

The excavating sponges of the Santa Marta area, Colombia, with description of a new species

Caroline C. Hofman¹ & Margriet Kielman²

¹ Institute of Taxonomic Zoology (Zoölogisch Museum), University of Amsterdam, P.O. Box 4766, 1009 AT Amsterdam, The Netherlands; ² Instituto de Investigaciones Marinas de Punta de Betín (INVEMAR), A. A. 1016, Santa Marta (Magdalena), Colombia

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Abstract

From June till December 1987 an inventory of the excavating sponges of the Santa Marta area, Colombian Caribbean, was made by scuba diving to depths not exceeding 18 m. Sixteen species were recorded and compared morphologically, using spicule sizes, papillae shapes, and excavation characteristics. Four little-known species are fully described and illustrated by submarine color photographs *in situ*. One appears to be a new species: *Axinyssa flavolivescens*, belonging to a genus not known to excavate so far. The other three species could not be identified with certainty: *Aka* aff. *xamaycaensis*, *Aka* aff. *brevitubulata*, and *Cliona* aff. *flavifodina*. A key to the excavating sponges of the area studied is provided.

Resumen

Se presenta un inventario de las esponjas excavadoras en la región de Santa Marta, Caribe Colombiano, realizado durante el período Junio-Diciembre 1987, utilizando "scuba" equipo de buceo a profundidades no mayores de 18 m. Dieciséis especies encontradas fueron comparadas morfológicamente, utilizando el tamaño de las espículas, la forma de las papilas y las características de la excavación. Cuatro especies poco conocidas son descritas y se presentan ilustraciones submarinas *in situ*. Una de ellas, *Axinyssa flavolivescens*, constituye una nueva especie, y representa el primer reporte para el género de un hábito excavador. Las otras tres especies no pudieron ser identificadas con certeza total: *Aka* aff. *xamaycaensis*, *Aka* aff. *brevitubulata* y *Cliona* aff. *flavifodina*. Se presenta una clave de las esponjas excavadoras de la región.

Introduction

The warm waters of the West Indian coral reefs, with their abundance of calcium carbonate substrata, in the form of dead bases of living corals, dead corals, calcareous algae, sclerosponges, and carbonate rock, are an extremely favorable environment for excavating sponges. In the last decades, several investigations on sponges excavating in scleractinian corals have been made in the Caribbean (Goreau & Hartman, 1963; Neumann, 1965, 1966; Pang, 1973; Rützler, 1971, 1974, 1975). No special study of excavating sponges from the Santa Marta area has been carried out so far, although some species were mentioned in systematic surveys of the sponges of the area (Wintermann-Kilian & Kilian, 1983, 1984; Zea, 1983, 1987).

The shallow-water marine benthic communities of the Santa Marta area, Colombian Caribbean, consist of what are possibly unique coral reefs in which sponges, algae, and octocorals are relatively abundant. The corals are relatively poorly developed (although individual coral heads may reach considerable size); they are often based on metamorphic rocks rather than on limestone. The causes of this stunted coral reef growth are presumed to be at least two-fold. On the one hand, there is considerable discharge of terrigenous sediments by the Río Magdalena, not too far away (ca. 200 km), by the waters of the Ciénaga Grande de Santa Marta, and by little local rivers. This accounts for an increasing sediment load and decreasing light pene-

tration. On the other hand, there is seasonal upwelling along the steep slopes of the coastal Sierra Nevada de Santa Marta, which accounts for a temperature drop (29°C decreases to 23°C in two days, and 20.5°C in extreme conditions on a few days each year) and a salinity rise (29 ‰ increases to 37 ‰ in two days) (Blanco, 1988; Müller, 1979).

Perhaps related to the poor development of the corals there is a striking presence of a rich and diverse sponge fauna. Activity of excavating sponges is affected by environmental and biological interactions and fluctuates greatly; boring activity might be affected by strong water movements, sediment load, favorable light conditions, and low water temperatures (Rützler, 1975). A correlative quantitative study on the excavating sponges of the Santa Marta area is in preparation (Kielman & Hofman, unpublished). The distribution of the sixteen sponge species, described herein, has been surveyed in relation to coral species, locations, and some abiotic factors. In general, shallow substrates are more strongly excavated than deeper locations. Species of the genus *Cliona* prefer shallow waters, while species of the genus *Aka* prefer deeper waters.

Three species attained a high percentage of coverage: *Aka* aff. *brevitubulata* Pang, 1973, *Spheciospongia vesparia* Lamarck, 1814, and *Cliona caribbaea* Carter, 1882. Granate Bay is the most affected by the excavating sponges, especially in the shallowest locations, where species of the genus *Cliona* were abundant. The waters of the island El Morro showed the second highest percentage of cover, where species of the genus *Aka* had their highest percentage cover of all locations. In Nenguange Bay the lowest percentages of coverage were found for almost all species.

The aim of the present paper is to describe and compare the excavating sponges of the Santa Marta area, Colombia. One species is new to science. A reference collection of all sponges and slides has been deposited at the Zoological Museum, University of Amsterdam (ZMA). One paratype each of *Axinyssa flavolivescens* n. sp. is deposited at the United States National Museum, Smithsonian Institution, Washington (USNM) and the Instituto de Investigaciones Marinas de Punta de Betín, Santa Marta (INVEMAR).

Material and methods

The area studied is adjacent to the city of Santa Marta (11°12'N 74°15'W), on the Atlantic coast of Colombia in the southern Caribbean. The fieldwork extended over the period June–December 1987. Samples of excavating sponges were collected southwest of the island El Morro (about 1.5 km southwest of Punta de Betín), along the northeast coast of Granate Bay (about 6 km northeast of the city of Santa Marta), and southeast of Nenguange Bay in shallow waters (about 20 km northeast of Santa Marta). A detailed description of the locations will be published in a forthcoming paper (Kielman & Hofman, in prep.).

The sponges here recorded were collected from coral heads and patches. To characterize the excavations, the top layer of the dead coral areas was removed with hammer and chisel in order to see the extent of the excavations inside the coral. For the identification of the sponge species, both slides of spicules and cross sections of the tissues were used. Spicule slides were made by boiling pieces of tissue in 5% HNO₃. The residue was washed three times in 70% alcohol. Between each washing the residue was centrifuged at 1200 rpm and the alcohol removed with a Pasteur pipette. Finally, the concentrated spicules were placed on a microscopical slide, dried, and mounted in Canada balsam. Sections to study spicule arrangement were made by hand, dried, and mounted in Canada balsam.

Systematic descriptions

Sixteen excavating sponge species were found to occur in the Santa Marta area, including:

- ✓ *Aka siphona* (De Laubenfels, 1949);
- ✓ *Aka* aff. *xamaycaensis* (Pulitzer-Finali, 1986);
- ✓ *Aka coralliphaga* forma *typica* (Rützler, 1971);
- ✓ *Aka* aff. *brevitubulata* (Pang, 1973);
- ✓ *Axinyssa flavolivescens* n. sp.;
- ✓ *Spheciospongia vesparia* (Lamarck, 1814);
- ✓ *Anthosigmella varians* (Duchassing & Michelotti, 1864);
- ✓ *Acarnus souriei* Lévi, 1952;
- ✓ *Cliona caribbaea* Carter, 1882;
- ✓ *Cliona flavifodina* Rützler, 1974;
- ✓ *Cliona* aff. *flavifodina* Rützler, 1974;
- ✓ *Cliona amplicavata* Rützler, 1974;
- ✓ *Cliona vermifera* Hancock, 1867;
- ✓ *Cliona dioryssa* (De Laubenfels, 1950);
- ✓ *Cliona laticavicola* Pang, 1973;
- ✓ *Cliona lampa* De Laubenfels, 1950.

Wintermann-Kilian & Kilian (1984) reported *Cliona dioryssa* and *Cliona vastifica* Hancock,

1849, from Nenguange Bay; it is here assumed that the latter is identical to our *Cliona lampa*. Zea (1987) reported also *Siphonodictyon* (= *Aka*) *coralliphagum* Rützler, 1971, and *Siphonodictyon brevitubulatum* Pang, 1973, from the Santa Marta area.

All 16 species are keyed and their spicules are illustrated (Figs. 1–16). All but four are well known from previous studies; these are not formally described here but spicule sizes and excavation characteristics are provided in Table I. One species is new to science and the remaining three species show one or more discrepancies from described species. These four species will be extensively described.

Order Haplosclerida

Family Oceanapiidae

Genus *Aka* De Laubenfels, 1936

(pro: *Acca* Johnson, 1899, preoccupied)

Syn. *Siphonodictyon* Bergquist, 1965

Diagnosis *Aka* sensu Rützler, 1971

Aka aff. *xamaycaensis* (Pulitzer-Finali, 1986)
(Fig. 2, Plate IIA)

Ref.: *Siphonodictyon xamaycaense* Pulitzer-Finali, 1986: 164.

Description. – Long, slender, slightly curved tubes with thin walls. At the inner surface of the tubes the skeleton consists of a fine network of spicule tracts, forming very small meshes. Inhalant and exhalant tubes are of equal lengths, ranging from 1 to 7 cm. Maximum diameter of the tubes is 0.5 cm; the diameter of the oscular opening varies from 1 to 4 mm. Tubes never fuse. The structure of the inhalant tubes is different from that of the exhalant tubes. The walls of the inhalant tubes have tracts of spicules (3 to 4 spicules wide) that diverge and fuse at regular intervals, thus forming meshes. The size of a mesh is $100\text{--}140 \times 110\text{--}170 \mu\text{m}$. The exhalant tubes have two distinct layers. The outer layer consists of a closed network of spicules, running parallel to each other and circling the tube perimeter. The inner layer, closest to the tube lu-

men, is formed by long spicule tracts running along the length of the tube. Sometimes thinner tracts split off and fuse with a thicker, neighbouring tract. The thicker tracts contain 5 to 8 spicules, the thinner ones 2 to 4 spicules.

Endolithic parts: The tissue is firm and slippery, but not slimy. The globular excavations often have offshoots in the surrounding coral; their diameter ranges from 1 to 5 cm. This species never excavates deeper than the upper 10 cm of the coral.

Colour: The tubes are white, the endolithic parts are cream coloured. The colour stays unchanged in alcohol.

Spicules: Oxeas and strongyles, slightly curved, sometimes straight. The apices of the oxeas are very blunt and vaguely stepped. Oxeas $120\text{--}150 \times 6\text{--}8 \mu\text{m}$. Strongyles $70\text{--}80 \times 6\text{--}8 \mu\text{m}$.

Habitat: This species seems to have a preference for darker habitats like cracks or small cavities in the coral. It was recorded on dead parts of the following corals: *Colpophyllia natans* (Houttuyn, 1773), *Diploria clivosa* (Ellis & Solander, 1786), *Diploria strigosa* (Dana, 1846), *Montastrea annularis* (Ellis & Solander, 1786), *Montastrea cavernosa* (Linnaeus, 1766), *Siderastrea siderea* (Ellis & Solander, 1786), and *Stephanocoenia michelinii* Milne Edwards & Haime, 1848.

Depth: at El Morro 8–15 m, at Granate 6–15 m, at Nenguange 4–8 m.

Discussion. – Van Soest (1980: 80, 114) erected the family Oceanapiidae, which is synonymous with Phloeodictyidae (Carter, 1882). The family name Phloeodictyidae was dropped from use in taxonomy by Topsent (1928: 66; as Phloeodictyinae, in the sense of Ridley & Dendy, 1887). Van Soest & Sten-toft (1988: 135) placed *Aka* in the family Oceanapiidae.

The present specimens differ from the description of the type specimen (Pulitzer-Finali, 1986) from Jamaica in the following characters: the tubes of the present specimens from Santa Marta are 1–7 cm high and up to 5 mm in diameter; the tubes of the specimens collected by Pulitzer-Finali are 8–11 cm high and 10–15 mm in diameter; the spicules of the species collected by Pulitzer-Finali consist of only oxeas that are “open” and the axial canal is

apparent; their extremities are short, regularly formed and they measure $110\text{--}125 \times 4.5\text{--}6 \mu\text{m}$.

Aka aff. *brevitubulata* (Pang, 1973)
(Fig. 4, Plate IIB)

Refs.: *Siphonodictyon brevitubulatum* Pang, 1973: 56; Pulitzer-Finali, 1986: 165; Zea, 1987: 97.

Description. – The short, fragile tubuli are 0.5 to 2 cm in length. The oscular opening measures 2 to 4 mm. The tubes never fuse.

Endolithic parts: The consistency is firm and slippery. The excavations are spherical with a diameter of 1 to 3 cm. The cavities are connected with the surface by tunnels. The species never excavates deeper than the upper 4 cm of the coral.

Colour: The tubuli have a white, cream, or dull yellow colour. The endolithic part has a cream or dull yellow colour. Yellow tubed specimens do not always have a yellow choanosome, just as cream tubed specimens do not always possess a cream coloured choanosome. The colour changes to white after the sponge has been preserved in alcohol.

Spicules: Oxeas and styles. The apices of the oxeas and styles usually are stepped; some oxeas have a smooth and sharp apex. Most oxeas are rather abruptly pointed, some are hastate. Oxeas $120\text{--}140 \times 4\text{--}8 \mu\text{m}$. Styles $120\text{--}140 \times 4\text{--}8 \mu\text{m}$.

Habitat: On dead parts of the following corals: *Agaricia agaricites* (Linnaeus, 1758), *Colpophyllia natans*, *Diploria clivosa*, *Diploria strigosa*, *Manicina areolata* (Linnaeus, 1758), *Montastrea annularis*, *Montastrea cavernosa*, *Siderastrea siderea*, *Stephanocoenia michelinii*, and *Porites astreoides* Lamarck, 1816.

Depth: at El Morro 6–17 m, at Granate 6–17 m, at Nenguange 4–8 m.

Discussion. – Rützler (1971) described two species of the genus *Siphonodictyon* (= *Aka*), *Aka cachacrouensis* and *Aka coralliphaga*, from the West Indies and distinguished four forms of *Aka coralliphaga*: forma *typica*, forma *obruta*, forma *tubulosa*, and forma *incrustans*. Pang (1973) described *Siphonodictyon* (= *Aka*) *brevitubulata*

from Jamaica. *Aka* aff. *brevitubulata* as described here, is considered an intermediate form between *Aka brevitubulata* and *Aka coralliphaga* because of the high resemblance of the habit and short tubuli (length 0.5–2 cm) to *Aka brevitubulata*; *Aka brevitubulata* and *Aka coralliphaga* forma *tubulosa* (Rützler, 1971) are obviously similar as is apparent from the following comparison between these two species.

Exposed parts: *Aka brevitubulata* does not overgrow the substratum, oscular and ostial papillae are separate and few in number. The oscules are cylindrical and rather prominent (7–9 mm in height). The perforations through which the ostial papillae protrude are elliptical. In some specimens ostial papillae are discrete and widely separated, while in others several papillae are confluent. These hill-like papillae, comparable in height to the oscules, are composed solely of a network of numerous small ostia. Diameter of oscular perforations: 1.98–3.72 mm, diameter of ostial papillae: 0.98–2.04 mm (short axis), 1.82–2.79 mm (long axis), $N = 4$ specimens.

Aka coralliphaga forma *tubulosa* extends over areas of 70–950 cm² between live coral heads and it consists of dense clusters of ectosomal, thin-walled tubes, frequently vase- or funnel-shaped, alternating with hollow finger-shaped processes which can be fused together along their sides, forming humpy pillows. Open tubes: height 50–65 mm, diameter 15–25 mm. Single closed fistules: height 6–30 mm, diameter 8–12 mm; closed double fistules: height 25–30 mm, diameter 12–39 mm.

Pang (1973) stated that of the four forms of *Aka coralliphaga*, *Aka* forma *tubulosa* from Scotts Head Bay, Dominica, W. I., is closest to *Aka brevitubulata*. “However, *Aka coralliphaga* forma *tubulosa* forms dense clusters of ostial and oscular tubules with the oscular tubules attaining a height of more than twice that of the ostial tubules” (Pang, 1973: 58). *Aka brevitubulata* was collected from 5–32 m, *Aka coralliphaga* forma *tubulosa* from 15, 20, and 35 m. The present material of *Aka* aff. *brevitubulata* was collected at 4–17 m depth.

Endolithic parts: The activity of *Aka brevitubulata* produces a single, large spherical excava-

tion completely filled with soft mucus-covered tissue of the sponge. In massive substrates the excavation may attain a diameter of 4–5 cm, in branching substrates 1–2 cm. For *Aka coralliphaga* forma *tubulosa* it is shown that in the transition zone to the choanosome, numerous exhalant canals with spicule-reinforced walls cause a ligneous consistency. The choanosome is soft, compressible, and very mucous.

Colour: When alive, the papillae of *Aka brevitubulata* are lemon yellow; the mass of the sponge within the excavation is a pale, dull yellow. Under water the sponge appears yellow to the diver. After fixation in 10% neutralized formalin and having been transferred to 70% ethyl alcohol the papillae are pale yellow and the internal portions are drab yellow-tan. In *Aka coralliphaga* forma *tubulosa* the ectosome is light yolk yellow; one specimen was whitish yellow in life. During exposure to air the colour changes to pinkish yellow; when preserved in alcohol the colour changes to dark beige or a greyish tan. The colour of the choanosome is yellow-beige.

Spicules: The spiculation and fistular skeleton of *Aka brevitubulata* resembles that of *Aka coralliphaga* forma *tubulosa*. Rützler (1971: 9) stated about the spicules of *Aka coralliphaga* forma *tubulosa*: “Bent oxea with fine central canal. The two size categories of the choanosome are distinct. The tips are rather blunt to mammiform, usually smooth, sometimes rough to stepped. Some styles and strongyles occur”. Spicule dimensions of the holotype of *Aka coralliphaga* forma *tubulosa* (USNM, coll. no. 24101, $N = 100$) are: $156.0\text{--}180.8 \times 5.0\text{--}7.1 \mu\text{m}$ (large oxeas) and $121.6\text{--}174.4 \times 1.3\text{--}4.0 \mu\text{m}$ (small oxeas). The oxeas of *Aka coralliphaga* forma *tubulosa*, which are said to occur in two size categories, are longer and thinner than those of *Aka brevitubulata*. Pang (1973: 56) stated about the spicules of *Aka brevitubulata* that “the abundant, smooth oxeas are relatively stout. They may be curved, sharply bent at the midpoint of the axis, or almost straight. The oxeas do not taper but are rather abruptly pointed. Neither styles nor strongyles have been observed. There is not great variety in the shape of the

spicules or in the curvature or termination of the axis. Oxea length: $134 \pm 2.7 \mu\text{m}$, 119–148 μm . Oxea width: $8.0 \pm 0.2 \mu\text{m}$, 6.9–9.1 μm . $N = 4$ specimens. Fifty spicules were measured for each specimen considered. No other categories of spicules were observed to be present”.

Zea (1987) reported both *Siphonodictyon* (= *Aka*) *coralliphagum* and *Siphonodictyon* (= *Aka*) *brevitubulatum* from the Santa Marta area. He stated that the excavations of *Siphonodictyon brevitubulatum* are very similar to those of *Siphonodictyon coralliphagum* forma *obruta* and he reported *Siphonodictyon coralliphagum* from the Santa Marta area with single and grouped fistules on rock and dead corals, as found for *Siphonodictyon coralliphagum* forma *tubulosa*. He compared *Siphonodictyon brevitubulatum* with *Siphonodictyon coralliphagum* and stated that the spicules of the former are slightly smaller than the spicules of the latter.

Cross sections of *Aka* aff. *brevitubulata* were compared with those of a specimen of *Aka coralliphaga* from Curaçao (ZMA POR 4591, det. R.W.M. van Soest). It appeared that both species had the same tube structure, which is different for inhalant and exhalant tubes. The walls of the inhalant tubes consist of tracts of spicules which diverge and fuse at regular intervals, thus forming meshes. They are crossed sometimes by tracts of 2 to 4 spicules wide. The tracts that form the partitions of the meshes are 5 to 10 spicules wide. Average mesh size is 300 by 400 μm . The smallest size is 200 by 270 μm , the largest 420 by 450 μm . The walls of the exhalant tubes are built slightly differently and are formed by two distinct layers. The outer layer consists of a loose network of criss-cross arranged spicules and the inner layer, closest to the tube lumen, has a structure that resembles that of the inhalant tube walls. The only difference is that the meshes are smaller: the average size is 100 by 150 μm ; the smallest are 80 by 100 μm and the largest 175 by 200 μm .

Future studies might reveal that all differences between *Aka* aff. *brevitubulata*, *Aka brevitubulata*, and *Aka coralliphaga* forma *tubulosa* are within the variability of one single species.

Order Halichondrida

Family Halichondriidae

Genus *Axinyssa* Von Lendenfeld, 1897

Diagnosis *Axinyssa* sensu Van Soest et al., 1990

Axinyssa flavolivescens n. sp.

(Fig. 5, Plate IA–D)

Material. – Holotype: ZMA POR 6458, Colombia, Santa Marta area, El Morro, on dead parts of the coral *Montastrea cavernosa*, 18 m depth, 30 Oct. 1987.

Paratypes: ZMA POR 8330, 8331, 8333, 8334, 8341, 8342, 8343, Colombia, Santa Marta area, El Morro, on dead parts of coral, 9–16 m depth, Dec. 1989. ZMA POR 8332, Colombia, Santa Marta area, Granate, on dead parts of coral, 14 m depth, Dec. 1989. One paratype: USNM 42461, Colombia, Santa Marta area, El Morro, on dead parts of coral, 16 m depth, Dec. 1989.

One paratype: INVEMAR POR 0388, Colombia, Santa Marta area, El Morro, on dead parts of coral, 16 m depth, Dec. 1989.

Description. – Rather large protrusions emerge from the dead coral, maximum height 5 cm, maximum diameter 7 cm. The oscular openings are very conspicuous and measure between 0.5 and 1 cm in diameter. Sometimes several protrusions fuse. Thick organic ectosome with sparsely scattered spicules.

Endolithic parts: Nearest the coral surface, the galleries are lined with fleshy tissue. Deeper in the coral, the galleries are completely filled with tissue. The shape of the galleries measures up to 2 cm in diameter. Excavation depth 15–20 cm. Sometimes the galleries extend under living coral polyps.

Colour: The exposed parts and the choanosome are bright yellow. When a piece of the sponge is removed from the coral substratum, the colour changes very rapidly into purple blue. When the sponge is exposed to air or alcohol, the colour changes to dark purple blue, almost black.

Spicules: Styles, strongyles, and strongyloxeas of equal size, 200–320 (mean 290) $\mu\text{m} \times 5\text{--}10$ (mean 6.8) μm . The apices are mostly rather blunt and stepped, but some are smooth and sharp. Styles are straight or curved. Strongyles are mostly straight. The transitional skeletal arrangement of the spicules in the exposed and endolithic parts is plumose axinellid to confused halichondrid.

Habitat: On dead parts of the following corals: *Acropora cervicornis* (Lamarck, 1816), *Colpophyl-*

lia natans, *Diploria clivosa*, *Diploria strigosa*, *Montastrea annularis*, *Montastrea cavernosa*, and *Stephanocoenia michelinii*.

Depth: At El Morro 7–18 m, at Granate 14–17 m, at Nenguange 6–8 m.

Etymology. – From the Latin *flavus* = yellow and *livescere* = turn bluish black. The name *flavolivescens* refers to the ability of the sponge to change in colour from bright yellow to purple blue, almost black.

Discussion. – The colour change, characteristic of the related genus *Spongosorites*, depends on the unique compound bromotopsentin (Bartik et al., 1987). The chemical contents of the species newly described were examined by J.C. Braekman (University of Brussels) and he concluded (pers. comm.) that no bromotopsentin is present. There is little resemblance in spiculation to *Spongosorites*, which possesses only oxeas, whereas species of *Axinyssa* typically have interchangeable strongyles, styles, and strongyloxeas. *Spongosorites* spp. are found mostly at 100–200 m depth.

Von Lendenfeld (1897: 116) described the genus *Axinyssa* as massive axinellids with conules at the surface in which the skeleton is composed of only oxeas. Burton (1931: 350) redefined the genus *Axinyssa* as “Axinellidae of massive form in which the skeleton is composed of vertically ascending fibres of oxea of one sort only, the fibres branching and anastomosing throughout their length and ending at the surface in small tufts which project to a greater or lesser extent”. Burton (1931) makes it clear that this genus was erected to accommodate species without distinct size categories of oxeotes and which have no reticulate skeleton, but rather a confused skeleton.

Recently, the genus *Axinyssa* was redefined (Van Soest et al., 1990) to include a series of species among which *Axinyssa topsenti* Von Lendenfeld, 1897, *Pseudaxinyssa tethyoides* (Kirkpatrick, 1903), *Leucophloeus lewisi* Van Soest & Stentoft, 1988, and *Raphisia ambrosia* De Laubenfels, 1936. These species have massive amorphous bodies and a transitional skeletal arrangement between typical plumose axinellid to confused halichondrid skeletons. Van Soest et al. (1990: 25) redefined the genus

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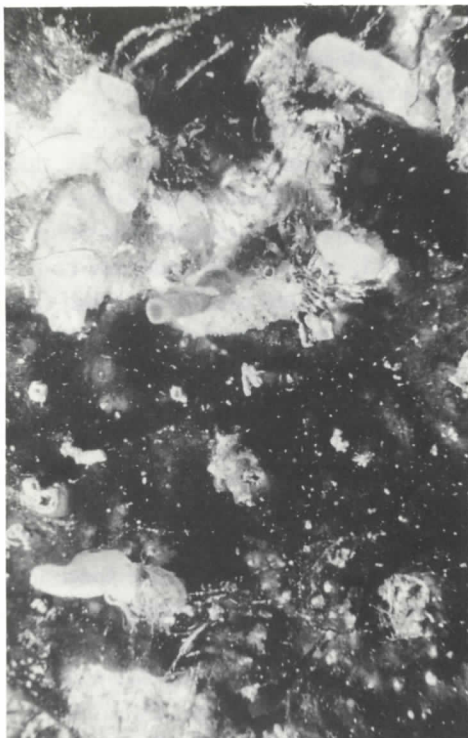
(clm)

Erratum

The prints of Plate I and Plate II on p. 211 and p. 213 are mixed up.

The colour prints on p. 213 must be placed on p. 211, they concern the new species *Axinyssa flavolivescens*; this is Plate I.

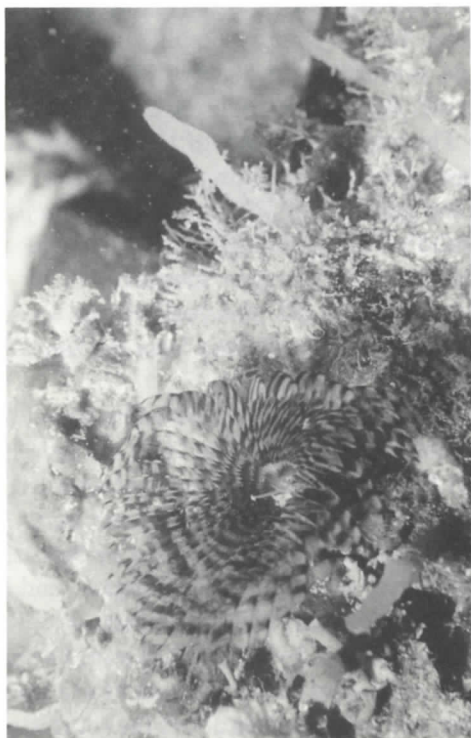
The black-and-white prints on p. 211 must be placed on p. 213, Plate II.



B



D



A



C

Plate I. Submarine photographs of *Axinyssa flavolivescens* n. sp., close up views: A, on dead coral *Diploria clivosa*, 13 m depth; B, on dead coral *Diploria clivosa*, 13 m depth; C, on dead coral *Diploria clivosa*, 15 m depth; D, on dead coral *Stephanocoenia michelinii*, 15 m depth.

Axinyssa as “Halichondriidae of the genus group *Axinyssa-Collocalypta* with vague choanosomal tracts ending at the surface in regularly distributed spicule brushes producing a regularly spaced conulation”. For detailed information about the revision of the Halichondriidae in which the genus *Axinyssa* is included, see Van Soest et al. (1990).

The new species resembles members of the genus *Axinyssa* (sensu Van Soest et al., 1990) in the following characters: the thick organic ectosome with sparsely scattered spicules, the spicules being composed of strongyloxeas and styles with indistinct strongylote/oxeote apices, and the typical plumose axinellid to confused halichondrid transitional skeletal arrangement. The new species differs from other members of the genus *Axinyssa*, including the Caribbean *Axinyssa ambriosa*, in the following characters: The usual spicule length of *Axinyssa* species is 400–800 μm and the spicules are of widely different sizes, whereas the spicule length of the new species is 200–320 μm and the spicules are of equal size. All kinds of spicules that are usually found in *Axinyssa* were also found in the new species, but most of its spicules are anisostrongyles. Neither excavating habit nor colour changes were known in the genus *Axinyssa* so far.

Order Hadromerida

Family Clionidae

Genus *Cliona* Grant, 1826

Diagnosis *Cliona* sensu Pang, 1973

Cliona aff. *flavifodina* Rützler, 1974

(Figs. 10–11, Plate IIC)

Ref.: *Cliona flavifodina* Rützler, 1974: 9.

Description. – Incrusting patches, on which small club-shaped papillae occur, are spread across the substratum. The consistency is firm, dry, and rough to the touch. The diameter of a patch can be up to 8 cm; sometimes several smaller patches fuse.

Endolithic parts: Large irregular galleries, filled solidly and spreading out from the base of the patches, riddle the upper 15 cm of the coral. Diameter of the excavations ranges from 2 to 5 cm.

Colour: Smoky-grey papillae, the gallery tissue is

yellow-ochre to brown. The colour stays unchanged in alcohol.

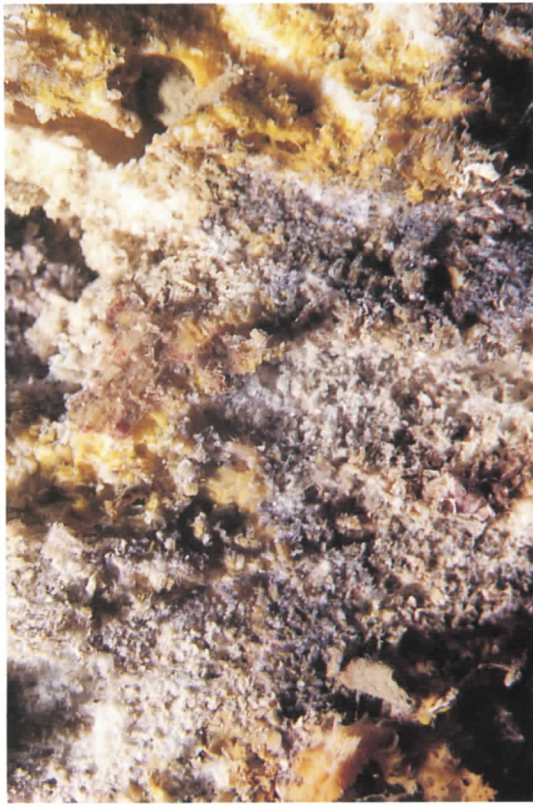
Spicules: Tylostyles and spirasters. Tylostyles 210–410 (mean 280) μm \times 6–12 μm . Spirasters 16–48 \times 3–5 μm . The tylostyle heads are round, droplet shaped or asymmetric. Usually they are subterminal. Often a swelling just below the heads occurs. All tylostyles are straight. Some spirasters have one bend, others four; some are completely straight. The spines are usually long and sharp.

Habitat: On dead parts of the following corals: *Colpophyllia natans*, *Diploria strigosa*, and *Montastrea cavernosa*.

Depth: At El Morro 8, 12, and 15 m, at Nenguane 4 m.

Discussion. – Only five specimens of this *Cliona* aff. *flavifodina* were found. These specimens are assigned to *Cliona* aff. *flavifodina* because they differ more from *Cliona flavifodina* Rützler (1974) from Bermuda than other *Cliona flavifodina* found by us in the Santa Marta area, Colombia. *Cliona* aff. *flavifodina* differs from the descriptions of the type specimens from Bermuda in shape, diameter, colour of the exposed parts and in the endolithic excavations. Rützler found tapering tunnels radiating into the substratum to a depth of 20 mm, while *Cliona* aff. *flavifodina* riddle the upper 15 cm of the coral. The papillary canals of the type specimens are lined with grayish-yellow tissue (Rützler, 1974), while the galleries of *Cliona* aff. *flavifodina* are filled solidly with yellow-ochre to brown tissue. The exposed parts of the type specimens differ very much from *Cliona* aff. *flavifodina*; they are compared with *Cliona flavifodina* from the Santa Marta area below.

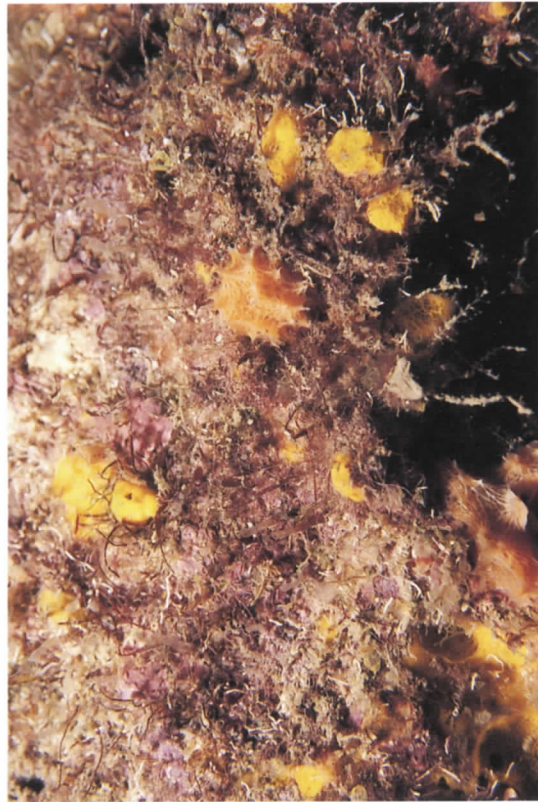
All specimens of *Cliona flavifodina* found by us in the Santa Marta area differ from the type specimens of Rützler in the following characters: shape, diameter, and colour of the exposed parts. The papillae of the specimens described by Rützler are inconspicuous, circular, rarely elongate, and level with the substratum; their diameters are 1.5–5 (mean 2.8) mm \times 1.5–3 (mean 2.2) mm. The papillae of the specimens from the Santa Marta area are irregular, sometimes raised above the substrate and reach a maximum diameter of 3 cm, which is much



B



D

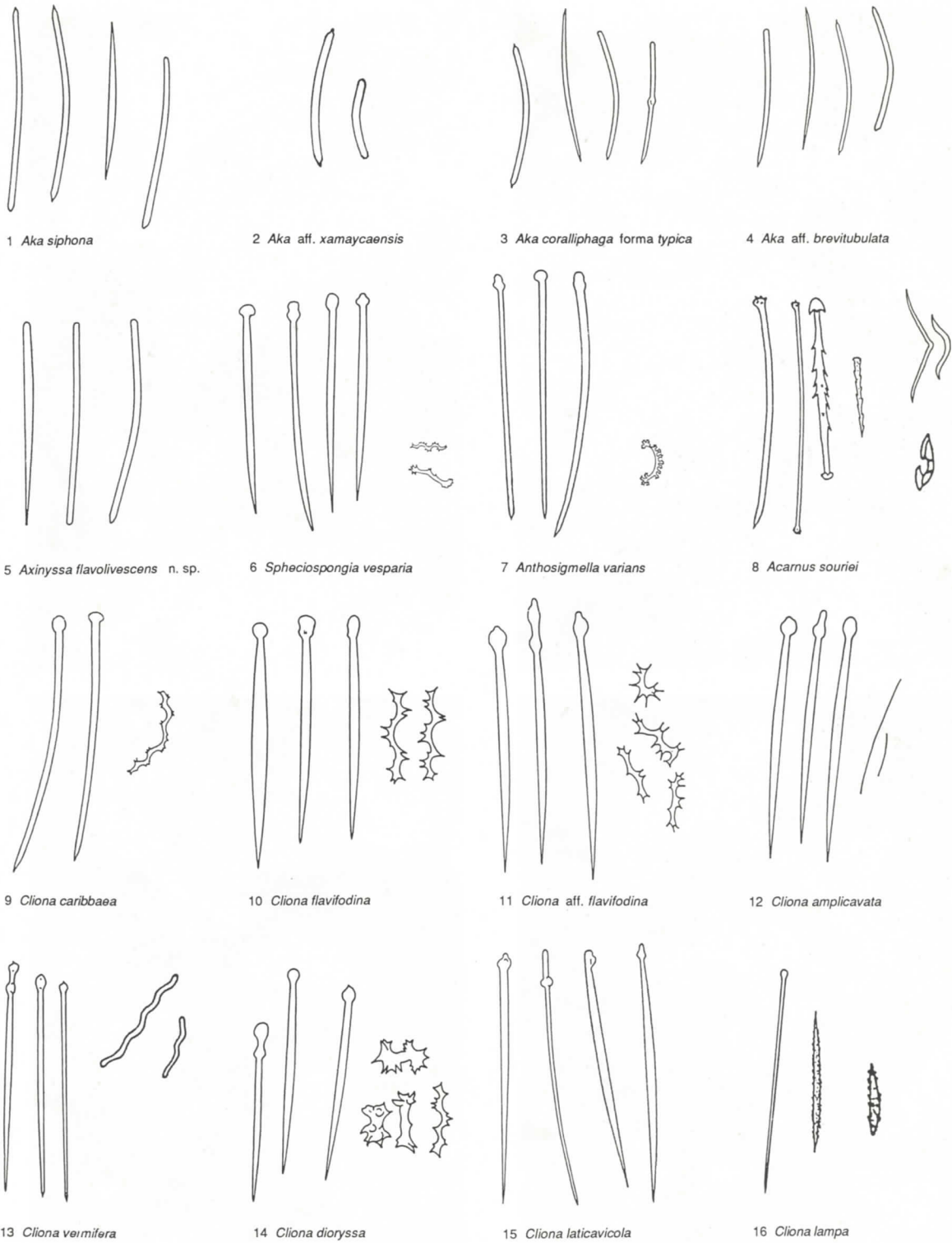


A



C

Plate II. Submarine photographs, close up views: A, *Aka* aff. *xamaycaensis*, on dead coral *Siderastrea siderea*, 3 m depth; B, *Aka* aff. *brevitubulata*, on dead coral *Montastrea cavernosa*, 15 m depth; C, *Cliona laticavicola*, on dead coral *Diploria strigosa*, 3 m depth; D, *Cliona laticavicola*, on dead coral *Stephanocoenia mitchelini*, 6 m depth.



Figs. 1–16. Spicules of sixteen excavating sponges of the Santa Marta area, Colombia. Scales of microscleres: 10 mm = 22.5 μ m; scales of megascleres: 10 mm = 60 μ m. Types and sizes of spicules are given in Table I.

larger than in the type specimens. The oscules of the type specimens open to about 3 mm; oscules of *Cliona flavifodina* specimens from the Santa Marta area reach a maximum diameter of 5 mm, which is only a little difference. The colour of the papillae of the type species varies from bright yellow to greyish yellow and chestnut brown. In alcohol and upon drying it fades to pale grey or greyish brown. The colour of *Cliona flavifodina* from the Santa Marta area is brown to moss-green and is unchanged when the specimens are preserved in alcohol.

Key to the excavating sponges described from the Santa Marta area, Colombia

- 1 – Exposed parts consisting of tubes; endolithic tissue firm but mucous or slippery 2
 - Exposed parts consisting of patches, or separate papillae 5
- 2 – Tube colour soft-yellow to brown, thick-walled and sturdy, tube length up to 15 cm, large galleries up to 20 cm across, gallery length up to 50 cm, filled with mucous cream to brown tissue; spiculation of only oxeas 120–200 μm by 4–10 μm (Fig. 1) *Aka siphona*
 - Tubes usually more delicate, excavations smaller than in previous one 3
- 3 – Tube colour white, tube length up to 7 cm, excavation vacuities up to 5 cm across, excavation depth up to 10 cm, filled with slippery cream tissue; spiculation of oxeas and strongyles, apices blunt and vaguely stepped (Fig. 2, Plate IIA) *Aka* aff. *xamaycaensis*
 - Tube colour cream to yellow 4
- 4 – Tube colour bright yellow, tube length up to 15 cm, excavation cavities up to 4 cm across, connected with the surface by tunnels of up to 3 cm, filled with yellowish beige tissue; spiculation of oxeas and styles, apices sharp or mucronate with a distinct central canal (Fig. 3) *Aka coralliphaga* forma *typica*
 - Tube colour cream to dull yellow, tube length up to 2 cm, excavation cavities up to 3 cm across, connected with the surface by tunnels of up to 1 cm, filled with slippery cream or dull yellow tissue; spiculation of oxeas and styles, apices sharp, stepped, or mucronate (Fig. 4, Plate IIB) *Aka* aff. *brevitubulata*
- 5 – Exposed parts consisting of bulgy patches 6
 - Exposed parts consisting of flat patches or separate papillae 9
- 6 – Patches rather large and bulgy, hollow galleries 7
 - Patches completely overgrowing or at least covering small patches of coral 8
- 7 – Patches and bulgy protrusions of brilliant yellow colour which turns to blue after damaging, galleries nearest to the coral surface hollow, galleries deeper in the coral filled; spicules confusedly arranged, consisting of styles, strongyles, and strongyloxeas (Fig. 5, Plate IA–D) *Axinyssa flavolivescens* n. sp.
- Black patches in which 3 or more small holes occur, leading to wide hollow galleries which are lined with a thin layer of yellow ochre tissue; spiculation of tylostyles and spirasters (Fig. 6) *Sphecospongia vesparia*
- 8 – Yellow-brown tissue usually covering a large surface area; spiculation of tylostyles and anthosigmas (Fig. 7) *Anthosigmella varians*
 - Thin layer of red-brown rough tissue covering patches of coral; spiculation of styles, tyloles, cladotyloles, acanthostyles, chelae, and toxas (Fig. 8) ... *Acarus souriei*
- 9 – Papillae or patch brown, moss-green, grey, or black, sometimes raised above the substrate and/or fused ... 10
 - Papillae or patch orange or yellow 12
- 10 – Papillae brown or grey-black, each up to 15 mm across, small galleries, excavation depth up to 2 cm, filled with dark yellow tissue; spiculation of tylostyles and spirasters with short spines (Fig. 9) *Cliona caribbaea*
 - Papillae or patch brown, moss-green or smoky-grey, large galleries 11
- 11 – Papillae moss-green to brown, each up to 3 cm across, galleries filled with yellow-ochre tissue; spiculation of tylostyles and spirasters with long spines (Fig. 10, Plate IIC) *Cliona flavifodina*
 - Patch smoky grey up to 8 cm across, usually raised above the substrate, galleries filled with dark brown tissue; spiculation of tylostyles and spirasters with long spines (Fig. 11) *Cliona* aff. *flavifodina*
- 12 – Minute yellow papillae arranged in groups of 2 to 6, each up to 1.5 mm across, regular ovoid chambers up to 2 cm across, excavation depth up to 7 cm, filled with soft mucous yellow or cream tissue; spiculation of tylostyles and raphides (Fig. 12) *Cliona amplicavata*
 - Papillae orange 13
- 13 – Spiculation including spirasters 14
 - Spiculation not including spirasters 15
- 14 – Small red-orange papillae, each 2–3 mm across, chambers up to 4 mm across, excavation depth up to 1 cm, filled with orange tissue; spiculation of tylostyles and worm-like spirasters without spines (Fig. 13) ... *Cliona vermifera*
 - Small deep-orange to yellow-orange papillae, each up to 2 mm across, chambers up to 4 mm across, excavation depth up to 3 cm, filled with cream to ochre tissue; spiculation of tylostyles and spirasters (Fig. 14) *Cliona dioryssa*
- 15 – Large orange papillae, each up to 15 cm across, chambers up to 15 cm across, excavation depth up to 20 cm, filled with soft rubbery orange tissue; spiculation of only tylostyles (Fig. 15, Plate IID) *Cliona laticavicola*
 - Small orange papillae, each up to 3 mm across, chambers up to 5 mm across, excavation depth up to 2 cm, filled with red-orange tissue; spiculation of tylostyles, acanthostyles and microrhabds (Fig. 16) *Cliona lampa*

Table 1. Comparison of the excavating sponges described from the Santa Marta area, Colombian Caribbean: colour, spicule sizes, papillae, and excavation characteristics.

Species	Colour	Megascleres (μm)	Microscleres (μm)	Papillae shape	Pap. size (mm)	Papillae fusion	Osc. op. (mm)	Depth (mm)	Excav. (mm)
<i>Aka siphona</i>	yellow, brown	Ox: 120–200 \times 4–10	absent	Tubes	10–150	often	max 10	500	200
<i>Aka aff. xamayaensis</i>	white	Ox: 120–150 \times 6–8 Str: 70–80 \times 6–8	absent	Tubes	10–70	never	1–4	100	50
<i>Aka coralliphaga</i> forma <i>typica</i>	bright yellow	Ox: 120–150 \times 4–6 Styl: 112–128 \times 4–6	absent	Tubes	5–150	some	3–10	65	35
<i>Aka aff. brevitubulata</i>	white, cream, yellow	Ox: 120–140 \times 4–8 Styl: 120–140 \times 4–8	absent	Tubes	5–20	never	2–4	40	30
<i>Axinyssa flavolivescens</i> n. sp.	bright yellow	Styl: 200–320 \times 5–10 Str: 200–320 \times 5–10 Str.ox: 200–320 \times 5–10	absent	Patches	max 70	some	5–10	200	20
<i>Spheciospongia vesparium</i>	black	Tyl: 160–350 \times 3–12	Spir: 8–20 \times 1–2	Patches	40–70	–	–	200	30
<i>Anthosigmella varians</i>	yellow-brown	Tyl: 240–400 \times 4–10	Anth: 16–20 \times 2–4	Patches	max 2000	–	max 10	20	–
<i>Acarnus souriei</i>	red	Styl: 220–270 \times 4–8 Tylotes: 300–340 \times 2–4 Clad: 220–280 \times 4–10 Ac.styl: 60–100 \times 6–10	Chelae: 15–30 Tox: 70–90 and 170–190	Patches	max 150	–	–	10	–
<i>Cliona caribbaea</i>	brown, grey	Tyl: 180–300 \times 3–10	Spir: 28–36 \times 1–2	Papillae	2–15	some	–	20	7
<i>Cliona flavifodina</i>	brown, mossgreen	Tyl: 200–425 \times 4–12	Spir: 16–37 \times 1–2	Papillae	max 30	some	max 5	60	30
<i>Cliona aff. flavifodina</i>	smoky-grey	Tyl: 250–410 \times 6.4–12.8	Spir: 16–48 \times 3–5	Patches	max 80	some	–	60	50
<i>Cliona amplicavata</i>	yellow	Tyl: 165–320 \times 4–10	Raphides: 125–172	Papillae	max 1.5	never	–	70	20
<i>Cliona vermifera</i>	red-orange	Tyl: 136–248 \times 4–9.6	Spir: 28–48 \times 4–8.2	Papillae	2–3	never	–	10	4
<i>Cliona dioryssa</i>	deep-orange	Tyl: 115–250 \times 4–6.5	Spir: 16–32 \times 1.3–2.6	Papillae	max 2	often	–	30	4
<i>Cliona laticavicola</i>	orange	Tyl: 240–360 \times 6–8	absent	Papillae	max 15	some	2–4	200	150
<i>Cliona lampa</i>	orange	Tyl: 176–264 \times 3.7–7.2 Ac.ox: 96–136 \times 4–8	Mic: 28–72 \times 3.2–7.4	Papillae	max 3	never	–	20	50

Megascleres: Oxeas (Ox), Strongyles (Str), Styles (Styl), Strongyloxeas (Str.ox), Tylotyles (Tyl), Tylotes, Cladotylotes (Clad), Acanthostyles (Ac.styl), Acanthoxeas (Ac.ox).

Microscleres: Spirasters (Spir), Anthosigmas (Anth), Chelae, Texas (Tox), Raphides, Microrhabds (Mic).

Pap. size: length of tubes, diameter of papillae and patches.

Osc. op.: diameter of oscular openings.

Depth: maximum excavation depth from the coral surface within the coral.

Excav.: maximum diameter of the excavations.

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