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Cliona microstrongylata, a new species of boring sponge from the Sea of Cortés (Pacific Ocean, México)

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Abstract: A new species of excavating sponge of the family Clionaidae, *Cliona microstrongylata* sp. nov. was found in detritic bottoms from the Sea of Cortes at 26 m depth. The type grows in alpha stage boring a dead bivalve shell. It presents very small orange-red papillae (from 150 to 850 µm in diameter), which are regularly distributed on the surface of the shell. They are level with the surface of the substratum and don't fuse. The boring activity of the species produces a network of reticulate spherical-ovoid or quadrangulate chambers with the longer axis from 1.6 to 2.6 mm in length. Tylostyles are thin or ensiform (shaft thicker in central part). Reduced tylostrongyles occasionally appear. However, the most notable characteristic of the new species is the presence of unusual oval and curved bean-like microstrongyles, which are unique in the genus *Cliona* so far. Eggs from 70 to 90 µm in diameter were present in different parts of the choanosome. After the present study, the number of boring species along the Mexican Pacific coast has increased to 15 species.

Résumé : Cliona microstrongylata, *une nouvelle espèce d'éponge perforante de la Mer de Cortes (Océan pacifique, Mexique).* Une nouvelle espèce d'éponge perforante de la famille Clionaidae, *Cliona microstrongylata* sp. nov., a été trouvée sur des substrats détritiques de la Mer de Cortes à 26 m de profondeur. L'espèce se développe au stade alpha en perforant une coquille vide de bivalve . Cette espèce présente des papilles rouge-orange très petites (de 150 à 850 µm de diamètre) distribuées régulièrement sur la surface de la coquille. Elles sont situées au niveau de la surface du substrat et ne fusionnent pas. L'activité perforante de cette espèce produit un réseau de chambres sphériques-ovales ou quadrangulaires dont l'axe le plus long est de 1,6 à 2,6 mm. Les tylostyles sont mince ou ensiformes. Des tylostrongyles réduits apparaissent de temps en temps. La caractéristique la plus importante de cette espèce est la présence de microstrongyles ovales et recourbés en forme de haricot qui sont uniques dans le genre *Cliona.* Des oeufs de 70 au 90 µm de diamètre sont présents dans différentes parties du choanosome. Cette nouvelle espèce porte à 15 le nombre d'éponges perforantes pour l'Océan Pacifique mexicain.

Keywords: Boring sponges, Clionaidae, Taxonomy, Reproduction, SEM, Northeast Pacific Ocean, Mexico.

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Introduction

The Pacific Mexican coast has been widely studied for sponge diversity for several years. Preliminary results showed a high number of undescribed species (Gómez & Bakus, 1992; Gómez, 1998; Carballo et al., 2003). So far, the boring sponges are among the better known groups, which encompass 14 species belonging to four genera (Carballo et al., 2004).

Bioeroding sponges are known because they bore intensively in carbonate substrata, especially in corals, red algae and mollusks shells (Rützler, 1974; Schönberg, 2000). They are very important because they can accelerate the erosion of the coral reef framework (Tunnicliffe, 1979),

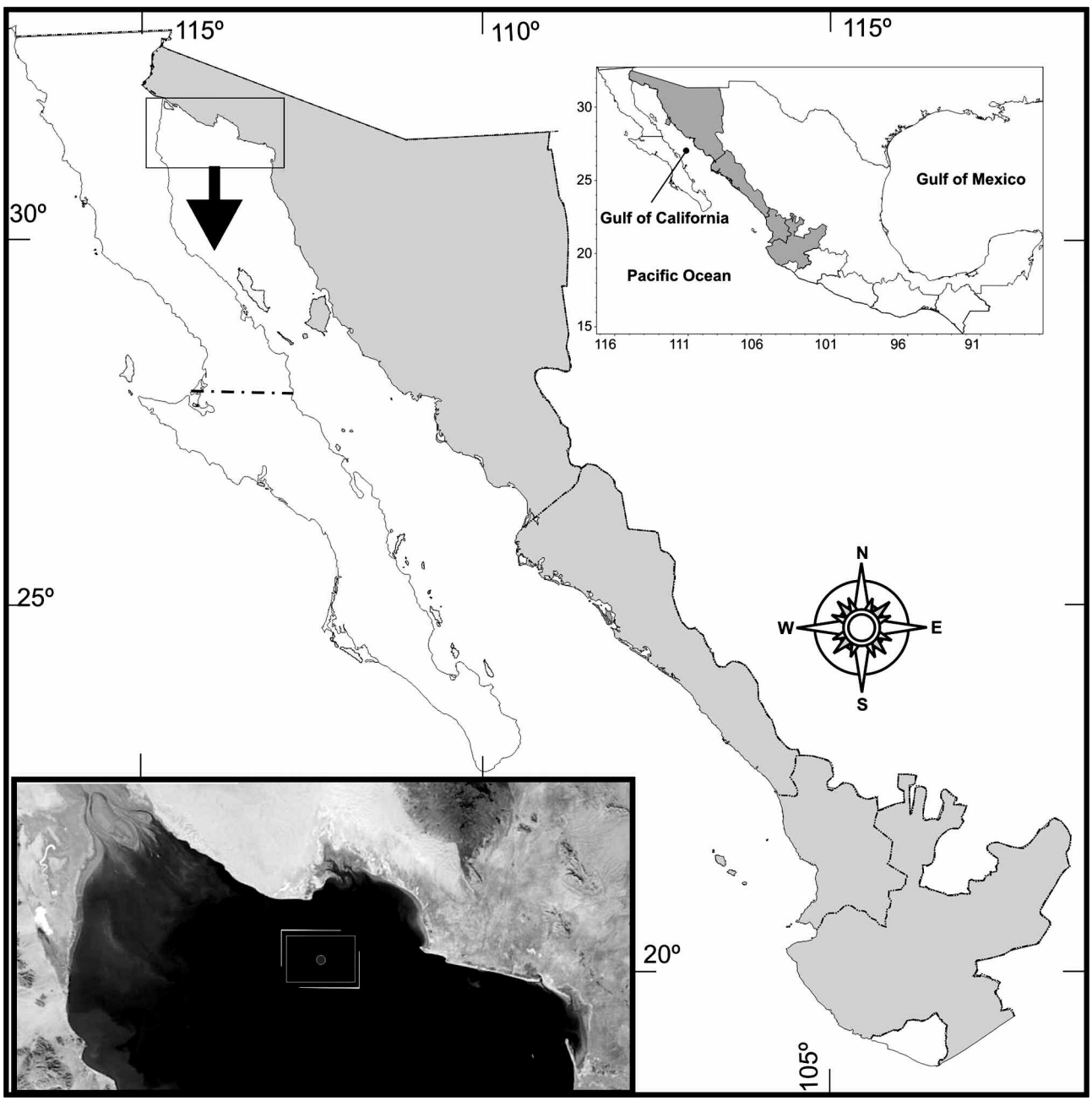

Figure 1. *Cliona microstrongylata* sp. nov. Location of the collection site in Bahía Adair (Sea of Cortes, Mexico).
Figure 1. *Cliona microstrongylata* sp. nov. Localisation du site de prélèvement à Bahia Adair (Mer de Cortes, Mexique).

contribute to the production of sediment in some bottoms (Futterer, 1974) and, when they burrow into the living shells of commercial shellfish stocks, become a pest (Thomas, 1981). However, despite their ecological importance, bioeroding sponges tend to be overlooked during surveys because of their cryptic habit and their inconspicuous papillae (Carballo et al., 2004). This is especially true for small bioeroding sponges that only occur in alpha-form, i.e., only papillae are exposed to the external environment.

In a recent survey, a cryptic specimen of an undescribed species of *Cliona* growing in alpha stage with unusual microscleres was found in biodetritic bottoms of the northern Sea of Cortes. The genus *Cliona* is here redescribed on the basis of the presence of this unusual microscleres in the new species. A description of the new species along with its boring pattern is also provided.

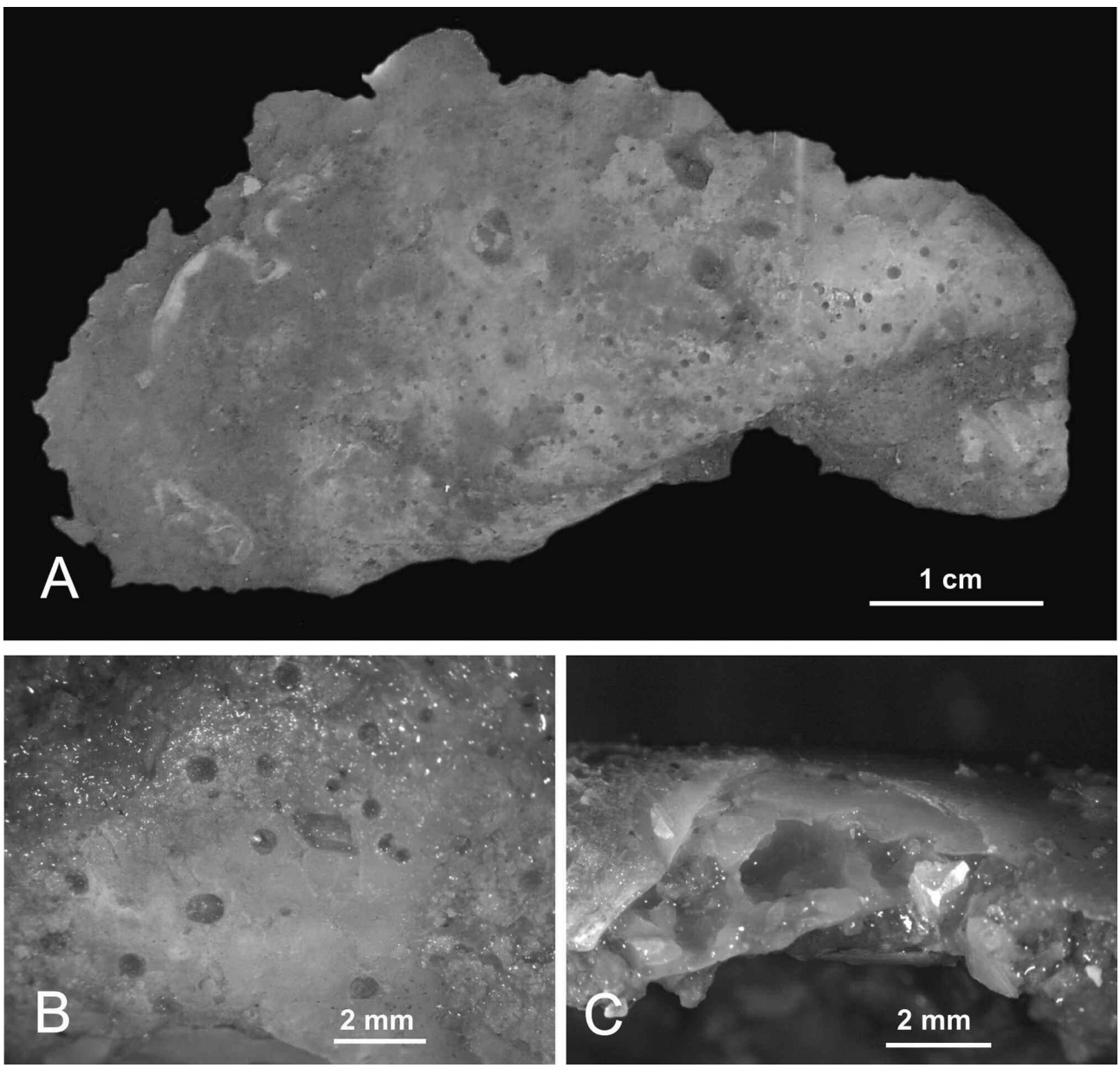

Figure 2. *Cliona microstrongylata* sp. nov. External morphology. **A.** Photograph of the holotype excavating a fragment of bivalve shell. **B.** Detail of the papillae. **C.** A cross section of the shell showing a chamber.

Figure 2. *Cliona microstrongylata* sp. nov. Morphologie externe. **A.** Photographie de l'holotype perforant un fragment de coquille de bivalve. **B.** Détail des papilles. **C.** Section transversale de la coquille montrant une chambre.

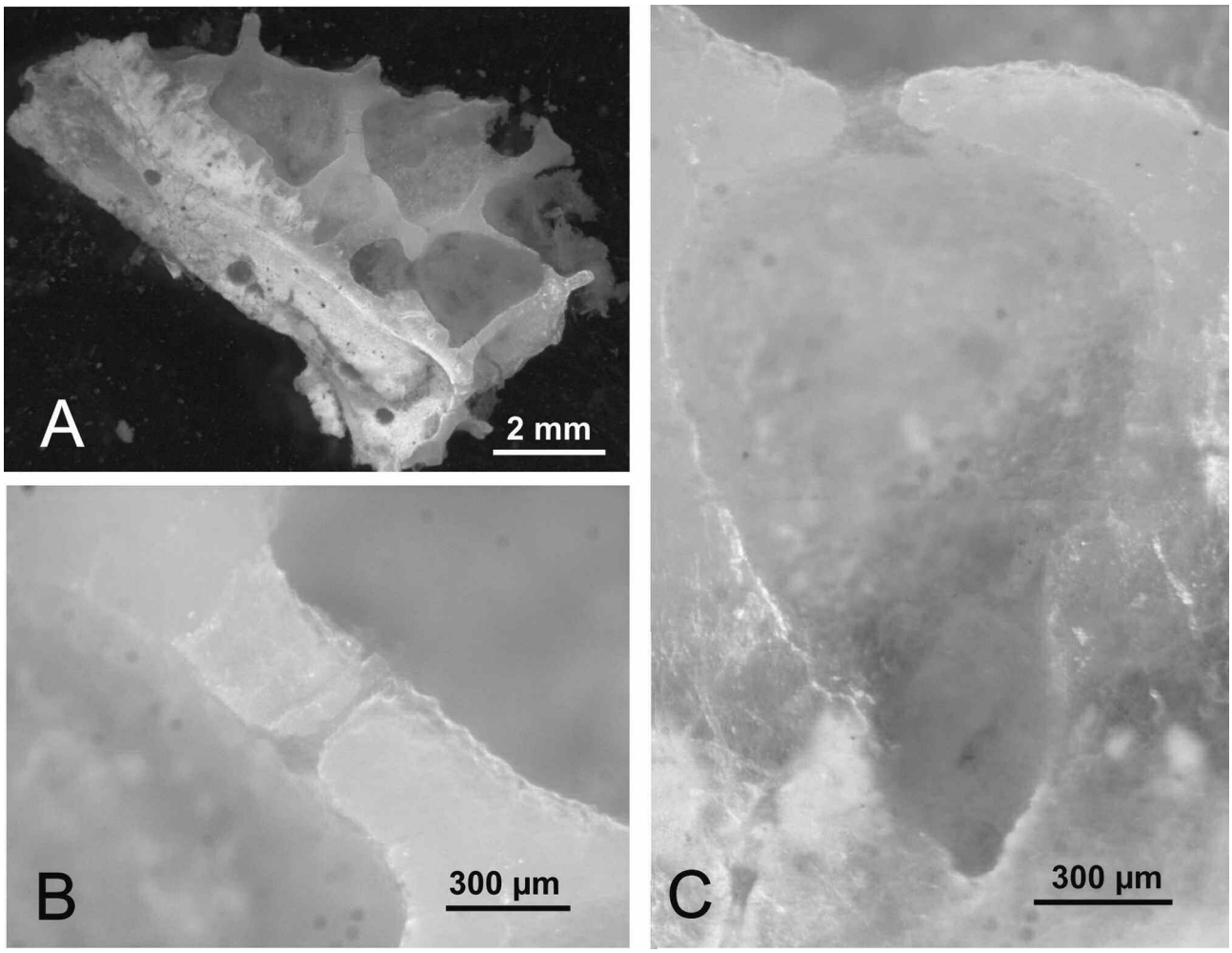

Figure 3. *Cliona microstrongylata* sp. nov. Excavating patterns. **A.** View of a network of reticulate chambers. **B.** Detail of a duct. **C.** Detail morphology of a chamber.

Figure 3. *Cliona microstrongylata* sp. nov. Patrons de perforations. **A.** Vue du réseau de chambres réticulées. **B.** Détail d'un conduit. **C.** Détail de la morphologie d'une chambre.

Material and methods

The specimen was collected by scuba diving in Bahía Adair, at the Upper Gulf of California, Pacific coast of Mexico (Fig. 1). The specimen was fixed in formaldehyde 4% and transferred to alcohol 70% after 24 h. Spicule preparation followed the techniques described by Rützler (1974) for light and for electron microscopy (SEM). Microscleres were photographed by scanning electron microscopy, for which clean spicules were dried on a cover glass and coated with gold. Twenty to 50 spicules chosen at random were measured in the specimen in order to find different size classes. Mean size of spicules is given as minimum-(mean)-maximum. The specimen examined was deposited in the Instituto de Ciencias Naturales in Madrid, Spain (MNCN). One fragment (schizotypes) was deposited in the "Colección de Esponjas" (LEB-ICML-UNAM), of the Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, in Mazatlán (México), and in the Natural History Museum (BMNH) (London).

Results

Family Clionaidae d'Orbigny, 1851.
Genus *Cliona* Grant, 1826

Synonymy

See Rützler, 2002

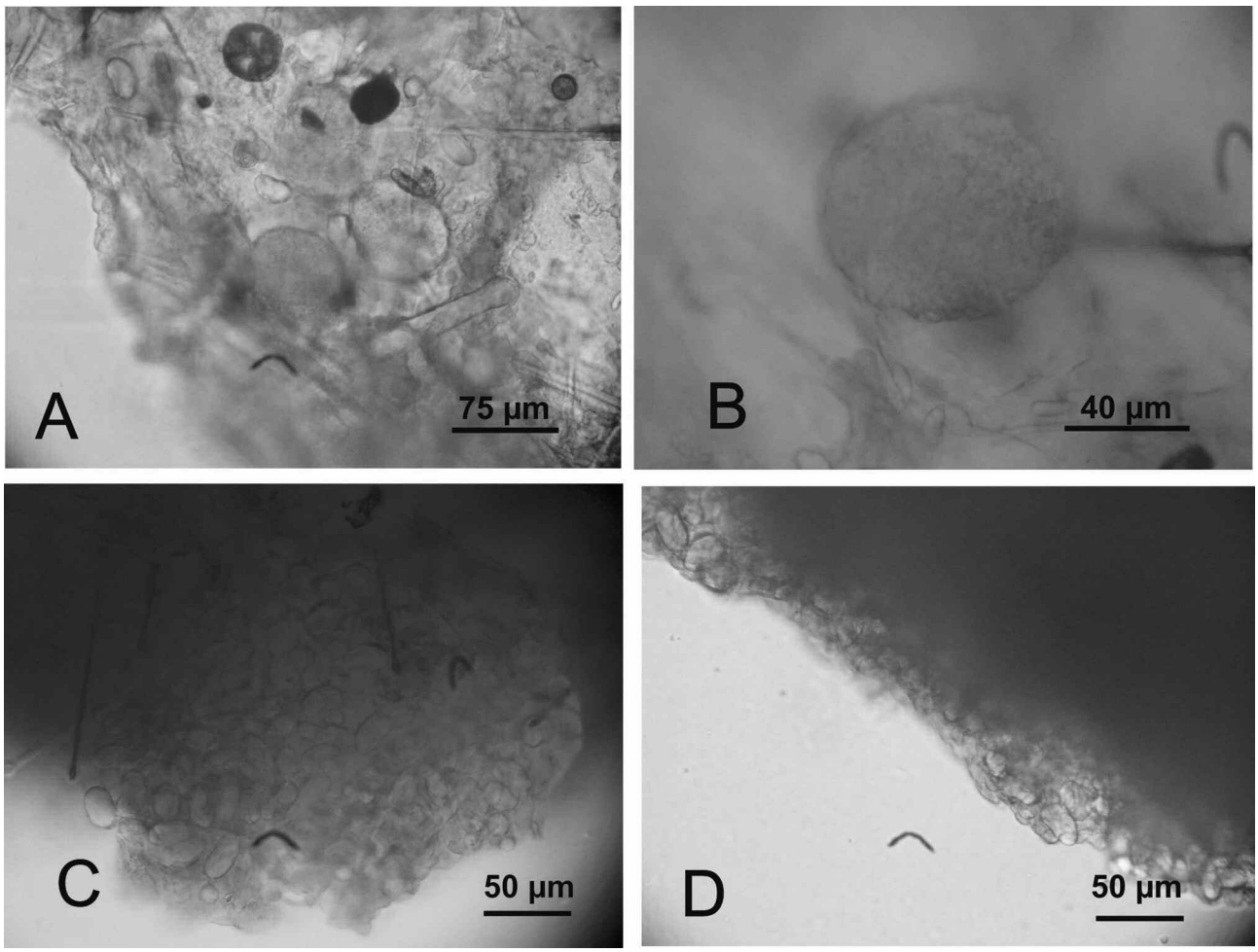

Figure 4. *Cliona microstrongylata* sp. nov. Optical microscopy. **A & B.** Eggs in the choanosome. **C & D.** Skeletal structure of the mesohyl in the papillae.

Figure 4. *Cliona microstrongylata* sp. nov. Microscopie optique. **A & B.** Oeufs dans le choanosome. **C & D.** Structure squelettique du mésohyle des papilles.

Type species

Cliona celata Grant, 1826

Diagnosis

Sponges primarily in alpha growth form (excavating chambers, communicating through papillae), some species developing beta stage by merging of papillae, very few regularly outgrowing their substratum and occurring in gamma stage. Some gamma stage species attain a large, irregular massive or cup shape but do not develop specialized incurrent or excurrent features other than, the original pori- and oscula-bearing papillae in some forms. Megascleresas are tylostyles. Microscleres can be straight, bent, kinked, spiraled, or undulated spiny rhabds spirasters, including amphiastrose forms, raphides, smooth spirasters and bean-like microstrongyles (slightly amended from Rützler, 2002).

Cliona microstrongylata sp. nov.
(Figs 2 to 6)

Material examined

Holotype: MNCN 1.01/357 Bahía Adair (Sonora, México), 31°18'05"N, 113°59'11"W, 25 m depth, 03/03/05, boring a shell of bivalve of genus *Pecten*. Schizotypes: LEB-ICML-UNAM-1134. BMNH: 2005.4.21.3.

Description of the holotype

Sponge in alpha stage of growth, excavating a fragment of bivalve shell 5.5 cm in length, 2.5 cm wide and 4 mm thick

(Fig. 2A). It has very small papillae, which are very difficult to see in *situ*. The papillae are circular or oval, from 150 to 850 µm in diameter, and they are level with the surface of the substratum (Fig. 2B). They are 0.5 to 3 mm apart from each other and regularly scattered on the surface of the shell. Fusion of papillae was not observed. No distinction between inhalant and exhalant papillae could be made because of the difficulty to recognize each type after fixation. The papillae have firm consistency, but the choanosome is soft and easily crumbled. Some eggs of 70-(78)-90 µm in diameter were observed in the choanosome of the specimen (Fig. 4 A-B). The colour of papillae and choanosome were red alive and light red in alcohol. The shell contained another sponge of the genus *Haliclona* growing on its surface.

Excavation

A network pattern of reticulate chambers (Fig. 3A). The chambers are spherical-ovoid or quadrangulate in shape (Fig. 3A-C) with the longer axis measuring 1.6-(2)-2.6 mm, generally parallel to the substratum surface (Fig. 2C). The chambers are separated from each other by substrate walls (132 to 332 µm in long) and connected by some ducts 320 to 500 µm in diameter (Fig. 3).

Skeletal characters

Tylostyles are thin or ensiform and mostly straight, sometimes slightly curved (Fig. 5, 6 D-E), with a well differentiated globular head, mucronate or ovoid, sometimes with an apical knob (Fig. 6B). Tylostyles mean measurements are (length x width shaft; head width): 192.5-(234)-292.5 x 3.8-(8.3)-14; 5-(11)-15 µm. Reduced tylostrongyles occasionally appear. They are straight, generally with an oval head (Fig. 6C), measuring 100-(106)-113 x 20-(21)-23; 21-(23)-24 µm. The microscleres are very characteristic bean-like microstrongyles (Fig. 6A, D-E). They are short with round ends, usually thick, and most are slightly bent at the middle. Some microscleres show an end more reduced than the other, and others appear to be finely porous on the surface. They measure 17.5-(25)-37.5 µm in length, and 3-(10.3)-20 µm in diameter. The skeletal structure of the papillae is a dense cortex formed mainly by accumulated microstrongyles and scarce tylostyles (Fig. 4 C-D). In the choanosome there are fewer microstrongyles, and the tylostyles are irregularly scattered. Occasional tracts of tylostyle bundles appear, generally with the tylostyle head anchored in tissue and pointed end piercing the surface.

Etymology

The proposed name "*microstrongylata"* alludes to the form of the microscleres.

Distribution

Sea of Cortes (Upper Gulf of California, Mexican Pacific Ocean. Present study (Fig. 1).

Discussion

Only four clionaids: *C. desimoni* Bavestrello et al., 1995, *C. ensifera* Sollas, 1878, *C. argus* var. *laevicollis* Thiele, 1898, and *Cliona raromicrosclera* (Dickinson, 1945) have reduced tylostrongyles comparable to those of *Cliona microstrongylata* sp. nov. *Cliona desimoni* Bavestrello et al., 1995 is characterized by short tylostyles (45-145 x 7-19 µm) often reduced to spherulose spicules. *C. ensifera* has several malformations on the tylostyles different from the reductions of our species. In *C. argus* var. *laevicollis* tylostyles are larger, measuring 400-500 x 18 µm, tylostrongyles measure 240 x 5 µm. *Cliona raromicrosclera* (Dickinson, 1945) has straight or slightly curved tylostyles (341 x 9 µm on average), with a generally round, oval or malformed head with annular swellings. Reduced tylostrongyles in this species are straight, thick and with a round head, sometimes with incipient heads in the distal extreme; but the most characteristic feature of this species

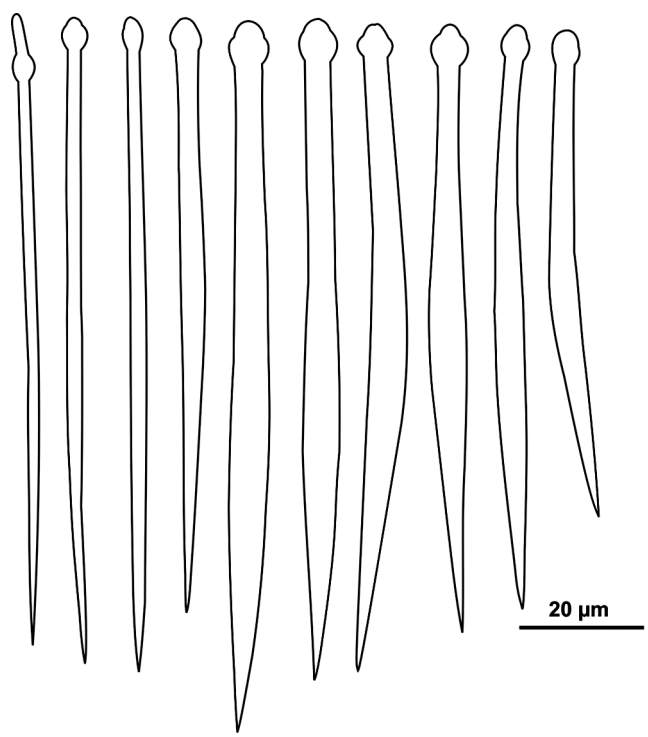

Figure 5. *Cliona microstrongylata* sp. nov. Drawings of the tylostyles morphology.

Figure 5. *Cliona microstrongylata* sp. nov. Schémas de la morphologie des tylostyles.

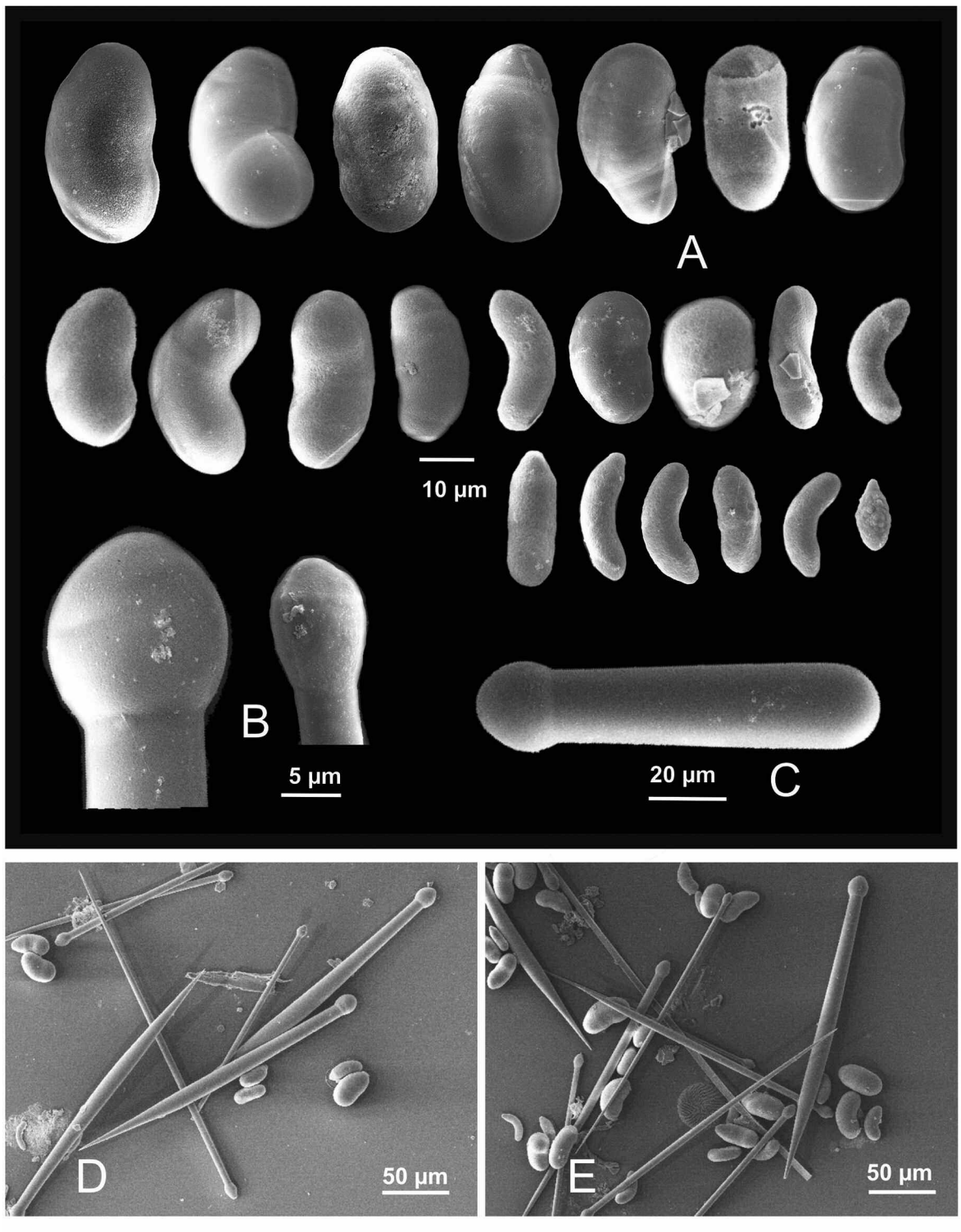

Figure 6. *Cliona microstrongylata* sp. nov. SEM images of the skeletal material. **A.** Morphology of the microstrongyles. **B.** Heads of the tylostyles. **C.** Tylostrongyle. **D & E.** Tylostyles and microstrongyles.

Figure 6. *Cliona microstrongylata* sp. nov. Photographies par MEB du materiel squelettique. **A.** Morphologie des microstrongyles. **B.** Têtes des tylostyles. **C.** Tylostrongyle. **D & E.** Tylostyles et microstrongyles.

is that it grows on littoral rocks like an encrusting to massive sponge (0.5 to 4 cm thick), covering areas up to several m². These characteristics clearly support the separation of these four species from *C. microstongylata*. However, the most important differences are in the form of the microscleres. *C. desimoni* is characterized by short and spiny straight microrhabds (13-25 µm) (Bavestrello et al., 1995), *C. ensifera* and *C. argus* var. *laevicollis* have true spirasters (Thiele, 1898), the spirasters of *Cliona raromicrosclera* are mostly like anthosigmas (Dickinson, 1945), and *C. microstrongylata* has curved or ovoid bean-like microstrongyles, unique to the genus *Cliona*.

The new species is very interesting because of the presence of unusual nodular microscleres. Of the four species with reduced tylostyles (see above), one of them, *Cliona desimoni* Bavestrello et al., 1995 has very short tylostrongyles (like *Cliona microestrongilata*), but in addition it presents spherulose spicules which were considered by the authors as drastically reduced tylostyles. However, we think that the microscleres found in the new species are not reduced tylostyles because: 1) Reduced tylostrongyles appear only occasionally but the microscleres are very abundant throughout the whole sponge, even in the eggs; 2) Microscleres are concentrated in the papillae where they form a dense cortex in the same way that the microscleres of others *Cliona* species do; 3) They have a very peculiar form, with round uneven ends, slightly bent at the middle, which are very different characteristics from those presented in the true reduced tylostyles of this species, or that of *C. desimoni*, in which a rounded end an incipient head in the opposite extreme is always distinguishable.

Three other alpha stage clionids of distinctive orange-red color are known from the Mexican Pacific coast (Carballo et al., 2004): *C. vermifera* Hancock, 1867*, Pione mazatlanensis* (Hancock, 1867), and *P. carpenteri* (Hancock, 1867). Characteristics such as size and distribution of the papillae (regularly or irregularly distributed), and fusion of the papillae, may help an underwater identification of these species (Carballo et al., 2004). However, the three species have very small circular or oval un-fused papillae, which are regularly distributed and usually don't protrude (*C. vermifera* from 0.3 to 1.5 mm in diameter; *P. mazatlanensis* from 0.1 to 1.4 mm in diameter; *P. carpenteri* from 0.1 to 0.8 µm in diameter), and these made the underwater distinction with the new species very difficult.

Species of the genus *Cliona* are known to be oviparous (Lévi, 1973), but sexual reproduction and the formation of eggs has been observed in very few species (Waburton, 1958). Thus, this paper also contributes to the knowledge of the reproduction biology of this group of sponges.

After the present study, the number of clionaid species along the northeast Pacific coast has increased to 19 species, which constitute a high number if we compare it with other profusely studied areas like the Caribbean (Rützler, 1974; Pang, 1973), the Mediterranean (Rossel & Uriz, 2002), or the east Atlantic coast mainly the works of Topsent (1883).

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