

NEW RECORDS OF RED ALGAE (RHODOPHYTA) FOR CABEZO REEF, NATIONAL PARK SISTEMA ARRECIFAL VERACRUZANO, GULF OF MEXICO

CITLALLI GALICIA-GARCÍA¹, NÉSTOR M. ROBINSON¹
AND YURI B. OKOLODKOV^{2,3}

¹Instituto Tecnológico de Boca del Río, Laboratorio de Biología, km 12 Carretera
Veracruz-Córdoba, 94290 Boca del Río, Veracruz, México.

²Universidad Veracruzana, Instituto de Ciencias Marinas y Pesquerías,
Laboratorio de Botánica Marina y Planctología, Calle Hidalgo 617,
Colonia Río Jamapa, 94290 Boca del Río, Veracruz, México.

³Author for correspondence: yuriokolodkov@yahoo.com

ABSTRACT

Descriptions of 21 red algal species collected in March and November 2008 and June 2010 are given. They are considered new records for Cabezo reef in the southeastern part of the National Park Sistema Arrecifal Veracruzano (NPSAV), southwestern Gulf of Mexico. The new records belong to the genera *Amphiroa*, *Bryothamnion*, *Ceramium*, *Ceratodictyon*, *Colaçonema*, *Galaxaura*, *Hypnea*, *Jania*, *Laurencia*, *Liagora*, *Neosiphonia*, *Pneophyllum*, *Polysiphonia*, *Porolithon*, *Styлонema*, *Titanophycus* and *Yuzurua*. The families Rhodomelaceae and Corallinaceae contain the largest number of species (6 and 5, respectively). Descriptions include morphometric and biological data and are accompanied by photographs and line drawings for each species. Geographic distribution of these algae in the State of Veracruz, park and the Gulf of Mexico are also provided. *Polysiphonia pseudovillum* is a new record for the Gulf of Mexico, while *Colaçonema hallandicum* and *Ceratodictyon planicaule* are new records for the park. Nine species have been found as epiphytes mainly on green and red algae. Tetrasporangia were the dominant reproductive structures found in the studied species during both rainy and dry seasons. Vegetative and reproductive thalli of 10 species from the NPSAV were usually smaller compared to those of the same species found in the Caribbean.

Key words: anatomy, Gulf of Mexico, new records, red algae, taxonomy.

RESUMEN

Se presentan las descripciones de 21 especies de algas rojas colectadas en marzo y noviembre de 2008 y junio de 2010. Estas se consideran nuevos registros para el arrecife Cabezo ubicado en la parte sureste del Parque Nacional Sistema Arrecifal Veracruzano (PNSAV) en el suroeste del Golfo de México, y pertenecen a los géneros *Amphiroa*, *Bryothamnion*, *Ceramium*, *Ceratodictyon*, *Colaçonema*, *Galaxaura*, *Hypnea*, *Jania*, *Laurencia*, *Liagora*, *Neosiphonia*, *Pneophyllum*, *Polysiphonia*, *Porolithon*, *Stylonema*, *Titanophycus* y *Yuzurua*. Las familias Rhodomelaceae y Corallinaceae son las mejor representadas en cuanto al número de especies (6 y 5, respectivamente). Las descripciones incluyen datos morfológicos y biológicos y están acompañadas con fotografías y dibujos a línea para cada especie. Se presenta la distribución geográfica de estas algas en el estado de Veracruz, el parque y el Golfo de México. *Polysiphonia pseudovillum* es nuevo registro para el Golfo de México, mientras que *Colaçonema hallandicum* y *Ceratodictyon planicaule* lo son para el parque. Nueve especies se encontraron como epífitas principalmente de algas verdes y rojas. Las estructuras reproductoras que predominaron en las algas estudiadas tanto en la época de lluvias como en la de secas fueron los tetrasporangios. Los talos vegetativos y reproductivos de 10 especies del PNSAV fueron usualmente más pequeños comparados con los de los mismos taxa encontrados en el Caribe.

Palabras clave: algas rojas, anatomía, Golfo de México, nuevos registros, taxonomía.

INTRODUCTION

Mexico has 11,593 km of coastline with various physiographic characteristics and climate types (Contreras-Espinosa, 1993). Both morphological and ecological diversity of macroalgae of the littoral zone are high; however, our knowledge, especially regarding management of this diversity, is still poor (Galicia-García & Morales-García, 2007). Mexico in general is no longer at the initial stage of marine phycological exploration (Pedroche & Senties-Granados, 2003); however, that is not the case for macroalgal flora of the National Park Sistema Arrecifal Veracruzano (NPSAV). The NPSAV is a marine protected area with an elevated marine biodiversity, including macroalgae. Taking into account all floristic, ecological and taxonomic studies on macroalgae performed in the NPSAV until 2011, nine reefs out of 25, including Cabezo reef, have not been considered at all, although floristic studies prevail among others (Huerta, 1960;

Humm & Hildebrand, 1962; De la Campa-Guzmán, 1965; Mendoza-González & Mateo-Cid, 1985; Lehman & Tunnell, 1992; Lehman, 1993; Mateo-Cid et al., 1996; Morales-García et al., 1997; Dreckmann, 1998; Ortega et al., 2001; Orduña-Medrano, 2004; Mateo-Cid, 2006). All these studies contributed to the knowledge of the species and their local distribution, their seasonality or other ecological aspects; however, only few works documented the algal morphology with photographs or line drawings, and most of previous studies were done in shallow water.

In the State of Veracruz, a total of 210 red algae species were found, and in the NPSAV in particular, 157 species (Galicia-García & Morales-García, 2007). The largest number of species was encountered in Isla de Enmedio, Isla Verde, Isla Sacrificios and Hornos reefs. This number is directly proportional to the number of studies carried out in these sites, followed by La Blanquilla, Santiaguillo, La Gallega, Punta Gorda, Giote, Ingenieros and Blanca reefs.

The main purposes of the present study were to contribute to our knowledge of the red algae of the NPSAV on the basis of the morphology of the species found in Cabezo reef and to document their records.

MATERIAL AND METHODS

In the southwestern Gulf of Mexico, in the coastal waters of the State of Veracruz, there are 31 coral reefs located on the continental shelf. Information on the general climate can be found in Anonymous (1987). The diurnal tidal range reaches 95 to 105 cm (Salas-Pérez et al., 2008; González et al., 2009). Average water temperature is 26.6 °C and usually fluctuates between 22.9 °C and 32 °C. The salinity offshore is about 36 to 38 psu (Carrillo et al., 2007; Okolodkov et al., 2007; Salas-Monreal et al., 2009). Cabezo reef is 6.2 km long and 2.5 km wide. It lies 15 km from the coastline at 19°04'26" N and 95°50'43" W (Fig. 1). It is composed almost exclusively of coral fragments and lacking terrestrial vegetation.

During *Cepia* boat trips within the NPSAV, specimens of red algae were collected manually or with a knife on Cabezo reef while snorkeling at 0.5 to 1.5 m depth on 1 and 11 March 2008, 12 November 2008 and 3 June 2010. Algal specimens were placed into a 500-ml plastic bottle or a Ziplock plastic bag filled with seawater from the sampling site. Immediately after sampling, a stock 37% formaldehyde solution was added to the samples to a final concentration of 4%. The samples were incorporated into the collection of liquid samples and the herbarium of macroalgae

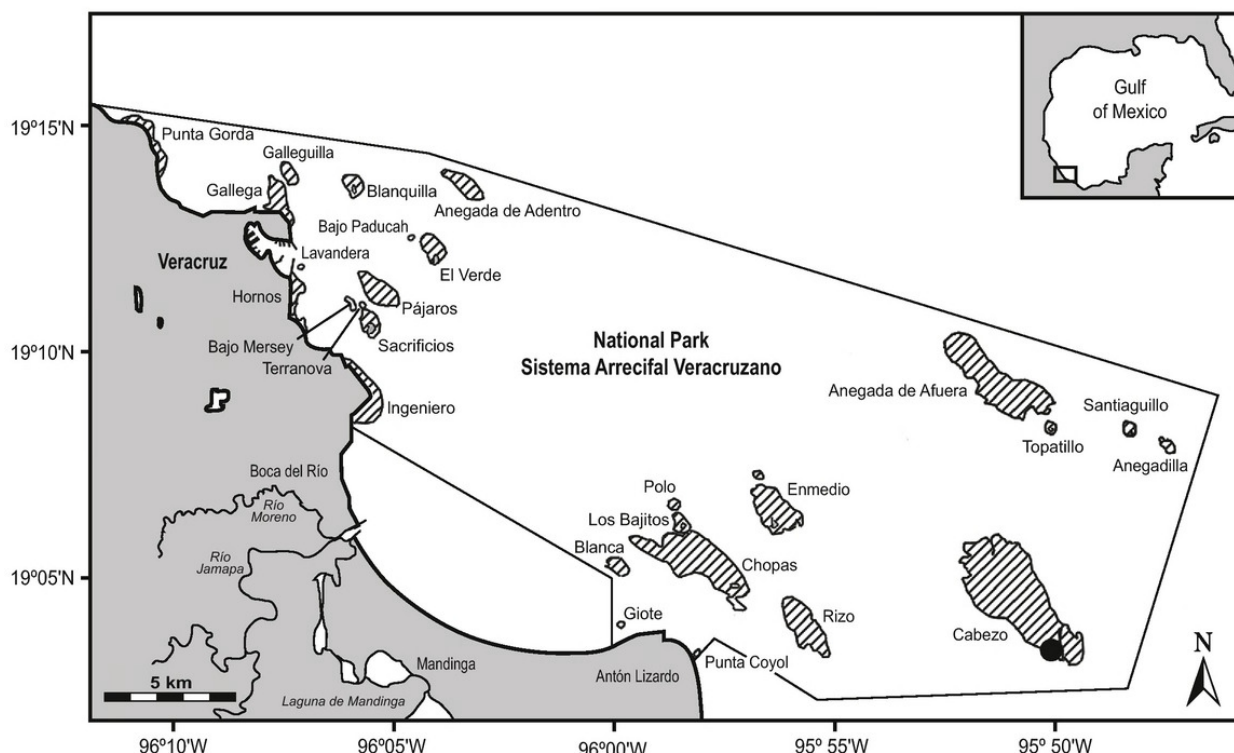


Fig. 1. Sampling site (filled circle) in the National Park Sistema Arrecifal Veracruzano. Hatched areas are coral reefs.

of the ICIMAP-UV. In the laboratory, morphological features were observed using a stereomicroscope Carl Zeiss Stemi 2000C. When necessary, cross-sections of algal thalli were made with a razor blade and photographed using an Olympus BX51 microscope equipped with phase-contrast objectives and an Olympus C7070 Wide Zoom 7.1-megapixel digital camera. Specimens were identified with the use of specialized literature (Taylor, 1960; Joly, 1967; Schneider, 1983; Schneider & Searles, 1991; Littler & Littler, 2000; Fujii et al., 2001; Senties-Granados & Fujii, 2002; Dawes & Mathieson, 2008; Mateo-Cid & Mendoza-González, 2009). The status of the current names for each species was checked using AlgaeBase (Guiry & Guiry, 2012) and Wynne (2011). Basionyms and synonyms were taken from the sources mentioned above.

Abbreviations used: bas. – basionym; diam. – diameter; GOM – Gulf of Mexico; ICIMAP-UV-AL – herbarium of macroalgae at the Institute for Marine Sciences and Fisheries of the University of Veracruz; LS – liquid sample; Mpio. – municipality; syn. - synonym.

RESULTS

Twenty-one species from 17 genera of red algae were identified from Cabezo reef. The families Rhodomelaceae and Corallinaceae contained the largest number of species (6 and 5, respectively). The descriptions include morphometric and biological data and are accompanied with photographs and line drawings for each species. Basionyms, synonyms and the data on the distribution in the State of Veracruz, NPSAV and the Gulf of Mexico are also given. The taxa are given in the order following Fredericq et al. (2009).

Division Rhodophyta

Class Stylonematophyceae

Family Stylonemataceae

1. ***Stylonema alsidii* (Zanardini) Drew, 1956** (Pl. 1, Fig. 1-3; Pl. 8, Fig. 1-3)

Bas.: *Bangia alsidii* Zanardini, 1840: 136.

Syn.: *Goniotrichum alsidii* (Zanardini) M.A. Howe, 1914: 75; *Stylonema elegans* (Chauvin) V. May, 1965: 352, 354.

Thallus filamentous, 100-800 µm high and 12-25 µm in diam. Filaments uniseriate at the base and branched in the upper parts, fixed to the host by one minute discoid cell. Cells of the filaments 5-12.5 µm long and 5-10 µm in diam. Monospores globose, 7-10 µm in diam. Epiphyte on *Ceratodictyon intricatum* (Rhodophyta).

Examined specimens: LS-11 (1 March 2008).

NPSAV: Isla Sacrificios, Isla Verde (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Elsewhere in Veracruz: Mpio. Actopan: Villa Rica (Punta Villa Rica); Mpio. Alto Lucero: Boca Andrea, Laguna Verde, Playa el Morro (Punta el Morro); Mpio. Pueblo Viejo: Laguna de Pueblo Viejo (Ortega et al., 2001).

GOM: throughout the Gulf (Fredericq et al., 2009).

References: Taylor, 1960: 288; Schneider & Searles, 1991: 178, fig. 211; Dawes & Mathieson, 2008: 169, pl. 22, fig. 3, 4.

Class Florideophyceae

Family Colaconemataceae

2. ***Colaconema hallandicum* (Kylin) Afonso-Carillo, Sanson, Sangil et Diaz-Villa, 2007** (Pl. 1, Fig. 4 and 5; Pl. 8, Fig. 4 and 5)

Bas.: *Chantransia hallandica* Kylin, 1906: 123, fig. 8.

Syn.: *Achrochaetium hallandicum* (Kylin) Hamel, 1927: 20, fig. 19-21; *Audouinella hallandica* (Kylin) Woelkerling, 1973: 82, fig. 1-4.

Thallus filamentous, erect, 1 mm high, growing into one or two filaments from each basal cell. Branching subdichotomous or alternate. Basal cell subglobose or ellipsoidal, 15-20 µm in diam. and 7.5-25 µm long, not penetrating into the host plant. Cells of the erect axes rectangular, 45-50 µm long and 7.5-10 µm wide. Apices fusiform. Monosporangia lateral, solitary, sessile or with one basal cell 7.5-10 µm long. Monospores ovoid or subglobose, 12.5-13 µm in diam. Epiphytic on *Laurencia obtusa* (Hudson) J.V. Lamouroux (Rhodophyta) and *Dictyota menstrualis* (Hoyt) Schnetter, Hörning et Weber-Peukert (Phaeophyta).

Examined specimens: LS-1 (3 June 2010).

A new record for the NPSAV.

Elsewhere in Veracruz: Mpio. Actopan: Playa Paraíso (Laguna La Mancha), Villa Rica (Punta Villa Rica); Mpio. Alto Lucero: Boca Andrea, Laguna Verde, Playa el Morro (Punta del Morro); Mpio. San Andrés Tuxtla: Montepío (Punta Morrillos) (Ortega et al., 2001).

GOM: throughout the Gulf (Fredericq et al., 2009).

References: Schneider, 1983: 9; Schneider & Searles, 1991: 202, fig. 238; Dawes & Mathieson, 2008: 178, pl. 23, fig. 3, 4.

Family Galaxauraceae

3. *Galaxaura rugosa* (J. Ellis et Sol.) J.V. Lamouroux, 1816 (Pl. 1, Fig. 6-10; Pl. 8, Fig. 6-10)

Bas.: *Corallina rugosa* J. Ellis et Sol., 1786: 115, pl. 22, fig. 3.

Syn.: *Dichotomaria lapidescens* (J. Ellis et Sol.) Lam., 1816: 146; *Galaxaura lapidescens* (J. Ellis et Sol.) J.V. Lamouroux, 1816: 264; *Galaxaura annulata* J.V. Lamouroux, 1816: 263; *Hololnema liebmanni* Areschoug, 1854: 357; *Microthoe lapidescens* (J. Ellis et Sol.) Harvey, 1855: 553; *Galaxaura tomentosa* Kütz., 1858: 18, pl. 38, fig. 2; *Galaxaura elongata* J. Agardh, 1876: 529; *Galaxaura lapidescens* var. *annuligera* Piccone et Grunow in Piccone, 1884: 312.

Tetrasporophyte stage. Thallus erect, pseudoparenchymatous, rigid, moderately calcified, 9 cm high, forming dense mats, loses color rapidly after being exposed to light. Branching alternate, irregular, with extreme dichotomous branches.

Branches cylindrical, 0.5-1 cm long and 0.1-0.2 cm in diam., covered with hairlike filaments. Basal cells of the filaments usually bulbous, 25-40 μm in diam., sometimes absent. Surface filaments 300-400 μm long and 15-20 μm wide.

Gametophyte stage. Thallus erect, pseudoparenchymatous, rigid, moderately calcified, 5-7 cm high, forming dense mats, loses color rapidly after being exposed to light. Branching irregularly dichotomous. Branches cylindrical, 0.1-0.2 cm in diam. Medullar filaments scarce and immersed in dense mucilage, 10-25 μm in diam. Cortex formed by 3-4 rows of cells. Its surface smooth or with rare hairs. Surface cells rounded, pigmented, 15-25 μm in diam., polyhedric in surface view. Subsurface cells globose, not pigmented, sometimes fused (unlike in the genus *Tricleocarpa*). Spermatangia located in cavities of 200-350 μm . Spermatia 6-9 μm in diam.

Examined specimens: ICIMAP-UV-AL 19, 19R, 23, 23R; LS-7, 20 (11 March 2008), 15, 25 (12 November 2008).

NPSAV: Blanquilla, Enmedio and Hornos reefs, Isla Sacrificios, Isla Santiaguillo, Isla Verde (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Elsewhere in Veracruz: Mpio. Tuxpan: Isla de Lobos (Ortega et al., 2001).

GOM: SW and SE (Fredericq et al., 2009).

References: Taylor, 1960: 337; Littler & Littler, 2000: 60, 61 (fig.); Dawes & Mathieson, 2008: 209, pl. 27, fig. 13-16.

Family Liagoraceae

4. *Liagora ceranoides* J.V. Lamouroux, 1816 (Pl. 1, Fig. 11; Pl. 2, Fig. 1; Pl. 8, Fig. 11-13; Pl. 9, Fig. 1)

Syn.: *Liagora patens* P.L. Crouan et H.M. Crouan in Schramm et Mazé, 1865: 14; *Liagora prolifera* P.L. Crouan et H.M. Crouan in Mazé et Schramm, 1878: 185; *Liagora viscida* f. *ceranoides* (J.V. Lamouroux) Hauck in Rabenhorst, 1882: 65; *Liagora opposita* J. Agardh, 1896: 101; *Liagora pilgeriana* Zeh, 1912: 272.

Thallus pseudoparenchymatous, 6-10 cm high, forming compact tufts. Axes multiseriate, smooth and soft, moderately calcified. Rose or white, loses color rapidly after being exposed to light. Branching loose, branches 0.1-0.2 cm in diam., diminishing in size toward the apices. Medullar filaments 20-30 μm in diam., with cells slightly swollen, bead-shaped. Cortical filaments radially extending inside the calcified mucilage, with the apical cells 5-10 μm in diam. Spermatia 1-3 μm in diam., located at branch extremes. Carpogonial branches formed of 3-4 cells, 12-20 μm in diam. Holdfast discoid, 0.2-0.3 cm in diam.

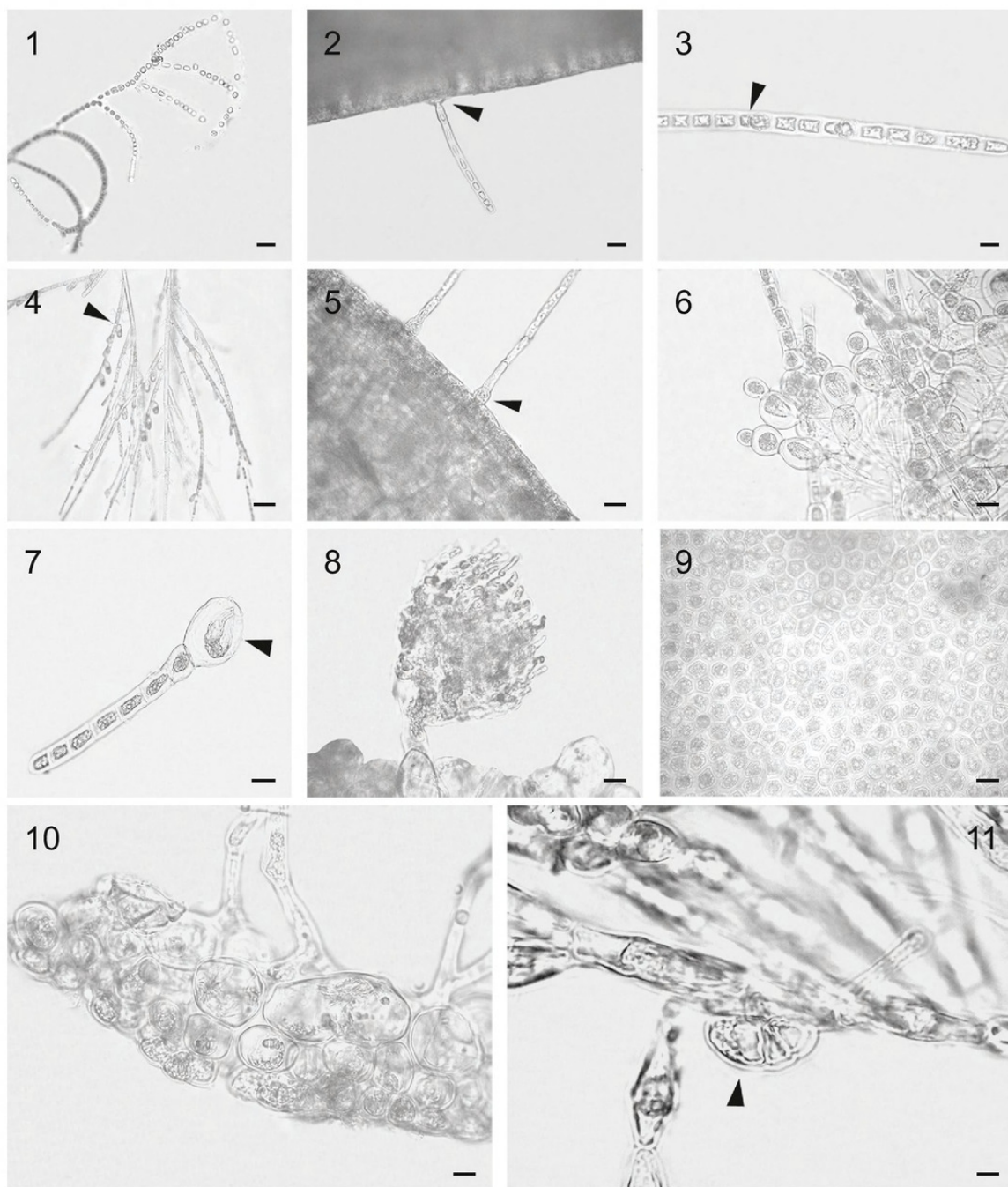


Plate 1. Fig. 1-3. *Stylonema alsidii*: 1. Branched filament. 2. Uniseriate filament with a discoid basal cell (arrowhead) that fixes to the host alga. 3. Mature filament with monospores (arrowhead). Fig. 4 and 5. *Colaonema hallandicum*: 4. Filaments with lateral, solitary, sessile monosporangia (arrowhead). 5. Erect axis with a globose initial spore (arrowhead). Fig. 6-10. *Galaxaura rugosa*: 6. Tetrasporophyte in transverse section. 7. Surface filament with a bulbous basal cell (arrowhead). 8. Gonimoblast. 9. Surface view of gametophyte thallus. 10. Transverse section of cortex of gametophyte showing compressed surface cells, oval subsurface cells and broad internal cells connected by means of medullar filaments. Fig. 11. *Liagora ceranoides*, cortical filaments with incurved carpogonial branch (arrowhead). Scale bars: 25 μ m in Fig. 1-3 and 5-11; 50 μ m in Fig. 4.

Examined specimens: ICIMAP-UV-AL 66, 66R, 21, 21R; LS-16 (11 March 2008), 25 (12 November 2008), 30 (1 March 2008).

NPSAV: Blanquilla reef, Isla de Enmedio, Isla Sacrificios, Isla Santiaguillo, Isla Verde (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Elsewhere in Veracruz: Mpio. San Andrés Tuxtla: Montepío (Ortega et al., 2001).

GOM: SW and SE (Fredericq et al., 2009).

References: Taylor, 1960: 326; Littler & Littler, 2000: 50, 51 (fig.); Dawes & Mathieson, 2008: 205, pl. 27, fig. 1, 2.

5. *Titanophycus validus* (Harvey) Huisman, G.W. Saunders et A.R. Sherwood, 2006 (Pl. 2, Fig. 2 and 3; Pl. 9, Fig. 2-4)

Bas.: *Liagora valida* Harvey, 1853: 138, pl. 31A, fig. 1-5.

Syn.: *Liagora annulata* J. Agardh, 1876: 518; *Liagora tenuis* J. Agardh, 1896: 101; *Liagora rosacea* Zeh, 1912: 271; *Liagora pseudorobusta* K.C. Fan in K.C. Fan et Yung C. Wang, 1974: 489.

Thallus pseudoparenchymatous, 8 cm high, forming compact erect tufts, with multiseriate axes. Thallus rigid in the inferior and middle portions, with the terminal branchlets mucilaginous and delicate. Calcification is strong in the inferior part of the thallus and moderate in the middle portion. Loses color rapidly after being exposed to light. Branching clearly dichotomous along the thallus. Main axes 700-1000 µm in diam., middle branches 550-750 µm in diam., and apices down to 400-600 µm. Medullar filaments 162-255 µm long and 17.5-25.0 µm wide. Cortical filaments radial, cylindrical to fusiform, 10 µm in diam., ramified 4 to 5 times. Apical cells pyriform, 7.5-9.0 µm in diam. Carpogonial branches formed of 4-5 cells, 11-13 µm in diam., slightly curved, located below the first branching of the cortical filaments. Carposporophytes hemispherical, 180-200 µm in diam., terminal on cortical filaments.

Examined specimens: ICIMAP-UV-AL 67, 67R; LS-16 (11 March 2008), 23 (12 November 2008), 30 (1 March 2008).

NPSAV: Isla de Enmedio, Isla Sacrificios, Isla Santiaguillo (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Veracruz: Mpio. San Andrés Tuxtla: Montepío (Ortega et al., 2001).

GOM: SE (Fredericq et al., 2009).

References: Taylor, 1960: 327; Littler & Littler, 2000: 54, 55 (fig.); Dawes & Mathieson, 2008: 205, pl. 27, fig. 3.

Family Corallinaceae

6. ***Amphiroa fragilissima* (L.) J.V. Lamouroux, 1816** (Pl. 2, Fig. 4-7; Pl. 9, Fig. 5-7)
Bas.: *Corallina fragilissima* Linnaeus, 1758: 806; 1759: 1305.

Thallus fragile, strongly calcified, 2-3 cm high, forming compact tangled tufts. Pale pink, white after being exposed to light. Branching dichotomous, segments 340-350 μm long and 370-400 μm wide, separated by a layer of shorter cells of 15-20 μm long. Intergenicula formed with 6 rows of cells per segment. Cortex formed by several layers of cells. Tetrasporangial conceptacles are lateral, hemispherical, 200-340 μm in diam., with one pore. Holdfast is small, crusty, barely visible. Epiphyte on *Halimeda opuntia* (L.) J.V. Lamouroux (Chlorophyta), a very common species in NPSAV.

Examined specimens: LS-1 (3 June 2010), 7 (11 March 2008).

NPSAV: Blanquilla and Hornos reefs (including breakwaters), Isla de Enmedio, Isla Santiaguillo, Isla Verde, Isla Sacrificios (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Elsewhere in Veracruz: Mpio. Tuxpan: Isla de Lobos; Mpio. Alto Lucero: Laguna Verde, Playa el Morro (Punta del Morro); Mpio. Catemaco: Playa Balzapote; Mpio. San Andrés Tuxtla: Montepío (Punta Morrillos) (Ortega et al., 2001).

GOM: NE, SW and SE (Fredericq et al., 2009).

References: Taylor, 1960: 403, pl. 47, fig. 1, 2; Littler & Littler, 2000: 22, 23 (fig.); Moura & Beauclair, 2005: 32 fig. 50-59; Dawes & Mathieson, 2008: 197, pl. 25, fig. 24-26.

7. ***Jania adhaerens* J.V. Lamouroux, 1816** (Pl. 2, Fig. 8-10; Pl. 9, Fig. 8-10)
Syn.: *Corallina adhaerens* (J.V. Lamouroux) Kütz., 1858: 40, pl. 83, figs. 2a-f; *Jania comosa* P.L. Crouan et H.M. Crouan in Mazé et Schramm, 1865: 18.

Thallus pseudoparenchymatous, fragile, strongly calcified, 2-4 cm high, forming small tangled tufts. Loses color rapidly after being exposed to light. Branching completely dichotomous. Segments cylindrical, 0.5-1 mm long and 80-170 μm in diam. Axes dichotomously branched usually in one plane, with rounded apices. Nodes not calcified in regular intervals between bifurcations. Initially fixed to substratum with a crusty holdfast and secondarily with calcareous pads. Medullar cells elongated, 75-90 μm long and 8-13 μm wide, groups in parallel rows. Cortex is absent. Tetraspores zonately divided, 100-200 μm long and 40-60 μm in diam. Tet-

rasporangial conceptacles with one pore, urn-shaped, 400 µm long and 310 µm in diam., located in terminal branches. Bifurcations with the branches forming an angle of 35°-55°.

Examined specimens: ICIMAP-UV-AL 20; LS-2 (12 November 2008), 11 (11 March 2008), 25 (12 November 2008), 28 (1 March 2008).

NPSAV: Isla de Enmedio, Isla Santiaguillo, Isla Verde, Isla Sacrificios, Hornos reef (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Elsewhere in Veracruz. Mpio. Actopan: Playa Paraíso (Laguna La Mancha); Mpio. Catemaco: Laguna de Sontecomapan (Ortega et al., 2001).

GOM: throughout the Gulf (Fredericq et al., 2009).

References: Taylor, 1960: 413; Schneider & Searles, 1991: 231; Littler & Littler, 2000: 30, 31 (fig.); Dawes & Mathieson, 2008: 194, Pl. 25, fig. 14.

8. ***Jania cubensis* Montagne ex Kütz., 1849** (Pl. 2, Fig. 11; Pl. 10, Fig. 1 and 2)
Syn.: *Corallina cubensis* (Montagne ex Kütz.) Kütz., 1858: 37, pl. 77, fig. 2; *Haliptilon cubense* (Montagne ex Kütz.) Garbary et H.W. Johansen, 1982: 218.

Thallus pseudoparenchymatous, erect or prostrate, 0.7-1.2 cm high, forming densely branched tufts, delicate but strongly calcified. Pinkish white to pinkish red. Axes cylindrical, tapering to the apices, irregularly branched, dichotomous or pinnate, in multiple planes. Segments in the inferior part 200-350 µm long and 100-250 µm wide, and in the middle portion 400-600 µm long and 150-250 µm wide. Medulla composed of rows of cells, 30-40 µm in diam. Cortical cells elongated in surface view, 20-40 µm long and 7-12 µm wide. Apices bluntly pointed. Articulations flexible, not calcified, composed of only one row of cells; can attach to a solid substrate with branch extremes. Holdfast crusty. Reproductive stages were not observed. Epiphyte on *Bryothamnion triquetrum* (Rhodophyta).

Examined specimens: LS-11 (11 March 2008).

NPSAV: Isla de Enmedio, Isla Sacrificios, Isla Verde (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Elsewhere in Veracruz: Mpio. San Andrés Tuxtla: Montepío; Mpio. Tuxpan: Tuxpan (Ortega et al., 2001).

GOM: throughout the Gulf (Fredericq et al., 2009).

References: Taylor, 1960: 409, pl. 50, figs. 3, 4; Schneider & Searles, 1991: 229, fig. 263-265; Littler & Littler, 2000: 26, 27 (fig.); Dawes & Mathieson, 2008: 193, pl. 25, fig. 10-12.

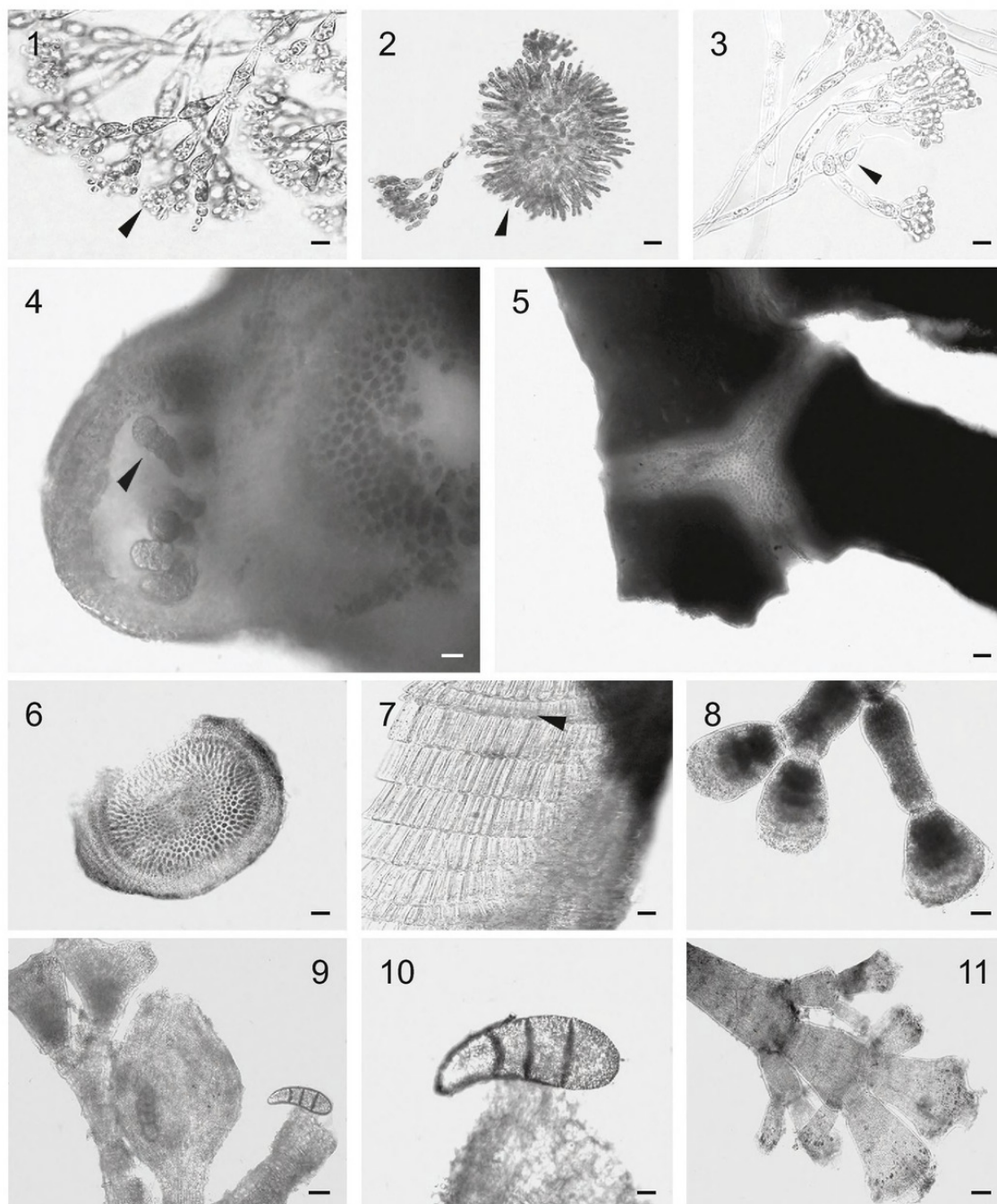


Plate 2. Fig. 1. *Liagora ceranoides*, terminal spermatangia in cortical filament (arrowhead). Fig. 2 and 3. *Titanophycus validus*: 2. Carposporophyte surrounded by involucreal filaments (on the left) with a gonimoblast (arrowhead). 3. Cortical filament with a carpogonial branch (arrowhead). Fig. 4-7. *Amphiroa fragilissima*: 4. Tetrasporangial conceptacle in transverse section showing zonately divided tetrasporangia (arrowhead). 5. Uncalcified genicula. 6. Transverse section of thallus showing medullar and cortical cells. 7. Longitudinal section showing a row of shorter cells (arrowhead) and 5-6 rows of longer cells. Fig. 8-10. *Jania adhaerens*: 8. Vegetative branch dichotomously ramified. 9. Tetrasporangial conceptacles. 10. A zonately divided tetrasporangium. Fig. 11. *Jania cubensis*: immature branch showing both opposite and dichotomous ramification. Scale bars: 100 µm in Fig. 5, 8, 9 and 11; 50 µm in Fig. 6; 25 µm in Fig. 1-4, 7, and 10.

9. ***Pneophyllum fragile* Kütz., 1843** (Pl. 3, Fig. 1 and 2; Pl. 10, Fig. 3 and 4)

Syn.: *Heteroderma lejolisii* (Rosanoff) Foslie, 1909: 56; *Fosliella lejolisii* (Rosanoff) M.A. Howe, 1920: 588; *Pneophyllum lejolisii* (Rosanoff) Chamberlain, 1983: 359, fig. 28-32.

Thallus prostrate, crusts 0.5-1.0 mm in diam. and 25-45 μm thick, white. Cells quadrate to quadrangular in surface view, 10-17 μm long and 5-8 μm wide, not interfused, located in radial pattern starting from an initial group of 8 cells. Young crusts formed with one cell, older ones composed of up to 4 layers of cells. Cap cells are wider than long, 4-7.5 μm wide. Hypothallus is formed with one layer of cells oriented parallel to the surface of thallus, 7.5-10 μm long and 6-8 μm wide. Epithallus monostromatic, composed of cells 3-7 μm high and 4-7 μm in diam. Trichocytes intercalary, rare, 10-12.5 μm long. Tetrasporangial conceptacles hemispherical, 50 μm in diam., with a central pore. Tetrasporangia zonately divided, 37.5 μm long and 18 μm in diam. Epiphyte on *Bryothamnion triquetrum*, almost entirely covering its thallus.

Examined specimens: LS-8 (1 March 2008).

NPSAV: Blanquilla reef, Isla de Enmedio, Isla Sacrificios, Isla Verde (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Elsewhere in Veracruz: Mpio. Tuxpan: Isla de Lobos; Mpio. Actopan: Playa Paraíso (Laguna La Mancha), Villa Rica (Punta Villa Rica); Mpio. Alto Lucero: Boca Andrea, Laguna Verde, Playa el Morro (Punta del Morro) (Ortega et al., 2001).

GOM: throughout the Gulf (Fredericq et al., 2009).

References: Taylor 1960: 387; Schneider & Searles, 1991: 244; Littler & Littler, 2000: 38, 39 (fig.); Mateo-Cid, 2006; Dawes & Mathieson, 2008: 191, pl. 25, fig. 4, 5; Mateo-Cid & Mendoza-González, 2009: 610, fig. 13-16.

10. ***Porolithon pachydermum* (Foslie) Foslie, 1909** (Pl. 3, Fig. 3-5; Pl. 10, Fig. 5 and 6)

Bas.: *Lithophyllum onkodes* f. *pachydermum* Foslie, 1904: 4.

Syn.: *Hydrolithon pachydermum* (Foslie) J.C. Bailey, J.E. Gabel et D.W. Freshwater, 2004: 8.

Thallus crusty, usually up to 100 μm , sometimes up to 1 mm wide, strongly calcified, frequently forming thick layers extending indefinitely. Surface chalky, pinkish grey. Cells of surface layers densely arranged, 8-14 μm long and 6-9 μm wide; layers frequently fused. Cell layers of the inferior surface part are horizontally

oriented, parallel to substrate. Trichocytes are common, horizontally grouped, 17-29 μm high and 8-16 μm in diam. Tetrasporangial conceptacles 150-250 μm in diam., with a central apical pore. Tetraspores 60-70 μm long and 30-40 μm in diam., zonately divided, being formed in the periphery of a conceptacle.

Taxonomic note: Kato et al. (2011: 669) resurrected the genus *Porolithon* (Foslie) Foslie, 1909, on the basis of molecular data that confirmed its original separation from *Hydrolithon* based on the arrangement of trichocytes.

Examined specimens: LS-18 (11 March 2008).

NPSAV: Isla Santiaguillo (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

GOM: SW (Fredericq et al., 2009).

References: Taylor, 1960: 401; Littler & Littler, 2000: 38, 39 (fig.); Dawes & Mathieson, 2008: 191, pl. 25, fig. 6-8; Mendoza-González et al., 2009: 229.

Family Lomentariaceae

11. *Ceratodictyon intricatum* (C. Agardh) R.E. Norris, 1987 (Pl. 3, Fig. 6-8; Pl. 10, Fig. 7-9)

Bas.: *Sphaerococcus intricatus* C. Agardh, 1822 (1822-1823): 333-334.

Syn.: *Gelidium intricatum* (C. Agardh) Kütz., 1849: 767; *Gelidiopsis intricata* (C. Agardh) Vickers, 1905: 61; *Acrocarpus intricatus* (C. Agardh) Kütz., 1868: 12, pl. 35: figs. d, e.

Thallus pseudoparenchymatous, rigid, rugged, tangled, 1-3 cm high, with erect or prostrate axes. Loses color rapidly after being exposed to light. Branching irregular, spaced, somewhat alternate. Main axes cylindrical, 400-500 μm in diam., sometimes fused. Apices slightly acute, multicellular, composed of 5 to 6 layers of cells. Medullar cells ovoid or spherical, 80-120 μm in diam., continuously diminishing in size toward cortex. Surface cells spherical to ovoid, 15-30 μm long in the principal axes. Cortex formed by one layer of spherical, strongly pigmented cells 20-25 μm in diam. Reproductive stages were not observed.

Examined specimens: LS-11 (11 March 2008).

NPSAV: Isla Blanquilla, Isla Verde, Isla de Enmedio (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

GOM: SW and SE (Fredericq et al., 2009).

References: Taylor, 1960: 353; Littler & Littler, 2000: 124, 125 (fig.); Dawes & Mathieson, 2008: 378, pl. 51, fig. 3-5.

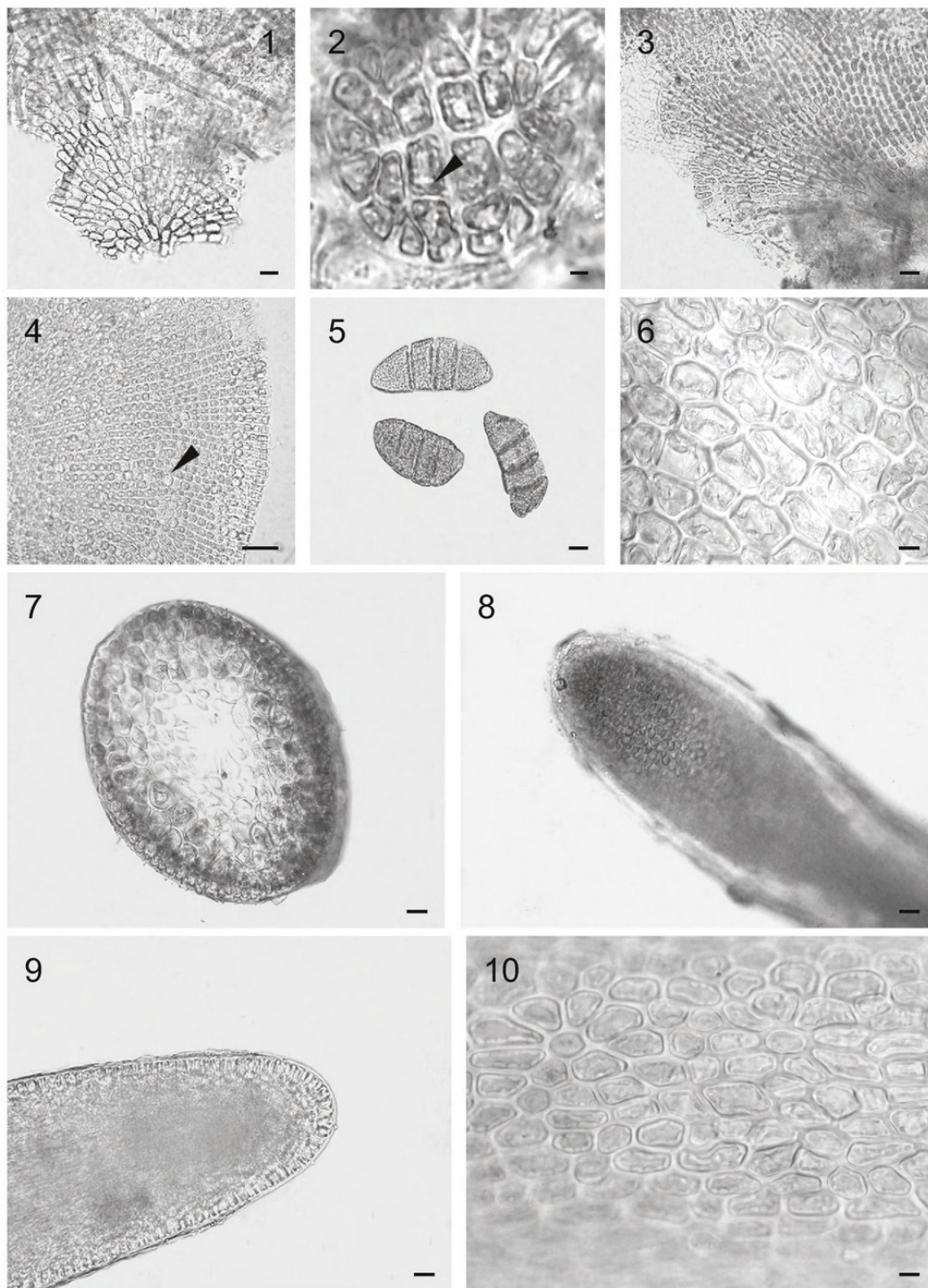


Plate 3. Fig. 1 and 2. *Pneophyllum fragile*: 1. Surface view of thin crusts. 2. Initial eight-celled structure (arrowhead) of thallus. Fig. 3-5. *Porolithon pachydermum*: 3. Surface view of crusty thallus. 4. Surface view of thallus showing megacells (arrowhead). 5. Zonately divided tetrasporangia. Fig. 6-8. *Ceratodictyon intricatum*. 6. Surface cells of a vegetative branch. 7. Transverse section of thallus showing medullar and cortical cells. 8. Extremities of a branch with multiple apical cells. Fig. 9 and 10. *Ceratodictyon planicaule*: 9. Extremities of a branch with multiple apical cells. 10. Surface cells of a vegetative branch. Scale bars: 100 μm in Fig. 7; 50 μm in Fig. 1, 3, 8 and 9; 25 μm in Fig. 4-6 and 10; 10 μm in Fig. 2.

12. ***Ceratodictyon planicaule* (W.R. Taylor) M.J. Wynne, 2011** (Pl. 3, Fig. 9 and 10; Pl. 4, Fig. 1; Pl. 10, Fig. 10-13)

Bas.: *Wurdemannia miniata* (Sprengel) J. Feldmann et Hamel var. *planicaulis* W.R. Taylor, 1943: 158.

Syn.: *Gelidiopsis planicaulis* (W.R. Taylor) W.R. Taylor, 1960: 353.

Thallus pseudoparenchymatous, rigid, prostrate, 2-3 cm high, forming small tangled mats. Loses color rapidly after being exposed to light. Branching irregularly alternate, somewhat dichotomous, spaced, branches growing by several apical cells. Axes flattened in the middle part. Surface cells spherical to ovoid, 10-20 µm in transverse section. Medullar cells spherical, 15-30 µm in diam., diminishing in size toward cortex. Medulla is formed by 5-7 layers of cells. Branches compressed, 400-500 µm wide and 150-200 µm high. Cortex is formed by 1-2 layers of spherical cells 10-15 µm in diam. Apices slightly rounded. Reproductive stages were not observed.

Examined specimens: LS-11 (11 March 2008).

A new record for the NPSAV.

Elsewhere in Veracruz: Mpio. Actopan: Villa Rica (Punta Villa Rica); Mpio. Alto Lucero: Playa el Morro (Punta del Morro); Mpio. Tuxpan: Isla de Lobos (Ortega et al., 2001).

GOM: SW and SE (Fredericq et al., 2009).

References: Taylor, 1960: 353; Littler & Littler, 2000: 124, 125 (fig.); Dawes & Mathieson, 2008: 379, pl. 51, fig. 6, 7.

Family Ceramiaceae

13. ***Ceramium luetzelburgii* O.C. Schmidt, 1924** (Pl. 4, Fig. 2-4; Pl. 11, Fig. 1-4)

Thallus filamentous, delicate, mainly prostrate, 15-18 mm high. Branches ascending, sparse or dichotomous, unilateral-alternate. Apices erect, forcipate. Rhizoids numerous, originating from the prostrate part of thallus. Axes uniseriate, with relatively large cells. Internodes 70-400 µm long, 30-50 µm wide and 20-50 µm in diam. Cells of the nodes strongly pigmented, arranged in three bands: superior cells rounded and small, cells in the middle part are larger and somewhat triangular, and inferior cells elongated and smaller than in the middle portion. Usually one, rarely two, tetrasporangium per node, tetrahedrally divided, 30-45 µm in diam.

Examined specimens: ICIMAP-UV-AL 30; LS-8 (1 March 2008).

NPSAV: Isla Verde (Ortega et al., 2001).

Elsewhere in Veracruz: Mpio. Actopan: Playa Paraíso (Laguna La Mancha), Villa Rica (Punta Villa Rica); Mpio. Alto Lucero: Boca Andrea, Laguna Verde, Playa el Morro (Punta el Morro) (Ortega et al., 2001).

GOM: SW (Fredericq et al., 2009).

References: Taylor, 1960: 529.

14. *Ceramium nitens* (C. Agardh) J. Agardh, 1851 (Pl. 4, Fig. 5-9; Pl. 11, Fig. 5-9)
Bas.: *Ceramium rubrum* var. *nitens* C. Agardh, 1824: 136.

Thallus filamentous, firm, 3-5 cm high, forming compact tufts. Filaments erect, red-orange, in some parts pink. Branching dichotomous-alternated, widely spreading, branchlets curved, not forcipate, in the middle part 300-380 µm in diam., terminally pointed. Central filament 180-190 µm in diam. Cortical cells strongly pigmented, completely encircling the central filament. Periaxial cells are formed from the cortical cells. Each periaxial cell divided into four cells: two acropetal and two basipetal ones. Carposporangia hemispherical, lateral in superior branches, 90-125 µm in diam. Carpospores 25 µm in diam. Epiphytic on *Halimeda* sp. (Chlorophyta); also grows on dead coral fragments.

Examined specimens: LS-13 (12 November 2008), 21 (1 March 2008).

NPSAV: Isla de Enmedio, Isla Sacrificios, Isla Santiaguillo, Isla Verde (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

GOM: NE, SW and SE (Fredericq et al., 2009).

References: Taylor, 1960: 535, pl. 66, fig. 14; Littler & Littler, 2000: 150, 151 (fig.); Fujii et al., 2001: 360; Dawes & Mathieson, 2008: 233, pl. 30, fig. 19, 20.

Family Rhodomelaceae

15. *Bryothamnion triquetrum* (S.G. Gmelin) M.A. Howe, 1915 (Pl. 4, Fig. 10 and 11; Pl. 5, Fig. 1; Pl. 11, Fig. 10 and 11; Pl. 12, Fig. 1)
Bas.: *Fucus triqueter* S.G. Gmelin, 1768: 122, pl. 8, fig. 4.

Thallus pseudoparenchymatous, erect, up to 14 cm high, forming compact, rigid mats. Red to dark-brown, loses color rapidly after being exposed to light. Branching alternate or irregular. Axes erect, covered with short, spine-like branchlets. Main axes of 6-9 pericentral globose cells of 200-300 µm, heavily corticated; cortical cells rectangular, 25-50 µm wide, strongly pigmented. Secondary axes polysiphonous, with 7-9 pericentral globose cells 150-220 µm in diam, completely cor-

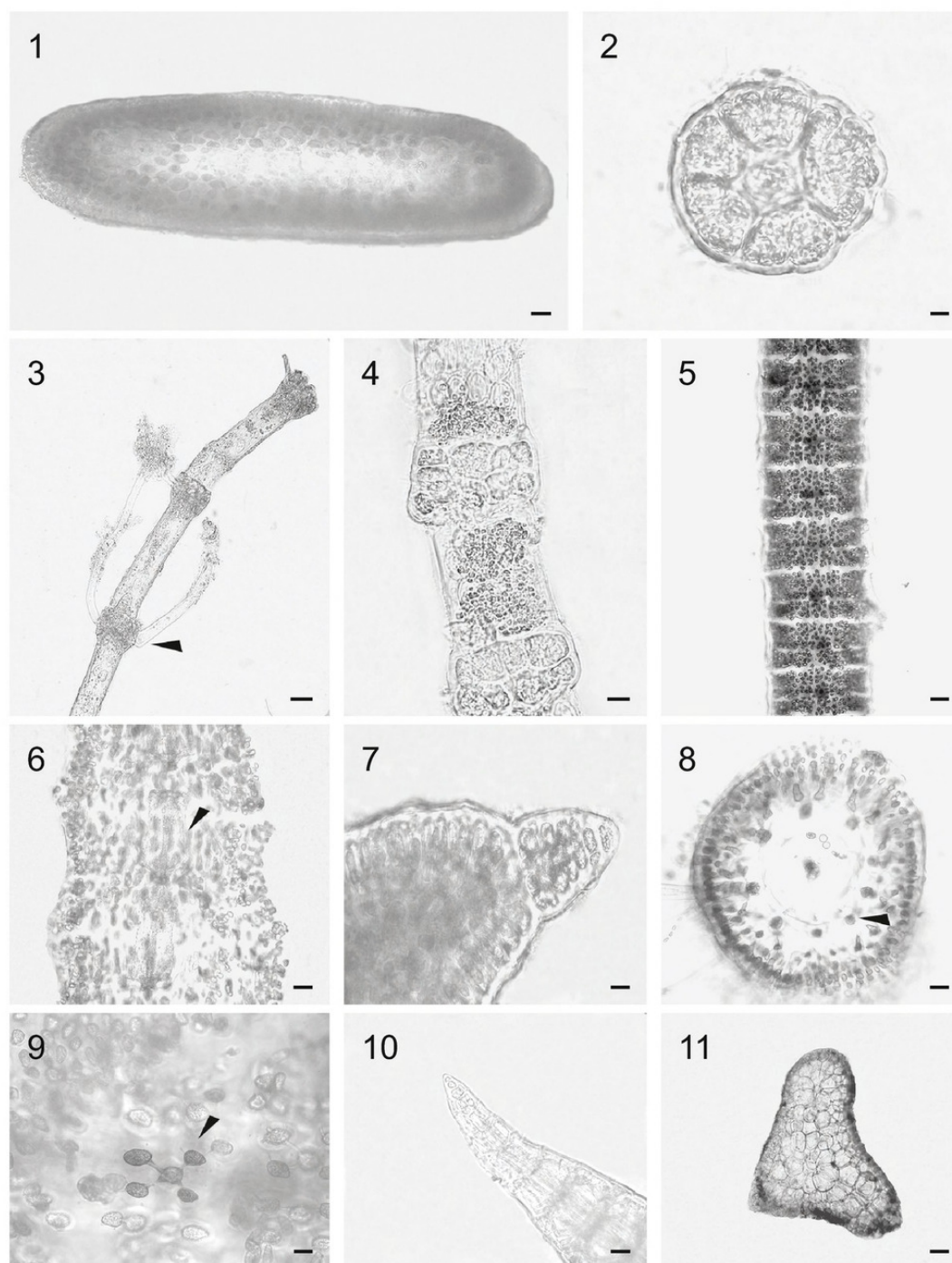


Plate 4. Fig. 1. *Ceratodictyon planicaule*, transverse section of a compressed branch. Fig. 2-4. *Ceramium luetzelburgii*: 2. Transverse section of nodes. 3. Vegetative filaments with rhizoids (arrowhead) developing from the nodes. 4. Structure of nodes composed of three rows of cells. Fig. 5-9. *Ceramium nitens*: 5. Vegetative filament completely corticated. 6. Longitudinal section showing the axial filament (arrowhead). 7. Apical part of a branch in surface view. 8. Transverse section of vegetative thallus showing nine periaxial cells (arrowhead). 9. Surface view of periaxial, two acropetal and two basipetal cells (arrowhead). Fig. 10 and 11. *Bryothamnion triquetrum*: 10. Apex of a vegetative branch. 11. Transverse section of a triangular branch. Scale bars: 100 µm in Fig. 5 and 11; 50 µm in Fig. 1, 3, 6 and 8; 25 µm in Fig. 2, 4, 7, 9 and 10.

ticated; cortical cells rounded, 25-50 µm in diam., strongly pigmented. Branchlets usually in three rows spirally twisted, 1-2 mm long, with simple branching inferiorly and trichotomous superiorly. Apices pointed, slightly curved, grouped distally. Fixed to substrate by a fleshy base with several erect, cylindrical axes, 2 cm in diam. Reproductive stages were not observed.

Examined specimens: LS-8 (1 March 2008).

NPSAV: Punta Gorda, Hornos and Ingeniero reefs, Isla de Enmedio, Isla Sacrificios (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Elsewhere in Veracruz: Mpio. Actopan: Villa Rica (Punta Villa Rica); Mpio. Alto Lucero: Laguna Verde, Playa el Morro (Punta del Morro); Mpio. Alvarado: Punta Antón Lizardo; Mpio. San Andrés Tuxtla: Montepío; Mpio. Tuxpan: Tuxpan; Mpio. Veracruz: Playa Hotel Pensiones, Playa Mocambo (Ortega et al., 2001).

GOM: SW and SE (Fredericq et al., 2009).

References: Taylor, 1960: 587, pl. 72, fig. 6, pl. 73, fig. 4; Littler & Littler, 2000: 196, 197 (fig.); Dawes & Mathieson, 2008: 280, pl. 37, fig. 16, 17.

16. *Laurencia intricata* J.V. Lamouroux, 1813 (Pl. 5, Fig. 2-5; Pl. 12, Fig. 2-6)
Syn.: *Laurencia implicata* J. Agardh, 1852: 745.

Thallus pseudoparenchymatous, flexible, forming loose mats. Axes erect, 3-4 cm high. Loses color rapidly after being exposed to light. Branching irregular, spaced, branches are positioned with a wide angle between them, almost at right angles. The main axis is not distinguished. Middle branches 660-900 µm in diam. Branchlets cylindrical, 60-90 µm in diam. at the apices, some apices slightly curved. Surface cells polyhedral, 36-54 µm in their widest part. Pericentral cells (five) 90-140 µm in diam., larger than the medullar ones. Cortical cells periclinally arranged, 20-35 µm in diam. Reproductive stages were not observed.

Examined specimens: LS-11 (11 March 2008).

NPSAV: Giote reef, Isla Sacrificios (Ortega et al., 2001, Galicia-García & Morales-García, 2007).

GOM: NW, SW and SE (Fredericq et al., 2009).

References: Taylor, 1960: 626; Littler & Littler, 2000: 214, 215 (fig.); Senties-Granados & Fujii, 2002: 142, fig. 22-31; Dawes & Mathieson, 2008: 294, pl. 39, fig. 21, 22.

17. *Laurencia obtusa* (Hudson) J.V. Lamouroux, 1813 (Pl. 5, Fig. 6-10; Pl. 12, Fig. 7-11)
Bas.: *Fucus obtusus* Hudson, 1778: 586.

Syn.: *Chondria obtusa* (Hudson) C. Agardh, 1817: pl. 18, fig. 35; *Sphaerococcus obtusus* (Hudson) Wahlenberg, 1826: 897.

Thallus pseudoparenchymatous, with erect axes 3-4 cm high, usually grouped. Pale pink, loses color rapidly after being exposed to light. Branching alternate, rarely opposite. Vegetative branches cylindrical, 630-700 µm in diam., 4-6 pericentral cells. Medullar cells ovoid, not pigmented, smaller than pericentral ones, 100-150 µm in diam. Cortical cells arranged in one or two layers, spherical, strongly pigmented, 50-60 µm in diam. Surface cells 25 µm in diam. in surface view, intercellular connections are barely visible. Lenticular thickenings in medullar cells absent; *corps en cerise* present. Cystocarps oval, 1 mm long and 0.8 mm in diam. Tetrasporocysts tetrahedrally or cruciately divided, 50-100 µm in diam., located on terminal branches. Epiphytic on *Halimeda* spp. (Chlorophyta).

Examined specimens: LS-1 (3 June 2010).

NPSAV: Blanquilla, Giote and Hornos reefs, Isla de Enmedio, Isla Sacrificios, Isla Verde, Isla Santiaguillo (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Elsewhere in Veracruz: Mpio. Tuxpan: Isla de Lobos; Mpio. Actopan: Playa Paraíso (Laguna La Mancha), Villa Rica (Punta Villa Rica); Mpio. Alto Lucero: Boca Andrea, Laguna Verde, Playa el Morro (Punta del Morro); Mpio. Catemaco: Laguna de Sontecomapan; Mpio. San Andrés Tuxtla: Montepío; Mpio. Veracruz: Playa Hotel Pensiones; Mpios. Pueblo Viejo, Tampico Alto, Ozuluama, Tamalín and Tamiahua: Laguna de Tamiahua (Ortega et al., 2001).

GOM: throughout the Gulf (Fredericq et al., 2009).

References: Taylor, 1960: 626. Littler & Littler, 2000: 216, 217 (fig.); Senties-Granados & Fujii, 2002: 149, fig. 41-52; Dawes & Mathieson, 2008: 295, pl. 39, fig. 24, 25.

18. *Neosiphonia gorgoniae* (Harvey) S.M. Guimarães et M.T. Fujii in S.M. Guimarães, M.T. Fuji, M.T. Pupo et N.S. Yokova, 2004 (Pl. 5, Fig. 11; Pl. 6, Fig. 1-3; Pl. 13, Fig. 1-3)

Bas.: *Polysiphonia gorgoniae* Harvey, 1853: 39.

Thallus filamentous, soft, 2 mm high, forming small mats. Brown to grey, loses color rapidly after being exposed to light. Axes usually erect, with four pericentral cells. Branching more or less dichotomous, spaced. Both gametophytes and sporophytes were observed.

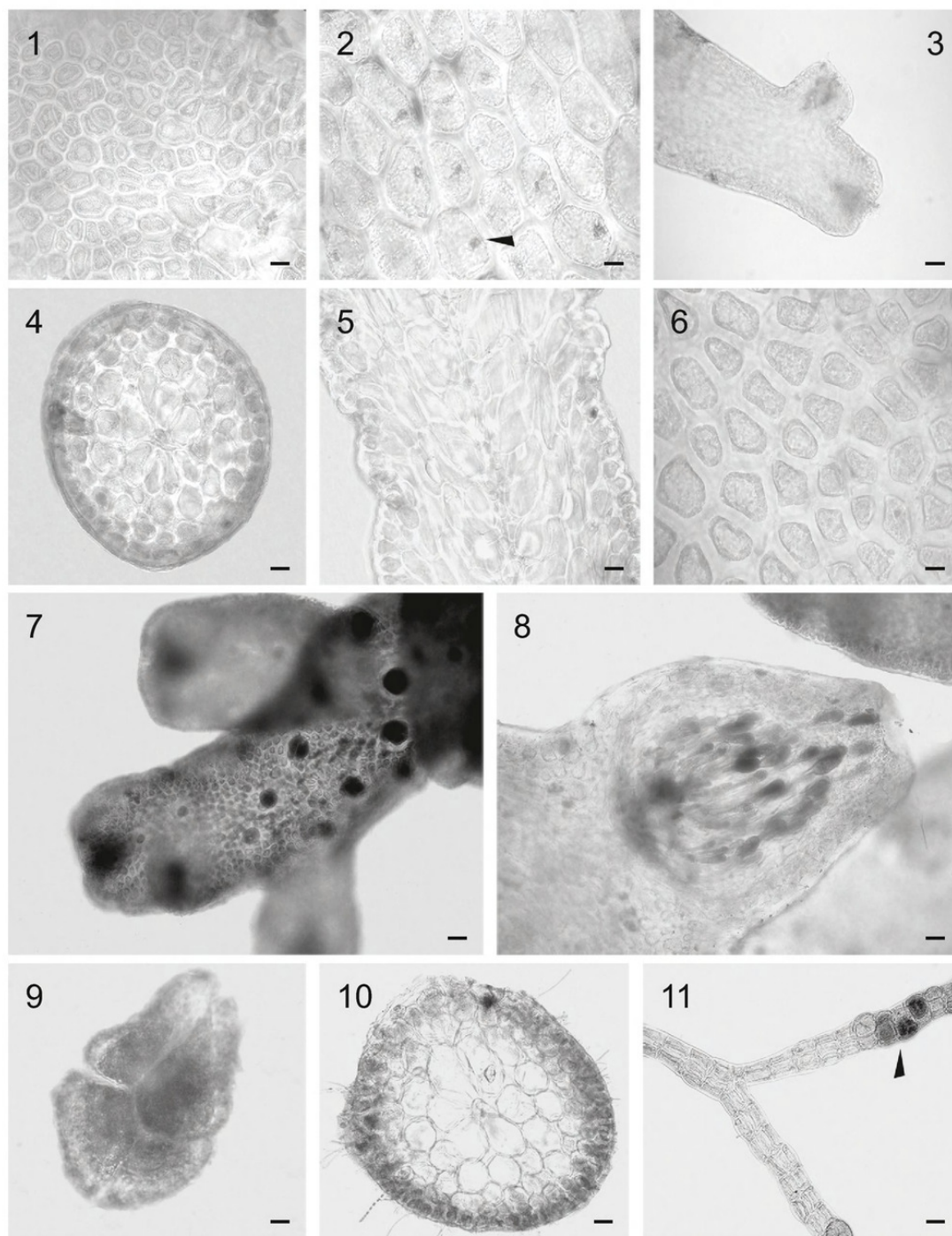


Plate 5. Fig. 1. *Bryothamnion triquetrum*, surface view of a vegetative branch. Fig. 2-5. *Laurencia intricata*: 2. Surface cells showing *corps en cerise* (arrowhead). 3. Apical part of a vegetative branch. 4. Transverse section of a vegetative branch showing a polysiphonic organization. 5. Longitudinal section of a vegetative branch. Fig. 6-10. *Laurencia obtusa*: 6. Surface view of a branch showing intercellular connections. 7. Distal part of a tetrasporophytic branch. 8. A cystocarp with carpospores. 9. Tetrasporangium cruciately divided. 10. Transverse section of a branch showing six pericentral cells. Fig. 11. *Neosiphonia gorgoniae*: tetrasporophytic branches with tetrasporangia (arrowhead) tetrahedrally divided. Scale bars: 100 μ m in Fig. 3, 7, 8 and 11; 50 μ m in Fig. 4, 5 and 10; 25 μ m in Fig. 1, 2, 6 and 9.

Female gametophyte. Principal branches 100-115 μm in diam., with segments 90-110 μm long. Cystocarps 200 μm long and 175 μm in diam.

Male gametophyte. Principal branches 70-80 μm in diam., with cells 90 μm long. Spermatangial stichidia 190-240 μm long and 60-80 μm in diam. Branchlets that bear stichidia 50 μm in diam.

Tetrasporophyte. Thallus 0.9-2.0 mm high. Principal branches 50-90 μm in diam., with segments 65-115 μm long, fixed to substratum by a unicellular rhizoid 50 μm in diam. Tetrasporangia 65-95 μm wide and 75 μm high. Branches substituting trichoblasts. Trichoblasts helicoidally arranged, with one basal cell 90-100 μm long and 15-20 μm in diam. Epiphyte on *Bryothamnion triquetrum*.

Examined specimens: LS-8 (1 March 2008).

NPSAV: Hornos and Blanquilla reefs, Isla de Enmedio, Isla Sacrificios, Isla Verde (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

GOM: throughout the Gulf (Fredericq et al., 2009).

References: Taylor, 1960: 576; Aguilar-Rosas & Aguilar-Rosas, 1988: 80, fig. 3-5; Schneider & Searles, 1991: 467; Littler & Littler, 2000: 228, 229 (fig.).

19. *Polysiphonia pseudovillum* Hollenberg, 1968 (Pl. 6, Fig. 4-7; Pl. 13, Fig. 4-7)

Thallus filamentous, delicate, 1-2 cm high, forming small tufts. Loses color rapidly after being exposed to light. Branching dichotomous, spaced. Prostrate axes 51-57 μm in diam., with segments of 75-90 μm long, scars from trichocytes common. Erect axes 40-45 μm in diam., slightly attenuated at the base, with four pericentral cells, not corticated. Segments one to two diameters long. Apical filaments deciduous, branching 2-3 times. Rhizoids unicellular, emerging proximally from pericentral cells, separated by the wall of the parent cell. Tetrasporangia spherical, 66-69 μm in diam., tetrahedrally divided, one per segment, in spiral series on superior branchlets. Cystocarps urn-shaped or globose, 160-170 μm in diam. Epiphyte on *Bryothamnion triquetrum*.

Morphological note. Tetrasporangia and cystocarps in our specimens were larger than those in Littler & Littler (2000): 40-50 μm and up to 150 μm , respectively.

Examined specimens: LS-8 (1 March 2008).

A new record for the Gulf of Mexico.

References: Schneider & Searles, 1991: 472; Littler & Littler, 2000: 230, 231 (fig.); Mamoozadeh & Freshwater, 2012: 338, Fig. 58-72.

20. *Yuzurua poiteaui* (J.V. Lamouroux) Martin-Lescanne, 2010 (Pl. 6, Fig. 8; Pl. 7, Fig. 1-3; Pl. 13, Fig. 8 and 9; Pl. 14, Fig. 1-3)

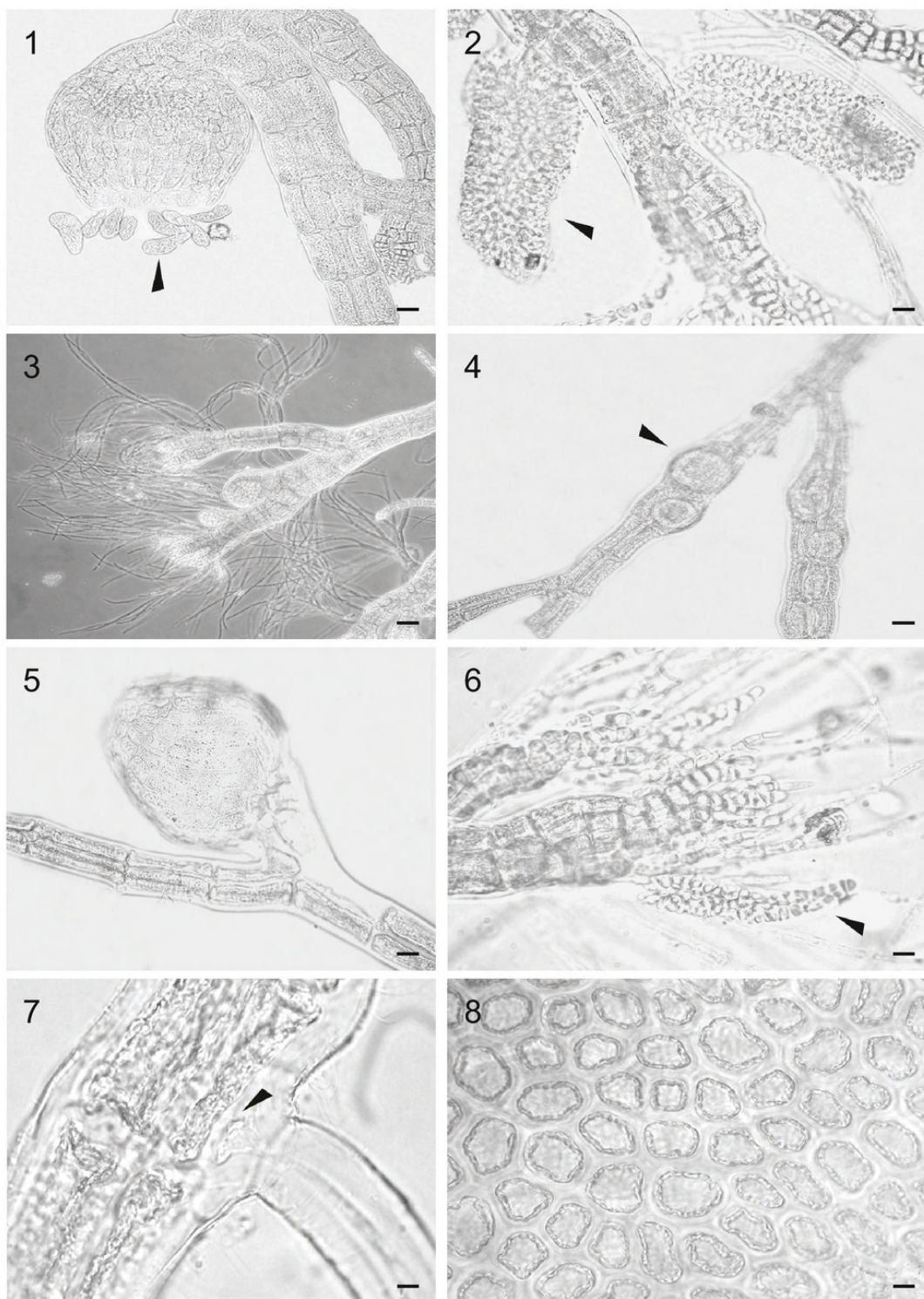


Plate 6. Fig. 1-3. *Neosiphonia gorgoniae*: 1. Cystocarps and released carpospores (arrowhead). 2. Apices of erect axes with spermatangial branches (arrowhead). 3. Erect axes with abundant trichoblasts. Fig. 4-7. *Polysiphonia pseudovillum*: 4. Erect axes with tetrasporangia in formation (arrowhead). 5. Erect axis showing a cystocarp. 6. Apices of branches with spermatangial stichidia (arrowhead). 7. Prostrate axis with a rhizoid without connection with the parent cells (arrowhead). Fig. 8. *Yuzurua poiteau*, surface view of a vegetative branch. Scale bars: 50 µm in Fig. 3-5; 25 µm in Fig. 1, 2 and 6-8.

Bas.: *Fucus poiteau* J.V. Lamouroux, 1805: 63, pl. 31, fig. 2, 3.

Syn.: *Chondrophycus poiteau* (J.V. Lamouroux) K.W. Nam, 1999: 463; *Laurencia poiteau* (J.V. Lamouroux) M.A. Howe, 1905: 583, 1918: 518; *Palisada poiteau* (J.V. Lamouroux) K.W. Nam, 2006: 69.

Thallus pseudoparenchymatous, compact, cartilaginous, 1.5-4.0 cm high. Loses color rapidly after being exposed to light. Branching alternate, irregular, branchlets helicoidally arranged. Main branches cylindrical or slightly compressed, 1.0-1.2 mm in diam. Secondary branches 960 µm in diam. Branchlets numerous, cylindrical, 1.3-1.5 mm long and 0.4-1.0 mm in diam. Apices covered with fine tufts of trichomes, dichotomously branched filaments extending beyond the border of the depression. Surface cells of irregular shape, rounded to oblong, 24-34 µm long and 18-24 µm in diam. Secondary connections present. Medullar cells 105-150 µm long and 69-156 µm in diam. Cortical cells 24-39 µm long and 18-24 µm in diam. Surface cells 45-54 µm in diam. Tetrasporangia oval, tetrahedrally divided, 90-105 µm long and 60-63 µm in diam.

Examined specimens: LS-11 (1 March 2008).

NPSAV: Hornos reef, Isla de Enmedio, Isla Sacrificios, Isla Verde (Ortega et al., 2001).

GOM: NE, NW and SE (Fredericq et al., 2009).

References: Taylor, 1960: 625; Schneider & Searles, 1991: 454, fig. 537; Littler & Littler, 2000: 218, 219 (fig.); Senties-Granados & Fujii, 2002: 170, fig. 103-113; Dawes & Mathieson, 2008: 304, pl. 38, fig. 21, 22.

Family Cystocloniaceae

21. *Hypnea spinella* (C. Agardh) Kütz., 1847 (Pl. 7, Fig. 4-8; Pl. 14, Fig. 4-6)

Bas.: *Sphaerococcus spinellus* C. Agardh, 1822: 323.

Syn.: *Hypnea cervicornis* J. Agardh, 1851: 451.

Thallus subpseudoparenchymatous, wiry, forming entangled and decumbent mats, up to 3 cm high. Brown-red. Growing in all directions starting from the apical meristem. Branches cylindrical, 400-1000 µm in diam. Branchlets spine-like, numerous, 2.5 mm long, apices pointed, tapering distally. Medullar cells with thick walls, irregular shaped to oval, 100-350 µm in diam., encircling the central filament 70-80 µm in diam. with a thickened wall. Cortex consisting of one or two layers of cells, rounded to irregular-shaped, 7.5-25 µm in diam., strongly

pigmented. Tetrasporangia oval, 25-30 μm long and 10-20 μm in diam., zonately divided, in swollen sori (nemathecia) as a fringe in the middle parts of the lateral branchlets. Holdfast discoid.

Examined specimens: LS-11, 24 (1 March 2008).

NPSAV: Hornos, Gallega and Ingenieros reefs, Isla Blanquilla, Isla de Enmedio, Isla Sacrificios, Isla Verde (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Elsewhere in Veracruz: Mpio. Actopan: Playa Paraíso (Laguna La Mancha); Mpio. San Andrés Tuxtla: Montepío; Mpio. Tuxpan: Barra de Tuxpan, Tuxpan, Isla de Lobos; Mpio. Veracruz: Playa Hotel Pensiones, Playa Mocambo; Mpios. Pueblo Viejo, Tampico Alto, Ozuluama, Tamalín and Tamiahua: Laguna de Tamiahua (Ortega et al., 2001).

GOM: NE, SW and SE (Fredericq et al., 2009).

References: Taylor, 1960: 465, 466, pl. 73, fig. 2; Schneider & Searles, 1991: 306, fig. 356; Littler & Littler, 2000: 78, 79 (fig.); Dawes & Mathieson, 2008: 320, pl. 42, fig. 26, 27.

DISCUSSION

Out of 21 species present in this work, *Polysiphonia pseudovillum* is a new record for the Gulf of Mexico, and *Colaconema hallandicum* and *Ceratodictyon planicaule* are new records for NPSAV. The genus *Polysiphonia* Grev. is one of the genera of red algae widely distributed throughout the world, with 993 species and infraspecific names at present, of which 192 have been accepted taxonomically (Guiry & Guiry, 2012). *Ceratodictyon planicaule* is a rare species known from the Caribbean, Brazil, the Canary Islands and West African waters (Dawes & Mathieson, 2008). In Puerto Rico, its vertical distribution is rather wide, from the littoral to the sublittoral, associated with two other red algae, *Gelidium pusillum* (Stackhouse) Le Jolis and *G. crinale* (Hare ex Turner) Gaillon. Additionally, it has been reported from the Greater and the Lesser Antilles, Barbados, Belize, Costa Rica, Cuba, Dominican Republic, French Guyana, Jamaica, Martinica, Trinidad and Tobago, and Venezuela, including Aves Island (Cabrera et al., 2004). *Ceratodictyon intricatum* is another species with an exclusively island distribution.

Colaconema hallandicum is an inconspicuous species due to its small size. It is usually found attached to macroalgae or seagrasses. It is known from North Carolina (USA), throughout the Caribbean, Sargasso Sea, Brazil and from Uruguay.

Furthermore, it has been reported from the NE and tropical Atlantic and the tropical Pacific (Dawes & Mathieson, 2008). In the State of Veracruz, this species has been previously reported only from rocky-shore localities (Ortega et al., 2001).

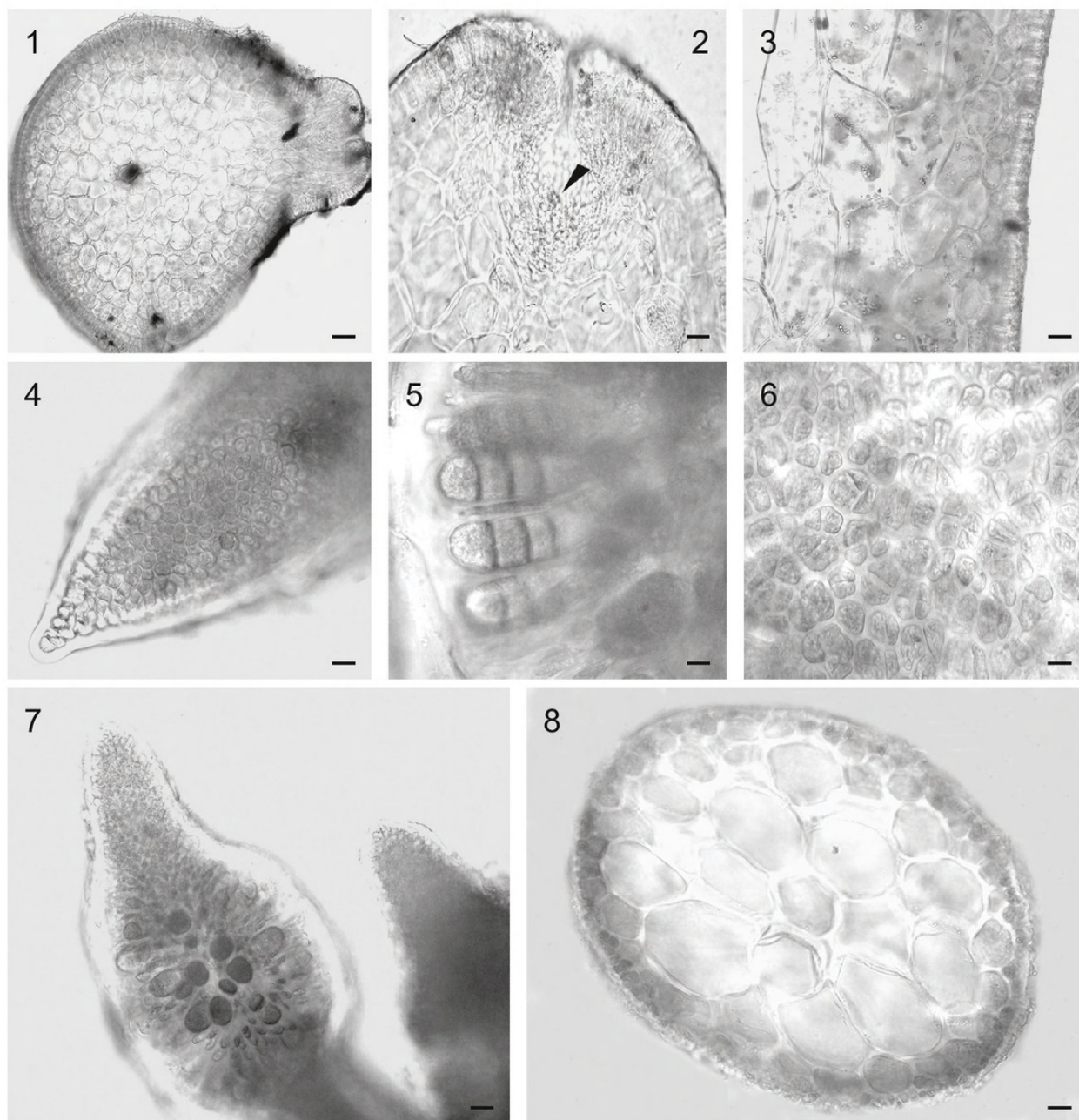


Plate 7. Fig. 1-3. *Yezurua poiteaui*: 1. Transverse section of a vegetative branch. 2. Transverse section showing inconspicuous apical filament tuft in terminal depression (arrowhead). 3. Longitudinal section of a branch. Fig. 4-8. *Hypnea spinella*: 4. Apical part of a branch. 5. Tetrasporangia zonately divided. 6. Surface view of a branch. 7. Swollen tetrasporangial sori. 8. Transverse section of a vegetative branch. Scale bars: 100 μ m in Fig. 1; 50 μ m in Fig. 2, 3, 7 and 8; 25 μ m in Fig. 4-6.

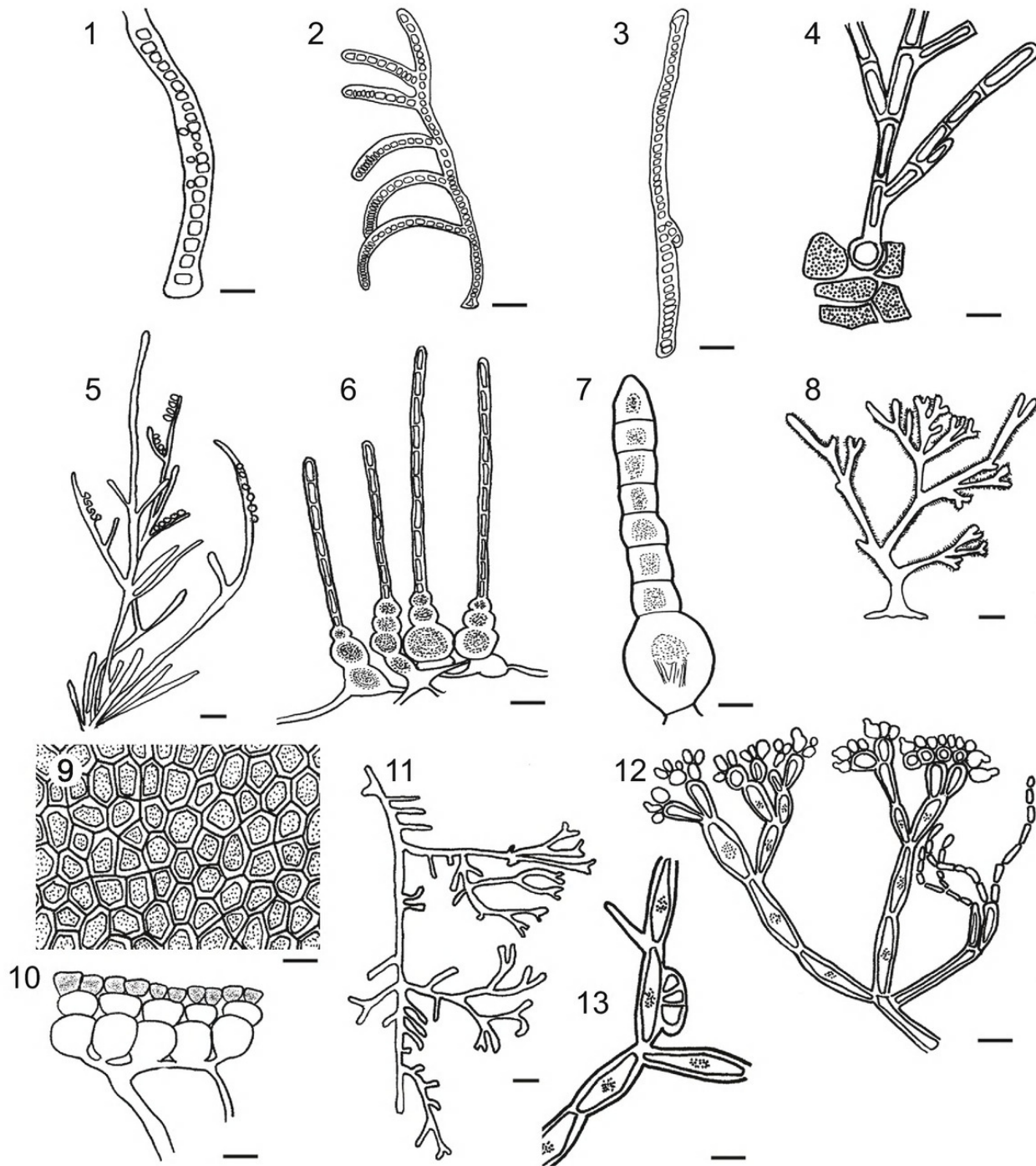


Plate 8. Fig. 1-3. *Stylonema alsidii*. 1. Mature filament with monospores. 2. Branched filament. 3. Immature unbranched filament. Fig. 4 and 5. *Colaconema hallandicum*. 4. Erect axis with a globose initial spore. 5. Filaments with lateral, solitary, sessile monosporangia. Fig. 6-8. *Galaxaura rugosa*, a tetrasporophyte. 6. Assimilating filaments. 7. Surface filament with a bulbous basal cell. 8. General view of thallus. Fig. 9 and 10. *Galaxaura rugosa*, a gametophyte. 9. Surface view of thallus. 10. Transverse section of cortex showing interfused subsurface cells. Fig. 11-13. *Liagora ceranoides*. 11. General view of branches. 12. Cortical filaments. 13. Carpogonial branch. Scale bars: 2 mm in Fig. 8 and 11; 100 μ m in Fig. 5; 50 μ m in Fig. 2 and 6; 25 μ m in Fig. 1, 3, 4, 7, 9, 10, 12 and 13.

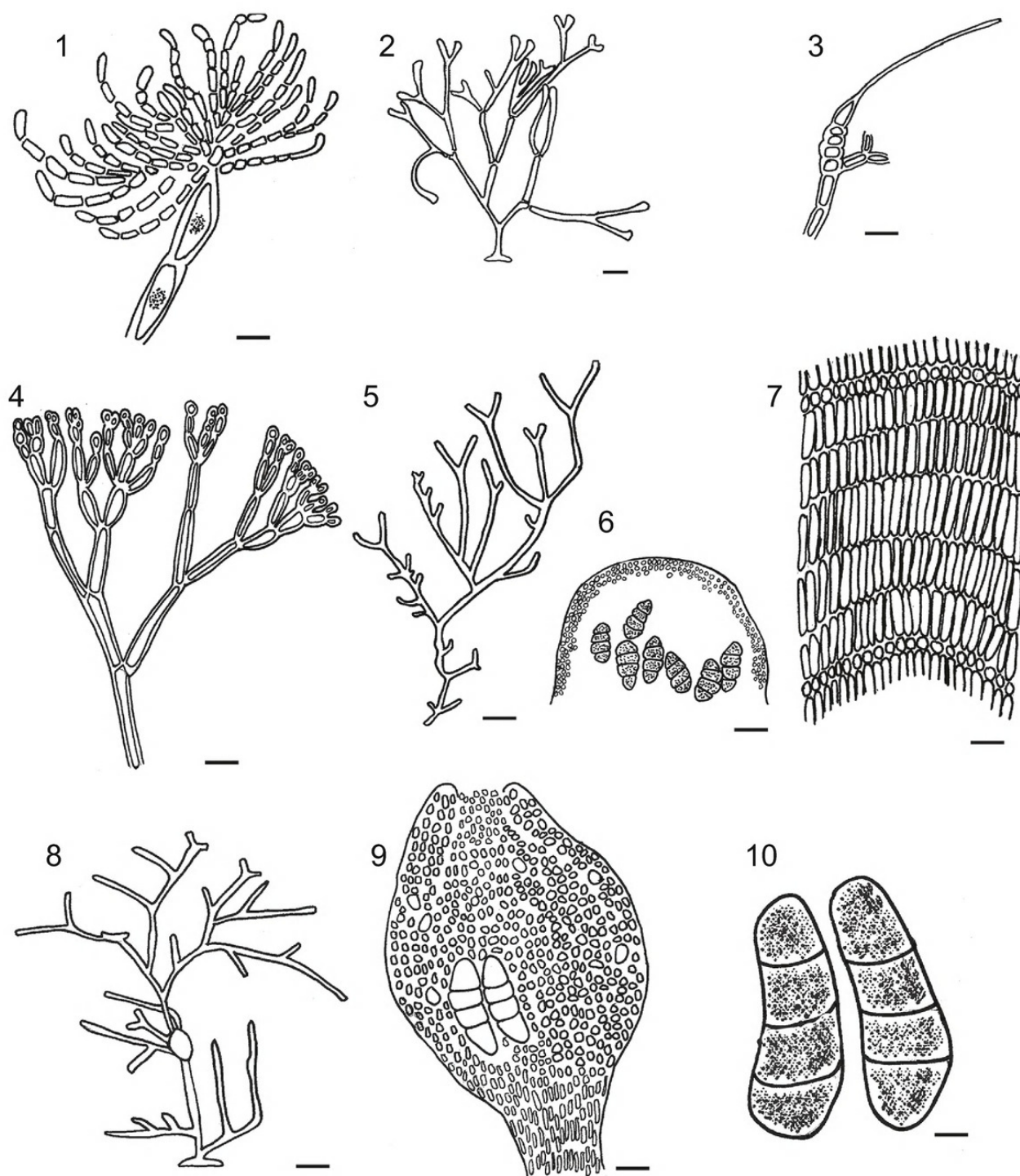


Plate 9. Fig. 1. *Liagora ceranoides*, cortical filaments. Fig. 2-4. *Titanophycus validus*. 2. General view of thallus. 3. Carpogonial branch. 4. Cortical filaments. Fig. 5-7. *Amphiroa fragilissima*: 5. General view of branches. 6. Transverse section of tetrasporangial conceptacle. 7. Longitudinal section of a branch. Fig. 8-10. *Jania adhaerens*: 8. General view of thallus. 9. Tetrasporangial conceptacle. 10. Tetrasporangia. Scale bars: 2 mm in Fig. 2, 5 and 8; 100 μ m in Fig. 9; 50 μ m in Fig. 6 and 7; 25 μ m in Fig. 1, 3, 4 and 10.

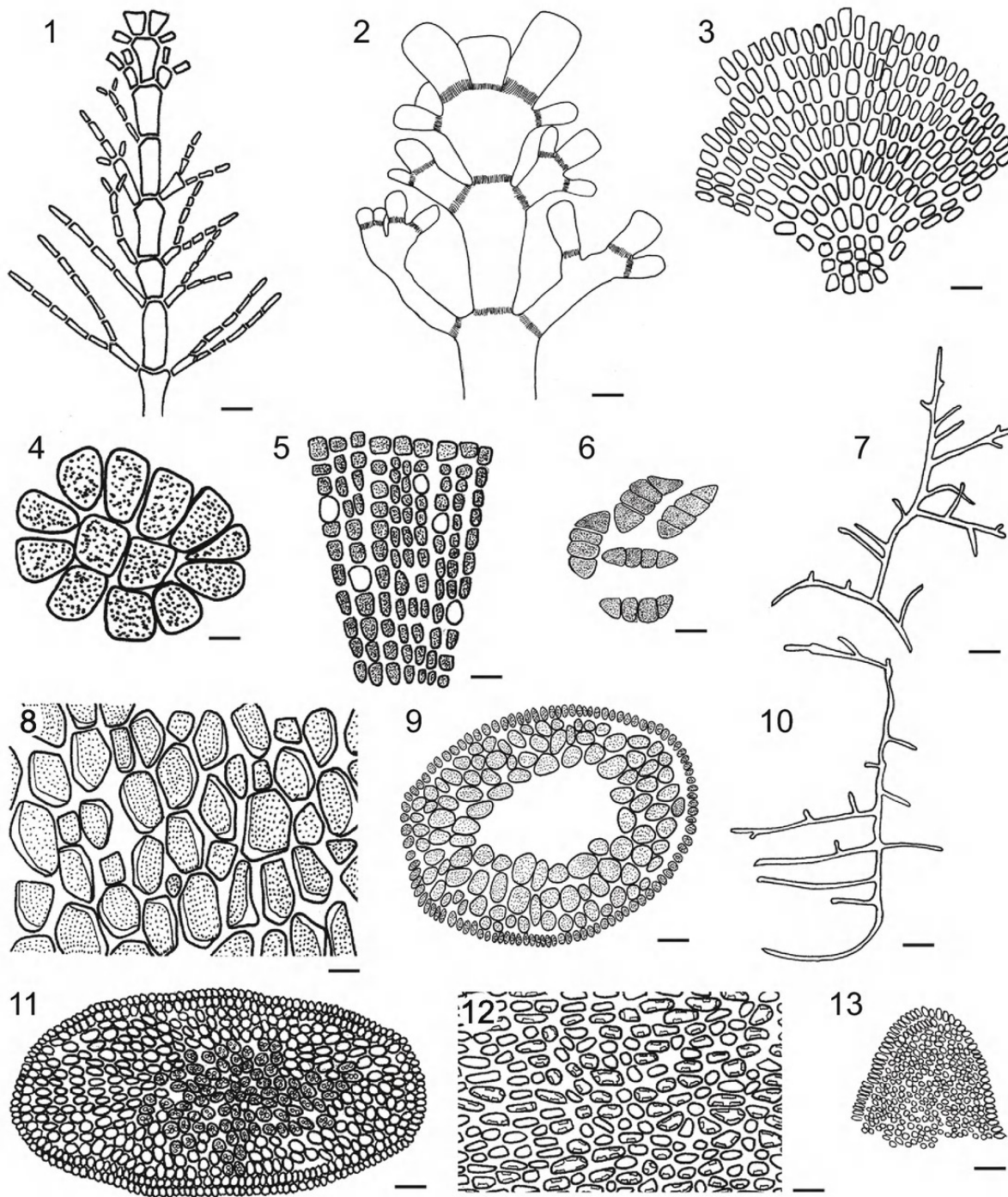


Plate 10. Fig. 1 and 2. *Jania cubensis*: 1. General view of vegetative branches. 2. Distal part of a branch. Fig. 3 and 4. *Pneophyllum fragile*: 3. General view of crusty thallus. 4. Initial eight-celled structure of thallus. Fig. 5 and 6. *Porolithon pachydermum*: 5. Transversal section showing megacells. 6. Zonately divided tetrasporangia. Fig. 7-9. *Ceratodictyon intricatum*. 7. General view of branches. 8. Surface cells of a vegetative branch. 9. Transverse section of thallus showing medullar and cortical cells. Fig. 10-13. *Ceratodictyon planicaule*. 10. General view of a branch. 11. Transverse section of a vegetative branch. 12. Surface cells of a vegetative branch. 13. Extremity of a branch with multiple apical cells. Scale bars: 2 mm in Fig. 1, 7 and 10; 50 μ m in Fig. 2, 9 and 11; 25 μ m in Fig. 3, 5, 6, 8, 12 and 13; 15 μ m in Fig. 4.

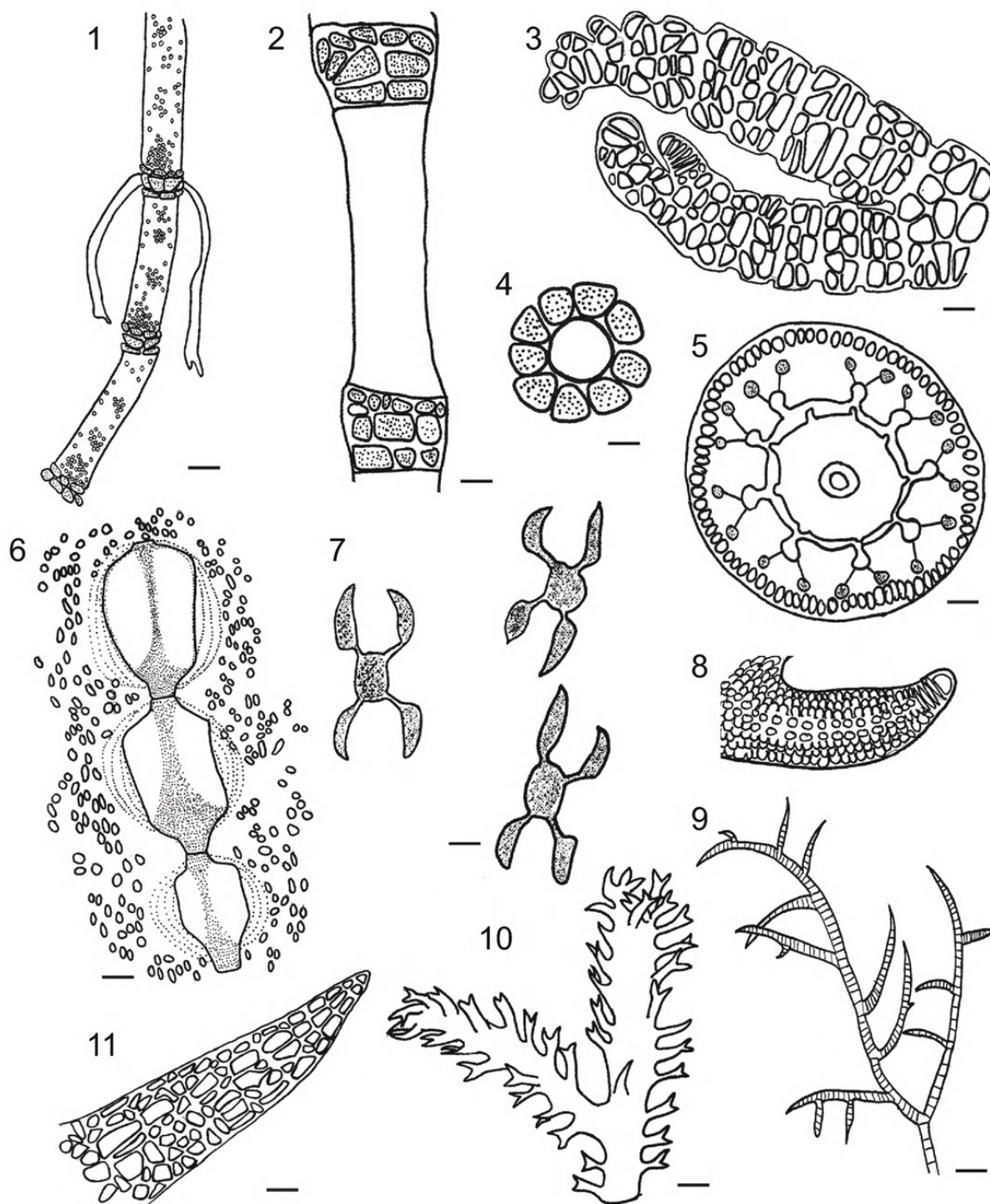


Plate 11. Fig. 1-4. *Ceramium luetzelburgii*. 1. Vegetative filaments with rhizoids developing from the nodes. 2. Structure of nodes composed of three rows of cells. 3. Distal part of a vegetative branch. 4. Transverse section of nodes. Fig. 5-9. *Ceramium nitens*. 5. Transverse section of vegetative thallus showing nine periaxial cells. 6. Longitudinal section showing the axial filament. 7. Periaxial cells with two acropetal and two basipetal cells. 8. Apical part of a branch in surface view. 9. General view of a vegetative branch. Fig. 10 and 11. *Bryothamnion triquetrum*. 10. General view of branches. 11. Apical part of a vegetative branch. Scale bars: 2 mm in Fig. 9 and 10; 50 μ m en Fig. 1, 5, 6, 8 and 11; 25 μ m in Fig. 2-4 and 7.

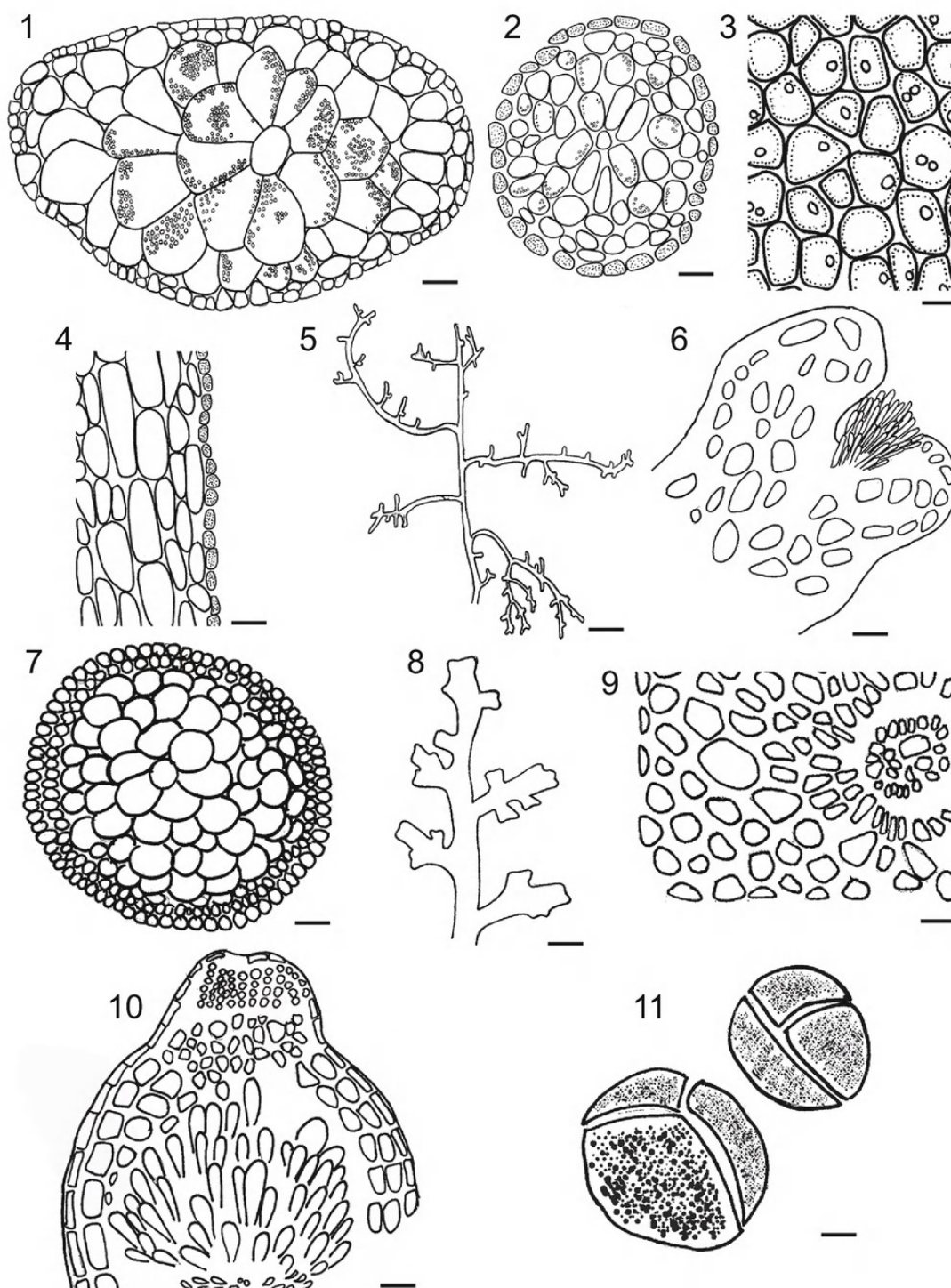


Plate 12. Fig. 1. *Bryothamnion triquetrum*, transverse section of a vegetative branch. Fig. 2-6. *Laurencia intricata*. 2. Transverse section of a vegetative branch. 3. Surface cells showing *corps en cerise*. 4. Longitudinal section of a vegetative branch. 5. General view of branches. 6. Apical part of a vegetative branch. Fig. 7-11. *Laurencia obtusa*. 7. Transverse section of a branch. 8. General view of branches. 9. Surface view of a tetrasporangial branch. 10. Fragment of a cystocarp. 11. Tetrasporangia tetrahedrally divided. Scale bars: 2 mm in Fig. 5 and 8; 100 μ m in Fig. 1, 7 and 10; 50 μ m in Fig. 2-4, 6 and 9; 25 μ m in Fig. 11.

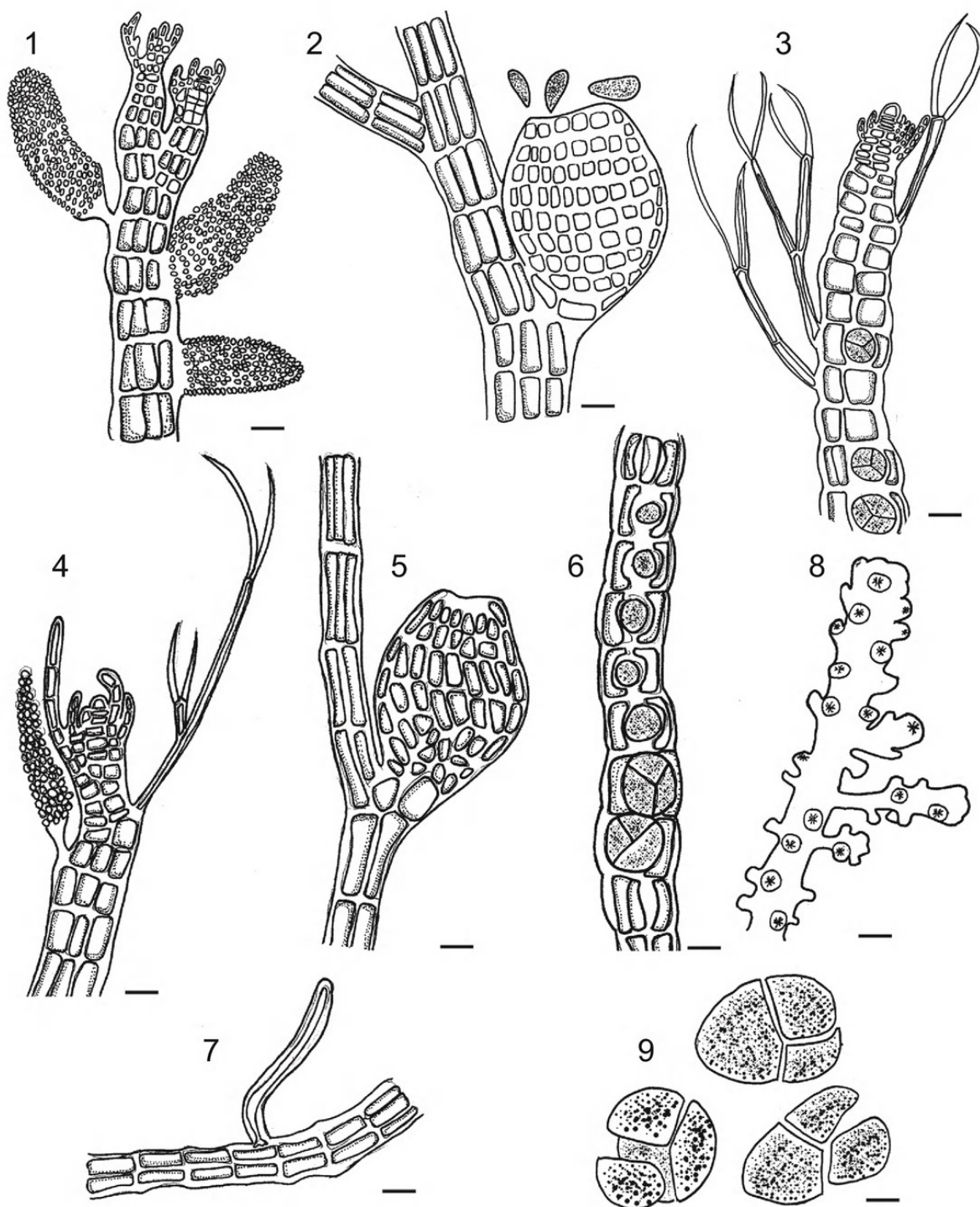


Plate 13. Fig. 1-3. *Neosiphonia gorgoniae*. 1. Distal part of erect branch with spermatangial stichidia. 2. Cystocarps releasing carpospores. 3. Erect axis with tetrasporangia. Fig. 4-7. *Polysiphonia pseudovillum*. 4. Distal part of a branch with a spermatangial stichidium (on the left). 5. Erect axis showing a cystocarp. 6. Erect axis with tetrasporangia in formation. 7. Prostrate axis with a rhizoid without connection to the parent cells. Fig. 8 and 9. *Yuzurua poiteaui*. 8. General view of a tetrasporangial branch. 9. Tetrasporangia tetrahedrally divided. Scale bars: 2 mm in Fig. 8; 50 μ m in Fig. 1-3 and 5-7; 25 μ m in Fig. 4 and 9.

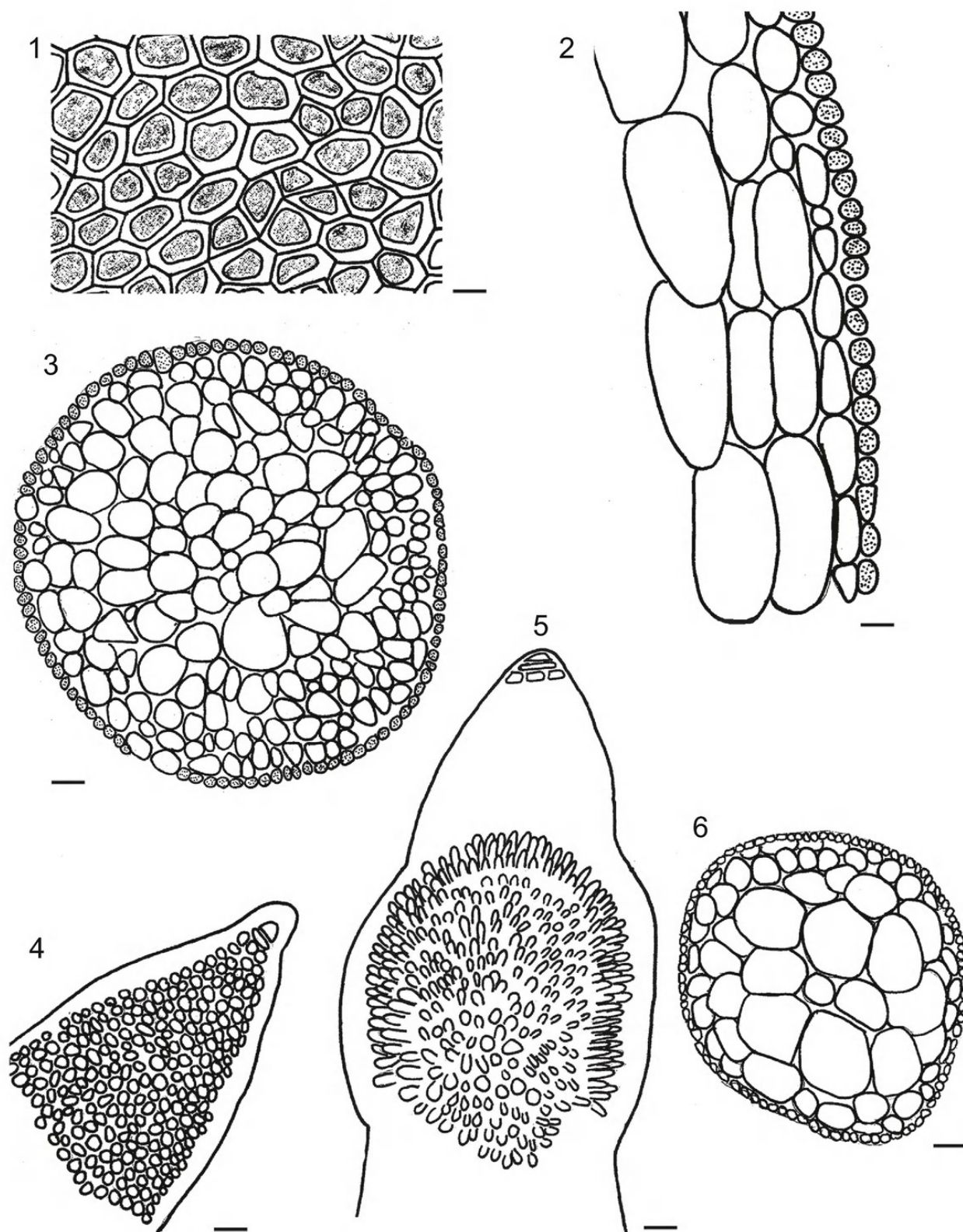


Plate 14. Fig. 1-3. *Yuzurua poiteaui*. 1. Surface view of a tetrasporangial branch. 2. Longitudinal section of a branch. 3. Transverse section of the principal axis. Fig. 4-6. *Hypnea spinella*. 4. Apical part of a branch. 5. Swollen tetrasporangial sorus. 6. Transverse section of the principal axis. Scale bars: 100 µm in Fig. 3 and 6; 50 µm in Fig. 2; 25 µm in Fig. 1, 4 and 5.

Porolithon pachydermum was found earlier only on Santiaguillo reef (Ortega, et al. 2001). *Ceramium luetzelburgii* was collected on rocky shores and within the NPSAV only on Isla Verde reef. In the State of Veracruz, *Ceramium nitens* and *Laurencia intricata* have been known exclusively from island localities, whereas *Neosiphonia gorgoniae* and *Yuzurua poiteaui* have been found only on reefs (Ortega et al., 2001; Galicia-García & Morales-García, 2007).

Often the morphological characteristics of the species reported in the present article did not correspond exactly to those presented by others. For example, the thalli of 10 species from the NPSAV and their reproductive structures were usually smaller compared to the same species from the Caribbean (Taylor, 1960; Littler & Littler, 2000).

On Cabezo reef, red algae dominate the macroalgal community, and the families Rhodomelaceae and Corallinaceae are the best represented in terms of number of species (6 and 5 species, respectively). Out of 21 species given in the present study, nine of them (42%) were epiphytes. On Isla Verde reef, Mateo-Cid et al. (1996) observed 36 red algal species, including 13 (36%) epiphytic ones. These findings are evidence that red algal epiphytism is very common in reef environments. Six species, *Stylonema alsidii*, *Colaconema hallandicum*, *Jania cubensis*, *Pneophyllum fragile*, *Neosiphonia gorgoniae* and *Polysiphonia pseudovillum*, have been found exclusively as epiphytes on other algae. Our new record of *P. pseudovillum* for the Gulf of Mexico suggests that red algae, primarily the small-sized epiphytes, are a source of yet undocumented diversity.

Comparing the red algal flora between Cabezo reef and the adjacent and most studied reefs (Isla de Enmedio y Santiaguillo), Cabezo reef shares 14 and 8 species, respectively.

In the studied specimens, reproductive structures were infrequently observed. However, it should be noted that reproductive specimens with tetrasporangia predominated during the rainy (June) and dry seasons (March and November). The mode of reproduction by means of tetrasporangia has the advantage of rapid dissemination without wasting much energy, thus allowing the species a more efficient dispersal (Santelices, 1977).

Most of the analyzed species are distributed in tropical seas. It was previously shown that the macroalgal flora of Isla Verde is of tropical character (Zizumbo-Alamilla, 1995). That is also true for Cabezo reef. Most examined species have been found earlier in the NPSAV, except for *Laurencia intricata* and the following new records for the park: *Polysiphonia pseudovillum*, *Ceratodictyon planicaule*, and *Colaconema hallandicum*. This implies the necessity for further taxonomic work, especially on unstudied reefs of the region.

ACKNOWLEDGMENTS

Our thanks to the captain Cipriano Anaya-Cruz for logistic support, Luz Elena Mateo-Cid and A. Catalina Mendoza-González for their hospitality in the Laboratory of Phycology at Escuela Nacional de Ciencias Biológicas del Instituto Politécnico Nacional in Mexico City, Horacio Pérez-España from ICIMAP-UV for both logistic and financial support with the boat trip in 2010. Marcia M. Gowing from the University of California at Santa Cruz, California, USA, and the two anonymous referees kindly improved the writing style and made some useful suggestions. We thank Michael Wynne from the University of Michigan Herbarium, USA, for helping with the literature. The present study was a part of the project of Dirección General de Investigaciones de la Universidad Veracruzana “Algas de la zona arrecifal Veracruzana, Golfo de México, con énfasis en las algas rojas, diatomeas y dinoflagelados” (2007-2009) given to YBO. Financial support of PROMEP to the project “Patrones de distribución de la diversidad y biomasa de grupos funcionales clave para el Sistema Arrecifal Veracruzano” (2011-2012) is also appreciated.

LITERATURE CITED

- Aguilar-Rosas, M. A. & L. E. Aguilar-Rosas. 1988. Anomalías reproductivas en *Heterosiphonia gibbesii* (Harvey) Falkenberg y *Polysiphonia gorgoniae* Harvey (Rhodophyta, Ceramiales). Caribb. J. Sci. 24: 78-81.
- Anonymous. 1987. Atlas/memoria del levantamiento geofísico de la zona económica exclusiva y margen continental oeste de México SMPO8710. Secretaría de Marina. México, D.F., Mexico.
- Cabrera, R., B. Martínez-Daranas, A. M. Suárez & A. Moreira. 2004. Adiciones a las rodoficeas marinas de Cuba. Rev. Invest. Mar. 25(2): 163-166.
- Carrillo, L., G. Horta-Puga & J. P. Carricart-Ganivet. 2007. Climate and oceanography. In: Tunnell, J. W. Jr., E. A. Chávez & K. Withers (eds.). Coral reefs of the southern Gulf of Mexico. Texas A&M University Press. Corpus Christi, USA. pp. 34-40.
- Contreras-Espinosa, F. 1993. Ecosistemas costeros mexicanos. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. Universidad Autónoma Metropolitana Unidad Iztapalapa. México, D.F. Mexico. 415 pp.
- Dawes, C. J. & A. C. Mathieson. 2008. The seaweeds of Florida. University Press of Florida. Gainesville, USA. viii + 591 pp., 51 pl.
- De la Campa-Guzmán, S. 1965. Notas preliminares sobre un reconocimiento de la flora marina del estado de Veracruz. An. Inst. Nac. Invest. Biol.-Pesq. 1: 9-49.

- Dreckmann, K. M. 1998. Clasificación y nomenclatura de las macroalgas marinas bentónicas del Atlántico mexicano. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México, D.F., Mexico. 140 pp.
- Fredericq, S., T. O. Cho, S. A. Earle, C. G. Frederico, D. M. Krayesky, L. E. Mateo-Cid, A. C. Mendoza-González, J. N. Norris & A. M. Suárez. 2009. Seaweeds of the Gulf of Mexico. In: Tunnell, J. W. Jr., D. L. Felder & S. A. Earle (eds.). Gulf of Mexico origin, waters and biota. Vol. 1. Biodiversity. Harte Research Institute for Gulf of Mexico Studies Series, Texas A&M University Press. Corpus Christi, USA. pp. 187-259.
- Fujii, M. T., A. L. M. Cocentino & S. M. B. Pereira. 2001. *Ceramium nitens* (Ceramiaceae, Rhodophyta), an uncommon species from Brazil. Rev. Brasil. Bot. 24(3): 359-363.
- Galicia-García, C. & A. Morales-García. 2007. Investigaciones sobre macroalgas realizadas en el Sistema Arrecifal Veracruzano. In: Granados-Barba, A., L. Abarca-Arenas & J. M. Vargas-Hernández (eds.). Investigaciones Científicas en el Sistema Arrecifal Veracruzano. Universidad Autónoma de Campeche. Campeche, Mexico. pp. 141-160.
- González, J. I., R. Soto & J. Ochoa. 2009. Predicción de mareas en México. Oceanografía Física, Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE). Ensenada, México. predmar.cicese.mx en línea. Consulted on april 15, 2011.
- Guiry, M. D. & G. M. Guiry. 2012. AlgaeBase. World-wide electronic publication. National University of Ireland, Galway. <http://www.algaebase.org>; searched on 27 January 2012.
- Huerta, L. 1960. Lista preliminar de las algas marinas del litoral del estado de Veracruz. Bol. Soc. Bot. Méx. 25: 39-45.
- Humm, H. J. & H. H. Hildebrand. 1962. Marine algae from the gulf coast of Texas and Mexico. Publ. Inst. Mar. Sci. Univ. Tex. 8: 227-268.
- Joly, A. B. 1967. Gêneros de algas marinhas da costa atlântica latino-americana. Ed. Universidad de São Paulo. São Paulo, Brasil. 461 pp.
- Kato, A., M. Baba & S. Suda. 2011. Revision of the Mastophoroideae (Corallinales, Rhodophyta) and polyphyly in nongeniculate species widely distributed on Pacific coral reefs. J. Phycol. 47: 662-672.
- Lehman, R. L. 1993. Field and laboratory investigations of the macroalgae of Enmedio coral reef, with specific taxonomic reference to the genus *Caulerpa*. Ph dissertation. Texas A&M University. Texas, USA. 161 pp.
- Lehman, R. L. & J. W. Tunnell Jr. 1992. Species composition and ecology of the macroalgae of Enmedio Reef, Veracruz, Mexico. Texas J. Sci. 44(4): 445-457.
- Little, D. S. & M. M. Little. 2000. Caribbean reef plants. An identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico. Offshore Graphics, Inc. Washington, D.C., USA. 542 pp.
- Mamoozadeh, N. R. & D. W. Freshwater. 2012. *Polysiphonia sensu lato* (Ceramiaceae, Florideophyceae) species of Caribbean Panama including *Polysiphonia lobophoralis* sp. nov. and *Polysiphonia nuda* sp. nov. Bot. Mar. 55: 317-342.
- Mateo-Cid, L. E. 2006. Estudio taxonómico de los géneros *Neogoniolithon*, *Spongites* y *Pneophyllum* (Corallinales, Rhodophyta) en la costa del Atlántico de México. Tesis de Doctorado. Universidad Autónoma Metropolitana. México, D.F., Mexico. 161 pp.

- Mateo-Cid, L. E. & A. C. Mendoza-González. 2009. Revisión de las especies mexicanas de *Pneophyllum* Kützinger (Corallinales, Rhodophyta). *Rev. Biol. Mar. Oceanogr.* 44(3): 603-618.
- Mateo-Cid, L. E., A. C. Mendoza-González & C. Galicia-García. 1996. Algas marinas de Isla Verde, Veracruz, México. *Acta Bot. Mex.* 36: 59-75.
- Mendoza-González, A. C. & L. E. Mateo-Cid. 1985. Contribución al conocimiento de la flora marina bentónica de las islas Sacrificios y Santiaguillo, Veracruz, México. *Phytologia* 59(1): 9-16.
- Mendoza-González, A. C., F. F. Pedroche & L. E. Mateo-Cid. 2009. The genus *Hydrolithon* Foslie (Corallinales, Rhodophyta) along the Atlantic and Caribbean coasts of Mexico. *Gayana Bot.* 66(2): 218-238.
- Morales-García, A., M. K. Román-Magaña & L. Martínez-Cárdenas. 1997. Algas del Sistema Arrecifal Veracruzano. *Oceanología* 3(15): 25-34.
- Moura, C.W. do N. & S. M. P. Beauclair. 2005. O gênero *Amphiroa* (Lithophylloideae, Rhodophyta) no litoral do Brasil. *Monografías Ficológicas* 2: 3-65.
- Okolodkov, Y. B., G. Campos-Bautista, I. Gárate-Lizárraga, J. A. G. González-González, M. Hoppenrath & V. Arenas. 2007. Seasonal changes of benthic and epiphytic dinoflagellates in the Veracruz reef zone, Gulf of Mexico. *Aquat. Microb. Ecol.* 47(3): 223-237.
- Orduña-Medrano, R. E. 2004. Distribución y abundancia de la ficoflora en la llanura arrecifal Isla Sacrificios, Veracruz, México (verano 2002 e invierno 2003). Tesis profesional. Facultad de Biología, Universidad Veracruzana. Xalapa, Veracruz, Mexico. 124 pp.
- Ortega, M. M., J. L. Godínez & G. Garduño-Solórzano. 2001. Catálogo de algas bénticas de las costas mexicanas del Golfo de México y mar Caribe. Universidad Nacional Autónoma de México. México, D.F., Mexico. 594 pp.
- Pedroche, F. F. & A. Senties-Granados. 2003. Ficología marina mexicana. Diversidad y problemática actual. *Hidrobiológica* 13(1): 23-32.
- Salas-Monreal, D., D. A. Salas-de-León, M. A. Monreal-Gómez & M. L. Riverón-Enzástiga. 2009. Current rectification in a tropical coral reef system. *Coral Reefs* 28: 871-879.
- Salas-Pérez, J. J., D. Salas-Monreal, V. E. Arenas-Fuentes, D. A. Salas-de-León & M. L. Riverón-Enzástiga. 2008. Tidal characteristics in a coral reef system from the western Gulf of Mexico. *Cienc. Mar.* 34: 467-478.
- Santelices, B. 1977. Ecología de algas marinas bentónicas. Documento de la Dirección General de Investigaciones. Universidad Católica de Chile. Santiago de Chile, Chile. 488 pp.
- Schneider, C. W. 1983. The red algal genus *Audouinella* Bory (Nemaliales: Acrochaetiaceae) from North Carolina. *Smith. Cont. Mar. Sci.* 22: 1-20.
- Schneider, C. W. & R. B. Searles. 1991. Seaweeds of the southeastern United States: Cape Hatteras to Cape Canaveral. Duke University Press. Durham, N.C., USA xiv+553.
- Senties-Granados, A. & M. T. Fujii. 2002. El complejo *Laurencia* (Rhodomelaceae, Rhodophyta) en el Caribe mexicano. *Monografías Ficológicas* 1: 77-112.
- Silva, S., L. Brito & A. Lemus. 2003. Nuevas adiciones de algas marinas para el Parque Nacional Mochima, Sucre, Venezuela. *Rev. Biol. Trop.* 51: 159-165.

- Taylor, W. R. 1960. Marine algae of the eastern tropical and subtropical coasts of the Americas. University of Michigan. Ann Arbor, USA. xi + 870 pp.
- Wynne, M. J. 2011. A checklist of benthic marine algae of the tropical and subtropical Western Atlantic: third revision. *Nova Hedw., Beih.* 140: 1-166.
- Zizumbo-Alamilla, L. E. 1995. Estudio ficoflorístico de las macroalgas bénticas del arrecife coralino Isla Verde, Veracruz, México. Tesis Profesional. Escuela Nacional de Estudios Profesionales-Iztacala, Universidad Nacional Autónoma de México. México, D.F., Mexico. 107 pp.

Recibido en abril de 2011.

Aceptado en septiembre de 2012.



Galicia-García, Citlalli, Robinson, Néstor M., and Okolodkov,

I

-

U

-

riñ B. 2013. "NEW RECORDS OF RED ALGAE (RHODOPHYTA) FOR CABEZO REEF, NATIONAL PARK SISTEMA ARRECIFAL VERACRUZANO, GULF OF MEXICO." *Acta Botánica Mexicana* 102, 39–76.

View This Item Online: <https://www.biodiversitylibrary.org/item/200625>

Permalink: <https://www.biodiversitylibrary.org/partpdf/176959>

Holding Institution

Instituto de Ecología A.C.

Sponsored by

Instituto de Ecología A.C., Centro Regional del Bajío

Copyright & Reuse

Copyright Status: In copyright. Digitized with the permission of the rights holder.

Rights Holder: Instituto de Ecología A.C.

License: <http://creativecommons.org/licenses/by-nc-sa/4.0/>

Rights: <https://biodiversitylibrary.org/permissions>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at

<https://www.biodiversitylibrary.org>

This file was generated 15 April 2022 at 20:50 UTC