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## New records of Lumbrineridae (Annelida: Polychaeta) in the Mediterranean biogeographic province, with an updated taxonomic key

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### Abstract

The present study is a part of a larger project aiming to characterise the benthic macrofaunal assemblages from the Gulf of Milazzo (Southern Tyrrhenian Sea, Central Mediterranean). Forty-eight samples from 16 sites were collected during the summer of 2010 by means of van Veen grab (0.1 m<sup>2</sup>) at 20 and 50 m depths to characterise taxonomically, ecologically and biogeographically the present species of Lumbrineridae. Sandy-silt mixed sediments characterised the study area. *Abyssoninoe hibernica* and *Lumbrineris luciliae* are newly recorded for the Mediterranean Sea, and *Gallardonensis iberica*, *Lumbrineris geldiaiyi* and *Lumbrineris lusitanica* are new records for the Central Mediterranean Sea. Therefore, a total of 29 species of Lumbrineridae are currently present and recognised on Mediterranean coasts. Additionally, we provide an updated key to the Mediterranean species of the family.

**Keywords:** Central Mediterranean Sea, Lumbrineridae, ecology, biogeography, new records

### Introduction

Lumbrineridae Schmarda, 1861 is a worldwide polychaete family whose members generally show cylindrical bodies with a relatively simple external morphology, well adapted to a burrowing mode of life (Pleijel 2001). The taxonomy of the species within the family is based on the morphology of chaetae, aciculae and parapodial lobes, as well as on internal structures, such as maxillary apparatus and mandibles. The maxillary apparatus is a complex structure with four to six maxillary plates, a variable number of teeth and a variety of shapes depending on the genera and species (Carrera-Parra 2006a). The mandibles have a flattened shape, generally with proximal forked cutting edges and more or less divergent distal processes. The Lumbrineridae has been widely studied worldwide, which gave rise to several new species and new records recently discovered (e.g. Aguirrezabalaga & Carrera-Parra 2006; Carrera-Parra 2006a,b, 2009; Martins et al. 2012; Arias & Carrera-

Parra 2014; Bertasi et al. 2014; D'Alessandro et al. 2014; Gómez et al. 2015). Now, at least 13 genera with more than 200 valid species are recognised worldwide (Carrera-Parra 2006a,b; Carrera-Parra et al. 2011; Martins et al. 2012). To date, nine genera had been reported in Mediterranean: *Abyssoninoe* Orensanz, 1990; *Gallardonensis* Carrera-Parra, 2006; *Hilbigneris* Carrera-Parra, 2006; *Lumbricalus* Frame, 1992; *Lumbrinerides* Orensanz, 1973; *Lumbrineriopsis* Moore, 1911; *Lumbrineris* Blainville, 1828; *Ninoe* Kinberg, 1875; and *Scoletoma* Blainville, 1828, including 27 valid species (Bellan 2001; Costello et al. 2001; Castelli et al. 2008; Carrera-Parra et al. 2011; Bertasi et al. 2014; Gómez et al. 2015). Among them, eight genera and 23 species are known to occur on Italian coasts (Castelli et al. 2008; Bertasi et al. 2014; D'Alessandro et al. 2014).

Within the frame of a wide study on macrofaunal communities of the Gulf of Milazzo, the present paper aims to report new records of species belonging to the

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Lumbrineridae, as well as to provide novel insights on its species taxonomy, ecology and biogeography.

## Materials and methods

The study area is a stretch of coast of about 20 km, located in the Gulf of Milazzo, in front of the Aeolian Archipelago, a geostrategic area of the Central Mediterranean Sea (Figure 1). This region is influenced by anthropogenic activities, namely an international harbour (sites 1A, 2B, 3C and 4D) and oil refineries (sites 5E, 6F, 7G and 8H).

Soft-bottom samples were collected in summer 2010 with a 0.1-m<sup>2</sup> van Veen grab. Sixteen sampling sites were located at 20 m and 50 m depth (Table I); three replicates per site were taken for macrofaunal analysis, and others for grain-size determination. Benthic samples were sieved on board through a 0.5-mm mesh and fixed with 4% buffered formalin; after 48 h the samples were transferred for long-term storage in 70% ethanol. In the laboratory, specimens were sorted under a stereomicroscope equipped with a micro-camera (Axio-Cam vs 40 v. 4.8.20) and identified under an optical microscope equipped with Optika Vision Lite 2.1 software. Grain size analysis was performed according to Buchanan and Kain (1971), by ASTM (American Standard Test Method) series for the fraction above 63 µm (saves spaced by 1 Φ), and by column-dispersion method for the silt and clay fraction (< 63 µm). Sediment types were classified according to the ternary Wentworth (1922) scale.

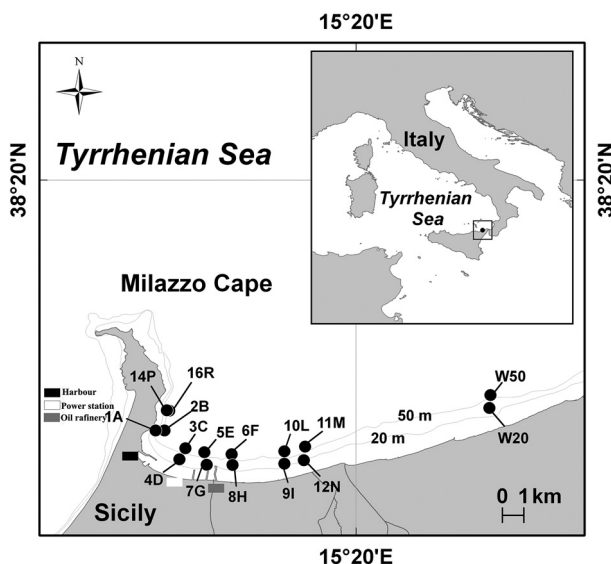


Figure 1. Map of the Gulf of Milazzo (Sicily, Tyrrhenian Sea, Western Mediterranean Sea), showing the location of the sampling sites (black circles).

Table I. Sampling site coordinates, water depth (m), sediment type and abundance of Lumbrineridae species.

| Site | <i>Abyssoninoe hibernica</i> | <i>Gallardoneris iberica</i> | <i>Lumbrineris geldiaiyi</i> | <i>L. luciliae</i> | <i>L. lusitanica</i> |
|------|------------------------------|------------------------------|------------------------------|--------------------|----------------------|
| 14P  | 0                            | 6                            | 5                            | 1                  | 0                    |
| 16R  | 0                            | 0                            | 0                            | 0                  | 0                    |
| 1A   | 2                            | 2                            | 0                            | 0                  | 0                    |
| 2B   | 0                            | 0                            | 1                            | 0                  | 0                    |
| 3C   | 0                            | 0                            | 0                            | 0                  | 0                    |
| 4D   | 0                            | 4                            | 2                            | 1                  | 3                    |
| 5E   | 1                            | 1                            | 4                            | 2                  | 1                    |
| 6F   | 1                            | 3                            | 3                            | 0                  | 0                    |
| 7G   | 3                            | 0                            | 0                            | 0                  | 0                    |
| 8H   | 6                            | 1                            | 2                            | 0                  | 3                    |
| 9I   | 2                            | 1                            | 3                            | 0                  | 0                    |
| 10L  | 2                            | 0                            | 13                           | 1                  | 0                    |
| 11M  | 0                            | 1                            | 0                            | 0                  | 0                    |
| 12N  | 2                            | 4                            | 0                            | 0                  | 2                    |
| W20  | 0                            | 4                            | 0                            | 0                  | 0                    |
| W50  | 2                            | 0                            | 4                            | 0                  | 0                    |

The dichotomous key of valid Mediterranean species of Lumbrineridae follows Carrera-Parra (2006a,b), where M (followed by a Roman numeral) indicates the position in maxillae apparatus from dorsal to ventral; CMHH indicates composite multidentate hooded hooks that may have long (about 11 times longer than wide) and short (about 5 times longer than wide) blades; SMHH indicates simple multidentate hooded hooks; SBHH indicates simple bidentate hooded hooks. The frequency of each species was estimated as the percentage of samples containing the species with respect to the total number of samples.

All specimens are deposited in the formal collection of the Laboratory of Biodiversity of the Institute for Environmental Protection and Research (ISPRA Messina, Italy).

## Results

Five species belonging to three genera were found in the study area (Figure 1), namely *Abyssoninoe hibernica* (McIntosh, 1903), *Gallardoneris iberica* (Martins et al., 2012) *Lumbrineris geldiaiyi* (Carrera-Parra et al., 2011), *L. luciliae* (Martins et al., 2012) and *L. lusitanica* (Martins et al., 2012). Figure 2 represents the spatial abundance distribution of each species in the study area.

## Systematics

Class Polychaeta Grube, 1850  
 Order Eunicida Dales, 1962  
 Family Lumbrineridae Schmarda, 1861  
 Genus *Abyssoninoe* Orensanz, 1990  
*Abyssoninoe hibernica* (McIntosh, 1903)  
 (Figure 3)

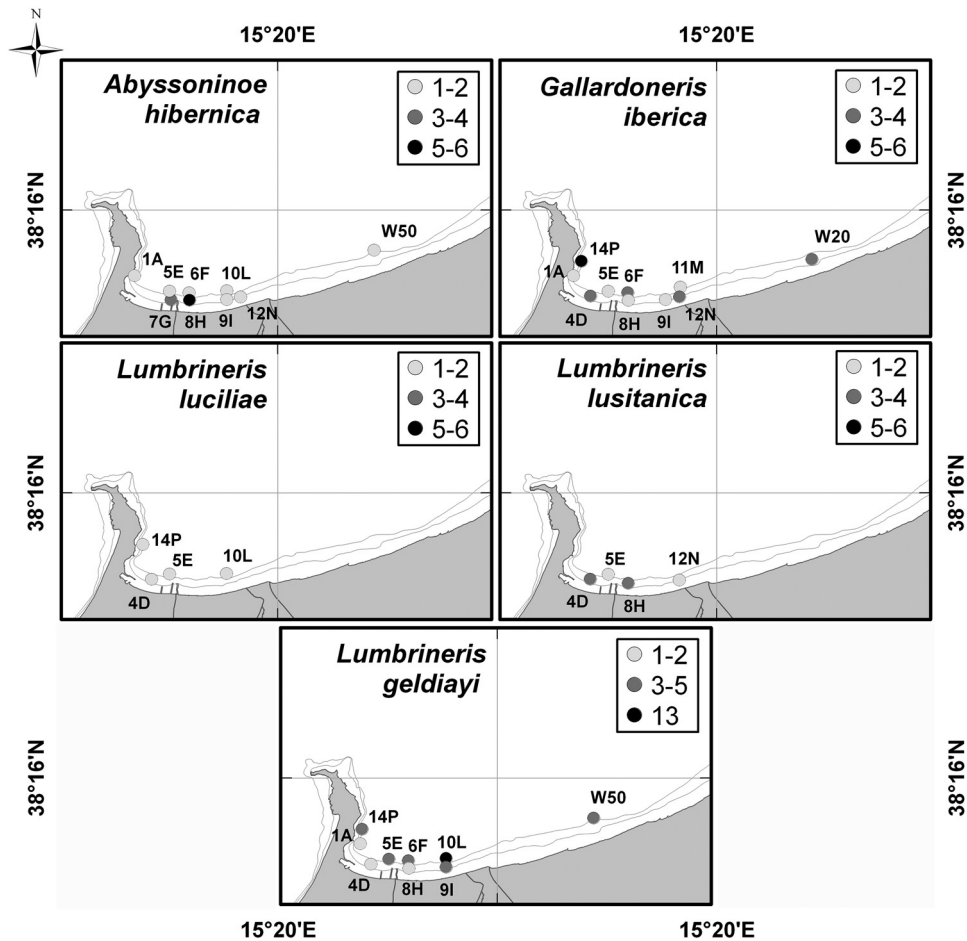


Figure 2. Spatial distribution of the absolute abundance of all species recorded in the study area.

*Material examined.* Complete specimen (ISPRA Abhi\_9I/3); Gulf of Milazzo, NE Sicily, Italy, site 9I, coordinates: 38°12.663'N, 15°18.023'E, water depth: 20 m, silty sand; ISPRA collection, deposited in May 2015.

*ISPRA, 20 specimens.* Site: 1A, 38°13.500'N, 15°14.659'E, 20 m depth, sandy-silty sediment, specimens Abhi\_1A/1, Abhi\_1A/2. Site: 5E, 38°12.953'N, 15°16.015'E, 50 m depth, pebbles, specimen Abhi\_5E. Site: 6F, 38°12.900'N, 15°16.700'E, 50 m depth, sandy silt sediment, specimen Abhi\_6F. Site: 7G, 38°12.638'N, 15°16.070'E, 20 m depth, sandy silt sediment, specimens Abhi\_7G/1, Abhi\_7G/2, Abhi\_7G/3. Site: 8H 38°12.630'N, 15°16.720'E, 20 m depth, sandy silt sediment, specimens Abhi\_8H/1, Abhi\_8H/2, Abhi\_8H/3, Abhi\_8H/4, Abhi\_8H/5, Abhi\_8H/6. Site: 9I, 38°12.663'N, 15°18.023'E, 20 m depth, silty sand

sediment, specimens Abhi\_9I/1, Abhi\_9I/2. Site: 10L, 38°12.974'N, 15°18.023'E, 50 m depth, sandy silt sediment, specimens Abhi\_10L/1, Abhi\_10L/1. Site: 12N, 38°12.750'N, 15°18.512'E, 20 m depth, silty sand sediment, specimens Abhi\_12N/1, Abhi\_12N/2. Site: W50, 38°14.393'N, 15°23.200'E, 50 m depth, sandy silt sediment, specimens Abhi\_W50/1, Abhi\_W50/2.

*Description.* Prostomium pointed, peristomial two rings of similar size (Figure 3a); prechaetal lobe of anterior parapodia (until parapodium 4) without a distinct shape and postchaetal lobe small and conical (Figure 3b); median parapodia with prechaetal and posterior lobe digitiform basally wide (up to parapodium 50; Figure 3c), posterior prechaetal and postchaetal lobes digitiform. Chaetae of four types: capillary, bilimbate (in anterior parapodia, dorsal ones longer than ventral), truncate bilimbate (in

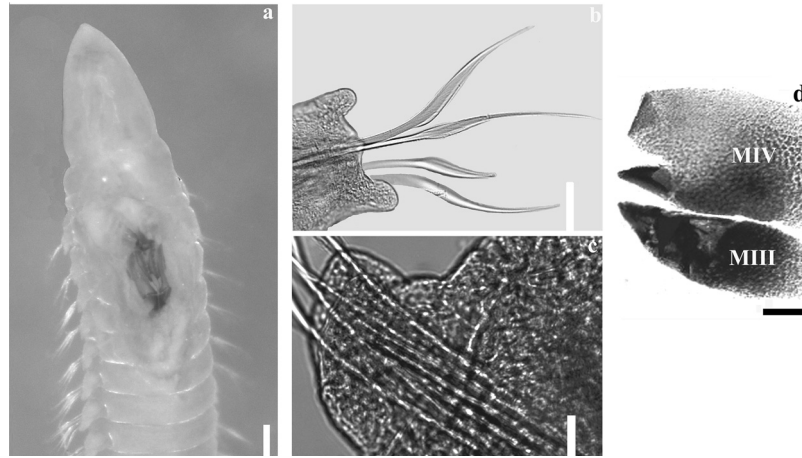


Figure 3. *Abyssoninoe hibernica*, adult: (a) anterior end; (b) parapodium 10, dorsal view; (c) parapodium 43, dorsal view (d) MIII (Mandible III) and MIV (Mandible IV). Scale bars: a = 0.2 mm; b = 0.03 mm; c = 0.2 mm; d = 0.041 mm.

anterior parapodial) becoming SMHH from parapodia 18. Aciculae yellow. Rounded pygidium with two pair of anal cirri. Maxillary apparatus with mandible fused up to two thirds of its length; five pairs of maxillae: MI forceps-like without internal accessory teeth, with attachment lamella; MII as long as MI; MIII unidentate, pigmented, triangular (Figure 3d); MIV unidentate pointed and pigmented, semi-circular (Figure 3d); MV connected to MIV.

**Taxonomic remarks.** No major differences were found comparing with the original description of McIntosh (1903) and Parapar et al. (1994). Therefore, *A. hibernica* is the third species of the genus present in Mediterranean waters, together with *A. bidentata* and *A. scopa*. *A. hibernica* differs from *A. bidentata* by having MIII with only one tooth, and in the distribution of truncate bilimbate chaeta that only appear from chaetiger 10 in *A. bidentata*. *A. hibernica* differs from *A. scopa* mostly due to the size of the posterior postchaetal lobe comparatively to the prechaetal lobe, equal in *A. hibernica* and longer in *A. scopa*.

**Ecology and distribution.** *A. hibernica* was found in nine sites (F = 56.25%) characterised by silty sand sediment. A total of 21 specimens were found mainly distributed at 20 m depth (Figure 2). The species seems to prefer fine-grained sediments with a high proportion of mud and clay (Parapar et al. 1994; Martins et al. 2012, 2013). The bathymetric range is fairly wide, ranging from shallow to bathyal waters (Parapar et al. 1994). It is well distributed in the Temperate Northern Atlantic realm, from boreal waters of the Northern European Seas province (Norway) to the warmer waters of the Lusitanian province (Spain, Parapar et al. 1994; Portugal, Martins et al. 2012, 2013). Our report enlarges the

area to the Mediterranean biogeographic province, following the marine bioregionalisation nomenclature proposed by Spalding et al. (2007).

Genus *Gallardoneris* Carrera-Parra, 2006a  
*Gallardoneris iberica* Martins et al., 2012  
 (Figure 4)

**Material examined.** Complete specimen (ISPRA GALMY\_12N/3); Gulf of Milazzo, NE Sicily, Italy, site 12N, coordinates: 38°12.750'N, 15°18.512'E, water depth: 20 m, silty sand sediment; ISPRA collection, deposited in May 2015. ISPRA, 26 specimens. Site: 14P, 38°14.001'N, 15°15.075'E, 50 m depth, gravelly sands sediment specimens GALMY\_14P/2, GALMY\_14P/3, GALMY\_14P/4, GALMY\_14P/5, GALMY\_14P/6. Site: 1A, 38°13.500'N, 15°14.659'E, 20 m depth, silty sand sediment, specimens GALMY\_1A/1, GALMY\_1A/2. Site: 4D, 38°12.775'N, 15°15.387'E, 20 m depth, sandy sediment, specimens GALMY\_4D/1, GALMY\_4D/2, GALMY\_4D/3, GALMY\_4D/4. Site: 5E, 38°12.953'N, 15°16.015'E, 50 m depth, pebbles, specimen GALMY\_5E. Site: 6F, 38°12.900'N, 15°16.700'E, 50 m depth, sandy silt sediment, specimens GALMY\_6F/1, GALMY\_6F/2, GALMY\_6F/3. Site: 9I, 38°12.663'N, 15°18.023'E, 20 m depth, silty sand sediment, specimen GALMY\_9I/1. Site: 11M, 38°13.095'N, 15°18.546'E, 50 m depth, sandy silt sediment, specimen GALMY\_11M. Site: 12N, 38°12.750'N, 15°18.512'E, 20 m depth, silty sand sediment, specimens GALMY\_12N/1, GALMY\_12N/2, GALMY\_12N/4. Site: W20, 38°14.065'N, 15°23.170'E, 20 m depth, silty sand sediment,

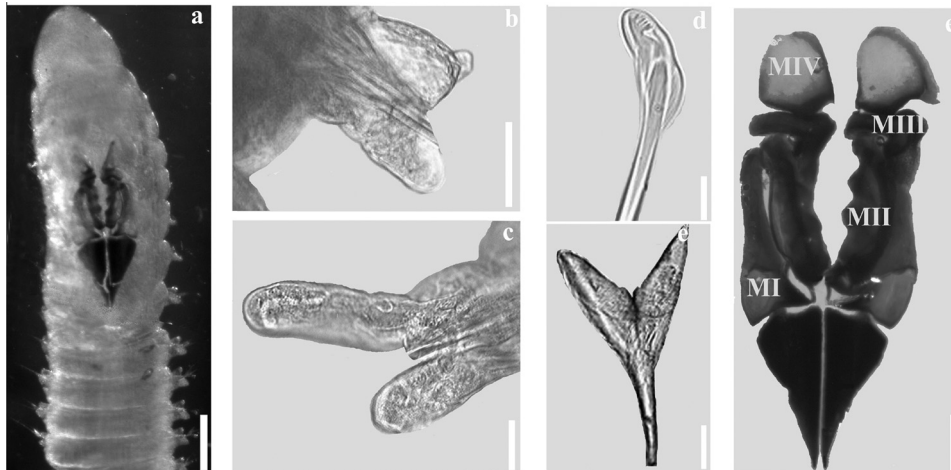


Figure 4. *Gallardoneris iberica*, adult: (a) anterior end; (b) parapodium 5, frontal view; (c) parapodium 43, frontal view; (d) mandible, frontal view; (e) maxillary apparatus, dorsal view. Scale bars: a = 0.2 mm; b = 0.03 mm; c = 0.02 mm; d = 0.01 mm; e = 0.03 mm. MI: Mandible I; MII: Mandible II; MIII: Mandible III; MIV: Mandible IV.

specimens GALMY\_W20/1, GALMY\_W20/2, GALMY\_W20/3, GALMY\_W20/4.

**Description.** Prostomium conical, peristomium with two achaetigerous rings of similar size (Figure 4a); anterior prechaetal lobe inconspicuous and then digitiform (Figure 4b); anterior postchaetal lobe auricular and then digitiform in median parapodia, longer than prechaetal lobe (Figure 4b); both posterior lobes digitiform, prechaetal longer than postchaetal (Figure 4c); 2–3 yellow aciculae; CMHH with short blade in parapodia 1–11 (Figure 4d); simple multidentate hooded hooks with short hood. Pygidium without anal cirri; mandibles totally fused (Figure 4e). Maxillary apparatus with four pairs of maxillae (Figure 4f); maxillary carriers as long as MI, triangle-shaped; MI forceps-like with wide curved base, without attachment lamellae; MII as long as MI, with ligament, and three rounded and stout teeth; no attachment lamellae; MIII edentate with evident longitudinal heavily chitinised crest (cutting edge) and narrow attachment lamella and MIV edentate sub-quadrangular plate, with whitish central area and dark postero-distal pointed corner (Figure 4f).

**Taxonomic remarks.** Italian specimens differs from the Portuguese ones in having 2–3 aciculae instead of only one acicula, in agreement with Bertasi et al. (2014).

To date, *G. iberica* is the only species of *Gallardoneris* present in Mediterranean and Atlantic waters (Martins et al. 2012; Bertasi et al. 2014; García-Gómez et al. 2015). It may be easily distinguished from any other Mediterranean species of Lumbrineridae species present in Mediterranean

waters through the large edentate MIV plate that as a whitish central area.

**Ecology and distribution.** Twenty-seven specimens of *G. iberica* were found in 10 sites, mainly at shallow waters (Figure 2) with silty sand bottoms (Table I). This species showed the highest frequency ( $F = 62.5\%$ ). In general, *G. iberica* inhabits coastal and continental shelf sediments (up to 180 m), preferring finer sediments (Martins et al. 2012). Our report is the third record for *Gallardoneris* in the Mediterranean Sea after its recent description in Portuguese waters, namely in Italy (Sicily, this study; northern Adriatic Sea, Bertasi et al. 2014) and Spain (Gómez et al. 2015). The present study supports a wide distribution, in addition to its presence in the Lusitanian province (South European Atlantic Shelf ecoregion).

Genus *Lumbrineris* de Blainville, 1828

*Lumbrineris geldiaiyi* Carrera-Parra et al., 2011  
(Figure 5)

**Material examined.** Complete specimen (ISPRA Lgeld5E/2); Gulf of Milazzo, NE Sicily, Italy, site 12N, coordinates: 38°12.953'N, 15°16.015'E, water depth: 50 m, pebbles; ISPRA collection, deposited in May 2015. ISPRA, 37 specimens. Site: 14P, 38°14.001'N, 15°15.075'E, 20 m depth, gravelly sands, specimens Lgeld14P/1, Lgeld14P/2, Lgeld14P/3, Lgeld14P/4, Lgeld14P/5, Lgeld14P/6. Site: 14P, 38°13.500'N, 15°14.884'E, 50 m depth, silty sand sediment, specimen Lgeld14P/1. Site: 4D, 38°12.775'N, 15°15.387'E, 20 m depth, sand sediment, specimens Lgeld4D/1, Lgeld4D/2. Site: 5E, 38°12.953'N, 15°

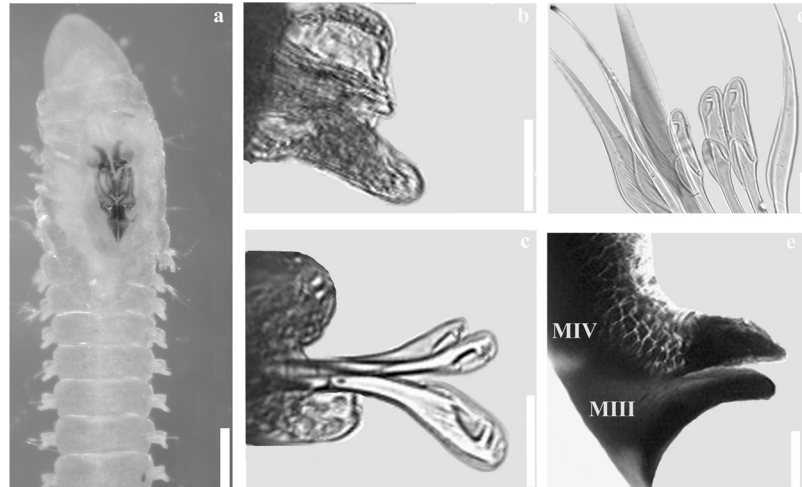


Figure 5. *Lumbrineris geldiaiyi*, adult: (a) anterior end; (b) parapodium 4, frontal view; (c) parapodium 24, frontal view; (d) MIII (Mandible III) and MIV (Mandible IV), dorsal view. Scale bars: a = 0.2 mm; b = 0.03 mm; c = 0.02 mm; d = 0.03 mm; e = 0.1 mm.

16.015°E, 50 m depth, pebbles, specimens Lgeld5E/1, Lgeld5E/3, Lgeld5E/4, Lgeld5E/5. Site: 6F, 38°12.900'N, 15°16.700'E, 50 m depth, sandy silt sediment, specimens Lgeld 6F/1, Lgeld 6F/2, Lgeld 6F/3. Site: 8H, 38°12.630'N, 15°16.720'E, 20 m depth, silty sand sediment, specimens Lgeld 8H/1, Lgeld 8H/2. Site: 9I, 38°12.663'N, 15°18.023'E, 20 m depth, silty sand sediment, specimens Lgeld9I/1, Lgeld9I/2, Lgeld9I/3. Site: 10L, 38°12.974'N, 15°18.023'E, 50 m depth, sandy silt sediment, specimens Lgeld10L/1, Lgeld10L/2, Lgeld10L/3, Lgeld10L/4, Lgeld10L/5, Lgeld10L/6, Lgeld10L/7, Lgeld10L/8, Lgeld10L/9, Lgeld10L/10, Lgeld10L/11, Lgeld10L/12, Lgeld10L/13. Site: W50, 38°14.393'N, 15°23.200'E, 50 m depth, sandy silt sediment, specimens Lgeld W50/1, Lgeld W50/2, Lgeld W50/3, Lgeld W50/4.

**Description.** Prostomium rounded; peristomium with two rings similar in size (Figure 5a). Anterior prechaetal lobe inconspicuous; postchaetal digitiform (Figure 5b); median pre- and postchaetal lobes digitiform, similar in size; posterior postchaetal lobe longer than prechaetal, both digitiform (Figure 5c). CMHH with short blade up to parapodium 10, 2–3 per parapodia (Figure 5d). Aciculae reddish. Pygidium with terminal anus, with two pairs of anal cirri with same length. Maxillary apparatus with five pairs of maxillae: MI forceps like, as long as MII; MII with four teeth of similar size; MIII unidentate arcuate (Figure 5e); MIV unidentate (Figure 5e); MV free and lateral to MIII and MIV; mandible distally divided.

**Taxonomic remarks.** The Milazzo specimens did not significantly differ from the original description

(Carrera-Parra et al. 2011). Nine valid *Lumbrineris* species are currently known to inhabit Mediterranean waters. They can be grouped according to the morphology of the MIII. Specimens of *L. geldiaiyi* have an arcuate unidentate MIII which is shared with *L. notatoi* and *L. luciliae*. *L. geldiaiyi* differs from both species by having reddish aciculae (yellow in the other two species). The species also differs from *L. notatoi* in having posterior postchaetal lobe longer than prechaetal lobe, and from *L. luciliae* in having a more narrow distribution of the CMHH (present from up to chaetiger 21 in *L. luciliae*).

**Ecology and distribution.** *L. geldiaiyi* was the most abundant lumbrinerid in the study area, being found in nine sites (F = 56.25%). The highest abundance (13 specimens) was found at 50 m depth (Figure 2), in silty sediments (Table I). This is in agreement with Carrera-Parra et al. (2011) who reported a preference for shallow water and very fine sediments (5–70 m depth). Our findings represent the second record of species, after its original description from Turkish coasts. Thus, its biogeographic distribution is now extended farther west in the Mediterranean Sea, and we certainly expect to find it in other Mediterranean biogeographic ecoregions.

*Lumbrineris luciliae* Martins et al., 2012  
(Figure 6)

**Material examined.** Complete specimen (ISPRA LLuc10L/1); Gulf of Milazzo, NE Sicily, Italy, site 10L, coordinates: 38°12.974'N, 15°18.023'E, water depth: 50 m, sandy silt sediment; ISPRA collection,

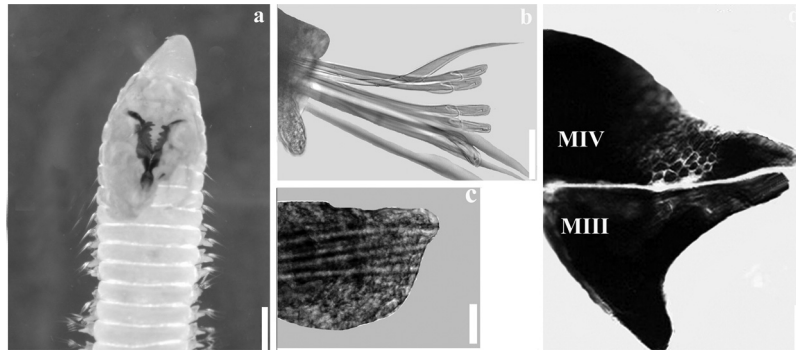


Figure 6. *Lumbrineris luciliae*, adult: (a) anterior end; (b) parapodium 4, frontal view; (c) parapodium 10, frontal view; (d) CMHH (composite multidentate hooded hooks) and limbate chaeta from parapodium 3; (e) MIII (Mandible III) and MIV (Mandible IV), dorsal view. Scale bars: a = 0.2 mm; b = 0.02 mm; c = 0.03 mm; d = 0.03 mm.

deposited in May 2015. ISPRA, four specimens. Site: 14P, 38°14.001'N, 15°15.075'E, 20 m depth, gravelly sands sediment, specimen LLuc14P/1. Site: 4D, 38°12.775'N, 15°15.387'E, 20 m depth, sandy sediment, specimen LLuc4D/1. Site: 5E, 38°12.953'N, 15°16.015'E, 50 m depth, pebbles, specimens LLuc5E/1, LLuc5E/2.

**Description.** Prostomium conical, peristomium with two rings, the posterior half the length of the anterior one (Figure 6a); parapodia with prechaetal lobe rounded and postchaetal lobe digitiform wide basally in anterior parapodia (Figure 6b–c) and digitiform in posterior parapodia, always longer than prechaetal lobe. CMHH with short hood in the first 20 chaetigers, up to eight per parapodia (Figure 6b), SMHH with short hood from chaetiger 21; aciculae yellow. Maxillary apparatus with five pair of maxilla: MI forceps-like, as long as MII; MII with four teeth; MIII arcuate unidentate (Figure 6d); MIV unidentate with a well-developed plate (Figure 6d); MV free, lateral to MIV and MIII; mandibles divided in half of their length.

**Taxonomic remarks.** The specimens from Milazzo slightly differed from the Portuguese ones in the shape of MIV, the latter having a less pointed tooth (Martins et al. 2012). *L. luciliae* belongs to a group of *Lumbrineris* having an arcuate unidentate MIII, together with *L. geldiaiyi* and *L. nonatoi* in the Mediterranean Sea. *L. luciliae* differs from *L. geldiaiyi* in the colour of the aciculae (reddish in *L. geldiaiyi*) and in the number and distribution of CMHH (2–3 CMHH per parapodia from the first to tenth chaetiger in *L. geldiaiyi*). *L. luciliae* can be distinguished from *L. nonatoi* by the prechaetal lobe size, which is always smaller than the postchaetal lobe in *L. luciliae* and longer than the posterior postchaetal lobes in *L. nonatoi*.

**Ecology and distribution.** This species was one of the less abundant (five specimens) in the study area and the less frequent ( $F = 25\%$ ), together with *L. lusitanica*. The species was mostly recorded in the western sector of the gulf, in coarse and/or sandy sediments from shallow waters (20 to 50 m depth; Figure 2). In Portuguese waters, *L. luciliae* occurred in a wide range of sediment types, from gravel to mud, and a wide range of shelf depths (33–179 m depth) (Martins et al. 2012). Thus, our findings extend the bathymetric range of the species towards shallower waters (20 m depth), and represent the second record after the original description of Martins et al. (2012) in the Atlantic waters of the Portuguese continental shelf. The biogeographic distribution of *L. luciliae* ranges now from the Lusitanian province (South European Atlantic Shelf ecoregion) to the Mediterranean province (Western Mediterranean ecoregion).

*Lumbrineris lusitanica* Martins et al., 2012  
(Figure 7)

**Type material.** Complete specimen (ISPRA Llus5E/1); Gulf of Milazzo, NE Sicily, Italy, site 5E, coordinates: 38°12.953'N, 15°16.015'E, water depth: 50 m, pebbles; ISPRA collection, deposited in May 2015 were ISPRA, eight specimens. Site: 4D, 38°12.775'N, 15°15.387'E, 20 m depth, sandy sediment, specimens Llus4D/1, Llus4D/2, Llus4D/3. Site: 8H, 38°12.630'N, 15°16.720'E, 20 m depth, silty sand sediment, specimens Llus8H/1, Llus8H/2, Llus8H/3. Site: 12N, 38°12.750'N, 15°18.512'E, 20 m depth, silty sand sediment, specimens Llus12N/1, Llus12N/2.

**Description.** Prostomium conical, peristomium with two rings of similar size (Figure 7a). Prechaetal lobe inconspicuous in most anterior parapodia



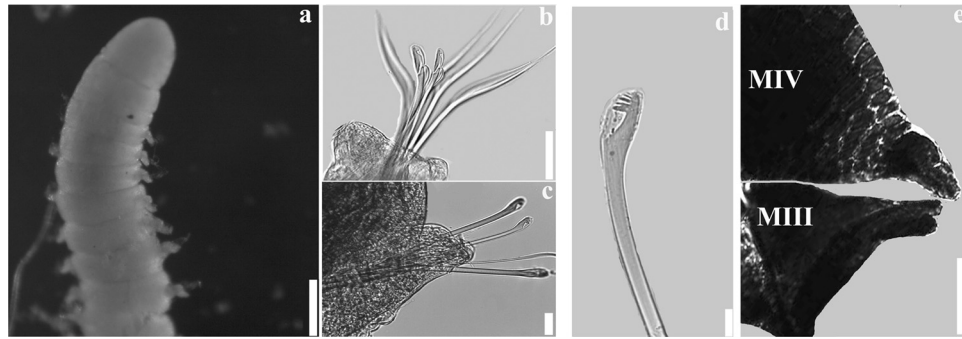


Figure 7. *Lumbrineris lusitanica*, adult: (a) anterior end; (b) parapodium 3, frontal view; (c) parapodium 41, frontal view; (d) SMHH (simple multidentate hooded hooks); (e) MIII (Mandible III) and MIV (Mandible IV), dorsal view. Scale bars: a = 0.2 mm; b = 0.04 mm; c = 0.02 mm; d = 0.01 mm; e = 0.02 mm.

and then digitiform (Figure 7b); postchaetal lobe small in first parapodia, digitiform wide basally in anterior and median parapodia, becoming digitiform in posterior parapodia, always bigger than prechaetal lobe (Figure 7c). CMHH with short hood in parapodia 1–10 (Figure 7b); SMHH with short hood present from parapodia 11 (Figure 7d); aciculae yellow. Pygidium with terminal anus with two pairs of anal cirri, ventral shorter than dorsal pair. Maxillary apparatus composed by five pairs of maxillae, of which MII as long as MI with four teeth; MIII unidentate followed by a knob and with a very prominent basal projection (Figure 7e); MIV unidentate (Figure 7e); MV free, lateral to MIV and MIII; mandibles divided in half of their length.

**Taxonomic remarks.** The specimens from Italian waters did not significantly differ from the Portuguese ones (Martins et al. 2012). Only two Mediterranean species of *Lumbrineris* have have MIII unidentate followed by a knob: *L. luciliae* and *L. pinaster*; the latter was recently found in Spanish Mediterranean waters (Gómez et al. 2015). The two species are distinguished by the size of CMHH blades (short in *L. lusitanica*, long in *L. pinaster*), size of preacicular and postacicular SMHH (similar size in *L. lusitanica*, twice in *L. pinaster*) and by the anterior postchaetal lobe shape (digitiform wide basally in *L. lusitanica*, auricular in *L. pinaster*).

**Ecology and distribution.** *L. lusitanica* showed low abundance (nine specimens) and frequency (F = 25%) in the study area. It was found in sand, silty sand or pebbles, mostly at 20 m depth, in agreement with the preference for very fine sand at 14 to 190 m depth reported in the original description (Martins et al. 2012). *L. lusitanica* is widely distributed in the Lusitanian province (Portuguese

continental shelf) and in the western Mediterranean ecoregion (NE Sicily, Italy, this study; Spanish Mediterranean coast, Gómez et al. 2015).

## Discussion

Despite the fact that the Mediterranean is probably among the best and most-studied ecosystems, over the long term, in the world, the number of reported species has been continuously increasing, even in recent times (Çinar 2009; Coll et al. 2010). Among the reasons proposed to explain this trend, it has been postulated that some anthropogenic activities (such as the maritime shipping traffic through ballast waters, fisheries, aquaculture, tourism, wind farms), can be important vectors for the introduction of alien species, including polychaetes (e.g. Çinar 2009; Occhipinti-Ambrogi et al. 2011; Zenetos et al. 2011; Martins et al. 2013; Azzurro et al. 2014). Climate changes may also have an influence, as periodic seawater temperature anomalies can generate expansion and retreats in species distribution, as recently reported for some species of *Arenicola* and *Diopatra* (e.g. Berke et al. 2010; Wetthey et al. 2011; Pires et al. 2015). However, as postulated by Martin et al. (2008) when describing a very large new Mediterranean species of *Mesochaetopterus*, most of this recent increase in knowledge may also be explained by the growing interest of academia in the assessment of the benthic macrofaunal communities from areas never studied so far, as well as from others that are revisited to update and/or correct the respective taxonomic lists. This is certainly the case of the family Lumbrineridae, where novel insights on the taxonomy and phylogeny of the family have been recently stated by Carrera-Parra (2006a,b). These studies erected new genera and described new species, but also several species were considered misidentified or even invalid, and their records considered doubtful in certain areas, including the Mediterranean. Among

them, *Lumbrineris cingulata* Ehlers, 1897 was reported for the Mediterranean Sea (Capaccioni-Azzati 1991) while its distribution is currently considered restricted to the Magellanic biogeographic province (Carrera-Parra et al. 2011). *Lumbrineris inflata* Moore, 1911 was reported from the Mediterranean Sea (Giangrande et al. 1981) and later considered a non-indigenous species (Streftaris et al. 2005), but its record is doubtful since it normally occurs in the Pacific Ocean (Northwestern United States to Western Mexico; Carrera-Parra 2006b). *Lumbrineris labrofimbriata* was misidentified as juveniles of other species of *Lumbrineris*, due to ontogenetic changes (Carrera-Parra 2006b). *Lumbrineris perkinsi* Carrera-Parra, 2001 was reported as a non-indigenous species in the Mediterranean Sea (Çinar 2009; Carrera-Parra et al. 2011) despite the fact that its recognised *terra typica* is the Pacific side of the Grand Caribbean Region and Panama (Carrera-Parra 2006b). *Ninoe kinbergi* Ehlers, 1887 was synonymised with *N. nigripes* Verrill, 1873 by Pettibone (1963) and probably is not present in the Mediterranean Sea. *Scoletoma tetraura* (Schmarda, 1861) (originally described from South Africa) was synonymised with *S. impatiens* (Claparède, 1868) (originally described from France) without formal revision (George & Hartmann-Schröder 1985). However, Martins et al. (2012) recommended using *S. impatiens* for European coasts until a complete phylogenetic revision of the genus could unveil the validity and the real biogeographic distribution of all species within this genus. Therefore, we are here considering *L. cingulata*, *L. inflata*, *L. labrofimbriata*, *N. kinbergi* and *S. tetraura* as not present in the Mediterranean Sea.

In summary, the number of species of Lumbrineridae present in the Mediterranean Sea increased from 27 to 29, considering the new records of *A. hibernica* and *L. luciliae* occurring in this biogeographic province, so that the taxonomic key for the Mediterranean Lumbrineridae is updated here below to accommodate our new finding.

#### Key to Family Lumbrineridae from the Mediterranean Sea

1. Maxillary apparatus with five pairs of maxillae ..... 2
- Maxillary apparatus with four pairs of maxillae ..... 18
2. Anterior parapodia with postchaetal branchiae ... (*Ninoe*) ..... 3

- Anterior parapodia without postchaetal branchiae ..... 4
3. MIII unidentate, mandibles long, well developed ..... *Ninoe nigripes* Verrill, 1873
- MIII multidentate, mandibles short, thin ..... *Ninoe armoricana* Glémarec, 1968
4. MII as long as MI ..... 5
- MII half as long as MI ..... 17
5. With both SMHH and CMHH ... (*Lumbrineris*) ..... 6
- With SMHH only ... (*Scoletoma*) ..... 12
6. MIII unidentate ..... 7
- MIII unidentate followed by a knob ..... 9
- MIII bidentate ..... 10
- MIII quadridentate ..... *Lumbrineris perkinsi* Carrera-Parra, 2001
7. Aciculae yellow ..... 8
- Aciculae reddish ..... *Lumbrineris geldiaei* Carrera-Parra et al., 2011<sup>TS</sup>
8. Prechaetal lobe always smaller than postchaetal lobe ..... *Lumbrineris luciliae* Martins et al., 2012<sup>TS</sup>
- Prechaetal lobe longer than postchaetal lobe in posterior parapodia ..... *Lumbrineris nonatoii* Ramos, 1976
9. CMHH with short blade, postchaetal lobe digitiform wide basally in anterior parapodia ..... *Lumbrineris lusitanica* Martins et al., 2012<sup>TS</sup>
- CMHH with long blade, postchaetal lobe auricular in anterior parapodia ..... *Lumbrineris pinaster* Martins et al., 2012
10. CMHH multidentate ..... 11
- CMHH bidentate ..... *Lumbrineris longipodiata* Cantone, 1990
11. CMHH with long blade ..... *Lumbrineris latreilli* Audouin & Milne-Edwards, 1834
- CMHH with short blade ..... *Lumbrineris coccinea* (Renier, 1804)
12. MIII unidentate ..... 13
- MIII bidentate ..... 15
13. SMHH bidentate ..... *Scoletoma debilis* (Grube, 1878)
- SMHH multidentate ..... 14
14. Up to 2 SMHH per parapodium ..... *Scoletoma rovigensis* (Fauvel, 1940)
- Numerous SMHH per parapodium ..... *Scoletoma fragilis* (O.F. Müller, 1776)
15. Only with capillary chaeta and SMHH ..... 16
- With capillary chaeta, SMHH and 3–4 truncate bilimbate chaeta per parapodium, from chaetiger 1–20 ..... *Scoletoma emandibulata mabiti* (Ramos, 1976)
16. Capillary chaetae present in first 10–20 chaetigers *Scoletoma funchalensis* (Kinberg, 1865)

- Capillary chaetae extending backwards to chaetigers 50–60 ..... *Scoletoma impatiens* (Claparède, 1868)
- 17. With composite spinigers ..... *Lumbricalus adriatica* (Fauvel, 1940)
- Without composite spinigers ..... *Hilbigneris gracilis* (Ehlers, 1868)
- 18. With limbate SMHH; MIV with a peculiar semicircular shape (*Abyssoninoe*) ..... 19
- Without limbate SMHH; shape of MIV different as above ..... 21
- 19. MIII unidentate ..... 20
- MIII bidentate ..... *Abyssoninoe bidentata* D'Alessandro et al., 2014
- 20. Transitional chaetae from 1 to 20–25, postchaetal longer than prechaetal lobe in posterior parapodia ..... *Abyssoninoe* cf. *scopa* (sensu Miura, 1980)
- Transitional chaetae from 1 to 15–20, postchaetal and prechaetal lobes in posterior parapodia with similar size ... ..... *Abyssoninoe hibernica* (McIntosh, 1903) <sup>TS</sup>
- 21. With SBHH, without SMHH or CMHH, MIV without whitish central area ..... 22
- With both CMHH and SMHH, without SBHH, MIV with whitish central area ..... *Gallardoneris iberica* Martins et al., 2012 <sup>TS</sup>
- 22. MIV with 10 minute teeth *Lumbrineriopsis paradoxo* (Saint-Joseph, 1888)
- MIV edentate ... (*Lumbrinerides*) ..... 23
- 23. One peristomial ring ..... *Lumbrinerides carpinei* (Ramos, 1976)
- Two peristomial rings ..... 24
- 24. MI unidentate with zero or one blunt internal tooth ..... 25
- MI unidentate with two blunt internal teeth, MIII tridentate ..... *Lumbrinerides acutiformis* (Gallardo, 1967)
- 25. MI unidentate without internal tooth ..... 26
- MI unidentate with one blunt internal tooth, SBHH from chaetigers 1–2 ..... *Lumbrinerides neogesae* Miura, 1980
- 26. SBHH from chaetigers 2–6 ..... *Lumbrinerides amoureuixi* Miura, 1980
- SBHH from chaetigers 15–16 ..... *Lumbrinerides* cf. *acuta* sensu Ramos, 1976

Legend: TS, found in this study.

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