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Some Delesseriaceae (Ceramiales, Rhodophyta) new to the southwestern Atlantic

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ABSTRACT - (Some Delesseriaceae (Ceramiales, Rhodophyta) new to the southwestern Atlantic). Up to now 18 species of Delesseriaceae have been referred to the Brazilian coast, nine of which belong to the subfamily Delesserioideae. Here we report for the first time the occurrence of *Apoglossum gregarium* (Dawson) Wynne, *Branchioglossum minutum* Schneider and *Hypoglossum anomalum* Wynne & Ballantine collected by SCUBA diving on islands of the south and southeastern coast of Brazil. This report is an indication that the subtidal has been undersampled on the southwestern Atlantic.

RESUMO - (Algumas Delesseriaceae (Ceramiales, Rhodophyta) novas para o sudoeste do Atlântico). Até agora 18 espécies de Delesseriaceae (Rhodophyta) foram citadas para a costa brasileira, dentre as quais nove pertencentes à subfamília Delesserioideae. Aqui reportamos, pela primeira vez, a presença de *Apoglossum gregarium* (Dawson) Wynne, *Branchioglossum minutum* Schneider e *Hypoglossum anomalum* Wynne & Ballantine coletadas através de mergulho autônomo em ilhas do sul e sudeste do Brasil. Esta é mais uma contribuição mostrando que a biodiversidade algal do infralitoral é ainda pouco conhecida no Atlântico Sul Ocidental.

Key words - Delesseriaceae, *Apoglossum*, *Branchioglossum,* Brazil, *Hypoglossum*

Introduction

The family Delesseriaceae (Ceramiales, Rhodophyta) has more than 90 genera divided into two subfamilies (Wynne 1996). In the subfamily Delesserioideae procarps are located on the primary cell row near the blade tip, whereas in the Nitophylloideae procarps are randomly distributed over the blade surface (Maggs & Hommersand 1993).

Among the 18 species of Delesseriaceae referred to Brazil (cf. www.ib.usp.br/algamare-br, based on Oliveira Filho 1977, Cordeiro-Marino & Guimarães 1981, Yoneshigue 1985, Bouzon 1989) nine belong in the Delesserioideae, assigned to the genera *Caloglossa* (Harv.) G. Martens, *Cottoniella* Børgesen, *Hypoglossum* Kützing, *Platysiphonia* Børgesen, and *Taenioma* J. Agardh.

Although the flora of the southeastern coast of Brazil is the best known in the country, most of the information is based on collections from the intertidal and on relatively few dredgings. Here we refer for the first time to the Brazilian coast and southwestern Atlantic species of the genera *Hypoglossum*, *Apoglossum* J. Agardh, and *Branchioglossum* Kylin.

The three genera dealt with here have a similar morphology. The genus *Apoglossum*, however, is distinct from *Hypoglossum* and *Branchioglossum* because not all initials of third order rows reach the blade margin, whereas in *Hypoglossum* and *Branchioglossum* the initials of all the third-order cell rows do reach the margin (Wynne 1988, Maggs & Hommersand 1993). In *Branchioglossum* primary branching is marginal, by conversion of a distal second-order cell row into a primary initial, whereas in *Hypoglossum* primary branching is endogenous and produced from the midrib (Millar & Wynne 1992).

Material and methods

Sampling was made by SCUBA dives, in different sites, depths and occasions at the southeastern coast of Brazil. Material preserved in formalin 4% in seawater was stained with aniline blue 1%, acidified with 1 N HCl, and mounted in 50% Karo Syrup. The photographs were taken on a standard Leica microscope. The studied specimens are deposited at the Phycological Herbarium of the University of São Paulo, Brazil (SPF).

Results and Discussion

Apoglossum gregarium (Dawson) Wynne
Bull. Southern California Acad. Sci., 84: 164. 1985.
Basionym: *Hypoglossum gregarium* Dawson, 1966, J. Ariz. Acad. Sc. 4, p. 65, figure 6c; *Phrix gregarium* (Dawson) Stewart, 1974, Phycologia 13: 147.

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Synonym: *Membranoptera spatulata* Dawson, 1950, Am. J. Botany 37: 157, figure 15.
Studied material: São Paulo, Rapada Island (23°26' S, 44°54' W), 02/04/99, 9 m deep, on rhodoliths, PH 28; Castilho Island (25°17' S, 47°57' W), 13/01/99, PH 11 (tetrasporic), 12 m deep, epilithic. Coll. P. Horta.

Plants consisting of delicate erect monostromatic blades, except at the midrib, 2.5-6.4 mm long and 0.6-2.5 mm wide, attached by a compact discoid rhizoidal system (figure 1). A light rhizomatous cortication is present at the basal portion (figure 2); apex emarginate (figure 3); lateral microscopic veins can be seen on older blades (figure 4). Axial cells 76-135 µm long and 11-20 µm in diameter; lateral pericentral cells, 48-155 µm long and 15-30 µm in diameter, do not divide transversely except in portions within the tetrasporangial sori. Continuous tetrasporangial sori distributed along midrib, 0.95-1.6 µm long and 0.14-0.30 µm at the widest portions; tetrasporangia tetrahedrally divided 30-36 µm in diameter (figures 5-7). Spermatangial sori separated by sterile cells (figure 8). Female plants were not found.

Apoglossum gregarium is distinct from *A. ruscifolium* (Turner) J. Agardh, a species already reported from the Atlantic (Schneider & Searles 1991, Maggs & Hommersand 1993, Coppejans & Kling 1995, Stegenga *et al*. 1997), by its smaller thallus and tetrasporangia size. Besides that, *A. ruscifolium* has spermatangial sori as a series of narrow striae running diagonally from the midrib towards the blade margins (Wynne 1984).

Other related species are *Apoglossum spathulatum* (Sonder) Womersley *&* Shepley and *A. unguiculescens* Millar. Both can be distinguished from *A. gregarium* by having lateral branches produced from the central midrib (Wynne 1984, Millar 1990), whereas in *A. gregarium* they arise from a cylindrical basal axis or from decumbent fragments (Ballantine & Wynne 1985).

Our plants are very similar to *A. gregarium* studied by Ballantine & Wynne (1985) from the Caribbean and Gulf of Mexico, Sartoni & Boddi (1993) from the Mediterranean, Wynne (1985) from California and Pacific Mexico, Wynne & Norris (1991) from South Africa, and by Schneider (2000) from Bermuda, being equally corticated by rhizoids in the basal portions and with spermatangial sori separated by sterile cells.

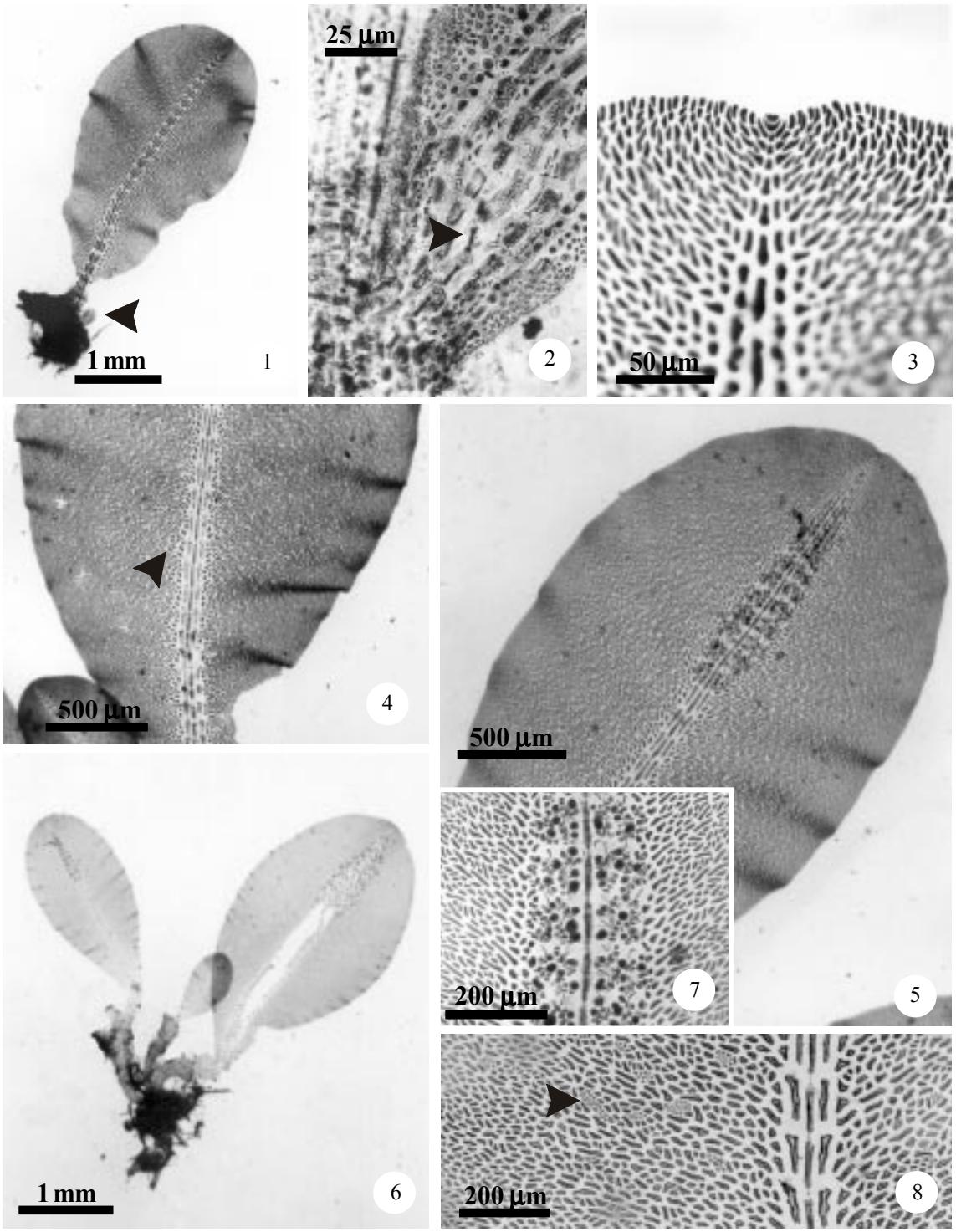
Branchioglossum minutum C.W. Schneider
Nova Hedwigia, 24: 92, figures 13, 15, 16. 1974.
Studied material: Santa Catarina, Tacami Island (28°21' S, 48°36' W), 17/01/99, 8-15 m deep, PH 42-44; São Paulo, Rapada Island (23°26' S, 44°54' W), 02/04/1999, 10 m deep, on rhodoliths, PH - 39. Coll. P. Horta.

Pink delicate plants, 3-12 mm in height and 350-2260 µm in width. Thallus erect or prostrate, monostromatic blade presenting an evident central midrib, corticated at the basal portion; all cells of second-order rows bearing third-order rows; attached to the substract by a rhizoidal disk; oblanceolate to linear-lanceolate blades produce branches at the margin from the terminal cells of the second-order cell rows, with irregular, opposite or occasionally alternate disposition; apices pointed, occasionally obtuse (figures 9-11); thallus margin undulated, presenting multicellular rhizoids (figure 21). Axial cells 78-166 µm in length and 19-60 µm in diameter, surrounded by pericentral cells.

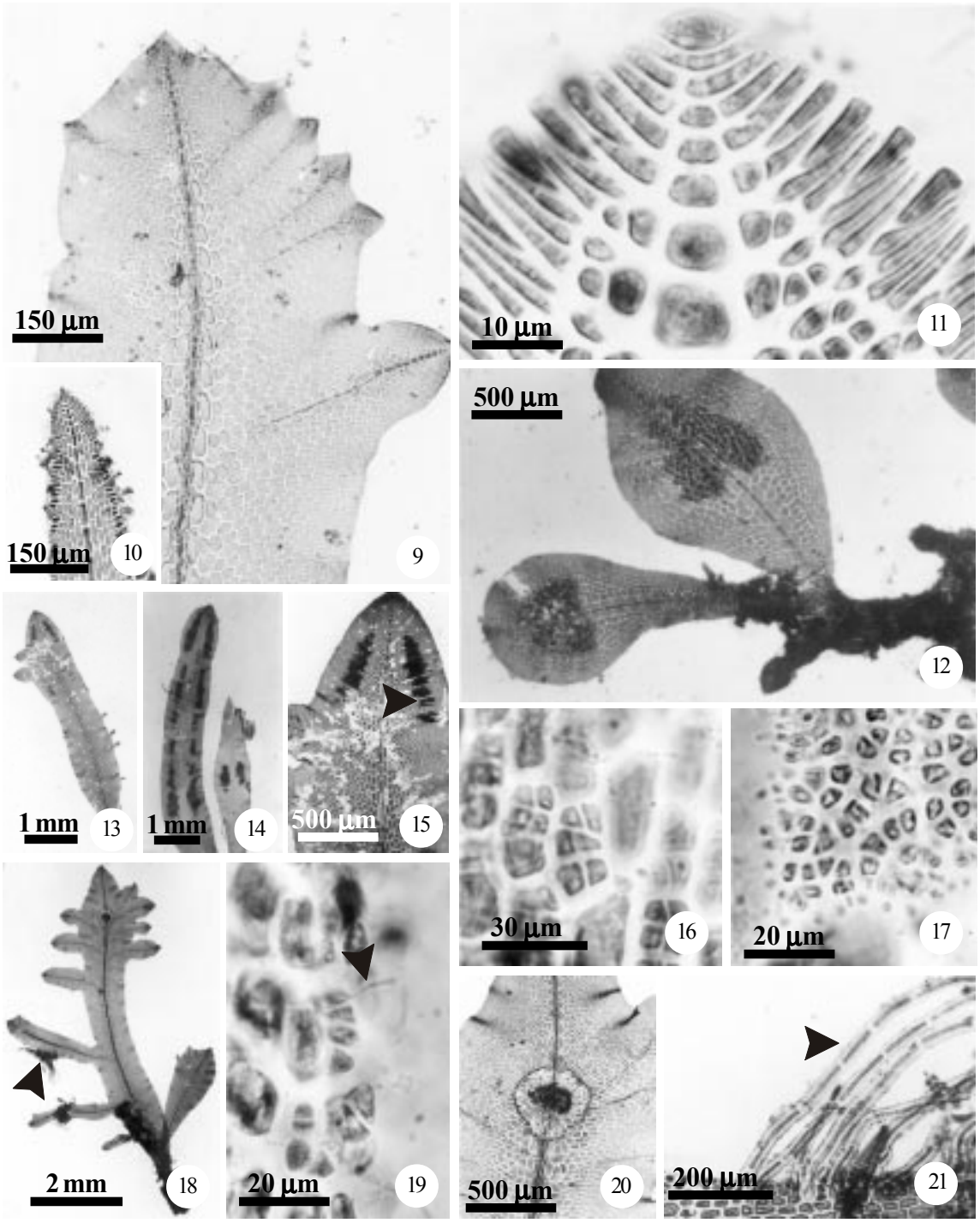
Tetrasporangia tetrahedrally divided, 15-40 (-56) µm in diameter, arranged in contiguous rounded sori along the midrib, 330-700 µm long and 300-530 µm wide (figure 12). Male plant with spermatangial sori diagonally located, confluent or interrupted when young, on both sides of the midrib, occupying the distal half or almost the whole extension of the male frond (figures 13-17). Female plant with four-celled carpogonial branch (figure 19) produced from the midrib; cystocarps (figures 18, 20) 220-605 µm in diameter at the base; carpospores spherical 20-39 (54) µm in diameter.

The distribution of tetrasporangia in groups of scattered circular sori in *Branchioglossum pygmaeum* Wynne *&* Norris (Wynne & Norris 1991), from South Africa, distinguishes it from our specimens. On the other hand, *B. epiphyticum* Millar *et* Wynne presents holdfasts produced submarginally in association with lateral blades, or rarely from the blade apices (Millar & Wynne 1992), what differs from our material.

Our specimens present several similarities with *Branchioglossum bipinnatifidum* (Montagne) Wynne from the eastern Pacific. However, *B. bipinnatifidum* differs from our plants in the location of the tetrasporangial sori which are in an intermediate portion between the margin and the midrib (Abbott & Hollenberg 1976, Wynne 1988). *Branchioglossum nanum* Inagaki is also distinct from our plants by having elongate tetrasporangial sori, in only one or two rows on both sides of the midrib (Millar & Wynne 1992), whereas *B. minutum* presents rounded tetrasporangial sori contiguous with the midrib.



Figures 1-8. *Apoglossum gregarium*. 1. General aspect of sterile blade; arrow head points to a young branch. 2. Basal region with a light rhizomatous cortication (arrow head). 3 Details of the tip with the apical cell. 4. Old portion of the blade showing microscopic veins (arrow head). 5. General aspect of tetrasporic plant, with the typical elongated tetrasporangial sori. 6. General aspect of tetrasporic plant, with a compact discoid rhizoidal system at the basal portion. 7. Detail of tetrasporangial sori.. 8. Male plant with spermatangial sori (arrow head) separated by sterile cells.



Figures 9-21. *Branchioglossum minutum*. 9 and 10 General view of blade tips. 11. Details of the blade tip. 12. Tetrasporangiate blades. 13-15 Different aspects of male plants, showing sequences of discrete spermatangial sori (arrow head). 16. and 17. Details of young and mature spermatangial sori. 18. General aspects of a female plant, with tuft of rhizoids at the margin (arrow head). 19. Detail of carpogonial branch (arrow head points a trichogyne). 20. Cystocarp over the midrib. 21. Margin with multicellular rhizoids (arrow head).

Branchioglossum spiniferum Yoshida & Mikami differ from our plants because not all secondary cell rows give rise to third-order cell rows (Yoshida & Mikami 1992).

Branchioglossum minutum differs from *Frikkiella pseudoprostrata* (Ballantine & Wynne) Wynne & Schneider (Wynne & Schneider 1996), described by Ballantine & Wynne (1987, as *B. pseudoprostratum*) for in *Frikkiella* not all the cells of the second-order rows produce third-order rows. Besides, in oposition to *Branchioglossum*, in *Frikkiella* branches are initiated from marginal cells.

Branchioglossum prostratum Schneider, in spite of having about the same morphology and dimensions as our material, can be distinguished for having scattered spermatangial sori. However, Wynne (1988) concluded that variations in the height and margin of the blade and the location of the tetrasporangial sorus are not discrete criteria for distinction between *Branchioglossum bipinnatifidum* (Montagne) Wynne and *B. woodii* (J. Agardh) Kylin. Wynne's observation leads us to question the maintenance of *Branchioglossum minutum* (table 1) because of the variability we found within populations at Tacami and Rapada Island, in addition to the information presented in the literature (Schneider 1974, Schneider & Searles 1975, Schneider & Searles 1991). The finding of scattered spermatangial sori in some plants of the Brazilian populations indicates that this criterion should be more critically evaluated.

Hypoglossum anomalum Wynne & Ballantine
J. Phycol., 22: 185. 1986.
Studied material: São Paulo, Queimada Grande Island (46°41' W, 24°29' S), 27/08/97, PH 81-87, 8-12 m deep, 11/11/97, PH 88-90, 08-16 m deep, epilithic. Coll. P. Horta.

Rosy delicate plants with undulated blade, monostromatic except at the midrib; thallus prostrate, dorsiventral, 20 mm long and 2 mm wide. Frequent anastomoses and multicellular rhizoids arising from abaxial face of the midrib or blade margin attaching to other blades and producing an entangled aspect. Opposite pairs of branches originating from the axial cells of the midrib but emerging at an intermediary position between the margin and the midrib (figures 22-30).

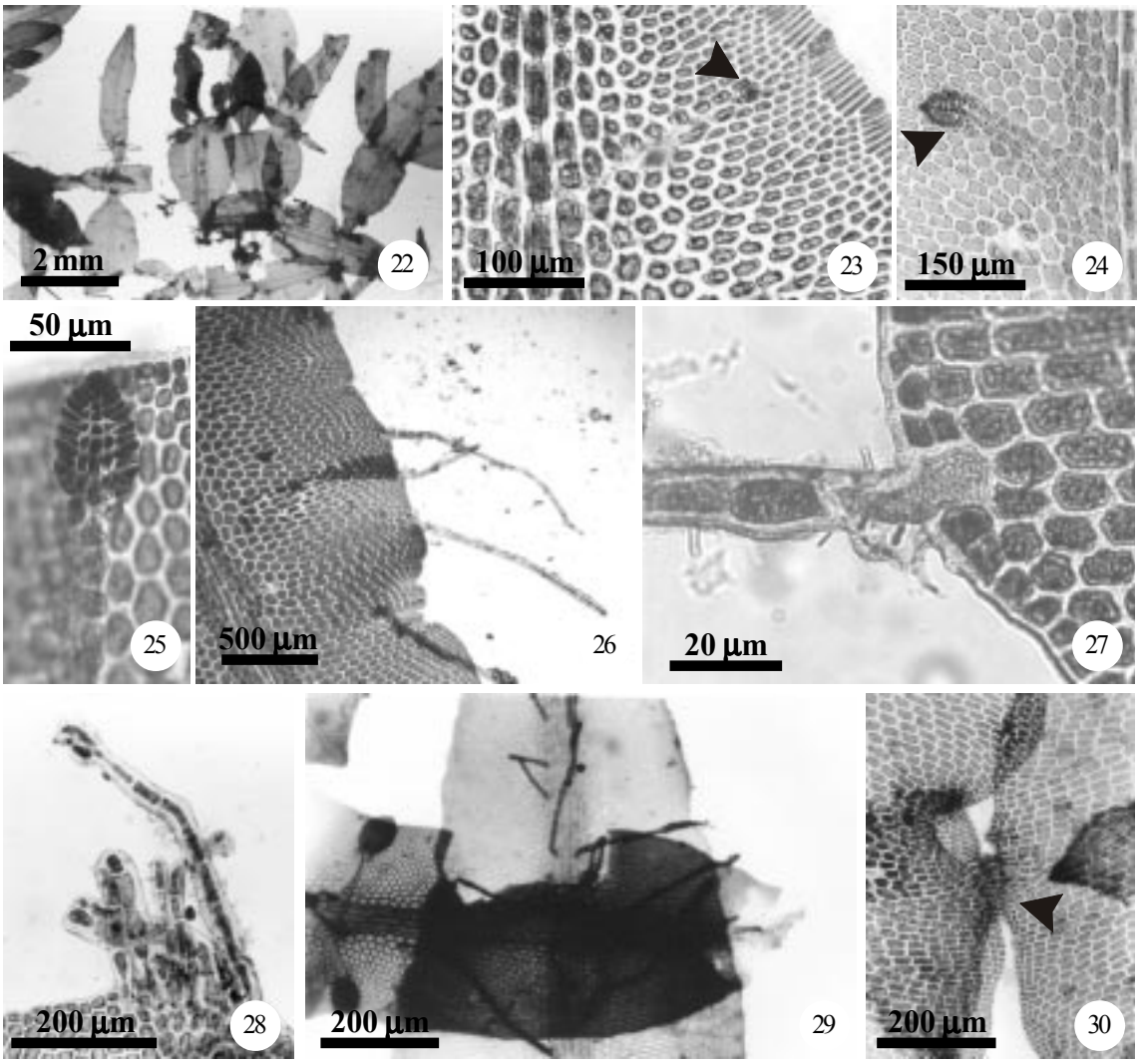
Fertile plants were not found, which perhaps is an indication that the species is at its southern limit of distribution, propagating only vegetatively.

This species differs from the two other species of *Hypoglossum* referred to Brazil by the pattern of blade construction. *Hypoglossum hypoglossoides* (Stackhouse) Collins & Hervey, referred to Oliveira Filho (1969) and Yoneshigue (1985) as *Hypoglossum tenuifolium* (Harvey) J. Agardh var. *carolinianum* Williams, although having all the cells of the second-order rows producing third-order rows, branches from the midrib, whereas *H. tenuifolium* (Cordeiro-Marino & Guimarães 1981) does not produce third-order rows from every cell of the second-order rows.

Table 1. Comparison of different species of *Branchioglossum* from the Atlantic Ocean.

	*B. minutum**	*B. prostratum*[1]	*B. minutum*[2]	*B. pygmaeum*[3]	*Frikkiella pseudoprostrata*[4]
Length (mm)	3-10	2	< 10	15-18**	9-20
Width (µm)	350-2260	700-1500	1000-3000	1000-4000**	750-2100
Branching	scattered to dense	dense	scattered	scattered	scattered
Branch	ob - linear - lanceolate	linear - lanceolate	oblanceolate	oblanceolate	lanceolate
Margin	smooth – wavy	smooth	wavy	wavy	wavy
Apex	sharp-obtuse	sharp	sharp-obtuse	sharp	sharp-obtuse
Axial cell length (µm)	l.: 78-166	185	80-120	—	—
	d.: 19-60	40	18-40	—	—
Tetrasporangial sori	continuous	continuous	continuous	discrete	continuous
Tetrasporangia (µm)	15-40 (56)	30-40	20-40	20**	55
Spermatangial sori	scattered to confluent	scattered	confluent	scattered	—
Cystocarp (µm)	220-605	—	250-650	130**	550
Carposporangia (µm)	20-39 (54)	—	25-32	—	90

*Brazilian studied plants; ** - values calculated from figures offered by: 1- Schneider 1974, Schneider & Searles 1991, 2- Schneider & Searles 1975, Schneider & Searles 1991; 3- Wynne & Norris 1991, 4- Wynne & Schneider 1996.



Figures 22-30 *Hypoglossum anomalum*. 22. General aspect. 23. and 24. Detail of branch origin (arrow heads). 25. Detail of young branch. 26. Plant with lateral rhizoids. 27. and 28. Details of lateral rhizoids. 29. Rhizoids produced from the midrib. 30. Anastomoses between adjacent blades.

In spite of the Brazilian specimens being a little smaller than the type material (Wynne & Ballantine 1986) the diagnostic presence of the branch primordia initiated endogenously (Wynne 1994, Wynne & Norris 1991) supports our identification. None of the taxa described for other regions by Womersley & Shepley (1982), Wynne & Kraft (1985), Yoshida & Mikami (1986), Ballantine & Wynne (1988), Wynne (1989), Wynne *et al.* (1989), Wynne (1994) and Abbott (1996) fit the attributes of the Brazilian plants better than *H. anomalum,* previously described for Guadeloupe, Puerto Rico, Florida, South Africa and Indian Ocean (Wynne & Ballantine 1986, Wynne & Norris 1991, Wynne 1989).

This paper is a first contribution reporting the results of a new effort to survey the infralittoral benthic seaweed flora of Brazil, so far based mostly on intertidal sampling. The finding of the three new references of Delesserioideae algae reported in this paper is an indication that other taxa may be found in other groups as well. This will certainly enlarge the list of species that are known for this part of the world and will supply new evidence to test the biogeographic hypothesis put forward to explain the origins and affinities of the

Brazilian seaweed flora as discussed by Taylor (1955), Joly (1965), and Oliveira Filho (1977).

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