



## Sponges from Clipperton Island, East Pacific

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## Abstract

Twenty sponge species (totalling 190 individuals) were collected during the 1938, 1994 and 2004/5 expeditions to the remote island of Clipperton in the East Pacific Ocean. Seven species are widespread Indo-Pacific sponges; nine species comprise sponges new to science; four species were represented only by small thin patches insufficient for proper characterization and could be only determined to genus. The new species may not be necessarily endemic to the island, as several show similarities with species described from elsewhere in the East and West Pacific. Four species: *Tethya sarai* Desqueyroux-Faúndez & Van Soest (1997), *Callyspongia* (*Callyspongia*) *roosevelti* n.sp., *Spongia* (*Spongia*) *sweeti* (Kirkpatrick, 1900) and *Suberea etiennei* n.sp. were found commonly occurring in localities around the island in depths between 10 and 55 m, growing on dead corals, under overhangs and rubble stones. The remaining sponges were either rare or were thinly encrusting on coral fragments. The latter may be more abundant than appears from the present study as they are probably not easily observed. The sponge fauna of Clipperton Island shows strongest affinities with the Central and West Pacific regions and only two or three species are shared with the East Pacific region.

**Key words:** Clipperton, East Pacific, sponges, new species, endemism

## Introduction

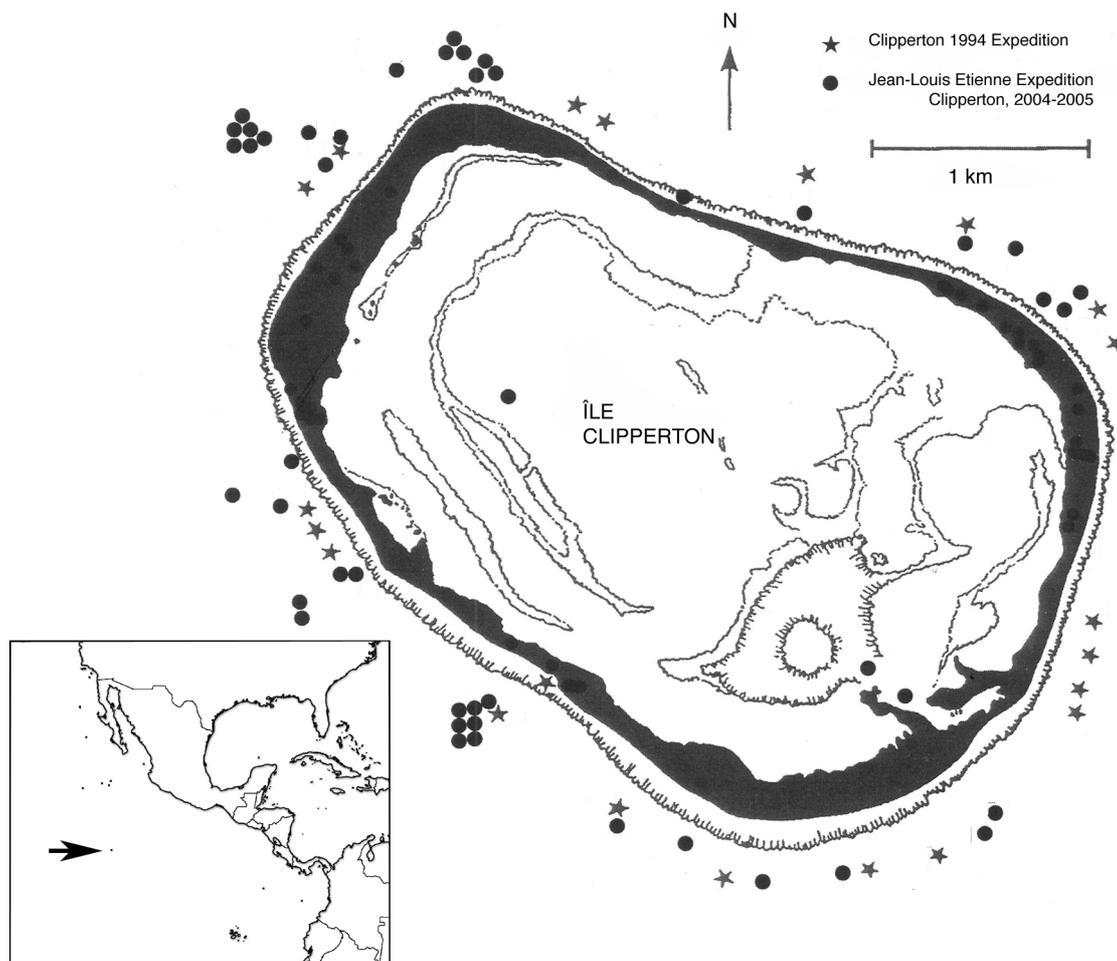
Clipperton Island (10°17–18'N 109°11–13'W) is the only true atoll in the Eastern Pacific, formed around an extinct volcanic base now largely eroded away above the sea surface. The island has a circumference of 11.8 km and a landmass of 1.7 km<sup>2</sup> enclosing a central brackish lagoon (Fig. 1, Kaiser 2007). Clipperton is the easternmost atoll of the Pacific Ocean situated in the middle of the East Pacific Barrier (Glynn *et al.* 1996). Clipperton is a French 'public domain' resorting under the authority of the High Commissioner of French Polynesia (Salvat *et al.* 2008).

Clipperton barely breaks the surface of the sea. Most of the atoll is coral rock and sand, only a few meters above sea level. Clipperton Rock, the only emergent volcanic rock remnant and the highest point, is about 30 meters above sea level. The atoll is situated in the inter-tropical convergence zone between two major ocean currents which pass by about 500 km to the north (the westward trending North Equatorial current, at about 15° N) and 500 km to the south (the eastward flowing Equatorial Countercurrent, at about 5° N). It is generally out of the path of most tropical storms which mostly track westward to the north of the island along the North Equatorial Current. However, the inter-tropical convergence zone produces convection clouds that commonly build throughout the day resulting in a high amount of rainfall. Physically, the nearshore environment around the atoll consists of a fringing coral reef that receives a near constant pounding from waves generated around the Pacific Ocean. This breaks up the reef into coral rock and sand, especially in areas close to the shore less than 5 meters deep. Living coral heads are interspersed with dead coral flats and coral sand along a gentle slope to seaward from about 5–20 meters depth. At a depth of about 20 meters, the substratum slopes more steeply down to about 50 meters where it levels out into a platform. Presumably, this platform was cut into the reef by waves during the lower sealevel stands of the Pleistocene.

Clipperton is extremely isolated from other land masses, with the Islas Revillagigedo at 1000 km distance to the north, the mainland Mexico coast at 1100 km to the east. To the southeast at longer distances are the Galápagos archipelago (2300 km) and the Cocos (2500 km) and Malpelo islands (3100 km). The nearest archipelago of the Central Pacific (the Marquesas) is almost 4000 km away. This isolation yielded a number of endemic species (fishes: approx. 5–20%: Robertson & Allen 1996; Béarez & Séret 2008; molluscs 2.6%: Kaiser 2007; possibly two coral species: Glynn *et al.* 1996; the only barnacle species: Zullo 1969), but the majority of taxa apparently are widespread tropical Indo-Pacific and East Pacific species. Many invertebrate groups were already studied (e.g. molluscs, crustaceans, holothurians (Hertlein & Emerson 1957).

Two sponge species originating from Clipperton Island were previously mentioned in a small paper on sponges from the East Pacific by De Laubenfels (1939). They were collected on a cruise made by Captain G. Allan Hancock on board the motor cruiser *Velero III*. The species De Laubenfels identified were the Californian *Haliclona enamelata* De Laubenfels (1930) and the West Indian *Callyspongia vaginalis* (Lamarck, 1814). The specimens were donated to the collections of the United States National Museum (Smithsonian Institution). A small collection of sponges was obtained by the Clipperton 1994 Expedition, organized by K.L. Kaiser and J.D. Jackson; this collection was equally divided among the Zoological Museum of Amsterdam and the California Academy of Sciences.

The largest collection of sponges was obtained by the 2005 Jean-Louis Etienne Clipperton Expédition, incorporated in the Muséum national d'Histoire naturelle, Paris.



**FIGURE 1.** Map of Clipperton Island (10°17–18'N 109°11–13'W), indicating approximate positions of diving stations where collections of sponges were made. Asterisks indicate positions of the Clipperton 1994 Expedition localities (material shared between CASIZ and ZMA), dots indicate positions of the Jean-Louis Etienne Clipperton Expédition 2004/5 (material kept in MNHN). For details of the collecting positions of individual samples of the various sponges cf. the descriptions under each species heading. Positions of the two samples obtained by the 1939 the motor cruiser *Velero III* visit to Clipperton are not indicated as they are unclear ('rocks to south of landing place'). Inset showing position (arrow) of Clipperton Island in the East Pacific.

### Material and methods

Approximately 190 specimens were found among the various collections. Details of localities of these specimens are given with the descriptions and an overview of collecting stations is indicated in the map of Fig. 1. Abbreviations are: CASIZ = California Academy of Sciences Invertebrate Zoology, MNHN = Muséum national d'Histoire naturelle, Paris, USNM = United States National Museum, Washington, ZMA = Zoological Museum of the University of Amsterdam. Loans are gratefully acknowledged.

Thick sections of sponges were made with a surgical blade and subsequently mounted into Canada balsam and examined by light microscopy at 20–400 x magnification. Dissociated spicule suspensions were obtained by boiling in concentrated nitric acid (siliceous spicules) or in warm sodiumhypochlorite (calcareous spicules) and subsequently mounted on stubs for examination under a JEOL scanning electron microscope (SEM). Residues of the spicule suspensions were mounted for light microscopic measurements. For species lacking a mineral skeleton, histological sections were made by Jack van Oyen (National Museum of Natural History, Naturalis, Leiden) using Mallory Cason stain; after dehydration sections were mounted in Euparal.

Spicule size data are given as minimum–average–maximum based on a minimum of 25 measurements for each spicule type unless otherwise indicated.

Images of specimens, sections and SEM preparations were obtained digitally. SEM images were cleaned up and aligned using the Adobe Photoshop CS3 package licensed to R.W.M. Van Soest.

Systematics and the order of treatment of the families and genera follows the Systema Porifera (Hooper & Van Soest 2002) and the World Porifera Database (Van Soest *et al.* 2008).

## Systematics

### Class Demospongiae

### Order Homosclerophorida

### Family Plakinidae

### Genus *Plakinastrella* Schulze, 1880

#### ***Plakinastrella clippertonensis* n. sp.**

(Figs 2A, 3A–D)

**Holotype.** MNHN DCL 4042–A, Jean-Louis Etienne Expédition Clipperton 2005, station 18, 55 m, on dead corals, 20–01–2005. 1 specimen.

**Description.** Cake-shaped (Fig. 2A), elongate mass of 3.5 x 1.5 x 1 cm. Surface smooth, but faintly grooved. Color light beige in alcohol. Consistency rather firm, but easily damaged.

**Skeleton.** A dense mass of diods and triods arranged around the aquiferous system. At the surface the skeleton is alveolar consisting of rounded meshes of approx. 50–100 µm diameter surrounded by tangential diods. The tangential crust of diods is carried by perpendicular bundles of diods mixed with triods, making small subdermal cavities. In the overall spiculation diods dominate, but there is a relatively large proportion of triods, and there are also rare small calthrops.

**Spicules.** Diods (Fig. 3A), centrotylote or crooked in the middle, occasionally two crooks occur, and small spines or incipient rays issue from the middle; size relatively small but quite variable, rendering computation of averages meaningless, 4–75 x 0.2–7 µm, the smallest (Fig. 3B) being irregular sinuous microdiods which do not appear a separate spicule category. A frequent size of the larger diods is 60–70 x 5–6 µm.

Triods (Fig. 3D) either equiangular, with conical rays, or Y shaped, variable in size, most frequently with a ‘cladome’ of 40–45 µm, rays ranging from 5–33 x 1–3 µm. The smallest are comparable in size with the microdiods, but their frequency is too low to consider them a separate microtriod category.

Calthrops (Fig. 3C), rare, mostly small, but ranging from 15–24 µm in overall diameter of the cladome, with rays 9–15 µm in length, usually unequal (N=12).

**Ecology.** Encrusting dead corals in deep reef habitat (55 m).

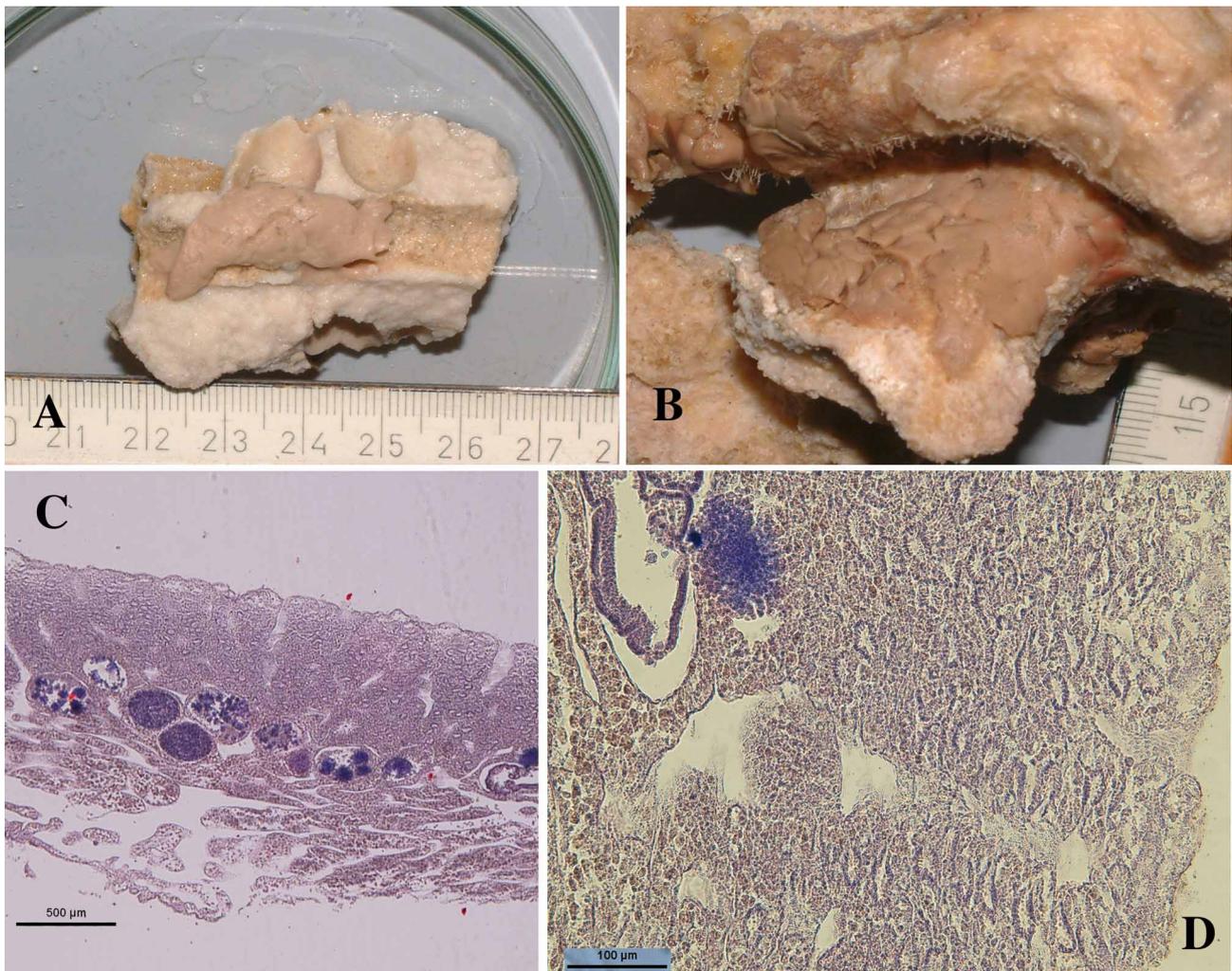
**Etymology.** Named after the locality.

**Remarks.** By the possession of calthrops this species is assigned to *Plakinastrella* but it appears close to many *Plakortis* species. Most *Plakinastrella* species, with the exception of *Plakinastrella clathrata* (Kirkpatrick, 1900 as *Placinastrella*) described from Funafuti, Tuvalu, and *Plakinastrella microspiculifera* Moraes & Muricy, 2003 described from Northeast Brazil have calthrops much larger and in a similar size range of the diods. A recent definition of the genus (Muricy & Díaz, 2002) emphasizes the occurrence of calthrops in three size categories. This supports the above suggestion that both the present new species and *Plakinastrella clathrata* and *Plakinastrella microspiculifera* would fit better in *Plakortis* than in *Plakinastrella*. *Plakinastrella clathrata* differs from our new species in the overall larger size of all spicule categories and by diods in two size categories, 140 and 36 µm, the smaller of which form an ectosomal palisade. Triods predominantly have a Y shape, they are up to 120 µm in cladome size; calthrops have rays 18–36 µm. *Plakinastrella microspiculifera* is very close in spiculation to our new species, but diods reach an upper size of 128 µm and triods are Y shaped and rare. The inter-ocean occurrence of

both precludes the possibility that *Plakinastrella clippertonensis* **n. sp.** and *Plakinastrella microspiculifera* are conspecific.

*Plakinastrella polysclera* Lévi & Lévi, 1989 from the Philippines has much larger spicules and calthrobs of 200–400  $\mu\text{m}$ . This also applies to *Plakinastrella mammillaris* Lendenfeld, 1907 from Western Australia, but additionally this species appears to lack triods. Atlantic representatives of the genus, *Plakinastrella copiosa* Schulze, 1880 and *Plakinastrella onkodes* (Uliczka, 1929) are likewise different in overall spicule sizes.

Like Moraes & Muricy (2003) we believe that the affinities of *Plakinastrella* with small calthrobs lie with *Plakortis* Schulze, 1880. If such spicules would be overlooked in casual studies this would result in a classification as *Plakortis*. To avoid a possible confusion, we compare our new species here with regional representatives of *Plakortis* as well. The comparison is also facilitated by a summary table (Table 1).

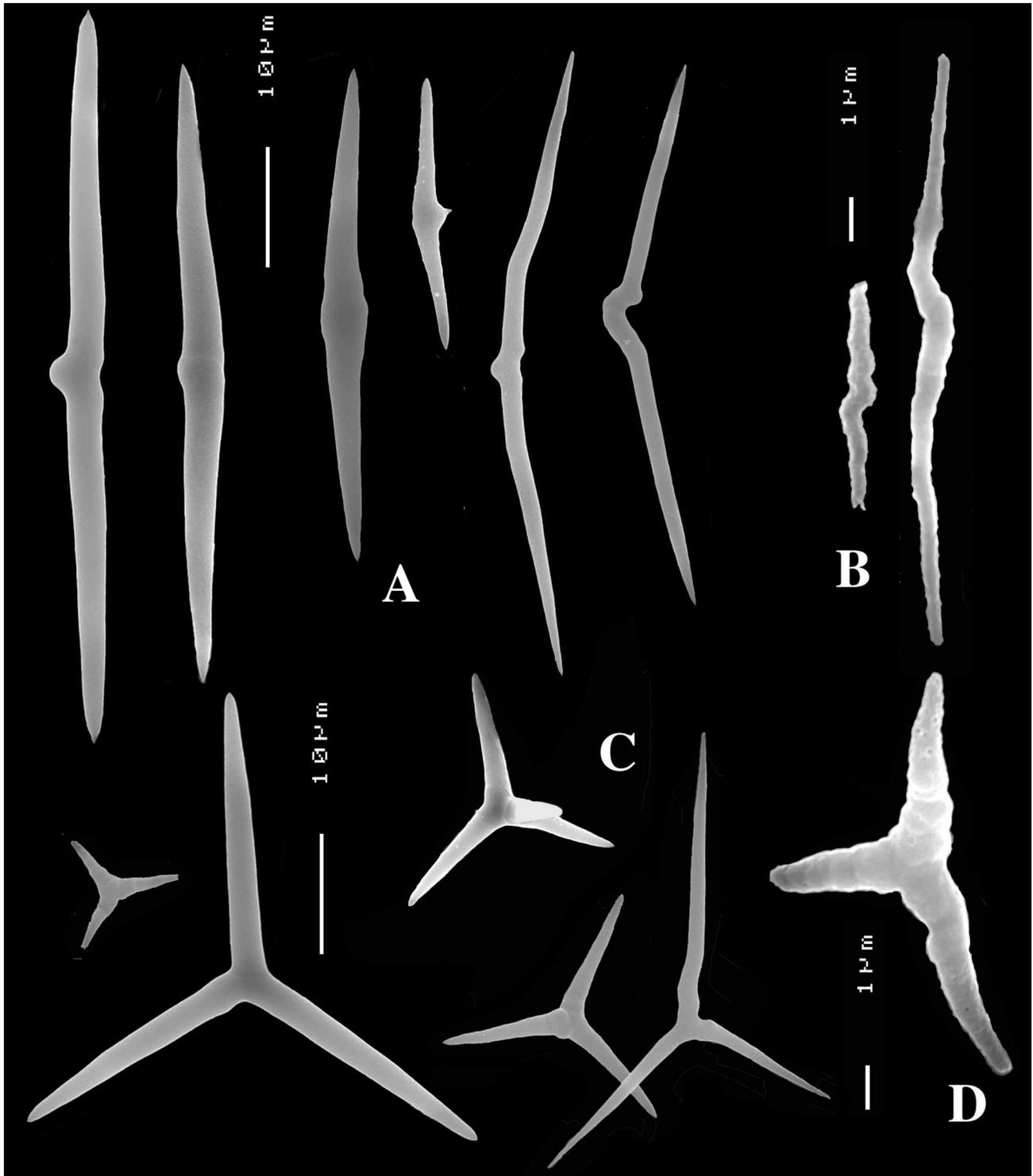


**FIGURE 2.** A. *Plakinastrella clippertonensis* **n. sp.** habit of holotype, MNHN DCL 4042–A. B–D. *Oscarella carmela* Muricy & Pearse, 2004, B. habit of specimen MNHN DCL 4050–A, C–D. *Oscarella carmela* Muricy & Pearse, 2004, C. histological cross section showing basal lacunae and embryos, D. detail of the same showing choanocyte chambers separated by peripheral grooves.

The new species appears close to *Plakortis albicans* Cruz-Barraza & Carballo, 2005 from the Pacific coast of Mexico. Color is white vs. light beige in our specimen. Size of diods and triods are basically similar, although diods in *Plakortis albicans* have a larger upper size range (132  $\mu\text{m}$  vs. 75  $\mu\text{m}$  in the new species). The smallest diods in *Plakortis albicans* are larger (12 vs. 4  $\mu\text{m}$  in the new species) and appear less sinuous. There are microtriods like in *Plakinastrella clippertonensis* **n. sp.** The major difference is the apparent absence in *Plakortis albicans* of small calthrobs. The second tropical East Pacific *Plakortis* species, *Plakortis galapagensis* Desqueyroux-Faúndez & Van Soest, 1997 shares the beige color with our new species, but diods are larger (up to 165  $\mu\text{m}$ ) and a distinct category of larger (126–165) and smaller (27–92) diods is reported. No calthrobs were recorded and do not appear to be

present in the type material (re-examined). The Japanese species *Plakortis japonica* (Hoshino, 1977 as *Monotria*) differs from *Plakortis albicans* and *Plakortis galapagensis* in a larger upper range of the diods (200  $\mu\text{m}$ ), but likewise lacks small calthrops.

The Pacific *Plakortis lita* De Laubenfels, 1954 recorded from the Caroline Islands, Indonesia, Papua New Guinea and Japan, shares the extremely small sinuous microdioids (see Díaz & Van Soest 1994), but has very few if any trioids and has a peculiar liver-like consistency. A further Pacific species is *Plakortis quasiampfiaster* Díaz & Van Soest, 1994 from Vanuatu, which has strongly spined dioids and trioids.



**FIGURE 3.** *Plakinastrella clippertonensis* n. sp., spicules of holotype MNHN DCL 4042–A. A. diods, B. microdioids, C. calthrops, D. trioids, including ‘microtrioid’ (at right).

**TABLE 1.** Pacific records of *Plakinastrella* and *Plakortis* species and their spicule sizes ( $\mu\text{m}$ ).

Name	Color	Diods	Microdiods	Triods (rays)	Calthrops (rays)	Locality
<i>Plakinastrella clippertonensis</i> n. sp.	light beige (alcohol)	21–75 x 3–6	4–12 x 0.2–0.5	5–33 x 1–5	9–15 x 1–3	Île Clipperton
<i>Plakinastrella clathrata</i> (Kirkpatrick, 1900)	dirty white (alcohol)	(1) 140 x 5 (2) 36 x 1.5	not recorded	36–60 x 4	18–36 x 3–5	Funafuti, Tuvalu, Micronesia
<i>Plakortis albicans</i> Cruz-Barraza & Carballo, 2005	white	12–137 x 1–7.5	not recorded	6–47.5 x 1–7.5	not recorded	Sea of Cortez, Mexico
<i>Plakortis galapagensis</i> Desqueyroux-Faúndez & Van Soest, 1997	beige (alcohol)	(1) 126–165 x 4–8 (2) 27–92 x 1–4	not recorded	17–36 x 1–4	not recorded	Galápagos Islands
<i>Plakortis lita</i> (De Laubenfels, 1954)	reddish brown	20–80 x 2–3	5–8 x 1	subsequently recorded	not recorded	Caroline Islands
<i>Plakortis quasiamphias-ter</i> Díaz & Van Soest, 1994	dark red	66–136 x 4–6 (smooth & spined)	not recorded	14–47 x 3–5 (smooth & spined)	not recorded	Vanuatu, Papua New Guinea
<i>Plakortis japonica</i> (Hoshino, 1977)	pinkish white (dry)	40–200 x 2–8	not recorded	30 x 4	not recorded	Japan
<i>Plakortis nigra</i> Lévi, 1953, Hooper, 1994	black	not recorded	not recorded	not recorded	not recorded	Sahul Shelf, NE Australia

Hooper (1994) recorded the Red Sea species, *Plakortis nigra* Lévi, 1953 from reef atolls of the Sahul Shelf. This is a black species and it has neither triods nor calthrops.

Spicule sizes of Pacific *Plakinastrella* and *Plakortis* species compared in Table 1.

### Genus *Oscarella* Vosmaer, 1887

#### *Oscarella carmela* Muricy & Pearse, 2004

(Figs 2B–D)

*Oscarella carmela* Muricy & Pearse, 2004: 600, Figs 2–4.

**Material examined.** MNHN DCL 4050–A, Jean-Louis Etienne Expédition Clipperton 2004/5, station 42, 8 m, on dead corals, 31–01–2005, 1 specimen.

MNHN DCL 4051–A, Jean-Louis Etienne Expédition Clipperton 2005, station 43, 8 m, on dead corals, 31–01–2005, 1 specimen.

**Description.** Soft encrustations on dead corals, with lobate upper surface. Lobes flattened in preservation, clearly demarcated by grooves surrounding slight round elevations of 1–2 mm diameter. The material consists of two separated encrustations on the same coral block (Fig. 2B), one 5 cm in widest expansion, the other 2 cm, closely together but apparently separated. Lobes in preserved condition only a few mm high.

Thin sections (Figs 2C–D) are 1.4 mm thick and show a strongly folded upper part and large lacunae just above the substrate, as is usual for the genus. Folds in the sections are approx. 0.5 mm in diameter, separating grooves 0.6 mm deep. These folds contain dense concentrations of rounded choanocyte chambers crowded around exhalant canals leading to the lacunae. Folds are covered by a thin pinacoderm. Choanocyte chambers (Fig. 2D), ovoid to rounded, 29–55  $\mu\text{m}$  in diameter. Numerous embryos and pre-release larvae (Fig. 2C), size up to 350  $\mu\text{m}$  in diameter, are crowded at the bottom of the grooves.

**Ecology and distribution.** Encrusting dead corals under overhangs and in crevices in shallow reef environment, 8 m; known from Île Clipperton and Central California.

**Remarks.** Species of this genus are distinguished based on features of the soft tissue, which means properly fixed material is a necessity. Our specimen was ‘postfixed’ after first having been kept in 75% alcohol for four years. Thus, the characters described above are somewhat suspect and may need to be revisited based on adequately fixed material (live material fixed in glutaraldehyde for two days). Notwithstanding this, we believe that the Clipperton material is closest to *Oscarella carmela* Muricy & Pearse, 2004 described from the Central California coast (Monterey Peninsula), where it encrusts rocks and artificial substrates. Many features of this species appear to conform with our material, including the size of the choanocyte chambers. Differences are subtle: slightly larger upper size of the choanocyte chambers (25–65 µm), larvae are slightly smaller (50–350 µm). A further indication that our material may be conspecific with *O. carmela* is the fact that this species is known to invade artificial structures, which is characteristic for species with great dispersal capabilities.

Further *Oscarella* species reported from the Pacific Ocean are: *Oscarella tenuis* Hentschel, 1909 described from Western Australia (along with *O. membranacea* Hentschel, 1909), and subsequently recorded from North East Australia (Burton 1934) and an aquarium in Hawaii (De Laubenfels 1954b). The latter specimen is described as papillate and very thin, choanocyte chambers 30 µm diameter. This is clearly smaller than the sizes found in our material. Likewise, *O. stillans* Bergquist & Kelly, 2004 from the Philippines, has much smaller choanocyte chambers. *Oscarella lobularis* (Schmidt, 1862) was reported from the Pacific end of the Panama Canal (Panama City, intertidal) by De Laubenfels (1936b). The only relevant descriptive information provided is the size of the choanocyte chambers, given as 25 µm. *O. lobularis* is a Mediterranean species, subsequently reported from many areas of the world, but these probably form a cryptic species complex (Muricy & Díaz 2002). Recently, *O. malakhovi* was described from the NW Pacific (Ereskovsky 2006). This has much smaller choanocyte chambers and its occurrence in cold water make it unlikely that this could be the same species.

## Order Hadromerida

### Family Hemiasterellidae

#### Genus *Paratimea* Hallmann, 1917

##### *Paratimea globastrella* n. sp.

(Figs 4A–F)

**Holotype.** ZMA Por. 21202, Clipperton Island, 10°18'N 109°13'W, 9–18 m, coll. K. Kaiser, 14–26 April 1994.

**Description.** Thinly encrusting in shallow pockets underneath *Porites* coral rubble (Fig. 4A), pale beige in alcohol, surface uneven, microhispid, consistency soft. Lateral size approx. 2 x 1 cm, less than 0.5 mm in thickness.

**Skeleton.** Megascleres erect on the substrate, united in ill defined bouquets consisting of tylostyles surrounded by centrotylote oxeas, among which large numbers of globular siliceous bodies are arranged (Fig. 4B). Little spongin, except at the substrate.

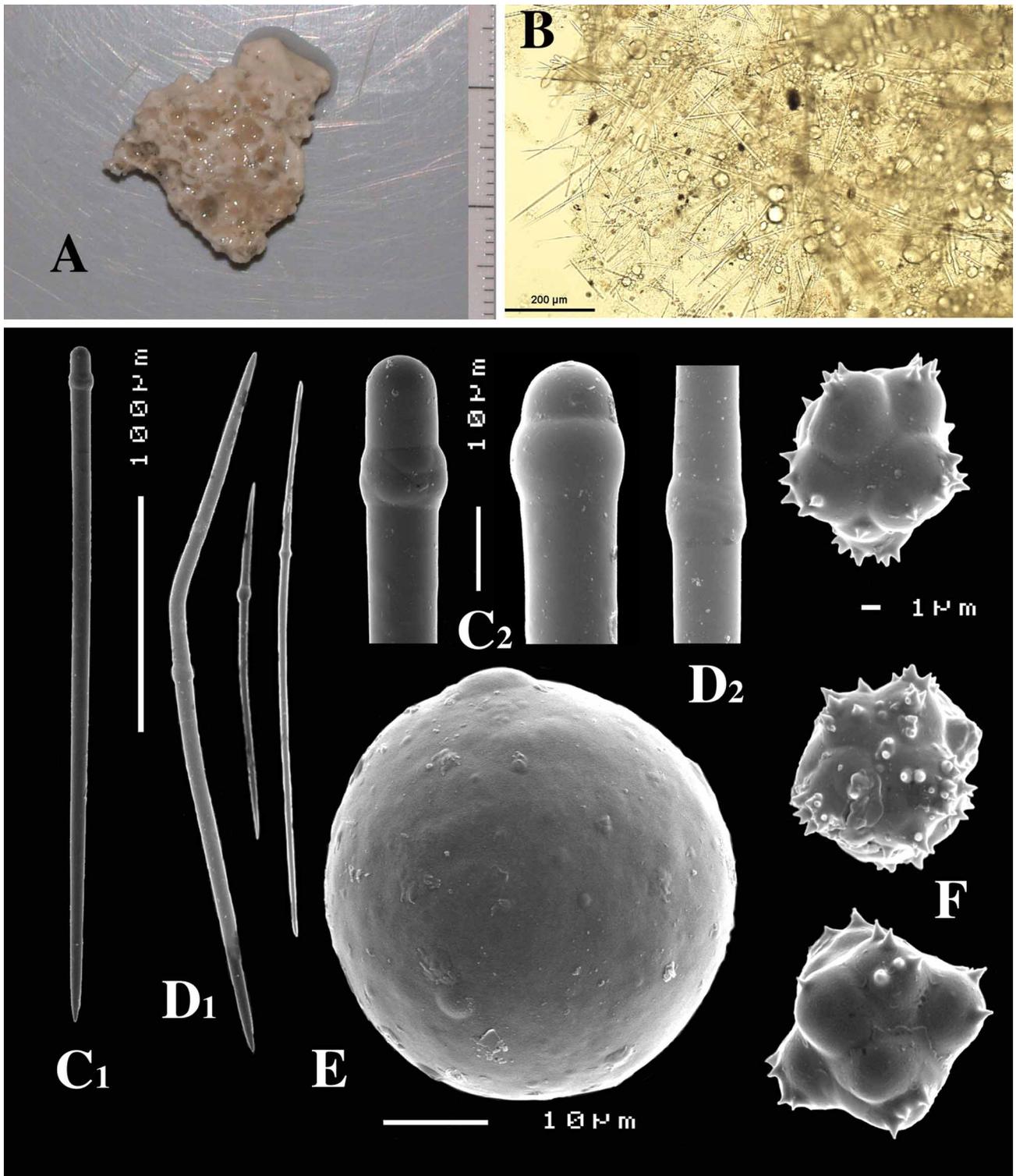
**Spicules** (Figs 4C–F). Megascleres smooth tylostyles and centrotylote oxeas, of variable size but both in a similar size range. Tylostyles (Fig. 4C) 129–349.7–481 x 4–8.1–12 µm, centrotylote oxeas (Fig. 4D) 105–294.8–483 x 3–4.6–7 µm; rare, modified, thick siliceous rods (not shown) of up to 120 x 22 µm are assumed to be derived from the megascleres. Microscleres rounded and irregularly formed spheres, the larger ones (Fig. 4E) more or less globular or slightly elliptical with smooth surface, 36–48.1–60 µm diameter, smaller ones (Fig. 4F) more irregular with knobs, lobes and often irregularly spined, 12–17.7–34 µm diameter. They appear to form an almost continuous range of shapes from more spined smaller objects to increasingly more regular smooth spheres.

**Etymology.** The name refers to the round microscleres assumed to be modified asters (see below).

**Ecology.** In a fringing reef at some depth in a sheltered position underneath coral rubble.

**Remarks.** The specimen is assigned to the genus *Paratimea* on account of the spicule complement of tylostyles, centrotylote oxeas and aster(-derived) microscleres. No *Paratimea* species have been recorded from Pacific waters so far. From the nine species described in the genus (all from the Atlantic Ocean), the new species differs rather strongly in the possession of microscleres that are only assumed to be modified asters. Similar globular modifications of (spher-)asters are known from certain *Tethya* species (family Tethyidae), such as *T. omanensis* Sarà & Bavestrello, 1995 (see also Van Soest & Beglinger 2008: 779) and *T. irregularis* Sarà & Bavestrello, 1998. The

modification from a sphaeraster to a siliceous sphere appears to be associated with isolation as *T. omanensis* and *T. irregularis* are only known from an inland sinkhole several hundreds of meters from the sea. If the elongate siliceous rods reported above are indeed derivations of the megascleres, then a parallel is found with similar hypersilicified megascleres reported by Van Soest *et al.* (2007) in *Hymeniacidon* and *Haliclona* specimens from inshore waterbodies in The Netherlands. Possibly, the isolated sponge-unfriendly waters of Clipperton created similar conditions for a species of *Paratimea* causing its originally normal sphaerasters to develop into the present anomalous partly spined spheres.



**FIGURE 4.** *Paratimea globastrella* n. sp., A. habit of holotype ZMA Por. 21202, B. thick section of skeleton showing dominance of globular silica bodies interpreted as modified asters, C. tylostyles, D. centrotylote oxeas, E. large globular aster, F. smaller globular asters showing various stages of aster-derived lobes and spines.

De Laubenfels (1954b) described *Kotimea tethya* from the Honolulu Aquarium, an encrusting species with styles of 700 x 14 µm and variably sized spherasters (5–38 µm) with conical rays. If as could be hypothesized the sphere microscleres of *Paratimea globastrella* n. sp. are environmentally deformed asters, then possibly *Kotimea tethya* may be a related sponge. Rützler (2002) assigned *K. tethya* to *Timea*, likewise an encrusting sponge genus differing from *Paratimea* in the absence of centrotylote oxeas.

It is possible that *Hymedesmia lophastraea* Hentschel, 1909 from SW Australia is also a member of Hemiasterellidae, and if so, a likely member of the genus *Paratimea* because of its thinly encrusting habit. This species possesses proper asters with peculiar anthaster-like micromorphology.

## Family Timeidae

### Genus *Timea* Gray, 1867

#### *Timea clippertoni* n. sp.

(Figs 5A–E)

**Holotype.** MNHN DCL 4044–A, Jean-Louis Etienne Expédition Clipperton 2005, station 18, 55 m, on dead corals, 20–01–2005, 1 specimen.

**Description.** Thinly encrusting on the underside of dead corals, less than 1 mm in thickness, forming microhispid patches of a few mm<sup>2</sup>. No apparent oscules. Pale beige in alcohol.

**Skeleton.** Tight mass of small tylostyles and asters pierced by the shafts of long tylostyles. Tylostyles with heads on the substrate, pointed ends directed outwards. Large asters form a basal layer on the substrate.

**Spicules.** Tylostyles, euasters in three distinct categories (Fig. 5B).

Tylostyles (Fig. 5A) with prominent, often slightly subterminal heads, usually slightly to strongly curved, in a large size range, possibly divisible in long tylostyles few in number and numerous small tylostyles, but some intermediates occur, 119–366.0–963 x 2–4.6–9 µm, heads 3–6.8–11 µm.

Asters 1 (Fig. 5C), calthrops-like, with usually 4 rays, but occasionally 3 or 5–6 heavily spined conical rays ending in a sharp point, large size variation, diameter 21–42.2–78 µm, individual rays 15–28.5–51 x 4–6.8–9 µm.

Asters 2 (Fig. 5D), strongylospherasters with large center, approx. 8–16 heavily spined conical rays, 9–15.7–19 µm.

Asters 3 (Fig. 5E), oxyspherasters with large center, small size, approx. 8–12 smooth or lightly spined rays, diameter 5–7.1–9 µm.

**Etymology.** Named after the discoverer of the Island, John Clipperton, who sighted the island in 1705.

**Ecology.** Encrusting dead corals, deep reef environment (55 m).

**Remarks.** The large heavily spined calthrops-like asters are reported from six *Timea* species (see Table 2).

(1) *Timea tetractis* Hentschel, 1912 from Indonesia, is similar to our material, but the upper size of the calthrops-like asters (called chelotrope-like aster by Hentschel) is given as 15–31 µm, clearly considerably less than those of *T. clippertoni* n. sp. Also the tylostyles are smaller (up to 520 µm). Strongylasters are present of up to 12 µm only.

(2) *Timea stellifasciata* Sarà & Siribelli, 1960 from the Mediterranean differs from our new species in the smaller megasclere size (125 – 595 µm) and the smaller calthrops-like asters (up to 21 µm) The asters are regarded to have a continuous variation from very small regular oxyspherasters to large irregular branched and spined types, whereas our material has distinct categories of smaller regular asters and larger calthrops-like asters. *Timea stellifasciata* also has the latter with branched rays, which is not found in our material.

(3) The species *Timea stellifasciata* was also reported from Brazil (Boury-Esnault 1973), but this likely concerns an undescribed species. The large spined calthrops-like asters of this material are much smaller than those of our new species. Boury-Esnault (1973) also described *Timea agnani* with large four-rayed microscleres; however, this is in all probability a species of *Cyamon*.

(4) *Timea irregularis* Sarà & Siribelli, 1960, also from the Mediterranean, is more similar to our new species with megascleres in the same size range (252–1025 µm), distinct categories of small regular oxyspherasters, and a larger upper size range of the calthrops-like asters (up to 35 µm), though still quite a bit smaller than the upper size in our new species. The shape of the calthrops-like asters in *T. irregularis* is clearly much more irregular than those of our material and constitutes a distinct difference.

(5) *Timea cumana* Pulitzer-Finali, 1978 from the Mediterranean has the calthrope-like asters similar in shape as those of *T. clippertoni* **n. sp.**, but smaller in size (up to 27  $\mu\text{m}$ ), whereas the tylostyles reach a length of 1600  $\mu\text{m}$ , clearly in excess of those of our material. A second smaller category of strongylasters appears similar.

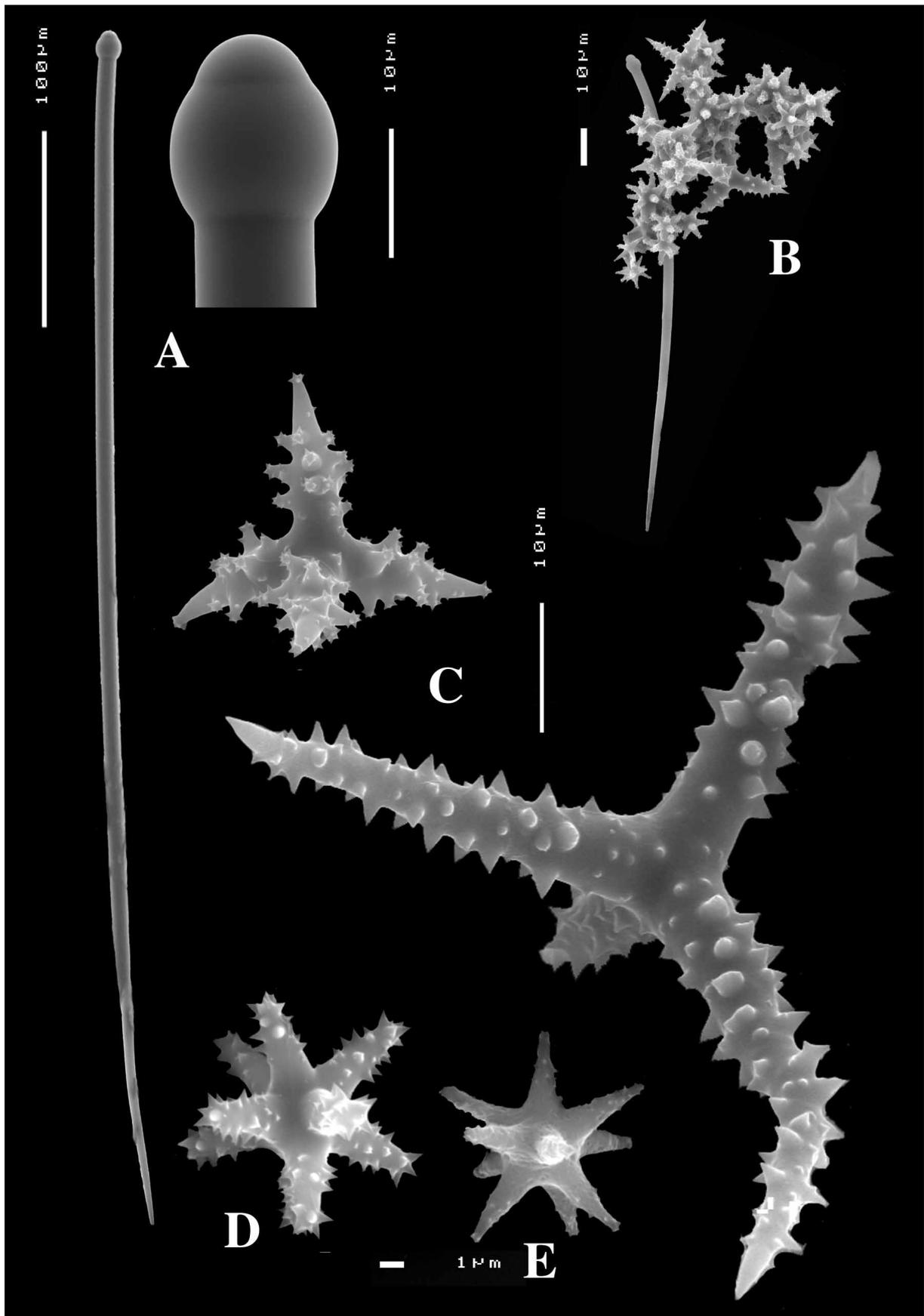
(6) *Timea curacaoensis* Van Soest, 2009 was recently described from coral reef rubble off the coast of Curaçao. The aster complement is likewise consisting of normal shaped smaller asters and larger asters with irregular shape, which is caused by proliferation / branching of the rays, quite unlike the asters of our new species. The size of the latter is also clearly smaller.

**TABLE 2.** *Timea* species with modified, irregular or calthrope-like asters.

Name	Color	Tylostyles ( $\mu\text{m}$ )	Modified asters (diameter $\mu\text{m}$ )	Strongylospherasters (diameter $\mu\text{m}$ )	Oxyspherasters (diameter $\mu\text{m}$ )	Locality
<i>Timea clippertoni</i> <b>n. sp.</b>	beige (alcohol)	119–963 x 2–9	21–78	9–19	5–9	Île Clipperton
<i>Timea tetractis</i> Hentschel, 1912	bright grey (alcohol)	184–520 x 2–7	15–31	7–12	7–12	Aru Islands, Indonesia
<i>Timea stellifasciata</i> Sar & Siribelli, 1960	yellow brown	125–595 x 3–8	7–21	7–21	7–21	Mediterranean, Italy
<i>Timea irregularis</i> Sar & Siribelli, 1960	ochre brown	252–1020 x 3–8	14–21	7–10	7–10	Mediterranean, Italy
<i>Timea cumana</i> Pulitzer-Finali, 1978	dull yellow	210–1600 x 4–20	16–27	6–15	6–15	Mediterranean, Italy
<i>Timea cumana</i> ; Maldonado, 1992	greenish cream (alcohol)	187–1237 x 11	20–36	5–7	11–17	Mediterranean, Alboran Sea
<i>Timea</i> aff. <i>stellifasciata</i> sensu Boury-Esnault, 1973	not recorded	160–730 x 3–6	12–28 (ray length, so probably at least up to 40)	16–30	6–9	NE Brazil
<i>Timea curacaoensis</i> Van Soest, 2009	off-white (alcohol)	299–1357 x 2–14	14–23	5.5–7.5	not recorded	Curacao, Caribbean

Other, more ‘normal’ *Timea* species from the Indo-West Pacific are: *Timea ohuirae* Carballo & Cruz-Barraza, 2006 from the Pacific coast of Mexico is similar to our new species in the sizes of the tylostyles and the diversity of asters. Like our new species it has three categories of asters, approximately in the same size range, but the largest category is a commonplace oxyaster with spined rays, not calthrope-like and proliferated; the smallest category is a strongylaster, not an oxyaster like our new species. *Timea granulata* Bergquist, 1965 from Palau also has a diversity of asters, including some with a reduced number of rays, but sizes are much smaller than those of our new species. *Timea* species from Hawaii reported by De Laubenfels (1954b), *T. xena* and *T. tethya* (as *Kotimea*) differ from the new species in lacking the large proliferated asters.

*Timea lophastraea* (Hentschel, 1909 as *Hymedesmia*) has peculiar ‘lophasters’ consisting of four or six rays with proliferated apices, different from the calthrope-like asters of our new species. Also this sponge apparently possesses bouquets of small oxeads at the surface, which make it likely that is a member of Hemiasterellidae, not Timeidae. *Timea centrifera* (Hentschel, 1909 as *Hymedesmia stellata* var. *centrifera*) is a proper *Timea* with commonplace strongylasters of 10–18  $\mu\text{m}$  diameter. Both species are from West Australia.



**FIGURE 5.** *Timea clippertoni* n. sp., spicules from holotype MNHN DCL 4044–A, A, tylostyle, B, overview of spiculation to demonstrate relative sizes, C, larger and smaller calthrops-like asters, D, strongylospheraster, E, oxyspheraster.

## Family Tethyidae

### Genus *Tethya* Lamarck, 1814

#### *Tethya sarai* Desqueyroux-Faúndez & Van Soest, 1997

(Figs 6A–E)

*Tethya sarai* Desqueyroux-Faúndez & Van Soest, 1997: 424, figs 119–124.

**Material examined.** ZMA Por. 13992, Clipperton Island Expedition 1994, 10°18'N 109°13'W, 9–18 m, coll. K. Kaiser, 14–26 April 1994, 3 specimens.

ZMA Por. 13993, same collecting data, 1 specimen.

ZMA Por. 13994, same collecting data, 1 specimen.

ZMA Por. 13995, same collecting data, 1 specimen.

ZMA Por. 13996, same collecting data, 1 specimen.

ZMA Por. 13997, same collecting data, 1 specimen.

ZMA Por. 13999, same collecting data, 1 specimen.

CASIZ 103402, Clipperton Island Expedition 1994, E side, 10°18.53'N 109°11.98'W, 13.5 m, coll. R.J. van Syoc nr. RVS-235, 23–04–1994, 1 specimen.

CASIZ 103404, Clipperton Island Expedition 1994, SE corner, 10°17.02'N 109°12.79'W, 12 m, coll. R.J. van Syoc nr. RVS-238, 24–0–1994, 1 specimen.

CASIZ 180252, Clipperton Island Expedition 1994, aboard M/V Royal Star, 15 m, coll. R.J. van Syoc nr. RVS-242, 26–04–1994, 3 specimens.

CASIZ 180253, Clipperton Island Expedition 1994, NE side, under coral flats, 9–10.5 m, coll. R.J. van Syoc nr. RVS-221, 18–04–1994, 1 specimen.

CASIZ 180254, Clipperton Island Expedition 1994, NW side, 12 m, coll. R.J. van Syoc nr. RVS-225, 20–04–1994, 1 specimen.

MNHN DCL 4041–A, Jean-Louis Etienne Expédition Clipperton 2005, station 45, 22 m, 5–02–2005, 1 specimen.

MNHN DCL 4045, Jean-Louis Etienne Expédition Clipperton 2005, station 13, 33 m, on dead corals, 18–01–2005, 1 specimen.

MNHN DCL 4062, Jean-Louis Etienne Expédition Clipperton 2005, station 25, 18 m, 17–01–2005, 2 specimens.

MNHN DCL 4063, Jean-Louis Etienne Expédition Clipperton 2005, station 10, 13 m, 17–01–2005, 1 specimen.

**Description.** Spherical sponges (Fig. 6A), dark grey in preserved condition, consistency hard (probably due to contraction), size up to 2 cm in diameter. Surface warty, but relatively smooth.

**Skeleton** (Fig. 6B). Consists of radiating bundles of megascleres, with a distinct peripheral cortical region of approximately 500–750 µm thick (preserved condition). The outer region of the cortex is a thin single layer of micrasters supported by a thicker layer of megasters. Below these layers is a collagenous region with a low density of microscleres traversed by megasclere bundles. The inner region of the cortex is formed by a dense layer of megasters. The choanosomal region consists of dense masses of radiating megasclere bundles, some of which end at the underside of the cortex while others traverse the cortex and fan out to form the surface warts. Numerous microscleres are dispersed among the choanosomal megasclere bundles; predominantly represented by megasters, but with a minority of strongylasters or tylasters similar in shape to the ectosomal micrasters, but slightly larger. Also found in most specimens are rare oxyasters.

**Spicules.** Strongyloxeas, micrasters and megasters.

Strongyloxeas (Fig. 6C) in two overlapping size categories, 456–522–624 x 4–7.8–9 µm and 720–945–1175 x 12–14 µm.

Megasters (Fig. 6D): Spherasters with a large centre and 20+ conical rays, in a large size range, but no size zonation is evident, 18–41.7–66 µm, RC = 0.4–0.6 (index of length of rays divided by diameter of the centre).

Micrasters of the cortex, tylasters (Fig. 6E) 9–15 µm with approx. 8 rays; further into the interior similarly shaped asters are slightly larger than those at the surface, but appear morphologically identical. Choanosomal oxyasters (Fig. 6F) appear to be present but they are barely differentiated from micrasters in size and shape. They have oxyaster-like or strongylote morphology and are relatively rare, up to 28 µm, with approx. 10 rays.

**Ecology and distribution.** Under coral blocks and overhangs in the shallow reef down to 33 m; known from Île Clipperton and Galápagos Islands.

**Remarks.** The assignment of the present material to *T. sarai* is not without hesitation, as there are some differences in skeleton and spicule categories, and because the description of Desqueyroux-Faúndez & Van Soest (1997) is rather ambiguous. The most striking similarity is the occurrence of choanosomal micraster-like oxyasters/strongylasters. These occur rarely in our material as well as in Desqueyroux-Faúndez & Van Soest's material. The Galápagos spicules are overall more robust, but overlap in size with the Clipperton spicules.

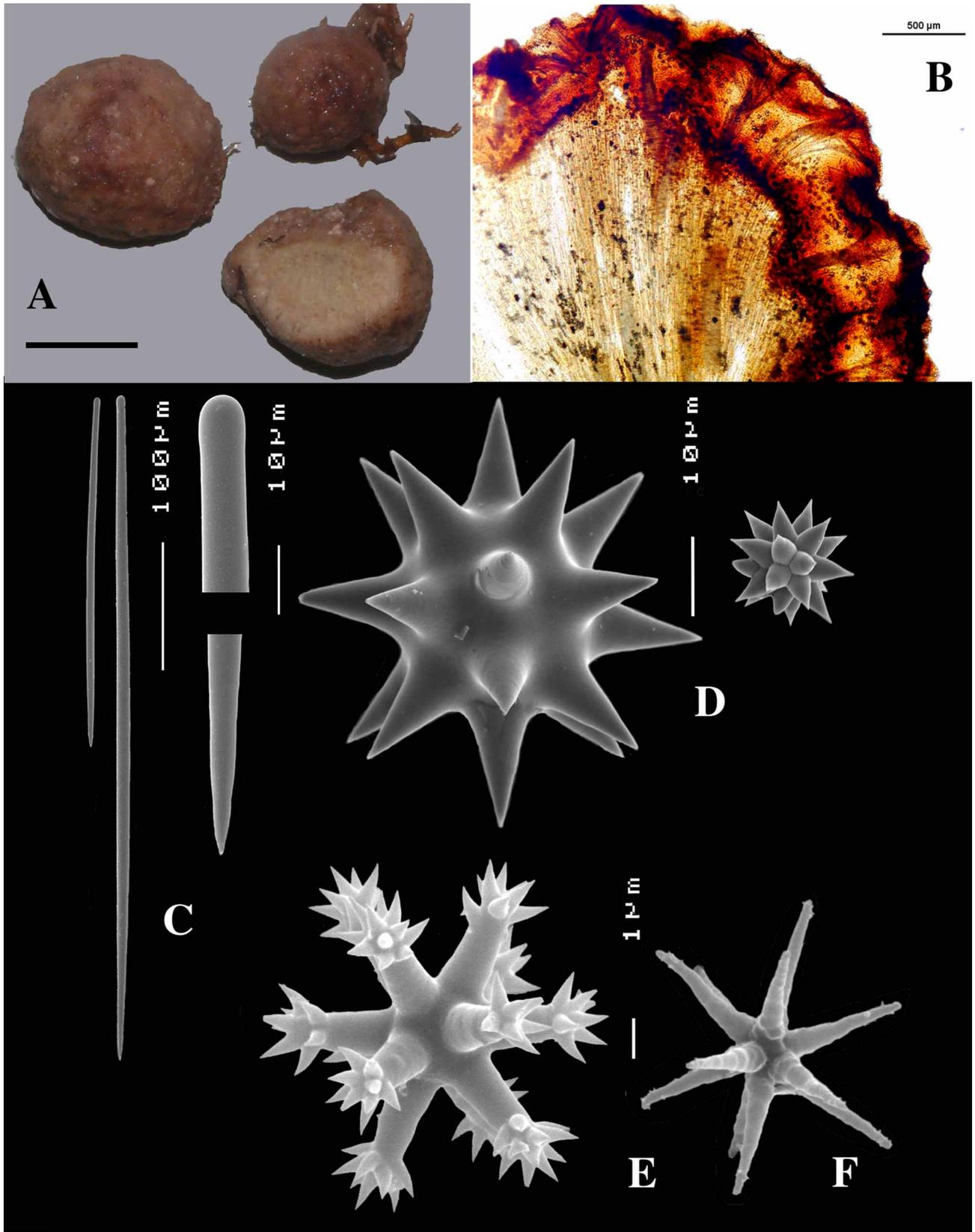
*Tethya taboga* (De Laubenfels, 1936b as *Taboga*) described from Panama has larger megascleres and larger choanosomal oxyasters. *T. californiana* de Laubenfels, 1932 described from California also has larger megascleres and lacks choanosomal oxyasters.

Bakus (1975) reported the occurrence of '*Tethya aurantia*' from Isla del Coco, but did not provide a description.

Sarà *et al.* (2001) described five new species from the Pacific coast of Mexico, all very similar to the Galápagos and Clipperton specimens, but they lack choanosomal oxyasters and four of these species differ from the present species in having strongyloxeas clearly much larger (see Table 3). *Tethya deformis* as reported by Desqueyroux-Faúndez (1990) from Easter Island has similar spicule sizes as *T. sarai*, but it lacks choanosomal oxyasters. Whether this material is conspecific with records of this species from Japan (Thiele, 1898 as *Donatia*), Chile (Thiele, 1905 as *Donatia papillosa*) and New Zealand (Bergquist, 1968) as Desqueyroux-Faúndez (1990) suggested, remains to be further investigated.

**TABLE 3.** Spicule categories and sizes of East Pacific *Tethya* species.

Name	Color	strongyloxeas (µm)	micrasters (diameter µm)	megasters (diameter µm)	oxyasters (diameter µm)	Locality
<i>Tethya sarai</i> Clipperton material	cream or reddish brown (alcohol)	(1) 456–624 x 4–9 (2) 720–1175 x 12–14	9–15	18–66 (RC=0.4–0.6)	9–28	Île Clipperton
<i>Tethya sarai</i> Desqueyroux-Faúndez & Van Soest, 1997	cream (alcohol)	920–1500 x 20–30	8–15	38–90 (RC=not recorded)	21–28	Galápagos Islands
<i>Tethya taboga</i> (De Laubenfels, 1936)	dull red	1670 x 30	8–12	40–80 (RC=0.3–0.6)	25–60	Panama
<i>Tethya californiana</i> (De Laubenfels, 1932)	yellow or orange	2200–2375 x 40–43	8–13	45–83 (RC=0.6–1.1)	not present	Gulf of California
<i>Tethya ensis</i> Sara <i>et al.</i> , 2001	creamy white (alcohol)	(1) 225–965 x 10–25 (2) 2312 x 47	9–13	50–115 (RC=0.5–0.9)	not present	Mexico
<i>Tethya mexicana</i> Sara <i>et al.</i> , 2001	orange	2130 x 41	8–13	70 – 1208 (RC=0.7–1.2)	not present	Mexico
<i>Tethya ovum</i> Sara <i>et al.</i> , 2001	dirty white (alcohol)	(1) 357–995 x 10–27 (2) 1885 x 39	8–13	75–110 (RC=0.7–1.2)	not present	Mexico
<i>Tethya paraoxeata</i> Sara <i>et al.</i> , 2001	orange	(1) 300–1300 x 1–20 (2) 2620 x 50	8–13	40–91 (RC=0.6–1)	not present	Mexico
<i>Tethya socius</i> Sara <i>et al.</i> , 2001	pink (alcohol)	1700 x 30	8–12	60–118	not present	Mexico
<i>Tethya deformis</i> sensu Desqueyroux-Faúndez, 1990	orange	(1) 9120987 x 13–17 (2) 1045–1386 x 21–29	13.5	54 (RC=not recorded)	not recorded	Easter Island



**FIGURE 6.** *Tethya sarai* Desqueyroux-Faúndez & Van Soest, 1997. A. habit of specimens from sample ZMA Por. 13992, B. cross section of peripheral region showing the cortex and arrangement of megascleres and megasters, C. two sizes of strongly-loxeads, D. two sizes of megasters, E. micraster of the ectosome, F. small oxyaster of the choanosome.

## Order Poecilosclerida

### Suborder Microcionina

#### Family Microcionidae

##### Subfamily Microcioninae

##### Genus *Clathria* Schmidt, 1862

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

##### *Clathria* (*Thalysias*) *hermicola* n. sp.

(Figs 7A–G)

**Holotype.** MNHN DCL 4043–A, Jean-Louis Etienne Expédition Clipperton 2005, station 19, 10 m, on dead corals, 24–01–2005, 1 specimen.

Paratype MNHN DCL 4053–A, Jean-Louis Etienne Expédition Clipperton 2005, station and depth not recorded, on dead corals, 1 specimen.

Paratype MNHN DCL 4054–A, Jean-Louis Etienne Expédition Clipperton 2005, station 8, 15 m, on dead corals, 14–01–2005, 1 specimen.

**Description.** Thin (< 1 mm) encrustation on undersides of corals (Fig. 7A), with microhispid surface, pale orange in alcohol (possibly bright red in life), lateral size indefinite, at least several cm. Consistency soft.

**Skeleton.** Small groups of larger styles and smaller acanthostyles are perpendicular to the substratum, embedded with their heads in the spongin plate covering the substrate (microcionid structure). The ectosomal megascleres comprise two categories of subtylostyles which form loose bouquets, not a closed palisade.

**Spicules.** Choanosomal styles, ectosomal subtylostyles, acanthostyles, toxas, palmate isochelae.

Styles (Fig. 7B), shaft smooth, swollen in the mid-section, with narrow smooth or microspined heads, 126–430 x 4–8 µm

Ectosomal subtylostyles, with microspined heads, in two distinct size categories, (1, Fig. 7C) 297–343.5–396 x 3–3.35–4 µm, (2, Fig. 7D) 177–183.8–189 x 1.5–2 µm.

Acanthostyles (Fig. 7E), with barely developed head and overall low degree of spination, but more heavily spined in the lower half, 67–86.8–98 x 1.5–4.3–6 µm.

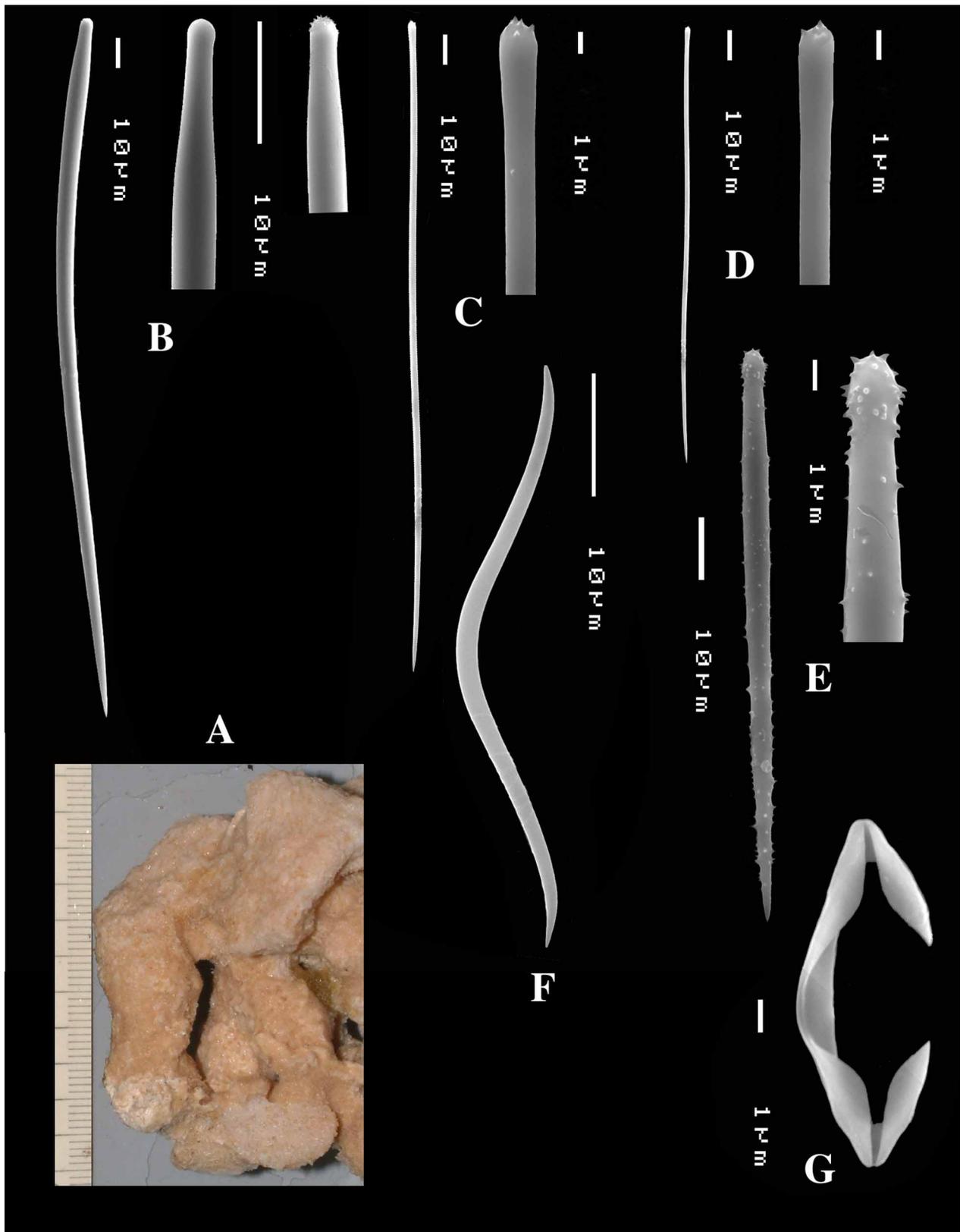
Toxas (Fig. 7F), fairly robust, with shallow curve ('oxhorn'-type), in a large overlapping size range, but not divisible in categories, 13–45.9–64 µm.

Isochelae (Fig. 7G) of normal shape, with slightly thickened shaft and relatively sparsely cut alae, 12–13.9–15 µm.

**Etymology.** Herma (Gr.) = mound or coral reef, -cola = inhabiting, referring to the habit of encrusting corals in shallow reef environment.

**Ecology.** On the underside of dead corals, 10–15 m.

**Remarks.** The new species is assigned to the subgenus *Thalysias* because it has two distinct size categories of ectosomal subtylostyles arranged in bouquets at the surface. Possibly the widespread Central Pacific *Clathria* (*Thalysias*) *eurypha* (De Laubenfels, 1954a as *Dictyociona*) is close to our new species in spicule sizes and shapes, but three features are distinctly different from the original description: there are apparently no echinating acanthostyles in *C. (T.) eurypha*. Subsequent records by Bergquist (1965), Kelly-Borges & Bergquist (1988) (both as *Microciona*) and Pulitzer-Finali (1996) described these for this species, if correct. The larger ectosomal subtylostyles and the choanosomal styles are apparently not distinct, and there is a second category of tiny isochelae of approx. 4 µm. The latter feature is also described for *Clathria* (*Thalysias*) *coralliophila* (Thiele, 1903 as *Rhaphidophlus*) from Ternate (see review of specimens in Hooper, 1996). There is an outside possibility that *C. (T.) eurypha* is a junior synonym *C. (T.) coralliophila*, but the difference with our material in the possession of a second category of very small isochelae remains a clear distinction.



**FIGURE 7.** *Clathria (Thalysias) hermicola* n. sp., holotype MNHN DCL 4043–A. A. habit, thinly encrusting on dead corals, B. choanosomal styles with smooth and microspined heads, C. subectosomal subtylostyle with microspined head, D. ectosomal subtylostyle with microspined head, E. echinating acanthostyle with relatively lightly spined upper half, F. oxhorn-like tox, G. palmate isochela.

On paper the new species looks similar to *Clathria (Microciona) plinthina* (De Laubenfels, 1954a as *Microciona*) from the Central West Pacific, but this species has raphides and lacks a smaller category of subtylostyles. Resemblance is also apparent to West Pacific *Clathria (Thalysias) linda* (De Laubenfels, 1954a as *Axocielita*), but no echinating acanthostyles were recorded and the differentiation of the megascleres, which have prominent heads ('tylostyles') in ectosomal subtylostyles and choanosomal styles is apparently not present, so its assignment to the subgenus *Thalysias* may not be warranted. Another remote possibility is the material from Hawaii from deep water (200 m) that De Laubenfels (1957) described as *Microciona haematodes*, assigned to *Clathria (Microciona)* by Hooper (1996); the description is quite vague, and the author suggests there are no proper toxas.

**TABLE 4.** Thinly encrusting *Clathria (Thalysias)* species recorded from the warmer waters of the Pacific.

Name	ectosomal sub-tylostyles (I) (µm)	ectosomal sub-tylostyles (II) µm	choanosomal styles (µm)	echinating acanthostyles (µm)	toxas µm)	isochelae (µm)	Locality
<i>C. (T.) hermicola</i> <b>n. sp.</b>	297–396 x 3–4	177–189 x 1.5–2	126–430 x 4–8	67–98 x 1.5–6	13–64	12–15	Île Clipperton
<i>C. (T.) eurypa</i> (De Laubenfels, 1954a)	290 x 6	115 x 4	not recorded	not recorded	30–54	(I) 4, (II) 19	Palau
<i>C. (T.) eurypa</i> sensu Bergquist, 1965	237–490 x 7.5–13	112–200 x 3.5–5	not recorded	80–106 x 4–6.5	36–181	(I) 3.5–5 (II) 13.5–18	Palau
<i>C. (T.) eurypa</i> sensu Kelly Borges & Bergquist, 1988	267–495 x 2.5–9	91–163 x 2.5–9	not recorded	87–113 x 6–12.5	(I) 30–90 (II) 190–210	(I) 12.5–20 (II) 3–5.5	Papua New Guinea
<i>C. (T.) eurypa</i> sensu Pulitzer-Finali, 1996	270–430 x 7–9.5	96–260 x 2–5	not recorded	60–81 x 7–9	35–180	7–20	Bismarck Sea
<i>C. (T.) corallio-phila</i> (Thiele, 1903)	213–488 x 3–9	102–206 x 2–5	145–350 x 7–15	48–95 x 2–5	18–244 x	(I) 2–8 (II) 11–17	Indonesia, Great Barrier Reef
<i>C. (T.) linda</i> (De Laubenfels, 1954a)	400 x 2–3	200 x 2–3	435 x 9	not recorded	(I) 15–33, (II) 55–80	12–20	Chuk, Central Pacific
<i>C. (T.) longitoxa</i> (Hentschel, 1912)	432–584 x 4–9	240–408 x 13–15	592–840 x 22–26	64–80 x 6–7	400–800	12–13	Indonesia
<i>C. (T.) calochela</i> (Hentschel, 1912)	376–480 x 3–5	376–480 x 3–5	304–824 9–13	88–104 x 5	(I) 56–64 (II) 120–160	19–21	Indonesia
<i>C. (T.) toxifera</i> (Hentschel, 1912)	228–494 x 2–13	123–229 x 1.5–6.5	194–685 x 5–25	122–208 x 3–14	16–241	10–30	Indonesia, Australia
<i>C. (T.) maunaloa</i> (De Laubenfels, 1951)	240 x 9	120–160 x 6	425 x 13	42 x 8	56–132	14	Hawaii
<i>C. (T.) kilauea</i> (De Laubenfels, 1951)	280 x 12	144 x 2	630 x 15	not recorded	30–60	14	Hawaii
<i>C. (T.) tingens</i> Hooper, 1996	259–502 x 4.5–10.5	118–208 x 2–5.5	198–524 x 9–19	80–151 x 4.5–12.5	37–342	10–20	Great Barrier Reef
<i>C. (T.) hallmani</i> Hooper, 1996	284–450 x 2–4.5	94–151 x 0.8–2.5	312–419.5 x 8–11	52–72 x 3–6.5	174–481	5–17	North Australia
<i>Clathria (Thalysias) naikaiensis</i> (Hoshino, 1981)	up to 385 x 8	as small as 185 x 3	145–362 x 9–12	58–65 x 4–7	not recorded	not recorded	Japan

Other thinly encrusting species from the Central and West Pacific are likewise clearly dissimilar to our new species: *Clathria (Thalysias) longitoxa* (Hentschel, 1912 as *Hymenaphia*) from the Arafura Sea has raphide-like toxas of 800 µm. *Clathria (Thalysias) toxifera* and *Clathria (Thalysias) calochela* (both described by Hentschel, 1912 as *Hymenaphia*) also from the Arafura Sea have chelae twice as long as those of the Clipperton material including two size classes of toxas, plus overall spicules are considerable thicker. *Clathria (Microcionia) placenta* (De Laubenfels, 1954a as *Microcionia*) and *Clathria (Microcionia) lajorei* (De Laubenfels, 1954a as *Anaata*), both from the Central Pacific, lack toxas. *Clathria (Microcionia) mima* (De Laubenfels, 1954a as *Ophlitaspongia*) likewise from the Central Pacific lacks chelae. *Clathria (Thalysias) maunaloa* (De Laubenfels, 1951 as *Microcionia*) from Hawaii has tiny chelae of 5–6 µm and much longer toxas (up to 132 µm) with a short shallow curve in the middle and straight ends. *Clathria (Thalysias) kilauea* (De Laubenfels, 1951 as *Axocielita*) lacks echinating acanthostyles and has C shaped chelae with reduced alae. *Clathria (Microcionia) micronesia* (De Laubenfels, 1954a as *Microcionia*) has very large, deeply curved toxas of 170 µm, and lacks a second category of ectosomal subtylostyles. *Clathria (Microcionia) spinatoxa* (Hoshino, 1981 as *Microcionia*) from Japan has toxas with spined endings. *Clathria (Thalysias) naikaiensis* (Hoshino, 1981 as *Eurypon*) lacks both toxas and chelae. *Clathria (Thalysias) tingens* Hooper, 1996 has the sizes of the echinating acanthostyles and the toxas twice that of the new species. *Clathria (Thalysias) hallmanni* Hooper, 1996 is essentially similar to our new species but differs sharply by the shape and the size of the ‘accolada’-type toxas.

Very few encrusting microcionids have been reported from the tropical East Pacific coasts, and no matching descriptions from that area are apparent. Northern California has several species, but none of these appear similar: *Clathria (Microcionia) microjoanna* (De Laubenfels, 1930 as *Microcionia*) has the overall spiculation like our new species, but this is a thickly encrusting (2 cm) compact sponge, with the main styles much thicker and shorter (approx. 300 x 20–27 µm) and entirely smooth, without the subterminal constriction found in the Clipperton species. Toxas are twice as long and the chelae include peculiar reduced C shapes. *Clathria (Microcionia) parthena* (De Laubenfels, 1930 as *Microcionia*) is likewise much thicker in shape, has much thicker smooth styles and chelae twice as large. *Clathria (Wilsonella) pseudonapyra* (De Laubenfels, 1930 as *Clathriopsamma*) lacks chelae and has microxeas. *Clathria (Microcionia) pennata* (Lambe, 1895 as *Desmacella*) lacks chelae and acanthostyles.

To facilitate comparison of closely similar species, the thinly encrusting *Clathria (Thalysias)* species of the warmer waters of the Pacific are summarized in Table 4.

## Suborder Myxillina

### Family Coelosphaeridae

#### Genus *Coelosphaera* Thomson, 1873

#### Subgenus *Coelosphaera* Thomson, 1873

#### ?*Coelosphaera (Coelosphaera)* sp.

(Figs 8A–D)

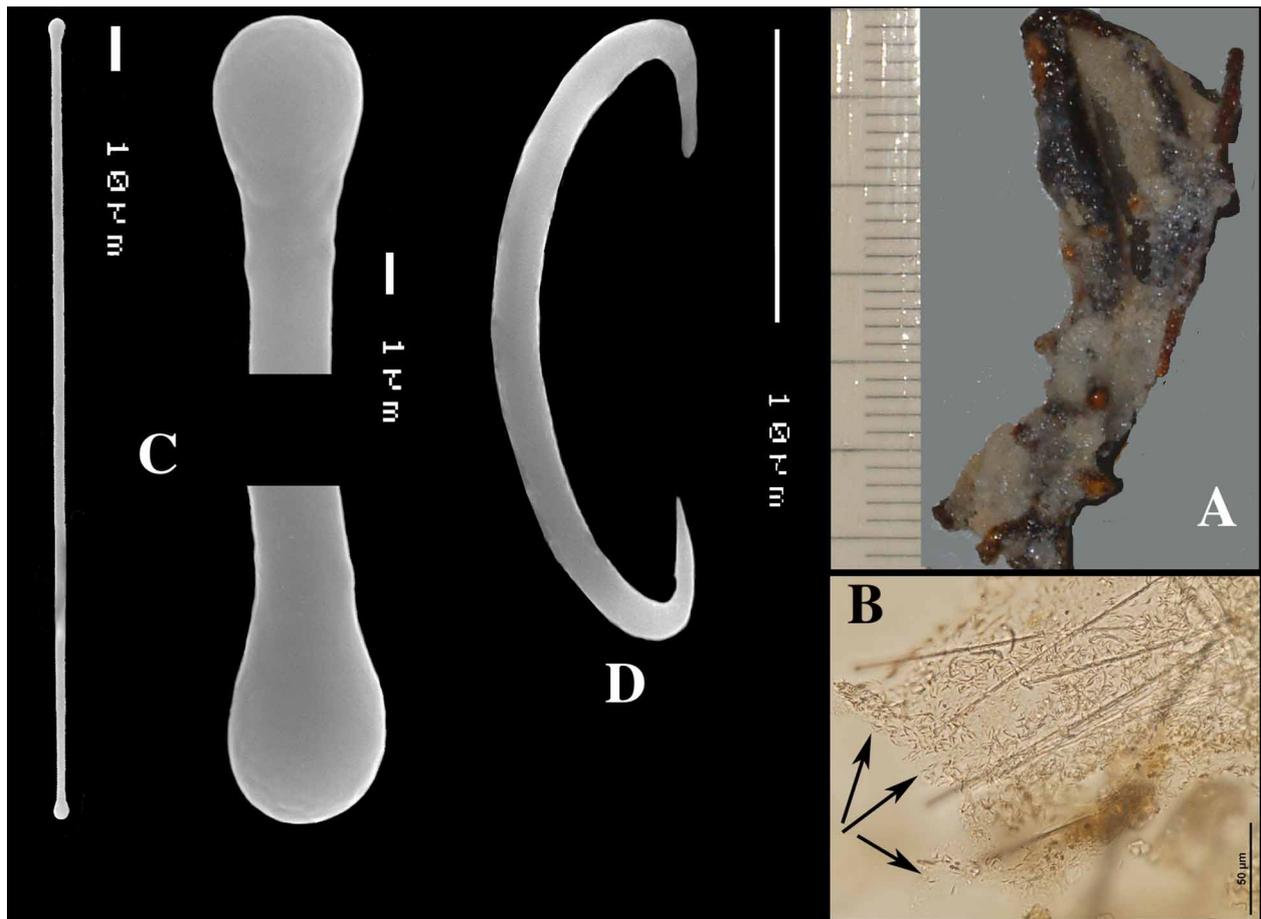
**Material examined.** MNHN DCL 4056–A, Jean-Louis Etienne Expédition Clipperton 2005, station 16, 55 m, on dead antipatharians, 01–2005, 1 specimen.

MNHN DCL 4940, Jean-Louis Etienne Expédition Clipperton 2005, station 26, on dead antipatharians, 01–2005, 1 specimen.

**Description.** Thin, transparent crust, growing on black corals (Fig. 8A). Less than 0.5 mm in thickness and less than 1 cm in lateral expansion. In alcohol, translucent blue, black coral substratum visible through sponge. Oscules not apparent, no other distinctive surface characteristics.

**Skeleton** (Fig. 8B). Loose bundles of tylotes, 10–20 spicules in cross section, rise from the substrate and fan out at the surface without forming a continuous tangential skeleton. Microscleres scattered in the surface membrane.

**Spicules.** Tylotes, sigmas and trichodragmata.



**FIGURE 8.** ?*Coelosphaera* (*Coelosphaera*) sp., undetermined specimen MNHN DCL 4056–A. A. habit encrusting black corals, B. light microscopy view to show skeleton, sigmas and numerous wedge-shaped presumed trichodragmas (arrows), scale-bar = 50 µm, C. tylole and details of heads, D. sigma.

Tyloles (Fig. 8C), thin, with prominent globular heads, entirely smooth, often slightly curved, 177–186.1–207 x 2.5–3.2–4 µm, tyloles 4–4.8–6 µm.

Sigmas (Fig. 8D), of common shape, fairly robust, 18–22.9–29 µm.

Trichodragmas (Fig. 8B, arrows), usually arranged in loose groups of 4–8 dragmas, each individual dragma peculiarly shaped with raphides arranged such that the dragmas are usually slightly swollen in the mid-section, 6–8.4–11 x < 0.5 µm.

**Ecology.** Deeper reef slope, on the dead base of bushy antipatharians at 55 m.

**Remarks.** We refrain from naming this sponge material, as it is too flimsy and possibly displays reduced spiculation. More elaborate specimens are necessary to properly describe it as a likely new species. Assignment of this material to the myxilline family Coelosphaeridae is made on the possession of smooth tyloles and sigmas as the main spicule types present. Assignment to the genus *Coelosphaera*, subgenus *Coelosphaera*, despite its lack of the usual isochela microscleres, is made on the basis of the lack of further megasclere types and on the lack of choanosomal structure. However, assignment to *Coelosphaera* is tentative and based on the assumption that isochelae somehow have become lost in the differentiation of the species. *Coelosphaera* are also usually hollow bladder-like sponges provided with fistules, whereas the new species is thinly encrusting. Although trichodragmas are commonly reported in *Coelosphaera* species, the precise shape and size in our new species are quite unusual and provide the principal characteristic of the species. It is not certain that the trichodragma-like structures (arrows in Fig 7B) are indeed siliceous as we were unable to find them in the SEM preparations. An outside possibility is that the structures are organic and are e.g. cellular inclusions of unknown composition.

There is one other species in *Coelosphaera* possessing, on paper, similar spiculation: the North Atlantic thinly encrusting deep sea species *Coelosphaera* (*Coelosphaera*) *macrosigma* (Topsent, 1890 as *Gellius*), possessing

tylotes, sigmas and trichodragmas. The similarity is not very great, however, as the spicules sizes are many times those of the present new species (tylotes of 700 x 10 µm, sigmas in two size categories, the larger of which is over 400 µm, and trichodragmas of 15–65 µm). For this North Atlantic material, the genus *Xytopsoocha* was erected by De Laubenfels (1936a). This is considered a junior synonym of *Coelosphaera*, but it should perhaps be revived now that the existence of two species answering to its diagnosis have been demonstrated. Hartman (in Lewis 1965) reports a *Xytopsoocha* sp. from Barbados deep water, but he did not give any description so the properties of this material remain uncertain.

Possibly the species could also fit in the coelosphaerid genus *Lissodendoryx* Topsent, 1892, subgenus *Anomodoryx* Burton, 1934, the only megascleres of which are likewise smooth tylotes, but for that assignment our specimen should have isochelae. Species so far in that subgenus have fairly massive or elaborate growth forms unlike our material.

*Strongylacidon* Lendenfeld, 1897 species have simple skeletal structures of loose bundles of diactinal megascleres and are known to possess reduced microsclere complements consisting of sigmas only (e.g. Caribbean *S. viride* Van Soest, 1984), but megascleres in that genus are strongyles, not tylotes.

## Family Hymedesmiidae

### Genus *Hymedesmia* Bowerbank, 1864

#### Subgenus *Hymedesmia* Bowerbank, 1864

#### *Hymedesmia* (*Hymedesmia*) *prostrata* Thiele, 1903

(Figs 9A–E)

*Hymedesmia prostrata* Thiele, 1903: 955, fig. 20.

**Material examined.** MNHN DCL 4042–B, Jean-Louis Etienne Expédition Clipperton 2005, station 18, 55 m, on dead corals, 20–01–2005, 1 specimen.

MNHN DCL 4049–A, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 31–01–2005, 1 specimen.

**Description.** Thinly encrusting (Fig. 9A), microhispid, covering areas of several cm<sup>2</sup>. No apparent oscules or porefields. Consistency soft, easily damaged.

**Skeleton.** Megascleres are arranged erect on the substrate (hymedesmioid), loose bundles or single tornotes at the surface.

**Spicules.** Anisotornotes, acanthostyles and arcuate isochelae.

Tornotes (Fig. 9B) with one end mucronate and slightly swollen, the other end tapering evenly rounded, 114–137.3–156 x 1.5–2.5 µm.

Large acanthostyles (Fig. 9C) densely spined at the head, more sparingly spined towards the pointed end, 149–186.2–233 x 7–8.4–10 µm.

Small acanthostyles (Fig. 9D) heavily spined all over, 57–65.3–78 x 4–5.6–6 µm.

Arcuate isochelae (Fig. 9E) in a large size range but not divisible in categories, alae frequently somewhat irregular or partially split, 12–17.5–21 µm.

**Ecology and distribution.** Encrusting undersides of corals over a wide depth range; reported from Île Clipperton, Ternate and Aldabra.

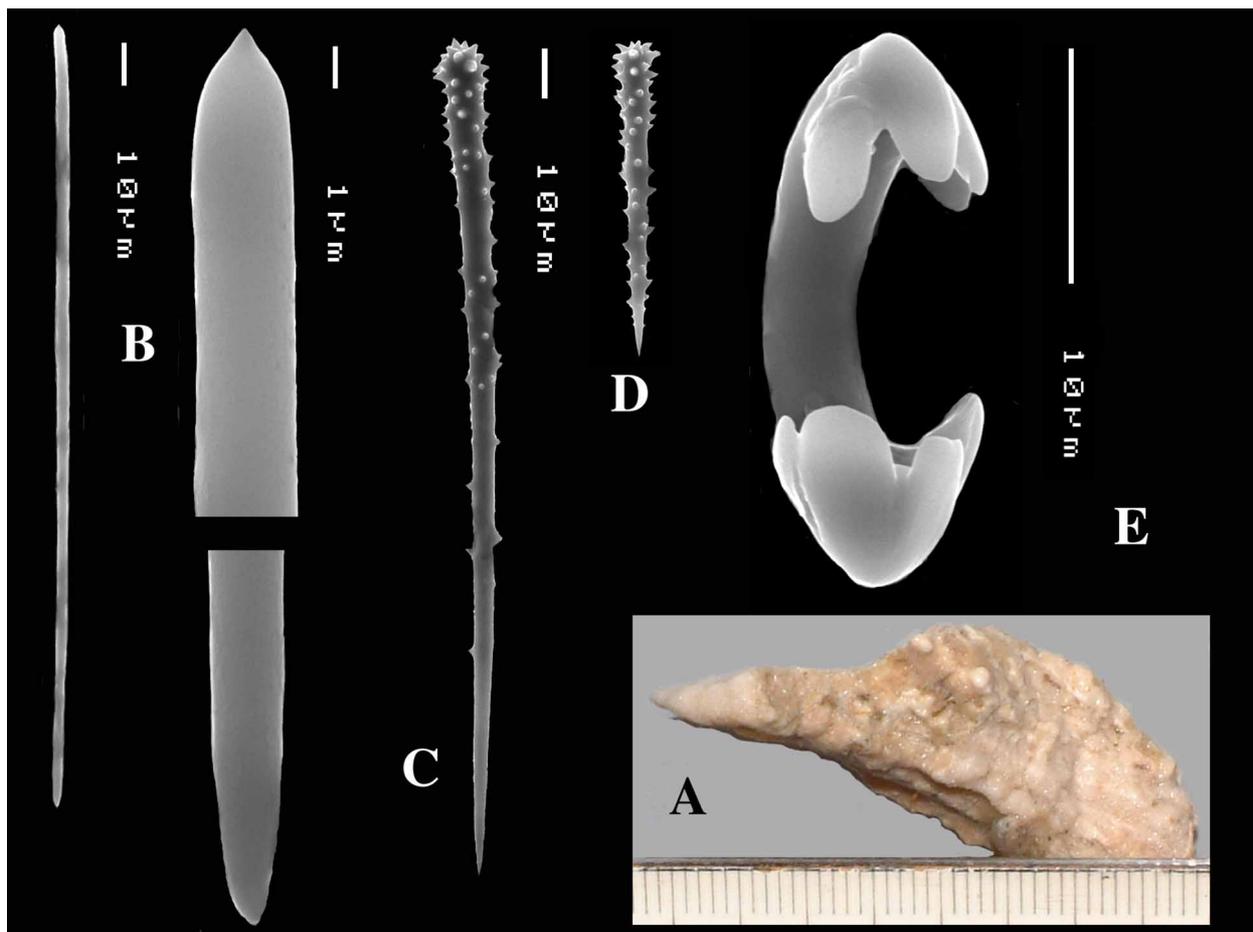
**Remarks.** The identification with Thiele's Ternate species is made on the basis of generally similar spicular characters, although the tornotes of Thiele's specimen were slightly longer (200 µm). Sizes of acanthostyles (240 and 90 µm) are close and particularly the aniso-condition of the tornotes is similar to our specimen. *Hymedesmia* records from shallow Indo-Pacific waters are few.

Sponges of the genus *Hymedesmia* are typical deep-water / cold-water species, with relatively few known from shallow-water and even fewer from shallow coral reef environments. Most species have been described from the North Atlantic, and only half a dozen were recorded from the Pacific and none from the tropical East Pacific. The

nearest recorded shallow-water species is *Hymedesmia* sp. from Hawaii (Bergquist 1977), apparently blue colored, but no further data were provided. As far as is known *H. (H.) prostrata* is never blue-colored. A record from Indonesia, apart from Thiele's from Ternate, is *Hymedesmia (Hymedesmia) mertoni* Hentschel, 1912 from the Arafura Sea. This has similar megasclere sizes and shapes, but differs sharply from our species in possessing two categories of both isochelae and sigmas. Eastward, Sim & Bakus (1986) report the occurrence of the North Atlantic deep sea species *Hymedesmia (Hymedesmia) levis* Lundbeck (1910) from the coast of California; their specimen has tornotes in the form of tylotes, unlike our tornotes, and their acanthostyles were considerably shorter than ours. It is unlikely that their material from 9 m depth is conspecific with Lundbeck's deep sea species.

Further away to the south (Patagonia) two species described by Thiele (1905), *Hymedesmia irritans* and *Hymedesmia laevis* were assigned to other genera (*Forcepia* Carter, 1874 and *Hymenancora* Lundbeck, 1910, respectively) by Van Soest *et al.* 2008. In the South West Pacific, northern New Zealand, three species of *Hymedesmia* have been recorded, viz. *Hymedesmia (Hymedesmia) lundbecki* Dendy, 1924, *Hymedesmia (Hymedesmia) microstrongyla* Bergquist & Fromont, 1988 and *Hymedesmia (Hymedesmia) anisostrongyloxea* Bergquist & Fromont, 1988. All three differ from *H. (H.) prostrata* in having larger, more robust chelae, but *H. (H.) microstrongyla* is closely similar to our material in other aspects.

To the north, in Japanese waters, occurs *Hymedesmia (Hymedesmia) uchinourensensis* Hoshino, 1981, which differs clearly in having the shaft of the chelae 'serrated' (bluntly spined) quite unlike the commonplace smooth chelae of our species. Two deep-water species from New Caledonia, *Hymedesmia (Hymedesmia) spiniarcuata* Lévi & Lévi, 1983 and *Hymedesmia (Hymedesmia) brachyrhabda* Lévi & Lévi, 1983 also have spined chelae. All three should perhaps be transferred to the genus *Acanthancora* Topsent, 1927 because of the spined condition of the chelae.



**FIGURE 9.** *Hymedesmia (Hymedesmia) prostrata* (Thiele, 1903), specimen MNHN DCL 4042-B, A. habit encrusting a piece of dead coral, B. tornote and detail of apices showing anisotornote condition, C. large acanthostyle, D. small acanthostyle, E. arcuate isochela.

Shallow-water species from the Indian Ocean, e.g. *Hymedesmia* (*Hymedesmia*) *tenuissima* (Dendy, 1905 as *Myxilla*) (subsequently recorded from the Great Barrier Reef by Burton 1934), and *Hymedesmia* (*Hymedesmia*) *dichela* (Hentschel, 1911 as *Leptosia*) are not only far removed from the present location but they also differ in spicule sizes (shorter acanthostyles and larger chelae in *tenuissima*) and categories (two sizes of chelae in *dichela*).

*Hymedesmia* (*Hymedesmia*) *prostrata* was also recorded by Lévi (1961) from the Western Indian Ocean. Spicule categories and sizes are closely similar to ours. Lévi (1961) suggests that *Hymedesmia* (*Hymedesmia*) *lancifera* Topsent, 1906 from the Western Indian Ocean is a junior synonym.

## Family Tedaniidae

### Genus *Tedania* Gray, 1867

#### Subgenus *Tedania* Gray, 1867

#### *Tedania* (*Tedania*) *strongylostylota* Kennedy & Hooper, 2000

(Figs 10A–E)

*Tedania* (*Tedania*) *strongylostylota* Kennedy & Hooper, 2000: 447, fig. 1.

**Material examined.** MNHN DCL 4045–A, Jean-Louis Etienne Expédition Clipperton 2005, station 13, 33 m, on dead corals, 18–01–2005, 5 specimens.

MNHN DCL 4053–B, Jean-Louis Etienne Expédition Clipperton 2005, station and depth not recorded, on dead corals, 1 specimen.

MNHN DCL 4054–B, Jean-Louis Etienne Expédition Clipperton 2005, station 8, 15 m, on dead corals, 14–01–2005, 1 specimen.

MNHN DCL 4056–B, Jean-Louis Etienne Expédition Clipperton 2005, station 16, 55 m, on dead antipatharians, 01–2005, several specimens. (Fig. 10A).

**Description.** Thickly encrusting, up to 0.5 cm thick and several cm in lateral expansion, with irregular but smooth surface (Fig. 10A). No oscules apparent. Whitish in alcohol. Consistency soft.

**Skeleton.** Irregular reticulation of megascleres leading to an ill-developed surface skeleton. Megascleres of choanosome and ectosome at first glance differing only in the spined apices of the latter.

**Spicules.** Tylotes, strongylylotylotes, onychaetes.

Tylotes (Fig. 10B) with slightly swollen, microspined apices, overall smooth and straight, 195–221.7–236 x 2.5–3.8–5 µm (heads 4.5–5.3–6.5 µm).

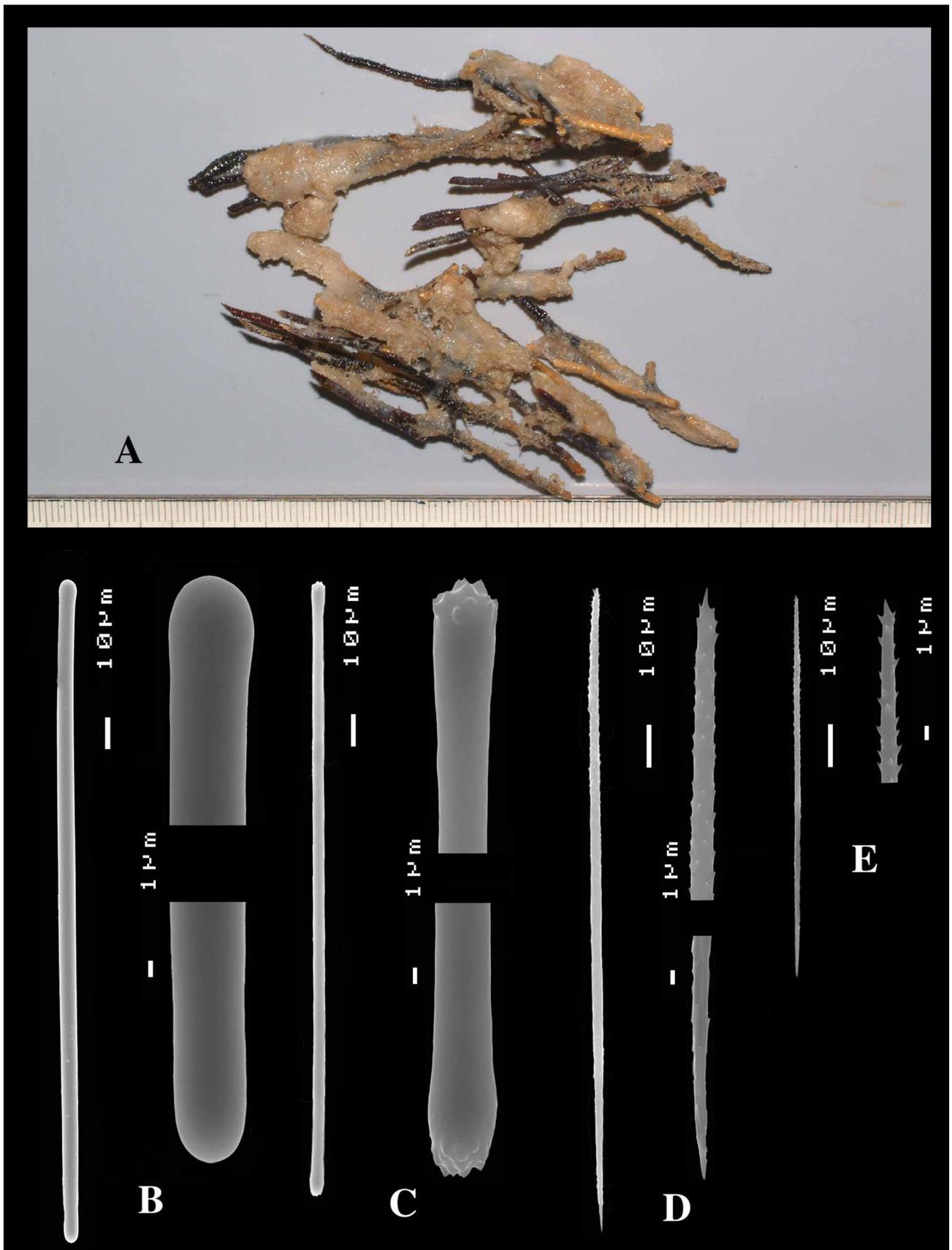
Strongylylotylotes (Fig. 10C), anisotylote with one end slightly swollen but smooth, the other end of the same thickness as the shaft, 207–225.4–238 x 4–5.2–8 µm (swollen end 4.5–6.1–9 µm).

Onychaetes, asymmetric style-shaped, in two non-overlapping size categories: (1, Fig. 10D) 121–152.1–177 x 1–1.8–2.5 µm, (2, Fig. 10E) 21–45.3–66 x 0.5–1 µm.

**Ecology and distribution.** On dead corals and antipatharians in a wide depth range; known from Île Clipperton and Vanuatu.

**Remarks.** Our specimens differ slightly from the type specimen of *T. (T.) strongylostylota* from Vanuatu in having one end of the strongylylotylotes slightly swollen whereas these of the type are not swollen at one end, merely asymmetrical. Also the second onychaete category differs in the maximum length (up to 66 µm in our material, up to 103 µm in the type, although the average lengths are closely similar). It nevertheless appears closest to our material and specific distinction appears unlikely in view of spicular similarity. Its origin in Vanuatu suggests a possible colonization of Clipperton from the west. Like in the type material the principal megascleres of our specimens differ from Chinese *T. (T.) strongyla* in being asymmetrical.

The species belongs to a group of small-spiculed *Tedania* (*Tedania*) species with choanosomal styles modified to strongylylote forms, such as *Tedania* (*Tedania*) *brasiliensis* Mothes *et al.*, 2000 and *Tedania* (*Tedania*) *strongyla* Jinhe, 1986. They appear to have the ectosomal and choanosomal spicules similar in length and thickness, while the onychaetes are predominantly in two size categories roughly between 100–200 and 40–80 µm.



**FIGURE 10.** *Tedania (Tedania) strongylostylota* Kennedy & Hooper, 2000, sample 4056-B, A. habit of specimen growing on antipatharian stalks, B. choanosomal strongylostylote with details of apices, C. ectosomal tylote and details of microspined apices, D. large onychaete and details of apices, E. small onychaete and detail of anterior apex.

*Tedania* species reported from geographically closer areas such as Galápagos (*Tedania (Tedania) galapagensis* Desqueyroux-Faúndez & Van Soest, 1997, Easter Island *Tedania (Tedania) tepitootehenuaensis* Desqueyroux-Faúndez, 1990, Mexican *Tedania (Tedania) nigrescens* sensu Green & Gómez, 1986 (not: Schmidt, 1862), Californian *Tedania (Tedania) obscurata* (De Laubenfels, 1930 as *Tedanione*), *Tedania (Tedania) topsenti* De Laubenfels, 1930, and *Tedania (Tedania) toxicalis* De Laubenfels, 1930, differ clearly in having normal choanosomal styles. This also applies to several *Tedania* species reported from various Pacific locations by Thiele (1903), Hentschel (1912), Hoshino (1981) and Bergquist & Fromont (1988).

## Suborder Mycalina

## Family Esperipsidae

## Genus *Ulosa* De Laubenfels, 1936a

### *Ulosa pacifica* n. sp.

(Figs 11A–C)

**Holotype.** ZMA Por. 13998, Clipperton Island, 10°18'N 109°13'W, 9–18 m, coll. K. Kaiser, 14–26 April 1994.

Additional specimens examined (not type material). MNHN DCL 4048–A, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 31–01–2005, 1 specimen.

MNHN DCL 4059–A, Jean-Louis Etienne Expédition Clipperton 2005, station 1, on dead corals, 6–01–2005, 1 specimen.

**Description.** Thin transparent to dirty white encrustation underneath coralline algae and found occupying crevices in dead coral. In places the dark red color of the coralline alga on which it grew shines through the transparent skin (Fig. 11A). Approx. 10 x 5 mm in lateral size, less than 1 mm in thickness. Surface smooth, faintly irregular. Consistency soft.

**Skeleton** (Fig. 11B). A wispy, loose reticulation of spongin enclosed spicule tracts running parallel with the surface, seen through the skin at low magnification as whitish lines, amber-colored in transmitted light. Although some of the spicule-fibers are clearly thicker and more continuous than the majority of intercrossing and parallel fibers, there is no regular anisotropic reticulation with clear primary and secondary fibers. Spicule-fibers varying in thickness from 8–12 µm in the smallest to 60 µm in the prominent ones. The number of spicules in the fibers is less variable, 3 to 9 spicules per cross section, with the connecting fibers having fewest spicules. Meshes formed by the fibers are irregularly rectangular, 160 – 420 µm wide.

**Spicules.** Only megascleres, no microscleres. Spicules thin, curved or wavy styles (Fig. 11C) and strongylote forms, with one or both ends variably pointed, rounded, stair-stepped or with open-ended axial canals, 273–331.3–384 x 3–3.9–5 µm.

**Etymology.** Named for its regional occurrence.

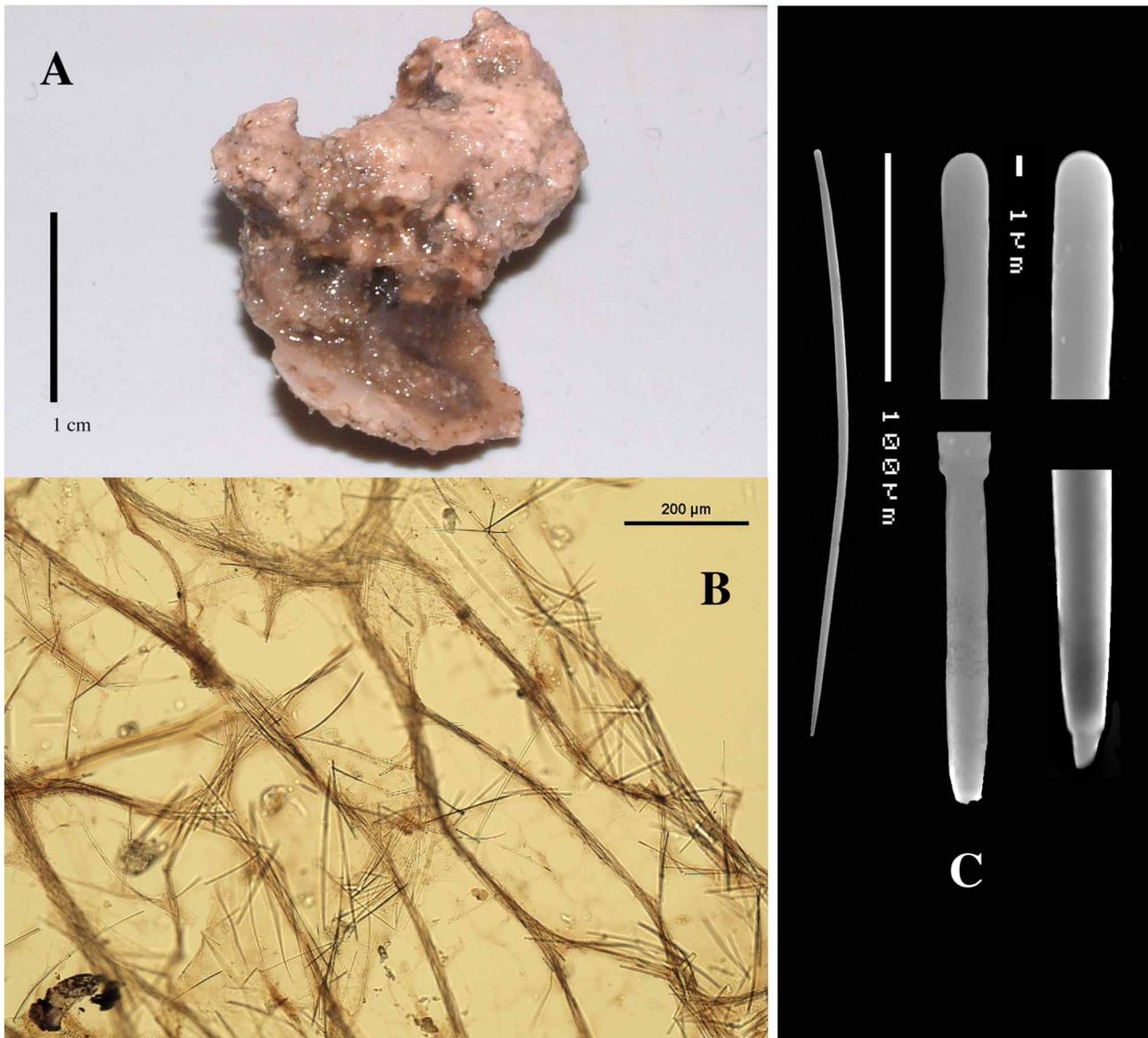
**Ecology.** Under dead coralline rubble in shallow reef environment.

**Remarks.** In addition to the holotype, several other thin crusts with only styles as spicules were found among the 2005 material. These crusts were so tiny and thin that no structure of the skeleton could be detected and spicules appeared thinner. These crusts were likely incipient specimens of the present species.

The genus *Ulosa* was earlier reported from the Central Pacific by De Laubenfels (1954a) with *Ulosa spongia*, a species of similar habit (encrusting), skeleton (spongin reticulation) and spiculation (styles). However, the largest styles of this species are 500 x 5 µm, clearly much larger than those of our new species. The specimen was also larger (10 cm) and thicker (10 mm) than the present material. *Ulosa rhoda* De Laubenfels, 1957 from Hawaii is ramose and has styles much thicker than those of our specimens (300–400 x 13–15 µm).

The World Porifera Database (Van Soest *et al.* 2008) assigned the Pacific *Protophilitaspongia ada* De Laubenfels, 1954a to *Ulosa*. This is a thinly ramose species with hastate oxeads of less than 100 µm in length, thus quite unlike our species.

The type of *Ulosa*, *U. angulosa* (Lamarck, 1814 as *Spongia*) from South Australia is not well characterized as it is only known from Topsent's (1931) redescription. It is a massive sponge with spongin fiber reticulation containing smaller (125–180 µm) and relatively thicker styles (5 µm).



**FIGURE 11.** *Ulosa pacifica* n. sp., holotype ZMA Por. 13998, A. habit encrusting a piece of dead coral, scale bar = 1 cm, B. light microscopical view of the skeleton, scale bar = 200 µm, C. stylote megasclere with details of various posterior apices.

## Order Halichondrida

### Family Halichondriidae

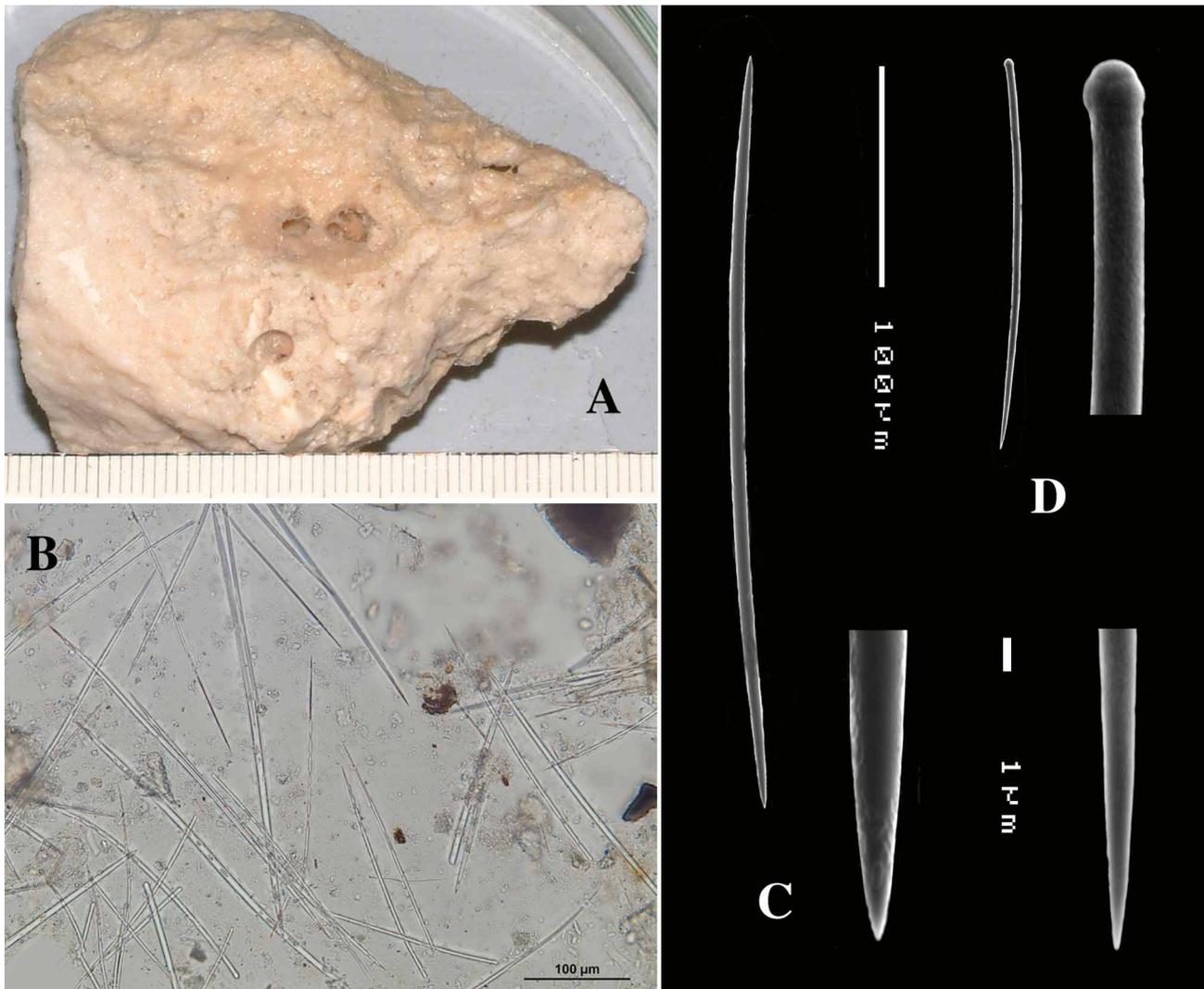
#### Genus *Johannesia* Gerasimova *et al.* 2008

#### *Johannesia* sp.

(Figs 12A–D)

**Material examined.** MNHN DCL 4042–C, Jean-Louis Etienne Expédition Clipperton 2005, station 18, 55 m, on dead corals, 20–01–2005, 1 specimen.

**Description.** Sponge forming a thin membrane over seemingly empty spaces underneath dead corals (Fig. 12A), largest patch 15 x 10 µm. Surface smooth. Two large rounded apertures are present on the location of a deeper hole which may be caused by damaging of the sponge. Consistency soft, easily damaged.



**FIGURE 12.** *Johannesia* sp., undetermined specimen MNHN DCL 4042–C, A. habit encrusting a dead coral, B. light microscopic overview of spicules, scale bar = 100 µm, C. oxea and detail of apex, D. (sub-)tylostyle and detail of head.

**Skeleton** (Fig. 12B). Ectosomal skeleton is a tangential arrangement of loose oxeas and tylostyles, forming a detachable skin. There is no clear choanosomal skeletal arrangement of spicules other than loose individual spicules in confusion.

**Spicules.** Oxeas (Fig. 12C), thin, symmetrical, evenly tapering to a sharp point,  $384\text{--}419.1\text{--}517 \times 6\text{--}7.7\text{--}9 \mu\text{m}$ ; (sub-)tylostyles (Fig. 12D) with distinct but slight tyle,  $182\text{--}237.4\text{--}291 \times 2\text{--}3.59\text{--}5.5 \mu\text{m}$  (tyle  $3\text{--}4.2\text{--}6 \mu\text{m}$ ).

**Ecology.** Encrusting the underside of corals at greater depths (55 m).

**Remarks.** The material is thin and sparse, and spiculation and skeletal arrangement are insufficient for proper characterization of the species to which it belongs. The combination of oxeas and tylostyles in a halichondroid arrangement is characteristic of the genus *Johannesia* Gerasimova *et al.* 2008. This genus is based on type species *Vosmaeria reticulosa* Thiele, 1905 from the SE Pacific (Northern Chile and Peru). It is a massive sponge with a halichondroid skeleton with spicules similar in length but clearly thicker: oxeas  $200\text{--}700 \times 4\text{--}20 \mu\text{m}$  and (sub-)tylostyles of  $100\text{--}400 \times 3\text{--}15 \mu\text{m}$ . Another major difference is the presence of spicule tracts, which are entirely lacking in our specimen. Still, it is not impossible that our material is an incipient sponge of this species.

## Order Haplosclerida

### Suborder Haplosclerina

#### Family Callyspongiidae

## Genus *Callyspongia* Duchassaing & Michelotti, 1864

### Subgenus *Callyspongia* Duchassaing & Michelotti, 1864

#### *Callyspongia* (*Callyspongia*) *roosevelti* n. sp.

(Figs 13A–F)

*Callyspongia vaginalis* sensu De Laubenfels, 1939: 2 (not: *Callyspongia* (*Cladochalina*) *vaginalis* (Lamarck, 1814).

**Holotype.** ZMA Por. 13984, Clipperton Island Expedition 1994, 10°18'N 109°13'W, 9–18 m, coll. K. Kaiser, 14–26 April 1994, 1 specimen.

Paratype ZMA Por. 13983, same data, 1 specimen.

Paratype ZMA Por. 13985, same data, 1 specimen.

Paratype USNM 22659, Clipperton Island, shore collecting on rocks, to south of landing place, coll. W.L. Schmitt, July 21, 1938, nr. 9, 'Presidential Cruise 1938, Honorable Franklin D. Roosevelt, donor' (Fig. 13B).

Paratypes CASIZ 180250, Clipperton Island Expedition 1994, NE side, 15 m, coll. R.J. van Syoc nr. RVS–221, 18–04–1994, 2 specimens.

Paratypes MNHN DCL 4039, Jean-Louis Etienne Expédition Clipperton 2005, station 38, 17 m, on dead corals, 28–01–2005, 2 specimens.

Paratypes MNHN DCL 4041, Jean-Louis Etienne Expédition Clipperton 2005, station 45, 22 m, on dead corals, 5–02–2005, 3 specimens.

Paratypes MNHN DCL 4043, Jean-Louis Etienne Expédition Clipperton 2005, station 29, 10 m, on dead corals, 24–01–2005, 10 specimens.

Paratypes MNHN DCL 4046, Jean-Louis Etienne Expédition Clipperton 2005, station 3, 20 m, on dead corals, 8–01–2005, 4 specimens.

Paratypes MNHN DCL 4048–B, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 31–01–2005, 4 specimens.

Paratypes MNHN DCL 4049–B, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 31–01–2005, 17 specimens (Fig. 13C).

Paratypes MNHN DCL 4050–A, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 31–01–2005, 5 specimens.

Paratypes MNHN DCL 4052–A, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 6–01–2005, 6 specimens.

Paratypes MNHN DCL 4053–C, Jean-Louis Etienne Expédition Clipperton 2005, station and depth not recorded, on dead corals, 20 specimens.

Paratype MNHN DCL 4058, Jean-Louis Etienne Expédition Clipperton 2005, station 2, on dead corals, 7–01–2005, 1 specimen.

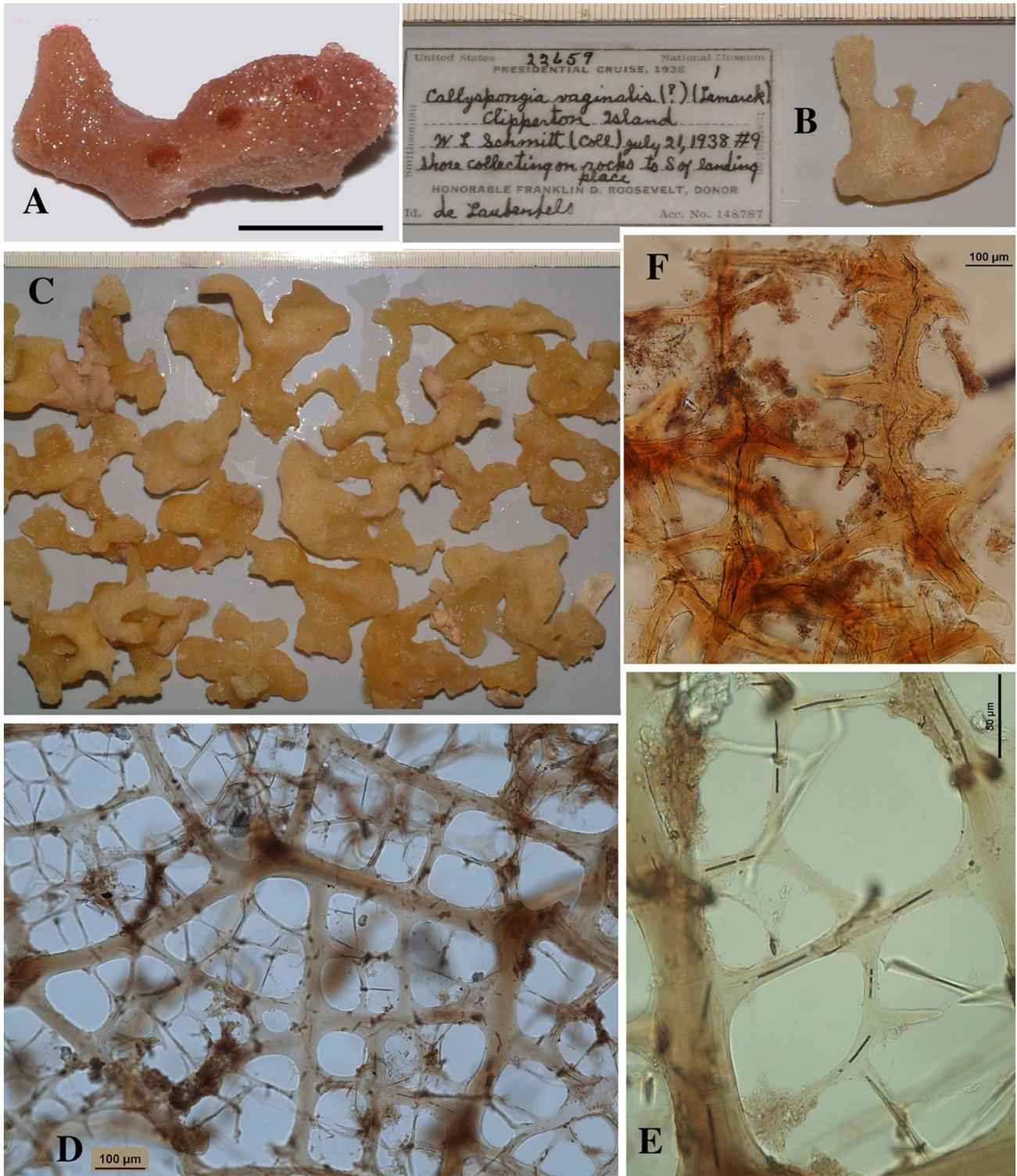
Paratype MNHN DCL 4060, Jean-Louis Etienne Expédition Clipperton 2005, station 1, on dead corals, 6–01–2005, 1 specimen.

Paratype MNHN DCL 4062–B, Jean-Louis Etienne Expédition Clipperton 2005, station 25, 18 m, on dead corals, 23–01–2005, 1 specimen.

**Description.** Repent ramose sponge with lobate outgrowths (Figs 13A–C). Most specimens are attached partly or wholly to dead coral. Surface optically smooth, color red-brown (in alcohol). Maximum length of branches 3.5 cm, diameter approx. 0.6–1 cm, lobes also up to 1 cm in diameter. Oscules regularly distributed over branches and lobes, usually not at the summit of lobes, but slightly off-centre; they are flush with the surface and have a diameter of 2–4 mm. Consistency toughly compressible, not easily damaged.

**Skeleton.** Strongly developed stratified spongin fibers cored sparingly by diactinal spicules. Ectosomal skeleton (Figs 13D–E) the usual double network of polygonal primary meshes 500–750 µm in diameter made by primary fibers of 30–90 µm thickness, subdivided by triangular secondary meshes of 100–250 µm made by fibers of 15–27 µm thickness. All fibers are cored by single spicules. The surface of the ectosomal network is in places echinated by small brushes of one or two spongin-encased spicules, but only irregularly so, not like in the subgenus *Euplaccella*. Choanosomal skeleton (Fig. 13F) is a relatively irregular reticulation of heavily stratified knotty fibers forming occasional rectangular but more frequently polygonal meshes. Little distinction between primary and sec-

ondary fibers other than direction and more frequent pausicircular coring in the former. Meshes 150–500  $\mu\text{m}$  in diameter. Primary fibers 60–90  $\mu\text{m}$  in thickness with a core of 1–5 spicules (usually 1 or 2) which are not aligned but tend to fan out within the fiber core. Secondary fibers 40–70  $\mu\text{m}$  in thickness, usually cored by a single spicule.



**FIGURE 13.** *Callyspongia (Callyspongia) roosevelti* n. sp., A. holotype ZMA Por. 13984, scale bar = 1 cm, B. paratype USNM 22659 originally reported as *Callyspongia vaginalis* by De Laubenfels (1939), C. paratypes MNHN DCL 4049–B, D. light microscopic view of the ectosomal skeleton showing the characteristic double-meshed *Callyspongia* skeleton, scale bar = 100  $\mu\text{m}$ , E. detail of the same, showing single thin spicules coring the fibers, scale bar = 50  $\mu\text{m}$ , F. choanosomal skeleton showing knotted fibers with a light core of spicules, scale bar = 100  $\mu\text{m}$ .

**Spicules.** Thin, strongylote, apices rounded but tapering, size 48–60.8–71 x 0.5–1 µm.

**Etymology.** Named after President Franklin D. Roosevelt, who facilitated the 1938 cruise to Île Clipperton which allowed W.L. Schmitt to collect the first specimen of the new species.

**Ecology.** Encrusting dead coral in shallow-water down to 22 m.

**Remarks.** De Laubenfels (1939) recorded *Callyspongia vaginalis* (Lamarck, 1814) from Clipperton Island but he did not provide a description. *C. vaginalis* is a common Caribbean species belonging to the subgenus *Cladochalina* Schmidt, 1870, forming large tubes with a strongly conulose surface, polyspicular fibers and oxea-shaped spicules. The Clipperton material of De Laubenfels (Fig. 13B) is quite dissimilar in shape to the Caribbean species.

Dickinson (1945) described *Callyspongia californica* from the Pacific coast of Mexico. This is similar in shape to our new species but differs clearly in the size of the spicules (oxeas of up to 150 x 5 µm) and coring of the choanosomal fibers (up to 20 spicules). The species was recently redescribed by Cruz-Barraza & Carballo (2008) as blue in life, with a multispicular skeletal reticulation and spicules of 52–73–117 x 1.3–2.4–5 µm. It is likely that this species belongs to the subgenus *Cladochalina*, unlike our new species.

Desqueyroux-Faúndez (1990) reported *Callyspongia fusifera* (Thiele, 1905 as *Chalina*) from Easter Island. This species, originally from Patagonia, forms similar small lobes as the above described specimens, but differs also clearly by the thickness of the spicules (up to 7 µm), the extent of coring of the main fibers (up to 8 spicules in cross section) and the consistency (soft).

The Clipperton collection of the Jean-Louis Etienne 2004/5 Expedition contains a further specimen of *Callyspongia* (*Callyspongia*) which is so macerated that it is not possible to classify it properly; its skeleton is much lighter built than that of the above specimens, fibers are thinner and meshes are larger. The spicules are similar in size and shape to those of *C. (C.) roosevelti* n. sp., but it could also belong to the genus *Chalinula* Schmidt, 1868.

## Family Chalinidae

### Genus *Haliclona* Grant, 1836

#### Subgenus *Gellius* Gray, 1867

#### *Haliclona* (*Gellius*) *violacea* De Laubenfels, 1950

(Figs 14A–D)

*Haliclona enamela* sensu De Laubenfels, 1939 (not: *Haliclona enamela* De Laubenfels, 1930).

*Toxadocia violacea* De Laubenfels, 1950: 16, fig. 9.

**Material examined.** USNM 22658 Clipperton Island, shore collecting on rocks, to south of landing place, coll. W.L. Schmitt, July 21, 1938, nr. 9, 'Presidential Cruise 1938, Honorable Franklin D. Roosevelt, donor' (Fig. 14A).

**Description.** Encrusting sponge with small lobes, several of which bear a terminal oscule (Fig. 14A). Size approx. 3.5 x 2 x 1 cm. Consistency soft, limp. Color (alcohol) light pinkish brown.

**Skeleton** (Fig. 14B). Largely unispicular, but rather irregular, due to virtual absence of nodal spongin.

**Spicules.** Oxeas and toxas.

Oxeas (Fig. 14C), of the characteristic *Haliclona* form, slightly curved, sharply pointed, 93–105.1–119 x 3–3.6–4.5 µm.

Toxas (Fig. 14D), thin, variably curved, in a wide size range, 34–42.2–63 x 0.5 µm.

**Ecology and distribution.** On intertidal coral rocks. Known from Île Clipperton and Hawaii (Oahu).

**Remarks.** We were able to compare a fragment of the type from Hawaii (USNM 22752) with the present specimen and this conforms in most details to De Laubenfels' type. Habit and size of the sponge, unispicular skeleton with little or no spongin, size and shape of oxeas, size and shape of toxas. The only difference appeared to be the thicker toxas (1 µm against 0.5 µm in the present material). The live color is not preserved in the fragment of the type, nor in the Clipperton material, but we assume the specimen to have had a violet live color.

It is not clear why De Laubenfels (1939) assigned the specimen to the Central Californian *Haliclona enamela* De Laubenfels (1930). This species does not possess toxas and is otherwise also dissimilar (spongin rich skeleton with ascending fibers cored by 8–12 spicules, cf. De Laubenfels 1932: 119).

A second Central Pacific *Haliclona* species with toxas is the sponge originally described as *Toxadocia tyroeis* De Laubenfels (1954a) from Palau. This has a cheesy consistency and a dense mass of oxeas of two size classes, quite unlike the present material.



**FIGURE 14.** *Haliclona (Gellius) violacea* (De Laubenfels, 1950), specimen USNM 22658, A. habit, originally identified as *Haliclona enamela* De Laubenfels, 1930 by De Laubenfels (1939), B. light microscopic view of surface skeleton showing unispicular arrangement of the spicules, scale bar = 100 µm, C. oxeas, D. toxas.

### Subgenus *Reniera* Schmidt, 1862

#### *Haliclona (Reniera)* sp.

**Material examined.** MNHN DCL 4053–D, Jean-Louis Etienne Expédition Clipperton 2005, station and depth not recorded, on dead corals, 1 specimen.

MNHN DCL 4054–C, Jean-Louis Etienne Expédition Clipperton 2005, station 8, 15 m, on dead corals, 14–01–2005, 2 specimens.

**Description.** Flimsy, thin patches on the underside of dead corals. Skeleton unispicular, oxeas thin, 105–126 x 2–4 µm. No microscleres other than a few sigmas that are almost certainly contaminations.

**Remarks.** This material is insufficient to characterize it against the many *Haliclona (Reniera)* species. These are likely incipient specimens. They are mentioned here only to draw attention to the existence of a species of *Haliclona (Reniera)* at Clipperton Island.

## Order Dictyoceratida

### Family Spongiidae

#### Genus *Spongia* Linnaeus, 1759

## Subgenus *Spongia* Linnaeus, 1759

### *Spongia* (*Spongia*) *sweeti* (Kirkpatrick, 1900)

(Figs 15A–D)

*Polyfibrospongia sweeti* Kirkpatrick, 1900: 359, pl. XV figs 2a–c.

?*Spongia virgultosa* sensu Desqueyroux-Faúndez 1990: (not: *Euspongia virgultosa* Schmidt, 1868)

**Material examined.** ZMA Por. 13987, Clipperton Island Expedition 1994, 10°18'N 109°13'W, 9–18 m, coll. K. Kaiser, 14–26 April 1994, 1 specimen (Fig. 15A).

ZMA Por. 13989, same data, 1 specimen.

ZMA Por. 13990, same data, 1 specimen.

ZMA Por. 13991, same data, 1 specimen.

CASIZ 180256 (see below under *Clathrina passionensis* n. sp.).

MNHN DCL 4045–B, Jean-Louis Etienne Expédition Clipperton 2005, station 13, 32 m, on dead corals, 18–01–2005, 5 specimens.

MNHN DCL 4048–C, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 31–01–2005, 10 specimens.

MNHN DCL 4048–D, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 31–01–2005, 6 specimens (Fig. 15B).

MNHN DCL 4050–B, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 31–01–2005, 3 specimens.

MNHN DCL 4051, Jean-Louis Etienne Expédition Clipperton 2005, station 43, 8 m, on dead corals, 31–01–2005, 1 specimen.

MNHN DCL 4052–B, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 6–01–2005, 5 specimens.

MNHN DCL 4053–E, Jean-Louis Etienne Expédition Clipperton 2005, station and depth not recorded, on dead corals, 2 specimens.

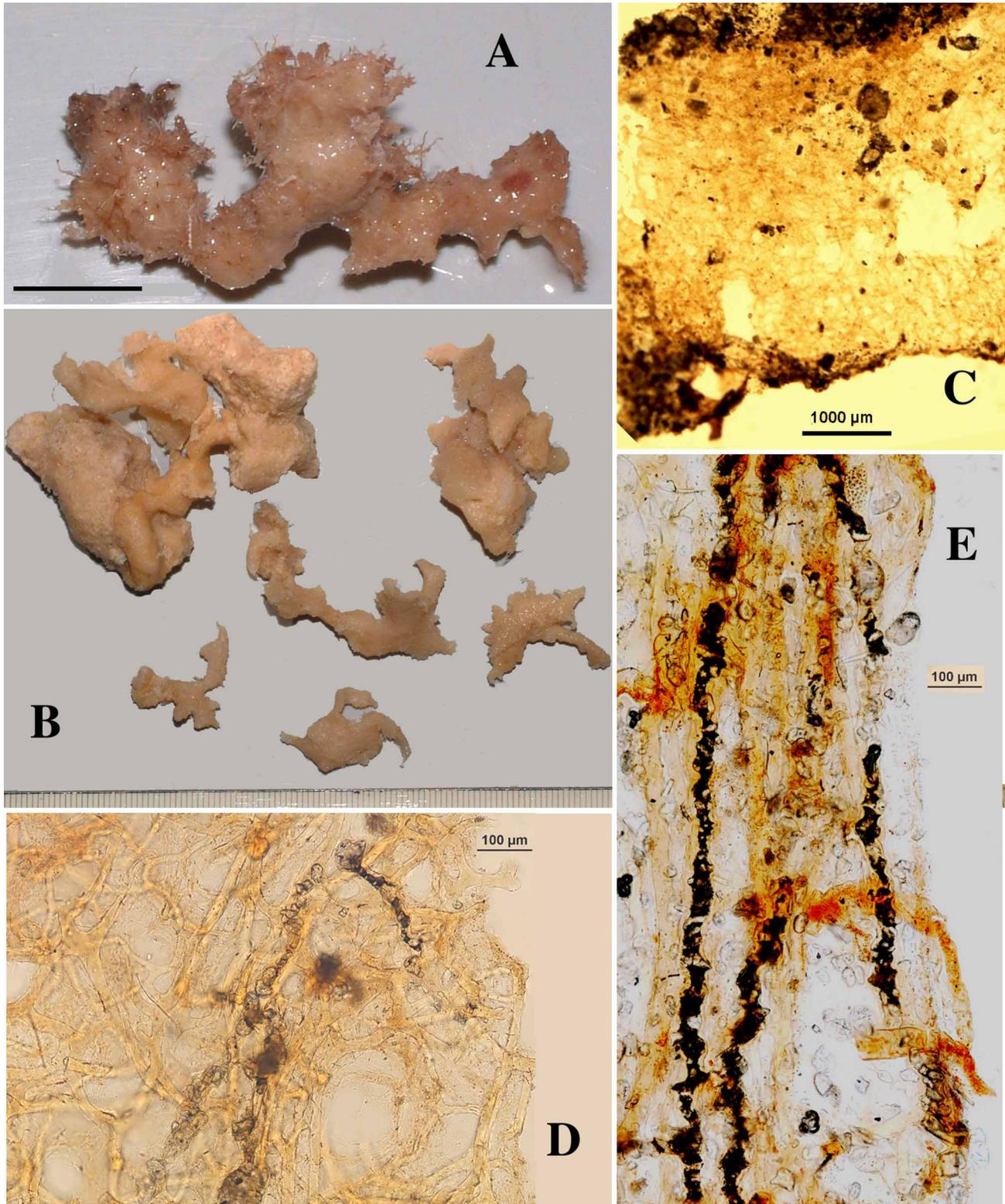
**Description.** Repent ramose (Figs 15A–B), with thin irregular branches sometimes anastomosing into low growing masses; surface irregular, finely conulose, with frequent fistular outgrowths. Several individuals have ingrown hydroids. Size up to 4 cm long, individual branches 0.4–0.5 cm in diameter. Color pale beige (alcohol).

**Skeleton.** Ectosome bears a thin sand coat (Fig. 15C), which appears more or less continuous. The fiber skeleton (Fig. 15D) is typical *Spongia*-like with a predominance of uncored secondary fibers of uniform diameter throughout the sponge, 10–30 µm. Meshes variable in size, 50–200 µm. Primary fibers cored by sand grains, lying at 700–1000 µm distance, their diameter is 35–90 µm. They are readily recognized near the surface (Fig. 15D) but become rarer inwards. The surface fistules are characteristically supported by fascicles of primary fibres (Fig. 15E).

**Soft tissue.** As evidenced by histology choanocyte chambers are uniformly sized and rounded, diameter 24–33 µm. The center areas of many fistules are occupied by numerous embryos in various stages of development, largest embryos 400 µm in diameter.

**Ecology and distribution.** Encrusting dead corals in shallow reef environment down to 32 m; known from Île Clipperton and Funfuti, Tuvalu.

**Remarks.** The shape of the new species is similar to the sponge described as *Polyfibrospongia sweeti* by Kirkpatrick, 1900 from Funafuti, Tuvalu, Central Pacific, which was assigned to *Carteriospongia* by Bergquist (1980). Although she did not explain this assignment, it is likely she based this on the structure of the ectosomal skeleton with a reticulation of prominent primary fibers. Also, Kirkpatrick likened *P. sweeti* to *Polyfibrospongia flabellifera* Bowerbank, 1877 which is a *Carteriospongia*. The drawing of Kirkpatrick's sponge is essentially like our own in dimensions and in the reticulated pattern of primary fibers in the walls of the fistules (Fig. 15E). Kirkpatrick's specimen had much longer fistules, and that appears to be the only difference with our material. Kirkpatrick's (1900) description of the skeleton is misleading where he emphasized bundles of secondary fibers, which occur only in the walls of the fistules. In the main body, the secondary fibers form a continuous anastomosing mass which is characteristic for the genus *Spongia*. The drawing of his Fig. 2a is, in fact, a good representation of the secondary fiber arrangement.



**FIGURE 15.** *Spongia (Spongia) sweeti* (Kirkpatrick, 1900), A. specimen ZMA Por. 13987, scale bar = 1 cm, B. sample MNHN DCL 4048–D with diversity of forms, C. light microscopic view of cross section showing light incomplete surface armour of sand grains, scale bar = 1 cm, D. light microscopic view of peripheral choanosomal skeleton with cored primary fibers and dense mass of secondary fibers, scale bar = 100 µm, E. light microscopic view of a longitudinal section through a fistule to show characteristic parallel primary fiber system, scale bar = 100 µm.

This species is assigned to the subgenus *Spongia* because the secondary fibers are of uniform thickness. The species has an uncommon shape and size for a member of the genus *Spongia* which is predominantly massive,

globular or flabellate, in any case usually much larger and more elaborate. The sponge described as *Spongia virgultosa* by Desqueyroux-Faúndez (1990) from Easter Island is similar in shape and size to our material and the overall skeletal features are also like our specimen with the exception of the finer surface network recorded by Desqueyroux-Faúndez. It is unlikely that the Mediterranean species *Spongia virgultosa* (Schmidt, 1868 as *Euspongia*), although likewise unusual in being low-growing and possessing fistular outgrowths, would occur in the Indo-Pacific. Thus, regardless whether the Easter Island sponge is the same species as ours, the present material clearly belongs to a so far unnamed species. There are no further *Spongia* species recorded from Pacific waters with similar habit.

## Family Thorectidae

### Genus *Aplysinopsis* Lendenfeld, 1888

#### *Aplysinopsis bergquistae* n. sp.

(Figs 16A–F)

**Holotype.** CASIZ 103429, Clipperton Island Expedition 1994, shallow coral platform, under coral rocks, 0.6 m, coll. R.J. van Syoc, nr. RVS–231, 22–04–1994 (Figs 16A–B).

**Description.** Massively encrusting sponge (Fig. 16A), size 14 x 5.5 x 2 cm, with conulose surface (Fig. 16B). Color mottled brown-purple, with irregularly distributed lighter parts. Conules low, blunt, less than 1 mm high or wide. Oscules not certainly present, as the few holes visible appear to be made by commensal organisms. Consistency toughly compressible.

**Surface armour** (Fig. 16C). There is a fairly light but uninterrupted sand cover of approx. 0.3 mm. Interior structure rather lacunose, with large canals and cavities, but some of these may be caused by thin vermetids (Mollusca) which are present in most sections.

**Skeleton** (Fig. 16D). A system of simple, densely cored primary fibers (Fig. 16E), with variable diameter of 45–148 µm, depending of the extent of coring and coarseness of coring material, lying at distances of 0.5–1.4 mm, and irregular secondary/tertiary fibers, uncored, faintly laminated and much thinner, 6–25 µm in diameter, forming fenestrated connections ('secondary webs') (Fig. 16F) with the primary fibers.

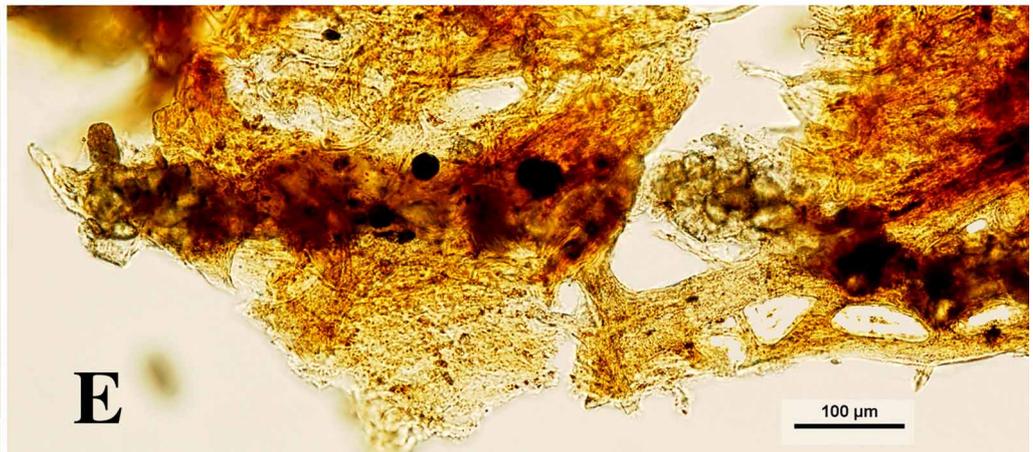
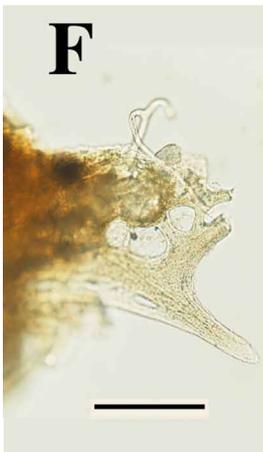
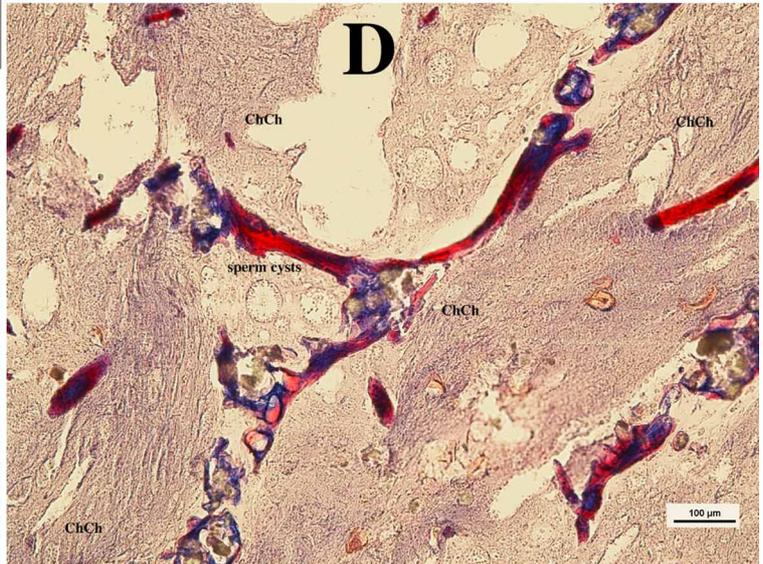
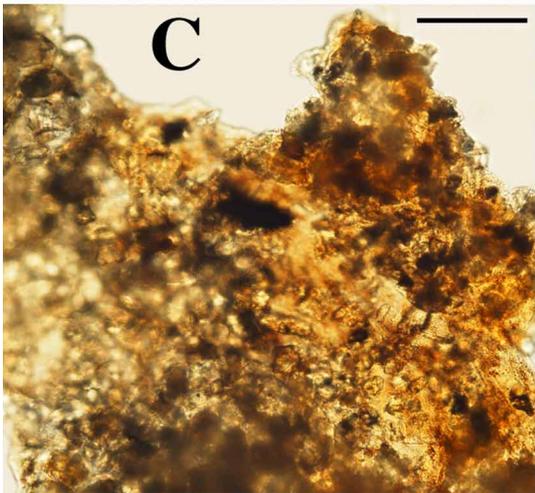
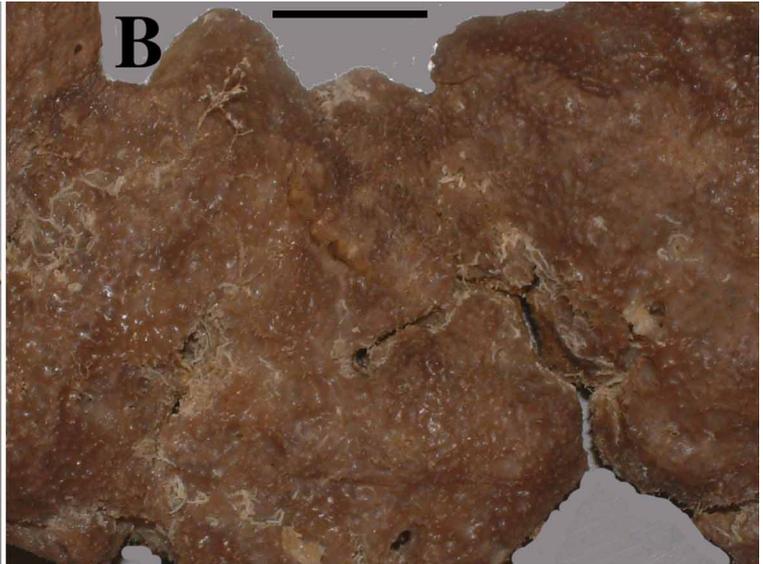
**Soft tissue** (Fig. 16D). Choanocyte chambers (ChCh in Fig. 16D) variable in size, usually elliptical in shape, 24–39 µm in diameter. In the center parts numerous sperm cysts occur in various sizes and stages of development.

**Etymology.** Named after Dame Patricia R. Bergquist, on the occasion of her death, September 2009, to honour her invaluable contributions to the systematics of 'keratose' sponges.

**Ecology.** Under intertidal coral rocks.

**Remarks.** Assignment of the new species to the genus *Aplysinopsis* is based on Cook's (2007) key, an improved version of that of Cook & Bergquist (2002). The combination of a light surface armour, cored primary fibers and uncored irregular secondary fibers is only found in *Aplysinopsis*. However, so far this genus is only reliably represented by its Australian type species *A. elegans* Lendenfeld, 1888 with junior synonyms *A. digitata* Lendenfeld, 1888 and *A. pedunculata* Lendenfeld, 1888 (both described in the same work), despite six more previous assignments of species which are either referred to other existing genera (*A. massa* Szymanski, 1904, *A. tuberosa* Szymanski, 1904, both assigned to *Cacospongia* Schmidt, 1862, *A. reticulata* Hentschel, 1912 to *Fascaplysinopsis* Bergquist, 1980, *A. thielei* Topsent, 1934 to *Dactylospongia* Bergquist, 1965), or are *incertae sedis* (*A. schmidti* Marenzeller, 1877 and *A. lobosa* Burton, 1932). The occurrence of a second valid species of *Aplysinopsis* in a remote locality such as Île Clipperton is thus remarkable. If we would ignore the sand cover at the surface, the present species would key out as *Luffariella* Thiele, 1899 and perhaps this genus is potentially an alternative assignment. However, the skeleton of *Luffariella* is quite regular with primary and secondary fibers strictly rectangular and additionally there are finer tertiary fibers. Another close genus is *Hyrtios* Duchassaing & Michelotti, 1864, with several species described from the SE Pacific (Thiele 1905). However, in this genus, all fibers are cored by foreign material, and the surface is unarmoured.

Group# 1 Cat# 103429  
 Phylum PORIFERA Acc# 27016  
 Taxon  
 Family  
 Name  
 Locality PACIFIC OCEAN: Clipperton Island: shallow coral platform:  
 under coral flats/rocks, DEPTH: 2 ft [RVS-231]  
 Coll. R.J. Van Soest aboard M/V "Royal Star" CollDate 22 Apr 1994  
 Ident IdDate  
 OrigFix: 98% ISOH Pres. 75% EIOH  
 Notes 1 spec.  
 Clipperton Island Exped. 1994  
 CALIFORNIA ACADEMY OF SCIENCES INVERTEBRATE ZOOLOGY



**FIGURE 16.** *Aplysinopsis bergquistae* n. sp., holotype CASIZ 103429, A. habit, B. detail of surface showing a surface with 'goose flesh' (low conules), scale bar = 1 cm, C. light microscopic view of surface armour of sand grains, scale bar = 100 µm, D. histological section of choanosome showing cored primary fiber, uncored (fragments of) secondary fibers and sperm cysts, ChCh = choanocyte chambers, scale bar = 100 µm, E. light microscopic view of primary fiber and irregularly anastomosed secondary fibers, scale bar = 100 µm, F. detail of fenestrated connection of primary and secondary fiber, scale bar = 50 µm.

## Order Verongida

### Family Aplysinellidae

#### Genus *Suberea* Bergquist, 1995

##### *Suberea etiennei* n. sp.

(Figs 17A–C)

**Holotype.** CASIZ 180255, Clipperton Island Expedition 1994, NE side, 15 m, coll. R.J. van Syoc nr. RVS–221, 18–04–1994.

Paratype MNHN DCL 4045–C, Jean-Louis Etienne Expédition Clipperton 2005, station 13, 32 m, on dead corals, 18–01–2005, 1 specimen.

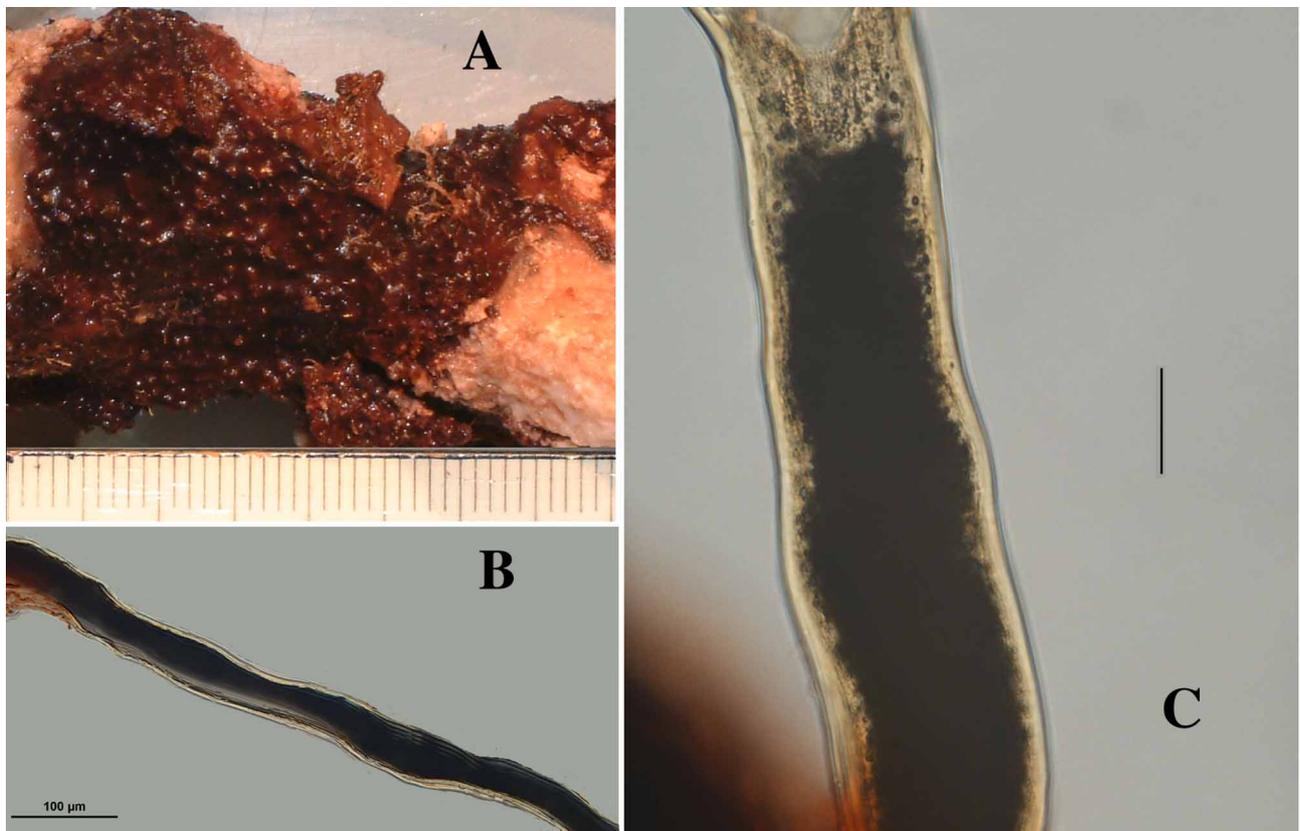
Paratypes MNHN DCL 4049–B, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 31–01–2005, 2 specimens.

Paratypes MNHN DCL 4050–C, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 31–01–2005, 2 specimens.

Paratypes MNHN DCL 4052–C, Jean-Louis Etienne Expédition Clipperton 2005, station 42, 8 m, on dead corals, 6–01–2005, 7 specimens.

Paratypes MNHN DCL 4053–F, Jean-Louis Etienne Expédition Clipperton 2005, station and depth not recorded, on dead corals, 2 specimens. (Fig. 17A).

**Description.** Thickly encrusting to lumpy sponges with surface provided with sharp conules (Fig. 17A). Consistency barely compressible, tough. Size of encrusting patches up to 5 x 4 cm, lumpy parts may be elevated up to 1 cm. No apparent oscules (preserved material). Conules approx. 0.5 mm high, 1–1.5 mm apart, with supporting fiber endings often protruding. Color reddish brown to violet-black (live color unknown, likely to be altered by aerophobic reaction, as is usual for the genus).



**FIGURE 17.** *Suberea etiennei* n. sp. A. one of the paratypes MNHN DCL 4053–F, habit encrusting a coral, B. fiber of the same, scale bar = 100 µm, C. fiber detail of holotype CASIZ 180255, scale bar = 50 µm.

**Skeleton.** Low proportion of pithed fibers compared to the soft tissue. Fibers (Fig. 17B) following a dendritic course, dividing dichotomously or trifold at irregular distances as much as 2 mm or more. Near the surface, fiber divisions are more frequent and the endings support the surface conules. Fibers relatively thin for the genus, 55–97  $\mu\text{m}$  in diameter over much of their length but petering out to the pointed ending of approx. 30  $\mu\text{m}$  diameter. Bark making up approx. 15–20 % of the fiber diameter and strongly laminated (Figs 17B–C).

**Soft tissue.** Although no properly fixed material was available, distributions of cells suggest small rounded choanocyte chambers of 20–25  $\mu\text{m}$  diameter.

**Etymology.** Named after Jean-Louis Etienne, the leader of the 2004/5 Expedition to Île Clipperton, who brought the significant collection of Clipperton sponges to the Muséum national d’Histoire naturelle, Paris.

**Ecology.** Encrusting dead corals in deeper parts of the reef.

**Remarks.** The new species conforms in all major aspects to the genus *Suberea*, including sprawling conulose shape, high organic vs. fiber ratio, dendritic fiber system of pithed fibers with modest bark component, and probable aerophobic color change. Among the species of *Suberea* the new species stands out by its relatively thin fibers. *Suberea* is so far confined to the Indo-Pacific, and one species has been reported from East Pacific waters, *Suberea azteca* (Gomez & Bakus, 1992 as *Aplysina*). This differs clearly from our new species in having an elaborate stalked shape and occasionally anastomosing fibers forming irregular large meshes. This feature seems to exclude it from *Suberea* proper. Nearly all other *Suberea* species have much thicker fibers than our new species, usually well over 200  $\mu\text{m}$  diameter. Only *Suberea creba* Bergquist, 1995 from New Caledonia shows some similarities, as its fibers are ‘only’ 120–250  $\mu\text{m}$  diameter, approx. twice as thick as those of the Clipperton species. The surface of *S. creba* is described and pictured as mostly smooth, lacking the dense conulose aspect of the new species.

## Class Calcarea

### Subclass Calcinea

### Order Clathrinida

### Family Clathrinidae

### Genus *Clathrina* Gray, 1867

#### *Clathrina passionensis* n. sp.

(Figs 18A–E)

**Holotype.** CASIZ 180256, Clipperton Island Expedition 1994, E side, 9–12 m, coll. R.J. van Syoc, nr. RVS–235, 23–04–1994, growing on a specimen of *Spongia* (*Spongia*) *sweeti*.

**Description.** Encrusting mass (Fig. 18A) of tightly anastomosing thin tubes, overall size 4 x 4 x 0.5 cm. The sponge encrusts a specimen of *Spongia* (*Spongia*) *sweeti* and it follows the irregular surface contours. Tube network forms a continuous sheet without elevations, but several larger oscules protrude slightly. Individual tubes (Fig. 18C) approx. 0.2 mm in diameter, meshes (Fig. 18B) approx. 0.5 x 0.2 mm. Water-collecting tubes are absent. Consistency fairly soft, easily damaged. Color dirty white (in alcohol).

**Skeleton.** Asconoid with a single layer of triactines and tetractines forming the tube walls.

**Spicules.** Triactines and tetractines variable in size, but not divisible in size categories, both generally of the same size. Rays conical with sharp points.

Triactines (Fig. 18D), equiangular, rays 27–77.0–117 x 4–8.6–13  $\mu\text{m}$ .

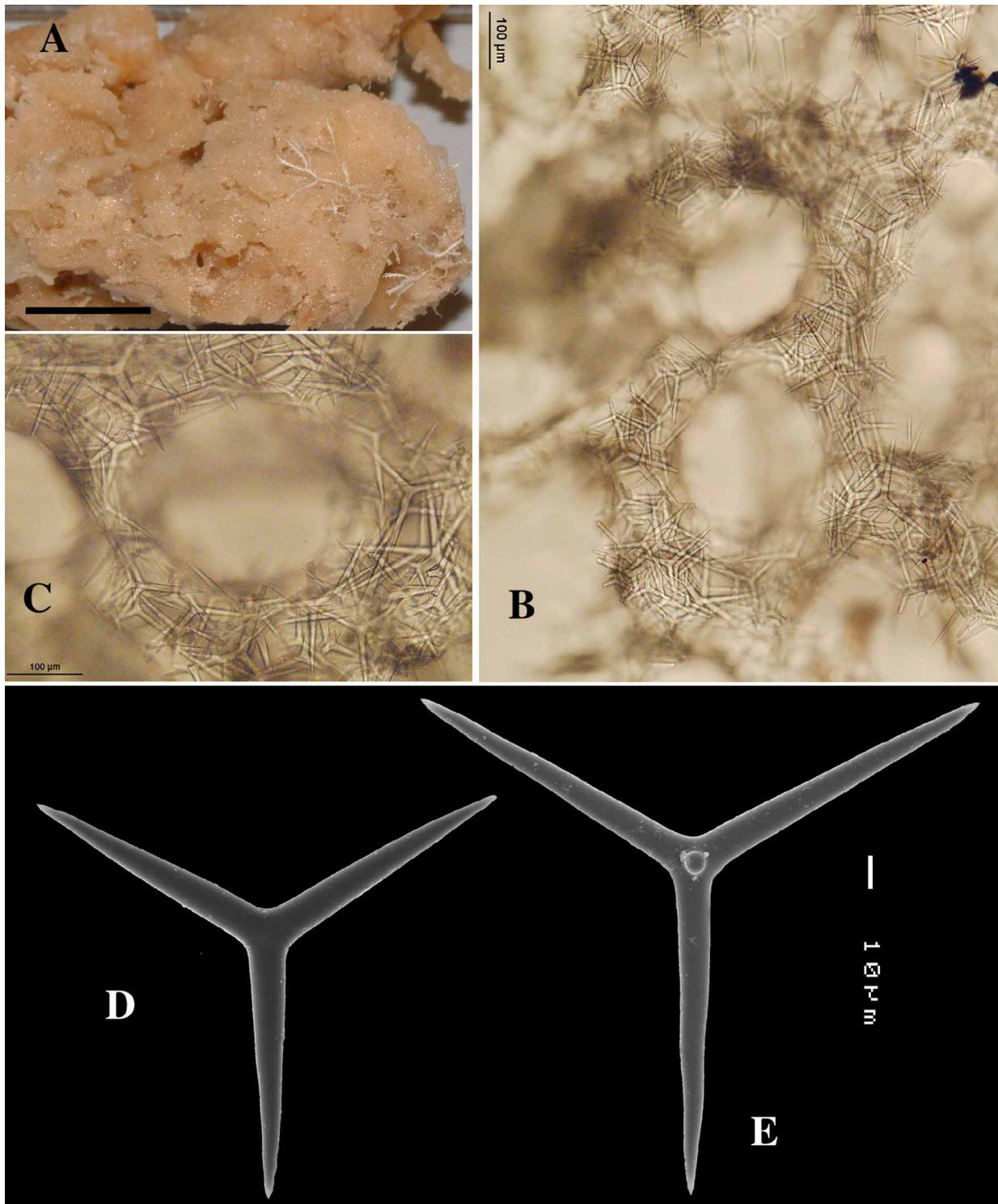
Tetractines (Fig. 18E), equiangular, facial rays 18–67.8–99 x 5–7.8–12  $\mu\text{m}$ , apical rays shorter and sharply pointed, 27–41 x 3–4  $\mu\text{m}$ .

**Etymology.** Named after ‘Isla de Pasión’, the original name for Île Clipperton.

**Ecology.** Encrusting sponges in shallow reef habitat.

**Remarks.** A recent monograph of *Clathrina* by Klautau & Valentine (2003) allowed us to compare the present species with descriptions of *Clathrina* from the Indo-Pacific. Among these are three species possessing both triactines and tetractines, and sharing the lack of diactines, trichoxeas or tripods with our new species, viz. *Clathrina adusta* Wörheide & Hooper, 1999 from the Great Barrier Reef, *Clathrina gardineri* Dendy, 1913 from the Western

Indian Ocean and *Clathrina africana* Klautau & Valentine, 2003 from South Africa. *Clathrina adusta* is similar to our new species in habit, tube diameter, and tight anastomosis, but average / upper sizes of spicule rays (triactines 110 / 156, tetractines 111/192  $\mu\text{m}$ ) clearly exceed those of the Clipperton material. Furthermore, *C. adusta* changes color from white to brown in preservation, unlike our material. *Clathrina gardineri* likewise is similar, but its triactines are divisible in those with a smaller size category (rays 45–65  $\mu\text{m}$ ) and a larger size category (rays 87–137  $\mu\text{m}$ ). *Clathrina africana* has spicule characters closely similar to our new species, but it is dissimilar in habit as it is a loosely anastomosing network of coarser tubes. A further argument to keep the two distinct at the species level is the distance between Cape Town and Clipperton Island which is assumed to be too great for conspecificity.



**FIGURE 18.** *Clathrina passionensis* n. sp., holotype CASIZ 180256, A. habit encrusting a specimen of *Spongia* (*Spongia*) *sweeti*, scale bar = 1 cm, B and C. details of surface, scale bar = 100  $\mu\text{m}$ , D. triactine, E. tetractine.

## Subclass Calcaronea

### Order Leucosolenida

#### Family Heteropiidae

#### Genus *Sycettusa* Haeckel, 1872

##### *Sycettusa* aff. *sibogae* (Burton, 1930) n.comb.

(Figs 19A–H)

*Grantessa sibogae* Burton, 1930: 4.

**Material examined.** MNHN DCL 4045–D, Jean-Louis Etienne Expédition Clipperton 2005, station 13, 32 m, on dead corals, 18–01–2005, 2 specimens.

MNHN DCL 4057, Jean-Louis Etienne Expédition Clipperton 2005, station 5, 17 m, on dead corals, 10–01–2005, 1 specimen. (Fig. 19A).

MNHN DCL 4064, Jean-Louis Etienne Expédition Clipperton 2005, station 40, 20 m, on dead corals, 29–01–2005, 1 specimen.

Examined for comparison: Holotype, ZMA Por. 00148, Siboga Exped. stat. 077, Indonesia, Borneo Bank, Makassar Strait, 3.45°S 117.6°E, depth 59 m, 10–06–1899.

**Description.** A clustered mass of tubes (Fig. 19A), the largest 5x5x2 cm, individual tubes up to 1 cm long and 0.5 cm in diameter. Color (alcohol) pale yellow-brown.

**Skeleton.** Compressed syconoid without articulation (Fig. 19B). The thin cortex is made up of the actines of cortical equiangular triactines, the choanosome is made up of the unpaired actines of the subcortical larger sagittal triactines; atrial skeleton likewise made up of the paired actines of smaller equiangular triactines.

**Spicules.** Triactines only (Fig. 19C). These are quite diversified, basically divisible in (1) equiangular triactines, large (Fig. 19D), with actines up to 530 x 47 µm, and small (Fig. 19E) up to 164 x 19 µm, and (2) unequiangular triactines which often have downcurved or upcurved paired actines, consisting of large triactines (Fig. 19F) with paired actines up to 290 x 38 and unpaired actine up to 525 x 45 µm, and small triactines (Fig. 19G) with paired actines up to 47 x 7 and unpaired actine 90 x 9 µm. There are also atrial intercrossing trichoxeas (Fig. 19H), invariably broken, largest unbroken fragment: 240 x 1.5 µm.

**Ecology and distribution.** Encrusting dead corals in shallow reefs; if conspecific with the Indonesian material the species is known from Île Clipperton and the Makassar Strait region.

**Remarks.** The genus *Sycettusa* unites former *Grantessa* species lacking an articulated skeleton (Borojevic *et al.* 2002). The species *Grantessa sibogae* Burton (1930) was synonymised with the apparently widespread Indo-Pacific species *Sycettusa sycilloides* (Schuffner, 1877 as *Sycortis*) by Burton (1963) without further comments. For that reason and because Schuffner's material was from East Africa (Mauritius) we prefer to retain *Sycettusa sibogae* n.comb. as a distinct species. The type of *S. sibogae* n.comb. (ZMA Por. 00148) from Makassar Strait, Indonesia, is a single tube and the large triactines have their rays somewhat more curved than in our material but spicule sizes and categories match to a large extent. The possibility that the Clipperton specimens belong to a closely related but distinct species cannot be entirely excluded. For that reason we added 'aff.' to the species identification.

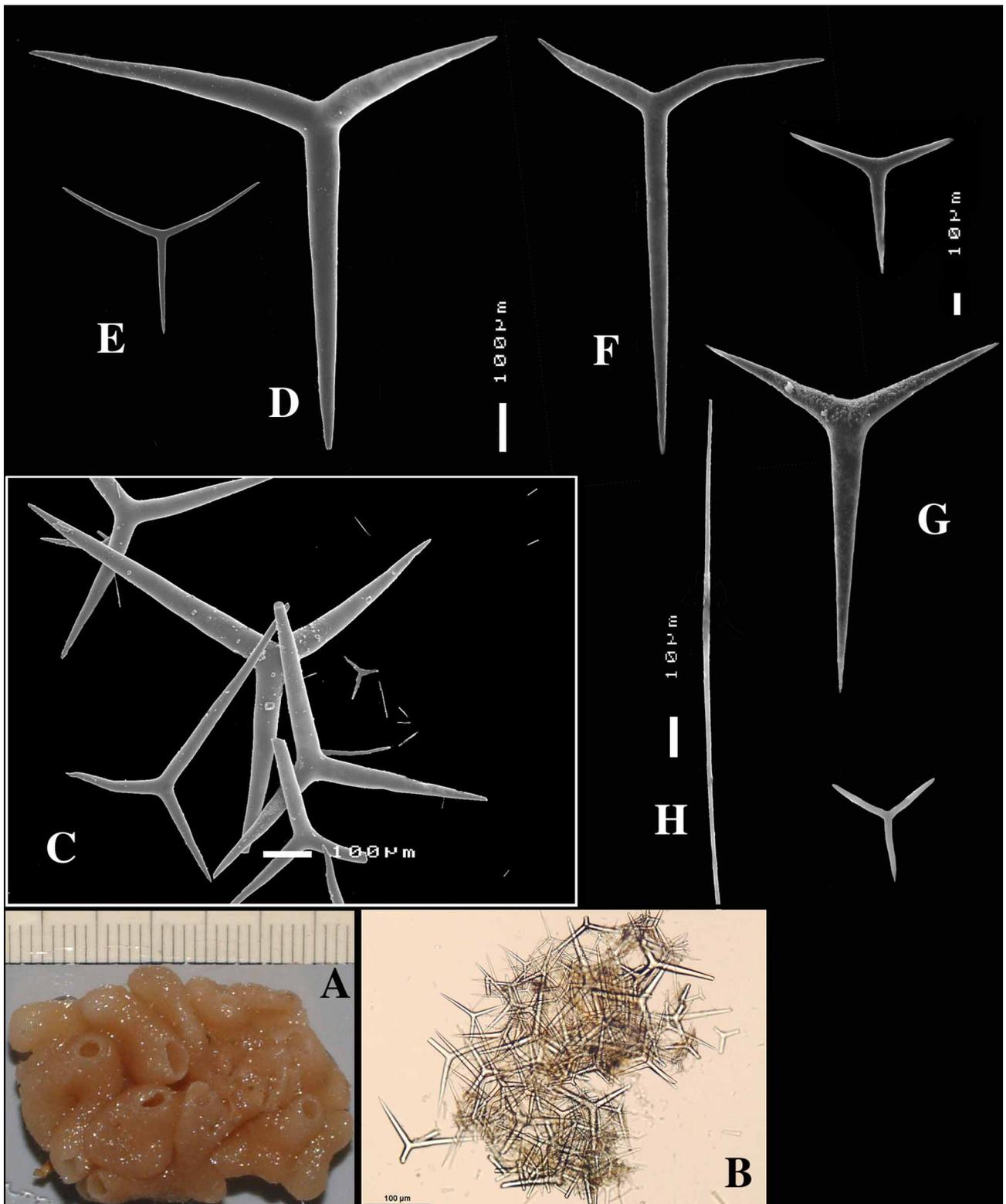
*Sycettusa tenuis* Borojevic & Klautau (2000) from New Caledonia differs from the present material in possessing atrial tetractines and lacking the subdivision in larger and smaller triactines.

#### Family Leucosoleniidae

#### Genus *Leucosolenia* Bowerbank, 1864

##### *Leucosolenia* sp.

**Material examined.** MNHN DCL 4042–D, Jean-Louis Etienne Expédition Clipperton 2005, station 18, 55 m, on dead corals, 20–01–2005, 1 specimen.



**FIGURE 19.** *Sycettusa* aff. *sibogae* (Burton, 1930), A. habit of specimen MNHN DCL 4057, B. light microscopic view of peripheral skeleton, scale bar = 100  $\mu$ m, C. overview of spicule complement, D. large equiangular triactine, E. small equiangular triactine, F. large unequiangular triactine, G. various sizes of unequiangular triactine, H. fragment of trichoxea.

**Description.** Tiny, hollow, lobate branches of less than 0.5 mm diameter. The spiculation consists of triactines both regular and sagittal, with rays varying from 18 x 1  $\mu$ m to 90 x 3  $\mu$ m; tetractines fairly uniform in size, facial rays 60–66 x 2–3  $\mu$ m, apical rays shorter, 10–20  $\mu$ m; oxeas in two distinct size classes 165–270 x 6  $\mu$ m and 75–90 x 1–2  $\mu$ m. A peculiar feature are triactines with strongly curved or hooked ray endings protruding beyond the surface.

**Remarks.** The material is insufficient to characterize properly against the many described *Leucosolenia* species.

### Ecological remarks

The majority of the twenty species are ‘sciophilous’, occurring as thin crusts underneath coral rubble and dead corals measured in millimeters. Only four species are relatively large - measuring centimeters - and are striking enough (bright colors, size) to have been frequently collected at several localities by non-specialist collectors at both the 1994 and the 2004/5 Expeditions of which the material was available for this study: *Tethya sarai*, *Callyspongia* (*Callyspongia*) *roosevelti* n. sp., *Spongia* (*Spongia*) *sweeti*, and *Suberea etiennei* n. sp. One other species of which only a single specimen was collected had similar size, *Aplysinopsis bergquistae* n. sp. All in all, even allowing that collections were made by non-specialists, the sponge fauna can be characterized as poor in numbers and volume, which is typical for exposed reefs at remote localities. Similar observations were made at Isla del Coco by Bakus (1975). Possibly, the phenomenon of high proportion of thin encrustations is not confined to remote and isolated islands, as Carballo & Nava (2007) reported that in some localities of the east Pacific Ocean the percentage of encrusting and ‘cryptic’ species is up to 90%.

### Geographic affinities

The number of species and specimens so far recorded from Clipperton Island is quite small and the sponge fauna must be considered as still insufficiently known. With nine new species the percentage of endemism is 45%, but this figure is probably without much meaning in view of the fact that the sponge fauna of the extensive Central Pacific area needs further exploration and revision of often poorly described material (Kelly-Borges & Valentine 2003). Comparison with adjacent regions to determine geographic affinities and identify likely source areas for the colonization of Clipperton thus remains speculative. A further complication hampering such comparisons is the overall unsatisfactory state of our knowledge of the East Pacific fauna south of California. *Oscarella carmela*, *Tethya sarai* and *Johannesia* sp. appear to be likely of East Pacific origin, but the remaining species are either geographically unaffiliated (*Paratimea globastrella* n. sp., *Aplysinopsis bergquistae* n. sp., *Coelosphaera* (*Coelosphaera*) sp.) or have widespread Central and West Pacific affinities. A very preliminary first conclusion may be that the majority of Clipperton species appear to have invaded from the west, evidenced by shared distributions or occurrence of close relatives in Hawaii, Tuvalu, Indonesia, New Caledonia and Australia. A study of the corals of Clipperton (Glynn *et al.* 1996) came to a similar conclusion.

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