

Research article

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A new species of *Paranerilla* Jouin & Swedmark, 1965 (Annelida: Polychaeta) from Brazil

Samuel Lucas da Silva Delgado MENDES^{1,*},
Jaqueline Carvalho RODRIGUES² & Alexandra E. RIZZO³

¹Universidade Federal do Rio de Janeiro, Programa de Pós-graduação em Zoologia, Museu Nacional, Quinta da Boa Vista, São Cristóvão, Rio de Janeiro, Brazil.

²Fundação Oswaldo Cruz (Fiocruz), Av. Brasil, 4365, Manguinhos, Rio de Janeiro, Brazil.

³Universidade do Estado do Rio de Janeiro, Departamento de Zoologia, Rua São Francisco Xavier, 524, Pavilhão Haroldo Lisboa Cunha, 20550-900 Maracana, Rio de Janeiro, Brazil.

*Corresponding author: slucasmendes013@gmail.com

²Email: rodrigues_jcr@live.com

³Email: aerizzo@hotmail.com

¹[urn:lsid:zoobank.org:author:6A9CDA3F-7809-49C7-904B-1CC5692B2007](https://zoobank.org/author:6A9CDA3F-7809-49C7-904B-1CC5692B2007)

²[urn:lsid:zoobank.org:author:3219D5DE-A2B0-4655-A2A1-81C350B5B207](https://zoobank.org/author:3219D5DE-A2B0-4655-A2A1-81C350B5B207)

³[urn:lsid:zoobank.org:author:4EFF4F30-3957-4C49-834C-354966630B20](https://zoobank.org/author:4EFF4F30-3957-4C49-834C-354966630B20)

Abstract. Nerillids are small marine annelids, once placed at the artificial group ‘Archiannelida’, which contained all families of the exclusively interstitial polychaetes. Nerillidae is the most species rich family among them, with 71 species grouped into 15 genera, and represents an important component of the interstitial fauna, occupying a wide bathymetric range. Despite its problematic placement among the ‘Archiannelida’ families, the group per se is considered monophyletic. Currently, only two species of *Paranerilla* are valid, both being reported from the northern hemisphere. It is presented herein as the first description of a species of *Paranerilla* from tropical waters, named as *Paranerilla schiavettii* sp. nov., which is also considered as a unique record by the presence of a modified acicular spine in noto- and neuropodia from chaetiger 3–7, not mentioned in its congeners descriptions. Hence, we also propose an emendation on the genus diagnosis to embrace the presence of acicular spines within *Paranerilla*. So, the presented information complements the current knowledge about the group’s taxonomy and expands its distribution to South Atlantic waters.

Keywords. Benthic macrofauna, deep-sea, first record, Atlantic Ocean, taxonomy.

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Introduction

Nerillidae Levinsen, 1883 is the most speciose family among the exclusively interstitial polychaetes, including 71 nominal species grouped into 15 genera (Worsaae 2005b; Rouse *et al.* 2022). They occupy a variety of marine habitats such as intertidal shelly sand, particulate substratum, muddy sediments in deep waters and thermal vents, and they are also kept in marine aquaria (Gelder 1974; Rouse & Pleijel 2001; Worsaae & Rouse 2009; Rouse *et al.* 2022). Their distribution also comprises occurrences along all continental coasts, including the Arctic region (Gelder 1974; Worsaae & Kristensen 2003; Rouse *et al.* 2022). The family is known as microphagous and bottom detritus browser feeding annelids, due to the use of ciliary bands in combination with the capture force provided by a muscular bulb located on their pharynx, keeping small particles on the mouth region and abrading the substratum (Gelder & Uglow 1973).

Following Rouse & Pleijel (2001) and Rouse *et al.* (2022), nerillids are minute-sized polychaetes, rarely exceeding 2 mm in length, transparent when alive and with colored gut. Their anterior region is characterized morphologically by a rounded prostomium with a pair of ventral palps, a pair of frontal antennae, a median antenna, one or two pairs of eyes, and a pair of nuchal organs in the dorso-posterior side forming ciliated pits. The peristomium is limited to the lips. Segment 1 usually differs from the rest of the body segments, with unique patterns of size, presence and length of cirri, and chaetae number and arrangement.

All interstitial polychaetes were once grouped in a taxon known as ‘Archiannelida’, containing the following families: Saccocirridae Bobretzky, 1872, Dinophilidae Macalister, 1876, Polygordiidae Czerniavsky, 1881, Protodrilidae Czerniavsky, 1881, Nerillidae Levinsen, 1883, Parergodrilidae Reisinger, 1925, Psammodrilidae Swedmark, 1952, Diurodrilidae Kristensen & Niilonen, 1982 and Protodriloididae Purschke & Jouin, 1988 (Hermans 1969). They were all characterized by a set of features associated with their microphagous and detritivore feeding habits, such as the presence of a muscular pharynx, adhesive glands and body ciliation used to explore the detritus, enhance adherence to the substratum and capture particles and microorganisms, respectively (Gelder & Uglow 1973).

However, at present the group is known to be artificial due to the contribution of molecular analyses combined with the refinement of morphological and ecological interpretations, which led to the conclusion that its taxonomic definition was based on characters that did not represent their common ancestry (Hermans 1969; Worsaae *et al.* 2004; Worsaae 2005a, 2005b). Hence, the phylogenetic position of Nerillidae is still discussed. Nevertheless, some authors argued that the group should be placed in a clade next to Aberrantidae, inside the Aciculata (Worsaae *et al.* 2004; Worsaae 2005b).

The nerillid genus *Paranerilla* Jouin & Swedmark, 1965 is considered as monophyletic, with two species descriptions from the Northern hemisphere. However, there is a knowledge gap about the genus diversity around the globe, which is mainly associated with the bias of fewer sampling campaigns in the Southern region when compared to the efforts in the Northern hemisphere (Worsaae 2014). This work aims to present the morphological description of a new species, belonging to *Paranerilla*.

Material and methods

The material analyzed was obtained in partnership with PETROBRAS, from samplings carried out to collect environmental data for environmental monitoring. The material identified comes from the sampling and sorting related to the “Projeto Santos – Caracterização Ambiental da Bacia de Santos, coordinated by CENPES/PETROBRAS” (Moreira *et al.* 2023). Sampling was carried out in two campaigns (2019 and 2021) aboard the R.V. “*Ocean Stalwart*” (2019) and R.V. “*Seward Johnson*” (2021). The sampling stations (Fig. 1) were positioned along eight transects (A–H), on 11 isobaths, five

of them positioned on the continental shelf (25, 50, 75, 100 and 150 m deep) and the six others were positioned on the slope (400, 700, 1000, 1300, 1900 and 2400 m deep). In addition to these, 12 sampling points were established to cover the northern area of the São Paulo Plateau (1300 to 2200 m deep). The sediment was collected in triplicate, with the aid of a modified van Veen (mostly on the continental shelf) or a box-corer grab (mostly on the continental slope), depending on the type of bottom sediment. For the analysis of the macrofauna, the first 10 centimeters of the sediment were considered, and for the slope, the samples were stratified at depths of 0–2, 2–5 and 5–10 cm. On board, samples were fixed in borax-buffered 10% formaldehyde.

The specimens were sorted from the sediment, identified, and deposited in the collection of Polychaeta at the Rio de Janeiro State University (UERJ-Pol) in the Invertebrate Zoology Laboratory (LZI-UERJ). Specimens were prepared for Scanning Electron Microscopy (SEM) using hexamethyldisilazane (HMDS) 99% solution, following this process: i) dehydration through ethanol (EtOH) in a series of 70%, 80%, 90%, then in absolute EtOH concentration, for 15–20 minutes in each step; ii) replacement of ethanol using HMDS in a series of 1:2, 1:1, 2:1 ratios of absolute EtOH and HMDS each step for 15–20 minutes, and finally iii) total evaporation of HMDS, during about 4 to 5 hours.

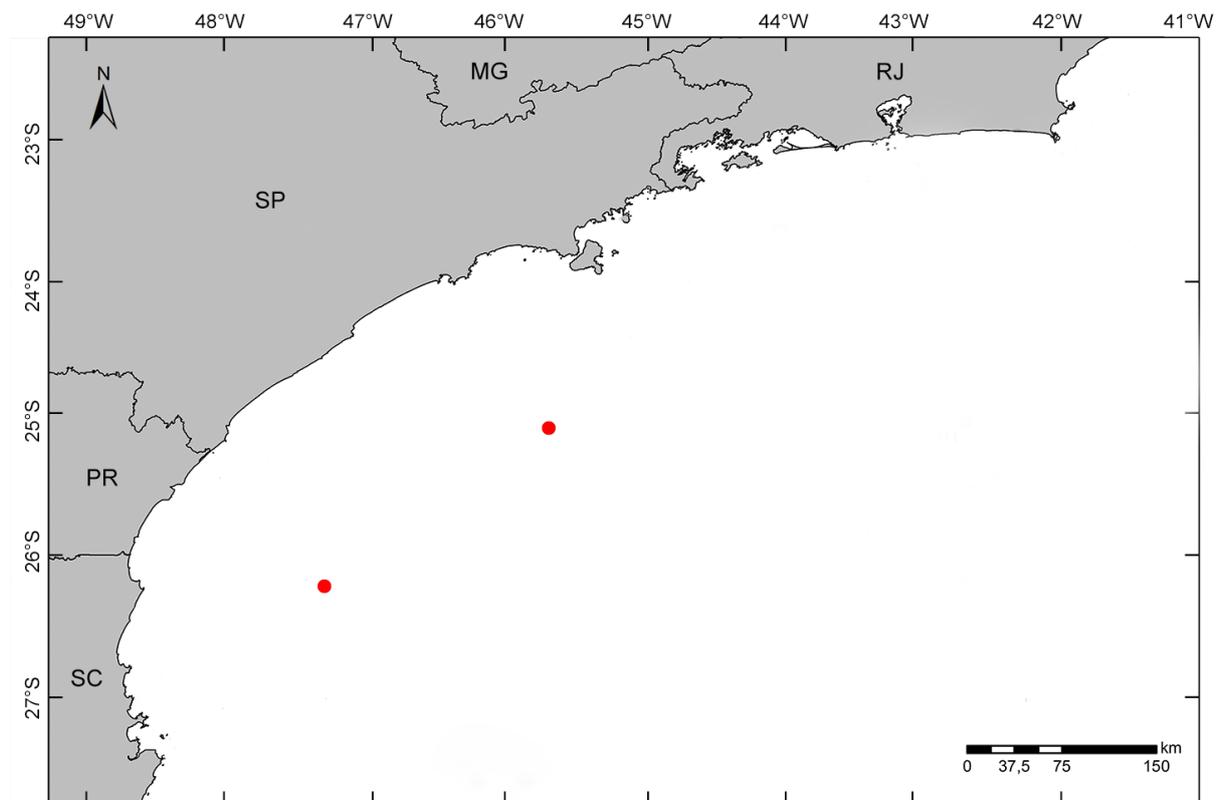


Fig. 1. Sampled area off the Brazilian coast. Each red point represents the type material sampling localities.

Results

Taxonomy

Class Polychaeta Grube, 1850
Family Nerillidae Levinsen, 1883

Genus *Paranerilla* Jouin & Swedmark, 1965

Type species

Paranerilla limicola Jouin & Swedmark, 1965, by original designation.

Diagnosis emendation (after Worsaae & Kristensen, 2003)

Seven chaetigers between prostomium and pygidium. Prostomium without appendages, only two lateral horns present. Compound chaetae and an acicular spine may be present. Dorsal and ventral ciliation well developed. Segment 1 with cirri fully developed. Cirri in following parapodia rudimentary. Two elongate pygidial cirri.

Remarks

Paranerilla Jouin & Swedmark, 1965 is one of the three Nerillidae genera which are found in deep waters (Worsaae & Kristensen 2003). *Paranerilla* is monophyletic (Worsaae 2005b) and currently has two accepted species: *Paranerilla limicola* Jouin & Swedmark, 1965 from Skagerrak, North Sea, and *Paranerilla cilioscutata* Worsaae & Kristensen, 2003 from Greenland, Arctic Ocean. They can be found in muddy sediments associated with diverse meiofaunal taxa from a range of 30 to 1216 meters deep (Jouin & Swedmark 1965; Worsaae & Kristensen 2003). The ciliation pattern presented by these species is not only important to their locomotion and feeding behavior as mentioned but it is also used to infer the phylogenetic relations among the Nerillidae genera, and to distinguish the current valid species of *Paranerilla* (Worsaae 2005b).

The following characters are also important to distinguish species of *Paranerilla*: parapodial cirri shape on chaetiger 1 in comparison to other body segments, number of spiniger compound chaetae in chaetiger 1 in relation to other body segments, and pygidial cirri features (Jouin & Swedmark 1965; Worsaae & Kristensen 2003). However, none of the already described species mentioned above presented an acicular chaeta emerging from any of their chaetal fascicles, based on their respective descriptions, *P. schiavettii* sp. nov. being the exception among them. This additional morphological feature may be used to separate species of *Paranerilla* in future descriptions, and we include it as an emendation on the genus diagnosis.

Paranerilla schiavettii sp. nov.

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Figs 2–3

Diagnosis

Specimens from grey to whitish color, with prostomium and segment 1 almost fused and about as long as each of the following segments. One acicular chaeta on noto- and one on neuropodia from chaetiger 3 to 7; 14 spiniger compound chaetae on chaetiger 1, 7–12 on chaetigers 3–7, both present as single pointed distal extensions following chaetal articulation. Prostomium, peristomium and entire dorsal and ventral body surfaces of segments 1–7 densely covered with cilia.

Etymology

The specific epithet '*schiaivettii*' was chosen to honor the professor and our friend Alexandre Schiavetti, for his important contributions to improve our scientific knowledge on marine ecology, especially marine protected areas in Brazil.

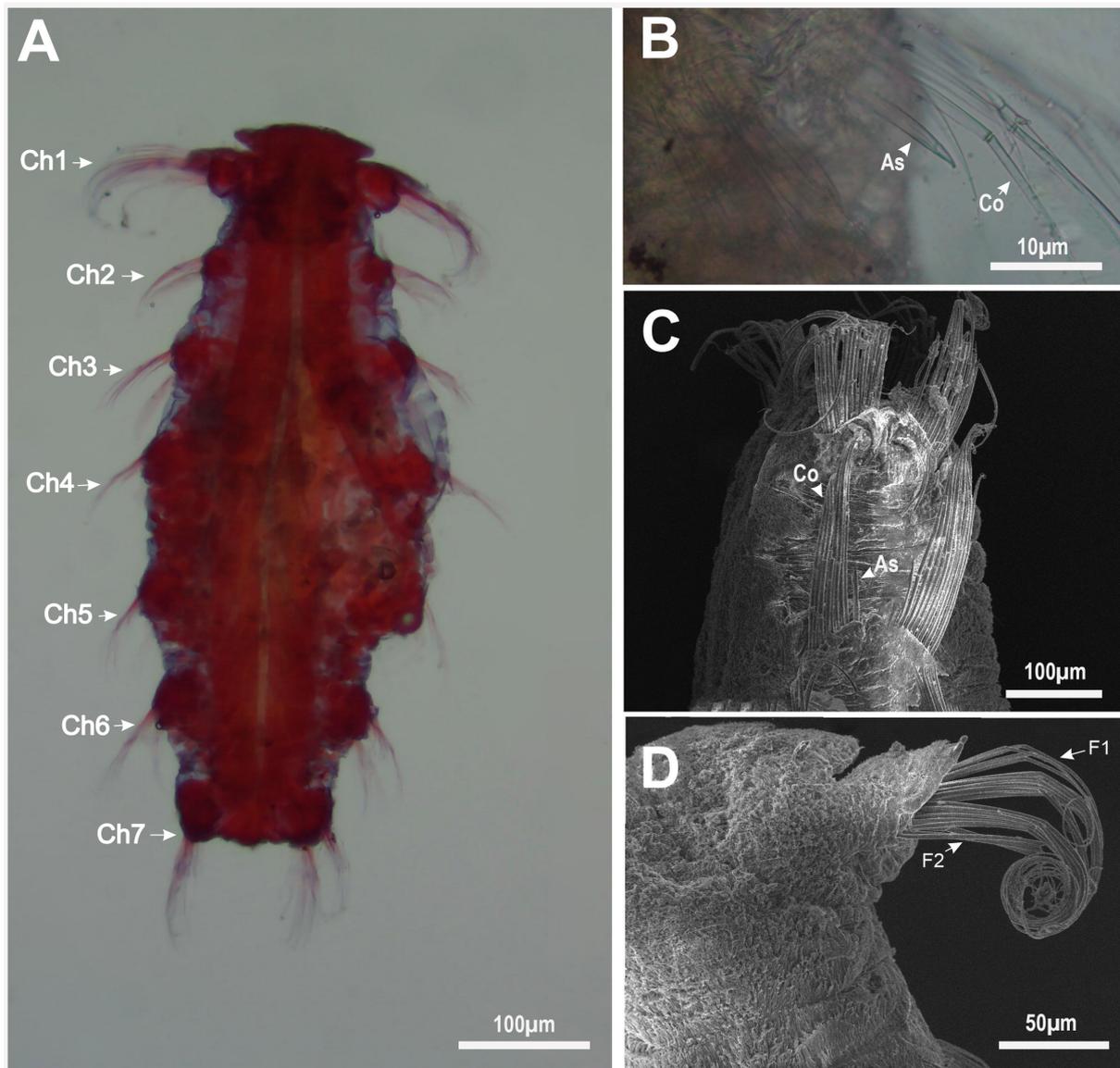


Fig. 2 *Paranerilla schiaivettii* sp. nov., under optical microscopy and SEM. **A.** Dorsal view of anterior body region of a specimen stained with Shirlastain A. **B.** Lateral view of mid body chaetal fascicle, emphasizing the nature of spiniger compound chaetae and acicular chaetae under optical microscopy. **C.** Lateral view of posterior body chaetal fascicle emphasizing the nature of spiniger compound chaetae and acicular chaetae under electron microscopy. **D.** Ventral view of body anterior region and the two chaetal fascicles of spiniger compound chaetae. Abbreviations: As = acicular spine; Ch 1–7 = chaetigers 1–7; Co = spiniger compound chaetae; F1 = chaetiger 1 anteriormost chaetal fascicle; F2 = chaetiger 1 posteriormost chaetal fascicle.

Type material

Holotype

BRAZIL – Santos basin • 1 complete spec.; 25°03'46.44" S, 45°35'45.24" W; depth 100 m; 22 Jun. 2021; UERJ 8904.

Paratype

BRAZIL – Santos basin • 8 specs without anal cirri; 26°09'24,84" S, 47°12'59" W; depth 100 m; 16 Jun. 2021; UERJ 8903.

Other material examined

BRAZIL – Santos basin • 2 specs; 27°01'18.8400" S, 47°43'45.8400" W; depth 100 m; 13 Jun. 2021; UERJ 8927 • 1 spec.; 23°29'12.8400" S, 43°58'30.7200" W; depth 75 m; 3 Jun. 2021; UERJ 8928 • 1 spec.; 24°05'20.0400" S, 43°40'23.5200" W; depth 150 m; UERJ 8929 • 5 specs; 29°09'25.200" S, 47°13'01.4800" W; depth 10 m; 15 Jun. 2021; UERJ 8930 • 1 spec.; 25°40'31.080" S, 43°59'20.8" W; depth 2169 m; 2 Jul. 2019; UERJ 8960.

Description

Holotype complete; measuring 980 µm long for 242 µm wide. Paratypes complete, measuring 319–870 µm long for up to 200–316 µm wide. Grey to whitish specimens, consisting of prostomium, seven chaetigers (Fig. 2A) and pygidium with pair of terminal cirri (Fig. 3E). Maximum body width always at chaetiger 4 excluding parapodia (Fig. 2A). Prostomium with pair of lateral horns and almost fused to chaetiger 1 (Fig. 2D). Prostomium up to 36 µm long, 144 µm wide including lateral horns (Fig. 3A); maximum length of lateral horns up to 40 µm, measured along the posterior edge. Prostomium and chaetiger 1 together about as long as each of the following segments. All body segments similar in width and length, except for slight expansion on chaetiger 4 (Fig. 2a). Nuchal organs not observed.

Parapodia on chaetiger 1, usually about 2 × as long as length of following parapodia (Fig. 2D). Short cirri with strongly ciliated band on chaetiger 1 (Fig. 2D). Rudimentary cirri with distal cilia may be found on chaetigers 2–7, between dorsal and ventral chaetal bundles. Two pygidial cirri up to 132 µm long (Fig. 3E). One acicular spine on noto- and one on neuropodia of chaetigers 3–7 accompanying spinigers compound chaetae (Fig. 3F), one emerging ventrally to them on notopodia and another dorsally to them on neuropodia. Spiniger compound chaetae present as single pointed distal extension following chaetae articulation (Fig. 2B). Chaetiger 1 uniramous, bearing two chaetal fascicles (Fig. 2D), with maximum of 14 chaetae; segments 2–7 biramous, with one dorsal and ventral fascicles, comprising 7–12 chaetae each, highest number in chaetigers 3–5. Chaetae on chaetigers 1 and 7 longer than those of other chaetigers (Fig. 3C), but chaetae on chaetiger 7 slightly shorter than those on chaetiger 1 (Fig. 3C).

Prostomium, peristomium and entire dorsal and ventral body surfaces of chaetigers 1–7 densely covered by cilia, except in gaps between ciliated bands (Fig. 3A) and parapodial rami on body lateral surface and among chaetal fascicles (Fig. 2C). Dorsally, chaetiger 1 presenting dorsal ciliary plate followed posteriorly by three transverse ciliary bands (Fig. 3A). Ventrally, chaetiger 1 having ventral ciliary plate around mouth opening followed posteriorly by two ventral transverse ciliary bands (Fig. 3D). Chaetigers 2–7 with four transverse ciliary bands each both dorsally and ventrally.

Ecology

Santos Basin, Brazil. From a range of 75 to 2169 meters deep. The habitat is characterized predominantly by muddy sediments on the continental slope, but some specimens were found living in sandy sediments on the continental shelf.

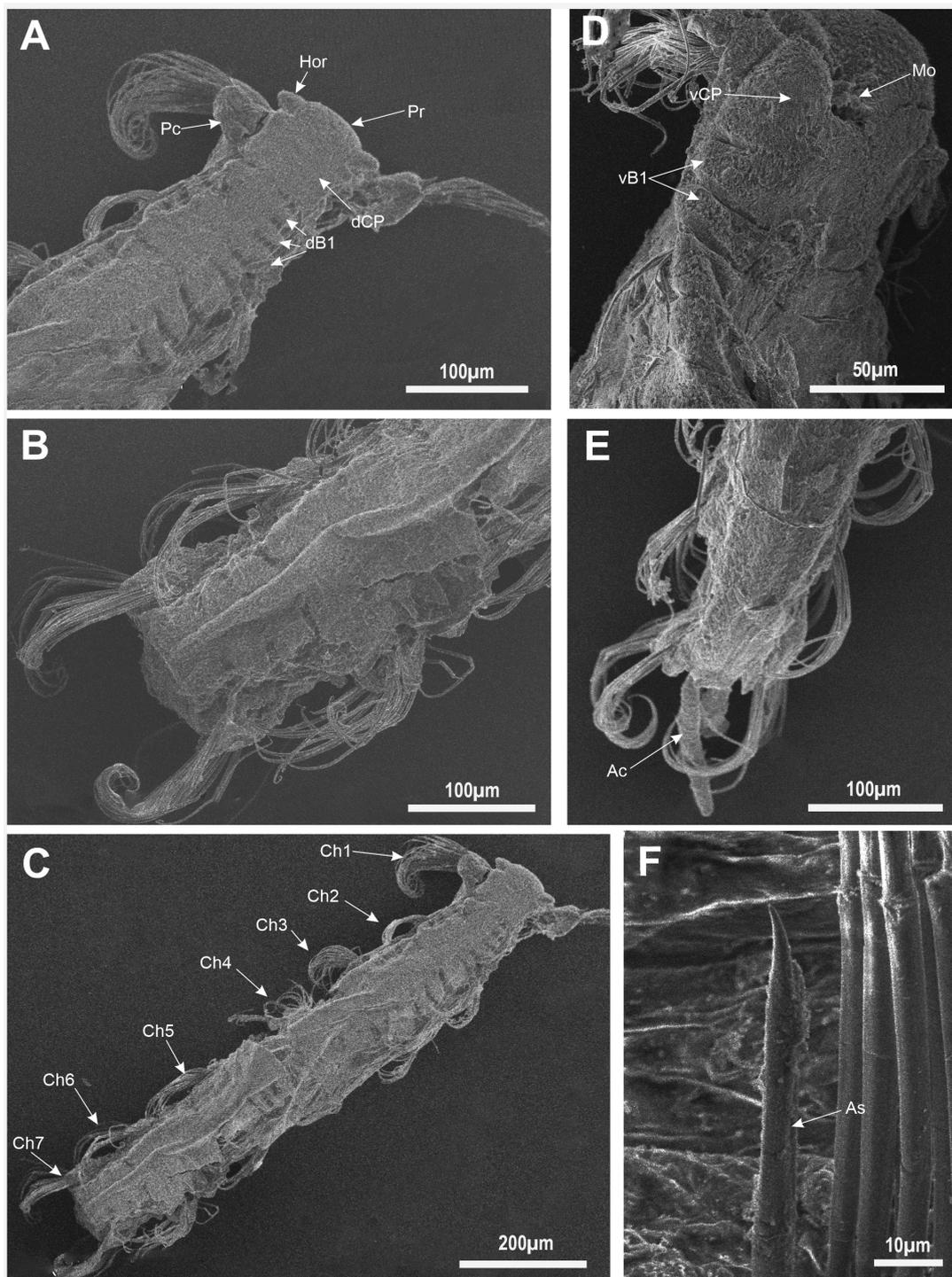


Fig. 3 *Paranerilla schiavettii* sp. nov. under SEM. **A.** Dorsal view of anterior body region. **B.** Dorsal view of posterior body region. **C.** Dorsal view of entire body, emphasizing the number of chaetigers. **D.** Ventral view of body anterior region, showing the mouth ciliary plate and succeeding ciliary bands. **E.** Ventral view of body posterior region showing the anal cirri. **F.** Acicular spine of chaetiger 3 in detail. Abbreviations: Ac = anal cirrus; As = acicular spine; Ch 1–7 = chaetigers 1–7; dB1 = dorsal ciliary bands on chaetiger 1; dCP = dorsal ciliary plate; Hor = lateral horn; Mo = mouth; Pc = parapodial cirri; Pr = prostomium; vB1 = ventral ciliary band of chaetiger 1; vCP = ventral ciliary plate.

Remarks

Despite their morphological differences, both *P. schiavettii* sp. nov. and the currently valid species present 7 chaetigers, two pygidial cirri, a well developed pattern of dorsal and ventral ciliation, chaetiger 1 with cirri fully developed and rudimentary cirri in following parapodia (Jouin & Swedmark 1965; Worsaae & Kristensen 2003). The prostomium and chaetiger 1 present large ciliated areas and the following segments present small transverse bands in *P. limicola*, but are densely ciliated in *P. cilioscutata* and *P. schiavettii* (Jouin & Swedmark 1965; Worsaae and Kristensen 2003). Both species present frontal horns, compound chaetae, chaetiger 1 with small cirri, and rudimentary cirri in all following chaetigers. *Paranerilla limicola* differs from *P. cilioscutata* not only in ciliation pattern but also on chaetal arrangement. Chaetiger 1 in *P. limicola* presents 13–17 chaetae, but *P. cilioscutata* and *P. schiavettii* present only 14 chaetae in the same chaetiger. On the other hand, in *P. schiavettii* and *P. limicola*, the chaetae on chaetiger 1 are longer in comparison to other chaetigers. Finally, the holotype of *P. schiavettii* presents a maximum body width at chaetiger 4, but this characteristic is variable among specimens of *P. schiavettii*, with chaetiger 4 commonly similar to other chaetigers in some paratypes.

Key to species of *Paranerilla* Jouin & Swedmark, 1965

1. Acicular spine absent 2
 – Acicular spine present *P. schiavettii* sp. nov., South Atlantic
2. Dorsal surface densely ciliated. *P. cilioscutata* Worsaae & Kristensen, 2003, Arctic Sea
 – Dorsal surface weakly ciliated *P. limicola* Jouin & Swedmark, 1965, North Sea

Discussion

The current valid species are specifically recorded from the Northern Hemisphere. However, this work presents the first record of the genus in South Atlantic sediments, expanding its distribution. *Paranerilla schiavettii* sp. nov. is unique among currently described species of *Paranerilla* by the presence of a single apically pointed acicular chaetae from chaetigers 3 to 7. Also, the ciliation pattern of both dorsal and ventral surfaces of the body clearly differentiates this species from the two already described species that were mentioned above. Future research should address efforts on the performance of molecular studies, in order to compare the differences among species and to provide important information to the comprehension of Nerillidae phylogeny. Finally, novel sampling projects in areas without any record of species of *Paranerilla* (Antarctic, Pacific and Indian Oceans) should reveal relevant information about its biogeography and diversity.

Author contribution statement

AER conceived the project elaboration and curated the analyzed material, initially maintained at family and genus level after sampling. JCR was responsible for the material identification and specimen's measurements and SLSDM elaborated the description, illustrations, and the manuscript.

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