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Laurencia caduciramulosa (Ceramiales, Rhodophyta) from Ilha Grande Bay, Rio de Janeiro, Brazil: a recent introduction into the Atlantic Ocean?

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Abstract – *Laurencia caduciramulosa* Masuda *et* Kawaguchi, previously reported from the Pacific Ocean and from the Mediterranean Sea, is recorded for the first time for the Atlantic Ocean, at different sites in Ilha Grande Bay, State of Rio de Janeiro, southeastern Brazil. The specimens were collected as epilithic or epiphytic plants from the lower intertidal zone to 5 m depth at sheltered to exposed rocky shores during the period 2001-2005. This *Laurencia* species is characterized by its reduced size, well-developed stolon-like basal system and abundant deciduous branchlets at the upper portion of the erect axes that function as propagules. As described in other reports of this species, gametangia and sporangia were not observed. The absence of reproductive structures could be efficiently replaced by a strategic mechanism such as vegetative propagation by these propagules. This study expands the geographical distribution of *L. caduciramulosa* to the southwestern Atlantic Ocean, suggesting its recent introduction into Brazilian coastal environments by transoceanic shipping.

Atlantic Ocean / Brazil / geographical distribution / introduced species / *Laurencia caduciramulosa* / Rhodophyta / taxonomy

Résumé – ***Laurencia caduciramulosa* (Ceramiales, Rhodophyta) de la baie de Ilha Grande Bay, Rio de Janeiro, Brésil : introduction récente en Océan Atlantique ?** *Laurencia caduciramulosa* Masuda *et* Kawaguchi, précédemment signalé dans l'océan Pacifique et la mer Méditerranée, l'est pour la première fois dans l'océan Atlantique. Les spécimens ont été récoltés en divers points de la Baie de Ilha Grande (Etat de Rio de Janeiro, sud-est du Brésil), de 2001 à 2005, sur les rochers et épiphytes sur d'autres algues, de la zone intertidale

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inférieure jusqu'à 5 m de profondeur, en mode abrité à modéremment exposé. Cette espèce est caractérisée par sa taille réduite, sa base stolonifère et par ses axes dressés pourvus dans leur partie supérieure de petites ramules caduques qui fonctionnent comme des propagules. Comme dans les travaux antérieurs, les gamétocystes et les sporocystes n'ont pas été observés. L'espèce compense probablement cette absence de reproduction par la multiplication végétative assurée par les ramules caduques. Cette étude étend l'aire de distribution géographique de *Laurencia caduciramulosa* au sud-ouest Atlantique, et suggère une introduction récente sur la côte brésilienne, probablement par le trafic maritime transocéanique.

Brésil / distribution géographique / espèce introduite / *Laurencia caduciramulosa* / Océan atlantique / Rhodophyta / taxonomie

INTRODUCTION

Laurencia caduciramulosa Masuda *et* Kawaguchi *in* Masuda *et al.* (1997) was originally described from Vietnam. Its geographical distribution was expanded by Masuda *et al.* (2001) who reported it for Malaysia and Furnari *et al.* (2001) and Klein & Verlaque (2005) for the Mediterranean Sea. Klein & Verlaque (2005) discussed the hypothesis of its recent introduction into this area.

In Brazil, *Laurencia caduciramulosa* was found for the first time in 2001, although in low abundance, in Ilha Grande Bay, southeastern Rio de Janeiro State. Later, in 2003-2005, the species was found at ten different sites around the Ilha Grande Bay. This paper describes and illustrates morphological characters of *Laurencia caduciramulosa* from Brazil, comparing it with related species, and discusses the hypothesis of its recent introduction into Brazilian coastal ecosystems.

MATERIALS AND METHODS

Study Area

Ilha Grande Bay is located in the State of Rio de Janeiro, southeastern Brazil (22°50' S - 23°20' S, 44°45' W - 44°00' W), an area rich in islands, inlets and smaller bays. An accelerated growth process has been shown by several urban centers along the Ilha Grande Bay coastal zone, including old cities such as Angra dos Reis and Parati, and villages like Monsuaba, Bracuí, Frade and Perequê. The main economic activities of this region are directly and indirectly related to the sea, such as fishery, tourism, aquatic sports and commercial shipping.

Macroalgae from Ilha Grande Bay have been listed in the literature since the beginning of 20th century but not in a systematic arrangement. The phycological flora of Ribeira Bay, subjected to the liquid effluent of the power plant "Central Nuclear Almirante Álvaro Alberto" (CNAAA) (Pedrini *et al.*, 1994; Széchy & Nassar, 2005), and that of Parati Bay (Figueiredo-Creed & Yoneshigue-Valentin, 1997; Figueiredo *et al.*, 2004) can be considered as the most studied ones among Ilha Grande Bay ecosystems.

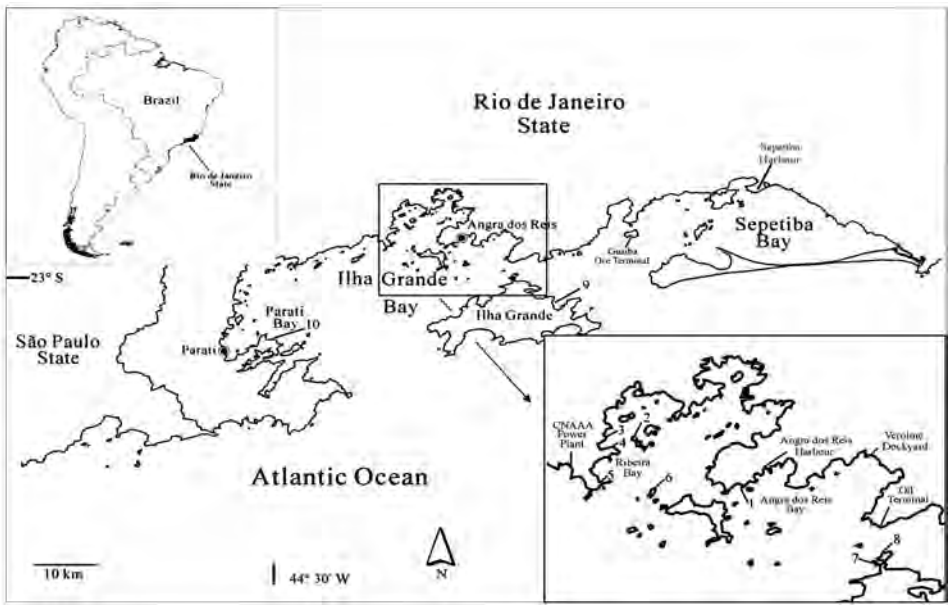


Fig. 1. Southern coast of the State of Rio de Janeiro, showing the sampling sites in Ilha Grande Bay. **1.** Gordas's Beach (Angra dos Reis Bay); **2.** Itanhangá's Island, **3.** Caiobá's Headland, **4.** Fortaleza's Headland, **5.** Velho's Beach, **6.** Brandão's Island (Ribeira Bay); **7.** Lagoa Azul's Island, **8.** Macacos's Island, **9.** Preta Beach (Ilha Grande Island); **10.** Lula's Beach (Parati Bay).

Laurencia caduciramulosa was identified from haphazardly taken phytobenthic samples of ten localities of Ilha Grande Bay, collected in 2001, 2003, 2004 and 2005. The study area included Angra dos Reis Bay (1 sampling site), Ribeira Bay (5 sampling sites), Ilha Grande Island (3 sampling sites) and Parati Bay (1 sampling site) (Fig. 1).

Morphological study

Specimens from all sampling sites, after fixation in 4% formalin/seawater solution, were analyzed for external and internal morphology, following Masuda *et al.* (1997). The presence of *corps en cerise* in the epidermal cells was analyzed in living specimens from Ilha Grande Island. Measurements were taken for morphometric characters, such as the diameter of branches and the dimensions of epidermal and medullary cells, at different portions of the thalli ($n \geq 3$ for each specimen).

Transverse hand-sections were made with a razor blade and stained with 0.5% aqueous aniline blue solution, acidified with 1N HCl (Tsuda & Abbott, 1985). Photomicrographs were taken with an Olympus BH-2 microscope (Tokyo, Japan) and a Vivitar 3675 digital camera (California, USA) coupled to a Nikon Eclipse E200 microscope (Tokyo, Japan).

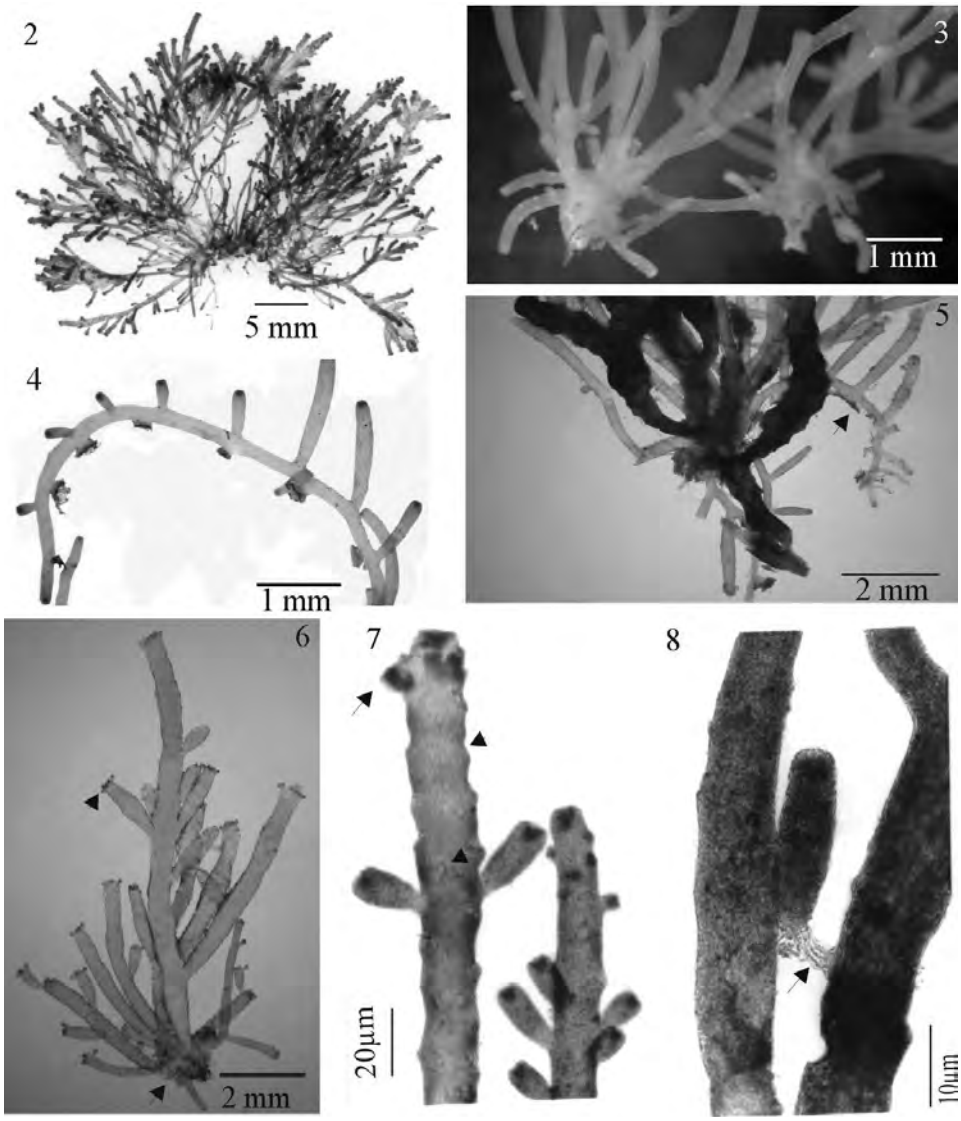
Voucher specimens are deposited in the Herbarium of the University of State of Rio de Janeiro (HRJ), Brazil and in the Herbarium of the Instituto de Botânica (SP), São Paulo, Brazil.

Specimens Examined: BRAZIL. State of Rio de Janeiro, Ilha Grande Bay: Angra dos Reis, Angra dos Reis Bay, Gordas's Beach (23°01'24" S, 44°20'06" W), ii. 2001, *leg. M.T.M. Széchy* (HRJ 10442), Ribeira Bay, Piraquara de Dentro Cove, Itanhangá's Island (22°59'30" S, 44°24'48" W), 22.x.2004, 5 m depth, *leg. B.L. Ignácio* (HRJ 10444); Caiobá's Headland (22°59'05" S, 44°26'04" W), 19.iii.2005, on *Sargassum, leg. A.P.A. Veloso* (HRJ 10443); Fortaleza's Headland (22°59'38" S, 44°25'54" W), 22.viii.2004, on *Sargassum, leg. M.T.M. Széchy* (HRJ 10333), 19.ix.2004, on *Sargassum, leg. M.T.M. Széchy* (HRJ 10332), 20.iii.2005, on *Sargassum, leg. M.T.M. Széchy* (HRJ 10440), Piraquara de Fora Cove, Velho's Beach (23°01'12" S, 44°26'12" W), 30.vii.2004, *leg. M.T.M. Széchy* (HRJ 10331), 21.iii.2005, on *Sargassum, leg. A.P.A. Veloso* (HRJ 10441); Brandão's Island (23°01'48" S, 44°24' 12" W), 04.ii.2003, *leg. A.B. Ramos* (HRJ 10339), 18.v.2003, *leg. D.N. Moysés* (HRJ 10330), 10.x.2003, *leg. D.N. Moysés* (HRJ 10340), ii.2004, *leg. D.N. Moysés* (HRJ 10337), 20.vi.2004, *leg. D.N. Moysés* (HRJ 10338), vii.2004, *leg. D.N. Moysés* (HRJ 10334), Ilha Grande Island, Lagoa Azul's Island (23°05'06" S, 44°14'28" W), 25.ii.2005, *leg. V. Cassano & J.C. De-Paula* (HRJ 10335), 29.vii.2005, *leg. V. Cassano & J.C. De-Paula* (HRJ 10457), Macacos's Island (23°04'48" S, 44°14'16" W), 29.vii.2005, *leg. V. Cassano & J.C. De-Paula* (HRJ 10455), Preta Beach (23°07'39" S, 44°10'18" W), 29.vii.2005, *leg. V. Cassano & J.C. De-Paula* (HRJ 10456); Parati, Parati Bay, Lula's Beach (23°11'47" S, 44°37'59" W), 09.ii.2005, *leg. V. Cassano* (HRJ 10336).

RESULTS

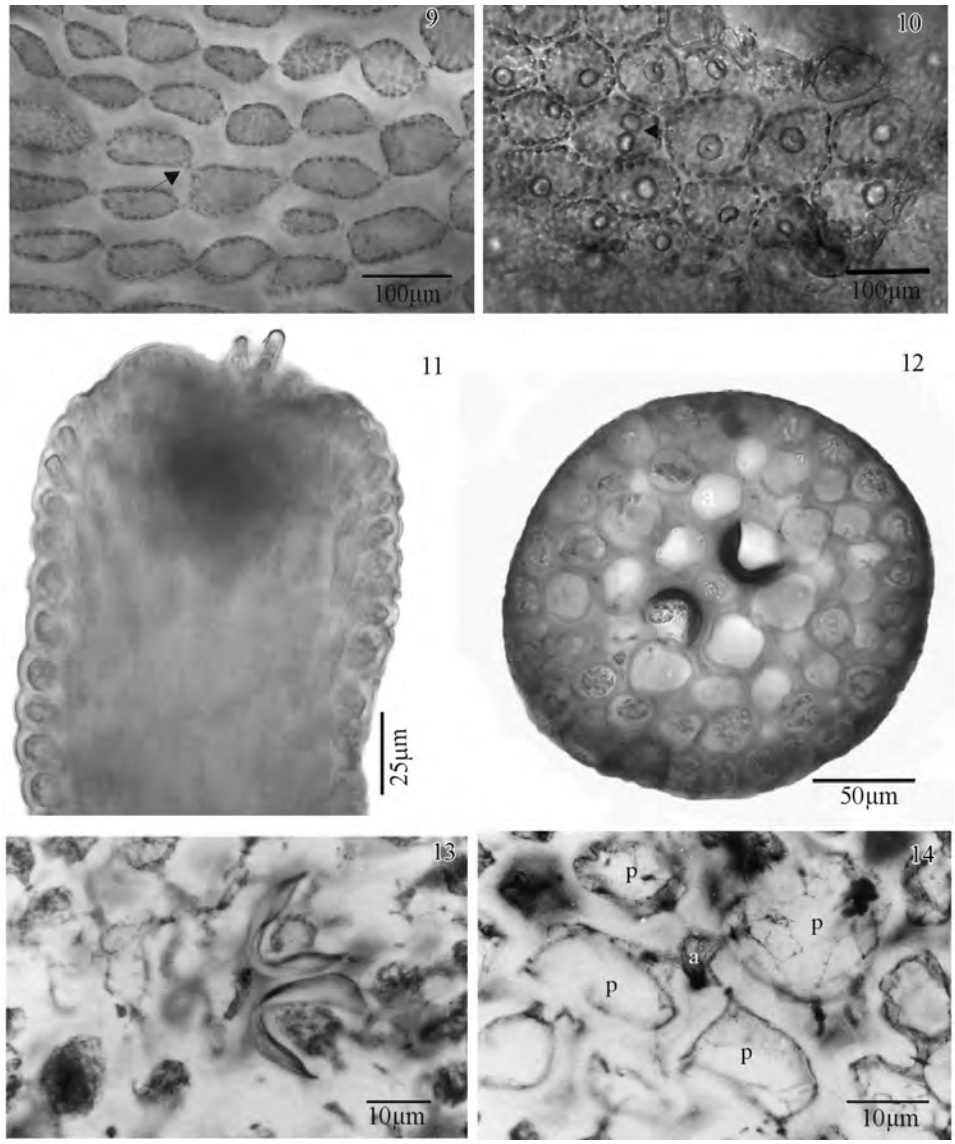
***Laurencia caduciramulosa* Masuda *et* Kawaguchi**, *in* Masuda *et al.*, 1997: 3, figs 1-10.

Holotype: Herbarium of the Hokkaido University (SAP 062086).
Type locality: Hon Tre Island, Vietnam.
Geographical distribution: Pacific Ocean: Vietnam: Hon Tre Island, Tien Hai Islands, Hatien, Kien Giang Province (Masuda *et al.*, 1997); Malaysia: Terengganu, Pasir Tiga Ruang, Pulau Perhentian Besar; Pahang, Kampung Mukut, Pulau Tioman (Masuda *et al.*, 2001); Mediterranean Sea: Italy: Sicily, Catania, Lachea Island; Pelagean Islands, Linosa Island (Furnari *et al.*, 2001); France: western Provence (Bouches-du-Rhône), Fos, Sausset-les-Pins, Marseille and Riou Island, Cassis; eastern Provence (Var), Embiez Islands and Toulon (Klein & Verlaque, 2005); Atlantic Ocean: Brazil: Rio de Janeiro: Ilha Grande Bay: Angra dos Reis and Parati (this paper).
Description: Plants form garnet-brown cushion-like tufts, up to 4 cm high (Fig. 2). Specimens are soft in texture, adhering well to herbarium paper when dried. Several erect axes arise from a discoid holdfast and from well-developed stolon-like branches formed from the lower portion of axes attached to the substrata by secondary and smaller discoid holdfasts (Figs 3-5). In epiphytic plants, stolon-like branches may be well-developed (Fig. 5), or may be lacking (Fig. 6) or inconspicuous. Erect axes are terete throughout, sparsely branched, mainly in the lower portions of the thalli, with few long first-order branches. Anastomoses between branches are frequent. The main axes are narrower in the lower portions of the thalli, 144-360 µm in diameter just above the holdfast; broader in the middle portions, 185-670 µm in diameter, and slightly narrowing towards the apices, 246-560 µm in diameter in the upper portions. In some populations, plants are clearly broader towards the apices (Figs 2, 6). Branching is irregularly alternate and spirally arranged, usually with 2-3 (4) orders of branches. The ultimate branchlets are clavate and develop throughout the thalli, but they are deciduous, detaching



Figs 2-8. *Laurencia caduciramulosa* Masuda *et* Kawaguchi. **2.** Habit of an epilithic plant. **3-4.** Basal portion of the epilithic plants. **3.** Discoid holdfasts and stolon-like branch. **4.** Detail of a stolon-like branch showing smaller discoid holdfasts. Figs 5-6. Epiphytic plants, growing on *Sargassum*. **5.** Basal portion of a plant showing stolon-like branches (arrow) on *Sargassum* receptacle. **6.** Plant with a single discoid holdfast (arrow). Note crown of deciduous branchlets at the apices (arrowhead). **7.** Upper portions of main branches showing small deciduous branchlets near apex (arrow) and scars of released branchlets (arrowheads). **8.** Released propagule attached on an erect axis of *L. caduciramulosa*. Note conspicuous rhizoid (arrow).

easily from the branches, which become denuded and with many scars, except only at the uppermost portions of the branches, where they can form a crown of branchlets (Figs 6 and 7). These branchlets are 123-450 µm long and 94-225 µm in



Figs 9-14. *Laurencia caduciramulosa* Masuda *et* Kawaguchi. **9.** Epidermal cells in surface view of the lower portion of a branch showing secondary pit connections (arrow). **10.** Epidermal cells in surface view, showing mostly a single *corps en cerise* per cell. Note two *corps en cerise* per cell (arrow; living material). **11.** Apex of a branch with slightly projecting epidermal cells. **12.** Transverse section of the middle portion of a branch showing lenticular thickenings in the walls of medullary cells. **13.** Lenticular thickenings in detail. **14.** Transverse section of the upper portion of a branch showing an axial cell (a) with four pericentral cells (p).

diameter at the tips, basally constricted, measuring 60-128 µm in diameter at the constrictions. The deciduous branchlets may adhere elsewhere and grow, thereby functioning as propagules (Fig. 8).

In surface view, epidermal cells are regularly arranged in longitudinal rows and connected to each other by longitudinally oriented secondary pit connections. Epidermal cells are polygonal in the upper portions of the thalli, 13-43 µm long and 11-38 µm wide; longitudinally elongated in the middle portions, 27-80 µm long and 15-47 µm wide; and elongate-polygonal in the lower portions of the thalli, 25 – 65 µm long and 14-37 µm wide (Fig. 9), possessing one, rarely two, *corps en cerise* per cell (Fig. 10), and only one per trichoblast cell. Epidermal cells, near branch apices, are slightly projected (Fig. 11). In transverse section, thalli with one or two layers of pigmented epidermal cells and two or three layers of colorless medullary cells (Fig. 12). Epidermal cells of first-order branches are 10-30 µm long and 10-35 µm wide in the upper portions and 14-48 µm long and 13-55 µm wide in the lower portions. Medullary cells are rounded or slightly radially elongated, measuring 22-108 µm long and 20-75 µm wide in the middle portions of the main axes. Medullary cells of first-order branches measuring 20-83 µm long and 16-58 µm wide in the middle to lower portions and 18-65 µm long and 24-46 µm wide in the uppermost portions. Lenticular thickenings are present in the walls of medullary cells, abundant, except in the upper portions of the thalli (Figs 12 and 13). Each vegetative axial segment cuts off four pericentral cells (Fig. 14) that are slightly larger than medullary cells of the surrounding layer. Gametangia and sporangia were not observed.

Habitat: The epilithic specimens were collected from the lower intertidal to subtidal zone at 5 m depth, associated with turfs of articulated Corallinaceae, *Caulerpa fastigiata* Montagne, *Hypnea spinella* (C. Agardh) Kützing, at moderately exposed sites. Some specimens were collected growing on species of *Sargassum* at sites protected from wave action.

DISCUSSION

Laurencia caduciramulosa is easily recognized mainly by the deciduous branchlets, its reduced size and well-developed stolon-like basal system. When Masuda & Kawaguchi (*in* Masuda *et al.*, 1997) described *L. caduciramulosa*, they pointed out the presence of deciduous branchlets as the most distinctive characteristic of this species. These deciduous branchlets function as propagules, and their detachments produce abundant scars on the branches (Masuda *et al.*, 2001). Garbary *&* Harper (1998) did not include the presence or absence of deciduous branchlets into the rank of characters used in their cladistic analysis of the *Laurencia* complex, but they confirmed this feature as an additional morphological character that can be taxonomically useful. Propagules or propagule-like branchlets were described for other species of *Laurencia sensu lato: L. poiteaui* (J.V. Lamouroux) M. Howe (Cruz Adames & Ballantine, 1996), *L. gracilis* Hooker *et* Harvey (Cribb, 1958), *L. decidua* Dawson and *L. subcorymbosa* Dawson (Masuda *et al.*, 1997). *Laurencia poiteaui* was transferred to *Chondrophycus poiteaui* (J.V. Lamouroux) K.W. Nam (Nam, 1999) by the presence of two vegetative pericentral cells per vegetative axial segment, besides other characters. The presence of true propagules was confirmed for *C. poiteaui* by Cruz Adames & Ballantine (1996), although Fujii *et al.* (1996) did not mention this character for the specimens from Nichupté Lagoon, Caribbean region of Mexico.

Deciduous branchlets described by Cribb (1958) for specimens identified as *Laurencia gracilis* (Table 1). Yamada (1931: 275) however, who examined authentic material of this species, did not report such deciduous branches. The specimen depicted by Yamada (1931) is about 15 cm high and morphologically very different from that reported by Cribb (1958) as *L. gracilis* from South-eastern Queensland. According to Yamada (1931) the slenderness and dark color of the frond and the inflated branchlets are peculiar for *L. gracilis*. On the other hand, Cribb (1958) mentioned as characteristic of *L. gracilis* the production of numerous small, clavate or cylindro-clavate branchlets in crowded arrangement near the apices, which may perhaps function as a means of vegetative reproduction. In these specimens, although deciduous propagule-like branches could be present, the prostrate stolon-like attachment system is lacking, thus differing from *L. caduciramulosa sensu* Masuda *et al.* (1997). Then, *L. gracilis* could be a misapplied name for the Cribb's specimens.

Laurencia decidua and *L. subcorymbosa,* both described for the Pacific Mexican, are morphologically very similar to *Laurencia caduciramulosa* (Table 1). Dawson (1963) segregated *Laurencia decidua* from *L. subcorymbosa* mainly based on their habitat: *L. decidua* being epilithic, whereas *L. subcorymbosa* is only found epiphytic on *Sargassum*. He also described different types of basal system for the species: "creeping, ramified branches, densely intergrown" for *L. decidua* and "a very small discoid attachment" for *L. subcorymbosa*. Other diagnostic characters are the branching pattern of deciduous branchlets (densely imbricated for *L. decidua*, and subcorymbose crown of deciduous branchlets for *L. subcorymbosa*), and the presence or absence of projecting epidermal cells (Table 1).

Laurencia caduciramulosa and *L. decidua* were distinguished by Masuda *et al.* (1997) based on the following morphological characters: 1) length of branchlets; 2) presence or absence of projecting epidermal cells; 3) presence or absence of intergrowing, creeping, ramified basal system; 4) tetrasporangia production [*L. decidua* produces tetrasporangia (Dawson, 1954, 1963; Abbott & Hollenberg, 1976), which are unknown for *L. caduciramulosa*]. On the other hand, *Laurencia subcorymbosa* was distinguished from *L. caduciramulosa* by Masuda *et al.* (1997) based on: 1) slender and sparsely branched axes [partly tetrasporangial (Dawson, 1963)], and 2) absence of stolon-like branches (Table 1).

According to Masuda *et al.* (1997), the basal system described by Dawson (1963) for *L. decidua* is not found in *L. caduciramulosa*. However, the Brazilian specimens of *L. caduciramulosa* showed a well-developed stolon-like basal system that is not critically different from that described by Dawson (1963). Furthermore, the basal system of *L. decidua* was interpreted as "creeping stoloniferous" by Abbott & Hollenberg (1976). Thus, the morphological differences in regard to basal system of these species seem to be a matter of interpretation. Moreover, our specimens of *L. caduciramulosa* were found growing on different substrata: rocky boulders and *Sargassum*, and showed variations in their basal systems. Epilithic plants of *L. caduciramulosa* produce dense tufts with well-developed stolon-like branches, whereas epiphytic plants have inconspicuous stolon-like branches or none, despite their potential for development of these branches. Nevertheless, the presence or absence of projecting epidermal cells seems to be a conservative species character and can constitute a diagnostic feature for some species of the *Laurencia* complex. The lack of projecting epidermal cells in *L. decidua* can separate it from *L. subcorymbosa* and *L. caduciramulosa* (Table 1). However, the presence of projecting epidermal cells in these latter species, and their habitat overlap suggest that they might be conspecific. Thus, a critical examination of the types of these species is required to confirm if they are taxonomically independent

Table 1. Comparison among *Laurencia caduciramulosa* Masuda *et* Kawaguchi and other species with deciduous branchlets. – = not described nor observed by the authors.

Characters	*L. caduciramulosa*				*L. decidua*	*L. subcorymbosa*	*L. gracilis*
	This paper	*Masuda* et al. *(1997, 2001*)*	*Furnari* et al. *(2001)*	*Klein & Verlaque (2005)*	*Dawson (1963)*	*Dawson (1963)*	*Cribb (1958)*
Habitat	lower intertidal to shallow subtidal zone (5 m depth); epilithic or epiphytic on *Sargassum*	lower intertidal zone; epilithic	lower intertidal zone; epilithic	shallow subtidal zone (4-8 m depth); epilithic	epilithic	epiphytic (on *Sargassum*)	upper sublittoral zone; epiphytic, often on *Cystophyllum*
Thallus height (cm)	up to 4	2-5	up to 5	up to 1.5	–	2.5	5
Stolon-like branches	present	present	present	present	present	absent	absent
Main axis diameter lower to middle portions (µm)	185-670	500-600 700-800*	–	360-440	500	200	300-625
Deciduous branchlets length × diameter at the tips (µm)	123-450 × 94-225	100-400 × 100-180 100-600 × 100-160*	–	500-560 × 240-260	1000	150	280 × 112
Corps en cerise	one, rarely two per cell	one per cell*	–	–	–	–	–
Cell wall projections	present (slight)	present (slight)	present (slight)	present (slight)	absent	mammiform	present
Lenticular thickenings	abundant (except for upper portions)	abundant (except for upper portions)	present	present	frequent	abundant	abundant (absent or very sparse in a few plants)
Geographic distribution	Atlantic (Brazil)	Pacific (Vietnam, Malaysia)	Mediterranean sea (Italy)	Mediterranean sea (France)	Pacific (Mexico)	Pacific (Mexico)	Pacific (Australia)

entities. Because the holotypes of Dawson's two species *Laurencia decidua* and *L. subcorymbosa* were not available for this study, we decided to cite the Brazilian material as *L. caduciramulosa* until comparative studies can clarify the relationships of these three taxonomic entities.

Besides the very distinctive deciduous branchlets of *L. caduciramulosa*, the Brazilian specimens are in agreement with the descriptions given by Masuda *et al.* (1997, 2001), Furnari *et al.* (2001) and Klein & Verlaque (2005) in the following features: 1) basal system formed by well-developed stolon-like branches, especially in epilithic plants; 2) epidermal cells, in surface view, longitudinally elongated in the middle to lower portions of the thalli; 3) epidermal cells slightly projecting near the uppermost portion of the branches, and 4) medullary cells with abundant lenticular thickenings in the walls, mainly in the lower portions of the thalli.

Similar to the Brazilian material, reproductive structures (gametangia or sporangia) have not been found in the collections of Vietnam (Masuda *et al.*, 1997), Malaysia (Masuda *et al.*, 2001) and the Mediterranean Sea (Furnari *et al.*, 2001; Klein & Verlaque, 2005). The absence of such reproductive structures seems to be efficiently replaced by a strategic mechanism of vegetative propagation made by the deciduous branchlets. These branchlets and, consequently, peculiar scars were constant in all Brazilian collections. Many detached branchlets were observed growing on the parental plants, producing conspicuous rhizoids. This observation also confirms that these branchlets are true propagules able to disseminate the species as pointed out by Masuda *et al.* (2001). The existence of the propagules as an alternative way of reproduction is important to understand the appearance and dispersion of *L. caduciramulosa* in Ilha Grande Bay.

Previous floristic surveys of Ilha Grande Bay listed eight species of *Laurencia sensu lato: L. catarinensis* Cordeiro-Marino *et* M.T. Fujii, *L. filiformis* (C. Agardh) Montagne, *L. intricata* J.V. Lamouroux, *L. majuscula* (Harvey) Lucas, *L. microcladia* Kützing, *L. obtusa* (Hudson) J.V. Lamouroux, *Chondrophycus flagelliferus* (J. Agardh) Garbary *et* J. Harper, *C. papillosus* (C. Agardh) Garbary *et* J. Harpe. These studies referred neither to *L. caduciramulosa* nor to any species of *Laurencia* with deciduous branchlets (Falcão *et al.*, 1992; Figueiredo-Creed & Yoneshigue-Valentin, 1997; Brito *et al.*, 2002; Figueiredo *et al.*, 2004; Széchy & Nassar, 2005). *Laurencia caduciramulosa* is referred neither to the remaining coast of the State of Rio de Janeiro nor to the coast of the State of Espírito Santo (Horta, 2000; Fujii & Sentíes, 2005), which show the richest phycological flora of Brazil, reflecting more complete taxonomic surveys (Horta *et al.*, 2001; Guimarães, 2003). Therefore, it is unlikely that this macroalga has been previously overlooked.

The geographical expansion of *Laurencia caduciramulosa* worldwide since its first description from Vietnam is in agreement with the introduction hypothesis proposed by Ribera & Boudouresque (1995). According to these authors´ criteria, *L. caduciramulosa* can be considered an introduced species in Brazil because: 1) when it was discovered, in 2001, it showed low abundance; 2) the sampling sites were close to potential introduction zones such as harbours; and 3) afterwards it was found in greater abundance around the original sampling site.

Two important harbours are located in the Ilha Grande Bay: Ilha Grande Bay's Oil Terminal at Ponta Leste, and Harbour of Angra dos Reis at Angra dos Reis city, which is responsible for the exportation of the National Siderurgical Company production. There are also one dockyard (Verolme) at Jacuacanga Inlet, many private piers and incipient mariculture. All these features are potential sources of species introduction (Carlton, 2001). Adjacent to Ilha Grande Bay, Sepetiba Bay is

subjected to a higher degree of human interference, including sewage and industrial discharges and activities related to the Guaíba Ore Terminal and to the Harbour of Sepetiba. Harbour of Sepetiba, known as a hub harbour, is responsible for bulk import and export terminals plus a multipurpose terminal. These harbours receive ballast water, although the discharged volume is unknown (Clarke *et al.*, 2004). Ballast water is recognized as a vector for introduced species into marine environments (Carlton, 1985). Considering the shipping routes and the seawater circulation along the coastline of the State of Rio de Janeiro, transport of seawater mass between Sepetiba Bay and Ilha Grande Bay is possible (Villac *et al.*, 2004), and this is an important point for the analysis of the potential destination of non-native species.

Recent introduction of macroalgal species has not been reported for the area under the influence of the Harbour of Sepetiba, but the cirriped *Megabalanus coccopoma* (Darwin, 1854) and the decapod *Charybdis hellerii* (A. Milne-Edwards, 1867) were referred to the area as introduced species (Villac *et al.*, 2004). On the other hand, a green macroalga, *Caulerpa scalpelliformis* (Turner) C. Agardh (Falcão & Széchy, 2005) and the scleractinian corals *Tubastraea coccinea* Lesson, 1829 and *T. tagusensis* Wells, 1982 (Paula & Creed, 2004) have been considered as recently introduced into Ilha Grande Bay. Likewise, it is likely that *Laurencia caduciramulosa* is a recently introduced species in the area.

Recently, another small-sized species, *Laurencia venusta* Yamada, originally described from Japan, was reported for the first time in Brazilian waters (Fujii *et al.*, 2005). The species was collected only at a single site at Espírito Santo State, and the authors proposed the hypothesis of *L. venusta* being a recently introduced species into Brazil.

The local introduction of *Laurencia caduciramulosa* is difficult to determine because it could have arrived at other geographical areas in the Brazilian coast before its present discovery at Ilha Grande Bay, as described in a species introduction risk assessment made for the adjacent Sepetiba Bay (Clarke *et al.*, 2004). Following its probable accidental introduction in Ilha Grande Bay, *L. caduciramulosa* seems to have successfully established in the shallow subtidal zone of rocky shores. Due to its reduced thallus height, we do not believe that this species is a potential marine pest for Ilha Grande Bay ecosystems. This report expands the geographical distribution of *L. caduciramulosa* to the western Atlantic Ocean.

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