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An overview of the shallow-water calcified hydroids from Brazil (Hydrozoa: Cnidaria), including the description of a new species

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Abstract

Five species of calcified hydroids occur in shallow waters along the Brazilian coast: four milleporids –*Millepora alcicornis* Linnaeus, *Millepora braziliensis* Verrill, *Millepora nitida* Verrill, and a new species, *Millepora laboreli* – and one stylasterid – *Stylaster roseus* (Pallas). Compared to the scleractinian corals, the calcified hydroids of Brazil have received little attention. Nevertheless, Milleporidae are an important component of Brazilian reefs, with colonies that can reach up to 2 m in diameter. Among the aspects that have been studied for *Millepora* spp, their distributions and skeletal morphometries are the most distinctive. Due to their complex taxonomy, several morphometric characters have been used to facilitate their identification. Molecular systematics has also been used as a complementary technique to traditional taxonomic tools. Other aspects of Brazilian *Millepora* spp, such as their nematocysts, medusae and ecology, have received less attention; nevertheless, the few existing studies reveal several remarkable features of this genus. Comprehensive studies of Brazilian stylasterids are still lacking.

Key words: Calcified hydroids, Brazil, *Millepora*, *Millepora laboreli* **n. sp.**, *Stylaster roseus*

Introduction

Milleporidae and Stylasteridae currently are included in Class Hydrozoa, but before Agassiz (1858) studied the structure of their tissue in detail these organisms were classified as scleractinian Anthozoa (Boschma 1956; Moseley 1881). These two families are also commonly grouped as “calcified hydroids”, “calcareous hydrocorals” or, simply, “hydrocorals”—terms that refer to hydrozoans that secrete a calcareous skeleton. They are, however, a polyphyletic grouping that includes families from two different orders. The one order that represented this grouping, Hydrocorallia, was discontinued in 1979 (Petersen 1979). Here we use the term “calcified hydroids”, which includes Milleporidae, Stylasteridae, and a few species, such as *Janaria* spp., in the family Hydractiniidae, a family that does not occur in the western Atlantic Ocean.

The genus *Millepora* has a circum-tropical distribution with up to 17 recognized species, including eight in the Indian Ocean, nine in the western and central Pacific Ocean, four in the eastern Pacific Ocean, and six in the western Atlantic Ocean (Cairns *et al.* 1999). On the Brazilian coast, four species of *Millepora* have been identified (Amaral 1997; Amaral *et al.* 2002): *Millepora alcicornis* Linnaeus, 1758; *M. braziliensis* Verrill,

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1868; *M. nitida* Verrill, 1868; and *M. laboreli* Amaral (this publication).

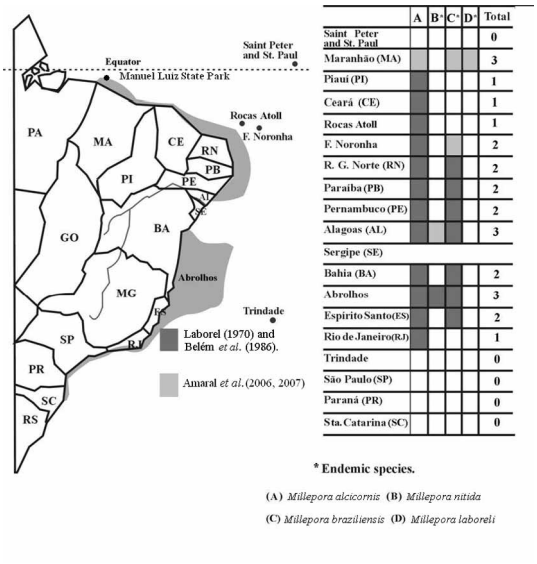
Eight genera and 42 species of Stylasteridae occur in the western Atlantic Ocean, and particularly in the Antilles, Bahamas, and Florida Keys (Cairns 1986). But only one species occurs in Brazilian littoral environments—*Stylaster roseus* (Pallas, 1766). Laborel (1970) and Hetzel and Castro (1994) cite it for the northeastern coast, from the states of Pernambuco to Bahia. It is also present in the Rocas Atoll, Fernando de Noronha Archipelago and in the Abrolhos area, as well as in the Manuel Luiz Coral Banks (Amaral *et al.* 2006).

Laborel (1970) provided the first comprehensive study of the Brazilian reef coral fauna, subsequent to which Brazil's scleractinian corals received considerable attention. Yet, despite their abundance, the calcified hydroids have been poorly studied (Amaral 1997; Amaral *et al.* 1997, 2002; Oliveira 2002). This overview summarizes the known life histories of the identified calcified hydroids in Brazil and includes a description of a previously unidentified species, classified as *M. laboreli* **n. sp.**

The Milleporidae

Distribution. *Millepora* are abundant throughout the world's tropical oceans and are a significant component of coral reefs, where they form large, conspicuous colonies (Lewis 1989). In Brazil, as elsewhere in the tropics, *Millepora* can be easily found on coral reefs, beach rocks, and other similar habitats. They are an important constituent of Brazilian reefs and often occur in extensive colonies up to 2 m in diameter, especially in the northeastern region.

Using a range of morphological characters, 112 colonies of *Millepora* (collected at numerous locations in northeastern Brazil) were recently identified as four species (Amaral *et al.* 2002): *M. alcicornis*, *M. braziliensis*, *M. nitida* and *M. laboreli* **n. sp.** *Millepora alcicornis* was identified at nine locations from Cabo Frio (Rio de Janeiro) to the Manuel Luiz Coral Banks (Maranhão) and was easily distinguished from its congeners. It is the only species in common with the Caribbean fauna (according to presently available studies). The remaining species seem to be endemic to Brazil. Figure 1 shows the geographical distribution of the four species of *Millepora.*



	A	B*	C*	D*	Total
Saint Peter and St. Paul					0
Maranhão (MA)					3
Piauí (PI)					1
Ceará (CE)					1
Rocas Atoll					1
F. Noronha					2
R. G. Norte (RN)					2
Paraiba (PB)					2
Pernambuco (PE)					2
Alagoas (AL)					3
Sergipe (SE)					
Bahia (BA)					2
Abrolhos					3
Espirito Santo(ES)					2
Rio de Janeiro(RJ)					1
Trindade					0
São Paulo (SP)					0
Paraná (PR)					0
Sta. Catarina (SC)					0

FIGURE 1. Geographical distribution of the Milleporidae from Brazil (map not to scale).

Synonyms. Laborel (1970) admitted that Brazilian *Millepora* had several synonym problems. Boschma (1948) described *M. braziliensis* as *M. alcicornis*, probably due to the varied shape of *M. alcicornis* (incrusting in agitated waters and ramified in calmer areas), while Laborel (1970) observed that *M. braziliensis* takes

a honeycombed shape in wave-disturbed areas and a ramified, leaf-like form in the back-reef area, becoming similar to *M. complanata* and *M. squarrosa*. In fact, *M. squarrosa* has been cited for Brazil based on studies using material from scientific collections: Boschma (1962) affirmed that *M. squarrosa* and *M. braziliensis* coexisted on the Brazilian coast, while de Weerdt (1990) suggested that it might be a synonym of *M. braziliensis*. However, *M. squarrosa* was never found again on the Brazilian coast or oceanic islands. Furthermore, despite having found no significant differences in gastropore and dactylopore diameter, a morphometrical study suggested that it is in fact a different species from *M. braziliensis* (Amaral 1997; Amaral *et al*. 2002) because of overall differences in skeletal morphology. Yet, it is difficult to distinguish between the various species of *Millepora* in the field, particularly *M. braziliensis* and *M. squarrosa*, due to their high phenotypic plasticity.

To add to the synonym problems, de Weerdt (1984) stated that the holotype for *M. alcicornis* is unknown and is probably lost. Boschma (1948) and de Weerdt (1984) provide further details on synonyms.

Morphometry. Owing to their plasticity and lack of definitive morphological characters, in any study that seeks to identify *Millepora*, it would seem appropriate to collect information on as many different characters as possible. Using this logic, Amaral *et al.* (2002) measured more than 20 variables, which included the growth form and the height of colonies, along with the density and diameter of the dactylopores and gastropores. Data were analyzed and compared to earlier studies to successfully separate the different species of *Millepora* occurring in Brazil (Amaral *et al.* 2002). The key morphological characters used to distinguish the different species from their congenerics along with their general descriptions are summarized below.

TABLE 1. Qualitative characters of the four *Millepora* species that occur in Brazil, according to Amaral (1997).

Character	*M. alcicornis* (34 colonies)	*M. braziliensis* (45 colonies)	*M. nitida* (13 colonies)	*M. laboreli* (11 colonies)
Location of specimens (n)	Manuel Luiz Coral Banks (1) Atol das Rocas (1) João Pessoa (3) Tamandaré (4) Japaratinga (3) Maceió (5) Abrolhos Islands (7) Guarapari (2) Cabo Frio (8)	Manuel Luiz Coral Banks (1) João Pessoa (3) Serrambi (2) Tamandaré (5) Maragogi (4) Japaratinga (8) Maceió (15) Abrolhos Islands (4) Guarapari (3)	Maceió (1) Abrolhos Islands (12)	Manuel Luiz Coral Banks (9)
Predominant growth form	Ramified (mostly), hemispherical and columnar	Honeycombed (mostly) and columnar	Ramified with rounded branches and hemispherical	Columnar
Superior part of colony	Ramified	Honeycombed	Ramified with rounded branches	Sharp
Surface texture	Irregular	Very irregular	Smooth	Very smooth
Ampullae	Shallow	Varying between deep and shallow	Shallow and isolated	Shallow and rare
Dactylopore form	Predominantly rounded	Predominantly rounded	Generally deformed	Deformed and very shallow
Gastropore form	Predominantly rounded	Predominantly rounded	Generally deformed	Deformed and very shallow
Epibionts	Many cirripeds	Some cirripeds	Few cirripeds	No cirripeds
Substratum	Calcareous algae, mud or gorgonians	Calcareous algae Scleractina, *Agaricia agaricites* or mud	Calcareous algae Scleractina, *Agaricia agaricites*	Calcareous algae and bryozoans

***Millepora alcicornis* Linnaeus, 1758**

Boschma (1948), in a description of *Millepora alcicornis*, stated that it "is so highly variable in shape that it is impossible to characterize the species in this respect". A study by Amaral (1997) showed that most colonies are ramified, but can also be incrusting, hemispheric, or a mixture of these forms. The shapes of the ramifications also vary (most are flattened). Yet, despite these variations in form, this species can be easily identified among other Brazilian *Millepora*. Colonies can exceed 1 m in height; according to Laborel (1970), colonies are 2–3 m high and important building components in Brazilian reefs. Amaral *et al.* (2002) noted that, of the morphometric characters studied for *M. alcicornis*, the shape and size of the dactylopores and gastropores were the most distinctive, as these were predominantly rounded and larger than in all of the other species studied (Table 1). This species also had the largest mean number of gastropores and ampullae per cm^2, yet the number of cyclosystems per cm^2 was relatively smaller. Another distinguishing morphometric feature of *M. alcicornis* among other Brazilian calcified hydroids is the diameter of the ampullae, which measures 0.41 mm on average (Amaral 1997) (Table 2).

***Millepora braziliensis* Verrill, 1868**

Similar to *M. alcicornis*, *M. braziliensis*, is also highly variable in form. According to Amaral (1997) and Amaral *et al.* (2002), most colonies are honeycombed, but can also be hemispheric, ramified, columnar, laminate, fan shaped, totally incrusting, or a mixture of these forms. The surface texture also varies, but in most colonies tends towards irregular. Laborel (1970) suggested that *M. braziliensis* varied in shape according to wave exposure: colonies in sheltered sites tend to have laminate and fine branching forms, whereas specimens in more exposed areas tend to have more massive, honeycombed forms. Nevertheless, Amaral (1997) and Amaral *et al.* (2002) did not confirm these observations, with specimens collected from a single area of a reef at Tamandaré Beach (Pernambuco) observed to have several different forms. *Millepora braziliensis* has a very irregular surface texture, ampullae that varied from shallow to deep (Table 1), and the greatest mean number of dactylopores per gastropore (Table 2). The mean diameters of gastropores and dactylopores are similar to *M. nitida* (Table 2) (Amaral 1997).

***Millepora nitida* Verrill, 1868**

Verrill (1868) described this species as having a "corallum forming low rounded clumps, four to six inches high, consisting of short, rapidly forking, rounded or slightly compressed branches" and Boschma (1962) stated that *M. nitida* is easily distinguishable from other species of *Millepora* of the western Atlantic Ocean. Amaral (1997) and Amaral *et al.* (2002) observed that *M. nitida* occurs predominantly in ramified form, although hemispheric and honeycombed forms also occur. Most colonies are smooth in texture, with few commensal cirripeds (Table 1). Amaral *et al.* (2002) showed that *M. nitida* had shallow and isolated ampullae, mean diameters of gastropores and dactylopores comparable to *M. braziliensis* and a similar mean ratio of dactylopores per gastropore (Table 2). Unlike *M. alcicornis* and *M. braziliensis*, the form of the pores was predominantly irregular (Table 1). Compared to all other species examined, *M. nitida* showed a greater transverse diameter, an intermediate colony height, and had greater and fewer mean numbers of cyclosystems and gastropores per cm^2, respectively (Amaral *et al.* 2002).

TABLE 2. Means (±SE) [number and range of measurements pooled across specimens] of various skeletal characters of the four *Millepora* species that occur in Brazil, according to Amaral (1997). (-) = the characteristic was not recorded, Dia = diameter, No = number. All measurements are in mm.

Characteristic	*M. alcicornis* (34 colonies)	*M. braziliensis* (45 colonies)
Height of colony	138.20 (11.31) [23; 53.7–306.0]	109.00 (7.04) [41; 36.5–217.8]
Transverse diameter	103.60 (8.82) [22; 35.0–188.0]	102.10 (5.73) [35; 50.0–190.0]
No principal branches	1.90 (0.22) [23; 1–5]	3.20 (0.62) [16; 1–7]
Dia of principal branch	22.85 (1.913) [26]	20.20 (2.63) [50]
Dia of terminal branch	6.65 (0.34) [491]	24.60 (1.56) [144]
No of ampullae	11.08 (2.08) [23; 1–44]	6.50 (1.41) [23; 1–27]
Dia of ampullae	0.41 (0.02) [171]	0.53 (0.01) [136]
No of cyclosystems	1.10 (0.037) [32; 1.0–1.5]	2.00 (0.10) [38; 1.0–3.5]
No of epibionts	16.80 (5.18) [12; 1–50]	5.40 (2.07) [14; 1 – 30]
Dactylopores per gastropore	5.20 (0.13) [8; 5.0–5.5]	7.75 (0.72) [4; 5.0–7.5]
Dia of dactylopores	0.14 (0.001) [872]	0.10 (0.001) [1130]
Dia of gastropores	0.29 (0.002) [827]	0.25 (0.001) [1152]
No of gastropores per cm^2	29.25 (3.17) [35; 4–88]	18.15 (1.41) [39; 4–48]

continued.

Characteristic	*M. nitida* (13 colonies)	*M. laboreli* **n. sp.** (11 colonies)
Height of colony	102.70 (8.96) [13; 56.5–170.7]	162.70 (15.52) [11; 95.8–266.7]
Transverse diameter	129.30 (10.51) [13; 64.7–210.0]	83.78 (11.98) [11; 52.7–187.7]
No principal branches	1.40 (0.30) [10; 1–4]	1.00 (0.00) [11; 1–1]
Dia of principal branch	84.10 (8.45) [15]	-
Dia of terminal branch	11.55 (0.93) [72]	-
No of ampullae	10.60 (7.94) [6; 1–50]	1.00(0.00) [1; 1]
Dia of ampullae	0.45 (0.02) [22]	0.36 (0.03) [11]
No of cyclosystems	2.10 (0.07) [11; 2.0–2.5]	1.45 (0.21) [11; 1.0–3.0]
No of epibionts	5.40 (2.64) [7; 1–20]	-
Dactylopores per gastropore	6.80 (0.14) [6; 6.0–7.0]	6.30 (0.41) [11; 5.0–8.0]
Dia of dactylopores	0.10 (0.002) [240]	0.08 (0.002) [200]
Dia of gastropores	0.24 (0.003) [259]	0.11 (0.004) [203]
No of gastropores per cm^2	11.00 (1.00) [12; 8–16]	23.27 (2.54) [11; 12–42]

***Millepora laboreli* Amaral, this publication**
Figures 2–6

Millepora sp. a Amaral *et al.* 2002

Type material: BRAZIL, Manuel Luiz Marine State Park, State of Maranhão (type locality), 1998, 30 m, collector Marco Hudson (holotype, Cnidarian Collection of the Laboratório de Ambientes Recifais da Universidade Federal Rural de Pernambuco, LAR/UFRPE nº 095 (Fig. 2); 10 paratypes. One paratype (number

02957) has been deposited at the National Museum in Rio de Janeiro.

Description (based on 11 samples—Figs. 3 and 4): Brown in color, growing in the form of pillars or fans at a depth of 30–32 m, with a single principal branch. Growth form always columnar (average height of 162.7 mm ± 15.5 SE—higher in the field), with a smoother and flatter texture than the other species of *Millepora*. Transverse of 83.8 mm (± 12). Mean gastropore diameter is 0.11 mm (± 0.004), gastropore density is 23.3 per cm^2 (± 2.50) and dactylopore diameter is 0.08 mm (± 0.002) with 6.30 (± 0.40) dactylopores and 1.45 (± 0.21) cyclosystems per gastropore. Mean ampullae diameter is 0.36 mm (± 0.03).

Diagnosis of the holotype. The holotype's growth form is columnar, with two smooth projections and an irregularly textured base. It is 265 mm high, with the secondary projection measuring 145 mm. The transverse diameter is 205.6 mm. The average gastropore diameter and density are 0.3 mm and 20.67 per cm^2, respectively. Dactylopore diameter is 0.09 mm, with 6.38 dactylopores and 1 cyclosystem per gastropore. Ampullae diameter is 1.1 mm. Dactylopores and gastropores are deformed and very shallow.

FIGURE 2. Holotype (a columnar specimen) of *Millepora laboreli* collected from the Manuel Luiz Marine State Park (State of Maranhão, northern coast of Brazil). Photo courtesy of Fernando Azevedo.

Etymology. This species' name honors Dr. Jacques Laborel (retired professor of the Université de Aix-Marseille, France) for his pioneering work and great contribution to the knowledge of Brazilian reefs.

Diagnosis of the species (Figs. 5–6). *Millepora laboreli* can be identified from all other specimens of *Millepora* due to its restricted distribution (it only occurs in the Manuel Luiz Coral Banks, differently from the other species which have a wider distribution within Brazil and/or the tropics); its always columnar growth form, sometimes with projections (vs. variable forms); its very smooth texture (vs. more irregular surfaces);

and its reduced number of ampullae (approximately one vs. five to thirteen per colony). Overall, the characters of *M. laboreli* are smaller than those of the other Brazilian *Millepora* species (diameter of ampullae, dactylopores, and gastropores) and there are fewer ampullae (Figs 5–6). Specifically in relation to the other *Millepora* species, *M. laboreli* can be distinguished from *M. alcicornis* and *M. braziliensis* because of its small, deformed and extremely shallow dactylopores and gastropores (vs. rounded, larger pores); and from *M. nitida* due to its closely located gastropores (vs. few gastropores per cm^2).

FIGURE 3. Specimens of *Millepora laboreli* collected at the Manuel Luiz Marine State Park (State of Maranhão, northern coast of Brazil) deposited in Laboratório de Ambientes Recifais (Universidade Federal Rural de Pernambuco). Photo courtesy of Fernando Azevedo.

Distribution. *Millepora laboreli* has a very restricted distribution and is only known from the type locality, the Manuel Luiz Marine State Park. However, it was very abundant in this area.

Molecular systematics. Although, in general, the amount of data collected on the physical characters of Brazilian *Millepora* has proved adequate to differentiate between species, in some cases phenotypic plasticity may preclude positive identification and/or require substantial sample sizes. A complementary technique that can be used to validate identification involves analyses of molecular characters, and in recent years this has become popular in many studies, including those concerning marine invertebrates (Solé-Cava and Thorpe 1991; Knowlton 1993). Although molecular techniques have been used in other cnidarians, such as hydroids (Thorpe *et al.* 1992) and corals (Stoddart 1983; Ayre and Wills 1988; Knowlton *et al.* 1992; Weil 1992; Garthwaite *et al*. 1994; Weil and Knowlton 1994), to date the only studies on the molecular systematics of calcified hydroids are by Manchenko *et al.* (1993), Amaral (1997), Amaral *et al*. (1997), Miller *et al.* (2004) and Lindner *et al*. (2008), the middle three being the only ones done with Brazilian species. Amaral *et al.* (1997) compared *M. alcicornis* and *M. braziliensis* by means of enzyme electrophoresis and confirmed what

morphometric studies had already shown: there is no possibility of *M. braziliensis* being a synonym of *M. alcicornis.* Amaral (1997) also compared *M. alcicornis* and *M. braziliensis* to *M. nitida*, proving that these are three separate species. Molecular data should also be gathered in order to test the validity of *Millepora laboreli*.

FIGURE 4. Colony of *Millepora laboreli* at the Manuel Luiz Marine State Park (State of Maranhão, northern coast of Brazil). Photo courtesy of Luiz Rocha.

Nematocysts. Among the species of *Millepora* (including *M. alcicornis*) studied by Boschma (1949), only two types of nematocysts were observed, which Boschma (1949) called "larger nematocysts" and "smaller nematocysts". For Brazil *M. alcicornis*, Amaral (1997) observed stenotele nematocysts with an average length of 44.6 µm and holotrich nematocysts with a mean length and width of 24.7 µm and 24.2 µm, respectively. A single exploded nematocyst was observed: a holotrich**,** with a capsule measuring 26.2 µm and a 275.1 µm filament, totaling 301.3 µm. Stenotele and holotrich nematocysts were also observed in *M. braziliensis*. The stenotele averaged 44.5 µm in length, while the holotrich averaged 31 µm in length and 27.8 µm in width. Statistical analyses showed that the differences in the average length of these two species' nematocysts were not significant. In *M. nitida*, a single holotrich nematocyst was observed, but was not measured.

Medusae. Amaral (1997) found medusae of *M. alcicornis* in the rainy season (June–August). Similarly, medusae of *M. braziliensis* were found in the beginning of the rainy season (March–June). The medusae of both species fit the description by Boschma (1956) "hydromedusae of reduced structure, for they lack velum, tentacles, and radial canals". The *M. alcicornis* medusae averaged 17 µm in size, varying from 15 to 23 µm. Medusae from *M. braziliensis* were observed but not measured. Medusae from *M. nitida* and *M. laboreli* were not observed.

Ecology. Lewis (1989) noted the lack of information on the ecology of most species of *Millepora*, including those occurring in Brazil. Some information is available with respect to general characteristics such as preferred depth distributions and general habitats and their associated micro- and macrofauna and flora. Most of these observations are fairly recent, but compare favorably with earlier notes on *Millepora* from other regions of the world.

According to Lewis (1989), the genus *Millepora* occurs in depths from less than 1 m to about 40 m, but Amaral (1997) cited *M. alcicornis* occurring from 0 to 50 m. Likewise, to date there have been no comprehensive studies on this topic for Brazilian species, yet some ecological data can be found in other kinds of studies. Laborel (1969) recorded the following depth ranges for the Milleporidae of Brazil: 0–15 m for *M. alcicornis*, 1–5 m for *M. braziliensis*, and 0–5 m for *M. nitida*. More recently, Amaral *et al.* (2002) enlarged two of these species bathymetric distribution for Brazil: *M. alcicornis* was found up to 25 m deep and *M. braziliensis* was found at 30 m—both at the Manuel Luiz Coral Banks. Further, the bathymetric distribution of *Millepora laboreli* **n. sp.**, endemic to the Manuel Luiz area, was recorded, with tall, unusually shaped colonies observed

at depths of around 30 m. Although Laborel (1969) appointed specific reef zones for the occurrence of the different species of Brazilian *Millepora*, such as the reef front for *M. braziliensis*, these species have been observed in most reef regions and in other areas with coral fauna.

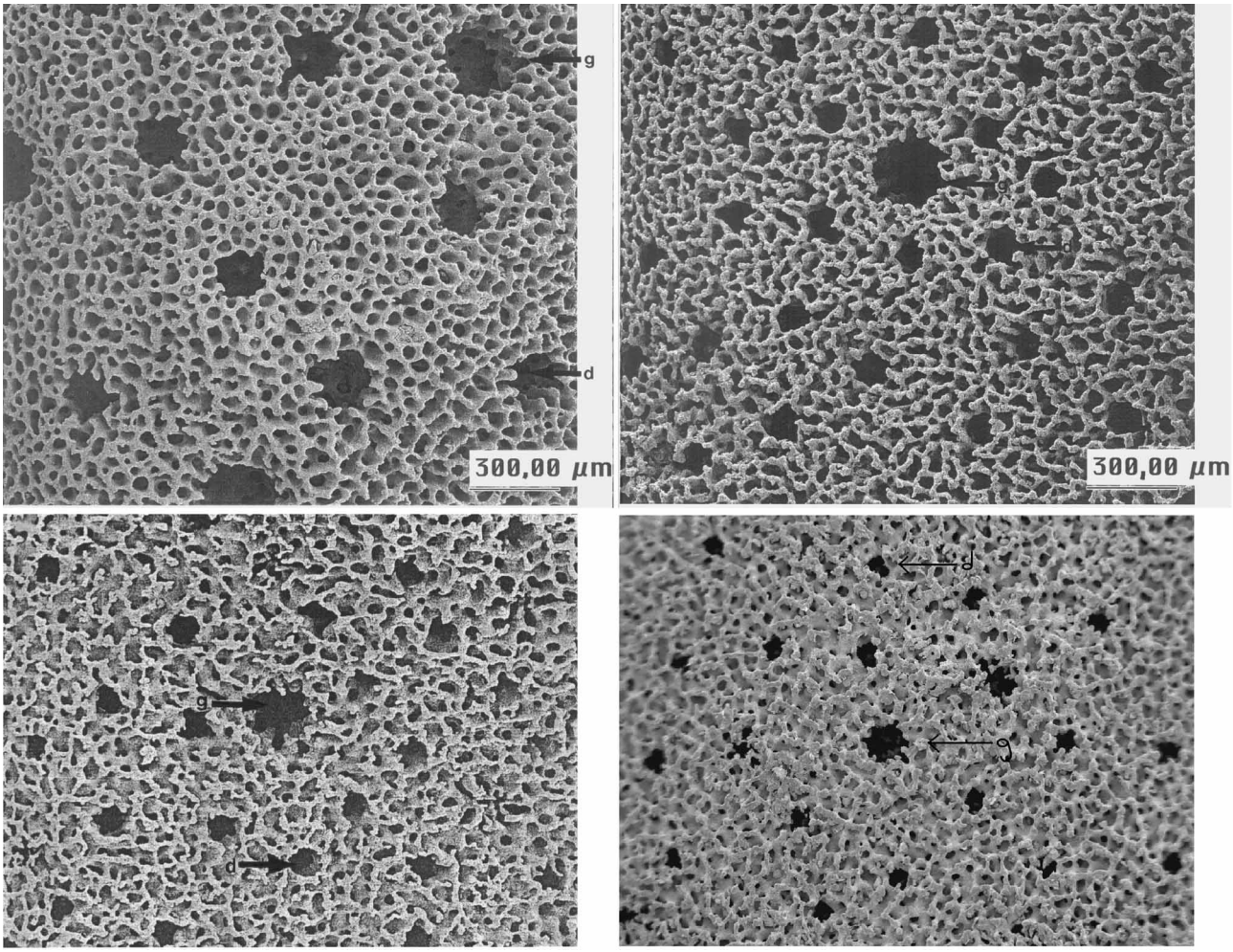


FIGURE 5. Scanning microscopy showing the surface (gastropores and dactylopores) of *Millepora alcicornis*, *M. nitida*, *M. braziliensis*, and *M. laboreli* (50x).

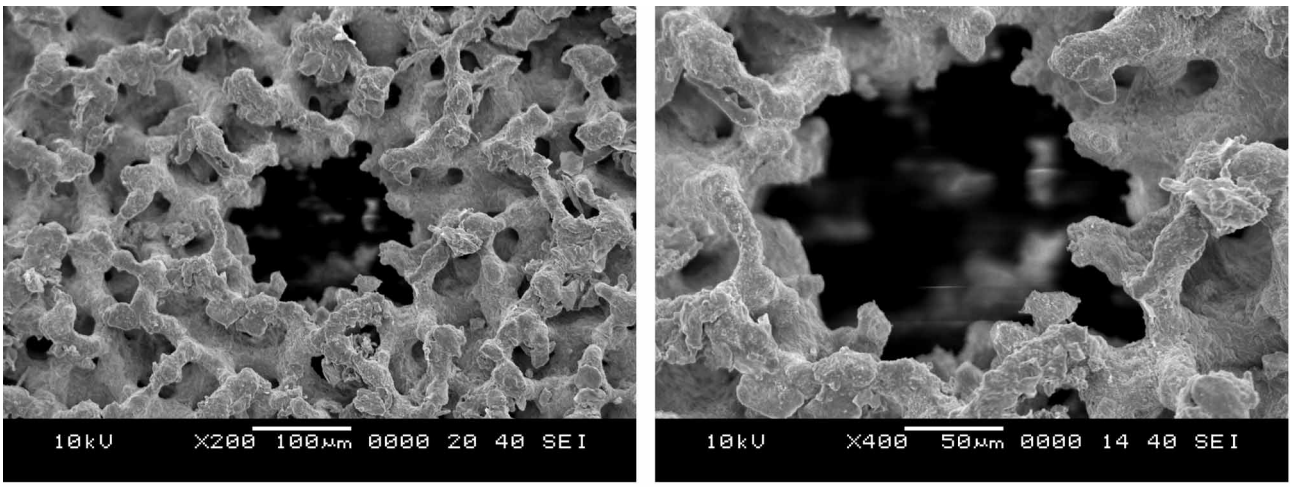


FIGURE 6. Scanning microscopy of *M. laboreli* (200x and 400x).

TABLE 3. Associated fauna and flora to three *Millepora* species that occur in Brazil, according to Amaral (1997), excluding zooxanthellae.

	M. alcicornis (34 colonies)	*M. braziliensis* (45 colonies)	*M. nitida* (13 colonies)
Associated microfauna	Ciliated protozoa, including *Euplotes* sp.; flagellated protozoa (*Euglena* sp.); Cyprinidae ostracods	Ciliated protozoa, (including Euplotes sp.), flagellated protozoa (*Euglena* sp.), Cyprinidae ostracods, and Tunicata *Oikopleura.*	
Associated macrofauna	Unidentified species from Phylum Sarcomastigophora (*Homotrema* sp.), Phylum Porifera (occurring in the dead parts of some colonies), Phylum Cnidaria (*Favia gravida* Verrill, 1868 and *Siderastrea stellata* Verrill, 1868), Phylum Mollusca (*Lithophaga nigra* (Orbingny) and *Noetia bisulcata* (Lamarck)), Phylum Annelida (families Nereidae, Sabellidae, Serpulidae, and Syllidae), Phylum Crustacea (*Megabalanus stultus* (Darwin), *Eriphia gonogra* (Fabricius), *Pachycheles* sp., and Family Alpheidae), Phylum Bryozoa, and Phylum Echinodermata (*Ophiothrix angulata* Say).	Phylum Cnidaria (*Agaricia agaricites* (Linnaeus); *Favia gravida* Verrill; and *Siderastrea stellata* Verrill), Phylum Mollusca (*Lithophaga* nigra (Orbingny); *Noetia bisulcata* (Lamarck), *Petaloconchus macrophragma* Carpenter, and *P. erectus* (Dall)), Phylum Annelida (families Serpulidae, Sabellidae, and Syllidae), Phylum Crustacea (*Megabalanus stultus* (Darwin)), and Phylum Bryozoa.	Phylum Cnidaria (*Agaricia agaricites* (Linnaeus)), Phylum Annelida (only tubes were observed and identification was not possible), Phylum Crustacea (unidentified Cirripedia), and Phylum Bryozoa.
Associated microflora	The diatoms *Climacosphenia moniligera* (Ehrenberg), *Cylindrotheca closterium* (Ehrenberg), *Mastogloia* sp., *Navicula* sp., *Nitzschia* sp., and *Cocconeis scutellum* (Ehrenberg), and the Crysophyta algae *Symbella* sp.	The diatoms *Climacosphenia moniligera* (Ehrenberg), *Cylindrotheca closterium* (Ehrenberg), *Mastogloia* sp., *Navicula* sp., *Nitzschia* sp., and *Amphora* sp.	
Other	Cyanobacteria: *Croococales* sp., *Spirulina* sp., and *Lyngbya* sp.; unidentified bacteria.	Cyanobacteria: *Croococales* sp., *Spirulina* sp., and *Lyngbya* sp.; unidentified bacteria.	

Amaral (1997) also observed some species of microflora associated with *M. alcicornis* and *M. braziliensis* (Table 3). Special attention was paid to zooxanthellae in *M. alcicornis*, *M. braziliensis*, and *M. nitida*, in which all the phases of the life cycle of *Symbiodinium* sp. (according to Freudenthal 1962) were observed. There was a high relative density of these zooxanthellae and *M. alcicornis* had the highest density of the three species: the mean densities were 14.4 x 10^5 cells/cm^2 for *M. alcicornis*, 4.5 x 10^5 cells/cm^2 for *M. braziliensis* and 3.3 x 10^5 cells/cm^2 for *M. nitida*. Statistical analyses showed that these differences were significant, although the low value for *M. nitida* might have been due to the fact that the studied specimens had been frozen, unlike the two other species, which were alive. In a study of the scleractinian coral *Montastraea cavernosa* from Mexico, Carricart-Ganivet and Beltrán-Torres (1993) found that the density was 1.99 x 10^5 cells/cm^2.

The diameters of the zooxanthellae were also examined by Amaral (1997). In *M. alcicornis* they varied from 7.9 to 26.2 µm (12.5 µm on average); in *M. braziliensis* the diameter ranged from 7.9 to 18.3 µm (14.7 µm on average); and in *M. nitida* the variation was from 10.5 to 18.3 µm (15.1 µm on average). The differences among the zooxanthellae diameters of the three species were found to be statistically significant. In addition, when compared to scleractinian corals the diameter of these zooxanthellae can be considered large

(William Fitt, pers. comm.). For example, Amaral and Costa (1998) compared the zooxanthellae of *M. alcicornis* and *M. braziliensis* to that of the scleractinian corals *Favia gravida* and *Siderastrea stellata* and found that zooxanthellae of the latter had smaller mean diameters.

Few other aspects of the ecology or life histories of Brazilian *Millepora* have been documented; a bleaching event was observed for calcified hydroids in Brazil during a survey done in 1998 in the Manuel Luiz Coral Banks (Amaral *et al*. 2006, 2007). All of the observed Milleporidae (*M. alcicornis*, 25 m; *M. braziliensis*, 30 m; *M. laboreli*, 30 m) were bleached or dead and covered by algae and/or other organisms; only *S. roseus* was unaffected. According to the authors, the *Millepora* bleaching coincided with that of co-occurring scleractinians observed, apparently due to the same factors – an increase in the average sea surface temperature of at least 1°C higher than the previous year. Future studies should point to the impact of these bleaching events and overall climate change on the Brazilian hydrocoral species.

The Stylasteridae

Stylasterids occur worldwide at depths from the intertidal to almost 2800 m, although most species are found between 200 and 700 m. Of the 42 species known from the western Atlantic (Cairns 1986), only one is recorded for shallow-water, *Stylaster roseus* (Pallas 1766), which has a wide geographic range from the Bahamas to the state of Bahia (Brazil) and is the only species positively identified for the Brazilian coast. Nevertheless, a second stylasterid, *Stylaster duchassaingi* De Pourtalès, 1867, was recorded off the coast of Brazil: first by Rathbun (1879) and then by Mosely (1881), in a report on stylasterids collected aboard the Challenger. Almost a century later, Laborel (1970) reported that a specimen was observed off the northeastern coast, in the state of Pernambuco and Hetzel & Castro (1994) to the Southern state of Bahia. However, as other occurrences were never recorded, we believe that these specimens were in fact *Stylaster roseus.*

Conclusions

The available literature suggests the presence of at least five species of shallow-water calcified hydroids in Brazil: four *Millepora* (*M. alcicornis, M. braziliensis, M. nitida*, and *M. laboreli* **n. sp.**) and one stylasterid (*Stylaster roseus*). Despite their obvious importance to Brazilian reef systems, these species have received less attention than this country's scleractinian corals. The few studies that have been done concern the *Millepora* species and mostly are limited to descriptions of their skeletal morphometry, taxonomy and general distributions. This information, along with some molecular systematic work has been used to successfully delineate among species. The ecology of Brazilian calcified hydroids has received an even more cursory examination and it is apparent that future research would benefit from detailed analyses of life history parameters and particularly growth and reproduction.

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