

THE GENUS *HYDROLITHON* FOSLIE (CORALLINALES, RHODOPHYTA)
ALONG THE ATLANTIC AND CARIBBEAN COASTS OF MEXICO

EL GÉNERO HYDROLITHON FOSLIE (CORALLINALES, RHODOPHYTA)
EN LA COSTA ATLÁNTICA Y CARIBE DE MÉXICO

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ABSTRACT

This paper provides the first monographic account of the genus *Hydrolithon* Foslie (1909) along the Atlantic and Caribbean coast of Mexico. We found five species of this genus including two new records for this region: *H. onkodes* (Heydrich) D.Penrose et Woelkerling and *H. reinboldii* (Weber van Bosse et Foslie) Foslie. The most common species in the study area was *H. farinosum* (J.V.Lamouroux) D.Penrose et Y.M.Chamberlain. *H. onkodes* and *H. pachydermum* (Foslie) J.C.Bailey, J.E.Gabel et D.W.Freshwater were compared with lectotype specimens. All species may be differentiated between them on the basis of the next characteristics: 1) Habit: with or lacking protuberances, free or attached; 2) Thallus construction: monomerous or dimerous; 3) Basal region: unistratose or multistratose; 4) Trichocytes: scattered or in horizontal or vertical rows or large pustulous fields; 5) Pore canal cells: shape. Morphological, anatomical and reproductive accounts are provided, including keys, information on distribution, habitat and nomenclature.

KEYWORDS: Coralline, *Hydrolithon*, non-geniculate, taxonomy, distribution.

RESUMEN

Se realizó el primer informe monográfico sobre el género *Hydrolithon* Foslie (1909) a lo largo de la costa Atlántica y Caribe de México. Se encontraron 5 especies para este género incluyendo dos nuevos registros para esta región *H. onkodes* (Heydrich) D.Penrose et Woelkerling e *H. reinboldii* (Weber van Bosse et Foslie) Foslie. La especie más común en el área de estudio fue *H. farinosum* (J.V.Lamouroux) D.Penrose et Y.M.Chamberlain. *H. onkodes* and *H. pachydermum* (Foslie) J.C.Bailey, J.E.Gabel et D.W.Freshwater fueron comparados con los lectotipos de ambas especies. Los cinco taxa pueden distinguirse entre sí por las siguientes características: 1) hábito: costrosos lisos, con o sin protuberancias, libres o adheridos; 2) construcción del talo: monómera o dímera; 3) región basal: uniestratosa o multiestratosa; 4) tricocitos: solitarios, en hileras horizontales o verticales o densamente agregados bajo las células epiteliales y la superficie del talo y 5) forma de las células del poro del canal. Se presenta información sobre la morfología, anatomía y estado reproductivo, incluyendo clave, distribución y hábitat de este género.

PALABRAS CLAVE: Corallinaceae, *Hydrolithon*, no-geniculada, taxonomía, distribución.

INTRODUCTION

The biodiversity of Coralline red algae (Corallinales, Rhodophyta) along the Atlantic and Caribbean coasts of Mexico is poorly known. These algae are characterized by cell wall impregnated with calcium carbonate, mainly calcite, which gives the thallus a hard, rigid texture (Chamberlain 1983). Coralline algae constitute locally abundant populations of *Neogoniolithon* Setchell & Mason, *Hydrolithon* and *Porolithon* Foslie from sub-polar to tropical waters (Littler 1972). The best represented non-geniculate forms on the Mexican Atlantic and Caribbean coasts are members of the subfamily Mastophoroideae (Setchell 1943), which includes eight genera (Harvey *et al.* 2003) and represented on the east coast of Mexico by *Spongites*, *Neogoniolithon* and *Hydrolithon*.

The family Corallinaceae, encompassing those Corallinales whose tetrasporangia produce zonately arranged spores, and whose tetrasporangia and bisporangia are borne in conceptacles that are uniporate and do not produce apical plugs, do not develop beneath multiporate plates or roofs, and are not enclosed individually within calcified sporangial compartments (Harvey *et al.* 2003). This family includes four subfamilies: Amphiroideae, Corallinoideae, Lithophylloideae and Mastophoroideae, whose genera are mostly calcified, pseudoparenchymatous structure are partly to largely composed of unconsolidated or contiguous filaments; organization is usually dorsiventral and/or radial or isobilateral; construction is monomerous and/or dimerous or diffuse, geniculate and/or non geniculate; spores are zonately arranged (Harvey *et al.* 2003, Guiry & Guiry 2007). The Subfamily Mastophoroideae contains genera which lack genicula; cells of adjacent filaments are linked principally by cell-fusions, secondary pit-connections are absent or rare; tetra- bisporangial conceptacles are uniporate and lack apical plugs. Within the Mastophoroideae, the genus *Hydrolithon* comprises non-geniculate algae with a dorsiventral organization of dimerous and/or monomerous construction (Penrose & Woelkerling 1988), but lack a ventral layer of palisade cells; cells of adjacent filaments are joined by cell fusions and do not have haustoria; trichocytes present or absent, if present appearing in section single, in horizontal fields, horizontal rows,

and vertical rows (Penrose 1996). Tetrasporangial-bisporangial conceptacle pore canals are lined by cells that are oriented more or less perpendicularly to the roof surface and do not protrude laterally into the pore canal.

The genera *Hydrolithon* and *Neogoniolithon* are both important components of Mexican Caribbean coral reefs (Huerta *et al.* 1987, Mendoza-González & Mateo Cid 1992, Ortega *et al.* 2001, Mateo-Cid & Pedroche 2004). In addition, *Hydrolithon* is very common on the majority of rocky shores of Atlantic Mexico. However, in spite of their abundance, representatives of this genus from Mexico have received little attention, and no previously description of *Hydrolithon* from the eastern coast from Mexico has been found, thus have not been critically examined. Only three species, *H. boergesenii* (Foslie) Foslie, *H. farinosum* (J.V.Lamouroux) D.Penrose et Y.M.Chamberlain and *H. improcerum* (Foslie et Howe) Foslie have been reported from the Caribbean and Atlantic coasts of Mexico (Ortega *et al.* 2001). The aims of this paper are to provide morphological, anatomical and reproductive accounts of *Hydrolithon*'s taxa, in order to identify species in a modern context. Distinctive field characters as well as pertinent photographs are provided for each species. Data on distribution of the species along the Atlantic and Caribbean coast of Mexico is included.

MATERIALS AND METHODS

The lectotype specimens of *Hydrolithon onkodes* (Heydrich) D.Penrose et Woelkerling (*Porolithon onkodes* (Heydrich) Foslie) and *H. pachydermum* (Foslie) J.C.Bailey, J.E.Gabel et D.W.Freshwater (*Lithophyllum onkodes* f. *pachydermum* Foslie) were borrowed from TRH (Department of Botany, Museum of Natural History and Archeology, University of Trondheim, Norway). Specimens of *Hydrolithon* were borrowed from ENCB (Department of Botany, National School at Biological Sciences, Mexico, D.F.) this samples were collected for different people from 1964 to 2001. Also, specimens of *Hydrolithon* were found in samples of general collections of common corallines collected by reef-walking or snorkeling at Banco Chinchorro, Cozumel and Mujeres islands, El Zarzal, Playa del Carmen and Akumal (Quintana Roo); Alacrán Reef (Yucatán); and La Blanquilla,

Verde and Enmedio islands, Punta Morro and Villa Rica (Veracruz) (Fig. 1). Samples were preserved in 5% formalin/seawater. Preserved specimens were decalcified with 0.6M HNO₃ and dehydrated with ethyl alcohol. Small segments were embedded in paraffin and sectioned at 9-12 μm thick with a manual microtome. Sections were then, fixed on slides with Riuter's adhesive (Martoja & Martoja-Pierson 1970), and stained with aniline blue and hematoxilin-eosine for anatomical observations and measurements.

The classification system of Penrose & Chamberlain (1993), Penrose (1996); Chamberlain (1994), Keats & Chamberlain (1994) and Harvey *et al.* (2003) are used throughout this paper. In cell

measurements length denotes the distance between primary pit connections whereas diameter denotes the maximum width of the cell lumen at right angles to this. Conceptacle measurements follow the system of Adey & Adey (1973). Descriptive terminology follows Woelkerling (1988) and Penrose (1996). Growth-forms terminology follows Woelkerling *et al.* (1993). Typification data follow Woelkerling (1993). Pertinent remarks about the morphology, anatomy, detailed descriptive accounts, and specimens examined and distributions are provided for each species. In this study we made observations on a total of 100 specimens are housed at herbarium of the Escuela Nacional de Ciencias Biológicas (ENCB).

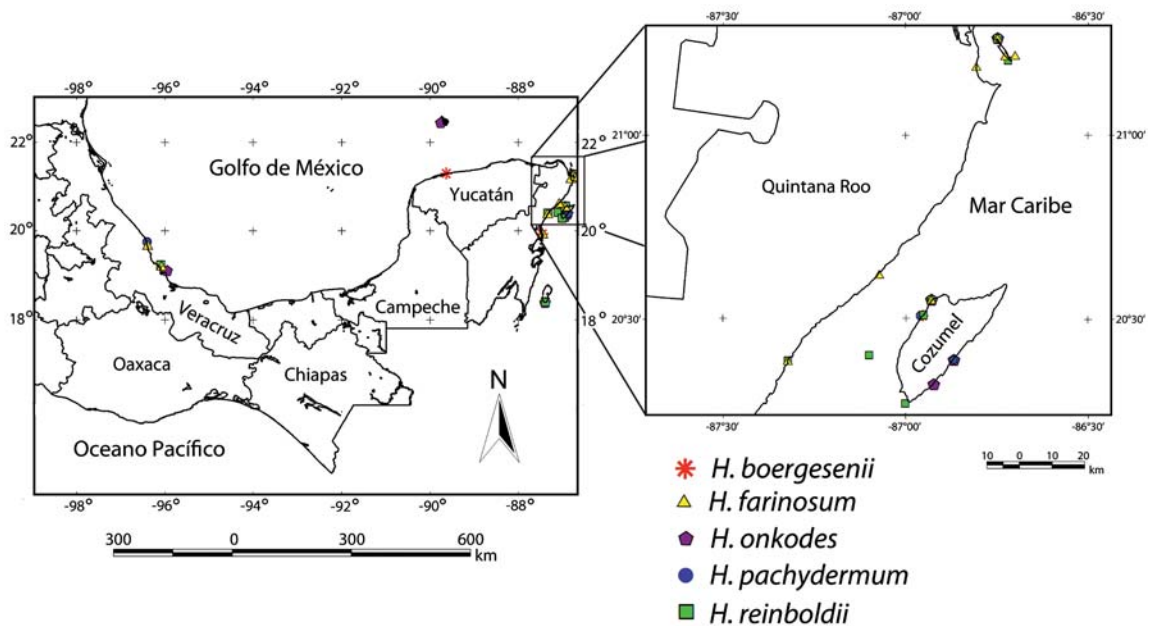


FIGURE 1. Location of the study sites and distribution of *Hydrolithon*'s species in the study area.

FIGURA 1. Ubicación del área de estudio y distribución de las especies de *Hydrolithon*.

RESULTS

Hydrolithon Foslie (1909:55) emend Penrose et Woelkerling (1992: 87)

Five species representing the genus *Hydrolithon* were encountered during the present study, two of which are new record from the Atlantic and Caribbean coasts of Mexico.

Key to the Mexican *Hydrolithon*

1. Plants only epiphytic *H. farinosum*
1. Plants mainly epilithic or epizoic 2
 2. Thallus entirely dimerous; trichocytes most often occurring singly, occasionally in pairs and/or small horizontal or vertical rows..... 3
 2. Thallus mostly monomerous; trichocytes most often occurring in large horizontal pustulate fields without any vegetative filaments between the individual trichocytes.....4
 3. Cells of erect filaments strongly horizontally arranged *H. reinboldii*
 3. Cells of erect filaments not strongly horizontally arranged..... *H. boergesenii*
 4. Plants smooth, warty or lumpy, commonly with 3-4 layers of epithallial cells and conceptacle chamber elliptic..... *H. onkodes*
 4. Plants with small protuberances, commonly with a one layer of epithallial cells and conceptacle chamber orbicular..... *H. pachydermum*

DESCRIPTION OF THE SPECIES

1. *Hydrolithon boergesenii* (Foslie) Foslie, K. Norske Vidensk. Selsk. Skr. 2: 56. 1909.

Basionym: *Goniolithon boergesenii* Foslie, K. Norske Vidensk. Selsk. Biol. Skr. 2: 19-21. 1901.

Synonyms: *Lithophyllum boergesenii* (Foslie) Foslie, K. Norske Vidensk. Selsk. Biol. Skr. 2: 5. 1901; , K. Norske Vidensk. Selsk. Biol. Skr. 2: 19-21.1901; *Porolithon boergesenii* (Foslie) M.Lemoine, in Børgesen. Dansk. Bot. Ark. 3: 178. 1917; *Spongites boergesenii* (Foslie) Woelkerling, Dreckmann Hidrobiológica 1(2): 35. 1991.

Type locality: St. Croix, US Virgin Islands.

HABIT AND VEGETATIVE STRUCTURE. Thallus attached to the substratum ventrally by cell adhesion, surface with warty protuberances (Fig. 2a), and 420 µm-2 mm thick. Pseudoparenchymatous; thallus construction dimerous, basal region unistratose with ventral cells vertically elongated, 6-15µm in diameter and 12-30 µm high, others square, 9 µm in diameter; fusion cells 9-18 µm in diameter and 12-30 µm high; epithallial cells unistratose or bistratose with oblong cells 3-6 µm high and 6-12µm diameter; dorsal region composed of filaments becoming oriented perpendicularly to thallus surface with rounded and square cells 9-15

µm diameter, depressed-globose, 4 µm high and 6 µm diameter with plasmodesmata and several fusions (Fig. 2b). Trichocytes occurred singly and scattered in dorsal region, in small horizontal with vegetative cells scattered between them and vertical rows, 15-26 µm in diameter and 21-39 µm long, some of these cells have a prolonged wall on top like a bell (Fig. 2c). Growing by oblong or triangular meristematic initial cell 18-21 µm in diameter and 15-36 µm tall.

REPRODUCTIVE STRUCTURES. Tetra/bisporangial thallus 1-2 mm thick with uniporate, protruding, domoid conceptacles, others buried in the pseudoparenchymatous tissue, several or scattered on the thallus surface, approximately 50/24 conceptacles per mm² (Fig. 2d); tetra/bisporangial chambers lacking a central columella, ovoid or elliptical, 174-216/81-165 µm in diameter and 81-96 µm high, roof of conceptacle with 3 or more cell layers and 24µm high, pore canals lined by cells oriented more or less perpendicular to the thallus surface, not protruding into the canal, cells concave, 6-7.5 µm in diameter and 12-28/9-30 µm high (Figs. 2e,f); tetrasporangium usually 25-42 µm in diameter and 63 µm high. Bisporangium 45-50 µm diameter and 77- 90 µm high (Fig. 2g). Gametangial thalli not observed.

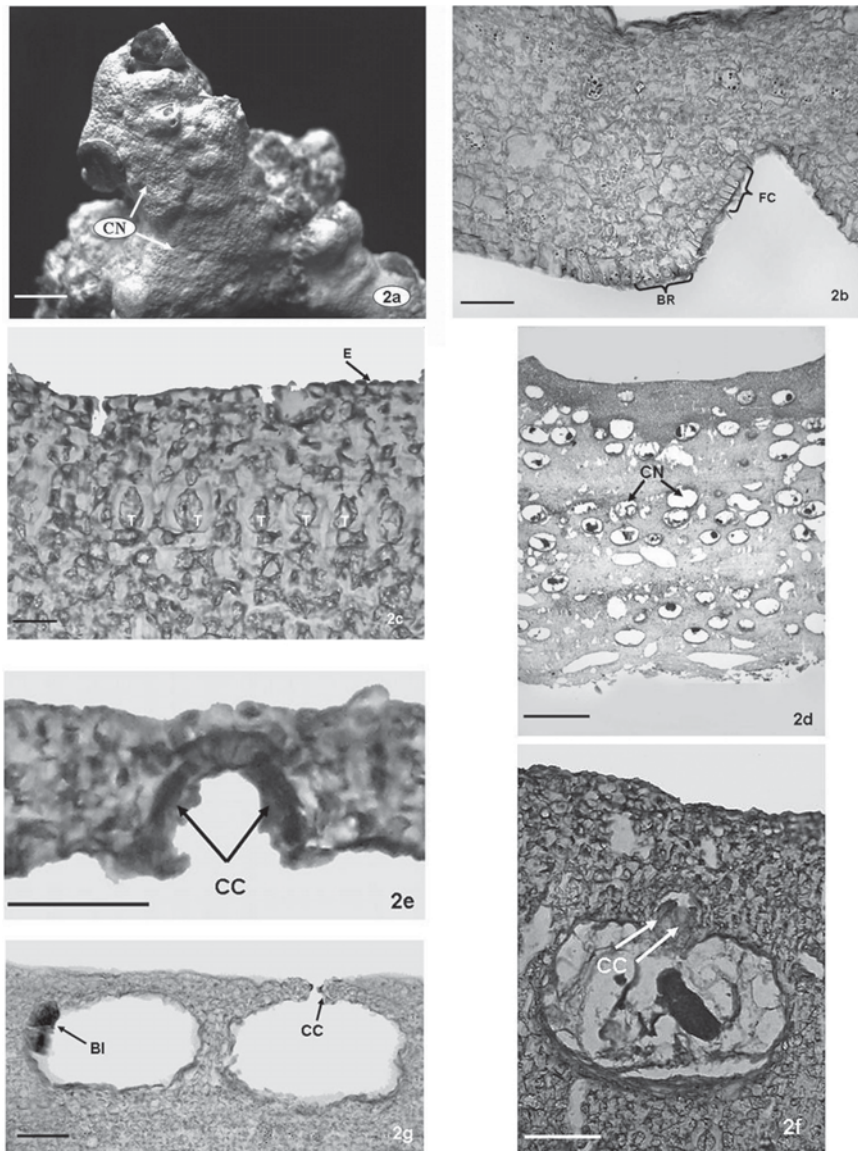


FIGURE 2. *Hydrolithon boergeseni*, El Zarzal, Quintana Roo, 17-V-1998 (ENCB 17185). a. Habit of a plant encrusting dead coral. Conceptacles (CN) are highlighted by arrows. Scale: 1.2 cm. b. A dimerous thallus showing a unistratose basal region (BR). Note also the cell fusions (FC) between cells of adjacent basal filaments. Scale: 44 μ m. c. Section through cortical region of the thallus showing trichocytes (T) in a horizontal rows and a single layer so epithial cells (E). Scale: 26 μ m. d. Longitudinal view of the thallus showing several buried conceptacles (CN).Scale: 288 μ m. e. Tetrasporangial conceptacle showing pore canal lined by enlarged cells (CC). Scale: 32 μ m. f. Pore of buried tetrasporangial conceptacle showing enlarged pore canal cells (CC). Scale: 63 μ m. g. Bisporangial conceptacle showing pore canal cells (CC) and a single bisporangium (BI). Scale: 100 μ m.

FIGURA 2. *Hydrolithon boergeseni*, El Zarzal, Quintana Roo, 17-V-1988 (ENCB 17185). a. Talo incrustante en coral muerto. Conceptáculos (CN) indicados con flecha. Escala: 1,2 cm. b. Talo dímero mostrando una región basal uniestratosá (BR). Observe las fusiones celulares (FC) entre las células de filamentos basales adyacentes. Escala: 44 μ m. c. Sección transversal de la región cortical, mostrando tricocitos (T) en hileras horizontales y una capa de células epiteliales (E). Escala: 26 μ m. d. Corte longitudinal del talo mostrando numerosos conceptáculos (CN). Escala: 288 μ m. e. Conceptáculo tetrasporangial mostrando el poro delineado por células alargadas del canal (CC). Escala: 32 μ m. f. Poro del conceptáculo tetrasporangial, mostrando las células alargadas del canal (CC). Escala: 63 μ m. g. Conceptáculo bisporangial, células del canal (CC) y un bisporangio (BI). Escala: 100 μ m.

SPECIMENS EXAMINED: MEXICO, Quintana Roo, Cozumel Island, south deck (20°30'32"N, 86°57'07"W), 10-IX-1985, C. Mendoza & L.E. Mateo s.n. (ENCB 17186); El Zarzal (19°55'47.7"N, 87°26'32.7"W), 18-V-1998, C. Mendoza & L. E. Mateo s.n. (ENCB 17185), Yucatán: Arrecife Alacranes, Pérez Island (21°17'55"N, 89°37'04"W), 22- I-1986, L. Huerta s.n. (ENCB 17198).

HABITAT: Epiphytic on *Lithoporella* sp.: epilithic on rocks and epizoic on coral skeletons; intertidal.

REMARKS: The vegetative and reproductive structure of these plants is clearly similar to that described as *Porolithon boergesenii* by Lemoine (in Børgesen 1917) and Masaki (1968) and as *Goniolithon boergesenii* by Taylor (1960). In the other hand, Lemoine (1917) and Taylor (1960) describe tetrasporangial conceptacle chamber diameters of 300-400µm without indicating whether these were inner or external dimensions. Our specimens have tetra/bisporangial conceptacle chambers 174-216 µm in diameter and 81-96 µm high. Pore canal cells of tetra/bisporangial conceptacles appear to arise from filaments interspersed amongst sporangial initials and are concave or reniform, and are 6-8 µm diameter, 12-24 µm high.

It is primarily a tropical western Atlantic species, but also reported from the African Atlantic and Japan (Guiry & Guiry 2007) and the Caribbean Sea (John *et al.* 1979).

2. *Hydrolithon farinosum* (J.V.Lamouroux) D.Penrose & Y.M.Chamberlain, *Phycologia* 32: 295-303. 1993. Figs. 1-19.

Basionym: *Melobesia farinosa* J.V.Lamouroux, Poisson: *Caen.* 315. 1816.

Synonyms: *Fosliella farinosa* (J.V.Lamouroux) M.A.Howe. *The Bahama Flora*, p. 587, 1920; *Fosliella cruciata* G.Bressan, D.Miniati-Radin & L.Smundin, *Giorn. Bot. Ital.* 111: 27. 1977.

Type locality: The Mediterranean Sea.

HABIT AND VEGETATIVE STRUCTURE. Epiphytic, covering up to 10 cm of host (Fig. 3a), thallus attached to the host ventrally by cell adhesion, dorsal surface flattened (Figs. 3b), lacking protuberances; thallus pseudoparenchymatous, thin 20-90 µm

diameter, cells of adjacent filaments connected laterally by fusions, secondary pit-connections not seen; thallus construction dimerous with 2-5 layers of cells (Fig. 3c); epithallial cells unistratose with oblong cells 3-6 µm high and 6-18 µm diameter; growth by marginal initial cells, reniform, obovoid or rounded 12-27 µm high and 24-30 µm diameter; basal region unistratose with square cells 15 µm diameter or rectangular 12-30 µm high and 9-21 µm diameter; dorsal region composed of filaments that become oriented perpendicularly to the thallus surface, unistratose or multistratose, cells square, 12 µm in diameter, some of them vertically elongate, 6-15 µm diameter and 9-33 µm high, oblong, 15-27 µm in diameter and 6-12 µm high, with numerous cell-fusions; with few or many cell fusions in the dorsal and basal regions, 12-30 µm diameter, others 9-12 µm high and 15-21 µm diameter; trichocytes or megacells occur singly and in small horizontal rows with vegetative cells scattered between them, cells 12-36 µm diameter and 24-42 µm high.

REPRODUCTIVE STRUCTURES: Tetrasporangial plants 20-90 µm thick, conceptacles up to 180µm in diameter, uniporate, protruding, domoid, approximately 50 per mm²; pore appears deeply sunken when open; tetrasporangial chambers elliptical, 31-100 µm high and 100-300 µm diameter, and with a central columella; roof of 2-3 cell layers 15-45 µm high, the chamber floor raised centrally; pore canal cells elongated and orientated more or less perpendicular to the thallus surface and does not protrude into the pore canal, pore canal shape convex or triangular, 3-12 µm diameter and 15-33 µm high. Tetrasporangium 20-57 µm diameter and 31-63 µm high. Bisporangial plants not observed. Carposporangial plants 20-75 µm thick; conceptacles uniporate, protruding, domoid, densely packed, approximately 100 per mm²; carposporangial chambers have the same elliptical shape as tetrasporangial conceptacles, 76-207 µm in diameter and 40-107 µm high, roof conceptacle with 3-6 layers cells, roof 10-21 µm high, lined by elongated cells angularly oriented or convex 4 µm diameter and 10 µm high, or triangular, 2 µm in diameter and 27 µm high (Fig. 3d); conceptacles with lump of mucilage obstructing pore canals, carposporangia 24-42 µm in diameter and 25-50 µm high (Fig. 3e). Gonimoblast filaments borne from the margins of the fusion cell (Fig. 2d). Spermatangial plants 21-60 µm thick with

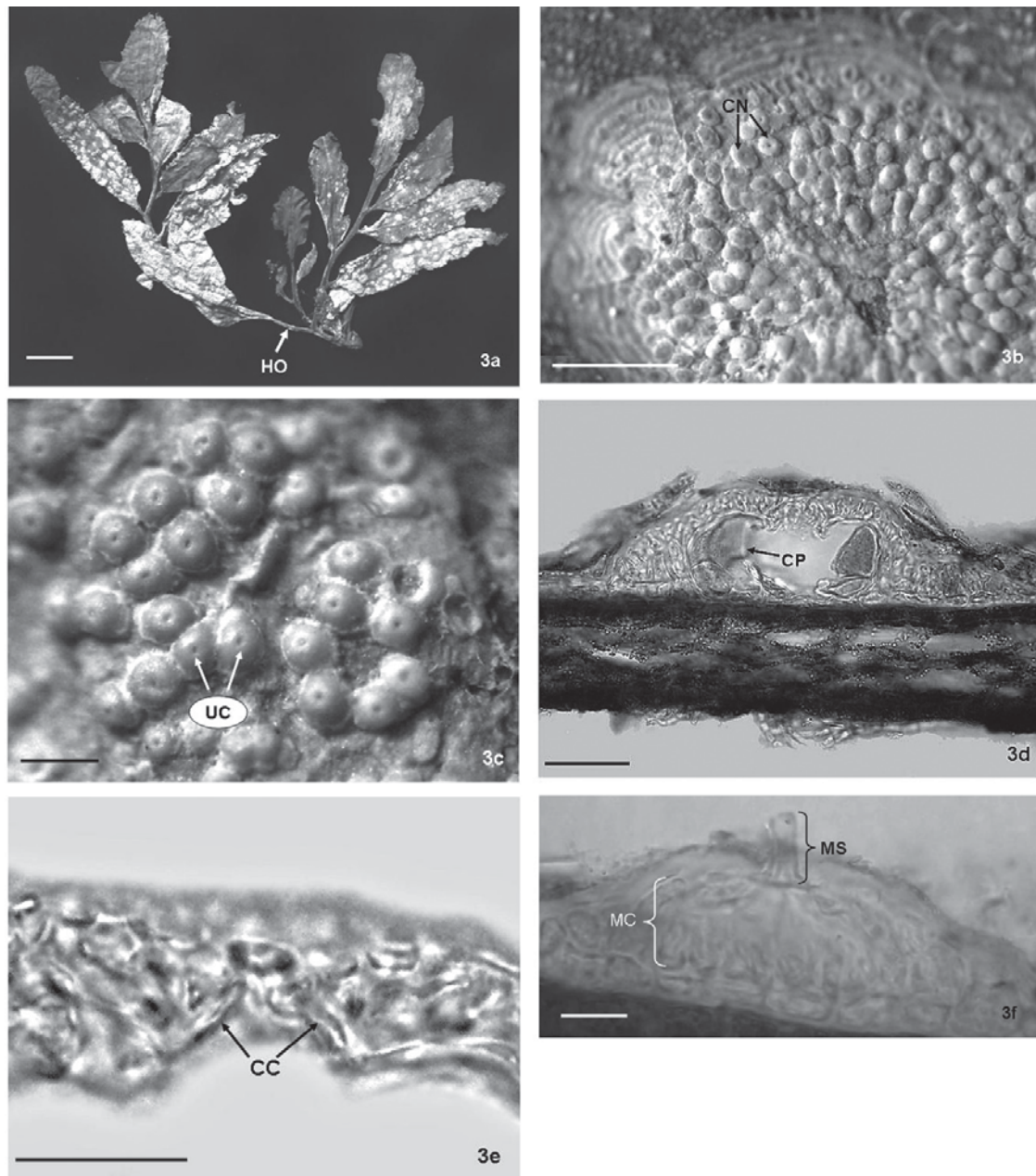


FIGURE 3. *Hydrolithon farinosum*, Villa Rica, Veracruz, 14-XI-1994 (ENCB 17 158). a. Thallus epiphytic on *Sargassum* (HO) host. Scale: 7mm. b. Thallus surface showing congested uniporate conceptacles (CN). Scale: 1.4 mm. c. Close-up of thallus surface showing uniporate conceptacles (UC). Scale: 330 μ m. d. Section of the thallus showing a carposporangial conceptacle bearing peripherally arranged gonimoblast filaments terminating in carpospores (CP). Scale: 55.5 μ m. e. Pore of tetrasporangial conceptacle lined by enlarged pore canal cells (CC). Scale: 24 μ m. f. Immature spermatangial conceptacle (MC) with mucilaginous spout (MS). Scale 26 μ m.

FIGURA 3. *Hydrolithon farinosum*, Villa Rica, Veracruz, 14-XI-1994 (ENCB 17 158). a. Talo epífito en *Sargassum* (HO). Escala: 7mm. b. Superficie del talo, mostrando un denso agregado de conceptáculos uniporados (CN). Escala: 1.4 mm. c. Detalle de la superficie del talo mostrando conceptáculos (UC). Escala: 330 μ m. d. Sección del talo mostrando el conceptáculo carposporangial con filamentos gonimoblásticos que terminan en carposporas (CP). Escala: 55.5 μ m. e. Poro del conceptáculo tetrasporangial delineado por células alargadas del canal del poro (CC). Escala: 24 μ m. f. Conceptáculo espermatangial inmaduro (MC) con tapón mucilaginoso (MS) Escala: 26 μ m.

the same structure as the tetrasporangial plants; uniporate conceptacles protrude above thallus surface; conceptacles scattered and small, domoid, approximately 14-20 conceptacles per mm²; roof 3 cell layers, pore 6-10 µm diameter with a large mucilaginous spout 6-12 µm high; orbicular or elliptical, 48-73 µm diameter and 11-40 µm high, spermatangia are singled and restricted only at conceptacle floor; pore canal cells long and angularly oriented, 24 µm diameter (Fig. 3f).

SPECIMENS EXAMINED. MEXICO, Veracruz, Villa Rica (19°40'33"N, 96°23'32"W), 14-XI-1994, C. Mendoza & L.E. Mateo s.n. (ENCB 17158); Verde Island (19°12'13"N, 96°04'23"W), 13-XI-1986, L.E. Mateo Cid s.n. (ENCB 7922), 14-V-1984, C. Mendoza & L.E. Mateo s.n. (ENCB 6871); Quintana Roo, Cozumel Island, Playa San Juan (20°33'02"N, 86°55'49"W), 4-VI-1998, C. Mendoza & L.E. Mateo s.n. (ENCB 6868), Punta Norte, Mujeres Island (21°15'52.5"N, 86°44'56"W), 13-VIII-1997 C. Mendoza & L.E. Mateo s.n. (ENCB 17156), 13-X-1983, L. Huerta, C. Mendoza, L.E. Mateo & A. Cisneros s.n. (ENCB 10260), east zone, Mujeres Island (21°13.5'0"N, 86°42.5'0"W), 2-III-1985, C. Mendoza & L.E. Mateo s.n. (ENCB 7876), Playa Lancheros, Mujeres Island (21°12'59.4"N, 86°43'41"W), 1-II-1984, L.E. Mateo & C. Mendoza s.n. (ENCB 6875), El Zarzal (19°55'47.7"N, 87°26'32.7"W), 19-V-1998, L.E. Mateo & C. Mendoza s.n. (ENCB 17141), Puerto Juárez, Cancún (21°11'15.3"N, 86°48'25.6"W), 1-III-1985, L.E. Mateo & L. Huerta s.n. (ENCB 10255), Akumal (20°23'9.8"N, 87°19'21.6"W), 24-XII-1992, L. Huerta s.n. (ENCB 17142), Playa del Carmen (20°37'17"N, 87°04'19"W), 1-XI-1984, C. Mendoza & L.E. Mateo s.n. (ENCB 13219).

HABITAT: Always epiphytic on *Thalassia testudinum*, *Sargassum* sp. and *Dictyota* sp., intertidal.

REMARKS. All specimens were found growing on *Sargassum*, *Dictyota* or *Thalassia*, and associated with species of the genera *Pneophyllum*, *Peyssonnelia*, *Taenioma*, *Calothrix* and other cyanobacteria. Our specimens are in general agreement with the dimensions reported for Australian plants by Penrose & Chamberlain (1993), who provided a detailed description of *H. farinosum*. These authors mentioned

that gametangial plants are monoecious with spermatangial and carpogonial conceptacles occurring on the same plant. They also did not see bisporangial conceptacles. The same authors described the pore canals of tetrasporangial conceptacles as bearing elongate cells. Our plants are, however, dioecious with carpogonial and spermatangial conceptacles occurring on separate thalli.

H. farinosum is a cosmopolitan species and is the most common species in the eastern coast of Mexico.

3. *Hydrolithon onkodes* (Heydrich) D. Penrose & Woelkerling, *Phycologia* 31: 834, figs 4, 5. 1992.

Basionym: *Lithothamnion onkodes* Heydrich, *Bibl. Bot.* 41: 6, pl. 1. 1897.

Synonyms: *Goniolithon onkodes* (Heydrich) Foslie, *K. Norske Vidensk. Selsk. Skr.* 2: 8. 1898; *Lithophyllum onkodes* (Heydrich) Heydrich, *Bot. Jb.* 28: 529-545, pl. 11. 1901; *Porolithon onkodes* (Heydrich) Foslie, *K. Norske Vidensk. Selsk. Skr.* 2: 57. 1909; *Spongites onkodes* (Heydrich) D. Penrose et Woelkerling, *Phycologia* 26: 159, figs. 10-14. 1988 (See also Penrose 1990: 134, figs 44-49).

Lectotype: TRH, A26-1494! (Designated by Adey *et al.* 1982: 9).

Type locality: Tami I., north-west edge of Huon Gulf, New Guinea (Heydrich 97, *Bambler*, 1894).

HABIT AND VEGETATIVE STRUCTURE. Thallus encrusting, attached to the substratum ventrally by cell adhesion, without rhizoids, with a more or less flattened dorsal surface (Fig. 4a) or with small protuberances (Fig. 4b), 200 µm-4 mm thick; construction mostly monomerous (Fig. 4c); but also dimerous; dimerous portions consisting of a single ventral layer of non palisade cells, and erect multicellular simple or branched filaments; monomerous portions consisting of a multiaxial system of branched filaments (basal region) that collectively contribute to a ventrally or centrally situated core, and a peripheral region where portions of core filaments or their derivatives curve outwards towards the thallus surface, the ventral cells are oblong or rectangular 4-13 µm high and 9-30 µm diameter, the cortical cells are square or rounded 12-20 µm diameter globose, 6-9 µm in diameter with several fusions and vertically long cells 8-18 µm diameter, 18-24 µm high; epithallial cells unistratose with rounded cells 6-9 µm in diameter, or bistratose

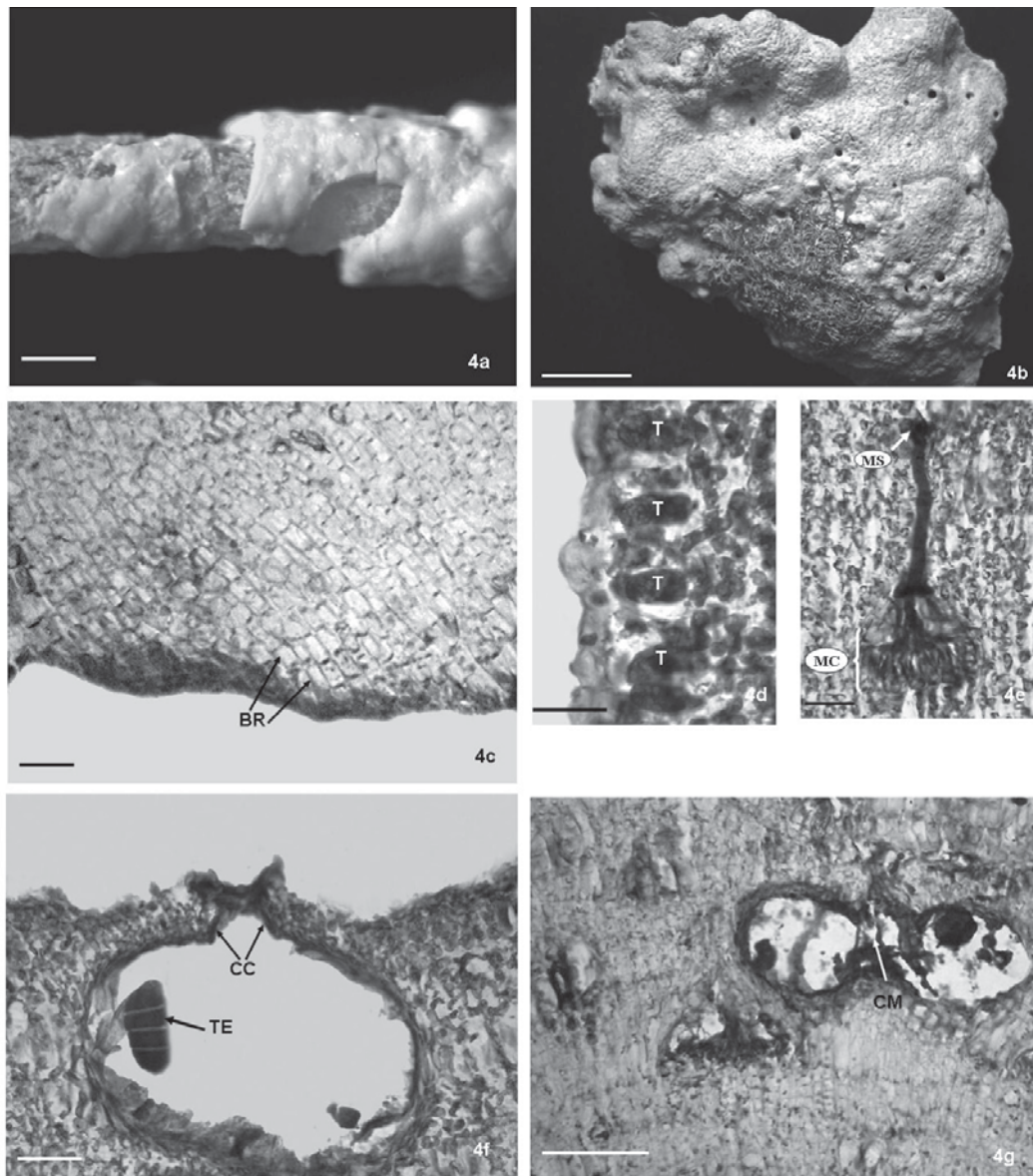


FIGURE 4. *Hydrolithon onkodes*, Playa Azul, Cozumel Island, Quintana Roo, 22-V-1993 (ENCB 17 184 ♀ and ♂); Playa San Juan, Cozumel Island 27-II-1985 (ENCB 17 181 tetrasporangial). a. Habit of gametangial plant. Scale: 2 mm. b. Habit of tetrasporangial plant. Scale: 1.1 cm. c. Section through a monomerous thallus showing a multistratose basal region (BR) with downward curving filaments. Scale: 28 μ m. d. Trichocytes in horizontal rows (T). Scale: 21 μ m. e. A buried spermatangial conceptacle (MC) with mucilaginous spout (MS). Scale: 67 μ m. f. A tetrasporangial conceptacle bearing a single tetrasporangium (TE) and showing a pore canal lined by enlarged cells (CC). Scale: 44 μ m. g. A buried tetrasporangial conceptacle with a central columella (CM). Scale: 85 μ m.

FIGURA 4. *Hydrolithon onkodes*, Playa Azul, Isla Cozumel, Quintana Roo, 22-V-1993 (ENCB 17 184 talo gametangial); Playa San Juan, Isla Cozumel 27-II-1985 (ENCB 17 181 talo tetrasporangial). a. Hábito del talo gametangial. Escala: 2 mm. b. Hábito del talo tetrasporangial. Escala: 1,1 cm. c. Corte longitudinal del talo monómero que muestra una región basal multiestratosa (BR) con filamentos que siguen el contorno del sustrato. Escala: 28 μ m. d. Tricocitos en hileras horizontales (T). Escala: 21 μ m. e. Agregado de conceptáculos espermatangiales (MC) con tapón mucilaginoso (MS). Escala: 67 μ m. f. Conceptáculo tetrasporangial con un tetrasporangio (TE) mostrando el poro del canal delineado por células alargadas (CC). Escala: 44 μ m. g. Conceptáculo tetrasporangial con columella central (CM) Escala: 85 μ m.

with square or rectangular cells 3-9 μm high and 5-8 μm diameter; the peripheral region, with rounded or square cells 15-21 μm diameter, rectangular cells 9-12 μm high, 15-21 μm diameter, polygonal cells 9-12 μm tall and 6-12 μm diameter; near the basal region, several cells have fusions; trichocytes occur in vertical and horizontal rows (Fig. 4d), individual trichocytes 12-24 μm diameter and 18-33 μm high; growth by oblong initial cells 12-21 μm diameter and 21-30 μm high.

REPRODUCTIVE STRUCTURES. Tetra/bisporangial thallus 216/4000 μm thick, the conceptacles domoid, protruding or flush from thallus surface approximately 10 per mm^2 , others buried in the pseudoparenchymatous tissue; tetra/bisporangial chambers elliptical and rounded 36-165/ 36-180 μm high, 186-231/141-255 μm diameter, roof of conceptacle 4-8 cells thick and 39 μm tall, pore canals lined by cells oriented perpendicular to the thallus surface, triangular, 12-24 μm diameter, 15-36 μm tall, or convex 9-18 μm diameter and 30-33 μm tall; tetrasporangium 16-51 μm diameter and 36-72 μm high, with or without a mucilage plug in the conceptacle pore and with a central columella (Fig. 4f). Bisporangium usually 21-75 μm diameter and 41-95 μm tall. Gametangial plants monoecious; carpogonia and spermatangia produced on the same thallus, but in separate conceptacles, thallus 470 μm -1 mm thick with the same vegetative structure as the tetra/bisporangial plants; carposporangial conceptacles uniporate, buried in the pseudoparenchymatous tissue or protruding, apiculate or not, scattered, approximately 9 per mm^2 ; elliptical chambers 114-140 μm in diameter and 30-60 μm high. Mature carposporophytes composed of a large central fusion cell and gonimoblast filaments bearing terminal carposporangia, roof of conceptacle 4-8 layers cells and 30 μm high, pore canals lined by cells oriented more or less perpendicular to the surface thallus and not protruding into de canal, cells form angular long or concaves 6 μm diameter and 21 μm tall with carposporangial plug (Fig. 4g), carposporangia 21 μm diameter and 27-33 μm tall. Spermatangial conceptacles on the same thallus with uniporate buried, or protruding above, or flush with surrounding thallus surface; conceptacles scattered approximately 10 per mm^2 ; elliptical chambers 67 μm diameter and 30 μm tall, roof of conceptacle 24 μm high spermatangial filaments unbranched arising from the floor of male conceptacle chambers (Fig. 4e).

SPECIMENS EXAMINED: MEXICO, Veracruz, Enmedio Island (19°06'01"N, 95°56'19.5"W), 5-VI-2001, C. Galicia s.n. (ENCB 17176), Yucatán, Arrecife Alacrán, Desertora island, 15-X-1985, L. Huerta, L.E. Mateo & E. Hidalgo s.n. (ENCB 17169), Quintana Roo, Cozumel Island, Playa San Juan (20°33'02"N, 86°55'49"W), 27-II-1985, C. Mendoza & L.E. Mateo s.n. (ENCB 17181), El Mirador (20°19'15"N, 86°55'27"W), 7-VI-1985, L.E. Mateo & C. Mendoza s.n. (ENCB 17182), Chen Río (20°23'18"N, 86°52'08"W), 07-VI-1985, C. Mendoza & L.E. Mateo s.n. (ENCB 17183), Playa Azul (20°33'02"N, 86°55'49"W), 22-V-1993, C. Mendoza, L.E. Mateo, L. Huerta & C. Galicia s.n. (ENCB 17184), Punta Norte, Mujeres Island (21°15'52.5"N, 86°44'56"W), 12-VI-1987, C. Mendoza & L.E. Mateo s.n. (ENCB 17174), Banco Chinchorro, Cayo Lobos (18°23'11"N, 87°22'53"W), 19-VI-1984, L. Huerta & L.E. Mateo s.n. (ENCB 17180).

HABITAT: Epilithic on rocks, and encrusting dead coral skeletons, intertidal and subtidal.

REMARKS: On the basis of examination of the lectotype of *Hydrolithon onkodes* from TRH, We concluded that the Mexican specimens of *H. onkodes* agree well with the lectotype. Our observations confirm those reported by Penrose & Woelkerling (1988). Measurements of somatic cells (inclusive trichocytes) in all Mexican specimens that we revised are largely concordant with the lectotype of *H. onkodes* (Table I). In addition, the measurements of conceptacle chambers of the lectotype of *H. onkodes* match perfectly that tetra/bisporangial conceptacle of Mexican specimens (Table II) we found no clear differences between the lectotype and specimens from Mexico identified as *H. onkodes*. In fact, our observations confirm that in all Mexican specimens and lectotype specimen are very similar (Figs. 5a-f). Also, Penrose (1996) and (Adey *et al.* 1982) mentioned that trichocytes are commonly arranged singly, in small horizontal rows and in large pustulous arrangement. We found trichocytes to occur singly, in horizontal rows and large pustulous fields. Ours is the first record of *Hydrolithon onkodes* from the Atlantic coast of Mexico and the Mexican Caribbean.

Hydrolithon onkodes is essentially a tropical species and has been recorded from Australia, South Africa, Indian Ocean, Hawaiian Islands, New Guinea and the Pacific coast of Mexico.

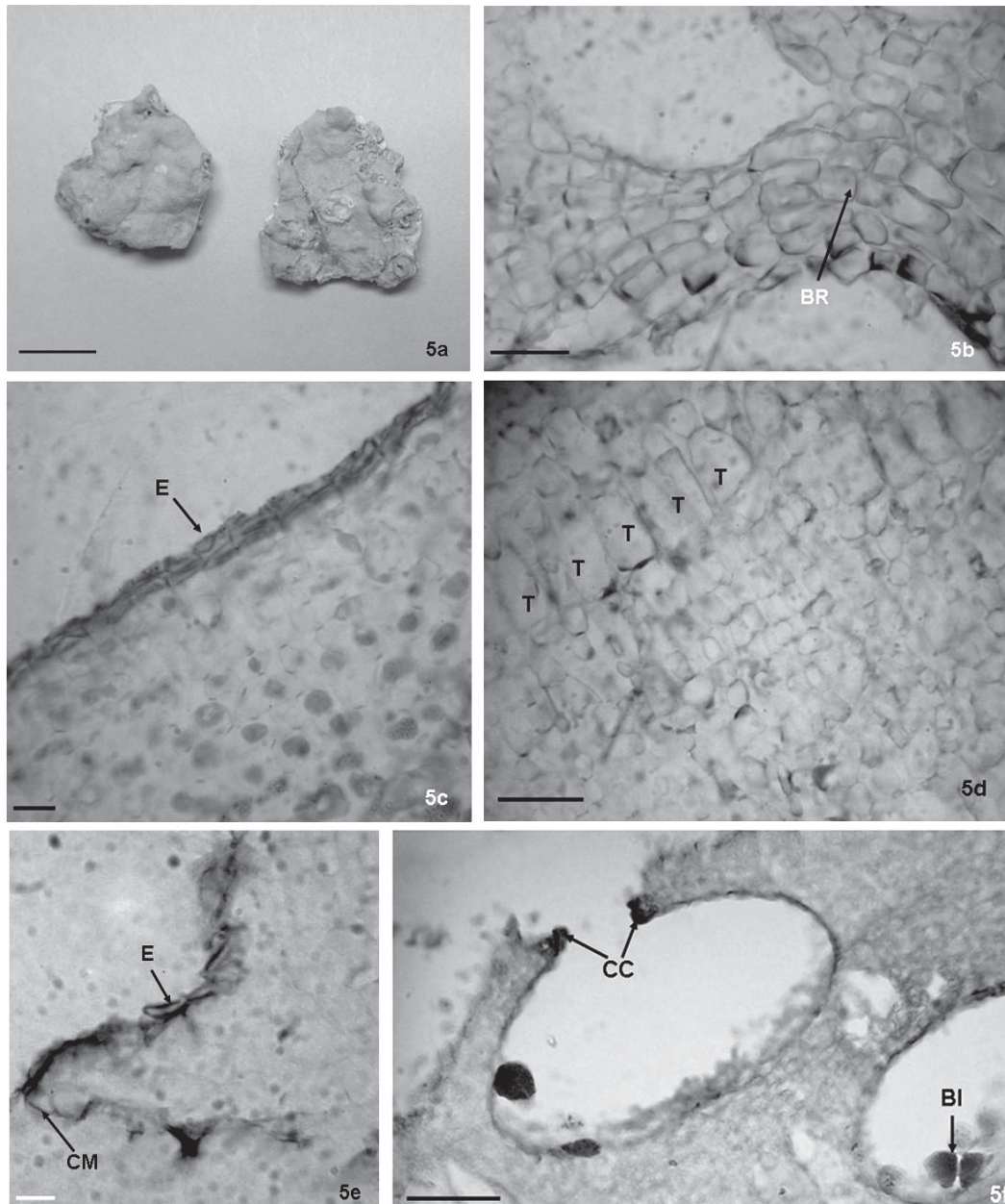


FIGURE 5. Lectotype (LT) of *Hydrolithon onkodes*. These fragments corresponds with specimen on extreme right showed by Penrose et Woelkerling (1988: 81, figs. 4, 5). a. Habit of sporangial plant. Scale: 2 cm. b. Section through a monomerous thallus showing a multistratose basal region (BR) with downward curving filaments. Scale: 25 μ m. c. Section through cortical region of the thallus showing a four layers of epithallial cells (E) Scale 15 μ m. d. Trichocytes in horizontal rows (T). Scale: 30 μ m. e. Close-up the meristematic cell (CM) and the unistratose epithallium (E). Scale 25 μ m. f. A bisporangial conceptacle with bisporangium (BI) and showing a pore canal lined by enlarged cells (CC). Scale: 75 μ m.

FIGURA 5. Lectotipo de *Hydrolithon onkodes*. Estos fragmentos concuerdan con lo mostrado por Penrose et Woelkerling (1988: 81, figs. 4, 5). a. Hábito del talo esporangial. Escala: 2cm. b. Corte longitudinal del talo monómero que muestra una región basal multiestratosa (BR) con filamentos que siguen el contorno del sustrato. Escala: 25 μ m. c. Sección mostrando cuatro capas de células epiteliales (E). Escala 15 μ m. d. Tricocitos en hileras horizontales (T). Escala: 30 μ m. e. Acercamiento de la célula meristemática (CM) y células epiteliales (E). Escala 25 μ m. f. Conceptáculo bisporangial con bisporangios (BI) y poro con células del canal (CC). Escala: 75 μ m.

4. *Hydrolithon pachydermum* (Foslie) J.C.Bailey, J.E.Gabel & D.W.Freshwater. *Phycologia* 43(1): 8. 2004.

Basionym: *Lithophyllum onkodes* f. *pachydermum* Foslie, K. Norske Vidensk. Selsk. Skr. 2: 5. 1904. Synonyms: *Lithophyllum pachydermum* (Foslie) Adey et Lebednik, K. Norske Vidensk. Selsk. Skr. 1: 47. 1967; *Porolithon pachydermum* (Foslie) Foslie, K. Norske Vidensk. Selsk. Skr. 2: 57. 1909.

Lectotype: TRH, A26-1553 Ørsted no. 548! (designated by Adey in Adey and Lebednik, 1967: 47).

Type locality: St. Croix (?), West Indies.

HABIT AND VEGETATIVE STRUCTURE. Plants attached to the substratum ventrally by cell adhesion, without rhizoids, with small rounded protuberances (Fig. 6a), 400 µm-2.7 mm thick, the crusts can be overlapping; thallus pseudoparenchymatous, cells of adjacent filaments connected laterally by fusions, secondary pit-connections not seen; thallus construction predominantly dimerous; basal region unistratose with rounded, square cells 15 µm diameter, to rectangular cells 6-15 µm diameter and 15-24 µm high, or multistratose with square and rectangular cells 12-21 µm diameter and 6-12 µm tall, some of which have cell fusions; dorsal region composed of filaments that become oriented perpendicularly to the thallus surface, cells rounded, square, 6-15 µm diameter, or rectangular, 6-15 µm diameter, 15-21 µm high, or irregular with fusions and 3-15 µm diameter and 6-18 µm tall; each dorsal filament terminated by an oblong epithallial cell 6-12 µm diameter, 3-6 µm high, that form a unistratose layer (Fig. 6b); trichocytes single, in vertical and horizontal rows and large pustulous rows (Fig. 6c), 9-29 µm diameter and 15-54 µm tall; marginal growth by a irregular shaped cell 15-33 µm diameter and 12-24 µm tall (Fig. 6d).

REPRODUCTIVE STRUCTURES: Tetra/bisporangial plants 480 µm-2.7 mm thick, conceptacles buried in pseudoparenchymatous tissue, congested or widely scattered; tetra/bisporangial chambers

orbicular or elliptical, small, 102-165/63-225 µm in diameter and 30-114/75-165 µm high, roof of conceptacle 3-12 cells thick and 24-30 µm tall, pore canals lined by cells oriented perpendicular to the thallus surface, triangular, longer 4.5 µm diameter, 18 µm tall or convex, 3-9 µm diameter, 15-24 µm tall, lacking a central columella, tetrasporangium 15-24 µm diameter and 45-48 µm tall (Fig. 6f). Bisporangium 51-84 µm diameter and 60-105 µm tall (5e).

SPECIMENS EXAMINED: MEXICO, Veracruz, Punta Morro (19°44'17"N, 96°24'01"W), 14-XI-1994, C. Mendoza & L.E. Mateo s.n. (ENCB 17197), Quintana Roo, Cozumel Island, Chen Río, (20°23'18"N, 86°52'08"W), 11-IX-1985, L.E. Mateo & C. Mendoza s.n. (ENCB 17196), San Miguel Cozumel (20°30'28"N, 86°57'37"W), 26-II-1985, L.E. Mateo & C. Mendoza s.n. (ENCB 17195).

HABITAT: Epilithic on rocks, and encrusting dead coral skeletons, intertidal.

REMARKS: Mexican specimens of *H. pachydermum* agree well with the lectotype of *Lithophyllum onkodes* f. *pachydermum* from Virgin Islands (TRH Ørsted no. 548). Table I and II, contains data, which showed this similitude. The measurements of epithelial, cortical, and medullar cells are concordant between both lectotype and Mexican specimens (Figs. 7a, b, c, d). The tetra/bisporangial chambers are similar in size and shape in both lectotype and *H. pachydermum* from Mexico (Figs. 7e, f and Table II). Nevertheless, *H. onkodes* and *H. pachydermum* from Mexico are very similar, the differences between them are: The number of epithallial's layers cells, the occurrence and arrangement of trichocytes and the sporangial pore canal cells shape. In the other hand, ours specimens agree in general characters with the description given by Taylor (1960) for *Porolithon pachydermum* (Foslie) Foslie.

H. pachydermum has been recorded in several localities from Caribbean as *P. pachydermum* (Littler & Littler 2000).

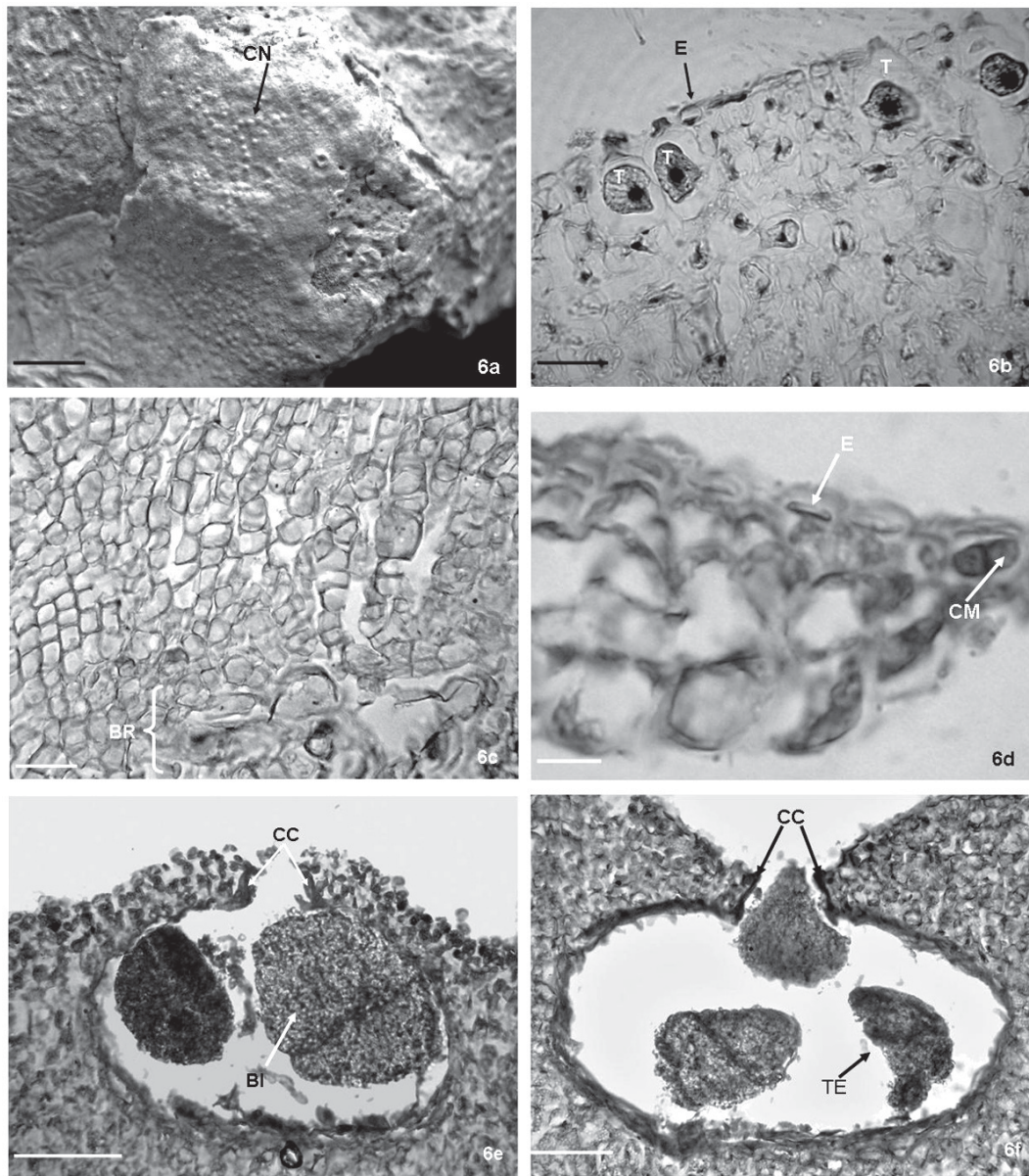


FIGURE 6. *Hydrolithon pachydermum*, Cozumel Island 26-II-1985 (ENCB 17 195). a. Surface of thallus showing conceptacles (CN).Scale: 6 mm. b. Section of thallus showing solitary trichocytes (T) as well and in horizontal rows and epithallial cels (E). Scale: 29 μ m. c. A monomerous thallus showing a thin multistratose basal region (BR) from which upwards derivatives are being formed. Scale: 22 μ m. d. Close-up the meristematic cell (CM), and the unistratose epithallium. Scale: 30 μ m. e. Bisporangial conceptacle showing bisporangia (BI), and pore canal lined by enlarged cells (CC). Scale: 24 μ m. f. Tetrasporangial conceptacle showing tetrasporangium (TE) and pore canal lined by enlarged cells (CC). Scale: 20 μ m.

FIGURA 6. *Hydrolithon pachydermum*, Isla Cozumel, 26-II-1985 (ENCB 17 195). a. Superficie del talo mostrando los conceptáculos (CN).Escala: 6 mm. b. Sección del talo mostrando tricocitos solitarios y en hilera horizontal, y las células epiteliales (E). Escala: 29 μ m. c. Talo monómero mostrando una delgada región basal multiestratosa, (BR) de la cual emergen filamentos de células. Escala: 22 μ m. d. Detalle de la célula meristemática (CM) y una capa de células epiteliales (E). Escala: 30 μ m. e. Conceptáculo bisporangial con bisporangio (BI), poro delimitado por células alargadas (CC). Escala: 24 μ m. f. Conceptáculo tetrasporangial con tetrasporangio (TE) y poro delimitado por células alargadas (CC). Escala: 20 μ m.

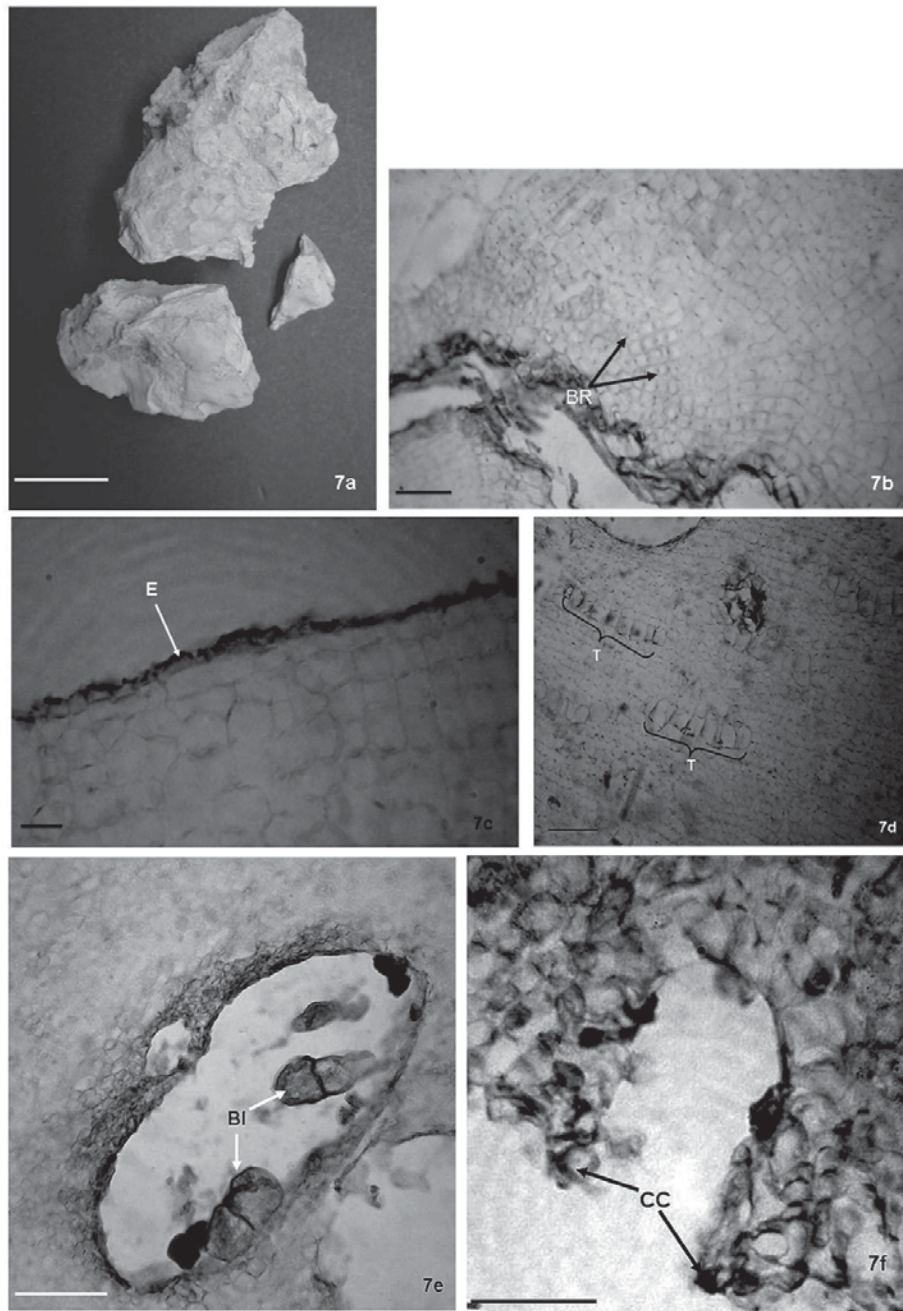


FIGURE 7. Lectotype of *Hydrolithon pachydermum*. a. Habit of bisporangial plant. Scale: 3 cm. b. Section through a monomerous thallus showing a multistratose basal region (BR) with downward curving filaments. Scale: 40 μm . c. Section through cortical region of the thallus showing a unistratose epithallium (E). Scale: 10 μm . d. Trichocytes arranged in horizontal rows (T). Scale: 45 μm . e. A buried conceptacle showed bisporangium (BI). Scale: 45 μm . f. Close-up of conceptacle showing a pore canal lined by enlarged cells (CC). Scale: 25 μm .

FIGURA 7. Lectotipo of *Hydrolithon pachydermum*. a. Habito del talo costroso. Escala: 3 cm. b. Talo monómero mostrando una región basal multiestratosa, (BR) de la cual emergen filamentos de células. Escala: 40 μm . c. Sección de la región cortical donde se observa un epitalo unistratificado (E). Escala: 10 μm . d. Sección del talo mostrando hileras horizontales de tricocitos (T). Escala: 45 μm . e. Conceptáculo bisporangial con bisporangios (BI). Escala: 45 μm . f. Acercamiento del canal del conceptáculo, mostrando el poro delineado por células alargadas (CC). Escala: 25 μm .

TABLE I. Morphoanatomical characteristics of *Hydrolithon onkodes* and *H. pachydermum* (lectotypes and Mexican specimens).

TABLA I. Caracteres morfológicos de *Hydrolithon onkodes* y *H. pachydermum* (lectotipos y especímenes mexicanos).

Character	<i>Hydrolithon onkodes</i> (from Mexico)	<i>H. onkodes</i> (lectotype)	<i>H. pachydermum</i> (from Mexico)	<i>H. pachydermum</i> (lectotype)
Habit	Encrusting or with small protuberances	Encrusting	With small protuberances	Encrusting
Thallus construction	Mostly monomerous	Monomerous	Mostly monomerous	Monomerous
Medulla	No coaxial	No coaxial	No coaxial	No coaxial
Epithallium	1-4 layers	3-4 layers	Unistratose	Unistratose
Trichocytes	Singly, in horizontal rows or in field pustules	Singly, in horizontal rows or in field pustules	Singly, or in horizontal rows, rarely in field pustules	Singly, or in horizontal rows
Cell Fusions	Present	Present	Present	Present
Epithallial cells	3-9 µm tall 5-8 µm diam.	3-4 µm tall 7-11 µm diam.	3-6 µm tall 6-12 µm diam.	4-6 µm tall 9-13 µm diam.
Cortical cells	6-9 µm tall 8-18 µm diam.	9-15 µm tall 6-12 µm diam.	15-21 µm tall 6-15 µm diam.	12-15 µm tall 9-12 µm diam.
Medullary cells	4-13 µm tall 9-30 µm diam.	14-22 µm tall 7-9 µm diam.	6-12 µm tall 12-21 µm diam.	18-20 µm tall 7-11 µm diam.
Trichocytes size	18-33 µm high 12-24 µm diam.	18-26 µm high 16-22 µm diam.	27-54 µm high 18-26 µm diam.	32-41 µm high 24-26 µm diam.
Thallus thickness	0.2-4.0 mm thick	12-25 mm thick	0.4-2.7 mm thick	1.9-2.0 mm thick

TABLE II. Reproductive characteristics of *Hydrolithon onkodes* and *H. pachydermum* (lectotypes and Mexican specimens).

TABLA II. Caracteres reproductivos de *Hydrolithon onkodes* y *H. pachydermum* (lectotipos y especímenes mexicanos).

Character	<i>Hydrolithon onkodes</i> (from Mexico)	<i>H. onkodes</i> (lectotype)	<i>H. pachydermum</i> (from Mexico)	<i>H. pachydermum</i> (lectotype)
Chamber size of tetra/bisporangial conceptacle	36-165/ 36-180 µm high, 186-231/141-255µm diameter	111 µm high and 233 µm diameter	102-165/63-225 µm diameter 30-114/75-165 µm high	126 µm high 222 µm diameter
Chambers shape	elliptic or rounded	elliptic	orbicular, elliptic or rounded	Orbicular
Tetra/bisporangia size	16-51/21-75 µm diameter 36-72/41-95µm high	22 µm diameter 32 µm high Apparently bisporangium	15-24/51-84 µm diameter, 45-48/60-105 µm high	15 µm diameter and 45 high
Columella	Present	Present	Absent	Absent
Roof layers	4-8	6-9	3-4	4

5. *Hydrolithon reinboldii* (Weber-van Bosse et Foslie) Foslie, K. Norske Vidensk. Selsk. Biol. Skr. 2: 55. 1909.

Basionym: *Lithophyllum reinboldii* Weber-van Bosse et Foslie, K. Norske Vidensk. Selsk. Biol. Skr. 2: 5. 1901.

Synonyms: *Goniolithon reinboldii* (Weber-van Bosse et Foslie) Weber van Bosse et Foslie, K. Norske Vidensk. Selsk. Biol. Skr. 2: 49. 1904; *Porolithon reinboldii* (Weber-van Bosse et Foslie) Lemoine, Ann. Inst. Oceanogr. Monaco 2(2): 166. 1911; *Spongites reinboldii* (Weber-van Bosse et Foslie) D. Penrose et Woelkerling, Phycologia 26: 173. 1988.

Type locality: Moearas Reef on the east coast of Borneo (East Kalimantan), Indonesia.

HABIT AND VEGETATIVE STRUCTURE: Attached to the substratum ventrally by cell adhesion, without rhizoids, 130 μm - 4 mm thick, also occurring as free-living rhodoliths with rounded protuberances (Fig. 8a), 4 to 5 cm thick; thallus pseudoparenchymatous; cells of adjacent filaments connected laterally by fusions, secondary pit-connections not observed; thallus construction dimerous, basal region unistratose, with square cells 12-15 μm diameter, others vertically elongate, 12-45 μm tall and 9-24 μm diameter with several fusions (Fig. 8b); epithallial cells in unistratose layer with oblong cells 1.5-9 μm tall and 4.5-15 μm diameter; cortical region composed of filaments that become oriented perpendicularly to the thallus surface. Cells of erect filaments are strongly horizontally arranged (Fig. 8c) due to extensive connections by broad cell fusions; cells rounded, square 6-15 μm diameter, irregular cell fusion 6-25 μm diameter and 9-30 μm tall; trichocytes single, or in vertical rows, 6-27 μm diameter and 15-45 μm tall; marginal growth by irregularly shaped initial cells 12-33 μm in diameter and 12-24 μm tall (Fig. 8d).

REPRODUCTIVE STRUCTURES. Tetra/bisporangial plants 140 μm - 4mm thick, tetra/bisporangial conceptacles domoid and apiculate; tetra/bisporangial chambers rounded, 88/195 μm diameter, or orbicular, 95 μm diameter and 100/129 μm high, or elliptical, 165-180/250 μm diameter and 105/205 μm high; roof of conceptacle 4 layers cells thick, 25-30 μm tall; and lacking central columella; pore canals lined by cells oriented perpendicular to the thallus surface,

reniform to concave, 2.5-9 μm diameter and 37 μm tall, or triangular-longer 2.5-9 μm diameter and 24-37 μm tall; the sterile filaments given raise to the roof still persistent in the conceptacle chamber (Fig. 8e); tetrasporangium 15-69 μm diameter and 50-84 μm high, bisporangium 33-125 μm diameter and 62-102 μm tall (Fig. 8f).

SPECIMENS EXAMINED: MEXICO, Veracruz, Arrecife La Blanquilla (19°13'24"N, 96°05'54"W), 3-V-1964, L. Huerta s.n. (ENCB 17159), Quintana Roo, Cozumel Island, (20°30'32"N, 86° 57'07"W), 10-IX-1985, 20-V-1993; 14-IX-1993; 19-III-1994, C. Mendoza, L.E. Mateo, L. Huerta & C. Galicia s.n. (ENCB 17162, 17165, 17167, 17168), San Francisco Reef, 17-V-1993, L.E. Mateo, C. Mendoza & L. Huerta s.n. (ENCB 17170), Playa San Juan, (20°33'02"N, 86°55'49"W), 17-III-1994, L.E. Mateo, C. Mendoza & R. Robles s.n. (ENCB 17163), 2-VI-1995, Tunich Reef, R. Robles & E. Caister s.n. (ENCB 17171), Mujeres Island, Garrafón Reef (21°12'12.9"N, 86°43'16.5W), 20-V-1998, L.E. Mateo & C. Mendoza s.n. (ENCB 17161), Punta Norte, 13-IX-1985, C. Mendoza & L.E. Mateo s.n. (ENCB 17160), Banco Chinchorro, Cayo Lobos (18°23'11"N, 87°22'53"W), 19-VI-1984, L. Huerta & L.E. Mateo s.n. (ENCB 17166), Akumal (20°23'9.8"N, 87°19'21.6"W), 16-IX-1993, C. Mendoza, L.E. Mateo, R. Robles & R.B. Searles s.n. (ENCB 17164).

HABITAT: Epilithic on rocks, and encrusting dead coral skeletons or as free-living rhodoliths, intertidal and subtidal.

REMARKS: Our observations of this species are in general agreement with the descriptions of Lemoine (1917), Mason (1954), Dawson (1960), Adey & Lebednik (1967), and Penrose & Woelkerling (1992), except for the relatively small size of the sporangial conceptacles in our specimens. Desikachary & Ganesan (1967), however, have described tetrasporangial conceptacles similar in size to those we observed. We did not observed gametangial plants, but Krishnamurthy & Jayagopal (1987) described a procarpic conceptacle 150 μm in diameter and 40 μm high, spermatangial conceptacles 40-70 μm in diameter and 25-50 μm high.

No previously published descriptions of this taxon included information of the size and shape of sporangial conceptacle pore canal cells. Bisporangial plants were more common than tetrasporangial plants. This species occurs

in Veracruz and Quintana Roo and is the first record from the Atlantic coast of Mexico. In the other hand, *H. reinboldii* has been recorded from Revillagigedo Island at the Pacific coast of Mexico by Dawson (1960) and Adey *et al.* (1982).

Hydrolithon reinboldii has been recorded from Pacific Ocean, Maldives and Lacadive Islands, Indian Ocean, Heron Reef of Australia, Hawaii and French Polynesian reefs.

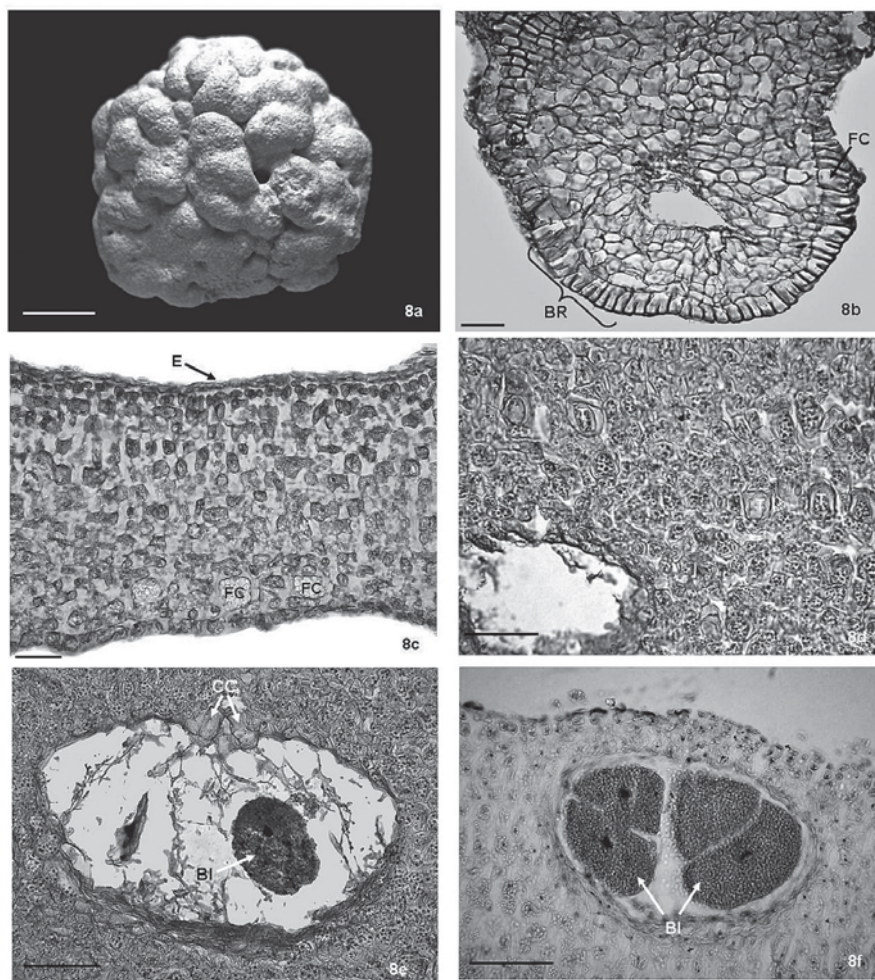


FIGURE 8. *Hydrolithon reinboldii*, Cozumel Island, 14-IX-1993 (ENCB 17 162). a. A free-living Rhodolith with several rounded and fused protuberances. Scale: 8mm. b. Section of the thallus showing the dimerous construction with a unistratose basal region (BR) bearing extensive cell fusions (FC). Scale: 37 μ m. c. Longitudinal view of the dimerous thallus showing a single epithelial layer (E). Note too the strong horizontal arrangement of the erect filaments resulting from extensive cell fusions between adjacent erect filaments. Scale: 22 μ m. d. Section of thallus showing numerous solitary trichocytes (T). Scale: 40 μ m. e. Section through a bisporangial conceptacle showing a pore canal lined by enlarged cells (CC) and bisporangium (BI). Scale: 69 μ m. f. Bisporangial conceptacle showing two mature bisporangium (BI). Scale: 44 μ m.

FIGURA 8. *Hydrolithon reinboldii*, Isla Cozumel, 14-IX-1993 (ENCB 17 162). a. Un rodolito de hábito libre, con numerosas protuberancias redondeadas y fusionadas. Escala: 8mm. b. Sección longitudinal que muestra una construcción dímica con una región basal unistratosa (BR) y con numerosas fusiones celulares (FC). Escala: 37 μ m. c. Sección longitudinal del talo dímero mostrando una capa de las células epiteliales (E). Observe el marcado arreglo horizontal de los filamentos erguidos y que muestran numerosas fusiones celulares entre filamentos adyacentes (FC). Escala: 22 μ m. d. Sección del talo que muestra numerosos tricocitos solitarios (T). Escala: 40 μ m. e. Conceptáculo bisporangial con poro delineado por células alargadas (CC) y bisporangios (BI). Escala: 69 μ m. f. Sección del talo bisporangial con dos bisporangios (BI). Escala: 44 μ m.

DISCUSSION AND CONCLUSION

The delimitation of the genus *Hydrolithon* was circumscribed by Penrose & Woelkerling (1992) who indicated the main characters distinguishing *Hydrolithon* from other mastophoroid coralline algae and are: pore canals of sporangial conceptacles lined by a ring of conspicuous elongate cells that arise from filaments interspersed among sporangial initials.

The five species of *Hydrolithon* discussed here belong to *Hydrolithon* on the basis of their mastophoroid characters in combination with the above sporangial pore structure; have confirmed the presence of this species in the waters of

eastern Mexico. In the other hand, the clearest differences between into the species are: the habit, if is crustose, with protuberances or free-living rhodoliths; the construction of the thallus is dimerous or monomerous; the occurrence of trichocytes singly, in horizontal and vertical rows or in field pustules, although trichocytes may be present singly or in field pustules in the same species (Table III). The distinguishing reproductive features of our *Hydrolithon*'s taxa are as follows: gametangial plants monoecious or dioecious; shape and size of tetra/bisporangial chambers as well as the size and shape of the pore canal cells (Table IV).

TABLE III. Morphological characters of *Hydrolithon* species from the Atlantic Coast of Mexico and Mexican Caribbean.

TABLA III. Caracteres morfológicos de las especies de *Hydrolithon* presentes en la costa del Atlántico y Caribe mexicano.

Character	<i>H. boergesenii</i>	<i>H. farinosum</i>	<i>H. onkodes</i>	<i>H. pachydermum</i>	<i>H. reinboldii</i>
Habit	Crustose with warty protuberances	Crustose smooth lacking protuberances	Crustose, warty or lumpy	Crustose with small protuberances	Unattached (rhodoliths) or crustose with numerous round protuberances
Sporangial Thallus Thickness	0.4-2 mm	20-90 µm	0.2-4 mm	0.4-2.7 mm	Crustose 0.1-4 mm rhodoliths 4-5 cm
Thallus Construction	Dimerous	Dimerous	Mostly Monomerous	Mostly Monomerous	Dimerous
Basal region	Unistratose	Unistratose	Multistratose	Multistratose	Unistratose rarely multistratose
Arranged cell of erect filaments	No horizontally arranged	No horizontally arranged	No horizontally arranged	No horizontally arranged	Strongly horizontally arranged
Epithallium	Unistratose or bistratose	Unistratose	3-4 layers	Unistratose	Unistratose
Trichocytes	Solitary or in horizontal and vertical rows.	Solitary and in horizontal rows	Solitary, horizontal rows and field pustules	Solitary, horizontal and vertical rows, rarely field pustules	Solitary, in short horizontal and vertical rows






As we showed at Fig. 1, *Hydrolithon farinosum* is one of the most common species that occurs along the Atlantic and Caribbean coasts of Mexico. In contrast, *H. boergesenii* appears restricted to Cozumel Island, Quintana Roo and Yucatan. The present study should not be regarded as an exhaustive treatment of the diversity of *Hydrolithon* in eastern coast Mexico, but rather it is baseline study. The area surveyed encompasses 2768 km of

coast along which less 70 sites were sampled, these sites represented less than 10% of the total coastline; for this reason is necessary to do further detailed studies in the rocky shores and reefs poorly know in the Atlantic and Caribbean coast of Mexico.

Finally, *H. onkodes* appears to be closely related to *H. pachydermum* and further ecological and molecular studies are needed to evaluate the Mexican populations of both taxa.

TABLE IV. Reproductive characters of *Hydrolithon* species from the Atlantic Coast of Mexico and Mexican Caribbean.

TABLA IV. Caracteres reproductivos de las especies de *Hydrolithon* presentes en la costa del Atlántico y Caribe mexicano.

Character	<i>H. boergesenii</i>	<i>H. farinosum</i>	<i>H. onkodes</i>	<i>H. pachydermum</i>	<i>H. reinboldii</i>
Chamber shape of tetra/bisporangial conceptacle	elliptic or ovoid	elliptic	elliptic or rounded	orbicular, elliptic or rounded	orbicular, elliptic or rounded
Chamber size of tetra/bisporangial conceptacle	174-216/81-165 μ m in diameter and 81-96 μ m high	100-300 μ m diameter and 31-100 μ m high	36-165/ 36-180 μ m high, 186-231/141-255 μ m diameter	102-165/63-225 μ m diameter 30-114/75-165 μ m high	165-180/250 μ m diameter and 100/205 μ m high
Tetra/bisporangia size	25-42/45-50 μ m in diameter and 63/77-90 μ m high.	20-57 μ m diameter and 31- 63 μ m high	16-51/21-75 μ m diameter 36-72/41-95 μ m high	15-24/51-84 μ m diameter, 45-48/60-105 μ m high	15-69/33-125 μ m diameter and 50-84/62-102 μ m high,
Columella	Absent	Present	Present	Absent	Absent
Roofs layers	3-6	2-3	4-8	3-4	4
Gametangial thallus	not seen	dioecious	monoecious	not seen	not seen
Shape of canal's cells	Concave 	Triangular-Convex 	Triangular 	Elongated 	Reniform-Triangular 

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