A new species of *Characella* (Demospongiae, Astrophorida, Pachastrellidae) from the south Brazilian continental shelf

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Abstract: This work deals with the taxonomic description of *Characella capitolii* sp. nov., providing the second record of the genus *Characella* Sollas, 1886 for the southern Brazilian coast (Rio Grande do Sul State; 170-173 m depth). The new species is characterized by two types of oxeas, one being large and abundant, the other being small and rare; by having all tetraxons transformed into three-rayed forms; spiny microxeas in two sizes; and streptasters with straight axis (plesiasters and metasters transitional to amphiasters).

Keywords: Pachastrellidae, South Brazilian coast, Taxonomy, *Characella capitolii* sp. nov.

Introduction

The genus *Characella* Sollas, 1886 was erected for a large massive sponge collected from deep Brazilian waters (640 m) by the 'Challenger' Expedition and described as *Characella aspera* Sollas, 1886. Ever since no other species of *Characella* has formally been reported from Brazilian waters. Likewise, the current knowledge of the family Pachastrellidae, in which *Characella* is currently contained (Maldonado 2002), indicates that very few representatives of this group are known from the Brazilian coast and slope. The previous knowledge of the family in the area can be summarized (in chronological order) as it follows: 1) *Characella aspera* Sollas, 1886 from Bahia State (Sollas 1888); 2) *P. monilifera* Schmidt, 1868 from Rio Grande do Sul State (Mothes-de-Moraes 1978); 3) *Pachastrella monilifera*, "*Poecillastra sollasi"* Topsent, 1904, and *Vulcanella* sp. from São Paulo State (Hajdu *et al*. 2004); 4) Unidentified Pachastrellidae from Rio Grande do Sul State (Mothes *et al*. 2004); 5) *Pachataxa lutea* Pulitzer-Finali, 1986 from Atol das Rocas (Moraes *et al*. 2006); 6) *Stoeba* sp. and a unidentified Pachastrellidae from Espírito Santo and Rio de Janeiro State (Muricy *et al*. 2006). Because most of the above records belong to relatively recent work, we suspect that pachastrellid sponges may be more common in Brazilian waters than it is suggested by the available literature. Subsequent explorations of the deep shelf and upper slope, the preferred habitat of this group, are expected to bring to light more new species of this demosponge family. In this study we report on a new species of the genus *Characella* collected off the coast of Rio Grande do Sul State (Brazilian Atlantic coast) by the oceanographic program "REVIZEE - Score Sul".

Material and methods

A single individual of the new species was collected by trawling on the continental shelf (170-173 m), at 31°08'86" S - 49°32'04" W, off the coast of Rio Grande do Sul State (Fig. 1), during the Federal Government Oceanographic cruise "Programa Recursos Vivos da Zona Econômica Exclusiva" (REVIZEE), by R/V "Atlântico Sul", in 2001. General information on the sponge fauna and geomorphological features of the studied area can be found elsewhere (Silva and Mothes 2000, Mothes *et al*. 2004).

The studied material was fixed in formalin, then preserved in 96° GL alcohol, and stored in the Museu de Ciências Naturais - Porifera Collection (MCNPOR) Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre, RS, Brazil. The light microscocopy study of the skeletal features followed the standard procedures and methodology described elsewhere (e.g., Mothes-de-Moraes 1978, Mothes *et al*. 2004). The Scanning Electron Microscopy (SEM) study followed the procedures outlined in Silva and Mothes (1996). Spicule size

was described by minimum, *mean* and maximum values of lenght and (/) width, and given in microns.

Systematic description

Class Demospongiae Sollas, 1885
Order Astrophorida Sollas, 1888
Family Pachastrellidae Carter, 1875

Genus *Characella* Sollas, 1886

Definition: Pachastrellidae whose megascleres consist of abundant oxeas and scarce calthrops (and/or short-shafted triaenes), mostly restricted to subectosomal regions. Microscleres are spiny or smooth microxeas-microstrongyles in at least two size categories and streptasters with a straight central axis (never spirasters); streptasters may be very scarce in some species. Anatriaene with cladomes that protrude the sponge surface and blunt rhabdomes embedded in the choanosome occur in some species (Maldonado 2002).

***Characella capitolii* sp. nov.**
(Figs. 2A-H, 3, 4, 5A-C)

Material studied: Holotype, Brazil, off Rio Grande do Sul State, 31°08'86" S - 49°32'04" W, MCNPOR 6926, 170-173 m depth, REVIZEE - Sul, R/V "Atlântico Sul" leg., 02.XI.2001.

Distribution: Rio Grande do Sul State (only known from the holotype description).

Diagnosis: *Characella capitolii* sp. nov. is characterized by the presence of two types of megascleric oxeas, the largest ones being relatively short and slender when compared with the stout, conical oxeas of the remaining members of the genus; the smallest being hastate oxeas completely atypical for the genus. It is also remarkable the fact that all short-shafted triaenes are consistentely reduced to three-rayed forms. Streptasters are metasters and plesiasters, a combination atypical among the remaining *Characella* species.

Macroscopic features (Fig. 2A): Small massive sponge (2.5 x 1.5 x 1.5 cm), being probably a young individual. Irregular, hispid surface, forming some ridges and folds. A single oscule (0.1 cm in diameter) occurred, being slightly elliptical. Small openings, possibly ostia (<0.1 cm in diameter), occurred sparsedly at some areas over the sponge surface. In spirit, the external colour was light beige, being the choanosome withish. The sponge consistency was hard but friable, as typically in the genus.

Skeleton (Fig. 2B): The ectosomal skeleton consisted of a feltwork of microxeas, streptaster, and small oxeas. This pseudocortex was internally supported by large oxeas in confuse arrangement and triactinal "calthrops", which may protrude the sponge surface. In deeper regions of the sponge, the skeletal organization was similar, characterized by triactinal "calthrops" irregularly scattered and large oxeas arranged more or less radially through the body. Microxeas were also abundant in the choanosome, along with streptasters.

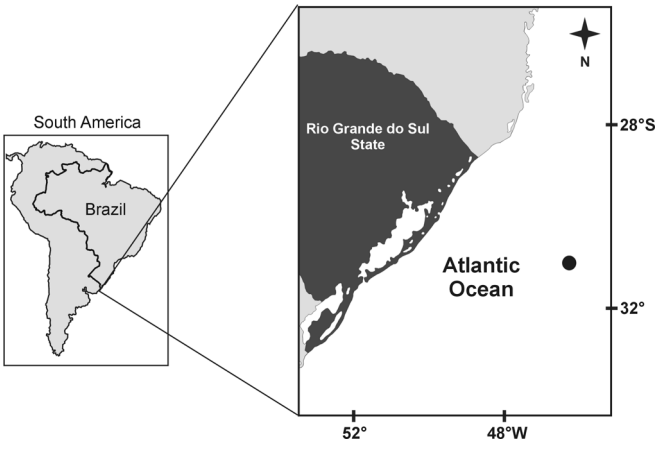
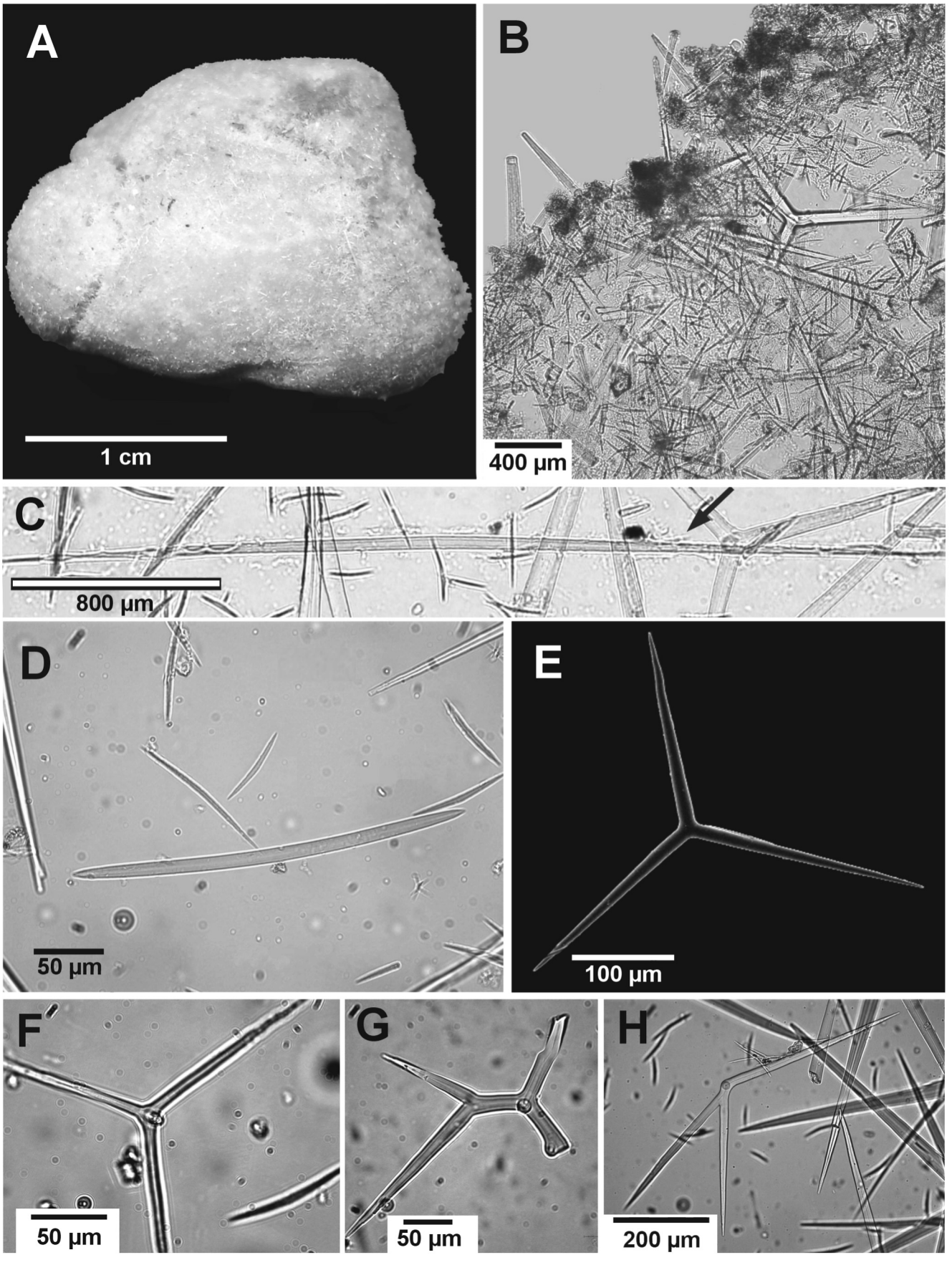


Fig. 1: Location of the holotype collection (●).

Spicules: 1) Oxeas I: not very abundant, though well represented in the slides; mostly occurring through the choanosome. They were relatively slender, hardly fusiform and nearly isodiametric, slightly curved in the middle or somewhat sinuous, with one or both blunt ends (Fig. 2C), measuring 700-*1166.7*-2400 / 7.5-*8*.3-20.8 µm (n=12). 2) Oxeas II: mostly located at the pseudocortex. They were rare in the slides, being slightly curved in the middle, with acerate ends. These ectosomal spicules were very similar to the hastate oxeas of the genus *Haliclona* (Fig. 2D). They measured 230-*274.4*-310 / 5.0-*9.5*-12.5 µm (n=25). 3) Triactinal "calthrops": (Fig. 2E) abundant in the slides, occurring in a large size range, with actines measuring 123.5-*350.1*-598.5 / 9.2-*20.5*-36.8 µm (n=150). They never showed tetraxonid appearance, since one of the actines was consistently underdeveloped and reduced to a small protuberance, which became more obvious for the small spicules (Fig. 2F). In most cases, the remaining three actines were similar in dimensions and showed equiangular distribution. Nevertheless, in very few cases, the actines were also noticed to be bifurcated (Fig. 2G). Some spicules showed two and even three of their actines malformed and reduced to protuberances (Fig. 2H). 4) Microxeas (Fig. 3) were very abundant in the slides. They appeared to be distributed in two size categories connected by some transitional spicules (graph Fig. 4). The small category was characterized by uniformly microspined spicules, curved or centroangulated, rarely sinuous, with acerate ends. They were markedly fusiform, in many cases being centrotylote and more rarely with swellings occurring along the shaft, typically measuring 27.6.-*69.2*-80 µm. The large category was characterized by uniformly microspined spicules, softly curved, never centroangulated,

Fig. 2: *Poecillastra capitolii* sp. nov.: **A.** Holotype MCNPOR 6926. **B.** Transverse section of the body showing the skeletal architecture. **C.** Choanosomal oxeas. **D.** Ectosomal hastate oxeas, along with the representatives of the two categories of microxeas. **E.** SEM of a triactinal calthrop. **F.** Small calthrop with an underdeveloped actine reduced to a small protuberance. **G-H.** Malformed calthrop showing a malformed and bifurcated actines.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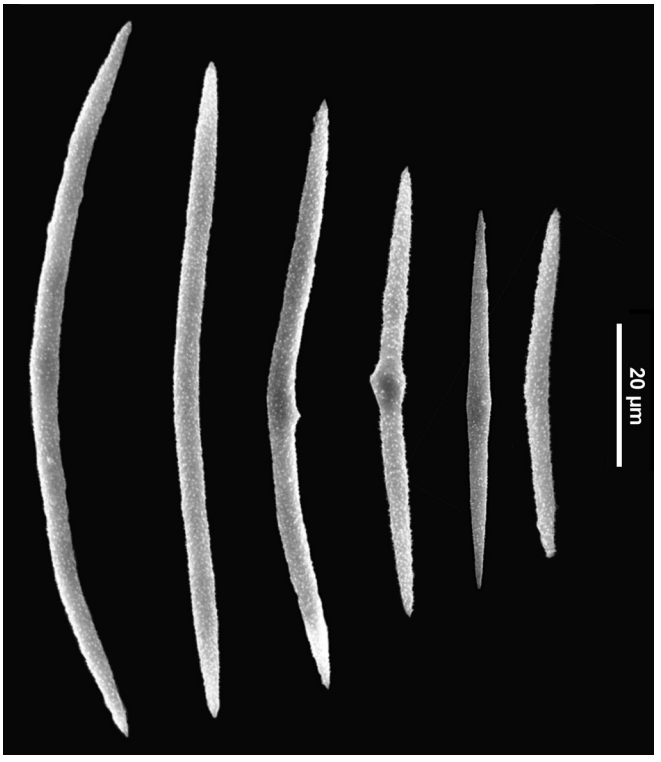

Fig. 3: SEM micrographs showing shape and microornamentation of microxeas in both the small and large size categories, as well as in between-category intermediate stages.

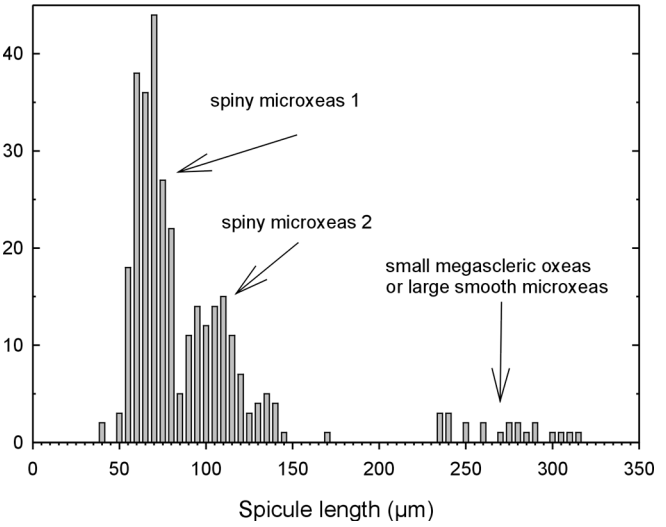

Fig. 4: Length frequency distribution (counts; N= 320 spicules; size interval = 5 µm) of microspiny microxeas and smooth hastate oxeas. Microxeas distribute in two size populations connected by some transitional spicules occurring at low abundance. Hastate oxeas occur in a relatively wider size range and are uncommon when compared to the microspiny microxeas.

hardly fusiform, very rarely centrotylote, typically measuring from 90-*109.3*-170 µm. 5) Streptasters were moderately abundant in the slides, displaying two morphological types, pleasiasters and metasters, both characterized by a straight central axis and microspiny actines (Fig. 5A-C). Plesiasters were a bit larger (17 to 25 µm in total diameter) than metasters, having a very short axis with few (4 to 7) relatively long (up to 10 µm) actines (Fig. 5A, C). Metasters measured 12 to 16 µm in maximum total diameter, having 7 to 11 actines, thinner and shorter (5 to 8 µm) than those of the plesiasters (Fig. 5B, C). Because many actines are inserted on a short, straight central axis, the metaster axis often looked bumpy. Both plesiasters and metasters showed occasional forms that were transitional to amphiasters, i.e., with the central portion of the axis lacking actines (Fig. 5C).

Etymology: This species is named after Ricardo Capítoli, who has enriched the Porifera Collection (MCNPOR) of the Museu de Ciências Naturais with relevant material collected from the continental shelf and slope off the coast of the Rio Grande do Sul State.

Discussion

The general skeletal features of the new species suggest assignation to the genus *Characella*. This taxonomic allocation was largely based on the shape and size of the two categories of microspiny microxeas in combination with the shape and moderated abundance of the two categories of streptasters, a set of features strongly similar to those described from other *Characella* species (e.g., Maldonado 2002). Occurrence of at least two categories of microxeas in combination with small streptasters characterized by a short, central axis is a key diagnostic character for *Characella*. In the studied specimen, we found some transitional stages between the two categories of microxeas (Fig. 3), which at first sight could suggest that there was only one size category rather than two. Nevertheless, the probability function of spicule size rendered by a higher number of measurements (N= 320) revealed two major populations of microxeas despite occurrence of some transitional spicules (Fig. 4). Indeed, such scarce transitional spicules between the size categories of microxeas also occur in other species of *Characella* (see Maldonado 2002), including the type species *Characella aspera* and *C. connectens* (Schmidt, 1870).

The metasters of the studied specimen were very similar in shape and size to those described in other *Characella*. By contrast, the small accompanying pleasiasters were a characteristic trait of the new species. The plesiaster is a streptaster type often found in species of the sister genus *Poecillastra* Sollas, 1888. Nevertheless, the plesiasters of the new species, which were comparatively small -up to 24 µm in maximum diameter- and characterized by 4 to 7 actines, are clearly distinguishable from those found in *Poecillastra* species, which are typically larger (often larger than 30 µm) and usually have 2 to 5 actines only. In addition, the newly described sponge could not be allocated into *Poecillastra*, since it lacks streptasters with twisted axis (i.e., spirasters), one of the diagnostic characters of the genus *Poecillastra* (Maldonado 2002).

The new species *Characella capitolii* is clearly distinguishable from previously known *Characella* species by not only its small pleasiasters, but also its small megascleric

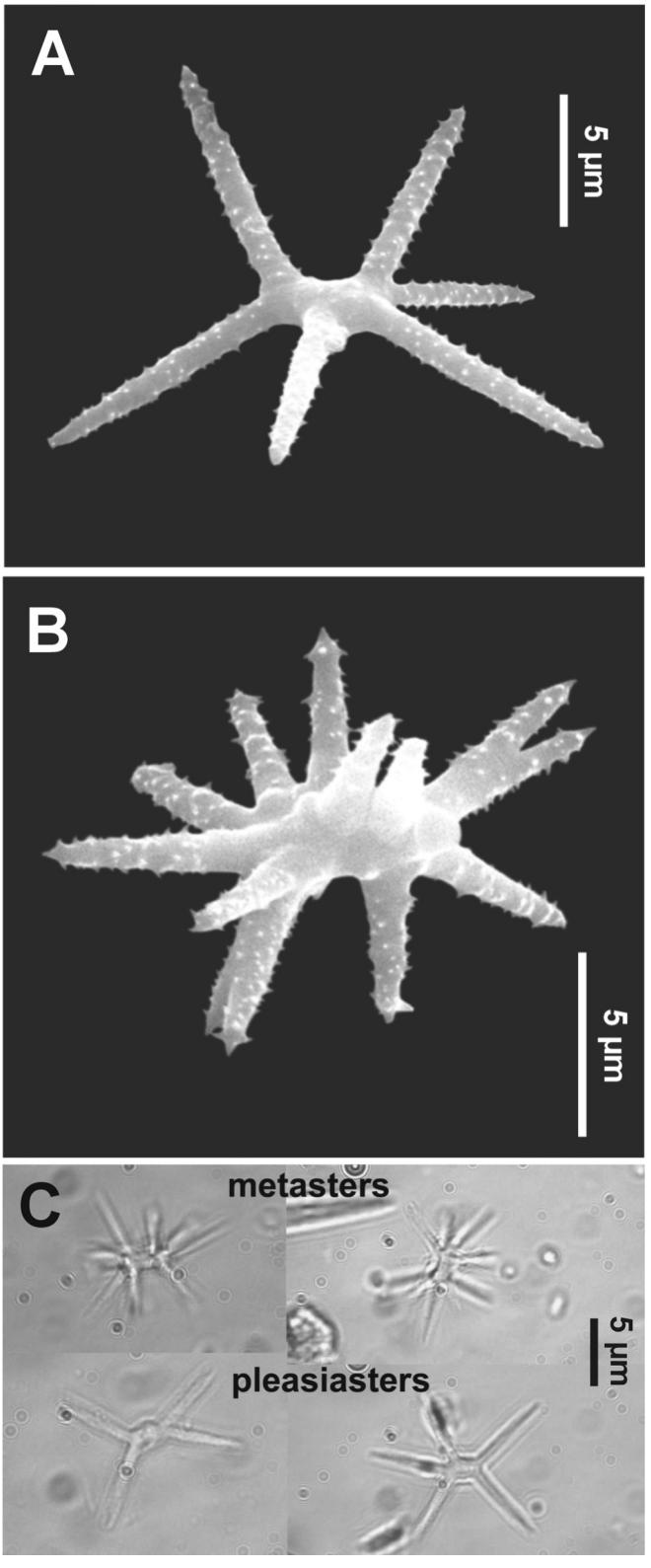

Fig. 5: Streptasters. **A.** SEM micrograph of a plesiaster. **B.** SEM micrograph of a metaster. **C.** Light microscopy micrographs showing comparative views of metasters and streptasters.

oxeas (230-*274.4*-310 / 5.0-*9.5*-12.5 µm) and its tetraxons consistently reduced to triactinal forms. To our knowledge, the small ectosomal oxeas of hastate appearance occurring in *C. capitolii* have never been reported in other *Characella* species. Nevertheless, they are known to occur in some members of at least other pachastrellid genus, *Pachastrella* Schmidt, 1868 (e.g., Maldonado 1996, 2002). These small oxeas of *C. capitolii* have tentatively been interpreted as megascleres because they are smooth (i.e. lack micro-ornamentation) and can grow to a thickness (5-12 µm) that is unconventional for pachastrellid microxeas. However, we cannot discard the possibility that they are a third category of microxeas. It should be kept in mind that C*haracella aspera*, the type species of the genus and also from Brazilian waters, is characterized by two categories of smooth microxeas, and that those in the largest category are of length (150-300 µm) similar to that of the putative megascleric oxeas of the new species, but thinner (4-5 µm). It is unlikely that these hastate oxeas, which are very similar to those of many haplosclerid demosponges, are exogoneous to the sponges. They certainly occur in low abundance compared to the microspiny microxeas (Fig. 3, 4), but are too well represented to be contaminating spicules. A definitive interpretation on the taxonomic status and value of these hastate oxeas may require future descriptions of new specimens from different locations.

An additional striking feature of the studied sponge is that all their tetraxons spicules had at least one of their actines reduced to a small protuberance. Occurrence of three-rayed spicules by development of a dwarf actine rather than a full grown actine is not uncommon in some species of the genus *Characella*, such as *C. connectens.* Yet, *C. capitolii* appear to be the only species in the genus in which all tetraxons are affected by such a phenomenon. At this stage, it is impossible to ascertain whether such an actine reduction was a malformation caused in the studied individual by ecological or physiological factors or is a feature genetically fixed and representative of this new species. Among the pachastrellids, occurrence of some calthrops and short-shafted triaenes with aberrant and reduced actines is common in some species of the genera both *Characella* and *Poecillastra* Sollas, 1888, but consistent reduction of all tetraxons to triactinal and diactinal forms was only previously reported in *Ancorella paulini* von Lendenfeld, 1906*,* from the Pacific coast of Chile. Despite sharing the complete reduction of tetraxons to triactinal forms, the newly described material could never be classified into the genus *Ancorella* von Lendenfeld, 1906, since the current diagnosis of this monotypic genus is defined to include pachastrellids lacking streptasters (Maldonado 2002).

The newly described species *Characella capitolii* provides the second record of the genus in Brazilian waters, which was only previously known from the description of the type species *Characella aspera*. In this regard, there is an additional confusing report indicating occurrence of pachastrellid material collected from São Paulo State that could be related to the genus *Characella*. It has never been described skeletally, but just mentioned under the name *Poecillastra sollasi* Topsent, 1904 in a check list elaborated by Hadju *et al*. (2004). Several problems arise from such a report. First of all, the authority of the species name is mistaken, since

the original description of the species, as *Characella sollasi*, was due to Topsent, but in 1892 rather than in 1904. More importantly, Topsent himself acknowledged in subsequent revisions of the *Characella sollasi* type that the material he used to erect the species *C. sollasi* was conspecific with that of *Characella pachastrelloides* (Carter, 1876) and that, consequently, *C. sollasi* was not longer a valid species, but a junior synonym of *C. pachastrelloides* (see, Topsent 1902, Topsent 1904). Therefore, the definitive taxonomic assignation of the material referred to as "*Poecillastra sollasi*" by Hadju and co-workers (2004) is pending on further examination. If it is finally proved to belong to *C. pachastrelloides*, it will make the third record of the genus in this biogeographical region.

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