Spongites yendoi (Foslie) Chamberlain (Corallinales, Rhodophyta) on the coast of Bahia, Brazil

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Spongites yendoi (Foslie) Chamberlain (Corallinales, Rhodophyta) on the coast of Bahia, Brazil

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Abstract (*Spongites yendoi* (Foslie) Chamberlain (Corallinales, Rhodophyta) on the coast of Bahia, Brazil). We report the first occurrence of *S. yendoi* (Foslie) Chamberlain on the northeastern coast of Brazil, and the second record of the species on the Brazilian coast. We collected specimens on two beaches in the cities of Salvador and Camaçari, Bahia, Brazil. The species were identified by the presence of monomerous thallus construction, trichocytes arranged in horizontal fields, central columella, and tetrasporangial conceptacle morphometry. Our record extends the distribution range of this species into Brazilian waters.

Keywords Corallinaceae · Mastophoroideae · Nonarticulated algae · Taxonomy

Introduction

Spongites Kützing is one of eight genera to the subfamily Mastophoroideae (Corallinaceae). The genus has a broad distribution, occurring in the Atlantic, Pacific, and Indian Oceans. Of the 13 valid species of *Spongites* (Guiry and Guiry 2014), three were reported to occur in the western Atlantic: *S. absimilis* (Foslie and M. Howe in Foslie) Afonso-Carr., *S. fruticulosa* Kütz., and *S. yendoi* (Foslie) Chamberlain (Wynne 2011).

Spongites yendoi was originally described from the North Pacific Ocean off the Japanese coast (Foslie 1900, as *Goniolithon yendoi*) as being a cosmopolitan species, occurring in tropical, temperate, and polar regions (Penrose 1996). Its occurrence has been recorded for the coast of Alaska, Australia, China, Indian Ocean Islands, Indonesia, Japan, Korea, Mauritius, Mozambique, Namibia, New Zealand, Saudi Arabia, South Africa (Guiry and Guiry 2014), and Mexico (Fragoso and Rodriguez 2002; Mateo-Cid et al. 2007).

In the tropical and warm temperate western South Atlantic, the genus is represented by the species *S. yendoi*, which was recorded in the state of Espírito Santo, on the southeastern coast of Brazil (Henriques et al. 2011).

Here, we present the first record of *S. yendoi* on the northeastern coast of Brazil, and the second record of the species on the Brazilian coast. We describe the morphological, anatomical, vegetative, and reproductive features of the investigated specimens.

Materials and methods

We collected samples on two beaches—Itapuã (12°57′22″S, 38°21′31″W) and Arembepe (12°44′25″S, 38°08′58″W)—located in the municipalities of Salvador and Camaçari, respectively, Bahia state, northeastern Brazil. The samples were collected from the subtidal region (9–25 m depth), using scuba diving and a Peterson dredge and preserved in 4 % formalin seawater.

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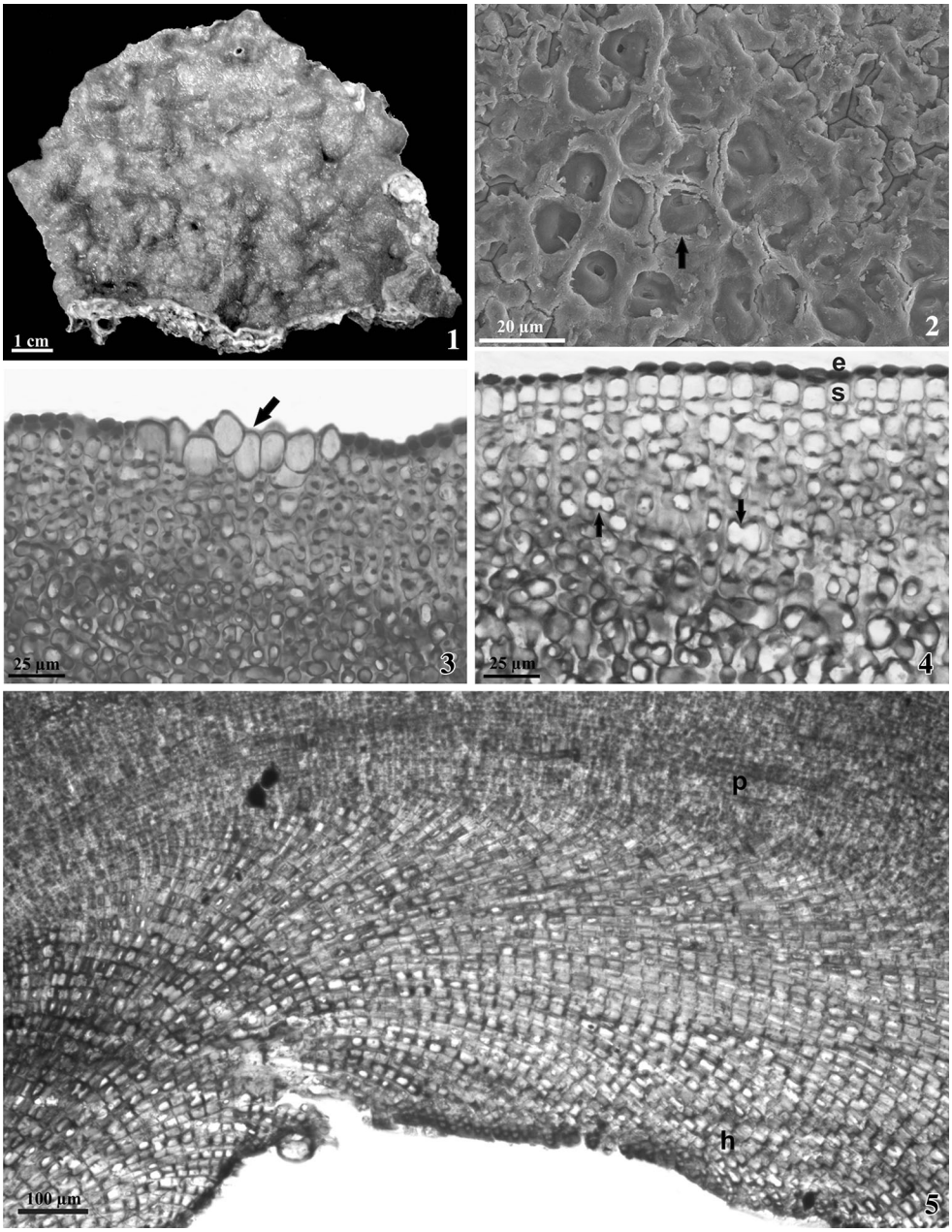
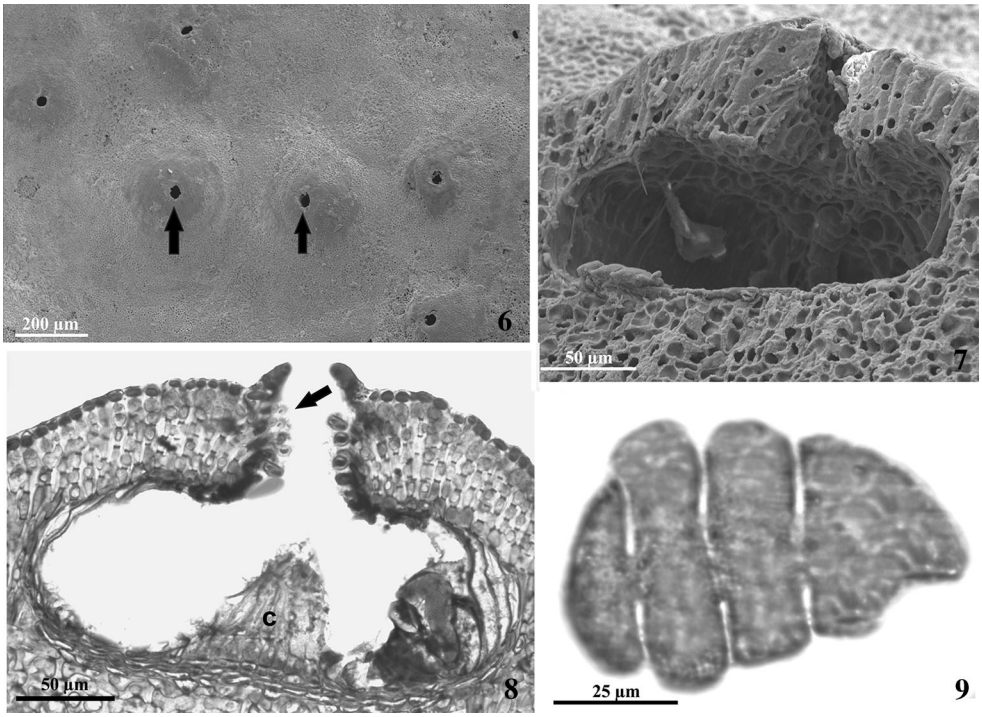


Figs. 1–5 General aspects and micrographs of *Spongites yendoi* (Foslie) Chamberlain. **1** General aspects. **2** Trichocytes in surface view, SEM (*arrow*). **3** Longitudinal section showing trichocytes grouped in horizontal row (*arrow*). **4** Longitudinal section showing epithallial cells (*e*) more or less elliptical. Subepithallial initial cells (*s*) markedly longer than subtending ones, and cells of adjacent filaments linked by lateral cell fusions (*arrows*). **5** Longitudinal section showing monomerous construction (*p* perithallial; *h* hipothallial)

The sampled materials were decalcified with 0.6 M HNO_3 for 24 h, followed by dehydration with ethanolic series (30, 50, 70, 90, and 100 %), infiltration, and inclusion in a Leica Historesin embedding Kit, according to the manufacturer's instructions. Sections (6–12 µm thick) were cut using a Leica microtome (Model 2040) and stained with acidified aqueous toluidine blue (Riosmena-Rodriguez 1993, Moura et al. 1997). The sections were observed under a scanning electron microscope, following Chamberlain (1993). The specimens were deposited in the Herbarium Alexandre Leal Costa (ALCB), Federal University of Bahia.



Figs. 6–9 Micrographs of *Spongites yendoi* (Foslie) Chamberlain. **6** Tetrasporangial conceptacles uniporate in surface view, SEM, showing pores (*arrows*). **7** Longitudinal fracture, SEM, tetrasporangial conceptacles uniporate. **8** Longitudinal section of the tetrasporangial conceptacle showing pore canals lined by cells orientated parallel to the thallus surface, projected into the canal (*arrow*), and the presence of central collumela (*c*). **9** Detail of a zonate tetrasporangia

Results

Family Corallinaceae Lamouroux 1812: 185
Subfamily Mastophoroideae Setchell 1943: 134
***Spongites yendoi* (Foslie) Chamberlain 1993: 100**
Basionym: *Goniolithon yendoi* Foslie 1900: 25
Synonyms: *Lithophyllum yendoi* (Foslie) Foslie 1900b: 20; *Pseudolithophyllum yendoi* (Foslie) Adey 1970: 14; *Lithophyllum natalense* Foslie 1907:27.
Figures: 1–9.
Description: Plants non-geniculate, thallus-forming free-living rhodoliths or attached to substrate, growth-form encrusting (Fig. 1). Color varying from grayish to brownish-red. Thallus pseudoparenchymatous with monomerous construction (Fig. 5). Epithallial cells single and more or less elliptical, 5–7.6 µm long and 7.5–9 µm in diameter (Fig. 4). Subepithallial initial cells markedly longer than subtending ones, 9.5–13.7 µm long and 6–8.8 µm in diameter (Fig. 4). Cells of perithallial filaments, 8–12.1 µm long and 6.5–9 µm in diameter (Fig. 5). Cells of hipothallial filaments 13–17.2 µm long and 8–11 µm in diameter (Fig. 5). Trichocytes arranged in horizontal fields, 18–25 µm long and 12–18.7 µm in diameter (Figs. 2, 3). Cells of adjacent filaments linked by lateral cell fusions (Fig. 5). Secondary pit-connection not observed. Tetrasporangial conceptacles uniporate, 75–116.2 µm long and 102–266 µm in diameter (Figs. 6–8), chambers are more or less elliptical (Figs. 7, 8). Conceptacle roofs 3–6 cells thick, including the epithallial cells, pore without an apical plug; central collumela present; conceptacle chamber floor with 3–5 cell layers; tetrasporangial conceptacle pore canals lined by cells that are orientated parallel to the thallus surface, projected into the canal (Fig. 8). Tetrasporangia transversally divided, 38–90 µm long and 19–45 µm in diameter (Fig. 2d). Gametangial thallus not observed.
Material examined: BRAZIL, BAHIA, Salvador, Itapuã, 29-IX-2011, *I. O. Costa* et al. (ALCB 103456; ALCB 103457); Camaçari, Arembepe, 12-VII-2012, *CETREL* (ALCB 103458).

Discussion

The Bahian specimens were identified as *S. yendoi* based on the following morphological features: monomerous thallus construction; trichocytes arranged in horizontal fields; the presence of central columella; and tetrasporangial conceptacle morphometry—location, size, and position of the cells forming the canal pore (Table 1). These characteristics are in agreement with those observed by Penrose and Woelkerling (1992), Chamberlain (1993),

Table 1 Comparison between descriptions of specimens sporophytic of *Spongites* based on vegetative and reproductive features

Characters (measured in µm)	*S. yendoi* (this study)	*S. yenda*[a] (lectotype) Japan	*S. yendoi*[b] Australia	*S. yendoi*[c] Mexico	*S. yendoi*[d] Brazil	*S. decipiens*[a] United States	*S.tunicata*[b] Australia
Protuberances	−	+/−	+/−	−	+	−	+/−
Thallus construction	Monomerous	Monomerous	Monomerous	Monomerous	Monomerous	Dimerous	Dimerous
Trichocytes	+	+	+	+	−	+	−
Trichocytes organization	Horizontal fields	Horizontal rows or singly	Horizontal fields or singly	Horizontal fields	–	Singly	–
Trichocyte length	18–25	15	ND	15–17.5	–	18	–
Trichocyte diameter	12–18.7	8	ND	12.5–15	–	7	–
Epithallial cells	Rounded	ND	Rounded	Rounded	Flattened	Quadratic	Rounded or flattened
Epithallial cell length	5–7.6	ND	ND	2.5–3	2–3	ND	ND
Epithallial cell diameter	7.5–9	ND	ND	4–6	6–8	ND	ND
Perithallial cell length	8–12.1	3–10	2–6	ND	4–8	4–13	2–11
Perithallial cell diameter	6.5–9	3–8	5–22	ND	6–10	4–10	2–9
Hypothallial cell length	13–17.2	6–12	ND	ND	10–19	9–22	ND
Hypothallial cell diameter	8–11	3–8	ND	ND	3–7	8–15	ND
Tetrasporangial conceptacle length	75–116.2	80	109–185	80–150	105–110	70–78	109–158
Tetrasporangial conceptacle diameter	102–266	170	164–232	180–295	280–290	143–208	136–142
Central columella	+	+	+	+	−	−	−
Number of cells in the roof of tetrasporangial conceptacle	3–6	ND	3–5	ND	3–8	ND	3–4
Tetrasporangia length	38–90	ND	ND	32.5–75	17–20	55–75	ND
Pores surrounded by coronas of filaments	−	−	−	−	−	−	+

Featured characters diagnostics

+ present, − absent, *ND* not disclosed

[a] Chamberlain (1993)

[b] Penrose (1996)

[c] Mateo-Cid et al. (2007)

[d] Henriques et al. (2011)

Penrose (1996), and Mateo-Cid et al. (2007), except for the dimensions of the epithallial cells, trichocytes, and tetrasporangia; the size of these varied among the specimens investigated in the present study and the specimens recorded from Mexico and Japan (Table 1). *Spongites yendoi* was previously reported to show considerable morphological plasticity, and also vegetative and reproductive anatomy (Chamberlain 1993), probably because of environmental conditions (Maneveldt and Keats 2008).

In comparison with the specimens examined in the present study, those recorded in the state of Espírito Santo by Henriques et al. (2011) on the southeastern coast of Brazil had smaller epithallial cells and tetrasporangia and lacked trichocytes (Table 1). The occurrence and position of trichocytes are considered important in the delimitation of *Spongites* species; however, their presence is known to vary according to the environmental conditions; and they are commonly found on species occurring in conditions of high temperature and luminosity (Woelkerling 1985). The samples examined in the present study were collected at a depth of 9–25 m, whereas those described by Henriques et al. (2011) were collected at a depth of 50 m. This difference in depth likely causes a variation in the available irradiance and temperature, which may, in turn, explain the observed plasticity.

Spongites yendoi has similar characteristics to *S. decipiens* (Foslie) Chamberlain and *S. tunicata* Penrose (Table 1). However, *S. decipiens* has a strictly dimerous thallus construction, with a unistratose basal filament composed of relatively large cells (Chamberlain 1993).

Further, *S. tunicata*, besides having a dimerous thallus construction, has tetrasporangial conceptacles with pores surrounded by coronas of filaments; this morphological characteristic does not occur in *S. yendoi* (Penrose 1996).

The results of our present study expand the distribution of *S. yendoi* to the coast of Brazil. Previously, the species was recorded only in the southeast of the country, specifically in the state of Espírito Santo. The presence of *S. yendoi* in the tropical South Atlantic (Horta et al. 2001) reinforces the need to evaluate the molecular affinity of this taxon to species described under the same epithet in other regions of the world, especially those occurring in temperate areas as the zone that represents the type locality on the Japanese coast.

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