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Deep-sea polychaetes (Annelida) from the Malta Escarpment (western Ionian Sea)

J. LANGENECK^{1*}, G. BUSONI¹, S. ALIANI², & A. CASTELLI¹

¹Department of Biology, University of Pisa, Pisa, Italy, and ²Institute of Marine Sciences, National Research Council (ISMAR-CNR), Lerici, Italy

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Abstract

The polychaete assemblages from an escarpment area in the western Ionian Sea are characterised in terms of species richness, evenness and trophic composition. Moreover, the first occurrence of the genus *Barantolla* in the Mediterranean Sea, and of *Lumbrinerides carpinei* and *Exogone (Parexogone) campoyi* in Italian waters, is reported. *Aricidea trilobata* Laubier and Ramos, 1974 is redescribed on the basis of new material with the new name *Aricidea (Acmira) jeaneteae*, together with a brief description of two deep-water species belonging to the genus *Levinsenia*.

Keywords: Deep-sea assemblages, *Aricidea jeaneteae*, *Barantolla sp.*, *Levinsenia sp.*

Introduction

Mediterranean deep environments are still scarcely known, despite a number of relevant cruises, such as the “POLA Expedition” (1890–1893) (Sturany 1896), the Polymède campaigns (1970–1972) (Negoescu 1984), and, more recently and to a lesser extent, the METEOR expeditions (1987–1998) (Janssen 1989; Fiege et al. 1999). A vast majority of the knowledge about benthic assemblages of the deep Mediterranean Sea is due to these oceanographic cruises (Laubier et al. 1973; Katzmann & Laubier 1974; Katzmann et al. 1974; Laubier & Ramos 1974; Ramos 1976; Miura 1980; Negoescu 1984). Generally, however, the majority of studies on the deep Mediterranean environment have focused on oceanography and geography, and on species of commercial interest (Sardá et al. 2004). On the other hand, until recently the sampling effort on benthic assemblages has been low, and the majority of studies have concentrated on the western basin, whereas the eastern Mediterranean Sea, despite being considerably deeper, is still scarcely known from a faunistic and ecological point of view (Coll et al. 2010; Mamouridis et al. 2011; Baldrighi et al. 2013, 2014).

Polychaetes represent a major component of macrobenthic assemblages, in terms of abundance, diversity and biomass, at every bathymetric level (Gambi & Giangrande 1986; Abbiati et al. 1987; Baldrighi et al. 2013), and have a paramount role in processes of organic matter transformation, nutrient recycling and bioturbation (Flach et al. 2002; Gremare et al. 2003). As already suggested by previous studies, the characterisation of polychaetes at the lowest taxonomic level can contribute to a better understanding of the ecology of benthic communities (Chatzigeorgiou et al. 2012), and this is especially true when the study regards poorly known environments such as the deep sea, where a rough taxonomic resolution, the so-called “taxonomic sufficiency” approach, can lead to serious mistakes if not supported by previous detailed knowledge (Terlizzi et al. 2003; Rice et al. 2012).

This work represents a further insight from a previous study led on the Maltese Slope (Ionian Sea) in order to evaluate ecological features of an escarpment system along a bathymetric range of about 1000 m (1200–2100 m depth) (Baldrighi et al.

*Correspondence: J. Langeneck, Dipartimento di Biologia, Università di Pisa, via Derna 1, 56126, Pisa, Italy. Tel: +39 050 2211447. Fax: +39 050 2211410. Email: jangeneck@biologia.unipi.it

2013). More specifically, we will focus on ecology and taxonomy of the polychaete component of the benthic assemblage.

Materials and methods

The study area is located in the western Ionian Sea, south of Capo Passero near the Sicilian Coast. During a scientific cruise carried out in May 2009 on the vessel *Urania*, samples were obtained from three sampling sites located at 1200, 1800 and 2100 m depth; for each site three replicates were obtained (for more precise data, see Baldrighi et al. 2013). Samples were fixed with 4% buffered formalin and stained with rose

Bengal, then transferred for identification in 70% ethanol (Baldrighi et al. 2013). Polychaetes present in samples were identified at the lowest possible taxonomic level; however, several individuals could not be identified at the species level, or even at the genus level, and are reported in Table I as “sp.” and “n.d.”, respectively. The impossibility to identify individuals at the species level was due in some cases to their poor conservation status, but in other cases there are differences between the examined material and extant congeneric species that may suggest their belonging to undescribed taxa. Drawings were performed with the help of microphotographs and a camera lucida, and refined with GIMP 2.8.18 (software downloadable and

Table I. Polychaetes from deep environments along the Maltese Escarpment. CS: carnivore/scavenger; SDF: surface deposit feeder; SSDF: sub-surface deposit feeder.

Polychaete taxon	Trophic category	Depth (m)		
		1200	1800	2100
Capitellidae				
<i>Barantolla</i> sp.	SSDF	1		
<i>Notomastus latericeus</i> Sars, 1851	SSDF		5	1
Cossuridae				
<i>Cossura soyeri</i> Laubier, 1964	SSDF	1		
Orbiniidae				
<i>Phylo</i> sp.	SSDF	1		
Paraonidae				
<i>Aricidea (Acmira) jeanetteae</i> nom. nov.	SDF		2	1
<i>Aricidea (Strelzovia) quadrilobata</i> Webster & Benedict, 1887	SDF	3	3	
<i>Levinsenia</i> cf. <i>demiri</i> Çinar, Açık & Dağlı, 2011	SDF	5		
<i>Levinsenia</i> sp. 1	SDF	1		1
Paraonidae n.d.	SDF		1	1
Cirratulidae				
<i>Aphelochaeta</i> sp.	SSDF	3		1
Pilargidae				
<i>Ancistrosyllis groenlandica</i> McIntosh, 1879	CS		2	
<i>Pilargis verrucosa</i> Saint-Joseph, 1899	CS	1		
Syllidae				
<i>Exogone (Parexogone) campoyi</i> San Martín et al., 1996	CS	1		
Glyceridae				
<i>Glycera</i> cf. <i>oxycephala</i> Ehlers, 1887	CS	1	2	
Lumbrineridae				
<i>Lumbrinerides carpinei</i> Ramos 1976	CS	2		
<i>Gallardoneris</i> sp.	CS		1	
Oweniidae				
<i>Myriochele</i> sp.	SDF			1
Terebellidae				
Terebellinae n.d.	SDF	2	1	1
Thelepininae n.d.	SDF	1		
Spionidae				
<i>Laonice</i> sp.	SDF	2		
<i>Prionospio fallax</i> Söderström, 1920	SDF	7		
<i>Prionospio</i> sp. 1	SDF		1	
<i>Scolecopsis</i> sp.	SDF	1		
<i>Spiophanes reyssii</i> Laubier, 1964	SDF	4	1	2
Longosomatidae				
<i>Heterospio mediterranea</i> Laubier, Picard & Ramos, 1973	SDF	1	1	
<i>Heterospio reducta</i> Laubier, Picard & Ramos, 1973	SDF	5	6	5

documentation available at <http://www.gimp.org> following the guidelines in Montesanto (2015, 2016). The examined material is currently deposited in the polychaete collection of the Department of Biology, University of Pisa.

The analysis of assemblage composition was performed with the software Primer 5.0. Samples were compared by non-metric multi-dimensional scaling (nMDS) (Kruskal & Wish 1978; Clarke 1993), and the null hypothesis of no differences between depths was tested with ANalysis Of SIMilarities (ANOSIM) (Clarke 1993). Moreover, in order to evaluate the significance of variations in polychaete assemblages, Shannon–Wiener’s and Pielou’s indexes were calculated (Heip et al. 1998). By checking specific literature (Fauchald & Jumars 1979; Gambi & Giangrande 1985; Bremner et al. 2003), all species were characterised from a tropho-ecological point of view, in order to make inferences about the ecological processes that affect the assemblages.

Results

Polychaete assemblage structure

In this study we examined 88 specimens, belonging to 13 families and 28 polychaete taxa (Table I). The dominant species in the majority of samples, and at all depths, is *Heterospio reducta* Laubier, Picard & Ramos, 1973; other well-represented polychaete families are Spionidae and Paraonidae. Among the identified taxa, *Exogone (Parexogone) campoyi* San Martín, Ceberio & Aguirrezabalaga, 1996 and *Lumbrinerides carpinei* (Ramos, 1976) are reported for the first time in Italian waters. Moreover, the specific identity of some individuals belonging to Capitellidae and Paraonidae is discussed below. The average number of specimens for each sample is 14 at 1200 m depth, nine at 1800, and six at 2100.

From an ecological point of view, the majority of the reported species are burrower vagile polychaetes, without or with faint, temporary tubes, whereas surface-dwelling polychaetes represents a lesser component of the assemblage. Sampled polychaetes can be divided into three trophic categories in accordance with Baldrighi et al. (2013), namely surface deposit feeders (SDF), that feed on detritus in the highest sediment layer and above the surface, such as Heterospionidae, Spionidae and Paraonidae; sub-surface deposit feeders (SSDF), that feed under the sediment surface, such as Capitellidae (Levinton & Kelaher 2004); and carnivores/scavengers (CS), a category that includes organisms that actively prey or scavenge above the sediment, such as Lumbrineridae, Pilargidae and Syllidae. In our study SDF appears to be the most numerous trophic category,

and is found in all samples 3–7 times more than SSDF. On the other hand, the number of CS is comparable to that of SSDF at 1200 and 2100 m depth, whereas at 1800 m depth they are absent (Figure 1).

The H' index in the considered samples ranges from 1.24 to 2.55, thus highlighting a remarkable variability in the assemblage; more interestingly, the J' index shows a very narrow variation, ranging from 0.89 to 1. The evenness of the studied assemblages is therefore remarkably high. Multivariate analyses performed on the abundance matrix highlight the absence of a structuring among samples at different depths. The MDS shows that samples coming from different depths are scattered, and not very similar (Figure 2a). The ANOSIM performed on this data set confirms that the differences between depths are not statistically significant (significance level, SL = 7.9%). The absence of significant differences is confirmed at the trophic category level, both from the MDS (Figure 2b) and from the ANOSIM (SL = 18.6%).

Remarks on species of particular interest

Family Capitellidae Grube, 1862

Barantollasp. (Figure 3)

Material examined: 1200 m, one specimen.

Description

An anterior fragment, 15 chaetigers, with 0.5 mm maximum width. Prostomium simple, very short, subtriangular, depressed, with slightly prominent palpode. Peristomium as long as prostomium, achaetous; three buccal lips clearly noticeable in ventral view. Eleven thoracic chaetigers. Parapodia biramous, poorly developed. First six thoracic segments relatively short; parapodia with capillary chaetae in both rami; from chaetiger 7 segments more elongated, with hooks at both rami. Branchiae absent (Figure 3a). Hooks relatively short and thick, with a transparent hood; distal part of the hook with a strong, blunt primary tooth and several secondary teeth on the top (Figure 3b).

Remarks

According to Fauchald (1977), this specimen should be assigned to *Barantolla* Southern, 1921, because of the presence of 12 thoracic segments, with first segment achaetous, followed by six thoracic segments with capillary chaetae. Currently this genus includes four species, of which *Barantolla sculpta* Southern, 1921, and *Barantolla leptе* Hutchings, 1974, are typical brackish-water species, *Barantolla orientalis* Yabe and Mawatari, 1998 is a shallow water species, and

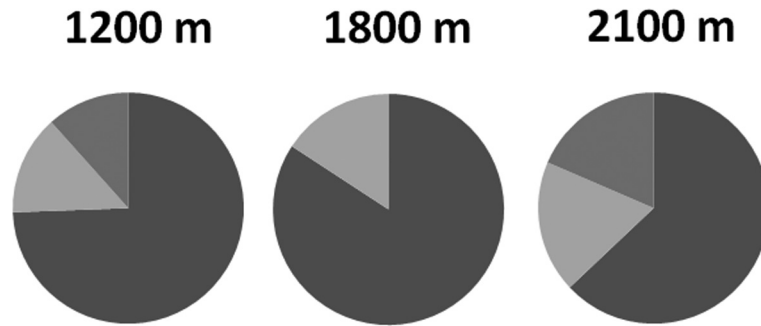


Figure 1. Ratio among trophic categories identified in polychaetes from the Maltese slope at different depths. Dark grey: surface deposit feeders; medium grey: sub-surface deposit feeders; light grey: carnivores/scavengers.

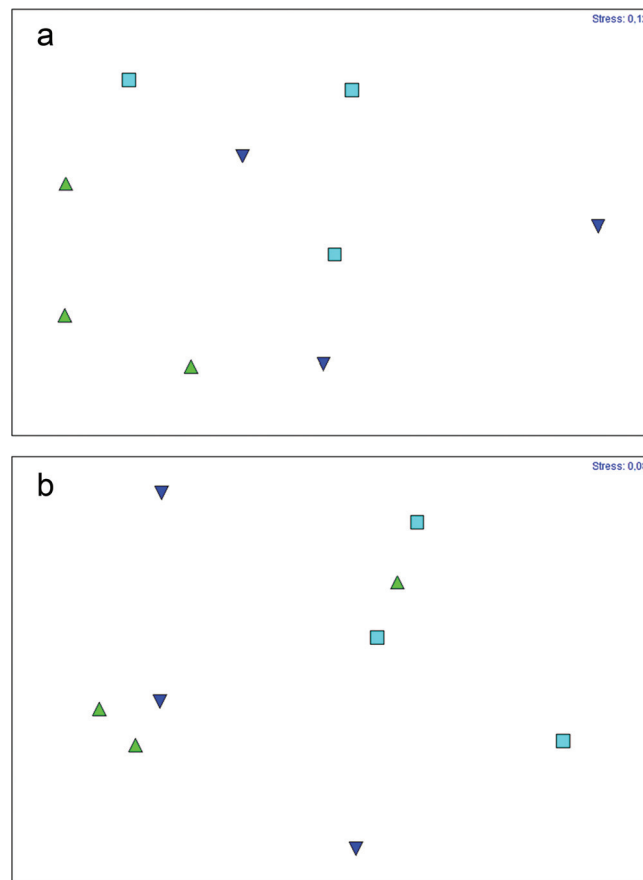


Figure 2. Multi Dimensional Scaling (MDS) representation of the similarity relationships among samples. (a) Abundances of taxa; (b) trophic categories. Δ: 1200 m; □: 1800 m; ∇: 2100 m.

finally *Barantolla americana* Hartman, 1963 is a wide-ranging species, originally described from the bathyal stage (280–900 m depth) (Hartman 1963), but currently reported from the intertidal zone to 3700 m depth (Hobson 1974). While all species of *Barantolla* have been described for the Indo-Pacific basin, *Barantolla* near *americana* has been reported also from the western Atlantic Ocean (Hartman &

Fauchald 1971); the extremely wide bathymetric and geographic range of occurrence of this species supports the hypothesis that *B. americana* actually is a species complex (Hartman & Fauchald 1971).

The reported specimen does not correspond to any of the described species of the genus. *B. sculpta*, *B. lepte* and *B. orientalis* are significantly larger shallow-water species, with thorax evidently reticulated;

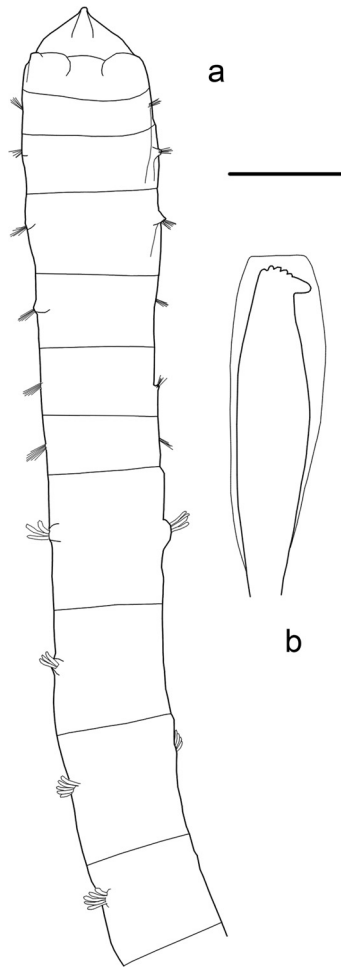


Figure 3. *Barantolla* sp.: (a) ventral view; (b) thoracic hook. Scale bar: a = 0.5 mm; b = 20 μ m.

in addition, *B. sculpta* shows evident branchiae and long-handled thoracic hooks (Southern 1921), *B. lepte* has only notopodial chaetae in the first chaetiger (Hutchings 1974), and *B. orientalis* has long-handled thoracic hooks (Yabe & Mawatari 1998). *Barantolla americana* is the most similar species within the genus, showing the complete absence of branchiae and smooth thorax epidermis, but it has capillary chaetae also at the notopodium of the 7th chaetiger (Hartman 1963), whereas at this chaetiger the studied specimen has only hooded hooks in both parapodial rami.

Like the Atlantic specimens reported by Hartman and Fauchald (1971) and the numerous records of undetermined *Barantolla* sp. (Schaff et al. 1992; Silva et al. 2013), this record probably refers to an undescribed species belonging to this genus. However, because of the scarce material, we prefer to await additional material before describing it.

Family Paraonidae Cerruti, 1909

Aricidea (Acmira) jeaneteae nom. nov. (Figure 4) = *Aricidea trilobata* Laubier & Ramos, 1974 (junior homonym of *Aricidea (Acmira) trilobata* Imajima, 1973)

Material examined: 1800 m, two specimens; 2100 m, one specimen.

Description

All specimens incomplete and very small; best specimen with 25 chaetigers, with a maximum width of 0.2 mm. Prostomium sub-trapezoidal, with anterior edge clearly divided into three triangular lobes. Antenna well-developed, with central insertion, elongated, slightly tapering, 1.5 times longer than the prostomium. Body relatively slender, with well-developed parapodia. Appendages (notopodial lobes and branchiae) very brittle, easily broken. Notopodial lobes elongated, approximately as long as branchiae, bottle-shaped. Branchiae relatively short and wide, somewhat corrugated (Figure 4a). Semi-circular dorsal lobes described by Laubier and Ramos (1974) apparently absent.

Parapodia bear mostly strong capillaries in pre-branchial and branchial regions. Capillaries strongly curved in first parapodia, becoming straighter and thinner in posterior part of branchial region, somewhat thicker in the neuropodium. Modified chaetae from chaetiger 20 (Figure 4b) consist of up to five thick, slightly curved and strongly pointed hooks (Figure 4d). At chaetigers 20–21 transition chaetae thick, but with elongated tips, are noticeable (Figure 4c). Fewer modified chaetae, with strongly curved tip, at chaetigers 24–25 (Figure 4e).

Remarks

After the original description by Laubier and Ramos (1974), this deep-water species has been cited only in the eastern Mediterranean Sea at 600 m depth (Çinar 2005). Type material, collected in the western Mediterranean Sea at 2100–2800 m depth, consists of six anterior fragments, the most complete with 16 chaetigers. The absence of the posterior part of the body made impossible to determine whether modified neurochaetae, that are present in the majority of *Aricidea* s. l., are actually lacking, or begin behind the 16th chaetiger. Since the subgenera recognised within *Aricidea* s. l. are distinguished by the presence and shape of neuropodial modified chaetae, on the basis of Laubier and Ramos' (1974) description it is impossible to assign this species to one of the subgenera proposed by Strelzov (1973). Our material allowed us to verify the presence of up to five thick, pointed neuropodial chaetae beginning

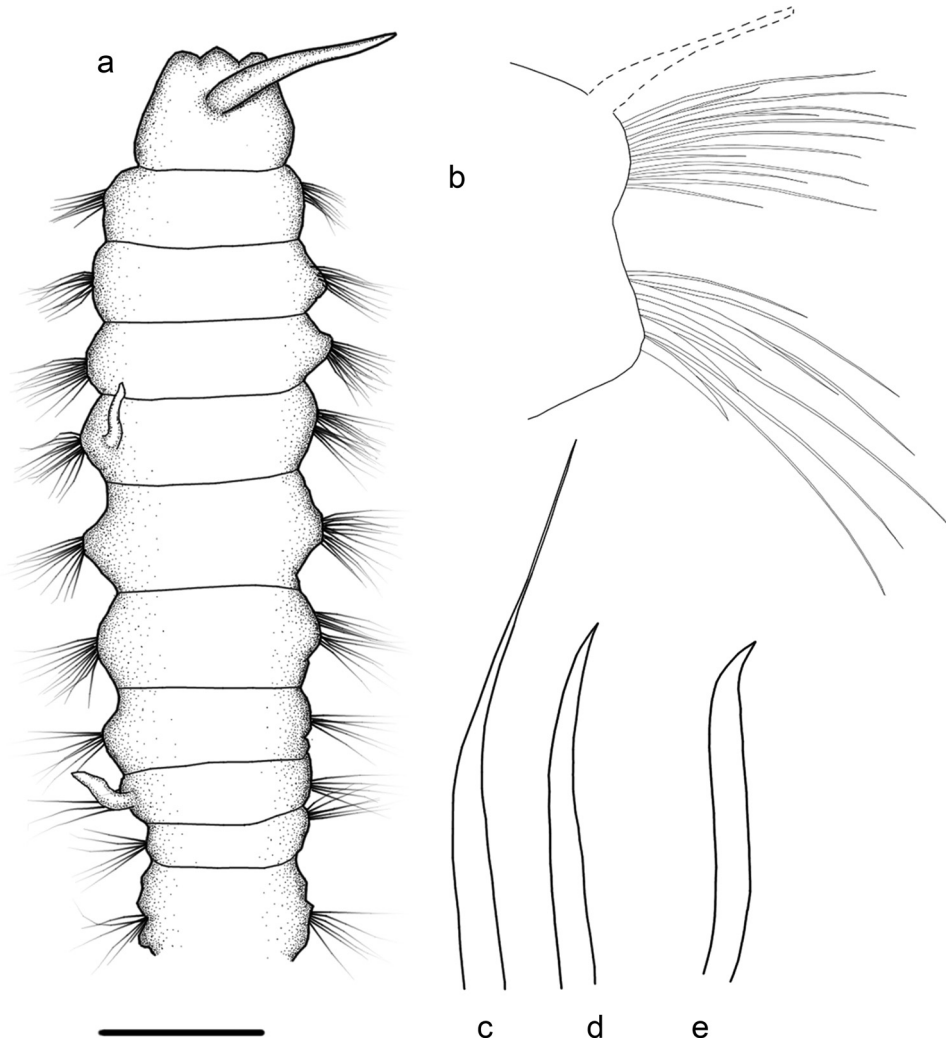


Figure 4. *Aricidea jeaneteae* nom. nov.: (a) Dorsal view of an anterior fragment; (b) 20th chaetiger (notopodial lobe reconstructed after Laubier & Ramos 1974); (c) transition chaeta of the 20th chaetiger; (d) modified chaeta of the 20th chaetiger; (e) modified chaeta of the 24th chaetiger. Scale bar: a = 0.2 mm; b = 100 μ m; c-e = 15 μ m.

approximately from chaetiger 20, where transition chaetae with long, thin tips are also noticeable. This feature is considered diagnostic for *Acmira* Hartley, 1981.

The examined material closely matches with *Aricidea trilobata* Laubier & Ramos, 1974. Even if semi-circular dorsal lobes are not noticeable, the poor condition of the examined material probably accounts for this lack. However, this taxon is a junior homonym of *Aricidea trilobata* Imajima, 1973, a species described from the Pacific Ocean that was assigned to *Acmira* by Blake (1996). Therefore, we suggest a new name, *Aricidea (Acmira) jeaneteae*, in honour of the late Dr. Jeanete Maron Ramos (1932–2011) in recognition of her important contribution to Mediterranean Paraonidae taxonomy. *Aricidea (Acmira) jeaneteae* closely resembles *Aricidea (Acmira) trilobata* in having the anterior margin

of the prostomium distinctly divided into three lobes, median antenna slender and pointed, reaching the 2nd chaetiger, branchiae short and quite wide with regard to their length, and neuropodial modified chaetae thick, with slightly curved tip, and the presence of transition chaetae. However, *A. jeaneteae* differs from *A. trilobata* in the presence of semicircular dorsal lobes from chaetigers 6–8 to chaetigers 9–12 (absent in *A. trilobata*), in the lower number of branchiae (4–8 in *A. jeaneteae*, 20 in *A. trilobata*), and in the beginning of modified chaetae (at chaetiger 20 in *A. jeaneteae*, after chaetiger 24 in *A. trilobata*) (Imajima 1973; Laubier & Ramos 1974). The two species differ also with regard to their distribution (*A. jeaneteae*: Mediterranean Sea; *A. trilobata*: Pacific Ocean) and their bathymetric occurrence (60 m – upper circalittoral for *A. trilobata*, 600–2800 m – bathyal for *A. jeaneteae*). Nevertheless,

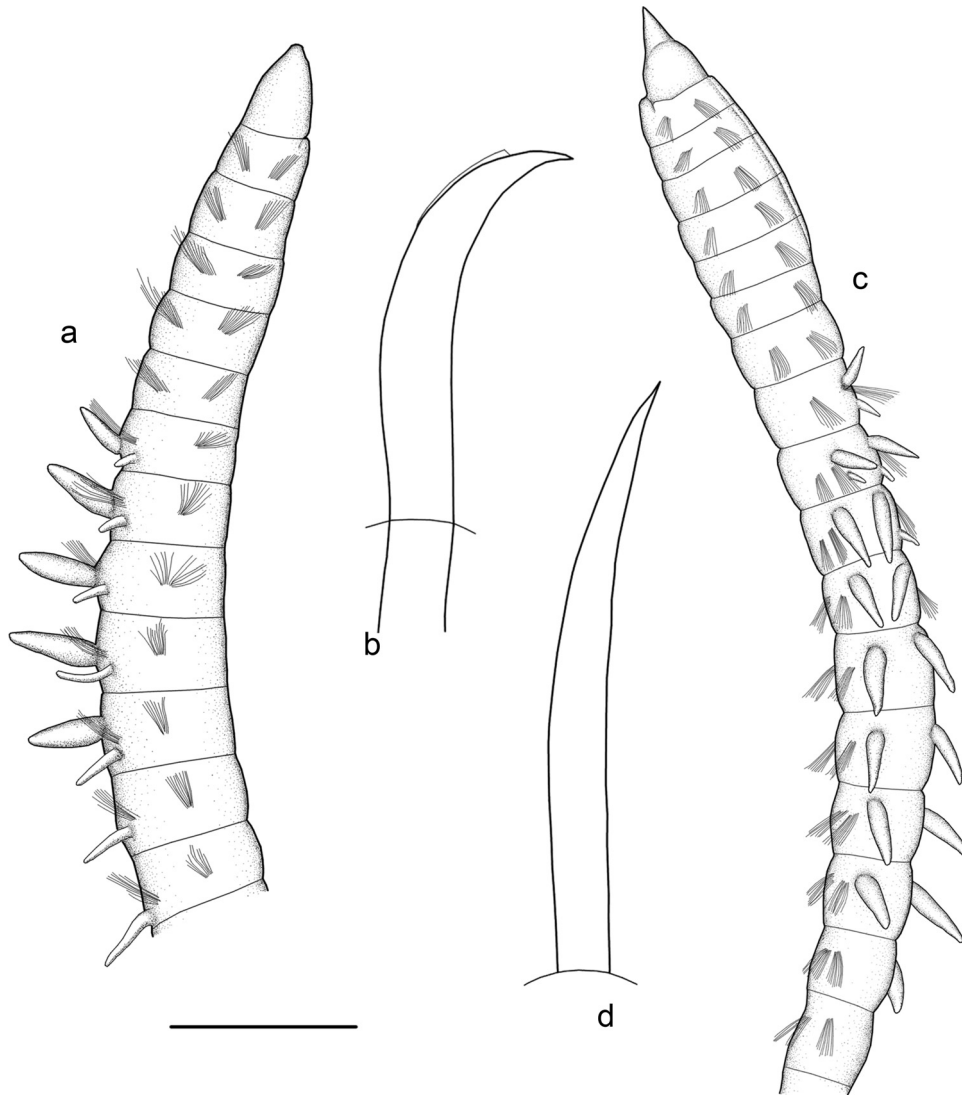


Figure 5. *Levisensia* cf. *demiri*: (a) lateral view of an anterior fragment; (b) modified neurochaeta from chaetiger 17. *Levisensia* sp. 1: (c) lateral view of an anterior fragment; (d) modified neurochaeta from chaetiger 25. Scale bar: a, c = 0.2 mm; b, d = 10 μ m.

there is a strong morphological affinity between the two species, and probably they are strictly related.

Aricidea (*Acmira*) *jeaneteae* nom. nov. is known from the whole Mediterranean Sea (Laubier & Ramos 1974; Çinar 2005; present study). The present data represent its first occurrence in Italian waters.

Levisensia* cf. *demiri Çinar, Dağlı & Açı̇k, 2011
(Figure 5a, b)

Material examined: 1200 m, five specimens.

Description

All individuals incomplete, 0.15–0.18 mm wide. Prostomium conical, 1.5 times longer than wide, without eyes, with a terminal sensorial button. Five

pre-branchial chaetigers, with very small notopodial lobes. Five branchial chaetigers; branchiae cirriform, blunt and distinctly shorter than body width. Notopodial lobes in branchial and post-branchial regions slender, cirriform (Figure 5a).

Parapodia biramous; both rami with thick capillaries. Three to four modified neuropodial chaetae present from chaetiger 15, consisting of strong, relatively short hooks with a thin dorsal hood. First parapodia with relatively straight hooks, hooks strongly curved in the posterior part of the body (Figure 5b).

Remarks

The morphological features of the collected individuals closely match those of *Levisensia demiri* Çinar,

Dağlı & Açıık, 2011, a species recently described from shallow environments of the eastern Mediterranean Sea (Çinar et al. 2011). However, the environment where these specimens have been collected is closer to that of *Levinsenia kantauriensis* Aguirrezabalaga & Gil (2009), a bathyal species described from the Eastern Atlantic Ocean (Aguirrezabalaga & Gil 2009). The shape of the hooded hooks and the shape of notopodial lobes are clearly different from those of *L. kantauriensis*; however, the depth where the specimens were collected indicates we should be careful with their identification as *L. demiri*.

***Levinsenia* sp. 1 (Figure 5c, d)**

Material examined: 1200 m, one specimen; 2100 m, one specimen.

Description

Both individuals incomplete. Best-preserved anterior fragment 0.18 mm wide, 3 mm long, 30 chaetigers. Prostomium conical, strongly pointed, almost 2 times longer than wide, without eyes, without conspicuous nuchal organs. Seven pre-branchial chaetigers, with very small notopodial lobes. Nine branchial chaetigers, with slender notopodial lobes; branchiae cirriform, moderately long, pointed. In the post-branchial region notopodial lobes become very short and difficult to see (Figure 5c).

Parapodia biramous, with thick capillaries at both rami. Two to four modified neuropodial chaetae after chaetiger 22, consisting in relatively straight, strongly pointed hooks, apparently without dorsal hood (Figure 4d).

Remarks

Following Çinar et al. (2011), the most similar species appears to be *Levinsenia oculata* (Hartman, 1957), because of the number of branchiae (10) and the shape of the abdominal hooks which are only slightly curved, strongly pointed and without dorsal hood. However, the shape of the prostomium and the beginning of modified chaetae are not consistent with the examined specimens. Moreover, the wide variation in the number of pre-branchial chaetigers stressed by Strelzov (1973) in *L. oculata* suggests that actually the examined material did not refer to a single species. A peculiar feature of the examined specimens is represented by the presence of seven pre-branchial chaetigers; with regard to this feature, *Levinsenia* sp. 1 appears similar to *Levinsenia acutibranchiata* (Strelzov, 1973), *Levinsenia kirbyae* Lovell, 2002, *Levinsenia*

materi Çinar and Dağlı, 2013, and *Levinsenia reducta* (Hartman, 1965). However, all these species show a noticeable hood on dorsal side of the notopodial hooks. Moreover, *L. kirbyae* has strongly curved hooks that in posterior chaetigers are arranged in a double row; *L. materi* has distinctly longer notopodial lobes in the branchial region (Çinar & Dağlı 2013); and *L. reducta* has very short, tubercular notopodial lobes along the whole body, strongly curved hooks and rounded, relatively short prostomium. Further, *L. acutibranchiata*, *L. kirbyae* and *L. materi* are infralittoral to circalittoral species (Strelzov 1973; Çinar & Dağlı 2013), whereas *L. reducta* is a bathyal species known from the central Atlantic Ocean (Strelzov 1973).

Among the described species of the genus *Levinsenia*, our specimens appear closer to *L. acutibranchiata*. However, the absence of a dorsal hood, and the different environments where these individuals were collected, suggest that they could actually belong to an undescribed deep-water species. Because of the scarcity of the available material, and because of the poor knowledge about the reliability of morphological features in the taxonomy of the genus *Levinsenia*, we prefer to avoid an official description while waiting for better, more complete material.

Discussion

Although the first studies on deep Mediterranean assemblages were mainly focused on taxonomic issues (Laubier et al. 1973; Laubier & Ramos 1974; Negoescu 1984), later studies adhered to the paradigm of “taxonomic sufficiency”, also because of the lack of skilled taxonomists and/or updated literature. Polychaetes, in particular, have been sporadically identified at the species, and even at the genus, level (Mamouridis et al. 2011; Baldrighi et al. 2013, 2014). The “taxonomic sufficiency” approach is money- and time-saving, and proved to be useful in well-characterised systems (Tataranni et al. 2009), where, however, its alternation with analysis at a fine taxonomic level is advisable anyway (Musco et al. 2011). However, this approach becomes hazardous when applied to poorly known environments, especially if they are characterised by low density of organisms, as in the case of the deep sea. A higher rank taxonomy could in this case lead to a relevant loss of information, and a misinterpretation of ecological processes occurring in this kind of environment. Recent studies focused on deep Mediterranean polychaete taxonomy highlighted the occurrence of a number of undescribed taxa, or taxa unknown in the Mediterranean Sea (Fiege et al. 2000; Sardá et al. 2009; Böggemann et al. 2012; Borda et al. 2012; Kurt-Şahin

et al. 2016). For this reason, the characterisation of polychaete deep assemblages at a fine taxonomic level is of paramount importance for the interpretation of the functioning of these systems.

In the present work 28 polychaete taxa were collected; 14 of them were identified at the species level, whereas nine of them could be identified only at the genus level. Among them, *Lumbrinerides carpinei* (Ramos, 1976), *Exogone (Parexogone) campoyi* San Martín, Ceberio and Aguirrezabalaga, 1996, and *Aricidea (Acmira) jeaneteae* nom. nov. are reported for the first time in Italian waters. A new name has been created for this latter species because of homonymy with a previously described species. Moreover, an individual belonging to the genus *Barantolla* is reported for the first time in the Mediterranean Sea. Individuals identified as *Gallardoneris* sp., *Laonice* sp. and *Levinsonia* sp. 1 might represent undescribed species and are currently under study, also on the basis of additional material coming from other deep-water campaigns. As reported in previous studies, the most diverse families turned out to be Paraonidae and Spionidae, whereas Syllidae are scarcer than usual in this kind of environment (Fiege et al. 1999); as expected, the most abundant trophic category is the SDF, whereas SSDF and CS are comparable, except at the 1800 m station, where CS are absent. Both univariate and multivariate analyses highlighted the absence of differences among assemblages at different depths. This depends probably on the high variability observed among samples at the same depth, which conceals the effect of different depths on the assemblage, and also on the size of the box-corer samples, that could possibly be too small to obtain representative estimates of the benthic assemblage, at least if treated with traditional statistic methods for benthic assemblage analysis (Baldrihi et al. 2014). The remarkably high evenness observed in the assemblages is strongly consistent with this hypothesis. Our interpretation of this result is that this is an artefact due to the sample size, rather than to actual features of the assemblage.

The present study shows that the diversity of deep-water polychaetes in the Mediterranean Sea is still largely unknown. In several cases, the identification at only the genus level was not due to bad preservation conditions of the specimens, but due to the impossibility to refer them to described species. Unfortunately, the extremely low density values observed for the majority of the collected species make the collection of more complete material difficult, and the knowledge on several deep-water species appears still fragmentary. The study of deep-water polychaetes from several areas of the Mediterranean

Sea is currently on-going and will possibly help us to better understand diversity patterns in this kind of environment.

References

- Abbiati M, Bianchi CN, Castelli A. 1987. Polychaete vertical zonation along a littoral cliff in the Western Mediterranean. *Marine Ecology* 8:33–48. DOI:10.1111/j.1439-0485.1987.tb00173.x.
- Aguirrezabalaga F, Gil J. 2009. Paraonidae (Polychaeta) from the Capbreton Canyon (Bay of Biscay, NE Atlantic) with the description of eight new species. *Scientia Marina* 73:631–666. DOI:10.3989/scimar.2009.73n4.
- Baldrihi E, Aliani S, Conversi A, Lavaley M, Borghini M, Manini E. 2013. From microbes to macrofauna: An integrated study of deep benthic communities and their response to environmental variables along the Malta Escarpment (Ionian Sea). *Scientia Marina* 77:625–639. DOI:10.3989/scimar.2013.77n4.
- Baldrihi E, Lavaley M, Aliani S, Conversi A, Manini E. 2014. Large spatial scale variability in bathyal macrobenthos abundance, biomass, α - and β -diversity along the Mediterranean continental margin. *PLoS One* 9:e107261. DOI:10.1371/journal.pone.0107261.
- Blake JA. 1996. Family Paraonidae Cerruti, 1909. In: Blake JA, Hilbig B, Scott PH, editors. Taxonomic atlas of the benthic fauna of the Santa Maria Basin and Western Santa Barbara channel. 6 - The Annelida part 3. Polychaeta: Orbiniidae to Cossuridae. Santa Barbara, CA: Santa Barbara Museum of Natural History. pp. 27–70.
- Böggemann M, Bienhold C, Gaudron S. 2012. A new species of Glyceridae (Annelida: Polychaeta) recovered from organic substrate experiments at cold seeps in the eastern Mediterranean Sea. *Marine Biodiversity* 42:47–54. DOI:10.1007/s12526-011-0091-2.
- Borda E, Kudenov JD, Bienhold C, Rouse GW. 2012. Towards a revised Amphinomidae (Annelida, Amphinomida): Description and affinities of a new genus and species from the Nile Deep-sea Fan, Mediterranean Sea. *Zoologica Scripta* 41:307–325. DOI:10.1111/zsc.2012.41.issue-3.
- Bremner J, Rogers SI, Frid CLJ. 2003. Assessing functional diversity in marine benthic ecosystem: A comparison of approaches. *Marine Ecology Progress Series* 254:11–25. DOI:10.3354/meps254011.
- Chatzigeorgiou G, Faulwetter S, López E, Sardá R, Arvanitidis C. 2012. Can coastal biodiversity measured in four Mediterranean sites be representative of the region? A test for the robustness of the NaGISA protocol based on syllid (Annelida, Polychaeta) taxocommunities. *Hydrobiologia* 691:147–156. DOI:10.1007/s10750-012-1065-5.
- Çinar ME. 2005. Polychaetes from the coast of northern Cyprus (eastern Mediterranean Sea), with two new records for the Mediterranean Sea. *Cahiers de Biologie Marine* 46:143–159.
- Çinar ME, Dağlı E. 2013. Polychaetes (Annelida: Polychaeta) from the Aegean and Levantine coasts of Turkey, with descriptions of two new species. *Journal of Natural History* 47:911–947. DOI:10.1080/00222933.2012.752543.
- Çinar ME, Dağlı E, Açıık S. 2011. Annelids (Polychaeta and Oligochaeta) from the Sea of Marmara, with descriptions of five new species. *Journal of Natural History* 45:2105–2143. DOI:10.1080/00222933.2011.582966.
- Clarke KR. 1993. Non-parametric multivariate analyses of changes in community structure. *Australian Journal of Ecology* 18:117–143. DOI:10.1111/j.1442-9993.1993.tb00438.x.

- Coll M, Piroddi C, Steenbeek J, Kaschner K, Lasram FBR, Aguzzi J, Ballesteros E, Bianchi CN, Corbera J, Dailianis T, Danovaro R, Estrada M, Frogliola C, Galil BS, Gasol JM, Gertwagen R, Gil J, Guilhaumon F, Kesner-Reyes K, Kitsos M-S, Koukouras A, Lampadariou N, Laxamana E, López-Fé de la Cuadra CM, Lotze HK, Martin D, Mouillot D, Oro D, Raicevich S, Rius-Barile J, Saiz-Salinas JJ, San Vicente C, Somot S, Templado J, Turon X, Vafidis D, Villanueva R, Voultsiadou E 2010. The biodiversity of the Mediterranean sea: Estimates, patterns, and threats. *PLoS One* 5:e11842.
- Fauchald K. 1977. The polychaete worms: Definitions and keys to the orders, families and genera. Natural history museum of Los Angeles County, Los Angeles, CA (USA). *Science Series* 28:1–188.
- Fauchald K, Jumars PA. 1979. The diet of worms: A study of polychaete feeding guilds. *Oceanography and Marine Biology - An Annual Review* 17:193–284.
- Fiege D, Allspach A, Apel M, Barnich R, Coleman CO, Doulgieraki S, Jellinek T, Kitsos M, Koukouras A, Kröncke L, Rosenboom W. 1999. Macro- and megabenthos. In: Hieke W, Hernleben C, Linke P, Türkay M, Weikert H, editors. *Mittelmeer 1997/98, Cruise No. 40, 28 October 1997–10 February 1998*. Vol. 99–2. Hamburg, Germany: METEOR-Berichte, Universität Hamburg. pp. 114–116.
- Fiege D, Kröncke I, Barnich R. 2000. High abundance of *Myriochele fragilis* Nilsen & Holthe, 1985 (Polychaeta: Oweniidae) in the deep sea of the Eastern Mediterranean. *Hydrobiologia* 426:97–103. DOI:10.1023/A:1003947318925.
- Flach E, Muthumbi A, Heip C. 2002. Meiofauna and macrofauna community structure in relation to sediment composition at the Iberian margin compared to the Goban Spur (NE Atlantic). *Progress in Oceanography* 52:433–457. DOI:10.1016/S0079-6611(02)00018-6.
- Gambi MC, Giangrande A. 1985. Caratterizzazione e distribuzione delle categorie trofiche dei policheti nei fondi molli del Golfo di Salerno. *Oebalia n.s.* 11:223–240.
- Gambi MC, Giangrande A. 1986. Distribution of soft-bottom polychaetes in two coastal areas of the Tyrrhenian Sea (Italy): Structural analysis. *Estuarine, Coastal and Shelf Science* 23:847–862. DOI:10.1016/0272-7714(86)90076-4.
- Gremare A, Medernach L, DeBovée F, Amouroux J, Charles F, Dinet A, Vétion G, Albert P, Colomines J. 2003. Relationship between sedimentary organic matter and benthic fauna within the Gulf of Lion: Synthesis on the identification of new biochemical descriptors of sedimentary organic nutritional value. *Oceanologica Acta* 26:121–137. DOI:10.1016/S0399-1784(03)00018-5.
- Hartman O. 1963. Submarine canyons of southern California. Part III. Systematics: Polychaetes. *Allan Hancock Pacific Expeditions* 27:1–93.
- Hartman O, Fauchald K. 1971. Deep-water benthic polychaetous annelids off New England to Bermuda and other North Atlantic Areas. Part II. *Allan Hancock Monographs in Marine Biology* 6:1–327.
- Heip CHR, Herman PMJ, Soetaert K. 1998. Indices of diversity and evenness. *Oceanis* 24:61–68.
- Hobson KD. 1974. *Orbiniella nuda* new species (Orbiniidae) and nine new records of other sedentary polychaetous annelids from Washington and British Columbia. *Canadian Journal of Zoology* 52:69–75. DOI:10.1139/z74-011.
- Hutchings PA. 1974. Polychaeta of Wallis Lake, New South Wales. *Proceedings of the Linnean Society of New South Wales* 98:175–195.
- Imajima M. 1973. Paraonidae (Polychaeta) from Japan. *Bulletin of the National Science Museum Tokyo* 16:253–292.
- Janssen R. 1989. Benthos-Mollusken aus dem Tiefwasser des östlichen Mittelmeeres, gesammelt während der “Meteor“-Fahrt 5 (1987). *Senckenbergiana Maritima* 20:265–276.
- Katzmann W, Laubier L. 1974. Le genre *Fauvellopsis* (Polychète sédentaire) en Méditerranée. *Mikrofauna Meeresboden* 50:529–542.
- Katzmann W, Laubier L, Ramos J. 1974. Pilargidae (Annélides Polychètes errantes) de Méditerranée. *Bulletin de l’Institut Océanographique* 71:1–40.
- Kruskal JB, Wish M. 1978. *Multidimensional scaling*. Beverly Hills, CA: Sage Publications.
- Kurt-Şahin G, Çınar ME, Gönülal O. 2016. A new species of *Augeteria* (Polychaeta: Lumbrineridae) from deep waters of the Aegean Sea (eastern Mediterranean). *Mediterranean Marine Science* 17:708–713.
- Laubier L, Picard C, Ramos J. 1973. Les Heterospionidae (Annélides Polychètes Sédentaires) de Méditerranée occidentale. *Vie et Milieu, Series A* 23:243–254.
- Laubier L, Ramos J. 1974. Paraonidae (Polychètes sédentaires) de Méditerranée. *Bulletin du Muséum National d’Histoire Naturelle, Series 3(168)*:1098–1147.
- Levinton J, Kelaher B. 2004. Opposing organizing forces of deposit-feeding marine communities. *Journal of Experimental Marine Biology and Ecology* 300:65–82. DOI:10.1016/j.jembe.2003.12.008.
- Mamouridis V, Cartes JE, Parra S, Fanelli E, Saiz Salinas JJ. 2011. A temporal analysis on the dynamics of deep-sea macrofauna: Influence of environmental variability off Catalonia coasts (western Mediterranean). *Deep Sea Research I* 58:323–337. DOI:10.1016/j.dsr.2011.01.005.
- Miura T. 1980. Lumbrineridae (Annélides Polychètes) abyssaux récoltés au cours de campagnes du Centre Océanologique de Bretagne dans l’Atlantique et la Méditerranée. *Bulletin du Muséum d’Histoire Naturelle, Paris, 4ème Série. Section A, Zoologie, Biologie et Écologie animales* 2:1019–1057.
- Montesanto G. 2015. A fast GNU method to draw accurate scientific illustrations for taxonomy. *Zookeys* 515:191–206. DOI:10.3897/zookeys.515.9459.
- Montesanto G. 2016. Drawing setae: A GNU way for digital scientific illustrations. *Nauplius* 6:e2016017.
- Musco L, Mikac B, Tataranni M, Giangrande A, Terlizzi A. 2011. The use of coarser taxonomy in the detection of long-term changes in polychaete assemblages. *Marine Environmental Research* 71:131–138. DOI:10.1016/j.marenvres.2010.12.004.
- Negoescu I. 1984. The study of the anthuridean isopods (Crustacea, Isopoda, Anthuridea) from the cruises of the French oceanographic vessels. *Travaux du Muséum d’Histoire Naturelle “Grigore Antipa”* 26:45–59.
- Ramos JM. 1976. Lumbrineridae (Polychètes errantes) de Méditerranée. *Annales de l’Institut Océanographique* 52:103–137.
- Rice J, Arvanitidis C, Borja A, Frid C, Hiddink J, Krause J, Lorance P, Ragnarsson SA, Skold M, Trabucco B, Enserink L, Norkko A. 2012. Indicators for sea floor integrity under the European marine strategy framework directive. *Ecological Indicators* 12:174–184. DOI:10.1016/j.ecolind.2011.03.021.
- Sardá F, Calafat A, Flexas M, Tselepidis A, Canals M, Espino M, Tursi A. 2004. An introduction to Mediterranean deep-sea biology. *Scientia Marina* 68(Suppl. 3):7–38. DOI:10.3989/scimar.2004.68s37.
- Sardá R, Gil J, Taboada S, Gili JM. 2009. Polychaete species captured in sediment traps moored in northwestern Mediterranean submarine canyons. *Zoological Journal of the Linnean Society* 155:1–21. DOI:10.1111/zoj.2008.155.issue-1.

- Schaff T, Levin L, Blair N, DeMaster D, Pope R, Boehme S. 1992. Spatial heterogeneity of benthos on the Carolina continental slope: Large (100 km)-scale variation. *Marine Ecology Progress Series* 88:143–160. DOI:10.3354/meps088143.
- Silva C, Barroso R, Amaral C. 2013. Capitellidae from Southern Brasil. 11th International Polychaete Conference, 4–9 August 2013, Sydney, Australia.
- Southern R. 1921. Polychaeta of the Chilka Lake and also of fresh and brackish waters in other parts of India. *Memoirs of the Indian Museum* 5:563–659.
- Strelzov VE. 1973. Polychaete worms of the family Paraonidae Cerruti, 1909 (Polychaeta, Sedentaria). Moscow: Akademia Nauk. 170 pp.
- Sturany R. 1896. *Zoologische Ergebnisse VII. Mollusken I (Prosobranchier und Opisthobranchier; Scaphopoden; Lamellibranchier) gesammelt von S.M. Schiff "Pola"* 1890-1894. *Denkschriften der Kaiserlichen Akademie der Wissenschaften, Mathematische-Naturwissenschaftlichen Classe* 63:1–36.
- Tataranni M, Maltagliati F, Floris A, Castelli A, Lardicci C. 2009. Variance estimate and taxonomic resolution: An analysis of macrobenthic spatial patterns at different scales in a Western Mediterranean coastal lagoon. *Marine Environmental Research* 67:219–229. DOI:10.1016/j.marenvres.2009.02.003.
- Terlizzi A, Bevilacqua S, Fraschetti S, Boero F. 2003. Taxonomic sufficiency and the increasing insufficiency of taxonomic expertise. *Marine Pollution Bulletin* 46:556–561. DOI:10.1016/S0025-326X(03)00066-3.
- Yabe K, Mawatari SF. 1998. Two new species of Capitellidae (Annelida: Polychaeta) from Hokkaido, northern Japan. *Species Diversity* 3:201–209.