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Two new species and a new record of Scale-worms (Polychaeta) from Southwest Atlantic deep-sea coral mounds

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Abstract

Two new species of scale-worms, *Harmothoe ruthae* sp. nov. (Polynoidae) and *Pholoides sinepapillatus* sp. nov. (Sigalionidae) are described. In addition, we expand the description of *Harmothoe gilchristi* and extend its distribution to the Southwest Atlantic. The three species were found among the species of corals *Lophelia pertusa*, *Solenosmilia variabilis*, *Enallopsammia rostrata*, *Madrepora oculata* and *Errina* sp., a total of 257 samples of these corals were taken between 570 m and 1040 m depth, at the North-East coast of Rio de Janeiro, Brazil.

Key words: Deep-sea coral, *Enallopsammia rostrata*, *Lophelia pertusa*, *Solenosmilia variabilis*, *Harmothoe*, Polynoidae, *Pholoides*, Sigalionidae, Pholoidae

Introduction

The deep-sea is a very interesting environment for the study of adaptation and biodiversity. The deep-sea bottoms include a variety of habitats, including a variety of extremes such as cold seeps and hydrothermal vents (Grassle 1985; Dover *et al*. 2002; Howe 2008), whale fall (Baco & Smith 2003; Rouse *et al*. 2004; Wiklund *et al*. 2009), coral reefs (Rogers 1999; Buhl-Mortensen & Mortensen 2004; Cordes *et al*. 2008; Lessard-Pilon *et al*. 2010) and coral mounds (Roberts *et al*. 2006; Henry & Roberts 2007; Mastrototaro *et al.* 2010).

Polychaetes are amongst the most abundant animals in cold water coral reefs (Cordes *et al*. 2008), often playing important roles in the protection and cleaning of the reefs, as reported for *Eunice norvegica* (Linnaeus, 1767) (Mortensen 2001), or producing new reefs through the aggregation of coral fragments with their tubes (Roberts 2005). Other polychaetes, such as the polynoids are often found in association with antipatharian, gorgonian, scleractinian and stylasterid species (Pettibone 1991 a, b, Fiege & Barnich 2009). Those associations are still poorly understood, and new studies on the association of polychaetes with deep-water cnidarian species are needed to clarify the knowledge of the polychaetes-reefs interaction.

Surveys of the Campos Basin off southeast Brazil have evidenced the presence of several coral mounds (Vianna *et al*. 1998; Cavalcanti *et al*. in press), in which the most common species of corals are *Lophelia pertusa* (Linnaeus, 1758), *Solenosmilia variabilis* (Duncan, 1873), *Madrepora oculata* Linnaeus, 1758 and *Enallopsammia rostrata* (Pourtalès, 1878) (Cavalcanti *et al*. in press). Those species have a complex tridimensional arrangement of branches, which creates a potential habitat for other animals, providing a shelter from marine currents and predators, thus serving as a biodiversity amplifier (Rogers 1999; Fossa *et al*. 2002; Cordes *et al*. 2008; Bongiorni *et al*. 2010).

The studies of polychaetes from the Brazilian deep-sea environments are still in the beginning, concerning basically on the description of species (Barroso & Paiva 2008, 2011; Lavrado & Viana 2007; Lavrado & Brasil 2010; Padovanni & Amaral 2013). One group of these worms that has not been dealt with more extensively is the *s*cale-worms group. There are few studies of this group and the last revisions of were made by Lana (1991) and Amaral & Nonato (1982, 1984). Although their systematic is often problematic, it is possible to foresee that the species richness occurs between Argentina and Brazil may be higher than presently recognized (Barnich *et al*.

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2012). In this paper we describe two new species of scale-worms one from family Polynoidae and other from family Sigalionidae. We also register the occurrence of *Harmothoe gilchristi* Day, 1960 for the Southwestern Atlantic.

Material and methods

The material analyzed in this work was obtained using a Remotely Operated Vehicle (ROV) at the Campos Basin, an area of over 100,000 km^2 that represents one of the most important Brazilian offshore petroliferous provinces. The Campos Basin is located on the Brazilian continental margin, between 20.5° S (Vitoria High) and 24° S (Cabo Frio High) (Figure 1). The continental slope in this area is 100 km from the coastline and extends 40 km down-slope from the shelf-break (130 m isobath) down to 2,000 m depth, with an average gradient of 2.5° (Viana *et al*. 1998; Cavalcanti *et al*. in press.).

The surveying projects are CAP-BC—Campos Basin Deep-sea Corals Assessment Project, with three campaigns carried out between 2004–2007 and ECOPROF—Deep-Sea Ecosystems Project, between 2008–2011 with 14 campaigns. Both conducted by the research & development center of the Brazilian energy company Petrobras. On each project, samples of the following corals and their associated fauna were collected: *Lophelia pertusa*, *Madrepora oculata*, *Enallopsammia rostrata*, *Solenosmilia variabilis* and a hydrocoral *Errina* sp. The samples (fragments) were fixed in a combination of formaldehyde and borax, in a concentration of 10%, without any anesthesia process.

The polychaetes were manually separated from the corals and identified using a Zeiss Discovery V8 stereomicroscope and an Olympus BX40 microscope. All drawings were made with the aid of a camera lucida attached to the Zeiss V8 stereomicroscope and to a Wild M20 microscope. All photographs were made using a Sony Cybershot W350. Eleven scale-worms samples were found isolated from any corals, probably because they fell off or left the corals during transportation in the ROV. All specimens were deposited in the *Edmundo Ferraz Nonato* collection located at the Instituto de Biologia of the Universidade Federal do Rio de Janeiro (IBUFRJ) in the State of Rio de Janeiro, Brazil.

Parapodia and elytra were mounted on permanent slides using mounting media as the Gray & Wess (Humason 1979) for elytra, and Hoyer´s for parapodia. Specimens submitted to scanning electron microscope (SEM) were dehydrated following the procedures described by Kirk Fitzhugh (*pers. com.*): first dehydrate through a graded ethanol (EtOH) series; then replace EtOH for Hexamethyldisilazane (HMDS) through a graded series, and finally evaporation of HMDS. After this procedure the specimens were covered with gold-palladium and examined in a JEOL JSM-6390LV.

Measurements were done in all specimens: the length was taken from the anterior most portion of the prostomium to the posterior most portion of the pigidial segment; the width was taken from the segment located at the middle of the body, from the tip of one parapodium to the other (not considering the chaetae).

Results

The 63 specimens of scale-worms found in the 257 coral samples analyzed belongs to three species: *Harmothoe ruthae* sp. nov, *Harmothoe gilchristi* Day, 1960 and *Pholoides sinepapillatus* sp. nov. (Table 1).

TABLE 1. Associations observed between coral species and scaled worms.

	Harmothoe ruthae sp. nov.	*Harmothoe gilchristi*	*Pholoides sinepapillatus sp. nov.*
S. variabilis	7	16	2
Errina sp.	1	4	2
L. pertusa	4	9	
M. oculata	1	1	
E. rostrata	3	13	
Totals	16	43	4

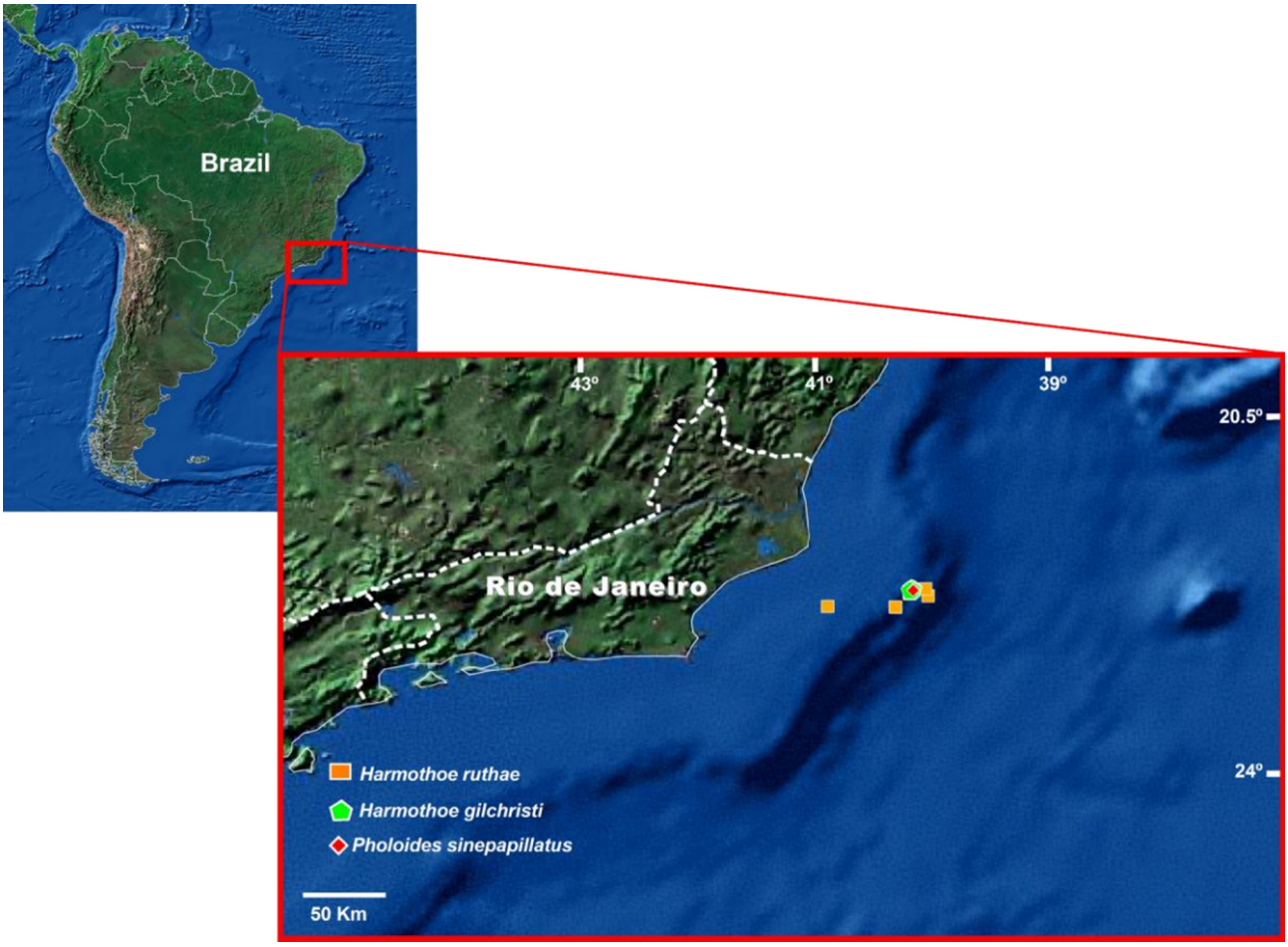

FIGURE 1. Study area of ECOPROF and CAP-BC projects with occurrence of the species herein described.

Systematics

Family: Sigalionidae Kinberg, 1856

Genus: *Pholoides* Pruvot, 1895

Type species: *Pholoe dorsipapillata* Marenzeller, 1893.

Diagnosis: Prostomium subtriangular, with ceratophore of median antenna on anterior border, without lateral antennae; tentaculophores of segment 1 with a bundle of notosetae and single tentacular cirrus. Parapodia biramous. Middorsum not covered by elytra, with or without scattered adhesive tubercles. Elytra on segments 2, 4, 5, 7, continuing on alternate segments to the end of the body, thick, with concentric rings and numerous long border papillae. Segments up to 48.

***Pholoides sinepapillatus* sp. nov.**

Figures: 2 A–E; 3 A–K

Material Examined: 4 spms.; HOLOTYPE: 2 spms., IBUFRJ-2131, ECOPROF 9, 639 m, 40º5'45,06"W–22º22'41,48"S, 22/12/2008, on *Solenosmilia variabilis*. PARATYPES: 2 spms., IBUFRJ-2130, ECOPROF 10, 622 m, 40º5'39,24"W–22º22'3,21"S, 17/01/2009, on *Errina* sp.

Diagnosis: Prostomium globular, with two pair of eyes. Lips of the mouth, the surface of the elytra and the ventral surface of the body smooth. Biramous parapodia with noto- and neuropodium of the same size. Elytra with faint concentric rings easily observed by transparency.

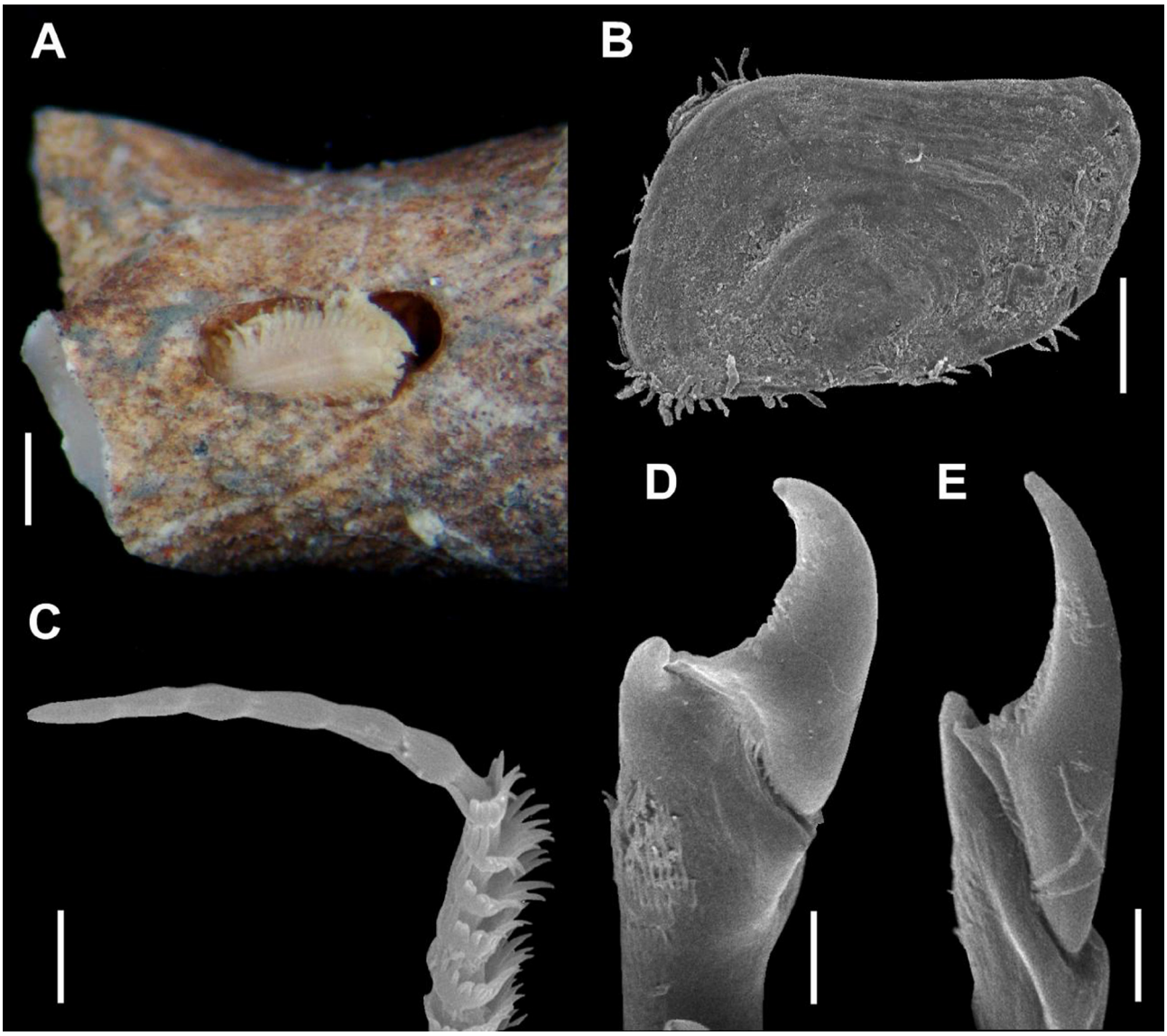

FIGURE 2. *Pholoides sinepapillatus* sp. nov. (A) View of the Holotype in a hole on dead *Solenosmilia variabilis*; (B) SEM of the dorsal surface of middle right elytra; (C) Detail of the tip of a notochaeta from a middle parapodium; (D) Blade and distal shaft of upper neurochaeta; (E) Blade and distal shaft of lower neurochaeta. (Scales bars: A=1 mm; B=200 µm; C, D, E= 10 µm).

Description: Holotype with 36 segments (length: 5.07 mm; width 0.7 mm); paratypes with number of chaetigers varying from 27 (length: 2.6 mm; width: 0.6 mm) up to 35 (length: 4.62 mm; width 0.7 mm).

Body dorsoventrally flattened, dorsal and ventral surfaces without papillae or tubercles (Fig. 2A). Prostomium and tentacular segment fused (Fig. 3A). Prostomium globular, as wide as long, one pair of eyes; antenna with ceratophore at anterior margin of prostomium, style papillate and inflated subdistally, 1.5 times longer than prostomium. First segment anterior and lateral to prostomium (Fig. 3B), parapodia uniramous with notoacicula not extending beyond epidermis and without papillae on the ventral side; each parapodia with bundle of long, serrate capillary chaetae (Fig. 3C–D); dorsal cirrus (Fig. 3E) length similar to median antenna, and a stout ventral palp.
Elytra on bulbous elytrophores on segments 2, 4, 5, 7, continuing on alternate segments to end of body; last two segments without elytra or dorsal tubercles. Elytra large, thick, subtriangular (Fig. 3F) to reniform (Fig. 3G), papillae on margins not covered by adjacent elytra; smooth surfaces and faint concentric rings visible (Figs. 2B). Segments without elytra with small dorsal tubercles (Fig. 3A).

Second segment with biramous parapodia (Fig. 3H), one acicula per ramus, not extending beyond epidermis; ventral cirri with short, papillate cirrostyles. Notochaetae (Figs. 2C; 3C–D) capilliform, curved and serrate. Neurochaetae compound (Figs. 2D–E; 3I–J), supracicular shorter than subacicular; shafts and blades of supracicular neurochaetae smooth; shafts of subacicular neurochaetae subdistally spinose, blades serrate and longer than blades of supracicular neurochaetae.

Remaining parapodia biramous (Fig. 3K); notopodia as long as neuropodia, distally rounded to subconical, with serrate capilliform notochaetae (Figs. 2C; 3C–D) and notoaciculae slightly extending beyond epidermis. Neuropodia with compound neurochaetae of two kinds: supracicular smaller than subacicular, shafts and blades of supracicular smooth; shafts of subacicular subdistally spinose, blades serrate and longer than supracicular (Figs. 2D–E; 3I–J); neuroaciculae not extending beyond epidermis, each neuroacicular lobe with small digitiform process near distal end of acicula. Ventral cirri present, with few short papillae on cirrostyles (Fig. 3K).

Etymology: The name of the species refers to the fact that it doesn´t have papillae over the dorsal and ventral surfaces of the body, neither over the surface of the elytra, as observed in the other species of the genera.

Habitats: Associated with *Solenosmilia variabilis* and Dendrophiliidae corals, in a depth range from 600m to 640m.

Remarks: *P. sinepapillatus* sp. nov. differs from the other two recognized species of *Pholoides* by having smooth ventral and dorsal surfaces: papillae are present on the ventral surface of the body of the two other *Pholoides* species (*P. dorsipapillatus* (Marenzeller, 1893) and *P. asperus* (Johnson, 1897)). The surface of the buccal lips differs among the three species. While *P. dorsipapillatus* has papillae over the ventral lip and *P. asperus* both lips papillated, *P. sinepapillatus* sp. nov. has both lips smooth. Additionally specimen of *P. sinepapillatus* sp. nov. did not show papillae on the dorsal tubercle, as is observed in the other two species of *Pholoides*. As in *P. dorsipapillatus, P. sinepapillatus* sp. nov. did not show papilla on the ventral side of the first segment, while this papilla is present in *P. asperus.*

In both species already described, the elytra show papillae on the dorsal surface, while *P. sinepapillatus* sp.nov. has smooth dorsal and ventral surface of elytra. Pettibone (1992) already emphasized the presence of knobbed papillae near the margins and middle region of elytra in *P. asperus*. While *P. asperus* presents strongly marked concentric rings, *P. sinepapillatus* sp. nov. and *P. dorsipapillatus*, show faintly marked concentric rings.

According to the description provided by Pettibone (1992) for *P. dorsipapillatus, P. sinepapillatus* sp.nov. is not significantly different regarding the parapodium and the compound chaetae. Both species present noto- and neuropodium almost with the same size; upper neurochaetae with blades longer than lower neurochaetae, presenting faintly spinose or smooth, and the shafts can be smooth or subdistally spinose. But when compared with *P. asperus* some differences can be noticed such as the notopodium in *P. asperus,* that is smaller than the neuropodium and presents a pair of papillae in the presetal lobe and postsetal lobe covered with papillae; the neurochaetae of *P. asperus* differ from *P. sinepapillatus* sp.nov. by having larger and serrated blades and a longer spinose shaft.

Another outstanding distinctive character is the number of eyes, while *P. dorsipapillatus* and *P. asperus* show two pairs of eyes*, P. sinepapillatus* sp.nov. has only one pair of eyes situated on the widest part of the prostomium. *Pholoides mendeleevi* (Averincev 1978) was illustrated with one pair of eyes (Fig. 8: 76–80 p. 69), so this would not be the first register of *Pholoides* presenting this character, which is not mentioned by Pettibone (1992) in her revision of the genus. We believe that the presence of at least one pair of eyes could be used as a basic characteristic of the genus *Pholoides*.

Pholoides sinepapillatus sp.nov. is not the first species of *Pholoides* recorded for Brazilian waters. Sumida *et. al* (2004) reported *P. asperus* occurring in seabed pockmarks at Santos Basin, off the coast of São Paulo (26ºS; 46ºW) at a depth of almost 700m. Pinto (2014) also reported another species of *Pholoides* for Brazil, however the species described by her possess oval prostomium, first segment with prominent ventral papilla, body surface presenting papillae, elytra with faint concentric rings and notopodia smaller than neuropodia; instead of the global prostomium, first segment without ventral papilla, elytra with strongly marked concentric rings and noto- and neuropodia with the same size, as observed in *Pholoides sinepapillatus* sp.nov. described herein.

Distribution: Southwest Atlantic, currently known only from the type locality, Campos Basin, State of Rio de Janeiro , Brazil.

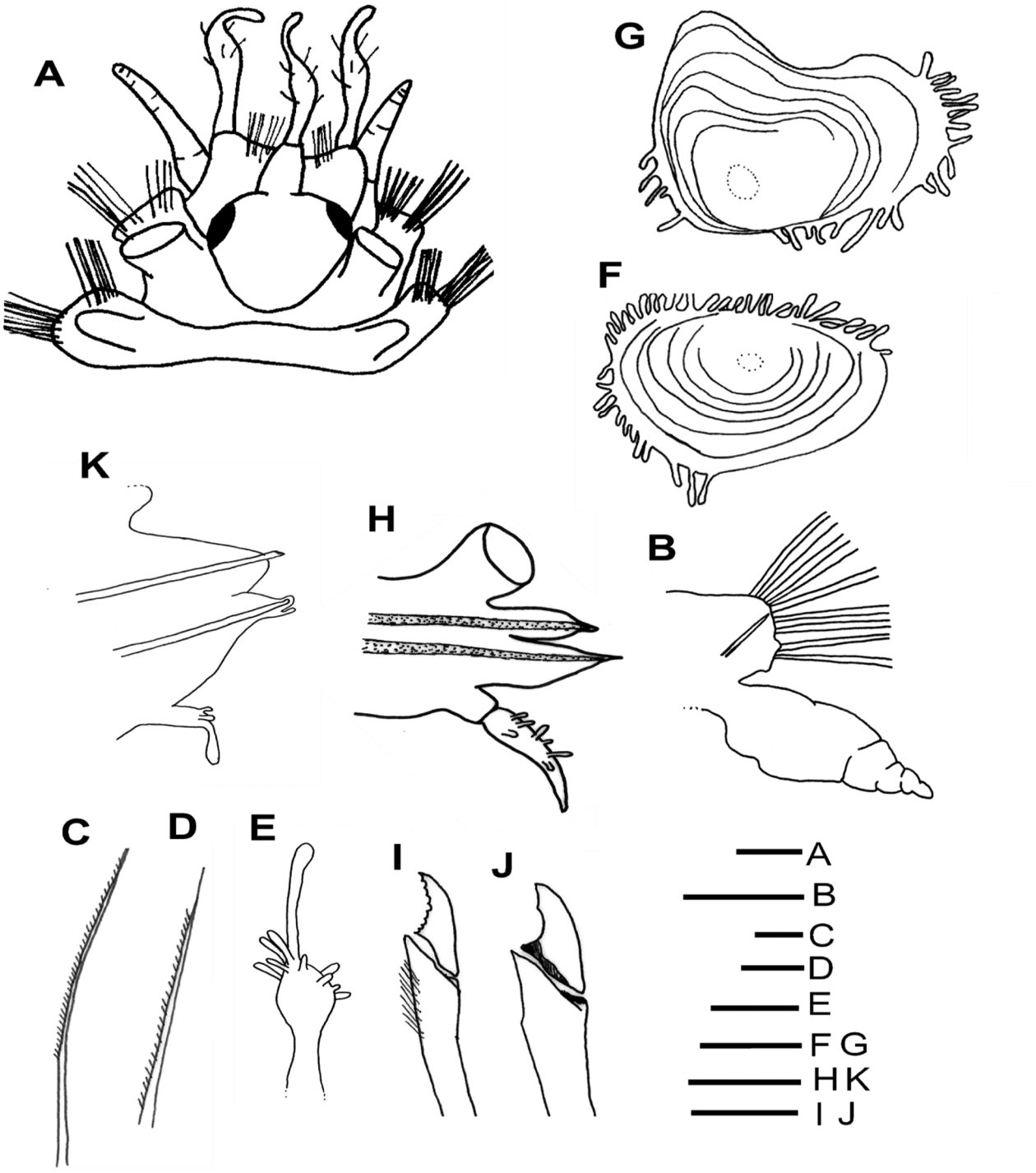

FIGURE 3. *Pholoides sinepapillatus* sp. nov. (Holotype, IBUFRJ-3121) (A) Dorsal view of the anterior end; (B) Tentaculophore from right side (without dorsal cirrus); (C) Notochaeta; (D): Tip of same; (E) Style of dorsal cirrus of tentaculophore; (F) First elytra, right side; (G) Middle elytra, right side; (H) Parapodium from second segment; (I) Lower compound neurochaeta; (J): Upper compound neurochaeta; (K) Left middle elytrigerous parapodium. (Scales bars: A= 500 µm; B= 250 µm C= 50 µm, D, I and J= 150 µm and E= 75 µm; F, G, H and K = 300 µm).

Family Polynoidae Kinberg, 1856

Subfamily: Polynoinae Kinberg, 1856

Type genus: *Harmothoe* Kinberg, 1856

Type species: *Harmothoe spinosa* Kinberg, 1856

Diagnosis (according to Barnich & Fiege 2003): Body flattened dorsoventrally, short, up to 50 segments, more or less covered by elytra or short tail uncovered (large specimens). Elytra, 15 pairs present on segments 2, 4, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 26, 29, 32. Prostomium with distinct cephalic peaks and three antennae; lateral antennae with ceratophores inserted ventrally to the median antennae; two pairs of eyes, anterior pair dorsolaterally on widest part of prostomium or anteroventrally beneath cephalic peaks, posterior pair dorsally near hind margin of prostomium. Parapodia biramous, noto- and neuropodia with elongate acicular lobe; tips of noto- and neuroacicula penetrating epidermis; neuropodia with digitiform supra-acicular process. Notochaetae all similar, stout, with numerous rows of spines and blunt tips; neurochaetae more slender, distal region falcate with numerous rows of spines, tips bi- and unidentate. Nephridial papillae visible from segment 5 or 6 onwards.

***Harmothoe gilchristi* Day, 1960**
Figures: 4 A–K; 5 A–C

Harmothoe gilchristi Day, 1960: 275–277, fig. 1a–f. Day 1967: 68, fig. 1.10A–E. Barnich & Fiege 2000: 1922–1924, fig. 17A–D. Barnich & Fiege 2003: 43–45, fig. 19A–D.

Material examined: 43 spms. , 1 spm., IBUFRJ-2123, CAP-BC, 870 m, 39º 59' 30,33"W–22º 22' 17,79"S, 11/04/2004, on *Solenosmilia variabilis*; 3 spms., IBUFRJ-2128, CAP-BC, 867 m, 39º59'17,32"W–22º21'54,38"S, 13/07/2005, on *Lophelia pertusa*; 3 spms., IBUFRJ-2115, CAP-BC, 1040 m, 39º58'2,46"W–22º25'25,72"S, 23/07/2005, on *Lophelia pertusa*; 1 spm., IBUFRJ-2127, CAP-BC, 747 m, 40º49'49,47"W–22º30'52,33"S, 17/03/2006, on *Lophelia pertusa*; 4 spms., IBUFRJ-2119, ECOPROF 1, 603 m, 40º 10' 33,33"W–22º 30' 16,96" S, 28/01/2008, on *Errina* sp.; 7 spms., IBUFRJ-2120, ECOPROF 1, 617m, 40º 6' 5,13"W–22º 22' 36,31"S, 28/01/2008, on *Enallopsammia rostrata*; 5 spms., IBUFRJ-2122, ECOPROF 1, 626 m, 40º 6' 17,48"W–22º 22' 34,34"S, 29/01/2008, on *Enallopsammia rostrata*; 2 spms., IBUFRJ-2124, ECOPROF 2, 747 m, 40º10'33"W–22º37'53"S, 10/06/2008, on *Lophelia pertusa*; 1 spm., IBUFRJ-2114, ECOPROF 3, 608 m, 40º6'11,55"W–22º22'30,79""S, 05/07/2008, on *Madrepora oculata*; 3 spms., IBUFRJ-2117, ECOPROF 4, 612 m, 40º 6' 11,04"W–22º 22' 33,53"S, 05/08/2008, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2102, ECOPROF 5, 603 m, 40º6'11,42"W–22º22'31,77"S, 01/09/2008, on *Solenosmilia variabilis*; 2 spms., IBUFRJ-2121, ECOPROF 6, 608 m, 40º7'21,81"W–22º22'59,31"S, 26/09/2008, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2110, ECOPROF 7, 609 m, 40º6'18,81"W–22º22'24,43"S, 25/10/2008, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2113, ECOPROF 8, 606 m, 40º6'17,87"W–22º22'24,44"S, 21/11/2008, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-1974, ECOPROF 9, 639 m, 40º5'45,06"W–22º22'41,48"S, 22/12/2008, on *Solenosmilia variabilis*; 2 spms., IBUFRJ-2104, ECOPROF 10, 613 m, 40º5'42,21"W–22º22'3,02"S, 17/01/2009, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2116, ECOPROF 11, 608 m, 40º7'35,34"W–22º24'13,33"S, 14/02/2009, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2118, ECOPROF 11, 603 m, 40º7'20,69"W–22º22'58,22"S, 14/02/2009, on *Solenosmilia variabilis*; 2 spms., IBUFRJ-2111, ECOPROF 12, 628 m, 40º6'47,32"W–22º22'53,31"S, 13/03/2009, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2126, ECOPROF 13, 626 m, 40º6'45,87"W–22º22'59,21"S, 23/04/2009, on *Enallopsammia rostrata*.

Diagnosis: Prostomium bilobed, with two pair of eyes: the anterior pair situated dorsolaterally at the widest part of prostomium and posterior pair at the hind margin of prostomium. Anterior margin of elytra with digitiform papillae, surface covered mainly by conical microtubercles in anterior part, becoming gradually larger and club-shaped towards the posterior margin. Parapodia biramous; notochaetae shafts with several rows of spines and a blunt tip; all neurochaetae bidentate and presenting rows of spines on the distal half of it.

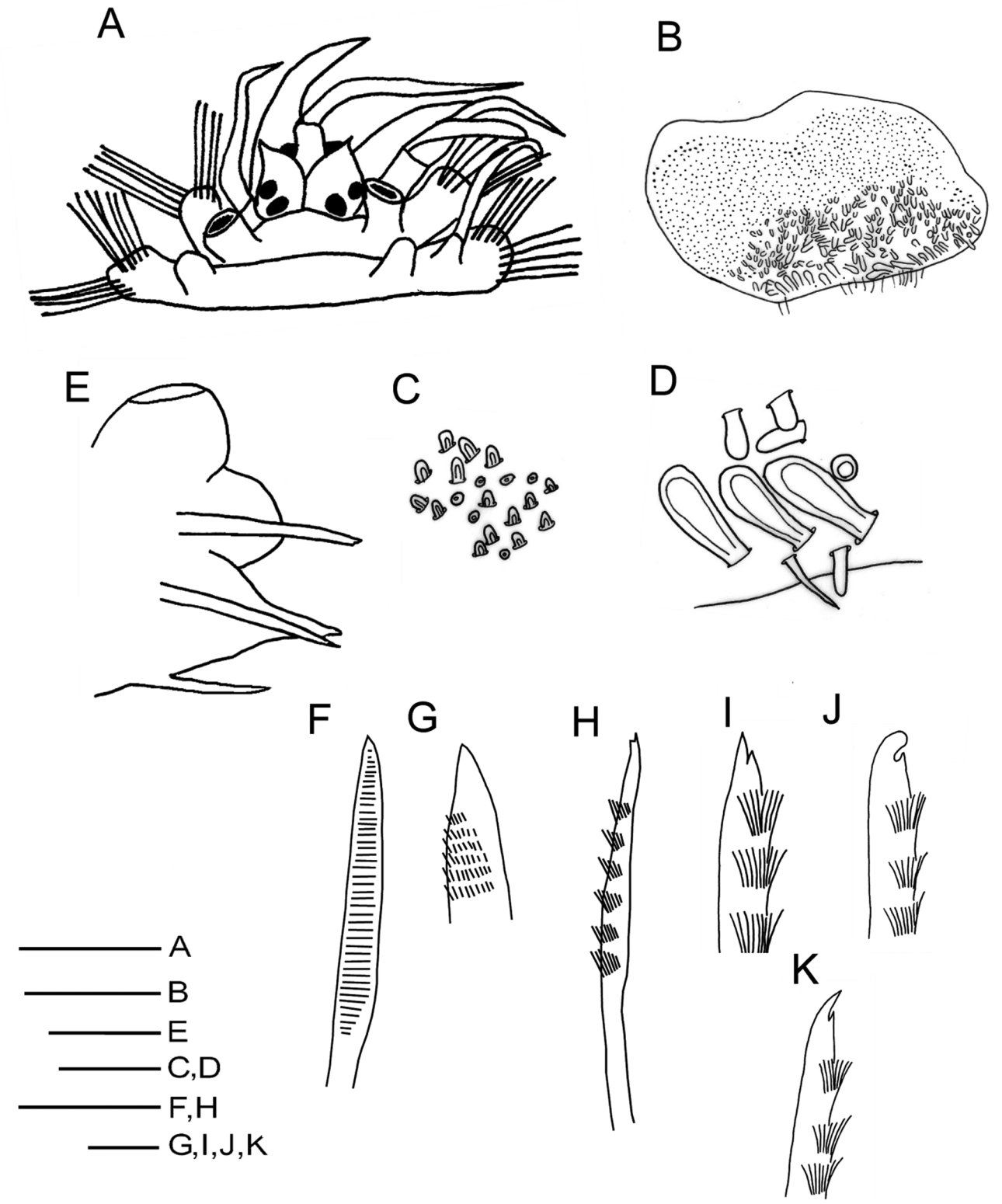

FIGURE 4. *Harmothoe gilchristi*. (A) Dorsal view of the anterior end; (B) Middle elytron, right side; (C) Small conical microtubercles; (D) Club-shaped microtubercles; (E) Left middle elytrigerous parapodium; (F) Notochaeta; (G) Tip of same; (H) Bidentate neurochaeta; (I) Tip of lower neurochaeta; (J) Tip of middle neurochaeta; (K) Tip of upper neurochaeta (Scales bars: A: 1 mm; B, C, D: 150 µm; E: 400 µm; F, H: 200 µm; G, I, J, K: 20 µm).

Description: Specimens varying in size from 32 segments (length: 09 mm; width 04 mm) up to 46 segments (length: 24 mm; width: 07 mm), but the majority of specimens with 42 segments. Prostomium bilobed (Fig. 4A), with distinct cephalic peaks; median antenna missing or detached in many specimens, in all of them the ceratophore is inserted in anterior notch; lateral antennae inserted ventrally, styles with few small papillae over the surface and abruptly tapering, subdistally, to a filliform tip. Anterior pair of eyes situated dorsolaterally at the widest part of prostomium, posterior pair situated dorsally at hind margin of prostomium. Palps ventrolaterally inserted, with pointed tips. Tentaculophores inserted laterally to prostomium, each presenting two or three notochaetae; dorsal and ventral cirrus also present, styles with small papillae, tapering distally to a filliform tip. Second segment (Fig. 4A) with the first pair of elytra, parapodia biramous and long buccal cirri. Following segments present a tapering ventral cirrus in the parapodia.

Fifteen pairs of elytra, covering dorsum, on segments 2, 4, 5, 6, 7, and on alternating segments until segment 23, then on segments 26, 29 and 32, last segments cirrigerous. Elytra (Fig. 4B) presenting posterior margin with digitiform papillae, surface covered mainly by conical microtubercles (Fig. 4C) in anterior part of elytra, becoming gradually larger and club-shaped towards the posterior margin (Fig. 4D). Segments without elytra present a distinct dorsal tubercle and a dorsal cirrus, cirrostyles sparsely papillate.

Parapodia biramous (Fig. 4E); notopodia and neuropodia with elongate acicular lobe, neuropodia presenting a digitiform supra-acicular process; tips of notoacicula and neuroacicula extending beyond epidermis. Notochaetae stouter than neurochaetae, with distinct rows of spines and blunt tips (Figs. 4 F–G). All neurochaetae with distinct rows of spines and bidentate tips (Fig. 4H–K), the lower neurochaetae with both teeth not curving, they can be of the same size or one smaller than the other (Figs. 4I, 5A); middle neurochaetae with curved and blunt primary tooth (Figs. 4J, 5B); upper neurochaetae with curved and pointed primary tooth (Figs. 4K, 5C).

Remarks: This species was previously identified as *Lagisca floccosa* Augener, 1906 by Brasil *et al*. (2007), but *Lagisca* was later considered a junior synonym of *Harmothoe* by Pettibone (1953) and Barnich & Fiege (2000), which would mean that the species identified as *L. floccosa* should be treated as *H. floccosa.* However, a detailed analysis of this species and of a larger sample of other 38 specimens shows that it does not present macrotubercles over the elytra, revealing that it belongs, instead, to *H. gilchristi*. The misidentification of the specimens may have resulted from the fact that the microtubercles near posterior margin of the elytra are large, which could have been confused with the macrotubercles found in *H. floccosa*.

Of the species of *Harmothoe* already reported for the Brazilian coast by Amaral *et al*. (2013), none of them seems to be like *H. gilchristi*, *H. aculeata* Andrews, 1891, *H. ernesti* Augener, 1931 and *H. macginitiei*, Pettibone, 1955 possess macrotubercles over the surface of the elytra. While *H. lepida* (Amaral & Nonato, 1982) presents the borders of elytra smooth. According to Barnich & Fiege (2003) *H. gilchristi* can be easily confused with *H. goreensis* Augener, 1918, but they differ from each other in the fact that *H. gilchristi* has all neurochaetae bidentate and conical microtubercles which become bigger and club-shaped toward the posterior margin of the elytra, while *H. goreensis* possess uni- and bidentate neurochaetae and only conical and never club-shaped microtubercles over the elytra.

The species *H. gilchristi* was originally described from South Africa (Day 1960, 1967). Its occurrence was later extended to the Northeast Atlantic (Brito *et al*. 1991) and to the Mediterranean Sea (Barnich & Fiege 2000). Here, we provide the first record of the species for the Southwestern Atlantic, occurring at Campos Basin, off Rio de Janeiro, southeast coast of Brazil. All of the specimens were associated with the corals *S. variabilis*, *L. pertusa*, *M. oculata* and *E. rostrata*, with depth range from 605 m to 1040 m.

Habitats: The species was described as associated with cnidarian and algae species (*Isidella sp.*, *Cladocora caespitosa* (Linnaeus, 1767) and *Dendrophyllia ramea* (Linnaeus, 1758)) and also to other substrata (sand grains and rubble). This species was previously recorded living from shallow water down to 845m, now we extend the occurrence of *H. gilchristi* down to 1040m and found it associated with the corals *E. rostrata*, *S. variabilis*, *L. pertusa* and *M. oculata*.

Distribution: Southwest Atlantic (Campos Basin—Brazil), Southeast Atlantic, Northeast Atlantic, and Mediterranean Sea.

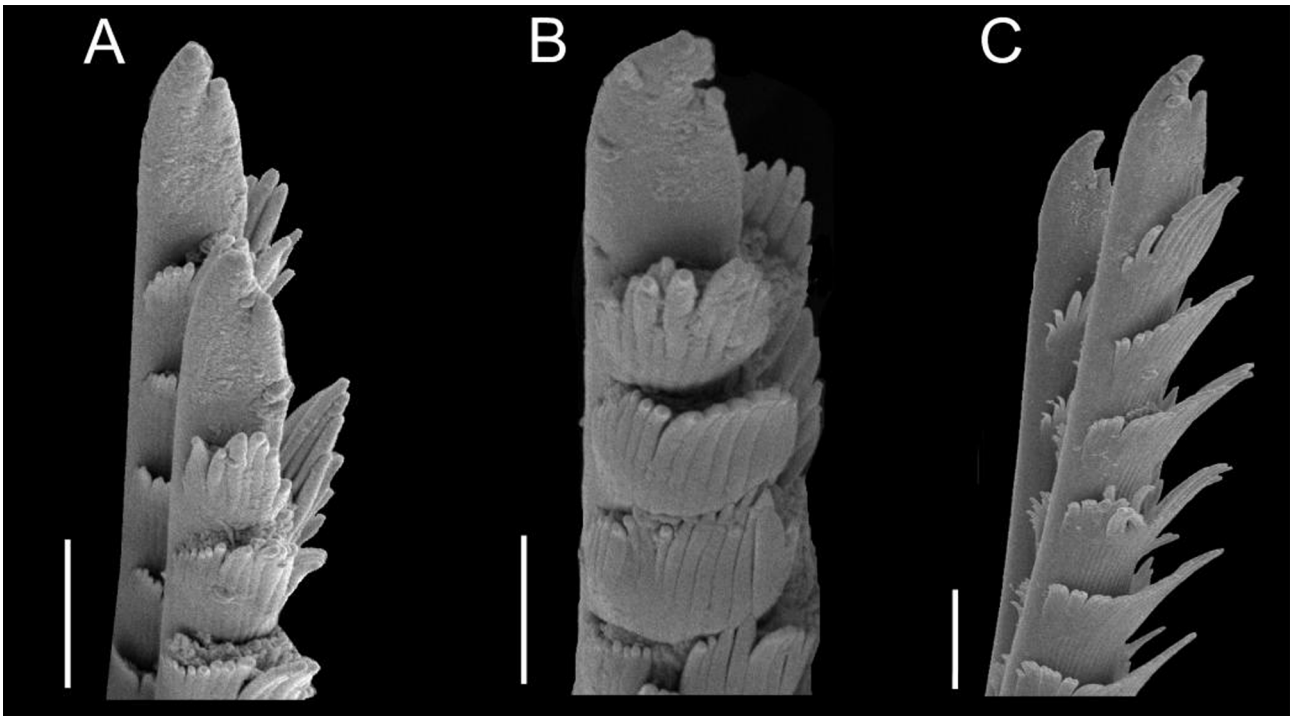

FIGURE 5. *Harmothoe gilchristi* SEM of the neurochaeta. (A) Tip of lower neurochaeta; (B) Tip of middle neurochaeta; (C) Tip of upper neurochaeta (Scales bars: A, B= 10 μm; C= 20 μm).

Harmothoe ruthae **sp.nov.**
Figures: 6 A–J; 7A–C

Material examined: 16 spms. HOLOTYPE: 1 spm., IBUFRJ-2132, ECOPROF 5, 612 m, 40º6'10,36"W–22º22'29,95"S, 01/09/2008, on *Lophelia pertusa*. PARATYPES: 1 spm., IBUFRJ-2134, CAP-BC, 605 m, 40º14'50,56"W–22º31'13,46"S, 17/03/2006, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2146, ECOPROF 2, 622 m, 40º6'11,57"W–22º22'32,97"S, 10/06/2008, on *Lophelia pertusa*; 1 spm., IBUFRJ-2135, ECOPROF 3, 572 m, 40º6'11,45"W–22º24'31,12"S 05/07/2008, on *Enallopsammia rostrata*; 1 spm., IBUFRJ-2145, ECOPROF 5, 608 m, 40º6'16,16"W–22º22'33,75"S, 31/08/2008, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2138, ECOPROF 5, 622 m, 40º6'42,56"W–22º21'50,42"S, 01/09/2008, on *Madrepora oculata*; 1 spm., IBUFRJ-2137 ECOPROF 5, 622 m, 40º6'16,26"W–22º22'33,43"S, 31/08/2008, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2141, ECOPROF 7, 608 m, 40º6'20,74"W–22º22'7,74"S, 25/10/2008, on *Errina* sp.; 1 spm, IBUFRJ-2142, ECOPROF 7, 617 m, 40º6'18,81"W–22º22'24,43"S, 25/10/2008, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2147, ECOPROF 7, 612 m, 40º6'19,30"W–22º22'16,24"S, 25/10/2008, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2136, ECOPROF 9, 701 m, 40º5'46,88"W–22º22'41,33"S, 22/12/2008, on *Lophelia pertusa*; 1 spm., IBUFRJ-2144, ECOPROF10, 605 m, 40º5'39,21"W–22º22'3,21"S, 17/01/2009, on *Enallopsammia rostrata*; 1 spm., IBUFRJ-2148, ECOPROF 10, 636 m, 40º5'39,21"W–22º22'3,21"S, 17/01/2009, on *Enallopsammia rostrata*; 1 spm., IBUFRJ-2143, ECOPROF 11, 617 m, 40º7'35,34"W–22º24'13,33"S, 14/02/2009, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2133, ECOPROF 12, 599 m, 40º6'49,28"W–22º22'53,39"S, 13/03/2009, on *Solenosmilia variabilis*; 1 spm., IBUFRJ-2139, ECOPROF 14, 609 m, 40º7'46,79"W–22º23'35,01"S, 23/05/2009, on *Lophelia pertusa*.

Diagnosis: Rounded to sub-reniform elytra; surface covered by conical microtubercles which become gradually bigger toward the posterior margin, all tubercles with bifid tips. Parapodia biramous; notochaetae shafts with several rows of spines and blunt tip; neurochaetae with rows of spines on the distal half, supra-acicular chaetae with pointed tip, sub-acicular chaetae falcate with bifid tips.

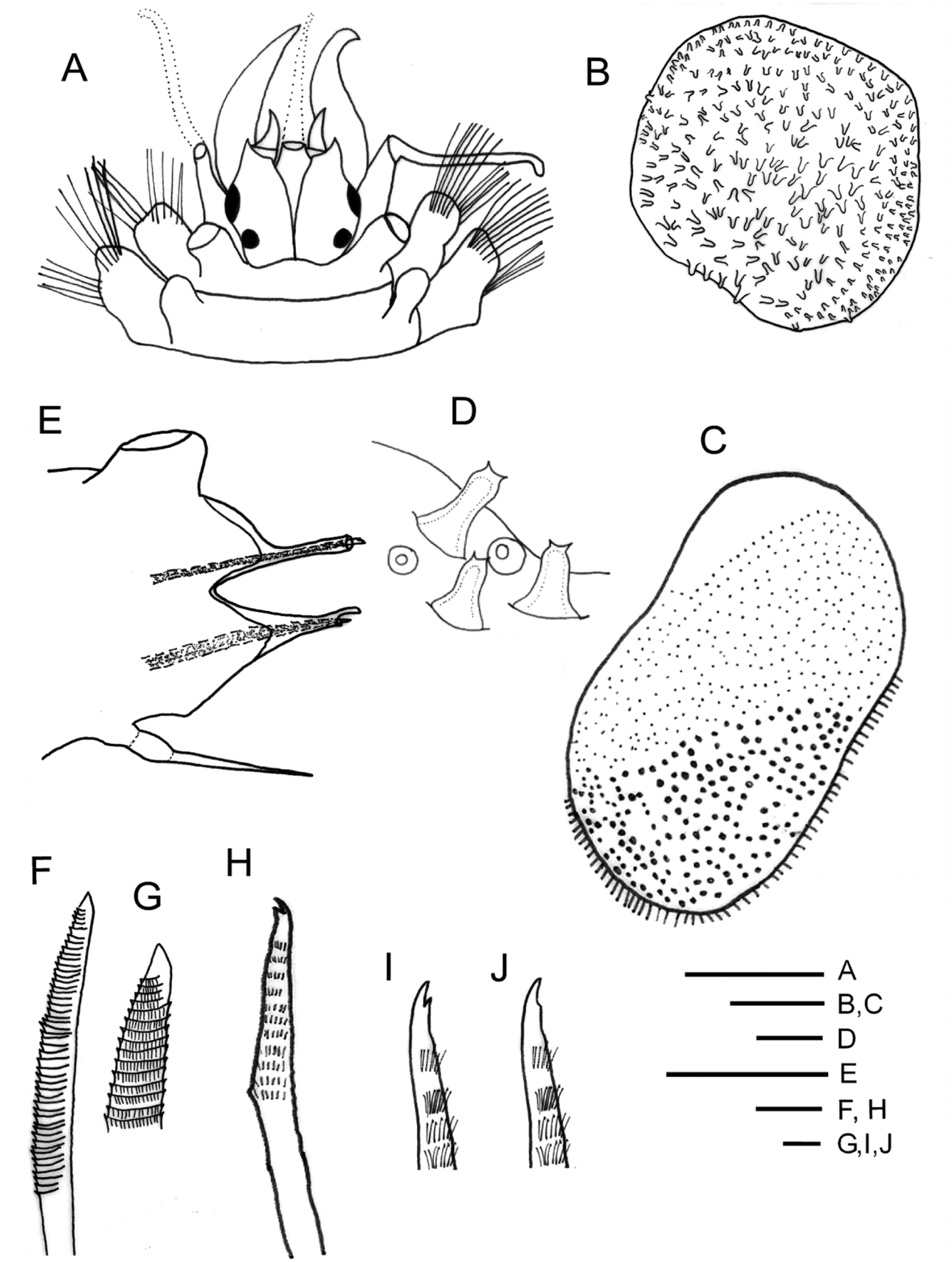

FIGURE 6. *Harmothoe ruthae* sp. nov. (Holotype, IBUFRJ-2132). (A) Dorsal view of the anterior end; (B) first elytron, left side; (C) Middle elytron right side; (D) Right middle parapodium; (E) Detail of microtubercles and posterior margin of elytra; (F) Notochaeta; (G) tip of same chaeta; (H) Bidentate neurochaeta (I) Tip of same chaeta; (J) Tip of unidentate neurochaeta (Scales bars: A= 2 mm; B, C= 200 µm; D= 500 µm; E= 15 µm; F, H= 250 µm; G, I, J= 40 µm).

Description: Holotype with 42 segments (length: 21 mm; width 05 mm); paratypes with number of chaetigers varying from 30 (length: 07 mm; width 03 mm) up to 45 (length: 23 mm; width: 08 mm). Body slightly flattened dorsoventraly. Prostomium bilobed, with distinct cephalic peaks (Fig. 6A). Median antennae missing but ceratophore in anterior notch, lateral antennae inserted ventrally, styles of antennae with smooth surface, tapering to filiform tip. Anterior pair of eyes situated laterally at widest part of prostomium, posterior pair situated dorsally near hind margin of prostomium. Palps ventrolaterally inserted with smooth surface and pointed tips.

Tentaculophores inserted laterally to prostomium, presenting two notochaetae and a pair of dorsal and ventral tentacular cirri, styles of cirri smooth, tapering gradually to filliform tip. Second segment with the first pair of elytra (Fig. 6B), parapodia biramous with a ventral buccal cirri, which is as long as all tentacular cirrus. Following segments present only tapering ventral cirri in the parapodia.

Fifteen pairs of elytra, covering dorsum, on segments 2, 4, 5, 6, 7, on alternating segments until segment 23, then on segments 26, 29 and 32, last ten segments cirrigerous. First pair of elytra nearly circular (Fig 6B), subsequent ones larger and more or less reniform (Fig. 6C). First pair of elytra with margin smooth and surface tubercles from first elytra shows bifid tips (Fig. 6D). Remaining elytra with cirriform papillae on the posterior margin; surface covered by microtubercles which become slightly bigger toward the posterior margin (Fig. 6C). Microtubercles conical shape with bifurcate tips, some of the tubercles, present single tips. Segments without elytra with distinct dorsal tubercle and filliform dorsal cirri with sparsely papillate surface and abruptly tapering tip.

Parapodia biramous (Fig. 6E); notopodia with elongate acicular lobe and neuropodia with elongate prechaetal acicular lobe, bigger than postchaetal, presenting a digitiform supra-acicular process. Tips of notoacicula and neuroacicula penetrating epidermis. Notochaetae stouter than neurochaetae, both with distinct rows of spines; notochaetae with blunt tips (Figs. 6F–G; 7A); neurochaetae mainly with bidentate tips and a distinct secondary tooth (Figs. 6H–I; 7B), a minority, located above, with single tip (Figs. 6J; 7C).

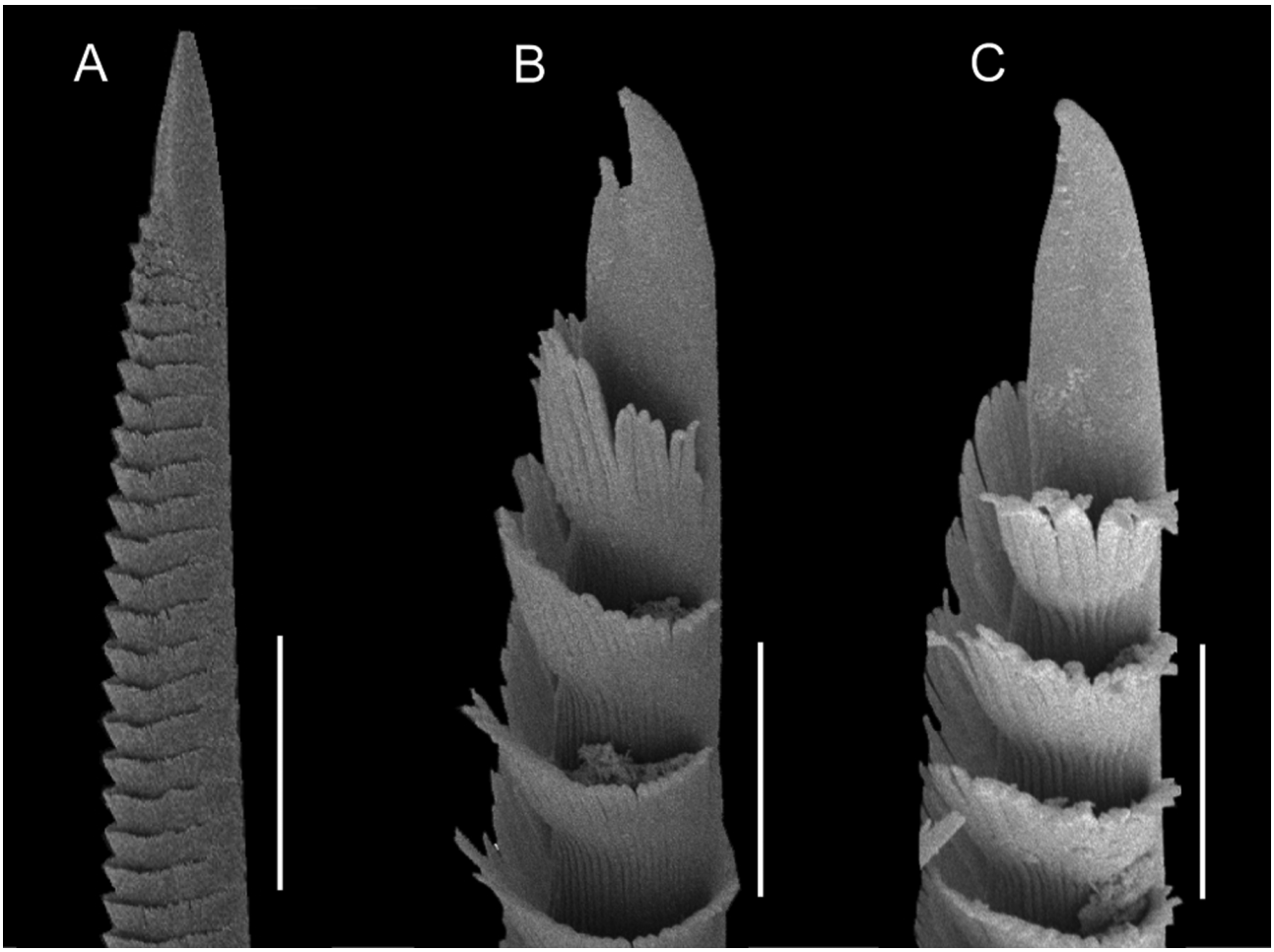

FIGURE 7. *Harmothoe ruthae* sp. nov. chaeta SEM. (A) Notochaeta; (B) tip of lower neurochaeta; (C) tip of upper neurochaeta (Scales bars: A= 100 µm; B, C= 20 µm).

Remarks: Some characters present on the elytra of *H. ruthae* sp.nov. make it distinct from all other species of *Harmothoe* previously reported to Brazil. By possessing only microtubercles and no macrotubercles, *H. ruthae* sp.nov. is distinct from *H. aculeata* Andrews, 1891 and *H. ernesti* Augener, 1931. When *H. ruthae* sp.nov. is compared with *H. lepida* (Amaral & Nonato, 1982), also reported for Brazil, they differ from each other because *H. ruthae* sp.nov. possess microtubercles with bifid tips while *H. lepida* presents conical and single microtubercles. *Harmothoe ruthae* sp.nov. can be differentiated from other species that present microtubercle with bifid tips, such as *H. macginitiei* Pettibone, 1955, *H. propinqua* (Malmgren, 1867) and *H. antilopes* McIntosh, 1876, because those species also present tubercles with other kinds of tips: *H. macginitiei* presents single and quadrifid tips; *H. propinqua* presents quadrifid tips but lacks the single ones; in *H. antilopes* the bifid tips are present, but also are the crown-like and some scattered ones. *Harmothoe discoveryae* Pettibone, 1993 also has microtubercles with bifid tips with different size, but according to the description provided by the author the species presents tubercles with two to five tips; another discriminating characteristic between *H. discoveryae* and *H. ruthae* sp. nov. is the fact that the former possess mottled areas over the elytra and the latter has translucid elytra. Lastly, some elytra may present microtubercles with single tips, possibly these are the oldest ones and one of the tips suffered abrasion.

Etymology: The species epithet is homage to Dr. Ruth Barnich, for her important contributions to the study of the Polynoidae and other scale-worms.

Habitats: Individuals of *Harmothoe ruthae* sp.nov. were collected associated with the coral species *L. pertusa*, *S. variabilis*, *E. rostrata* and the hydrocoral *Errina* sp., at a depth range from 570m to 647m.

Distribution: Southwest Atlantic, currently known only from the type locality, Campos Basin off Rio de Janeiro, Brazil.

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References

Amaral, A.C.Z. & Nonato, E.F. (1982) *Anelídeos Poliquetos da Costa Brasileira. 3. Aphroditidae e Polynoidae.* CNPq, Brasília, 46 pp.

Amaral, A.C.Z. & Nonato, E.F. (1984) *Anelídeos Poliquetos da Costa Brasileira. 4. Polydontidae, Pholoidae, Sigalionidae e Eulepethidae.* CNPq, Brasília, 54 pp.

Amaral, A.C.Z., Nallin, S.A.H., Steiner, T.M., Forroni, T.O. & Gomes, D.F. (2013) Catálogo das espécies de Annelida Polychaeta do Brasil. Available from: http://www.ib.unicamp.br/museu_zoologia/files/lab_museu_zoologia/Cat%C3%A1logo_Polychaeta_Brasil_Amaral_et_al_2013_1a.pdf (accessed 29 August 2013)

Andrews, E.A. (1891) Report upon the Annelida Polychaeta of Beaufort, North Carolina. *Proceedings of the United States National Museum*, 14 (852), 277–302.
http://dx.doi.org/10.5479/si.00963801.14-852.277

Augener, H. (1906) Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico and the Caribbean Sea, and on the east coast of the United States, 1877 to 1880, by the U.S. Coast Survey Steamer Blake, Lieut. Commander C.D. Sigsbee, U.S.N., and Commander J.R. Bartlett, U.S.N. commanding. 42. Westindische Polychaeten. *Bulletin of the Museum of Comparative Zoology,* 43 (4), 91–196.

Augener, H. (1918) Polychaeta. *Beitrage zur Kenntnis der Meeresfauna Westafrikas*, 2 (2), 67–625.

Augener, H. (1931) Die bodensässigen Polychäten nebst einer Hirudinee der Meteor-Fahrt. *Mitteilungen der Zooologisches Staatinstitut und zoologisches Museum, Hamburg,* 44, 279–313.

Averincev, V.G. (1978) The Polychaetous Annelids of the Aphroditiformia of the Shelf and Upper Bathyal of Australian and New Zealand Region and of Macquarie Island (on the Base Data of 16th Cruise of R/V DM. Mendeleev). *Transactions of the P.P.Shirov Institute of Oceanology Academy of Sciences of the USSR, Moscow,* 113, 51–72.

Baco, A.R. & Smith, C.R. (2003) High species richness in deep-sea chemoautotrophic whale skeleton communities. *Marine Ecology - Progress Series,* 260, 109–114.
http://dx.doi.org/10.3354/meps260109

Barnich, R., Orensanz, J.M. & Fiege, D. (2012) Remarks on some scale worms (Polychaeta, Polynoidae) from the Southwest Atlantic with notes on the genus Eucranta Malmgren, 1866, and description of a new Harmothoe species. *Marine Biodiversity*, 42 (3), 395–410.
http://dx.doi.org/10.1007/s12526-012-0117-4

Barnich, R. & Fiege, D. (2000) Revision of the Mediterranean species of Harmothoe Kinberg, 1856 and Lagisca Malmgren, 1865 (Polychaeta: Polynoidae: Polynoinae) with descriptions of a new genus and a new species. *Journal of Natural History*, 34 (10), 1889–1938.
http://dx.doi.org/10.1080/00222930050144783

Barnich, R. and Fiege, D. (2003) *The Aphroditoidea (Annelida: Polychaeta) of the Mediterranean Sea.* Abhandlungen der Senckenbergischen Naturforschende Gesellschaft, Frankfurt a. M., 167 pp.

Barroso, R. & Paiva, P.C. (2008) A new deep sea species of *Paramphinome* (Polychaeta: Amphinomidae) from southern Brazil. *Journal of the Marine Biological Association of the United Kingdom*, 88, 743–746.
http://dx.doi.org/10.1017/S0025315408001549

Barroso, R. & Paiva, P.C. (2011) A new deep-sea species of *Chloeia* (Polychaeta: Amphinomidae) from southern Brazil. *Journal of the Marine Biological Association of the United Kingdom*, 91, 419–423.
http://dx.doi.org/10.1017/S0025315410001499

Bongiorni, L., Mea, M., Gambi, C., Pusceddu, A., Taviani, M. & Danovaro, R. (2010) Deep-water scleractinian corals promote higher biodiversity in deep-sea meiofaunal assemblages along continental margins. *Biological Conservation*, 143, 1687–1700.
http://dx.doi.org/10.1016/j.biocon.2010.04.009

Brasil, A.C.S., Paiva, P.C., Cavalcanti, G.H. & Fernandez, M.P.C. (2007) *Deep-sea polychaetes associated with coral banks of Campos Basin: first records for the Brazilian continental margin, Southwest Atlantic*. 9th International Polychaete Conference, 101 pp.

Brito, M.C., Nuñes, J. & Bacallado, J.J. (1991) Polynoidae (Polychaeta) from the Canary Islands. *Bulletin Marine Sciences*, 48 (2), 180–188.

Buhl-Mortensen, L. & Mortensen, P.B. (2004) Symbiosis in deep-water corals. *Symbiosis*, 37, 33–61.

Cavalcanti, G.H., Curbelo Fernandez, M.P., Falcão, A.P.C, Arantes, R.C.M., Silva Silveira, M.A., Viana, A.R. & Brasil, A.C.S. *(*2013) *Ecossistemas de corais de águas profundas da Bacia de Campos*. *In*: Curbelo Fernandez, M.P. & Braga, A.C. (Eds.), *Caracterização ambiental regional da Bacia de Campos - Atlântico Sudoeste: Nécton Demersal e Bioconstrutores. 1st Edition*. Editora ELSEVIER, Rio de Janeiro, in press.

Cordes, E.E., McGinley, M.P., Podowski, E.L., Becker, E.L., LessardPilon, S. Viada, S.T. & Fisher, C.R. (2008) Coral communities of the deep Gulf of Mexico. *Deep-Sea Research*, 55, 777–787.
http://dx.doi.org/10.1016/j.dsr.2008.03.005

Day, J.H. (1960) The Polychaet [sic] fauna of South Africa. Part 5. Errant species dredged off Cape coasts. *Annals of the South African Museum*, 45 (3), 261–373.

Day, J.H. (1967) *Polychaeta of Southern Africa. Part 1. Errantia.* British Museum (Natural History), London. 458 pp

Dover, C.L.V, German, C.R., Speer, K.G., Parson, L.M. & Vrijenhoek, R.C. (2002) Evolution and biogeography of deep-sea vent and seep invertebrates. *Science,* 295, 1253.
http://dx.doi.org/10.1126/science.1067361

Duncan, P.M. (1873) A description of the Madreporaria dredged up during the expeditions of H.M.S. "Porcupine" in 1869 and 1870. *Transactions of the Zoological Society of London*, 8 (5), 303–344.
http://dx.doi.org/10.1111/j.1096-3642.1873.tb00560.x

Fiege, D. & Barnich R. (2009) Polynoidae (Annelida: Polychaeta) associated with cold-water coral reefs of the northeast Atlantic and the Mediterranean Sea. *Zoosymposia,* 2, 149–164.

Fosså, J.H., Mortensen, P.B. & Furevik, D.M. (2002) The deep-water coral Lophelia pertusa in Norwegian waters: distribution and fishery impacts. *Hydrobiologia*, 471, 1–12.
http://dx.doi.org/10.1023/A:1016504430684

Grassle, J.F. (1985) Hydrothermal vent animals: Distribution and biology. *Science,* 229, 713–717.
http://dx.doi.org/10.1126/science.229.4715.713

Henry, L.A. & Roberts, J.M. (2007) Biodiversity and ecological composition of macrobenthos on cold-water coral mounds and adjacent off-mound habitat in the bathyal Porcupine Seabight, NE Atlantic. *Deep Sea Research,* 54, 654–672.
http://dx.doi.org/10.1016/j.dsr.2007.01.005

Howe, A. (2008) Deep-sea hydrothermal vent fauna: Evolution, dispersal, succession and biogeography. *Macalester Reviews in Biogeography*, 1, 1–21. [Article 6]

Humason, G.L. (1979) *Animal tissue techniques*. W. H. Freeman and Company, San Francisco, 661 pp.

Johnson, H.P. (1897) A preliminary account of the marine annelids of the Pacific coast, with descriptions of new species. *Proceedings of the California Academy of Sciences*, 1 (5), 153–199.

Kinberg, J.G.H. (1856) Nya slägten och arter af Annelider, *Öfversigt af Kongl. Vetenskaps-Akademiens Förhhandlingar Stockholm,* 12 (9–10), 381–388.

Lana, P.C. (1991) Sigalionidae (Polychaeta) from the Coast of Paraná (SE Brazil) and adjacent areas. *Ophelia Supplement*, *5*, 121–132

Lavrado, H.P. & Brasil, A.C.S. (2010) *Biodiversidade da região oceânica profunda da Bacia de Campos: macrofauna.* SAG Serv Rio de Janeiro, 232 pp.

Lavrado, H.P. & Viana, M.S. (2007) *Atlas de invertebrados marinhos da região central da Zona Econômica Exclusiva brasileira, parte 1*. Museu Nacional, Rio de Janeiro, 258 pp.

Lessard-Pilon, S.A., Podowski, E.L., Cordes, E.E. & Fisher, C.R. (2010) Megafauna community composition associated with Lophelia pertusa colonies in the Gulf of Mexico. *Deep Sea Research Part II: Topical Studies in Oceanography*, 57, 1882–1890.
http://dx.doi.org/10.1016/j.dsr2.2010.05.013

Linnaeus, C. (1758) *Systema Naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis.* Laurentius Salvius, Holmiae, 824 pp.

Linnaeus, C. (1767) Systema naturae sive regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. *Laurentii Salvii, Holmiae*, 1 (2), 533–1327.

Malmgren, A.J. (1867) Annulata polychaeta Spetsbergiae, Groenlandiae, Islandiae et Scandinaviae hactenus cognita, *Öfversigt af Kongl. Vetenskaps-Akademiens Förhhandlingar Stockholm,* 24, 127–235.

Marenzeller, E. von. (1893) Berichte der Commission für Oceanographische erforschung des Östlichen mittelmeeres. Zweite Reihe. VI. Zoologische Ergebnisse II. Polychäten des Grundes, gesammelt 1890, 1891, 1892. *Denkschriften der Akademie der Wissenschaften,* 60, 25–48. [Wien]

Mastrototaro, F., D'Onghia, G., Corriero, G., Matarrese, A., Maiorano, P., Panetta, P., Gherardi, M., Longo, C., Rosso, A., Sciuto, F., Sanfilippo, R., Gravili, C., Boero, F., Taviani, M. & Tursi, A. (2010) Biodiversity of the white coral bank off Cape Santa Maria di Leuca (Mediterranean Sea): An update. *Deep Sea Research Part II: Topical Studies in Oceanography*, 57, 412–430.
http://dx.doi.org/10.1016/j.dsr2.2009.08.021

McIntosh, W.C. (1876) On British Annelida. Part I. Euphrosynidae, Amphinomidae, Aphroditidae, Polynoidae, Acoetiidae, and Sigalionidae. *Transactions of the Zoological Society of London*, 9 (7), 371–394.

Mortensen, P.B. (2001) Aquarium observations on the deep-water coral *Lophelia pertusa* (L., 1758) (Scleractinia) and selected associated invertebrates. *Ophelia*, 54, 83–104.
http://dx.doi.org/10.1080/00785236.2001.10409457

Padovanni, N. & Amaral, A.C.Z. (2013) New species of the scale worm genus Pholoe (Polychaeta: Pholoidae) from southeast Brazil. *Zootaxa*, 3710 (5), 485–497.
http://dx.doi.org/10.11646/zootaxa.3710.5.6

Pinto, N.O.P. (2014) *Poliquetas de escama da região Sudeste do Brasil.* Universidade Estadual de Campinas, Campinas, 189 pp.

Pettibone, M.H. (1953) *Some Scale-bearing Polychaetes of Puget Sound and Adjacent Waters.* University of Washington Press, Seattle, 89 pp.

Pettibone, M.H. (1955) New species of polychaete worms of the family Polynoidae from the east coast of North America. *Journal of the Washington Academy of Sciences*, 45 (4), 118–126.

Pettibone, M.H. (1991a) Polynoids commensal with gorgonian and stylasterid corals, with a new genus, new combinations, and new species (Polychaeta: Polynoidae: Polynoinae). *Proceedings of the Biological Society of Washington*, 104 (4), 688–713.

Pettibone, M.H. (1991b) Polynoid polychaetes commensal with antipatharian corals. *Proceedings of the Biological Society of Washington*, 104 (4), 714–726.

Pettibone, M.H. (1992) Contribution to the polychaete family Pholoidae Kinberg. *Smithsonian Contributions to Zoology,* 532, 1–24.

Pettibone, M.H. (1993) Revision of some species referred to Antinoe, Antinoella, Antinoana, Byglides, and Harmothoe (Polychaeta: Polynoidae: Harmothoinae). *Smithsonian Contributions to Zoology*, 545, 1–41.

Pourtalès, L.F. (1878) Report of the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico, by the U.S. Coast Survey Steamer Blake. Corals. *Bulletin of the Museum of Comparative Zoölogy,* 5 (9), 197–212.

Pruvot, G. (1895) Coup d'oeil sur la distribution général des invertébrés dans la région de Banyuls (Golfe du Lion). *Archives de zoologie expérimentale et générale,* 3 (3), 629–658.

Roberts, J.M. (2005) Reef-aggregating behavior by symbiotic eunicid polychaetes from cold-water corals: do worms assemble reefs? *Journal of the Marine Biological Association of the United Kingdom,* 85, 813–819.
http://dx.doi.org/10.1017/S0025315405011756

Roberts, J.M., Wheeler, A.J. & Freiwald, A. (2006) Reefs of the deep: the biology and geology of cold-water coral ecosystems. *Science,* 312, 543–547.
http://dx.doi.org/10.1126/science.1119861

Rogers, A.D. (1999) The biology of Lophelia pertusa (Linnaeus 1758) and other deep-water reef-forming corals and impacts from human activities. *International review of hydrobiology,* 84, 315–406.
http://dx.doi.org/10.1002/iroh.199900032

Rouse, G.W., Goffredi, S.K. & Vrijenhoek, R.C. (2004) Osedax: Bone-eating marine worms with dwarf males. *Science*, 305, 668–671.
http://dx.doi.org/10.1126/science.1098650

Sumida, P.Y.G., Yoshinaga, M.Y., Madureira, L.A.S. & Hovland, M. (2004) Seabed pockmarks associated with deepwater corals off SE Brazilian continental slope, Santos Basin. *Marine Geology,* 207, 159–167. http://dx.doi.org/10.1016/j.margeo.2004.03.006

Viana, A.R, Faugères, J.C., Kowsmann, R.O., Lima, J.A.M., Caddah, L.F.G. & Rizzo, J.G. (1998) Hydrology, morphology and sedimentology of the Campos continental margin, offshore Brazil. *Sediment Geology,* 115, 133–157. http://dx.doi.org/10.1016/S0037-0738(97)00090-0

Wiklund, H., Glover, A.G. & Dahlgren, T.G. (2009) Three new species of Ophryotrocha (Annelida: Dorvilleidae) from a whale-fall in the North-East Atlantic. *Zootaxa*, 2228, 43–56.