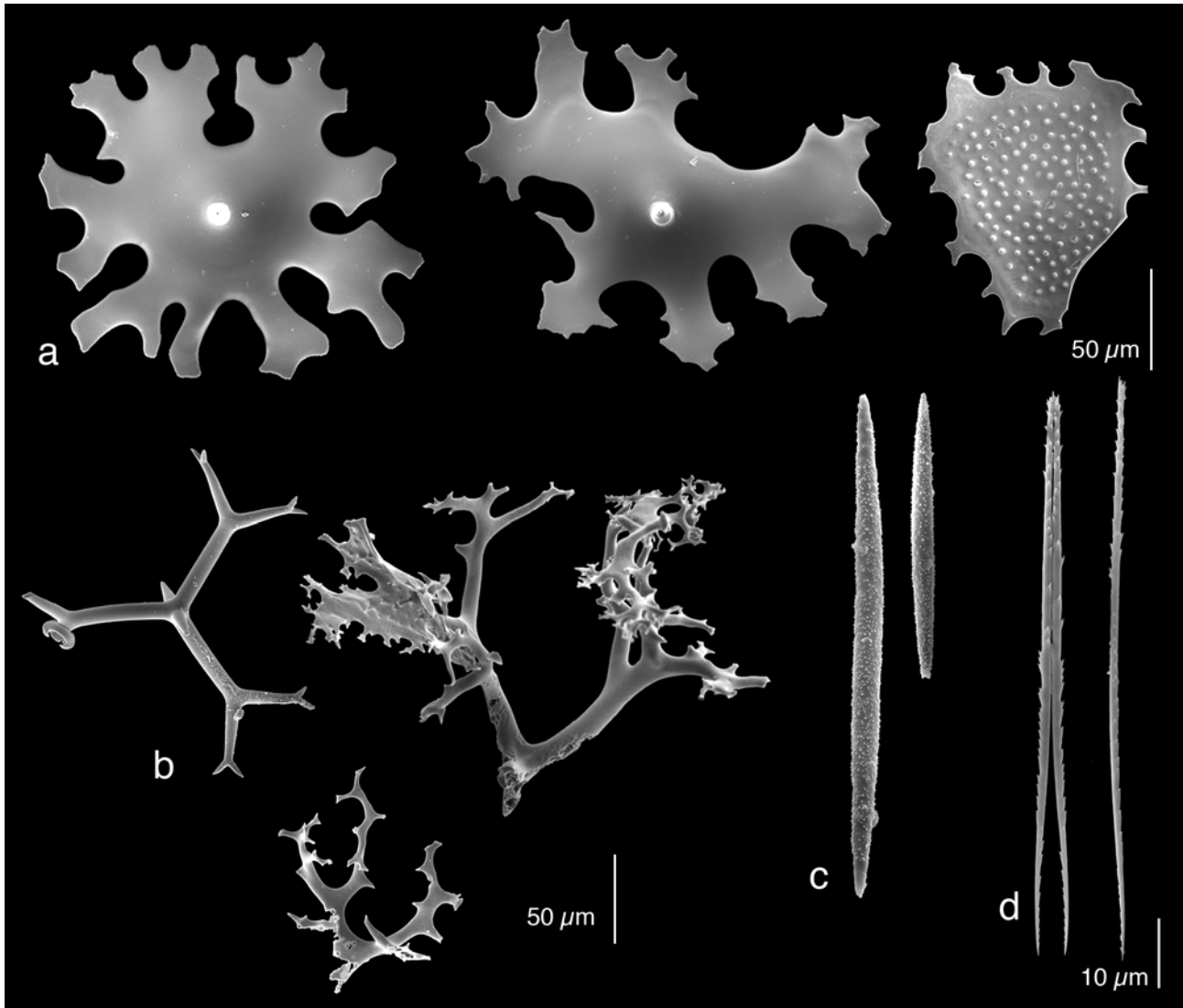
**Spicules.** Discotriaenes are microspined, with more or less strongly incised margins; the rhabd appears like a short thorn. Perpendicular disk diameters: 125 x 100 to 260 x 200  $\mu\text{m}$  (209 x 159  $\mu\text{m}$ , n=10). Desmas (triders) are broken but intact pieces measure up to 280  $\mu\text{m}$  in diameter.

Microxeas, microspined, a few having stylote modifications (one end rounded): 21–60 x 2–5 (46 x 3)  $\mu\text{m}$ . Raphids, with one sharp and one dull point, microspined, with spines pointing saw-like from the sharp toward the dull end (only seen loose on SEM preparations): 80–83 x 1.1–1.3  $\mu\text{m}$  (n=5).

**Ecology.** Both specimens occurred on the underside of coral rock in a high-energy habitat behind the reef crest, 0.5 m.

**Distribution.** The type locality of *Kaliapsis cidaris* is Fiji Islands, in the South Pacific.

**Comments.** *K. cidaris* is not a very well known species but spicule morphology and measurements agree well with Pisera and Lévi's (2002) redescription, except that the microspined micro-“strongyles” of our material are more oxeote than strongylote and that we observed saw-toothed raphids. Because of these details and the geographic separation we are presenting our identification with some hesitation.



**FIGURE 30.** *Kaliapsis* cf. *cidaris*, spicules (SEM): a, discotriaenes with incised margins and short rhabd pointing at the viewer, and tuberculated upper surface (far right); b, various developmental stage of triders (desmas); c, microspined microxeas; d, microspined (saw-like) raphids.

## Order Poecilosclerida

### Suborder Microcionina

#### Family Acarnidae

#### Genus *Acarnus* Gray, 1867

#### *Acarnus* cf. *nicoleae* van Soest, Hooper & Hiemstra, 1991

Synonymy and references. *Acarnus nicoleae* van Soest, Hooper & Hiemstra, 1991: 68 (including synonymy); *Acarnus* (*Acanthacarnus*) *souriei* (Lévi, 1962): van Soest, 1984a: 63, fig. 23.

**Material.** USNM 1191321, Carrie Bow Cay, back reef near crest, 0.3 m; inside and underside of platy coral rubble (*Acropora palmata*). K. Ruetzler, col. 23 Apr 1974.

**External morphology.** Thin crusts covering 2–20 cm<sup>2</sup> area; porous surface shows outlines of the larger, exhalant canals. Color deep red.

**Skeleton structure.** Indistinct tracts of styles and cladotylotes, tangential spicules (tylotes) in the ectosome.

**Spicules.** Ectosomal tylotes with well developed, microspined heads:  $310-390 \times 5-8$  ( $357 \times 6$ )  $\mu\text{m}$ ; choanosomal styles and subtylostyles, also with microspined heads:  $430-460 \times 6-10$  ( $442 \times 8$ )  $\mu\text{m}$ ; cladotylotes with spined shaft and 4–5 clads:  $140-220 \times 13-22$  ( $187 \times 17$ )  $\mu\text{m}$ ; acanthostyles, densely covered by small spines:  $70-90 \times 3-6$  ( $79 \times 5$ )  $\mu\text{m}$ ; chelae:  $15-18$  ( $17$ )  $\mu\text{m}$ ; toxa:  $110-210 \times 1-2$  ( $150 \times 2$ )  $\mu\text{m}$ .

**Ecology.** Found on lower surfaces of platy coral rock in wave-exposed backreef habitats, 0.2–1.5 m.

**Distribution.** Reported from many locations in the Caribbean, particularly the southern region.

**Comments.** Our specimen differs from the description of the type material by having only one size category of cladotylotes; a smaller (often rare) kind was not seen. Likewise, only one type and size class of toxa was found (and no “oxhorn” toxa), and that rarely, although our preparations are rich in all other spicule types.

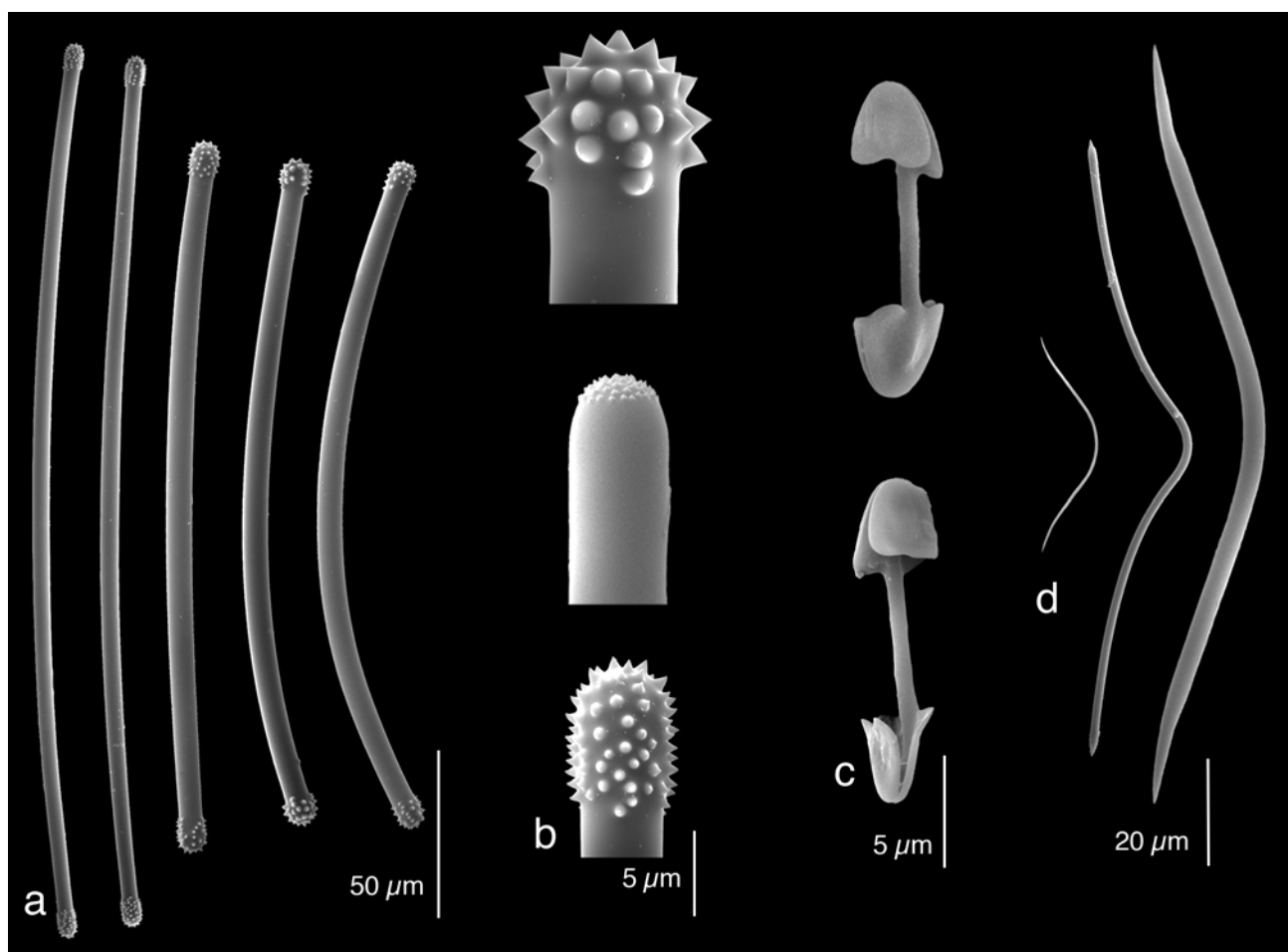
## Genus *Cornulum* Carter, 1876

### *Cornulum johnstoni* (de Laubenfels, 1934)

(Figure 31)

Synonymy and References. *Coelosphaerella johnstoni* de Laubenfels, 1934: 21.

**Material.** USNM 1229001, 1229002 Carrie Bow Cay, South reef, lower surface of *Acropora* coral plates in exposed zone behind reef crest, 1 m. K. Ruetzler col. 6 Mar 2006. USNM 1229003, Curlew Bank, forereef slope, 21 m; C. Piantoni and M. Parrish col. 21 Aug 2012. USNM 1229004, Curlew Bank, forereef slope, 20 m; C. Piantoni and M. Parrish col. 23 Aug 2012.



**FIGURE 31.** *Cornulum johnstoni*, spicules (SEM): a, strongyles (tylotes) with microspined ends (tyles), three ends magnified; b, palmate isochelas; c, toxa.



Comparative material examined: USNM 22364 *Coelosphaerella johnstoni* de Laubenfels, 1934 (holotype), Puerto Rico.

**External morphology.** Minute, whitish fistules protruding from the dead coral substratum. Their dimensions are 1.5–2.5 mm diameter, 3–5 mm height; they are spaced a few millimeters apart from each other, over a surface area of about 10 to 50 cm<sup>2</sup>, or more. About half of the fistules are closed at the distal end and seem to serve as incurrent structures, the others (tubules) are open, end in an osculum. The choanosomal parts of the sponge are mostly inside the substratum, penetrating or excavating small cavities that are filled with tissue. The initial impression of this sponge is that of a miniature *Siphonodictyon* species. Most of the epilithic sponge structures are white, but some from the deeper cave appeared yellowish and purplish gray in life.

**Skeleton structure.** The megascleres (strongyles/tylotes) occur in netlike criss-cross fashion in the walls of the ectosomal fistules but are not cemented at their ends, as in an isodictyal reticulation. In the choanosome they occur in lesser numbers and without orientation. Microscleres (chelas, toxas) occur in between the strongyles, particularly in the ectosome.

**Spicules.** Strongyles, with microspined ends that are mostly slightly thickened, approaching the form of tylotes: 202–300 x 5–12 (255 x 7) µm; palmate isochelas, most with one end twisted 90° in relation to the other: 13–15 (14) µm; toxas, in large size range: 41–171 x <1–6 (127 x 3) µm.

**Ecology.** Very common on shaded substrata and in dark caves, but not easily seen with the unaided eye. Here found to a depth of 21 m, originally described from deep-sea bottoms at 360–720 m.

**Distribution.** Caribbean Sea.

**Comments.** We verified the original description by examining the holotype (USNM 22364). Although the sizes of the strongyles in the type are somewhat larger (345 x 9 µm, on average), all other morphological characteristic agree fully with our material.

## Genus *Wigginsia* de Laubenfels, 1953a

### *Wigginsia curlewensis* new species

(Figures 4a, 32)

Synonymy and references. *Wigginsia* de Laubenfels, 1953a: Hooper (2002): 428, fig. 12.

**Material.** Holotype: USNM 1229005, Curlew Bank, forereef slope, framework cave, 21 m; C. Piantoni & M. Parrish col. 21 Aug 2012.

Additional material examined: USNM 23222 *Wigginsia wigginsi* de Laubenfels, 1953a (holotype).

**Diagnosis.** *Wigginsia* with ectosomal tylotes, microspined at both ends (tyles), two size classes of choanosomal acanthostyles, microspined strongyles, and palmate isochelas.

**External morphology.** A very thin crust (<1 mm) coating about 25 cm<sup>2</sup> of the rock substratum. Smooth surface with a few porous areas but no distinctive openings. Live color is yellow orange.

**Skeleton structure.** Two size classes of acanthostyles and a small number of acanthostrongyles are positioned more or less erect and echinating on the substratum; longer, slim tylotes occur tangentially near the surface; rare isochelas are dispersed throughout the tissue.

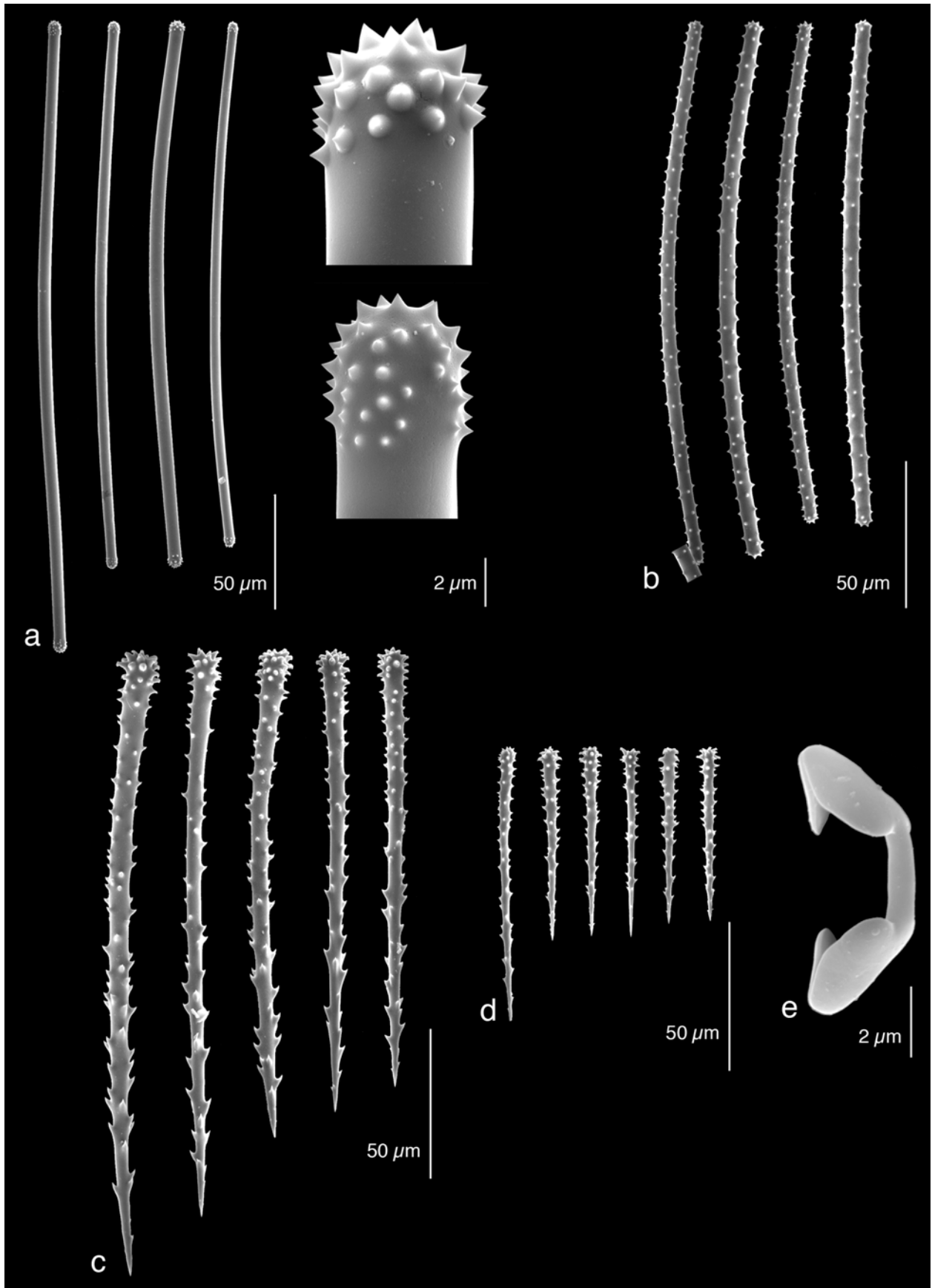
**Spicules.** Ectosomal tylotes, microspined at the swollen ends (tyles): 220–295 x 5–8 (266 x 7) µm; strongyles, microspined over entire shaft (acanthostrongyles): 161–200 x 3–7 (175 x 6) µm; acanthostyles I, with coarse spines pointed away from the point, toward the rounded end: 146–210 x 10–17 (183 x 13) µm; acanthostyles II, of similar shape but smaller: 53–114 x 5–9 (73 x 7) µm; palmate isochelas (rare, n=5): 7–8 µm.

**Ecology.** Found only once, in a reef cave at 21 m.

**Distribution.** Belize.

**Etymology.** Named after the type locality, Curlew Bank (formerly Curlew Cay; the islet was washed away by a hurricane in the 1940s).

**Comments.** The type and only described species in this genus (*Wigginsia wigginsi* de Laubenfels, 1953a) was reported from the Arctic (North Pacific); this is the first record of the genus from the tropical Atlantic. As shown in Hooper (2002, fig. 12), our species differs from *W. wigginsi* by longer, slimmer ectosomal tylotes, smaller and thinner but more heavily spined acanthostyles in two distinct size classes, and the microspination of the strongyles.



**FIGURE 32.** *Wigginsia curlewensis*, spicules (holotype USNM 1229005, SEM): a. Ectosomal tyloids, with microsperined tyloids; b. Acanthostrongyles; c. Acanthostyles I; d. Acanthostyles II; e. Isochele.

## Family Microcionidae

### Genus *Clathria* Schmidt, 1862

#### Subgenus *Microciona* Bowerbank, 1862

#### *Clathria (Microciona) bulbotoxa* van Soest, 1984

(Figures 2b, 33)

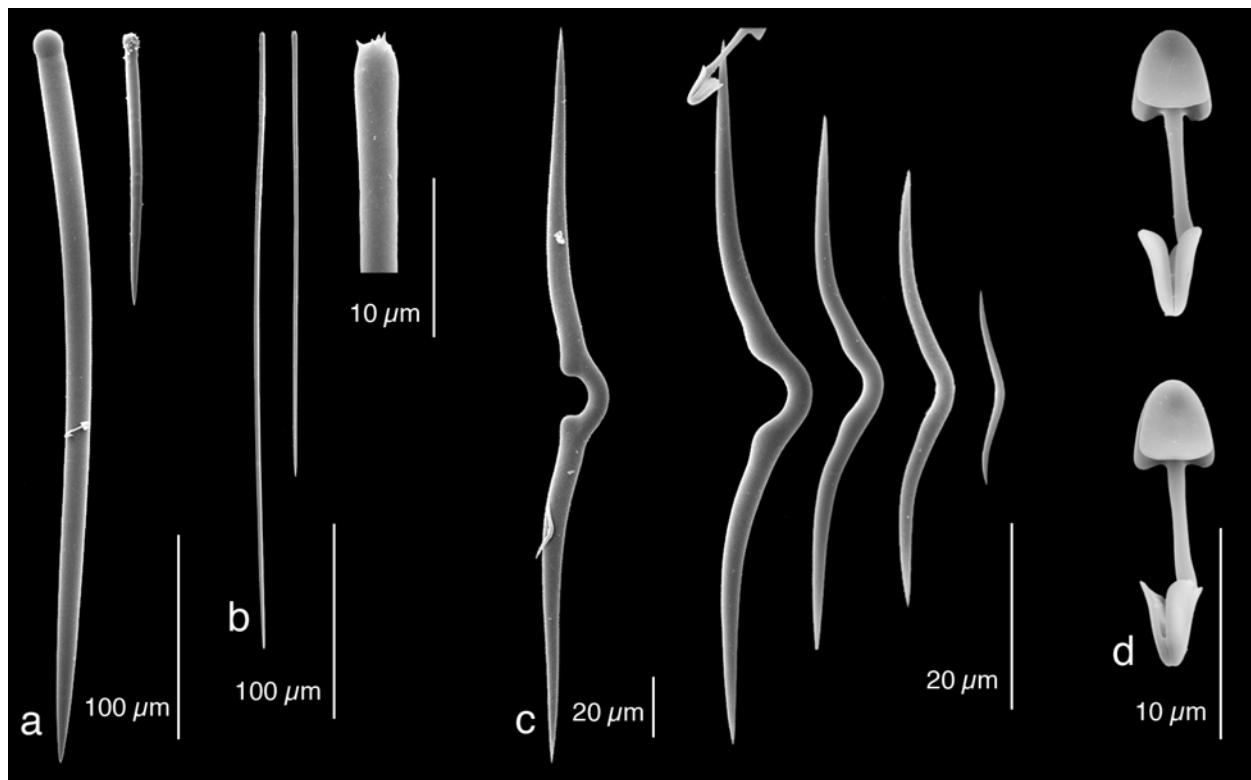
Synonymy and references. *Clathria (Microciona) bulbotoxa* van Soest, 1984a: 103, fig. 41, pl. 7: 5–8.

**Material.** USNM 1229006, Carrie Bow Cay, North channel, underside of coral rock, 6 m; K. Ruetzler, col. 23 May 1979. USNM 1229007, Curlew Bank, forereef framework cave wall, 20 m; C. Piantoni col. 29 Jun 2007.

**External morphology.** Thinly encrusting, covering up to 60 cm<sup>2</sup> substratum. Soft consistency, slightly mucous; smooth surface, except for protruding substrate structure and a few subectosomal canals; numerous, very small (ca.1 mm) oscula. Bright red, uniform color in life, only oscular rims being slightly less pigmented (appearing pink).

**Skeleton structure.** Disorderly strands of spongin cored and echinated by (sub-)tylostyles; in places, these megascleres are arranged in criss-cross fashion. Microscleres were found throughout the ecto- and choanosome. An irregular network of spongin fibers cored by (sub-) tylostyles, echinated by stubby acanthostyles. Smaller tylostyles are in the ectosome, some forming brushes at the surface.

**Spicules.** All megascleres have more or less pronounced heads (subtylostyles), the larger ones rough or with a few spines on top, many of the smaller category with distinctly microspined heads. Subtylostyles I (choanosomal): 132–550 x 10–20 (357 x 14) μm; subtylostyles II (ectosomal): 120–390 x 3–8 (290 x 6) μm; bulbous toxas: 58–182 (104) μm; their thickness measures 3.0–8.0 (5) μm in the bulbous parts, as compared to 2.0–5.7 (3) μm at the center of the arch; smaller, regular toxas (possibly early developmental stages of the bulbous kind, as suggested by van Soest in the description of the type): 20–47 (29) μm length, 1.1–4.7 (2) μm thick, at the center of the arch; palmate isochelas (most of them twisted): 13.4–14.0 (14) μm.



**FIGURE 33.** *Clathria (Microciona) bulbotoxa*, spicules (SEM): a, subtylostyles I (choanosomal); b, subtylostyles II (with one rounded end enlarged); c, bulbous and developing (non-bulbous) toxas; c, twisted palmate isochelas.

**Ecology.** Occurs under rock and in cave habitats in deeper parts of reefs, to 25 m.

**Distribution.** Found in the Netherlands Antilles and Belize, so apparently Caribbean-wide.

**Comments.** Both the original author (van Soest, 1984a) and our group found the characteristic bulbous toxas as foreign spicules in some preparations made from other reef sponges.

### *Clathria (Microciona) campecheae* Hooper, 1996

(Figure 34)

Synonymy and references. *Hymeraphia affinis* Topsent, 1889: 43, fig. 8A; *Microciona affinis* (Topsent): Macintyre *et al.* (1982): 134; *Clathria (Microciona) affinis* (Topsent, 1889): van Soest (1984a): 93, fig. 36 (not *Clathria (Microciona) affinis* (Carter, 1880), a valid species); *Clathria (Microciona) campecheae* Hooper, 1996: 220.

**Material.** USNM 32864, Columbus Cay cave, Belize, 18–21 m; G. Hendler & I. G. Macintyre col. 26 Apr 1979. USNM 1191352, Carrie Bow Cay, forereef cave, off Curlew Bank, 20 m; C. Piantoni col. 2 Jul 2007. USNM 1229009, Carrie Bow Cay, forereef cave, off Curlew Bank, 21 m; C. Piantoni & M. Parrish, col. 21 Aug 2012.

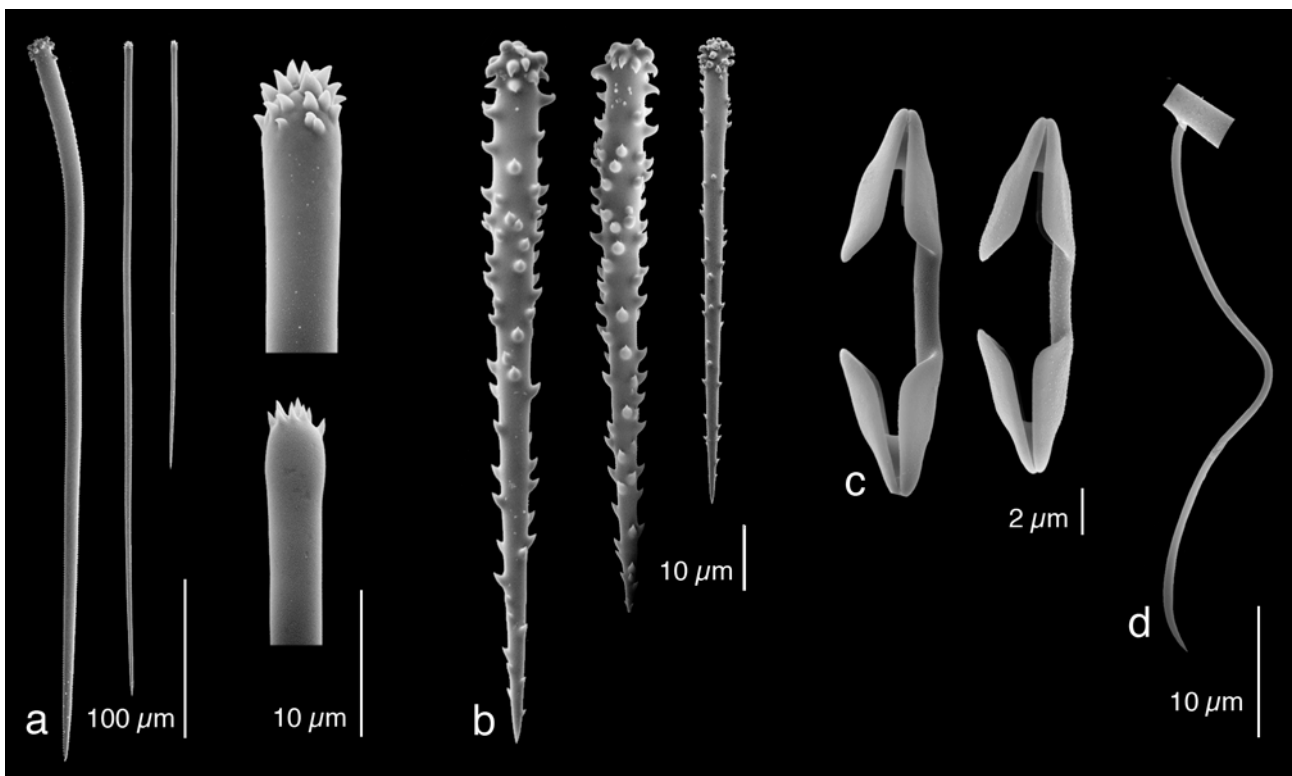
**External morphology.** Forming very thin crusts on rock and other organisms, bristly from large protruding spicules. Tiny oscula visible in live specimens but fully contracted in preserved material. Color yellow orange to reddish brown.

**Skeleton structure.** Large styles/tylostyles arranged perpendicular to the substrate, accompanied by smaller acanthostyles, with heads embedded in basal spongin layer. Other megascleres and microscleres occur throughout, without particular orientation.

**Spicules.** Choanosomal styles or subtylostyles with spiny heads, 400–880 x 13–25 (573 x 18)  $\mu\text{m}$ . Ectosomal subtylostyles with microspined heads, 230–660 x 5–14 (491 x 7)  $\mu\text{m}$ . Acanthostyles, 70–190 x 8–18 (133 x 12)  $\mu\text{m}$ . Palmate isochelae, 12–17 (15)  $\mu\text{m}$ . Toxa, 42–380 x 1–7 (287 x 4)  $\mu\text{m}$ .

**Ecology.** Encrusting various substrates on reefs and in reef caves, including serpulid worm tubes and other sponges, such as *Agelas schmidti*; 18–25 m depth.

**Distribution.** Known from the Gulf of Mexico and the western and southern Caribbean.



**FIGURE 34.** *Clathria (Microciona) campecheae*, spicules (SEM): a, choanosomal tylostyle (left) and ectosomal subtylostyles (with heads enlarged); b, acanthostyles; c, palmate isochelae; d, toxa.

**Comments.** Transfer of Topsent's species to *Clathria (Microciona)* by van Soest (1984a) created a taxonomic conflict with *Clathria affinis* (Carter), prompting Hooper (1996a) to introduce the new name *C. campecheae*.

### ***Clathria (Microciona) cf. echinata* (Alcolado, 1984)**

Synonymy and References. *Axociella echinata* Alcolado, 1984: 7, figs 3B, 4B; *Clathria (Microciona) simpsoni* van Soest, 1984: 97, fig. 38, pl. 7:2–4.

**Material.** USNM 1229010, Carrie Bow Cay, South reef, surf-exposed zone behind reef crest, underside of dead *Acropora* coral plates, 0.5 m; K. Ruetzler col. 6 Mar 2006.

Field identification (06-KC4f, not preserved): Carrie Bow back reef and reef flat, inside dead conch shells, 1 m; K. Ruetzler & C. Piantoni col. 23 Feb 2006.

**External morphology.** Thin crusts, covering up to 25 cm<sup>2</sup> area. Very small (<1 mm) oscula, barely noticeable. Live color bright red.

**Skeleton structure.** Ascending, branching fiber tracts, cored and echinated by styles. Subtylostyles and microscleres free in the tissue, particularly in the ectosome.

**Spicules.** Robust styles of large size range, most thickest at the (top) round end, some fusiform, thickest in the upper third of the length: 150–550 x 7–15 (341 x 9) µm; subtylostyles, with microspined tops: 210–450 x 2–10 (263 x 4) µm; toxas (some oxeote): 190–280 x 5–8 (243 x 6) µm; raphide-like toxas: 60–90 x 1 (75 x 1) µm; cleistocheles (tips of palmate chela hooks almost touch): 9–13 (11) µm.

**Ecology.** Only found in shaded locations on shallow reef substrates, 0.5–1 m.

**Distribution.** Bermuda, Bahamas, Gulf of Mexico and throughout the Caribbean.

**Comments.** Our specimens differ from the descriptions by Alcolado (1984) and van Soest (1984a) by lacking the large toxiform oxeas and regular (non-cleistochele) chelas. More material will be needed to clarify this inconsistency.

### **Subgenus *Thalysias* Duchassaing and Michelotti, 1864**

#### ***Clathria (Thalysias) curacaoensis* Arndt, 1927**

(Figures 2a, 35)

Synonymy and references. *Aulospongia schoenus* de Laubenfels, 1936b: 100, pl. 13 (3); *Raphidoplus schoenus* (de Laubenfels, 1936): van Soest (1984a): 112, fig. 44.

**Material.** USNM 1229011, Carrie Bow Cay, inner reef slope, cave ceiling, 18 m; K. Ruetzler col. 14 May 1975. USNM 1229012, Carrie Bow Cay lagoon, under concrete dock, 1 m; K. Ruetzler col. 17 Jun 1977. USNM 1229013, Carrie Bow Cay lagoon, lower surface of coral plate. K. Ruetzler col. 8 May 2007. USNM 1229014, Carrie Bow Cay lagoon, under concrete dock, 1 m; K. Ruetzler col. 3 July 2007. USNM 1229015, 1229016, 1229017, 1229018, Carrie Bow Cay South reef, lower surface of rock slab, 1 m; K. Ruetzler col. 13 Mar 09.

**External morphology.** Thinly encrusting 4–60 cm<sup>2</sup> areas; dry feeling (non-mucous). Live color is deep red, dull red, greenish orange to ochre.

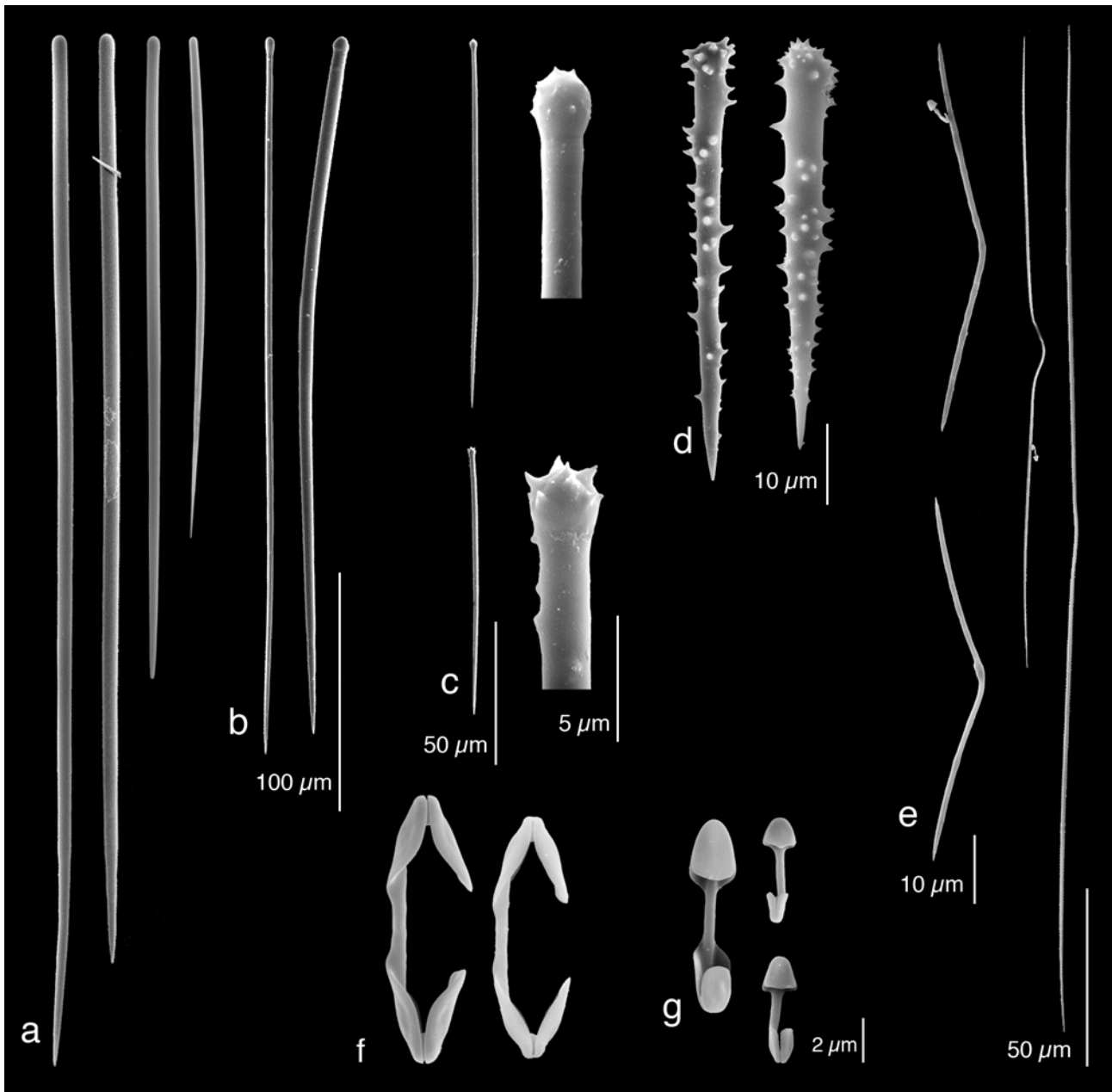
**Skeleton structure.** Interconnected spicule tracts (including styles and tylostyles), ending in reticulation and some brushes at the sponge surface. Acanthostyles occur mainly near the base.

**Spicules.** Styles, many subtylote: 220–360 x 5–9 (324 x 7) µm; (sub-)tylostyles I (some with microspined heads): 220–330 x 3–4 (262 x 4) µm; (sub-)tylostyles II: 80–160 x 2–3 (122 x 2) µm some with microspined heads; acanthostyles: 38–60 x 5–10 (48 x 6) µm; regular toxas: 45–100 (67) µm, all about 1 µm thick; raphidiform toxas: 200–275 (160) µm, all <1–1 µm thick; palmate isochaelas in two size categories, I: 8–13 (12) µm and II: 3–8 (5) µm, the latter mostly twisted.

**Ecology.** Common on the lower surfaces of coral rubble; also found on concrete pillars under a boat dock, and on the ceiling of a small cave on the forereef; 1–18 m.

**Distribution.** Florida, Bahamas, Gulf of Mexico, and throughout the Caribbean.

**Comments.** Lobate, ramose, and flabellate specimens are known from non-cryptic habitats in mangroves and on reefs (van Soest, 1984a). The synonymy of this species has been clarified in a recent revision by van Soest *et al.* (2013a).



**FIGURE 35.** *Clathria (Thalysias) curacaoensis*, spicules (SEM): a, styles; b, (sub)-tylostyles I; c, (sub)-tylostyles II (with spiny heads enlarged); d, acanthostyles; e, regular and raphidiform toxas; f, isocheles I; g, isocheles II (regular and twisted forms).

***Clathria (Thalysias) venosa* (Alcolado, 1984)**  
(Figure 2a)

Synonymy and References. *Microciona venosa* Alcolado, 1984: 6, fig. 4A.

**Material.** USNM 1229019, Carrie Bow Cay, reef flat East, 0.5 m, underside of coral plate; K. Ruetzler col. 1 May 1974. USNM 1229020, 1229021 Carrie Bow Cay, under concrete dock; K. Ruetzler col. 12 May 1978. USNM 1229022, Carrie Bow Cay, South reef, lower surface of coral slab, 1 m; K. Ruetzler col. 9 Jan 1988. USNM

1191357, Carrie Bow south barrier back reef, underside of platy coral rubble, 0.5 m; K. Ruetzler col. 6 Mar 2006. USNM 1191358, Carrie Bow Cay, under CBC concrete dock, 1 m; K. Ruetzler col. 3 Jul 2007.

**External morphology.** Thin, soft and somewhat mucous crusts, 25–40 cm<sup>2</sup>, with vein-like canals leading toward small oscula (1 mm, fully contracted in alcohol). Live color gray to yellow-orange on the surface, red below.

**Skeleton structure.** Megasclere tracts (subtylostyles echinated by small acanthostyles) extending from the substrate toward the surface; brushes of small subtylostyles protruding from ectosome. Very thin toxas (toxa-shaped raphids) and chelas throughout the tissue.

**Spicules.** Subtylostyles I, some with minute spines (only seen by SEM) on the heads: 190–450 x 3–7 (274 x 4) µm; subtylostyles II, some are styles: 60–150 x 1–3 (138 x 2) µm; acanthostyles: 43–60 x 3–8 (48 x 5) µm; toxas: 30–325 x <1 (164 x <1) µm; palmate isochelas, 9–15 (13) µm long, some of them twisted.

**Ecology.** Found under a concrete dock in the lagoon and on the lower surface of dead *Acropora palmata* plates in a wave-exposed zone of the barrier-reef crest, in 0.5–1 m depth.

**Distribution.** Gulf of Mexico and Caribbean.

**Comments.** Chelae are rare or absent in some specimens.

### ***Clathria (Thalysias) virgultosa* (Lamarck, 1814)**

Synonymy and References. *Raphidophlus juniperinus* (Lamarck, 1814): van Soest (1984a): 109, fig. 43.

**Material.** USNM 1229024, Carrie Bow Cay lagoon, under concrete dock, 1 m; K. Ruetzler col. 17 Jun 1977. USNM 1229025, Carrie Bow Cay reef flat, under coral rubble, 0.5 m; K. Ruetzler col. 29 Jan 1986. USNM 1229026, Carrie Bow Cay lagoon, under coral rubble, 1 m; K. Ruetzler col. 8 May 2007. USNM 1229027, Carrie Bow Cay back reef and reef flat, inside dead conch shells, 1 m; K. Ruetzler and C. Piantoni col. 23 Feb 2006. USNM 1229028, Curlew Bank, forereef cave, 20 m; C. Piantoni, col. 28 Jun 2007. USNM 1229029, Carrie Bow Cay forereef, lower surface of *Agaricia* coral plate, 21 m; C. Piantoni col. 28 Jun 2007. USNM 1229030 Carrie Bow Cay, South reef, lower surface of rock slab; K. Ruetzler col. 13 Mar 09. USNM 1229031, Carrie Bow Cay, south back reef, lower surface of platy coral rubble, 1 m; K. Ruetzler col. 17 Aug 2012. USNM 1229032, 1229033, 1229034, Carrie Bow Cay lagoon, under concrete dock, 0.5 m; K. Ruetzler col. 18 Aug 2012.

**External morphology.** Cryptic specimens are encrusting, fleshy soft, slightly mucous; they cover 30–50 cm<sup>2</sup> area. Oscula are inconspicuous, generally about 1 mm, maximum 2 mm in diameter. Live color is bright red to orange red, some specimens were recorded to have a greenish yellow hue over dark red.

**Skeleton structure.** An irregular network of spongin fibers cored by (sub-) tylostyles, echinated by stubby acanthostyles. Smaller tylostyles are in the ectosome, some forming brushes at the surface.

**Spicules.** Styles, thickest near the rounded ends: 200–400 x 3–13 (318 x 7) µm; (sub-)tylostyles I: 260–320 x 3–6 (283 x 5) µm; (sub-)tylostyles II: 100–143 x 2–3 (122 x 3) µm; acanthostyles: 38–70 x 5–8 (50 x 7) µm; regular toxas: 20–60 (35) µm; raphidiform toxas: 108–280 (167) µm; palmate isochaelas: 12–14 (13) µm.

**Ecology.** All cryptic specimens were found either on concrete pillars under a boat dock, on the undersides of reef rubble, or inside small forereef caves; from 0.5–21 m.

**Distribution.** Florida, Bahamas, Gulf of Mexico and throughout the Caribbean.

**Comments.** Branching growth forms of the sponge are also found in full light, both in reef and lagoon habitats.

## **Family Raspailiidae**

### **Genus *Ectyoplasia* Topsent, 1931**

#### ***Ectyoplasia ferox* (Duchassaing & Michelotti, 1864)**

Synonymy and references. *Ectyoplasia ferox* (Duchassaing & Michelotti, 1864): Zea (1987): 202, fig. 73, pl. 12: 6–7.

**Material.** USNM 1229035, Carrie Bow Cay, forereef cave, 22 m; K. Ruetzler col. 24 Apr 1974. USNM 1229036, Carrie Bow Cay, forereef slope, coral rock underside, 25 m; K. Ruetzler col. 26 Apr 1974. USNM 1229037 Curlew

Bank, forereef cave, 20 m; C. Piantoni col. 28 Jun 2007. USNM 1229038, 1229039, Curlew Bank, forereef cave, 20 m; C. Piantoni col. 2 Jul 2007. USNM 1229040, 1229041, 1229042, Carrie Bow Cay, South reef, lower surface of rock slab, 1m; K. Ruetzler col. 13 Mar 09. USNM 1229043, Curlew Bank forereef cave, 18 m; C. Piantoni & M. Parrish col. 25 Aug 2012.

**External morphology.** Thick cushions (1–4 cm) extending to 150 cm<sup>2</sup> area, with oscula elevated on cones, volcano-like. Oscular diameters 3–7 mm. Surface smooth to velvety and verrucose. Consistency firm, elastic, but easily crumbled. Color rich, clear orange to orange brown, to ochre, purplish and grayish brown, yellow orange, and yolk yellow; interior lighter, cream to yellow.

**Skeleton structure.** The choanosome is very porous but supported by ascending, plumose spicule tracts that branch and coalesce; in between the columns, spicules are found in halichondriid arrangement, without particular orientation. There is no ectosomal specialization.

**Spicules.** The spiculation consists of robust styles, mixed with a varying number of delicate acanthostyles. The styles are curved or sharply bent at the upper third of their length (near the blunt end): 286–370 x 9–17 (359 x 14) µm; acanthostyles have most spination on the lower half (toward the point) and are smooth above; in many, the longest spines are surrounding the point, perpendicular to the main axis: 114–180 x 4–11 (156 x 6) µm.

**Ecology.** Common on the open forereef but also under rocks and in caves, 1–25 m. One cave specimen (USNM 1229043) fully overgrew another sponge, *Iotrochota birotulata*.

**Distribution.** Florida, Bahamas, and Caribbean.

**Comments.** Specimens from the light-exposed open reef tend to form groups of laterally fused tubes; the encrusting shape seems typical for caves and other cryptic habitats.

## Suborder Myxillina

### Family Chondropsidae

#### Genus *Strongylacidon* von Lendenfeld, 1897

##### *Strongylacidon rubrum* van Soest, 1984

Synonymy and references. *Strongylacidon rubra* van Soest, 1984a: 44, fig. 15.

**Material.** USNM 1229044, Carrie Bow Cay forereef, spur and groove zone, cryptic, 6 m; K. Ruetzler col. 1 Feb 1997.

**External morphology.** A very thin (0.1–1 mm) crust covering about 20 cm<sup>2</sup>. Surface smooth, porous under high magnification but without obvious oscula. A few circular openings belong to overgrown serpulid worm tubes. Soft consistency, bright red color in life.

**Skeleton structure.** A cross-section shows wisps of thin megascleres (strongyles) ascending brush-like from the base to the surface; sigmoid microscleres are dispersed throughout the tissue.

**Spicules.** Very thin, mostly straight strongyles with wide axial canal (black under transmitted light): 185–220 x 1–3 (200 x 2) µm; sigmas in two size classes (some s-shaped), I: 27–30 (29) µm; II: 13–17 (15) µm.

**Ecology.** Overgrowing the base of a massive specimen of the sponge *Svenzea zeai* (Alvarez, van Soest and Ruetzler), 20 m.

**Distribution.** Caribbean Sea.

### Family Crambeidae

#### Genus *Monanchora* Carter, 1883a

##### *Monanchora arbuscula* (Duchassaing & Michelotti, 1864)

(Figure 3d)

Synonymy and References. *Echinostylinos unguiferus* de Laubenfels, 1953b: 528, fig. 6. *Monanchora barbadensis* Hechtel, 1969: 21, fig. 3; van Soest (1984a): 40, fig. 12.



**Material.** USNM 1229045, Carrie Bow Cay forereef, low spur and groove zone, underside of *Agaricia* coral rubble, 8–9 m; K. Ruetzler col. 7 May 1973. USNM 1229046, 1229047, Carrie Bow Cay forereef slope, lower surface of coral rock, 25 m; K. Ruetzler col. 26 Apr 1974. USNM 1229048, Carrie Bow Cay forereef, low spur and groove zone, underside of *Agaricia* coral rubble, 8–9 m; K. Ruetzler col. 11 May 1975. USNM 1229049, Carrie Bow Cay forereef, high spur and groove zone, mini-cave, 4 m; K. Ruetzler col. 11 May 1979. USNM 1229050, Carrie Bow Cay forereef spur, at the base of the sponge *Svenzea zeai* (Alvarez, van Soest & Ruetzler), 6 m; K. Ruetzler col. 1 Feb 1997. USNM 1229051, 1229052, Curlew Bank, forereef cave, 20 m; C. Piantoni col. 28 Jun 2007. USNM 1229053, Curlew Bank forereef, lower surface of dead *Agaricia* coral plate, 21 m; C. Piantoni, col. 28 Jun 2007. USNM 1229054, Carrie Bow Cay forereef, cryptic in cavity, 28 m; M. C. Diaz col. 8 Sep 2009. USNM 1229055, Curlew Bank forereef slope, small cave, 20 m; C. Piantoni and M. Parrish col. 23 Aug 2012. Field observation (12–30, no material preserved): Curlew Bank forereef slope, small cave, 20 m; C. Piantoni and M. Parrish col. 23 Aug 2012.

**External morphology.** All specimens encountered were thin (1–3 mm) encrustations covering 2–50 cm<sup>2</sup> substratum. Small oscula (1–2 mm), slightly elevated. Most specimens, when undisturbed, show dark red subectosomal canals leading toward the oscula, contrasted against a whitish hue in the surrounding ectosome. Color is deep red throughout.

**Skeleton structure.** Megascleres (subtylostyles, tylostyles) may be erect at the base but are mostly forming tracts that brush out toward the ectosome. Microscleres are dispersed between the tracts.

**Spicules.** Thick subtylostyles I, usually straight, ranging from pure styles to tylostyles with poorly pronounced tyle: 160–360 x 4–15 (237 x 9) µm; thin subtylostyles II (more common than I), straight or slightly curved: 120–280 x 3–8 (237 x 4) µm; anchorate isocheles (unguiferate, with 3–5 teeth): 20–30 (23) µm; reduced chelae (appearing like sigmas): 6–12 (8) µm.

**Ecology.** In forereef caves or cryptic under rocks and platy coral rubble, 4–28 m.

**Distribution.** Gulf of Mexico, Caribbean, off Brazil.

## Family Hymedesmiidae

### Genus/subgenus *Hymedesmia* Bowerbank, 1864

#### *Hymedesmia (Hymedesmia) agariciicola* van Soest, 1984

Synonymy and references. *Hymedesmia agariciicola* van Soest, 1984a: 82, fig. 31.

**Material.** USNM 1229056, Curlew Bank forereef cave, 20 m; C. Piantoni col. 28 Jun 2007.

**External morphology.** Thin crust covering the basal body of another sponge (*Oceanapia bartschi*), about 35 cm<sup>2</sup> area; smooth surface, a few inconspicuous oscula of less than 1 mm diameter. Live color is orange red.

**Skeleton structure.** Acanthostyles (two size classes) in the choanosome, erect, held by a basal sponging plate. Tornotes positioned tangentially in the ectosome. Chelas in between the megascleres.

**Spicules.** Tornotes, very thin, slightly thicker just before the points: 175–230 x 1–3 (198 x 2) µm; acanthostyles I: 150–210 x 7–5 (179 x 11) µm; acanthostyles II: 50–80 x 5–10 (66 x 8) µm; chelas I: 30–40 (35) µm; chelas II: 17–23 (20) µm

**Ecology.** Encrusting another sponge (*Oceanapia bartschi*) in a forereef cave, 20 m.

**Distribution.** Netherlands Antilles and Belize, probably Caribbean-wide.

**Comments.** All spicule dimensions are larger than those reported for the holotype but all other morphological features agree well.

#### *Hymedesmia (Hymedesmia) curacaoensis* van Soest, 1984

Synonymy and references. *Hymedesmia curacaoensis* van Soest, 1984a: 84, fig. 32.

**Material.** USNM 1229057, Carrie Bow Cay forereef, low spur and groove zone, on lower surface of *Agaricia*

coral rubble, 8–9 m; K. Ruetzler col. 7 May 1973. USNM 1229058, Carrie Bow Cay forereef, inner reef slope, cave ceiling, 20 m; K. Ruetzler col. 14 May 1975. USNM 1229059, Carrie Bow Cay, South reef, lower surface of *Acropora* coral plates in exposed zone behind reef crest, 1 m. K. Ruetzler col. 6 Mar 2006.

**External morphology.** Thinly encrusting, patches of 16–40 cm<sup>2</sup> area; smooth surface, without openings visible to the unaided eye. Color in life, bright red to orange.

**Skeleton structure.** Acanthostyles in two size classes, positioned perpendicular to the substratum; tornotes and microscleres mainly located in the ectosome.

**Spicules.** Tornotes, with one end slightly swollen: 220–330 x 2–3 (255 x 2) µm; acanthostyles I: 210–351 x 12–18 (233 x 15) µm; acanthostyles II: 50–130 x 6–18 (89 x 11) µm; chelas: 30–38 (32) µm.

**Ecology.** Encrusting lower surfaces of platy coral rock on the forereef, 8–9 m.

**Distribution.** Netherlands Antilles and Belize, probably Caribbean-wide.

**Comments.** Macrosclere dimensions are somewhat longer (tornotes) or thicker (acanthostyles) than those reported for the holotype, but agree well morphologically.

## Genus *Phorbas* Duchassaing & Michelotti, 1864

### *Phorbas aurantiacus* new species

(Figures 4b, 36)

Synonymy and references. *Phorbas* Duchassaing & Michelotti, 1864: van Soest (2002b): 585, fig. 6 (for generic assignment).

**Material.** Holotype: USNM 1229060, Curlew Bank, forereef slope, framework cave, 21 m; C. Piantoni and M. Parrish col. 23 Aug 2012.

Paratype: USNM 1229061 Carrie Bow Cay, forereef slope, coral rock underside, 30 m; K. Ruetzler col. 26 Apr 1974.

**External morphology.** Fleishy crust extending over about 30 cm<sup>2</sup>, 1–4 mm thick. Soft consistency, surface covered by low bumps (conules) with 2–4 mm diameter oscules in between, alternating with ostial sieves of about the same size. Live color deep orange red.

**Skeleton structure.** Tracts of styles echinated by acanthostyles run from the base of the sponge toward the surface; very thin styles fan out from the end of the tracts, giving them a brush-like appearance.

**Spicules.** Smooth, slender styles with gradually narrowing points; of great size range without falling into distinct categories: 155–590 x 2–10 (221 x 4) µm; acanthostyles in three size categories, I: 223–410 x 13–21 (324 x 15) µm; one was observed deformed as a centrotylote acanthoxea; II: 140–190 x 10–15 (151 x 13) µm; III: 75–98 x 8–13 (87 x 10) µm.

**Ecology.** Forereef cave and on lower surface of coral rubble, 21–30 m.

**Distribution.** Belize.

**Etymology.** The species name reflects the vivid color of the sponge in life, *aurantiacus* (Latin) = orange.

**Comments.** In this species the smooth styles replace the tornotes usually encountered in species of *Phorbas*; the absence of microscleres is within the generic definition.

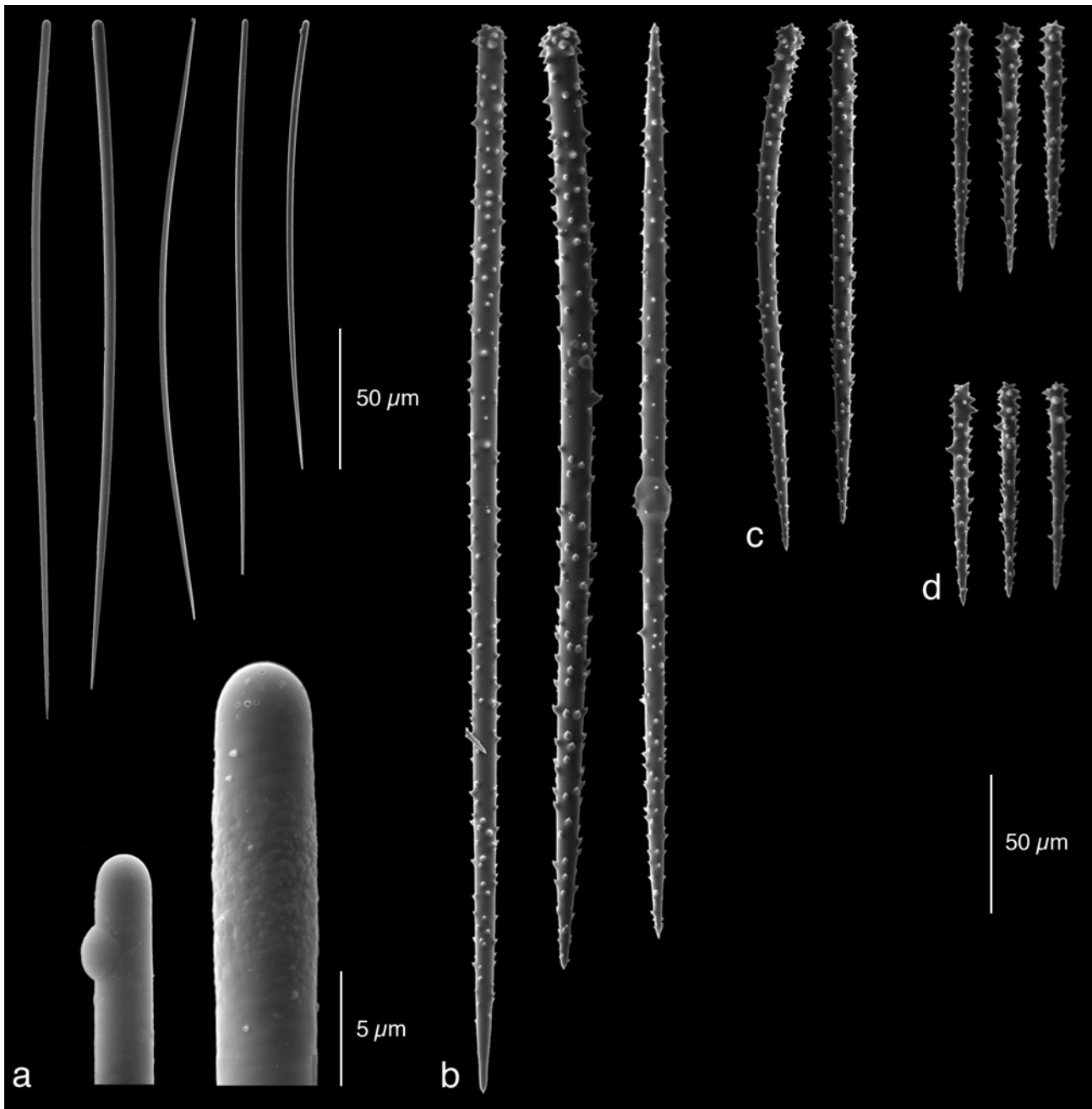
## Family Iotrochotidae

### Genus *Iotrochota* Ridley, 1884

#### *Iotrochota birotulata* (Higgin, 1877)

Synonymy and references. *Iotrochota birotulata* (Higgin, 1877): Rützler *et al.* (2007): 175, fig. 1–3.

**Material.** USNM 1229062, Carrie Bow Cay, under concrete dock, 0.5–1; K. Ruetzler, col. 17 Jun 1977. USNM 1229063, Carrie Bow Cay forereef cave wall, 25 m; M. C. Diaz col. 8 Sep 2009. USNM 1229064, Curlew Bank forereef cave, 18 m; C. Piantoni and M. Parrish col. 25 Aug 2012.



**FIGURE 36.** *Phorbast aurantiacus*, spicules (holotype USNM 1229060, SEM): a, styles; b, acanthostyles I; c, acanthostyles II; d, acanthostyles III.

**External morphology.** Thickly encrusting (50 cm<sup>2</sup>, 15 mm thick) or stout, creeping branches (12 cm long, 1.5 cm diameter, average), with corrugated, finely conulose surface and a few scattered oscula (>2 mm). Consistency stiff but elastic, difficult to tear. Color in life dark greenish to brown, golden brown when growing in very dark habitats; turning dark purple in alcohol and secreting a purplish mucus when squeezed.

**Skeleton structure.** A meshwork of spongin fibers, 200–400 μm thick, packed with spicules, the primary tracts ending in the surface conules.

**Spicules.** The fibers are filled with straight or slightly bent strongyles, mixed with a few stout styles (styles I). Interstitial spicules are thin styles (styles II, quite rare) and birotules. Strongyles: 94–256 x 3–7 (172 x 6) μm; styles I (n=5): 153–175 x 5–8 (161 x 7) μm; styles II (n=5): 200–154 x 3–5 (230 x 4) μm; birotules, length: 14–16 (15) μm.

**Ecology.** Occurs on the shallow, open reef, cryptic under rocks and in caves, 0.5–65 m. One cave specimen was almost entirely overgrown by another sponge, *Ectyoplasia ferox*.

**Distribution.** Gulf of Mexico, Caribbean, and northeastern Brazil..

## Suborder Mycalina

### Family Desmacellidae

#### Genus *Desmacella* Schmidt, 1870

##### *Desmacella polysigmata* van Soest, 1984

Synonymy and references. *Desmacella polysigmata* van Soest, 1984a: 138, fig 54, pl. 9: 3.

**Material.** USNM 1229065, Curlew Bank, forereef cave, 21 m; C. Piantoni and M. Parrish col. 21 Aug 2012.

**External morphology.** Cushion, about 4 cm in diameter and 2 cm thick. Surface partially covered by a web of filamentous red algae and a thin coralline algal crust. There are a few circular, low and porous incurrent papillae and oscula, 3–5 mm in diameter. The sponge is brittle and shows a cavernous interior where broken. The color in life is grayish white.

**Skeleton structure.** In the ectosome, styloid megascleres placed tangentially, a few perpendicular; numerous microscleres (sigmas). In the choanosome, megascleres in bundles and arranged in halichondrioid fashion, spaces in between densely filled with sigmas.

**Spicules.** Long, slender styles, many with strongylote modifications (rounded at both ends: 550–880 x 12–18 (639 x 14)  $\mu\text{m}$ ; sigmas I: 36–55 (46)  $\mu\text{m}$ ; sigmas II: 13–16 (15)  $\mu\text{m}$ .

**Ecology.** Only one specimen was collected, from a forereef cave in 21 m; a second one from the same habitat was found as overgrowth of *Prosuberites carriebowensis*. Van Soest (1984a) reported the type found among muddy sand off Barbados, 100 m.

**Distribution.** Caribbean Sea.

**Comments.** The megascleres in our specimen are somewhat longer and thinner than those of the type, but all other morphological characteristics agree well with the type description.

### Family Mycalidae

#### Genus *Mycale* Gray, 1867

##### Subgenus *Carmia* Gray, 1867

##### *Mycale (Carmia) microsigmatosa* Arndt, 1827

Synonymy and references. *Mycale (Carmia) microsigmatosa* Arndt, 1827: van Soest (1984a): 24, fig. 7, pl. 2: 6; Hajdu & Rützler (1998): 758, figs. 12, 13, 17f.

**Material.** USNM 1229066, Carrie Bow Cay, south back reef, lower surface of platy coral rubble, 1 m; K. Ruetzler col. 17 Aug 2012.

**External morphology.** A thin (2–4 mm) incrustation over about 25 cm<sup>2</sup> of rock surface. Soft consistency, scattered oscula (1–2 mm) at the ends of subectosomal canals. The base color is a light orange, but enhanced by clusters of dark orange pigment grains throughout the tissue.

**Skeleton structure.** No ectosomal specialization, mostly single megascleres and sigmas. Dendritic tracts of megascleres lead from the sponge base toward the surface, with microscleres scattered among them.

**Spicules.** Subtylostyles with oval heads not much wider than the center of the shaft: 221–310 x 4–6 (294 x 5)  $\mu\text{m}$ ; anisocyles I: 17–20 (18)  $\mu\text{m}$ ; anisocyles II: 8–13 (1)  $\mu\text{m}$ ; sigmas, a small percentage s-shaped: 25–80 (51)  $\mu\text{m}$ .

**Ecology.** Occurrence on the wave-exposed back reef is rare, the species is mostly found in lagoon and mangrove habitats; 0.5–1.5 m.

**Distribution.** Bermuda, Bahamas, Gulf of Mexico, and throughout the Caribbean.

**Comments.** The clusters of dark orange pigment grains in pale, translucent tissue are unique to this species.

## Subgenus *Grapelia* Gray, 1867

### *Mycale (Grapelia) unguifera* Hajdu, Zea, Kielman & Peixinho, 1995

Synonymy and References. *Mycale (Grapelia) unguifera* Hajdu, Zea, Kielman & Peixinho, 1995: 9, figs. 18–30.

**Material.** USNM 1229067, Curlew Bank forereef slope, small cave, 20 m; C. Piantoni & M. Parrish col. 23 Aug 2012.

**External morphology.** A thin cushion, 45 x 15 mm (6 cm<sup>2</sup>), up to 4 mm thick. The smooth surface shows 5 small (1.5 mm) circular oscula. Consistency is soft and mucous when handled, live color grayish blue.

**Skeleton structure.** Choanosomal subtylostyles dispersed without orientation, accompanied by various microscleres. Ectosomal subtylostyles more or less tangential, anisocheles in between, some arranged in rosettes.

**Spicules.** Subtylostyles slender, with elongate, oval heads and mostly dull points: 284–386 x 4–7 (356 x 5) µm; anisocheles I, with curved shaft, unguiferate head and palmate foot with alae topped by spines: 34–41 (36) µm; anisocheles II, with curved shaft, head composed of spines of different sizes (no alae recognizable) and palmate foot with alae topped by spines: 15–18 (17) µm; sigmas, with sharply bent, sharp hooks: 50–53 (52, n=10) µm.

**Ecology.** Growing on the wall of a forereef cave, 20 m. Type material is reported from coral bases and rock substrate in 6–10 m.

**Distribution.** Caribbean Colombia and Belize.

**Comments.** Anisocheles III described from the type material were not found in our preparations, otherwise all morphological characteristics and dimensions agree well.

## Subgenus *Mycale* Gray, 1867

### *Mycale (Mycale) laevis* (Carter, 1882)

Synonymy and References. *Mycale (Mycale) laevis* (Carter, 1882): van Soest (1984a): 14, fig. 2, pl. 1, 1–4; Hajdu & Rützler (1998): 763, figs. 14, 15.

**Material.** USNM 1229068, Carrie Bow South back reef, lower surface of rock slab; 1 m; K. Ruetzler col. 13 Mar 09.

**External morphology.** A crust covering 35 cm<sup>2</sup>, 3 mm thick. Surface rough to the touch, with scattered and slightly elevated 2 mm oscula. Color greenish yellow.

**Skeleton structure.** In the ectosome, megascleres occur more or less tangentially with microscleres in between. In the choanosome, most megascleres form dendritic tracts, along with many loose spicules that occur without orientation.

**Spicules.** Slim subtylostyles, with elongate oval heads, more or less sharply pointed: 379–530 x 8–15 (495 x 12) µm; anisocheles I: 45–56 (51) µm; anisocheles II, with foot reduced to a hook and a downward spur: 12–15 (14) µm; sigma I: 36–40 (38) µm; sigma II: 14–17 (16) µm; raphids in two size classes, all about 0.8 µm or less thick and bundled as trichodragmas, I: 44–80 (66) µm; raphids II: 19–24 (21) µm.

**Ecology.** The described specimen was cryptic under coral rubble on the shallow reef, but the species is more commonly observed at the base of forereef corals, also on mangrove stilt roots in well-flushed mangrove channels, 1–25 m.

**Distribution.** Caribbean, including the Gulf of Mexico.

**Comments.** Spicule dimensions are small compared to previously described material. This is considered a young specimen of this common forereef species.

## Family Merliidae

### Genus *Merlia* Kirkpatrick, 1908

### ***Merlia deficiens* Vacelet, 1980**

Synonymy and references. *Merlia deficiens* Vacelet, 1980: van Soest, 1984b: 211, figs. 1–5.

**Material.** This species was observed by our colleague Philippe Willenz (Royal Belgian Institute of Natural Sciences, Bruxelles, Belgium) during a survey of small forereef caves between South Water Cay and Curlew Bank, 24–39 m, in April 1987. No specimens were collected for Museum deposit.

**Ecology.** Cryptic, in dark parts of caves and on reefs (Vacelet, 1980), 5–39 m.

**Distribution.** Mediterranean and Caribbean.

**Comments.** Characteristic spicules (clavids combined with tylostyles) found as foreign components in other sponges collected in forereef caves probably originated from this species during episodes of overgrowth.

The view of synonymizing *Merlia deficiens* with *M. normani* is no longer upheld (van Soest *et al.*, 2013b).

### ***Merlia normani* Kirkpatrick, 1908**

Synonymy and references. *Merlia normani* Kirkpatrick, 1908: Hajdu & van Soest (2002): 692, fig. 1; Cruz (2002): 190 (2 figs.)

**Material.** USNM 1229067, Carrie Bow Cay forereef slope, lower surface of coral rock; 25 m; K. Ruetzler col. 26 Apr 1974. USNM 1229070, Carrie Bow Cay forereef slope, cave, 35 m; K. Ruetzler col. 26 Apr 1974. USNM 1229071, Carrie Bow Cay forereef, lower side of dead *Agaricia* coral, 8–10 m; K. Ruetzler col. 11 May 1975. USNM, 1229072, Curlew Bank forereef cave, 20 m; C. Piantoni col. 2 Jul 2007.

**External morphology.** Very thin crusts, 1–8 cm<sup>2</sup>, 1 mm thick at most. No visible openings, color yellow to yellow orange.

**Skeleton structure.** The tissue overlays and fills the honeycombed calcareous base skeleton. Tylostyles form some tracts, from the base to the surface, points outward; they are accompanied by raphids (bundled in trichodragmas). Clavids occur throughout the tissue but are most common in the ectosome, commas are found mostly in the choanosome.

**Spicules.** Very thin, straight tylostyles with oval head and sharp points: 120–182 x 3 (148 x 3) µm; the shaft reaches 2 µm thickness at most; clavids: 50–86 x 30–66 (65 x 48) µm; raphids, microspined, a few are centrotylote: 60–88 x 1–2 (80 x 2) µm; microspined microxeas, bent in the center („commas“, but with points on both sides, no knob-like thickening): 19–26 x <1–2 (23 x 1) µm.

**Ecology.** A typical representative of forereef caves and similar cryptic habitats, 25–35 m and below.

**Distribution.** Eastern Mediterranean, eastern Atlantic (Azores, Canaries, Madeira), Bermuda, Caribbean.

## **Order Halichondrida**

### **Family Axinellidae**

#### **Genus *Dragmacidon* Hallmann, 1917**

##### ***Dragmacidon reticulatum* (Ridley & Dendy, 1886)**

Synonymy and references. *Pseudaxinella lunaecharta* (Ridley & Dendy, 1886): Wiedenmayer (1977): 155, fig. 156, pl. 31: 7–10, pl. 32: 1–3. *Pseudaxinella reticulata* (Ridley & Dendy, 1886): Alvarez *et al.* (1998): 15. *Dragmacidon reticulatum* (Ridley & Dendy, 1886): Rützler *et al.* (2009): 301.

**Material.** USNM 1191334, off Curlew Bank, forereef cave, 20 m; C. Piantoni col. 2 Jul 2007.

**External morphology.** Cushion with lobes, about 5 cm total diameter. Surface finely conulose (0.5 mm conules), with conspicuous, slightly raised circular oscula, 2–3 mm in diameter. Color bright orange red in live.

**Skeleton structure.** Plumose spicule tracts leading from substrate to surface, some interconnected, loose spicules without particular orientation in between.

**Spicules.** The main spiculation is made up by styles, most of them bent in the upper third (toward the round end) where they are also the thickest: 290–340 x 15–20 (323 x 18)  $\mu\text{m}$ . Along with the styles occur, fewer in number, slightly bent hastate oxeas: 360–410 x 15–18 (336 x 17)  $\mu\text{m}$ . A small percentage of shorter and thinner styles and oxeas (averaging 180 x 9  $\mu\text{m}$ ) are probably developmental stages

**Ecology.** Generally found on reefs and other hard bottoms, 1–70 m, also epibiotic, overgrowing other sessile organisms, including sponges.

**Distribution.** From Bermuda to North Carolina, Florida, throughout the Gulf of Mexico and the Caribbean, and to northeastern Brazil.

## Genus *Dragmaxia* Hallmann, 1916

### *Dragmaxia undata* Alvarez, van Soest & Rützler, 1998

Synonymy and references. *Dragmaxia undata* Alvarez, van Soest & Rützler, 1998: Alvarez *et al.* (1998): 26 (with synonyms).

**Material.** USNM 1229073, Carrie Bow forereef slope, 15–35 m; coral rock, underside. K. Ruetzler col. 26 April 1974. USNM 1229074, Carrie Bow reef flat, underside of corrugated roofing tile, 0.5 m; K, Ruetzler col. 1 May 1974. USNM 1191336, Off Curlew Bank, forereef cave, 20 m; C. Piantoni col. 2 Jul 2007. USNM 1229075, Carrie Bow forereef cave wall, 25 m; M. C. Diaz col. 8 Sep 2009.

Comparative material: USNM 39451; paratype from Curaçao.

**External morphology.** Crusts and cushions, 4–30  $\text{cm}^2$ , up to 10 mm thick, with corrugated, hispid surface. Brittle, bright orange red in life.

**Skeleton structure.** Tracts of styles leading toward surface and protruding from the ectosome. Criss-cross arrangement of styles and abundant trichodragmas in between.

**Spicules.** Styles and subtylostyles of great size range, gently curved, some with subterminal asymmetrical swellings: 300–1280 x 7–28 (890 x 16)  $\mu\text{m}$ ; raphids, making up trichodragmas, are 60–600 x >1–2 (254 x 1)  $\mu\text{m}$ ; they have fine spines near the ends, pointing back toward the shaft.

**Ecology.** In cave habitats, including the lower surface of platy (coral) rubble, 0.5–35 m.

**Distribution.** Known from the Netherlands Antilles and Colombia, now also from Belize.

**Comments.** The mean dimension of spicules in our material are larger than those in one paratype we examined (USNM 39451) but they still fall within the ranges of length and width. The great length of some raphids (bundled in trichodragmas) is unusual for known sponges.

## Genus *Ptilocaulis* Carter, 1883b

### *Ptilocaulis walpersii* (Duchassaing & Michelotti, 1864)

Synonymy and references. *Pandaros walpersii* Duchassaing & Michelotti, 1864; *Ptilocaulis walpersi* (Duchassaing & Michelotti, 1864): Alvarez *et al.* (1998): 22 (with synonyms).

**Material.** USNM 1191335, Off Curlew Bank, forereef cave, 20 m; C. Piantoni col. 2 July 2007.

**External morphology.** A small erect fan with ridged and stubby surface, 2 cm tall (size of retained fragment). Tough, elastic, bright orange red in life.

**Skeleton structure.** Bundles of styles bound by spongin, extending from the base into the surface processes. They are interconnected by fibers and spicule tracts.

**Spicules.** Styles in two size classes. Shorter styles are more common, most of them with a sharp bend in the upper third of their length. Longer ones are bent (upper third) or straight, a few have subtylote heads. Styles I: 340–450 x 10–18 (396 x 16)  $\mu\text{m}$ ; Styles II: 420–690 x 12–14 (557 x 13)  $\mu\text{m}$ .

**Ecology.** On reefs and in cave habitats, 1–35 m.

**Distribution.** Bermuda, Florida, and the entire Caribbean; not reported from the Gulf of Mexico.

## Family Heteroxyidae

### Genus *Myrmekioderma* Ehlers, 1870

#### *Myrmekioderma laminatum* new species

(Figures 4c, 37)

**Material.** Holotype: USNM 1229076, Carrie Bow Cay forereef, inner reef slope (near sand rough), between sheets of coralline algae under coral overhang, 20 m; K. Ruetzler col. 14 May 1975.

Paratype: USNM 1229077, Same location as holotype.

**Diagnosis.** *Myrmekioderma* with smooth, even or slightly bumpy surface, with long, smooth oxeads and styles, short, microspined oxeads, and one size class of raphids.

**External morphology.** Crusts on dead coral and coralline algae, penetrating crevices and forming multiple layers. Size, as sampled, up to 8 x 6 cm, 3–9 mm thick, depending on spaces between substratum pieces. Firm consistency, difficult to compress. Surface smooth or slightly bumpy, rough to the touch, with a few dispersed oscula (1–2 mm diameter). Color is orange at the surface, yellowish orange to ochre in the interior.

**Skeleton structure.** The ectosome shows a layer of embedded sediment and phalanx of perpendicular small acanthoxeads. The choanosome contains large oxeads and styles, acanthoxeads, and raphids in criss-cross fashion, without orientation except for a few short tracts.

**Spicules.** Long, thin, smooth oxeads and styles, with frequent modifications to strongyloxeads of large size range: 304–1050 x 5–16 (897 x 13)  $\mu\text{m}$ ; microspined oxeads, with common styloid, strongylote, or (rare) tylostyloid modifications: 289–440 x 7–16 (365 x 12)  $\mu\text{m}$ ; very thin (0.1–0.5  $\mu\text{m}$ ), smooth raphids, about 7–130  $\mu\text{m}$  long, in preparations often wrapped around megascleres making length determinations difficult.

**Ecology.** In the shade of a forereef coral overhang, encrusting and invading crevices of rubble, 20 m.

**Distribution.** Belize.

**Etymology.** The species name reflects the growth pattern in sheets, sandwiched between layers of coralline algae and coral rubble: lamina (Latin) = plate, sheet.

**Comments.** Two other species of *Myrmekioderma* occur in similar reef habitats, *M. gyroderma* (Alcolado) (Diaz *et al.*, 1993: 303, figs. 39, 45; as *M. rea*) and *M. rea* (de Laubenfels) (see below). Our new species differs from both by lacking meandering surface grooves and thick, robust oxeads as megascleres. The microspined acanthoxeads are similar to those of *M. rea* (see below), whereas in *M. gyroderma* they are replaced by smooth, short and stout oxeads.

#### *Myrmekioderma rea* (de Laubenfels, 1934)

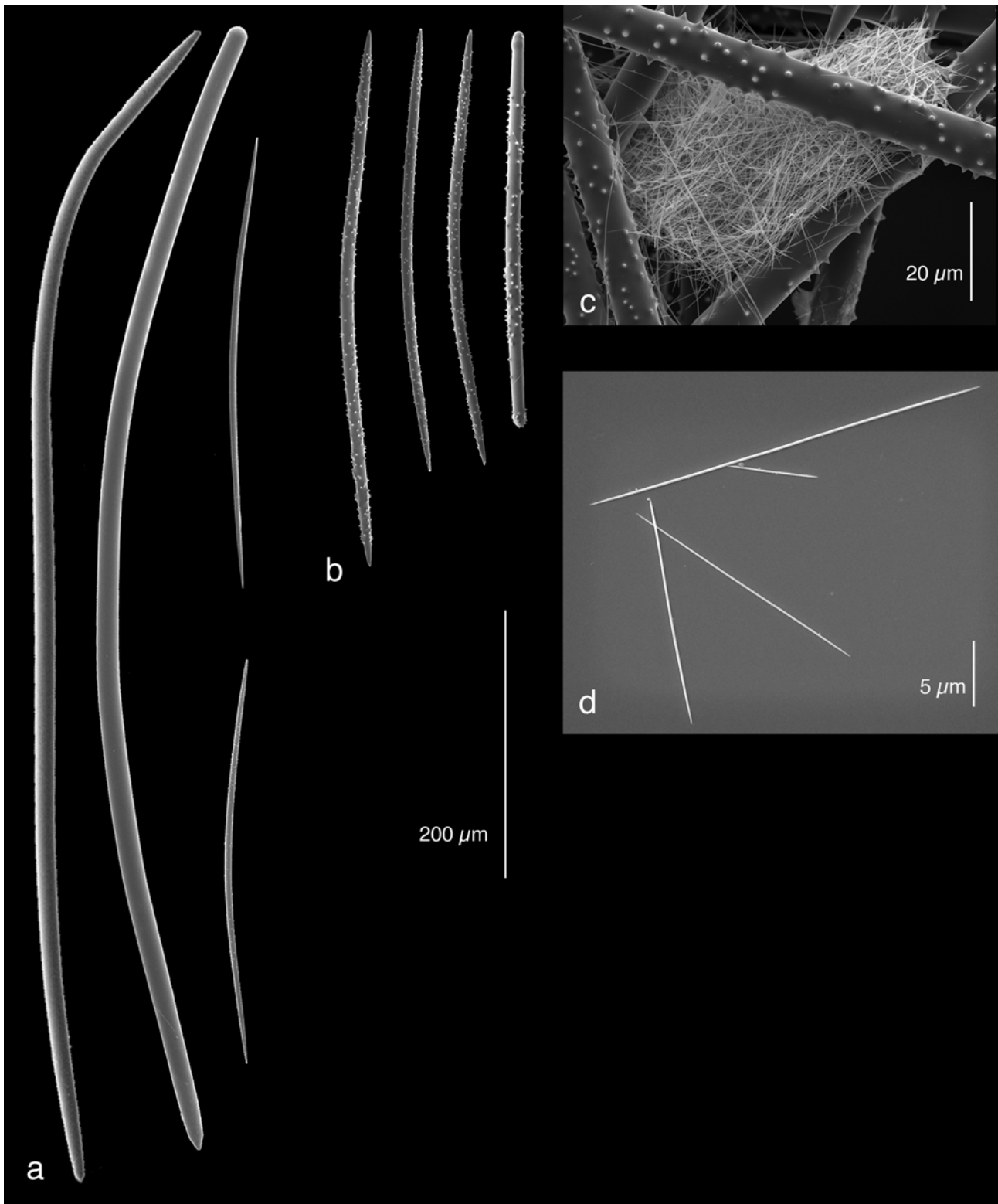
Synonymy and references. *Myrmekioderma styx* (de Laubenfels, 1934): Diaz *et al.* (1993): 303, figs. 38, 44.

**Material.** USNM 1229078, Carrie Bow Cay forereef cave, 18 m. K. Ruetzler col. 19 May 1979. USNM 1229079, Curlew Bank forereef cave, 20 m; C. Piantoni col. 2 Jul 2007. USNM 1229080, Curlew Bank forereef cave, 18 m; C. Piantoni and M. Parrish col. 22 Aug 2012.

**External morphology.** Cushion-shaped to irregularly massive, with surface structured by meandering ridges and grooves, with oscula elevated on lobes. Specimens up to 11 x 5 x 4 cm, oscula 1–3 mm in diameter. Consistency firm but easily crumbled; mucous when squeezed. Color yellow to orange red.

**Skeleton structure.** In the ectosome, small spicules (acanthoxeads) are oriented in paratangential to perpendicular fashion forming a crust. In the choanosome, large spicules (oxeads) occur without orientation, in criss-cross fashion with small ones mixed in, some form vague tracts leading toward the surface.





**FIGURE 37.** *Myrmeioderma laminatum*, spicules (holotype USNM 1229076, SEM): a, oxeas and modifications; b, acanthoxeas, with one acanthotylole form; c, raphid cluster among acanthoxeas; d, individual raphids.

**Spicules.** Large oxeas smooth, gently bent, thickest in the center and gradually tapering to sharp points; a few are double bent (in the same direction) and there are some styloid and strongylote modifications: 680–1000 x 18–34 (673 x 27) µm; acanthoxeas (microspined), more or less gently bent, sharply pointed at the ends, with surface covered irregularly with minute spines (0.5–1 µm): 226–410 x 8–15 (327 x 11) µm; raphids (bundled in trichodragmas) very thin and easily overlooked, 110 x <1 µm.

**Ecology.** In forereef caves, 18–20 m; reported from deep reefs to 100 m.

**Distribution.** From Florida to the Gulf of Mexico and throughout the Caribbean.

## Family Dictyonellidae

### Genus *Scopalina* Schmidt, 1862

#### *Scopalina ruetzleri* (Wiedenmayer, 1977)

(Figure 2g)

Synonymy and references. *Ulosa ruetzleri* Wiedenmayer, 1977: 145, fig. 149, pl. 30: 6, 7.

**Material.** USNM 1229081, Curlew Bank forereef cave, 20 m; C. Piantoni col. 28 Jun 2007. USNM 1229082, Carrie Bow Cay west, lagoon, under rubble, 1 m; K. Ruetzler, col. 20 Aug 2012. Additional specimens were noted in the Twin Cays and Tobacco Range mangroves but not collected.

**External morphology.** Thin (2–5 mm) cushions, covering up to 20 cm<sup>2</sup>. Surface conulose (1–2 mm tall conules, 2–4 mm apart), with oscular openings (2 mm) here and there, some in small clusters. Consistency very soft and limp, color bright orange.

**Skeleton structure.** Ascending, ribbon-like spongin fibers, cored and accompanied by styloid spicules, end in the conules at the surface; spicules may protrude beyond like fine brushes.

**Spicules.** Long, slender styles, a few of them with oxete modifications: 510–680 x 5–9 (600 x 8) µm.

**Ecology.** Observed mainly in shaded habitats, such as mangrove prop roots and in the back of peat undercuts, and under reef overhangs as well as in caves, 0.3–20 m.

**Distribution.** Tropical western Atlantic, from Bermuda to the Bahamas and throughout the Caribbean region.

**Comments.** The spicule dimensions in our specimens are larger than those given by the original author (350–450 x 5–7 µm: Wiedenmayer, 1977) but all other taxonomic characteristics are identical.

## Family Halichondriidae

### Genus *Amorphinopsis* Carter, 1887

#### *Amorphinopsis* sp.

Synonymy and references. *Nailondria* de Laubenfels, 1954: 182, fig. 121. *Amorphinopsis* Carter, 1887: Erpenbeck and van Soest (2002): 790, fig. 1.

**Material.** USNM 1229083, Curlew Bank forereef cave, ceiling, 1 m from entrance, 20 m; C. Piantoni and M. Parrish col. 22 Aug 2012.

Comparative material studied: USNM 23083 *Nailondria maza* de Laubenfels, 1954 (holotype, West-Central Pacific).

**External morphology.** Filling cavities and crevices in coral rock, 3–15 mm below the substratum surface. No epilithic structures were seen except small, white tubules and fistules that turned out to belong to a co-occurring *Siphonodictyon*. From calcareous fragments and pitting of the substratum it seems that the sponge is excavating. Color white.

**Skeleton structure.** Cavernous tissue filling the rock cavities, including densely packed spicules without orientation (criss-cross). No spongin visible on a histological section, only a variety of cells, including small (18 µm) choanocyte chambers.

**Spicules.** Strongyles of great size range but may be lumped into three size classes. Most are bent more or less sharply, once, twice, or three times in the same or in opposing directions (wavy). Some of the thinner ones show oxete modifications, but are rare and assumed to be developmental stages rather than a different spicule type. Strongyles I: 430–1020 x 20–48 (789 x 29) µm; II: 440–940 x 6–15 (620 x 10) µm; III: 240–420 x 5–10 (343 x 7) µm.

**Ecology.** Inhabiting and (possibly) excavating cavities in coral rock of a framework cave ceiling, 20 m. The sponge is closely associated with other sponges, that is, specimens of *Agelas sventres* and *Siphonodictyon coralliphagum*.

**Distribution.** Belize.

**Comments.** Our material does not show ectosomal differentiation, but the choanosomal skeleton agrees with the definition of *Amorphinopsis* and the type species of its synonym *Nailondria*, *N. maza* de Laubenfels, which however has oxeas or stronglyloxeas and styles for spicules (Erpenbeck and van Soest, 2002). The only other *Amorphinopsis* known from the Atlantic Ocean is *A. atlantica* Carvalho, Hajdu, Mothes and van Soest, which is usually grayish green and has oxeas and styles as spicules.

## Genus *Hymeniacidon* Bowerbank, 1858

### *Hymeniacidon caerulea* Pulitzer-Finali, 1986

Synonymy and references. *Hymeniacidon caerulea* Pulitzer-Finali, 1986: 117, fig. 37.

**Material.** USNM 1229084, Carrie Bow Cay north back reef near crest, inside and underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1229085, Carrie Bow Cay south back reef, behind reef crest, under coral rock, 1 m; K. Ruetzler col. 17 Jun 1977. USNM 1229086, Carrie Bow Cay reef flat, in dead conch shells, 1 m; K. Ruetzler and C. Piantoni col. 23 Feb 2006. USNM 1229087, Curlew Bank forereef cave, 20 m; C. Piantoni col. 29 Jun 2007. USNM 1229088, Curlew Bank forereef cave, 20 m; C. Piantoni and M. Parrish col. 23 Aug 2012.

**External morphology.** Crusts of 1–3 mm thickness, up to 6 cm<sup>2</sup> horizontal extension. Surface smooth; color deep blue, which barely changes in alcohol, even after years of storage.

**Skeleton structure.** Some spicules are arranged in tracts but most occur disorganized throughout the tissue

**Spicules.** Slender styles, the larger ones are generally thickest in the upper third of their length (toward the rounded end): 300–600 × 5–12 (443 × 9) μm.

**Ecology.** Common in shaded habitats, 0.3–20 m

**Distribution.** Florida, Bahamas, and the entire Caribbean.

**Comments.** In the field this species is easily confused with *Terpios fugax*, which occurs in similar habitats and is also encrusting and of similar color. In both species, this conspicuous, deep blue color is caused by the same micro-symbiont, a blue-pigmented, multicellular, filamentous bacterium (Rützler & Smith, 1993).

## Genus *Topsentia* Berg, 1899

### *Topsentia bahamensis* Diaz, Pomponi & van Soest, 1993

(Figure 2b)

Synonymy and references. *Topsentia bahamensis* Diaz, Pomponi & van Soest, 1993: 290, fig. 11, 14.

**Material.** USNM 1229089, Curlew Bank forereef cave, 20 m; C. Piantoni col. 2 Jul 2007. USNM 1229090, Carrie Bow Cay forereef crevice, on wall, 25 m; M. C. Diaz col. 8 Sep 2009. USNM 1229091, Curlew Bank, forereef cave, ceiling, 1 m from entrance, 20 m; C. Piantoni and M. Parrish col. 22 Aug 2012. USNM 1229092, Curlew Bank forereef cave, 18 m; C. Piantoni and M. Parrish col. 25 Aug 2012.

**External morphology.** A whitish knob, plate, or cup protruding from the cave wall, also penetrating crevices in rock, up to 3 cm thick, 9–12 cm maximum width by length. Very hard, brittle consistency, macroscopically no obvious oscula or ostia. Color white, to off-white (grayish to brown), with yellow-orange symbiotic zoanthids (*Parazoanthus swiftii*) covering part of the surface.

**Skeleton structure.** Spicules densely packed in criss-cross fashion throughout the body, generally directed in some angle toward the sponge surface. Many of the smaller spicules tend to be near or in the ectosome, more or less tangential.

**Spicules.** Fusiform oxeas, straight or curved, with sharp points. Size varies greatly but two main classes can be distinguished, I: 540–890 x 15–32 (721 x 23)  $\mu\text{m}$ ; II: 115–300 x 3–12 (243 x 8)  $\mu\text{m}$

**Ecology.** On deep reef and rock bottoms, more shallow in caves, 18–160 m.

**Distribution.** Bahamas and Caribbean.

**Comments.** The type material was collected by manned submersibles from deep-reef areas in the Bahamas (40–160 m). These are the first samples from shallower cave habitats.

### ***Topsentia ophiraphidites* (de Laubenfels, 1934)**

Synonymy and references. *Topsentia ophiraphidites* (de Laubenfels, 1934): Diaz, van Soest & Pomponi, 1993: 290, figs. 6, 12.

**Material.** SNM 1229093, Carrie Bow Cay south back reef, *Acropora palmata* coral plate in exposed zone behind reef crest, 1 m; K. Ruetzler col. 6 Mar 2006. USNM 1229094, Curlew Bank forereef cave, 20 m; C. Piantoni col. 28 Jun 2007. USNM 1229095, Curlew Bank forereef cave, 20 m; C. Piantoni col. 29 Jun 2007.

**External morphology.** Small cushion to conical projection with lobate extensions, 35 mm long, 15 mm diameter. Lumpy surface, hard consistency. Color gray to purplish pink..

**Skeleton structure.** Large spicules in dense but confused-radial arrangement, smaller spicules in between but in highest concentration near the sponge surface.

**Spicules.** Fusiform, curved oxeas, some with styloid modifications, in great size range. Three size classes can be distinguished, but separation is not always easy because there are many transitions; the smallest kind often shows angular bends (kinks) or is wavy; I: 650–1050 x 17–35 (822 x 22)  $\mu\text{m}$ ; II: 420–580 x 8–20 (504 x 12)  $\mu\text{m}$ ; III: 190–360 x 4–9 (289 x 7)  $\mu\text{m}$ .

**Ecology.** Occurs under shallow coral rubble and in forereef caves, 1–20 m; elsewhere reported from 40 m and below.

**Distribution.** Caribbean and off northeastern Brazil.

## **Order Agelasida**

### **Family Agelasidae**

#### **Genus *Agelas* Duchassaing & Michelotti, 1864**

##### ***Agelas citrina* Gotera & Alcolado, 1987**

Synonymy and references. *Agelas citrina* Gotera & Alcolado, 1987: 2, figs 1-2; Parra-Velandia *et al.*, 2014: 331, figs. 1C, 1G, 13 (including synonymy).

**Material.** USNM 1191322, Carrie Bow Cay forereef slope, 15–35 m; K. Ruetzler, col. 26 Apr 1974. USNM 1191323, Carrie Bow Cay forereef slope, 21 m; C. Piantoni, col. 27 Jun 2007. USNM 1191324, Carrie Bow Cay forereef slope, 21 m; C. Piantoni, col. 2 Jul 2007. USNM 1229096, Curlew Bank forereef slope (wall), small cave, 20 m; C. Piantoni and M. Parrish, col. 23 Aug 2012.

**External morphology.** Small (2–6 cm diameter) cushions with smooth or knobby surface structure and few (1–3) circular oscular openings of 2–4 mm diameter. The color is yellow to yellow orange.

**Skeleton structure.** As usual in this genus, the skeleton consists of coarse, ascending primary and interconnecting secondary and tertiary spongin fibers. The fibers are partly cored, partly echinated by the spicules.

**Spicules.** Characteristic acanthostyles with verticillated spines. Spicules in this species are the longest of all agelasids examined. They measure 148–360 x 18–20 (226 x 19)  $\mu\text{m}$  with 14–29 (17) whorls of spines. The longer spicules tend to show a reduction of spine length and density along the center portion of the shaft.

**Ecology.** Collected from lower surfaces of platy coral rock (*Agaricia*) and inside a framework cave, 15–35 m.

**Distribution.** Common on reefs throughout the Caribbean region (Parra-Velandia *et al.*, 2014)

**Comments.** The length of spicules in our material exceeds that of all specimens previously studied in Belize

and elsewhere in the Caribbean (Parra-Velandia *et al.*, 2014). Unlike these authors, we find acanthostyles with reduced spines along the middle of the shaft, a characteristic thought to be unique to *Agelas schmidti* (Wilson, 1902) and *A. sventres* (Lehnert & van Soest, 1996) (see below). However, examining illustrations and specimens of other, not yellow-orange species, for instance, *Agelas conifera* (Schmidt, 1870) (Wiedenmayer, 1977), we find similar spine reductions. This raises the possibilities that the morphological aberration is age- or environment-related and not a useful taxonomic feature.

### ***Agelas dispar* Duchassaing & Michelotti, 1864**

Synonymy and references. *Agelas dispar* Duchassaing & Michelotti, 1864: 76, pl. 15 fig. 1; Parra-Velandia *et al.*, 2014: 306, figs. 1D, 2, 15C, 15E (including synonymy).

**Material.** USNM 1191325, Carrie Bow Cay, North Channel, 6 m; K. Ruetzler, col. 23 May 1979. USNM 1191326, 1191327, Curlew Bank forereef, framework cave, 20 m; C. Piantoni, col. 27 Jun 2007. USNM 1229097, Curlew Bank forereef slope (wall), small cave, 20 m; C. Piantoni & M. Parrish, col. 23 Aug 2012.

**External morphology.** Massive, thickly encrusting, or lobate, 10–20 cm in diameter. One specimen (USNM 1191327) growing at the ceiling of a cave had brain-like ridges and depressions. Porous to cavernous interior. Oscula scattered, 2–4 mm in diameter, a few merged, key-hole-like. Color is grayish to reddish brown and brownish orange.

**Skeleton structure.** Interconnected spongin fibers, cored and echinated by spicules.

**Spicules.** Acanthostyles with spines in equidistant whorls. They measure 110–210 x 10–25 (158 x 18)  $\mu\text{m}$ , with 7–17 (12) whorls of spines; no reduced spines were noted.

**Ecology.** Found under coral rock and on ceiling and walls of framework caves, 6–20 m.

**Distribution.** The species has been reported from several locations in the eastern and southern Caribbean (Parra-Velandia *et al.*, 2014).

**Comments.** The brain-like morphology of specimen USNM 1191327 is unusual but might have been caused by healed fish or sea turtle bites. Spicule dimensions and characteristics were very close to those of the other samples.

### ***Agelas schmidti* Wilson, 1902**

Synonymy and References. *Agelas schmidti* Wilson, 1902: 398. Parra-Velandia *et al.*, 2014: 329, fig.12 (including synonymy).

**Material.** USNM 1191328, Carrie Bow Cay, forereef cave, 18 m; K. Ruetzler, col. 19 May 1979. USNM 1191329, Curlew Bank, framework cave, 20 m; C. Piantoni, col. 1 July 2007. USNM 1229098, Curlew Bank, forereef slope (wall), 50–150 cm inside framework cave, ceiling, 20 m; C. Piantoni & M. Parrish, col. 22 Aug 2012. USNM 1229099 Curlew Bank forereef slope (wall), framework cave, 18 m; C. Piantoni & M. Parrish, col. 25 Aug 2012.

**External morphology.** Coalescent tubes filling coral crevices and protruding as hollow cones (1–3 cm at the base) and tapering to terminal oscula, 4–10 mm in diameter. The base is yellow orange, exposed apical parts are orange red.

**Skeleton structure.** Interconnected spongin fibers, cored and echinated by spicules.

**Spicules.** Acanthostyles with spines in whorls. They measure 103–230 x 8–20 (151 x 16)  $\mu\text{m}$ , with 9–15 (13) whorls; spines can be reduced in length or missing along the mid-portion of the spicules.

**Ecology.** Common in small framework caves on the forereef, 18–20 m. Exposed surfaces are generally covered by encrusting coralline algae and sponges, for instance the bright red *Clathria campecheae*.

**Distribution.** The species is common throughout the Caribbean and the Gulf of Mexico (Rützler *et al.*, 2009; Parra-Velandia *et al.*, 2014).

**Comments.** We compared the spicules with those of the holotype from St. Thomas, U. S. Virgin Islands, and found them to be nearly identical in dimensions and number of whorls, as well as reduction of spines in the center region of some.

## ***Agelas sventres* Lehnert & van Soest, 1996**

Synonymy and references. *Agelas sventres* Lehnert & van Soest, 1996: 65, figs. 6, 22, 55; Parra-Velandia *et al.*, 2014: 334, fig. 14 (including synonymy).

**Material.** USNM 1191330, Carrie Bow Cay back reef near crest, 0.3 m; inside and underside of *A. palmata* rubble; K. Ruetzler, col. 23 Apr 1974. USNM 1191331, Carrie Bow back reef and reef flat, 1 m; in old conch shells; K. Ruetzler & C. Piantoni col. 23 Feb. 2006. USNM 1229100, Curlew Bank, forereef slope (wall), 50–150 cm inside framework cave, ceiling, 20 m; C. Piantoni & M. Parrish, col. 22 Aug 2012.

**External morphology.** Massive cushions, 6–8 cm in diameter, up to 3 cm thick. Surface smooth, with irregularly dispersed, circular openings, 2–6 mm in diameter. The color is bright orange red, only slightly duller in the cavernous interior.

**Skeleton structure.** Network of coarse spongin fibers cored and echinated by spicules.

**Spicules.** Acanthostyles with spines in whorls: 80–220 x 11–18 (*152 x 14*)  $\mu\text{m}$ , 10–16 (*12*) whorls of spines. Some spicules, particularly the longer ones, have reduced spines along the center half of the shaft.

**Ecology.** In the survey area it occurs on lower surfaces of platy coral rock (*Acropora palmata*) and inside empty conch shells with apex cut off, 1 m or less deep. Elsewhere it is reported from reefs between 5–30 m.

**Distribution.** Occurs on reefs throughout the Caribbean region (Parra-Velandia *et al.*, 2014)

**Comments.** Because of its color, the species can be confused with some specimens of *Agelas citrina* and *A. clathrodes* (Schmidt, 1870) but we found that the former is easily distinguished by its substantially longer spicules, the latter by its particularly short acanthostyles (almost one third less than *A. sventres*); also, we did not encounter *A. clathrodes* in cave habitats we studied.

## ***Agelas wiedenmayeri* Alcolado, 1984**

Synonymy and references. *Agelas wiedenmayeri* Alcolado, 1984: 11, fig 7B, C, 8B; Parra-Velandia *et al.*, 2014: 313, figs. 4, 15F (including synonymy).

**Material.** USNM 1191332, Carrie Bow Cay forereef cave, 20–28 m; M. C. Diaz col. 8 Sep 2009. USNM 1229101, Curlew Bank forereef slope (wall), framework cave, 18 m; C. Piantoni & M. Parrish, col. 25 Aug 2012.

**External morphology.** Groups of short tubes or hollow lobes (5–12 cm) protruding from crevices in coral rock. Apical openings of the tubes measure 5–15 mm, on the lobes they are also apical but scattered and small (1–3 mm). Color is brown to reddish brown, cream in the interior of the sponge.

**Skeleton structure.** Interconnected spongin fibers, cored and echinated by spicules.

**Spicules.** Acanthostyles with spines in equidistant whorls: 88–200 x 8–18 (*139 x 14*)  $\mu\text{m}$ , 9–15 (*12*) whorls of spines.

**Ecology.** Found under platy coral rock and in framework caves, 5–28 m.

**Distribution.** The species seems to occur throughout the Caribbean region.

**Comments.** This is the species erroneously described as *Agelas schmidtii*, from the Bahamas (Wiedenmayer (1977: 13, fig. 137; pl. 27, fig. 1). We confirmed the identity with our material by examining a microscope slide made from a fragment of the holotype of *A. wiedenmayeri*, generously provided by P. Alcolado (USNM 39266); spicule dimensions and number of whorls are nearly identical. A slight reduction of spine size in the middle of some of the largest spicules was evident but far less obvious than in the real *A. schmidtii* and in *A. sventres*.

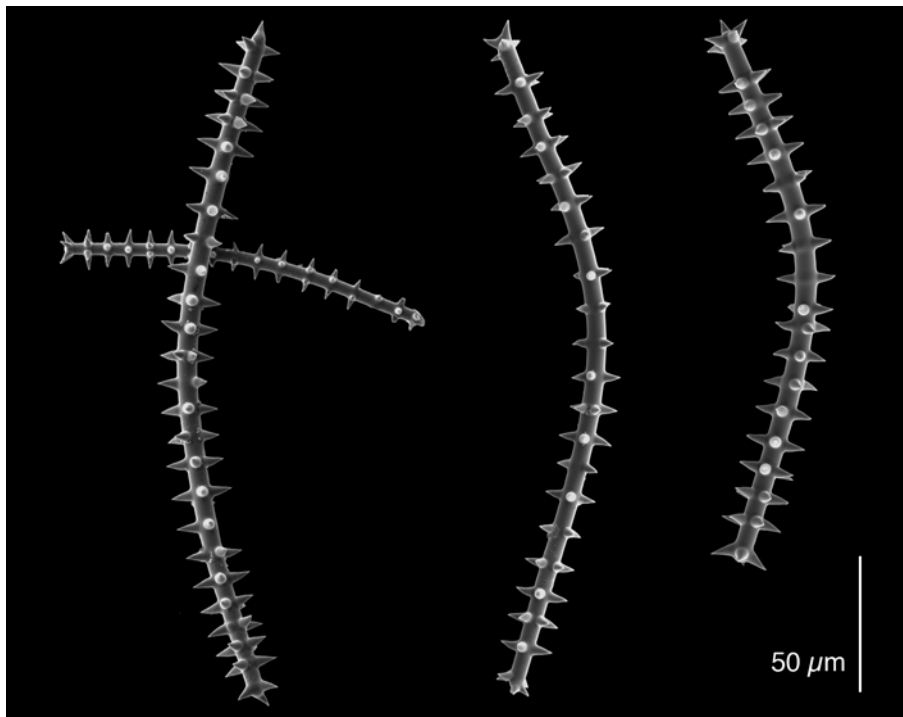
## **Family Astroscleridae**

### **Genus *Goreauiella* Hartman, 1969**

#### ***Goreauiella auriculata* Hartman, 1969**

(Figure 38)

Synonymy and references. *Goreauilla auriculata* Hartman, 1969: 17, figs. 10–12.



**FIGURE 38.** *Goreauiella auriculata*, spicules (SEM): verticillate acanthostrongyles.

**Material.** No specimen was collected but the characteristic spicules were found inside neighboring sponges. Occurs closely associated with *Timea oxyasterina* (USNM 1228987) from Curlew Bank, forereef slope, small cave, 20 m; C. Piantoni, col. 28 Jun 2007. Also in *Mycale (Grapelia) unguifera* (USNM 1229067), Curlew Bank forereef slope, small cave, 20 m; C. Piantoni and M. Parrish col. 23 Aug 2012.

A few actual specimens were observed by our colleague Philippe Willenz (Royal Belgian Institute of Natural Sciences, Bruxelles, Belgium) during a survey of small forereef caves between South Water Cay and Curlew Bank, 24–39 m, in Apr 1987; all occurred in deep, inaccessible cave parts and could not be collected for Museum deposit.

**External morphology.** This is a hypercalcified sponge (“sclerosponge”), with calcareous (aragonitic) base skeleton covered by a very thin veneer of soft, yellow tissue containing siliceous spicules.

**Skeleton structure.** Not observed.

**Spicules.** Very characteristic, verticillate acanthostrongyles, gently or (once) sharply bent: 120–350 x 11–30 (244 x 22)  $\mu\text{m}$  overall dimensions; shafts measure 5–12 (9)  $\mu\text{m}$ , spines are 2–8 (6)  $\mu\text{m}$  tall.

**Ecology.** Occurs in dark parts of forereef framework caves forereef caves, 20–39 m; elsewhere reported from caves and deep forereef bottoms at 8–70 m.

**Distribution.** Caribbean.

**Comments.** The spicule dimensions we measured are more than double those given for the type material but their appearance is identical. We hope to recover whole specimens for further study.

### Genus *Hispidopetra* Hartman, 1969

#### *Hispidopetra miniana* Hartman, 1969

Synonymy and references. *Hispidopetra miniana* Hartman, 1969: 13, figs. 7–9, 15, 19, 23, 27, 31.

**Material.** This species was observed by our colleague Philippe Willenz (Royal Belgian Institute of Natural Sciences, Bruxelles, Belgium) during a survey of small forereef caves between South Water Cay and Curlew Bank, 24–39 m, in Apr 1987. No specimens were collected for Museum deposit.

**Ecology.** Cryptic on reefs, 10–90 m.

**Distribution.** Caribbean.

## Order Haplosclerida

### Family Chalinidae

#### Genus *Haliclona* Grant, 1835

##### Subgenus *Halichoclona* de Laubenfels, 1932

##### *Haliclona (Halichoclona) stoneae* de Weerdt, 2000

Synonymy and references. *Haliclona (Halichoclona) stoneae* de Weerdt, 2000: 50, figs. 2B, 3A, 36.

**Material.** USNM 51541, Carrie Bow Cay East, forereef, under coral overhang, 21 m; W. H. de Weerdt col. 10 Dec 1988. USNM 54542, Carrie Bow Cay East, forereef, under coral overhang, 21 m; W. H. de Weerdt col. 9 Dec 1988.

**External morphology.** Cushion shape, to 20 mm thick, with more or less elevated oscula of 4–9 mm diameter. Surface smooth, consistency brittle, color in life pink.

**Skeleton structure.** Subisotropical, paucispicular reticulation, spicules held together by minute amounts of spongin (only visible if stained).

**Spicules.** Slightly curved, slim oxeas: 286–359 x 8–13 (321 x 12)  $\mu\text{m}$ ; simple, c-shaped sigmas: 12–21 (17)  $\mu\text{m}$ .

**Ecology.** Under coral overhangs, 21 m.

**Distribution.** Mesoamerican Barrier Reef, Belize; probably Caribbean-wide.

**Comments.** Characterization of this species was taken from the original description (de Weerdt, 2000).

##### *Haliclona (Halichoclona) vansoesti* de Weerdt, de Kluijver & Gomez, 1999

Synonymy and references. *Haliclona (Halichoclona) vansoesti* de Weerdt, de Kluijver & Gomez, 1999: de Weerdt, 2000: 49, figs. 2D, 3C, 34.

**Material.** USNM 1229102, Carrie Bow Cay East, forereef crevice, bottom, 24 m; M. C. Diaz col. 8 Sep 2009.

**External morphology.** Cavernous cushions, to 25 mm thick, extending over 10–80 cm<sup>2</sup> (and more) of coral-rock substratum and partly covered by crustose coralline algae. The sponge also encrusts the calcareous plates of dead *Halimeda* algae. Oscula large and conspicuous, usually raised, more or less circular in outline, up to 12 mm in diameter. Consistency hard and brittle, live color light (neon-tone) blue, turning black during preservation in alcohol (which becomes stained blackish as well).

**Skeleton structure.** Unispicular reticulation in the ectosome, becoming denser in the choanosome where it is interrupted by numerous cavities. Spongin connecting the spicule tips is only visible in stained sections.

**Spicules.** Lightly curved oxeas tapering to sharp points: 160–280 x 3–7 (219 x 6)  $\mu\text{m}$ .

**Ecology.** In forereef caves and under coral overhangs, to 52 m depth.

**Distribution.** Caribbean-wide.

**Comments.** The original authors of this species (de Weerdt *et al.*, 1999) suspected its limestone excavating capability. This we could confirm on sections of epoxy resin-embedded sponge-substratum interface, where sponge tissue is seen that penetrated rock crevices and dislodged fragments of limestone resembling clonaid excavation chips. These sections also show a great abundance of large cells (7–14 (9)  $\mu\text{m}$ ), which stain dark blue in toluidin blue dye and could possibly be the storage cells for secondary metabolites mentioned in the cited paper.

##### *Haliclona (Halichoclona) sp.*

**Material.** USNM 1229103, Curlew Bank forereef cave, 20 m; C. Piantoni and M. Parrish col. 23 Aug 2012.

**External morphology.** Cushion-shaped specimen, covering about 8 cm<sup>2</sup> area, 15 mm thick. Smooth surface except for about 10 rounded depressions of 2–4 mm in diameter; on closer look they turned out to be pore sieves. Firm consistency but fragile, yellowish white color in life, white in alcohol.



**Skeleton structure.** In the ectosome there is a subisotropic spicule reticulum except for the pore-sieve areas which are surrounded and crossed by meshes of multispicular tracts. The choanosome is also supported by a subisotropic reticulation of spicules, alternating with a few multispicular strands.

**Spicules.** Oxeas, most of them curved, in two size categories. Oxeas I: 150–180 x 4–9 (171 x 8)  $\mu\text{m}$ ; oxeas II: 90–130 x 2–7 (109 x 5)  $\mu\text{m}$ .

**Ecology.** Found in a cave on the forereef, 20 m.

**Distribution.** Only known from Belize.

**Comments.** The skeleton structure is that of a *Haliclona*, subgenus *Halichoclona*, but no described species is similar to our specimen. The yellow color, pore sieves, and two size classes of oxeas are the most distinctive characteristics of our specimen. We decided not to name a new species until at least one other specimen has been found that can confirm our diagnosis.

### Subgenus *Reniera* Schmidt, 1862

#### *Haliclona (Reniera) implexiformis* (Hechtel, 1965)

Synonymy and references. *Haliclona (Reniera) implexiformis* (Hechtel, 1965): de Weerd, 2000: 17, figs. 3M, 6.

**Material.** USNM 1229104, Carrie Bow Cay back reef, inside dead conch shell, 0.5 m. K. Ruetzler and C. Piantoni col. 23 Feb 2006. USNM 1229105, Carrie Bow Cay south back reef, lower surface of rock slab, 1 m; K. Ruetzler col. 13 Mar 09.

**External morphology.** Thin (3 mm) crust covering 8 cm<sup>2</sup> area. Oscula flush with smooth surface, 2 mm diameter. Live color was cream.

**Skeleton structure.** Ectosome and choanosome show the same isodictyal reticulation of oxeas, held together by small amounts of spongin.

**Spicules.** Slightly curved oxeas, tapering to blunt points: 110–170 x 3–10 (143 x 6)  $\mu\text{m}$ .

**Ecology.** Very common on reefs and in mangroves, to 25 m.

**Distribution.** Bermuda, Florida, and throughout the Caribbean.

#### *Haliclona (Reniera) manglaris* Alcolado, 1984

Synonymy and references. *Haliclona (Reniera) manglaris* Alcolado, 1984: de Weerd, 2000: 19, figs. 2G, 3X, 8A–D.

**Material.** USNM 1229106, Carrie Bow Cay west, under concrete dock, 0.5 m; K. Ruetzler, col. 18 Aug 2012.

**External morphology.** A cushion, 5–15 mm thick and covering 75 cm<sup>2</sup> of substratum, with a few rope-like processes, 4 mm thick, up to 15 mm long, either with a rounded distal end or, in one case, bifurcated. Velvety surface; a few scattered, circular, 1–2 mm oscula.

**Skeleton structure.** Both ectosome and choanosome show a regular, isotropic reticulation of single spicules; the choanosome is cavernous.

**Spicules.** Fusiform oxeas, more or less curved, with sharp points: 100–150 x 3–6 (126 x 4)  $\mu\text{m}$ .

**Ecology.** Previously only known from the submerged stilt roots of red mangrove, 0.1–1 m.

**Distribution.** From the Florida Keys throughout the Caribbean.

**Comments.** Most specimens of this common mangrove sponge are turquoise in color but a brown variety has also been reported (de Weerd, 2000). The latter author also listed smaller spicule dimensions (93 x 3  $\mu\text{m}$ ), a difference that can be explained by the high energy environment in which our specimen was found.

#### *Haliclona (Reniera) mucifibrosa* de Weerd, Rützler & Smith, 1991

Synonymy and references. *Haliclona mucifibrosa* de Weerd *et al.*, 1991: 190, figs. 2a–c, 3b, 4a, b. *Haliclona (Reniera) mucifibrosa* de Weerd, Rützler & Smith, 1991: de Weerd, 2000: 21, figs. 3D, 10.

**Material.** USNM 1229107, Carrie Bow Cay North, back reef near crest, underside of *A. corpora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974.

**External morphology.** Cushions of about 20 cm<sup>2</sup>, 10 mm thick. Few, scattered oscula of 2 mm diameter. Soft, elastic consistency, mucous when rubbed between fingers. Live color grayish blue.

**Skeleton structure.** More or less isodictyal reticulation throughout, with a few multispicular tracts in the choanosome.

**Spicules.** Some straight, but mostly slightly curved oxeas: 210–270 x 7–15 (248 x 11) μm.

**Ecology.** Common on subtidal mangrove roots but also reported from reefs, 0.1–20 m.

**Distribution.** Florida and throughout the Caribbean.

**Comments.** This species is usually found with stout oscular chimneys but our specimen, and others observed in the same location, were crustose, apparently due to the high-energy conditions in this habitat.

### **Subgenus *Soestella* de Weerdt, 2000**

#### ***Haliclona* (*Soestella*) *lehnerti* de Weerdt, 2000**

Synonymy and references. *Haliclona* (*Soestella*) *lehnerti* de Weerdt, 2000: 33, figs. 3N, 18.

**Material.** USNM 1229108, Carrie Bow Cay East, forereef cave, 18 m; K. Ruetzler col. 19 May 1979.

**External morphology.** Cushions encrusting and nested into coral rubble and crevices, partly covered by crustose coralline algae, about 30 ml in total volume. Lumpy surface, cavernous inside, firm and brittle consistency. Oscula circular and elevated, up to 4 mm diameter. Color reddish purple at the exposed surfaces, off-white to cream inside.

**Skeleton structure.** The ectosome shows a paucispicular reticulation, the choanosome is a paucispicular meshwork with sporadic, ill-defined tracts.

**Spicules.** Slightly curved oxeas with sharp points: 130–160 x 4–8 (151 x 6) μm.

**Ecology.** Known from reef caves, 8–18 m.

**Distribution.** So far only found in Jamaica and Belize.

**Comments.** We did not observe meandering aquiferous canals mentioned by the species' author (de Weerdt, 2000) but our specimen arrived as part of a rock sample and was not observed alive.

#### ***Haliclona* (*Soestella*) *luciensis* de Weerdt, 2000**

Synonymy and references. *Haliclona* (*Soestella*) *luciensis* de Weerdt, 2000: 33, figs. 3E, 20.

**Material.** USNM 1229109, Curlew Bank, lower surface of *Agaricia* coral plate, 21 m; C. Piantoni col. 28 Jun 2007. USNM 1229110, Curlew Bank, inside forereef cave, 20 m; C. Piantoni col. 29 Jun 2007.

**External morphology.** Thick cushions nested into coral crevices and covered by crustose coralline algae and sponge crusts; specimens were 20–100 ml in volume. Cavernous inside, oscular chimneys protrude from the encrusted mass; oscular diameters, 5–12 mm. Consistency soft and brittle, exposed surfaces smooth to the touch, dark brown in color.

**Skeleton structure.** Tangential meshwork of oxeas, many loosely in between, in the ectosome, multispicular tracts and meshes in the choanosome.

**Spicules.** Slightly curved oxeas with blunt points: 160–200 x 5–8 (174 x 7) μm; raphids (rare): 107–150 (121) x <1 μm.

**Ecology.** Previously described from a shallow reef slope, now found in cave habitats; 18–21 m.

**Distribution.** Caribbean.

### *Haliclona (Soestella) sp.*

**Material.** USNM 1229111 Carrie Bow Cay South reef, lower surface of rock slab, 1 m; K. Ruetzler col. 13 Mar 2009.

**External morphology.** A cushion of about 15 cm<sup>2</sup> extension, 5 mm thick. Smooth surface interrupted by numerous circular oscula, 1–2.5 mm in diameter. Brittle consistency, cavernous inside. Color in life purplish to brown, white in alcohol.

**Skeleton structure.** In the ectosome, a loose subisotropical reticulation of spicules; similar but denser in the choanosome, with multispicular, rounded meshes.

**Spicules.** Curved, fusiform oxeas and similar styles; styles making up 15% of the spicule population: 160–200 x 8–10 (180 x 8) μm.

**Ecology.** Cryptic in the shallow back reef, 1 m.

**Distribution.** So far only known from Belize.

**Comments.** Color and spicule dimensions are similar to those in *Haliclona (Halichoelona) vansoesti* but the abundance of styloid modifications among the oxeote spicules clearly separates the two species. The small amount of material of a single specimen available to us makes it unadvisable to establish a new species.

## Family Niphatidae

### Genus *Amphimedon* Duchassaing & Michelotti, 1864

#### *Amphimedon erina* (de Laubenfels, 1936)

Synonymy and references. *Haliclona erina* de Laubenfels, 1936a: 457; Hechtel (1965): 19, pl. 1 (2, 3).

**Material.** USNM 1229112, Carrie Bow Cay, back reef near crest, inside and underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1191333, Carrie Bow Cay, lagoon, under concrete dock, 0.5 m; K. Ruetzler, col. 12 May 1978. Carrie Bow Cay, lagoon, under concrete dock, 0.5 m; K. Ruetzler, col. 12 May 1978.

**External morphology.** Encrusting or cushion-shaped, with repent branches extending from the base; 1–1.5 cm thick, including elevated oscula, covering about 100 cm<sup>2</sup>. Color deep green, consistency crumbly.

**Skeleton structure.** Irregular reticulum of fibers cored by spicules, or tracts of 2–8 spicules in parallel. Some tangential fiber meshes at the surface.

**Spicules.** Robust oxeas with acerate tips, except for a few styloid modifications: 130–200 x 7–10 (167 x 8) μm. A small percentage of thinner and slightly shorter, fusiform oxeas (130–170 x 3–5 (143 x 4) μm) can be considered developmental stages.

**Ecology.** Common in the lagoon, hidden among seagrass and under coral rubble, and in mangroves in deep shade, 0.5–2 m.

**Distribution.** Jamaica and western Caribbean (Panama and Belize); may be more abundant but has often been confused with another green (non-symbiotic) species, *Amphimedon viridis* Duchassaing & Michelotti.

**Comments.** Although not a typical cave species, its distribution extends to the lower surfaces of coral rock and similar shaded habitats. The green color is proper to the sponge, not a photosynthetic pigment from a symbiont. We separate this species from *Amphimedon viridis* by its brittle, “dry-feeling” consistency and more robust oxeas. *A. viridis* has soft and limp consistency and is slightly mucous when rubbed, and its oxeas are thin and fusiform, not more than 150 x 3 μm in dimensions; the latter species is found in the shallow lagoon west of Carrie Bow Cay, in fully light-exposed habitats.

### Genus *Cribrochalina* Schmidt, 1870

#### *Cribrochalina vasculum* (Lamarck, 1814)

Synonymy and references. *Cribrochalina vasculum* (Lamarck, 1814): Wiedenmayer (1977): 119, fig. 131, pl. 16: 2–4.

**Material.** USNM 1229113, Curlew Bank, forereef cave, 20 m; C. Piantoni col. 28 Jun 2007.

**External morphology.** An erect plate, cut during collecting but estimated to have been about 3 x 7 cm (height x width), 5–8 mm thick. Consistency firm but elastic. Surface velvet-like, densely covered by the symbiotic zoanthid *Parazoanthus parasiticus*. Color in the ectosomal region (outer 3 mm) chestnut brown, the interior is cream.

**Skeleton structure.** The choanosomal skeleton is a multispicular mesh, alternating with ascending spicule tracts which contain the larger oxeas and are more or less interconnected by secondary spicule fibers. In the ectosome, the ascending spicule fibers end or protrude; there they are echinated by smaller oxeas, like minute bottle brushes.

**Spicules.** Slightly curved oxeas of great size range but without separation into size classes; with blunt or hastate points, some approaching strongyloxeas: 70–350 x 4–14 (208 x 8)  $\mu\text{m}$ ;

**Ecology.** Found once inside a framework cave in 20 m.

**Distribution.** Bermuda, Florida, Bahamas, Caribbean Sea.

**Comments.** Wiedenmayer (1977) found the sponge on open reef platforms, in less than 10 m. The brown color (and microscope examination) indicates that this species is associated with unicellular cyanobacteria and is thus partly supported by photosynthesis.

## Genus *Niphates* Duchassaing and Michelotti, 1864

### *Niphates alba* van Soest, 1980

Synonymy and references. *Niphates alba* van Soest, 1980: 40, fig. 14, pls. 6: 4, 7: 1. *Protophlitaspongia antillana* Pulitzer-Finali, 1986:138, figs. 59, 60.

**Material.** USNM 1229114, Curlew Bank forereef cave, 20 m; C. Piantoni, col. 28 Jun 2007.

**External morphology.** An erect, cylindrical branch emerging from a small cushion, 12 cm long, 15–23 mm in diameter. Two obvious oscula, flush with the surface, 2–4 mm diameter, numerous smaller pores of undetermined function. Rough surface, stiff elastic consistency. Color light gray, with tan to orange tinge in the crustose part.

**Skeleton structure.** The ectosomal skeleton is a meshwork of 20–60  $\mu\text{m}$  thick fibers cored by spicules. In the choanosome, the skeleton is formed by robust, ascending, interconnected fibers cored and accompanied by spicules. Primary fibers up to 100  $\mu\text{m}$  in diameter, secondary fibers 30–80  $\mu\text{m}$ .

**Spicules.** Isodiametric oxeas with abrupt, dull points, approaching strongylote forms; a few are styloid: 150–180 x 6–9 (164 x 8)  $\mu\text{m}$ .

**Ecology.** The only specimen encountered was found in a forereef cave, in 20 m; elsewhere reported from reefs in 20–40 m.

**Distribution.** Gulf of Mexico and Caribbean.

### *Niphates amorphia* Wiedenmayer, 1977

Synonymy and references. *Niphates amorphia* Wiedenmayer, 1977: van Soest (1980): 39, fig 13, pl. 19: 4.

**Material.** USNM 1229115, Carrie Bow Cay west, pillar under concrete dock, 0.5 m; K. Ruetzler col. 12 May 1978. USNM 1229116, Curlew Bank forereef cave, 20 m; C. Piantoni, col. 28 Jun 2007. USNM 1229117, Carrie Bow Cay South reef, lower surface of rock slab, 1 m; K. Ruetzler col. 13 Mar 2009. USNM 1229118, Carrie Bow Cay west, pillar under concrete dock, 0.5 m; K. Ruetzler, col. 18 Aug 2012.

**External morphology.** Cushions and creeping branches, which may divide and merge again; covering 2–80  $\text{cm}^2$  surface, 5–12 mm thick. Oscula circular, slightly raised, 2–4 mm in diameter. Surface rough to the touch, consistency tough, compressible but elastic. Color in life bluish or bluish to purplish gray.

**Skeleton structure.** In the ectosome there is an irregular meshwork of fibers cored by spicules, 30–150  $\mu\text{m}$  thick. The choanosome is supported by similar fibers, the primaries ascending toward the surface reaching at least 250  $\mu\text{m}$  diameter; they are interconnected by thinner secondary lines.

**Spicules.** Slender, curved oxeas with sharp points 190–270 x 4–13 (239 x 8)  $\mu\text{m}$ .

**Ecology.** On reefs, open as well as cryptic, in locations of strong current flow; 0.5–20 m.

**Distribution.** Gulf of Mexico and Caribbean.

**Comments.** No sigmas were found in our specimens.

***Niphates arenata* new species**

(Figures 4d, 39)

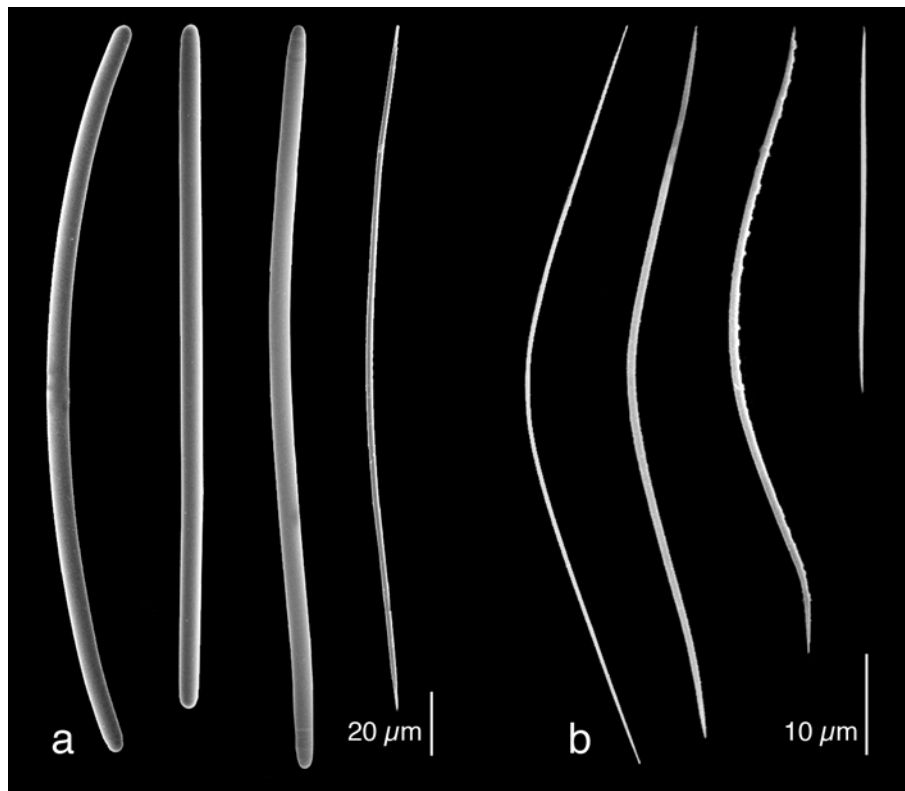
**Material.** Holotype: USNM 1229119, Carrie Bow Cay forereef, bottom of small cave, 25 m; M. C. Diaz col. 8 Sep 2009.

Paratype: USNM 1229120, same data as holotype.

**Diagnosis.** Encrusting to cushion-shaped *Niphates*, pinkish orange in color, with sediment incorporated in net-like pattern in the ectosome and abundant throughout the choanosome. Spicules are strongyles, accompanied by rare, small toxas.

**External morphology.** The holotype is an elongate cushion, up to 17 mm thick, covering about 25 cm<sup>2</sup>. Oscula evenly dispersed over the surface, slightly elevated, 2–4 mm diameter, and each surrounded by a low, membranous collar. Surface bristly conulose from protruding primary fibers, whitish from fine sand embedded in a net-like pattern. Consistency firm but elastic. Color in life orange, with a pink hue due to the ectosomal sand, light cream in preservation alcohol.

**Skeleton structure.** The ectosome shows a tangential network of spicules and multispicular fibers and is charged with fine sand and foreign spicules; brushes of perpendicular primary fibers disrupt the pattern. Circular areas of ostial groups are surrounded and crossed by spicule fibers. In the choanosome, spicules are arranged in an isotropic network, interrupted by multispicular tracts, 30–130  $\mu\text{m}$  thick, that lead toward and penetrate the ectosome. There are also loose spicules without orientation and sand grains occur throughout the choanosome but are particularly numerous along the fibers tracts.



**FIGURE 39.** *Niphates arenata*, spicules (holotype USNM 1229119, SEM): a, strongyles, including a developmental stage (right); b, toxas, including a raphidoid modification.

**Spicules.** Straight to somewhat curved and a few double-bent strongyles and rare, delicate toxas, some straight and resembling raphids. Strongyles: 205–280 x 5–8 (235 x 7)  $\mu\text{m}$ ; a few shorter and thinner strongyles and oxeas appear to be developmental stages. Hairlike toxas: 36–76 x <1  $\mu\text{m}$  (some appear rugose on the concave side, possibly an artifact).

**Ecology.** Found on the bottom of a forereef cave in 25 m.

**Distribution.** So far only found on the Belize barrier reef off Carrie Bow Cay.

**Etymology.** The species name, *arenata*, is Latin for “with sand,” referring to the abundance of sediment-derived sand embedded in the surface net and throughout the body.

**Comments.** Color and a spiculation of strongyles make this species resemble *Niphates lutea* Lehnert & van Soest, 1999, from the deep forereef of Jamaica. The principal characteristics that distinguish *N. arenata* are the large quantity of incorporated fine sand, particularly the net-like pattern at the surface, and the presence of toxas as microscleres. Some species of *Niphates* are known to have sigmas as microscleres, but toxas like in our material are easily overlooked for their thinness (0.5–0.8  $\mu\text{m}$ ). In fact, Zea & van Soest (1986) report the occurrence of minute toxas in some specimens of their new species *Niphates caycedoi* (Zea & van Soest, 1986; first described as *Xestospongia*), an encrusting to branching species distinguished by vivid blue to violet color. Because many foreign spicules were seen in our preparations (including oxeas, sigmas, anisocleles, long raphids), we sampled tissue from various parts of all available specimen fragments; only the toxas were consistently present.

### ***Niphates erecta* Duchassaing & Michelotti, 1864**

Synonymy and references. *Niphates erecta* Duchassaing & Michelotti, 1864: van Soest (1980): 35, fig. 12, pl. 5: 2–4

**Material.** USNM 1229121, Curlew Bank forereef cave, 20 m; C. Piantoni col. 29 Jun 2007.

**External morphology.** An erect branch of 13 mm diameter, 50 mm tall. Oscula 2–4 mm in diameter, irregularly distributed and flush with the rough, bristly surface. The zoanthid *Parazoanthus parasiticus* is spread over most of the surface. Consistency spongy, elastic. Color, light purplish grey.

**Skeleton structure.** Spongin fibers (30–200  $\mu\text{m}$  thick) cored by spicules radiate toward the surface where they partly protrude, causing the bristly surface, partly change to a more or less delicate, tangential network. The primary fibers are interconnected by similar secondary ones. Loose spicules are seen in abundance among the tracts.

**Spicules.** Slightly bent, hastate oxeas, a few of them in styloid modifications: 220–270 x 8–11 (242 x 9)  $\mu\text{m}$ . A few shorter and thinner ones can be considered developmental.

**Ecology.** Common on reefs, 1–40 m.

**Distribution.** Bermuda, Bahamas, and the entire Caribbean.

## **Suborder Petrosina**

### **Family Phloeodictyidae**

#### **Genus *Calyx* Vosmaer, 1885**

#### ***Calyx podatypa* (de Laubenfels, 1934)**

Synonymy and references. *Pachypellina podatypa* (de Laubenfels, 1934): van Soest (1980): 91, fig. 34, pl. 14: 3; Zea (1987): 132, fig. 41, pl. 9: 8.

**Material.** USNM 1229122, Carrie Bow Cay South Reef, lower surface of *Acropora palmata* coral slab, 1 m; K. Ruetzler col. 9 Jan 1988.

Additional material examined: holotype, USNM 22305, Puerto Rico.

**External morphology.** Branching crust, with meandering branches reaching 25 mm width and 7 mm thickness. Hollow inside, oscula flush with surface, circular, irregularly dispersed or clustered in small groups; 1–3

mm in diameter. Smooth surface, crumbly consistency. Color chestnut brown where exposed to light at the edge of the coral slab, cream elsewhere.

**Skeleton structure.** Tangential orientation of spicules in the ectosome, an unispicular, isotropic reticulation and a few ill-defined tracts in the choanosome.

**Spicules.** Slim, acerate, slightly bent oxeas 140–165 x 4–6 (146 x 5)  $\mu\text{m}$ .

**Ecology.** Mostly cryptic on reefs (1–35 m), also on open substrata of the deep foreereef; to 90 m.

**Distribution.** Bahamas and Caribbean.

**Comments.** The spicule dimension means of our specimen are smaller than those reported from Puerto Rico (van Soest, 1980: 170 x 5  $\mu\text{m}$ ) and Colombia (Zea, 1987: 155 x 6  $\mu\text{m}$ ) but fit well with the holotype, USNM 22305, also from Puerto Rico (130 x 4  $\mu\text{m}$ ).

## Genus *Siphonodictyon* Bergquist, 1965

### *Siphonodictyon coralliphagum* Rützler, 1971

Synonymy and references. *Siphonodictyon coralliphagum* Rützler, 1971: 5; figs. 4–9, 10c; pls. 3–6, 8: c, d, f, 9a–c, e, f.

**Material.** USNM 1229123, Carrie Bow Cay back reef, near reef crest, inside and underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1229124, Curlew Bank foreereef cave, 20 m; C. Piantoni col. 2 Jul 2007 USNM 1229125, Carrie Bow South reef, lower surface of rock slab, 1 m; K. Ruetzler col. 13 Mar 2009. USNM 1229126, Curlew Bank, foreereef cave, ceiling (50–150 cm inside cave), 20 m; C. Piantoni and M. Parrish col. 22 Aug 2012.

**External morphology.** All specimens are endolithic, ovoid (8–11 x 5–7 mm), with only one or two tissue-lined canals (ca. 1 mm in diameter) leading toward a circular opening at the substratum surface or ending as short tubules or fistules. Consistency soft and slightly mucous. Live color yellowish beige, except for the external tubule or fistule, which may appear whitish from its supporting spicule network.

**Skeleton structure.** Oxeas in abundance throughout the tissue but without orientation (criss-cross), here and there bundled into a short tract.

**Spicules.** Oxeas in two size categories, slightly curved, the larger ones with fairly dull points, some with rounded or stepped tips; oxeas I: 140–190 x 5–10 (164 x 8)  $\mu\text{m}$ ; oxeas II: 135–155 x 4–7 (144 x 6)  $\mu\text{m}$ .

**Ecology.** Excavating inside coral rubble and rock on the foreereef, 0.3–25 m.

**Distribution.** Caribbean-wide, including the Gulf of Mexico.

**Comments.** This endolithic growth form was named “forma *obruta*” in the original description (Rützler, 1971). We now consider it a mere growth stage that, in cryptic environments, does not develop epilithic tubules, fistules, or crusts.

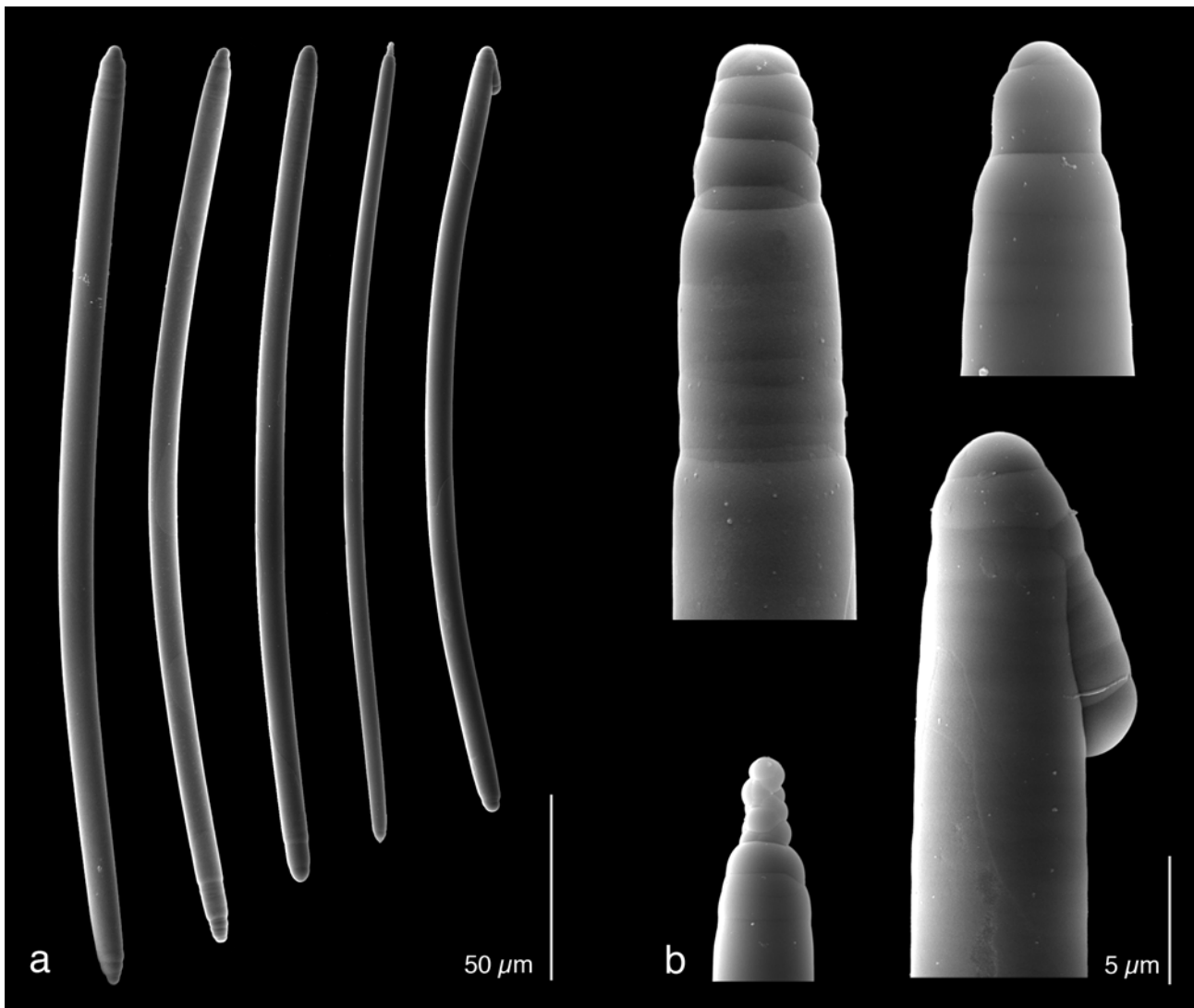
### *Siphonodictyon occultum* new species

(Figures 4e, 40)

**Material.** Holotype: USNM 1229127, Curlew Bank foreereef cave, 18 m; C. Piantoni and M. Parrish col. 23 Aug 2012.

**Diagnosis.** Cryptic (cave-dwelling) *Siphonodictyon* with small (25 x 6 mm), gray, well-separated inhalant and exhalant siphons and dull-pointed oxeas approaching the shape of strongyles.

**External morphology.** Inhalant fistules and exhalant oscular tubes protrude from the rock surface, are well separated from each other and similar in size, 15–27 mm tall, 3–7 mm in diameter. The principal sponge body fills ovoid cavities and crevices, 2–5 mm below the substratum surface and extending at least 6 cm horizontally. Because the collected material was incomplete we could not determine endolithic extension precisely. Inhalant fistules are closed by a pore sieve at the top, the oscular tubes are fully open. The siphons are hard and brittle and gray to purplish in color, although they are in part covered by thinly encrusting coralline algae and sponges; the color becomes nearly white at the top, around the openings. The endolithic choanosome is also grayish white.



**FIGURE 40.** *Siphonodictyon occultum*, spicules (holotype USNM 1229127, SEM): a, oxeas, grading to strongyloxeas; b, malformations of oxeote points.

**Skeleton structure.** Oxeas in the siphons are arranged in a unispicular network. This pattern is maintained in the choanosome as well but, here and there, gives way to disorganized placement.

**Spicules.** Most are slightly bent oxeas with dull points, more or less approaching strongyles. Some are styloid, many have stepped or otherwise malformed points: 220–270 x 7–10 (249 x 9) µm.

**Ecology.** Only found in one cave on the forereef, 18 m.

**Distribution.** Belize.

**Etymology.** The species name refers to the cryptic occurrence of this species, *occultus* (Latin) = hidden.

**Comments.** Six species of *Siphonodictyon* are known from the tropical Western Atlantic, that is, *S. brevitubulatum* Pang, *S. cachacrouense* Ruetzler, *S. coralliphagum* Ruetzler, *S. ruetzleri* (Calcinai, Cerrano & Bavestrello), *S. siphonum* (de Laubenfels), and *S. xamaycaense* Pulitzer-Finali. This new sponge differs from all by the small size and solitary growth of the epilithic structures (fistules) and the relatively large size of almost strongyloxeas. More study will be needed to determine whether this species is restricted to cave habitats.

### *Siphonodictyon ruetzleri* (Calcinai, Cerrano & Bavestrello, 2007)

Synonymy and references. *Aka ruetzleri* Calcinai, Cerrano & Bavestrello, 2007: 1362, fig. 5.



**Material.** USNM 1229128, Carrie Bow forereef, outer ridge, in lower surface of *Agaricia* coral plate, 12 m; K. Ruetzler, col. 12 May 1975.

**External morphology.** A ragged cavity (1 x 2 x 4 cm) inside coral rock filled with tissue, with a tissue-lined tunnel (2–4 mm diameter) leading to papillate structures at the substratum surface. Consistency soft, color yellowish ochre.

**Skeleton structure.** Oxeas in criss-cross arrangement, with a few tracts and multispicular meshes.

**Spicules.** Oxeas, slightly bent, with sharp or, less commonly, rounded points; in two size categories, mainly determined by thickness; oxeas I: 160–220 x 7–9 (189 x 8)  $\mu\text{m}$ ; oxeas II: 160–200 x 3–5 (180 x 4)  $\mu\text{m}$ .

**Ecology.** Excavating coral on the forereef, 11–15 m.

**Distribution.** Belize.

**Comments.** Only the endolithic stage of this species was found and identification is based mainly on the spicule dimensions, which are different from other *Siphonodictyon* species in this habitat and agree closely with those of the type material, which was discovered at the same location.

### ***Siphonodictyon xamaycaense* Pulitzer-Finali, 1986**

Synonymy and References. *Siphonodictyon xamaycaense* Pulitzer-Finali, 1986: 164, figs. 77, 78.

**Material.** USNM 1229129, Carrie Bow forereef, inner slope (toward trough), lower side of platy coral rubble, 18 m; K, Ruetzler col. 14 May 1975. USNM 1229130, Curlew Bank forereef slope, lower surface of *Agaricia* coral plate, 21 m; C. Piantoni, col. 28 Jun 2007. USNM 1229131, Curlew Bank forereef cave, 20 m; C. Piantoni col. 2 Jul 2007. USNM 1229132, Curlew Bank forereef slope, 50–150 cm inside framework cave, ceiling, 20 m; C. Piantoni and M. Parrish col. 22 Aug 2012.

**External morphology.** This excavating sponge consist of tissue filling endolithic cavities connected by tunnels to epilithic, ectosomal oscular tubes and inhalant fistules (apically closed tubes). The excavations are spherical, ovoid, or (the larger ones) irregular in outline and measure from 1 x 1 x 1 cm to about 2 x 2 x 5 cm, in our specimens, and are located 0.5–2 cm below the substratum surface. They connect to the epilithic structures by more or less (2–8 mm) narrow tunnels lined by tissue. The exterior structures of small specimens are tiny hollow cylinders (exhalant tubules, 5–12 mm tall, 1.5–3 mm in diameter), some apically closed (inhalant fistules). In larger specimens they reach 4 cm in height, 1 cm in diameter (at the base, tapering toward the apical end). Specimens observed on the open reef may have tubes and fistules as big as 10 x 1.5 cm. The endolithic tissue is soft and mucous, beige in color, the external tubes are brittle and white, some with a grayish or purplish tint.

**Skeleton structure.** In the endolithic choanosome, oxeas are abundant but without particular orientation. In the ectosomic inhalant-exhalant structures, they form meshes or a network of tracts, with loose spicules in between.

**Spicules.** Oxeas are curved, with dull or rounded, some with stepped or mucronate points: 100–150 x 4–10 (131 x 6)  $\mu\text{m}$

**Ecology.** Excavating dead coral, on the open forereef and in caves, 18–21 m.

**Distribution.** Caribbean.

**Comments.** This species is quite common in cryptic environments but the larger specimens, as judged from epilithic tubes and fistules, occur on the open reef, in 20–45 m.

### **Genus *Oceanapia* Norman, 1869**

#### ***Oceanapia bartschi* (de Laubenfels, 1934)**

Synonymy and references. *Oceanapia bartschi* (de Laubenfels, 1934): Campos *et al.* (2005): 11, figs. 7A–F, Tab. 3.

**Material.** USNM 1229133, Curlew Bank forereef cave, 20 m; C. Piantoni col. 28 Jun 2007. USNM 1229134, Curlew Bank forereef cave, 20 m; C. Piantoni col. 29 Jun 2007.

**External morphology.** Spherical specimen, 5 cm diameter, with eight fistules (distally closed) and oscular tubes protruding. These fistular processes reach 25 mm in height, 5 mm in diameter. The surface, where not

covered by epizoans, is leathery smooth, the consistency firm but elastic, compressible. Color is purplish gray to brown.

**Skeleton structure.** The ectosome of the body shows tangentially positioned spicules, some arranged in tracts. The choanosome is supported by a network of thick (50–150  $\mu\text{m}$ ) fibers cored densely by spicules. Spicule tracts in the fistules also form meshes but are more delicate and there are more loose spicules, without particular orientation.

**Spicules.** These are slender strongyles, slightly curved, many having the bend one third of the length from one end. There is only one size class, some of the thinner ones seem to be developmental stages: 275–310 x 5–13 (265 x 8)  $\mu\text{m}$ .

**Ecology.** Most of the body was encrusted by another sponge, the bright orange red *Hymedesmia* (*H.*) *agariciicola*, both collected from a forereef cave, 20 m; elsewhere on forereefs to more than 80 m depth.

**Distribution.** Gulf of Mexico, Caribbean, northeastern Brazil.

## Family Petrosiidae

### Genus *Petrosia* Vosmaer, 1885

#### Subgenus *Petrosia* Vosmaer, 1885

#### *Petrosia* (*Petrosia*) *weinbergi* van Soest, 1980

Synonymy and references. *Petrosia weinbergi* van Soest, 1980: 75, fig. 27, pl. 12: 3, 4.

**Material.** USNM 1229135, Carrie Bow Cay, forereef cave, 25 m. M. C. Diaz col. 8 Sep 2009. USNM 1229136, Curlew Bank forereef cave, 18 m. C. Piantoni and M. Parrish col. 23 Aug 2012.

**External morphology.** Crust- to cushion-shaped, reaching 110  $\text{cm}^2$  coverage, up to 10 mm thick. Oscula scattered, slightly elevated, 1–4 mm in diameter. Consistency firm and brittle, color in life brown, with an olive tinge.

**Skeleton structure.** In the ectosome there is a tangential crust of large and small spicules, supported by a choanosomal network of thick (50–80  $\mu\text{m}$ ), multispicular fibers forming rounded meshes. Free spicules are abundant, arranged in criss-cross fashion.

**Spicules.** These are curved, blunt oxea, with transitions to styles and strongyles, in at least three size classes; the smallest ones, instead of being gently curved, tend to have a sharp kink in the center. Oxeas I: 250–350 x 10–15 (291 x 13)  $\mu\text{m}$ ; oxeas II: 120–240 x 5–13 (152 x 9)  $\mu\text{m}$ ; oxeas III: 30–90 x 3–7 (58 x 4)  $\mu\text{m}$ .

**Ecology.** Deep reef slopes and caves, 18–43 m.

**Distribution.** Entire Caribbean.

**Comments.** Spicules of our specimens are slightly larger than those of the type material but all other characteristics (shape, color, skeleton structure, ecology) agree well.

#### *Petrosia* (*Petrosia*) sp.

Synonymy and references. *Petrosia* (*Petrosia*) Vosmaer, 1885: Desqueyroux-Faúndez & Valentine (2002): 911, 912, fig. 3.

**Material.** USNM 1229137, Carrie Bow Cay, back reef, inside dead conch shell, 1 m. K. Ruetzler and C. Piantoni col. 23 Feb. 2006.

**External morphology.** Thin, uneven cushions, 40–50 x 20–35 mm, up to 5 mm thick, with a few 1–2 mm oscula. Rough surface, firm but fragile consistency. Color white, in life as well as preserved in alcohol.

**Skeleton structure.** In the ectosome, oxeas are in tangential position, the large ones forming a vague network, but mainly criss-cross, with small ones laying interstitially. In the choanosome, the oxeas are in multispicular reticulation.

**Spicules.** Gently curved, acerate oxeas of two size classes, a few of the larger ones with one or two sharp kinks. Oxeas I: 330–410 x 11–18 (374 x 16)  $\mu\text{m}$ ; oxeas II: 130–280 x 7–10 (150 x 9)  $\mu\text{m}$ .

**Ecology.** Our specimen was found cryptic inside a dead conch shell discarded in the back reef, 1 m.

**Distribution.** Carrie Bow Cay, Belize.

**Comments.** Our material does not resemble any described species but is too small to justify establishing a new species. Based on skeleton structure and oxeas as spicules, the species resembles *Petrosia* (*Petrosia*) *weinbergi*, but it differs in color (white instead of brown) and larger and more pointed oxeas without styloid and strongyloid modifications.

## Genus *Xestospongia* de Laubenfels, 1932

### *Xestospongia arenosa* van Soest & de Weerdt, 2001

Synonymy and references. *Xestospongia arenosa* van Soest & de Weerdt, 2001: 110, figs. 1–3.

**Material.** USNM 1229138, Carrie Bow Cay forereef crevice, 25 m; M. C. Diaz col. 8 Sep 2009.

**External morphology.** The specimen is a conical process rising from the substratum (a crevice bottom), 40 x 25 mm at the base, 90 mm tall, ending in an osculum of 12 mm diameter. Surface finely rough, consistency brittle. Color in life white, more like cream in alcohol.

**Skeleton structure.** At the surface, oxeas form a tangential uni- or paucispicular meshwork. The choanosomal network is similar but accompanied by loose spicules in no particular orientation. Sand grains are common throughout the sponge's interior.

**Spicules.** All are oxeas, slightly bent and many with blunt tips: 420–560 x 8–18 (480 x 13)  $\mu\text{m}$ .

**Ecology.** A coral reef-associated species, 14–41 m.

**Distribution.** Caribbean-wide.

**Comments.** The type specimens were reported to have been found largely covered by sand and small-size coral rubble. Our specimen was free of sand cover but instead was light-protected inside a reef crevice. Sand grains inside the body showed its affinity for such foreign material.

### *Xestospongia deweerdtiae* Lehnert & van Soest, 1999

Synonymy and references. *Xestospongia deweerdtiae* Lehnert & van Soest, 1999: 163, figs. 44–47; van Soest & de Weerdt (2001): 114; figs 4C, D; 5C, D.

**Material.** USNM 1229139, Carrie Bow Cay forereef cave, 26 m; M. C. Diaz col. 8 Sep 2009.

**External morphology.** Encrusting, up to 20 mm thick, covering about 90 cm<sup>2</sup> substratum. Irregularly dispersed oscula, most of them elevated on conical protrusions, 3–5 mm diameter. Surface smooth, consistency firm but crumbly. Color, a milky rose red.

**Skeleton structure.** An unispicular reticulation of strongyles in the ectosome. A similar reticulation in the choanosome, but complemented by multispicular tracts which also form meshes.

**Spicules.** All are strongyles, most a bit curved, of similar lengths but two classes of thickness; the thinner ones could be considered as earlier growth stages (Lehnert & van Soest, 1999) although juvenile stages were also identified to be oxeote (van Soest & de Weerdt, 2001). Strongyles I: 280–330 x 11–15 (311 x 13)  $\mu\text{m}$ ; strongyles II: 270–340 x 3–9 (308 x 6)  $\mu\text{m}$ ; strongyles I and II combined: 270–340 x 3–15 (310 x 10)  $\mu\text{m}$ . No oxeote spicules were found in our preparations.

**Ecology.** So far found on the open, deep forereef to 82 m and in reef caves at 10–26 m.

**Distribution.** Caribbean-wide.

**Comments.** Our specimen entirely covered another sponge, *Plakortis angulospiculatus*, adhering tightly to the exopinacoderm of the substratum sponge. A similar situation is also described by Zea *et al.* (2009), who noted that specimens of *Xestospongia deweerdtiae* are “always living over *Plakortis halichondrioides*.”

***Xestospongia purpurea* new species**

(Figures 4f, 41)

**Material.** Holotype: USNM 1229140, Carrie Bow forereef cave, 18 m. K. Ruetzler col. 19 May 1979.

Paratype: USNM 1229141, Carrie Bow South reef, lower surface of rock slab, 1 m. K. Ruetzler col. 13 Mar 09.

**Diagnosis.** Encrusting to cushion-shaped, knobbed, purple *Xestospongia*, with dull-pointed oxeas and styloids of 385 x 19  $\mu\text{m}$  mean dimensions, accompanied by less common, shorter and thinner oxeas, 308 x 7  $\mu\text{m}$ , possibly developmental stages.

**External morphology.** A knob or knobby cushion, to 20 mm thick, covering up to 15 cm<sup>2</sup> area (holotype), with some scattered oscula (2–5 mm) on the top of the bumps. Firm and brittle consistency, bristly surface. Live color deep purple outside, whitish interior; preserved, light tan in alcohol.

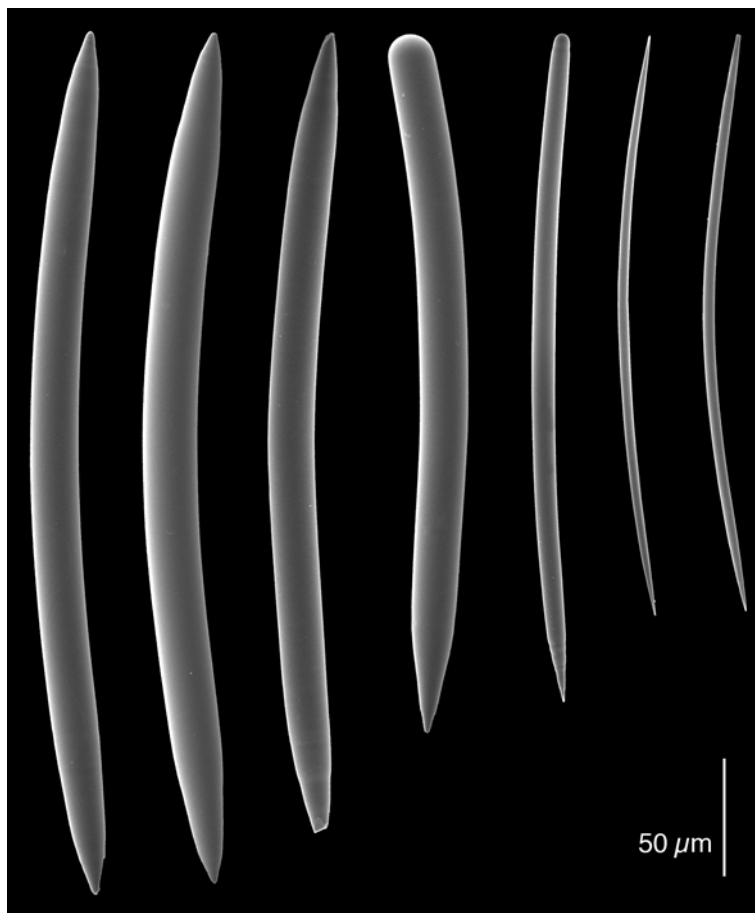
**Skeleton structure.** A multispicular, choanosomal network of fiber tracts (60–90  $\mu\text{m}$  thick), which end in the ectosome and cause the bristly surface, alternating with an isodictyal, multispicular mesh. Loose, disorganized spicules throughout.

**Spicules.** Mostly curved oxeas, points ranging from sharp to dull; styloid modifications are common. In the holotype they measure 340–420 x 15–20 (383 x 17)  $\mu\text{m}$ , in the paratype they are thicker, 370–400 x 18–24 (387 x 21)  $\mu\text{m}$ . A smaller, thinner kind could be developmental; it has the same range and means in both specimens: 240–350 x 4–8 (316 x 6)  $\mu\text{m}$ .

**Ecology.** Cryptic habitats on the forereef, 1–18 m.

**Distribution.** Only known from the Belize barrier reef.

**Etymology.** The species is named for its purple color, *purpurea* (Latin).



**FIGURE 41.** *Xestospongia purpurea*, spicules (holotype USNM 1229140, SEM): oxeas, including (thinner) developmental stages, and styloid modifications.

**Comments.** Of the 10 recognized Caribbean species of *Xestospongia* (van Soest *et al.*, 2013b) and based on the important characteristics of growth form and color (van Soest & de Weerd, 2001), *X. purpurea* compares best with *X. bocatorensis* Diaz, Thacker, Ruetzler & Piantoni. This species from Caribbean Panama is also encrusting and purple, but it occurs as much thinner crusts, with very small oscula (1–2 mm), and it is purple throughout and associated with endosymbiotic, filamentous cyanobacteria. Accordingly, it grows on shallow, light-exposed reef and mangrove substrata. It also differs from the present species by having smaller and more delicate oxeas, which are supplemented by sigmas.

### ***Xestospongia rampa* (de Laubenfels, 1934)**

Synonymy and references. *Strongylophora rampa* de Laubenfels, 1934: 19; *Xestospongia rampa* (de Laubenfels, 1934): van Soest *et al.* (2013b).

**Material.** USNM 1229142, Carrie Bow Cay, back reef near crest, 0.3 m; inside and underside of *Acropora palmata* coral rubble. K. Ruetzler col. 23 Apr 1974.

Other material studied: holotype USNM 22386 from Puerto Rico.

**External morphology.** A low cushion (22 x 15 mm, 4 mm thick) bearing two slightly raised oscula (1–2 mm diameter). Smooth surface, spongy but fragile consistency; color gray.

**Skeleton structure.** The thinner spicules (oxeas), are in tangential position in the ectosome, some are connected to form an unispicular network. In the choanosome, strongyles form a multispicular mesh, with a few poorly defined tracts and numerous loose strongyles and oxeas in between.

**Spicules.** The principal spicules are strongyles, some grading into blunt-pointed styles and oxeas; all are somewhat bent: 270–345 x 10–19 (310 x 16)  $\mu\text{m}$ ; in addition there are slender oxeas: 270–345 x 10–19 (310 x 16)  $\mu\text{m}$ .

**Ecology.** Our specimen was found cryptic under shallow reef rubble. The type material from Puerto Rico was dredged from 68–216 m.

**Distribution.** Belize and Puerto Rico; presumably Caribbean-wide.

**Comments.** The type material was described as irregular to cylindrical; ours is obviously a young, encrusting specimen. The spicules agree morphologically well with the type, except that the strongyles are slightly shorter and thicker (holotype: 360 x 13  $\mu\text{m}$ ). The oxeas are of the same dimension.

## **Order Dictyoceratida**

### **Family Irciniidae**

#### **Genus *Ircinia* Nardo, 1833**

##### ***Ircinia felix* (Duchassaing & Michelotti, 1864)**

Synonymy and references. *Ircinia felix* (Duchassaing & Michelotti, 1864): Wiedenmayer (1977): 60, pl. 4: 3; van Soest (1978): 33, fig. 11; pl. 6: 4.

**Material.** USNM 1229143, Carrie Bow Cay west, under concrete dock, 0.5 m; K. Ruetzler col. 12 May 1978. More specimens were observed under rock and in forereef caves but not collected.

**External morphology.** Irregular massive and lobate, with oscula slightly raised on lobes. Overall dimensions, 10 x 7 cm, 2 cm thick. Finely conulose surface, conules about 1 mm tall and 2 mm apart. Oscules measure up to 8 mm in diameter. Consistency very tough; color purplish brown, oscules surrounded by a darker, nearly black collar.

**Skeleton.** The ectosome is a tough, conulose skin. Ascending, fasciculated primary fibers (300–500  $\mu\text{m}$  thick) support the conules and are loaded with sediment particles. The connecting secondaries (20–100  $\mu\text{m}$ ) are mostly clear of debris. Associated filaments (3  $\mu\text{m}$ ) occur in thick strands, their ends ball-shaped and about 10  $\mu\text{m}$  in diameter.

**Ecology.** A member of the open-reef and mangrove community, but also observed under rocks and in cave habitats, 0.5–20 m.

**Distribution.** Bermuda, Florida, and the entire Caribbean region.

### ***Ircinia strobilina* (Lamarck, 1816)**

Synonymy and references. *Ircinia strobilina* (Lamarck, 1816): Wiedenmayer (1977): 61, pl. 5: 1, 2; van Soest (1978): 40; pl. 8: 2.

**Material.** USNM 1229144, Curlew Bank forereef cave, 20 m; C. Piantoni col. 29 Jun 2007.

**External morphology.** This specimen is cone-shaped, 4 cm tall, 3 cm in diameter. The surface conules are large, up to 7 mm tall and about that much apart from each other, and many are interconnected by ridges. There are a few oscula of 2 mm diameter, one of 5 mm near the top. Color is dark grayish brown.

**Skeleton.** The ectosome is a tough skin, with sand grains embedded. The fiber network is very similar to that in *Ircinia felix*, but coarser: primary, fasciculated fibers can be nearly 1 mm thick and are connected by branching secondaries. Filaments and their end knobs too resemble the ones in *I. felix*.

**Ecology.** Large specimens occur in abundance on the open reef, occasionally in the mangrove, but the species is rare in caves; most specimens were seen in 2–20 m.

**Distribution.** Bermuda, Florida, and the entire Caribbean region; also off Brazil.

## **Family Thorectidae**

### **Genus *Smenospongia* Wiedenmayer, 1977**

#### ***Smenospongia cerebriformis* (Duchassaing & Michelotti, 1864)**

Synonymy and references. *Fasciospongia cerebriformis* (Duchassaing & Michelotti, 1864): van Soest (1978): 43, fig. 14, pl. 8: 3,

**Material.** USNM 1229145, Curlew Bank forereef cave, 20 m. C. Piantoni col. 28 Jun 2007.

**External morphology.** A massive, egg-shaped specimen, 40 x 45 mm tall and wide, 60 mm long, with one osculum on top, 9 mm in diameter. Surface conulose (about 3 mm tall conules), consistency stiff elastic, color in life dark grayish brown.

**Skeleton.** Fasciculated main fibers are 80–190  $\mu\text{m}$  in diameter; they are connected by perpendicular secondary fibers of 20–60  $\mu\text{m}$ . On our microscope section (made at the periphery of the specimen), fiber meshes measure about 100–800  $\mu\text{m}$  in diameter. All fibers are clear, without core or foreign inclusions, and striated, particularly the primary ones.

**Ecology.** Found in reef habitats, including forereef caves, 18–30 m.

**Distribution.** Florida, Gulf of Mexico, and Caribbean Sea.

#### ***Smenospongia* cf. *echina* (de Laubenfels, 1934)**

(Figures 2b, 42)

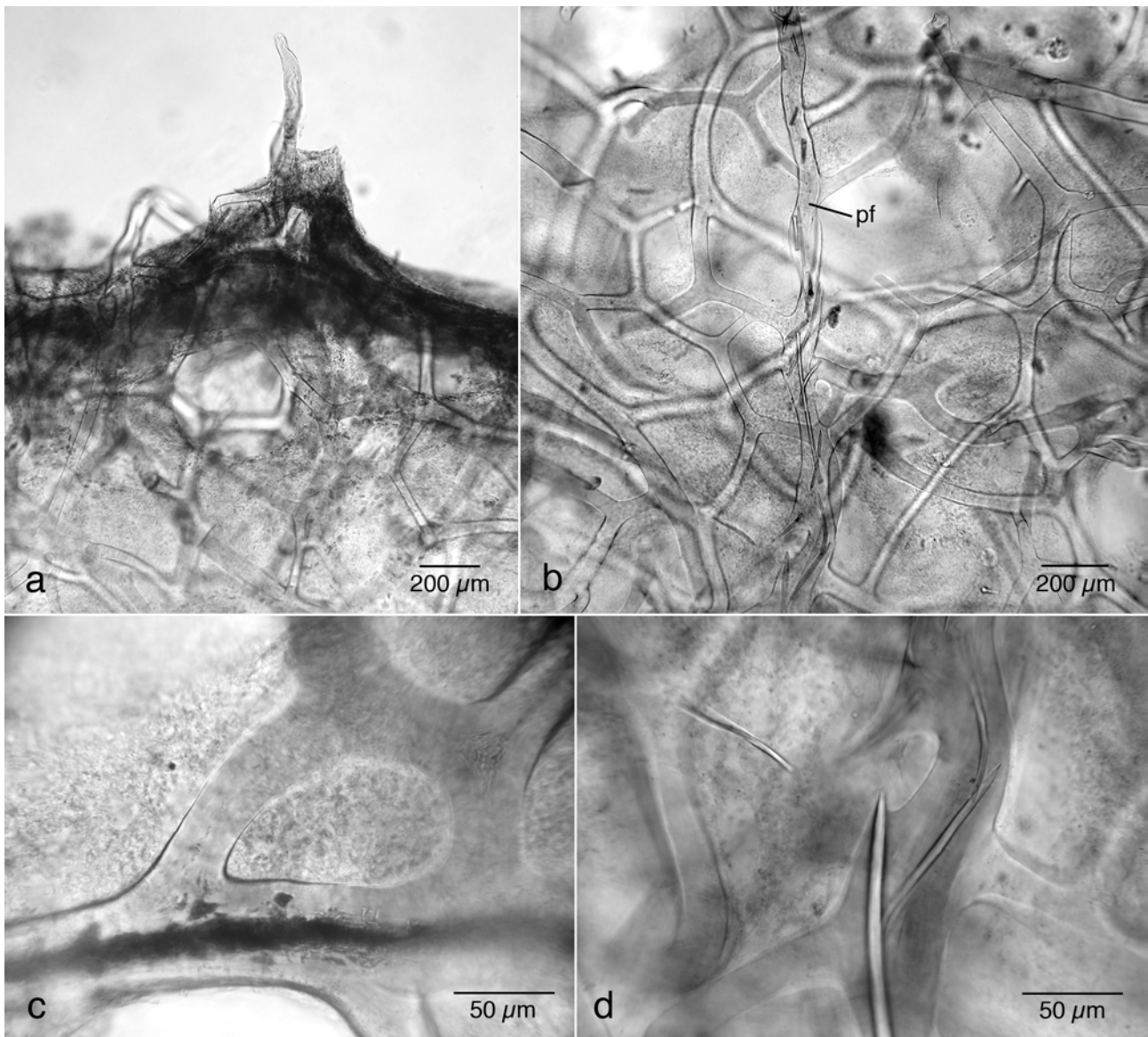
Synonymy and references. *Polyfibrospongia echina* de Laubenfels, 1934: 25; van Soest (1978): 70, fig. 23.

**Material.** USNM 1229146, Curlew Bank forereef cave, 20 m. C. Piantoni col. 2 Jul 2007.

Comparative material examined: USNM 22315 *Polyfibrospongia echina* (holotype) from Puerto Rico, 59–72 m.

**External morphology.** An elongate cushion of 50 x 30 mm, 15 mm thick, with two oscula with elevated rims on top, 4 and 6 mm in diameter. Surface covered with rounded conules, 1–1.5 mm tall, 2–3 mm apart. Pore (ostial) fields appear in the depressions between the conules. The consistency is spongy, elastic compressible, even in

preservation alcohol. Color was brownish yellow in life and changed to a medium gray in alcohol, which became stained light purple during fixation.



**FIGURE 42.** *Smenospongia cf. echina*, fiber skeleton (light microscopy): a, ectosomal reticulation ending in a conule; b, choanosomal reticulation, including primary fiber containing sediment particles; c, primary fiber with pith; d, primary fiber containing foreign (sedimentary) sponge spicules. Abbreviation: pf=primary fiber.

**Skeleton.** Primary fibers are fasciculated, three or more ending inside or near each conule. They measure 40–60 (49) μm in diameter and are cored by few sediment particles, mainly sponge spicules. A fine striation is barely visible under transmitted light. Stretches of pith show only in a preparation in epoxy resin, not in regular mounting medium (Permount, Fisher Scientific, USA). Secondary fibers are richly branched, resembling those of a bath sponge (*Spongia* spp.) but have a more golden color. They measure 8–35 (23) μm, are clear except for a faint striation and free of sediment particles; meshes are about 70 x 70 μm to 300 x 550 μm in diameter. As in the primaries, stretches of pith become visible in epoxy-resin-embedded material only. These stretches can be just 50 μm or up to 600 μm long and occupy 13–33% of the fiber diameter (up to 40 % at some nodes).

**Ecology.** Inside a forereef cave, 20 m.

**Distribution.** Belize.

**Comments.** In his original description, de Laubenfels (1934) pointed out skeletal similarities of his *Polyfibrospongia echina* with spongiid commercial sponges, particularly the elaborate meshwork of the secondary fibers and sediment-cored primaries (like in *Spongia* spp., except that they were fasciculated, not evenly

distributed). He described detritus particles coring the primary fibers but did not mention occurrence of pith. Van Soest (1978), however, restudied the holotype and illustrated (fig. 23) pithed primary fibers. We reexamined the holotype as well and confirmed the skeleton structure, including cored primaries, and presence of pith. The main difference between the specimens is that the type shows conical processes whereas our material is cushion-shaped. Because the type specimen is badly macerated we cannot evaluate the significance of these differences. De Laubenfels' (1936:15) description of a specimen of *S. echina* from the Dry Tortugas is problematic because the specimen he deposited (USNM 22482) turns out to be *Hyrtilos violaceus* (Duchassaing & Michelotti, 1864), a very different sponge and obviously a mistake.

On the generic level, our material agrees with the definition of *Smenospongia* (Wiedenmayer, 1977; Cook & Bergquist, 2002) by having aerophobic properties (turning from yellow to purplish gray or black upon exposure to air), fasciculated primary fibers cored by small sediment particles, and a well-developed secondary fiber reticulum. Conflicting with the diagnosis is presence of some pith in parts of both fiber types. Since appearance of pith seems to be connected to processing techniques (epoxy resin versus synthetic histological mounting media) we maintain placement in *Smenospongia* until further investigations may suggest otherwise.

## Family Dysideidae

### Genus *Dysidea* Johnston, 1842

#### *Dysidea etheria* de Laubenfels, 1936

Synonymy and references. *Dysidea etheria* de Laubenfels, 1936: van Soest (1978): 53, pl. 10: 1.

**Material.** Field observation 78-0512-4A (photo and microscope examination only, not preserved). Carrie Bow Cay west, concrete pillar under concrete dock, 1 m; B. Spracklin photo 12 May 1978.

**External morphology.** A small cushion, about 3 cm<sup>2</sup> and 4 mm thick, covered by 1 mm tall conules; a few scattered oscula. Soft, compressible consistency, grayish-blue color in life.

**Skeleton.** A reticulation of fibers (70–300 µm thick) charged with sediment grains (sand particles and foreign spicules).

**Ecology.** Common on mangrove stilt roots and on rock and coral bases in the lagoon, also observed in limestone caves, 1–10 m.

**Distribution.** Bermuda, Florida, Bahamas, and throughout the Caribbean region.

**Comments.** The dysideid skeleton and the characteristic color make this species easy to identify.

## Order Dendroceratida

### Family Dictyodendrillidae

#### Genus *Igernella* Topsent, 1905

#### *Igernella notabilis* (Duchassaing & Michelotti, 1864)

Synonymy and references. *Igernella notabilis* (Duchassaing & Michelotti, 1864): van Soest (1978): 77, fig. 26, pl. 14: 4; Uriz & Maldonado (1996): 154, fig. 1, 2.

**Material.** USNM 1229147, Carrie Bow Cay forereef, low spur & groove, lower surface of *Agaricia* coral rubble, 8–9 m; K. Ruetzler col. 7 May 1973.

**External morphology.** A crust of 6 cm<sup>2</sup>, 5 mm thick, covered by 2 mm tall conules and showing two minute oscular openings. Consistency very soft, color brick red in life, cream in alcohol.

**Skeleton.** A base layer of spongin supporting dendritic fibers, some of which are interconnected. Sediment particles occur throughout the body, some are incorporated in the fibers. There are numerous spongin spiculoids, mainly triactines with rays, 30–50 µm at the center and lengths of 540–1650 (905) µm.



**Ecology.** The species is known from reef locations, but not much is known about its habitats; to 20 m.

**Distribution.** Bermuda and Caribbean region.

**Comments.** Our only specimen from cryptic locations is a juvenile but its skeleton is typical for the species; only the rays of its triradiate spiculoids are a bit longer than described from other material.

## Order Verongida

### Family Aplysinidae

#### Genus *Aplysina* Nardo, 1834

##### *Aplysina cauliformis* (Carter, 1882)

Synonymy and references. *Aplysina cauliformis* (Carter, 1882): Wiedenmayer (1977): 68, pl. 7: 1–3 (including synonymy); van Soest (1978): 62, pl. 11: 1, pl. 13: 2.

**Material.** USNM 1191351, Carrie Bow forereef cave, off Curlew Bank, 20 m; C. Piantoni col. 2 Jul 2007.

**External morphology.** A single branch, attached by a small encrusting base, protruding perpendicularly from a cave wall toward the light. Diameter 12 mm at the base, reaching 16 mm toward the distal rounded end. Tiny oscular opening (less than 0.5 mm, after fixation), irregularly dispersed along the branch. Firm but elastic consistency. Color reddish brown, changing to brown in alcohol (no aeophobic blackening).

**Skeleton.** The fiber meshes are 0.2–2.5 mm in diameter. Thickness of the amber fibers is 70–120 (202)  $\mu\text{m}$ , the pith takes up about a third of the diameter.

**Ecology.** Common on the open reef where its color is brownish to purplish, often with a bluish iridescent hue; less common in shaded environments; 8–30 m.

**Distribution.** Tropical western Atlantic, from the Bahamas to Brazil.

##### *Aplysina fistularis* (Pallas, 1766)

Synonymy and references. *Aplysina fistularis* (Pallas, 1766) forma *fistularis*: Wiedenmayer (1977): 64, pl. 5 fig. 3 (including synonymy).

**Material.** USNM 1191349, Curlew Bank forereef slope (wall), framework cave, 20 m; C. Piantoni col. 28 Jun 2007.

**External morphology.** The specimen is cushion-shaped, measuring 20 x 15 mm, 15 mm thick. There is one principal osculum on top, 2.5 mm in diameter, a few smaller ones dispersed over the body. The surface is conulose, with some conules connected by ridges. The consistency is spongy but firm, the color yellow to brown, turning to greenish upon exposure to air and, finally (after fixation), to dark purple.

**Skeleton.** The amber, striated and pithed skeleton fibers form contorted meshes, 0.6–2.2 mm in diameter. Their diameters have a large range: 30–150 (88)  $\mu\text{m}$ ; the pith occupies about 40 % of that, on average.

**Ecology.** A common sponge of the forereef, its distribution spreads occasionally into shaded habitats. under a coral slab and inside the entrance of a small reef crevice under semi-obscure conditions; 3–20 m.

**Distribution.** From Bermuda throughout the Caribbean to Brazil.

**Comments.** Typical specimens of this species develop thick-walled chimneys but those were not found in the caves. But the cushions observed by us have the same surface structure, consistency, color (including aerophobic change), and skeleton properties and are therefore considered conspecific.

##### *Aplysina fulva* (Pallas, 1766)

Synonymy and references. *Aplysina fistularis* (Pallas, 1766) forma *fulva* (Pallas): Wiedenmayer (1977): 66, pl. 6 (including synonymy); van Soest (1978): 57, pl. 11 fig. 2.

**Material.** USNM 1191350, Carrie Bow forereef cave, off Curlew Bank, 20 m; C. Piantoni col. 29 Jun 2007.

**External morphology.** A creeping branch, 4 cm long (fragment), 14 mm diameter. Finely conulose surface, with a few skeleton fibers protruding; oscular openings (1 mm) along the sides. Spongy but firm consistency. Color yellow-brown, which turned to dark purple in alcohol preservative.

**Skeleton.** Amber fibers form meshes, 0.5–3 mm in diameter. The fibers are 60–110 (100)  $\mu\text{m}$  in diameter, the pith averaged 41% of the width.

**Ecology.** Common on the forereef, only a sporadic cave dweller; 4–25 m.

**Distribution.** Throughout the tropical and subtropical western Atlantic, from Bermuda to Brazil.

**Comments.** More specimens need to be studied as it is unusual to find only a creeping branch of this usually erect-growing sponge.

### *Aplysina ocracea* Alcolado, 1984

Synonymy and references. *Aplysina ocracea* Alcolado, 1984: 2, fig. 1A.

**Material.** USNM 1191348, Carrie Bow forereef, spur & groove zone cave, 8–10 m; crevice entrance. K. Ruetzler col. 11 May 1975. USNM 1229148, Curlew Bank forereef slope (wall), framework cave, 18 m; C. Piantoni & M. Parrish, col. 25 Aug 2012.

**External morphology.** The sponge grows in cushion-shape, 30 x 20 x 12 mm (thick) to 70 x 30 x 20 mm. There are individual oscula, 1–2 mm, or one large atrial opening of about 10 mm diameter, into which lead 4 canals of 2–4 mm. The surface is finely conulose, with conules that are less than 0.5 mm tall and less than 1 mm distant from each other. The color is rich ochre, with a luminescent purple hue over the surface; it barely changes after conservation in alcohol.

**Skeleton.** The skeleton fibers are amber, as typical in the genus, 50–145 (97)  $\mu\text{m}$  in diameter, with the pith occupying on average 24 % of the width.

**Ecology.** Found under coral slabs and inside the entrance of small reef caves under semi-obscure conditions; 8–30 m.

**Distribution.** Described originally from Cuba, this is the first record from Belize.

**Comments.** The most distinctive features of this species are the finely conulose surface and ochre color that does not change during fixation.

### *Aplysina sciophila* new species

(Figures 4g, 43)

**Material.** Holotype: USNM 1229149, Carrie Bow forereef, 25 m; crevice entrance bottom; M. C. Diaz, col. 8 Sep 2009.

Paratypes: USNM 1191344, Carrie Bow forereef cave, 18 m; K. Ruetzler col. 19 May 1979. USNM 1191340, 1191341 Carrie Bow forereef, 22 m; under ledge in deep shade; M. C. Diaz and E. Villamizar col. 23 Jul 2008. USNM 1191343, USNM 1229150, Carrie Bow forereef, 25 m; crevice entrance bottom; M. C. Diaz col. 8 Sep 2009.

Other material examined: USNM 1191339, Carrie Bow forereef, 22 m; under ledge in deep shade; M. C. Diaz & E. Villamizar col. 23 Jul 2008. USNM 1191342, Carrie Bow forereef, 20 m; under ledge in deep shade; M. C. Diaz & E. Villamizar col. 23 Jul 2008.

**Diagnosis.** Thinly ramose *Aplysina* in Caribbean reef caves and in the shaded parts of ledges and overhangs. Branches less than 4 mm in diameter and up to about 150 mm long, arising from a small cushion. Delicate fibers, measuring less than 50  $\mu\text{m}$  in mean diameter and forming meshes averaging 0.7 x 0.4 mm. Color yellow to ochre, not changing to purple or black upon exposure to air.

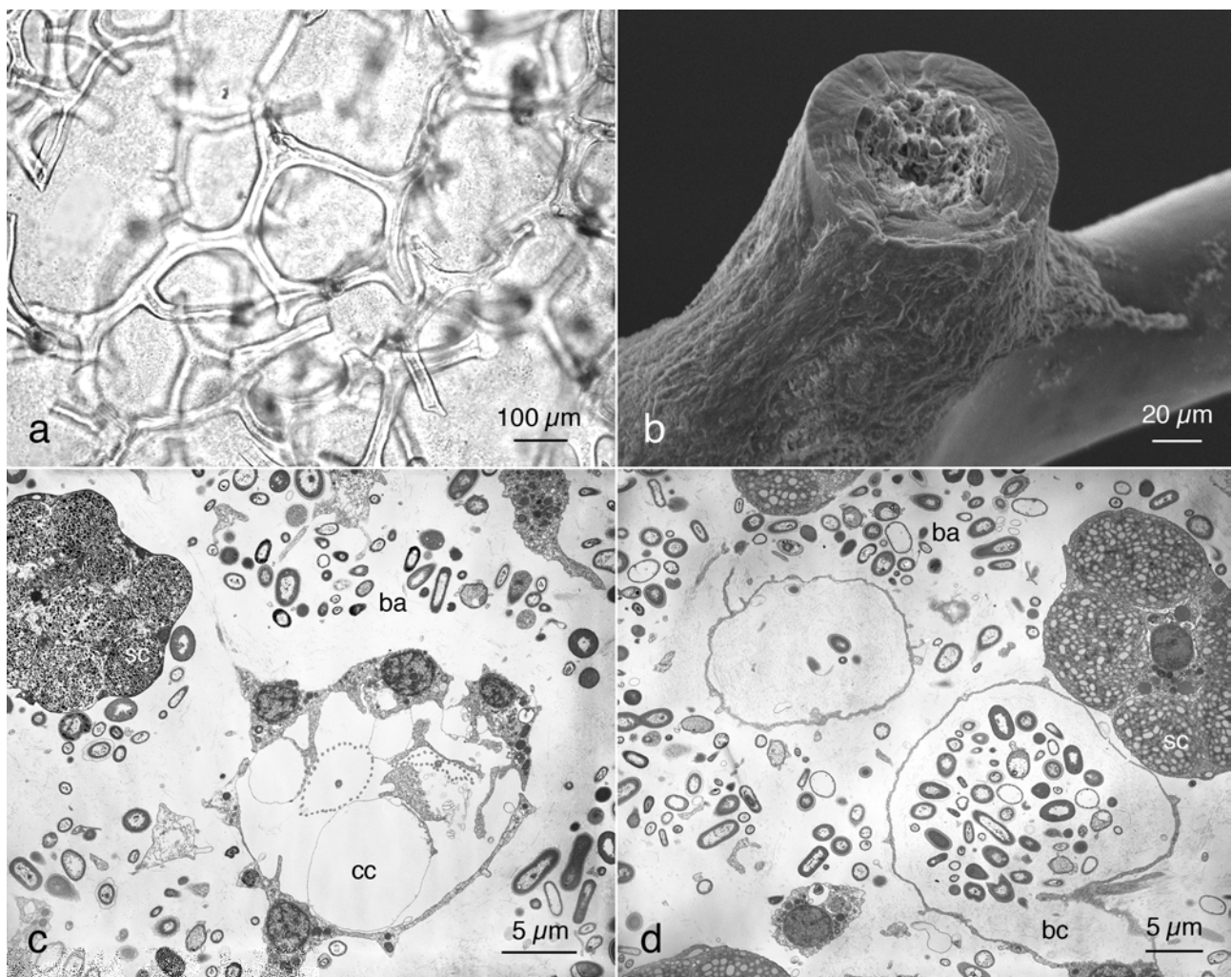
**External morphology.** The holotype consists of a small cushion, 23 x 14 x 13 mm in dimensions and supporting one whip-like branch, 154 mm long, 2–3 mm thick. Other specimens have similar dimensions, with a base 1–5  $\text{cm}^3$  in volume; there may be 1–8 branches extending from one base, 3–180 mm in length, 1–4 mm in

diameter, with no tendency to subdivide. The surface pattern is very finely conulose and interrupted, here and there, by very small (<1–2 mm) oscula, most located on the base cushion but also along the side of branches. The consistency is soft but elastic. Color: dull yellow to reddish tan in life, some specimens with a bluish, luminescent hue over the reddish tan background; reddish tan after fixation in alcohol.

**Skeleton structure.** The typical (for *Aplysina*) golden yellow, pithed fibers of the holotype measure 20–63 (42)  $\mu\text{m}$  in diameter, with the pith occupying two thirds of the thickness (an average of 67 %). These fibers form meshes of (largest perpendicular diameters) 260–1520 x 110–650 (682 x 349)  $\mu\text{m}$ . Fiber diameters of all specimens measured combined ranged 20–81 (47)  $\mu\text{m}$ , meshes 220–1520 x 110–650 (641 x 376)  $\mu\text{m}$ .

**Cellular fine structure.** Transmission electron microscopy (TEM) revealed choanocyte chambers of about 25  $\mu\text{m}$  diameter and the typical (for genus *Aplysina*) spherulous cells (24–28  $\mu\text{m}$ ) and pocket-type bacteriocytes (28–32  $\mu\text{m}$ ). Symbiotic bacteria, numerous inside bacteriocytes and throughout the mesohyle, are heterotrophic; no cyanobacteria were seen.

**Ecology.** Occurs on walls, ceilings, and ledges in medium to deeply shaded caves and under overhangs on the forereef, 20–25 m.



**FIGURE 43.** *Aplysina sciophila*, anatomy/histology (holotype USNM1191343, light and electron microscopy): a, light-microscope view of fiber skeleton; b, SEM view of fiber cross-section, showing bark and pith; c, TEM view of choanocyte chamber, mesohyle full of bacteria, and spherulous cell; d, TEM view of bacteriocyte, spherulous cell, and mesohyle containing free bacteria. Abbreviations: ba=bacteria in mesohyle; bc=bacteriocyte; cc=choanocyte; sc=spherulous cell.

**Distribution.** The material studied by us is from the Belize barrier reef but one of us (MCD) found specimens in similar environments in the Cayman Islands.

**Etymology.** The species name is derived from the Greek words skia (shade) and philia (love, fondness).

**Comments.** Judging from its shape and color (and the lack of aerophobic color change when removed from the

water and preserved in formalin or alcohol), this species is closest to *Aplysina cauliformis* (Carter, 1882) with which it co-occurs in the same reef environment. The latter flourishes in full exposure to ambient light but in places its distribution extends into caves, thus overlapping with that of our new species. For comparison, we collected a piece of *A. cauliformis*, a specimen taken nearby on a reef in South Cut, in 4 m depth, and subjected it to the same processing techniques (fixation, fiber and mesh measurements). It too has branches that originate from a cushion-shaped base and do not usually subdivide. But the branches are often clavate and their diameter ranges from 5 to 20 mm, the length can reach 50 cm or more. The color may be dull yellow to brown, reddish brown, and purple. As in our new species, there is no strong color change upon exposure to air or fixative. The fiber diameter measured in *A. cauliformis* is about double that of *A. sciophila*, 65–120 (90)  $\mu\text{m}$ , and fibers form considerably coarser meshes: 620–2800 x 330–660 (1164 x 478)  $\mu\text{m}$ . From the fine structure, cell types and inclusions in both species are identical except that in *A. cauliformis* more than a third of the bacterial symbionts are photosynthetic (cyanobacteria). Similar observations were made by Vacelet (1967, 1975) when comparing cellular structures in a similar photophilic and sciophilic species pair in the Mediterranean, *Aplysina aerophoba* Nardo and *A. cavernicola* (Vacelet) (both as *Verongia*). It was later shown that specimens of *A. cavernicola* transplanted to illuminated habitats retained its original bacterial symbionts and did not acquire cyanobacteria from their new environment (Thoms *et al.*, 2003).

Another yellow, rope-like *Aplysina* species on the Belize forereef is *Aplysina fulva* (Pallas). Its branches, however, are 5–25 mm in diameter and up to 28 cm long and the dimensions of fibers and skeleton meshwork are coarse, the same as in *A. cauliformis*, and we never found it in cryptic environments. Above all, *A. fulva* is aerophobic and turns dark purplish to almost black when it is exposed to air and subjected to fixation, thus making it easily identifiable. Kobluk & van Soest (1989) list *A. fulva* from a framework cave in 12–24 m in the Netherlands Antilles, but it is likely that this material belongs to our new species.

## Family Aplysinellidae

### Genus *Suberea* Bergquist, 1995

#### *Suberea? flavolivescens* (Hofman & Kielman, 1992)

Synonymy and references. *Axinyssa flavolivescens* Hofman & Kielman, 1992: 210, fig. 5, pl. 1: A–D.

**Material.** USNM 1229151, 1229152, Carrie Bow Cay back reef near crest, under- and inside *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1229153, Carrie Bow Cay reef crest, underside of *Acropora palmata* coral rubble, 0.5 m; K. Ruetzler col. 26 Apr 1974. USNM 1229154, Carrie Bow Cay forereef, low spur and groove zone, lower side of *Agaricia* coral rubble, 8–10 m; K. Ruetzler col. 11 May 1975. USNM 1229155, Carrie Bow Cay forereef, high spur and groove zone, small cave, 4 m; K. Ruetzler col. 11 May 1979. USNM 1229156, Curlew Bank, forereef slope cave, 21 m; C. Piantoni and M. Parrish col. 21 Aug 2012. USNM 1229157, Curlew Bank, forereef slope cave, 18 m; C. Piantoni and M. Parrish col. 23 Aug 2012.

Field examination only (86-01-G), no specimen preserved: Carrie Bow Cay reef flat, under *Porites porites* and *Acropora cervicornis* rubble, 0.5 m; K. Ruetzler col. 29 Jan 1986.

**External morphology.** Small crusts and cushions protruding from the substratum, some with circular oscula (3–5 mm diameter). These cushions also penetrate the coral rock below and fill cavities of several cubic centimeter volume, some of which the sponge seems to excavate. Consistency is soft, the color deep yellow, which turns to purplish black when exposed to air.

**Skeleton.** We observed fragments of verongid fibers and a great variety of spicules and other sediment particles throughout the tissue. All spicules seem to be foreign, as were those described and figured by Hofman & Kielman (1992).

**Ecology.** Common inside reef coral and rubble, also in caves, 0.3–21 m; may occur to 100 m and more (P. Alcolado, pers. comm.)

**Distribution.** Caribbean.

**Comments.** The generic relocation of this species is tentative, pending further study of its fiber structure and histology (in progress by S. Zea, pers. comm.)

## Class Calcarea

### Order Clathrinida

#### Family Clathrinidae

#### Genus *Clathrina* Gray, 1867

#### *Clathrina hondurensis* Klautau & Valentine, 2003

Synonymy and references. *Clathrina hondurensis* Klautau & Valentine, 2003: 46, fig. 38; *Clathrina coriacea* (Montague, 1814): Wiedenmayer (1977): 190; *Clathrina* aff. *coriacea*: Rützler *et al.* (2004): 7.

**Material.** USNM 1191353, Carrie Bow forereef, spur and groove zone, 8–10 m; lower surface of coral block. K. Ruetzler, col. 11 May 1975. USNM 1191356, Carrie Bow south reef crest, under coral rubble, 1 m. K. Ruetzler col. 6 Mar 2006. USNM 1191354, USNM 1191355, Carrie Bow forereef, 25 m. M. C. Diaz col. 8 Sep 2009. USNM 1229159, Carrie Bow Cay, south back reef, lower surface of platy coral rubble, 1 m; K. Ruetzler, col. 17 Aug 2012.

**External morphology.** Clusters of meshwork of tubes, forming cushions of 0.5–8 cm<sup>2</sup> extension. Oscula (1–3 mm) are in places where several tubules merge, forming an atrium, but distinctive water-collecting tubes are only seen in young specimens. The sponges are strongly contractile and shrink considerably when touched and removed from the substrate. Color is bright yellow to brownish yellow.

**Skeleton structure.** Spicules are triactines packed densely and tangentially in the wall of the asconoid tubes, thus allowing for strong contractions.

**Spicules.** The triactines have equal actines and are equiangular, except for a few that are misformed. The actines taper gradually to a sharp point; they measure 85–100 (92) µm in length, 8–12 (10) µm in width at the base.

**Ecology.** Common in forereef cavities and on the lower surfaces of coral rubble; also in peat caves in the mangrove, away from sediment bottoms (Rützler *et al.*, 2004). Depth: 0.5–25 m.

**Distribution.** Probably Caribbean-wide but easily overlooked and generally misidentified as *C. coriacea*, a Mediterranean species.

**Comments.** The triactines of the studied material have shorter and thinner rays as described for the holotype from Turneffe Island atoll (Belize) (mean, 133 x 16 µm), but the closeness of the type location to our study area and the fact that triactines are the only spicules and their morphology is identical with the type illustration prompt us to accept the name *C. hondurensis* for our species.

#### *Clathrina* cf. *panis* (Haeckel, 1872)

Synonymy and references. *Clathrina panis* (Haeckel, 1872): Klautau and Valentine, 2003: 31, fig. 24.

**Material.** USNM 1229160, Curlew Bank forereef, small cave, 20 m; C. Piantoni, col. 28 Jun 2007.

**External morphology.** A whitish cushion made up by interconnected, compressed tubules, the entire specimen was only about 6 mm in diameter, 3 mm high. All was used up in making a microscope preparation.

**Skeleton structure.** Mostly composed of intermeshed triactines, with a few accompanying diactines and rare tetractines.

**Spicules.** Triactines are equiradial and equiangular, with actines gradually tapering to dull points. Tetractines are similar in shape but the apical actine is about 20 % shorter than the others. Actines, as much as one can see in the section, measure about 120–140 µm in length and are 14 µm thick at the base. Diactines, also tapering gradually toward the points, are 350–500 µm long, 14–16 µm thick.

**Ecology.** Not much is known about the habitats of this inconspicuous species. We only found one specimen in a medium-dark cave environment, along with encrusting demosponges, such as *Spirastrrella mollis* and *Monanchora arbuscula*.

**Distribution.** Florida Atlantic coast, Gulf of Mexico and the Caribbean; Cape Verde.

**Comments.** The specimen is too small to be certain of a correct identification.

## Family Leucettidae

### Genus *Leucetta* Haeckel, 1872

#### *Leucetta floridana* (Haeckel, 1872)

Synonymy and references. *Leucetta floridana* (Haeckel, 1872): Valderrama *et al.* (2009): 8, fig. 5.

**Material.** USNM 1229161, Carrie Bow Cay forereef cave, 18 m; K. Ruetzler col. 19 May 1979.

**External morphology.** An egg-shaped specimen, 28 x 16 x 16 mm, with two slightly elevated oscula (1.5 mm). Hard consistency, rough surface from large, tangential spicules. Color white.

**Skeleton structure.** Large triactines and tetractines are tangentially oriented and make up the cortex, tetractines have the apical actine pointing inward, into the choanosome. Spicule arrangement in the choanosome, mainly composed of small triactines, is disorganized; the smaller tetractines are most common along the canals and the atrium.

**Spicules.** All types are equiradiate and equiangular, actines tapering gradually to a point. Only the apical actine of tetractines is shorter than the others; sagittal deformations are rare. Measurements are lengths of actines x width at the base. The most common are the small triactines I: 116–230 x 12–25 (168 x 20)  $\mu\text{m}$ ; small tetractines I: 100–210 x 10–22 (137 x 16)  $\mu\text{m}$ ; large triactines II: 450–1520 x 30–250 (897 x 137)  $\mu\text{m}$ ; large tetractines II: 270–2050 x 70–360 (1220 x 229)  $\mu\text{m}$ .

**Ecology.** Observed in several caves on the foerereef, 18–25 m,

**Distribution.** Tropical western Atlantic: Bermuda, Gulf of Mexico, Caribbean, to Brazil.

## Order Leucosolenida

### Family Sycettidae

#### Genus *Sycon* Risso, 1827

##### *Sycon* sp.

Synonymy and references. *Scypha ciliata* (Fabricius): de Laubenfels (1950): 143, fig. 63. *Sycon ciliatum* (Fabricius): Rützler (1986): 126, fig. 45, pl. 4: 7.

**Material.** USNM 1229162, Carrie Bow back reef near crest, underside of *Acropora palmata* coral rubble, 0.3 m; K. Ruetzler col. 23 Apr 1974. USNM 1229163, Carrie Bow Cay, south back reef, lower surface of platy coral rubble, 1 m; K. Ruetzler col. 17 Aug 2012.

**External morphology.** Vase-shaped, thickest in the middle, syconoid aquiferous system, 14 mm tall, 4 mm diameter, one apical atrium of 2 mm diameter, crowned by oxeas. Firm but fragile, white in color.

**Skeleton structure.** Oxeas and sagittal tetractines surround the atrium, oxeas, triactines and tetractines make up the choanoskeleton.

**Spicules.** Dimensions are difficult to determine from this small sample, as many spicules are broken. Oxeas I: 300–1600 x 2–6  $\mu\text{m}$ ; oxeas II: 430–1950 x 8–20  $\mu\text{m}$ ; triactines, regular or sagittal, with two actines bent backward toward the third (which may be longer), at varying degree; actine dimensions: 60–180 x 5–13  $\mu\text{m}$ ; tetractines, many sagittal, with paired actines straight or bent in various directions; actine dimensions: 50–140 x 5–10  $\mu\text{m}$ .

**Ecology.** Observed in most cryptic habitats, undersides of shallow rubble to forereef caves, 0.5–30 m.

**Distribution.** Reported from many locations in the northern Atlantic.

**Comments.** Records from outside the northern Atlantic region are considered doubtful or not valid (van Soest *et al.*, 2013b). A more focused study of *Sycon* species (and many other Calcarea) from the tropical western Atlantic is most desirable.

## Conclusions

Here we examined the biodiversity and distributional ecology of the sponge fauna of Caribbean reef caves and other cryptic habitats. Over the past 40 years, we recorded and sampled sponges from a multitude of cryptic spaces within the Belize barrier reef ecosystem near Carrie Bow Cay, site of the Smithsonian Marine Field Station. These included the interstices and lower surfaces of coral rubble, reef overhangs, framework caves, mangrove peat bank undercuts, and a large drowned karst cave accessible through a sinkhole (“blue hole”) in the lagoon. Most of these habitats are densely populated by sponges that are rarely or never seen on open, sun-exposed substrates, either because they lack photosynthetic symbionts, have no chemical defenses against competing macroalgae or predatory invertebrates, fishes, or sea turtles, or are subject to a combination of such parameters.

From our observations, many of these coelobites are thinly encrusting and slow-growing but long-lived forms and tend to incorporate suspended fine sediments including spicules from the water column or from neighboring, overgrown sponges as part of their skeleton. This tendency of accumulating foreign spicules makes taxonomy difficult and, generally, requires several specimens from different habitats for reliable identifications.

We identified and characterized 123 sponge species from cryptic habitats near Carrie Bow Cay and described 14 as new species, including one new genus. We determined that 75 of these species (61 %) are strictly coelobites and not found on light-exposed reef surfaces or mangrove roots. Estimating total sponge biodiversity for the region, open-habitat versus cryptic species, is difficult owing to taxonomic uncertainties and shortage of expert surveys (every specialized study so far has resulted in several revisions and new species). However, based on a conservative estimate of at least 200 easily observable species, the coelobites may add 38 % to the biodiversity total. Our results were incorporated in a literature review of cryptic sponges for the entire Caribbean Sea (Table 2) where a total of 267 species are listed, 61 of them contributed by our study. It is apparent that, despite technical difficulties, there are still exciting discoveries in Caribbean biodiversity to be made by studying cryptic habitats.

## Acknowledgments

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TABLE 2. Sponges reported from Caribbean cryptic shallow-water habitats.

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<b>HOMOSCLEROMORPHA</b>			
<b>Homosclerophorida</b>			
<b>Oscarellidae</b>			
<i>Oscarella nathaliae</i> Ereskovsky <i>et al.</i> (2013)	Sciophilous on reef walls and in caves (ceilings); Jamaica, Martinique, Guadeloupe	15–28 m	4
<b>Plakimidae</b>			
<i>Corticium diamantense</i> Ereskovsky <i>et al.</i> (2013)	Vertical walls of reef caves, Martinique	22–28 m	4
<i>Corticium quadripartitum</i> Topsent, 1923	Under coral slab, barrier reef, Belize	0.3 m	This paper
<i>Plakina jamaicensis</i> Lehnert and van Soest (1998)	Undemeath <i>Montastraea</i> coral boulder, Jamaica	35 m	16
<i>Plakinastrella onkodes</i> Uliczka, 1929	Underside of coral plates, in caves, barrier reef, Belize	0.3–20 m	This paper
<i>Plakortis angulospiculatus</i> (Carter, 1879)	Under coral rubble, barrier back reef, Belize; coral framework cave, Netherlands Antilles; underside of coral rock, Colombia; under coral plates, in caves, barrier reef, Belize	0.5–3 m; 18–43 m; 0.5–15 m; 0.3–26 m	5; 10; 32; This paper
<b>Plakortis dariae</b> Ereskovsky <i>et al.</i> (2013)			
<i>Plakortis edwardsi</i> Ereskovsky <i>et al.</i> (2013)	Sciophilous on reef walls, Jamaica	26–28 m	4
<i>Plakortis myrae</i> Ereskovsky <i>et al.</i> (2013)	Shaded sides of reef boulders, Jamaica	23–26 m	4
“ <i>Plakortis simplex</i> ” complex	Sciophilous on reef wall and in cave, Jamaica	26–28 m	4
<i>Plakortis zygompha</i> (de Laubenfels, 1934)	Inside small fore-reef cave, Jamaica	31 m	14
<i>Tetralophophora mesoamericana</i> new species	Under platy rubble, barrier reef, Belize	0.3–1 m	This paper
	Forereef cave, barrier reef, Belize	18 m	This paper
<b>DEMOSPONGIAE</b>			
<b>Spirophorida</b>			
<b>Tetillidae</b>			
<i>Cinachyrella alloclada</i> (Uliczka, 1929)	Framework cave, Bermuda; in caves and under rocks, Bermuda; inshore karst cave, Bahamas	2–15 m; 0.5–2 m; 0–0.1 m	15 <sup>1</sup> ; 20; 25 <sup>2</sup>
<i>Cinachyrella kaekenthalii</i> (Uliczka, 1929)	Reef cave, Jamaica, forereef cave, barrier reef, Belize	25 m; 20 m	14; this paper
<i>Tetilla laminaris</i> George & Wilson, 1919	Cryptic under coral rubble, barrier reef, Belize	1 m	This paper
<b>Samidae</b>			
<i>Samus anonymus</i> Gray, 1867	Submerged karst cave; cryptic on barrier reef, Belize	18–25 m	16; this paper

..... continued on the next page



**TABLE 2. (continued)**

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<b>Astrophorida</b>			
Ancorinidae			
<i>Stelletta solidissima</i> (Wilson, 1902)	Under coral rock, barrier reef, Belize	1–30 m	This paper
<i>Cryptosyringa membranophila</i> Vacelet, 1979	Framework cave, Jamaica; inside cavities of coral rubble, Belize	20 m; 26 m	28; this paper
<i>Ecionemia megastylifera</i> Wintermann–Kilian, 1984	Among rubble and in small caves, Panama	1–25 m	3
<i>Jaspis</i> sp. 1	Framework cave, Netherlands Antilles	30–43 m	10
<i>Jaspis</i> sp. 2	Submerged karst cave, Belize	18–25 m	16 <sup>3</sup> ; this paper
<i>Stryphnus raratraiaenus</i> Cárdenas <i>et al.</i> , 2009	Under coral rubble, Panama	1 m	3
<b>Geodiidae</b>			
<i>Geodia cribrata</i> new species	Forereef caves, barrier reef, Belize	25–30 m	This paper
<i>Geodia gibberosa</i> Lamarek, 1815	Under rubble, back barrier reef, Belize; submerged karst cave, Belize	0.5–3 m; 18–25 m	5; 16; this paper
<i>Geodia neptuni</i> (Sollas, 1886)	Fore-reef cave, Jamaica	0.2–33 m	14
<i>Erylus formosus</i> Sollas, 1887	Framework cave, Netherlands Antilles; cryptic habitats, barrier reef, Belize	12 m; 3–30 m	10; this paper
<b>Pachastrellidae</b>			
<i>Dercitus (Halinastra) arubensis</i> van Soest, Beglinger & de Voogd, 2010	Underneath coral rubble, Netherlands Antilles	0–1 m	24
<i>Dercitus (Halinastra) luteus</i> (Pulitzer-Finali, 1986)	Under rubble, barrier back reef, Belize; under shaded overhang, Puerto Rico; in caves, Netherlands Antilles	0.5–3 m; 20–25 m; 10–20 m	5 <sup>4</sup> ; 19 <sup>5</sup> ; 24
<i>Dercitus</i> sp.	Framework cave, Netherlands Antilles	30 m	10
<i>Triptolemma endolithicum</i> van Soest, 2009	Insinuating coral rock, Colombia	25 m	23
<b>Thrombidae</b>			
<i>Thrombus jancai</i> Lehnert, 1989	Framework cave, Jamaica	30 m	12
<b>Hadromerida</b>			
Alectonidae			
<i>Spiroxya spiralis</i> (Johnson, 1899)	Under coral rubble, barrier reef, Belize	1–30 m	This paper
<b>Clionaidae</b>			

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**TABLE 2. (Continued)**

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<i>Cliona amplificavata</i> Rützler, 1974	Framework cave, Netherlands Antilles; inside conch shells, cryptic on barrier reef, Belize	24–30 m; 0.5–30 m	10; this paper
<i>Cliona caribbea</i> Carter, 1882	Under rubble, barrier back reef, Belize	0.5–3 m	5
<i>Cliona delirix</i> Pang, 1971	Framework cave, Netherlands Antilles	18–30 m	10
<i>Cliona flavifodina</i> Rützler, 1974	Framework cave, Bermuda; under rubble, in caves, barrier reef, Belize	2–15 m; 1 m	15; this paper
<i>Cliona janitrix</i> Pang, 1971	Framework cave, Netherlands Antilles	12 m	10
<i>Cliona</i> cf. <i>mucronata</i> Sollas, 1878	Cryptic in coral rock, barrier reef, Belize	8–30 m	This paper
<i>Cliona schmidti</i> (Carter, 1871)	Framework cave, Netherlands Antilles; cryptic on the barrier reef, Belize	24 m; 1–30 m	10; this paper
<i>Cliona varians</i> (Duchassaing & Michelotti, 1864)	Under rubble, barrier back reef, Belize; framework cave, Netherlands Antilles; fore reef caves, barrier reef, Belize	0.5–3 m; 18 m; 2–30 m	5 <sup>6</sup> ; 10 <sup>7</sup> ; this paper
<i>Cliona vermifera</i> Hancock, 1867	Framework cave, Netherlands Antilles	30 m	10
<i>Cliona</i> sp.	Cryptic on the fore reef	12 m	This paper
<i>Pione vastifica</i> (Hancock, 1849)	Cryptic in shallow reef substrates	1 m	This paper
<i>Sphectospongia vesparium</i> (Lamarck, 1815)	Under coral rubble, barrier back reef, Belize; cryptic on fore reef, barrier reef, Belize	0.3–3 m; 0.3–20 m	5, this paper
Placospongiidae			
<i>Placosphaerastra antillensis</i> van Soest, 2009	Under coral rubble and in reef caves, Netherlands Antilles; under rubble and in caves, barrier reef, Belize	20–35 m; 20–25 m	23; this paper
<i>Placosphaerastra micrastra</i> (Lehnert & Heimler, 2001)	Underside of coral plate ( <i>Agaricia</i> ), Jamaica	20 m	13 <sup>8</sup>
<i>Placospongia caribica</i> new species	In Karst cave, barrier reef, Belize	20–23 m	This paper
<i>Placospongia</i> sp. 1	Under rubble, fore reef, Belize; submerged karst cave, Belize	18–25 m	5 <sup>9</sup> ; 16 <sup>10</sup>
<i>Placospongia</i> sp. 2	Framework cave, Netherlands Antilles	18–24 m	10 <sup>11</sup>
Polymastiidae			
<i>Polymastia tenax</i> Pulitzer-Finali, 1986	Under coral rubble, barrier back reef, Belize; in crevices and other cryptic habitats, Cozumel (Mexico); in shaded cavity, Dominican Republic	0.5–3 m; 7 m	5; 11; 19
Spirastrellidae			

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<i>Diplastrrella megastellata</i> Hechtel, 1965	Framework cave, Netherlands Antilles; reef cave, Jamaica; cryptic, barrier reef, Belize	24 m; 24–27 m; 0.3–27 m	10; 14; this paper
<i>Spirastrella coccinea</i> (Duchassaing & Michelotti, 1864)	Framework cave, Netherlands Antilles; reef cave, Jamaica; framework cave, Bermuda; submerged karst cave, under rubble, in reef caves, barrier reef, Belize	12–24 m; 2–15 m; 25 m; 18–25 m; 0.5–21 m	10; 14; 15; 16; this paper
<i>Spirastrella mollis</i> Verrill, 1907	Under coral rubble, barrier back reef, Belize; Framework cave, Bermuda; undersides of rocks, Bermuda; under rubble, in caves, barrier reef, Belize	6–15 m; 0–5 m; 0.3–25 m	5 <sup>12</sup> ; 13 <sup>12</sup> ; 20; this paper
<i>Spirastrella</i> sp. (cf. <i>cunctatrix</i> ) Suberitidae	Framework cave, Netherlands Antilles	43 m	10 <sup>13</sup>
<i>Aaptos aaptos</i> (Schmidt, 1864)	Framework cave, Netherlands Antilles	24 m	10 <sup>14</sup>
<i>Aaptos permucleata</i> (Carter, 1870)	Under coral plates, in caves, barrier reef, Belize	0.5–20 m	This paper
<i>Prosuberites carriebowensis</i> new species	Under coral plates, in caves, barrier reef, Belize	7–35 m	This paper
<i>Prosuberites laughlini</i> (Diaz, Alvarez & van Soest, 1987)	Framework cave, Netherlands Antilles	12–43 m	10 <sup>15</sup>
<i>Protosuberites geracei</i> (van Soest & Sass, 1981)	Inshore karst cave, Bahamas	0 m (barely subtidal)	25
<i>Pseudosuberites</i> sp.	Framework cave, Netherlands Antilles	12 m	10
<i>Terpios fugax</i> Duchassaing & Michelotti, 1864	Framework cave, Bermuda; undersides of reef rubble, barrier reef, Belize	2–15 m; 0.5–9 m	15; this paper
<i>Terpios</i> cf. <i>fugax</i> Duchassaing & Michelotti, 1864	Framework cave, Netherlands Antilles	18 m	10
<i>Terpios</i> sp. Timeidae	Framework cave, Netherlands Antilles	12 m	10
<i>Timea curacaoensis</i> van Soest, 2009	Reef cavities, Netherlands Antilles	10 m	23
<i>Timea diplasterina</i> new species	Under coral rock, barrier reef, Belize	0.3 m	This paper
<i>Timea mixta</i> (Topsent, 1896)	Framework cave, Bermuda	2–15 m	15
<i>Timea oxyasterina</i> new species	In foreereef cave, barrier reef, Belize	20 m	This paper
<i>Timea stenoclera</i> Hechtel, 1969	Cryptic under coral rubble, inside conch shells, barrier reef, Belize	0.2–20 m	This paper
<i>Timea</i> cf. <i>unistellata</i> (Topsent, 1892)	Under coral rubble, barrier reef, Belize	1 m	This paper

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
Tethyidae			
<i>Tethya maza</i> Selenka, 1879	Cryptic under rubble, inside conch shells	0.2–20 m	This paper
<i>Tethya</i> cf. <i>maza</i> Sclenka, 1893	Underside of rocks; inshore karst cave, in pool, Bahamas	0.5 m	9; 25
Trachycladidae			
<i>Rhaphidhistia belizensis</i> new species	Forereef rock and caves, barrier reef, Belize	20–30 m	This paper
<b>Chondrosida</b>			
Chondrosiidae			
<i>Chondrilla caribensis</i> Ruetzler, Düran & Piantoni, 2007	Framework cave, Netherlands Antilles; framework cave, Bermuda; Submerged karst cave, Belize; framework caves, Bermuda; mangrove roots, under rubble, forereef caves, barrier reef, Belize	12–30 m; 2–15 m; 18–25 m; 0.5–5 m; 0.5–30 m	10 <sup>16</sup> ; 15; 16; 20; this paper
<b>‘Lithistid Demospongiae’</b>			
Scleritodermidae			
<i>Amphibleptula madrepora</i> Schmidt, 1879	Deep crevice, St. Vincent	15 m	18
Theonellidae			
<i>Discodermia dissoluta</i> Schmidt, 1880	Framework cave, Netherlands Antilles	12–43 m	10
Siphonidiidae			
<i>Gastrophanelia cavernicola</i> Muricy & Minervino, 2000	Submerged karst cave, Belize	18–25 m	16 <sup>17</sup> ; this paper
Desmanthidae			
<i>Desmanthus incrustans</i> (Topsent, 1889)	Framework cave, Netherlands Antilles; submerged karst cave, Belize	12–30 m; 18–25 m	10; 16
<i>Petromica</i> ( <i>Chaladesma</i> ) <i>ciocalypitoides</i> (van Soest & Zea, 1986)	Caves, Venezuela	15–24 m	18
Phymaraphiniidae			
<i>Kaliopsis</i> cf. <i>cidaris</i> Bowerbank, 1869	Under wave-exposed coral rock, barrier reef, Belize	0.5 m	This paper
<b>Poecilosclerida</b>			
<b>(Microcionina)</b>			
Acarnidae			
<i>Acarnus nicoleae</i> van Soest, Hooper & Hiemstra, 1991)	Framework cave, Netherlands Antilles; under platy, wave-exposed coral rock, barrier reef, Belize	18–24 m; 0.2–1.5 m	10 <sup>18</sup> ; this paper

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**TABLE 2. (Continued)**

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<i>Acheliaderma lisannae</i> van Soest, Zea & Kielman, 1994	Coral rubble (possibly excavating), Colombia	20–23 m	27
<i>Cornulella santamartae</i> van Soest, Zea & Kielman, 1994	Under rubble and overhangs, Netherlands Antilles and Colombia	4–25 m	27
<i>Cornulum johnstoni</i> (de Laubenfels, 1934)	Cryptic habitats, including caves, barrier reef, Belize	21 m	This paper
<i>Damiria leonorae</i> van Soest, Zea & Kielman, 1994	Framework cave and under rubble and dead coral, Netherlands Antilles, Colombia, U. S. Virgin Islands, Barbuda	2–12 m	10 <sup>19</sup> ; 27
<i>Megaciella incrustans</i> van Soest, 2009	Encrusting between bamacles, Colombia	10 m	23
<i>Zyzya invemar</i> van Soest, Zea & Kielman, 1994	Deep-reef cryptic habitats, Colombia	25 m	27
<i>Wigginsia curlewensis</i> new species Microcionidae	Forereef cave, barrier reef, Belize	21 m	This paper
<i>Clathria (Microcionia) bulbotoxa</i> van Soest, 1984	Framework cave, Netherlands Antilles; under rocks and in caves, barrier reef, Belize	18–24 m; 25 m	10; this paper
<i>Clathria (Microcionia) campecheae</i> Hooper, 1996	Framework cave, Netherlands Antilles; submerged karst cave, Belize; under rubble and in caves, barrier reef, Belize	18 m; 18–25 m; 18–25 m	10 <sup>20</sup> ; 16 <sup>21</sup> ; this paper
<i>Clathria (Microcionia) echinata</i> (Alcolado, 1984)	Framework cave, Netherlands Antilles; cryptic under reef rubble, barrier reef, Belize	24 m; 0.5–1 m	10, this paper
<i>Clathria (Microcionia) ferrea</i> (de Laubenfels, 1936)	Under dead coral, Netherlands Antilles	1 m	22
<i>Clathria (Microcionia) spinosa</i> (Wilson, 1902)	Framework cave, Netherlands Antilles; Shallow cave, Netherlands Antilles	30 m; 2 m	10; 22
<i>Clathria (Thalysias) collosclera</i> van Soest, 2009	Reef cavities, Netherlands Antilles	10 m	23
<i>Clathria (Thalysias) minuta</i> (van Soest, 1984)	Framework cave, Netherlands Antilles	18 m	10 <sup>22</sup>
<i>Clathria (Thalysias) curacaoensis</i> Arndt, 1927	Shaded habitats, including caves, barrier reef, Belize	1–18 m	This paper
<i>Clathria (Thalysias) venosa</i> (Alcolado, 1984)	Framework cave, Netherlands Antilles; shaded shallow rock substrates, barrier reef, Belize	12–43 m; 0.5–1 m	10 <sup>23</sup> ; this paper
<i>Clathria (Thalysias) virgultosa</i> (Lamarck, 1814)	Under rock, in caves, barrier reef, Belize	0.5–21 m	This paper
<i>Clathria</i> sp.	Framework cave, Bermuda	6–15 m	15 <sup>24</sup>
<i>Pandarus acanthifolium</i> Duchassaing & Michelotti, 1864	Framework cave, Netherlands Antilles	18 m	10

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<b>Raspaillidae</b>			
<i>Ectyoplasia ferox</i> (Duchassaing & Michelotti, 1864)	Under rubble, back barrier reef, Belize; framework cave, Netherlands Antilles; under rock, in caves, barrier reef, Belize	0.5–3 m; 12–43 m; 1–25 m	5; 10; this paper
<i>Eurypon clavatum</i> (Bowerbank, 1866)	Framework cave, Bermuda	2–15 m	15 <sup>25</sup>
<i>Eurypon viride</i> (Topsent, 1889)	framework cave, Netherlands Antilles; Framework cave, Bermuda	12–24 m; 6–15 m	10 <sup>26</sup> ; 15 <sup>27</sup>
<b>Rhabderemiidae</b>			
<i>Rhabderemia minutula</i> (Carter, 1876)	In coral crevices, Cozumel (Mexico)	Not stated	11 <sup>28</sup>
<b>(Myxillina)</b>			
<b>Chondropsidae</b>			
<i>Batzella fusca</i> van Soest, 2009	Under coral rubble, Netherlands Antilles	5 m	23
<i>Strongylacidon rubrum</i> van Soest, 1984	Cryptic on forereef, barrier reef, Belize	20 m	This paper
<i>Strongylacidon unguiferum</i> van Soest, 2009	Undersides of coral rubble, Netherlands Antilles; mangrove root and peat undercut, Belize	4 m; 0.5 m	23; this paper
<b>Coelospaeridae</b>			
<i>Forcepia (Forcepia) minima</i> van Soest, 2009	Under rubble and in reef crevices, Netherlands Antilles	3.5–25 m	23
<i>Forcepia (Forcepia) fistulosa</i> van Soest, 2009	Under rubble and overhangs, in reef crevices, Colombia	25 m	23
<i>Forcepia (Leptolabis) microlabis</i> van Soest, 2009	Under rubble, Netherlands Antilles	35 m	23
<i>Lissodendoryx (Lissodendoryx) isodictyalis</i> (Carter, 1882)	Framework cave, Bermuda	6–15 m	20
<b>Crambeidae</b>			
<i>Monanchora arbuscula</i> (Duchassaing & Michelotti, 1864)	Framework cave, Netherlands Antilles; under coral plates and in forereef caves, barrier reef, Belize	18 m; 4–28 m	10; this paper
<b>Crellidae</b>			
<i>Crella (Grayella) beglingerae</i> van Soest, 2009	Under coral rubble and in caves, Netherlands Antilles	5–14 m	23

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
Desmaciidae			
<i>Desmapsamma anchorata</i> (Carter, 1882)	Framework cave, Netherlands Antilles	30 m	10 <sup>29</sup>
Hymedesmiidae			
<i>Hymedesmia (Hymedesmia) agariciicola</i> van Soest, 1984	Framework cave and under coral, Netherlands Antilles; forereef cave, barrier reef, Belize	10–12 m; 20 m	10; 22; this paper
<i>Hymedesmia (Hymedesmia) bonaitrensis</i> van Soest, 2009	Under coral rubble, Netherlands Antilles	3.5–5 m	23
<i>Hymedesmia (Hymedesmia) curacaensis</i> van Soest, 1984	Under coral plates, forereef, barrier reef, Belize	8–9 m	This paper
<i>Hymedesmia (Hymedesmia) palmaticheifera</i> van Soest, 1984	Framework cave, Netherlands Antilles	18 m	10
<i>Phorbis amaranthus</i> Duchassaing & Michelotti, 1864	Framework cave and underside of dead coral, Netherlands Antilles	12–30 m; 0.6–33 m	10; 22
<i>Phorbis aurantiacus</i> new species	Under rubble and in forereef cave	21–30 m	This paper
Iotrochotidae			
<i>Iotrochota birotulata</i> (Higgin, 1877)	Under rock and framework cave, Netherlands Antilles; under rocks and in forereef caves, barrier reef, Belize	0.5–1.5 m and 12–43 m; 0.5–65 m	10; 22; this paper
Tedaniidae			
<i>Strongylamma baki</i> (van Soest, 1984)	Framework cave, Netherlands Antilles	18–43 m	10 <sup>30</sup>
<i>Tedania (Tedania) ignis</i> (Duchassaing & Michelotti, 1864)	Mangrove peat-undercut ceiling, Belize	1 m	21 <sup>31</sup>
<b>(Mycalina)</b>			
Desmacellidae			
<i>Desmacella polysigmata</i> van Soest, 1984	<i>Forereef cave, barrier reef, Belize</i>	21 m	This paper
<i>Biemna caribea</i> Pulitzer-Finali, 1986	Mangrove peat- undercut ceiling, Belize	1 m	21 <sup>32</sup>
<i>Biemna</i> sp.	Framework cave, Netherlands Antilles	30 m	10
<i>Neofibularia nolitangere</i> (Duchassaing & Michelotti, 1864)	Framework cave, Netherlands Antilles	18–30 m	10
Espertiopsidae			
<i>Ulosa monticulosa</i> (Verrill, 1907)	Inshore caves, Bermuda	0.5–1 m	20 <sup>33</sup>

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<b>Mycalidae</b>			
<i>Mycale (Aegogropila) americana</i> van Soest, 1984	Under rubble, back barrier reef, Belize	0.5–3 m	5 <sup>34</sup>
<i>Mycale (Aegogropila) arndti</i> van Soest, 1984	Underside of rock, Colombia	0.5 m	32
<i>Mycale (Aegogropila) citrina</i> Hajdu & Rützler, 1998	Underside of rock, Colombia	0.5–1 m	32 <sup>35</sup>
<i>Mycale (Arenochalina) laxissima</i> (Duchassaing & Michelotti, 1864)	Karst cave (“blue hole”), Jamaica	16 m	14 <sup>36</sup>
<i>Mycale (Carmia) microsigmatosa</i> Arndt, 1827	Wave-exposed back reef, barrier reef, Belize	0.5–1.5 m	This paper
<i>Mycale (Grapelia) unguifera</i> Hajdu, Zea, Kielman & Peixinho, 1995	Forereef cave, barrier reef, Belize	20 m	This paper
<i>Mycale (Mycale) laevis</i> (Carter, 1882)	Cryptic, back and forereef, barrier reef, Belize	1–25 m	This paper
<i>Mycale (Naviculina) diversisigmata</i> van Soest, 1984	Under rock, Netherlands Antilles	1 m	22
<i>Mycale (Paresperella) vitellina</i> van Soest, 2009	Under coral rubble, Netherlands Antilles	1–35 m	23
<b>Merliidae</b>			
<i>Merita deficiens</i> Vacelet, 1980	Dark reef habitats, including caves, barrier reef, Belize	5–39 m	This paper
<i>Merita normani</i> Kirkpatrick, 1903	Underside of coral and framework caves, Netherlands Antilles; on lower surfaces of coral plates ( <i>Agaricia</i> ), Cozumel (Mexico); forereef caves, barrier reef, Belize	18–24 m; not stated; 25–35 m	10 <sup>37</sup> ; 11; This paper
<b>Halichondrida</b>			
<b>Axinellidae</b>			
<i>Dragnacidon reticulatum</i> (Ridley & Dendy, 1886)	Forereef cave, barrier Reef, Belize	20 m	This paper
<i>Dragnaxia undata</i> Alvarez, van Soest & Rützler, 1998	Under coral plates and in caves, barrier reef, Belize	0.5–35 m	This paper
<i>Dragnaxia?</i> sp.	Framework cave, Netherlands Antilles	24 m	10
<i>Ptilocaulis marquezii</i> (Duchassaing & Michelotti, 1864)	Framework cave, Netherlands Antilles	12 m	10
<i>Ptilocaulis walpersi</i> (Duchassaing & Michelotti, 1864)	Inshore caves, Bermuda; forereef caves, barrier reef, Belize	0.5–2 m; 1–35 m	20 <sup>38</sup> ; this paper
<b>Bubaridae</b>			

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<i>Bubaris ammosclera</i> Hechtel, 1969	Agglutinating rubble under other sponges, Colombia	4 m	32
<i>Hymerhabdia</i> sp.	Framework cave, Netherlands Antilles	24 m	10
Heteroxyidae			
<i>Didiscus oxeatata</i> Hechtel, 1983	Framework cave, Netherlands Antilles; reef cave, Jamaica	12–30 m; 24 m	10; 14
<i>Myrmekioderma laminatum</i> new species	Under coral overhang, in crevices, barrier reef, Belize	20 m	This paper
<i>Myrmekioderma rea</i> (de Laubenfels, 1953b)	Framework cave, Netherlands Antilles; forereef cave, Jamaica; forereef caves, barrier reef, Belize	12–43 m; 31–35 m; 18–20 m	10 <sup>39</sup> ; 14 <sup>40</sup> ; this paper
<i>Myrmekioderma gyroderma</i> (Alcolado, 1984)	Framework cave, Netherlands Antilles	12–43 m	10 <sup>41</sup>
Dictyonellidae			
<i>Dictyonella</i> sp.	Framework cave, Netherlands Antilles	18–43 m	10
<i>Scopalina ruetzleri</i> (Wiedenmayer, 1977)	Framework cave, Netherlands Antilles; Mangrove peat-undercut wall and ceiling, Belize; forereef overhangs and caves, barrier reef, Belize	12–30 m; 0.5–1 m; 0.3–20 m	10 <sup>42</sup> ; 21; this paper
<i>Stylissa caribica</i> Lehnert & van Soest (1998)	Reef cave, Jamaica	30 m	14
Halichondriidae			
<i>Amorphinopsis</i> sp.	Mangrove peat- undercut ceiling, Belize; in caves and crevices, forereef, barrier reef, Belize	1 m; 0.3–20 m	21 <sup>43</sup> ; this paper
<i>Axiopssa ambrosia</i> (de Laubenfels, 1936)	Undersides of corals, Colombia	18–35 m	34
<i>Halichondria?</i> sp.	Framework cave, Netherlands Antilles	24 m	10
<i>Hymeniacion caerulea</i> Pulitzer-Finali, 1986	Cryptic reef habitats, barrier reef, Belize	0.3–20 m	This paper
<i>Hymeniacion</i> sp.	Framework cave, Netherlands Antilles	18–30 m	10
<i>Topsentia bahamensis</i> Diaz, van Soest & Pomponi, 1993	forereef caves, barrier reef, Belize	18–25 m	This paper
<i>Topsentia ophiraphidites</i> (de Laubenfels, 1934)	Framework cave, Netherlands Antilles; reef cave, Jamaica; under coral rubble, in caves, barrier reef, Belize	12–43 m; 25 m; 1–20 m	10 <sup>44</sup> ; 14; this paper
<b>Agelasida</b>			
Agelasidae			
<i>Agelas cervicornis</i> (Schmidt, 1870)	Deep caves and overhangs, Jamaica	14–30 m	17
<i>Agelas citrina</i> Gotera & Alcolado, 1987	Framework cave, Netherlands Antilles; in caves and crevices; Bahamas, Caribbean; under coral rock, in cave, barrier reef, Belize	4–43 m; 15–35 m	10 <sup>45</sup> ; 17; this paper

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<i>Agelas clathrodes</i> (Schmidt, 1870)	Fills crevices when in juvenile stages; Caribbean-wide, from Bahamas to Belize	7–36	17
<i>Agelas conifera</i> (Schmidt, 1870)	Framework cave, Netherlands Antilles	12–30 m	10
<i>Agelas dilatata</i> Duchassaing & Michelotti, 1864	Caves and overhanging reef walls, Bahamas	18–27 m	17
<i>Agelas dispar</i> Duchassaing & Michelotti, 1864	Partly cryptic, filling crevices and holes; Caribbean-wide, from Bahamas to Belize; under coral rock, in cave, barrier reef, Belize	2–32 m; 6–20 m	17; this paper
<i>Agelas repens</i> Lehnert & van Soest, 1998	Forereef caves, Jamaica	22–25 m	14; 17
<i>Agelas sceptirum</i> (Lamarek, 1814)	Framework cave, Netherlands Antilles	12–30 m	10
<i>Agelas schmidti</i> Wilson, 1902	Between rocks, in crevices and holes, from Bahamas throughout the Caribbean; forereef caves, barrier reef, Belize	10–38 m; 18–20 m	17; this paper
<i>Agelas sventres</i> Lehnert & van Soest, 1996	Framework cave, Netherland Antilles; partly cryptic, filling crevices, Bahamas and throughout Caribbean; under platy coral and inside conch shells, barrier reef, Belize	1–32 m; 1 m	10 <sup>46</sup> ; 17; this paper
<i>Agelas wiedenmayeri</i> Alcolado, 1984	In crevices, under foliose corals, Bahamas and Caribbean; under platy corals and in caves, barrier reef, Belize	10–35 m; 5–28 m	17; this paper
<i>Agelas</i> sp. 1 (thin incrustation)	Framework cave, Netherlands Antilles	18–24 m	10
<i>Agelas</i> sp. 2 (no description)	Framework cave, Bermuda	6–15 m	15
Astroscleridae			
<i>Ceratoporella nicholsoni</i> (Hickson, 1911)	Framework cave, Cuba; Framework caves, Jamaica; submerged karst cave, Belize	13 m; 15–95 m; 18–25 m	1; 8; 14; 16
<i>Goreauella auriculata</i> Hartman, 1969	Framework caves (ceilings), Jamaica; forereef caves, barrier reef, Belize	8–70+ m; 20 m	6; 8; 14; this paper
<i>Hispidopetra miniana</i> Hartman, 1969	Framework caves and under ledges, Jamaica; forereef caves, barrier reef, Belize	10–95 m	6; 8; this paper
<i>Stromatospongia vermicola</i> Hartman, 1969	Rock wall, underside of corals (deep shade), Jamaica	10–95 m	6; 8
<i>Stromatospongia norae</i> Hartman, 1969	Framework caverns and sub-reef tunnels (walls, ceilings), Jamaica	8–85 m	6; 8; 14
<b>Haplosclerida</b>			
( <b>Haplosclerina</b> )			
Callyspongiidae			

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<i>Callyspongia</i> ( <i>Callyspongia</i> ) <i>fallax</i> Duchassaing & Michelotti, 1864	Framework cave, Netherlands Antilles; Karst cave ("blue hole"), Jamaica	12–43 m; 15 m	10 <sup>47</sup> ; 14 <sup>48</sup>
<i>Callyspongia</i> ( <i>Callyspongia</i> ) <i>strongylophora</i> Hartman, 1955	Karst cave ("blue hole"), Jamaica	20 m	14 <sup>49</sup>
<i>Callyspongia</i> ( <i>Cladochalina</i> ) <i>armigera</i> (Duchassaing & Michelotti, 1864)	Framework cave, Netherlands Antilles	30–43 m	10 <sup>50</sup>
<i>Callyspongia</i> ( <i>Cladochalina</i> ) <i>vaginalis</i> (Lamarck, 1814)	Framework cave, Netherlands Antilles	12–30 m	10 <sup>51</sup>
Chalinidae			
<i>Chalinula molitba</i> (de Laubenfels, 1950)	Framework cave, Netherlands Antilles	18 m	10 <sup>52</sup>
<i>Haliclona</i> ( <i>Haliclona</i> ) <i>albifragilis</i> (Hechtel, 1965)	Under corals and coral rubble; Florida, Jamaica, Barbados, Venezuela, Bonaire, Curaçao	To 74 m	31
<i>Haliclona</i> ( <i>Haliclona</i> ) <i>stoneae</i> de Weerdt, 2000	Under coral overhangs, barrier reef, Belize	21 m	31; this paper
<i>Haliclona</i> ( <i>Haliclona</i> ) <i>vansoesti</i> de Weerdt, de Kluijver & Gomez	In reef crevices, under coral overhangs; Jamaica, Martinique, St. Vincent, Curaçao; in forereef crevice, barrier reef, Belize	2–52 m; 24 m	31; this paper
<i>Haliclona</i> ( <i>Haliclona</i> ) sp.	Forereef cave, barrier reef, Belize	20 m	This paper
<i>Haliclona</i> ( <i>Reniera</i> ) <i>implexiformis</i> (Hechtel, 1965)	Under rubble, forereef, Belize; framework cave, Netherlands Antilles; mangrove peat-undercut ceiling, Belize; cryptic reef habitats, barrier reef, Belize	0.5–3 m; 18–43 m; 1 m; 1–25 m	5; 10; 21 <sup>53</sup> ; this paper
<i>Haliclona</i> ( <i>Reniera</i> ) <i>manglaris</i> Alcolado, 1984	Mangrove peat-undercut ceiling, Belize; under boat dock, barrier reef, Belize	1 m; 0.5 m	21; this paper
<i>Haliclona</i> ( <i>Reniera</i> ) <i>mucifibrosa</i> de Weerdt, Ruetzler & Smith, 1991	Reef caves, Jamaica; cryptic habitats, mangrove and reef, barrier reef, Belize	8–12 m; 0.1–20 m	31, this paper
? <i>Haliclona</i> ( <i>Reniera</i> ) <i>tubifera</i> (George & Wilson, 1919)	Framework cave, Bermuda	2–4 m	15 <sup>54</sup>
<i>Haliclona</i> ( <i>Rhizoniera</i> ) <i>curacaoensis</i> (van Soest, 1980)	Under rubble, barrier back reef, Belize	0.5–3 m	5 <sup>55</sup>
<i>Haliclona</i> ( <i>Soestella</i> ) <i>caerulea</i> (Hechtel, 1965)	Under coral rubble, barrier back reef, Belize;	0.5–3 m	5 <sup>56</sup>
<i>Haliclona</i> ( <i>Soestella</i> ) <i>lehnerti</i> de Weerdt, 2000	Forereef caves, barrier reef, Belize	8–18 m	This paper
<i>Haliclona</i> ( <i>Soestella</i> ) <i>luciensis</i> de Weerdt, 2000	Forereef caves, barrier reef, Belize	18–21 m	This paper
<i>Haliclona</i> ( <i>Soestella</i> ) <i>piscaderaensis</i> (van Soest, 1980)	Karst cave ("blue hole"), Jamaica	20 m	14 <sup>57</sup>

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<i>Haliclona</i> ( <i>Soestella</i> ) <i>vermeuleni</i> de Weerd, 2000	Under stones, Bermuda	0.3 m	31
<i>Haliclona</i> ( <i>Soestella</i> ) sp.	Cryptic, shallow back reef, barrier reef, Belize	1 m	This paper
Niphatidae			
<i>Amphimedon compressa</i> Duchassaing & Michelotti, 1864	Karst cave ("blue hole"), Jamaica	25 m	14
<i>Amphimedon erina</i> (de Laubenfels, 1936)	Cryptic among seagrass, in mangrove, back-reef rubble, barrier reef, Belize	0.5–2 m	This paper
<i>Amphimedon viridis</i> Duchassaing & Michelotti, 1864	Framework cave; inshore cave; Bermuda	2–15 m; 0.5–5 m	15 <sup>38</sup> ; 20
<i>Cribrochalina vasculum</i> (Lamarck, 1814)	Forereef cave, barrier reef, Belize	20 m	This paper
<i>Niphates alba</i> van Soest, 1980	Forereef cave, barrier reef, Belize	20 m	This paper
<i>Niphates amorpha</i> Wiedenmayer, 1977	Cryptic on reef, high energy habitats, barrier reef, Belize	0.5–20 m	This paper
<i>Niphates arenata</i> new species	Forereef cave, barrier reef, Belize	25 m	This paper
<i>Niphates digitalis</i> (Lamarck, 1814)	Karst cave ("blue hole"), Jamaica	2–15 m	14
<i>Niphates erecta</i> Duchassaing & Michelotti, 1864	Under rubble, barrier reef, Belize; framework cave, Netherlands Antilles; Karst cave ("blue hole"), Jamaica; cryptic reef habitats, barrier reef, Belize	0.5–3 m; 12–43 m; 20 m	5; 10; 14; this paper
<i>Niphates</i> sp. (brown, lobate, tough; cf. van Soest, 1980)	Framework cave, Netherlands Antilles	12–18 m	10
(Petrosina)			
Phloeodictyidae			
<i>Calyx podatypa</i> (de Laubenfels, 1934)	Framework cave, Netherlands Antilles; Karst cave ("blue hole"), Jamaica; under coral rubble and sponges, Colombia; cryptic reef habitats, barrier reef, Belize	12 m; 6 m; 0.5–35 m; 1–35 m	10; 14; 32 <sup>39</sup> ; this paper
<i>Siphonodictyon coralliphagum</i> Rützler, 1971	Framework cave, Netherlands Antilles; under and in rubble and rock, barrier forereef, Belize;	24 m; 0.3–25 m	10; this paper
<i>Siphonodictyon occultum</i> new species	Forereef cave, barrier reef, Belize	18 m	This paper
<i>Siphonodictyon ruetzleri</i> (Calcinai, Cerrano and Bavestrello, 2007)	Inside rock in cryptic habitats, barrier reef, Belize	11–15 m	This paper
<i>Siphonodictyon xamaycaense</i> Pulitzer-Finali, 1986	Excavating rock in forereef caves, barrier reef, Belize	18–21 m	This paper
<i>Aka/Meischnikowia</i> sp.	Framework cave, Netherlands Antilles	24 m	10

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<i>Oceanapia bartschi</i> (de Laubenfels, 1934)	Karst cave ("blue hole"), Jamaica; in foreereef cave, barrier reef, Belize	5 m; 20 m	14; this paper
<i>Oceanapia penicilliformis</i> (van Soest & Sass, 1981)	Inshore karst cave, Bahamas	3–4 m	25 <sup>60</sup>
Petrosiidae			
<i>Neopetrosia subtriangularis</i> (Duchassaing, 1850)	Karst cave ("blue hole"), Jamaica	20 m	14 <sup>61</sup>
<i>Petrosia</i> ( <i>Petrosia</i> ) <i>weinbergi</i> van Soest, 1980	Framework cave, Netherlands Antilles; reef cave, Jamaica; foreereef caves, barrier reef, Belize	18–43 m; 18–25 m	10; 14; this paper
<i>Petrosia</i> ( <i>Petrosia</i> ) <i>pellasarca</i> (de Laubenfels, 1934)	Framework cave, Netherlands Antilles	12 m	10
<i>Petrosia</i> ( <i>Petrosia</i> ) sp.	Inside dead conch shell, barrier reef, Belize	1 m	This paper
<i>Xestospongia arenosa</i> van Soest & de Weerdt, 2001	Foreereef cave, barrier reef, Belize	25 m	This paper
<i>Xestospongia deweerdtiae</i> Lehnert & van Soest, 1999	Reef cave, Jamaica; foreereef cave, barrier reef, Belize	10–12 m; 26 m	26; this paper
<i>Xestospongia muta</i> (Schmidt, 1870)	Karst cave ("blue hole"); reef-cave ceiling; Jamaica	15 m; 25 m	14
<i>Xestospongia purpurea</i> new species	Cryptic foreereef habitats, barrier reef, Belize	1–18 m	This paper
<i>Xestospongia</i> aff. <i>muta</i> (Schmidt, 1870)	Framework cave, Netherlands Antilles	18 m	10
<i>Xestospongia rampa</i> (de Laubenfels, 1934)	Cryptic under reef rubble, barrier reef, Belize	0.3 m	This paper
<i>Xestospongia wiedenmayeri</i> van Soest, 1980	Under coral rubble, barrier back reef, Belize	0.5–3 m	5
<i>Xestospongia</i> sp.	Framework cave, Netherlands Antilles	24 m	10
Calcifibrospongiidae			
<i>Calcifibrospongia actinostromarioides</i> Hartman, 1979	Framework cave, Bahamas	30 m	7
<b>Dictyoceratida</b>			
Irciniidae			
<i>Ircinia felix</i> (Duchassaing & Michelotti, 1864)	Framework cave, Netherlands Antilles; under foreereef rock and in caves, barrier reef, Belize	12–30 m; 0.5–20 m	10; this paper
<i>Ircinia strobilina</i> (Lamarck, 1814)	Framework cave, Netherlands Antilles; foreereef cave, barrier reef, Belize	12–30 m; 20 m	10; this paper

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<i>Ircinia</i> cf. <i>campana</i> (Lamarck, 1814)	Framework cave, Netherlands Antilles	30 m	10
Thorectidae			
<i>Hyrtilos violaceus</i> (Duchassaing & Michelotti, 1864)	Framework cave, Netherlands Antilles	30 m	10
<i>Smenospongia cerebriformis</i> (Duchassaing & Michelotti, 1864)	Framework cave; foreereef cave, barrier reef, Belize	18–30 m; 20 m	10; this paper
<i>Smenospongia</i> cf. <i>echina</i> (de Laubenfels, 1934)	Foreereef cave, barrier reef, Belize	20 m	This paper
<i>Smenospongia</i> sp.	Framework cave, Netherlands Antilles	18–30 m	10
Dysideidae			
<i>Dysidea etheria</i> de Laubenfels, 1936	Karst cave (“blue hole”), Jamaica; cryptic on mangrove roots, on coral bases, under boat dock, barrier reef lagoon, Belize	8 m; 1–10 m	14, this paper
<i>Dysidea janiae</i> (Duchassaing & Michelotti, 1864)	Karst cave (“blue hole”), Jamaica	12–15 m	14
<i>Dysidea tubulata</i> (Lehnert & van Soest, 1998)	Karst cave (“blue hole”), Jamaica	5 m	14 <sup>62</sup>
<b>Dendroceratida</b>			
Darwinellidae			
<i>Aplysilla longispina</i> George & Wilson, 1919	Inshore cave, Bermuda	1 m	20
<i>Aplysilla</i> sp. aff. <i>sulfurea</i> Schulze, 1878	Framework cave, Netherlands Antilles	24 m	10
<i>Chelonaplysilla erecta</i> (Keller, 1891)	Framework cave	12–30 m	10
Dictyodendrillidae			
<i>Igernella notabilis</i> (Duchassaing & Michelotti, 1864)	Under coral rubble, foreereef, barrier reef, Belize	8–9 m	This paper
<b>Halisarcida</b>			
Halisarcidae			
<i>Halisarca caerulea</i> Vacelet & Donadey, 1987	Framework cave, Netherlands Antilles; lower surfaces of corals; Martinique and Guadeloupe	12–43 m; 2–15 m	10 <sup>63</sup> , 30
<i>Halisarca</i> sp.	Framework cave, Netherlands Antilles	12–30 m	10 <sup>64</sup>
<b>Verongida</b>			
Aplysinidae			

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<i>Aiolochoira crassa</i> (Hyatt, 1875)	Framework caves, Netherlands Antilles and Bermuda; Karst cave ("blue hole"), Jamaica	0.5–30 m; 2–15 m	10 <sup>65</sup> ; 14; 15 <sup>66</sup> ; 20 <sup>67</sup>
<i>Aplysina archeri</i> (Higgin, 1877)	Framework cave, Netherlands Antilles	18 m	10
<i>Aplysina bathyphila</i> Maldonado & Young, 1998	Caves and crevices, Bahamas	<30 m	33
<i>Aplysina cauliformis</i> (Carter, 1882)	Framework cave, Netherlands Antilles; shaded forereef habitats, barrier reef, Belize	30 m; 8–30 m	10; this paper
<i>Aplysina fistularis</i> (Pallas, 1766)	Framework cave, Netherlands Antilles; Karst cave ("blue hole"), Jamaica; under coral rubble, in forereef cave, barrier reef, Belize	18 m; 15 m; 6–15 m; 3–20 m	10; 14; 15 <sup>68</sup> ; this paper
<i>Aplysina fulva</i> (Pallas, 1766)	framework cave, Bermuda		
	Framework cave, Netherlands Antilles; forereef cave, barrier reef, Belize	12–24 m; 20 m	10; this paper
<i>Aplysina lacunosa</i> (Lamarck, 1814)	Karst cave ("blue hole"), Jamaica	15 m	14
<i>Aplysina ocracea</i> Alcolado, 1984	Under coral plate, Cuba; under coral slabs and in forereef caves, barrier reef, Belize	30 m; 8–30 m	2; this paper
<i>Aplysina sciophila</i> new species	Under forereef coral overhangs and in caves, barrier reef, Belize	20–25 m	This paper
<i>Aplysina</i> sp.	Submerged karst cave, Belize	18–25 m	16
<i>Verongula rigida</i> (Esper, 1794)	Framework cave, Netherlands Antilles	12–30 m	10
Aplysinellidae			
<i>Suberea? flavoivescens</i> (Hofman & Kielman, 1992)	Framework cave, Netherlands Antilles; under rubble and in fooreef caves, barrier reef, Belize	0.3–24 m	10 <sup>69</sup> ; this paper
<b>CALCAREA</b>			
<b>(CALCINEA)</b>			
<b>Clathrinida</b>			
Clathrimidae			
<i>Clathrina</i> aff. <i>coriacea</i> (Montagu, 1818)	Mangrove peat- undercut ceiling, Belize	1 m	21 <sup>70</sup>
<i>Clathrina canariensis</i> (Miklucho-Maclay, 1868)	Under rubble, back barrier reef, Belize	0.5–3 m	5 <sup>71</sup>
<i>Clathrina hondurensis</i> Klautau & Valentine, 2003	In mangrove peat caves, under forereef rubble and in caves, barrier reef, Belize	0.5–25 m	This paper

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TABLE 2. (Continued)

Taxa (CLASS, Order, family, species)	Habitat, Location	Depth	References/ Endnotes
<i>Clathrina</i> cf. <i>panis</i> (Haeckel, 1872)	Forereef cave, barrier reef, Belize	20 m	This paper
<i>Clathrina</i> sp.	Framework cave, Netherlands Antilles	18–24 m	10
Leucetidae			
<i>Leucetta floridana</i> (Haeckel, 1872)	Framework and inshore caves, Bermuda; forereef caves, barrier reef, Belize	2–15 m; 1 m; 18–25 m	15; 20 <sup>72</sup> ; this paper
<i>Leucetta imberbis</i> (Duchassaing & Michelotti, 1864)	Framework cave, Netherlands Antilles; Karst cave (“blue hole”), Jamaica	18–24 m; 10–25 m	10; 14
<b>Murrayonida</b>			
Paramurrayonidae			
<i>Paramurrayona corticata</i> Vacelet, 1967	Framework cave, Jamaica	20 m	29
(CALCARONEA)			
<b>Leucosolenida</b>			
Sycettidae			
<i>Sycon ciliatum</i> (Fabricius, 1780)	Framework cave, Bermuda; in caves and under rocks, Bermuda	2–15 m; 0.5–1 m	15 <sup>73</sup> ; 20
<i>Sycon</i> cf. <i>ciliatum</i> (Fabricius, 1780)	Under shallow rubble, in forereef caves, barrier reef, Belize	0.5–30 m	This paper
Grantiidae			
<i>Leucandra aspera</i> (Schmidt, 1862)	Framework cave, Bermuda	2–15 m	15 <sup>74</sup>

Literature cited: 1. Alcolado (1980); 2. Alcolado (1984); 3. Cárdenas *et al.* (2009); 4. Ereskovsky *et al.* (2013); 5. Gischler & Gimsburg (1996); 6. Hartman (1969); 7. Hartman (1979); 8. Hartman & Goreau (1970); 9. Hechtel (1965); 10. Kobluk & van Soest (1989); 11. Lehnert (1993); 12. Lehnert (1998); 13. Lehnert & Heimler (2001); 14. Lehnert & van Soest (1998); 15. Logan *et al.* (1984); 16. Macintyre *et al.* (1982); 17. Parra-Velandia *et al.* (2014, in press); 18. Pomponi *et al.* (2001); 19. Pulitzer-Finali (1986); 20. Rützler (1986); 21. Rützler *et al.* (2004); 22. van Soest (1984); 23. van Soest (2009); 24. van Soest *et al.* (2010); 25. van Soest & Sass (1981); 26. van Soest & de Weerd (2001); 27. van Soest *et al.* (1994); 28. Vacelet (1979); 29. Vacelet (1981); 30. Vacelet & Donadey (1987); 31. De Weerd (2000); 32. Zea (1987); 33. Zea *et al.* (2009); 34. Zea *et al.* (2013).

<sup>1</sup> Listed as *Cinachyra alloclada* Uliczka, 1929

<sup>2</sup> Described as *Cinachyrella subterranea* van Soest & Sass, 1981

<sup>3</sup> Identified as *Stellettinopsis* sp.

<sup>4</sup> Listed as *Pachataxa lutea* Pulitzer-Finali, 1986

<sup>5</sup> Described as *Pachataxa lutea* Pulitzer-Finali, 1986

<sup>6</sup> Listed as *Anthosigmella varians* forma incrustans (Duchassaing & Michelotti, 1864)

<sup>7</sup> Listed as *Anthosigmella varians* (Duchassaing & Michelotti, 1864)



- <sup>8</sup> Described as *Timea micrastrer* but, based on study of additional material, is now considered to be a *Placosphaerastra*
- <sup>9</sup> Listed as "*Placospongia carinata* Carter, 1879"
- <sup>10</sup> Identified as *Placospongia carinata* (Bowerbank, 1858)
- <sup>11</sup> Listed as *Placospongia melobesioides* Gray, 1867
- <sup>12</sup> Listed as *Spirastrella cunctatrix* Schmidt, 1868 (a Mediterranean species)
- <sup>13</sup> May be *Spirastrella mollis* Verrill, 1907
- <sup>14</sup> May be *Aptos pernucleata* (Carter, 1870)
- <sup>15</sup> Described as *Eurypon laughlini* Diaz, Alvarez & van Soest, 1987
- <sup>16</sup> Treated as *Chondrilla nucula* Schmidt, 1862 (a Mediterranean species) in all these references
- <sup>17</sup> Presented as *Gastrophanella implexa* Schmidt, 1879.
- <sup>18</sup> Treated as *Acarus souriei* (Levi, 1952)
- <sup>19</sup> Identified as *Damiria testis* Topsent, 1925
- <sup>20</sup> Identified as *Clathria affinis* (sensu Topsent, 1889)
- <sup>21</sup> Identified as *Microciona affinis* Carter, 1880.
- <sup>22</sup> Treated as *Rhaphidophilus cf. minutus* van Soest, 1984
- <sup>23</sup> Listed as *Rhaphidophilus venosus* (Alcolado, 1984)
- <sup>24</sup> Listed as *Microciona* sp.
- <sup>25</sup> Listed as *Eurypon clavata* (= *clavatum*) (Bowerbank 1866) (a questionable record of this northeast Atlantic species).
- <sup>26</sup> Listed as *Tricheurypon viridis* (Topsent, 1889).
- <sup>27</sup> Listed as *Tricheurypon viride* (Topsent, 1889).
- <sup>28</sup> Described as *Bienna demuthi* Lehnert, 1993
- <sup>29</sup> Listed as *Holopsamma helwigi* de Laubenfels, 1936
- <sup>30</sup> Listed as *Hemitidania baki* van Soest, 1984
- <sup>31</sup> Listed as red *Tedania*
- <sup>32</sup> Listed as yolk-yellow *Bienna*
- <sup>33</sup> Treated as *Haliclona monticulosa* (Verrill, 1907)
- <sup>34</sup> Listed as *Mycale americana* van Soest, 1984
- <sup>35</sup> Presented as *Mycale (Aegogropila) americana* van Soest, 1984
- <sup>36</sup> Listed as *Mycale laxissima* (Duchassaing & Michelotti, 1864)
- <sup>37</sup> Both forms, with calcareous skeleton and carbonate-deficient, are present
- <sup>38</sup> Treated as *Homaxinella rudis* (Verrill, 1907)
- <sup>39</sup> Listed as *Myrmekioderma styx* de Laubenfels, 1953b
- <sup>40</sup> Listed as as *Myrmekioderma styx* de Laubenfels, 1953b
- <sup>41</sup> Listed as *Myrmekioderma reisiwigi* (Diaz, Alvarez & van Soest, 1987)
- <sup>42</sup> Listed as *Dictyonella ruetzleri* (Wiedenmayer, 1977)
- <sup>43</sup> Listed as yolk-yellow *Amorphinopsis*
- <sup>44</sup> Listed as *Topsentia roquensis* Diaz, Alvarez & van Soest, 1987
- <sup>45</sup> Listed as *Agelas clathrodes* (Schmidt, 1870)
- <sup>46</sup> Listed as *Agelas dispar* Duchassaing & Michelotti, 1864
- <sup>47</sup> Listed as *Callyspongia fallax* Duchassaing & Michelotti, 1864
- <sup>48</sup> Listed as *Callyspongia fallax* Duchassaing & Michelotti, 1864

- 49 Listed as *Callyspongia strongylophora* Hartman, 1955
- 50 Listed as *Callyspongia armigera* (Duchassaing & Michelotti, 1864)
- 51 Listed as *Callyspongia vaginalis* (Lamarek, 1814)
- 52 Listed as *Acervochalina molitba* (de Laubenfels, 1950)
- 53 Listed as *Adocia implexiformis* Hechtel, 1965
- 54 Listed as "*Haliclona aquaeductus*" (= *Haliclona (Reniera) aquaeductus* (Schmidt, 1862)), which is a Mediterranean species
- 55 Listed as *Reniera curacaoensis* van Soest, 1980
- 56 Listed as *Sigmatocia caerulea* Hechtel, 1965
- 57 Listed as *Haliclona piscaderaensis* (van Soest, 1980)
- 58 Listed as *Haliclona viridis* (Duchassaing & Michelotti, 1864)
- 59 Treated as *Pachypellina podatypa* (de Laubenfels, 1934)
- 60 Described as *Pellina penicilliformis* van Soest & Sass, 1981
- 61 Listed as *Xestospongia subtriangularis* (Duchassaing, 1850)
- 62 Described as *Hyrtios tubulatus* (Lehnert & van Soest, 1998)
- 63 Listed as *Halisarca* sp. 1, but distinctive by its blue color, thinly encrusting growth, and star-shaped canal system (exhalant canals leading toward the oscula)
- 64 Listed as *Halisarca* sp. 2.
- 65 Listed as *Pseudoceratina crassa* (Hyatt, 1877)
- 66 Treated as *Ianthella ardis* de Laubenfels, 1950
- 67 Listed as *Pseudoceratina crassa* (Hyatt, 1877)
- 68 Listed as *Verongia fistularis* (Pallas, 1766)
- 69 Listed as Keratose? excavating sponge
- 70 Listed as sulfur-yellow *Clathrina*
- 71 Listed as *Leucosolenia canariensis* (Miklucho-Maclay, 1868)
- 72 Treated as *Leucetta microraphis* (Haeckel, 1872)
- 73 Listed as *Scypha ciliata* (Fabricius, 1780)
- 74 Listed as *Leuconia aspera* (Schmidt, 1862)

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