

NSF Pan-American Advanced Studies Institute

14 August – 4 September, 2009

Advanced Methods in Tropical Phycology



Field Guide to Common Marine Algae of the Bocas del Toro Area: II

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From August 14th – September 4, 2009, an NSF-funded Pan-American Advanced Studies Institute (PASI) grant (Rachel Collin, PI) supported 20 graduate students, postdocs and young faculty to attend an Advanced Methods in Tropical Phycology Workshop held at STRI's Bocas del Toro Research Station. The goal of this PASI Workshop in tropical phycology was to bring together junior and senior researchers in Latin America and their North American counterparts, at a high-tech facility, to combine hands-on fieldwork and practical application of modern techniques. By combining the high local biodiversity, cutting edge techniques, and international collaboration, this PASI will speed and further invigorate systematic phycology throughout the Americas.

Ten of the workshop participants came from the United States, and ten participants represented 7 other countries (Brasil, Colombia, Costa Rica, Cuba, El Salvador, Mexico, Thailand). The students and the three marine macroalgal taxonomy instructors (Brian Wysor, Roger Williams University; D. Wilson Freshwater, University of North Carolina at Wilmington; Suzanne Fredericq, University of Louisiana at Lafayette) worked synergistically with the Smithsonian Institution's DNA barcode initiative. Other instructors presented lectures ranging from Seaweed Curation and Data Management (Steve Paton, Smithsonian), Seaweed Chemical Ecology (Bernardo Antonio Perez da Gama, Universidade Federal Fluminense), Seaweed Ecology (Guillermo Diaz-Pulido, University of Queensland), the Biology of Calcareous Algae and Rhodoliths (Rafael Riosmena-Rodriguez, Universidad Autónoma de Baja California Sur), Terrestrial Algae (Juan Lopez-Bautista, University of Alabama), Education and Outreach (Rachel Collin & Rebecca Rissanen, Smithsonian), Photobiology (Nadine Schubert, Universidad Nacional Autónoma de México), and Special Topics in Marine Phycology (Erick Ask, FMC Corporation; Amy Driskell, Smithsonian; Ber).

As part of the NSF-PASI Training program in tropical phycology, lecture material included discussions of the current taxonomy and molecular systematics of the marine green, red and brown macroalgae, with emphasis on tropical Caribbean taxa; an overview and recent assessment of the diagnostic vegetative and reproductive characters that differentiate orders, families, genera and species of the red, green and brown seaweeds; and applications of molecular tools to current questions in seaweed evolution.

Instructors and students collected multiple samples of over 200 algal species by SCUBA diving, snorkeling and intertidal surveys. The samples were then examined back in the laboratory under the microscope, sectioned, photographed, identified, and curated. As part of the training in tropical marine phycology, each PASI student contributed three species plates shown in this publication. These plates will also be incorporated in an ongoing guide to the common seaweeds of the Bocas del Toro region that is being edited by B. Wysor, D.W. Freshwater, S. Fredericq and J.N. Norris. The voucher specimens upon which the plates and descriptions were based have been deposited in the Bocas station's seaweed reference collection and the University of Panama herbarium. Many of the collected samples will be used to elucidate phylogenetic and biogeographic questions pertaining to Panamanian algae in a worldwide context. The workshop also proved successful in its goal to establish a collaborative network of Central, South, and North American algal researchers.

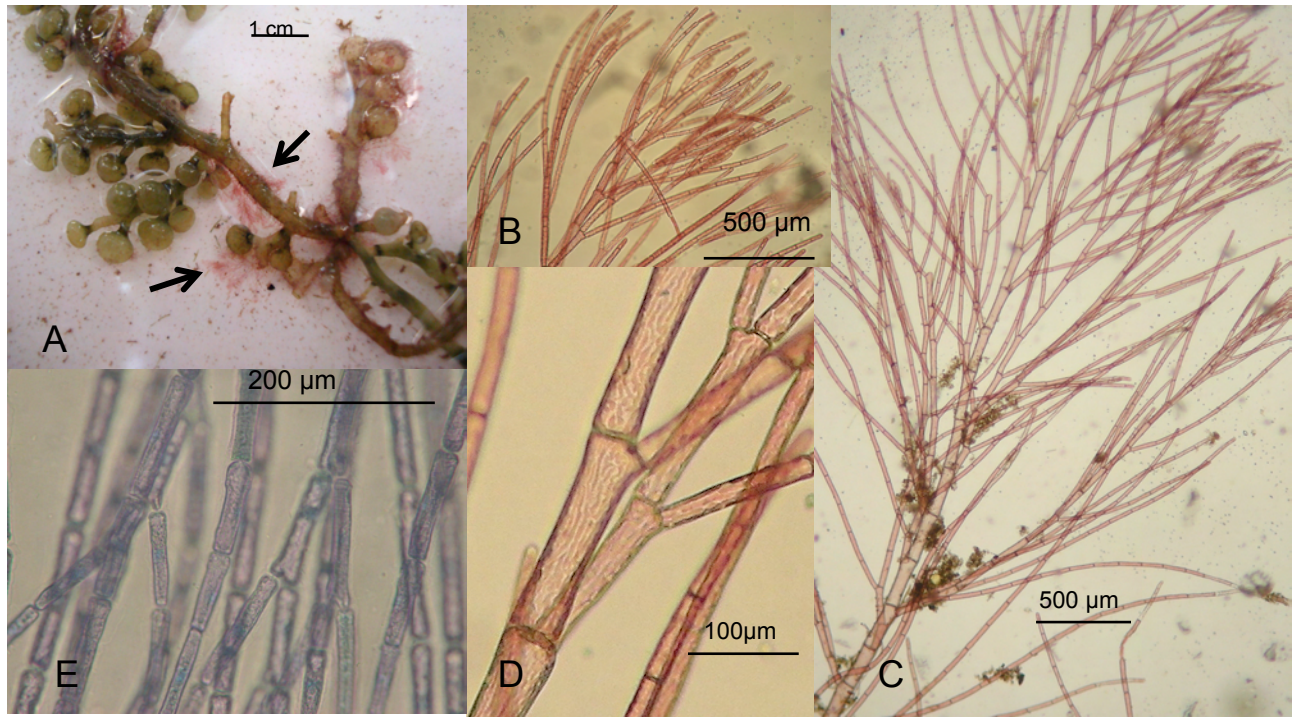
A special project that was initiated in 2008 and supported by a Smithsonian Institution's Science Network grant to barcode the Gracilariaceae (red algae) and Dictyotaceae (brown algae) for the Bocas Barcode initiative in collaboration with Dr. Amy Driskell of the Smithsonian's National Museum of Natural History was continued during the PASI workshop.

In addition to support from NSF PASI, additional funding came from the National Science Foundations Biodiversity Surveys and Inventories Program.



Aglaothamnion flexible N.E. Aponte & D.L. Ballantine

(Florideophyceae, Ceramiales, Callithamniaceae)



A-E. Specimen: PASI09.SA-003. **(A)** Specimens growing epiphytically on *Caulerpa racemosa* (arrows). **(B)** Branching showing simple monosiphonous laterals distally. **(C)** Central axis bearing irregular alternate uniseriate, simple branches. **(D)** Ribbon-shaped chloroplasts in cells. **(E)** Branches stained with aniline blue, showing single nucleus per cell.

Description: Thallus occasionally bushy, composed of soft, delicate, monosiphonous filaments, up to 10 cm tall, pale pink. Main axis uncorticated, uniseriate, up to 100 µm in diameter, branching alternate. Laterals fine, sparse, hair-like, 5-7 µm in diameter, their tips slightly incurved and flat-topped. Vegetative cells uninucleate with the nucleus commonly centrally located.

Remarks: This is the first distributional record of this species for Bocas del Toro. Although the description by Littler et al. (2008) mentions that the thallus can reach a height of 10 cm, the Bocas specimen I found was < 1 cm tall.

Habitat: Growing epiphytically on other algae in a mangroves

Bocas del Toro Distribution: Bocas Research Station, Isla Colón, Panamá

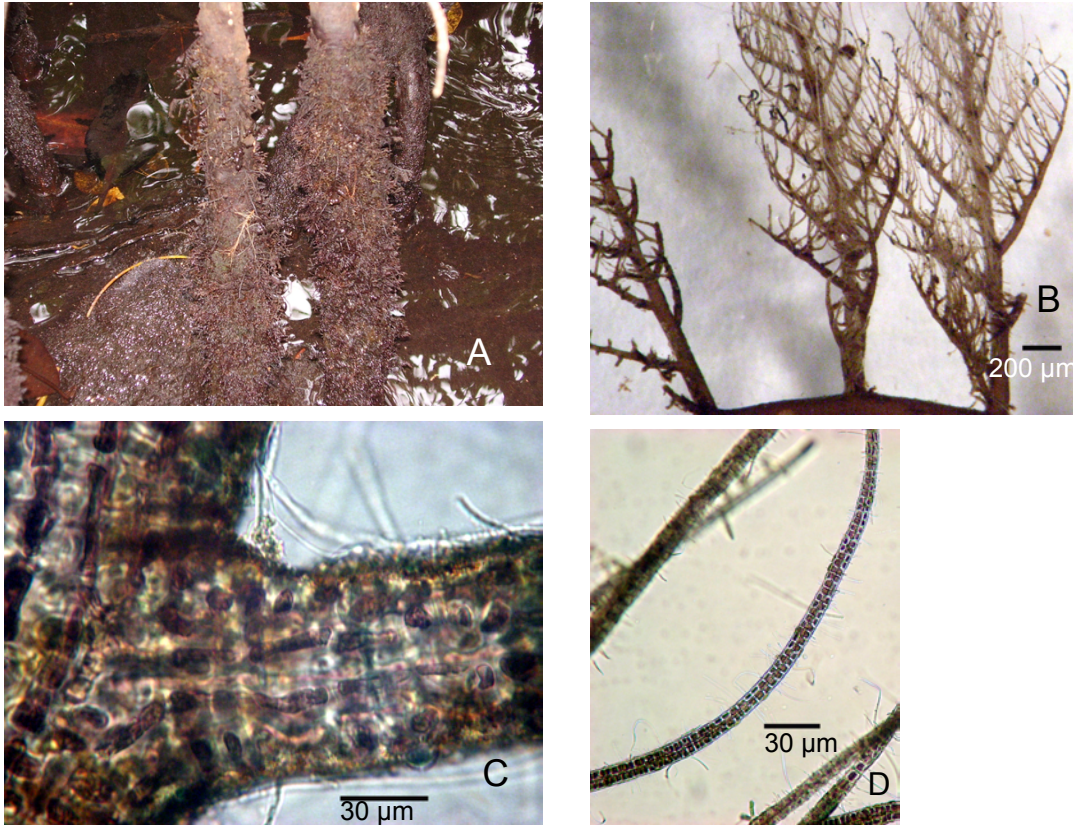
Worldwide Distribution: Florida, Greater Antilles, Lesser Antilles, Southern Caribbean.

Representative Specimens: PASI09.SA-003

References

- Guiry, M.D. & Guiry, G.M. 2009. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 20 August 2009.
- Littler, D.S., Littler, M.M. & Hanisak, M.D. 2008. Submersed plants of the Indian River Lagoon: A floristic inventory and field guide, 289 pp, 565 color photographs, 492 photomicrographs, 305 anatomical line drawings. Washington, DC: OffShore Graphics, Inc.. Notes: Distributed by Harbor Branch Foundation, Florida, USA.

***Bostrychia montagnei* Harvey**
(Florideophyceae, Ceramiales, Rhodomelaceae)



A-D: Specimen: PASI09.EP-0005. **(A)** Specimens adhering to mangrove prop roots. **(B)** Pinnately branched herbarium specimens. **(C)** Surface view of branching fork showing cortication. **(D)** Laterals becoming monosiphonous near terminal portions.

Description: Thalli pinnate, forming dense tufts and entangled masses to 8 cm high, dark purple in color (A). Main axes erect, with alternate polysiphonous branches that in turn bear elongate, simple laterals terminating in monosiphonous filaments (B). Main axes surrounded by 6 to 7 cortical cell layers (C). Apical branch portions uniseriate, 3 to 8 mm in diameter.

Remarks: Plants growing intermixed with *B. radicans* and *B. tenella*. The main diagnostic feature of this species is the number of pericentral cells along the main axis, and the presence of mono- or polysiphonous branchlets with or without cortication. No reproductive structures were found in BT site location.

Habitat: Commonly growing on mangrove prop roots as turfs, in protected locations.

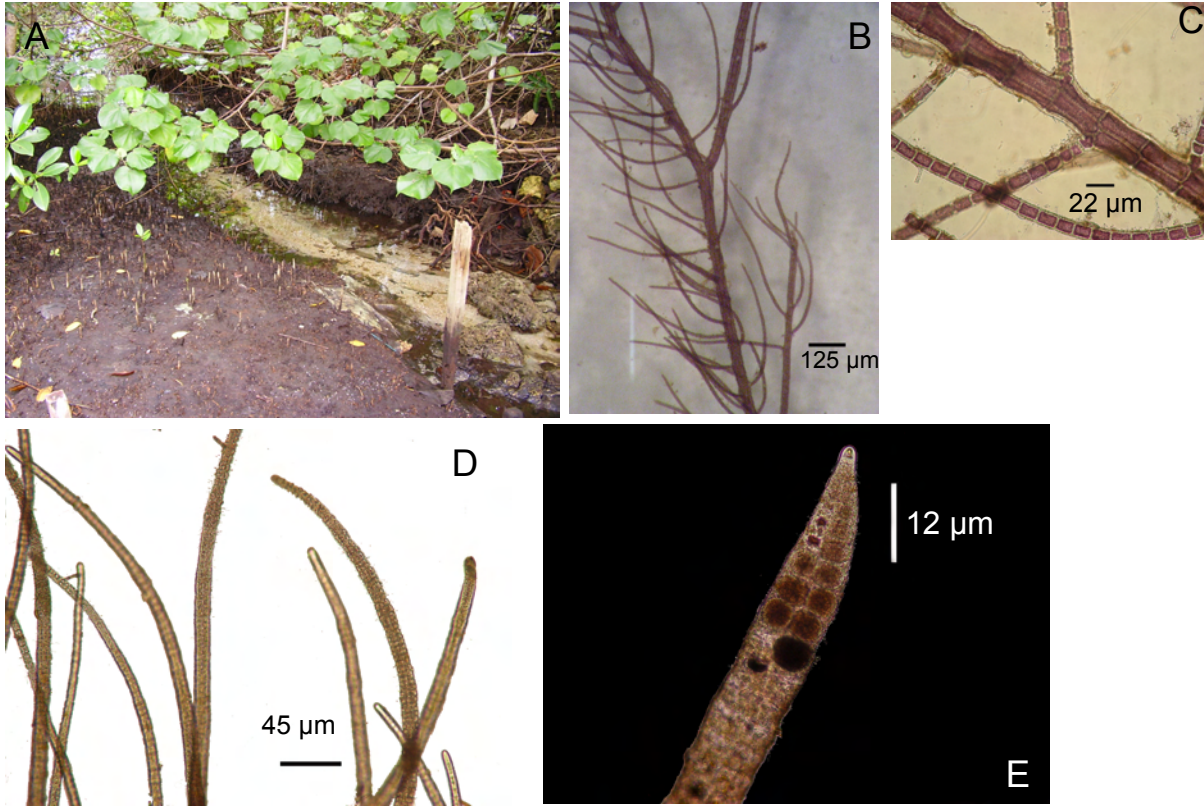
Bocas del Toro Distribution: on mangrove roots, < 1 m.

Worldwide Distribution: North, Central and South America, Caribbean Islands, Caribbean, South America.

Representative Specimens: PASI09.EP-0005.

References: Littler & Littler 2000, Zucarello & West 2002.

***Bostrychia radicans* (Montagne) Montagne**
(Florideophyceae, Ceramiales, Rhodomelaceae)



A-E: Specimen PASI09.RC-0005. **(A)** Specimens adhering to pneumatophores of *A. germinans*. **(B)** Simple, irregular-alternate laterals borne on main axis. **(C)** Uncorticated main axis and uniseriate laterals. **(D)** Uniseriate branchlets. **(E)** Close-up surface view of tetrasporangial stichidium with developing tetrasporangia.

Description: Thallus slender, erect or prostrate to 5-6 cm high, moss-like, pinnately branched (A). Branches 140-170 mm diam., alternate (B). Cortication absent, 6 to 8 pericentral cells (C). Secondary branchlets 1.5 mm long, pseudodichotomous and incurved near the tips (D). Tetrasporangial stichidia elongate (E).

Remarks: Plants commonly co-occurring with *Bostrychia montagnei* and *B. tenella*, growing on mangrove roots. The species distinction is based on the number of cortical cells. Main differences with *B. montagnei* include the absence of cortication. Local specimens lack well-defined pseudodichotomous branchlets, are prostrate, and more delicate than the coarse turfs of *B. montagnei*.

Habitat: Commonly growing at the base of mangrove pneumatophores, < 1 m depth.

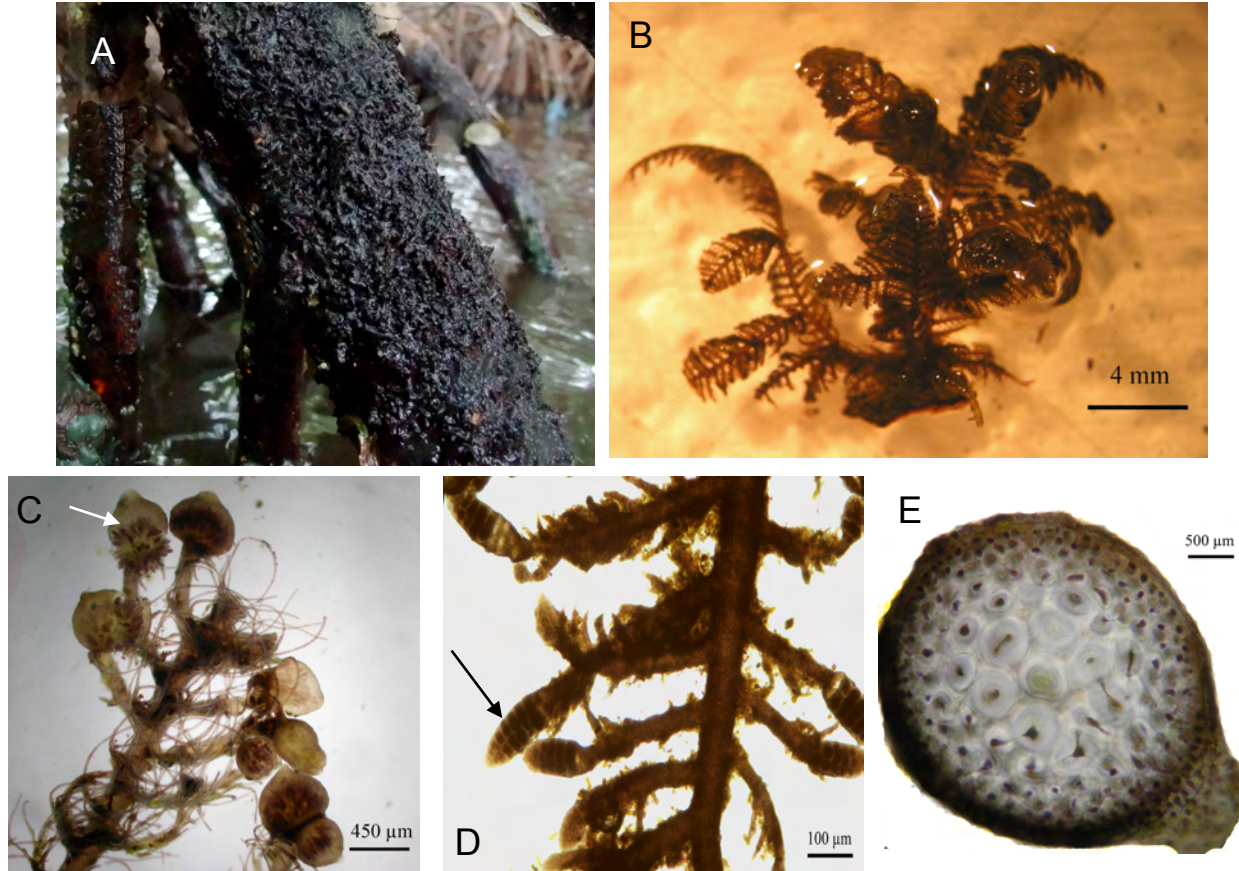
Bocas del Toro Distribution: BT station on mangrove roots

Worldwide Distribution: North, Central and South America, Caribbean Islands.

Representative Specimens: PASI09. RC-0005.

References: Taylor 1960, Littler & Littler 2000, Zucarello & West 2002.

***Bostrychia tenella* (J.V. Lamouroux) J. Agardh**
(Florideophyceae, Ceramiales, Rhodomelaceae)



A-E: Especimen PASI09.OT-0001. **(A)** Hábitat en el manglares. **(B)** Ramificación pinnada. **(C)** Cistocarpio maduro, mostrando los filamentos gominoblasticos y carposporas (indicados con la flecha). **(D)** Estiquidios tetrasporangiales en posición apical (indicados con la flecha). **(E)** Corte transversal con 8 células pericentrales de un diámetro de aproximadamente 200 µm.

Descripción: Talos postrados, formando matas de color púrpura oscuro casi negro, doblemente pinnada, con ápices encorvados. Tallas hasta de 2 cm de largo. Anatómicamente, el talo presenta de 6 a 8 células pericentrales rodeadas de 1 a 4 líneas de células corticales que tienden hacerse muy pequeñas hacia la superficie de la corteza. Esta especie presenta numerosas ramitas curvadas, con diámetros entre 25 a 30 µm. Las ramas se vuelven uniseriadas hacia los ápices. Presenta estiquidios tetrasporangiales lineales, que se dividen tetraédricamente y pueden alcanzar de 40 a 160 µm de diámetro, en los ápices de las ramas dividiéndose tetraédricamente.

Observaciones: Las ramitas jóvenes no siempre se observan doblemente pinnadas, ni los ápices típicamente encorvados, por lo que es fácil pensar que se trata de otra especie *Bostrychia*.

Habitat: Sobre las raíces de *Rhizophora mangle*.

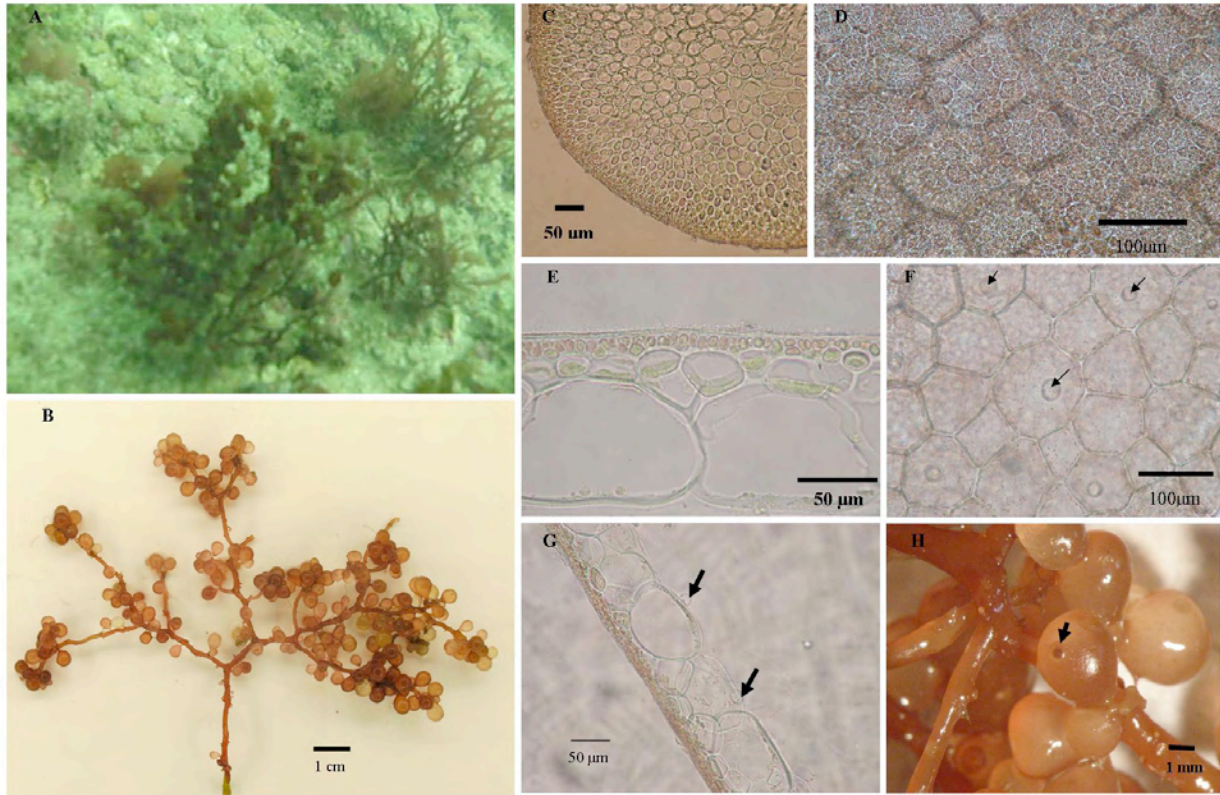
Distribución en Bocas del Toro: Manglares de la bahía, cerca de la Estación de STRI N09.35118° W 082.25697°

Distribución en el mundo: África y Sur África, China, Sur Este de Asia, Australia, Nueva Zelanda, Nueva Caledonia, Islas del Pacífico, Islas del Océano Atlántico, En La Florida, En América Central y Panamá. En las islas del Caribe. Sur América: Brasil, Venezuela y Galápagos.

Especimen representativo: PASI09.OT- 0001

References Guiry & Guiry 2009, Littler & Littler 2000, Taylor 1960

***Botryocladia occidentalis* (Børgesen) Kylin**
(Florideophyceae, Rhodymeniales, Rhodymeniaceae)



A-H. Specimen #8-17-09-1-10. **(A)** Habit of specimens in situ. **(B)** Habit of female gametophyte with cystocarps. **(C)** Cross section through branch. **(D)** Surface view of vesicle with complete cortication. **(E)** Cross section through vesicle showing the cortical and medullary cell layers. **(F)** Surface view of medullary cells bearing gland cells. **(G)** Cross section through vesicle showing gland cells borne on unmodified medullary cells. **(H)** Raised cystocarp on female gametophyte.

Description: Plants rose red to honey pink, erect, up to 11 cm in length, with irregular pseudodichotomous branching (Fig. B). Main axis and branches terete, 9-2.5 mm in diam., of solid construction, composed of small pigmented, round to oval, cortical cells (5 μ m diam.) that gradually increase in size thallus inward; medullary cells larger, hyaline, ovoid, up to 50 μ m (Fig C). Axis and branches bearing pyriform vesicles (Fig. B) 3–7 mm long. x 3-4.5 mm diam., filled with viscous mucilage. Vesicle walls 2-(3)-4 cells wide and 66-(100)-135 μ m thick (Fig. E). Cortex of vesicle complete, uni-bistratose, pigmented, composed of round to ovoid cells, 3-6 μ m in diameter, distal to larger medullary cells. Innermost medulla composed of 1-(2) layers of hyaline cells, with innermost layer polygonal, 77-(100-132)-180 μ m wide, outer medulla of intermediate-sized cells. Some unmodified medullary cells cutting off thallus inward spherical gland cells 17-(20)-25 μ m diam. borne singly or rarely paired (Figs. F-G). Cystocarps with single ostiole, borne on vesicles forming a slightly raised bulge thallus inward and outward. Carposporangia irregular in shape, 8-30 μ m in diameter. Tetrasporic and male gametophytes were not observed.

Remarks: Many of the measurement values given here, including axial width and maximum cell size, are different from those reported for the species by Gavio & Fredericq (2003), Afonso-Carillo & Sobrino (2003), Dawes & Mathieson (2008); however, these reports are in general agreement with diagnostic features such as a gradual transition from cortex to medulla throughout the thallus, vesicles with complete cortication lacking cortical spines, and unmodified medullary cells usually bearing one gland cell. Cystocarpic plants were collected during August.

Habitat: Epilithic in depths up to 7 m.

Bocas del Toro Distribution: Wild Cane Cay (8-16-09-1-15), Mimbi Timbi, Isla Colón (#8-17-09-1-10).

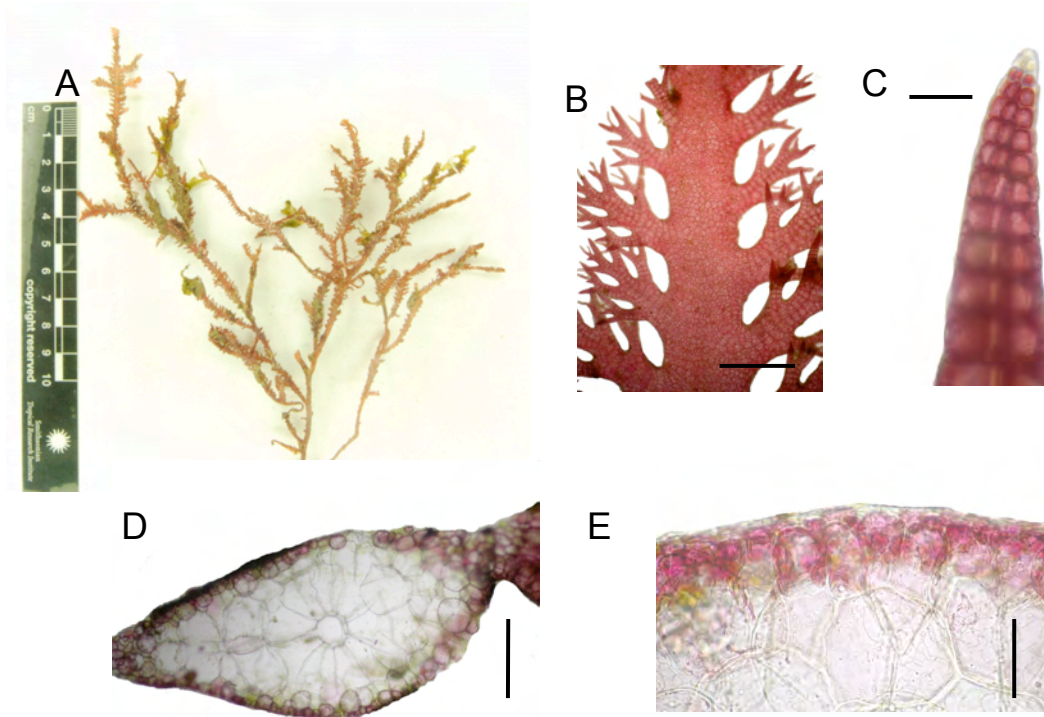
Worldwide Distribution: From North Carolina to Brazil in the Western Atlantic, and as far East as the Canary Islands (Afonso-Carrilo & Sobrino 2003).

Representative Specimens: (#8-16-09-1-15), (#8-17-09-1-10).

References

- Afonso-Carrilo, J. & Sobrino, C. 2003. Vegetative and reproductive morphology of *Botryocladia botryoides*, *B. occidentalis* and *B. canariensis* sp. nov. (Rhodymeniaceae, Rhodophyta) from the Canary Islands. *Phycologia* 44:138-50.
- Børgesen, F. 1920. The marine algae of the Danish West Indies. Part 3. Rhodophyceae (6). *Dansk. Bot. Arkiv.* 3:369-498.
- Dawes, C. J. & Mathieson, A. C. 2008. *The seaweeds of Florida*. University Press of Florida., Gainesville, 592 pp.
- Gavio, B. & Fredericq S. 2003. *Botryocladia caraibicia* sp. nov. (Rhodymeniales, Rhodophyta), a new species from the Caribbean. *Cryptogam. Algal.* 24:93-106
- Guiry, M.D. & Guiry, G.M. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 22 August 2009

***Bryothamnion seaforthii* Kützing**
(Florideophyceae, Ceramiales, Rhodomelaceae)



A. Habit. B. Pinnate Branching detail Scale= 500 µm C. Polysiphonious branch detail Scale= 50 µm D. Transverse section (middle part of thallus) Scale= 350 µm E. Cortex detail transverse section Scale= 90 µm

Description: Thallus reddish, cartilaginous, slightly flattened or compressed, about 20 cm high, densely alternate to irregularly branched main axes. The branchlets are pinnately branched. Holdfast disk-like. Inner structure uniaxial, pseudoparenchymatous, with 8-9 periaxial cells and large, globose, hyaline medullary cells surrounded by a 2-cell layered cortex.

Remarks: *Bryothamnion seaforthii* resembles *Bryothamnion triquetrum* in the field, however, they differ in ramification pattern with *B. triquetrum* having three vertical rows of branchlets that create a triangular structure, easily observed in a transverse section. The lack of this character in the collected specimens led to their identification as *B. seaforthii*. This is a newly reported species from Bocas del Toro (Panamá).

Habitat: subtidal, epilithic (*Wild Cane Cay*)

Bocas del Toro Distribution: Wild Cane Cay (N 09.34673 W 082.16953)

Worldwide Distribution: *North America:* Florida, Mexico, North Carolina, *Central America:* Belize, Costa Rica, *Caribbean Islands:* Barbados, Caicos Islands, Cuba, Hispaniola Jamaica, Lesser Antilles, Puerto Rico, Trinidad & Tobago, Virgin Islands, *South America:* Brazil, Colombia, Guyana, Venezuela, *Africa:* Angola, Guinea, São Tomé & Príncipe, *South-west Asia:* Sri Lanka.

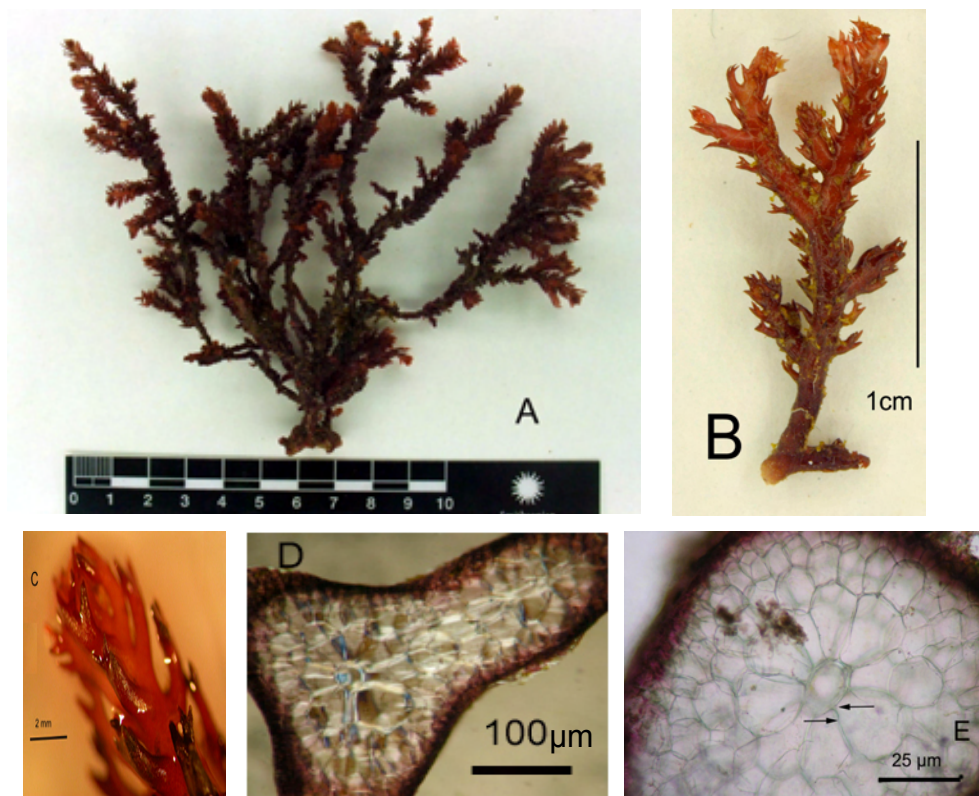
Representative Specimens: PASI09-GG-0003

References:

Chapman V. J. 1963. The Marine Algae of Jamaica. Part 2. Phaeophyceae and Rhodophyceae. Science Series No. 12 PT. 2.

Littler D & M. Littler. 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.

Bryothamnion triquetrum (S. G. Gmelin) M. Howe
(Florideophyceae, Ceramiales, Rhodomelaceae)



Bryothamnion triquetrum. (A) Thallus habit, (B) Close up of typical branch apices, (C) Branch apices, (D) Transverse section showing three-sided nature of branch, (E) Transverse section through thallus near side branch showing central axial filaments for main axes and branch (arrows).

Description: Thallus coarse and bushy, to 25 cm high. Dark brown to red. Branches numerous, irregularly alternate (A). Branchlets stiff to 3 mm long, in three vertical rows, creating triangular branches. The apices of branches incurved (B) and pointed (C). Axes polysiphonous with 7-9 pericentral cells, heavily corticated (E), and generally triangular in transverse section (D).

Remarks: Plants with main axes terete below, but with three vertical, sometimes twisted, rows of branchlets above giving the central axis a triangular shape in transverse sections. May be confused with forms of *Bryothamnion seaforthii* that have four vertical rows of branchlets.

Habitat: Found growing intertidal on jagged limestone shoreline on seaward side of small island, not in immediate "squash" zone (Fikes, PASI 2009). In protected areas and other hard surfaces, > 5 m deep (Cabrera & Peña, PASI 2009)

Bocas del Toro Distribution: Swan Key (Fikes, PASI 2008). Wild Care Cay (Cabrera & Peña, PASI 2009).

Worldwide Distribution: Atlantic Islands: Cape Verde Islands. North America: Florida, Mexico. Central America: Costa Rica, Panama. Caribbean Islands: Bahamas, Caicos Islands, Caribbean, Cuba, Jamaica, Lesser Antilles, Netherlands, Puerto Rico, Trinidad & Tobago, Virgin Islands. South America: Brazil, Colombia, Venezuela.

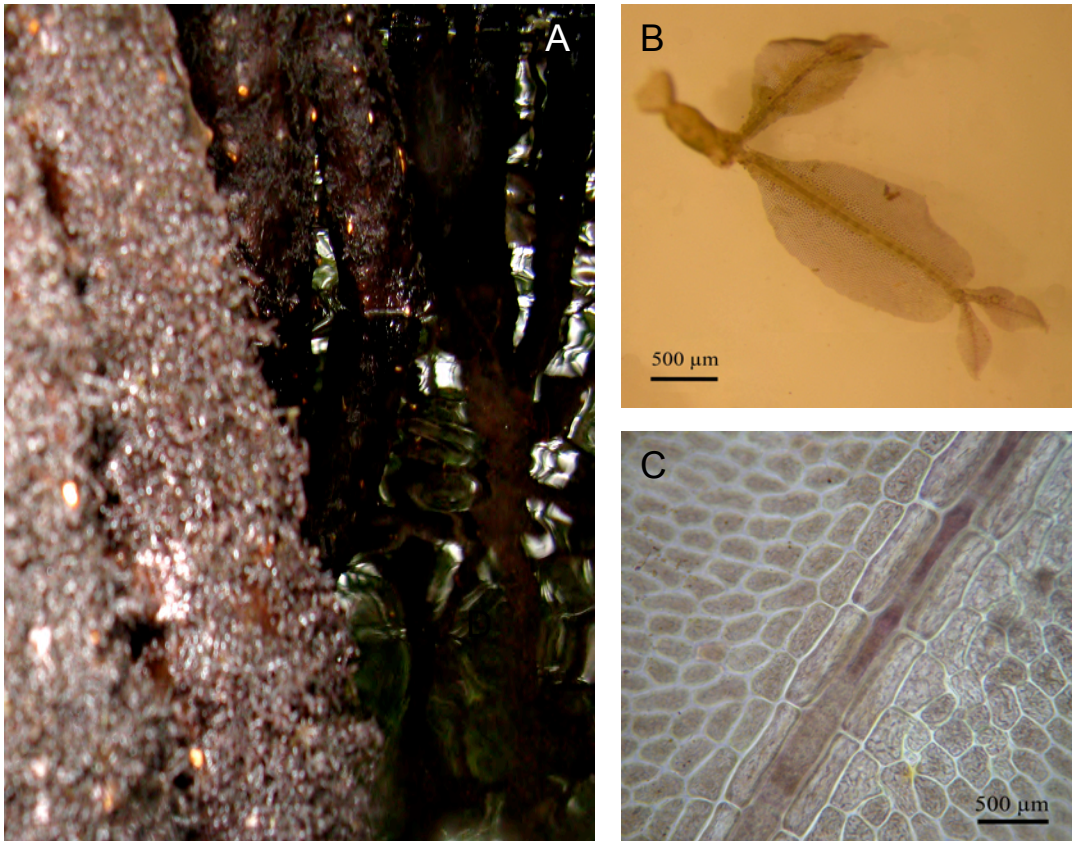
Representative Specimens: PASI09 RC- 0004.

References: Littler & Littler 2000, Littler *et al* 2008, Guiry & Guiry 2009 (accessed 18 August 2009).

Prepared by Ryan Fikes, Enrique Peña and Rubén Cabrera

Caloglossa sp.

(Florideophyceae, Ceramiales, Delesseriaceae)



A-C. Especímen PASI 09.OT- 0008. **(A).** Hábitat en el manglares. **(B)** Ramificación y constricciones en las bases de las hojitas. **(C)** Vena media con típicas células axiales alargadas, cubiertas por células corticales.

Descripción: Plantas de consistencia suave con talos foliosos que crecen postrados. Alga de color de café, violeta o rosa suave. Las hojitas son lobuladas u ovadas de 1-2 mm de ancho y 1-6 mm de largo, dicotómicas y constrictas en la base y se desarrollan a partir de una prominente célula central. Cada hojita presenta una evidente vena media, la cual esta constituida por una hilera de células axiales alargadas, rodeadas de células corticales. Laminas u hojitas monostromaticas con células sub exagonales que se expanden en series oblicuas desde la costa hasta el margen. En los ápices de las hojas se observa una característica bifurcación como una orquilla. Las hojitas secundarias se origina desde la vena media. Esta alga se adhiere al sustrato por medio de rizoides, los cuales se agrupan en la parte ventral del talo formando nodos a nivel de las bases constrictas de las hojas

Hábitat: raíces de *Rhizophora mangle*

Observaciones: Esta planta es diferente de *C. lepreurii* divulgada de la region. En las especie de Bocas las laminas estan mas constreñidas en la base que en *C. lepreurii*.

Distribución en Bocas del Toro: Manglares de la bahía, cerca de la Estación de STRI N09.35118° W 082.25697°

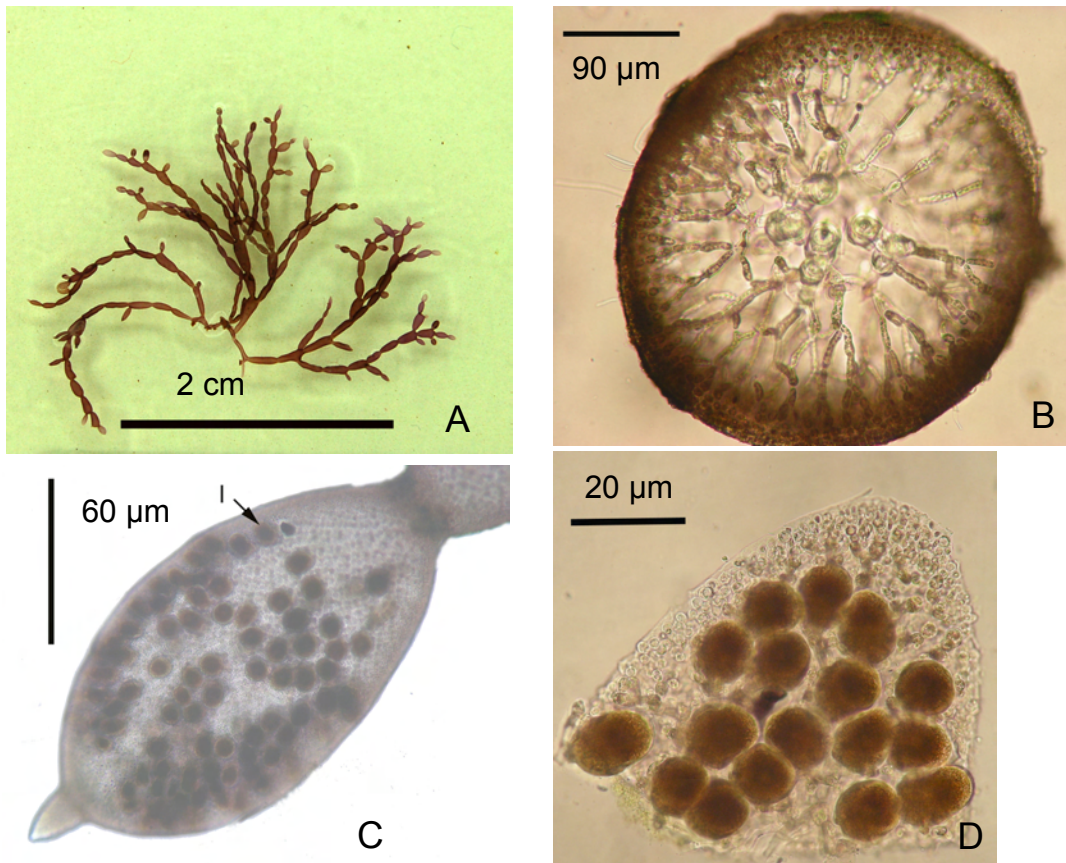
Distribución en el mundo: Islas del Atlántico, Islas del Pacifico. Norte América, México, América Central. Islas del Caribe, Sur América, África, islas del Océano Indico, Sureste de Asia, Asia, Australia y Nueva Zelanda.

Especímen representativo: PASI 09.OT-0008

Referencias: Guiry & Guiry 2009; Littler & Littler 2000; Taylor 1967

Preparado por Olga Lidia Tejada Rivas

***Catenella caespitosa* (Withering) L.M. Irvine in Parke & Dixon**
(Florideophyceae, Gigartinales, Caulacanthaceae)



A-D. Specimen PASI09 EP-0004. **(A)** Thallus habit. **(B)** Transverse section of axis showing fine medullary filaments and six pericentral cells surrounding axial cell. **(C)** Tetrasporangial branch with tetrasporangia (I). **(D)** Section through tetrasporangial sorus.

Description: Thallus small, inconspicuous, to 3-4 cm high, red-purple in color (A). Thallus uniaxial, segmented; branches primarily pseudodichotomous, attaching to mangrove roots by haptera. Segments elongated, oval or flattened, generally 3 to 5 times longer than wide, 0.3-0.5 μm diameter (A). Thallus consisting of a central axial cell filament surrounded by 5 to 6 pericentral cells that give rise to fine, thick-walled medullary filaments bearing small, spherical outer cortical cells. (B). Tetrasporangial branches bearing tetrasporangia in swollen subapical areas (C, D).

Remarks: Plants of *C. caespitosa* are generally intermixed with *Bostrychia* species and attached to mangrove roots. Taxonomic distinctions between this species and *C. impudica* are based on branchlet size and general branching pattern, the size of specialized tetrasporangial sori, and their location on terminal branch segments in *C. caespitosa*.

Habitat: On red mangrove prop roots, in depths < 1m.

Bocas del Toro Distribution: in mangrove in front of STRI Bocas Station.

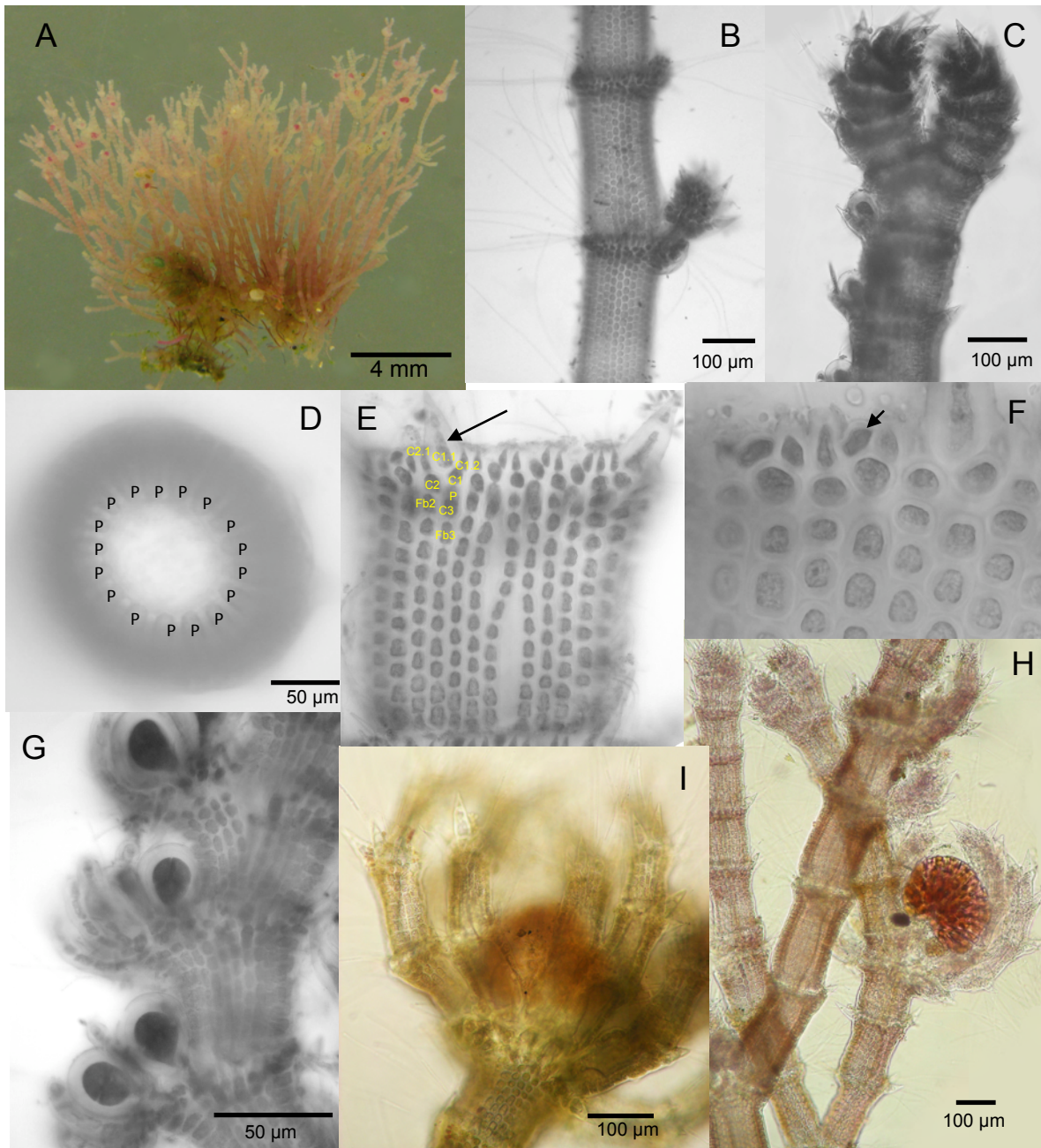
Worldwide Distribution: Europe: Atlantic Islands: North and South America.

Representative Specimens: PASI09 EP-0004.

References: Littler, D. S. & Littler, M. M. 2000; Guiry, M. C & Guiry, G. M. 2009. (accessed 19 August 2009).

Centroceras gasparrinii Kützing

(Florideophyceae, Ceramiales, Ceramiaceae)



A-H: Specimen PASI09.LQY-0005. **(A)** Habit of carposporophytic specimens. **(B)** Axis showing adventitious branch at node; fine hair-like extensions are also formed at the nodes. **(C)** Forcipulate apices, spines, and tetrasporangial structures at node. **(D)** Cross section through node showing 17 periaxial cells connected to axial cell. **(E)** Complete cortication showing three-celled spines (arrows). **(F)** Close-up showing ovoid gland cell (arrowhead). **(G)** Involute tetrasporangial structures. **(H)** Carposporophyte surrounded by involucre branchlets at node. **(I)** Close-up showing spiniferous involucre branches (arrows) surrounding carposporophyte.

Description: Female gametophyte thallus reddish, 1.0 to 3.5 cm high, filiform, erect, consisting of nodal and internodal segments, completely corticated. Main axes with alternate branching pattern, dichotomous at the middle-apical portion; trichotomous and tetrachotomous branching is common throughout the thallus, as are adventitious branches. Internodes 100–165 μm wide and 100–400 μm long. Apices forcipate. Cortication at node consisting of 17 periaxial cells, each cutting off three cortical initials. The first cortical initial cuts off two cortical cells, or a spine and a cortical cell, or a cortical cell and an ovoid gland cell. The second cortical initial cuts off a cortical cell acropetally and a cortical filament basipetally. The third cortical initial cuts off a basipetal filament. All the basipetal filaments contribute to the complete cortication of the internodes. Tetrasporangia tetrahedrally divided, positioned laterally or whorled at the distal to middle portions of thallus, covered by uniseriate involucrel branches. Carposporophytes globose, surrounded by several involucrel branches that also bear spines.

Remarks: The cortication pattern and the presence of involucrel branches surrounding the tetrasporangia are the main diagnostic features that led to the determination of this species. This is the first record of the carposporophytic stage in the species, indicating that the thalli in this reproductive phase are significantly smaller than in the other stages collected in the field.

Habitat: Growing epiphytically on *Laurencia*.

Bocas del Toro Distribution: Mimbi Timbi, Isla Colón (N 09.44106, W 82.27836)

Worldwide Distribution: North America (Florida), Bocas del Toro, Panama

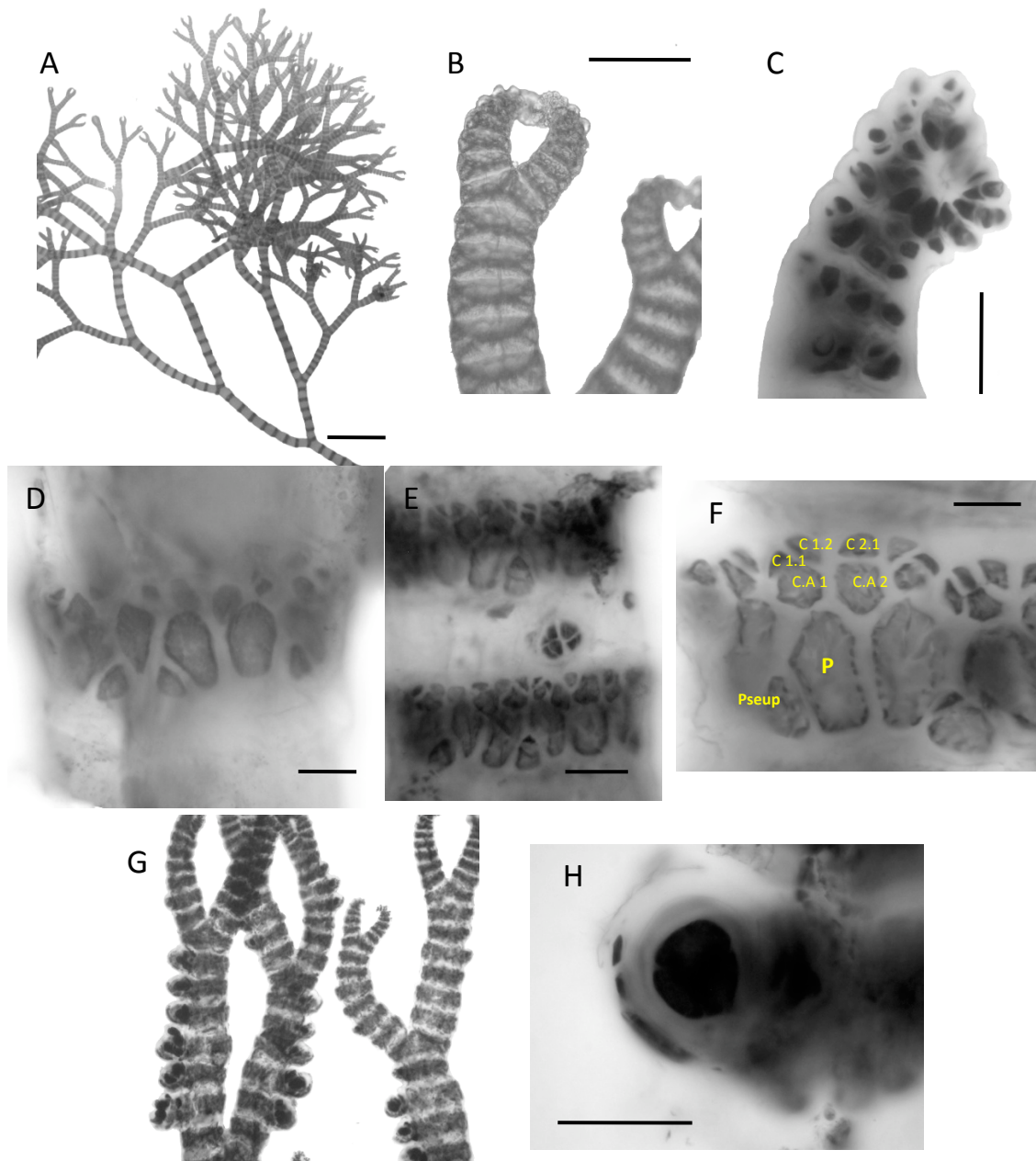
Representative Specimens: PASI09.LQY-0005 (preserved for herbarium material, formalin)

References:

Guiry, M.D. & G.M. Guiry. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>: accessed on 19 August 2009.

Won, B.Y., T.O. Cho & S. Fredericq. 2009. Morphological and molecular characterization of species of the genus *Centroceras* (Ceramiaceae, Ceramiales), including two new species. *J. Phycol.* 45: 1-24.

Ceramium brevizonatum var. *caraibicum* H.E. Petersen & Børgesen
 (Florideophyceae, Ceramiales, Ceramiaceae)



A. Habit of tetrasporophyte showing the pseudodichotomous branching pattern. Scale= 1 mm **B.** Forcipate apex. Scale= 115 μ m. **C.** Nodal cortication. Scale= 70 μ m. **D.** Cortication pattern detail at node in middle part of thallus branch. Scale= 20 μ m. **E.** Node with tetrasporangia **F.** Close-up of lateral position at node of tetrahedrally divided tetraspores in tetrasporangium. Scale= 70 μ m.

Description: Thallus about 3 cm high, filiform, erect, consisting of nodal and internodal segments, repeatedly pseudo-dichotomous branching pattern at 6-10 node intervals. Nodes 165 – 185 μm wide and 67.5 – 75 μm long. Internodal spaces tight, about 12.5 – 52.5 long (middle and apical portion). Apices forcipate to strongly enrolled. Cortication at node consisting of periaxial cells that each cut off one pseudo-periaxial cell laterally and two filaments in an acropetal direction. The first and second cortical initials each bearing two cortical cells acropetally. Tetrasporangia globose, tetrahedrally divided, positioned adaxially and laterally at the distal to middle portions of thallus, one or two per node, partially covered by cortical cells, 50 – 57.5 μm wide.

Remarks: Size, branching and cortication pattern, and presence of pseudoperiaxial cells led to the determination of this Bocas taxon as *Ceramium brevizonatum* var. *Caraibicum*. This specimen conforms to the description of Barros-Barreto et al. (2006) who showed that this species is commonly confused with *Ceramium tenerrimum*; however, the absence of triangular basipetal cells in older nodes and the presence of 1-2 rows of cortical cells at the nodes is a unique combination of characters that identify it as *C. brevizonatum* var. *caraibicum*. This is a new record for Bocas del Toro (Panamá)

Habitat: Epiphytic on *Bryothamnion seaforthii* (Wild Cane Cay)

Bocas del Toro Distribution: Wild Cane Cay (N 09.34673 W 082.16953)

Worldwide Distribution: *Atlantic Islands:* Bermuda, *North America:* Florida; Mexico, *Central America:* Belize, *Caribbean Islands:* Barbados, Caribbean, Cuba, Dominican Republic, Hispaniola, Lesser Antilles, *South America:* Brazil, Venezuela, *Africa:* Tanzania, *Indian Ocean Islands:* Seychelles

Representative Specimens: PASI09-GG-0004 (unique specimen)

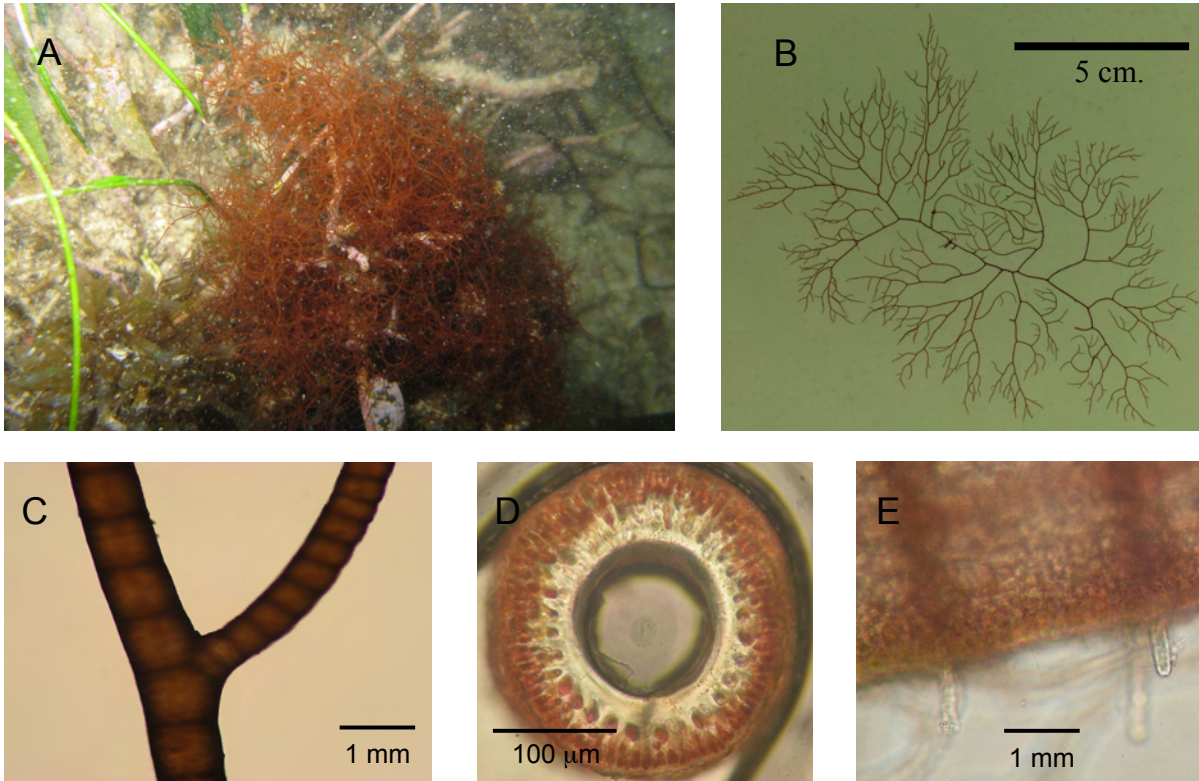
References:

Barros-Barreto M., McIvor L., Maggs C. & P. Gómez. 2006. Molecular systematics of *Ceramium* and *Centroceras* (Ceramiaceae, Rhodophyta) from Brazil. *J. Phycol.* 42, 905–921.

Guiry & Guiry. 2009. AlgaeBase. World Wide Web electronic publication. www.algaebase.com (August 18 2009)

Ceramium nitens (C. Agardh) J. Agardh 1851

(Florideophyceae, Ceramiales, Ceramiaceae)



(A) Specimen growing epiphytically on *Sargassum* sp. at Wild Cane Cay, Bocas del Toro, Panama (~3 ft); (B) Habit of pressed herbarium sample (BdT09-CA004); (C) Micrograph of primary axial branching pattern under dissecting scope. (D) Transverse section of primary lateral, central filament cell clearly visible surrounded by corticating cells; (E) Surface hairs present along main axis.

Description: Thallus bright red to orange, forming small tufts often found growing epiphytically on other macroalgae (A). Branching is dichotomous to alternate with apices often branching unilaterally and several laterals growing off primary axis (B). Large axial cell present surrounded completely by corticating cells (D). Straight projecting surface hairs, up to 1 mm, present at some joints while absent at others (E).

Remarks: Although morphologically similar, can be distinguished from other species in the family Ceramiaceae by its acute apices (not pincer like) and presence of projecting surface hairs.

Habitat: Common on rubble or growing epiphytically on other macroalgae; to 10 m deep.

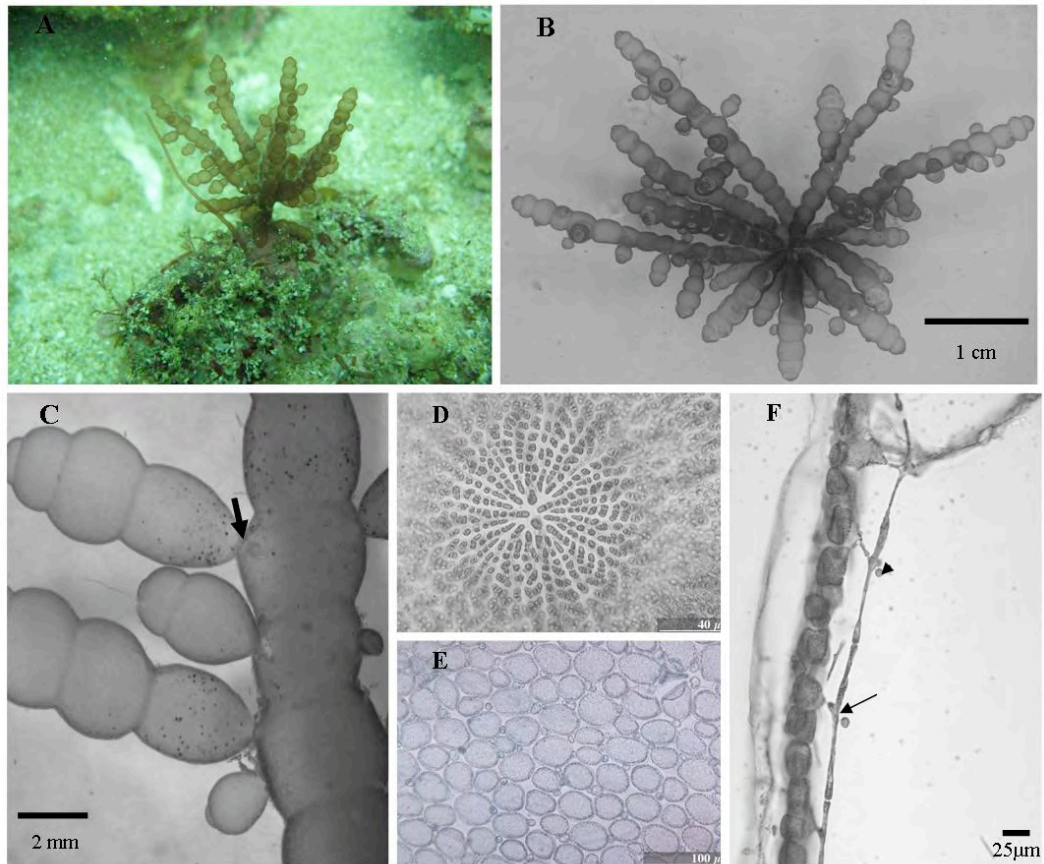
Bocas del Toro Distribution: Samples found south of North Rock off of Carenero.

Worldwide Distribution: Genus widely distributed along most coasts, commonly occurring in intertidal, shallow subtidal, and deep waters under a variety of environmental conditions.

Representative Specimens: BdT09-CA004

References: Guiry, M.D. & Guiry, G.M. 2009 *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 18 August 2009; Littler, D.S. & M.M. Littler. 2000. *Caribbean reef plants: an identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico*. Offshore Graphics: Washington, D.C. pp. 150.; Littler, D.S., Littler M.M. & M.D. Hanisak. 2008. *Submersed plants of the Indian River lagoon: a floristic inventory & field guide*. Offshore Graphics: Washington, D.C. pp. 49.

***Champia salicornioides* Harvey** (Florideophyceae, Rhodymeniales, Champiaceae)

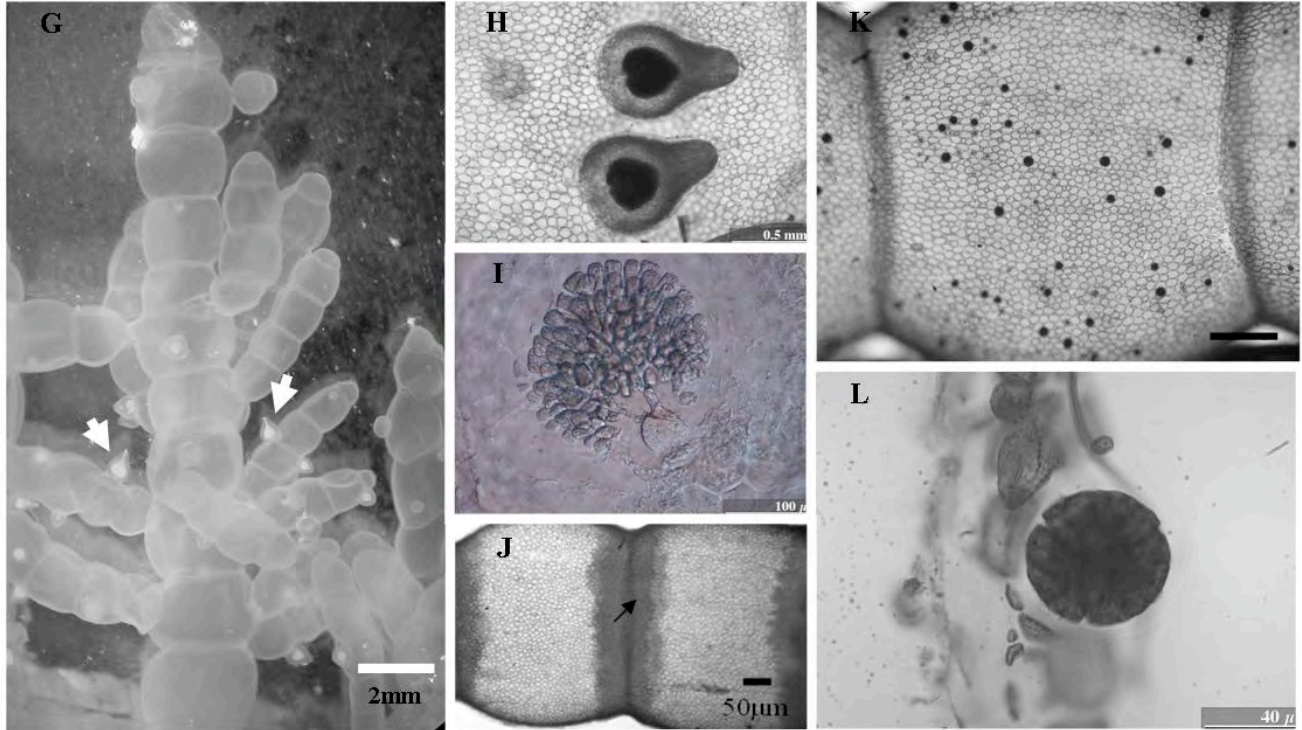


A-F: Various specimens. **(A)** Habit of specimen in the field (#8-16-09-1-5). **(B)** Habit of vegetative thallus (#8-17-09-1-1). **(C)** Tetrasporic thallus with branching point (arrow) originating at the internode. (#8-17-09-1-1). **(D)** Surface view of apex showing converging apical cells (#7-15-07-1-7). **(E)** Surface view of cortex (# -15-07-1-7). **(F)** Longitudinal section showing cells of longitudinal filament connected to (arrow) cortical cells, bearing gland cells (arrowhead) (#7-15-07-1-7).

Description: Plants light pink to honey brown, erect, up to 6 cm in height (A-B). One to six axes arising from discoid holdfast. Axis and branches terete, 2 to 3 mm in diameter. Branching irregular to whorled, occurring exclusively at the internodes (C). Apex of axes and branches rounded with up to 26 apical cells (D). Cortex composed of single layer of large, round to oblong cells, 30 to 85 μm in diameter (E), and covered in a layer of mucilage 45 μm thick (F). Medulla hollow, filled with a thick mucilage and lined with longitudinal filaments, 12.5–(17.5)–22.5 μm in diameter. Longitudinal filaments cutting off one or two spherical gland cells inwards, 10–20 μm diam. Gametophytes dioecious. Female gametophytes giving rise to ostiolate conical cystocarps, 600–850 μm wide, borne on internodal regions of branches and main axes (G-H). Carposporangia ovoid-rectangular to triangular (I). Spermatangia developing on upper two-thirds of thallus in a cortical band around the nodal region (J). Tetrahedrally divided tetrasporangia, 60–(90) μm in diameter, developing from cortical cells thallus inward (K).

Remarks: Plants are consistent with the description of Ballantine & Lozada-Troche (2008), and Dawes & Mathieson (2008). *Champia salicornioides* can be differentiated from co-occurring *Champia* by the number of apical cells. In the former, there are more than 20 apical cells, and branching occurs at the internodal region. One male gametophyte was collected in late August 2009 while two female gametophyte were collected in July 2008.

***Champia salicornioides* Harvey**
(Florideophyceae, Rhodymeniales, Champiaceae)



G-L: Specimen #7-15-07-1-7. **(G)** Conical cystocarps (arrows) on female gametophyte. **(H)** Pair of mature cystocarps with ostiole (arrows). **(I)** Cross section through young cystocarp. **(J)** Surface view of spermatangial band at node (arrow). **(K)** Surface view of tetrasporangia scattered along internode. **(L)** Cross section showing tetrahedrally divided tetrasporangia.

Habitat: Epilithic in waters up to 6 meters depth

Bocas del Toro Distribution: Wild Cane Key and Mimbi Timbi, Isla Colón

Worldwide Distribution: Reported from Bermuda, Caribbean Sea, Brazil, Colombia, Ghana, Senegal, Maldives, Seychelles, Pakistan, Indonesia, Philippines, Vietnam

Representative Specimens: #8-16-08-1-5, #8-17-09-1-1, and #7-15-07-1-7

References

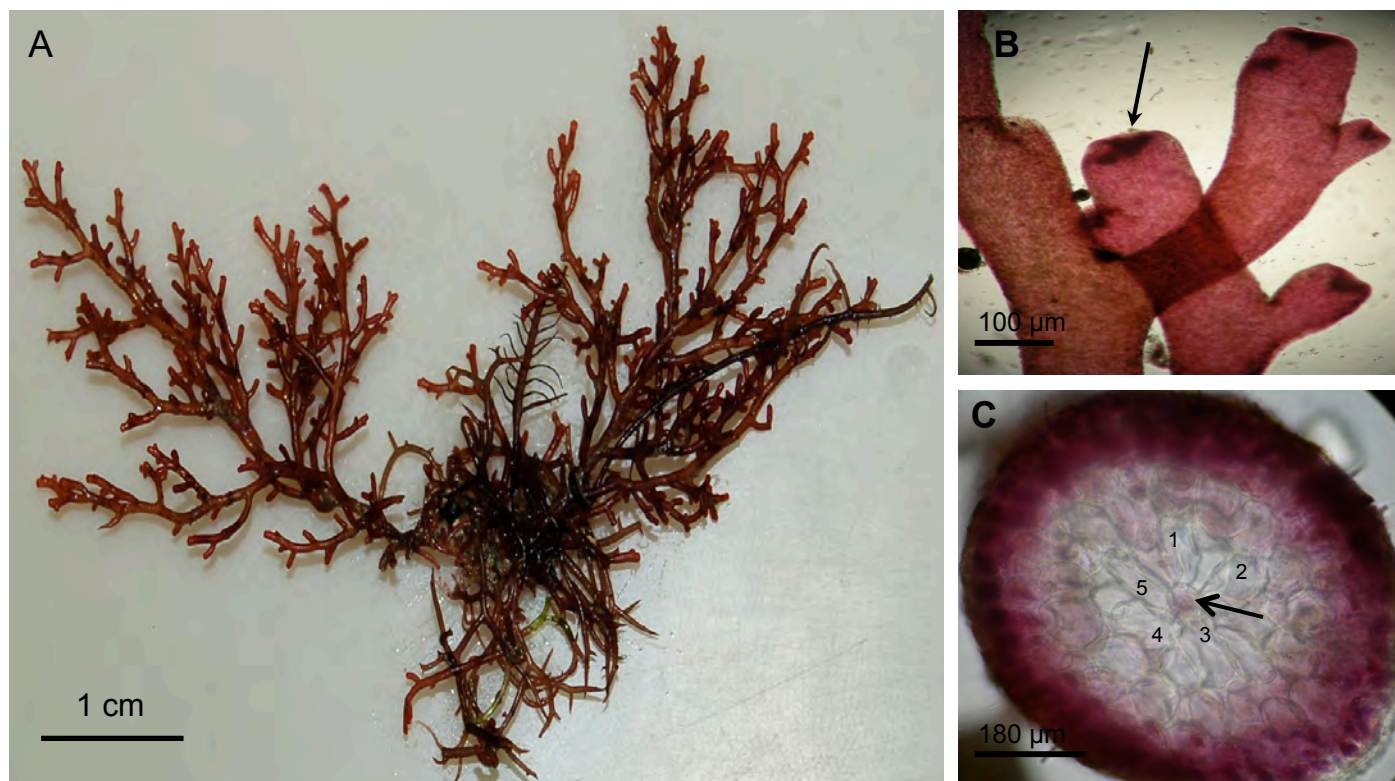
Ballantine, D. L. & Lozada-Troche C. 2008. *Champia harveyana* sp. nov. (Champiaceae, Rhodophyta) from Puerto Rico, Caribbean Sea. *Bot. Mar.* 51: 388-98

Dawes, C. J. & Mathieson, A. C. 2008 *The seaweeds of Florida*. University Press of Florida., Gainesville, 592 pp.

Guiry, M.D. & Guiry, G.M. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 22 August 2009.

Chondria floridana (F.S. Collins) M. A. Howe

(Florideophyceae, Ceramiales, Rhodomelaceae)



A-C: PASI09.RKEP.003. **(A)** Habit of vegetative herbarium specimen. **(B)** Apical pits (arrow) terminating the branchlets. **(C)** Cross section through main axis showing central axial cell surrounded by 5 pericentral cells.

Description: Thallus bushy, to 20 cm high, pink to yellow-red, often epiphytized (A). Branching alternate, coarse, consisting of cylindrical branches 0.5-3.0 mm in diameter, each bearing alternate branchlets 5-10 mm long or longer, not constricted at base. Apical cells within sunken depressions terminating branches, not exposed (B). Central axial cell surrounded by 5-6 pericentral cells (C). Holdfast disc-like, inconspicuous. Tetrasporangia spherical, tetrahedrally divided.

Remarks: The Bocas specimen was of a deeper red color than reported by Littler & Littler (2000).

Habitat: Found on a small rocks in shallow sandy bottom (< 2 m).

Bocas del Toro Distribution: Wild Cane Cay

Worldwide Distribution: North America (Florida, North Carolina), Caribbean Islands (Caribbean, Cuba, Jamaica, Lesser Antilles, Trinidad, Tobago), South America (Brazil, Venezuela).

Representative Specimens: PASI09.RKEP.003

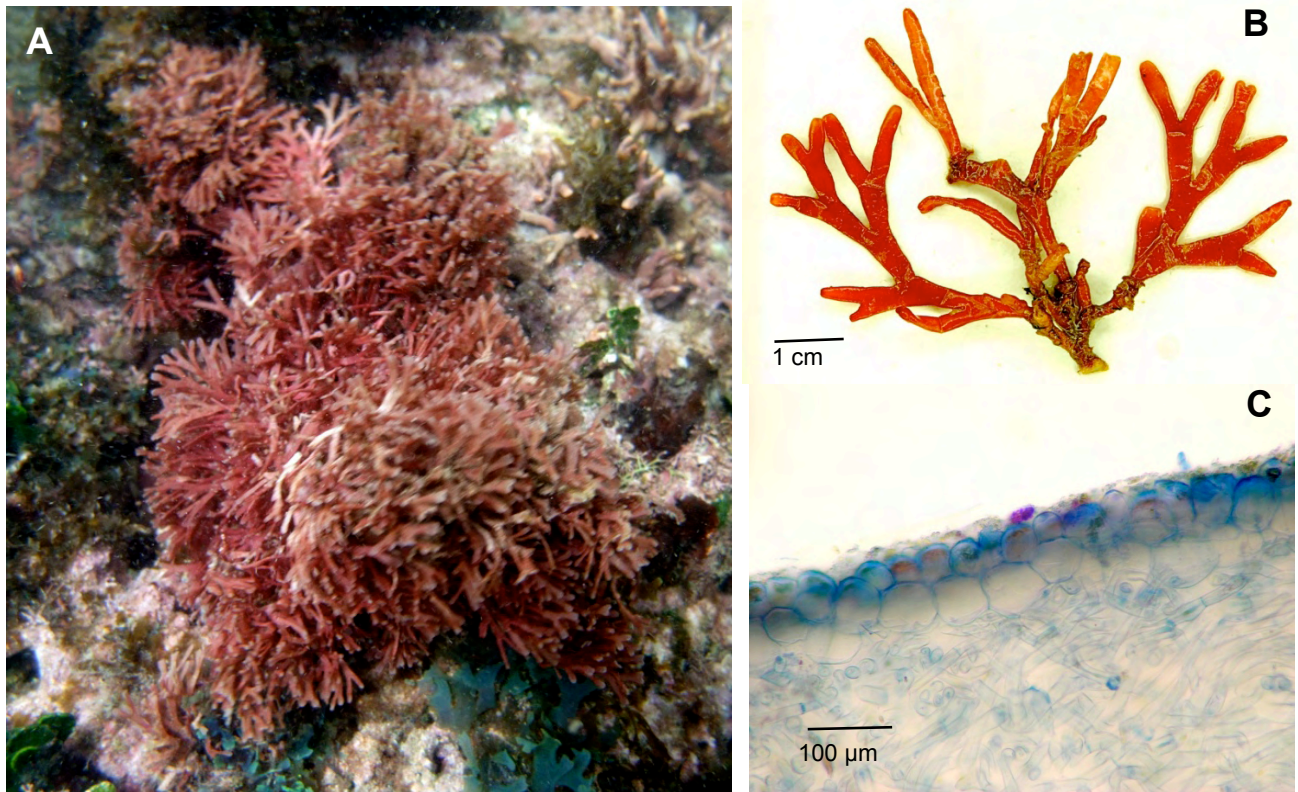
References:

Littler, D.S. & M. M. Littler (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.

Mendoza-Gonzalez, C. A., Mateo-Cid, L. E., and Searles, R. B. 2007. Yucatan seaweeds from offshore waters of Isla Mujeres, Quintana Roo, Mexico. *Botanica Marina*. Vol. 50: 280-287.

Dichotomaria marginata (Ellis & Solander) Lamarck

(Florideophyceae, Nemaliales, Galaxauraceae)



A-C: Specimen PASI09-AP0004. **(A)** *In situ* habit of dark-pink thalli, attached to rocky substratum. **(B)** Discoid holdfast bearing slightly calcified pseudodichotomously branched thallus. **(C)** Transverse section through branch showing filiform medullary filaments and 2-3 cortical cell layers.

Description: Thallus bushy, clumped, hemispherical, 5-20 cm high, cream-red; branching pseudodichotomous, lightly calcified, with faint cross banding pattern that becomes more obvious when dried. Branches 1.0-3.0 cm wide x 300-500 μm thick, flat, smooth. Medullary filaments 10-15 μm in diameter, sparse, intermixed with gelatinous mucilage. Cortex 2-3 cell layers thick; innermost cells 25-65 μm x 50-100 μm , lightly pigmented.

Remarks: Comparative molecular evidence, presence of an isomorphic alternation of generations and of a pericarp in the cystocarp, suggest that *Galaxaura marginata* belongs in the genus *Dichotomaria* (Wang et al., 2005).

Habitat: on shallow coral reefs, attached on coral rock

Bocas del Toro Distribution: Wide Cane Cay, Flat Rock Beach

Worldwide Distribution: Atlantic Islands, North America, Central America, Caribbean Islands, South America, Africa, Indian Ocean Islands, South-west Asia, Asia, South-east Asia, Australia and New Zealand, Pacific Islands.

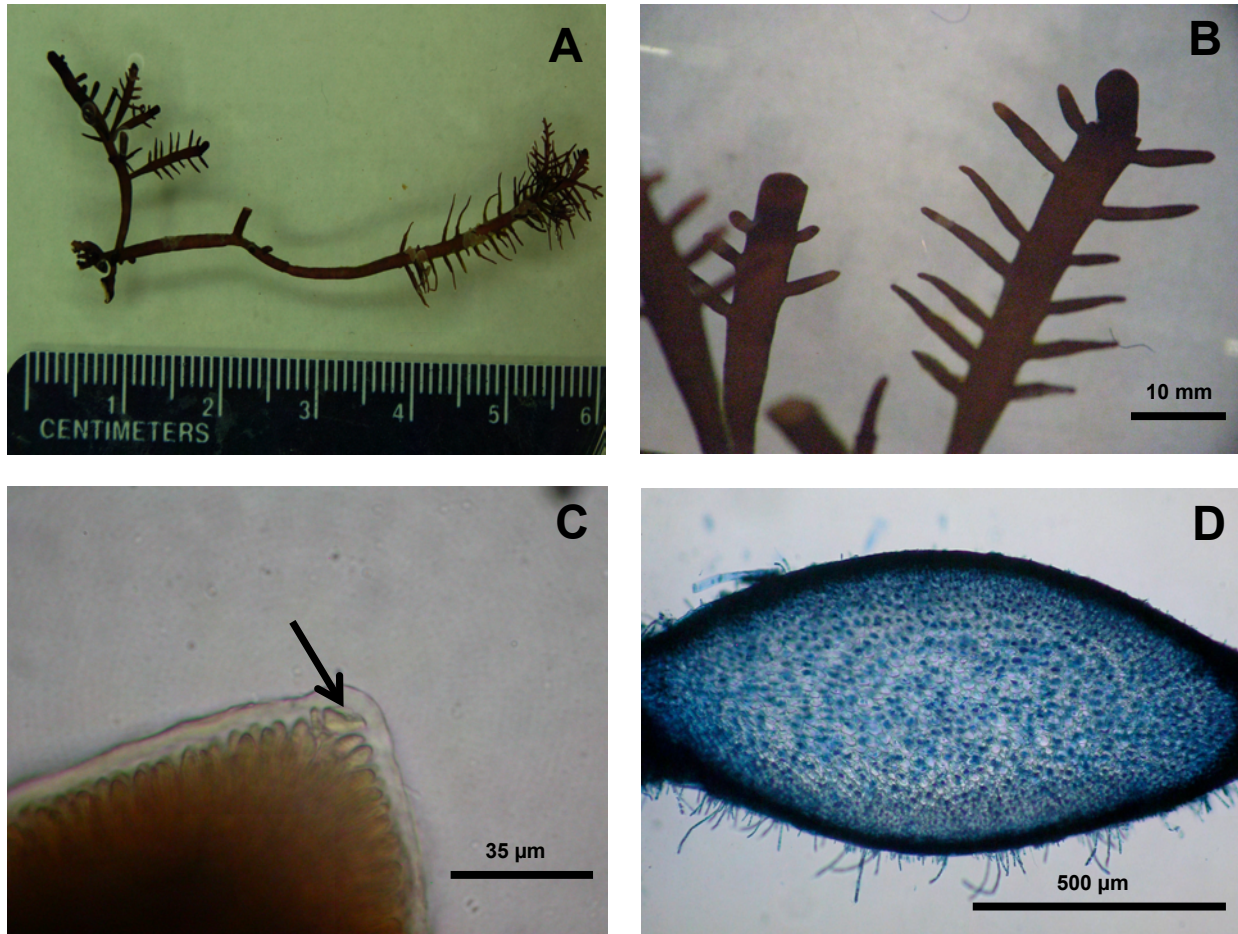
Representative Specimens: PASI09-AP0004

References

- Huisman, J.M., Harper, J.T. & Saunders, G.W. 2004. Phylogenetic study of the Nemaliales (Rhodophyta) based on large-subunit ribosomal DNA sequences supports segregation of the Sciniaceae *fam. nov.* and resurrection of *Dichotomaria* Lamarck. *Phycol. Res.* 52:224-234.
- Littler, D.S. & Littler, M.M. 2000. *Caribbean reef plants. An identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico.* Pp. 542. Washington: Offshore Graphics.
- Dawes, C.J. & Mathieson, A.C. 2008. *The seaweeds of Florida.* Gainesville, Florida. Pp. 591. University Press of Florida.
- Guiry, M.D. & Guiry, G.M. 2009. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; accessed on 18 August 2009.
- Wang, W-L., Liu, S.I. & Lin S.M. 2005. Systematics of the calcified genera of the Galaxauraceae (Nemaliales, Rhodophyta) with an emphasis on Taiwan species. *J. Phycol.* 41:685-708

Gelidiella acerosa (Forsskål) Feldmann & Hamel

(Florideophyceae, Gelidiales, Gelidiellaceae)



A-D. Specimen PASI09-HA001. **(A)** Pinnately branched herbarium specimen borne on fibrous holdfast. **(B)** Irregular-opposite pinnate side branches and main axes. **(C)** Apical cell (arrow) of side branch. **(D)** Cross section through main branch showing regularly-sized medullary cells and lack of rhizines.

Description: Thallus erect, about 6 cm tall, with cylindrical to compressed axes and stolons bearing simple rhizoids. Branches pinnately arranged in an alternate to opposite pattern, terminating in a single apical cell. Medullary cells are smaller toward the surface.

Remarks: The specimen is consistent with descriptions found in the literature, as it is a relatively easy alga to identify.

Habitat: Shallow subtidal

Bocas del Toro Distribution: Wild Cane Cay

Worldwide Distribution: South America, Pacific Islands, Europe, Atlantic islands, North America, Central America, Caribbean Islands, Africa, Indian ocean Islands, South-west Asia, South-east Asia, Australia and New Zealand, Pacific Islands.

Representative Specimens: PASI09-HA001

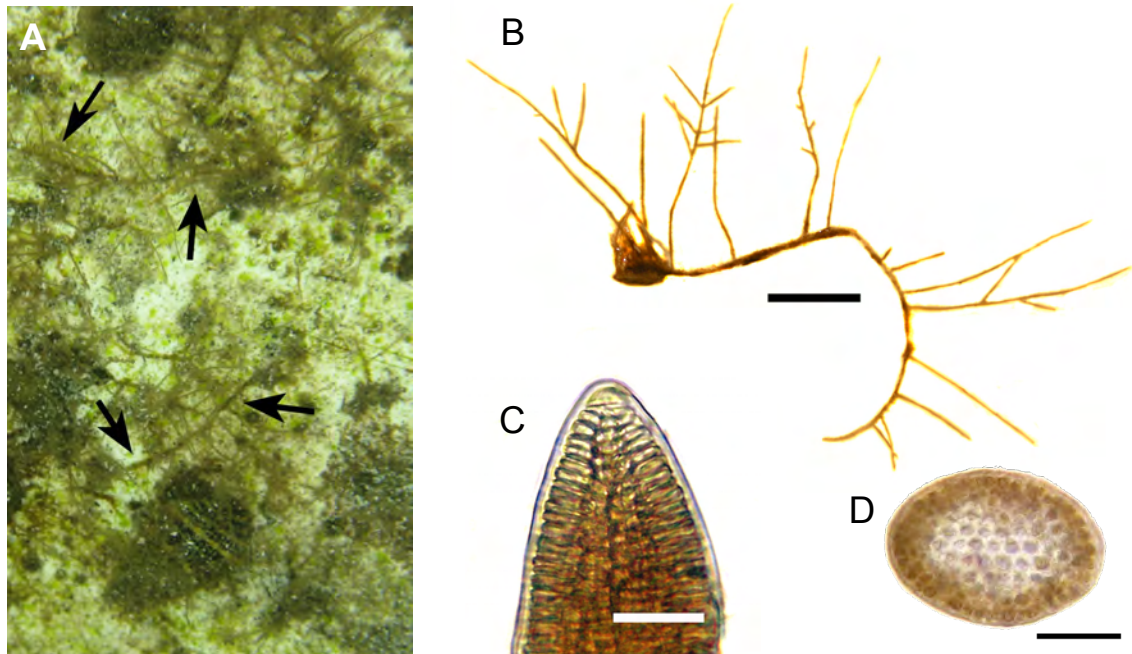
References: Lin, S.-M. & Freshwater, D.W. 2008. The red algal genus *Gelidiella* (Gelidiales, Rhodophyta) from Taiwan, including *Gelidiella fanii* sp. nov. *Phycologia* 47: 168-176.

Littler D.S. & Littler M.M. 2000. *Caribbean reef plants*. Offshore Graphics, Washington, DC

Guiry, M.D. & Guiry, G.M. 2007. Worldwide electronic publication, National University of Ireland, Galway. Available at: <http://www.algaebase.org>, accessed august 2009.

***Gelidiella trinitatensis* W.R. Taylor**

(Florideophyceae, Gelidiales, Gelidiellaceae)



A-D. Specimen PASI09.CN-0002. **(A)** Habit of specimens (arrows) in the field. **(B)** Habit of herbarium specimen. **(C)** Branch apex showing a single apical cell. **(D)** Transverse section through main branch. Scale bar: (B) 5 mm, (C-D) 50 μm . Photos: N. Cetz-Navarro.

Description: Thallus erect, delicate, soft, pale to brown, ~1 cm high, forming filamentous turfs, growing from creeping stolon bearing few rhizoids. Branches slender, firm, cylindrical to slightly flattened, ~125 μm in diameter. A single, lenticular apical cell at tip of each branch. Branching distichous or alternate. Cells in surface view rounded to irregular polyhedral, measuring ~5 μm in diameter. In transverse sections, medullary cells are colorless, ~10 μm in diameter, and cortical cell layers are pigmented, ~8 μm in diameter. Reproductive structures absent.

Remarks: The branch diameter in the Bocas specimen was larger (>120 μm) than reported for the species in Littler & Littler (2000).

Habitat: Growing on PVC tube of sewage outlet, to 1.5 m depth.

Bocas del Toro Distribution: Bocas Research Station, Colon Island, Panama; N 09.35118, W 082.25697

Worldwide Distribution: Reported from Central America, Caribbean Islands and South America.

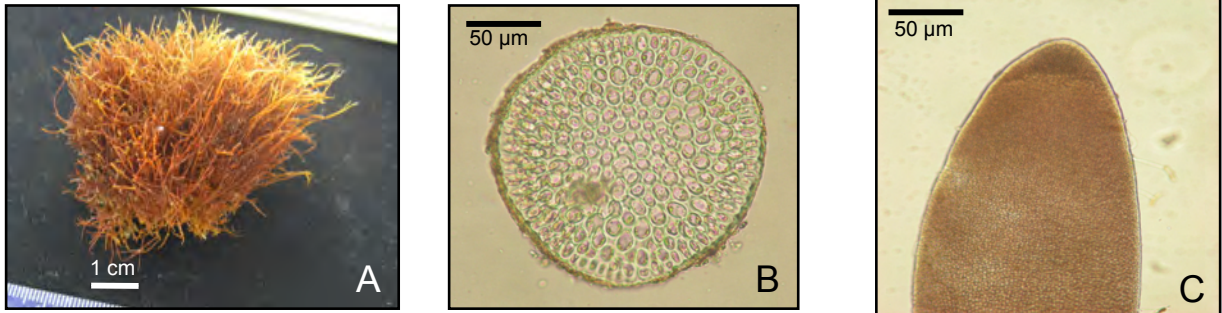
Representative Specimens: PASI09.CN-0002.

References

- Littler D.S. & M.M. Littler. 2000. *Caribbean reef plants: an identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico*. Off Shore Graphics, Washington. 542 pp.
- Guiry M.D. & G.M. Guiry. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; accessed 21 August 2009.

***Gelidiopsis variabilis* (J. Agardh) Schmitz**

(Florideophyceae, Rhodymeniales, Lomentariaceae)



A-C: Specimen PASI09.DM-004. **(A)** Clump of vegetative thalli. **(B)** Cross section through main branch showing cellular medulla. **(C)** Surface view of apical region

Description: Thalli erect, about 4 cm high, composed of a few, irregularly branched cylindrical branches (A). Thallus diameter reaching up to 180 µm in cross section, medullary cells measuring up to 14 µm (B). Apices blunt, rounded, showing multi-axial organization. Surface cells up to 12 µm diam. (C).

Remarks: *G. variabilis* is the type of *Gelidiopsis*, a genus of four accepted species in the Caribbean region. The main difference between the species is based on whether the apex is cylindrical or compressed.

Habitat: Found in the intertidal to 2 m depth.

Bocas del Toro Distribution: Hospital Bight–2 (N 09.33305 / W82.19992)

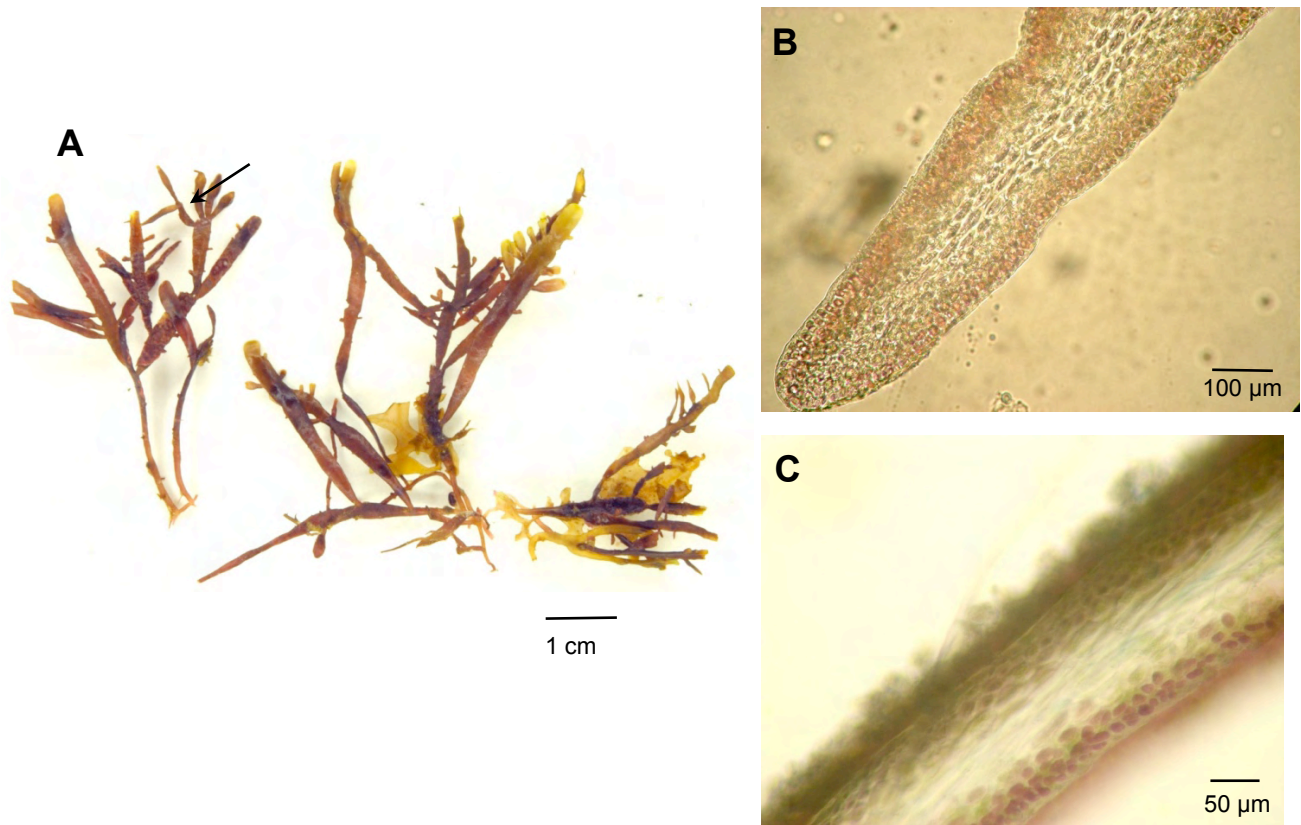
Worldwide Distribution: Reported from *South America:* Brazil, Colombia, Venezuela; *North America:* Gulf of California, Mexico; *Central America:* Belize; *Caribbean Islands:* Lesser Antilles, Trinidad & Tobago; *Africa:* Angola, Cameroon, Côte d'Ivoire, Equatorial Guinea, Eritrea, Gambia, Ghana, Guinea, Kenya, Liberia, Madagascar, Mauritania, Mauritius, São Tomé & Príncipe, Senegal, Sierra Leone, South Africa, Tanzania; *Indian Ocean Islands:* Diego Garcia Atoll, Laccadive Islands, Seychelles; *South-west Asia:* India, Sri Lanka; *Asia:* Korea, Japan; *South-east Asia:* Indonesia, Philippines, Vietnam; *Australia and New Zealand.* *Pacific Islands:* Easter Island, Federated States of Micronesia, Fiji, Hawaiian Islands, Solomon Isls.

Representative Specimens: PASI09.DM-0004

References:

- Littler D.S. & Littler M.M. 2000. *Caribbean reef plants of the Caribbean Bahamas, Florida and Gulf of Mexico*. OffShore Graphics, Inc. Washington D.C.
- M.D. Guiry & G.M. Guiry. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 22 August 2009.

***Gelidium cf. americanum* (Ellis & Solander) Lamarck**
(Florideophyceae, Gelidiales, Gelidiaceae)



A-C. Specimen: PASI09-AP0005. **(A)** Habit of herbarium specimen showing tetrasporangial branchlets (arrow). **(B)** Transverse section through main branch showing cellular medulla and pigmented cortex. **(C)** Longitudinal section showing elongated medullary cells and 2-3 cortical cell layers.

Description: Thallus tough, erect, up to 5 cm high, red brown. Main axes short, branching irregular, sparse, alternate, pinnate, or palmate. Blades 1.0-3.0 mm wide, compressed to strap-shaped terminating in a single apical cell. Tetrasporangia ovoid, originating close to tip. Medullary cells elongated, 5-10 μm diameter. Cortex 2-3 layers of pigmented, ovoid cells, 5-8 μm in diameter.

Remarks: This species is a turf-forming alga that traps sediment providing habitat and shelter to other marine organisms

Habitat: Growing in shallow subtidal coral reefs associated with *Dictyota*.

Bocas del Toro Distribution: Wide Cane Cay

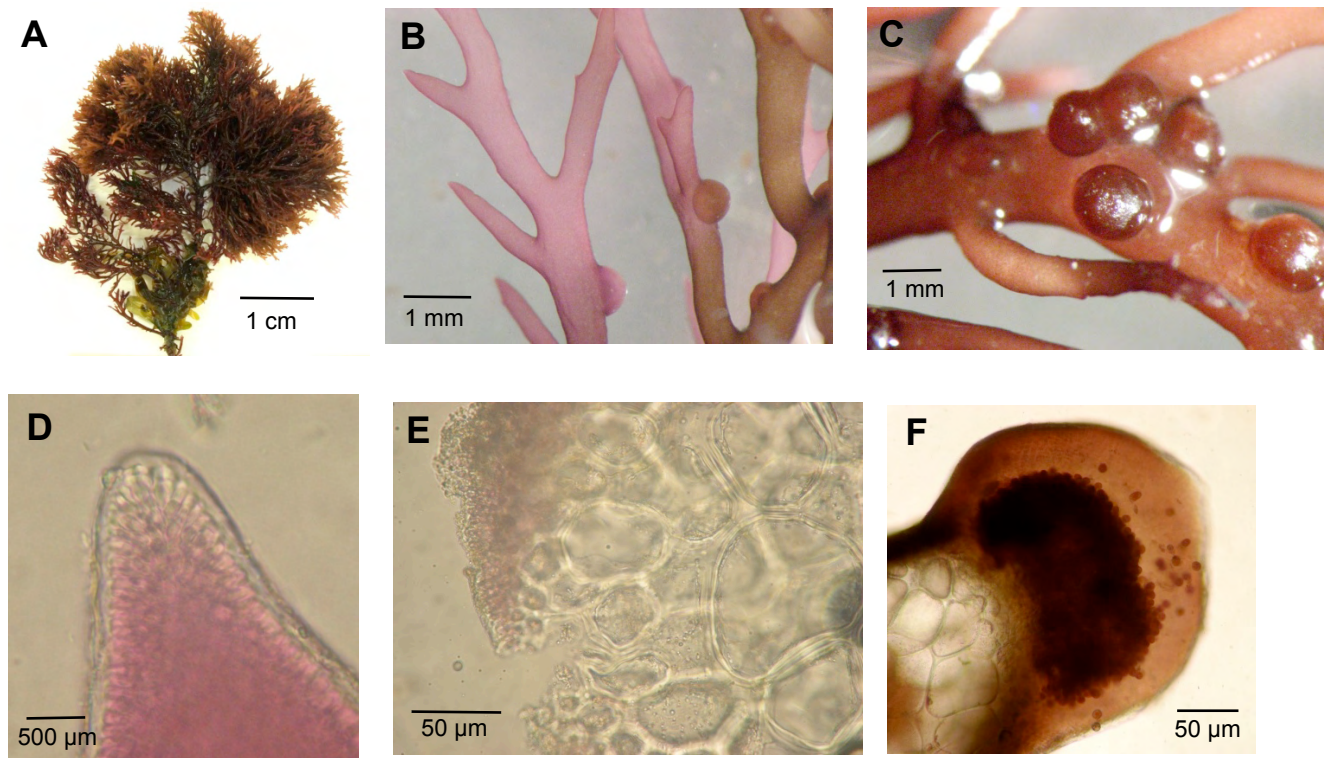
Worldwide Distribution: North America, Central America, Caribbean Islands, South America

Representative Specimens: PASI09-AP0005

References

Dawes, C.J. & Mathieson, A.C. 2008. *The seaweeds of Florida*. Gainesville, Florida. pp. 591. University Press of Florida.
Giry, M.D. & Giry, G.M. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 18 August 2009.

***Gracilaria apiculata* P. et H. Crouan**
(Florideophyceae, Gracilariales, Gracilariaceae)



A-F. Specimens PASI09-AP0006, PASI09-SA007 **(A)** Habit of specimen. **(B)** Reproductive branch with cystocarps. **(C)** Close up of cystocarps. **(D)** Apical region of branchlet. **(E)** Transverse section of branch showing cortex and medulla of large rounded cells. **(F)** Transverse section through mature cystocarp showing mass of carposporangia.

Description: Thallus 10 cm tall, bushy, dark red; main axis flattened to compressed, cylindrical towards base, and attached by discoid holdfast. Branching mostly alternate, occasionally irregular. Branchlet tips acute and pink. Medulla composed of large, overlapping isodiametric cells, 55-150 µm broad, cortex of 2-3 cell layers. Cystocarps hemispherical to spherical, constricted at base, scattered throughout thallus.

Remarks: This is the first report of *Gracilaria apiculata* in Panama. This species may be confused with the common species *Gracilaria cervicornis*. Reproductive thalli were found close to the shore growing on rock, and vegetative thalli were growing at 3 m on rock in the coral reef.

Habitat: High wave action, shallow coral reef and in the low intertidal on hard substratum.

Bocas del Toro Distribution: Mimbi Timbi, Isla Colon.

Worldwide Distribution: Mexico and Venezuela

Representative Specimens: PASI09-AP0006, PASI09-SA007

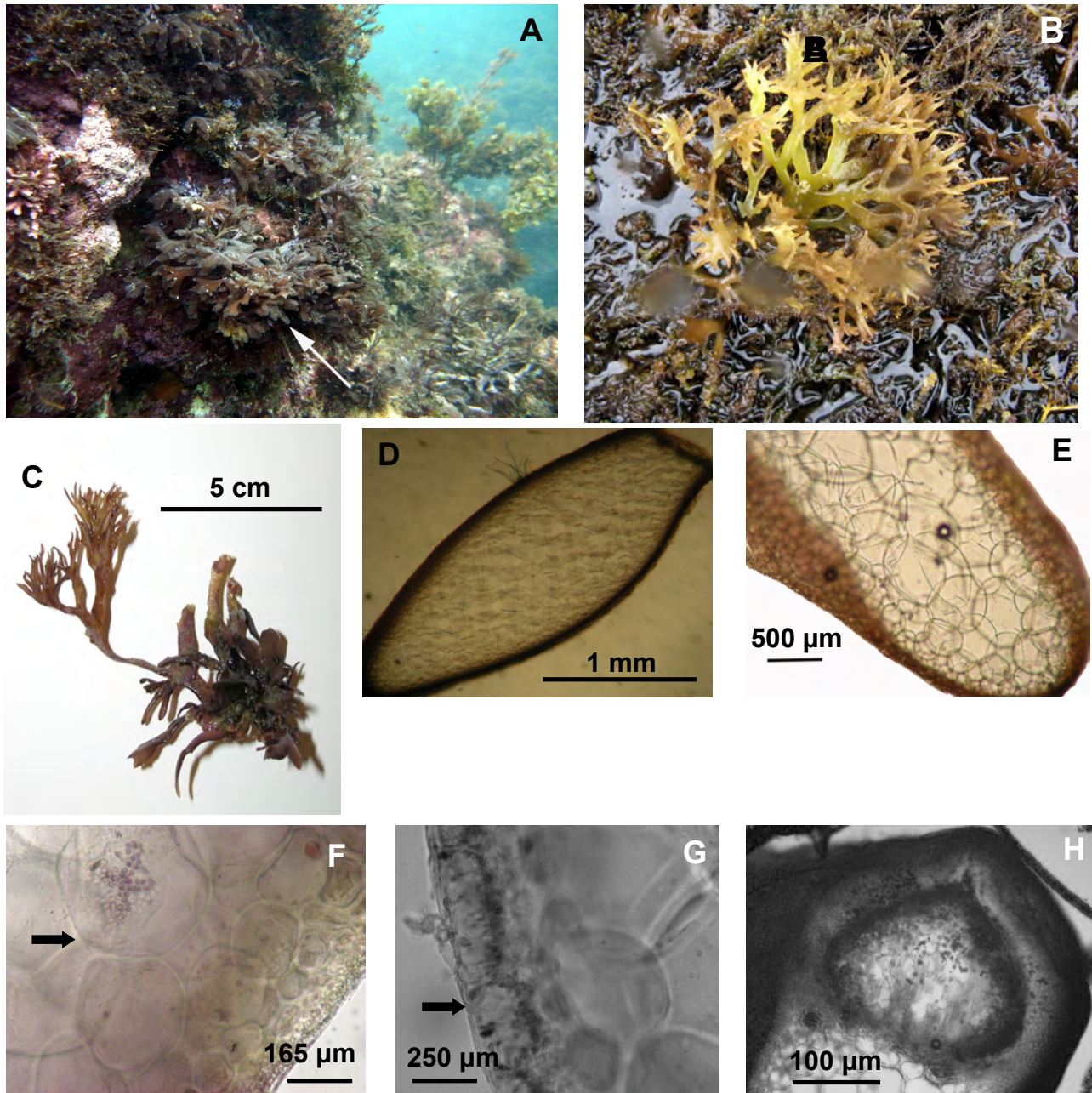
References:

Gurgel, C.F.D., Fredericq, S. & Norris, J.N. 2004. *Gracilaria flabelliformis* (Gracilariaceae, Rhodophyta): restoring old names for common tropical western Atlantic species, including the recognition of three new subspecies, and a replacement name for "*G. lacinulata*". *Cryptogamie Algologie* 25: 367-396.

Lopez-Bautista, J. & Kapraun, D.F. 1995. Agar analysis, nuclear genome quantification and characterization of four agarophytes (*Gracilaria*) from the Mexican Gulf Coast. *Journal of Applied Phycology* 7: 351-357.

Guiry, M.D. & Guiry, G.M. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 18 August 2009.

Gracilaria flabelliformis (P. & H. Crouan) Gurgel & Fredericq
 (Florideophyceae, Gracilariariales, Gracilariaceae)



A-H. Various specimens examined. **(A-B)** Habit of submerged and exposed specimens adhering to hard substratum at Flat Rock Beach. **(C)** Specimen TFP08-0289. **(D-E)** Transverse sections through main axes showing cellular medulla and cortex. **(F)** Close-up of medullary cells (arrow). **(G)** Transverse section through male spermatangial structures organized in shallow pits (arrow). **(H)** Transverse section through cystocarp.

Description:

Thallus flat to compressed, strap-like above, to 8 cm high, red-green in color, arising from a disk-like holdfast. Main axes indistinct beyond first or second order of branching; branches flattened, irregularly to alternately branched. Cortex 1-3 cell layers thick, surface cells 4 to 6 µm diam., densely pigmented. Medullary cells irregularly spherical, to 300 µm diam., thick-walled. Spermatagia organized in shallow pits. Cystocarps hemispherical, 75 to 125 µm diam., on upper surface of main axes.

Remarks:

This species has an affinity with *G. hayi*. Branching in *G. flabelliformis* is irregular to alternate below, and cervicorn at the tips. Branches in *G. hayi* are somewhat dichotomous, occasionally trichotomous, with rounded apices. Traditional specific distinction between species include morphology of thallus, and reproductive features. Recent molecular systematic studies of flattened species have partially solved some taxonomic problems in this confused group.

Habitat:

Found growing in the intertidal zone on rocky substratum intermixed with *Palisada perforata*, and on corals at 3 m depth.

BdT Distribution:

Flat Rock Beach, Swan Cay, Isla Carenero, STRI Beach, Bastimentos-Solarte Channel, Wild Cane Cay.

Worldwide Distribution:

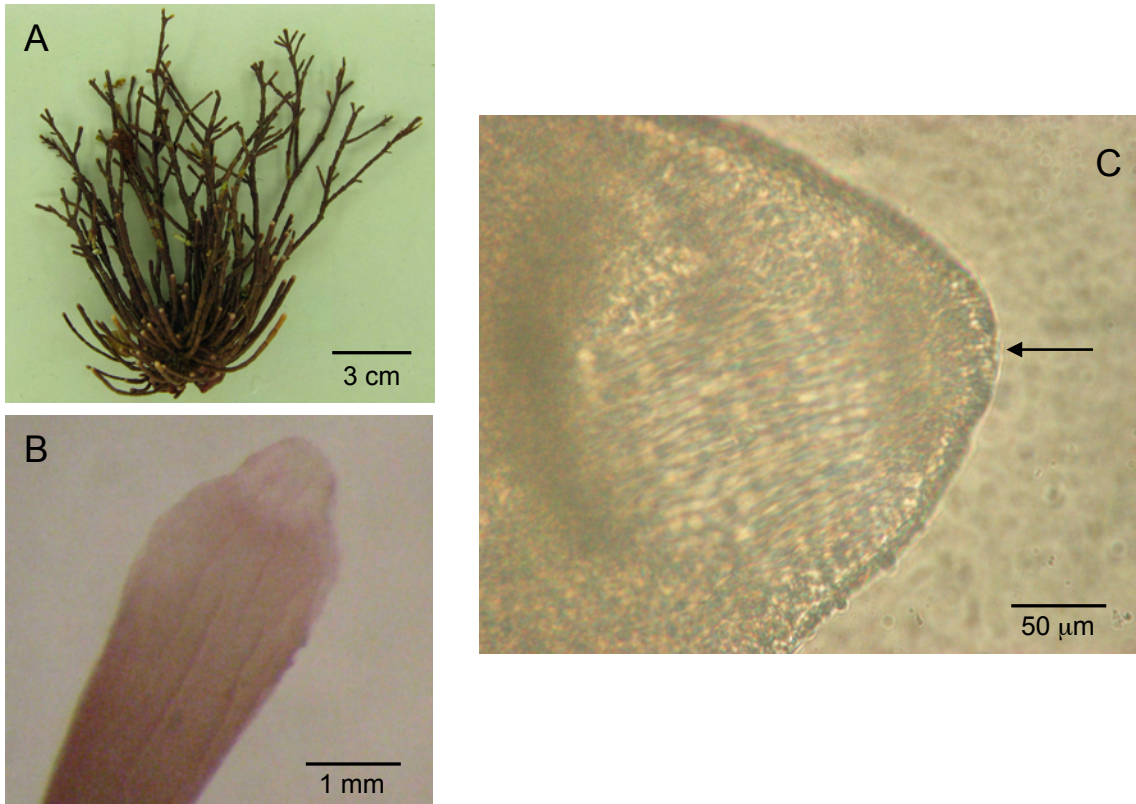
Central America (Panama), South America (Brazil), North America (Florida), Common throughout Caribbean Sea.

Representative Specimens: PASI09 EP-0002, PASI09-AP0007.

References:

- Gurgel C.F.D., S. Fredericq & J.N. Norris. 2004. Molecular systematics and taxonomy of flattened species of *Gracilaria* Greville (Gracilariaceae, Gracilariales, Rhodophyta) from the western Atlantic. Pp. 159-199 in Abbott, I.A. & McDermid, K.J., Eds, *Taxonomy of economic seaweeds, with reference to Pacific and other locations*, vol. IX, pp. 159-199. Honolulu, Univ. Of Hawaii Sea Grant College Program.
- Dawes, C. J. & Mathieson, A.C. 2008.
- Littler, D. S., Littler, M. M & Hanisak, M. D. 2008;
- Guiry, M. C & Guiry, G. M. 2009. (accessed 20 August 2009).

***Halptilon* sp. (Decaisne) Lindley**
(Florideophyceae, Corallinales, Corallinaceae)



A-C. Specimen: PASI09.RG0003. (A) Habit of specimen. (B) Apical segment with juvenile conceptacle. (C) Central pore (arrow) of conceptacle.

Description: This is an articulated, upright calcified alga that grows to approximately 12 cm in height. Main branches and genicula are cylindrical, with a loosely pinnate branching pattern. Conceptacles have a central pore, are spherical to urn-shaped, formed in terminal apical genicula.

Remarks: Superficially, this plant appears to be *H. cubense*; however, it is much taller than 3 cm, as is reported for this species in the literature (Littler & Littler, 2000). It can be differentiated from *H. subulatum* by the position of the conceptacles which are borne in swollen apical segments.

Habitat: Infrequent on solid substrates.

Bocas del Toro Distribution: Mimbi Timbi, Isla Colón, Bocas del Toro, N 09.44106, W 082.27836

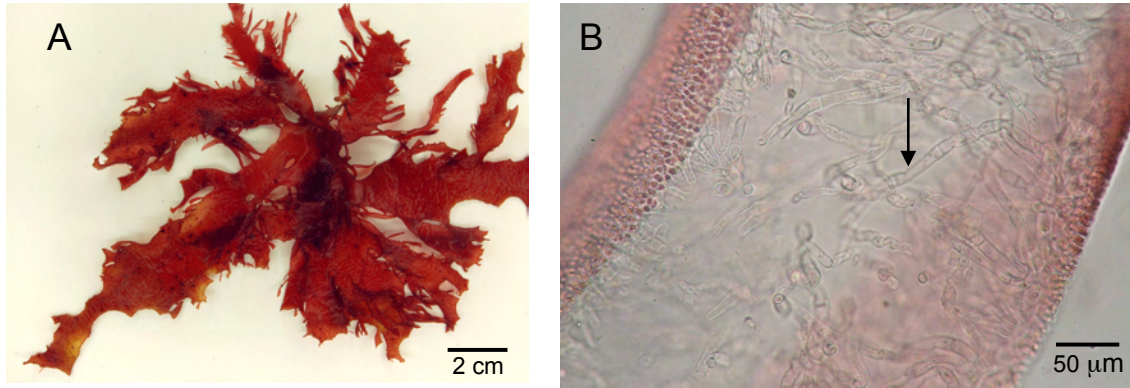
Worldwide Distribution: This genus is widely distributed throughout the world's oceans, including temperate and tropical oceans.

Representative Specimens: PASI09.RG0003

References:

Dawes & Mathieson. 2008. *The Seaweeds of Florida*. University Press of Florida
Guiry, M.D. & Guiry, G.M. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>
Littler D.S. & M.M. Littler. 2000. *Caribbean Reef Plants*. OffShore Graphics, Inc.
Littler D.S., Littler M.M, Bucher K., and Norris J.N. 1989. *Marine Plants of the Caribbean*. Off Shore Graphics, Inc.

***Halymenia pseudofloresii* Collins & M. Howe**
(Florideophyceae, Halymeniales, Halymeniaceae)



A-B. Specimen: PASI09.RG0001. **(A)** Habit specimen. **(B)** Cross section through side branch showing hyaline, filiform medullary filaments (arrow), and pigmented cortical region.

Description:

Halymenia pseudofloresii has a showy thallus that is very slick and gelatinous in texture. It is a large macroalga that can grow to 50 cm high. It branches from the base and has no stipe. It can have an irregular to opposite branching pattern. The blades are strap-like, approximately 5 cm wide. Branchlets off main blade margins are irregularly opposite and much smaller than main branches, with bluntly pointed apices. Medullary filaments cylindrical, hyaline, and moderately dense, branching from cortical cells.

Remarks: Differentiated from closely related *H. floresii* by having a higher density of the medullary filaments.

Habitat: Infrequent on solid substrata, growing in 5-40 meters depth.

Bocas del Toro Distribution: Wild Cane Cay. N 09.34673, W 082.16953

Worldwide Distribution: Known from North Carolina, Bermuda, the Caribbean, Gulf of Mexico, Brazil, and the eastern North and tropical Atlantic, Mediterranean, Red Sea, Indo-Pacific, and Australia.

Representative Specimens: PASI09.RG0001

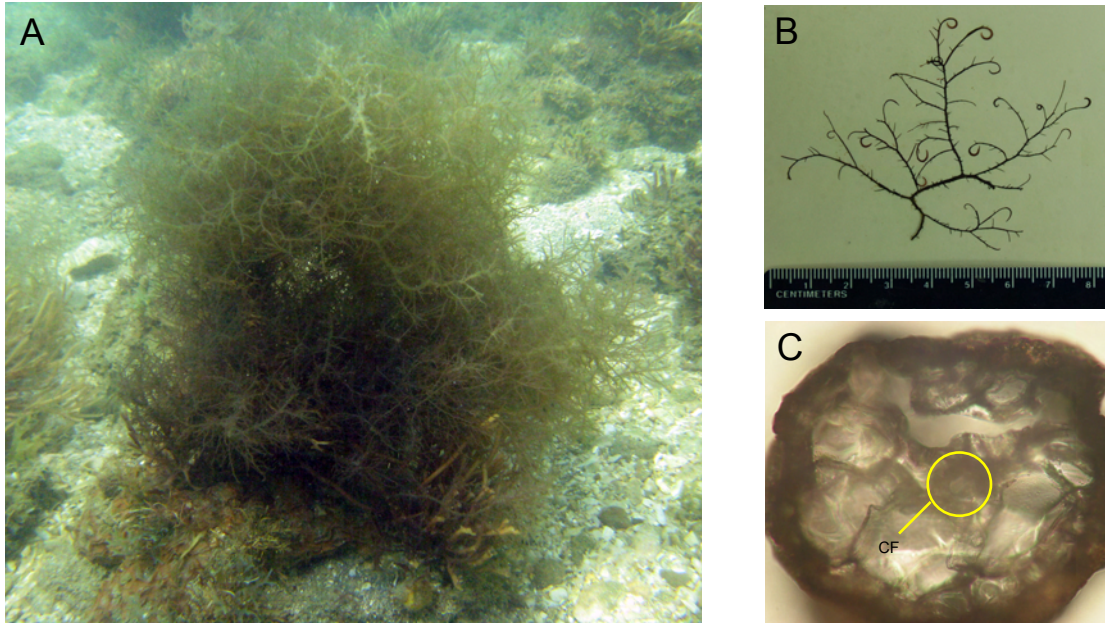
References:

Dawes, C. & Mathieson, A. 2008. *The Seaweeds of Florida*. University Press of Florida

Guiry, M.D. & Guiry, G.M. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>

Little D.S. & Little M.M. 2000. *Caribbean Reef Plants*. Off Shore Graphics, Inc.

***Hypnea musciformis* (Wulfen) J.V. Lamouroux 1813**
(Florideophyceae, Gigartinales, Cystocloniaceae)



(A) Alga specimen growing on rocky substratum at Limon Bay (Gracilaria Gardens), Panama (~ 2 m); (B) Habit of pressed herbarium sample (BdT09-CA002), notice that some apices end in enlarged hooks. (C) Transverse section of branch with a central filament (CF).

Description: Thallus can be yellow-orange to red with irregular yet numerous branches whose apices can end in enlarged, flattened hooks. Branches beset with numerous spur-like brachlets. Medulla of relatively large, thick-walled cells surrounding a smaller-celled central axial filament. Cortex composed of 1 to 2 layers of rounded to irregular pigmented cells.

Remarks: The apical hooks of *Hypnea musciformis* facilitate the hooking/fusing of thalli to other attached organisms leading to this species often appearing tangled or knotted. This may be advantageous when adrift, which is not uncommon for *H. musciformis*. Originally a member of the Hypneaceae, *Hypnea* was subsumed into the Cystocloniaceae on anatomical grounds, and this was later confirmed by Saunderson et al. (2003) based on small-subunit rDNA sequence studies.

Habitat: Found on hard substrates or, often, as drift algae; to 26 m deep.

Bocas del Toro Distribution: Samples found at Esquina de Panch

Worldwide Distribution: Western and Southern Caribbean along with Florida, Bahamas, and Gulf of Mexico

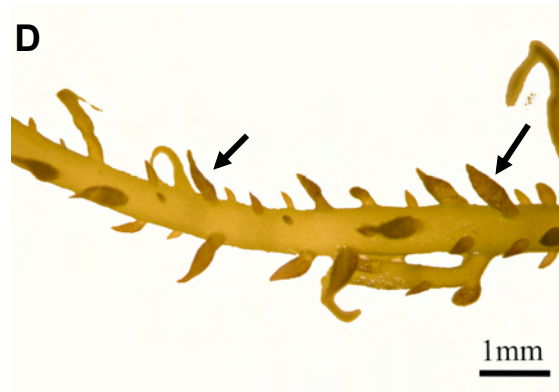
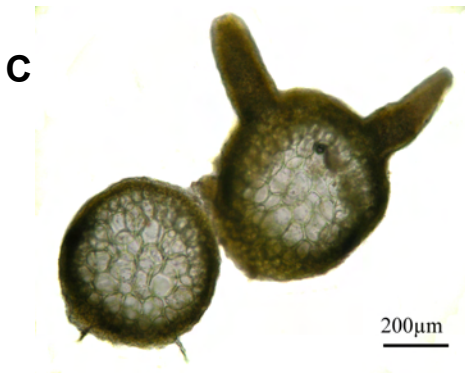
Representative Specimens: BdT09-CA002

References: Guiry, M.D. & Guiry, G.M. 2009 *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 18 August 2009

Little, D.S. & M.M. Little. 2000. *Caribbean reef plants*, Offshore Graphics: Washington, D.C. pp. 150.

Little, D.S., Little M.M. & M.D. Hanisak. 2008. *Submersed plants of the Indian River lagoon: a floristic inventory & field guide*. Offshore Graphics: Washington, D.C. pp. 183.

***Hypnea spinella* (C. Agardh)** (Florodeophyceae, Gigartinales, Hypneaceae)



A-D. Especimen: PASI09.OT-0006. **A.** Hábitat de especímenes (flechas) **B.** Ramificación del talo. **C.** Corte transversal del talo. **D.** Rama tetrasporangial con espina terminal (flechas).

Descripción: El talo puede ser erecto o formando matas enmarañadas, con tallas hasta de 3 cm de largo. Coloración roja, café o parda. Se ramifica en distintos planos. Las ramitas de 0.4-1.0 mm de diámetro, cilíndricas y terminadas en forma de espina ligeramente curvadas; la ramificación es dicotómica abajo y alternas arriba. Anatómicamente el talo muestra células medulares de paredes delgadas, con formas irregulares u ovaladas de 100 -350 μm de diámetro y densamente pigmentadas.

Habitat: Creciendo de forma masiva, formando matas enmarañadas sobre una roca en la zona intermareal.

Distribución en Bocas del Toro: Playa Mimbi Timbi, isla Colon. N 09.44106 W 82.27836

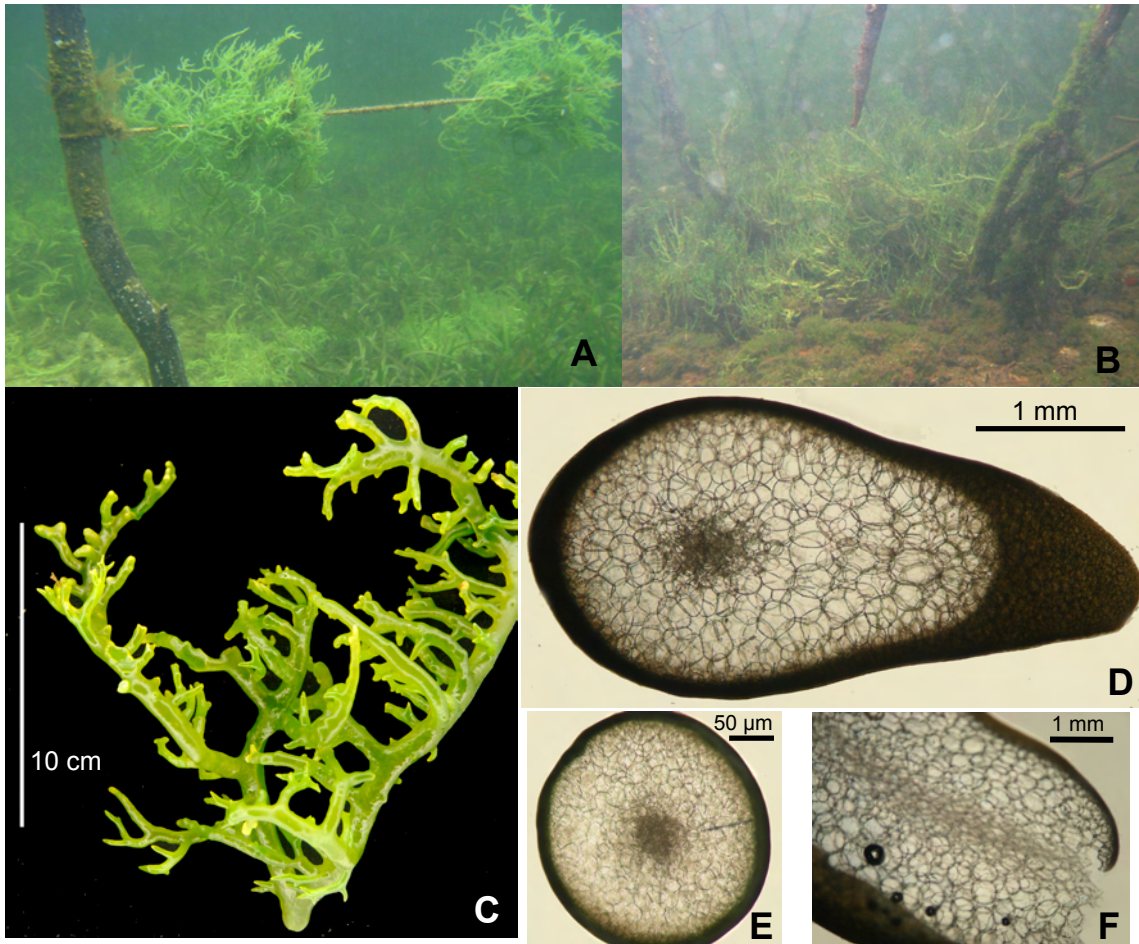
Distribución en el mundo: Europa, Islas del Atlántico, Norte América, México, América Central, Islas del Caribe, Sur América, África, Sur África, Islas del Océano Indico, Sureste de Asia, Australia y Nueva Zelanda.

Especimen representativo: PASI 09. OT-0006

Referencias: Guiry & Guiry 2009; Littler & Littler 2000, Taylor 1960

Kappaphycus alvarezii (Doty) Doty ex P.C. Silva

(Florideophyceae, Gigartinales, Solieriaceae)



A-F: Specimen PASI09.EIA-0001. **(A)** Specimens attached to rope, farmed for aquaculture in the Dark Land mangrove, Bocas. **(B)** Specimens dislodged from rope and continuing their growth at bottom of Dark Land mangrove. **(C)** Habit of vegetative plant. **(D-F):** Cross sections through branches at various parts of the thallus showing small-celled central region: **(D)** from upper branch, **(E)** from lower branch, and **(F)** grazed longitudinal section. Photo **A** & **B** courtesy of G. Jácome.

Description: Thalli fleshy, terete, reaching up to 30 cm in length, free-living at the bottom of a mangrove area. Branching pseudodichotomous to irregular. Axes multiaxial, with a central medulla of small cells surrounded by larger medullary cells (D, E).

Remarks: *Kappaphycus alvarezii* has been introduced in the Bocas region and is not native to the area. The species is farmed for carrageenan in tropical regions, especially in its native Philippines. Non-farmed populations grow attached to hard substratum in the reefs.

Habitat: In Bocas growing attached to ropes (A) or loosely unattached at the bottom of mangroves (B).

Bocas del Toro Distribution: Dark Land mangrove (N 09.121408, W 82.172943)

Worldwide Distribution: The species occurs in the Sulu Sea and the Sulu Archipelago, although it has been introduced in several western and central Pacific areas for farming. It was introduced to America around 1992 in Venezuela, Colombia, Panama, and Brasil

Representative Specimens: PASI09.EIA-0001

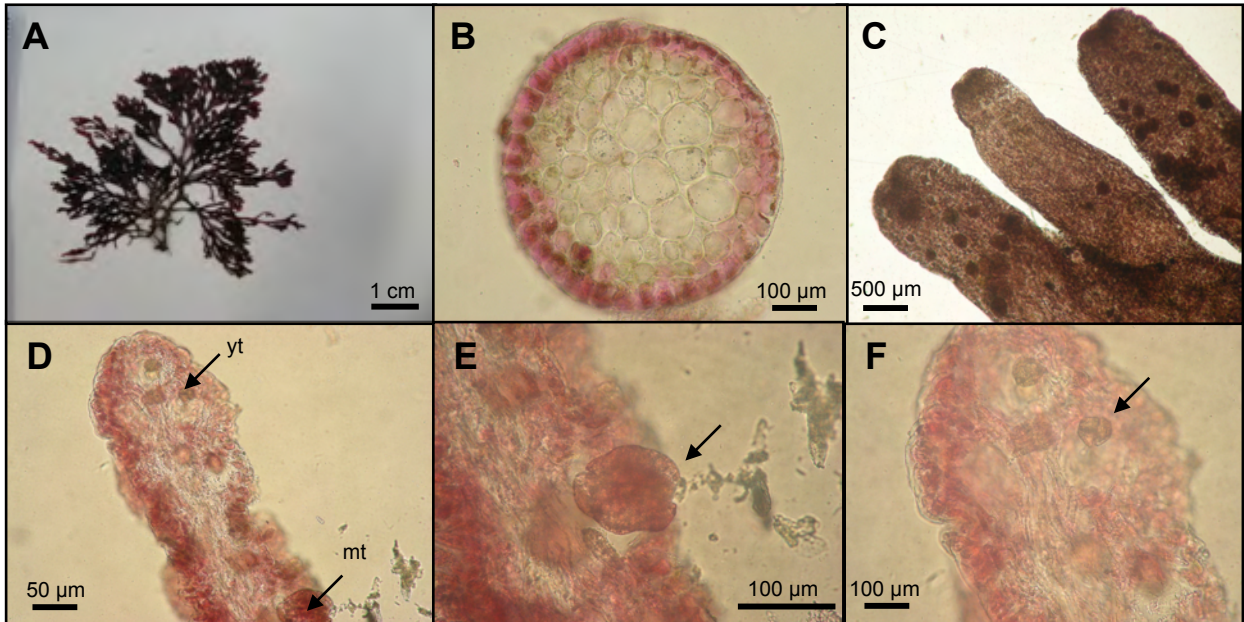
References:

Chandrasekaran, S., N. Arun Nagendran, D. Pandiaraja, N. Krishnankutty & B. Kamalakannan. 2008. Bioinvasion of *Kappaphycus alvarezii* on corals in the Gulf of Mannar, India. *Current Science* 94: 1167-72.

Guiry, M.D. & G.M. Guiry. 2009. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; accessed on 19 August 2009.

Palisada poiteau (J.V. Lamouroux) K.W. Nam

(Florideophyceae, Ceramiales, Rhodomelaceae)



A-F. Tetrasporic specimen PASI09.DM-003. **(A)** Habit of the tetrasporophyte. **(B)** Cross section through main branch. **(C)** Surface view of branch apical regions. **(D)** Longitudinal section through thallus highlighting the tetrahedrally divided tetrasporangia (yt=young tetrasporangia, mt=mature tetrasporangia). **(E)** Mature tetrasporangium (arrow). **(F)** Young, tetrahedrally divided tetrasporangia (arrow).

Description: Thallus cartilaginous and bushy (A). Main axes cylindrical, 0.6 mm in diameter, medullary cells 75-100 µm in diameter (B). Branchlets short (0.8 –1.3 mm long), alternate, cylindrical, 0.4 mm in diameter, alternating in pairs, blunt, wart-like and often swollen (C). Tetrasporangia tetrahedrally divided, 100 µm in diameter when mature (D-E), located near branchlet tips (C, D, F).

Remarks: The collected specimen described here is consistent with the description for the species *Laurencia poiteau* in Littler & Littler (2000), which was transferred to the genus *Palisada* by Nam (2007).

Habitat: This plant was collected on a rocky substratum at approximately 4 meters depth in a wave-swept area. The species is reported to inhabit deep reef areas up to 40 meters depth.

Bocas del Toro Distribution: Wild Cane Cay (N 09.34673 / W 082.16953).

Worldwide Distribution: (as *Laurencia poiteau* (J.V. Lamouroux) M.A. Howe: *Atlantic Islands*: Bermuda, Cape Verde Islands; *North America*: Florida, Mexico, North Carolina, Texas; *Central America*: Belize; *Caribbean Islands*: Bahamas, Barbados, Caicos Islands, Caribbean, Cuba, Hispaniola, Jamaica, Lesser Antilles, Netherlands Antilles, Puerto Rico, Virgin Islands. *South America*: Brazil, Colombia, Venezuela; *Africa*: Kenya, Tanzania; *Indian Ocean Islands*: Réunion; *South-west Asia*: India, Sri Lanka; *South-east Asia*: Philippines; *Australia and New Zealand*: Queensland.

Representative Specimen: PASI09.DM-0003

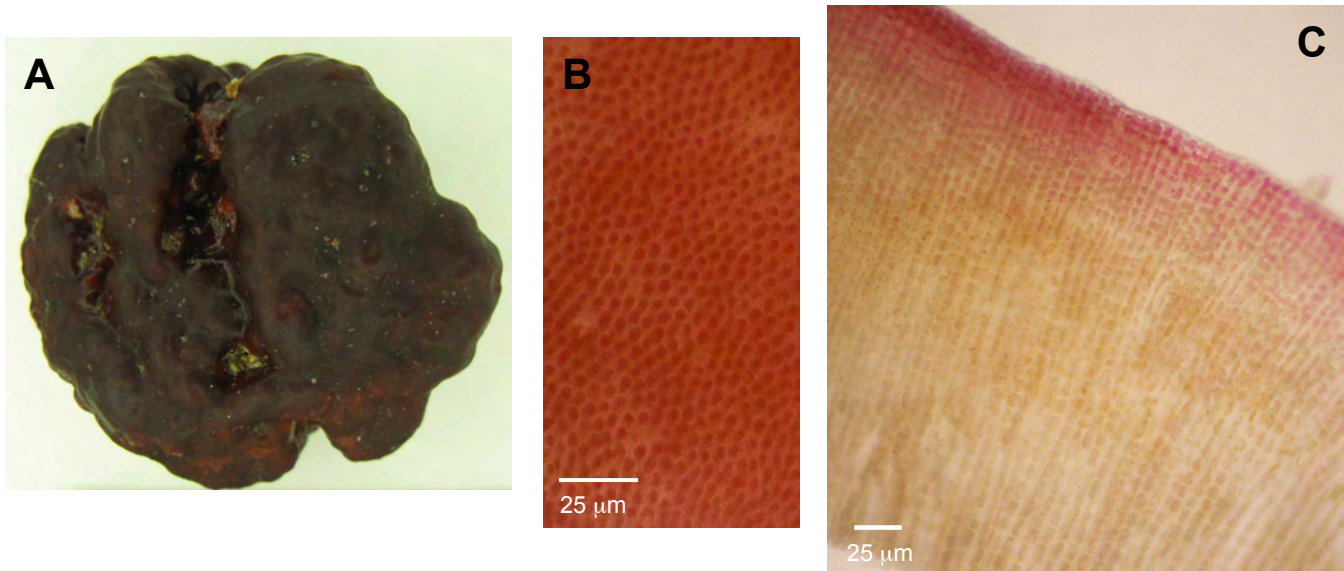
References: Dawes, C.J. & Mathieson, A.C. 2008. *The seaweeds of Florida*. 591pp., Gainesville, Florida: University Press of Florida.

Littler D.S. & Littler M.M. 2000. *Caribbean reef plants of the Caribbean Bahamas, Florida and Gulf of Mexico*. Off Shore Graphics, Inc. Washington D.C.

M.D. & Guiry, G.M. 2009. <http://www.algaebase.org>; searched on 22 August 2009.

Nam, K.W. 2007. Validation of the generic name *Palisada* (Rhodomelaceae, Rhodophyta). *Algae* 22: 53-55.

***Peyssonnelia* sp. (Decaisne)**
(Florideophyceae, Peyssonneliales, Peyssonneliaceae)



A-C. Specimen: PASI09.RG0002. **(A)** *Peyssonnelia* crust covering rock substratum. **(B)** Surface view of thallus. **(C)** Transverse-section through crust of closely appressed filaments.

Description: This *Peyssonnelia* sp. is a fleshy dark red to maroon crust that is only lightly calcified on the lower surface. It grows firmly attached to the hard substratum (A). Surface cells uniform and evenly spaced (B). Perithalial cells arranged in unbranched vertical rows (C).

Remarks: This genus is locally abundant in the area. The basal cells in this species are unbranched, which is a helpful trait in the delineation of *Peyssonnelia* species. Accordingly, the branched species, *P. inamoena*, *P. conchicola*, and *P. simulans*, can be excluded.

Habitat: On hard substrata at a variety of depths.

Bocas del Toro Distribution: Mimbi Timbi, Isla Colón, Bocas del Toro, Panama, N 09.44106, W 082.27836

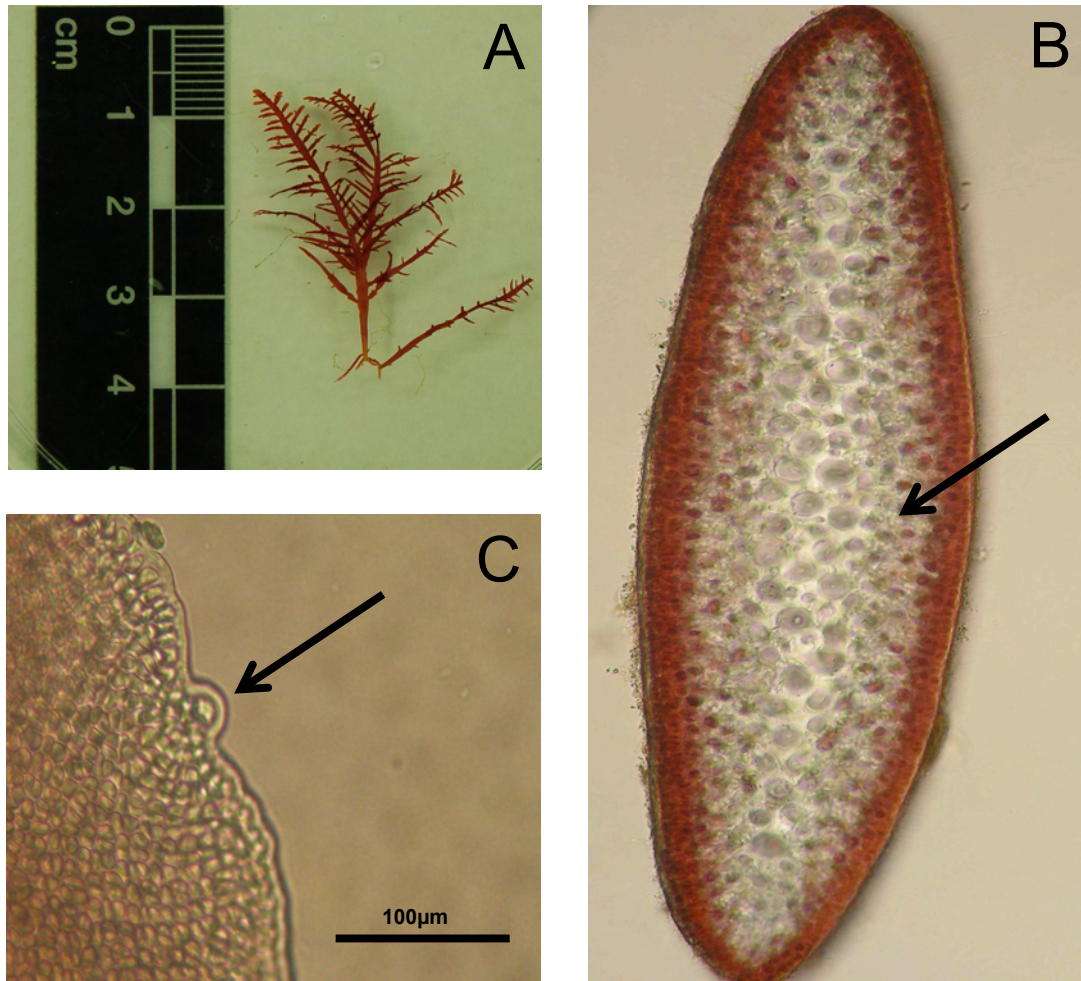
Worldwide Distribution: Representatives of the genus are widely distributed throughout the world's oceans in both hemispheres at a variety of depths from the intertidal to the lowest photic zone.

Representative Specimens: PASI09.RG0002

References

Dawes, C. & Mathieson, A. 2008. *The Seaweeds of Florida*. University Press of Florida.
Giry, M.D. & Giry, G.M. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>.
Littler, D.S & Littler, M.M. 2000. *Caribbean Reef Plants*. OffShore Graphics, Inc.

***Pterocliadiella capillacea* (S.G. Gmelin) Santelices & Hommersand**
(Florideophyceae, Gelidiales, Gelidiaceae)



A-C. Specimen: PASI09-HA002. **(A)** Specimen showing pinnate branchlets. **(B)** Transverse section through blade showing medullary cells surrounded by rhizines (arrow), and pigmented cortical cells. **(C)** Branch apex showing single prominent apical cell (arrow).

Description: Thallus dark brownish-red, commonly growing in dense tufts about 4 cm high, and composed of prostrate axes that give rise to flattened erect axes. Branching pinnate to irregularly opposite with uniaxial growth from single apical cells. Inner structure pseudoparenchymatous, with long, slender, thick-walled rhizine cells filling the spaces between elongated medullary cells that are surrounded by a three-layered cortex of smaller pigmented cells.

Remarks: The collected specimen is consistent with descriptions of *Pterocliadiella capillacea* but Caribbean specimens of this species may be confused with *P. caerulescens* (= *P. beachiae*) and *Gelidium floridanum*, which have been reported from the nearby waters of Costa Rica (Thomas & Freshwater 2001).

Habitat: Subtidal

Bocas del Toro Distribution: Mimbi Timbi

Worldwide Distribution: Europe, Atlantic Islands, North America, Caribbean Islands, South America, Africa, South-west Asia, Asia, South-east Asia, Australia and New Zealand, Pacific Islands.

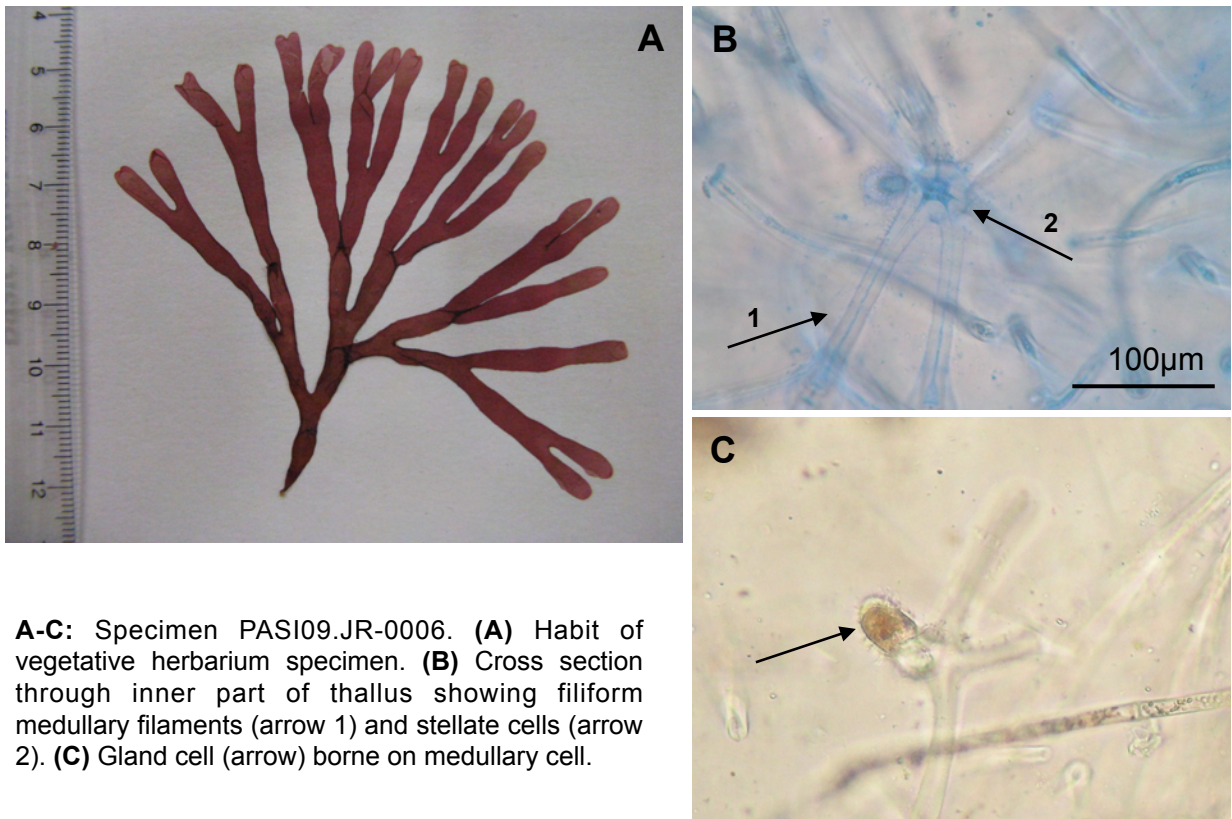
Representative specimens: PASI09- HA002

REFERENCES:

- Santelices, B. & Hommersand, M. (1997). *Pterocliadiella*, a new genus in the Gelidiaceae (Gelidiales, Rhodophyta). *Phycologia* 36: 114-119.
- Thomas, D.T. & Freshwater, D.W. (2001). Studies of Costa Rican Gelidiales (Rhodophyta): four Caribbean taxa including *Pterocliadiella beachii* sp. nov. *Phycologia* 40:340-350.
- Little DS, Little MM (2000) Caribbean reef plants. Offshore Graphics, Washington, DC
- Guiry, M.D. & Guiry, G.M. (2007). Worldwide electronic publication, National University of Ireland, Galway. Available at: <http://www.algaebase.org>, accessed august 2009.

Sebdenia flabellata (J. Agardh) Parkinson

(Florideophyceae, Sebdeniales, Sebdeniaceae).



A-C: Specimen PASI09.JR-0006. **(A)** Habit of vegetative herbarium specimen. **(B)** Cross section through inner part of thallus showing filiform medullary filaments (arrow 1) and stellate cells (arrow 2). **(C)** Gland cell (arrow) borne on medullary cell.

Description: Thallus gelatinous, slippery, soft, 4-30 cm high, pink, rose-red to brown in color. Main axis often pinched at base near discoid holdfast, broadening distally into cylindrical to slightly flattened pseudodichotomous branches 3-10 mm in diameter (A). Branches tapering terminally into blunt-tipped forks, 1-3 mm wide. Medullary filaments longitudinal, loosely arranged and entangled, 3-10 μm diam., radiating from stellate cells, 18-40 μm diam. (B). Gland cells are commonly borne on medullary cells (C) and produce a mucilaginous gel that fills the medulla.

Remarks: While reported to grow between depths of 10-55 m, this specimen was collected at 6 m depth. *S. flabellata* can be confused in the field with *Halymenia elongata* but branching in the latter is in more than one plane.

Habitat: Found on rocks and coral rubble of sand plains

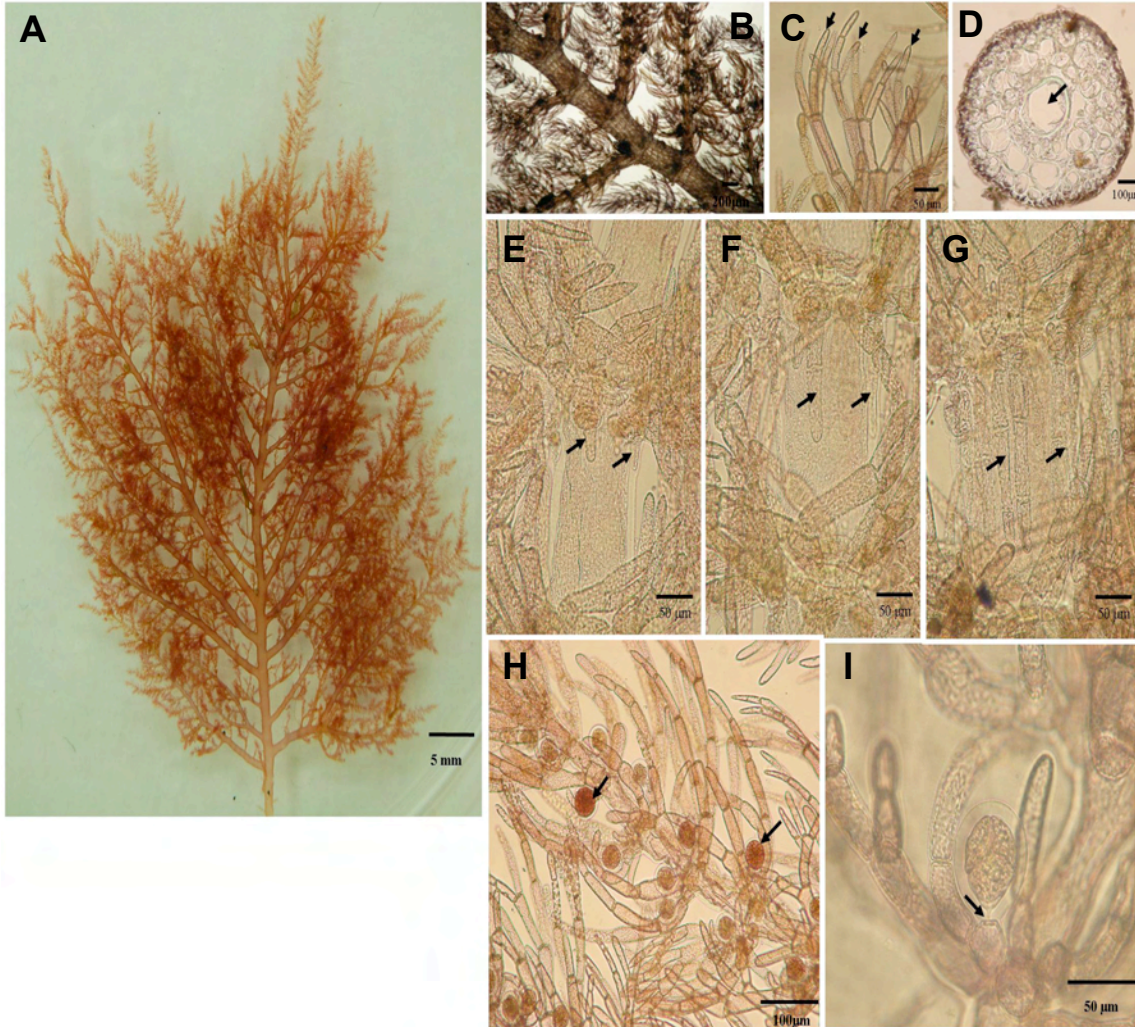
Bocas del Toro Distribution: Wild Cane Cay, N 09.34673 W 82.16953

Worldwide Distribution: Africa, Asia, Pacific Islands, Atlantic Islands, North America, Caribbean Islands, South America, Australia, and New Zealand.

Representative Specimens: PASI09.JR-006

References Littler & Littler. 2000. Caribbean Reef Plants. OffShore Graphics, Inc; Guiry & Guiry 2009, Algaebase.

***Wrangelia penicillata* (C. Agardh) C. Agardh**
(Florideophyceae, Ceramiales, Wrangeliaceae)



A-G. Specimen #8-17-09-1-9. **(A)** Habit of tetrasporic specimen. **(B)** Alternate branching pattern. **(C)** Terminal tips of branchlets. **(D)** Cross section through mature corticated main axis. **(E-G)** Development of downward growing rhizoids (arrows). **(H)** Tetrasporic branch with tetrasporangia (arrows). **(I)** Tetrahedrally divided tetrasporangium surrounded by involucral filaments, pit-connected (arrow) to first suprabasal cell of branchlet at axial node.

Description: Plants blood-red, soft, erect to 7.5 cm tall (A). Main axis terete, up to 1 mm diam., with axial cells 300-690 μm in length and up to 250 μm in diameter. Branching alternate with branches and branchlets arising from axial nodes (B). Branchlets whorled, slender, curved upwards terminating in tips that are not spine-like (C). Main axes and branches become completely corticated by the development of downward growing rhizoids from basal cells of branchlets (E-G). Spherical, tetrahedrally divided tetrasporangia 45-65 μm diam. are borne on branchlets in groups (H) and are surrounded by 2-3 celled involucral filaments (I) Gametophytes were not observed.

Remarks: The Bocas plant is consistent with the description given by Dawes & Mathieson (2008). The species which is the generitype of *Wrangelia* has recently been transferred from the Ceramiaceae to the Wrangeliaceae (Choi et al. 2008). *Wrangelia penicillata* can be differentiated from the co-occurring specimens of *Wrangelia* in Bocas del Toro by its upward curved branchlets lacking terminal spines and complete thallus cortication by means of downward growing rhizoids.

Habitat: Usually epiphytic on seagrasses and other seaweeds.

Bocas del Toro Distribution: Mimbi Timbi, Isla Colón.

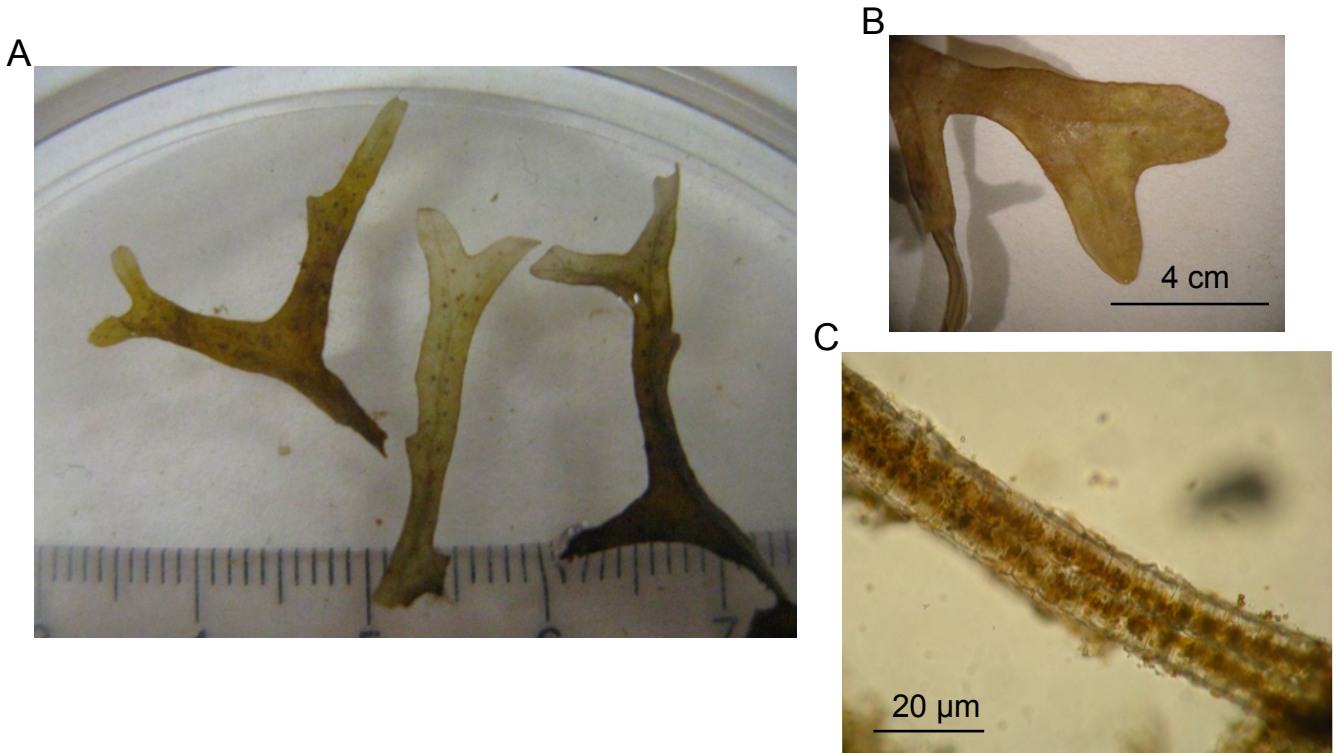
Worldwide Distribution: Western Atlantic: from Florida to Colombia; Eastern Atlantic: from Spain to South Africa; Mediterranean sea, Adriatic sea, Southeast Asia, NE Australia to the Hawaiian Islands.

Representative Specimens: (#8-17-09-1-9)

References

- Choi, H.-G., Kraft, G.T., Kim, H.-S., Guiry, M.D. & Saunders, G.W. 2008. Phylogenetic relationships among lineages of the Ceramiaceae (Ceramiales, Rhodophyta) based on nuclear small subunit rDNA sequence data. *Journal of Phycology* 44: 1033-1048.
- Dawes, C. J. & Mathieson, A. C. 2008 *The seaweeds of Florida*. University Press of Florida., Gainesville, 592 pp.
- Guiry, M.D. & Guiry, G.M. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 22 August 2009.

***Dictyopteris delicatula* Lamouroux**
(Phaeophyceae, Dictyotales, Dictyotaceae)



A-C: Specimen PASI09.JR-0004. **(A)** Fragments of habit. **(B)** Apical region at branch dichotomy showing bifurcating midrib. **(C)** Cross-section of branch showing darkly pigmented cortical layers.

Description: Thallus, 2-8 cm in height, can be spreading or erect, light to dark brown, consisting of irregularly branched dichotomies. Blade dichotomies 2-5 mm wide, comprised of two cell layers in parallel rows on both sides of a thin uniseriate midrib. Surface hairs clustered in tufts common. Holdfast attached to the substratum either basally or by filiform rhizoids at various thallus points. Reproductive structures organized in single rows on each side of the midrib.

Remarks: Specimen found attached to a small rock on the edge of a seagrass bed at 5 ft depth; it probably had drifted from deeper waters.

Habitat: growing epiphytically on mangrove prop roots or on hard substrata to 12 to 30 m depth,

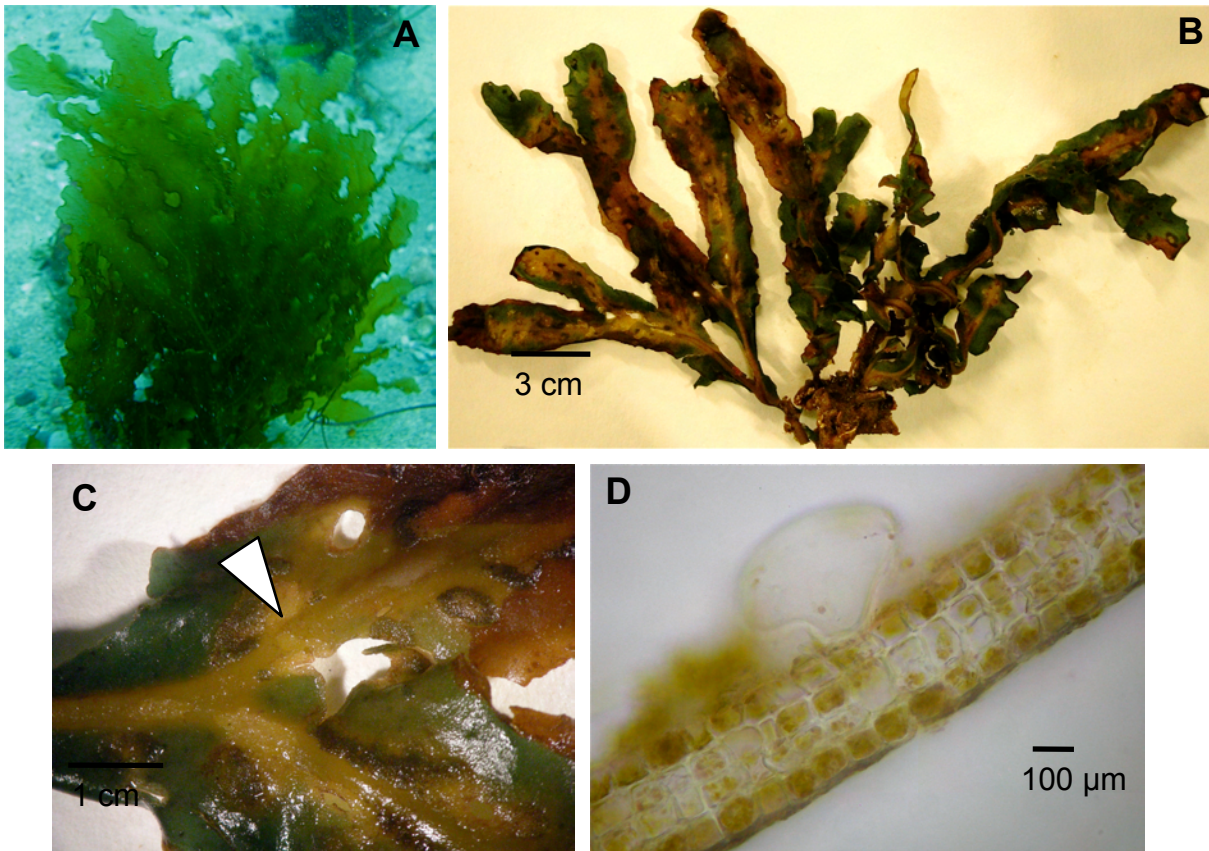
Bocas del Toro Distribution: South of North Rock off Carenero

Worldwide Distribution: Throughout the Americas, Atlantic and Caribbean Islands, Indian Ocean Islands, South-east and South-west Asia, Australia, and New Zealand

Representative Specimens: PASI09.JR-004

References: Littler & Littler 200; Algaebase

***Dictyopteris justii* Lamouroux**
(Phaeophyceae, Dictyotales, Dictyotaceae)



A-D. Specimen: PASI09.RK.001. **(A)** Habit in the field. **(B)** Habit of herbarium specimen. **(C)** Surface view of blade portion showing midrib (arrowhead). **(D)** Transverse section of blade showing bistratose medullary region flanked by cortical cells.

Description: Thallus olive to dark brown, up to 40 cm high, consisting of strap-shaped dichotomous blades 1.5-8 cm broad. Blades with distinct midrib and slightly ruffled margins. The cortex consists of a single layer of rectangular pigmented cells that cover a two-layered medulla of cells averaging 100 µm diam.

Remarks: Other specimens of *Dictyopteris justii* in Panama were collected at depths of 10-15 m and were heavily epiphytized along the midrib region (Wysor and De Clerk 2003); in contrast, the Bocas specimens were growing at 3 m depth. This species could be confused with *Dictyopteris jolyana*, but the medulla of *D. justii* is only 1-2 cell layers thick, which is a key characteristic distinguishing the species.

Habitat: Found at 3 m depth on coral rubble

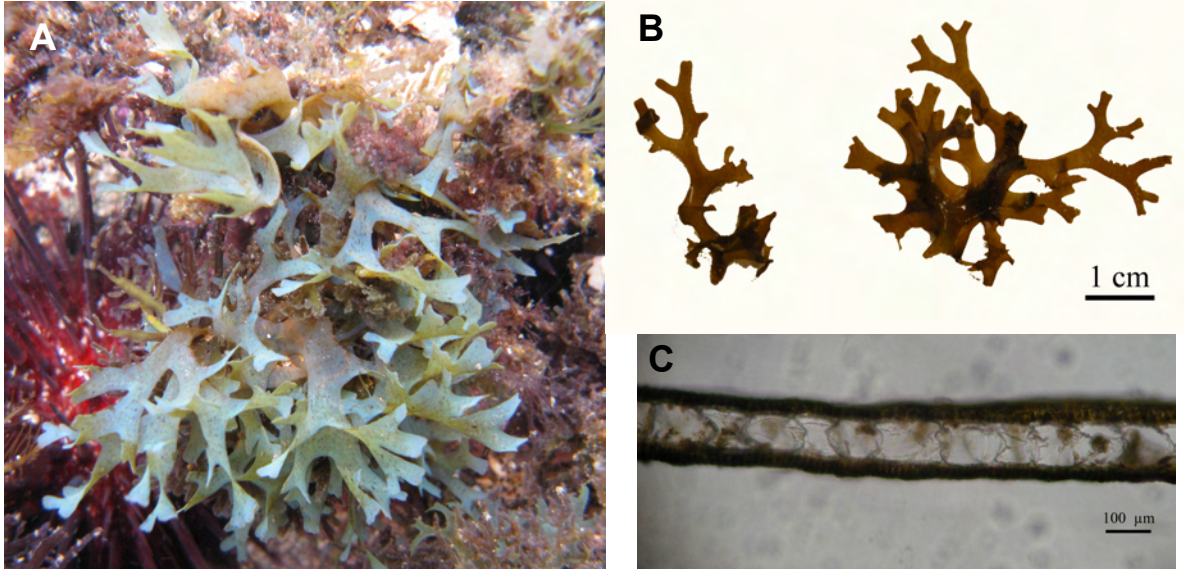
Bocas del Toro Distribution: Flat Rock Beach

Worldwide Distribution: South America, North America, Caribbean Islands

Representative Specimens: Preserved as Herbarium specimen, in silica gel for DNA studies

References: Littler & Littler 2000, algaebase.org, Wysor & De Clerk 2003

***Dictyota bartareysiana* J.V. Lamouroux**
(Phaeophyceae, Dictyotales, Dictyotaceae)



A-C: Specimen PASI09.CF-010. **(A)** Habit of bluish iridescent specimen in the field. **(B)** Blades showing irregular dichotomous branching. **(C)** Transverse section through main branch.

Description: Thallus erect, iridescent blue and green in the field, or light brown, often with dark olive-brown bands, branching dichotomous. Blades strap-shaped, with smooth margins, 3-5 mm wide, 100-140 μm thick. Medulla of one cell layer. Surface hairs uncommon.

Remarks: Bocas specimens were strikingly iridescent blue and lacked olive-brown bands.

Habitat: Found in intertidal pools, epiphytic on *Bryothamnion triquetrum*

Bocas del Toro Distribution: Flat Rock Beach

Worldwide Distribution: Atlantic Islands, southern USA, Pacific Mexico, Caribbean Islands, Brazil, Venezuela, Africa, Indian Ocean Islands, South-west Asia, Japan, Taiwan, South-east Asia, Australia and New Zealand, Pacific Islands, Atlantic Islands, Panama

Representative Specimens: PAS09.CF-010

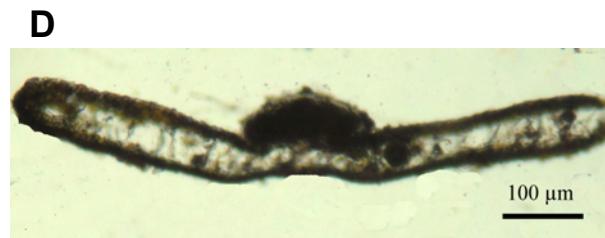
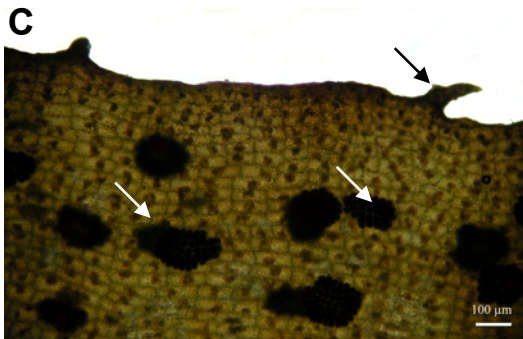
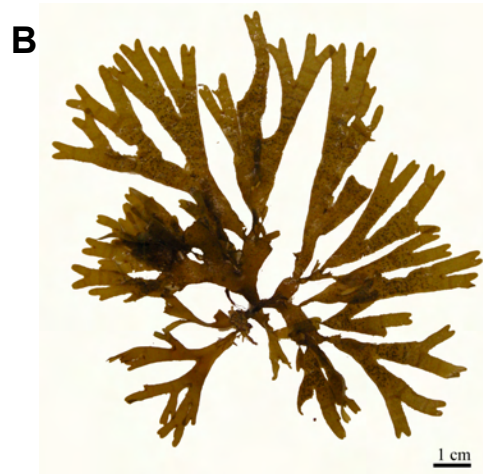
References:

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, Washington. 542 pp

Guiry M.D. & GM Guiry. 2009. *AlgaeBase*. Worldwide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; accessed 18 August 2009

Dictyota ciliolata Sonder ex Kützing

(Phaeophyceae, Dictyotales, Dictyotaceae)



A-D. Specimen: PASI09.CF-007. **(A)** Specimens in the field. **(B)** Habit of herbarium specimen. **(C)** Surface view of branch showing sori (white arrows), and slender marginal teeth (black arrow). **(D)** Transverse section through blade and reproductive sorus.

Description: Thallus erect, light brown with yellow-green iridescence in the field, sometimes with dark-brown transverse striations. Branching irregular to dichotomous, branches 7 mm in diameter, with scattered slender marginal teeth. Medullary cells one layer thick, rectangular. Surface cells rectangular.

Remarks: Abundant sori were present throughout the thallus. Some branches showed transverse brown striations. Very common in intertidal pools of Flat Rock Beach.

Habitat: in intertidal pools in moderately high energy habitats

Bocas del Toro Distribution: Flat Rock Beach, Swan Cay

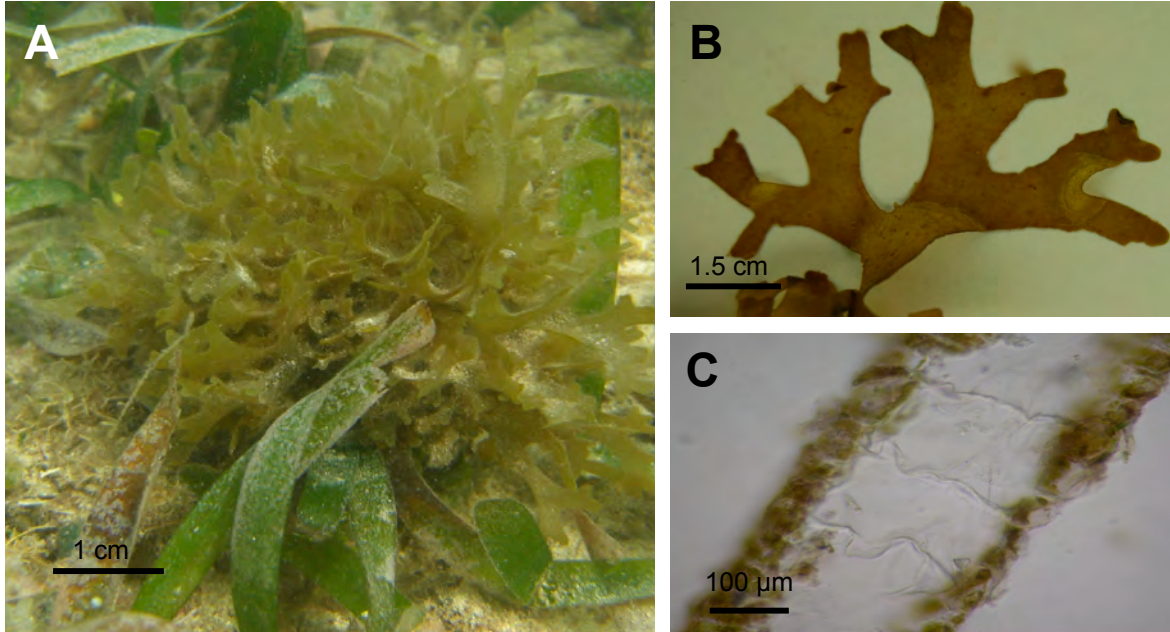
Worldwide Distribution: Spain, Atlantic Islands, Canary Islands, Madeira, Salvage Islands, Florida, Mexico (Atlantic, Pacific), North Carolina, Texas, Belize, Panama (Caribbean), Caribbean Islands, Brazil, Venezuela, Africa, Tanzania, Western Sahara, Indian Ocean Islands, Australia and New Zealand, Pacific Islands.

Representative Specimens: PASI09.CF-007, TFP-143, TFP-388

References:

- Littler D.S. & M.M. Littler. 2000. *Caribbean reef plants: an identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico*. Of Shore Graphics, Washington. 542 pp.
- Guiry M.D. & G.M. Guiry. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; accessed 18 August 2009

***Dictyota menstrualis* (Hoyt) Schnetter**
(Phaeophyceae, Dictyotales, Dictyotaceae)



A-C: Specimen PASI09.EP.001. **(A)** Habit of clumped specimens growing in seagrass beds. **(B)** Portion of thallus showing spreading dichotomous branching. **(C)** Transverse section of blade showing small-sized cortex and hyaline medullary layer.

Description: Thallus erect, 15-25 cm high. yellow brown to dark brown, dichotomously branched blades strap-shaped, 2-15 mm wide, with smooth margins and blunt apices. Surface cells rectangular to polygonal. Medullary layer of large hyaline cells (C).

Remarks: No rhizoids were present in the observed specimen; however, when present, rhizoids are marginal on young blades and more ventral on older blades.

Habitat: Epilithic on rocks and coral, and occurring in sandy areas and seagrass beds.

Bocas del Toro Distribution: Wild Cane Cay, Hospital Bight, Bocas Research Station

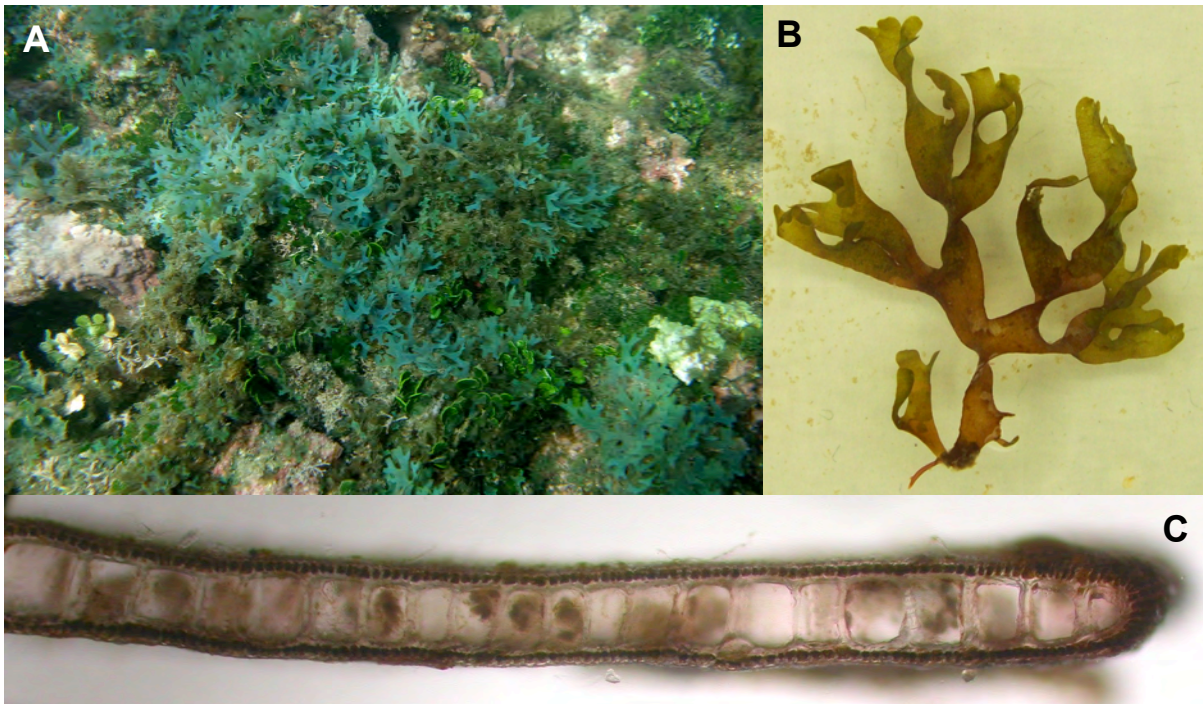
Worldwide Distribution: North America (Florida, North Carolina, South Carolina), Caribbean, South America (Brazil, Colombia, Venezuela), Atlantic Islands (Azores, Canary Islands, Cape Verde Islands, Salvage Islands)

Representative Specimens: PASI09.EP.001

References: Littler and Littler (2000).
AlgaeBase.com

Dictyota mertensii (Martius) Kützing

(Phaeophyceae, Dictyotales, Dictyotaceae)



A-C: Specimen PASI09DV011. **(A)** Habit of *Dictyota mertensii* in the field showing blades with an iridescent blue sheen. **(B)** Fragment of specimen showing alternate, twisted, broad branches and main axes. **(C)** Cross section of main branch showing unistratose medulla of large hyaline cells flanked by cortical layer of small pigmented cells. Photos B and C were taken on specimen PASI09DV011.

Description: Thallus erect, fluffy, bushy, to 8 cm high, brown out of the water, iridescent-blue/green in situ. Branching alternate, blades twisted up to 3.5 mm wide, 80-120 μm thick, >47 cells wide with apices broadly rounded. Medullary cells rectangular, hyaline, arranged in single distinct layer up to 100 μm thick. Surface cortical cells rectangular, 15-20 μm diam., arranged in a single row on both sides of medulla.

Remarks: Most characteristics described above are consistent with the description of the species by Littler & Littler (2000); however, there are some differences in the blade width as some blades are more than 3 mm wide and others are less than 50 cells wide. Sporangia, oogonia and surface hairs were not observed.

Dictyota mertensii in the field resembles *D. hamifera* and *D. humifusa*; however, those species show dichotomous to irregular branching and never show alternate branching. Moreover, *D. hamifera* bear lateral tendrils or hooks while *Dictyota humifusa*'s thallus is generally prostrate and rarely erect.

Habitat: On dead corals on wave-exposed reef crests

Bocas del Toro Distribution: Flat Rock Beach, Isla Colon

Worldwide Distribution: Western Atlantic, Eastern Atlantic, Indo-Pacific Ocean

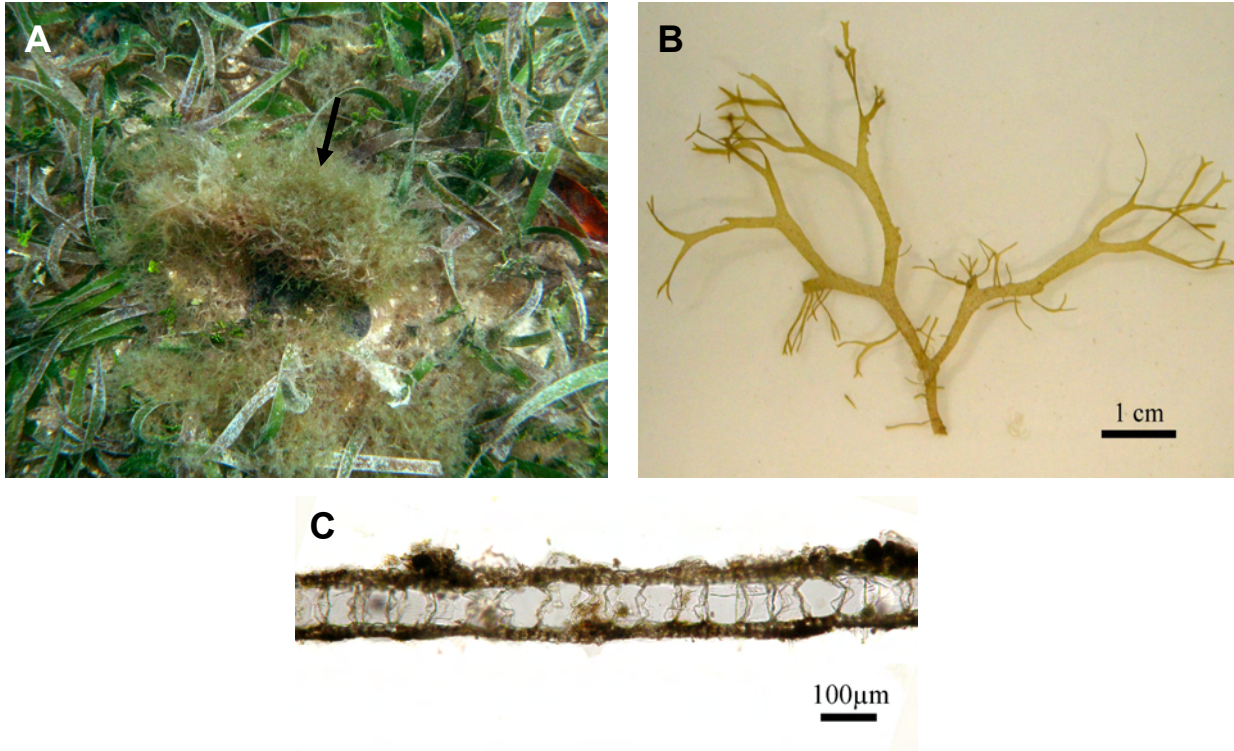
Representative Specimens: PASI09DV010, PASI09DV011

References

Guiry M.D. & Guiry G.M. 2009. *AlgaeBase*. Worldwide Electronic Publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 21 August 2009
Littler S.C. & Littler M.M. 2000. *Caribbean Reef Plants*. OffShore Graphics INC. Washington: 542pp

Dictyota pulchella Hörnig & Schnetter

(Phaeophyceae, Dictyotales, Dictyotaceae)



A-C. Specimen PASI09.CF-0001. **(A)** Thalli organized in clumps in seagrass bed. **(B)** Dichotomous branches becoming progressively narrower and cervicorn distally. **(C)** Transverse section through blade.

Description: Thalli light brown to green-iridescent in the field, erect, forming entangled clump of widely diverging dichotomous branches. Blades in lower portion 3-5 mm wide, becoming progressively narrower distally with each successive division. Medullary cells irregular-rectangular, 120-200 μm thick, arranged in single medullary layer.

Remarks: Although surface hairs have been reported to be common in this species (Littler & Littler 2009), no evident hairs were observed in the Bocas material.

Habitat: On shells and epiphytic on *Thalassia testudinum*, 1-2 m depth

Bocas del Toro Distribution: Bocas Research Station, Bastimento Solarte Chanel

Worldwide Distribution: Atlantic Islands: Bermuda, Canary Islands, Salvage Islands. *North America:* Florida, North Carolina, *Central America:* Belize, Panama, throughout Caribbean. *Caribbean Islands:* Bahamas, Cuba.

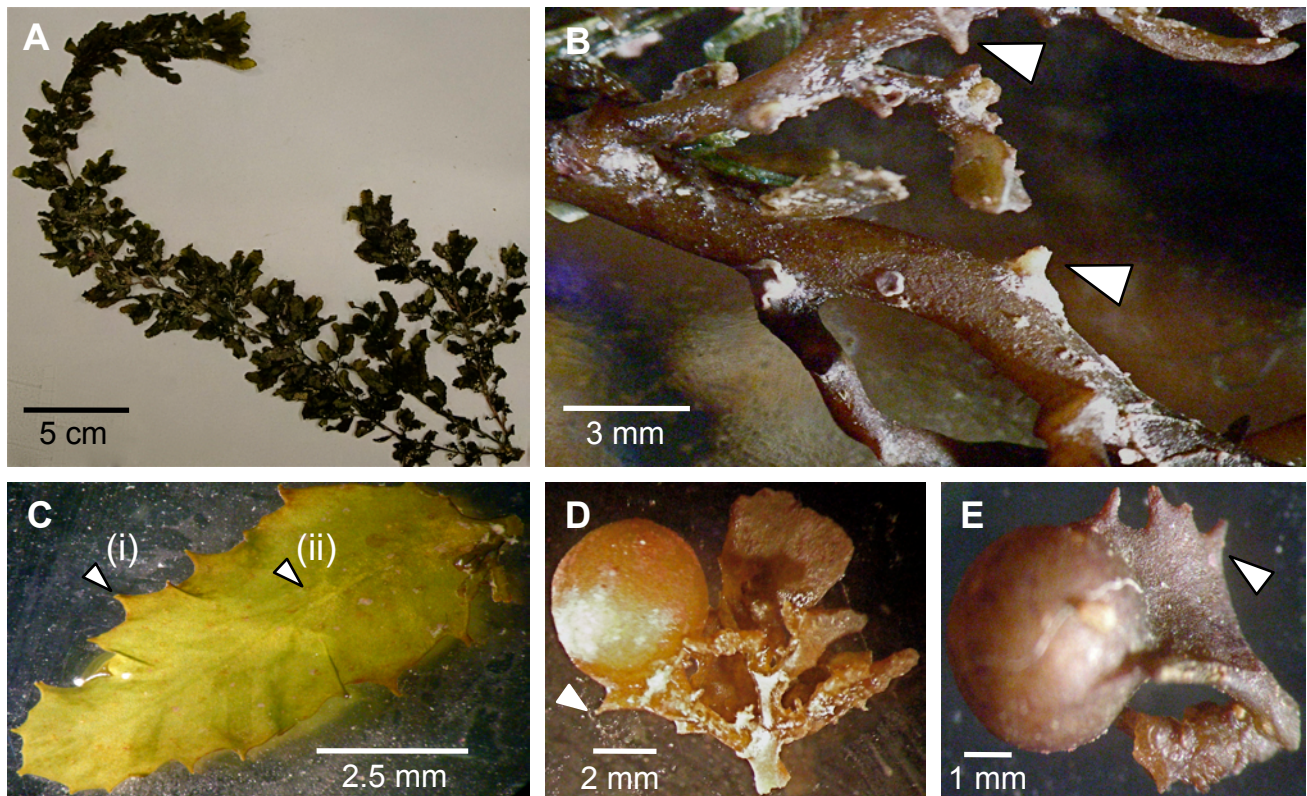
Representative Specimens: TFP-001, TFP-294, PASI09.CF-0001

References:

- Littler D.S. & M.M. Littler. 2000. *Caribbean reef plants: an identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico*. OffShore Graphics, Washington. 542 pp
- Guiry M.D. & G.M. Guiry. 2009. *AlgaeBase*. Worl-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; accessed 18 August 2009

Sargassum acinarium (Linnaeus) Setchell

(Phaeophyceae, Fucales, Sargassaceae)



A-E: Specimen PASI09.RKEP.001. **(A)** Habit of herbarium specimen. **(B)** Branchlet with spines (arrowheads). **(C)** Blade with toothed margins (arrowhead i), and prominent midrib (arrowhead ii). **(D)** Close-up of air bladder with solitary basal spine (arrowhead). **(E)** Close-up of air bladder with toothed stalks (arrowhead).

Description: Thallus tough, erect, to 60 cm high, densely branched (A), attached to hard substratum by distinct holdfast. Branchlets with spines (B-E). Blades with rounded apex 1-3 mm wide on distal branches, 1-7 cm long. Blades with deeply toothed margins (C, arrow i) and a distinct midrib (C, arrow ii). Air bladders spherical 3-7 mm diameter, often with solitary spine near base (D, arrow). Air bladders stalks flattened and often winged with toothed margins (E, arrow).

Remarks: This uncommon species is newly reported for Panama with collections from the 2008 TFP workshop (specimen PHYKOS-2835/TFP08-458) and the current 2009 PASI workshop where it was found both in the low intertidal on rocks as well as on the reef flat in high energy environments. The sporadic spines on the main axis, the solitary spine at the base of the air bladder, along with the flattened winged stalk, distinguish *S. acinarium* from other *Sargassum* species.

Habitat: On rocky or hard substratum in high energy environments to 3 m depth.

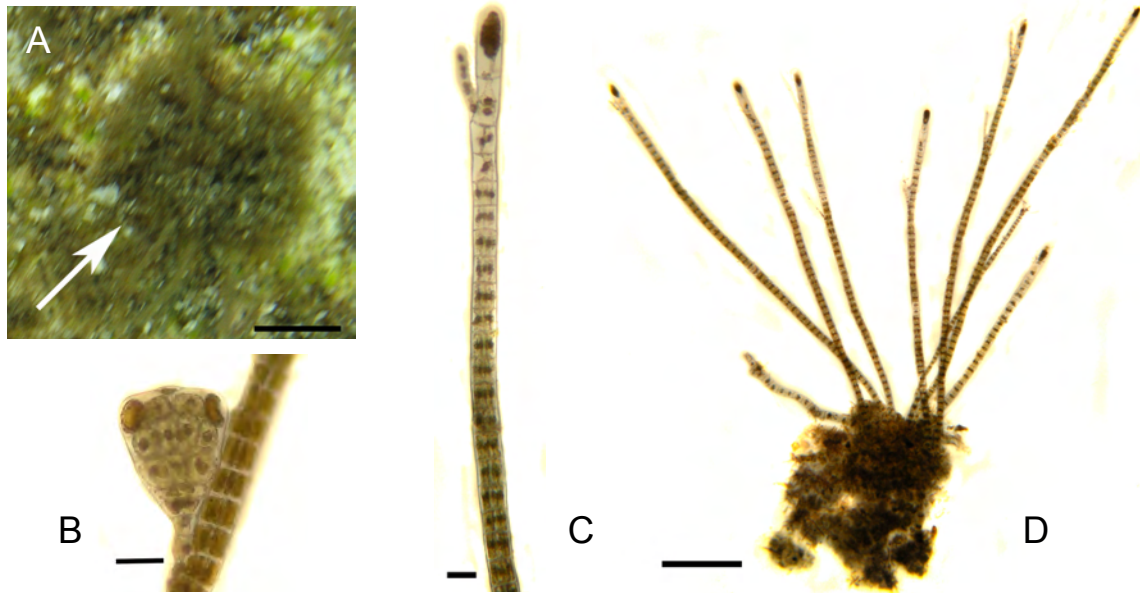
Bocas del Toro Distribution: fore-reef of Wild Cane Cay in high wave action, and in the intertidal reef flat at Flat Rock Beach.

Worldwide Distribution: Europe, Atlantic Islands, North America, Central America, Caribbean Islands, South America, Africa, South-west Asia

Representative Specimens: PASI09.RKEP.001

References: Littler & Littler (2000); Dawes & Mathieson (2008)

***Sphacelaria* sp.** (Phaeophyceae, Sphacelariales, Sphacelariaceae)



A-E: Specimen PASI09.CN-0001. **(A)** Habit of tufts in the field. **(B)** Developing propagule. **(C)** Unbranched, uniseriate filament at apical region, becoming multiseriate below the tip. **(D)** Close-up of thalli as seen under a stereomicroscope. Scale bar: (A) 5 mm, (B-C) 50 μm , (D) 1 mm. Photos: N. Cetz-Navarro.

Description: Thalli filamentous, dark brown, forming cushion-like mats ~6 mm high. Filaments slender and delicate, ~50 μm in diameter, multiseriate below the apical region, uniseriate at apex. Prominent apical cell measures 36 μm wide, 115 μm high. Multiseriate filaments composed of 2-5 longitudinal segments. Lateral, uniseriate hairs of 7 cells and 15 μm in diameter present. Intercalary cells of main filaments ~20 μm wide, ~60 μm high. Developing propagules borne on three-celled uniseriate stalk, rounded-triangular in shape, bearing distally a bilateral initial of a propagule arm. Propagules ~270 μm high and ~90 μm wide at distal end, uppermost layer composed of 4 cells.

Remarks: Propagules on specimens collected from Wild Cane Cay were not sufficiently numerous to enable identification at the species level. The observed propagules were still immature due to the lack of "arms". Three species of *Sphacelaria* have been recorded from the Caribbean basin: *S. novae-hollandiae*, *S. rigidula* and *S. tribuloides*; however, there are inconsistencies in the species illustrations of *S. novae-hollandiae* and *S. tribuloides* in the floristic treatments of Mendoza-González *et al.* (2000) and Littler and Littler (2000).

Habitat: Growing on PVC tube of sewage outlet, to 1.5 m depth.

Bocas del Toro Distribution: Bocas Research Station, Colon Island, Panama; N 09.35118, W 082.25697

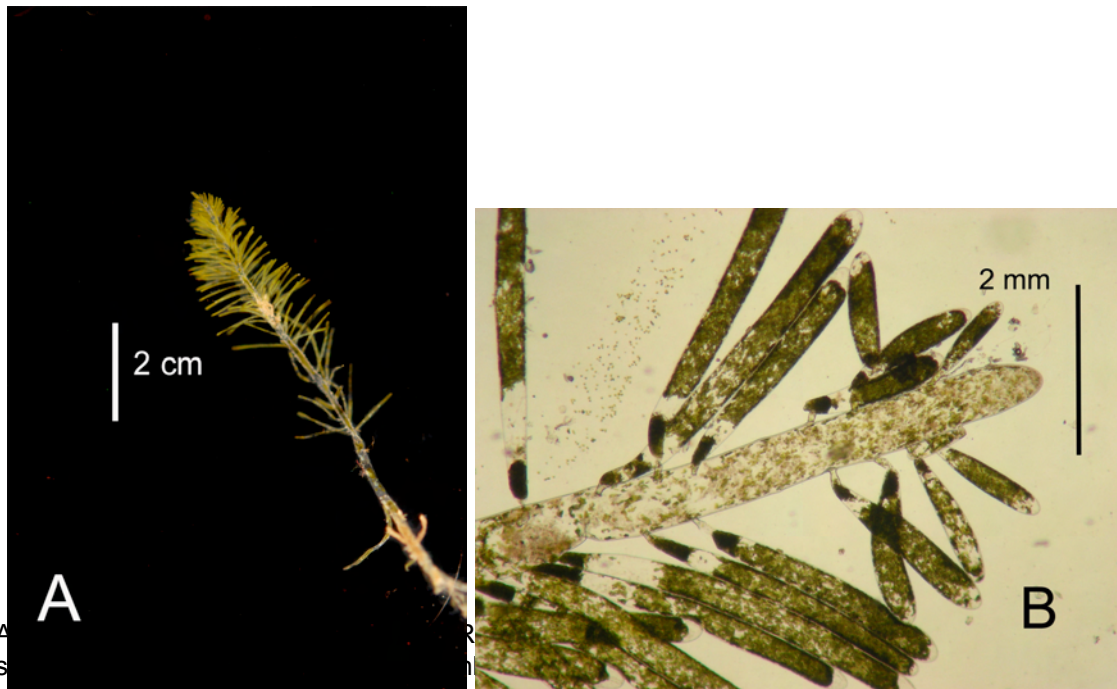
Worldwide Distribution: *Sphacelaria novae-hollandiae*, *S. rigidula* and *S. tribuloides* are reported from Europe, Atlantic Islands, North America, Central America, Caribbean Islands, South America, Africa, Indian Ocean Islands, Asia, South-west Asia, South-east Asia, Pacific Islands, Australia and New Zealand.

Representative Specimens: PASI09.CN-0001.

References

- Littler D.S. & M.M. Littler. 2000. *Caribbean reef plants: an identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico*. Off Shore Graphics, Washington. 542 pp.
- Mendoza-González A.C., Mateo-Cid L.E., Aguilar-Rosas R.E & L.E. Aguilar-Rosas. 2000. La familia Sphacelariaceae (Sphacelariales, Phaeophyta) en las Costas de México. *Polibotánica* 11: 21-41.
- Guiry M.D. & G.M. Guiry. 2009. AlgaeBase. Worldwide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; accessed 20 August 2009.

***Bryopsis pennata* Lamouroux**
(Chlorophyceae, Bryopsidales, Bryopsidaceae)



(A) Fronds featherlike, 5-8 mm in diameter, sparingly branched to 6 cm high, dark green in color, sometimes iridescent, attached by rhizoidal holdfasts on mangrove roots. **(B)** Lateral branchlets pinnate, of uniform length, giving a linear lanceolate or oblong shape to the narrow frond.

Remarks: Plants with secondary branchlets in opposite rows are referred in the literature as *B. plumosa*, in contrast to the irregular position of branchlets in the Bocas specimens. The main axes are not naked below in *B. pennata* as they are in *B. plumosa*. It is unlikely that all the worldwide reports of *B. pennata* conform to this species that was described from the West Indies.

Habitat: On red mangrove prop roots, in depths > 1m

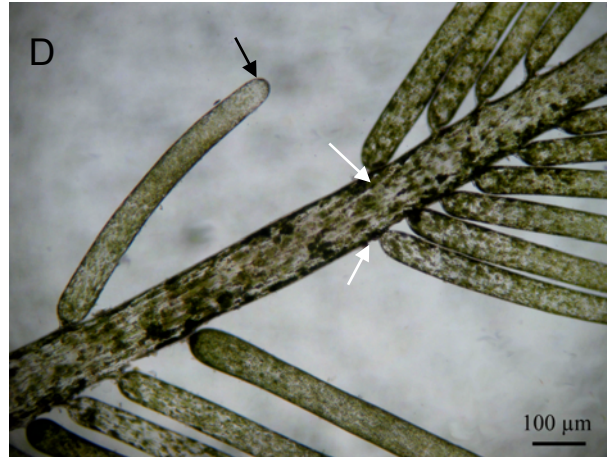
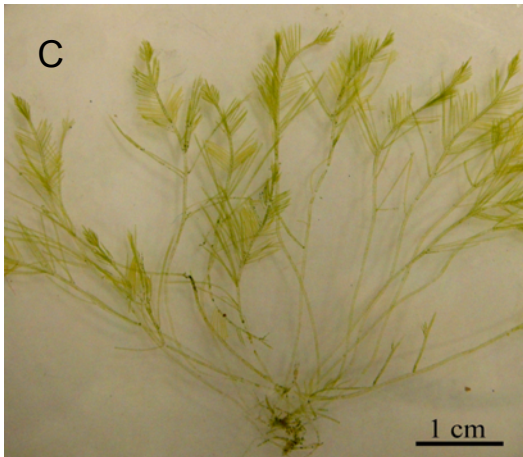
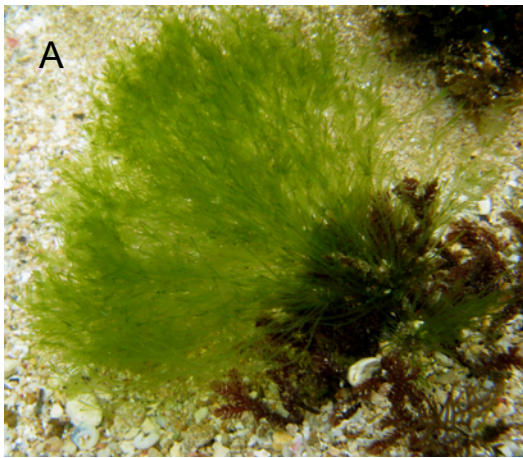
Bocas del Toro Distribution: on mangroves in front of STRI Bocas Station

Worldwide Distribution: Europe: Adriatic Balearic Islands, Italy, Portugal, Turkey. Atlantic Islands: Bermuda St. Helena. North America: Florida, North Carolina, Texas. Central America: Belize, México, Panama. Caribbean Islands: Bahamas, Cuba, Jamaica, Lesser Antilles, Netherlands Antilles, Puerto Rico, St. Thomas, Trinidad, Virgin Islands. South America: Brazil, Chile, Colombia, Guyana, Uruguay, Venezuela. Africa: Angola Cameroon Egypt, Equatorial Guinea, Gabon, Gambia, Kenya, Liberia Morocco, Nigeria.

References: Littler & Littler 2000, Littler *et al.* 2008, Guiry & Guiry 2009 (accessed 18 August 2009).

***Bryopsis ramulosa* (Montagne)**

(Bryopsidophyceae, Bryopsidales, Bryopsidaceae)



A-D. Specimen: PASI.CF-009. **(A)** Habit of pinnate specimens in the field. **(B)** Dark green talli growing interspersed among other seaweeds in the field. **(C)** Specimen showing pinnate fronds and naked stipes below. **(D)** Lateral branchlets with constrictions at base (white arrows), and rounded apices (black arrow).

Description: Featherlike, dark-green to light-green siphonous fronds, naked below. Branchlets short, inserted irregularly opposite or unilaterally on main axis, constricted at base, terminating in rounded apices.

Remarks: Very abundant in the rocky intertidal

Habitat: Tightly adhering to rocks in the intertidal zone, to 1 m depth

Bocas del Toro Distribution: Flat Rock Beach

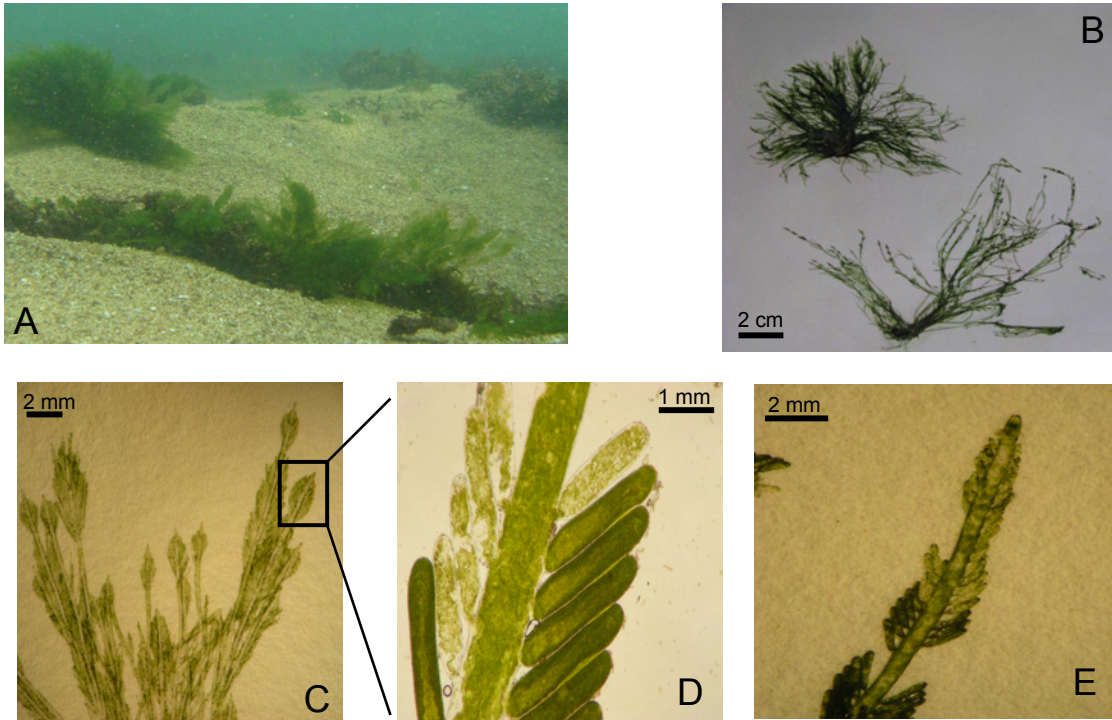
Worldwide Distribution: Florida, Barbados, Cuba, Virgin Islands, Brazil, India.

Representative Specimens: PASI.CF-009.

References:

- Littler D.S. & M.M. Littler. 2000. *Caribbean reef plants: an identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico*. Of Shore Graphics, Washington. 542 pp.
- Guiry M.D. & G.M. Guiry. 2009. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; accessed 18 August 2009

***Bryopsis rhizophora* M.A. Howe**
(Bryopsidophyceae, Bryopsidales, Bryopsidaceae)



A-E. Specimen PASI09.EL-004. **(A)** Specimens of *Bryopsis rhizophora* in sand plain. **(B)** Habit of herbarium specimens. **(C)** Surface view, highlighting the feather-like pinnules. **(D)** Pinnules organized bilaterally to main siphon, constricted at base. **(E)** Surface view showing irregular branching of pinnules.

Description: Coenocytic thallus, 6 to 9 cm high, light to dark green (B), consisting of feather-like siphons with pinnules constricted at their point of attachment to main siphon (C). Main axes approximately 360 µm in diameter, lateral pinnules up to 150 µm in diameter and up to 2 mm high. Shortest pinnules closer to apical region of axes (D, E).

Remarks: Bocas specimens of this species are generally consistent with the descriptions of Wysor (2004) and Littler *et al.* (2008). Although described as a dark green alga in Littler *et al.* (2008), one of the specimens collected is light green. In addition, one of the specimens collected at Wild Cane Cay was found at 50 feet, which is not consistent with previously reported depth distributions (see below). Both observations indicate that different morphotypes can occur and that the distribution of this species is wider than previously noted.

Habitat: According to Littler *et al.* (2008) this marine species can be found on mangrove prop roots or other solid substrata and in calm shallow waters in the lower intertidal to 5 m deep. As noted, Bocas specimens have been found deeper.

Bocas del Toro Distribution: This specimen was collected on Wild Cane Cay (N 09.34673 / W 082.16953).

Worldwide Distribution: *Atlantic Islands:* Tristan da Cunha; *North America:* Florida; *Central America:* Panama; *South America:* Argentina, Chile, Peru.

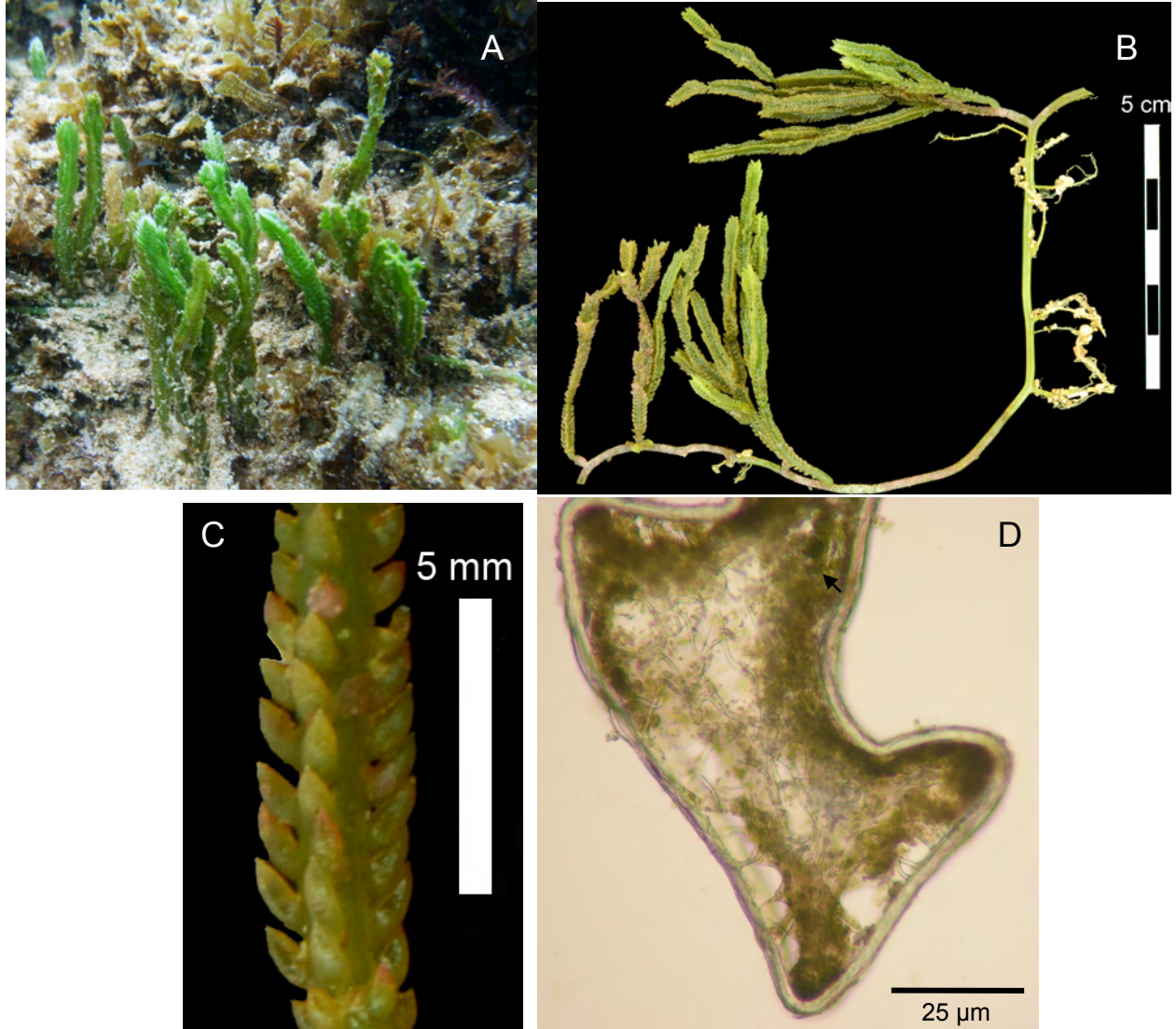
Representative Specimens: PASI09.DM-0002, PASI09.EL-0004

References: Littler, D.S., Littler M.M. & D. Hanisak. 2008. *Submersed plants of the Indian river lagoon. A floristic inventory and field guide.* OffShore Graphics, Inc. Washington D.C.

M.D. Guiry & G.M. Guiry. 2009. *AlgaeBase.* World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 23 August 2009.

Wysor, B. 2004. An annotated list of marine Chlorophyta from the Pacific Coast of the Republic of Panama with a comparison to Caribbean Panama species. *Nova Hedwigia* 78: 209-241.

***Caulerpa cupressoides* (West) C. Agardh**
(Bryopsidophyceae, Bryopsidales, Caulerpaceae)



A-D. PASI09.LQY-0004. **(A)** Habit of specimens in the field. **(B)** Habit of thallus showing creeping stolon bearing irregular erect uprights. **(C)** Close-up of erect upright branch, showing 4 rows of acute branchlets. **(D)** Cross section through stolon showing trabeculae (arrowheads). Photo **A** courtesy of A. Prathep.

Description: Erect uprights up to 25 cm high, green, departing from every 1-10 cm interval on creeping stolon 3 mm in diameter; rhizoids colorless and numerous, each branched irregularly bearing four longitudinal parallel series of branchlets. Branchlets stiff, closely clustered and conical, longer than wide, 0.3-0.4 mm in diameter, with pointed apices. Fine trabeculae evident in cross sections throughout plant.

Remarks: *Caulerpa cupressoides* includes a series of varieties and forms that are separated from one another on the basis of branchlet arrangement, shape of branchlet apices, and type of ramification. Results of chloroplast-encoded *tufA* sequence analysis do not support the traditional morphological sections, and according to Fama et al. (2002), *C. cupressoides* and *C. serrulata* cluster together in a paraphyletic group.

Habitat: Growing on rocks or sand in the shallow subtidal

Bocas del Toro Distribution: Mimbi Timbi, Isla Colón (N 09.44106, W 82.27836)

Worldwide Distribution: Atlantic islands, North and Central America (Belize, Panama, México), Caribbean islands, South America (Brazil, Colombia, Venezuela), Africa, Indian Ocean islands, Asia, Pacific islands

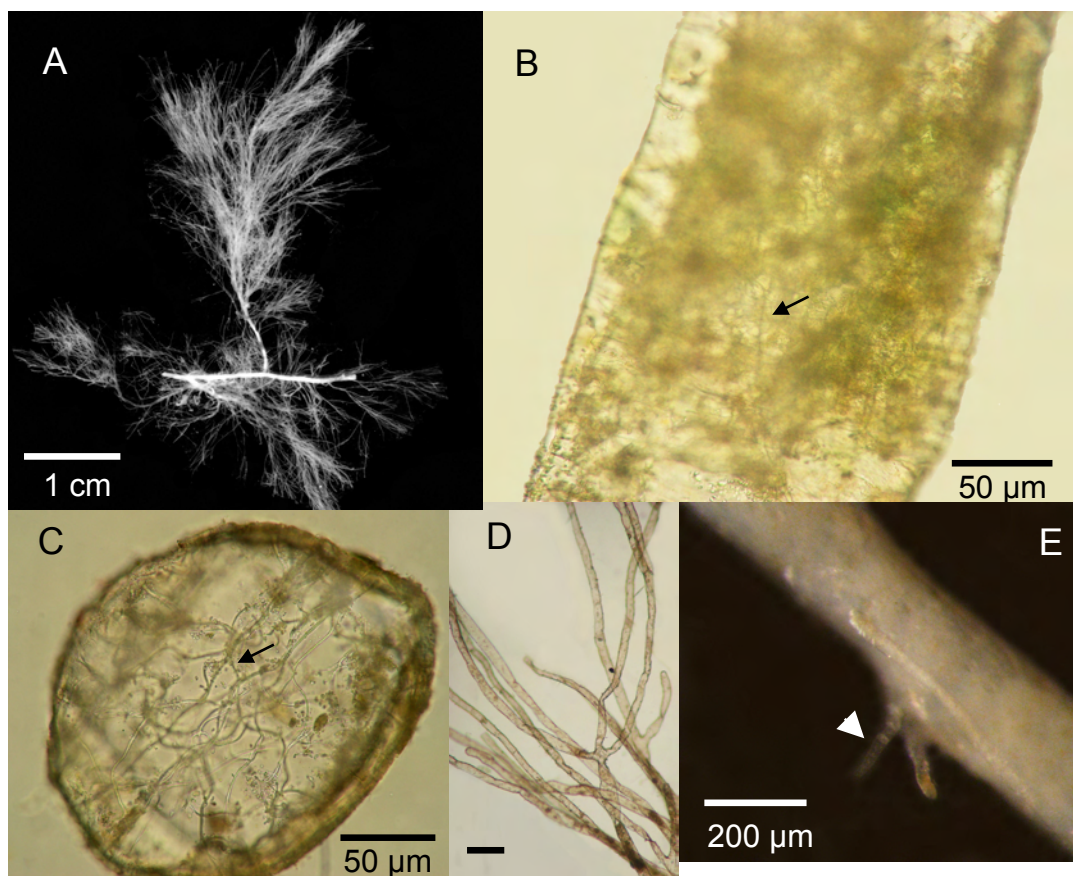
Representative Specimens: PASI09.LQY-0004 (herbarium specimen)

References:

Famà P., B. Wysor & W.H.C.F. Kooistra. 2002. Molecular phylogeny of the genus *Caulerpa* (Caulerpales, Chlorophyta) inferred from the chloroplast *tufA* gene. *J. Phycol.* 38: 1040-50.

Guiry, M.D. & G.M. Guiry. 2009. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 19 August 2009.

***Caulerpa fastigiata* Montagne**
(Bryopsidophyceae, Bryopsidales, Caulerpaceae)



A-E. Specimen PASI09.LQY-0001. **(A)** Habit of herbarium specimen showing dichotomous to irregular branching. **(B)** Trabeculae (arrow) seen in surface view of main siphon and **(C)** in cross section through stolon. **(D)** Close-up of fine, pseudodichotomous distal siphons. **(E)** Surface view showing close-up of stolon bearing small rhizoids (arrowheads).

Description: Thallus composed of fine siphons forming mat-like aggregations (A), up to 3 cm high. Branching of erect main siphons subdichotomous to irregular, width of erect siphons 100-200 µm and of lateral branchlets 30-60 µm. Trabeculae present in both the erect siphons and stolon (B-C, E). Stolon 250-300 µm diam., bearing very fine, short, rhizoids, 10 µm wide.

Remarks: The coenocytic giant *Caulerpa* cell is supported by a series of cell wall invaginations, the trabeculae, that are evident in surface view throughout the erect portions of *C. fastigiata*. In other species of *Caulerpa*, trabeculae are only visible in thallus portions. The Bocas material shows a more pronounced difference between the main siphons and stolon than was previously reported (e.g. Littler & Littler 2000).

Habitat: Epiphytic on *Halimeda simulans* growing in shallow areas of mangrove

Bocas del Toro Distribution: Uncommon in mangrove of Bocas Research Station (N 09.35118, W 82.25697)

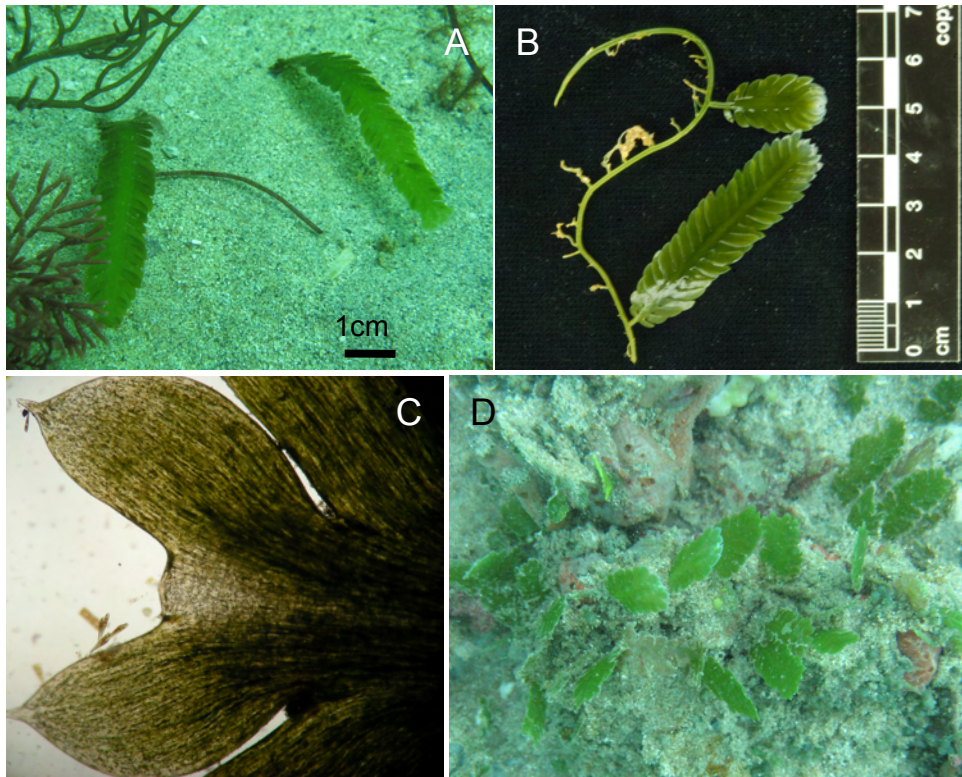
Worldwide Distribution: Atlantic islands (Bermuda, Canary islands), North America (Florida), Central America (Belize, Mexico, Panama), Caribbean islands, South America (Brazil, Venezuela), Africa, Indian Ocean

Representative Specimens: PASI09.LQY-0001 (Formalin-fixed)

References

Guiry, M.D. & G.M. Guiry. 2009. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 19 August 2009

***Caulerpa mexicana* Sonder ex Kützing**
(Bryopsidophyceae, Bryopsidales, Caulerpaceae)



E-D: Specimen PASI09.KD-0005. **(A)** Specimen with subterranean stolon growing in sand channel. **(B)** Specimen showing stolon bearing rhizoids and erect pinnately branched fronds. **(C)** Pinnule apices showing terminal spines. **(D)** Diminutive morph at exposed site.

Description: Multiple erect fronds arising from stolons that bear rhizoidal masses separated by 1-3 mm. Fronds can reach 25 cm in height and 25 mm in width. Fronds composed of simple axes with bipinnate branchlets terminating in pointed tips (C). Diminutive forms also occur commonly (D).

Remarks: *C. mexicana* is distinguished from morphologically similar *C. taxifolia* in that the former lacks constrictions at the base of branchlets. Additionally, the midrib of *C. mexicana* is almost completely flat while that of *C. taxifolia* is compressed but more ellipsoidal.

Habitat: Commonly found growing psammophytically in lagoons, seagrass beds, mangrove fringes, and shallow soft sediments. Also commonly found growing on rocks, pebbles, coral heads, and other hard substrata in reef communities.

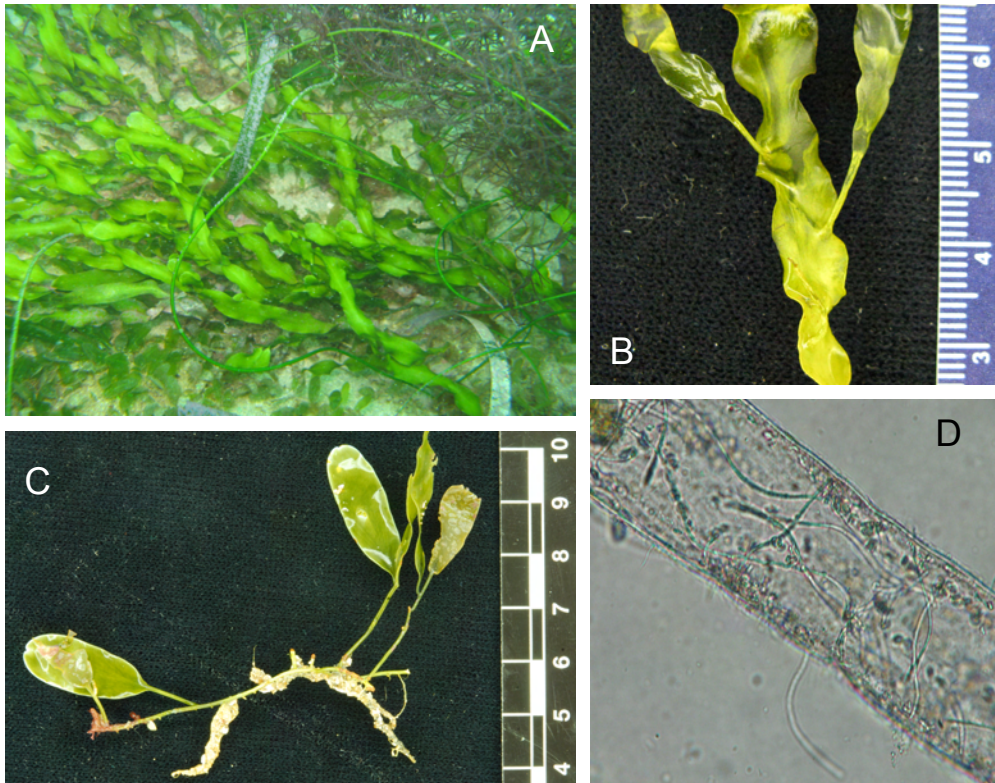
Bocas del Toro Distribution: Throughout local area up to 9 m depth.

Worldwide Distribution: SE USA, Bermuda, Caribbean, Gulf of Mexico, Venezuela, Brazil, Mediterranean, Canary Islands, Mauritania, Red Sea, Indo-Pacific, and Australia.

Representative Specimens: PASI09.KD-0005

References: Dawes, C.J. & A.C. Mathieson. 2008. *The Seaweeds of Florida*. University Press of Florida, Tampa, FL. USA.
Littler, D.S. & M.M. Littler. 2000. *Caribbean Reef Plants*. OffShore Graphics, Inc. Washington D.C. USA.

***Caulerpa prolifera* (Forsskål) J.V. Lamouroux** (Bryopsidaceae, Bryopsidales, Caulerpaceae)



A-D: Specimen: PASI09.KD-0006 (rulers are cm scale). **(A)** Field photograph of *C. prolifera* in a mixed species seagrass assemblage. **(B)** Blade showing proliferation of two addition blades. **(C)** Thallus showing stolon, rhizoids covered with sand, and blades proliferating from stipes. **(D)** Micrograph of a rhizoid showing trabeculae.

Description: Multiple flat, thin blades arising from a single stolon that may or may not branch. Blades linear to oval in shape and proliferating from stipes (C) and often other blades (B). Rhizoids (D) penetrating up to 3 cm into the sediment aiding in anchoring and nutrient absorption. The species often occurring in dense patches (A).

Remarks: *Caulerpa prolifera* is one of the most and easily identified of the *Caulerpa* species with smooth lanceolate blades.

Habitat: Common in seagrass beds, lagoons, and the mangrove fringe in soft siliciclastic to harder carbonate sediments.

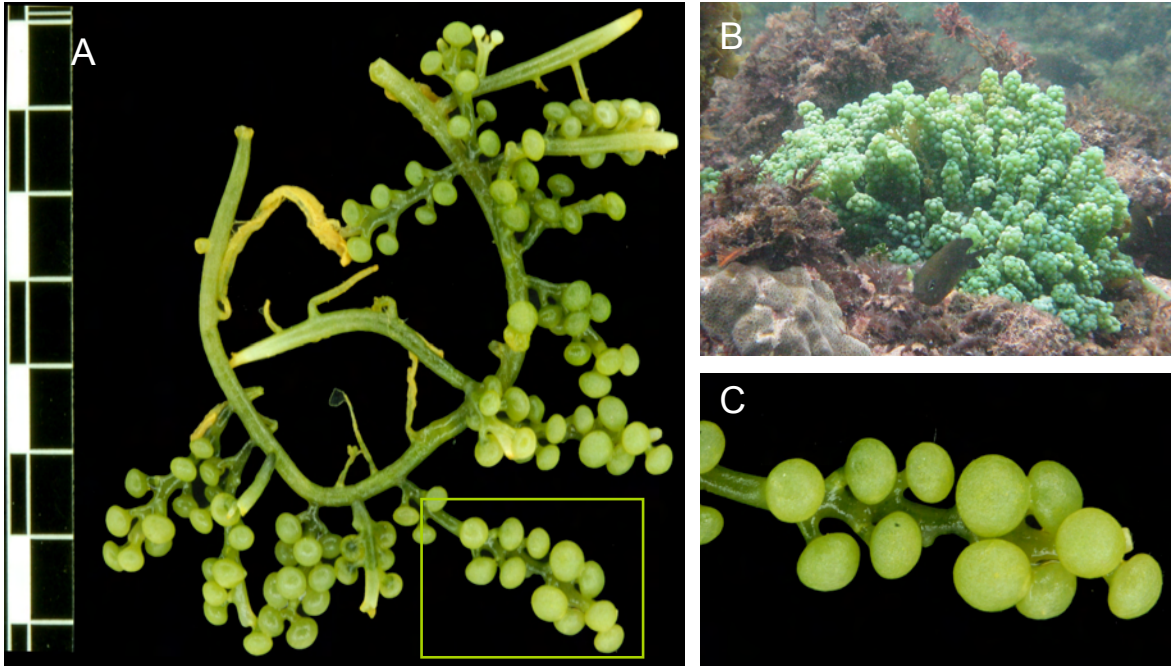
Bocas del Toro Distribution: Bocas Research Station, North Rock at Carenero, Wild Cane Cay, Isla Colón

Worldwide Distribution: Southeastern USA, Bermuda, Caribbean, Gulf of Mexico, Brazil, Spain, Portugal, Mediterranean, eastern tropical Atlantic, Red Sea, and Indo-Pacific.

Representative Specimens: PASI09.KD-0006

References Dawes, C.J. & A.C. Mathieson. 2008. *The Seaweeds of Florida*. University Press of Florida, Tampa, FL. USA.
Littler, D.S. & M.M. Littler. 2000. *Caribbean Reef Plants*. OffShore Graphics, Inc. Washington D.C. USA.

***Caulerpa racemosa* (Forsskål) J. Agardh**
(Bryopsidophyceae, Bryopsidales, Caulerpaceae)



A-C: Specimen PASI09.EL-0001. **(A)** Herbarium specimen showing repent stolon with rhizoids and erect siphons bearing elongate grape-like clusters. **(B)** *C. racemosa* *In situ* at Flat Rocks Beach. **(C)** Club-shaped terminal siphons.

Description: Fronds 1-5 cm high, evenly grass-green, consisting of creeping stolons with numerous rhizoids below and erect siphons above bearing elongate grape-like clusters of spherical to club-shaped branchlets, 2-4 mm diam., not constricted at base. Erect stalks 1-2 mm diam., stolons 2-3 mm diam.

Remarks: Branchlet and stolon measurements indicate that *C. racemosa* might be confused with *C. macrophysa*.

Habitat: 2 m depth; on sand-covered dead coral fragments

Bocas del Toro Distribution: Research Station Bay, Mimbi Timbi and Flat Rock Beach, Isla Colon

Worldwide Distribution: Australia, New Zealand, South America, Europe, Atlantic Islands, North America, Central America, Caribbean Islands, Africa, Indian Ocean Islands, Asia, Pacific Islands.

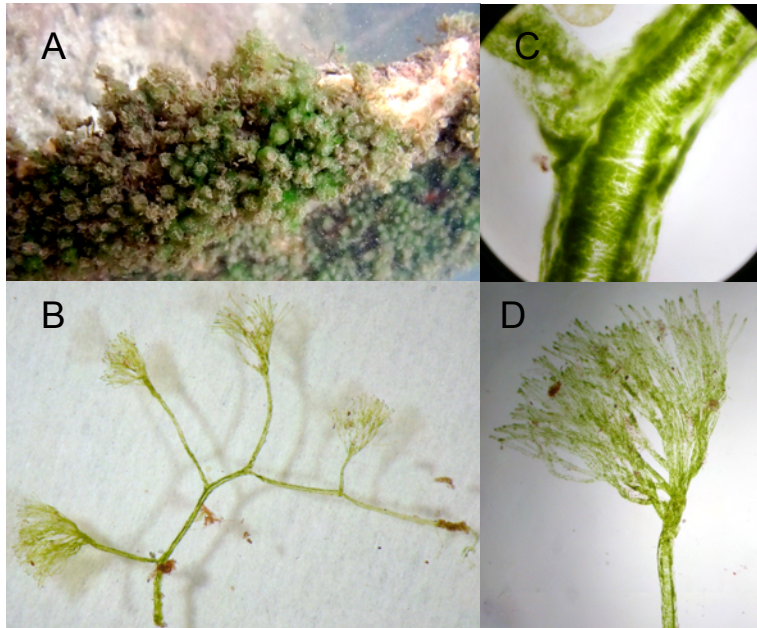
Representative Specimens: PASI09.EL-0001

References: www.algaebase.org accessed 18 August 2009

Littler D.S. & M.M. Littler. 2000. *Caribbean Reef Plants*. OffShore Graphics, Inc. Washington, D.C. 542 pp.

***Caulerpa verticillata* J. Agardh**

(Ulvophyceae, Bryopsidales, Caulerpaceae)



A-D: Specimen PASI09DV002. **(A)** Habit of *C. verticillata* in the field showing dense aggregation of branches and brachlets. **(B)** Habit under a stereomicroscope showing sparse aggregation of verticells. **(C)** Portion of stolon seen under microscope. **(D)** Close-up view of branch and branchlets. Photos B, C and D were taken on specimen PASI09DV002.

Description: Fronds light green, composed of creeping, slender stolons 300-560 μm in diameter, bearing erect cylindrical siphons 1-3 cm high, and 5-7 times dichotomously branched finer siphons. Central axes 140-200 μm in diameter. Upper portions lax, forming distinct whorls that are crowded distally, lower portions 100-210 μm in diameter; individual upper whorl siphons, 30-40 μm in diameter, terminating in pointed and abruptly forked apices. Rhizoids branched and few.

Remarks: All characteristics described above are consistent with the descriptions by Littler & Littler (2000); however, this species sometimes appears in a different form as *Caulerpa verticillata* f. *charoides*. The lower portion of this form reaches 80-100 μm diameter and 2-3 times the length of its diameter. Apical portions of the form *charoides* measure 20-40 μm diameter and are sometimes rounded, while stolons are 150-200 μm diameter, and whorled fronds reaching 5 mm in diameter. Trabeculae in the species are easily visible under magnification.

Habitat: on prop roots and small rocks in muddy bottoms of mangrove areas

Bocas del Toro Distribution: Dock of Bocas Research station, Isla Colon

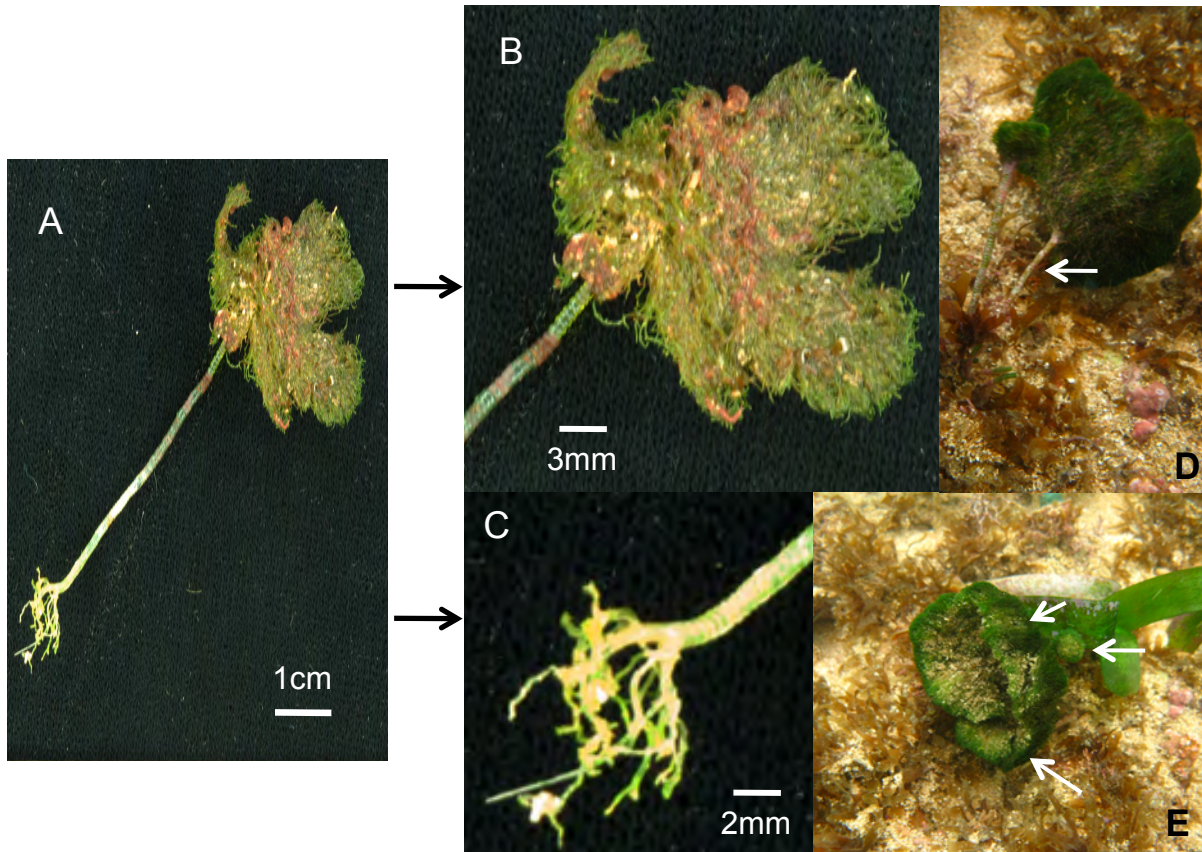
Worldwide Distribution: Western Atlantic, Eastern Pacific, Red Sea, Indo-Pacific, New Zealand, Pacific Islands

Representative Specimens: PASI09DV002

References

Guiry M.D. & Guiry G.M. 2009. AlgaeBase. Worldwide Electronic Publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 21 August 2009
Littler S.C. & Littler M.M. 2000. *Caribbean Reef Plants*. OffShore Graphics INC. Washington: 542pp

Chamaedoris peniculum (J. Ellis & Solander) Kuntze
(Ulvophyceae, Siphonocladales, Siphonocladaceae)



A-E: Specimen PASI09.KD-0009. **(A)** Thallus showing holdfast, stipe, and cap. **(B)** Close-up shot of cap and upper stipe showing annular constrictions and epiphytic *Foslarella chamaedoris* on stipe. **(C)** Close-up of holdfast showing individual rhizoids. **(D)** Angle of stipe illustrating the high current at collection site. **(E)** Typical tight cluster of individual caps (arrows).

Description: Thallus conspicuous with bright green caps composed of coarse filaments connected peltately to a green stipe often completely epiphytized with pink coralline crusts (A, B). Plant attached to rocks via rhizoidal masses (C), often found in high surge areas (D) and occurring in clusters of three or more (E).

Remarks: This species resembles *Penicillus capitatus* in gross morphology. However, these two species belong in different classes and have independently evolved this morphology. They may be differentiated by their stipes, which in *C. peniculum* have sequential constrictions and are usually covered with the crustose coralline epiphyte, *Foslarella chamaedoris*, while the stipe of *P. capitatus* lacks annual constrictions and is entirely siphonous.

Habitat: Subtidal (6m+) saxicolous in areas of high surge

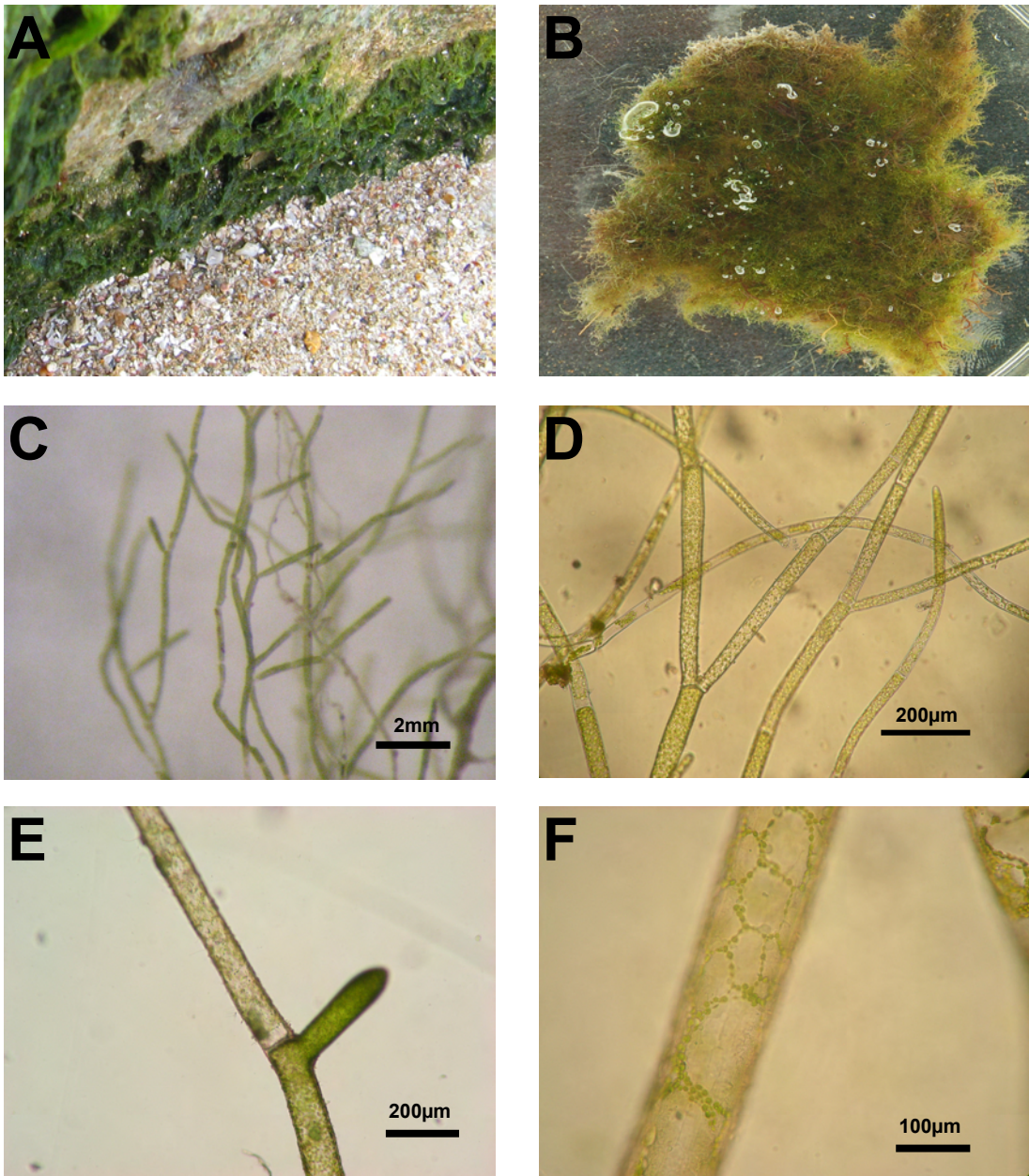
Bocas del Toro Distribution: Mimbi Timbi, Isla Colón

Worldwide Distribution: Florida, Panama, Caribbean, Brazil, Colombia, Venezuela

Representative Specimens: PASI09.KD-0009

References Littler, D.S. & M.M. Littler. 2000. *Caribbean Reef Plants*. OffShore Graphics, Inc. Washington D.C. USA.

***Cladophora liniformis* (Kützing)** (Ulvophyceae, Cladophorales, Cladophoraceae)



Morphology and anatomy of *Cladophora filiformis* (PASI09-HA003, PASI09.SA-011). A. Habitat on high intertidal rock B. Mats of *Cladophora* from the base of a mangrove, C-D. Typical branchlets, E. Unilateral branching at tips, F. Cells with ribbon-like chloroplast.

Description: The thallus is spongy and forms loose-laying mats, pale to dark green in color, dichotomously branched at base with one branch at joints; filaments are straight but can be curved at the tips; filament cells have ribbon like chloroplast; cells cylindrical 40-65 μm in diameter, 3.5-20 diameters long, can have curved apices.

Remarks: The record is described for the first time for Bocas del Toro. Consistent with Littler & Littler's (2000) ecological description, this specimen can be found close to freshwater outflows and mangroves.

Habitat: Intertidal, epiphytic on mangrove or on rocks in association with *Ulva* sp.

Bocas del Toro Distribution: Gran Caracol Creek & Esquina de Panch, Bocas del Toro, Isla Colón, Panamá

Worldwide Distribution: Europe, North America, Caribbean Islands, Asia.

Representative Specimens: PASI09-HA003, PASI09.SA-011.

References:

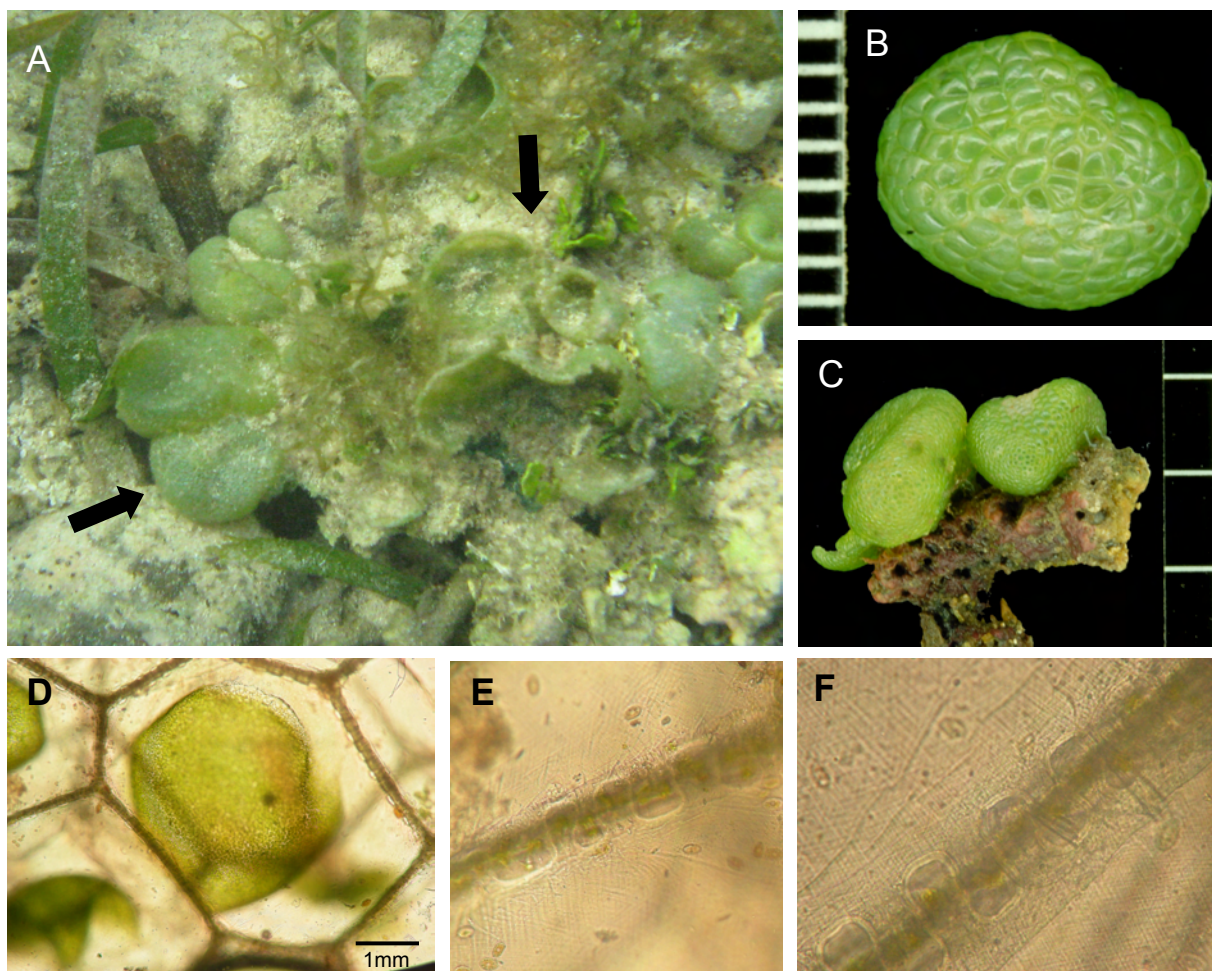
Guiry, M.D. & Guiry, G.M. 2009. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 20 August 2009.

Kützing, F.T. (1849). *Species algarum*. pp. [i]-vi, [1]-922. Lipsiae [Leipzig]: F.A. Brockhaus.

Littler, D.S. & Littler, M.M. (2000). Caribbean reef plants. An identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico. pp. 542.. Washington: Offshore Graphics.

Dictyosphaeria cavernosa (Forsskål) Børgesen)

(Ulvophyceae, Siphonocladales, Siphonocladaceae)



A-F: Specimen: PASI09.EL-0002. **(A)** Spherical (left arrow) and lacerated (right arrow) thalli growing on coral rubble in the field. **(B)** Solitary thallus with compartments resulting from segregative cell division. **(C)** Cluster of thalli growing on dead coral fragment. **(D)** Hexagonal cell with polyhedral cell inclusion. **(E-F)** Close-up view of cellular connections separating cells.

Description: Thallus sack-like, hollow, spherical when young and irregularly lobed or ruptured when old (A). Thallus 12 (-30) cm in diameter, light green in color. Primary cells 0.1-3.0 mm diameter, organized in single layer, angular or hexagonal in surface view (D), adhering to one another by microscopic hapteroid cells (E, F).

Remarks: The Bocas specimens conform to the species description.

Habitat: 2 m depth on coral rubble, often found within Agaricid colonies

Bocas del Toro Distribution: Research Station Bay

Worldwide Distribution: tropical America, Caribbean Islands, Africa, Indian Ocean Islands, Asia, Australia, New Zealand, Pacific Islands

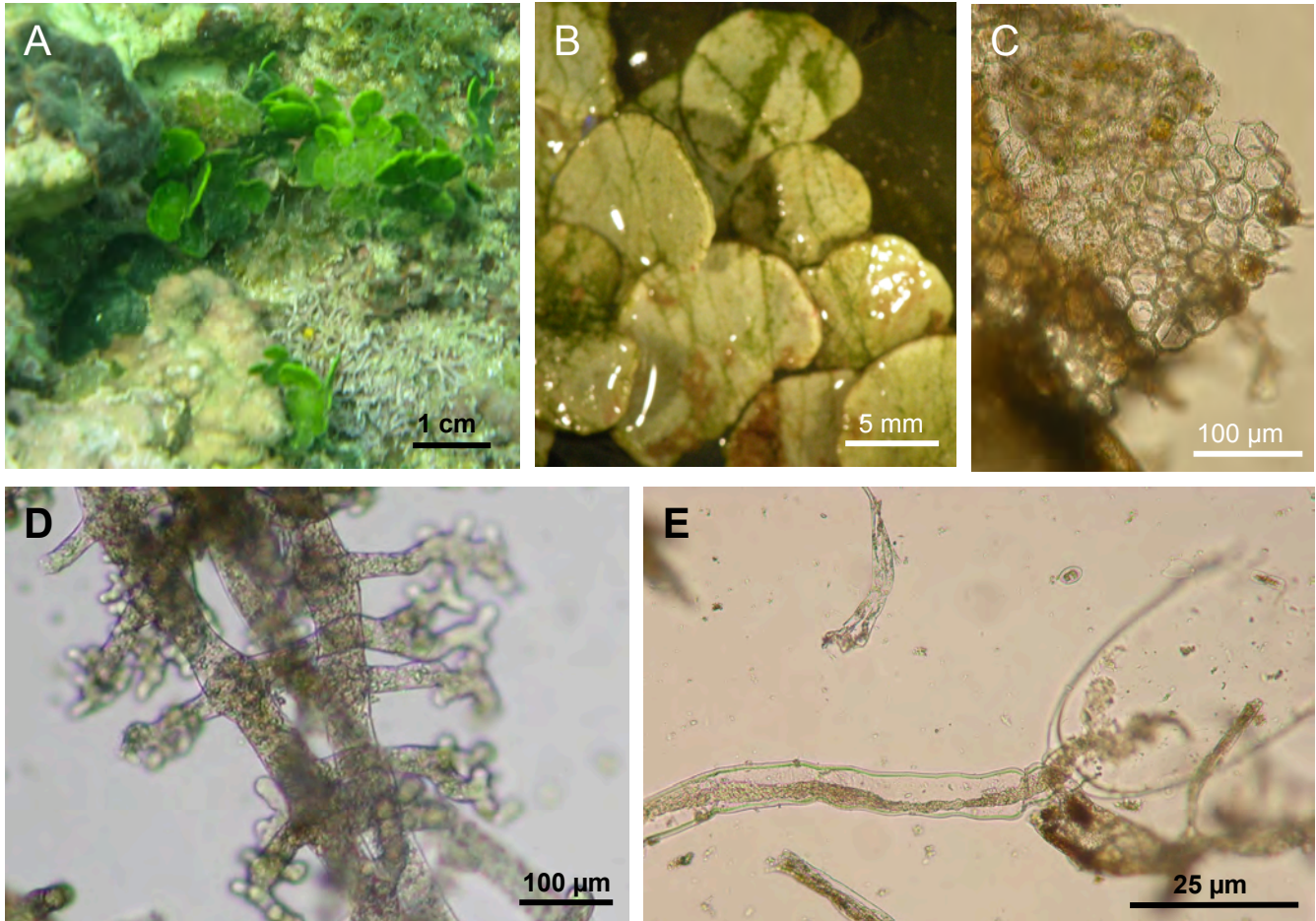
Representative Specimens: PASI09.EL-0002

References: www.algaebase.org accessed 18 August 2009

Littler, D.S. & M.M. Littler. 2000. *Caribbean Reef Plants*, OffShore Graphics, Inc. Washington, D.C. 542 pp.

Halimeda tuna (J. Ellis & Solander) J.V. Lamouroux

(Bryopsidophyceae, Bryopsidales, Halimedaceae)



A-E: Specimen PASI09.RKEP.006. **(A)** Habit of specimen in the field. **(B)** Surface view of segments. **(C)** Close-up view of surface utricles. **(D)** Longitudinal view through nodal siphons. **(E)** Utricle fragment.

Description: Thallus calcified, distinctly segmented with initial branching in one plane (A, B). Segments disc-like to triangular, up to 2 cm wide (B). Internodal siphons uncalcified, united in twos or threes, and terminating in pseudodichotomous laterals (D). Surface cells appressed to one another in a honeycomb pattern, 25-75 μm in diameter (C, E).

Remarks: This species superficially resembles *Halimeda scabra*; however, in *H. scabra* surface utricles appear swollen, which is not the case in *H. tuna*.

Habitat: Found on hard rocky substratum less than 2 m depth.

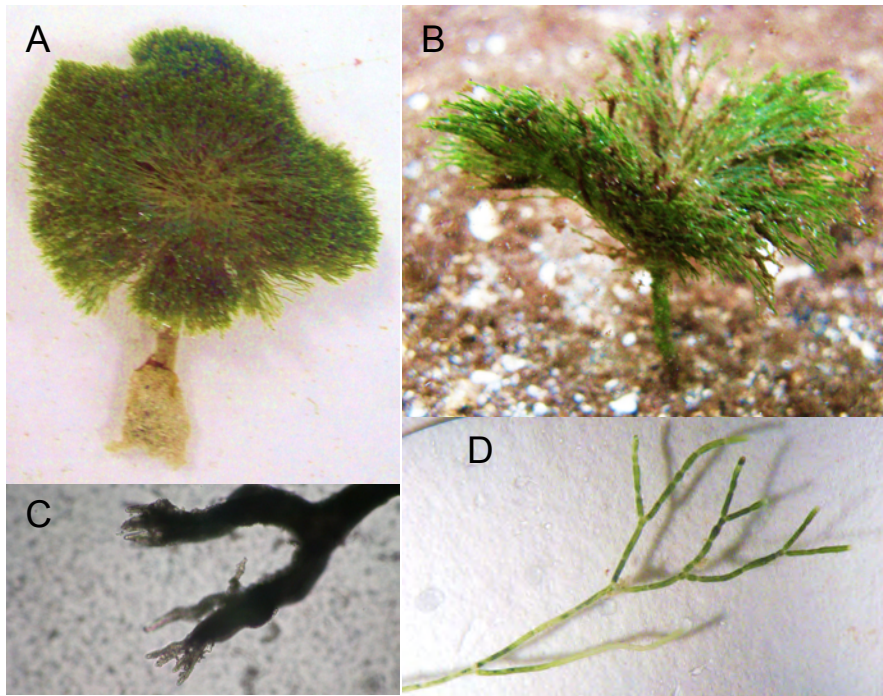
Bocas del Toro Distribution: Flat Rock Beach, Mimbi Timbi, and Esquina de Punch

Worldwide Distribution: Europe (Adriatic, France, Italy, and Spain), Atlantic Islands (Bermuda), North America (Florida and Mexico), Central America (Belize and Panama), Caribbean, Brazil, Africa (Tunisia), South-west Asia (Levant states and Sri Lanka), Australia and New Zealand.

Representative Specimens: PASI09.RKEP.006.

References: Littler & Littler (2000), Guiry & Guiry 2009 (accessed 20 August 2009)

***Penicillus pyriformis* A. Gepp & E. Gepp**
(Bryopsidophyceae, Bryopsidales, Udoteaceae)



A-D. Specimen PASI09DV012. **(A)** Habit of collected plant, and **(B)** in the field on sandy substratum. **(C)** Pseudodichotomously branched lateral appendages of stipe. **(D)** Cap siphon.

Description: Thallus calcified, compact, brush-like, <10 cm high. Stipe unbranched, <6 mm diameter, <8 cm long, greyish-green, cylindrical, rough-textured. Lateral appendages of stipe siphons terminating in long, tapering, bluntly pointed tips. Cap green, cone-shaped, flat-topped, calcified, composed of entangled stiff siphons, 150-250 μ m in diameter.

Remarks: All characteristics described above are consistent with the description by Littler & Littler (2000).

Habitat: Sandy bottoms in calm shallow areas

Bocas del Toro Distribution: Isla Solarte, Isla Bastimentos

Worldwide Distribution: Western Atlantic

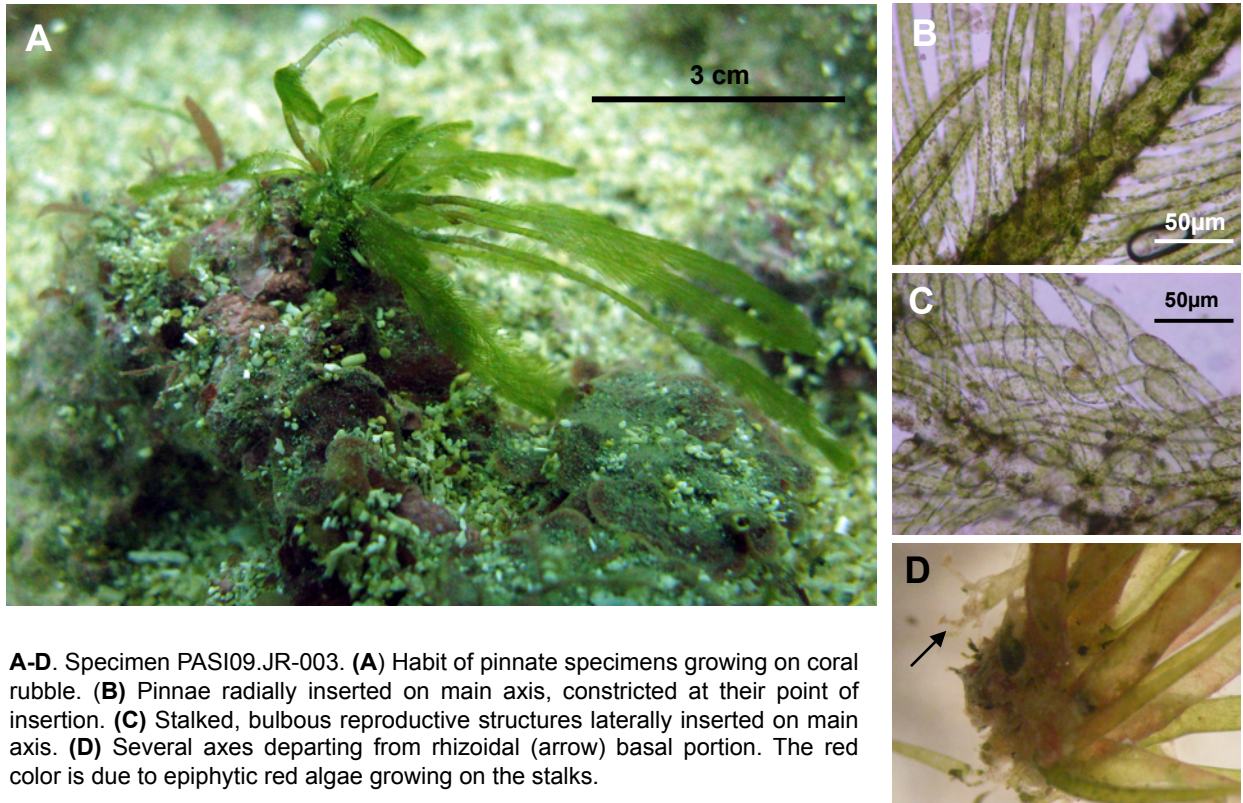
Representative Specimens: PASI09DV012, PASI09DV013

References

Guiry M.D. & Guiry G.M. 2009. *AlgaeBase*. Worldwide Electronic Publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 21 August 2009

Littler S.C. & Littler M.M. 2000. *Caribbean Reef Plants*. OffShore Graphics Inc. Washington: 542pp

***Pseudobryopsis* sp. (J. Ag.) Berthold**
(Bryopsidophyceae, Bryopsidales, Bryopsidaceae)



A-D. Specimen PASI09.JR-003. **(A)** Habit of pinnate specimens growing on coral rubble. **(B)** Pinnae radially inserted on main axis, constricted at their point of insertion. **(C)** Stalked, bulbous reproductive structures laterally inserted on main axis. **(D)** Several axes departing from rhizoidal (arrow) basal portion. The red color is due to epiphytic red algae growing on the stalks.

Description: Thallus siphonous, erect, consisting of one to many axes, radially surrounded by lateral siphons that are pinched at their point of insertion. Attached to rocky substratum by rhizoidal holdfast. Cross-walls absent but may be present at base of reproductive organs. Gametangial buds bulbous, stalked.

Remarks: A sole individual was found at Wild Cane Cay at 20 ft depth while at Mimbi Timbi multiple individuals were collected from the same depth.

Habitat: On rubble

Bocas del Toro Distribution: Wild Cane Cay (N 09.34673 W 82.16953) and Mimbi Timbi (N 09.44106 W 82.27836)

Worldwide Distribution: Mediterranean, Canary Islands, West Africa, Caribbean, Hawai'i, Solomon Islands, Japan, China, Vietnam, India, Maruitius and the Red Sea.

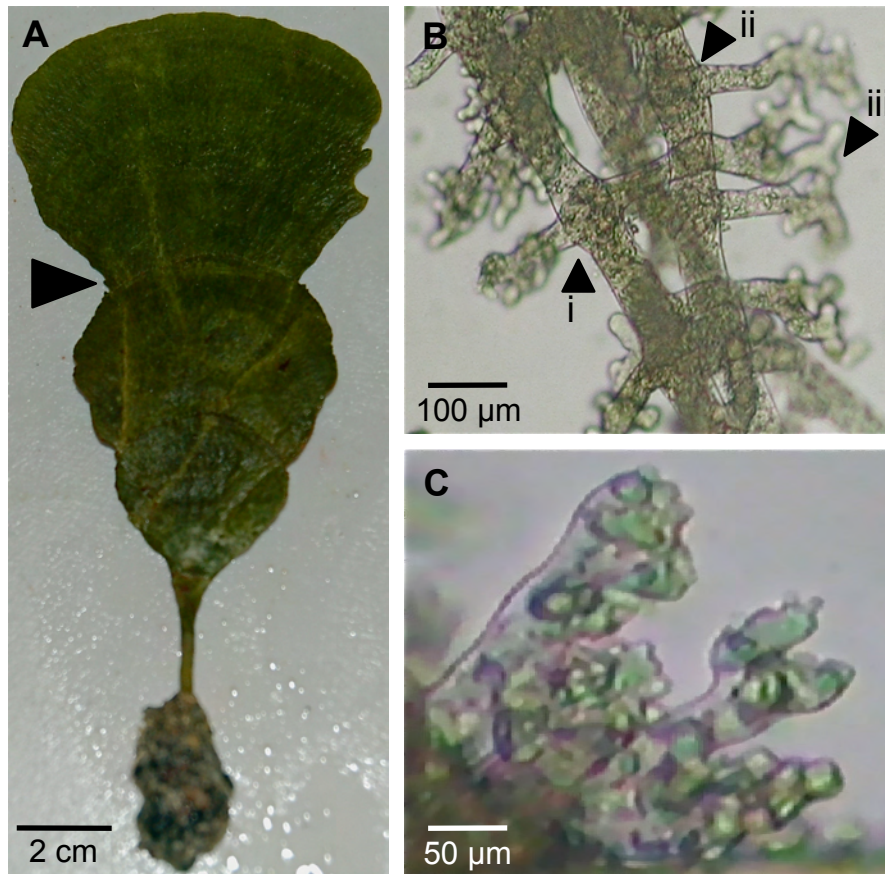
Representative Specimens: PASI09.JR-003

References:

Henne & Schnetter. 1999. Revision of the *Pseudobryopsis/Trichosolen* complex (Bryopsidales, Chlorophyta) based on features on gametangial behavior and chloroplasts. *Phycologia* 38:114.

Udotea dixonii Littler and Littler

(Bryopsidophyceae, Briopsidales, Udoteaceae)



A-D. Specimen: PASI09.RKEP.002. **(A)** Habit of herbarium specimen showing the slightly constricted (arrow) middle portion of blade, stalk, and bulbous holdfast. **(B)** Longitudinal view of stalk siphons showing lateral appendages terminating in irregular projections. **(C)** Close-up of lateral appendages of stalk siphons.

Description: *Udotea dixonii* is typically found in groups of 2-5 uprights or occasionally singly from a single bulbous holdfast. Blades longer (6-12 cm) than wide (4-10 cm) with a distinct zonation (A, arrow), fan-shaped, lightly calcified and yellow-green to dark green, up to 21 cm high (A). A longitudinal section of the blade shows siphons with lateral appendages opposite in rows (B arrow i), continuous cortex (B arrow ii), terminating in dichotomous, rounded apices (B arrow iii). Close up of apices have fingerlike projections (C).

Remarks: This lone specimen of *Udotea dixonii* was found on a sandy bottom, approximately at 4 m depth. This is shallower than the reported depth range of 15-54 m (Littler & Littler 2000). The opposite arrangement of the siphons and the stubby, fingerlike terminal stalk projections distinguish this species from other species of *Udotea*.

Habitat: Sandy bottom, found at 4 m depth

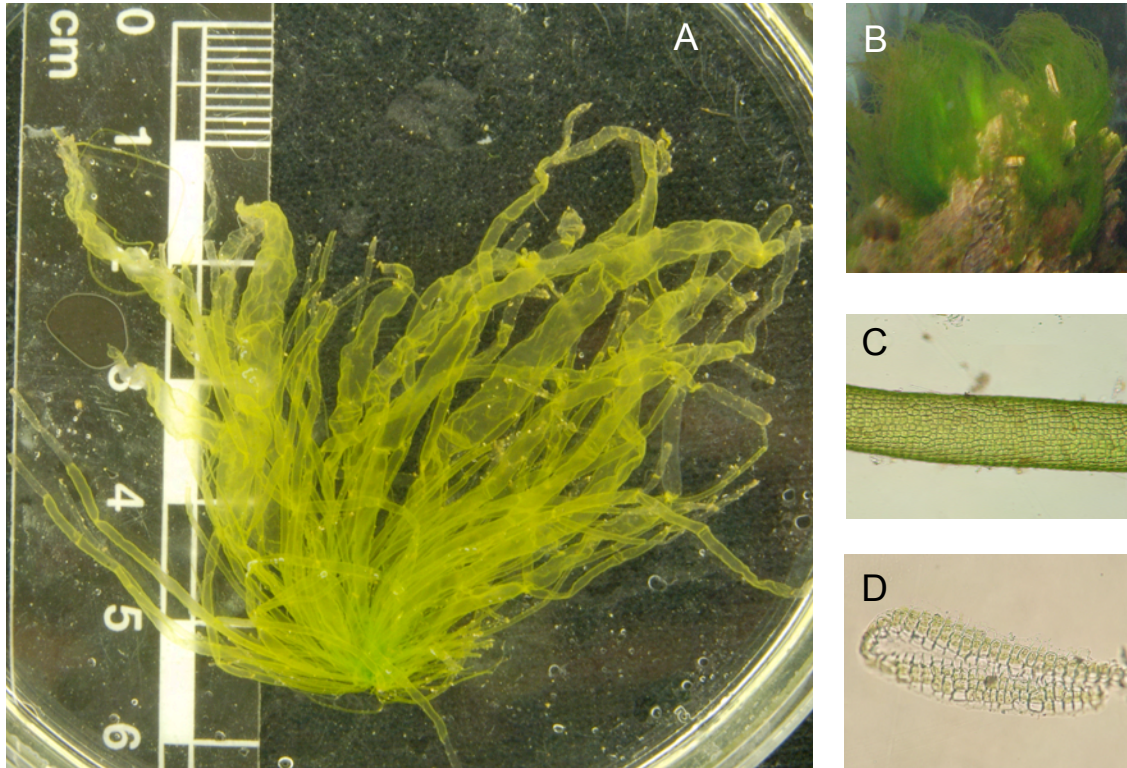
Bocas del Toro Distribution: Wild Cane Cay

Worldwide Distribution: North America, Caribbean

Representative Specimens: PASI09.RKEP.002

References: Littler and Littler 2000, algaebase.org

***Ulva flexuosa* Wulfen**
(Ulvophyceae, Ulvales, Ulvaceae)



A-D. Specimen BdT09-CA001. **(A)** Habit of live specimen, depicting the sparse branching near base; **(B)** Specimen growing on submerged plank at Bocas Research Station, Bocas del Toro, Panama (<1 ft.); **(C)** Surface view of blade cells which are often aligned; **(D)** Transverse section of blade.

Description: Alga characterized by groups of flaccid, thin blades that branch apart at the base. Range from light to dark green in color and are often found growing in distinct groupings (A). Cylindrical blades are completely hollow and are usually short (5-7 cm) but can grow up to 25 cm (B). Cells tend to be in linear rows (C). Blades consist of hollow tube whose walls are only one cell thick (D).

Remarks: Formally *Enteromorpha flexuosa*, Hayden et al. 2003 determined that *Enteromorpha* and *Ulva* were not distinct genera. Subsequently, *Enteromorpha flexuosa* was reclassified as *Ulva flexuosa*.

Habitat: Common on shallow submerged substrata, or epiphytic on other marine plants; to 5 m deep.

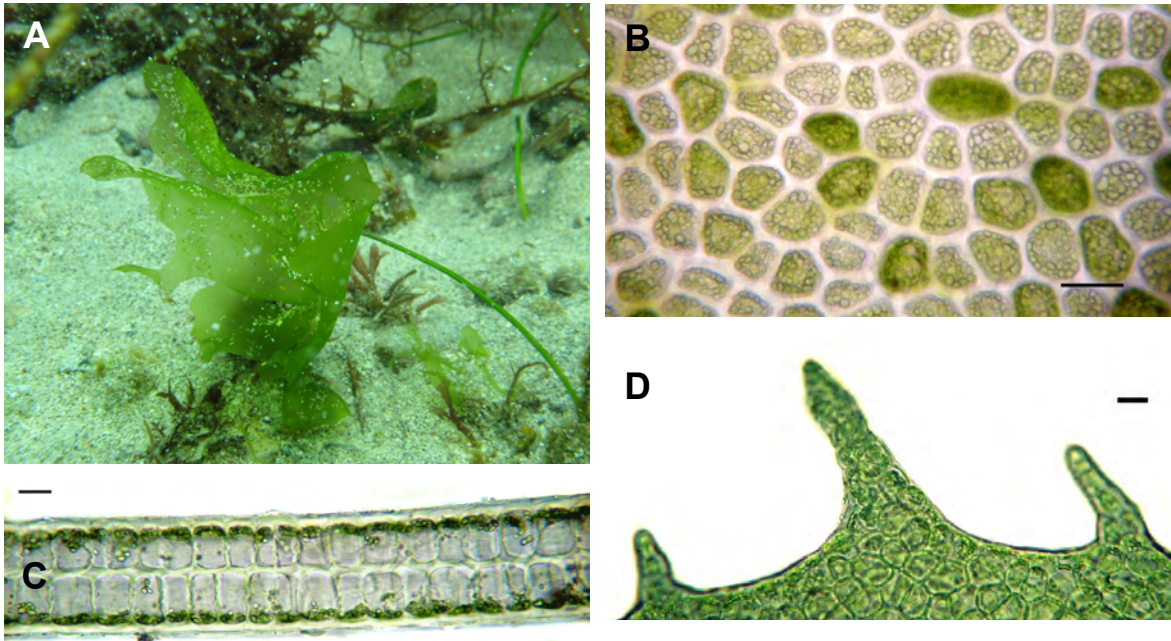
Bocas del Toro Distribution: Samples found near Bocas Research Station

Worldwide Distribution: Found along eastern seaboard from Quebec to Florida and throughout the Caribbean and the Gulf of Mexico. Note: Recent molecular evidence (e.g., Heesche et al. 2009) suggests that the application of species names for specimens collected significantly outside of their geographic range of the type locality may be inappropriate. Thus, the range of this species may be much smaller than suggested in the literature.

Representative Specimens: BdT09-CA001

References: Hayden et al. (2003) *Eur. J. Phyc.* 38: 277-294; Heesche et al. (2009) *Eur. J. Phycol.* 44:143-154; Guiry & Guiry (2009) www.algaebase.org; Littler & Littler (2000) *Caribbean Reef Plants*, Offshore Graphics: Washington, D.C. pp. 150.; Littler et al. (2008) *Submersed plants of the Indian River lagoon: a floristic inventory & field guide*, Offshore Graphics: Washington, D.C. pp. 183.

***Ulva rigida* (C. Agardh)** (Ulvophyceae, Ulvales, Ulvaceae)



A-C: Specimen PASI09.CN-0006. **(A)** Specimen growing attached to hard substratum in sand. **(B)** Surface cells showing pyrenoids. **(C)** Transverse section through bistrromatic blade showing longitudinal rectangular cells and parietal plastids. **(D)** Marginal teeth. Scale bar: 25 μm . Photos: (A) C. Fernández, (B-D) N. Cetz-Navarro.

Description: Thallus thin, soft, sheet-like, without perforations. Blade ~5 cm wide, 7 cm long. Color bright green in the field, but becoming darker upon processing in the laboratory. Bistrromatic blades measuring ~75 μm in thickness, with square to rectangular cells from 20 to 36 μm in diameter. Margins slightly undulating, with sporadic conical teeth, each tooth consisting of 3-7 cells, ~25 μm in diameter; shape of terminal teeth cells rounded. Cells in surface view rounded to irregular polyhedral, closely appressed, measuring 13-35 μm in diameter. Approximately 18 pyrenoids per cell present, measuring 2 to 6 μm in diameter.

Remarks: Even though the species has been reported in the literature (Littler & Littler 2000) as having perforations throughout the blade, material from Wild Cane Cay lacked holes. Marginal teeth in the Bocas material are conical with rounded tips instead of pointed, and the Bocas specimens also contain more pyrenoids per cell than reported for the species in Brodie *et al.* (2007) (~18 vs. ~2). This is the only species of *Ulva* in the Caribbean that is reported as having marginal teeth; however, it is necessary to confirm the species' identity as it was originally described from Cadiz, Spain. A worldwide revision of species of *Ulva* with marginal teeth is needed to resolve this question.

Habitat: On hard substrata, to 3 m depth

Bocas del Toro Distribution: Wild Cane Cay; N 09.34673, W 082.16953

Worldwide Distribution: Reported from the Arctic Ocean, Europe, Atlantic Islands, North America, Central America, Caribbean, Islands, South America, Africa, South Africa, Indian Ocean Islands, South-west Asia, South-east Asia, Pacific Islands, Australia and New Zealand, and the Antarctic Ocean and Subantarctic Islands.

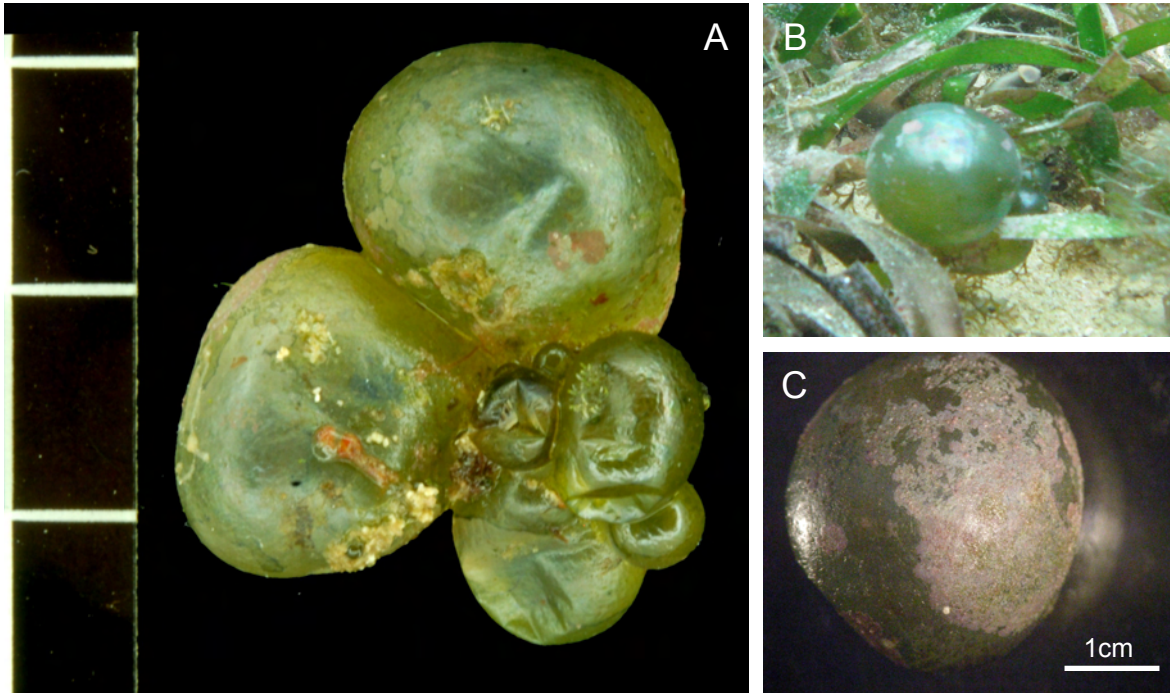
Representative Specimens: PASI09.CN-0006.

References

- Brodie J., Maggs A.C. & D.M. John. 2007. *Green seaweeds of Britain and Ireland*. British Phycol. Soc., Northern Ireland. 242 pp.
- Littler D.S. & M.M. Littler. 2000. *Caribbean reef plants: an identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico*. OffShore Graphics, Washington. 542 pp.
- Guiry M.D. & G.M. Guiry. 2009. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; accessed 18 August 2009.

Valonia ventricosa (J. Agardh 1887)

(Ulvophyceae, Siphonocladales, Valoniaceae)



A-C: Specimen PASI09.EL-0003. **(A)** Cluster of *V. ventricosa*. **(B)** Specimen in situ in the seagrass at STRI's Research Station Bay. **(C)** Solitary thallus with epiphytic crustose corallines.

Description: Thallus spherical, firm, egg-shaped, hollow, unbranched, growing solitary or in loosely appressed aggregations, 2-5(-10) cm in diameter, glossy dark green. Cell walls thin. Rhizoidal cells when present small and branched.

Remarks: This species was formerly known as *Ventricaria ventricosa*.

Habitat: Common in shallow waters at 2 m depth; found on dead coral fragments and in seagrass beds.

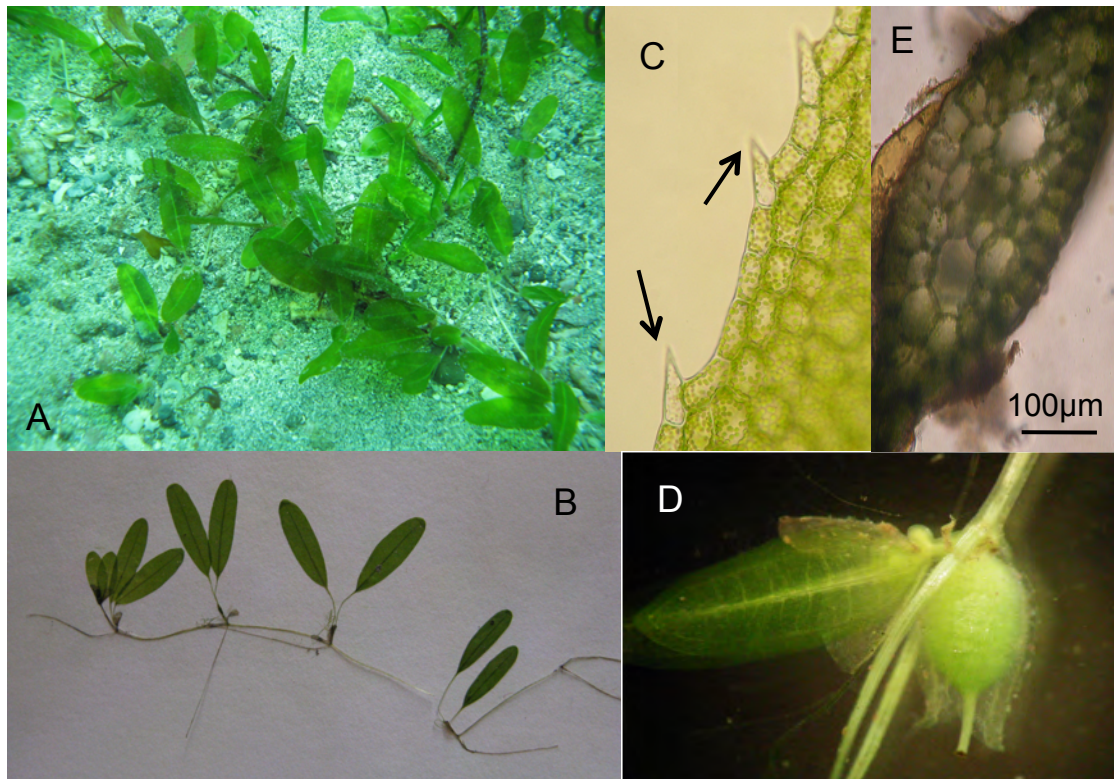
Bocas del Toro Distribution: Research Station Bay

Worldwide Distribution: Europe, Atlantic Islands, North America, Central America, Caribbean Islands, South America, Africa, Asia, Australia, New Zealand, Pacific Islands, Indian Ocean Islands.

Representative Specimens: PASI09.EL.0003

References www.algaebase.org, accessed 18 August 2009; Littler & Littler 2000, *Caribbean Reef Plants*, OffShore Graphics, Inc. Washington, D.C. 542 pp.

***Halophila decipiens* Ostenfeld** (Monocots, Hydrocharitales, Hydrocharitaceae)



A-E: Specimen PASI09.KD-0001. **(A)** Monospecific stand of *H. decipiens* in sandy bottom. **(B)** Herbarium pressing showing roots, shoots, and rhizome. **(C)** Micrograph showing lateral spines on leaves. **(D)** Spherical fruits. **(E)** Central vein cross section showing lacunae.

Description: Plants delicate and inconspicuous (up to 4 cm), though often forming dense monospecific stands (A). Oblanceolate leaves arise in opposite pairs at each node of the rhizome (B). Roots are formed opposite shoots, 1 per node. Fruits are spherical.

Remarks: Distinguished from morphologically similar *H. johnsonii* by the presence of lateral leaf spines (C). However, because *H. johnsonii* is thought to only exist in Eastern Florida, the only other species of *Halophila* in the area is likely *H. baillonis* which is larger and whose leaves are arranged in conspicuous whorls.

Habitat: Commonly forming dense beds in sandy bottom habitats 1 to 5+ meters.

Bocas del Toro Distribution: Bocas Research Station, North Rock at Carenero, Wild Cane Cay, Isla Solarte, Bastimento-Solarte Channel

Worldwide Distribution: Tropical Atlantic Islands, Caribbean, Florida, Japan, Australia, New Zealand, and French Polynesia.

Representative Specimens: PASI09.KD-0001

References Littler M.M. & D.S. Littler 2000. *Caribbean Reef Plants*. OffShore Graphics, Inc. Washington D.C. USA.