



Syllidae (Annelida: Phyllodocida) from the deep Mediterranean Sea, with the description of three new species

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Abstract

Despite almost two centuries of research, the diversity of Mediterranean deep-sea environments remain still largely unexplored. This is particularly true for the polychaete family Syllidae. We report herein 14 species; among them, we describe *Erinaceusyllis barbarae* n. sp., *Exogone sophiae* n. sp. and *Prosphaerosyllis danovaro* n. sp. and report *Parexogone wolfi* San Martín, 1991, *Exogone lopezi* San Martín, Ceberio & Aguirrezabalaga, 1996 and *Anguillosyllis* Day, 1963 for the first time from the Western Mediterranean, the latter based on a single individual likely belonging to an undescribed species. Moreover, we re-establish *Syllis profunda* Cognetti, 1955 based on type and new material. Present data, along with a critical analysis of available literature, show that Syllidae are highly diverse in deep Mediterranean environments, even though they are rarely reported, probably due to the scarce number of studies devoted to the size-fraction of benthos including deep-sea syllids. Most deep-sea Syllidae have wide distributions, which do not include shallow-waters. 100 m depth apparently represents the boundary between the assemblages dominated by generalist shallow water syllids like *Exogone naidina* Ørsted, 1843 and *Syllis parapari* San Martín & López, 2000, and those deep-water assemblages characterised by strictly deep-water species like *Parexogone campoyi* San Martín, Ceberio & Aguirrezabalaga, 1996, *Parexogone wolfi* San Martín, 1991 and *Syllis* sp. 1 (= *Langerhansia caeca* Katzmann, 1973).

Key words: Polychaetes, Syllidae, deep-sea, *Erinaceusyllis*, *Prosphaerosyllis*, *Anguillosyllis*, *Exogone*

Introduction

Although the Mediterranean Sea has been extensively studied, deep environments are still poorly known from a biological point of view (Coll *et al.* 2010). This is particularly true for the assemblage composition and species diversity of several groups of benthic invertebrates (Danovaro *et al.* 2010). Most taxonomic studies focused on molluscs (Bouchet & Taviani 1992; Koutsoubas *et al.* 2000; La Perna 2004; Gofas *et al.* 2014) and nematodes (Soetaert *et al.* 1995; Danovaro *et al.* 2009), while the few available studies dealing with polychaetes usually report their diversity at supra-specific level, focusing on ecology and avoiding taxonomic considerations (Mamouridis *et al.* 2011; Baldrighi *et al.* 2013; Romano *et al.* 2013; Baldrighi *et al.* 2014). The Syllidae (Annelida: Phyllodocida) often represent a major faunal component in hard bottom assemblages and are one of the most diverse polychaete families in shallow water ecosystems (Musco & Giangrande 2005; Musco 2012). However, they appeared to be poorly represented in the deep-sea until high diversity of *Exogone s.l.* was reported in the Bay of Biscay (San Martín *et al.* 1996) followed by reports of high diversity of the whole family in other areas, with the description of many species new to science (San Martín 2004; Böggeman and Purschke 2005; Böggemann 2009; Lucas *et al.* 2012; Barroso *et al.* 2017).

In the Mediterranean, the Syllidae are an important component of deep-sea assemblages (Kröncke *et al.* 2003), but deep-sea reports are scarce and restricted to narrow geographical areas. In fact, Çinar & Ergen (2003) and Çinar *et al.* (2003) reported *Sphaerosyllis hystrix* Claparède, 1863, *Syllis cruzi* Núñez & San Martín, 1991 and *Syllis*

caeca (Katzmann, 1973) from epibathyal and bathyal environments of the Aegean Sea; Simboura & Zenetos (2005) reported the occurrence of *Exogone lopezi* San Martín, Ceberio & Aguirrezabalaga, 1996, *Exogone sorbei* San Martín, Ceberio & Aguirrezabalaga, 1996, *Parexogone campoyi* San Martín, Ceberio & Aguirrezabalaga, 1996 and *Parexogone wolffi* San Martín, 1991 from the Aegean Sea; lastly, Sardá *et al.* (2009) described *Parexogone canyonicolae* as a new species and reported *Sphaerosyllis* sp. and *Syllides* cf. *longocirrata* Ørsted, 1845 for sediment traps moored in canyons in the western Mediterranean Sea. Subsequent works on Mediterranean deep-sea assemblages highlighted the occurrence of Syllidae in benthic communities, without a dedicated fine taxonomic analysis (Mamouridis *et al.* 2011; Baldrighi *et al.* 2013; 2014).

Samples from the Central Mediterranean deep-sea (i.e., from 75 to 2400 m depth) were collected from 2011 to 2017 during oceanographic cruises and monitoring surveys (trawling discards were analyzed as well). In this work, the above mentioned samples were analyzed to improve the knowledge on the diversity of the deep-sea Syllidae.

Here we report several syllid species for the first time for the Western and Central Mediterranean, and describe three species new to the science, namely *Erinaceusyllis barbarae* **n. sp.**, *Exogone sophiae* **n. sp.** and *Prosphaerosyllis danovaroii* **n. sp.**

Material and methods

Examined material was obtained during: 1) three oceanographic cruises carried out by the research vessel *Urania* (2011, 2012, 2015) (Baldrighi *et al.* 2013; 2014), 2) environmental monitoring campaigns carried out off Gorgona and Capraia Islands (Northern Tyrrhenian Sea, 2012–2017), 3) trawl bycatch (2014, 2015), and 4) sediment traps placed in the southern Adriatic deepest region (2012) (Table 1).

TABLE 1. List of the sampling stations of the examined material.

Station	Latitude	Longitude	Depth	Date
Adriatic Sea				
St. 1	41° 19' 33" N	17° 04' 27" E	215 m	03/2015
St. 2	40° 27' 01" N	19° 07' 59" E	340 m	03/2015
St. 3	40° 05' 01" N	18° 49' 60" E	730 m	03/2015
St. 4	41° 37' 88" N	17° 37' 23" E	1200 m	03-12/2012
Ionian Sea				
St. 5	36° 22' 47" N	15° 30' 59" E	1200 m	05/2009
St. 6	36° 14' 06" N	15° 39' 39" E	2100 m	05/2009
Tyrrhenian Sea				
St. 7	43° 41' 22" N	10° 00' 01" E	90 m	07/2015
St. 8	43° 38' 40" N	09° 59' 20" E	110 m	2012-2017
St. 9	43° 32' 07" N	09° 55' 31" E	180 m	07/2014
St. 10	43° 03' 60" N	09° 56' 13" E	100 m	08/2016
Sea of Sardinia				
St. 11	40° 31' 16" N	07° 46' 52" E	600 m	10/2009
St. 12	40° 32' 28" N	07° 43' 12" E	900 m	10/2009
St. 13	40° 32' 42" N	07° 41' 53" E	1200 m	10/2009
St. 14	40° 32' 46" N	07° 41' 01" E	1500 m	10/2009
St. 15	40° 32' 51" N	07° 40' 23" E	1800 m	10/2009
St. 16	40° 33' 17" N	07° 39' 27" E	2100 m	10/2009
St. 17	40° 33' 21" N	07° 38' 24" E	2400 m	10/2009
St. 18	39° 15' 00" N	04° 10' 40" E	1800 m	10/2009
St. 19	39° 16' 58" N	04° 37' 20" E	2100 m	10/2009
St. 20	39° 15' 52" N	04° 41' 55" E	2400 m	10/2009

Samples from Urania cruises were collected by a box corer (surface area 706.7 cm²), other samples were collected by a van Veen grab (surface area 0.1 m²). All samples were sieved on a 0.5 mm mesh, fixed in 4% buffered formalin in seawater and later preserved in 70% ethanol, except those from stations 1, 2, 3, 7, 8 (in part), 9 and 10 that were directly fixed in 70% ethanol. Drawings were performed with the help of a camera lucida and microphotographs, and improved with Gimp 2.8 following Montesanto (2015). For scanning electron microscopy (SEM), the specimens were critical point dried with an Balzers Union CPD 020 Critical Point Dryer, gold-coated with a S150B Edwards Sputter Coater, and examined with a Jeol JSM-5410 scanning electron microscope at the Department of Biology of the University of Pisa. Type material of the new species has been deposited in the Museo di Storia Naturale of the University of Pisa (MSNP) along with the remaining non-type material. The authorship of new species has been restricted to the authors who actively participated in each description.

Results

Systematics

Family SYLLIDAE Grube, 1850

Subfamily Exogoninae Langerhans, 1879

Genus *Erinaceusyllis* San Martín, 2005: 73. Diagnosis follows San Martín (2005).

Erinaceusyllis barbarae Langeneck, Musco & Castelli n. sp.

(Figures 1–2)

Material examined. Holotype (MSNP: P/236/V): St. 4, Southern Adriatic Sea, 1200 m depth; Paratypes: same data as holotype: 1 individual (MSNP: P/257/V); St. 8: 2 individuals (MSNP: P/243/V). St. 11: 2 individuals (MSNP: P/252/V; P/256/V).

Description. Holotype atokous, entire, with relatively stout and robust body, 26 chaetigers for ca. 2 mm long, maximum width 0.18 mm (Fig. 1a, b); paratype entire, epitokous male, 30 chaetigers, ca. 2 mm long, 0.20 mm maximum width (Fig. 1c). Dorsum covered by small, scattered papillae. Prostomium oval, with four reddish eyes in trapezoidal arrangement and two anterior black eyespots (apparently absent in some paratypes). Antennae with bulbous base, last 2/3 briskly shrunken in a small tip; central antenna inserted slightly posteriorly to posterior eyes, as long as prostomium; lateral antennae ca. half long as median one, inserted on anterior margin (Fig. 1b). Palps shorter than prostomium, lacking noticeable papillae. Peristomium shorter than subsequent segments, covering dorsally prostomial posterior margin; single pair of peristomial cirri, similar in size and shape to lateral antennae. Dorsal cirri similar to antennae on anterior chaetigers, becoming more elongated towards pygidium, with gradually less shrunken tip (Fig. 1a), absent at chaetiger 2 (Fig. 1a, b, c). Parapodia rectangular to conical, well developed, with 7–8 compound and two simple chaetae; number of chaetae per parapodium diminishing posteriorly to five compound and two simple chaetae in posterior parapodia. Compound chaetae heterogomph, with shafts marginally smooth; blades all unidentate, distally slightly hooked (Fig. 2a, 2b). A single, most dorsal compound chaeta with distinctly elongated, slightly sinuous blade on each parapodium (Fig. 2a, b); 40 µm long on anterior parapodia, provided with several thin spines basally, 35 µm long, smooth, on posterior parapodia. Remaining falcigerous chaetae with smooth blade ranging from 25 to 18 µm on anterior parapodia, 23 to 15 µm on posterior parapodia (Fig. 2a, 2b). Dorsal simple chaetae occurring throughout the whole body, unidentate, robust, slightly sinuous and with very short distal spines (Fig. 2c); ventral simple chaetae only in posterior parapodia, thinner than dorsal one, smooth, unidentate (Fig. 2d). Acicula solitary, acuminate, with slightly enlarged sub-distal part (Fig. 2e). Pharynx short, approximately half as wide as the proventricle, across three chaetigers, tooth not visible (holotype) or relatively small, triangular, pointed, near to pharynx opening (paratype). Proventricle long, wide, barrel-shaped, and extending across four chaetigers, with about 19–20 muscle cell rows. Pygidium small, with two elongated cirri, approximately 2½ long as posterior dorsal cirri (Fig. 2f). Paratype with long capillary notochaetae and large intra-coelomic sperm packages from chaetiger 8 to 23 (Fig. 1c).

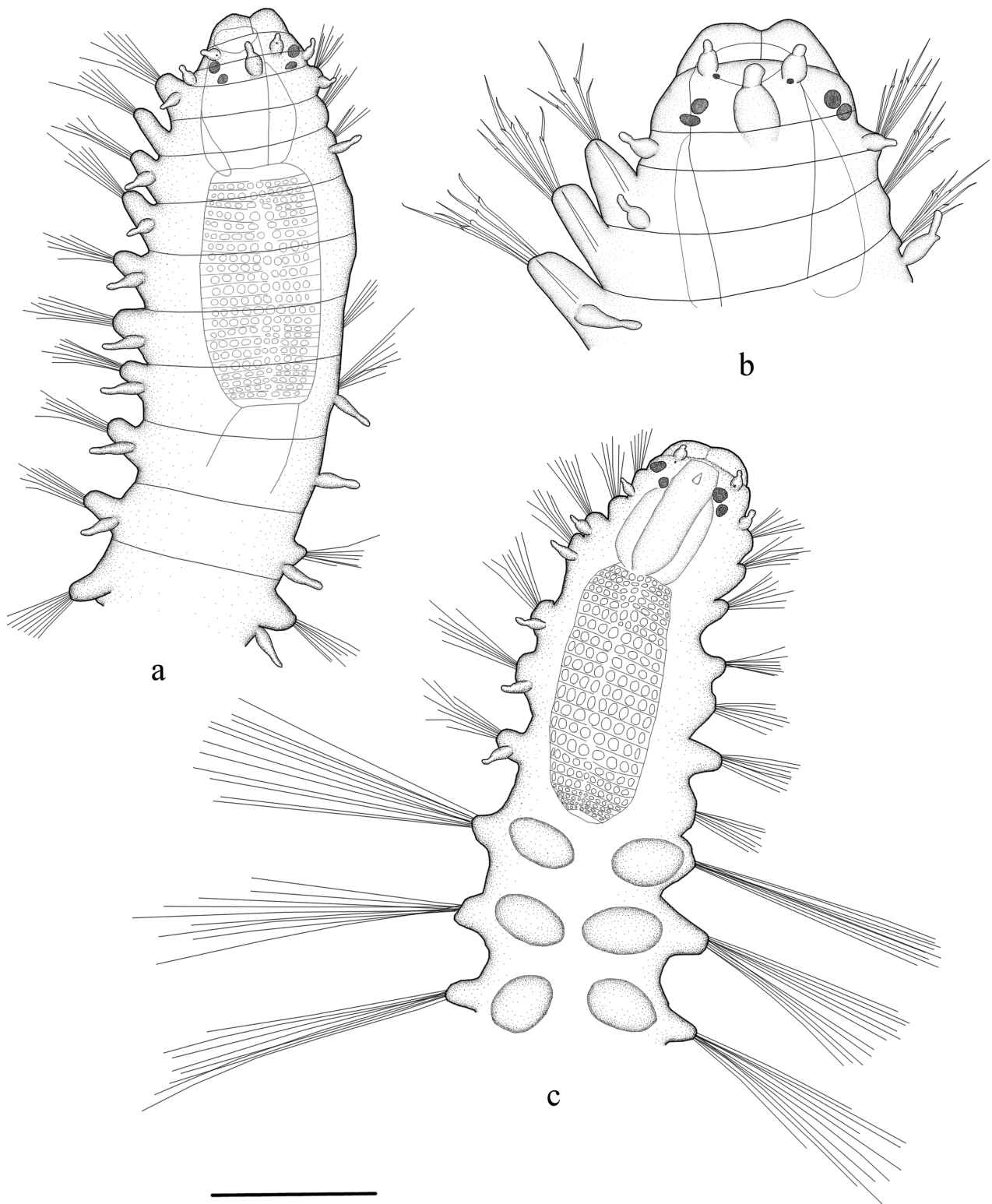


FIGURE 1. *Erinaceusyllis barbarae* n. sp. Holotype (atoke) (MSNP: P/236/V): a) anterior end in dorsal view; b) close-up of the prostomium, dorsal view; Paratype (epitoke male) (MSNP: P/257/V): g) anterior end in dorsal view. Scale-bar: a, c: 0.20 mm; b: 100 μ m

Etymology. This species is friendly dedicated to Dr. Barbara Mikac, in recognition of her important contribution to the knowledge on Mediterranean polychaetes, especially from the Adriatic Sea.

Distribution. Mediterranean Sea: Adriatic Sea (type locality), Tyrrhenian Sea, Sea of Sardinia; from 110 to 1200 m depth.

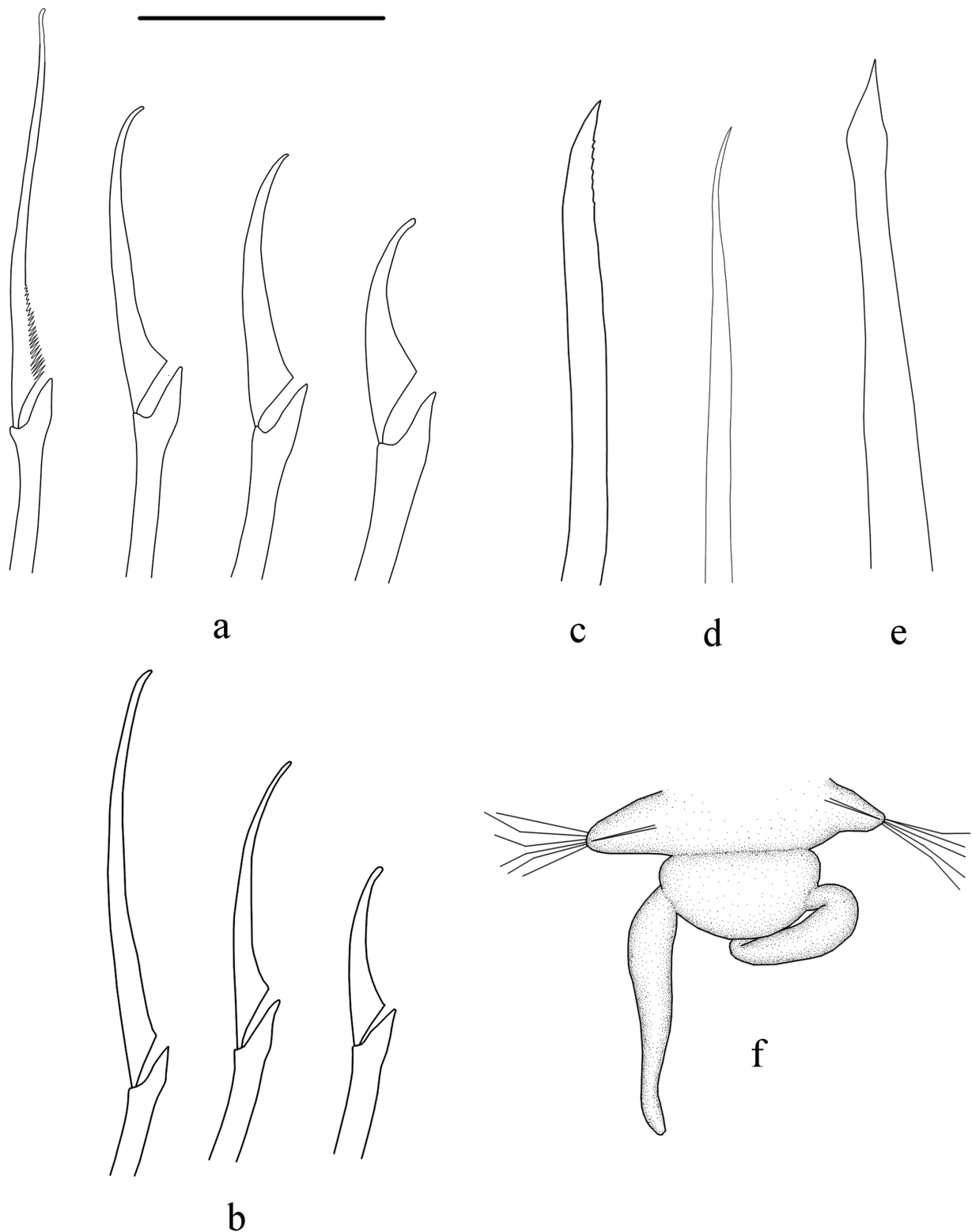


FIGURE 2. *Erinaceusyllis barbarae* n. sp. Holotype (atoke) (MSNP: P/236/V): a) compound chaetae of chaetiger 5; b) compound chaetae of chaetiger 20; c) dorsal simple chaeta; d) acicula. Scale-bar: a-b: 30 µm; c–e: 20 µm; f: 0.20 mm.

Remarks. Based on the chaetae with unidentate sabre-like blades, *E. barbarae* n. sp. resembles *Erinaceusyllis serratosetosa* (Hartmann-Schröder, 1982) and *Erinaceusyllis ettienei* San Martín, 2005. It differs from the former in lacking spinulation in most compound chaetae and as antennae and dorsal cirri in the anterior part of the body are shorter and thicker. *Erinaceusyllis ettienei* differs from the new species in having all blades with a more

pronounced spinulation, which gradually decreases dorsoventrally. Moreover, *E. ettiennei* is smaller than the new species and has longer antennae and dorsal cirri in the anterior part of the body. *Erinaceusyllis barbarae* **n. sp.** can be easily distinguished from the remaining Mediterranean *Erinaceusyllis* based on their compound chaetae: *Erinaceusyllis belizensis* (Russell, 1989) and *Erinaceusyllis cryptica* (Ben-Eliahu, 1977) have bidentate blades (San Martín 2003), while *Erinaceusyllis erinaceus* (Claparède, 1863) has unidentate, distinctly shorter blades, with a less pronounced dorso-ventral gradation (Verdes *et al.* 2013). Moreover, contrary to the new species, the species of *Erinaceusyllis* typically occur in shallow water environments (San Martín 2005; Ramos *et al.* 2010; Lucas *et al.* 2017), even if some abyssal species originally assigned to the genus *Sphaerosyllis* Claparède, 1863, as *Sphaerosyllis ridgensis* Blake & Hilbig, 1990, and *Sphaerosyllis ruthae* San Martín, 2004 could actually belong to *Erinaceusyllis* (G. San Martín, *pers. comm.*). *Sphaerosyllis ruthae*, originally described from abyssal depths (>4000 m) in Alaska shows some similarities with *E. barbarae* **n. sp.** as regards the shape of chaetae, that are very long, unidentate and with poorly developed ventral spinulation, but it clearly differs from the new species in the absence of eyes and in the proventricle shorter than the pharynx (longer than the pharynx in *E. barbarae* **n. sp.**).

Genus *Exogone* Ørsted, 1845: 20. Diagnosis follows San Martín (2005)

Exogone lopezi San Martín, Ceberio & Aguirrezabalaga, 1996

Exogone lopezi San Martín *et al.* 1996: 37: 255, Fig. 6; San Martín 2003: 259–262, Figs 140–141.

Material examined. St. 2: 1 individual; St. 11: 1 individual; St. 12: 5 individuals; St. 13: 1 individual.

Distribution. Eastern Atlantic Ocean (San Martín *et al.* 1996); Aegean Sea (Simboura & Zenetos 2005); Adriatic Sea (present data) and Sea of Sardinia (present data), Western Mediterranean.

Remarks. The examined individuals perfectly correspond to the original description (San Martín *et al.*, 1996). This is the first occurrence of this species in Italian waters.

Exogone naidina Ørsted, 1845

Exogone naidina Ørsted 1845: 20, Pl. 2; San Martín 1984a: 208, pl. 46.

Exogone (Exogone) naidina San Martín 2003: 262–265, Figs 142–143. San Martín 2005: 130–131, Fig. 79.

Syllis longiseta Gosse 1855: 32–33, Pl. 4, Figs 14–21.

Gossia longiseta Quatrefages 1866: 49.

Exogone gemmifera Pagenstecher 1862: 267; Fauvel 1923: 305, Figs 117a–d; Day 1967: 274, Figs 12.10 p.v.; Ben-Eliahu 1977: 78, Fig. 7.

Exogone kefersteinii Claparède 1863: 42–44, pl. 12, Figs 3–6.

Schmardia chauseyana Quatrefages 1866: 65–66, Pl. 8, Figs 16–17.

Paedophylax levis Bobretzky 1870: 234–238, Figs 54–57.

Material examined. St. 8: 3 individuals.

Distribution. Allegedly cosmopolitan (San Martín 2003).

Remarks. The examined material morphologically corresponds to *E. naidina* as described by San Martín (2003). The extremely wide geographical distribution, as well as the wide range of ecological conditions where this species occurs, however, led to speculate that it may actually represent a species complex, as supported by the occurrence of diploid and a tetraploid form in shallow Mediterranean waters (Cognetti Varriale, 1967). Further molecular studies, together with detailed morphological analyses are needed to clarify the taxonomic status of this widely distributed species.

Exogone sophiae Langeneck, Musco & Castelli **n. sp.**

(Figures 3–4)

Material examined. Holotype (MSNP: P/3879): St. 8, Northern Tyrrhenian Sea, 110 m. Paratypes: St. 8: 1

individual (MSNP: P/001/SEM); St. 10: 2 individuals (MSNP: P/242/V; P/246/V). Additional material: St. 8: 1 individual.

Description. Holotype complete specimen, 6 mm long for 47 chaetigers, 0.30 mm wide. All paratypes incomplete. Prostomium short, rectangular, distinctly broader than long, with four rounded, small eyes in trapezoidal arrangement, reddish, sometimes difficult to distinguish in preserved material. Antennae absent in all examined individuals (Fig. 4a). Palps long, broad, fused for their total length, with barely noticeable distal notch. Dorsal cirri very small, oval, slightly longer in the posterior region, lacking at chaetiger 2 (Fig. 3a). First four parapodia with 2 compound spiniger-like chaetae and 3–4 falcigers, after chaetiger 5 only 1 spiniger-like and 3 falcigers (Fig. 4c). Anterior spiniger-like compound chaetae with thick, distally spinulose shaft (Figs 3c, 4d), and thin, elongated blades 25–35 μm long; blades sometimes slightly curved with several long teeth on basal part (Figs 3c, 4d), difficult to see with the light microscope. Posterior spinigers-like chaetae similar but shorter and thinner, 15–20 μm long blades. Anterior falcigers with 7.5–10 μm long blade, with very small distal tooth, massive, strong proximal tooth, and relatively short, coarse serration along ventral edge (Figs 3d, 4e). Posterior falcigers shorter, blades 3.8–5 μm long, with thicker basal part. Anterior dorsal simple chaetae unidentate, smooth; posterior dorsal simple chaetae become distinctly thicker, with a subdistal notch (Fig. 3e). Ventral simple chaetae absent. Pharynx long, relatively wide, extending through six chaetigers, with a large, triangular distal tooth. Proventricle barrel-shaped, as long as pharynx, with 20–23 muscle cell rows. Pygidium sub-triangular with two very long, tapering anal cirri (Fig. 3b).

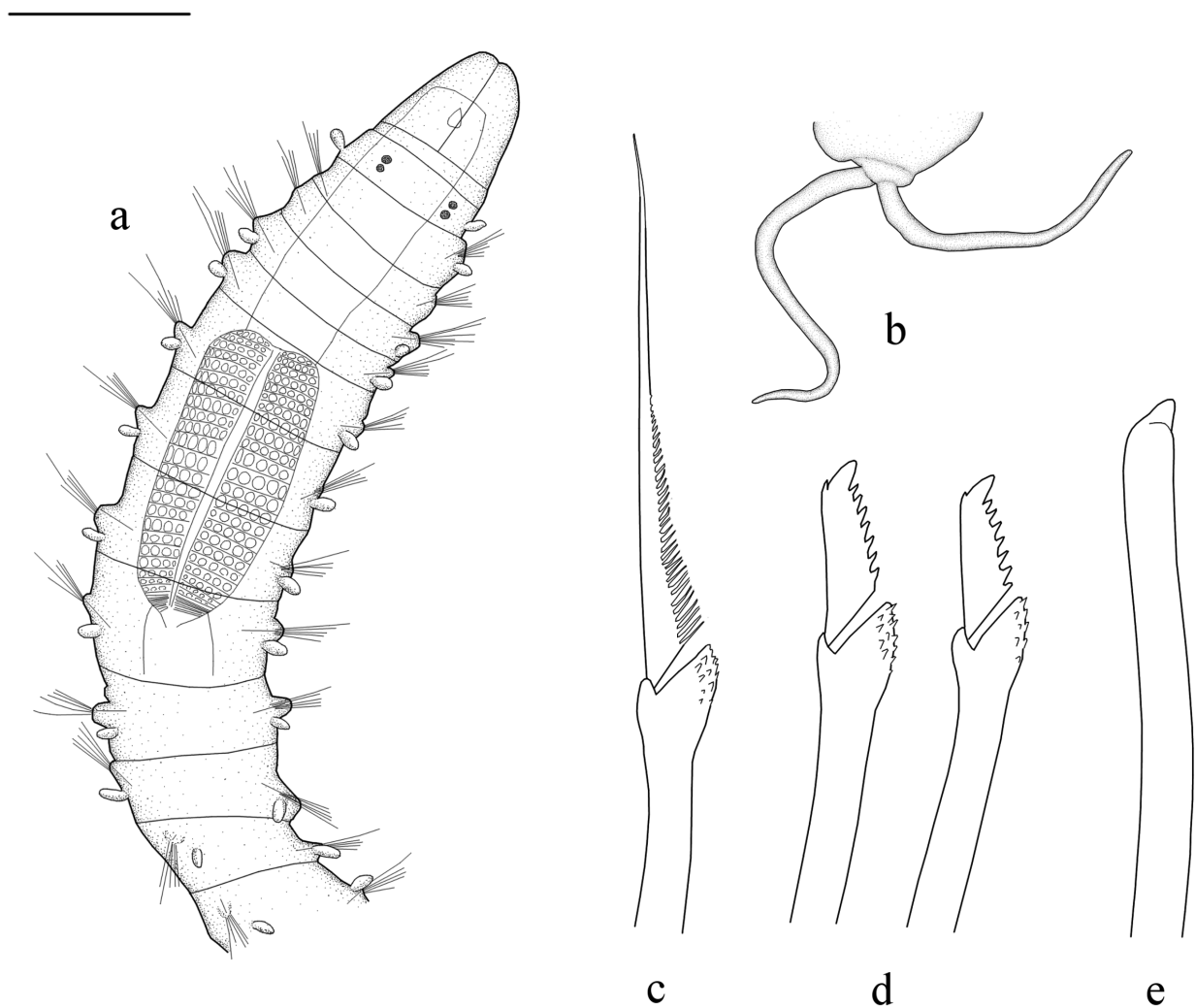


FIGURE 3. *Exogone sophiae* n. sp. Paratype (MSNP: P/0242/V) a) anterior end in dorsal view. Holotype (MSNP: P/3879): b) pygidium in dorsal view; c) spiniger-like chaeta from chaetiger 5; d) compound falciger chaetae from chaetiger 5; e) dorsal simple chaeta. Scale-bar: a–b: 0.20 mm; c–d–e: 7 μm .

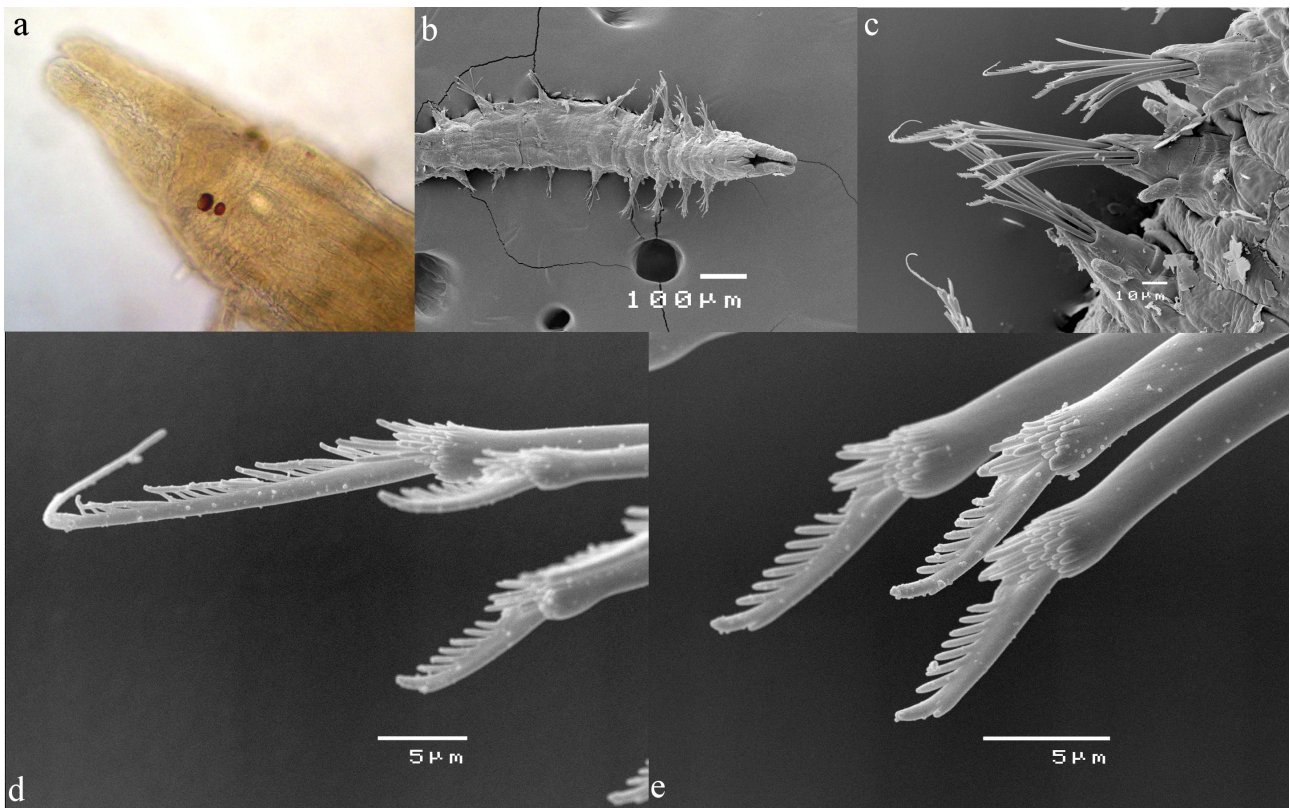


FIGURE 4. *Exogone sophiae* n. sp. Paratype (MSNP: P/001/SEM) a) Prostomium in dorsal view, showing the absence of antennae; b) anterior end in ventral view; c) anterior parapodia in ventral view; d) spiniger-like chaeta from chaetiger 2; e) falciger-like chaetae from chaetiger 2.

Etymology. This species is dedicated to Sophie Langeneck, sister of the first author.

Distribution. Tyrrhenian Sea, at a depth between 100 and 110 m.

Remarks. *Exogone sophiae* n. sp. is chiefly characterised by the absence of antennae; albeit preservation may cause the loss of antennae in some syllid species, we believe that this character is not a preservation artefact, as all the sampled individuals do not show any trace of antennae, nor of scars indicating the lost of antennae. Moreover, dorsal cirri are perfectly preserved, suggesting that preservation should not have altered the soft appendages of the collected specimens. Until now two species of *Exogone* without prostomial antennae have been described, namely *Exogone acerata* San Martín & Parapar, 1990, and *Exogone oculata* (Hartman & Fauchald, 1971) (San Martín, 1991). *E. sophiae* differs from *E. acerata* in the absence of dorsal cirri at chaetiger 2 (present in *E. acerata*), in the less pronounced spinulation on shafts of spiniger-like chaetae and in the longer spines on blades of spiniger-like chaetae (San Martín & Parapar, 1990). *Exogone sophiae* appears closer to *E. oculata*, as both species lack the dorsal cirrus at chaetiger 2, but *E. oculata* lacks spiniger-like chaetae on the first four chaetigers. Moreover, both species are provided of ventral simple chaetae, that are absent in all examined individuals of the new species.

Among Mediterranean species, *E. sophiae* appears particularly close to *Exogone verugera* (Claparède, 1868) and *Exogone dispar* (Webster, 1879) in size and overall body shape and number of proventricle cell rows. Apart from the absence of antennae, this species differs from *E. verugera* as *E. sophiae* has smaller, non-coalescent eyes, longer blades of falciger chaetae, with a higher number of marginal teeth, and slightly shorter blades of spiniger-like chaetae with a more pronounced spinulation along the ventral edge; moreover *E. sophiae* lacks ventral simple chaetae. *Exogone dispar* has similar blades of falciger chaetae, and a more pronounced spinulation along the ventral edge of spiniger-like blades (San Martín, 2003); however, in *E. sophiae* such spinulation is even more pronounced (Fig. 3d). Moreover, *E. dispar* has dorsal cirri at the second chaetiger. Lastly, *E. sophiae* might resemble *Exogone lopezi* San Martín, Ceberio & Aguirrezabalaga, 1996, since this last species apparently lacks ventral simple chaetae, and has very small antennae that are difficult to see. However, *E. lopezi* has falciger chaetae with long, thread-like marginal teeth that outgrow the chaetal tip, whereas in *E. sophiae* the marginal serration of falcigers is coarser and less developed.

Genus *Parapionosyllis* Fauvel, 1923: 289–290. Diagnosis follows San Martín (2005).

***Parapionosyllis labronica* Cognetti, 1965**

Parapionosyllis labronica Cognetti 1965: 68, Fig. 2; San Martín 1984a: 191–194, Pl. 41; San Martín 2003: 278–281, Figs 151–152.

Material examined. St. 10: 1 individual.

Distribution. Mediterranean Sea, Eastern Atlantic Ocean (San Martín 2003).

Remarks. The single, complete, well-preserved individual clearly corresponds to the original description (Cognetti 1965). It is noteworthy that this individual does not show parapodial glands, as in the original description (Cognetti 1965) and in other topotypic individuals from the Tyrrhenian Sea (*pers. obs.*). However, San Martín (2003) described *P. labronica* as a species with simple parapodial glands. This inconsistency between different descriptions may suggest that *P. labronica* actually represents a species complex.

Up to now this species appeared as typically related to shallow environments (Cognetti 1965; San Martín 2003), this is the first record in deep environments.

Genus *Parexogone* Mesnil & Caullery, 1918: 125. Diagnosis follows San Martín (2005)

***Parexogone campoyi* San Martín, Ceberio & Aguirrezabalaga, 1996**

Exogone (Parexogone) campoyi San Martín *et al.* 1996: 252–255, Figs 4–5; San Martín 2003: 244–247, Figs 131–132.
Parexogone campoyi Barroso *et al.* 2017: 408–411, Figs 4–6.

Material examined. St. 5: 1 individual; St. 11: 4 individuals; St. 12: 8 individuals; St. 13: 9 individuals; St. 14: 3 individuals; St. 15: 1 individual; St. 17: 2 individuals; St. 18: 2 individuals; St. 20: 1 individual.

Distribution. Eastern Atlantic Ocean (San Martín *et al.* 1996); Mediterranean Sea (Simboura & Zenetos 2005; Langeneck *et al.* 2017; present data); western Atlantic Ocean (Barroso *et al.* 2017).

Remarks. The examined individuals correspond to the original description (San Martín *et al.* 1996). *P. campoyi* is the most abundant Syllidae in Mediterranean deep environments below 900 m depth analysed in this study.

***Parexogone wolfi* (San Martín, 1991)**

(Figure 5)

Exogone (Parexogone) wolfi San Martín 1991: 726, Fig. 6; San Martín *et al.* 1996: 252, Fig. 3; San Martín 2003: 243–244, Figs 129–130.

Parexogone wolfi Böggemann & Purschke 2005: 223–225, Fig. 2; Böggemann 2009: 408–410, Figs 145–146; Barroso *et al.* 2017: 406–407, Fig. 3.

?*Paedophylax longicirris* Webster & Benedict 1887: 722, Figs 46–50.

?*Exogone longicirris* Perkins 1981: 1092, Fig. 11.

?*Parexogone longicirris* Lucas *et al.* 2017: 10–11, Fig. 2.

?*Exogone furcifera* Eliason 1962: 243–246, Fig. 11.

?*Exogone (Parexogone) canyonicolae* Sardá *et al.* 2009: 15–17, Fig. 7.

Material examined. St. 8: 4 individuals. St. 16: 3 individuals. St. 19: 2 individuals.

Description. All individuals lacking pygidium; two with regenerating anterior end. Best preserved individual ca. 6 mm long for 40 chaetigers, 0.20 mm wide. Prostomium wider than long, often hidden under dorsal part of peristomial segment, four rounded, relatively large eyes in trapezoidal arrangement (absent in regenerating individuals). Palps ca. twice as long as prostomium, entirely fused, clearly pointed; antennae well-developed, median one slightly longer than palps, lateral antennae ca. half as long as median one. Dorsal cirri oval, small, present in all chaetigers. Parapodia well-developed, with 8–14 compound chaetae, blades bidentate. Two spiniger-like chaetae with distinctly long, slightly sinuous blade (45–55 µm in the anterior part, 50–70 µm in the midbody,

30–45 μm in the posterior part of the body), with a strong serration in the distal part, less evident towards basal part (Fig. 5b). Several falcigers on each parapodium, with distinctly shorter blades and strong serration, with some longer spines distally, decreasing in size from the dorsal part of parapodium to the ventral one, approximately 15–25 μm in the anterior part of the body, 10–20 μm in the midbody, 15–8 μm in the posterior part of the body (Fig. 5c). Pharynx slender, longer than proventriculum, through 4 segments, bearing a strong, triangular tooth on anterior margin; proventricule short, through two segments approximately, with 15–17 cell rows.

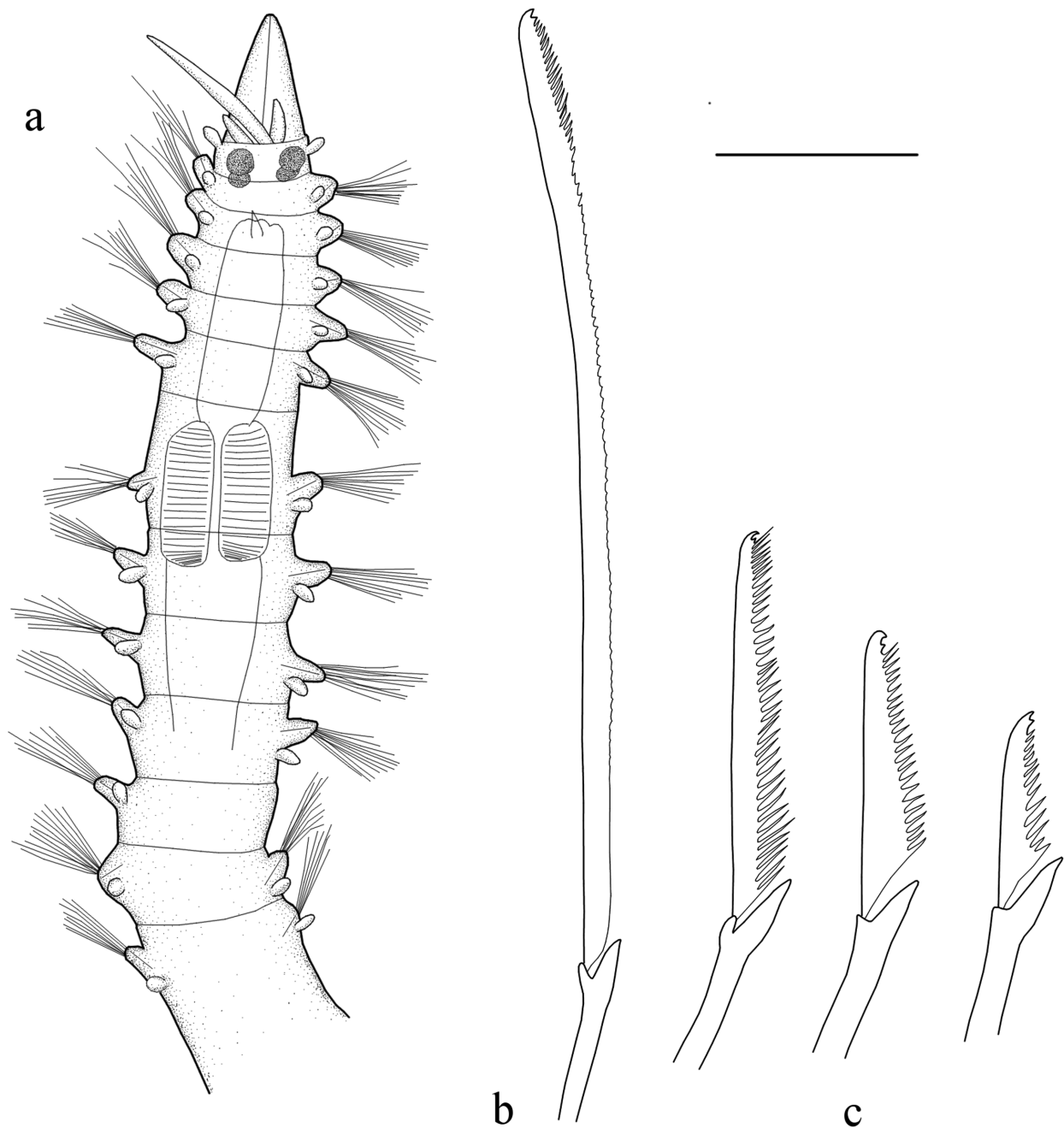


FIGURE 5. *Parexogone wolfi* San Martín, 1991 (St. 8, 110 m). a) anterior end in dorsal view; b) compound chaetae. Scale-bar: a: 0.30 mm; b–d: 15 μm .

Distribution. Western Atlantic Ocean (San Martín 1991; Barroso *et al.* 2017); Eastern Atlantic Ocean (San Martín *et al.* 1996; Böggemann 2009); Pacific Ocean (dubious) (San Martín 2005); Eastern Mediterranean Sea (Simboura & Zenetos 2005); from ca. 100 m depth (Simboura & Zenetos 2005) to more than 5000 m depth (Böggemann 2009). This is the first record of the species for the Western Mediterranean.

Remarks. *Parexogone wolfi* is one of the most widespread deep-water Exogoninae and shows remarkably wide depth range adaptation (San Martín 2003). The available descriptions, however, highlight slight differences between individuals from different areas, which might represent a clue of cryptic speciation (Barroso *et al.* 2017). For instance, shallow water (8 m depth) Pacific individuals are distinctly thinner, with a couple of additional eyespots and shorter spiniger-like chaetae in respect to the original description (San Martín 2005), which in our opinion suggests that they may represent an undescribed species.

Parexogone wolfi closely resembles *P. canyonicolae*, which differs mainly in measuring 2.5 mm long for 50 chaetigers, (ca. 6 mm and 40 chaetigers in *P. wolfi*). Therefore, the possibility that *P. canyonicolae* might just represent a juvenile stage of *P. wolfi* cannot be ruled out. On the other hand, *Exogone longicirris* Webster & Benedict, 1887 has been recently assigned to *Parexogone*, and closely resembles *P. wolfi*. The main differences are only a slightly lower number of proventricular cell rows (11–14 vs 15–21) and a less pronounced spinulation along the blade edge (Eliason 1962; Lucas *et al.* 2017). The spinulation of compound chaetae, however, shows geographical variability, as the Brazilian specimens examined by Barroso *et al.* (2017) show less pronounced spines than those reported in the original description (San Martín 1991), thus appearing closer to *P. longicirris*. Taking into account the current knowledge (including the similar depth range and geographical distribution), a synonymy between *P. wolfi* and *P. longicirris* cannot be ruled out.

Genus *Prosphaerosyllis* San Martín, 1984: 384. Diagnosis follows San Martín (2005)

***Prosphaerosyllis danovaro* Langeneck, Musco & Castelli n. sp.**

(Figure 6)

Material examined. Holotype (MSNP: P/253/V): St. 11, Sardinian Slope, 600 m depth. Paratypes: St. 8: 2 individuals (MSNP: P/239/V); St. 11: 3 individuals (MSNP: P/237/V; P/3887; P/3888); St. 13: 1 individual (MSNP: P/3889).

Description. All individuals lack pygidium. Holotype 2 mm long for 28 chaetigers, 0.16 mm maximum width. Body elongated, thread-like; anterior segments short, more elongated after proventricle, giving a moniliform appearance (Fig. 6a). Dorsal papillae small, scattered, not very conspicuous. Prostomium small, oval, fused with palps, with a small, pointed median antenna; lateral antennae smaller than median antenna, with rounded tip. Four small eyes in open trapezoidal arrangement, only seen in two paratypes (Fig. 6g). Palps entirely fused, covered by several, distinct papillae. Peristomial and dorsal cirri very small, papilliform, becoming slightly more elongated posteriorly.

Parapodia well-developed, conical, each with single dorsal simple chaeta, ventral simple chaeta and up to seven compound chaetae on anterior parapodia, diminishing progressively to five posteriorly. Compound chaetae hemigomph, with both hinges of shafts almost of same length (Fig. 6c); blades approximately 5 µm long, short, slightly hooked, unidentate, smooth. Dorsal simple chaetae slightly hooked, slightly spinulated subdistally (Fig. 6d); ventral simple chaetae similar in shape, distinctly thinner, smooth (Fig. 6e). Aciculae robust, thick, with widened subdistal region and slightly deviated tip (Fig. 6f). Pharynx relatively short and wide, through three chaetigers. Small, triangular, thin tooth, located close to pharyngeal opening (Fig. 6g), not seen in holotype and other paratypes. Proventricle long and wide, barrel-shaped, through four chaetigers (Fig. 6a), with 20–23 cell rows.

Etymology. The new species is dedicated to Prof. Roberto Danovaro, in recognition of his important scientific contributions to the knowledge of the Mediterranean deep-sea.

Distribution. Western Mediterranean Sea: Sea of Sardinia (type locality), Tyrrhenian Sea.

Remarks: One of the paratypes is a mature female, with very large intra-coelomic oocytes from chaetiger 10 to chaetiger 27. Individuals from the shallowest station (St. 8) show four very small, black eyes in trapezoidal arrangement. *Prosphaerosyllis danovaro* n. sp. resembles *Prosphaerosyllis giandoi* (Somaschini & San Martín 1994) in the extremely small size of antennae and cirri, as well as the hemigomph articulation of compound chaetae and the moniliform body. However, it differs in the absence of eyes (which may be present but being very small) and eyespots (four very large eyes and two eyespots in *P. giandoi*), in the blades of compound chaetae (5 µm in *P. danovaro* n. sp. for 9–10 µm in *P. giandoi*), in the body size (0.16 mm width, 28 chaetigers an incomplete individual of *P. danovaro* n. sp. for 0.12 mm width, 23 chaetigers a complete individual of *P. giandoi*) and in the

bathymetric distribution, circalittoral to bathyal (110–1200 m depth) in *P. danovaro* **n. sp.** vs. shallow waters (0–30 m depth) for *P. giandoi* (Somaschini & San Martín 1994; Olivier *et al.* 2012). *Prosphaerosyllis adela* San Martín, 1984b is also characterised by falcigers with hemigomph articulation and by papilliform cirri, but in this species the prostomium is usually retracted under the peristomium, and aciculae show a subdistal crown of spines. Also *Prosphaerosyllis opisthocolata* (Hartmann-Schröder, 1979) is characterised by hemigomph falcigers, but dorsal cirri are distinctly larger, and this species is provided with well-developed eyes hidden by the dorsal part of the peristomium. All remaining species of the genus *Prosphaerosyllis* are characterised by heterogomph articulation of falcigers and larger dorsal cirri and therefore can be readily distinguished from *P. danovaro* **n. sp.** (San Martín 2005; Ding and Westheide 2008; Fukuda *et al.* 2009; Çinar *et al.* 2011; Olivier *et al.* 2012; Salcedo *et al.* 2016).

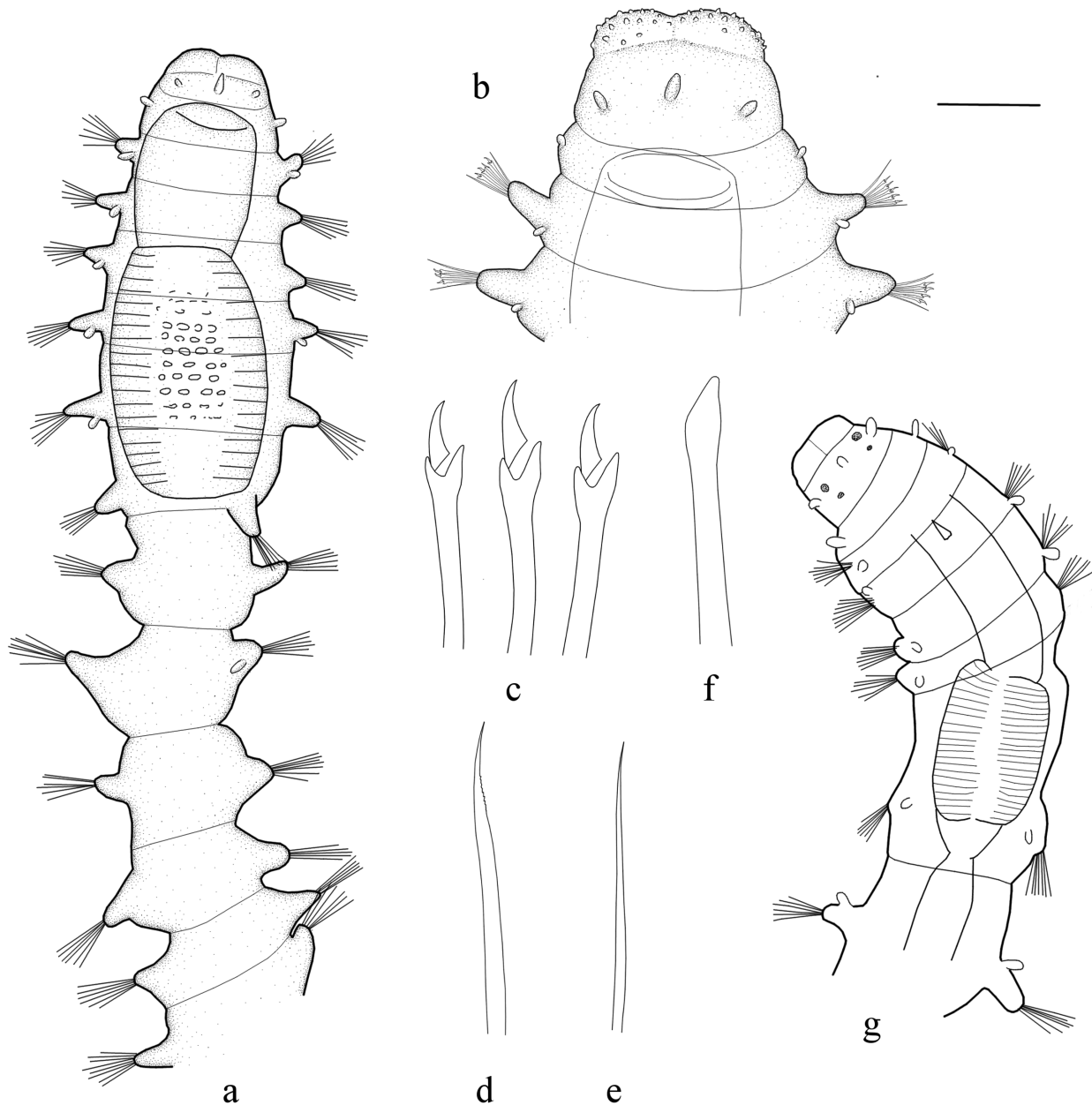


FIGURE 6. *Prosphaerosyllis danovaro* **n. sp.** Holotype (MSNP: P/253/V): a) anterior end in dorsal view; b) close-up of the prostomium, dorsal view; c) compound chaetae; d) dorsal simple chaeta; e) ventral simple chaeta; f) acicula. Paratype (MSNP: P/239/V): g) anterior end in dorsal view. Scale-bar: a, g) 0.10 mm; b) 60 μ m; c–f) 6 μ m.

Subfamily Syllinae Grube, 1850

Genus *Eurysyllis* Ehlers, 1864: 264. Diagnosis follows San Martín *et al.* (2008)

Eurysyllis tuberculata Ehlers, 1864

Eurysyllis tuberculata Ehlers 1864: 264–268, Pl. 11, Figs 4–7; Fauvel 1923: 271–272, Fig. 101 i–o San Martín 2003: 296–300, Figs. 162–164; San Martín *et al.* 2008: 141–144, Fig. 20.
Polymastus paradoxus Claparède 1864: 569–571, Pl. 8, Fig. 3.
Eurysyllis paradoxa Saint-Joseph 1887: 191–195, Figs 68–74.
Eurysyllis lenta Quatrefages 1866: 59–60, Pl. 8, Figs 18–23.

Material examined. St. 1: 1 individual.

Distribution. Mediterranean Sea, Atlantic Ocean, Red Sea (San Martín 2003) and Pacific Ocean (San Martín *et al.* 2008).

Remarks. The specimen agrees well with the description given by San Martín (2003). In the Mediterranean Sea this species is common in infralittoral algal assemblages suffering sediment deposition, it is less common on muddy bottoms and among circalittoral and bathyal white coral reefs. *E. tuberculata* has been reported from the surface down to 760 m depth (San Martín 2003), even though it is rare in deep environments. Following Nygren (2014) hypothesis on Syllidae species reported to have extremely wide geographical distributions and generalist environmental requirements, *E. tuberculata* could actually represent a species complex.

Genus *Syllis* Lamarck, 1818: 317. Diagnosis follows Álvarez-Campos *et al.* (2015)

Syllis parapari San Martín & López, 2000

Syllis parapari San Martín & López 2000: 426–429, Figs 1–2; San Martín 2003: 409–413, Figs 224–225.
Langerhansia cornuta (Rathke, 1843) *sensu* Campoy 1982: 378–386; Pls. 34–35.

Material examined. St. 8: 9 individuals; St. 10: 1 individual.

Remarks. The specimens agree well with the description by San Martín (2003). The Mediterranean species of *Syllis* with spiniger-like chaetae show different ecological requirements and bathymetric distributions. *Syllis parapari* mainly occurs on circalittoral muddy sands and mud between 20 and 60 m (Çinar & Ergen 2003; Faulwetter *et al.* 2011; Mikac 2015), being replaced by *Syllis* sp. 1 (present paper) in bathyal bottoms. The present ones represent the first records for the Tyrrhenian Sea and expand the species' depth range towards deeper circalittoral environments.

Distribution. Atlantic coast of the Iberian peninsula (San Martín 2003), Adriatic Sea (Mikac 2015), Eastern Mediterranean Sea (Çinar & Ergen 2003; Faulwetter *et al.* 2011), and possibly Indopacific area (San Martín 2003; Aguado *et al.* 2008). In addition, a number of questionable Mediterranean records of *S. cornuta* probably refer to *S. parapari*, since the former does not occur in this sea (Licher 1999). However, these questionable records refer to a variety of Mediterranean bottoms, and may possibly belong to several different species (Mikac & Musco 2010; Mikac 2015). Therefore, the actual distribution of *S. parapari*, especially in the Mediterranean Sea, is currently unknown.

Syllis profunda Cognetti, 1955 stat. nov.

(Figure 7)

Syllis variegata profunda Cognetti 1955: 3, Fig. 2b; Cognetti 1957: 20–21, Fig. 4b.
Syllis alternata Moore, 1908 *sensu* Çinar & Gambi 2005: 754–755.
?*Syllis alternata* Moore, 1908 *sensu* Çinar & Ergen 2003 *partim*: 777–778.

Material examined. Holotype: SZN-POL31: Grotta Azzurra, 100 m (04/09/1955). Additional material: St. 7: 3 individuals; St. 8: 2 individuals; St. 9: 1 individual.

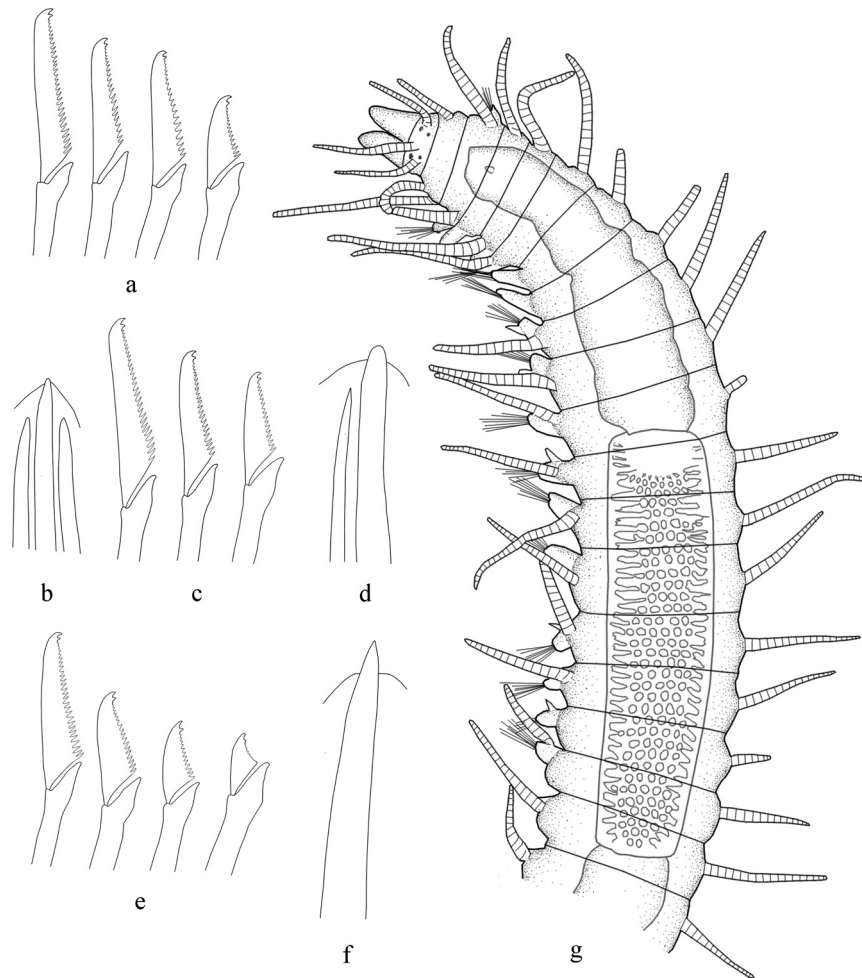


FIGURE 7. *Syllis profunda* Cognetti, 1955. Holotype (SZN: SZN-POL31, Grotta Azzurra, 100 m): a) compound chaetae from the anterior part of the body; b) aciculae from the anterior part of the body; c) compound chaetae from the midbody; d) aciculae from the midbody; e) compound chaetae from the posterior part of the body; f) acicula from the posterior part of the body. Non-type individual (St. 9, 180 m): g) anterior end in dorsal view. Scale-bar: a–f: 30 μ m; g: 0.40 mm

Description. Holotype with regenerating anterior end, 11.3 mm long, 0.29 mm wide for 90 chaetigers. Prostomium (regenerated) oval, palps approximately 1.5x as long as prostomium; four reddish eyes in subtrapezoidal arrangement. Median antenna with 22 articles, lateral antennae with 15 articles. Dorsal cirri slender, moniliform, alternating in length, with 25–49 articles anteriorly, 20–40 articles at mid-body, and 28–30 articles posteriorly. Anterior parapodia with 6–8 compound chaetae, two distinctly longer, 2–4 of intermediate size and two short (Fig. 7a); mid-body parapodia with 5–6 compound chaetae, one long, 3–4 intermediate and one short (Fig. 7c); posterior parapodia with 5–6 compound chaetae, one longer, two intermediate, 2–3 short (Fig. 7e). Blades of compound chaetae 42 to 17 μ m long, strongly bidentate, with subdistal tooth similar in size to distal one, and a coarse, moderately long ventral serration. Simple chaetae absent. Parapodia well-developed: anterior parapodia with 3 aciculae of similar thickness, central one slightly thicker and longer (Fig. 7b); midbody parapodia with 2 aciculae, larger acicula with tip progressively broad, smaller acicula pointed, straight (Fig. 7d); posterior parapodia with single, thick acicula, distally pointed (Fig. 7f), protruding out from parapodial lobes. Pharynx and proventricle impossible to notice in the regenerating individual.

Specimens from northern Tyrrhenian Sea (Fig. 7g) with very long, relatively wide pharynx, through nine chaetigers, with a small tooth close to opening; proventricle long, barrel-like, through 8 chaetigers, with ca. 35–40 muscle cell rows. Largest entire individual measuring ca. 20 mm long, 0.60 mm wide for 136 chaetigers, with up to 12 compound chaetae anteriorly, 10 at mid-body, and 8 posteriorly. Chaetae and aciculae as in holotype; anterior

parapodia with three aciculae, simple chaetae always absent. Colour in living specimens pale brown to yellowish; yellowish when preserved.

Distribution. Mediterranean Sea, from the Gulf of Naples (Cognetti 1955) to the Northern Tyrrhenian Sea (present data) and probably Levant Sea as *S. alternata* in Çinar & Ergen (2003); on hard and soft circalittoral bottoms (90–180 m, our data), including assemblages dominated by *Leptometra phalangium* and sponges. Other records of *S. alternata* in deep environments probably correspond to *S. profunda*.

Remarks. *Syllis alternata* was described by Moore (1908) from muddy bottoms between 15 and 350 m depth in the north Pacific Ocean and includes at least five cryptic Pacific species (Carr *et al.*, 2011). In the Mediterranean, this species has been reported mostly from shallow, hard bottoms, such as calcareous algae and coralligenous bottoms (San Martín 2003); such clear differences in ecological requirements in respect to the original description suggest that these hard bottom records might possibly belong to a different, undescribed species. However, other Mediterranean records of *S. alternata* refer to circalittoral habitats, i.e. hard bottoms (100 m) of the Gulf of Naples (Cognetti 1955—as *S. variegata profunda*) and muddy bottoms (90 m) of the Eastern Mediterranean Sea (Çinar & Ergen 2003). It is worth noting that the type material of *S. alternata* from the Pacific Ocean, shows pseudo-spiniger compound chaetae (Licher, 1999), which are neither present in the shallow-water, nor in the deep-water Mediterranean specimens. The examination of the holotype of *S. variegata profunda* Cognetti, 1955 showed that chaetal features are identical to the presently reported deep-water material, even if the dark pigmentation in peristomium reported by Cognetti (1955) is not visible anymore. This species was considered synonymous with *S. alternata* by Çinar and Gambi (2005); on the basis of the mentioned difference, we here consider *S. variegata profunda* a clearly different species, and in addition raise it to species rank as *Syllis profunda* Cognetti, 1955. The shallow-water Mediterranean specimens of *Syllis alternata sensu* San Martín (2003) differ from the deep water ones in having up to seven aciculae in the anterior parapodia (three in *S. profunda*), the blades of compound chaetae up to 60 µm (up to 45 µm in *S. profunda*) and the presence of simple chaetae (absent in *S. profunda*) (San Martín 2003). We here consider them as separate taxa, even if molecular analyses may be useful to correctly assess this taxonomic issue.

***Syllis* sp. 1**

(Figure 8)

Langerhansia caeca Katzmann 1973: 439–442, Fig. 3; Arvanitidis 2000: 77.

Typosyllis caeca Licher 1999: 64–66, Fig. 29.

Syllis katzmanni Arvanitidis 1994: 98–100.

Material examined: St. 3: 1 individual; St. 6: 1 individual; St. 11: 5 individuals; St. 12: 2 individuals.

Description. All individuals incomplete; best preserved individual 48 chaetigers for ca. 8 mm total length, 0.37 mm maximum width (Fig. 8a). Body thin, slender, elongate; prostomium ovate, distinctly wider than long, without eyes, palps elongate, distally rounded, longer than prostomium. Antennae, peristomial cirri and dorsal cirri moniliform, articulated, similar in shape, easily breakable; median antenna with more than 20 articles, lateral antennae with 10–15 articles, peristomial cirri and first dorsal cirri with up to 15 articles, then becoming shorter (7–9).

Parapodia well-developed, with two aciculae of similar shape, pointed, subdistally slightly enlarged; in anterior parapodia both aciculae similar in size; in midbody parapodia one acicula distinctly larger than other; in posterior parapodia single acicula, with slightly enlarged subdistal region and rounded tip. Up to 10 compound chaetae with smooth, heterogomph shafts: 1–2 long spiniger-like chaetae, with extremely long blade (80–100 µm), unidentate, with almost smooth margin (Fig. 8b); 1–3 shorter spiniger-like chaetae, with shorter blades (40–50 µm), finely bidentate, with almost smooth ventral edge (Fig. 8c); and 4–5 falcigers, with shorter blade (35–17 µm), bidentate, with finely serrated edge and slightly rounded tip (Fig. 8d). Simple capillary chaetae apparently absent. Pharynx through 6 chaetigers, relatively broad, with small, pointed tooth; proventricle through 7 chaetigers, with 31–34 muscle cell rows.

Distribution. Adriatic Sea (Katzmann 1973), Aegean Sea (Arvanitidis 2000), Levant Sea (Çinar & Ergen 2003), Sicily Channel and Sea of Sardinia; from deep circalittoral (140 m depth) of the Adriatic Sea (Katzmann 1973 Cantone & Di Pietro, 2002) to bathyal (500 and 1000 m depth with compact, clayish muds) bottoms (Arvanitidis 2000; Çinar & Ergen 2003). Records of this species (as *Syllis caeca*/*Langerhansia caeca*) from sciaphilous hard bottoms habitats at distinctly lower depths (10–45 m) (Campoy 1982; Rubbiani 1986; Sardá 1991) most likely refer to a different species.

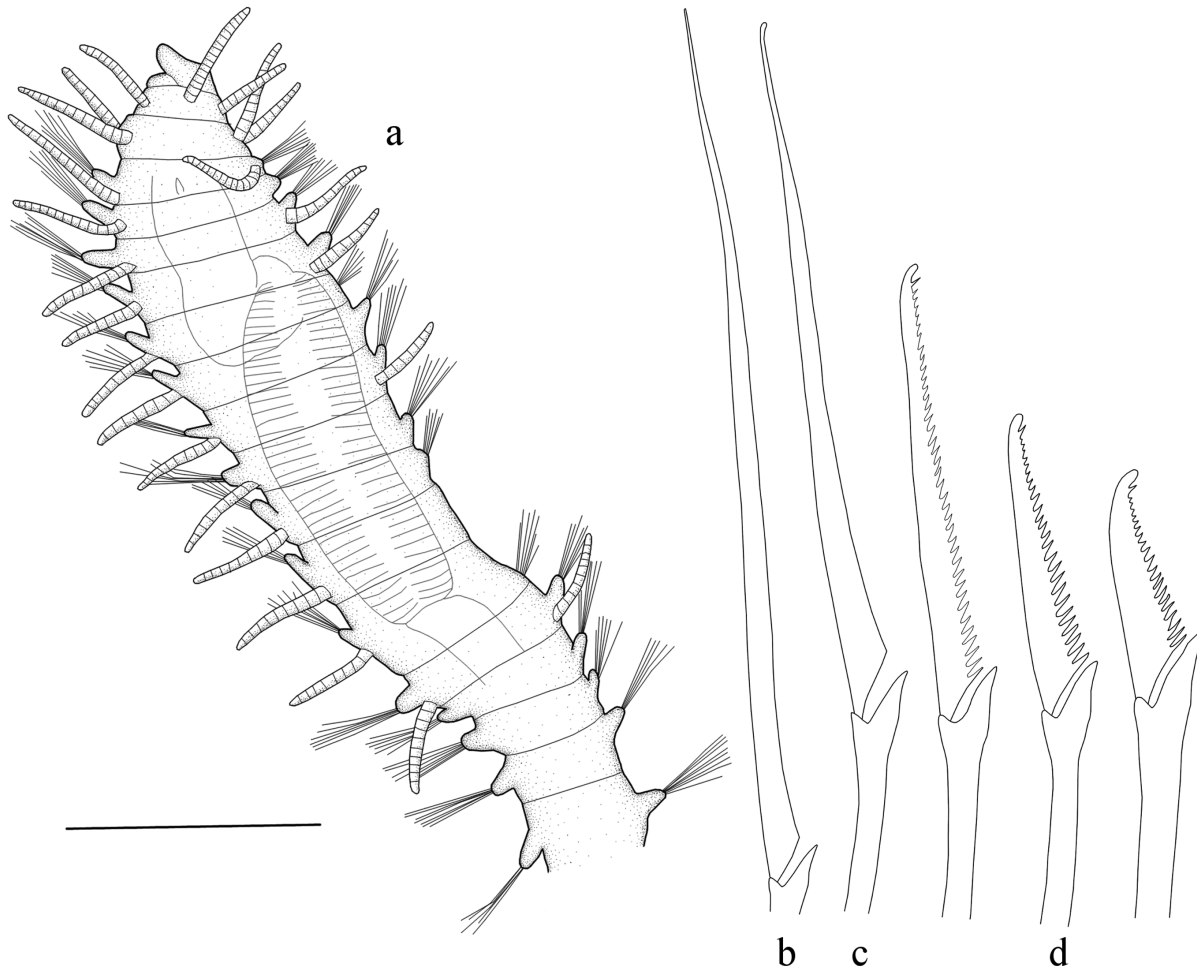


FIGURE 8. *Syllis* sp. 1 (St. 12, 900 m): a) anterior end in dorsal view; b) long spiniger-like chaeta from anterior chaetigers; c) short spiniger-like chaeta from anterior chaetigers; d) falcigers chaetae from anterior chaetigers. Scale-bar: a: 0.5 mm; b–d: 20 μ m.

Remarks. The morphology of the examined individuals agrees with that of the type material of *Langerhansia caeca* Katzmann, 1973 redescribed by Licher (1999) as *Typosyllis caeca*, even if secondary teeth in falciger chaetae are often difficult to see at 400x magnification. The only remarkable difference is the less pronounced spinulation along the ventral edge of spiniger chaetae. This species was described as *Langerhansia caeca* by Katzmann (1973) for the central Adriatic Sea. *Langerhansia* Czerniavsky, 1881 is currently a synonymy of *Syllis* Lamarck, 1818. However, the name is preoccupied by *Syllis caeca* Monro, 1933. Hence, the species was renamed as *Syllis katzmanni* Katzmann, 1973 by Arvanitidis (1994). Later, Licher (1999), placed *Langerhansia caeca* in *Typosyllis*, thus resurrecting *Typosyllis caeca* (with *T. katzmanni* as synonymy). Since Licher's use of *Typosyllis* is not widely accepted (San Martín 2003), and the taxonomy of *Syllis* is currently unclear (Aguado *et al.* 2012), Katzmann's original name (*L. caeca*) in the current combination would be unavailable. However, according to ICZN rules (ICZN code, art. 8) Arvanitidis' name (*S. katzmanni*) is not valid, as the dissertation where it was provided has not been published.

Our data confirm the bathymetric range, as well as the peculiar ecological requirements of this species, which appears to be the deepest Syllinae species occurring in the Mediterranean Sea.

?*Syllis* sp. 2

(Figure 9a–f)

Material examined. St. 3: 1 individual.

Description. Anterior fragment, 5 mm long, 0.35 mm wide for 44 chaetigers (Fig. 9a). Prostomium ovate, distinctly broader than long, with four small eyes in trapezoidal arrangement, palps united at the basis, longer than the prostomium. Antennae, tentacular cirri and dorsal cirri articulate, similar in length, approximately $\frac{1}{2}$ to $\frac{3}{4}$ of body width; antennae and tentacular cirri incomplete or broken, dorsal cirri of the same length throughout the body, with 20–25 articles. Parapodia well developed, with two aciculae similar in size anteriorly (Fig. 9e), becoming clearly different around chaetiger 30, larger one with squared to rounded tip, smaller one with pointed tip anterior parapodia with two aciculae of similar size (Fig. 9e), whilst around chaetiger 30 clearer difference in size (Fig. 9f). Up to 10 compound heterogomph falcigers per parapodium; anterior 4–5 parapodia dorsal chaeta with distinctly longer blade (Fig. 9c); blades slightly bidentate, with short spines on margin (Fig. 9c), midbody parapodia with a gradual gradation in size of blades (Fig. 9d), hooked, smooth on margin or with very short spines on margin. Blades of compound chaetae 30–20 μm long in anterior parapodia, gradually decreasing to 20–15 μm in midbody. Dorsal simple chaetae straight, with slightly curved tip and slightly serrated subdistally (Fig. 9b). Pharynx through five chaetigers, long and narrow, with a slightly backward pharyngeal tooth large, triangular. Proventricle through six chaetigers, with ca. 40 cell rows. Colour yellowish; chaetigers 3–11 with a thin dark bar along its posterior edge; posterior peristomium slightly darker in the freshly fixed individual, evenly whitish some months after fixation.

Distribution. Southern Adriatic Sea, at 730 m depth.

Remarks. The examined specimen shows intermediate features between the genera *Syllis* Lamarck, 1818 and *Opisthosyllis* Langerhans, 1879. Similarly, to *Opisthosyllis* it has a large tooth inserted backwards to the anterior part of the pharynx and compound chaetae sub-bidentate to unidentate; however, it does not show any trace of the occipital flap typical of *Opisthosyllis*. Moreover, the position of the pharyngeal tooth is relatively close to the pharynx opening for *Opisthosyllis*, and compatible with that of some species of the genus *Syllis* (Licher 1999; San Martín 2003). Among the currently known species of the genus *Opisthosyllis* the herein reported specimen appears close to *Opisthosyllis flaccida* (Grube, 1878) from the Pacific Ocean in the joint occurrence of bidentate compound chaetae with relatively small secondary tooth and unidentate chaetae, gradually becoming shorter towards the posterior end. It differs from this last species as the pharyngeal tooth is more massive (thin, dagger-like in *O. flaccida*), the dorsal cirri have 20–25 articles (26–40 in *O. flaccida*) and anterior parapodia have two aciculae (four in *O. flaccida*). Moreover, *O. flaccida* does not have compound chaetae with distinctly longer blade in anterior parapodia (Licher 1999; Aguado *et al.* 2008). These specimens most likely represents an undescribed species, but the currently available material is too scarce to proceed with a formal description.

Incertae sedis sensu Aguado et al. (2012)

Genus *Anguillosyllis* Day, 1963: 400. Diagnosis follows Aguado & San Martín (2008).

Anguillosyllis sp.

(Figure 9g–j)

Material examined. St. 16: 1 individual.

Description. Specimen complete, 2 mm long and 0.17 mm wide for 14 chaetigers (Fig. 9g). Prostomium ovate, broader than long, difficultly distinguishable from palps; palps distally acute, completely fused, without traces of longitudinal furrow. Eyes absent, lateral antennae short, papilliform; median antenna almost as long as the prostomium, digitiform, backwards directed. One pair of very long, thin cirri on peristomium. Segments becoming wider towards posterior part of body. Parapodia rectangular, elongated, dorsal cirri not seen, with 6–9 long chaetae. Dorsal simple chaeta very long and thin, with rounded tip and a well-developed subdistal spine (Fig. 9h); compound chaetae with smooth shafts, strong dorso-ventral gradation in the size of blades, from approximately 80 μm most dorsal to 12 μm most ventral. All blades unidentate, with smooth edge and blunt tip, longer blades slightly sinuous, shorter blades straight (Fig. 9i). One robust acicula, with briskly crooked tip, forming a ca. 90° angle (Fig. 9j). Pygidium rounded, wide, anal cirri not seen. Pharynx and proventricle difficult to distinguish; pharynx narrow, through three segments, without pharyngeal tooth; proventricle barrel-shaped, through two chaetigers, with 12–15 muscle cell rows.

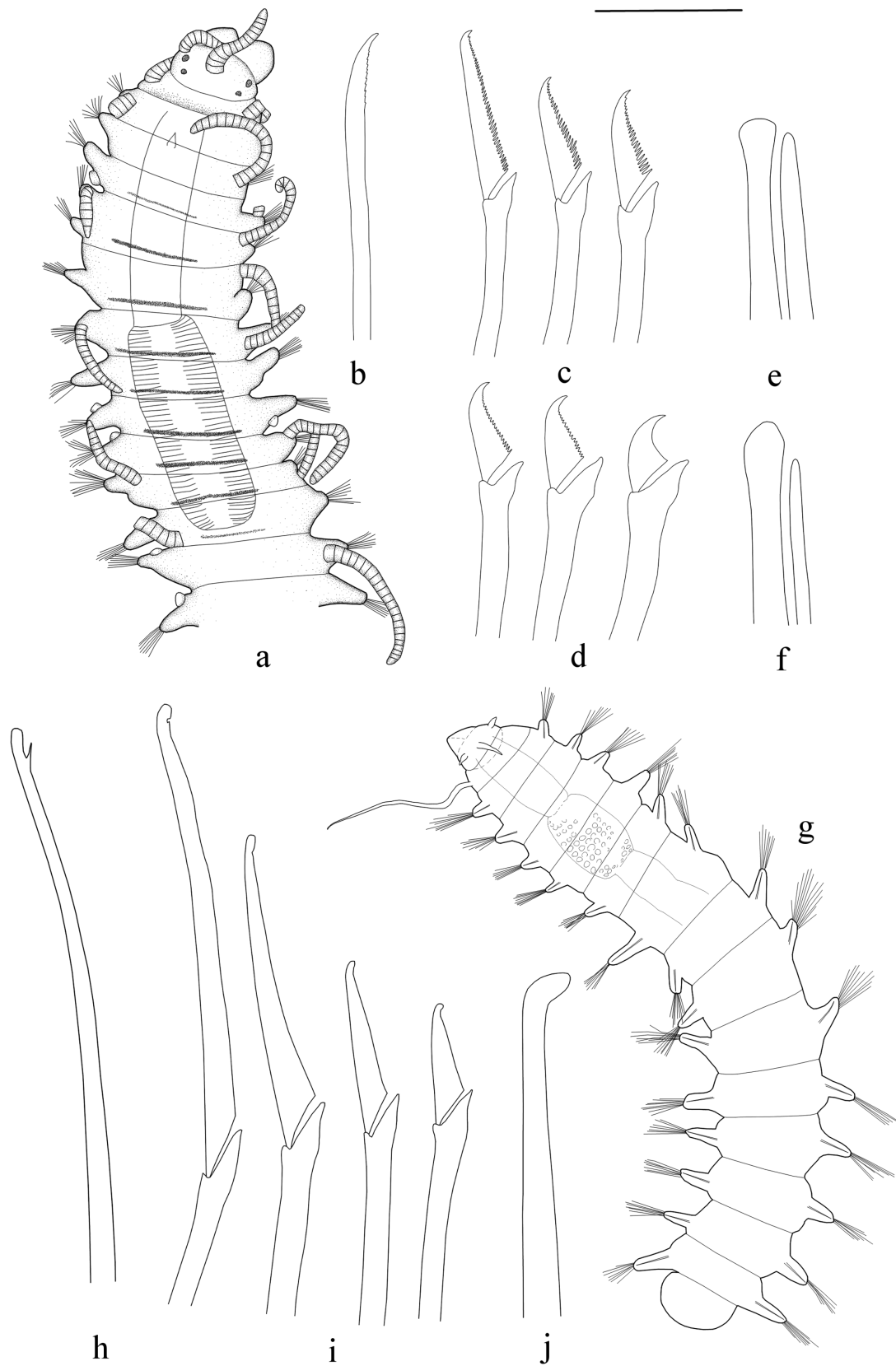


FIGURE 9. a–f) *?Syllis* sp. 2 (St. 3, 730 m): a) anterior end in dorsal view; b) dorsal simple chaeta; c) compound chaetae from the anterior part of the body; d) compound chaetae from the midbody; e) aciculae from the anterior part of the body; f) aciculae from the midbody. g–j) *Anguillosyllis* sp. (St. 16, 2100 m): g) complete individual in dorsal view; h) dorsal simple chaeta; i) compound chaetae; j) acicula. Scale-bar: a: 0.32 mm; b–f: 30 μ m; g: 0.20 mm; h–j: 25 μ m.

Distribution. Sardinian Slope, at 2100 m depth.

Remarks. The low number of body segments, along with the pharynx without tooth, the small size of antennae and the completely fused palps allow to assign the examined individual to the genus *Anguillostylis* Day, 1963 (Aguado & San Martín 2008). The morphology of the examined specimen, however, does not correspond to any of the four known species of *Anguillostylis*. The entirely fused palps resemble those in *A. lanai* Barroso, Paiva, Nogueira & Fukuda, 2017 and *A. pupa* (Hartman, 1965), while the shape of antennae and the number of proventricle cell rows resemble those of *A. lanai* (Barroso *et al.* 2017). However, it differs from the latter in having the blades of compound chaetae up to 80 µm long (up to 170 µm in *A. lanai*), up to 8 compound chaetae (up to 15 in *A. lanai*) and the parapodial glands absent (present in *A. lanai*). Our specimen shows 14 chaetigers (10 or 11 in all known *Anguillostylis* species), thin elongate tentacular cirri (papilliform in the other species) and a crooked acicula (unknown in the other species). Overall, our specimen seems to belong to an undescribed species. However, we consider our single individual in poor preservation status (most appendages are lacking) as not enough to formally describe it as a new species. Nonetheless, it represents the first Mediterranean record of the genus.

Discussion

The present work is the first to convey Syllidae samples from several separated studies in order to give a wider insight on the taxonomy and diversity of family in the deep Mediterranean Sea. Some sampling sites (St. 7–10) were under the shallow limit of the Mediterranean Sea (200 m depth according to Danovaro *et al.*, 2010). However, these last sites were characterised by a mixture of typical deep-sea and shallow-water species, which makes the depths between 100 and 200 m very interesting from an ecological point of view. Shallow-water eurybathic Syllidae as *E. naidina*, *P. labronica* and *S. hystrix* may reach these depths, where typical deep-sea species like *E. barbarae*, *P. wolffi*, *P. danovaro*i and *Syllis* sp. 1 have their upper limit of bathymetric distribution. It is worth mentioning that the presence of shallow-water species such as *E. naidina* and *E. tuberculata* in deep-sea environments may suggest possible cryptic, or pseudocryptic, speciation. In fact, in this work we confirm the validity of *S. profunda*, that was considered until now synonymous with *S. alternata*, and describe *E. sophiae* **n. sp.**, a circalittoral species close to *E. verugera* but showing stable differences. The scarce material available does not allow to identify *Anguillostylis* sp. and ?*Syllis* sp. 2, but they most likely represent undescribed species. The remaining two new species here described, *E. barbarae* **n. sp.** and *P. danovaro*i **n. sp.** are very small sized, and this might have prevented their discovery in previous studies focusing on macrofauna, in spite of their wide distribution and bathymetric range. Deep-sea Mediterranean Syllidae are still poorly known, and we expect the discovery of some undescribed taxa together with the collection of additional material.

The missed detection of the high syllid diversity that we observed in the Mediterranean deep sea, despite the high number of oceanographic cruises and researches carried out, can be explained by operative features of study approaches commonly employed. The extremely small size of the majority of deep-sea Syllidae most likely led to underestimate the abundance and diversity of this family in studies focused on macrobenthos. Sediment samples are most often sieved with a 0.5 mm mesh, which can cause the loss of very small species, as *P. danovaro*i. Studies on deep-sea meiobenthos usually focus on other, more abundant taxa, such as nematodes, that are considered more informative in studies aimed at assessing biodiversity patterns (Soetaert *et al.* 1995; Danovaro *et al.* 2009). Despite the small size, the Syllidae have been reported as an important component of deep sea assemblages by Kröncke *et al.* (2003), Mamouridis *et al.* (2011) and Baldrighi *et al.* (2013, 2014). A large part of the material studied in this paper corresponds to that from Baldrighi *et al.* (2014), who followed the taxonomic sufficiency approach (i.e. identification of samples at coarse taxonomic level) to estimate deep sea biodiversity patterns. We can therefore compare the different approaches used in Baldrighi *et al.* (2014) and in the present paper. The actual seven species occurring at St. 11–20 as herein detected were considered to belong to three operative taxa (Syllidae sp. 1, Syllidae sp. 2, Syllinae sp. 1) by Baldrighi *et al.* (2014). As a consequence, exactly as it happens when shallow water Syllidae diversity is analyzed, the taxonomic sufficiency approach can cause evident underestimation of the actual diversity of the deep sea Syllidae (Musco *et al.* 2009).

The present study shed light on the biodiversity of Mediterranean deep-sea Syllidae, but also Spionidae, Lumbrineridae, Dorvilleidae and Paraonidae appear to be highly diverse in the Mediterranean deep-sea (Busoni 2013; Langeneck *et al.* 2017). The recent description of several new species (Böggemann *et al.* 2012; Borda *et al.*

2012; Kurt-Şahin *et al.* 2016) strongly supports the view that quantifying and describing the real diversity of deep-sea Mediterranean polychaetes is still an open and interesting research field. The above mentioned studies together with the present one confirm that large part of the deep Mediterranean biota is still unknown, while the number of studies aiming at understanding deep sea ecosystem functioning is growing (Danovaro *et al.*, 2010). More detailed studies of deep-sea samples, including the collection of additional material and, possibly, the use of molecular techniques will be necessary to assess the real diversity, together with the patterns and evolution-driving processes in deep-sea Mediterranean polychaetes.

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