

Encrusting Sabellariidae (Annelida: Polychaeta) in rhodolith beds, with description of a new species of *Sabellaria* from the Brazilian coast

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Rhodoliths or maërl are calcareous nodules of coralline red algae growing unattached to the substrata. They sustain a high biodiversity, being one of the most important marine benthic environments dominated by macrophytes. Sabellariidae are tube-dwelling filter feeding marine polychaetes that build their tubes by secreting cement from their thoracic glands. Some species are solitary, while others build tubes together, forming large aggregates. This study analyses Sabellariidae collected in rhodolith beds along the subtidal zone of the coast of João Pessoa and Cabedelo, Paraíba, north-eastern Brazil. A total of 100 individuals of six species were identified. Four are reported for the first time for the north-east coast of Brazil: Phragmatopoma caudata Mörch (1863), Sabellaria bella Grube (1870), Sabellaria nanella Chamberlin (1919), and Sabellaria wilsoni Lana & Gruet (1989). The first occurrence of Sabellaria pectinata Fauvel (1923) along the western Atlantic is provided as well as the description of a new species of the genus Sabellaria.

Keywords: taxonomy, polychaetes, calcareous algae, maërl, Brazil, Sabellariidae

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INTRODUCTION

Rhodoliths or maërl are calcareous nodules of red algae (Rhodophyta: Corallinales) that grow unattached to the substrata and can accumulate on the sea bottom, forming extensive beds distributed worldwide from intertidal to subtidal zones (Bosence, 1979; Foster, 2001). Rhodolith beds may be one of the most important marine benthic environments dominated by macrophytes, considering the area covered (Foster, 2001). Vegetative characteristics of rhodoliths, such as shape, sphericity, ramification, number and length of protuberances, form complex tri-dimensional structures. These features enable the existence of channels, crevices and shelters, providing microhabitats for several species (De Grave, 1999). However, despite the importance of rhodolith beds, little information is available on the biodiversity of these environments (Barbera *et al.*, 2003). Sabellariidae are commonly known as sand-manson or honeycomb worms. They are tube-dwelling and filter-feeding marine polychaetes that occur worldwide, from the intertidal region up to 4500 m (Kirtley, 1994). Sabellariids capture and select particles from

the water column and secrete a proteinaceous cement from thoracic cement glands to build their tubes. Some sabellariid species live in solitary tubes in various kinds of substrata (Calline *et al.*, 1992; Kirtley, 1994; Pandolfi *et al.*, 1998; Wood, 1999; Nishi *et al.*, 2004), while others form aggregates of tubes that are capable of colonizing wide areas along the coast (Pawlick, 1988). In this paper we present a taxonomic account of the species of Sabellariidae from coralline beds collected off the north-eastern coast of Brazil.

MATERIALS AND METHODS

Specimens for this study were collected in rhodolith beds on the coast of João Pessoa and Cabedelo, Paraíba, north-eastern Brazil in March 2006 (Figure 1). Five replicated samples (50 × 50 cm quadrats) were collected by SCUBA in nine sites at 10, 15 and 20 m depth and conditioned in plastic bags. The specimens were retained after washing samples on a sieve of 0.5 mm mesh and preserved in 5% formalin. The material was sorted under a Zeiss stereoscopic microscope and the specimens were identified using current literature. The paleae of the opercular crown, notopodial and neuropodial chaetae, and nuchal hooks were considered diagnostic features and were observed under a microscope (Olympus BX41). Some specimens were prepared on permanent slides with

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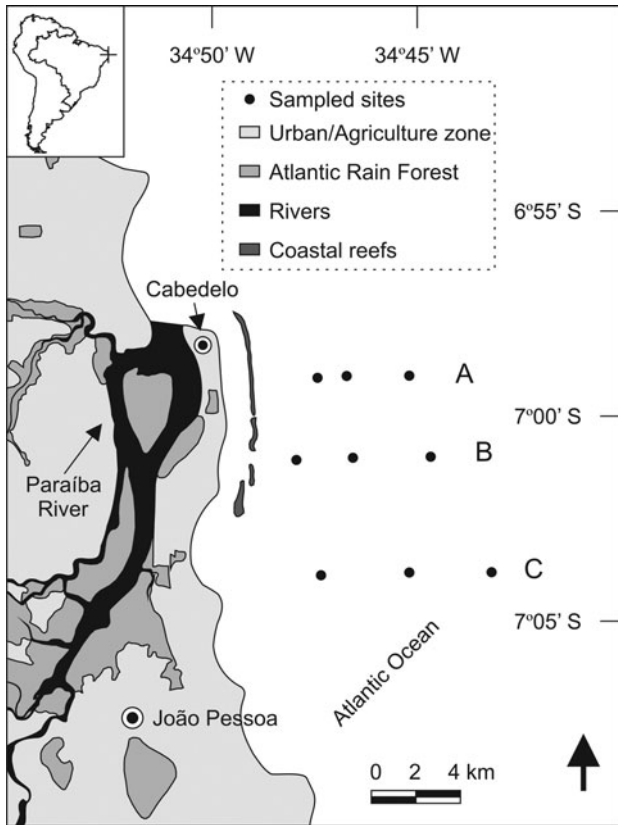


Fig. 1. Map of the sampled sites at Paraíba, north-east Brazil.

pure glycerin, or in Gray and Weiss (PVA) (Humason, 1979). Alternatively, to increase the contrast of some chaetae, some sections were hydrated, and stained with Mallory colouring. These methods enhanced the visualization of details of the opercular paleae, nuchal hooks, and notopodial and neuro-podial chaetae. The material is deposited in Coleção de Invertebrados Paulo Young, Departamento de Sistemática e Ecologia, Universidade Federal da Paraíba, Brazil (CIPY-POLY). Comparative material examined was borrowed from the following institutions: Museu do Centro de Estudos do Mar, Universidade Federal do Paraná, Brasil (MCBM-BPO), Natural History Museum of Los Angeles Country (LACM-AHF), and Zoological Museum of Copenhagen, Denmark (ZMUC).

RESULTS

Systematics

KEY TO SPECIES OF SABELLARIIDAE FROM SUBTIDAL RHODOLITH BEDS IN NORTH-EASTERN BRAZIL

- 1. Opercular stalk and crown completely fused. *Phragmatopoma caudata* Mörch, 1883
- Opercular stalk and crown not completely fused. *Sabellaria* Lamarck, 1812 (2)
- 2. One kind of middle paleae. 3
- Two kinds of middle paleae. 4

- 3. Outer paleae with 3–6 dial teeth on each side of spatulate medium plume, middle paleae short, quadrangular. *Sabellaria nanella* Chamberlin, 1919
- Outer paleae with 3–4 dial teeth on each side of spatulate and pilose medium plume, middle paleae long, narrow. *Sabellaria wilsoni* Lana & Gruet, 1989
- 4. Middle paleae of two kinds, short, oblong, and long, almost erect, outer paleae with distal denticles on each side of plume splayed toward outer margin of outer blade. 5
- Middle paleae of two kinds, short, oblong, and long, almost erect, outer paleae with plume penicillate, with distal denticles on each side of plume. *Sabellaria corallinea* sp. nov.
- 5. Outer paleae with distal denticles on both sides of plume splayed toward outer margin of outer blade, middle paleae without distal teeth. *Sabellaria bella* Grube, 1870
- Outer paleae with distal denticles of one side of plume splayed toward outer margin of outer blade, both middle paleae have bigger distal denticles in each side of paleae. *Sabellaria pectinata* Fauvel, 1928

Family SABELLARIIDAE Johnston, 1865
 Subfamily SABELLARIINAE Kirtley, 1994
 Genus *Phragmatopoma* (Krøyer) Mörch, 1863
Phragmatopoma caudata (Krøyer) Mörch, 1863
 Figure 2A, B

Serpula caudata (Krøyer, MS) Mörch, 1863: 456, plate, 11, figures 27–30; Johansson, 1927: 102; Hartman, 1959: 473.
Hermella caudata Quatrefages, 1866: 321.
Phragmatopoma lapidosa Kinberg, 1867: 349; Johansson, 1927: 2; Hartman, 1944: 348, plate, 36, figure 79; plate, 40, figures 10, 103; 1956: 248; plate 21; Remane, 1954: 177; Renaud, 1956: 33; Kirtley, 1968: 40; 1974: 2; Pardo de Figueroa Olivo, 1975: 1; Eckelbarger, 1976: 117, figures 7–13; Amaral, 1987: 471, figures 1–5; Pawlik, 1988: 41; Zale & Merrifield, 1989: 1; Lana & Bremec, 1994: 216, figures 1–2.
Sabellaria (Pallasia) castelnuai Quatrefages 1866—Grube, 1870: 69; Augener, 1926: 216; Fyfe, 1952: 29.
Centrocorone spinifera Treadwell, 1939: 1, figure 1.
Phragmatopoma attenuata Hartman, 1944: 353, plate, 38, figures 90–96; plate, 39, figures 100–101; Kirtley 1974: 28; Fauchald, 1977a: 54; 1977b: 119.
Phragmatopoma californica Marsden, 1960: 1028, figure 19.
Phragmatopoma lapidosa lapidosa Pawlik, 1988: 41; Pawlick & Hadfield, 1990: 452.
Phragmatopoma caudata Kirtley, 1994: 31, figures 2.3.1–2.3.6.

MATERIAL EXAMINED

Total: 83 specimens. 6°59'00"S 34°46'41"W (Station A15), 1 specimen (CIPY-POLY 1011). 7°01'02"S 34°47'55"W (Station B10), 2 specimens (CIPY-POLY 1012). 7°03'50"S 34°47'19"W (Station C10), 5 specimens (CIPY-POLY 1013). 7°01'02"S 34°47'55"W (Station B10), 32 specimens (CIPY-POLY 1014). 7°01'02" S 34°47'55"W (Station B10), 3 specimens (CIPY-POLY 1015). 6°59'01"S 34°47'23"W (Station A10), 4 specimens (CIPY-POLY 1016). 6°59'0" S 34°46'41"W (Station A15), 1 specimen (CIPY-POLY 1017). 6°59'01"S 34°47'23"W (Station A10), 11 specimens (CIPY-POLY 1018). 7°01'02"S 34°47'55"W (Station B10), 24 specimens (CIPY-POLY 1019).

ADDITIONAL MATERIAL EXAMINED

Phragmatopoma caudata (Krøyer, MS) Mörch, 1863. Type series: Virgin Islands: 3 syntypes, lectotype and 2 paralectotypes, determined in 18 January 1996 by D.W. Kirtley. The specimens were collected by Anders Sando Ørsted during 1845–1848 (ZMUC 450).

REMARKS

The specimens examined here agree with the type series. Kirtley (1994) shows that specimens identified as *P. lapidosa* along the Brazilian coast are identical to *P. caudata*. Both species are similar in the diagnostic characters of the operculum: three kinds of opercular paleae disposed in 3 concentric rows, only two being visible. The third row, that contains the inner paleae, is located below the second row that contains the middle paleae. Outer paleae caliciform, geniculate with two faces of thecae (Figure 2A). The plume consists of a palmate filamentous membrane (Figure 2B). Middle paleae elongate, dark chocolate, strongly geniculate, with a shallow sulcus along midline of lower surface of blades, without preeminent thecal ridges (Figure 2C). Inner series of paleae gold, strongly geniculate, elongate, with anterior ends more pointed, finishing in small extensions. These paleae always have a slight excavation in upper surface of thecal band that begins in a genicula proximal to anterior end (Figure 2D). The morphology of examined specimens corresponds totally to Kirtley's description.

BIOLOGICAL NOTE

This species is found in aggregates constructed onto rock substrata (Kirtley, 1994). However, in this work the majority of specimens were found at 10 m and some at 15 m depth. Kirtley (1994) reported the association of *P. caudata* with *Sabellaria nanella* (Chamberlin, 1919) in the intertidal region. This is the first time that this species was reported constructing their tubes in a substratum other than rocks.

GEOGRAPHICAL RANGE

Phragmatopoma caudata was originally described from the Virgin Islands, although the species is widely distributed along the tropical and subtropical coasts of the western Atlantic and records are known from Bermuda to Brazil. This species has been reported along the entire Brazilian coast, inhabiting rocky shores (Amaral *et al.*, 2006). Records of this species are known from Ceará (Kirtley, 1994), Rio de Janeiro (Lana & Bremec, 1994), São Paulo (Abreu, 1978; Amaral, 1987; Rocha, 1993; Lana & Bremec, 1994), Paraná, Santa Catarina, and Rio Grande do Sul (Lana & Bremec, 1994).

Genus *Sabellaria* Savigný, 1818

Sabellaria bella Grube, 1870

Figure 3A–E

Sabellaria bella Grube, 1870: 69; Augener, 1934: 151, figure 31; Hartman, 1944: 339, plate, 33, figures 53–56; plate, 35, figures 57–60; Wells & Gray, 1964: 76; Rullier & Amoureux, 1979: 187; Gruet & Lana, 1988: 32, figures 1 & 2; 1989: 243; Kirtley, 1994: 53, figure 4.3; Lana & Bremec, 1994: 216, figures 1 & 2. *Sabellaria floridensis* Hartman, 1944: 339; Duarte, 1980: 1; Morgado, 1980: 1; Souza, 1989: 1; Duarte & Nalesso, 1996: 139; Santa-Isabel *et al.*, 1996: 645.

MATERIAL EXAMINED

Total: 4 specimens. 7°01'02"S 34°47'55"W (Station B10), 1 specimen (CIPY-POLY 1022). 7°01'02"S 34°47'55"W (Station B10), 1 specimen (CIPY-POLY 1023). 7°01'02"S 34°47'55" W (Station B10), 2 specimens (CIPY-POLY 1024).

ADDITIONAL MATERIAL EXAMINED

Sabellaria bella (Grube 1870). Brazil, Paraná State, Bay of Paranaguá, Mel Island, Ponta das Conchas beach: 25°32'18"S 48°17'34"W: 1 specimen (MCBM-BPO 251). *Sabellaria floridensis* (Hartman, 1944). Type series: Florida. Cotypes, lectotype, and 3 paralectotypes, determined 19

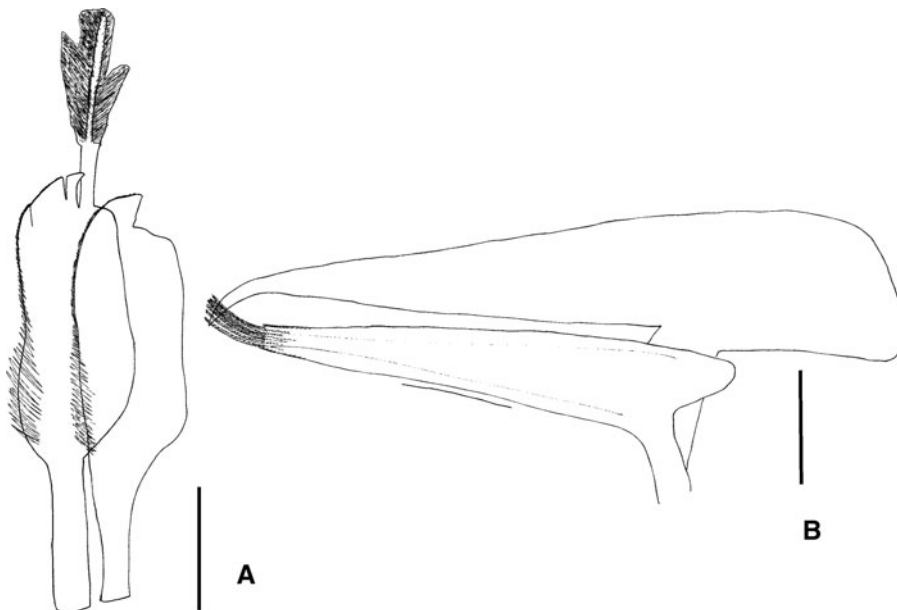


Fig. 2. *Phragmatopoma caudata* (Krøyer, MS) Mörch, 1863. CIPY-POLY 1011. (A) Outer palea; (B) middle and inner paleae. Scale bar: A & B = 174 µm.

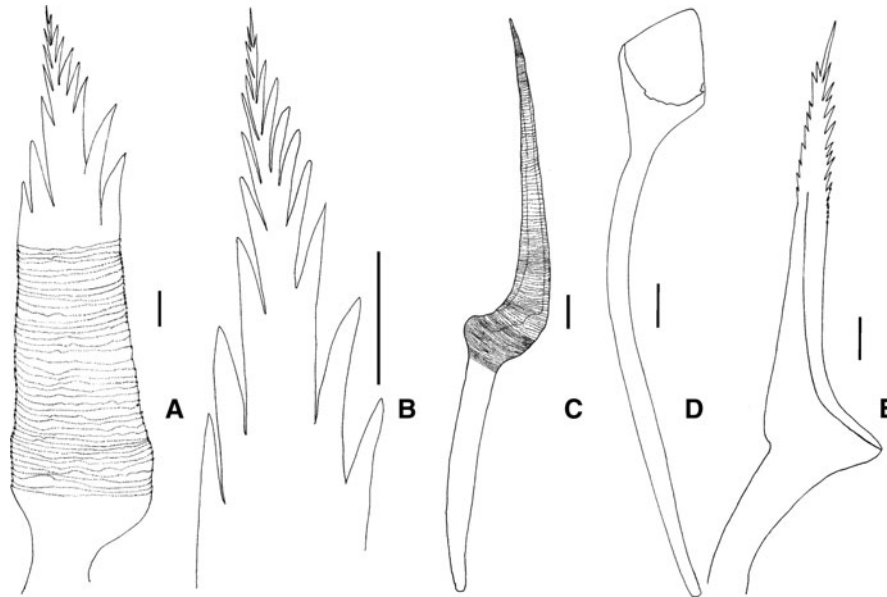


Fig. 3. *Sabellaria bella* Grube, 1870. CIPY-POLY 1022. (A) Outer palea; (B) detail of outer palea; (C) middle palea, long form; (D) middle palea, short form; (E) inner palea. Scale bar: A–E = 100 μ m.

July 2009 by A.S. Santos. The specimens were collected by Olga Hartman in 1939 (LACM-AHF).

REMARKS

The morphology of examined specimens agrees with the description in Lana & Gruet (1989). *Sabellaria bella* has an opercular morphology similar to that of *S. floridensis* Hartman (1944). It has outer paleae with 2–3 teeth on each side of plume (Figure 3A, B); middle paleae of long form, wide at base, with long blade (Figure 3C; Table 1); middle paleae of short form, elliptical (Figure 3D; Table 1); and inner series geniculate, with anterior ending in distal tip (Figure 3E; Table 1). However, *S. bella* differs from *S. floridensis* by having the medium plume long and erect, whereas in *S. floridensis* it is longer and curved toward the inner series. Kirtley (1994) examined diverse populations of *S. floridensis*, a species that was considered well-distributed in the Pacific and Atlantic Oceans until his revision, when the author considered diverse populations of *S. floridensis* as new species, but stated that a detailed study of these populations was necessary because he defined new species based in distribution and number of tooth of outer palea. The similarity of these species probably account for previous references to *S. floridensis* along the Brazilian coast made by Duarte (1980), Morgado (1980), Souza (1989), Duarte & Nalesso (1996) and Santa-Isabel *et al.* (1996).

BIOLOGICAL NOTE

Sabellaria bella is usually found in solitary tubes constructed onto rock substrata. The present substrate samples differ from previous accounts of sediments with fine sand and mud, or sometimes with shells (Kirtley, 1994; Amaral *et al.*, 2006). The specimens were found at 10 m depth. This is the first time that this species is reported constructing their tubes in rhodoliths.

GEOGRAPHICAL RANGE

Sabellaria bella was originally described from Desterro Island (now Santa Catarina Island) by Augener (1934). After that, *S. bella* was also reported from Espírito Santo (Lana & Bremec, 1994), Rio de Janeiro (Kirtley, 1994), Paraná (Lana & Gruet, 1989) and Rio Grande do Sul (Borzzone, 1988). This is the first record of *S. bella* from the north-east coast of Brazil.

Sabellaria nanella Chamberlin, 1919 Figure 4A–C

Sabellaria nanella Chamberlin, 1919: 261, plate 2, figures 5–7; Johansson, 1927: 98; Hartman, 1938: 16, figures 8–10; 1944: 340, plate 30, figures 18–20; Rullier & Amoureaux, 1979: 188; Lana & Gruet, 1989: 243; Kirtley, 1994: 71, figures 4.26.1–4. 26. 2; Lana & Bremec, 1994: 216, figures 1 & 2.

MATERIAL EXAMINED

Total: 2 specimens. 7°01'02"S 34°47'55"W (Station B10), 1 specimen (CIPY-POLY 1025). 7°01'02"S 34°47'55"W (Station B10), 1 specimen (CIPY-POLY 1026).

REMARKS

Sabellaria nanella is an uncommon species. It is the only taxon that has outer paleae semi-cylindrical or caliciform, concave, geniculate, with a series of small lateral teeth on the thecal margin, which may be curved towards the interior of the theca or straight, with one or two points (Figure 4A). Middle paleae short, strongly geniculate, square-shaped, with a slight central depression (Figure 4B), inner series of paleae strongly geniculate, elongate, with anterior end more pointed (Figure 4C; Table 3). Only two specimens were examined and morphological variation was not observed. We were not able to confirm if the specimens found along the Brazilian

Table 1. Denticulate species of *Sabellaria* that have four kinds of paleae (two kinds of middle paleae).

Species	Nuchal spine	Outer paleae	Middle paleae 1, long form	Middle paleae 2, short form	Inner paleae	Type locality	Distribution	Reference
<i>S. chandrae</i> de Silva, 1961	Not observed	2–3 teeth on each side of plume	Long blade	Clavate, without distal teeth, blade not twisted	Falciform	Ceylon (Sri Lanka)	Sri Lanka	Kirtley, 1994
<i>S. ranjhi</i> Hasan, 1960	Not observed	4–8 teeth on each side of plume	Long blade	Clavate, without distal teeth, blade twisted	Falciform	Karachi, Pakistan	Pakistan	Kirtley, 1994
<i>Sabellaria</i> sp.	Present	2–3 (usually 2) on side teeth, with short denticulate median teeth	Long blade, curved inwards inner series	Geniculate, elliptical, without distal teeth, blade twisted	Elongate, with blunt tip	Katsuura, Boso Peninsula, central Japan	Japan	This study
<i>S. bella</i> Grube, 1870	Present	2–3 teeth on each side of plume	Long blade	Elliptical, without distal teeth, blade not twisted	Geniculate, anterior ends in distal tip	Santa Catarina Island, Brazil	Brazil	Kirtley, 1994
<i>S. clava</i> Kirtley, 1994	Present	3 teeth on each side of plume, plume with 4 pairs of teeth on each side of plume	Long blade	Clavate, without distal teeth, blade not twisted	Falciform	Gulf of Guinea	West Africa	Kirtley, 1994
<i>S. floridensis</i> Hartman, 1944	Present	2–3 teeth on each side of plume	Long blade	Elliptical, without distal teeth, blade twisted	Geniculate, anterior ends in distal tip	Florida	Atlantic Coast of US, Mexico, and Cuba	Kirtley, 1994
<i>S. intoshi</i> (Fauvel, 1914) Kirtley, 1994	Not observed	2–3 teeth on each side of plume	Long blade and with proximal medial limbation	Elliptical, without distal teeth, blade twisted	Geniculate, anterior ends in distal tip	Gulf of Guinea, São Tomé	West Africa	Kirtley, 1994
<i>S. lotensis</i> Kirtley, 1994	Not observed	2–3 teeth on each side of plume	Falciform and curved inwards inner series	Elliptical without distal teeth	Geniculate, anterior ends on distal tip	?	Chile	Kirtley, 1994
<i>S. marskaae</i> Kirtley, 1994	Present	2–3 teeth on each side of plume	Long blade	Subovate, without distal teeth,	Geniculate, anterior ends on distal tip	East London	South Africa	Kirtley, 1994
<i>S. minuta</i> Carrasco & Bustus, 1981	Not observed	4–5 teeth on each side of plume	Long blade	Elliptical, without distal teeth	Geniculate, anterior ends on distal tip	?	Chile	Carrasco & Bustus, 1981; Kirtley, 1994;
<i>S. spinulosa</i> Leuckart, 1849	Not observed	2–4 teeth on each side of plume	Falciform	Clavate, without distal teeth	Geniculate, anterior ends on distal tip	?	Eastern North Atlantic and Mediterranean coast	Kirtley, 1994
<i>S. pectinata</i> Fauvel, 1928	Present	2–3 teeth on each side of plume	Long blade	Elliptical, with distal teeth	Geniculate, anterior ends on distal tip	Gulf of Manaar	India	Fauvel, 1928, 1953; Achari, 1974; Kirtley, 1994
<i>S. gracilis</i> Hartman, 1944	Not observed	3–5 teeth on each side of plume	Falciform and curved inwards inner series	Elliptical without distal teeth	Geniculate, anterior ends on distal tip	California	North Pacific	Hartman, 1944; Kirtley, 1994
<i>S. tottoriensis</i> Nishi <i>et al.</i> , 2004	Present	3–4 teeth on each side of plume	Long blade	Elliptical, without distal teeth	Geniculate, anterior ends on distal tip	Tottori	Japan	Nishi <i>et al.</i> , 2004

coast are identical to the type specimens, because all the descriptions are poorly illustrated. The specimens examined have six pairs of nuchal hooks positioned after a short digitiform medium organ. Kirtley (1994) described nuchal hooks for *S. nanella*, but did not state the number of pairs and position of the medium organ. Kirtley (1994) considered the occurrence of *S. nanella* in Brazil to represent a case of bioinvasion, possibly a consequence of ballast water.

BIOLOGICAL NOTE

All the occurrences of *S. nanella* along the Brazilian coast were associated with *Phragmatopoma* aggregates. This species was reported before from the State of Paraíba by Young (1989), in crevices of the coral *Mussismilia hispida* (Verrill, 1901) from Quebra Quilha Reef, at Tambaú Beach, João Pessoa, Paraíba. In the present study the specimens were found at 10, 15 and 20 m.

GEOGRAPHICAL RANGE

Sabellaria nanella was originally described from the Indo-West Pacific Ocean, but has also been reported from the eastern Pacific, from Ecuador (Kirtley, 1994), and along the Atlantic Ocean, from the coast of Ceará (Kirtley, 1994), Bahia (Lana & Bremec, 1994), Espírito Santo and Rio de Janeiro (Rullier & Amoureux, 1979; Lana & Bremec, 1994), São Paulo (Lana & Bremec, 1994) and Uruguay (Lana & Bremec, 1994).

Sabellaria pectinata Fauvel, 1928
Figure 5A–F

Sabellaria pectinata Fauvel, 1928: 163, figure 3; 1930: 53; 1932: 210; Day, 1967: 671, figure 33.3; Achari, 1974: 444; Kirtley, 1994: 72, figures 4.28.1–4.28.3.

Sabellaria pectinata var. *intermediata* Fauvel, 1932, 210, figure 35; 1953: 397, figure 207.

MATERIAL EXAMINED

Total: 2 specimens. 7°03'49"S 34°43'12"W (Station C20), 1 specimen (CIPY-POLY 1020). 7°03'49"S; 34°43'12"W (Station C20), 1 specimen (CIPY-POLY 1021).

REMARKS

The specimens reported here are identical to the illustrations provided by Fauvel (1928) and Kirtley (1994) for material collected from the Indian Ocean. In our material, the outer paleae has 2–3 teeth on each side of plume (Figure 5A, B); middle paleae of long form, one wide base with long blade (Figure 5C); middle paleae short form, wide base with falciform blades and denticulate margins (Figure 5D); and inner series geniculate, with anterior ends in distal tip (Figure 5E, F; Table 1). On the other hand, our specimens differ from the illustrations provided by Day (1967) and Kirtley (1994) for specimens collected in Natal, in South Africa, on the short middle and inner paleae morphology. The specimens from Natal do not present a denticulate margin. The same is true for specimens illustrated from India by Fauvel (1928) and those analysed in this study. As seen for *S. nanella*, the occurrence of *S. pectinata* in Brazil could represent a case of bioinvasion, possibly as a consequence of ballast water, considering that the study area is close to a sea port. Achari (1974) does not provide illustrations about the specimens analysed. Therefore, it is not possible to confirm if it is the same species.

BIOLOGICAL NOTE

The specimens were found only in 10 m. This is the first time that this species was collected living near other sabellariid species.

GEOGRAPHICAL RANGE

Sabellaria pectinata was originally described from the Indian Ocean (Fauvel, 1928), and, later, was reported from South Africa in Natal (Day, 1967). The species is reported for the first time for the western Atlantic.

Sabellaria wilsoni Lana & Gruet, 1989
Figure 6A–C

Sabellaria wilsoni Lana & Gruet, 1989: 239, figures 1–21; Kirtley, 1994: 80, figure 4.33; Lana & Bremec, 1994: 216, figures 1 & 2.

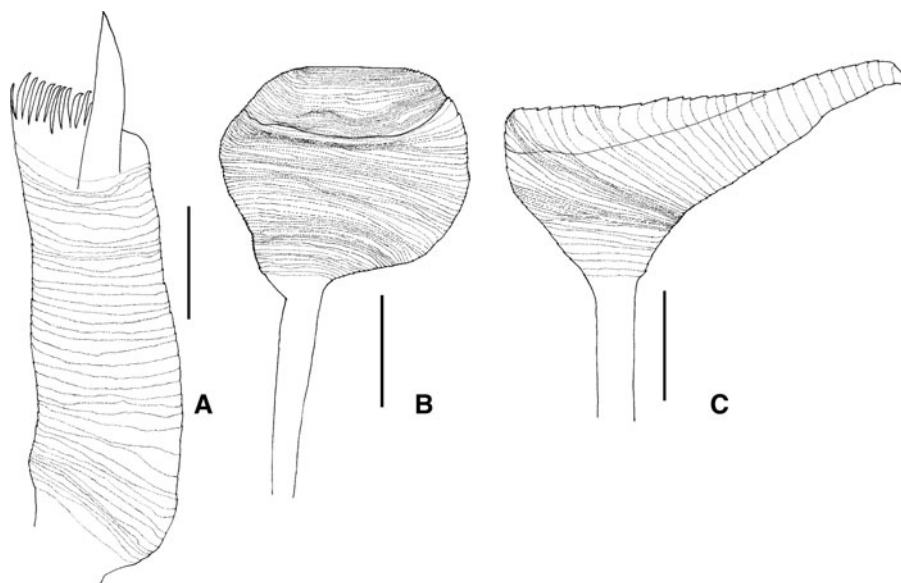


Fig. 4. *Sabellaria nanella* Chamberlin, 1919. CIPY-POLY 1025. (A) Outer palea; (B) middle palea; (C) inner palea. Scale bar: A, B = 87 μ m, C = 58 μ m.

Table 2. Denticulate species of *Sabellaria* that have three kinds of paleae.

Species	Nuchal spine	Outer paleae	Middle paleae	Inner paleae	Type locality	Distribution	Reference
<i>S. eupomatoides</i> Augener, 1918	Present	2–3 teeth on each side of plume	Longer, large and stout, falciform	Geniculate, anterior ends in distal tip	Angola	Southern Gulf of Guinea coast, Africa	Kirtley, 1994
<i>S. fucicola</i> Augener, 1918	Present	4–5 teeth on each side of plume	Long, light excavation, inner series curved inward	Geniculate, anterior ends in distal tip, palea little curved, in angle of 45°	Núbia, Africa	Africa	Kirtley, 1994
<i>S. gilchristi</i> (McIntosh, 1925) Kirtley, 1994	Present	1–2 teeth on each side of plume	Long, light excavation, geniculate	Geniculate, anterior ends in distal tip	?	Madagascar, East Africa to South Africa	Kirtley, 1994
<i>Sabellaria corallinea</i> sp. nov.	Present	3–4 teeth on each side of plume	Long blade, inner series curved inward	Geniculate, anterior ends in distal tip	João Pessoa, Paraíba, Brazil	João Pessoa, Paraíba, Brazil	This study

Table 3. Brazilian *Sabellaria* species that have three kinds of paleae and a denticulate plume.

Species	Nuchal spine	Outer paleae	Middle paleae	Inner paleae	Type locality	Distribution	Reference
<i>S. wilsoni</i> Lana & Gruet, 1989	Present	3–4 teeth on each side of plume	Geniculate, wide base with long blade	Geniculate, anterior ends in distal tip	Baía de Paranaguá, Brazil	South of Brazil and Argentina	Lana & Gruet, 1989; Kirtley, 1994
<i>S. nanella</i> (Chamberlin, 1919)	Present	3–6 distal teeth are present on each side of pilose plume	Clavate	Thick blades, tapered abruptly to acute, down-curved tip	California	Atlantic and Pacific coast	Kirtley, 1994; this study
<i>S. bellis</i> Hansen, 1882	Present	2–3 teeth on each side of plume	Alveolate, light excavation, concave	Geniculate, blade thicker, anterior ends bluntly	Baía de Guanabara, Rio de Janeiro, Brazil	Brazil and Argentina	Kirtley, 1994

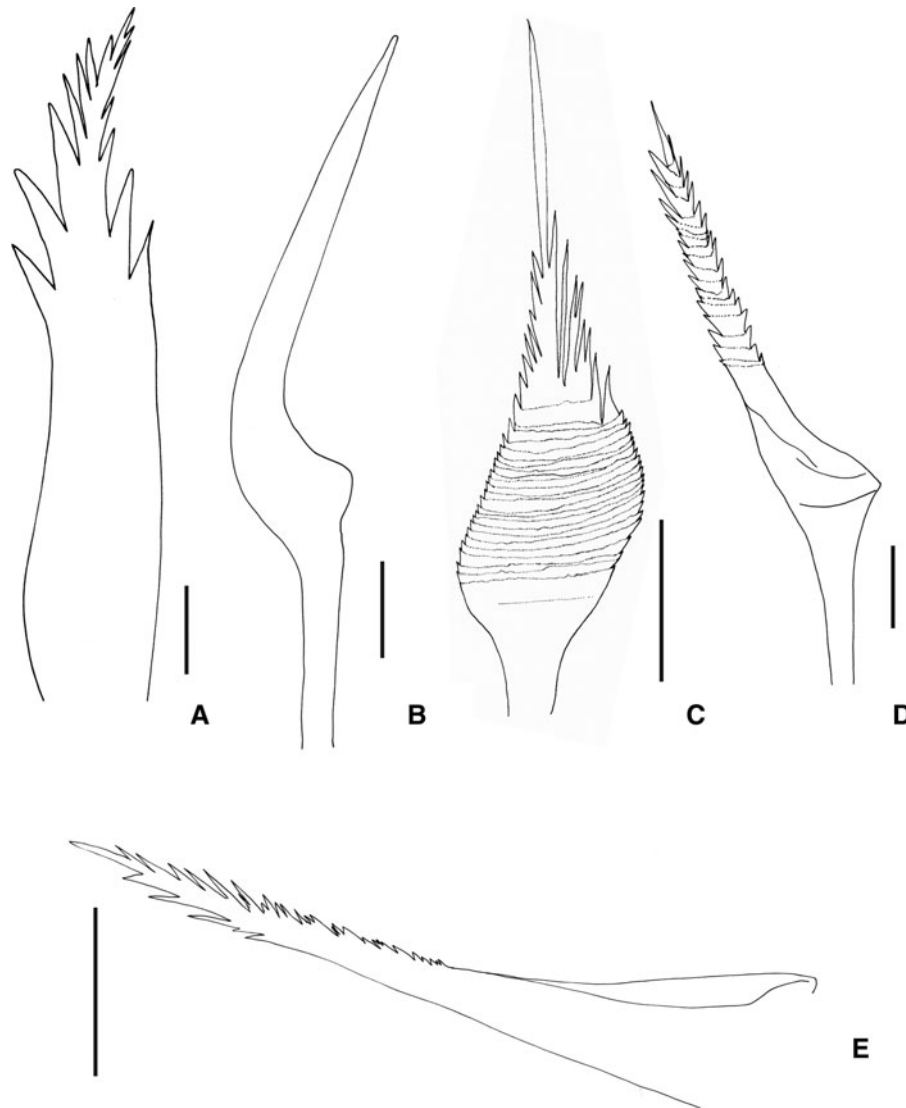


Fig. 5. *Sabellaria pectinata* Fauvel, 1923. CIPY-POLY 1020. (A) Outer palea; (B) middle palea one; (C) middle palea two; (D. & E) inner palea. Scale bar: A–F = 100 μ m.

MATERIAL EXAMINED

Total: 2 specimens. 7°01'02"S 34°47'55"W (Station B10), 1 specimen (CIPY-POLY 1027). 7°01'02"S 34°47'55"W (Station B10), 1 specimen (CIPY-POLY 1028).

ADDITIONAL MATERIAL EXAMINED

Sabellaria wilsoni Lana & Gruet (1989). Type series: Holotype: Paraná State, Ponta Grossa, Paranaguá Bay, 25°25'06"S 48°28'00"W, 10 m, collected 24 May 1982 (MCBM BPO 241). Paratype: Ponta Grossa, Paranaguá Bay, 25°25'06"S 48°28'00"W, 10 m, 15 specimens collected 24 May 1982 (MCBM BPO 242). Paratype: Ponta do Maciel, Paranaguá Bay, 25°33'S 48°25'W, 16.5 m, 1 specimen, collected 28 May 1982 (MCBM BPO 243). Paratype: Ponta do Maciel, Paranaguá Bay: 25°33'S 48°25'W. 16.5 m, 1 specimen, collected 5 June 1986 (MCBM BPO 244). Paratype: Ponta da Pita, Antonina Bay, 25°26'30"S 48°3'1W, 6 m, 1 specimen collected 3 July 1986 (MCBM BPO 245).

REMARKS

The material examined here agrees with specimens described by Lana & Gruet (1989). The outer paleae has flattened,

oblong, thecate blades; with teeth and medial plume on distal margin of blades with penicillate form; 3–4 distal teeth present on each side of dominant tooth, progressively smaller toward outer margins on either side of dominant tooth (Figure 6A). Middle paleae with 9–12 pairs on each side; strongly geniculate, with elongated blades slightly blunted, curved toward inner series of opercular crown (Figure 6B). Inner series of paleae alveolate in form, strongly geniculate on proximal upper surface of blades, with thecal bands weakly excavate, slanting upward from horizontal plane; blade thicker and wider toward base, ending in either a bluntly rounded point, or with distal dentition on margin or, in some specimens, in a series of sharp hooked tips (Figure 6C; Table 3).

BIOLOGICAL NOTE

Sabellaria wilsoni is known from mixohaline and polyhaline environments (estuaries and shallow bottoms of the continental shelf), living in sediments with sand and mud (sometimes with shells). The specimens were found at 15 m, similarly to those of the type series collected at 10 and 15 m. This is

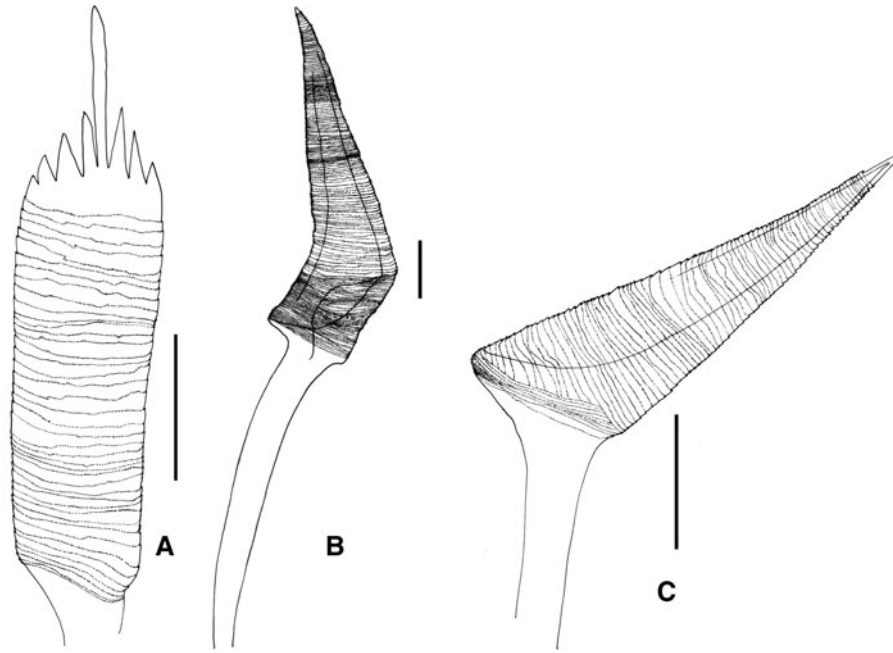


Fig. 6. *Sabellaria wilsoni* Lana & Gruet, 1989. CIPY-POLY 1028. (A) Outer palea; (B) middle palea; (C) inner palea. Scale bar: A–C = 100 μ m.

the first time that this species was collected living near other sabellariid species.

GEOGRAPHICAL RANGE

Sabellaria wilsoni was originally described from the coast of Paraná. The species has been reported only to the Atlantic Ocean, from French Guyana, Brazil to Argentina, and possible from the Gulf of Mexico (Lana & Gruet, 1989; Bremec & Lana, 1994).

Sabellaria corallinea sp. nov.

Figures 7, 8A–D, 9A–I; Table 2

MATERIAL EXAMINED

Type material: 7 specimens. Holotype $7^{\circ}01'02''S$ $34^{\circ}47'55''W$ (Station B10) (CIPY-POLY 634). Paratypes: $7^{\circ}01'02''S$ $34^{\circ}47'55''W$ (Station B10), 1 specimen (CIPY-POLY 635). $7^{\circ}01'02''S$ $34^{\circ}47'55''W$ (Station B10), 1 specimen (CIPY-POLY 636). $7^{\circ}01'02''S$ $34^{\circ}47'55''W$ (Station B10), 1 specimen (CIPY-POLY 637). $7^{\circ}01'02''S$ $34^{\circ}47'55''W$ (Station B10), 1 specimen (CIPY-POLY 638). $7^{\circ}01'02''S$ $34^{\circ}47'55''W$ (Station B10), 1 specimen (CIPY-POLY 639). $7^{\circ}01'02''S$ $34^{\circ}47'55''W$ (Station B10), 1 specimen (CIPY-POLY 779).

SLIDES

Paratype CIPY-POLY 639. Opercule and entire body.

ETYMOLOGY

The species is named for the order Corallinales in which the specimens were found.

DIAGNOSIS AND SUGGESTED AUTAPOMORPHY

The organization of opercular paleae with the outer paleae flattened, oblong, thecate blades; medial plume (or dominant tooth) denticulate, with teeth decreasing toward the tip; plume

penicillate with three distal teeth on one side and four on the other, decreasing progressively in size toward outer margins; with medium paleae strongly geniculate, with elongate blades, slightly blunted, curved toward inner series of opercular crown; inner paleae alveolate in shape, strongly geniculate at the proximal upper surface of blades, with thecal bands weakly excavate, slanting upward from horizontal plane; and the ornamented hooks are exclusive of this species.

DESCRIPTION

Holotype: complete specimen with 17 chaetigers. The body measures 4.7 mm in length, and 1 mm in diameter in thorax region. Opercular stalk measures 0.2 mm, and the opercular crown 1 mm in diameter. Thoracic region measures 0.2 mm, the paratoracic region 0.3 mm in length. Abdominal region 3.9 mm, and the caudal region 1.5 mm in length. Anterior end of opercular stalk and crown with deep mid-ventral indentation and divided into symmetrical halves. Opercular paleae yellow-gold, with vitreous luster, positioned in three concentric rows that surround the prostomium and peristomium, differing in shape and length (Figure 7). There are 24–28 pairs of outer paleae on each side of the symmetrical halves (Figure 7), flattened, oblong, thecate blades. Medial plume (or dominant tooth) denticulate, with teeth decreasing toward the tip (Figure 8A). Plume penicillate with three distal teeth on one side and four on the other, decreasing progressively in size toward outer margins (Figure 8A, B). Blades bent slightly outward from longitudinal axis of shaft; inner surface of blade with many fine closely-spaced striations. Each striation consists of a series of small teeth (tiny extensions) (Figure 8A). Twelve pairs of middle paleae on each side of the symmetrical halves. Paleae strongly geniculate, with elongate blades, slightly blunted, curved toward inner series of opercular crown and with series of tiny extensions. Distal ends almost erect, tapering to distal tip with weak excavation on inner face of thecal bands (Figure 8C). Twelve pairs of

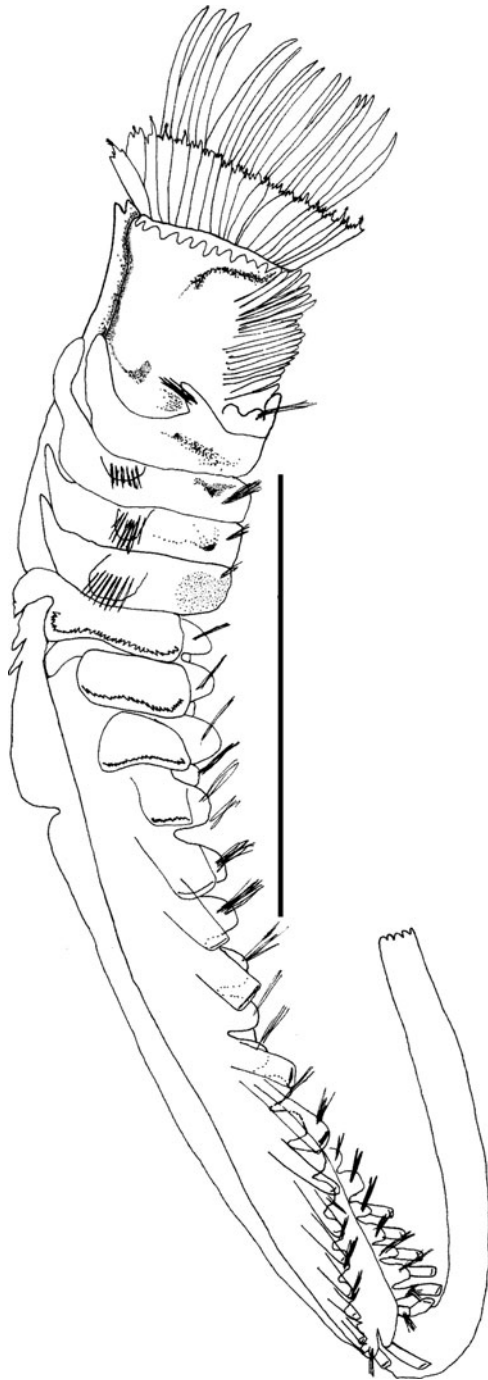


Fig. 7. *Sabellaria corallinea* sp. nov. holotype. CIPY-POLY 634. Body in lateral view. Scale bar: 2.7 mm.

inner paleae on each side of the symmetrical halves. Paleae alveolate in shape, strongly geniculate at the proximal upper surface of blades, with thecal bands weakly excavate, slanting upward from horizontal plane. Blade thicker and wider toward base, terminating distally in pointed tip, with tiny extensions (Figure 8D; Table 2). Opercular pedunculum with three pairs of dorsal (nuchal) spines on each side of the mid-line (Figure 9A). Anterior margin of pedunculum with series of flattened, big, spaced palps, attached to prostomium (Figure 7). Peduncle bases with a series of six longitudinal rows of compound feeding tentacles (12–15 in transverse

rows). Ventral and dorsal margins of buccal cavity attached to peristomium. Prostomium fused with peristomium and limited to a region situated in front of the mouth, bearing a pair of grooved prehensile tentacles, and medium digitiform cirrus. Peristomium lips beginning in front of the mouth and ending at the base of the compound feeding tentacles. Thoracic region consists of a 'U'-shaped building organ, and two segments with spiralled capillary chaetae. Thoracic segments with neuropodium, without notopodium, and conical palps located on each side of opercular pedunculum (Figure 9B). Cirri of first thoracic segment triangular, bent toward ventral side of body, quite similar to buccal cirri. Cirri of second thoracic segment triangular, elongated, bent toward dorsal side of body, on each side of the mid-ventral indentation of operculum (Figure 7). Parathoracic region with 3 segments and small biramous parapodia, with notopodium and neuropodium (Figure 7). Three pairs of ornamented hooks (Figure 9I) occurring along the body: the first in parathoracic region, the second in first abdominal segment and the third in sixth to seventh abdominal segments of the abdominal regions. Notopodium with shaves of large chaetae with lanceolate tips 'oar-shaped' (Figure 9C) and the thin large lanceolate chaetae with slightly curved tips positioned between the chaetae with large lanceolate tips (Figure 9D). Neuropodium with shaves of large chaetae with lanceolate tips, oar-shaped' (Figure 9E) and thin capillaries positioned between large chaetae with lanceolate tips (Figure 9F). Abdominal region with 18–20 segments and tori in numerous segments. Dorsal digitiform branchiae present in five anterior abdominal segments, becoming reduced in size and disappearing at segment 15. Uncinigerous tori with chaetae disposed in a single row. Notopodial uncini bipectinate, with 6 rows of teeth superposed (Figure 9H). Neurochaetal conical cirri arising from base of bundle on first abdominal segment. Neuropodium with ornamented capillaries (Figure 9G). Cirri diminishing in size posteriorly and disappearing on posteriormost segments (Figure 7). Caudal region or pygidium septate, composed of diverse fused achaetous segments. Cauda reflected on ventrum, with anus and more or less 10 papillae. Brownish to reddish red-brown eyespots on each expansion of the compound feeding tentacle filaments (or branchial filaments). These eyespots occur on all three parathoracic segments in great numbers. They are highly concentrated on first parathoracic segment, decreasing gradually in number and concentration in the direction of the first abdominal segment. A band of brownish eyespots were also observed on the ventral region of the third parathoracic segment (Figure 7). Black eyespots on the opercular pedunculum, on the inner face of serial conic palps, extended to mid-ventral indentation. These eyespots also occur on the prostomium, on the median cirrus, from the base to the upper edge, and on the peristomium, between the compound feeding tentacles, in the thoracic region (Figure 7). A few black eyespots are found on the paired cirri of the abdominal segments and in the lateral margin of the caudal region (Figure 7). Red eyespots are present on the ten last paired cirri of the abdominal segments (Figure 7).

VARIATIONS

The paratypes vary from 4.7 to 7 mm in length. There are no conspicuous variations except for one specimen that appears not to present the accessory hook (CIPY-POLY636) and the

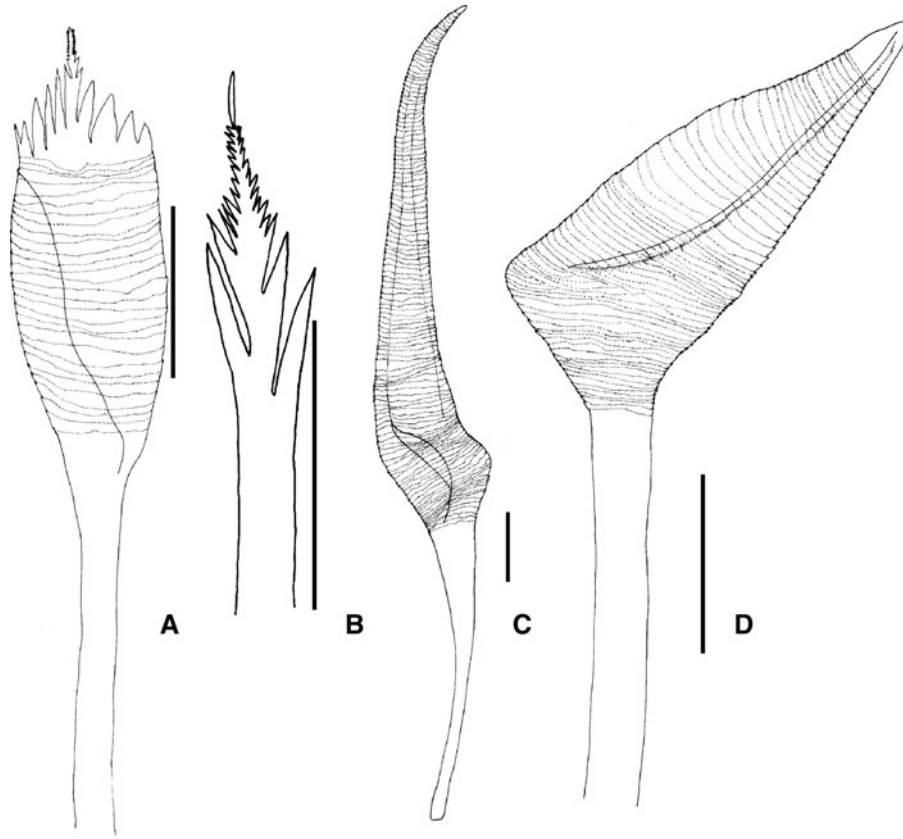


Fig. 8. *Sabellaria corallinea* sp. nov. paratype. CIPY-POLY 639. (A) Outer palea; (B) detail of plume of outer palea; (C) middle palea; (D) inner palea. Scale bar: A–C, D = 100 μ m, B = 39 μ m.

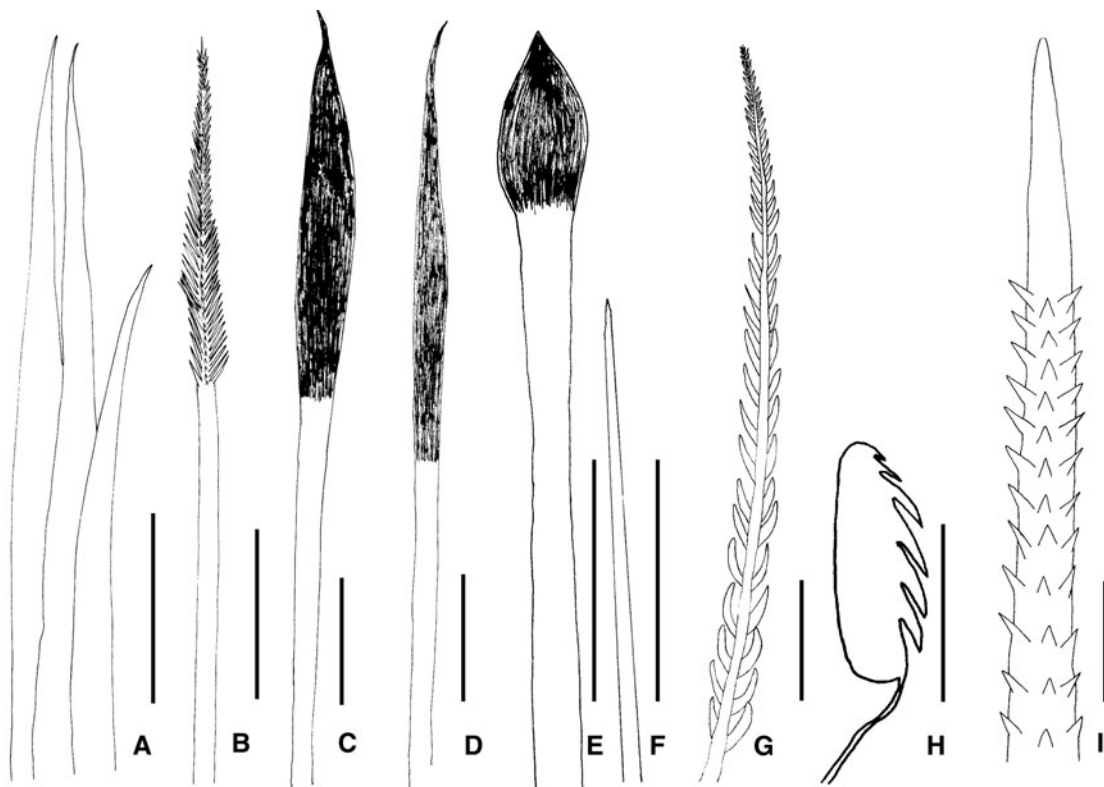


Fig. 9. *Sabellaria corallinea* sp. nov. paratype CIPY-POLY 639. (A) Nuchal hooks, thoracic region; (B) thoracic chaeta. Parathoracic region (C–F); (C) small lanceolate chaeta from notopodium; (D) big lanceolate chaeta from notopodium; (E) lanceolate chaeta from neuropodium; (F) capillar chaeta from neuropodium. Abdominal region (G–I); (G) neurochaeta; (H) notochaeta; (I) ornamented hook. Scale bar: A, E, F = 100 μ m, B, C, D, G = 39 μ m, H, I = 19 μ m.

number of eyespots, but the position is the same in all specimens.

REMARKS

Worldwide 34 species of *Sabellaria* are known (Kirtley, 1994; Nishi & Kirtley, 1999; Nishi & Kato, 2002; Nishi *et al.*, 2004), but only 18 have denticulate outer paleae (Tables 1 & 2). Of these species, only 3 have three kinds of paleae (Table 2) and none of these have a penicillate plume, series of middle paleae with 12 pairs on each side of the symmetrical halves, medium paleae strongly geniculate, with elongate blades slightly blunted, curved toward inner series of opercular crown and series of tiny extensions. Distal ends of these extensions almost erect, tapering to distal tip. Weak excavation on inner face of thecal bands.

One of the autapomorphies of *S. corallinea* sp. nov. is the presence of paired ornamented hooks (Figure 9I). This kind of hook was not reported before in other adult sabellariid species. Three pairs were found in these specimens, but the number of pairs could be higher than examined. These chaetae were previously only known from the prototroch of sabellariid larvae (Eckelbarger, 1975, 1976). We have described these structures in the parathoracic and abdominal region for the first time. The presence of these chaetae apparently cannot be explained by progenesis.

BIOLOGICAL NOTE

This species was found in rhodolith beds at 10 and 15 m depth.

TYPE LOCALITY

Shallow subtidal zone of João Pessoa, Paraíba, Brazil (7°01'02"S 34°47'5"W).

GEOGRAPHICAL RANGE

Coast of João Pessoa, Paraíba, Brazil.

DISCUSSION

The marine biodiversity from the western South Atlantic is still poorly known. Research is concentrated mainly in the south and south-east regions (Amaral & Jablonski, 2005). Data from the subtidal zone are scarce, with lack of information on the distribution and environments in which the species occurs. According to Amaral *et al.* (2006), eight species of Sabellariidae were identified along the Brazilian coast. Five were identified and recorded for the first time in rhodolith beds, in addition to *Sabellaria corallinea* sp. nov. Worldwide, sabellariids are known to build tubes made of sandy and mucous secretions, attached to various kinds of substrata, such as rocks (Hutchings, 2000), mollusc shells and seagrasses (Uebelacker, 1984). More recently, new associations have been reported with bryozoans (Morgado & Tanaka, 2001), fleshy seaweeds (Fraschetti *et al.*, 2002), turtle carapaces (Frick *et al.*, 2004) and even cnidarians (Pérez *et al.*, 2005). The occurrence of Sabellariidae in rhodolith beds is reported for the first time, adding some information on their biology. Therefore, detailed studies about association were not provided during collections and we can only report the presence of species in this area. In Brazil, rhodolith beds are assumed to occur along the entire continental shelf (Foster, 2001) and more than 100,000 metric tons of

rhodoliths per year are exploited (Riul *et al.*, 2008). The description of a new species of an ecologically relevant taxon such as Polychaeta, and the occurrence of more than half of the species of Sabellariidae known from Brazil in rhodolith beds, reinforces the need for more studies in this environment, that may help to establish more adequate conservation and management policies for the subtidal zone, specifically for an ecosystem recognized worldwide as a significant source for the maintenance of marine biodiversity.

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