UNIVERSIDAD NACIONAL DE COLOMBIA
SEDE BOGOTÁ
FACULTAD DE CIENCIAS
DEPARTAMENTO DE BIOLOGÍA

ACTA BIOLÓGICA COLOMBIANA
Nota breve

OCCURRENCE OF TETRASPORANGIA IN *Ceramium bisporum* (CERAMIALES, RHODOPHYTA)

Presencia de tetrasporangios en *Ceramium bisporum* (Ceramiales, Rhodophyta)

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Received 31 October 2013, first decision 26 February 2014, accepted 5 March 2014.

Citation / Citar este artículo como: RINCON-DÍAZ MN, GAVIO B, SANTOS-MARTÍNEZ A. Occurrence of tetrasporangia in *Ceramium bisporum* (Ceramiales, Rhodophyta). Acta biol. Colomb. 2014;19(2):315-318.

ABSTRACT

The presence of tetrahedrally divided tatrasporangia in *Ceramium bisporum* Ballantine is reported for the first time. The plant was found as epiphytic on calcareous *Halimeda tuna* in coral reef environment in Caribbean Colombia. The taxon represents a new record for the country.

Keywords: Caribbean, *Ceramium bisporum*, tetrasporangia.

RESUMEN

Se reporta por primera vez la presencia de tetrasporangios divididos tetrahedricamente para la especie *Ceramium bisporum*. El alga fue encontrada epífita del alga calcárea *Halimeda tuna* en arrecifes coralinos en el Caribe colombiano. El taxón representa un nuevo registro para el país.

Palabras clave: Caribe, *Ceramium bisporum*, tetrasporangios.

Ceramium bisporum Ballantine was originally described as a diminutive deep-water species offshore Puerto Rico and the United States Virgin islands (Ballantine, 1990). The species is characterized by an extensive prostrate system attached to calcareous substrate, short erect exes, ill-developed nodal cortication, and production of bisporangia. Since its description, *C. bisporum* has been reported only once, in the Mediterranean Sea (Sartoni y Boddi, 2002). Here we report the presence of the species in coral reef habitat in San Andres Island, Caribbean Colombia. We observed fertile thalli bearing tetrahedrally divided tetrasporangia. This is the first report of the taxon for Colombia, and the first observation of tetrasporangia for the species. Specimens were collected by scuba diving during a macroalgal survey in Wild Life, San Andres Island, at a depth of 12.5 m.

Algae were preserved in 5 % formalin in seawater. In the laboratory, plants were carefully removed from the substrate, stained with 1 % aniline blue and observed with a BX51 Olympus microscope (Olympus, Tokyo, Japan). Photographs were taken with a digital camera Moticam 2.0 (Motic, Hong Kong) mounted on the microscope.

Ceramium bisporum Ballantine

Type locality: Grappler Bank, offshore Puerto Rico, dredged 55-90 m.

Plants diminute, epiphytic on *Halimeda tuna*. Thalli prostrate and erect (Fig. 1), attached to the substrate by rhizoids. Erect axes to 1.4 mm tall. Axial cells in prostrate axes 25 µm diameter, 75-90 µm long.

Nodes scarcely developed, formed by a single band of cells, axial cell 30 um diameter and 65 µm long, node 40 µm diameter, 22 µm long, formed by four rectangular periaxial cells, wider than long 7-7.5 µm long x 10-12 µm wide (Fig. 2); tetrasporangia tetrahedrally divided, generally one, sometimes two per node, 55 µm diameter, not covered by nodal cells (Figs. 3, 4). Gametophytes were not observed.

Specimens observed: NRD 055, NRD 142, wild life (12° 30' 30, 77" N - 81° 43' 45, 53"W), San Andrés Island, 2/IX/2012; collected by hand, at a depth of 12.5 m.

Remarks: *Ceramium bisporum* is characterized by its small size, creeping nature, and minimally developed nodal cortication (Ballantine, 1990). In the Western Atlantic, there are six *Ceramium* species with nodal cortication similar to *C. bisporum*: *C. affine* Setchell and Gardner, *C. cimbricum* f. *flaccidum* (Petersen) Furnari and Serio, *C. codii* (Richards) Mazoyer, *C. comptum* Børgesen, *C. leptozonum* Howe, and *C. reptans* Cho and Fredericq.

However, these species differ from our specimen in the following characteristics (Table 1): *C. affine* has a node formed by 2-3 cortical bands (Setchell and Gardner, 1930), while our specimen has only one band (Fig. 2); *C. cimbricum* f. *flaccidum* and *C. codii* have tetrasporangia partially covered by short cortical cells (Setchell and Gardner, 1930; Schneider and Searles, 1990: p. 379, as *C. fastigiatum* f. *flaccidum*; Cho and Fredericq, 2006), while in our specimen the tetrasporangia are naked (Figs. 3, 4); *C. comptum* has a much larger thallus and axes with a diameter at least twice the size of our specimen (Taylor, 1960), as well as more than four pericentral

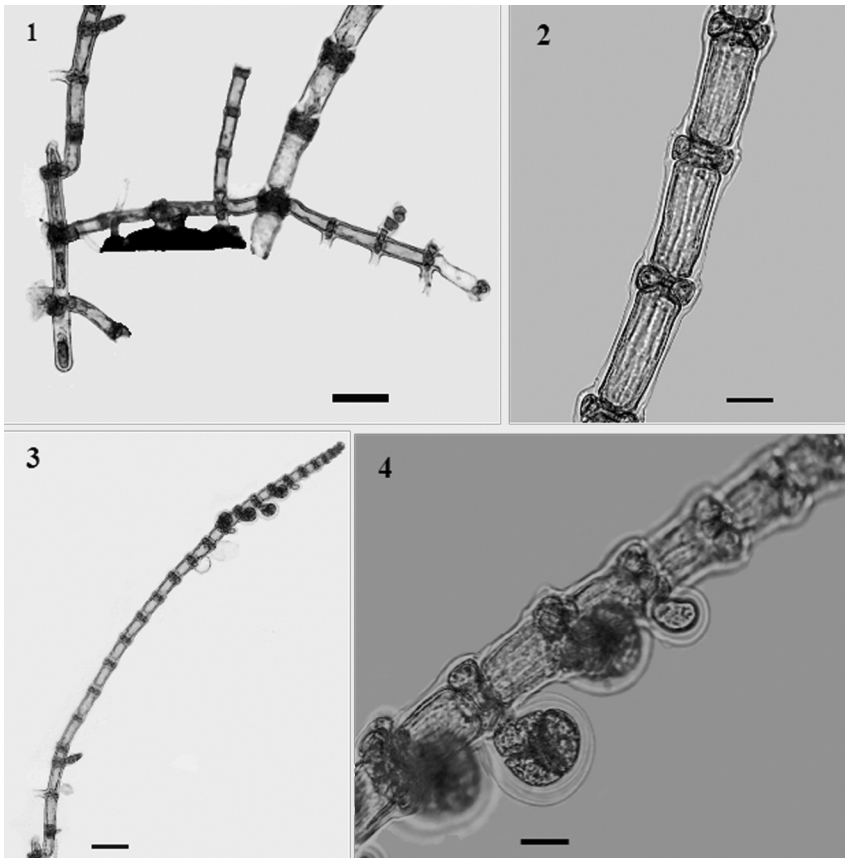

Table 1. Comparison among *Ceramium* species in the Western Atlantic.

	C. affine	*C. cimbricum* f. *flaccidum*	*C. codii*	*C. comptum*	*C. leptozonum*	*C. reptans*	*C. bisporum*	*Ourspecimen*
Habit	Mainly erect	Prostrate axes bearing erect branches	Prostrate axes bearing erect branches	Mainly prostrate	Mainly erect	Prostrate axes bearing erect branches	Mainly prostrate, with rare erect axes	Prostrate axes bearing erect branches
Thallus lenght (mm)	5-24	To 100	0.3-0.6	5	To 80	0.8-1.2	0.2-1	To 1.4
Axial cell diameter x length (m)	54-68 x 198-240	60 x 400	16 x 49	75 x 300	40-72 x 60- 280	31 x 74	30	30 x 65
Number of periaxial cells	4	4-6	4	>4	8-10	5	4	4
Node cortication	1 acropetal row	1 acropetal row	1 acropetal row, 0-1 basipetal row	1 acropetal row	0-1 acropetal row	1-2 acropetal rows, 0-1 basipetal rows	0-1 acropetal row	0 acropetal row
Tetrasporangia features (diameter, m)	Unilateral, abaxial, 1-2 per node, naked (52-61)	Spherical, partially covered by nodal cells, 1 to many (60)	Partially covered by nodal cells, 2 per node, (37-38)	1-2 per node, partially covered by nodal cells	Spherical, naked, solitary to whorled (50-65)	Whorled at node, almost completely covered by nodal cells (45)	Bisporangia, naked, 1 to whorled (35-48)	Tetrasporangia, 1-2 per node, naked (55)
References	Abbott and Hollenberg, 1976; Barros-Barreto *et al.*, 2006	Littler *et al.*, 2008	Cho and Fredericq, 2006	Børgesen ,1924; Taylor, 1960	Taylor, 1960: Littler *et al.*, 2008	Cho and Fredericq, 2006	Ballantine, 1990	This work

cells (Børgesen, 1924). *C. leptozonum* and *C. reptans* also have a greater number of pericentral cells, eight to ten cells longitudinally elongated in *C. leptozonum* (Littler *et al.*, 2008), five in *C. reptans* (Cho and Fredericq, 2006), compared to just four in our specimen. Our alga is small in size, and while has a total height of 1.2 mm, larger than 1 mm *exceptionally* large specimens reported by Ballantine (1990), the diameter of the axes, the number of pericentral cells, and the nodal cortication fits the description of *Ceramium bisporum*. In his original description, Ballantine (1990) reported inflated, two-celled rhizoids. However, for Mediterranean specimens, not inflated, three-celled rhizoids were reported (Sartoni and Boddi, 2002). When we detached the specimen from its substrate, the rhizoids broke (Fig. 1), so we were unable to determine their morphology. However, we found the species on calcareous substrate as did the former records, and Ballantine (1990) emphasized that he could not separate the plant from its substrate without decalcification because the rhizoids adhere very strongly to it, a character we can confirm as well. The presence of bisporangia in the Ceramiaceae has been observed occasionally on several species (Athanasiadis, 1987; Guiry, 1990; L'Hardy-Halos and Maggs, 1991), and is interpreted to represent an asexual function (Ballantine, 1990). The presence of tetrasporangia in our specimen, collected in a different season than former report in the Caribbean (November *vs.* August) may indicate a seasonal production of tetrasporangia and bisporangia, as it has been evidenced in *Crouania attenuata* (C. Agardh) J. Agardh, which produces bisporangia in winter and tetrasporangia in summer (Guiry, 1990). It would be interesting to determine the seasonality of the reproductive stages of *Ceramium bisporum* in the field.

ACKNOWLEDGEMENTS

The authors are grateful to Manuel Angarita, Land Divers and Andrés Felipe Melo for help in the field. We thank Julieta and Alejandro Rincón for assistance in managing Adobe Photoshop software. Sven Zea and Paola Rodriguez provided insightful comments for field work. We thank Michael Wynne for kindly providing critical literature. This research was funded by the Universidad Nacional de Colombia, sede Caribe, through the project Hermes #12388. This work is contribution N.º 390 of CECIMAR, Universidad Nacional de Colombia and Programa de Postgrado en Biología – Línea Biología Marina.

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