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A revision of the genus *Mycale* (Poecilosclerida: Mycalidae) from the Mexican Pacific Ocean

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Abstract

Knowledge about the sponge fauna from the Mexican Pacific Ocean has increased substantially in recent years, but most of these modern taxonomic studies have been focused on hadromerids. The aim of this study was to contribute to the knowledge of the order Poecilosclerida. At present, seven species of *Mycale* have been described or recorded from the Pacific coast of Mexico, but only three of them are considered valid: *M. contax*, *M. cecilia* and *M.* aff. *magnirhaphidifera*. After a revision of the material collected during the last eight years throughout the East Pacific coast of Mexico, along with the type material, and the literature available, eight species of *Mycale* are considered valid, three of them; *M. magnitoxa* sp. nov., *M. dickinsoni* sp. nov., and *M. ramulosa* sp. nov., are proposed as new to science. In addition, *M. adhaerens* is reported for the first time from the Mexican Pacific Ocean. Another *Mycale*-species that was identified was *M. psila,* which constitutes its seconLamberd record for the Mexican Pacific Ocean. The systematic, distribution and detailed species descriptions are based on newly collected material and previous descriptions from the literature.

Contents

Introduction

Knowledge on the sponge fauna from the Mexican Pacific Ocean has increased substantially in recent years (Gómez *et al*., 2002; Carballo *et al*., 2003; Carballo *et al*., 2004a; Carballo and Cruz-Barraza, 2005, 2006, 2008; Cruz-Barraza and Carballo, 2005, 2006, 2008). Most of these modern taxonomic studies have been focused on hadromerids of the sublittoral and littoral rocky areas, which have yielded a total of 40 valid hadromerid species so far. However, an understanding of the species composition, distribution, and biogeographic and ecologic relationships of the Mexican Pacific fauna is not yet possible, until other diverse sponge groups such as poecilosclerids, haplosclerids, etc., are studied as thoroughly as the hadromerids.

This new contribution to the taxonomy of Pacific sponges is focused on *Mycale* Gray, 1867, which is characterized by having a complex set of morphologic characters that makes their identification straightforward. *Mycale* has up to eight categories of microscleres, recognized by their distinct shape, a large variety of skeletal arrangements, and the common presence of different size categories in some spicules (Hajdu and Desqueyroux-Faúndez, 1994). It is one of the most diverse sponge genera, with almost 250 species described in the world (Doumenc and Lévi, 1987; Hajdu, 1999; Van Soest, 2010). This suggests a considerable adaptative radiation (Hajdu and Desqueyroux-Faúndez, 1994; Hajdu *et al.,* 1995; Carballo and Hajdu, 1998).

There were several suggestions to split the genus into subgenera. Dendy (1921), and later De Laubenfels (1936a) proposed a subdivision of *Mycale* by the presence/absence of some specific microsclere categories. This proposal was controversial and finally was abandoned by a subgeneric classification based on the arrangement of the ectosomal skeleton (Topsent, 1924; Van Soest, 1984; Bergquist and Fromont, 1988). Although currently largely accepted, this scheme of classification was shown to be plastic at the species level, for example *M.* (*A.*) *carmigropila* is a species that shows ectosomal skeletal patterns of the subgenus *Aegogropila* and *Carmia* (Hajdu and Rützler, 1998), as well as incongruence with the distribution of some microscleres types (see Carballo and Hajdu, 1998). Recently, a preliminary phylogenetic analysis of the genus *Mycale* using molecular data confirmed that *Mycale* is a monophyletic group within Poecilosclerida, and the presence of palmate anisochelae is a valid taxonomic character to identify this taxon; however, the study also suggested that the phylogenetic relationships of *Mycale* sub-genera may have to be reassessed (Loh *et al.*, 2010). Nevertheless, until a molecular phylogenetic classification of *Mycale* can be established, it is preferable to continue using the current classification scheme based on sub-genera for a genus as diverse as *Mycale* to avoid unnecessary confusion.

At present, seven species have been described or recorded from the Pacific coast of Mexico but only three of them are valid; *Mycale contax* Dickinson, 1945, *M. cecilia* De Laubenfels, 1936 and *M.* aff. *magnirhaphidifera* Van Soest, 1984. The aim of this study was to contribute to the knowledge of the order Poecilosclerida from the Eastern Pacific Ocean. Two goals were set for the genus *Mycale*: first, to review the type material of some species cited in the area, and second, to describe all the material collected.

Material and methods

One hundred and sixty specimens of *Mycale* were collected by scuba diving and snorkeling in sixty-three localities from the Pacific coast of Mexico (Fig. 1).

Spicule preparation followed the techniques we described in previous work for light and electron microscopy (SEM). The pictures of microscleres were taken by means of a scanning electron microscope for which clean spicules were dried on a cover glass and coated with gold. Twenty five or more spicules chosen at

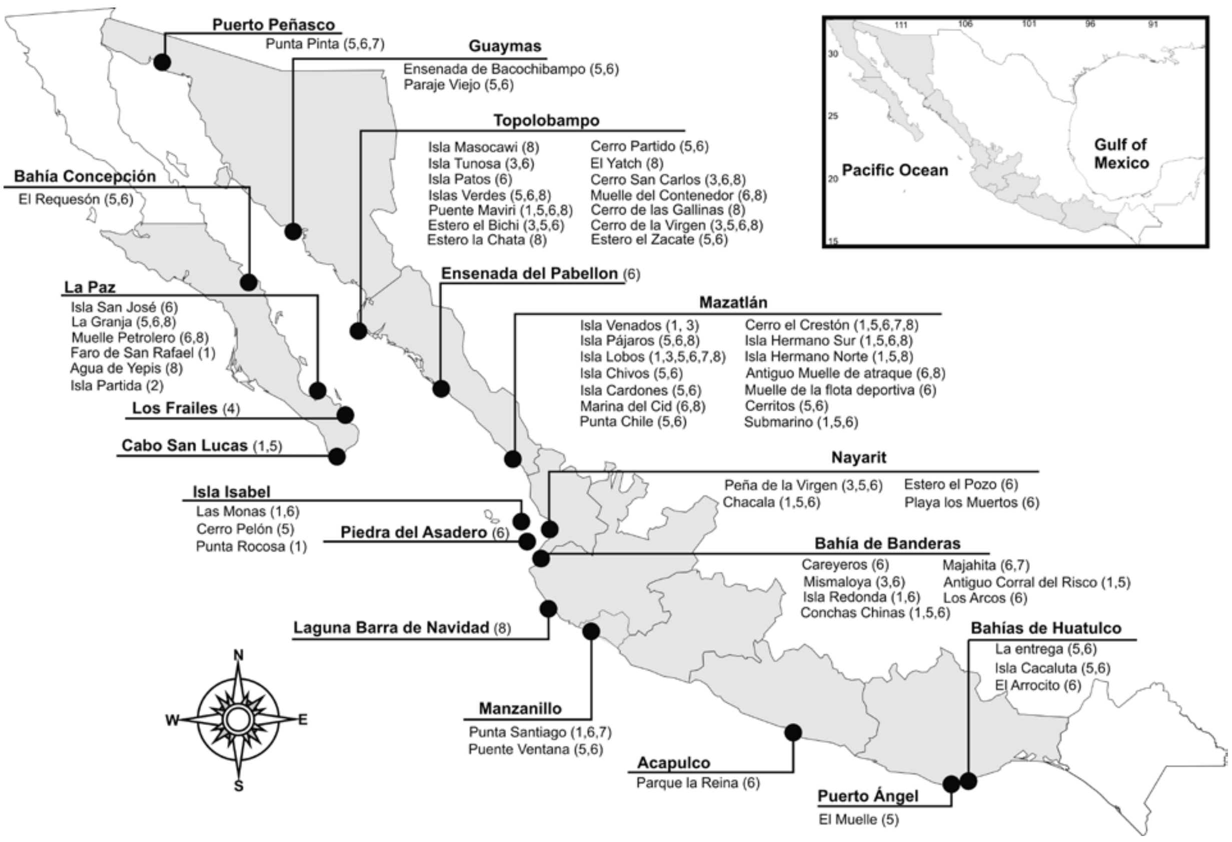

Fig. 1. Distribution and sample localities of *Mycale*-species from the Mexican Pacific Coast. Numbers refer to different species as follow: (1) *Mycale* (*Aegogropila*) *magnitoxa* sp. nov., (2) *M.* (*A.*) *dickinsoni* sp. nov., (3) *M.* (*A.*) *adhaerens* (Lambe, 1894), (4) *M.* (*Carmia*) *contax* Dickinson, 1945, (5) *M.* (*C.*) *aff. magnirhaphidifera* Van Soest, 1984, (6) *M.* (*C.*) *cecilia* de Laubenfels, 1936, (7) *M.* (*Paresperella*) *psila* (de Laubenfels, 1930), (8) *M.* (*Zygomycale*) *ramulosa* sp. nov.

random were measured for each of the specimens studied. The number between brackets in some descriptions is the average.

Frequency distributions of spicule size (histogram) were used to assess whether there was more than one size class. In general, a histogram is said to be multimodal if it has more than one peak.

The material studied came from the Natural History Museum of Los Angeles County (NHMLAC), where it is currently deposited the Allan Hancock Foundation (AHF) collection of sponges; material also came from the Natural History Museum of London (BMNH). The Mexican material has been deposited in the Colección de Esponjas del Pacífico Mexicano (LEB-ICML-UNAM), of the Instituto de Ciencias del Mar y Limnología, UNAM, in Mazatlán (Mexico), in the Museo Nacional de Ciencias Naturales in Madrid (Spain) (MNCN), and in the British Museum of Natural History (BMNH) (London).

Sponge-specific terms are used according to Boury-Esnault and Rützler (1997).

Results

Systematic part

Subgenus *Aegogropila* Gray, 1867
Mycale (*Aegogropila*) *magnitoxa* sp. nov.
Mycale (*Aegogropila*) *dickinsoni* sp. nov.
Mycale (*Aegogropila*) *adhaerens* (Lambe, 1894)
Subgenus *Carmia* Gray, 1867
Mycale (*Carmia*) aff. *magnirhaphidifera* Van Soest, 1984
Mycale (*Carmia*) *cecilia* De Laubenfels, 1936
Mycale (*Carmia*) *contax* Dickinson, 1945
Subgenus *Paresperella* Dendy, 1905
Mycale (*Paresperella*) *psila* (De Laubenfels, 1930)
Subgenus *Zygomycale* Topsent, 1930
Mycale (*Zygomycale*) *ramulosa* sp. nov.

The results consist of species descriptions, which can be found in the Appendix.

Discussion

On Mycale *diversity*

The Mexican Pacific coast extends for more than 8475 kilometers. Currently, the knowledge of some groups of Porifera in this vast coast such as hadromerids is similar to what has been studied in the Caribbean Sea, the Mediterranean Sea or the northeastern Atlantic Ocean. However, other diverse sponge groups such as poecilosclerids are scarcely known.

Before this study, seven species of *Mycale* had been described or recorded from the Pacific coast of Mexico; *Mycale* (*C.*) *fascibibula* (as *Carmia fascifibula*), *M.* (*A.*) *contax* (as *Carmia contax*), *Mycale cecilia*, *M. angulosa*, *M.* aff. *magnirhaphidifera*, *M. parishi* and *Oxymycale paradoxa*. However, after this research, only *M. contax*, *M. cecilia* and *M.* aff. *magnirhaphidifera* have been considered valid species.

After exhaustively sampling the Mexican Pacific during the last few years, we have a good collection of *Mycale*, which yielded eight valid species: three species belonging to the subgenus *Aegogropila* - *Mycale magnitoxa* sp. nov, *M. dickinsoni* sp. nov. and *M. adhaerens*; three species belonging to the subgenus *Carmia* - *M.* aff. *magnirhaphidifera*, *M. cecilia* and *M. contax*; one species of *Paresperella* - *M. psila*; and one species of *Zygomycale* - *M. ramulosa* sp. nov.

Mycale (Oxymycale) paradoxa (De Laubenfels, 1935) is not considered a valid species here. Hajdu (1994) revised slides from the type material and found it was not a mycalid at all, but a composite of what De Laubenfels (1935) called *Topsentia glabra* (Topsent, 1898) contaminated by spicules of *Mycale bellabellensis* (Lambe, 1905). Hajdu (1994) also found out that *T. glabra*, *sensu* De Laubenfels (1935) was actually a *Myrmekioderma*.

Besides the eight species described in this paper, at least two more different species could inhabit Mexican waters (Pacific Ocean). The anisochelae of *Mycale bellabellensis* that Hajdu (1994) found when he revised the holotype of *O. paradoxa* were depicted under SEM convincingly enough to tentatively include it in the list of Mexican species (Fig. 2A-B). In addition, some particular anisochelae with the head and foot of a similar length, and with a wide space between both terminations have been observed in the slides made from the type material of *Mycale* (*A.*) *dickinsoni* sp. nov. (Fig. 2C). These spicules aren't proper of this sponge since they belong to a clearly delimited species group within *Mycale* (*Mycale*) called 'curved assemblage' (see Hajdu *et al.*, 1995). In the East Pacific Ocean there are two species of this group; *M.* (*M.*) *darwini* Hajdu and Desqueyroux-Faúndez, 1994 from the Galapagos (Hajdu and Desqueyroux-Faúndez, 1994), and *M.* (*M.*) *toporoki* Koltum from California (USA) (Lee *et al.*, 2002). However, until fresh material is

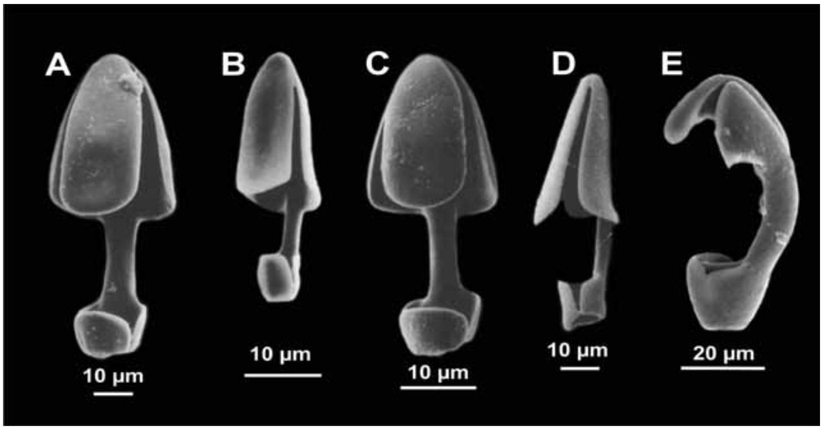

Fig. 2. SEM images of *Mycale* spicules found contamining Mexican pacific species. A-D spicules from Hajdu (1994). A, B, Anisochelae I and II respectively, found by Hadju contaminating *Myrmekioderma* sp. (de Laubenfels, 1935) and the type of *Oxymycale paradoxa*; C, D, Images of anisochelae I and II of *Mycale bellabellensis* (Lambe, 1905; *sensu* de Laubenfels 1932) for comparison purpose (from Hajdu 1994); E, Anisochelae found contamining the specimen type of *Mycale dickinsoni*.

collected, a specific identification of the Mexican material will not be possible.

The diversity of *Mycale*-species in the Mexican Pacific Ocean (10 species?), together with the five species reported in the Mexican Caribbean and Gulf coasts: *M.* (*A.*) *arndti* Van Soest, 1984, *M.* (*Arenochalina*) *laxissima* (Duchassaing and Michelotti, 1864), *M.* (*C.*) *microsigmatosa* Arndt, 1927, *M.* (*Z.*) *angulosa* (Duchassaing and Michelotti, 1864), and *M.* (*M.*) *laevis* (Carter, 1882) (Gómez and Green, 1984; Green *et al.*, 1986; Lehnert, 1993, and other authors), comprise a total of 15 species, which is a diversity similar to that of Brazil where 15 species are currently known (see Hajdu *et al.* 1994, 1995). Only the Caribbean, which has been profusely studied, presents a higher diversity of *Mycale* (17 species, Hajdu and Rützler, 1998), although particular areas, such as the mangroves on the barrier reef of Belize have yielded only eight species. In the South American coast of the Pacific Ocean, largely unexplored for sponges, only seven species are known so far (Hajdu and Desqueyroux-Faúndez, 1994).

Thus, we can consider that the *Mycale* fauna of Mexico is highly diverse, with at least 15 species known, mostly from shallow water, for which is expected that the study of deep fauna will yield more species.

Regarding the presence of the Caribbean M. *aff*. magnirhaphidifera *in the east Pacific Ocean*

From the ten species found in Mexican Pacific waters, only one, *M.* (*C.*) aff. *magnirhaphidifera* is known in the West Atlantic.

The possible amphiamericanism of *M.* (*C.*) *magnirhaphidifera* is difficult to explain. Currently, the Isthmus of Panama represents a barrier of fresh water across what was once a large neotropical marine environment approximately three million years ago (Coates and Obando, 1996; Craig *et al.*, 2004). However, the two freshwater lakes that the boats have to cross have proved insufficient as a fresh-water barrier (Jones and Dawson, 1973). Several species of marine fishes have survived during the crossing through the canal (McCosker and Dawson, 2004), and several invertebrates were found in the locks when they were drained for cleaning, which show that they have been transported through the canal by associating with fouling material on the underside of ships (Hildebrand, 1939). In fact, morphologically similar invertebrate species from the Atlantic and the Pacific are presently found on both sides of the Isthmus of Panama (Weinberg and Starczak, 1989; Knowlton and Mills, 1992; Knowlton *et al.*, 1993).

If we consider the presence of *M.* (*C.*) *magnirhaphidifera* in the East Pacific Ocean as an invasion, this means that this species survived in fresh water during a period required for a ship to cross of the canal (close to 8 hours (McCosker and Dawson, 1975). The influence of the salinity, in the particular case of marine sponges, has been documented only in a few cases, which show that some marine sponges, particularly clionaids, can live in a salinity of 1.5-2.0, and they can also recover from several days of exposure to salinities as low as 1 (Hopkins, 1956; Hartman, 1958). The presence of some Caribbean Clionids species in the East Pacific Ocean such as *C. amplicavata* or *C. flavifodina* could have this explanation (Carballo *et al.*, 2004a), but the confirmation that some sponges can survive during the crossing is supported by the presence of the sponge *Haliclona permollis* in the locks when they were drained (Hildebrand, 1939). Currently, the true identity of this species is uncertain because *H. permollis* is a junior synonym of *Haliclona* (*Reniera*) *cinerea*, which is not yet reported reliably from the NW Atlantic (Porifera DataBase), but whatever species it may be its presence shows that it has been transported through the canal by associating with fouling material on the underside of ships. The mechanism by which sponges can endure low salinity has not been studied enough, but it is known that the species *Microciona prolifera* occurs naturally in salinities ranging from 7 to 38 (De Laubenfels, 1947) and uses free amino acids for osmotic compensation (Knight *et al.*, 1992). Even though there are species that can support several hours in emersion (Carballo *et al.*, 2004b).

However, despite the possibility that *M.* aff. *magnirhaphidifera* has survived the crossing of the Panama Canal, it is not possible to decide whether Pacific *M. magnirhaphidifera* has recently been introduced into the Pacific, or on the contrary, it forms part of a sister-species pair which was separated together with the closure of the natural water way between the Caribbean and the eastern Pacific. De Laubenfels (1936b) found a large group of similar species that lived in both coasts of Panama, which suggested that they may have been introduced from one to the other side through the canal. Independently of the true identity of the De Laubenfels' records, when putative transisthmian populations of the sponge *Spirastrella* cf. *mollis* were studied using allozyme, morphological, and cytological data together, it was found that in reality they were two divergent lineages; the Caribbean lineage, which was named *S. hartmani*, and the Pacific lineage, which named *S. sabogae* (Boury-Esnault *et al.*, 1999).

In conclusion, given the limited number of morphological characters available to study marine sponges, it is not possible to decide whether Pacific *M.* aff. *magnirhaphidifera* is an invasive species in the Pacific, or if it is part of a sibling species. Such facts will only be demonstrated if we combine the classical methods of morphological measurement with the extensive use of genetic approaches.

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Appendix

Identification key

1 Ectosomal skeleton specialization 2
No ectosomal skeleton specialization (*Carmia*) ... 6

2 Isochelae present (*Zygomycale*) .... *Mycale* (*Z.*) *ramulosa*
Isochelae absent 3

3 Serrated sigmas (*Paresperella*) .... *Mycale* (*Paresperella*) *psila*
Not Serrated sigmas (*Aegogropila*) 4

4 Sigmas absent .... *M.* (*A.*) *dikinsoni*
Sigmas present 5

5 Toxas absent .... *M.* (*A.*) *adhaerens*
Toxas present .... *M.* (*A.*) *magnitoxa*

6 Raphidotoxas present .... *M.* (*C.*) aff. *magnirhaphidifera*
Raphidotoxas absent 7

7 Toxas present .... *M.* (*C.*) *contax*
Toxas absent .... *M.* (*C.*) *cecilia*

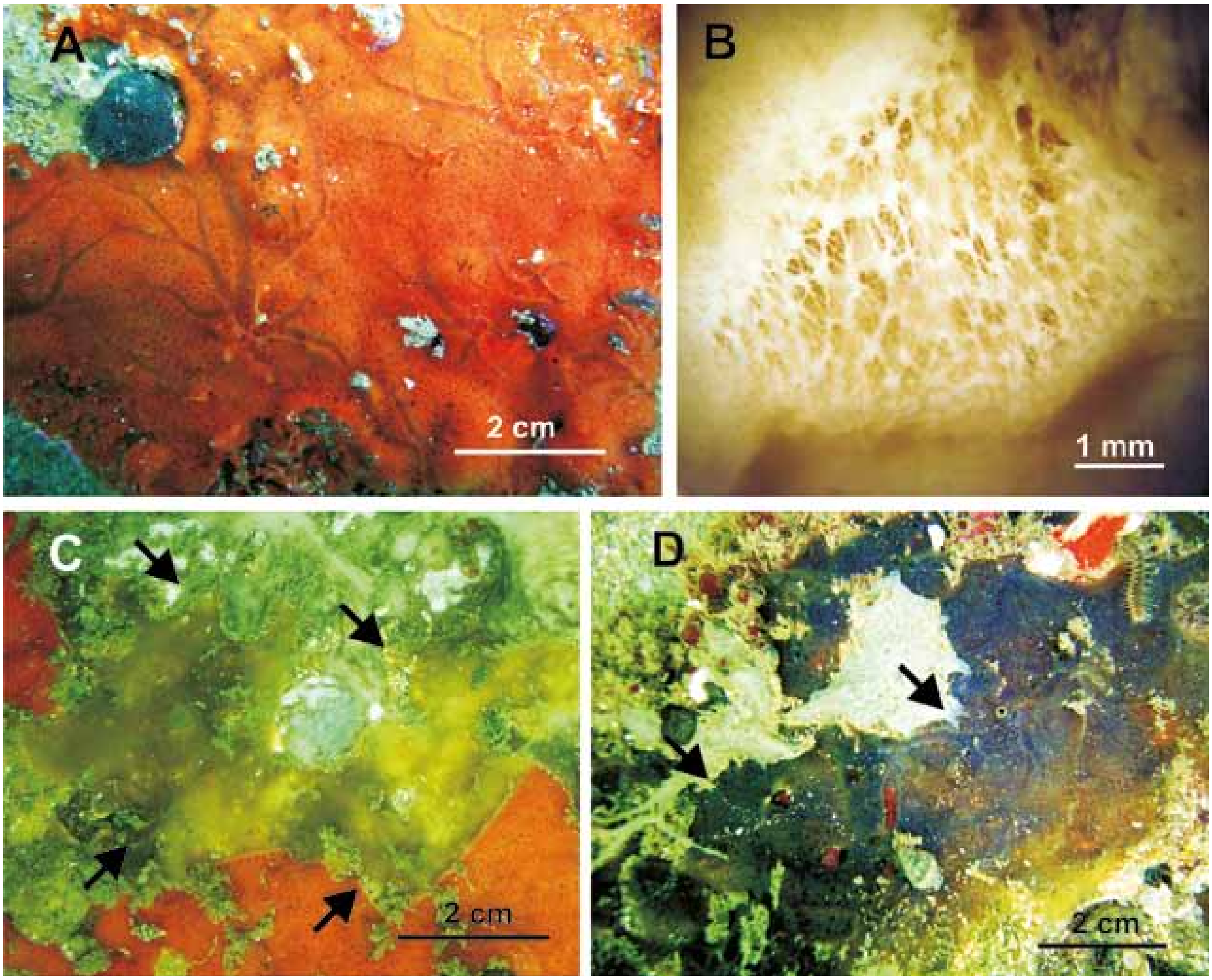

Fig. 3. External morphologies. A, *Mycale* (*Aegogropila*) *magnitoxa* sp. nov.; B, *Mycale dickinsoni* sp. nov.; C, *Mycale adhaerens* (Lambe, 1894); D, *Mycale magnirhaphidifera* Van Soest, 1984.

Descriptions of the species

Suborder Mycalina Hajdu, Van Soest and Hooper, 1994

Family Mycalidae Lundbeck, 1905
Genus *Mycale* Gray, 1867
Subgenus *Aegogropila* Gray, 1867
Mycale (*Aegogropila*) *magnitoxa* sp. nov.
(Figs 3A, 4)

Material examined. Holotype: MNCN 1.01/631, Isla Lobos (Sinaloa), 23º13’27’’N, 106º28’01’’W, 7 m, 3.x.2003. Paratypes: BMNH 2010.11.01.1. LEB-ICML-UNAM-388, Punta Santiago (Colima), 19°05’41’’N, 104°25’22’’W, 2 m, 16.xi.2001. LEB-ICML-UNAM-632, Conchas Chinas (Jalisco), 20º35’16’’N, 105º14’42’’W, 5 m, 8.x.2002. LEB-ICML-UNAM-730, puente Maviri (Sinaloa), 25°34’55’’N, 109°06’52’’W, 2 m, 14.xi.2002. LEB-ICML-UNAM-824, antiguo corral del risco (Nayarit), 20°46’20’’N, 105°32’49’’W, 2 m, 11.vi.2003. LEB-ICML-UNAM-870, Chacala (Nayarit), 21°09’57’’N, 105°13’38’’W, 4 m, 12.vi.2003. LEB-ICML-UNAM-904, Isla Lobos (Sinaloa), 23º13’27’’N, 106º28’01’’W, 7 m, 3.x.2003. LEB-ICML-UNAM-934, Isla Hermano Sur (Sinaloa), 23º11’16’’N, 106º25’11’’W, 6 m, 22.x.2003. LEB-ICML-UNAM-953, Isla Hermano Norte (Sinaloa), 23º10’59’’N, 106º26’24’’W, 8 m, 24.x.2003. LEB-ICML-UNAM-1067, Isla El Crestón (Sinaloa), 23º11’02’’N, 106º25’37’’W, 9 m, 2.ix.2003. LEB-ICML-UNAM-1199, Submarino (Sinaloa), 23º09’59’’N, 106º25’05’’W, 18 m, 5.iii.2005. LEB-ICML-UNAM-1353, faro San Rafael (Baja California Sur), 24º17’53’’N, 110º20’43’’W, 9 m, 26.x.2006. LEB-ICML-UNAM-1494, Isla Venados (Sinaloa), 23º10’15’’N, 106º26’42’’W, 4 m, 26.iii.2007. LEB-ICML-UNAM-1539, Cabo San Lucas (Baja California Sur), 22º52’45’’N, 109º54’15’’W, 1.5 m, 25.x.2007.

Table 1. Distribution and comparative data for the dimensions of spicules (in µm) of *Mycale* (*Aegogropila*) *magnitoxa* sp. nov. specimens. Values in parentheses are means.

material examined	mycalostyles length × width; head width	toxas length	anisochelae length	sigmas length	locality
holotype					
MNCN 1.01/631	225-(239)-255 × 2.5-(4.3)-5; 3-(4.5)-5	I: 242.5-(273)-295 II: 72.2-(121.5)-145	I: 35-(38.7)-42.5 II: 20-(20.7)-22.5 III: 11-(5)-15	I: 90-(101)-122.5 II: 28.8-(32)-35	Isla Lobos Sinaloa
paratypes					
BMNH 2010.11.01.1 388-LEB-ICML-UNAM	206-(237.5)-257.5 × 2.5-(4.6)-7; 3-(5.4)7.5	I: 187-(247.4)-352.5 II: 102.5-(120.3)-142.5	I: 30-(34.9)-45 II: 17-(19.5)-21.3 III: 10-(12.3)-16.3	90-(97.6)-117.5	P. Santiago Colima
632-LEB-ICML-UNAM	205-(237.1)-257.5 × 2.5-(3.8)-5; 3-(4.5)-5	I: 242.5-(270.2)-295 II: 57.5-(118.7)-157.5	I: 30-(36.6)-45 II: 18.8-(20.3)-22.5 III: 11.5 n = 1	I: 80-(98)-120 II: 28.7-(32)-35	Conchas Chinas Jalisco
824-LEB-ICML-UNAM	177.5-(194)-210 × 2.5-(2.9)-4; 3-(4.2)-5	I: 210-(263)-287 II: 62.5-(82)-125	I: 28-(29.3)-32.5 II: 17.5-(21)-25 III: 12.5-(13.5)-15	I: 90-(95)-105 II: 25-(27.5)-30	Antiguo Corral del Risco, Nayarit
870-LEB-ICML-UNAM	177-(237.5)-285 × 2-(4)-5; 2-(4)-5	I: 200-(249.3)-350 II: 60-(111)-145	I: 35-(38.8)-42.5 II: 18.7-(21.2)-22.5 III: 12.5-(13.5)-15	I: 70-(94.5)-110 II: 25-(28.7)-31.2	Chacala
904-LEB-ICML-UNAM	232.5-(263)-290 × 2.5-(4.5)-7; 3-(4.7)-7	I: 281.5-(301)-325 II: 62.5-(97.3)-150	I: 35-(39.4)-47.5 II: 20-(21.5)-23 III: 12.5-(13)-15	87-(96.3)-112.5 II: 35 n = 1	Isla Lobos Mazatlán
953-LEB-ICML-UNAM	190-(250)-277.5 × 1.3-(4.5)-5; 2-(4.1)-5	I: 290-(320)-345 II: 127.5-(138)-150	I: 32.5-(37.1)-40 II: 18.8-(20.6)-22.5 III: 12.5-(13.3)-15	I: 87.5-(93.8)-105 II: 37 n = 1	Hermano norte Mazatlán

LEB-ICML-UNAM-1589, Las Monas, Isla Isabel (Nayarit), 21º50’59”N, 105º52’46”W, 6 m, 25.ix.2007. LEB-ICML-UNAM-1591, Isla Redonda, Islas Marietas (Nayarit), 20º42’04”N, 105º34’31”W, 5 m, 10.iv.2002.

Description. Thin sheet to thick cushion-shaped sponge, 0.4 to 1 cm in thickness, which may extend 12 cm or more on rock surface (Fig. 3A). Alive the sponge is light orange to light red. It is light brown in alcohol. The surface is smooth, and pierced by small pores 200-500 µm in diameter, giving it a punctate appearance clearly visible through the transparent dermal membrane, which is detachable in parts. The pores bear many sieve-like ostia, 80 to 110 µm in diameter. The surface *in situ* also shows a clear vein pattern of superficial canals, 0.5 to 3 mm in diameter, that lead to slightly elevated small contracted oscules, 2-5 mm in diameter. Consistency is soft, but firm upon preservation in alcohol. Alive the sponge exudes some slime.

Spicules. The species bears mycalostyles as megascleres, and three types of microscleres: anisochelae, sigmas and very long toxas (Table 1). The mycalostyles are straight or slightly curved, sharp and thicker towards the middle of the spicule (Fig. 4A), and with a more or less pronounced head that varies between individuals (Fig. 4B). Measurements: 177-290 × 2-7 µm. Head diameter: from 2.5 to 7 µm.

Anisochelae of three sizes (Fig. 4D-F). I) 28-42 µm in length, with a palmate head that is ca. 62% of total length of the spicule. This category forms rosettes in the ectosome. II) 18.7-25 µm in length, with palmate head ca. 53% of total length of the spicule. III) 11.5-15 µm, palmate head ca. 56% of total length of the spicule. Sigmas are ‘C’ shaped in two size classes. The larger are numerous, robust, 70-120 × 6-8 µm (Fig. 4G). Smaller and fine sigmas are 25-35 × 1.3 µm, thinly scattered and very slender, and consequently sometimes hard to find. They were not found in some specimens.

Toxas of two types (Fig. 4C): the longest with small central bend, 187-352.5 × 2-5 µm. The shorter is deeply curved 60-157.5 × 1.3 µm.

Skeleton. Plumoreticulate. The ectosomal skeleton is a tangential, triangular or polygonal meshed reticu-

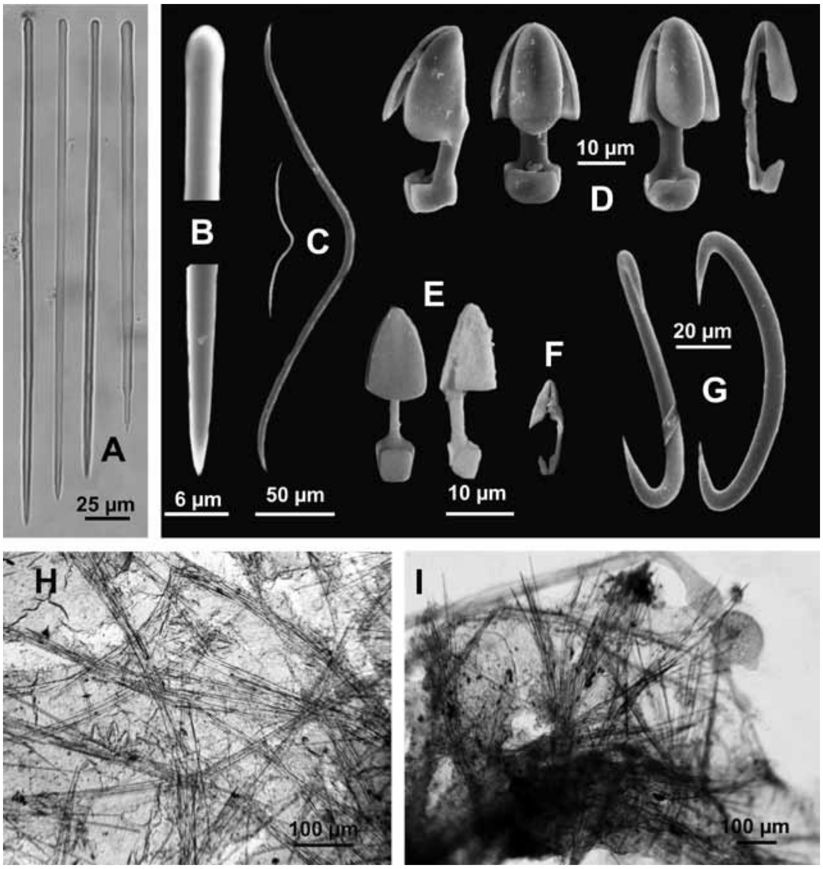

Fig. 4. LM and SEM images of spicules of *Mycale* (*Aegogropila*) *magnitoxa* sp. nov. A, Mycalostyles; B, Mycalostyles’ end detail; C, Toxa-I (larger) and Toxa-II (smaller); D, Anisochelae I, side and face views; E, Anisochelae II, side and face views; F, Anisochelae III, side view; G, Sigma; H, Tangential view of ectosomal reticular skeleton; I, Transversal view of choanosomal structure.

lation (45 a 60 μm wide) of multispicular fibers of mycalostyles (20 to 60 μm in thickness) (Fig. 4H). In some areas it is confused, and with single scattered megascleres. It is easily detachable. Anisochelae I form rosettes in the ectosome. The choanosomal skeleton consists of plumose bundles of megascleres (80-110 μm) ending at the surface (Fig. 4I). Spongin reinforces the skeletal fibres to a varying degree. Microscleres scattered throughout choanosome.

Distribution and habitat. Sea of Cortés (Mexican Pacific Ocean). Baja California Sur, Sinaloa, Nayarit, Jalisco and Colima, on rocks, from the intertidal to 18 m depth (Fig. 1).

Etymology. The proposed name *magnitoxa* alludes to the large size of their toxas.

Taxonomic remarks. Only two species of *Mycale* (*Aegogropila*) are known in the Northeastern Pacific: *M*. (*A*.) *adhaerens* (Lambe, 1893) (see next species) and *M*. (*A*.) *bamfieldensis* Reiswig and Kaiser, 1989. Nevertheless, these two species are clearly different from *M*. (*A*.) *magnitoxa* sp. nov.; the first one has no toxas, and *M*. (*A*.) *bamfieldense* differs from the new species by possessing micracanthoxeas and by having much smaller toxas (19-70 μm).

In the West Atlantic and Caribbean there are three species of the subgenus *Aegogropila* with long toxas; *M*. (*A*.) *arndti* Van Soest 1984 from the Caribbean, which has sigmas in three categories, and toxas up to 85 μm long (Hajdu and Rützler, 1998), *M*. (*A*.) *escarlatei* Hadju *et al*., 1995 from the Western Tropical Pacific, with microancanthoxas and toxas in two categories up to 140 μm long (Hadju *et al*., 1995), and *M*. (*A*.) *lilianae* which posses the longest toxas (300 μm) but clearly differs from *M*. (*A*.) *magnitoxa* sp. nov. by the presence of micracanthoxeas.

The closest NE Atlantic species to *M*. (*A*.) *magnitoxa* is *M*. (*A*.) *contarenii* (Martens, 1824). *M*. (*A*.) *contarenii* is a yellow, yellowish green, ochrous or orange-green massive, semi-encrusting and occasionally lobate sponge, with a surface typically covered by small conules (Van Soest and Hajdu, 2002), while *M*. (*A*.) *magnitoxa* sp. nov., is a red, or light red encrusting sponge with a smooth even surface. This morphological overview distinguishes the two species easily, but these species also differ in their spicules. Toxas are much longer (77 μm to 350 μm) in *M*. (*A*.) *magnitoxa* sp. nov. than in *M*. (*A*.) *contarenii* (70 μm), and the toxas of *M*. (*A*.) *contarenii* have a widely extended central bend. The larger sigmas of *M*. (*A*.) *contarenii* are generally shorter than 70 μm, while *M*. (*A*.) *magnitoxa* sp. nov. presents sigmas usually longer than 100 μm.

Mycale (*Aegogropila*) *dickinsoni* sp. nov.
(Figs 3B, 5)

Carmia fascifibula sensu Dickinson, 1945: 25 [not *Esperella fascifibula* Topsent, 1904]

Material examined. Holotype, here designed, material of *Carmia fascifibula* Dickinson, 1945 [L35661 D59: NHMLAC] (several fragments), R. V. Velero, Sta. 557-36, Isla Partida, Sea of Cortés, 45 m, 3.viii.1936.

Description. Encrusting to cushion-shaped sponge, up to 1.7 cm in thickness. The largest fragment examined measured 2.9 cm long by 1.2 cm wide. Surface is smooth but uneven, and consistency is soft. Subectosomal canals 0.25 to 0.4 mm in diameter sculpture the surface. Small pores from 33 to 67 μm in diameter are scattered over the surface. Circular or oval shaped oscules, from 0.7 to 1 mm in diameter. Ectosomal membrane is easily detachable (Fig. 3B).

Spicules. The species present mycalostyles, anisochelae in three categories, and rhaphides. Mycalostyles are straight or slightly curved, with a relatively abrupt point (Fig. 5A). Measurements: 370-435 μm × 7-14 μm, with elongate undeveloped tyle, sometimes as true styles (Fig. 5B).

Anisochelae I) 55-65 μm in length, grouped into rosettes in the surface. They are robust, with the shaft curved in profile view, moderately stout, palmate head ca. 56% of total length, characteristically with the frontal alae of equal length as the lateral ones (Fig. 5C). Anisochelae II) 25 to 30 μm in length, with slender shaft, and with palmate head 65% of total length (Fig. 5D). Anisochelae III) 10-20 long, slender, with a slightly curved shaft, head 40-45% of total length (Fig. 5E). Rhaphides 20-38 μm long by 3.8 to 5 μm thick, mostly grouped into trichodragmata. (Fig. 5F).

Skeleton. The estosomal skeleton consists of a reticulation of tracts of mycalostyles (50 a 90 μm thick) forming triangular meshes (200 to 500 μm) clearly visible to the naked eye (Fig. 3B). Many individual subtylostyles and microscleres are scattered among the tracts and in the organic ectosome. Rosettes of anisochelae I are also present in the ectosome. Choanosomal tracts 100-200 μm in diameter end in brushes carrying the ectosome (Fig. 5G).

Distribution. The species is only known from Isla Partida (Sea of Cortés, Mexican Pacific Ocean) (Fig. 1), at 45 m depth.

Etymology. The species is named after Malcolm Gibson Dickinson, one the first person in studying

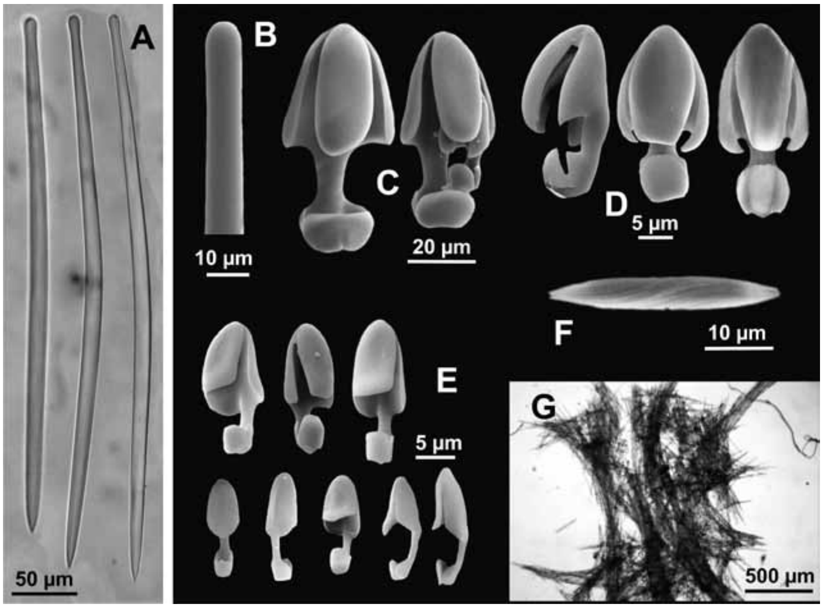

Fig. 5. LM and SEM images of spicules of *Mycale* (*Aegogropila*) *dickinsoni* sp. nov. A, Mycalostyles; B, Mycalostyles' heads detail; C, Typical anisochelae I; D, Anisochelae II; E, Anisochelae III; F, trichodragmata; G, Transversal view of choanosomal structure.

the sponges from the Sea of Cortés.

Remarks. Dickinson (1945) indentified a specimen collected in Isla Partida (Sea of Cortés) as *Carmia fascifibula* (Topsent, 1904). However, by having sigmas, *M. fascifibula* (Topsent, 1924), a valid species from the Azores, is clearly different from Dickinson´s material (Topsent, 1924). Thus, *Mycale* (*Aegogropila*) *dickinsoni* sp. nov. is proposed here as a new species for the material from México.

Although *M. fascifibula sensu* Dickinson (1945) has the typical tangential reticulum of spicules forming meshes, usual for the subgenus *Aegogropila*, he assigned his specimens to the genus *Carmia* because De Laubenfels (1936a) had previously synonymized *Aegogropila* with *Carmia*, moving all the *Mycale*-species with toxas to *Carmia*. However, *M. fascifibula sensu* Topsent is well placed in the subgenus *Carmia* (Topsent, 1904), in view of its lack of a tangential reticulation of spiculo-fibres.

Mycale (*A.*) *dickinsoni* sp. nov. is a clearly defined species, and there is no species in the subgenus *Aegogropila* matching its description (see remarks in the previous species *Mycale* (*A.*) *magnitoxa* sp. nov.). Probably, the only *Mycale* (*Aegogropila*) with a similar spicular complement is *Mycale* (*A.*) *tunicata* (Schmidt, 1862) from the Mediterranean Sea. This species also has anisochelae in three categories, and trichodragmas of similar size, but there are some important micromorphological differences among their microscleres. For example, the head of the anisochelae II of *M.* (*A.*) *dickinsoni* sp. nov. presents an extremely long frontal alae almost fusing with the foot, and the lateral alae is characteristically elongated in a profile view (Fig. 5D), which are characteristics not present in *M.* (*A.*) *tunicata*. In addition, the external morphology is also different; *M* (*A.*) *tunicate* consists of a massive base, from which irregular digitate processes arise, and in constrast *M.* (*A.*) *dickinsoni* is an encrusting to cushion-shaped sponge.

Mycale (*Aegogropila*) *adhaerens* (Lambe, 1893)
(Figs 3C, 6)

Esperella adhaerens Lambe, 1893: 27; Lambe, 1894: 133
Mycale adhaerens.- Hentschel, 1929: 931; De Laubenfels, 1961: 198; Bakus, 1966: 446

Material examined. LEB-ICML-UNAM-77, Peña de la Virgen (Nayarit), 21º31'05"N, 105º20'05"W, 5 m, 22.xi.1999. LEB-ICML-UNAM-221, Isla Tunosa (Sinaloa), 25º34'58"N, 109º00'51"W, 2 m, 22.vi. 2000. LEB-ICML-UNAM-242, Isla Tunosa (Sinaloa), 25º34'58"N, 109º00'51"W, 2 m, 22.vi.2000. LEB-ICML-UNAM-326, Isla Lobos (Sinaloa), 23º13'49"N, 106º27'43"W, 6 m, 26.i.2001. LEB-ICML-UNAM-415, Isla Lobos (Sinaloa), 23º13' 49"N, 106º27'43"W, 4 m, 17.x.2001. LEB-ICML-UNAM-533, antiguo muelle de atraque (Sinaloa), 23º11'57"N, 106º25'15"W, 2 m, 23.iv.2002. LEB-

ICML-UNAM-658, Cerro San Carlos (Sinaloa), 25º35'33"N, 109º02'39"W, 4 m, 12.xi.2002. LEB-ICML-UNAM-680, Isla Tunosa (Sinaloa), 25º34'58"N, 109º00'51"W, 2 m, 12.xi.2002. LEB-ICML-UNAM-796, Mismaloya (Jalisco), 20°31'56.22"N, 105°17'42"W, 6 m, 9.vi.2003. LEB-ICML-UNAM-903, Isla Lobos (Sinaloa), 23º13'27"N, 106º28'01"W, 7 m, 3.x.2003. LEB-ICML-UNAM-1073 Estero el Bichi (Sinaloa), 25°32'27"N, 109°05'29"W, 2 m, 4.iv.2004. LEB-ICML-UNAM-1348 Isla Venados (Sinaloa) 23º10'75"N, 106º26'42"W, 4 m, 26.v.2006. LEB-ICML-UNAM-1587, cerro de la Virgen (Sinaloa), 25º36'57"N, 108º58'11"W 2 m, 12.xi.2002.

Description. *Mycale adhaerens* is a light orange to yellow-brown encrusting sponge (Fig. 3C), 1.3 to 5 mm thick, spreading across small surfaces (3 cm × 2 cm). In alcohol it is white, almost transparent. Consistency is soft and fragile. The surface is evenly smooth, sculptured by meandering and bifurcating subectosome canals, from 0.2 to 1.5 mm in diameter, radiating from slightly elevated oval-circular oscules, 1.6 to 4 mm in diameter. Surface with abundant, scattered pore areas from 0.25 to 1.5 mm in diameter. The pores bear many ostia, 100 to 300 µm in diameter. Alive the sponge exudes some slime. The ectosomal skeleton is easily detachable in the dry specimens.

Spicules. Megascleres are mycalostyles, and the microscleres are anisochelae in two categories and sigmas (Table 2).

The mycalostyles are usually straight, occasionally slightly curved, with a short acerate point (Fig. 6A). They measure 180-365 × 2-10 µm. The head may be that of a typical style, or may tend to be that of a subtylostyle (Fig. 6B). The head diameter is from 2.5 to 11.3 µm.

Anisochelae I) 27-48 µm in length, with a palmate head ca. 50% of total length of the spicule (Fig. 6C). Anisochelae II) 8.5 to 27 µm in length, with a palmate

Table 2. Distribution and comparative data for the dimensions of spicules (in µm) of *Mycale* (*Aegogropila*) *adhaerens* Lambe, 1984 specimens, with to other Pacific Ocean specimens. Values in parentheses are means.

material examined	mycalostyles length × width; head width	sigmas length	anisochelae length	distribution area
LEB-ICML-UNAM-77	180-(305.3)-365 × 2.5-(7.9)-10; 2.5-(7.3)-11.3	50-(64)-70	I: 37.5-(41.5)-45 II: 10-(17)-27	Mexican Pacific
LEB-ICML-UNAM-221	180-(265.3)-325 × 3-(6.5)-10; 5-(6.7)-8	52.5-(58.9)-67.5	I: 30-(45.5)-51.2 II: 15-(19)-25	Mexican Pacific
LEB-ICML-UNAM-242	180-(291.5)-325 × 2.5-(8.5)-10; 6.3-(7.4)-8.8	47.5-(59.1)-72.5	I: 27.5-(34.8)-47.5 II: 12.5-(16.5)-20	Mexican Pacific
LEB-ICML-UNAM-326	252-(318.3)-362.5 × 2-(5)-7.5; 25-(4.8)-7.5	55-(60.8)-67.5	I: 35-(38.6)-42.5 II: 8.5-(15.5)-20	Mexican Pacific
LEB-ICML-UNAM-533	285-(333)-362 × 3-(7)-8.8; 3.8-(5)-7.5	52.5-(63.6)-72	I: 37-(41.5)-45 II: 12-(15)-21.3	Mexican Pacific
specimens of *Mycale* (*Aegogropila*) *adhaerens* Lambe, 1984 from the literature				
Lambe 1894	242-324 × 13	32-78	I: 19-32 II: small no measures	Canada
Lambe 1894	315-369 × 13µ	58	I: 72 II: 19-32	Canada
Hoshino 1891	440-(485)-545 × 8-(10)-12	40-70	I: 55 II: 20	Japon
Bakus 1966	292-(341)-371 × 10-(12)-12	44-(52)-63	I: 61-(65)-71 II: 15-(24)-36	San Juan Archipelago
Bakus 1966	277-(320)-337 × 10-(11)-12	44-(54)-64	I: 59-(64)-68 II: 18-(25)-34	San Juan Archipelago
Bakus 1966	292-(324)-360 × 7-(12)-12	37-(41)-46	I: 65-(69)-74 II: 29-(31)-37	San Juan Archipelago
Koltun 1959	242-457 × 10-17	27-83µ	I: 54-100 II: 25-52 III: 17-36	Bering Sea

head ca.56% of total length of the spicule (Fig. 6D). Sigmas tipically C-shaped and also twisted, from 37.5 to 72.5 µm, in a size class (Figs. 6E, 13A).

Skeleton. The ectosomal skeleton is made of the typical tangential reticulation of tracts of mycalostyles (3-8 mycalostyles per cross section), 50 to 100 µm in diameter, and scattered spicules, forming meshes 150 to 700 µm wide (Fig. 6F). Microscleres and rosettes of anisochelae I scattered in the ectosome. The choanosomal skeleton is made of tracts of mycalostyles that arise from the base of the sponge and end in brushes that carry the ectosome at the sponge surface. Between the tracts the microscleres are strewn at random.

Distribution and habitat. Eastern North Pacific Ocean. From Alaska (Lambe, 1893), and San Juan archipelago, northern USA (Bakus, 1966) to Gulf of California (Mexico, present study). It was found in the states of Sinaloa, Nayarit and Jalisco (Fig. 1). From the intertidal to 60 m depth. Frequently under boulders, between 2-7 depth.

Remarks. This is the first record of *M. adhaerens* from the Mexican Pacific. Our specimens agree well with the original description of *M. adhaerens* (Lambe, 1893, as *Esperella adhaerens)* and with the subsequent records by Bakus (1966) from San Juan (Washington) (see Table 2). *M. adhaerens* has been also recorded in Japan (Hoshino, 1981), but the spicule types and the micrometries of the Japan specimens are slightly different from the East Pacific records. For example, Hoshino's specimens have longer mycalostyles (up to 545 µm), and sometimes without the typical anisochelae I in rosettes. Another reason to doubt that they are the same species is the disjunct distribution. Whether or not the present species is the same cited by Hoshino remains a matter of consideration.

Subgenus *Carmia* Gray, 1867

Mycale (Carmia) aff. *magnirhaphidifera* Van Soest, 1984
(Figs 3D, 7)

Mycale (*Carmia*) *magnirhaphidifera,* Van Soest, 1984
Mycale (*Carmia*) *magnirhaphidifera*.- Hajdu and Rützler, 1998: 755; Carballo and Hajdu, 2001: 211; Cruz-Barraza and Carballo, 2008: 754
Mycale cecilia.- Wells and Wells in: Wells *et al*., 1960: 212. [not *M. cecilia* De Laubenfels, 1936b, a valid species; see below]

Material examined. LEB-ICML-UNAM-45, cerro el Crestón (Sinaloa), 23º10'46''N, 106º25'33''W, intertidal, 26.x.1999. LEB-ICML-UNAM-85, Peña de la Virgen (Nayarit), 21º31'05''N, 105º20'05''W, 5 m, 22.xi.1999. LEB-ICML-UNAM-130, Punta Chile (Sinaloa), 23º12'29''N, 106º25'40''W, intertidal, 19.ii.1992. LEB-ICML-UNAM-196, Isla Pájaros 1(Sinaloa), 23º15'29''N, 106º28'25''W, 8 m, 9.vi.2000. LEB-ICML-UNAM-227, puente Maviri (Sinaloa), 25º34'55''N, 109º06'52''W, 2 m, 21.vi.2000. LEB-ICML-UNAM-234, estero el Zacate (Sinaloa), 25º36'25''N, 109º04'33''W, 2 m, 21.vi.2000. LEB-

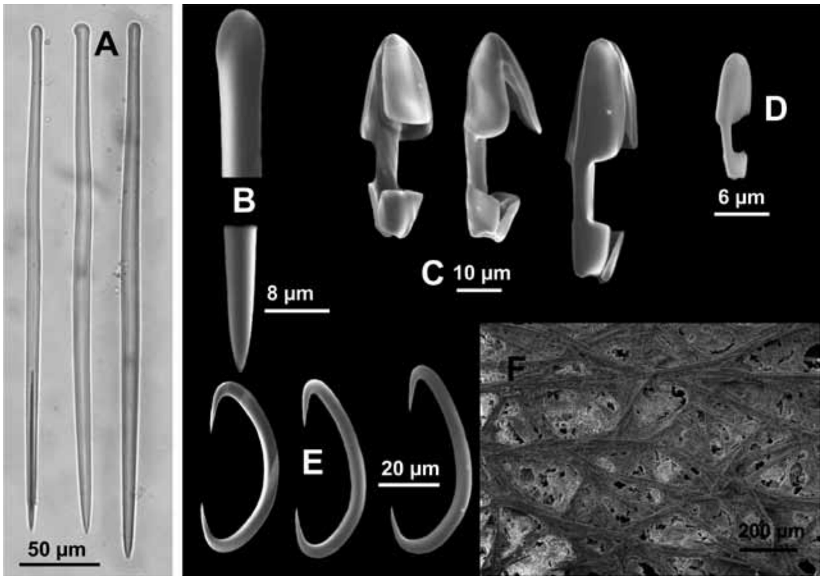

Fig. 6. LM and SEM images of spicules of *Mycale* (*Aegogropila*) *adhaerens* (Lambe, 1894). A, Mycalostyles; B, Mycalostyles' ends detail; C, Anisochelae I; D, Anisochelae II; E, Sigmas; F, Tangential view of ectosomal reticular skeleton.

ICML-UNAM-259, Paraje Viejo (Sinaloa), 27º55'34''N, 110º57'12''W, 8 m, 4.xi.2000. LEB-ICML-UNAM-280, ensenada de Bacochibampo (Sonora), 27º54'37''N, 110º57'12''W, 5 m, 6.xi.2000. LEB-ICML-UNAM-404, puente Ventana (Colima), 19º02'08''N, 104º20'34''W, 2 m, 15.xi.2001. LEB-ICML-UNAM-407, Cerritos (Sinaloa), 23°18'51''N, 106°29'31''W, 2 m, 30.x.2001. LEB-ICML-UNAM-619, Conchas Chinas (Jalisco), 20º35'16''N, 105° 14'42''W, 5 m, 8.x.2002. LEB-ICML-UNAM-687, Islas Verdes (Sinaloa), 25°31'47''N, 109°05'27''W, 2 m, 13.xi.2002. LEB-ICML-UNAM-696, estero 'El Bichi' (Sinaloa), 25°32'27''N, 109°05'29''W, 1 m, 13.xi.2002. LEB-ICML-UNAM-708, cerro Partido (Sinaloa), 25°32'7''N, 109°05'33''W, 1 m, 13.xi.2002. LEB-ICML-UNAM-710, estero el Zacate (Sinaloa), 25º36'25''N, 109º04'33''W, 2 m, 14.xi.2002. LEB-ICML-UNAM-722, Puente Maviri (Sinaloa), 25°34'55''N, 109º06'52''W, 8 m, 14.xi.2002. LEB-ICML-UNAM-776 Conchas Chinas (Jalisco), 20º35'16''N, 105°14'42''W, 5 m, 8.x.2002. LEB-ICML-UNAM-820, antiguo Corral del Risco (Nayarit), 20°46'20''N, 105°32'49''W, 2 m, 11.vi.2003. LEB-ICML-UNAM-871, Chacala (Nayarit), 21º09'57''N, 105º13'38''W, 4 m, 12.vi.2003. LEB-ICML-UNAM-890, Isla el Crestón (Sinaloa), 23º11'02''N, 106º25'37''W, 7 m, 10.ix.2003. LEB-ICML-UNAM-917, Isla Lobos (Sinaloa), 23º13'27.7''N, 106º28'01.6''W, 7 m, 3.x.2003. LEB-ICML-UNAM-937, Isla Hermano Sur (Sinaloa), 23º11'16.2''N, 106º25'11.5''W, 6 m, 22.x.2003. LEB-ICML-UNAM-950, Isla Hermano Norte (Sinaloa), 23º10'59''N, 106º26'24''W, 8 m, 24.x.2003. LEB-ICML-UNAM-978, Isla Chivos (Sinaloa), 23º10'40.''N, 106º24'48.2''W, 8 m, 26.xi.2003. LEB-ICML-UNAM-981, Isla Cardones (Sinaloa), 23º11'05''N, 106º24'07''W, 6 m, 26.xi.2003. LEB-ICML-UNAM-1110, Punta Pinta (Sonora), 31º20'14''N, 96º05'20''W, 4 m, 4.iii.2005. LEB-ICML-UNAM-1198, submarino (Sinaloa), 23º09'59''N, 106º25'05''W, 18 m, 5.iii.2005. LEB-ICML-UNAM-1217, La Entrega (Oaxaca), 15º42'50''N, 96º05'20''W, 4 m, 4.v.2005. LEB-ICML-UNAM-1303, Isla Cacaluta (Oaxaca), 15º38'23''N, 96º29'01''W, 4 m, 4.v.2005. LEB-ICML-UNAM-1383, El Requesón, bahía Concepción (Baja California Sur), 26º38'38''N, 111º49'53''W, 9 m, 29.x.2006. LEB-ICML-UNAM-1397, El Requesón, bahía Concepción (Baja California Sur), 26º38'38''N, 111º49'53''W, 9 m, 29.x.2006. LEB-ICML-UNAM-1438, La Granja, Isla Espíritu Santo (Baja California Sur), 24º25'32''N, 110º20'55''W, 0.5 m, 12.iii.2007. LEB-ICML-UNAM-1532, cerro Pelón, Isla Isabel (Nayarit), 21º51'21''N, 105º53'33''W, 5 m, 11.ii.2007. LEB-ICML-UNAM-1537, Cabo San Lucas (Baja California Sur), 22º52'45''N, 109º54'15''W, 1.5 m, 25.x.2007. LEB-ICML-UNAM-1586, cerro de la Virgen (Sinaloa), 25°36'57''N, 108°58'11''W, 2 m, 11.xii.2002.

Description. The species is always thinly encrusting, 0.5-2.5 mm thick, frequently covering several cm^2. Color in life most frequently deep-purple to bluish-purple; cream to orange-yellow in shaded zones (Fig. 3D). Preserved specimens are ochre or cream. They are fragile, very soft, and possess a smooth surface. Subectosomal canals are very conspicuous to the naked eye. In live specimens superficial canals (0.6-1.2 mm in diameter) are clearly visible from the surface by a translucent dermal membrane, and lead to slightly elevated oscules (0.3-1.0 µm in diameter). Surface of the sponge is punctuate, with subectosomal spaces 150-500 µm in diameter, abundant and regularly distributed on the surface. Over the spaces are very small ectosomal sieve-like pores 33-70 µm in diameter.

Spicules. Megascleres are mycalostyles, and the microscleres are anisochelae in two categories, sigmas, raphides and raphidotoxas (Table 3).

Mycalostyles, are slender smooth, mostly straight and with sharp points (Fig. 7A). Measurements: 155-317 × 2.5-5.0 µm; tyle diameter: 2.5-7.5 µm. (Fig. 7B).

Anisochelae I are slender, 20 to 45 µm in length, very slightly curved in profile view, head about ca. 50% of total spicule length (Fig. 7C). Anisochelae II from 10 to 19.5 µm in length, with palmate head ca. 55% of total length of the spicule (Fig. 7D). C-shaped sigmas are not very abundant (Fig. 7E). Measurements: 20-60 µm; raphides, short and fusiform (microxea-like), with a sharp point (Fig. 7F). Measurements: 10-25 µm. Raphidotoxas are very thin, straight, or slightly bent with a sharp point (Fig. 7G), from 230 to 317 µm long.

Skeleton. Ectosomal skeleton consisting mainly of raphidotoxas arranged tangentially without a defined structure (Fig. 7G). Rosettes of anisochelae -I and some other free anisochelae and sigmas are also present. The choanosomal skeleton is made of sinuous ascending tracts of mycalostyles 15-75 µm in diameter, which diverge slightly into brushes when approaching the surface (Fig. 7H).

Distribution. The species is widespread in the Tropical western Atlantic and Pacific Ocean (Carballo and Hajdu, 2001; Cruz-Barraza and Carballo, 2008) (Fig. 1).

Remarks. See in Discussion the paragraph *Regarding the presence of the Caribbean* M. magnirhaphidifera *in the east Pacific Ocean*.

Mycale (*Carmia*) *cecilia* De Laubenfels, 1936
(Figs 8A-B, 9)

Mycale cecilia De Laubenfels, 1936b: 447
Mycale microsigmatosa.- Green and Gómez, 1986: 284. [not *Mycale microsigmatosa* (Arndt, 1927), a valid species from the Western Atlantic]
Mycale angulosa.- Dikinson, 1945: 23. [not *Pandaros angulosa* (Duchassaing and Michelotti, 1864), a valid species from the Western Atlantic]
Mycale cecilia.- De Laubenfels, 1950: 24; Desqueyroux-Faúndez and Van Soest, 1997: 450; Cruz-Barraza and Carballo, 2008: 751
Mycale maunakea De Laubenfels, 1951

Material examined. [L35519 D46: NHMLAC] *Mycale angulosa* (Duchassaing and Michelotti, 1964).- Dickinson 1945, Velero Sta. 1039-40 (AHF), Guaymas, Sonora, 10 m, 23.i.1940, LEB-ICML-UNAM-1, Cerritos (Sinaloa), 23º18'27''N, 106º29'25''W, 3 m, 31.xi.1997. LEB-ICML-UNAM-20, muelle pesca deportiva (Sinaloa), 23º10'13''N, 106º25'46''W, 1 m, 14.x.1999. LEB-ICML-UNAM-23, muelle pesca deportiva (Sinaloa), 23º10'13''N, 106º25'46''W, 1 m, 14.x.1999. LEB-ICML-UNAM-40, Isla Lobos (Sinaloa), 23º13' 49''N, 106º27'43''W, 3 m, 25.x.1999. LEB-ICML-UNAM-43, cerro el Crestón (Sinaloa), 23º10'46''N, 106º25'33''W, intertidal, 26.x.1999. LEB-ICML-UNAM-44, cerro el Crestón (Sinaloa), 23º10'46''N, 106º25'33''W intertidal, 26.x.1999. LEB-ICML-UNAM-54, estero del pozo (Nayarit), 21º32'48''N, 105º17'57''W, 3 m, 19.xi.1999. LEB-ICML-UNAM-73, Peña de la Virgen (Nayarit), 21º31'05''N, 105º20'05''W, 5 m, 22.xi.1999. LEB-ICML-UNAM-112, Marina del Cid (Sinaloa), 23º10'89''N, 106º25'44''W, 3 m, 27.xi.1999. LEB-ICML-UNAM-127, Punta Chile (Si-

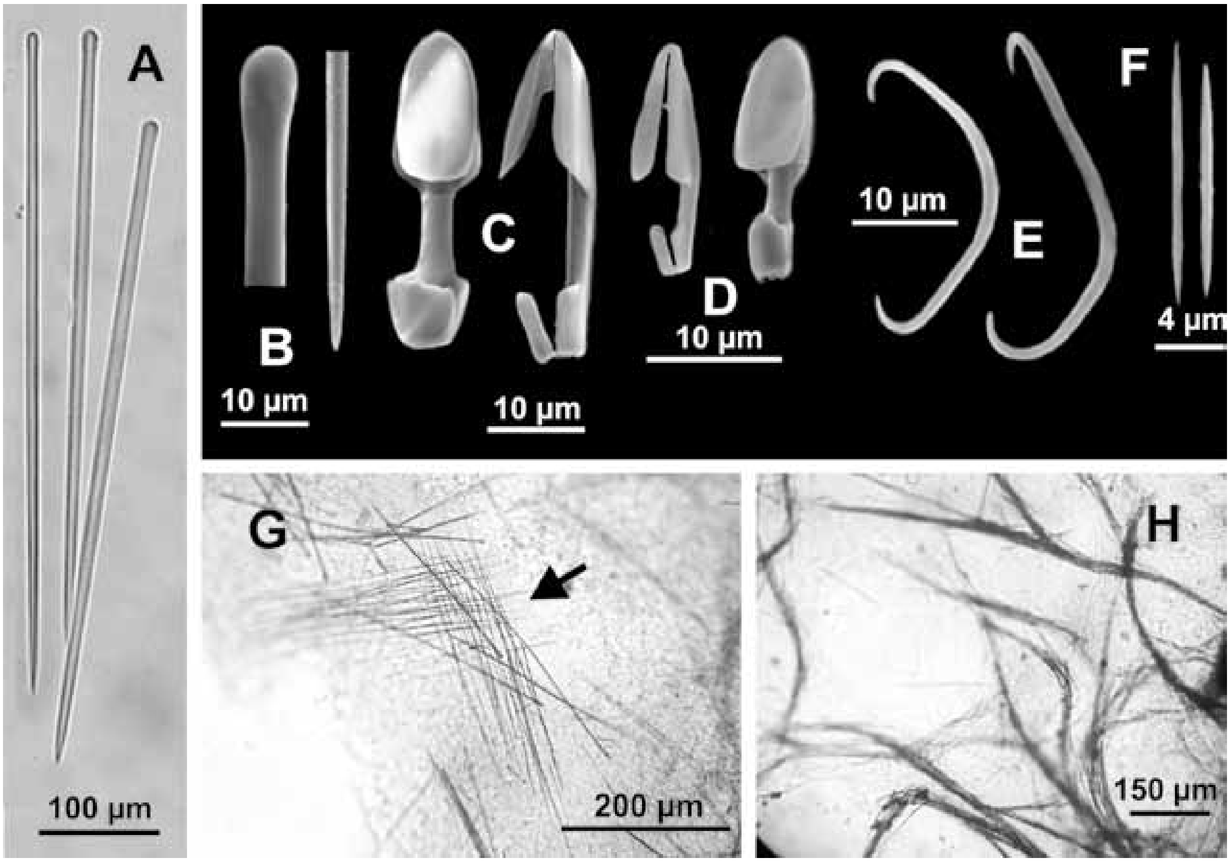

Fig. 7. LM and SEM images of spicules of *Mycale* (*Carmia*) aff. *magnirhaphidifera* Van Soest, 1984. A, Mycalostyles; B, Mycalostyles' ends detail; C, Anisochelae I; D, Anisochelae II; E, Sigmas; F, Rahides; G, Tangential view of ectosomal reticular skeleton, arrow shows a raphidotoxas group; H, Choanosomal structure.

naloa), 23°12’29”N, 106º25’ 40”W, intertidal, 19.ii.2000. LEB-ICML-UNAM-140, Chacala (Nayarit), 21º09’57”N, 105°13’38”W, 4 m, 20.ii.2000. LEB-ICML-UNAM-148, Chacala (Nayarit), 21º09’57”N, 105°13’ 38”W, 2 m, 20.ii.2000. LEB-ICML-UNAM-164, Isla Cardones (Sinaloa), 23°11’05” N, 106º24’07”W, 8 m, 15.iii. 00. LEB-ICML-UNAM- 166, Isla Pájaros (Sinaloa), 23°15’ 29”N, 106º 28’25”W, 5 m, 16. iii.2000. LEB-ICML-UNAM-202, estero el Zacate (Sinaloa), 25º36’25”N, 109º04’33”W, 1 m, 21.vi.2000. LEB-ICML-UNAM-223, puente Maviri (Sinaloa), 25º34’55”N, 109º 06’52”W, 2 m, 21.vi.2000. LEB-ICML-UNAM-229, estero el Zacate (Sinaloa), 25º 36’25”N, 109º04’33”W, 2 m, 21.vi.2000. LEB-ICML-UNAM-233, estero el Zacate (Sinaloa), 25º36’25”N, 109º04’ 33”W 2 m, 21.vi.2000. LEB-ICML-UNAM-239, Isla Patos (Sinaloa), 25º37’12”N, 109º 00’56”W, 3 m, 22.vi.2000. LEB-ICML-UNAM-248, Isla Tunosa (Sinaloa), 25º34’58”N, 109º00’51”W, 2 m, 22.vi. 2000. LEB-ICML-UNAM-252, Isla Tunosa (Sinaloa), 25º34’58”N, 109º00’51”W, 3 m, 22.vi.2000. LEB-ICML-UNAM-263, Paraje Viejo (Sonora), 27º52’20”N, 110º52’ 08”W, 12 m, 4.xi.2000. LEB-ICML-UNAM-282, Ensenada de Bacochibampo (Sonora) 27º54’37”N, 110º57’12”W, 5 m, 6.xi.2000. LEB-ICML-UNAM-350 Isla San José (Baja California Sur) 25°01’41”N, 110°42’19”W, 1 m, 29.iii. 2001. LEB-ICML-UNAM-385 punta Santiago (Colima), 19°05’41”N, 104°25’22”W 2

Table 3. Distribution and comparative data for the dimensions of spicules (in µm) of *Mycale* (*Carmia*) *magnirhaphidifera* Van Soest, 1984 specimens. Values in parentheses are means.

specimens of *Mycale* (*Carmia*) *magnirhaphidifera*	mycalostyles length × width; head width	raphidotoxas length	sigmas length	anisochelae length	raphides length	distribution
Atlantic Specimens (from literature)						
ZMA POR 4885 (Holotype)	236-(254.2)-270 × 1.5-(2.2)-3	260-(291.3)-310	I: Not found II: Not found	I: 19-(27.6)-33 II: 10-(12.4)-17	8-(9.4)-11	Curaçao
USMN 23633 Hajdu and Rutzler, 1998 (measures)	196-(231)-258 × 4-6	168-204	I: 46-(49.5)-55 II: Not found	I: 30-(30.9)-35 II: 13-(15-6)-18	11-20	North Carolina (USA)
MNRJ 196 Carballo and Hajdu, 2001	270-(287.5)-300 × 3.7-(5.6)-8.8; 2.5-(4.6)-7.5	243-(257)-310	Not found	I: 22-(30.6)-42 II: 12-(14)-16	Not found	Brazil
Pacific specimen of *Mycale* (*Carmia*) aff. *magnirhaphidifera* (examined)						
LEB-ICML-UNAM-45	167.5-(232.7)-252.5 × 2.5(3.4)4.5; 3.8(4.7)-5.5	237.5-(285.5)-317.5	20-(24)-28	I: 22.5-(30.5)-40 II: 12.5-(15)-18	12.5-(15.9)-20	Mexican Pacific
LEB-ICML-UNAM-85	192-(276.4)-317 × 2.5-(5.5)-7.5; 3-(5.9)-7.5	230-(273)-310	47.5-(52.3)-60	I: 27.5-(38.3)-45 II: 12.5-(14.4)-16.3	12.5-(18.3)-20	Mexican Pacific
LEB-ICML-UNAM-130	202.5-(238.7)-260 × 2.5-(5.5)-7.5; 3.8-(6.4)-7.5	255-(297)-342.5	25-(36.8)-47.5	I: 20-(28.1)-40 II: 12.5-(13.9)-15	12-(15.1)-20	Mexican Pacific
LEB-ICML-UNAM-196	212.5-(249.1)-275 × 2.5-(4.8)-6.3; 5-(5.7)-7.5	262.5-(305.8)-365	22.5-(26.6)-32.5	I: 22.5-(32.4)-43.8 II: 12.5-(15.3)-17.5	12-(15.4)-20	Mexican Pacific
LEB-ICML-UNAM-234	222.5-(256.3)-290 × 3.8-(5.4)-7.5; 5-(6.7)-8	260-(302.4)-327.5	25-(28)-35	I: 25-(35)-50 II: 15-(18.4-)-19.5	12.5-(16)-25	Mexican Pacific
LEB-ICML-UNAM-259	205-(238.1)-250 × 3-(4.6)-5; 3.8-(5.1)-6.3	225-(268.3)-320	23.8-(28.4)-43.8	I: 21.3-(29.5)-40 II: 10-(13.4)-17.5	12-(14.6)-23.8	Mexican Pacific
LEB-ICML-UNAM-280	155-(247.3)-292.5 × 2.5-(4.3)-5; 3.8-(4.7)-5.5	237.5-(298.8)-355	21.3-(25.2)-37.5	I: 20-(28.5)-37.5 II: 10-(12.9)-16.3	10.5-(13.5)17.5	Mexican Pacific

m, 16.xi.2001. LEB-ICML-UNAM-401 puente Ventana (Colima), 19º02’08”N, 104º 20’34”W, 2 m, 15.xi.2001. LEB-ICML-UNAM-468, Isla Redonda (Nayarit), 20°42’04” N, 105°33’89”W, 10 m, 5.iv.2002. LEB-ICML-UNAM-479, Careyeros (Nayarit), 20°47’13”N, 105°71’13”W, 2 m, 5.iv.2002. LEB-ICML-UNAM-497, Los Arcos (Jalisco), 20°32’73”N, 105°18’47’W, 4 m, 8.iv.2002. LEB-ICML-UNAM-505, Playa los Muertos (Nayarit), 20°52’29”N, 105 26’72”W, 3 m, 9.iv.2002. LEB-ICML-UNAM-552, Ensenada del Pabellón (Culiacán), 22º7’33”N, 107º18’37”W, 3 m, 6.vii.2002. LEB-ICML-UNAM-621, Conchas Chinas, (Jalisco), 20º35’16”N, 105 14’42”W, 3 m, 8.x.2002. LEB-ICML-UNAM-669, muelle del contenedor (Sinaloa), 25°34’55”N, 109°03’32”W, 4 m, 12.xi.2002. LEB-ICML-UNAM-682, Isla Tunosa (Sinaloa), 25º 34’58”N, 109º00’51”W, 2 m, 12.xi.2002. LEB-ICML-UNAM-684, Islas Verdes (Sinaloa) 25°31’47”N, 109°05’27”W, 2 m, 13.xi.2002. LEB-ICML-UNAM-693, estero ‘El Bichi’ (Sinaloa), 25°32’27”N, 109°05’29”W, 1 m, 13.xi.2002. LEB-ICML-UNAM-702, Cerro Partido (Sinaloa), 25°32’07”N, 109°05’33”W, 1 m, 13.xi.2002. LEB-ICML-UNAM-714, estero el Zacate (Sinaloa), 25º36’25”N, 109º04’33”W, 2 m, 14.xi.2002. LEB-ICML-UNAM-724, puente Maviri (Sinaloa), 25º34’55”N,

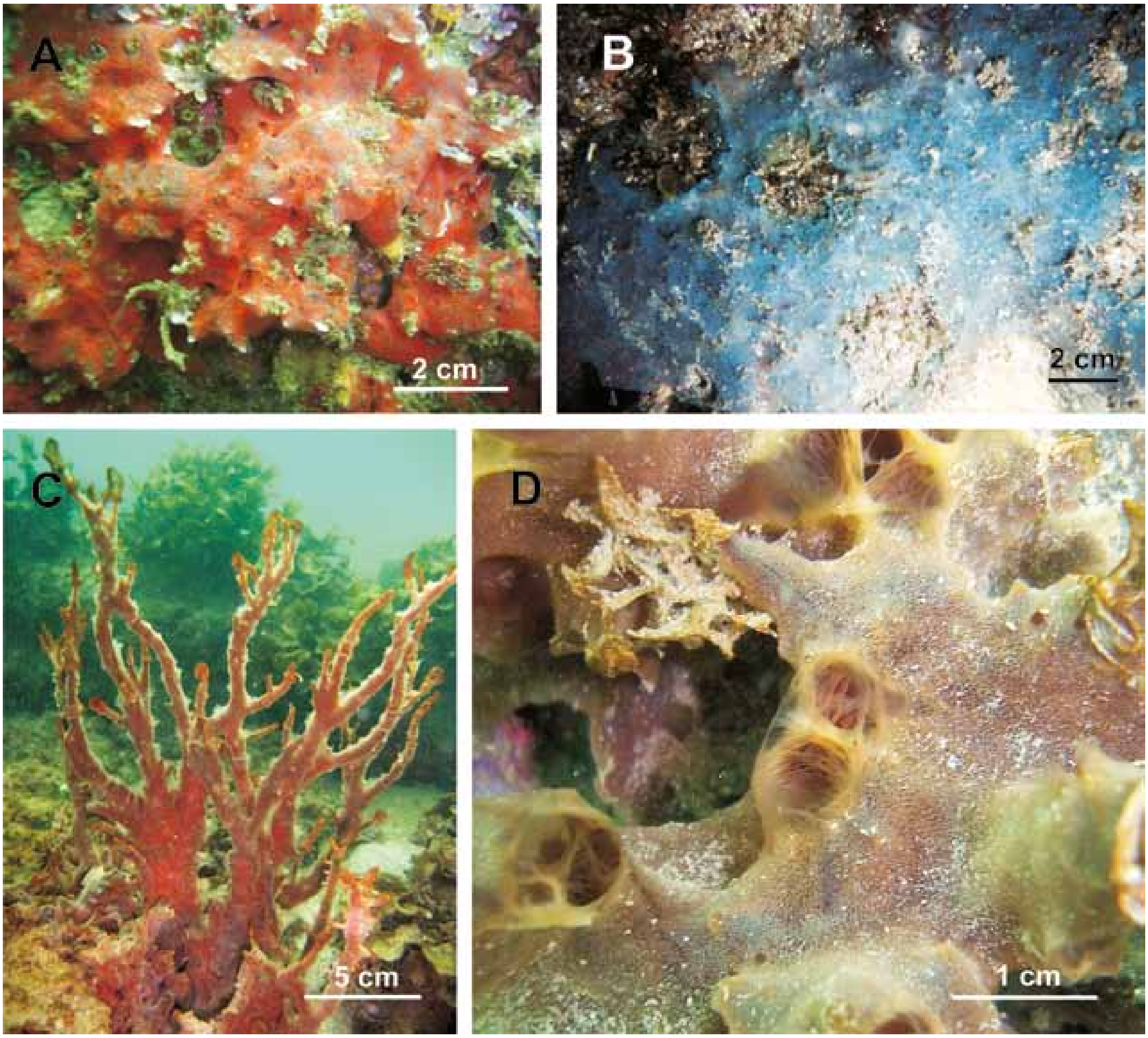

Fig. 8. External morphology. A, B, *Mycale* (*Carmia*) *cecilia* de Laubenfels, 1936; C, D, *Mycale ramulosa* sp. nov.

109º06'52"W, 4 m, 14.xi.2002. LEB-ICML-UNAM-747, Paraje Viejo (Sonora), 27º52'20"N, 110º52'08"W, 6 m, 26.xi.2002. LEB-ICML-UNAM-792, Mismaloya (Jalisco), 20°31'56.22"N, 105°17'42"W, 5 m, 9.vi.2003. LEB-ICML-UNAM-814, Isla Redonda (Nayarit), 20°42'04"N, 105°33'89"W, 12 m, 10.vi.2003. LEB-ICML-UNAM-852, Majahuita (Jalisco), 20°29'06"N, 105°35'03"W, 7 m, 8.vi.2003. LEB-ICML-UNAM-872, Chacala (Nayarit), 21º09'57"N, 105º13' 38"W, 4 m, 12.vi.2003. LEB-ICML-UNAM-883, Isla el Crestón (Sinaloa), 23º11'02"N, 106º25'37"W, 7 m, 10.ix.2003. LEB-ICML-UNAM-923, Isla Hermano Sur (Sinaloa), 23º11'16"N, 106º25'11.5"W, 8 m, 22.x.2003. LEB-ICML-UNAM-954, Isla Hermano Norte (Sinaloa), 23º10'59"N, 106º26'24"W, 8 m, 24.x.2003. LEB-ICML-UNAM-975, Isla Chivos (Sinaloa), 23º10'40"N, 106º24'48"W, 8 m, 26. xi.2003. LEB-ICML-UNAM-1019, Cerro San Carlos (Sinaloa), 25º35'33"N, 109º02'39"W, 2 m, 11.xii. 2002. LEB-ICML-UNAM-1099, La Entrega (Oaxaca), 15º42'50"N, 96º05'20"W, 6 m, 14.iv.2004. LEB-ICML-UNAM-1112, punta Pinta (Sonora), 31º20'14"N, 96º05'20"W, 4 m, 03.iv.2005. LEB-ICML-UNAM-1124, punta Pinta (Sonora), 31º20' 14"N, 96º05'20"W, 4 m, 03.iv.2005. LEB-ICML-UNAM-1143, El Muelle (Oaxaca), 15º40'23"N, 96º31'01"W, 25 m, 15.iv.2004. LEB-ICML-UNAM-1168, Las Monas, Isla Isabel (Nayarit), 21º 50'59"N, 105º52'46"W, 6 m, 07.ii.2005. LEB-ICML-UNAM-1200, submarino (Sinaloa), 23º09'59" N, 106º25'05"W, 18 m, 03.v.2005. LEB-ICML-UNAM-1216, La Entrega (Oaxaca), 15º42'50"N, 96º 05'20"W, 4 m, 05.iv.2005. LEB-ICML-UNAM-1230, Isla Cacaluta (Oaxaca), 15º38'23"N, 96º 29'01"W, 4 m, 04.viii.2005. LEB-ICML-UNAM-1287, El Arrocito (Oaxaca), 15º44'25"N, 96º05' 03"W, 4 m, 11.iv.2005. LEB-ICML-UNAM-1346, Isla Cacaluta (Oaxaca), 15º38'23"N, 96º29'01"W, 5 m, 24.vii.2005. LEB-ICML-UNAM-1376, El Requesón (Baja California Sur), 26º38'38"N, 111º49' 53"W, 9 m, 29.x.2006. LEB-ICML-UNAM-1435, La Granja, Isla Espíritu Santo (Baja California Sur), 24º25'32"N, 110º20'55"W, 0.5 m, 12.iii.2007. LEB-ICML-UNAM-1452, muelle petrolero (Baja California Sur), 24º13'23"N, 110º18'44"W, 4 m, 12.iii. 2007. LEB-ICML-UNAM-1583, cerro de la Virgen (Sinaloa), 25º36'57"N, 108º58'11"W, 2 m, 12.xi. 2002. LEB-ICML-UNAM-1602, piedra del Asadero (Nayarit), 21º34'45"N, 105º29'45"W, 2 m, 11.iii. 2007.

Description. Incrusting to cushion-shaped sponge 1-9 mm thick. Specimens commonly red to reddish-orange, or green with yellow, or almost blue, but always with distinctive small orange patches (Fig. 8A, B). Preserved specimens ochre or light brown. Consistency is very soft and fragile after preservation. Surface is smooth. Subectosomal canals, 150-850 μm in diameter, converging to oscula, and subectosomal spaces 20-759 μm, are common. Small ectosomal pores about 33 μm in diameter on sponge surface. Oscules circular to oval, 0.5-4.0 mm in diameter, and commonly elevated from the surface about 3 mm by a translucent dermal membrane.

Spicules. Megascleres are mycalostyles, and the microscleres are anisochelae in one category (Fig. 13B, C) and sigmas (Table 4).

Mycalostyles are straight, with sharp or blunt points and with a characteristic faintly marked oval head (Fig. 9A, B). Measurements: 130-290 × 2.1-8.8 μm; tyle diameter: 2.5-10.0 μm.

Anisochelae from 12.5 to 27.5 μm long but in a single category (Figs. 9C, 13B, C) and C-shaped sigmas from 15 to 50 μm (Fig. 9D).

Skeleton. The ectosomal membrane lacks spicules, only free tylostyles are arranged tangentially (Fig. 9E). Sigmas and anisochelae are also distributed throughout the surface. The choanosomal skeleton is plumoreticulate made of ascending multispicular tracts of mycalostyles (30-300 μm in diameter) reinforced with variable amounts of spongin, which slightly diverge into brushes when approaching the surface (Fig. 9F). In some places, a few of these choanosomal tracts 30-150 μm in diameter continue tangentially over the surface. Microscleres, anisochelae, and sigmas common all over the sponge.

Distribution. The species is quite common in the Mexican Pacific (Cruz-Barraza and Carballo, 2008, present study, see Fig. 1). It is common in the east Pacific Ocean from Hawaii (De Laubenfels 1950) to Panama (De Laubenfels 1936b).

Mycale (*Carmia*) *contax* (Dickinson, 1945)

Carmia contax Dickinson, 1945: 24

Material examined. The holotype labeled as AHF no. 12; Material- Sta. 751-37 Los Frailes 4-4-37 20 m was not found in the Hallan Hancock collection, currently deposited in the Museum of Natural History Museum of Los Angeles County (NHMLAC) (USA).

Description. No material was studied, so a brief description was adapted from Dickinson, 1945. The

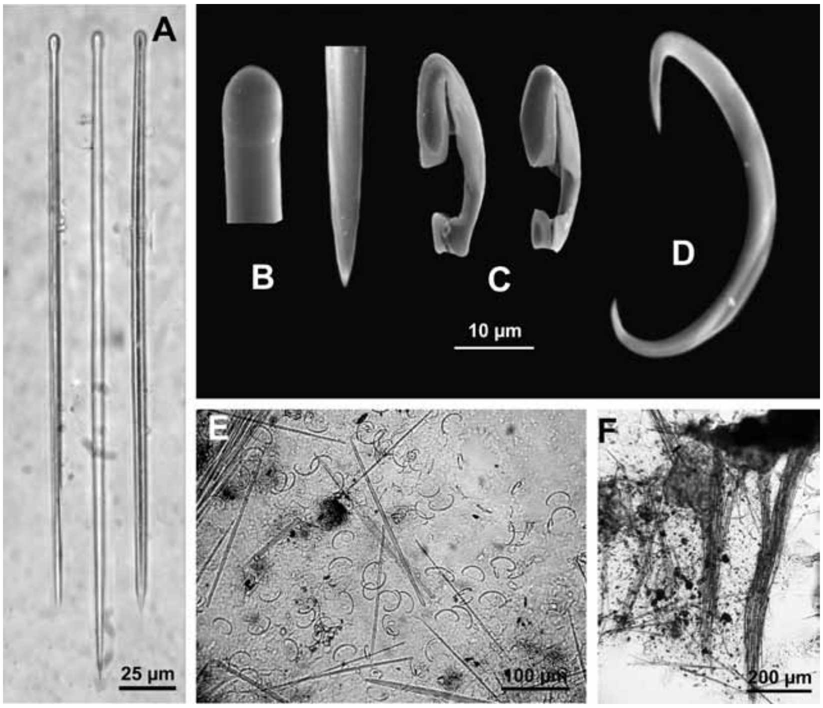

Fig. 9. SEM images of spicules of *Mycale* (*Carmia*) *cecilia* de Laubenfels, 1936. A, Mycalostyles; B, Mycalostyles' ends detail; C, Anisochelae; D, Sigma; E, Tangential view of ectosomal reticular skeleton; F, Transversal view of choanosomal structure.

sponge is about 2 cm^2 by 0.5 cm thick. The surface is irregular. The consistency is softly spongy. Pores and oscules are not evident. Ectosomal membrane very thin and detachable in some places.

Spicules. The megascleres are styles to subtylostyles, and as microscleres present anisochelae in 3 size categories, sigmas, toxas and raphides. Mycalostyles of 300 by 3 µm in average.

Anisochelae I) from 21 to 23 µm, anisochelae II) from 14 to 16 µm and anisochelae III) from 6 to 7 µm in length. Sigmas from 18 to 75 µm. Toxas are long, averaging 55 µm, and raphides are up to 150 µm long.

Skeleton. Ectosomal membrane with some spicules in confusion. The choanosomal skeleton made of ascending multispicular fibres of subtylostyles.

Distribution and habitat. Type locality, Los Frailes (Los Cabos, Lower California); 20 m; sand and algae bottom.

Remarks. The type material of *M. contax* (Dickinson, 1945) was not found in the Allan Hancock Foundation, where most of the sponges collected by Dickinson were deposited. However, the original description is clear enough to considerer it as a valid species.

The species is distinguished from other species belonging to the subgenus *Carmia* because of the presence of long toxas (55 µm, in average) and raphides up to 150 µm long. Other two *Mycale* (*Carmia*) with long raphides are, *M.* (*C.*) *magnirhaphidifera* Van Soest, 1984, which has longer raphides (from 315 to 367 µm) and shorter sigmas, and does not have toxas, and *M.* (*C.*) *rhaphidotoxa* Hentschel, 1912 from Arafura Sea (Indonesia), which has also larger raphides (200-400 µm), sigmas over 60 µm long, and in addition has not toxas (Carballo and Hajdu, 2001). Other two species with long raphides are *M.* (*Aegogropila*) *mannarensis* Thomas, 1968 from the Gulf of Mannar (India), and *Mycale* (*A.*) *kolletae* Carballo and Hajdu, 2001, from the Atlantic coast of Africa, both clearly different to *M.* (*C.*) *contax* by their typical *Aegogropila* ectosomal skeleton. *M. (Zygomycale) parishi* also has long raphides (from 30 to 160 µm), but the spicular complements of this species, and the ectosomal skeleton, are very different to those in *M.* (*C.*) *contax* (see Remarks in *M.* (*Zygomycale*) *ramulosa*).

Subgenus *Paresperella* Dendy, 1905

Mycale (*Paresperella*) *psila* (De Laubenfels, 1930)
(Fig. 10)

Paresperella psila.- *De* Laubenfels, 1930: 36; De Laubenfels, 1932: 70
Esperella serratohamata.- Lambe, 1895; 130 [not *Esperia serratohamata* Carter, 1880]

Mycale psila.- Bakus, 1966: 459; Bakus and Green, 1987

*Material examined***.** LEB-ICML-UNAM-329, Isla Lobos (Sinaloa), 23º 13’49’’N, 106º27’43’’W, 6 m, 20.iii. 2001. LEB-ICML-UNAM-853, Majahuita (Jalisco), 20°29’06’’N, 105° 35’03’’W, 10 m, 08.vi.2003. LEB-ICML-UNAM-896, Isla el Crestón (Sinaloa), 23º11’02’’N, 106º25’37’’W, 7 m, 12.ix.2003. LEB-ICML-UNAM-1118, Punta Pinta, Pto. Peñasco (Sonora), 31º20’14’’N, 96º05’20’’W 4 m, 04.iii.2005.

Description. Specimens of this species are thinly to thickly encrusting up to 2.5 mm thick. Live colors range from light yellow to almost white in some specimens, and turn pale brown in alcohol. Maximum substratum coverage of 9 cm long × 5 cm wide. Surface is smooth, but feels slightly hispid. The species presents numerous projections, 2.5 to 5.5 mm high and 1.3 to 1.8 mm thick. The consistency is soft but the projections are firm. Oscules are frequently oval, 0.4 to 1.2 mm in diameter. The body of the sponge and the surface harbor sand, and small fragments of shells.

Spicules. Megascleres are mycalostyles, and microscleres are anisochelae in two categories, toxas, and the typical serrated sigmas of the subgenus in two size classes.

Mycalostyles with shaft that is usually curved, tapering gradually to a sharp point (Fig. 10A, B), 245-325 µm long × 2.5-10 µm wide. With elliptical heads 2.5-7.5 µm in diameter, sometimes weakly mucronate.

Anisochelae I) with head about ca 55% of total spicule length (Fig. 10C). Size: 27-35 µm long.

Anisochelae II) with palmate head ca 56% of total length of the spicule (Fig. 10D). Size: 11-14 µm long.

Toxas are slender, central curve often marked, lateral curves often gentle,

Table 4. Distribution and comparative data of external color and the dimensions of spicules (in µm) of *Mycale* (*Carmia*) *cecilia* de Laubenfels, 1936 specimens. Values in parentheses are means.

specimens	mycalostyles length x width; head width	sigmas length	anisochelae length	color
LEB-ICML-UNAM-1	235-(251)-260 × 2.5-(4.2)-5; 3.8-(4.8)-5	15-(31.5)-50	16.3-(17.8)-20	orange
LEB-ICML-UNAM-20	215-(255.8)-277 × 3.8-(5)-7.5; 3.8-(5.4)-7.5	27.5-(36.5)-42.5	17.5-(22.9)-27.5	orange
LEB-ICML-UNAM-23	195-(227)-252.5 × 3.8-(5)-7.5; 3.8-(5.7)-7.5	30-(37.6)-43.8	17.5-(20)-22.5	red
LEB-ICML-UNAM-40	235-(249.8)-270 × 5-(6)-7.5; 5-(5.8)-6.3	32.5-(37.5)-45	17.5-(19.5)-22.5	red
LEB-ICML-UNAM-43	222.5-(264)-290 × 5-(5.5)-6.3; 5-(5.8)-7. 5	32.5-(35.5)-37.5	17.5-(20)-22.5	orange and red ornamentation
LEB-ICML-UNAM-44	200-(218)-257.5 × 2.5-(4.4)-5; 2.5-(4.5)-5	32.5-(38.1)-41.3	15-(19.3)-22.5	green and orange ornamentation
LEB-ICML-UNAM-54	130-(233.6)-260 × 2.5-(6)-8.8; 3.8-(5)-6.3	31-(41)-42.5	17.5-(23)-25	green and orange ornamentation
LEB-ICML-UNAM-112	135-(221.3)-287 × 5-(6.3)-7.5; 5-(7.1)-8.8	25-(36.6)-47.5	12.5-(17.5)-22.5	red
LEB-ICML-UNAM-127	190-(256)-282.5 × 2.5-(5.5)-7.5; 3.8-(6.3)-8.8	32.5-(37.8)45	13.3-(22.3)-23.8	red
LEB-ICML-UNAM-140	205-(254.9)-285 × 2.5-(6)-7.5; 3-(6.3)-7.5	33.8-(38.3)-47.5	12.5-(17)-22.5	orange
LEB-ICML-UNAM-148	203-(220.3)-241.3 × 4.8-(5.3)-6.3; 4.5-(5.5)-6.3	32.5-(36.5)-37.5	14-(17.4)-18.8	red
LEB-ICML-UNAM-164	172.5-(220.3)-250 × 2.5-(5.7)-8.8; 3.8-(6.6)-10	27.5-(38.8)47.5	16.3-(20)-22.5	red
LEB-ICML-UNAM-166	222.5-(251.5)-287.5 × 5-(6.5)-7.5; 7-(7.8)-8.8	27.5-(38.8)-45.5	17.5-(20.6)-22.5	orange and red ornamentation
LEB-ICML-UNAM-202	165-(239)-265 × 2.1-(5)-7.5; 3(6.5)-7.5	32.5-(34.8)-40	17.5-(20.5)-22.5	orange
LEB-ICML-UNAM-223	207-(253)272.5 × 2.5-(5.8)7.5; 3-(6.2)-7-5	27.5-(35.8)40	17.5-(20.8)-22.5	orange
LEB-ICML-UNAM-229	187.5-(238.8)-257.5 × 2.5-(5.9)-7.5; 3.8-(6.9)-8.8	37.5-(22.9)-40	20-(22.9)-25	red
LEB-ICML-UNAM-233	160-(222.8)-240 × 2.5-(4.8)-6.3; 3-(5.2)-6.3	42.5-(47.9)-50	20-(23.8)-25	red
LEB-ICML-UNAM-239	157.5-(217.3)-242.5 × 2.5-(3.3)-8.8; 3-(6.8)-8.8	35-(39.9)-45	18.8-(22)-23.8	red
LEB-ICML-UNAM-248	145-(224.5)-257.5 × 2.5-(5.9)-7.5; 3-(6.5)-8	37.5-(44.5)-50	21.3-(23.5)-25	red
LEB-ICML-UNAM-252	150-(254.3)-287.5 × 2.5-(6)-7.5; 3-(6.6)-8.8	32.5-(36.8)-42.5	20-(22.6)-25	red
LEB-ICML-UNAM-263	152.5-(223.5)-242.5 × 2.5-(4.6)-5; 3-(5)6.3	31.3-(37.3)-47.5	15-(17)-20	--
LEB-ICML-UNAM-282	225-(245.8)-262.5 × 2.5-(3.6)-5; 3.8-(4.6)-5.5	20-(34)-42.5	15-(16.4)-20	red

gradually tapering to sharp endings (Fig. 10E). Size: 42-63 µm long.

Sigmas with serrated edges (Fig. 10F, G), 'S-C' shaped, in two categories. Size category I: 130 to 188 µm long. Size category II: 37 to 60 µm long.

Skeleton.The ectosomal skeleton is made of a tangential reticulation of paucispicular (1-5 spicules), or pluriespicular tracts of mycalostyles (11-18 spicules). Meshes formed by the reticulation are 60 to 200 µm wide. Anisochelae-I are mostly organized in rosettes (Fig. 10H). The choanosomal skeleton is made of ascending tracts of mycalostyles, 150 µm thick (Fig. 10I). Tracts branch towards the ectosome where they diverge in paucispicular tufts 40-100 µm thick that support and slightly pierce the ectosomal reticulum and surface peel.

Distribution and habitat. Northeast Pacific Ocean: Vancouver (Canada) (as *Esperella serratohamata* Lambe, 1894), San Juan (Washington) (Bakus, 1966), California (De Laubenfels, 1930, 1932; Bakus and Green, 1987), and México (Sonora, Sinaloa, Jalisco and Guerrero) (Fig. 1), on sublittoral rocks.

Remarks. See Bakus (1966).

Subgenus *Zygomycale* Topsent, 1931
Mycale (*Zygomycale*) *ramulosa* sp. nov.
(Figs 8D-E, 11, 12)

Zygomycale parishii.- Green and Gomez, 1986: 288 [not *Mycale parishi* (Bowerbank, 1875)]

Material examined. Holotype of *Raphiodesma parishi* Bowerbank, 1875. Dry specimens (BMNH: 1877.5.21.1359) and slides (BK1358-1359). Holotype:

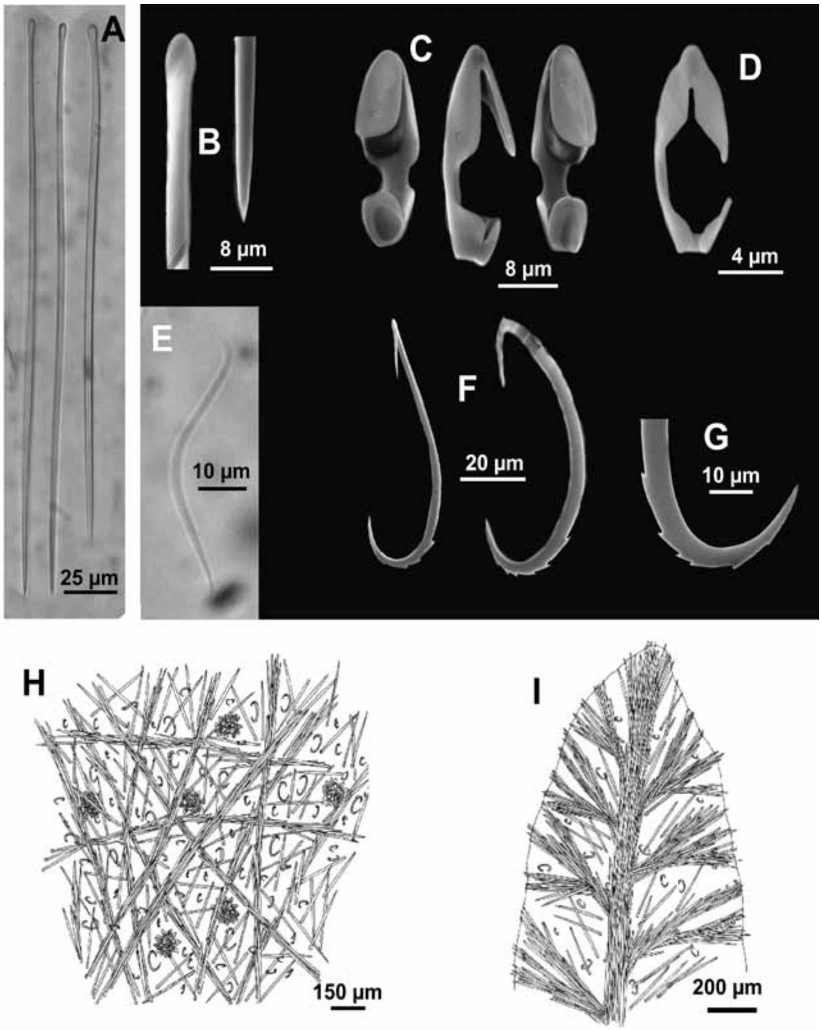

Fig. 10. Images of spicules and skeletal arrangement of *Mycale* (*Paresperella*) *psila* (de Laubenfels, 1930). A, (LM) Mycalostyles; B, (SEM) Mycalostyles' ends detail; C, (SEM) Anisochelae I; D, (SEM) Anisochelae II; E, (LM) Toxa; F, (SEM) Sigmas; G, (SEM) Detail of serrated edges. H, Drawing of tangential view of ectosomal structure; I, Drawing of transversal view of choanosomal structure.

Table 5. Distribution and comparative data for the dimensions of spicules (in μm) of *Mycale* (*Zygomycale*) *ramulosa* sp. nov. specimens. Values in parentheses are means. *Micracanthoxeas were not measured because these specimens where studied only with an optical microscope.

material examined	*mycalostyles* length x width; head width	toxa length	sigma length	anisochelae length	isochelae length	raphides length	microacantoxas length
Holotype							
MNCN 1.01/632	290-(296.3)-317.5 x 2.5-(5.9)-8.8; 2.5-(6.5)-8.8	35-(58)-85	I: 72.5-(78.4)-82.5 II: 13.8-(26)-35	I: 42.5-(45)-48.5 II: 17.5-(20.6) 25	10.5 (12.2) 15	25 (31.9)-37.5	3.5-(4)-5
Paratype							
BMNH 2010.11.01.2	157.5-(268.8)-312.5 × 2.5-(6.5)-10; 2.5-(6)-8.8	32.5-(48.5)-65.5	I: 62.5-(73)-80 II: 17.5- (27.2)-40	I: 40-(44.3)-47.5 II: 16.3-(18.5)-20	10 (11.6)-13.8	20 (27.1) 32.5	2.7-(3.5)-4.2
LEB-ICML-UNAM-17	197.5-(277.3)-307.5 × 2.5-(5.9)-8; 2.5-(5.6)-7.5	35-(60.5)-90	I: 72.5- (78.3)-82.5 II: 15-(28.1)-35	I: 38.8 (40.5)-50 II: 17.5(20)-21.3	10 (11.8)-13	23.8 (28.2) 35	3.3-(3.8)-4.8
LEB-ICML-UNAM-22	162.5-(260.3)-317.5 × 3.8-(6.4)-8.8; 5-(6.6)-7.5	42.5-(55.9)-73.8	I: 62.5-(79.2)-95 II: 13.8 (20)-32.5	I: 40 (44)-50 II: 17.5-(20.3)-22.5	10 (12)-15	22.5 (28)-37.5	*
LEB-ICML-UNAM-113	260-(294.5)-317.5 × 2.5-(6.1)-10; 2.5-(6)-8.8	32-(57)-97	I: 72 (84)-97.5 II: 12.5 (25.3)-37.5	I: 42-(47)-50 II: 17 (21)-25	10 (12.5)-15	22.5 (31.5) 37	*
LEB-ICML-UNAM-157	197.5-(279.8)-340 × 2.5-(7.5)-10; 2.5-(6.4)-10	27.5-(56.4)-82.5	I: 73.8-(77.9)-85 II: 16.3-(27.2)-37.5	I: 42.5-(47.5)-51.3 II: 18.8-(20.8)-22.5	10 (11.9)-13.8	25 (31.5) 35	*
LEB-ICML-UNAM-169	235-(303.3)-332.5 × 2.5-(7.1)-8.8; 2.5-(5.6)-7.5	40-(64)-90	I: 75-(80.5)-82.5 II: 16.3-(30.6)-45	I: 40-(44.3)-48.8 II: 16.3-(19.3)-22.5	10 (11.3)-12.5	25 (32) 42.5	2.4-(3)-3.8
LEB-ICML-UNAM-208	175-(264)-315 × 2.5-(10)-15; 2.5-(9.5)-12.5	40-(68.5)-90	I: 93.8-(96)-100 II: 15-(25)-40	I: 46.3-(52.4)-60 II: 17-(21.4)-24.5	11.3-(13.3)15	30-(36.1)-42.5	*
LEB-ICML-UNAM-212	175-(264.4)-313.8 × 2.5-(9.2)-12.5; 5-(8.3)-10	25-(56)-82.5	I: 80-(90)-95 II: 17.5-(27.7)-40	I: 40-(48)-55 II: 18-(21.8)-26.3	12-(13.8)-16.3	27.5-(34.7)-42.5	*
LEB-ICML-UNAM-216	187.5-(265.4)-302 × 2.5-(8.3)-11.3; 3-(6.3)8.8	40-(64.4)-87.5	I: 80-(87.3)-95 I: 15-(23.4)-33.8	45-(49.4)-55 18.8-(21)-22.5	11.3-(13)-15	30-(38)-45	*
LEB-ICML-UNAM-237	227-(298.1)-327.5 × 2.5-(9.9)-12.5; 2.5-(7.3)10	25-(55)-85	I: 82.5-(89)-95 II: 16.3-(21.6)-32.5	I: 45-(47.5)-50 II: 21.3-(23)-25	10-(11.8)-13.8	25-(30)-35	3-(3.7)-4
LEB-ICML-UNAM-1084	262.5-(301)-325 × 2.5-(7.5)-10; 3.8-(6.3)-8.8	27.5-(49)-75	I: 85-(87)-90 II: 17.5-(26)-36.3	I: 42.5-(48)50 II: 15-(19)-20	10-(11.8)-12.5	25-(27.5)-30	*
LEB-ICML-UNAM-1427	262.5-(284.5)-300 × 3.5-(6.2)-8.5; 5- (6.5)-8.5	22.5-(50)-67.5	I: 70-(77.8)-87.5 II: 20-(27)-30	I: 40-(43.8)-50 II: 16.2-(18)-25	8.8-(10.2)-11.3	25-(28)30	*

MNCN 1.01/632. Isla Lobos (Sinaloa), 23º13’49”N, 106º27’43”W, 4 m, 28.xi.1998.Paratypes: BMNH: code 2010.11.01.2. LEB-ICML-UNAM-17, Isla Lobos 1 (Sinaloa), 23º13’49”N, 106º27’43”W, 4 m, 28.xi.1998. LEB-ICML-UNAM-22, muelle flota pesca deportiva (Sinaloa), 23º10’93”N, 106º25’46”W, 1 m, 14.x.1999. LEB-ICML-UNAM-113, Marina del Cid (Sinaloa), 23º10’89”N, 106º25’44”W, 2 m, 27.xi.1999. LEB-ICML-UNAM-157, antiguo muelle de atraque (Sinaloa), 23º11’57”N, 106º25’15”W, 4 m, 15.iii.2000. LEB-ICML-UNAM-169, Isla Pájaros (Sinaloa), 23º15’29”N, 106º28’25”W, 5 m, 16.iii.2000. LEB-ICML-UNAM-208, Isla Masocawi (Sinaloa), 25º34’36”N, 109º00’ 32”W, 3 m, 22.vi.2000. LEB-ICML-UNAM-212, cerro San Carlos (Sinaloa), 25º35’33”N, 109º02’39”W, 5 m, 22.vi.2000. LEB-ICML-UNAM-216, estero la Chata (Sinaloa), 25º36’22”N, 109º05’02”W, 1 m, 21.vi.2000. LEB-ICML-UNAM-237, puente Maviri (Sinaloa), 25º34’55”N, 109º06’52”W, 1 m, 21.vi.2000. LEB-ICML-UNAM-545, El Yatch (Sinaloa), 25°36’12”N, 109°02’16”W, 3 m, 12.ix.1989. LEB-ICML-UNAM-547, cerro las Gallinas (Sinaloa), 25°35’11”N, 109°03’ 18”W, 3 m, 22.x.1988. LEB-ICML-UNAM-597, Islas Verdes (Sinaloa), 25°31’47”N, 109°05’27”W, 2 m, 13. xi.2002. LEB-ICML-UNAM-659, cerro San Carlos (Sinaloa), 25º35’33”N, 109º02’39”W, 6 m, 12.xi.2002. LEB-ICML-UNAM-661, Isla de la Virgen, (Sinaloa), 25°36’58”N, 108°58’12”W, 2 m, 12.xi.2002. LEB-ICML-UNAM-671, muelle del contenedor (Sinaloa), 25° 34’55”N, 109°03’32”W, 5 m, 12.xi.2002. LEB-ICML-UNAM-884, Isla el Crestón (Sinaloa), 23º11’02”N, 106º25’37”W, 7 m, 10.ix.2003. LEB-ICML-UNAM-922, Isla Hermano Sur (Sinaloa), 23º11’16.2”N, 106º25’ 11”W, 6 m, 22.x.2003. LEB-ICML-UNAM-946, Isla Hermano Norte (Sinaloa), 23º10’59”N, 106º26’24”W, profundidad 6 m, 24.x.2003. LEB-ICML-UNAM-1082, La Palma (Sinaloa), 24º37’54”N, 107º55’50”W, 6 m, 13.xii.1990. LEB-ICML-UNAM-1089, Estación 7 (Si-

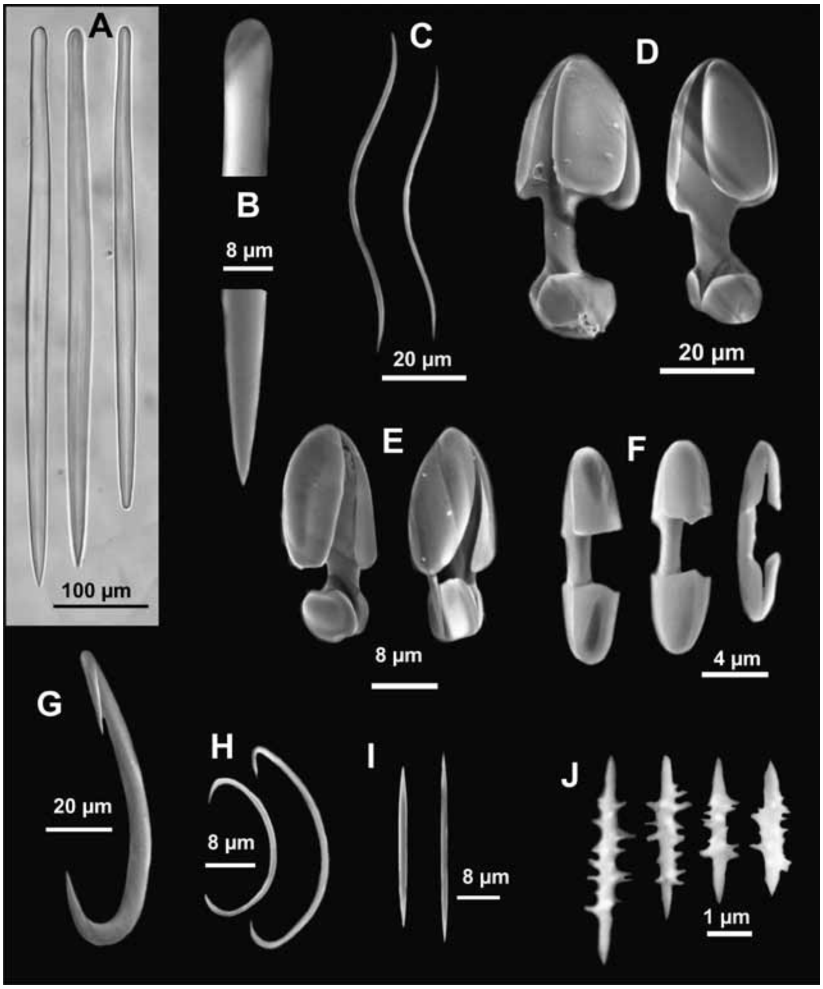

Fig. 11. SEM images of spicules of *Mycale* (*Zygomycale*) *ramulosa* sp. nov. A, Mycalostyles; B, Mycalostyles’ ends detail; C, Toxas; D, Anisochelae I; E, Anisochelae II; F, Isochelae; G, Sigma I; H, Sigma II; I, Raphides; J, Micracanthoxeas.

naloa), 24º38'40'N, 108º02'51"W, 3 m, 25.ix.1990. LEB-ICML-UNAM-1437, La Granja, Isla Espíritu Santo (Baja California Sur), 24º25'32"N, 110º20'55"W, 0.5 m, 12.iii.2007. LEB-ICML-UNAM-1448, muelle Petrolero (Baja California Sur), 24º13'23"N, 110º18' 44"W, 4 m, 12.iii.2007. LEB-ICML-UNAM-1550, muelle Petrolero (Baja California Sur), 24º13'23"N, 110º 18'44"W, 4 m, 12.iii.2007. LEB-ICML-UNAM-1554, Agua de Yépiz (Baja California Sur), 24º35'35"N, 110º35'53"W, 1 m, 09.i.2007.

Description. The sponge is very polymorphic. It can grow as thin, flat encrustations 3 mm thick, with oscules which are slightly elevated or flush with the surface, covering areas up to 9 cm long × 7.5 cm wide. It can also be massive with a surface of attachment of 10 × 8 cm, massive-lobose with lobes 0.8 to 2 cm high, and 1.5 to 2.5 cm in diameter, and massive with coalescent branches. It is also frequently found as a large arborescent sponge 45 cm high or more, and up to 30 cm across. This form consists of branches with an irregular outline 3-4 cm across, growing from a short stalk (Fig. 8C-D). The branches may remain isolated along their entire length, or fuse to such a degree that some branches become flabelliform. Commonly the diameter of the branches decreases toward the blind ends, but there is also variation in this feature. The branch form can also have small tubercles 0.1 and 1.5 mm high and 0.75-1.3 mm in diameter. The most common color is red-brown and brownish purple, but dirty yellow specimens are also common. Surface is smooth to uneven but slightly hispid under the binocular microscope. Consistency is soft, spongy, compressible and elastic. In live specimens subectosomal canals are clearly visible leading to slightly elevated, small, contracted, circular or oval shaped oscules, 0.1 to 1.5 cm in diameter (Fig. 8D).

Spicules. The species presents mycalostyles, anisochelae in two categories, palmate isochelae, sigmas also in two size classes, toxas, raphides and micracanthoxeas (Table 5).

Mycalostyles are curved and slightly thicker in the middle region (fusiform), with a more or less pronounced head and ending in a sharp point (Fig. 11A-B). Measurements: 157-340 × 2.5-10 µm.

Toxas slender, from 25 to 97 µm in length but in one size, gently curved in the middle and gradually tapering to sharp endings (Figs. 11C, 13D).

Anisochelae I) from 38.8 to 51.3 µm, with palmate head ca. 54% of the total length (Fig. 11D), anisochelae II) from 16 to 25 µm, with palmate head ca. 66% of the total length (Fig. 11E), and palmate isochelae from 10 to 15 µm long (Fig. 11F). Sigmas I from 62.5 to 100 µm, stout, C-shaped or contorted as S (Fig. 11G). Sigmas II from 12 to 45 µm, slender, gently curved on most of its extension (Fig. 11H). Raphides 20-46 µm long (Fig. 11I). Micracanthoxeas from 2.5 to 5 µm, straight, sharp pointed and heavily spined, very abundant but difficult to see under optical microscope (Fig. 11J).

Skeleton. Ectosomal skeleton formed by a tangential reticulation of multispicular tracts of mycalostyles (2-18 spicules across) 22 to 60 µm thick, forming meshes 180-450 µm wide (Fig. 12A). The choanosomal skeleton has a plumose architecture; tracts of mycalostyles arise from the base of the sponge and end in brushes that protrude the sponge surface (Fig. 12A-B). Microscleres are strewn at random among tracts. Anisochelae in rosettes are not common but present.

Distribution and habitat. Mexican Pacific Ocean. Sinaloa, Baja California Sur, and Jalisco (Fig. 1). The species has been previously cited as *Zygomycale parishii* by Green and Gómez (1986). Although the species can be found in open sea environments, it typically lives in lagoons and semi enclosed embayments, between 1 and 6 m depth. On rocks, shells, and attached to small rocks and shells in soft bottoms.

Etymology. The specific name *ramulosa* comes from the Latin *ramulosus,* 'with branches'.

Remarks. The subgenus *Zygomycale* is clearly characterized by having palmate isochelae (Van Soest and Hajdu, 2002). Only two species from this genus were known thus far; *Mycale parishi* (Bowerbank, 1875) from the Indo- Pacific Ocean, and *M. angulosa* (Duchassaing and Michelotti, 1864) from the western Atlantic Ocean. Both species are quite similar in form, color, and skeleton, but spicular differences exist between them (see Burton and Rao, 1932; see Van Soest, 1984 for more detail).

The most important difference between these two species and *Mycale ramulosa* sp. nov. is the presence of micracanthoxas in the latter. We could think that Bowerbank, and Duchassaing and Michelotti might have overlooked the micracanthoxas due to their minute dimensions. However, this kind of microsclere was not found in the holotype of *M. parishi* revised by SEM nor in *M. angulosa* (see Custódio *et al*., 2002, Lerner *et al.,* 2005). *M. parishi* also has long raphides (from 30 to 160 µm), which are not present in *M. ramulosa* sp. nov.

There are five species of *Mycale* known with micracanthoxeas: *M.* (*Carmia*) *micracanthoxea* (Buizer and

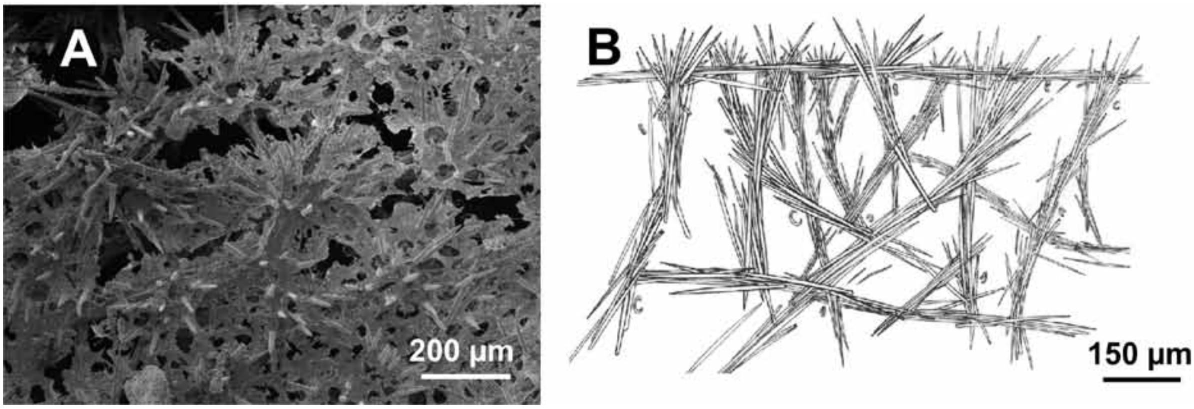

Fig. 12. Skeletal arrangement of *Mycale* (*Zygomycale*) *ramulosa* sp. nov. A, SEM tangential view of ectosomal structure; B, Scheme of transversal view of choanosomal structure.

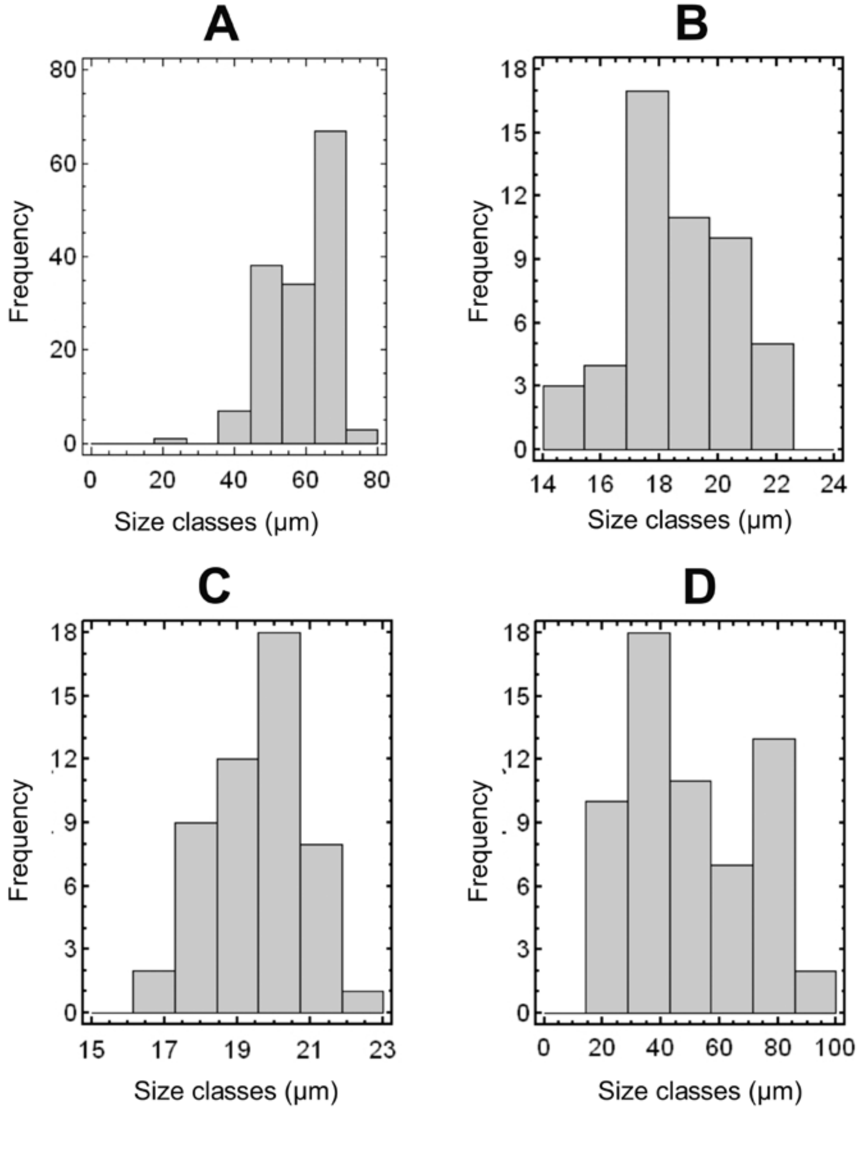

Fig. 13. Spicule dimension-frequency distribution of some *Mycale*-species: A, *M.* (*Aegogropila*) *adhaerens* sigmas of the specimens LEB-ICML-UNAM-221 (n = 100); B,C, *M.* (*Carmia*) *cecilia* anisochelae of the specimens LEB-ICML-UNAM-1 and LEB-ICML-UNAM-23 (n = 100); D, *M.* (*Zygomycale*) *ramulosa* sp. nov.' toxas of the specimens LEB-ICML-UNAM-113 (n = 100).

Van Soest, 1977) originally reported from the north-eastern Atlantic Ocean, and later from the Strait of Gibraltar (Carballo and García-Gómez, 1994), *M.* (*Aegogropila*) *bamfieldense* from the Pacific Ocean (Reiswig and Kaiser, 1989), *M.* (*A.*) *escarlatei* from the tropical Western Atlantic (Hajdu *et al.*, 1995), *Mycale* (*A.*) *lilianae* also from the tropical Western Atlantic, and *Mycale* (*C.*) *urizae* from the African coast (Carballo and Hajdu, 2001). *M. ramulosa* sp. nov. is the second *Mycale*-species bearing micracanthoxea from the Pacific Ocean. Species with a similar ectosomal skeletal arrangement are *M.* (*A.*) *bamfieldense*, *M.* (*A.*) *escarlatei* and *M.* (*A.*) *lilianae*, but these species are predominantly crustose, and don't posses the typical palmate isochelae of *M.* (*Z.*) *ramulosa* sp. nov.