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Presencia de *Laurencia caraibica* (Ceramiales, Rhodophyta) en Atol das Roc

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ABSTRACT

Laurencia caraibica P.C. Silva is being referred occurring in Atol das Rocas, a small island located about 1 miles off Brazilian northeastern coast. The specimens are characterized by the soft, reduced size thalli with fo periaxial cells per each axial segment and tetrasporangia in parallel arrangement; presence of lenticu thickenings in the wall of the medullary cells; epidermal cells near the apex not projected beyond the surfa of the thalli; presence of anastomose between branches and the occurrence of secondary pit connectio between epidermal cells. In this paper, previously unknown detailed morphological characters are present and compared to related species.

Key words: Atol das Rocas, Brazil, *Laurencia caraibica*, Rhodophyta, taxonomy

RESUMEN

Se registra por primera vez *Laurencia caraibica* P.C. Silva en Atol das Rocas, el cual es una pequeña is localizada a 237 km fuera de la costa del noreste de Brasil. Los especímenes se caracterizan por tener tal suaves, pequeños en talla, con cuatro células pericentrales por cada segmento axial; tetrasporangios arreglo paralelo; presencia de engrosamientos lenticulares en la pared de las células medulares; célul corticales cerca del ápice no proyectadas en la superficie del talo; presencia de anastomosis entre las ram y con uniones intercelulares secundarias entre las células corticales. En este trabajo, se detallan algun caracteres morfológicos y se comparan con especies relacionadas.

Palabras clave: Atol das Rocas, Brasil, *Laurencia caraibica*, Rhodophyta, taxonomía.

INTRODUCTION

Atol das Rocas Reef is a marine biological reserve in Northeast Brazil, and is considered the only atoll in the South Atlantic (Kikuchi and Leão, 1996; Guerardi and Bosence 2001). The reef consists of a calcareous rock ring, measuring about 3 km in diameter and bathed by the Southern branch of

members of tropical algae communities (Oliveira Ugadim 1976).

The benthic marine flora has been known ma 70's by Oliveira Filho (1972), Oliveira Filho and Mene and Oliveira Filho and Ugadim (1974, 1976). In the la ence 22 species of Chlorophyceae, 18 of Phaeophy

complex (*Laurencia* J.V. Lamouroux, *Chondrophycus* (Tokida et Saito) Garbary et J. Harper, *Osmundea* Stackhouse) only *L. decumbens* Kützing (as *L. pygmaea* Weber-van Bosse) and *Chondrophycus papillosus* (C. Agardh) Garbary et J. Harper (as *Laurencia papillosa*) have been referred to Atol das Rocas (Oliveria Filho and Ugadim, 1974; 1976).

In the last two years, recent studies on the marine algae from the Atol das Rocas Reef are bringing out new information about the ecology and flora of this unique environment in Brazilian coast (Villaça *et al.*, 2001).

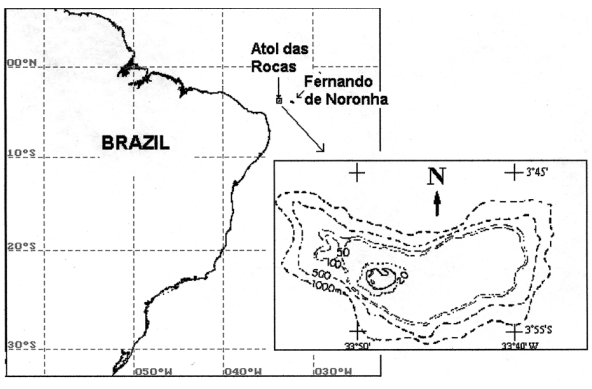
In this paper, *Laurencia caraibica* P.C. Silva is being added to the rhodophycean algal list from Atol das Rocas, and from Brazil. Previously unknown detailed morphological characters of the species are presented, compared to related species, and its geographical distribution is discussed.

STUDY AREA

Atol das Rocas is located in the Atlantic Ocean, at 3o51′ S and 33º49′ W, distant 150 miles from the city of Natal, Rio Grande do Norte State, in Northeast Brazil (Fig. 1). The atoll has an oval shape with an internal area of about 7.5 km^2. Its largest axis (E-W) is 3.7 km long, and the shortest (N-S) is 2.5 km long. An algal ridge limits the reef flat, which is dominated by a coralline algae-vermetid gastropods association growing as small linear ridges. Internally, the atoll is composed of two sand cays, a big sand plain, several pools of different sizes and depths, a permanent lagoon and an internal algal ridge (exposed at low tide).

MATERIAL AND METHODS

Voucher specimens and materials for morphological studies were fixed in 4% Formalin/seawater or pressed as herbarium sheets. The specimens were collected manually on internal ridge during low tide. Longitudinal and transverse ha sections were made with a stainless steel razor blade unde stereoscopic dissection microscope, and stained with 0.5 aqueous aniline blue solution, acidified with dilute HCl or aqueous ruthenium red (ca. 0.02%). Photomicrographs we taken with an Olympus BH-2 microscope. Voucher specime are housed at the herbarium of the Instituto de Botânica at S Paulo, Brazil (SP). Herbarium abbreviations are as given Holmgren *et al.*, (1990).



RESULTS

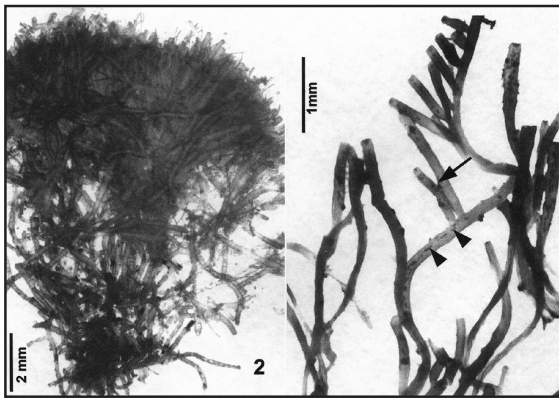
Laurencia caraibica P.C. Silva 1972: 205. Figures 2-11

Basyonim: *Laurencia nana* Howe in Britton a Millspaugh 1920: 566, nom. illeg.

Type locality: Mariguana (Mayaguana), Bahamas. Ty Howe 5393. Isotype: US 68437!

Habit: Plants heavily entangled forming cushion-l tufts, fixed to the substratum by mean of discoid holdfast with numerous holdfasts originated by prostrate branch Thalli are erect or decumbent, cylindrical, up to 1.6 cm hi and 0.16-0.21 mm in diameter, soft in texture, adhering well herbarium paper when dried. Color is pinkish-purple to g net-brown. Branching is unilateral to irregularly alterna bearing long unramified or shortly ramified ultimate branc lets, up to 6 mm long and 120-200 µm in diameter. Branch slightly constricted at the basis and with truncate ap Anastomose between branches are frequent (Figs. 2-3).

Vegetative Structures: In surface view, epidermal ce in the middle region of the thalli are elongate-polygonal, 3



Figures 2-3. *Laurencia caraibica*. 2. Habit. 3. Detail of tetraspor gial branches, with arrow indicating anastomosis and arrowhe

57 µm long x 20-26 µm wide, connected to one another by longitudinally oriented secondary pit connections (Fig. 4). Living material was not observed to check the occurrence of *"corps en cerise"*. In cross-section of the thallus a layer of pigmented epidermal cells and three-four layers of medullary cells (Fig. 5). Epidermal cells neither radially elongated nor arranged like palisade, 18-21 µm long and 20-26 µm wide. Secondary pit connections present between adjacent epidermal cells (Figs. 4, 6). Medullary cells are large and slightly flattened. Each vegetative axial segment cuts off four periaxial cells, 26-32 µm in diameter, which are slightly larger than cells of surrounding layer (Fig. 5). Lenticular thickenings are abundant in the walls of the medullary cells (Figs. 3, 7). In median longitudinal sections through a branchlet, the outer walls of the epidermal cells do not project beyond the surface (Fig. 8).

Reproductive Structures: Tetrasporangial branches are clavate with truncate apex, simple, 1-6 mm long. X 0.2 mm wide (Figs. 3, 9). Tetrasporangia are 53-76 µm in diameter, and display parallel arrangement on the fertile branches (Figs. 3, 9-11). Male and female plants were not found.

Sterile and tetrasporangial plants were collected in July 1999 and June 2000, over the hard bottom of an internal algal ridge and over small corals that link a reef flat section to the sand cay. The specimens were found in very intricate small turfs, heavily entangled with other macroalage such as *Gelidiopsis intricata* (C. Agardh) Vickers, *Lomentaria rawitscheri* A.B. Joly, *Jania adhaerens* J.V. Lamouroux, and *Lophosiphonia obscura* (C. Agardh) Falkenberg.

Geographical Distribution: Atlantic ocean: Bahamas (Mariguana [=Mayaguana], type locality) (Howe 1920 as *L. nana*; Littler and Littler 2000); Belize (Norris and Bucher, 1982); Mexico (Sentíes and Fujii, 2002); Jamaica (Taylor, 1960 as *L. nana*); Puerto Rico (Ballantine and Norris, 1989); Antigua (Taylor, 1969 as *L. nana*); Greater Antilles, Lesser Antilles, Western Caribbean, Gulf of Mexico (Littler and Littler 2000); Colombia (Bula-Meyer, 1986); Brazil, Atol das Rocas, (Oliveira Filho and Ugadim, 1974; 1976, as *L. pygmaea* Weber-van Bosse). Indic Ocean: India (Silva *et al.*, 1986).

Material Examined: SPF 025561 (as *L. pygmaea*), Atol das Rocas, Feb. 1972, coll. E.C. Oliveira, det.: M.T. Fujii. SP 355383, Atol das Rocas, 21 Jul. 1999, coll.: R. Villaça, det.: M.T. Fujii. SP 355384, Atol das Rocas, 13 Jun. 2000, coll.: R. Villaça, det.: M.T.Fujii.

Additional Material Examined: US 68437 (isotype), on corals, near low-water mark, Abraham bay, Mariguana,

DISCUSSION

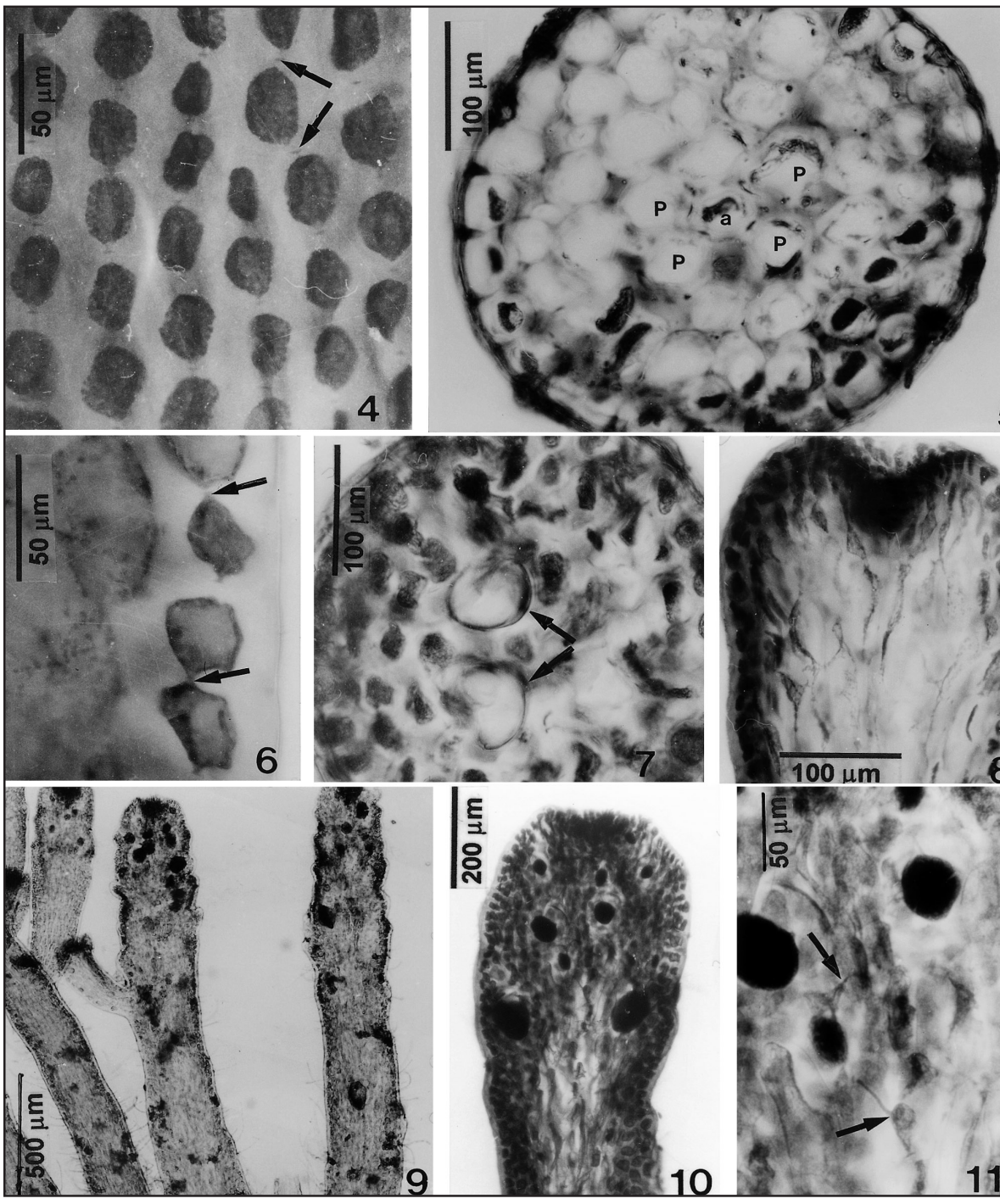
Laurencia nana was proposed by Howe (1920) species proceeding from Mariguana (=Ma Bahamas, characterized by having 1-2 cm high ar caespitose to intricate thalli with 0.15-0.45 mm in but without lenticular thickenings in the walls of cells.

According to Silva (1972), *L. nana* Howe is a la nym of *L. nana* (C. Agardh) Greville (1830), described as *Chondria nana* C. Agardh (1827). Thi which was found at Trieste, Italy, was considere form of *L. paniculata* (C. Agardh) J. Agardh (1863). T *Laurencia caraibica* was provided by Silva (1972) a tute name for *L. nana* Howe.

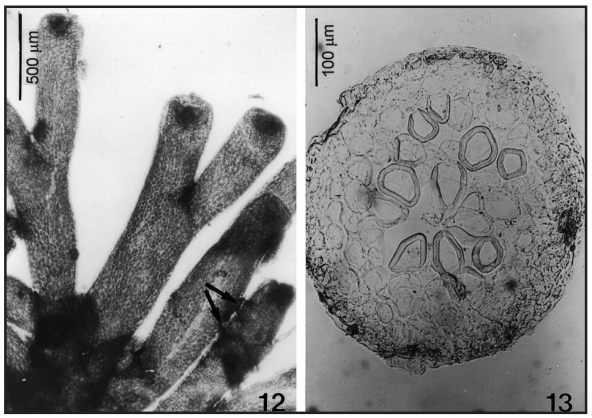
Laurencia caraibica is a typical member of showing four periaxial cells per each axial seg tetrasporangia cut-off from a particular periaxial lenticular thickenings in the walls of the medullary not reported either in the original description by H or later by Taylor (1960) in the specimens from However, lenticular thickenings were observed by Bucher (1982) and also by us in the isotype (US 68 12-13). Norris and Bucher (1982), Ballantine and No and Sentíes and Fujii (2002) stated the occasional o of lenticular thickening in the walls of the medulla specimens proceeding from Belize, Puerto Rico, ar respectively. In specimens from Atol das Rocas re lenticular thickenings are abundant in the wa medullary cells, and they are visible through the cells in surface view.

Mexican plants, reach up to 5 cm height an diameter of axis, resulting larger than our specimen and Fujii (2002) reported the presence of two (third a fertile periaxial cells per each axial segment tetrasporangia in specimens from Mexico. In Brazi mens, however, this feature is not clear enough bu suggests that only the fourth periaxial cell produces rangium as in *L. similis* Nam and Saito (1991) and oc in *L. brongniartii* J. Agardh (Nam and Sohn 1994) a *formis* (C. Agardh) Montagne (Fujii 1998). In Puerto Ri the secondary pit-connections between adjacent co are lacking and tetrasporangia display right-angle ment, suggesting that it could belong to another taxo

Baptista (1974) described *L. caraibica* (as *L. r* Ilha dos Lobos, Rio Grande do Sul, Southern Brazil. the habit, the larger size of thalli, and absence of thickenings in the walls of medullary cells, Baptis mens should be referred to as *L. intricata* J.V. Lam



Figures 4-11. *Laurencia caraibica.* Vegetative and tetrasporangial structures. 4. Longitudinally oriented secondary pit-connections (arro between adjacent epidermal cells in surface view of the thallus. 5. Transverse section through the thallus showing an axial cell producing four periaxial cells (p). 6. Longitudinal section through a thallus, showing detail of the epidermal cells with secondary connections (arrows). 7. Transverse section of the branch with lenticular thickenings (arrows) in the walls of the medullary cells Longitudinal section through a young tetrasporangial branchlet showing the apical pit and epidermal cells near the apex not projec beyond the surface. 9-10. Details of tetrasporangial branches in surface view with parallely oriented tetrasporangia. 11. Longitudi



Figures 12-13. *Laurencia caraibica*. Isotype specimen housed in the United States National Herbarium (US 68437). 12. Detail of the branches with anastomose (arrows). 13. Transverse section of the thallus with lenticular thickenings in the walls of the medullary cells.

Laurencia, which is referable to *L. caraibica* on the basis of the habit and morphological characteristics, except for the absence of the lenticular thickening in the medullary cell walls.

Baptista's (1974) *Laurencia* sp. corresponds to *L. oliveirana* Yoneshigue, an other dwarf species described from Rio de Janeiro, Brazil, by Yoneshigue (1985) and later also reported from São Paulo (Fujii 1990). *L. caraibica* differs from *L. oliveirana* in both the presence of lenticular thickenings in the medullary cells and anastomose between branches.

The presence or absence of lenticular thickening as a character to distinguish species within the genus *Laurencia* is somewhat controversial since this feature is not always easily detectable, although it has been used to characterize members of *Laurencia* included into the section Forsterianae Yamada (Saito 1967). In *L. caraibica*, however, the lenticular thickenings are visible through the epidermal cells in surface view and useful as diagnostic character.

Oliveira Filho and Ugadim (1974; 1976) described *L. decumbens* (as *L. pygmaea*) from Atol das Rocas, Brazil. From the study of last material (SPF 025561), however, it resulted that it showed all the characters of *L. caraibica*.

Laurencia pygmaea was originally described from Chagos archipelago, Diego Garcia, Indian Ocean, an specimens collected by Mr. J. Stanley Gardiner during the "Sealark expedtion" (Weber-van Bosse 1913). Later, based on the morphological similarity *L. pygmaea* was considered synonym of *L.* decumbens described from New Caledonia, Pacific Ocean, but also found in Mauritius, India (Børgesen 1945).

Although the description of *L. decumbens* (as *L. pygmaea*) that of *L. caraibica* because both have small thalli grow
cate tufts, according to Weber-van Bosse (1913), the bra
decumbens can be easily teased out under a pocket-len
in the case of *L. caraibica* this cannot be done without da
frond due to the presence of anastomose between
branches (Weber-van Bosse, 1913; Oliveira Filho and Uga

As concerns the geographical distribution, it shou
that *L. decumbens* occurs in Pacific and Indian Oceans
caraibica is more related to Atlantic Ocean, especially in
region, although it was reported also from India (Silva *e*

Considering the morphological characteris
bined with geographical distribution, we propos
decumbens sensu Oliveira Filho and Ugadim (1974
recognized as *L. caraibica* P.C. Silva.

Other two species of *Laurencia* described f
that possess reduced thalli are *L. catarinensis*
Marino et Fujii (1985) and *L. intricata* J. Agardh (F
The former has greenish color and the latter is
Both species develop in densely intricate tufts wit
ally or radially branched thalli, but their final gross
gy and the size are different from the present specie
lenticular thickenings are lacking in both species.

Laurencia caraibica was collected in well-i
habitats, emersed during the low tides, sometimes
period, but with no damages because of the close
tion with other species of algae and some small inv
also supporting an internal wet environment. The re
where *L. caraibica* was found is protected from di
impacts but it is regularly washed by the tide c
caraibica is reported from some reefs in the Caribb
the same environmental conditions (Littler and Littl

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