

RESULTS OF THE DIVA-1 EXPEDITION OF RV “METEOR” (CRUISE M48/1)  
**Abyssal benthic Syllidae (Annelida: Polychaeta) from the Angola Basin**

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### Abstract

Three species of Syllidae were obtained from the deep sea expedition DIVA-1 to the south-eastern sector of the Atlantic Ocean. *Anguillosyllis capensis* Day, 1963 has previously been recorded only from the Agulhas Bank, *Parexogone wolffi* San Martín, 1991 is also known from the northern Atlantic Ocean and the Gulf of México, and *Typosyllis* sp. might be a new species.

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**Keywords:** Polychaeta; Syllidae; Deep sea; Angola Basin; Biodiversity; Taxonomy

### Introduction

The DIVA-1 expedition is part of a programme to study the little-known abyssal benthic biodiversity of the Atlantic Ocean. The present paper deals with the Syllidae taken during the RV “Meteor” 48/1 cruise in July 2000, during which sampling was done along a transect of stations in the Angola Basin. The transect of approximately 700 km comprised six stations from 22°18.6'S 3°17.4'E to 16°17.0'S 5°27.0'E. Depths were between 5126 and 5450 m. Syllidae were obtained from all stations sampled successfully. The small collection contains 66 specimens belonging to only three species: *Anguillosyllis capensis* Day, 1963, *Parexogone wolffi* San Martín, 1991, and *Typosyllis* sp. An evaluation of the diversity will be given later in a broader context, including more polychaete species from various taxa.

### Materials and methods

Specimens were collected with a box corer (GKG 50 cm × 50 cm), sieved with 1-, 0.5- and 0.3-mm sieves,

then fixed either in a 4% formaldehyde–seawater solution or in 70% ethanol. After sorting, all specimens were transferred to 70% ethanol.

Observations, measurements and figures were made using a Leica Wild M 3 stereo microscope, a Zeiss compound microscope, and a Leitz Laborlux S compound microscope. Information referring to measurements rely on minimum and maximum values in the material examined.

For SEM investigation specimens were dehydrated by a graded ethanol series, critical-point dried using CO<sub>2</sub>, mounted on aluminium stubs, coated with gold and examined with a Zeiss DSM 962.

Abbreviations used in the “Material examined” section for each species include: cs: complete specimen and af: anterior fragment. This is followed by: number of chaetigers; length of specimen (in mm); width of specimen incl. parapodia and width excl. parapodia (in mm).

The following abbreviations are used for institutions: BMNH (Natural History Museum, London), SMF (Senckenberg Museum, Frankfurt am Main), USNM (United States National Museum, National Museum of Natural History (Smithsonian Institution), Washington DC), ZMH (Zoologisches Museum, Hamburg).

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Terminology of compound chaetae follows Licher (1999) and Böggemann and Westheide (2004).

**Results**

**Syllidae** Grube, 1850

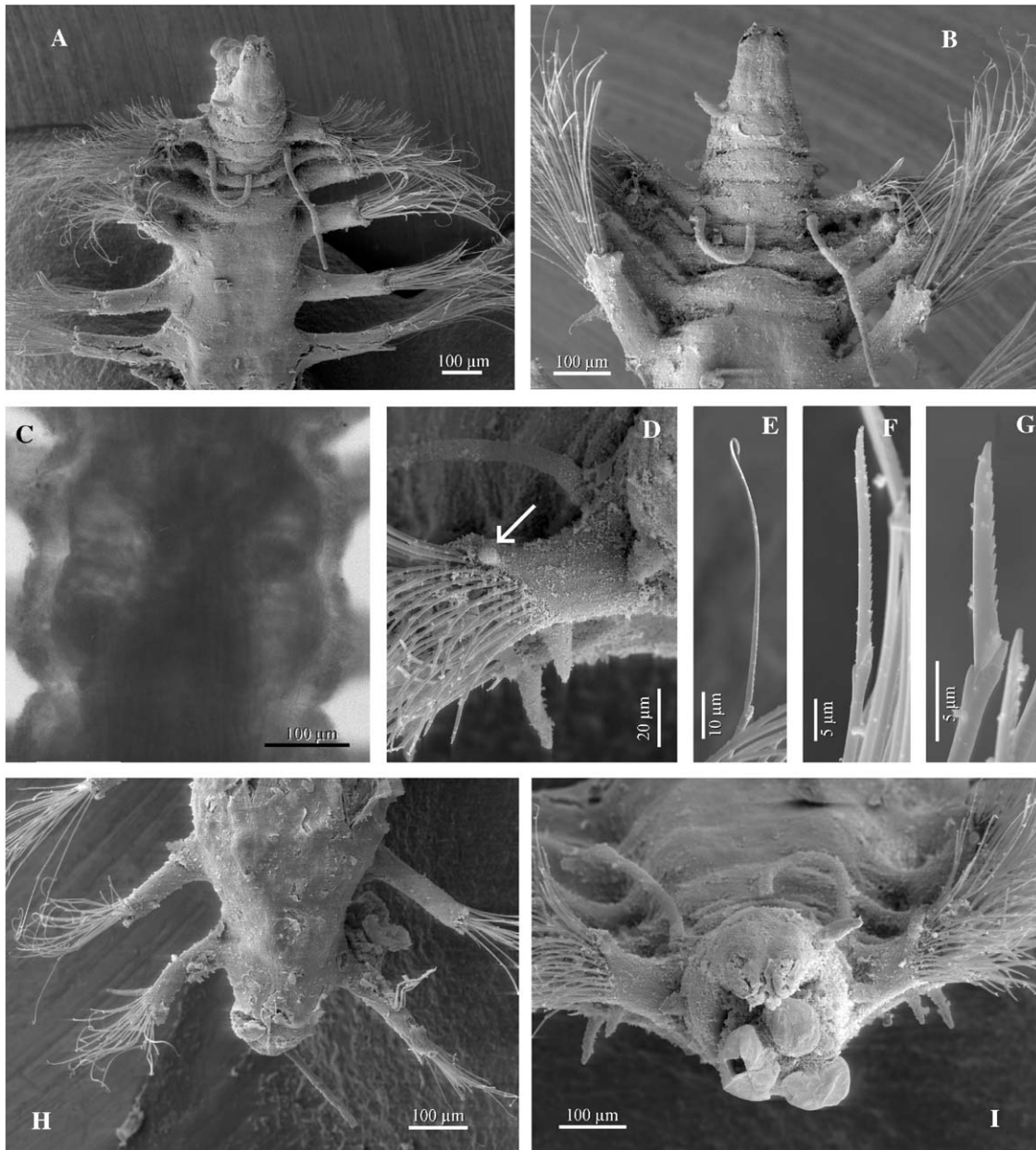
**Exogoninae** Langerhans, 1879

*Anguillosyllis capensis* Day, 1963 Fig. 1

*Anguillosyllis capensis* Day, 1963: 400, text-fig. 5a–d [Locus typicus: 34°51'S 23°41'E; holo- and paratype: BMNH 1963.1.29]

*Anguillosyllis capensis*—Day 1967: 271, fig. 12.10.z-zzz

Material examined: R/V “METEOR” 48/1 St. 324 GKG 6, 19°58.3'S 2°59.7'E, 13.vii.2000, 5449 m; cs/11/2.2/0.86/0.43, af/6/1.0/0.54/0.22 (SMF 13685)—St. 324 GKG 7, 19°58.3'S 2°59.9'E, 13.vii.2000, 5448 m; cs/11/1.3/0.58/0.22 (ZMH 24595)—St. 330 GKG 2, 19°07.1'S 3°51.9'E, 17.vii.2000, 5423 m; af/11/2.3/1.0/0.38 (SMF



**Fig. 1.** *A. capensis* Day, 1963. (A,B) Anterior region. (C) Proventricle. (D) Parapodia with chaetae; arrow points to possibly retractable dorsal projection. (E) Chaeta with pseudospiniger blade. (F) Chaeta with bread-knife-shaped blade. (G) Chaeta with paring-knife-shaped blade. (H) Posterior region. (I) Anterior end with partly everted pharyngeal tube probably with artificial swellings. (A,B) and (D–I) SEM-micrographs, (C) light micrograph.

13686)—St. 330 GKG 5, 19°07.0'S 3°52.0'E, 17.VII.2000, 5423 m; cs/11/2.5/0.95/0.42 (SMF 13694)—St. 330 GKG 7, 19°06.9'S 3°52.0'E, 17.VII.2000, 5423 m; af/10/1.3/0.67/0.27, af/10/1.1/0.62/0.26, af/10/1.1/0.37/0.17 (ZMH 24596)—St. 336 GKG 1, 18°16.7'S 4°44.4'E, 20.VII.2000, 5393 m; cs/11/2.0/0.48/0.26 (ZMH 24597)—St. 341 GKG 1, 17°08.0'S 4°42.0'E, 23.VII.2000, 5419 m; cs/11/1.7/0.48/0.20, cs/11/0.8/0.37/0.13 (ZMH 24598)—St. 341 GKG 8, 17°08.1'S 4°41.9'E, 24.VII.2000, 5419 m; cs/11/0.9/0.34/0.13, af/8/1.2/0.70/0.26, af/4/0.5/0.32/0.17 (ZMH 24599)—St. 341 GKG 9, 17°08.0'S 4°42.0'E, 24.VII.2000, 5415 m; cs/11/1.8/0.54/0.19, cs/11/1.4/0.55/0.20, cs/11/1.4/0.48/0.18, af/10/0.8/0.39/0.15, af/8/1.0/0.65/0.22, af/5/0.6/0.56/0.22 (SMF 13682)—St. 345 GKG 2, 16°17.0'S 5°27.0'E, 26.VII.2000, 5390 m; cs/11/0.7/0.44/0.17 (ZMH 24600)—St. 345 GKG 3, 16°17.0'S 5°27.1'E, 26.VII.2000, 5390 m; cs/11/2.0/0.54/0.23, cs/11/1.0/0.38/0.16, cs/11/0.8/0.32/0.14, af/8/1.6/0.70/0.27 (SMF 13683)—St. 345 GKG 4, 16°17.0'S 5°27.1'E, 26.VII.2000, 5389 m; cs/11/1.0/0.39/0.17, cs/11/1.0/0.38/0.15, cs/11/1.0/0.32/0.14, af/10/1.5/0.75/0.26, af/10/1.1/0.43/0.18, af/8/1.4/0.73/0.27 (SMF 13681)—St. 345 GKG 6, 16°17.0'S 5°27.0'E, 26.VII.2000, 5389 m; af/8/1.1/0.65/0.26 (ZMH 24601)—St. 345 GKG 7, 16°17.0'S 5°27.0'E, 26.VII.2000, 5390 m; cs/11/1.4/0.62/0.18, cs/11/1.2/0.43/0.16, cs/11/1.2/0.43/0.16, cs/11/1.0/0.34/0.15, cs/10/0.9/0.38/0.16, cs/8/0.8/0.50/0.22, af/10/1.0/0.65/0.22, af/9/0.9/0.52/0.20, af/3/0.4/0.38/0.16 (SMF 13684).

Material compared: South Africa, south coast of Cape Province, St. SCD 275, 34°51'S 23°41'E, 30.XI.1960, 183 m, khaki sand (BMNH 1963.1.29; holotype and paratype).

**Description:** Up to 2.5 mm long, with up to 11 chaetigers. Interparapodial width in mid-body up to 430 µm, about 1 mm including parapodia. Fixed specimens without pigmentation. Integument smooth.

Prostomium considerably wider than long (Fig. 1A and B); anterior margin slightly convex, nearly straight. Palps considerably longer than prostomium, somewhat bean-shaped, fused throughout their length, except for a terminal notch, from which a median furrow runs backwards. Eyes absent. Antennae smooth digitiform of subequal length (27–94 µm). Median antenna arising near posterior margin, lateral antennae close to anterior margin.

Peristomium with a pair of lateral tentacular cirri (Fig. 1A, B, D), shorter than antennae and more conical (16–43 µm).

Parapodia (Fig. 1D) large with long, smooth dorsal cirri (228–444 µm), which are mostly broken off; ventral cirri digitiform (35–89 µm), inserted near distal end of parapodia. Each chaetigerous lobe with a tapered dorsal projection (60–70 µm; Fig. 1D, arrow), which seems to be retractile (see Day 1963). Anterior chaetigers with about 2–7 and posterior chaetigers with 1–4 aciculae

having pointed tips. Chaetigers with numerous compound chaetae having unidentate, differently long blades (Fig. 1D–G), their lengths decreasing inferiorly, and their shape changing from pseudospiniger (Fig. 1E) to paring-knife-shaped falciger (Fig. 1G) within each bundle; subdistally blades with sawtooth serration over entire length of margin; shafts appearing always smooth. Posteriormost chaetigers sometimes with superior and inferior simple chaetae.

Pygidium (Fig. 1H) with one pair of smooth cirri (48–200 µm), and short, smooth, digitiform to conical median cirrus (16–30 µm).

Pharyngeal tube extending through about 4–5 segments, unarmed, probably with 9–10 terminal papillae. Proventricle barrel-shaped (Fig. 1C), extending through about two segments and with indistinct number (13–18?) of muscle rings.

**Distribution.** Agulhas Bank and Angola Basin; 183–5449 m.

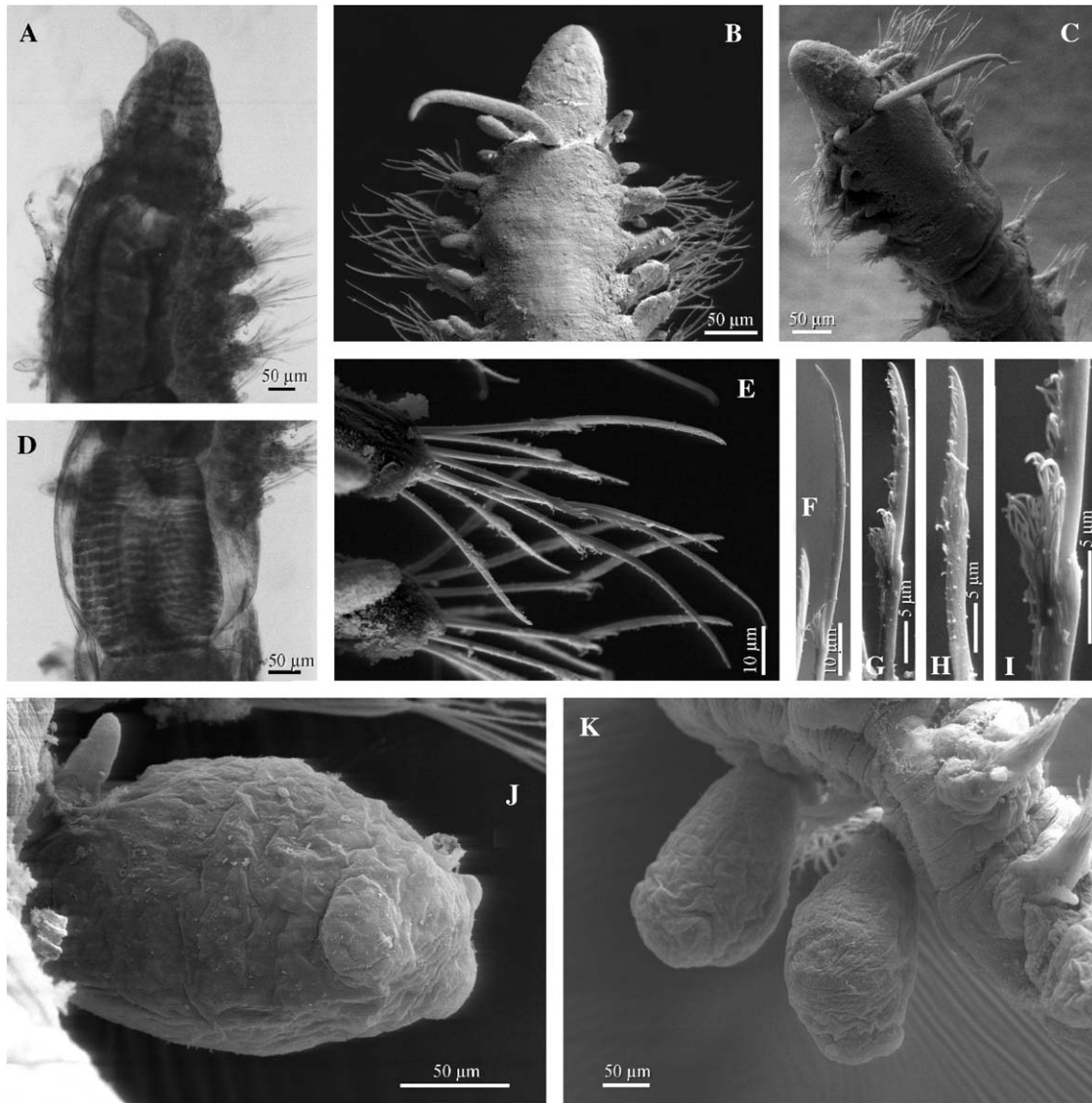
**Remarks.** The present specimens predominantly agree with the description and the type material of *A. capensis* Day, 1963. However, Day (1963, 1967) mentioned that the proventricle had about 30 muscle rings, which are very indistinct in the type material and therefore difficult to count.

*Parexogone wolfi* San Martín, 1991 Fig. 2

*Exogone (Parexogone) wolfi* San Martín, 1991: 726, fig. 6a–f [Locus typicus: 26°0.9'N 80°3.4'W, off Port Everglades, Florida, USA; holotype: USNM]

*Exogone (Parexogone) wolfi*—San Martín et al. 1996: 252, fig. 3A–I

Material examined: R/V “METEOR” 48/1 St. 324 GKG 3, 19°58.2'S 2°59.8'E, 13.VII.2000, 5447 m; cs/37/5.9/0.44/0.28, af/17/2.4/0.43/0.32 (SMF 13696 & 13697)—St. 324 GKG 6, 19°58.3'S 2°59.7'E, 13.VII.2000, 5449 m; af/41/5.8/0.27/0.18 (ZMH 24602)—St. 324 GKG 8, 19°58.3'S 2°59.8'E, 13.VII.2000, 5448 m; af/20/2.2/0.29/0.22 (ZMH 24603)—St. 330 GKG 1, 19°07.0'S 3°52.0'E, 17.VII.2000, 5424 m; af/32/3.8/0.43/0.29, af/28/3.3/0.37/0.27, af/18/2.3/0.29/0.22 (SMF 13689)—St. 330 GKG 2, 19°07.1'S 3°51.9'E, 17.VII.2000, 5423 m; af/23/2.9/0.30/0.22 (ZMH 24604)—St. 330 GKG 3, 19°08.3'S 3°51.0'E, 17.VII.2000, 5424 m; af/25/4.2/0.30/0.19 (ZMH 24605)—St. 330 GKG 4, 19°07.0'S 3°51.9'E, 17.VII.2000, 5423 m; af/36/5.0/0.37/0.22 (SMF 13693)—St. 330 GKG 5, 19°07.0'S 3°52.0'E, 17.VII.2000, 5423 m; af/35/4.0/0.28/0.14 (SMF 13695)—St. 330 GKG 6, 19°07.0'S 3°52.0'E, 17.VII.2000, 5422 m; af/34/5.5/0.34/0.24, af/28/3.1/0.29/0.19, af/23/3.0/0.26/0.18, af/15/1.8/0.26/0.13 (SMF 13691)—St. 330 GKG 7, 19°06.9'S 3°52.0'E, 17.VII.2000, 5423 m; af/31/4.0/0.27/0.18, af/31/3.7/0.37/0.27 (SMF 13692)—St. 330 GKG 8, 19°07.0'S 3°52.0'E, 18.VII.2000, 5424 m; af/48/6.0/0.33/0.22, af/38/6.2/0.37/0.27 (SMF 13690)—St. 336 GKG 1, 18°16.7'S 4°44.4'E, 20.VII.2000, 5393 m; af/28/3.3/0.41/0.25 (ZMH 24606)—



**Fig. 2.** *P. wolfi* San Martín, 1991. (A–C) Anterior region. (D) Proventricle. (E) Parapodia with chaetae. (F) Chaeta with pseudospiniger blade. (G) Chaeta with bread-knife-shaped blade. (H) Chaeta with paring-knife-shaped blade. (I) Chaeta shaft with very long spines. (J) Embryo. (K) Two embryos in posterior part of body. (A) and (D) light micrographs, (B,C) and (E–K) SEM-micrographs.

St. 341 GKG 9, 17°08.0'S 4°42.0'E, 24.vii.2000, 5415 m; af/33/4.8/0.33/0.24 (SMF 13688).

**Description.** Up to 6.2 mm long, with at least 48 chaetigers. Interparapodial width in mid-body 330  $\mu$ m, up to 480  $\mu$ m including parapodia. Fixed specimens without pigmentation. Integument smooth.

Prostomium about twice as wide as long (Fig. 2A–C), partly retracted into peristomium, anterior margin slightly convex, nearly straight. Palps extremely long and fused throughout, with median furrow running backwards. Eyes usually absent, but in some specimens two pairs of spherical-lensed eyes in almost trapezoidal arrangement in posterior half of prostomium. Antennae smooth and digitiform, arising nearly at same level near posterior margin of prostomium; lateral antennae

distinctly shorter (46–91  $\mu$ m) than median one (148–320  $\mu$ m).

Peristomium with a pair of tentacular cirri (Fig. 2A–C), similar in shape to antennae, but distinctly shorter (21–54  $\mu$ m). Lateral pair of ciliated knobs (nuchal organs?) present.

Parapodia (Fig. 2E) with smooth digitiform dorsal cirri of subequal length (30–73  $\mu$ m); ventral cirri conical to papilliform (19–54  $\mu$ m), inserted near parapodial base. Anteriorly about nine chaetigers probably with two, following chaetigers with one strong acicula with bent tips. Supra-acicularly one slightly sigmoid bidentate simple chaeta, beginning from 3rd to 19th chaetiger; distal tooth about as large as subdistal one; subdistally with curved and distally directed very long spines.

Anterior chaetigers with subacicular bundles of 5–15 compound chaetae, posterior chaetigers with 2–6 falcigers with differently long bidentate blades (Fig. 2E–H), their lengths decreasing inferiorly, and their shape changing from pseudospiniger (Fig. 2F) to paring-knife-shaped falcigers (Fig. 2H) within each bundle; distal tooth slightly larger than subdistal one; subdistally blades with long spines over entire length of margin; shafts with very long spines subdistally (Fig. 2I). Sometimes a few posteriormost chaetigers with one inferiormost simple chaeta; slender, slightly sigmoid and bidentate, distal tooth about as large as subdistal one; subdistally with curved and distally directed very long spines.

Pygidium with one pair of digitiform to conical cirri.

Pharyngeal tube extending through 3–4 segments (Fig. 2A); tooth near anterior opening. Proventricle with 18–21 muscle rings (Fig. 2D); about as long as pharyngeal tube.

This species shows external gestation; one specimen observed with developing embryos in ventral position of posterior part of body (Fig. 2J and K).

*Distribution:* Florida, Gulf of México, Capbreton Canyon (Bay of Biscay), and Angola Basin; 106–5449 m.

*Remarks.* The present specimens agree well with the description of *P. wolffi* (San Martín 1991; San Martín et al. 1996), even if most of the material has no eyes, which either might be lost during fixation or are truly absent in these specimens due to the abyssal habitat.

#### **Syllinae** Grube, 1850

##### *Typosyllis* sp.

Material examined: R/V “METEOR” 48/1 St. 330 GKG 5, 19°07.0'S 3°52.0'E, 17.vii.2000, 5423 m; cs/23/2.4/0.42/0.26 (SMF 13687).

*Description.* Complete specimen 2.4 mm long, with 23 chaetigers. Interparapodial width in mid-body ca. 260 µm, about 420 mm including parapodia. Fixed specimen of bad condition, without pigmentation, with red-brown pharyngeal tube. Dorsal integument smooth.

Prostomium considerably wider than long; anterior margin slightly concave. Palps slightly longer than prostomium, large and bean-shaped; separated from each other along their entire length. Eyes absent. Antennae articulated, articles somewhat wider than long to subquadrangular, distal article sometimes longer than wide; median antenna (ca. 360 µm) with 12–13 articles, arising near posterior margin of prostomium; anterolateral antennae shorter (ca. 190 µm), with nine articles.

Peristomium with two pairs of tentacular cirri, articulation similar in shape to that of antennae; dorsal ones (ca. 240 µm) with 11 articles, ventral ones distinctly shorter (ca. 135 µm) with four articles.

Parapodia uniramous; articles of dorsal cirri subquadrangular, distal article sometimes longer than wide; ventral cirri digitiform (ca. 60–70 µm), as long as

parapodial lobes, inserted near parapodial bases. Dorsal cirri of different lengths, decreasing in length posteriorly and articulated as follows: 1st with 12–15 (ca. 360 µm), 2nd with 6 (ca. 130 µm), 3rd with 6–7 (ca. 180 µm), 4th with 9 (ca. 280 µm), 5th with 8 (ca. 210 µm), 6th with 4 (ca. 100 µm), 7th with 4–5 (ca. 150 µm), 8th with 4 (ca. 120 µm), 9th with 8 (ca. 215 µm), 10th with 4 (ca. 120 µm), 11th with 8 (ca. 215 µm), 12th with 4 (ca. 120 µm), 13th with 6 (ca. 190 µm), 14th with 4 (ca. 120 µm), 15th not present, 16th with 3 (ca. 90 µm), 17th with 5 (ca. 160 µm), 18th with 3 (ca. 90 µm), 19th with 5 (ca. 130 µm), 20th with 3 (ca. 90 µm), 21st with 2 (ca. 80 µm), 22nd with 1 (ca. 56 µm), 23rd with 1 (ca. 38 µm) article. Anterior chaetigers possibly with two aciculae, other clearly with single match-shaped acicula. Seven posteriormost chaetigers supra-aciculary with one bidentate simple chaeta; teeth about the same size; blade subdistally with minute serration. Chaetigers with subacicular bundles of 2–6 subequal falcigers with paring-knife to sickle-shaped, bidentate blades; secondary tooth about as large as primary one; rest of blade minutely serrated; shafts with fine subdistal spines. Three posteriormost chaetigers with one slender inferiormost simple chaeta.

Anal cirri missing.

Pharyngeal tube extending through 4–5 segments with large tooth near anterior opening. Proventricle with about 50 muscle rings; slightly longer than pharyngeal tube.

*Distribution:* Angola Basin; 5423 m.

*Remarks:* Only a few species of *Typosyllis* are described as having no eyes (Licher 1999). This seems to be not a good character to distinguish species, because eyes either could be lost during fixation or their absence could be due to intraspecific variation as observed in the material of *P. wolffi*. Among the eyeless species, *Typosyllis anoculata* Hartmann-Schröder, 1962 has only falcigers with unidentate blades, and *Typosyllis bifida* Hartmann-Schröder, 1986 possesses antennae and cirri with a much higher number of articles.

Concerning the small number of articles, the specimen from the Angola Basin is similar to *Typosyllis curtircirris* Hartmann-Schröder, 1981, *T. gerundensis* Alós and Campoy, 1981, and *T. stellaepolaris* Hartmann-Schröder, 1993. However, all three species have, among other characters, a much smaller number of muscle rings in the proventricle.

Additional material is needed to describe the specimen as a new taxon because it might be a juvenile or an aberrant form of a known species.

## **Discussion**

*A. capensis* and *P. wolffi* seem to be species with a more or less wide geographical and vertical distribution.

Especially *P. wolfi* is known from the northern and now also from the southern Atlantic Ocean. Such a wide geographical distribution is usually explained by pelagic larvae and dispersal by sea currents, but such an explanation seems not to apply to the species of Exogoninae, a taxon characterized by external gestation (e.g., Garwood 1991; Kuper and Westheide 1998; Licher 1999). In the material investigated here, this phenomenon could be demonstrated to occur in *P. wolfi*. Exogoninae are typical interstitial meiofaunal polychaetes which are supposed to possess limited distribution capability (Westheide and Schmidt 2003). Moreover, the great range of vertical distribution might be problematic for some species as well. The deep basins are separated from each other by ridges more than 1000 m high. Thus, these two species represent another example of the so-called meiofauna paradox (Giere 1993): that species can show world-wide distribution patterns despite lacking pelagic propagation stages and active swimming modes (Westheide and Hass-Cordes 2001; Westheide and Schmidt 2003). *A. capensis* and *P. wolfi* are both known from littoral and abyssal zones, but the identifications are based only on phenotypic characters. The fixation of the material is too poor to allow observation of fine-structural details such as presence of external cilia or absence or presence of eyes. Therefore, better preserved material is necessary to address these questions. It is hoped that ethanol-fixed specimens will allow DNA to be isolated for genetic investigations. Such investigations using DNA fingerprinting methods seem to be necessary to clarify whether the specimens from the different zones either belong to the same species or represent cryptic species, the existence of which has been documented for other Syllidae (Westheide and Hass-Cordes 2001).

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