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Ophelia roscoffensis Augener, 1910: a new polychaete record in Italian waters

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Abstract
Ophelia roscoffensis Augener, 1910 is an opheliid worm identifiable by the number of anterior abranchiate chaetigers and the number of the gill pairs. Although it was already reported in the Mediterranean Sea, it has never been found in the Italian waters. This study represents the first record of *Ophelia roscoffensis* in the Italian waters. A total of 18 specimens were collected along the coast of Civitavecchia (Tyrrhenian Sea) in a *Posidonia oceanica* (L.) Delile bed at a depth of 7 m.

Keywords
First record, Italian waters, Mediterranean Sea, Opheliidae, *Posidonia oceanica* bed, Tyrrhenian Sea.

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Introduction

The family Opheliidae Malmgren, 1867 (Annelida, Scolecida) includes 5 genera and over 120 species (Magalhães et al. 2019). The most recent studies on the systematics of this family have shown that the genus *Travisia* Johnston, 1840 belongs to a separate family, Travisiidae Hartmann-Schröder, 1971 (Blake and Maciolek 2016b). Additionally, Blake and Maciolek (2016b) considered *Ammotrypanella* McIntosh, 1878, *Tachytrypane* McIntosh in Jeffreys, 1876, and *Antiobactrum* Chamberlin, 1919 as synonyms of *Ophelina*. The Opheliidae are usually grouped with Scalembregmatidae Malmgrem, 1987 (Rouse 2001), and there is no apomorphy supporting the monophyly of Ophelidae, as noted by Fauchald and Rouse (1997). The members of this family are typically sedentary burrowers, commonly found on sandy and muddy substrates (Fauvel 1927, Fauchald 1977, Rouse 2001, Maciolek and Blake 2006); their distribution in different substrates show specific patterns that are closely related to the granulometry of the sediments (Maciolek and Blake 2006). The opheliids have separate sexes, and some species become pelagic as sexually mature epitokes (Maciolek and Blake 2006). They usually show a fusiform body, characterized by a low number of segments (30–60) and by the presence of a ventral groove along the whole body. The prostomium is conical and without appendages; an anterior palpode and a pair of posterior nuchal organs are usually present. The peristomium is reduced and fused with the prostomium. The parapodia

are all morphologically similar and biramous, with small button-shaped parapodial lobes. The dorsal and the ventral cirri are usually absent, and the chaetae are all capillary, either smooth or marginally dentate. The pygidium usually bears numerous papillae (Malmgrem 1867, Fauvel 1927, Fauchald 1977, Parapar 2012).

In the European Register of Marine Species (Costello et al. 2001), 28 species of opheliids were reported, belonging to 9 genera. But, after the most recent taxonomic revisions (Brewer et al. 2011, Blake and Maciolek 2016a, 2016b, Magalhães et al. 2019, Read and Fauchauld 2019a), only 26 species belonging 5 genera are currently considered as valid: *Armandia* Filippi, 1861*, Ophelia* Savigny, 1822*, Ophelina* Örsted, 1843*, Polyophthalmus* Quatrefages, 1850, and *Thoracophelia* Ehlers, 1897. Along the Italian coasts, 4 genera and 14 species are currently reported (Castelli et al. 2008) and the genus *Ophelia* Savigny, 1822 is represented by 5 species: *Ophelia amoureuxi* Bellan & Costa, 1822, *O. barquii* Fauvel, 1927, *O. bicornis* Savigny, 1822, *O. limacina* (Rathke, 1843), and *O. traslucens* (Katzmann, 1973) (Castelli et al. 2008).

The genus *Ophelia*, which includes 38 species, is recognized by a fusiform body organized in 2 regions: an anterior cylindrical region and a posterior region furrowed by a deep ventral groove. The branchiae are present and located starting from 2 to 10 chaetigers (Malmgrem 1867, Fauvel 1927, Fauchald 1977, Maciolek and Blake 2006, Parapar 2012). *Ophelia roscoffensis* Augener, 1910 is a cylindrical worm with a body length up to 50 mm and a maximum of 32 segments. This species is identifiable by the presence of branchiae on the posterior body region and by the number of abranchiate anterior chaetigers (8) (Fauvel 1927, Parapar 2012). Moreover, Tebble (1952) has described a tegumentary structure that characterizes the posterior region of this species: in the last 4 segments (including anal segment), 2 pairs of sinuous lateral ridges are present, which enclose 3 dorsal grooves.

Ophelia roscoffensis was originally described by Augener (1910) based on specimens from the French Atlantic coast at Roscoff. In European waters, it has been found in the English Channel and along the North-East Atlantic coasts of France, Spain, and Portugal (Tebble 1952, 1953, Bellan 1964, Dauvin et al. 2003, Costello et al. 2001, Ramos 2010, Read and Fauchald 2019b). In the Mediterranean Sea it has been reported along the coasts of Spain, Greece (Simboura 1996, Zenetos et al 1997, Ramos 2010, Faulwetter et al. 2010, 2017), and Turkey (Çinar et al. 2014). The specimens of *O. roscoffensis* were collected from a shallow-water *Posidonia oceanica* (L.) Delile bed along the coast of Civitavecchia (central Tyrrhenian Sea) during scuba surveys performed in 2015 and 2016. All 18 specimens of *O. roscoffensis* were found in association with the polychaetes *Goniadella bobrezkii* (Annenkova, 1929) and *Acromegalomma messapicum* (Giangrande & Licciano, 2008) and with the isopod *Mesanthura* sp.; all these species were recently reported, for the first time in the Northern Tyrrhenian sea, in the same *P. oceanica* meadow (Tiralongo et al. 2017, Giangrande et al. 2018, Mancini et al. 2019).This study represents the first record of *Ophelia roscoffensis* in the Italian waters.

Methods

The specimens of *Ophelia roscoffensis* were collected along the coast of Civitavecchia (northern Tyrrhenian Sea), near the harbour (Fig. 1). Scuba surveys were performed during 2015 and 2016, in the months of October, March, May, and August, on sandy pools, located at a depth of about 7 m on a *Posidonia oceanica* bed. Samples were collected by means of corers. Following Gambi et al. (1998) and Buia et al. (2003), each PVC tube corer was 10 cm in diameter and 25 cm long (surface area = 78.5 cm^2) with a 0.4 mm mesh net on top. Corers were plunged into the sediment to a depth of 20 cm. At each sampling, 5 replicates were collected and sieved with a mesh size of 0.5 mm. The retained fraction of sediment was subsequently preserved in 4% buffered formalin. In the laboratory, all organisms were sorted and identified to the finest taxonomic level possible (i.e. species) and subsequently preserved in 75% ethanol. The morphological features and the diagnostic characteristics of *O. roscoffensis* specimens were examined following Augener (1910), Fauvel (1927), Tebble (1952), and Parapar (2012). The material was deposited in the marine invertebrate collection of Laboratory of Experimental Oceanology and Marine Ecology, University of Tuscia (Civitavecchia, Roma: CL-02-POS-17).

Ophelia limacina (SB-155-POS-14-17), preserved in the zoological collection of the Laboratory of Experimental Oceanography and Marine Ecology (University of Tuscia, Viterbo), was used for morphological comparison with *O. roscofensis* specimens.

Results

New records. Italy: Civitavecchia (Rome) (42.0844° N, 011.7990° E, 7 m depth), Emanuele Mancini, October 2015 (2 specimens), March 2016 (3 specimens), May 2016 (5 specimens), August 2016 (8 specimens).

Environmental characteristics. In the study area, the *Posidonia oceanica* bed extends at depths from approximately 3–18 m. The meadow architecture shows a fragmented coverage: live *P. oceanica* cover 69% of the seabed, 17% is covered by coarse sand, and 14% consists of small rocks. The *P. oceanica* density remains quite constant throughout the year, with a density of 260–312 shoots/m^2 (Paladini De Mendoza et al. 2018). The unvegetated areas were mostly represented by circular sandy patches of 1–6 m in diameter. In the sandy patches the sediment is composed by gravelly coarse sand; the gravel fraction (19–60%) mainly consisted of bioclasts composed by skeletal fragments and shells. The coastal site has moderate to high wave conditions. The wave

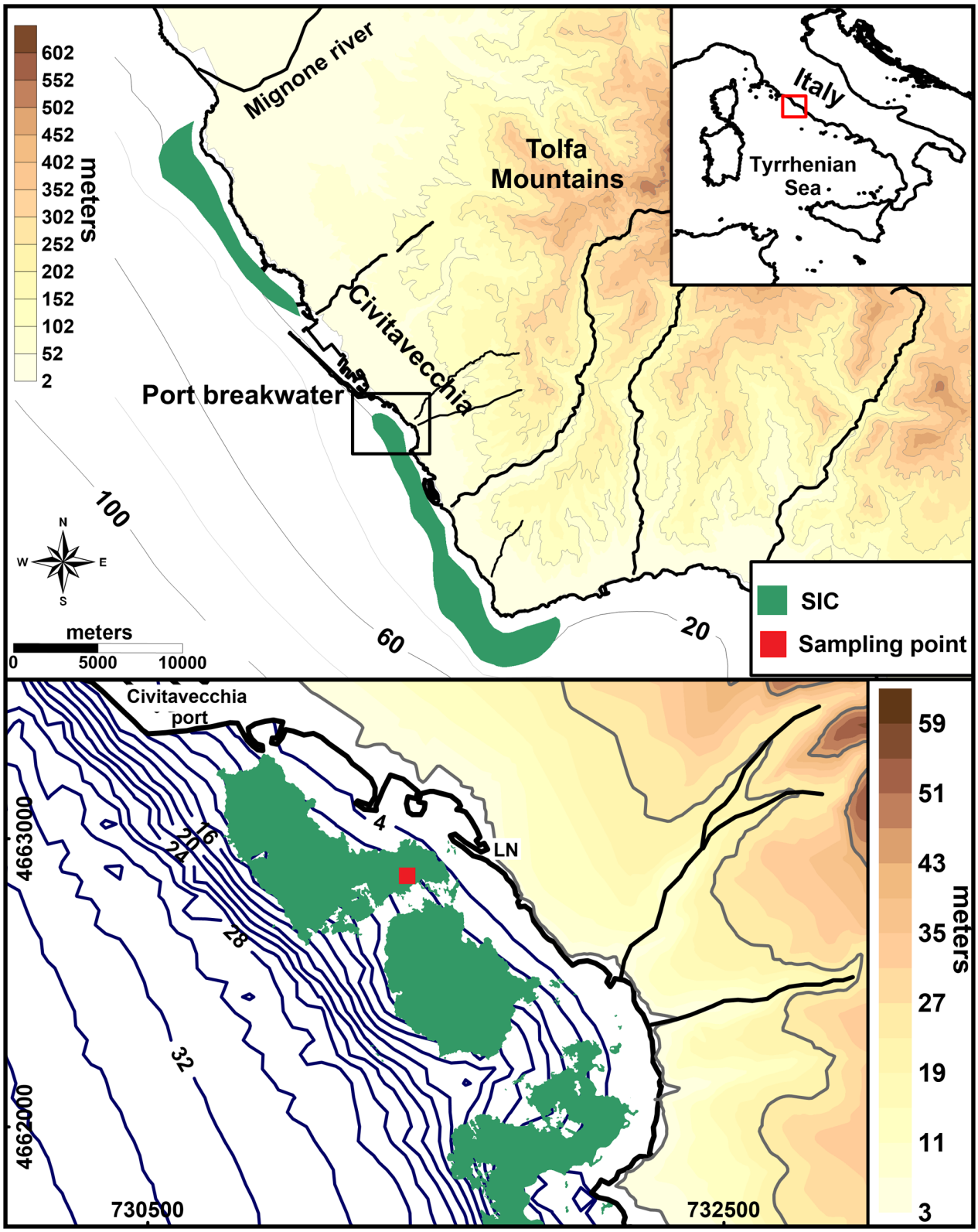

Figure 1. Map of study area with location of sampling site (SCI: Site of Community Importance "*Posidonia oceanica* meadows").

climate exhibits a seasonal fluctuation, with a maximum during autumn and winter (1.5–3 m) and a minimum in summer (0.5–1.5 m) (Paladini De Mendoza et al. 2018). In late summer, *P. oceanica* begins to shed leaves, which progressively covers the seafloor with leaf litter. The leaf litter remains on the seafloor until the first storm, which transports away a large part of the litter (Paladini De Mendoza et al. 2018).

Identification. The specimens were assigned to the genus *Ophelia* based on the following morphological characteristics: fusiform body organized externally into 2 regions, an anterior cylindrical region and a posterior region furrowed by a deep ventral groove; prostomium conical; proboscis globose and smooth; branchiae cirriformes, starting from 8th–11th segment; parapodia with reduced rami; chaetae all simple capillaries; pygidium

Figure 2. *Ophelia roscoffensis* (CL-02-POS-17). Lateral view of whole animal.

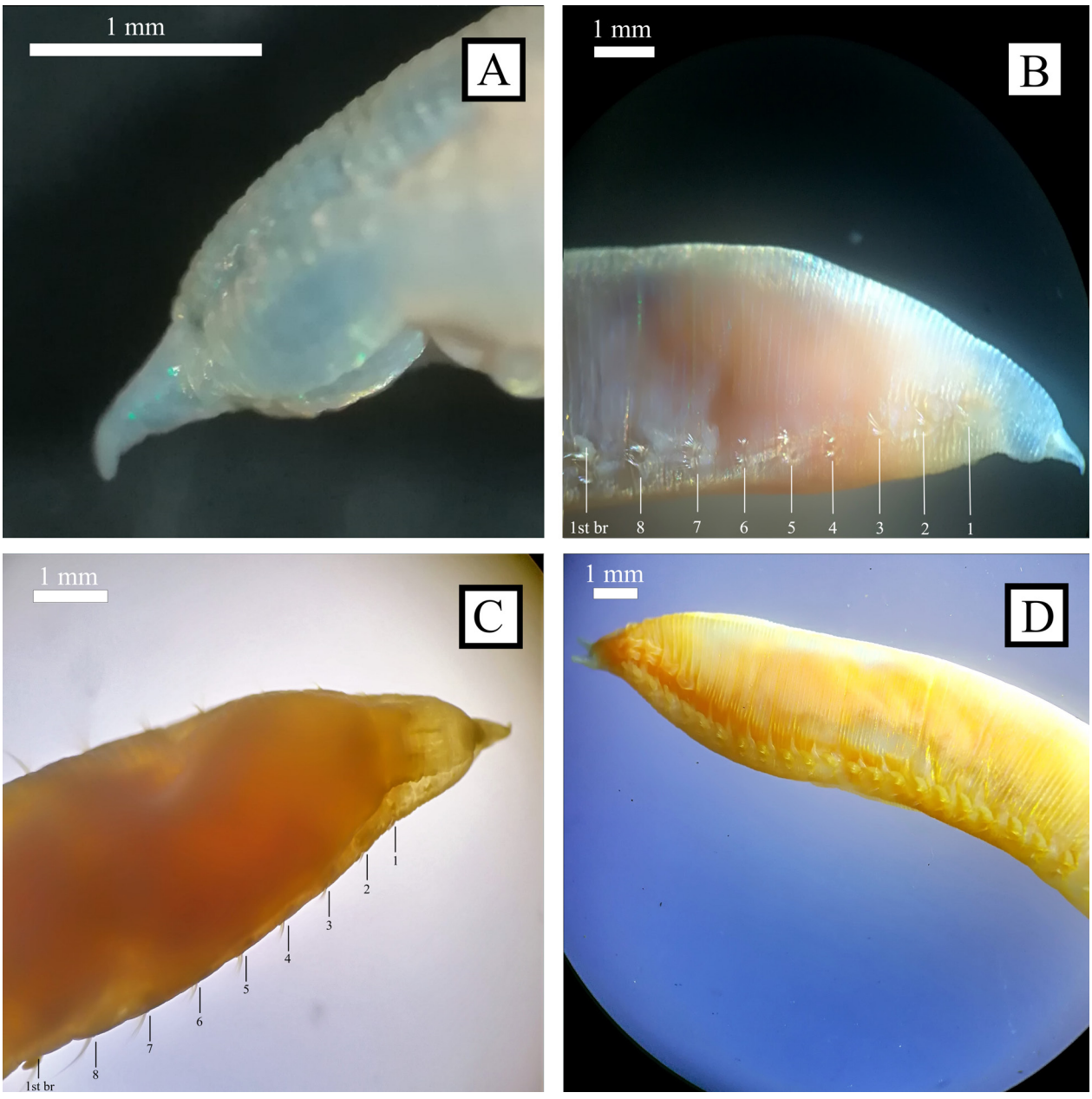

Figure 3. *Ophelia roscoffensis* (CL-02-POS-17). **A.** Lateral view of head. **B.** Lateral view of anterior region (1–8: anterior abranchiate chaetigers; 1st br: first branchia). **C.** Dorsal view of anterior region (1–8: anterior abranchiate chaetigers; 1st br: first branchia). **D.** Lateral view of posterior region.

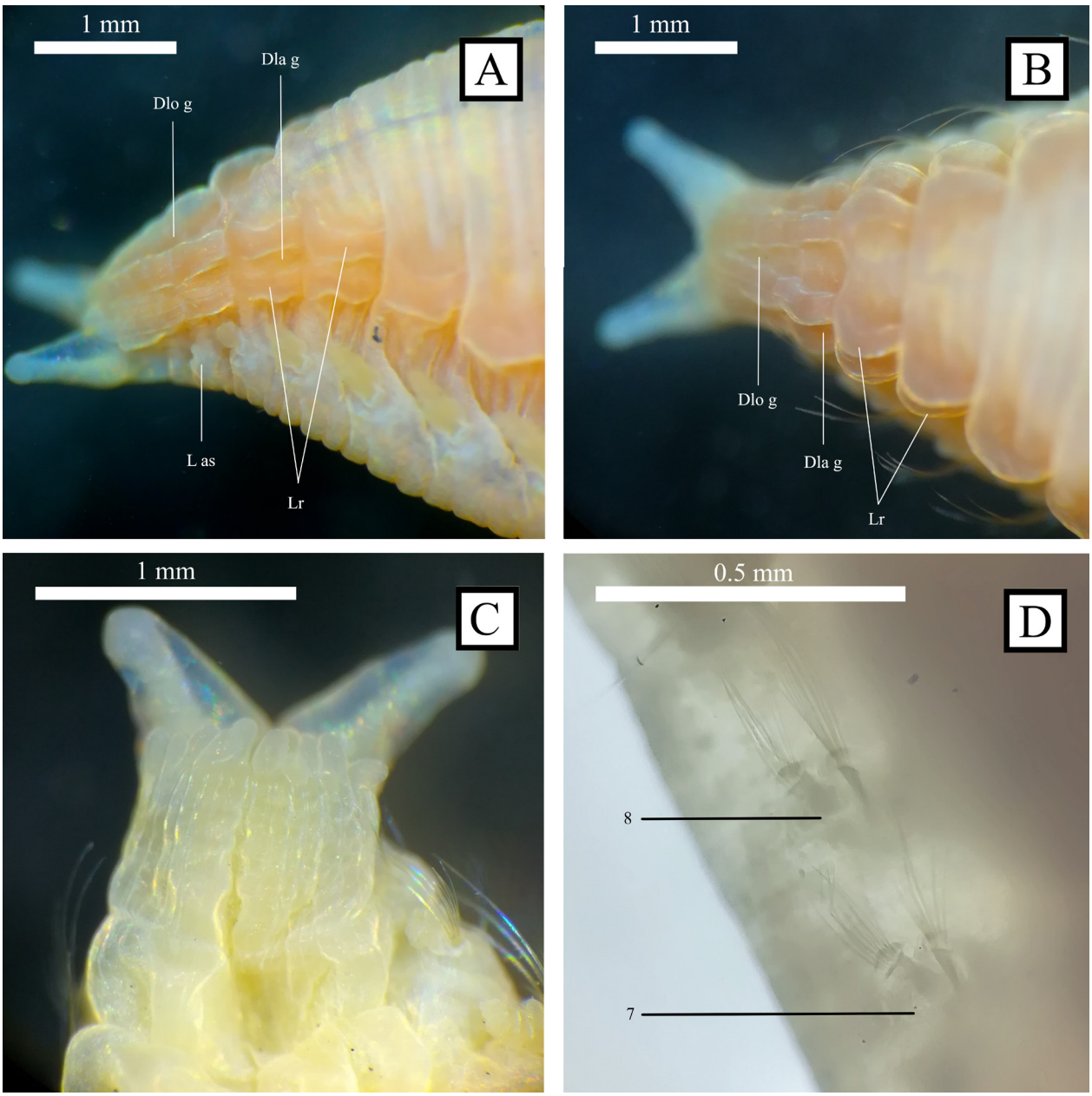

Figure 4. *Ophelia roscoffensis* (CL-02-POS-17). **A.** Lateral view of posterior tegumentary structures (Dlo g: dorsal longitudinal groove; Dla g: dorso-lateral groove; L as: last abranchiate chaetiger; Lr: lateral ridges). **B.** Dorsal view of posterior tegumentary structures (Dlo g: dorsal longitudinal groove; Dla g: dorso-lateral groove; Lr: lateral ridges). **C.** Dorsal papillae. **D.** Chaetigers 7 and 8.

with 1 or 2 ventral papillae and several smallest dorsal papillae (Augener 1910, Fauvel 1927, Parapar 2012). The specimens were subsequently identified as *O. roscoffensis* based on the presence of 8 anterior abranchiate segments, 32 segments, and 23 branchiae (Augener 1910, Fauvel 1927, Parapar 2012) and on the analysis of the posterior tegumentary structures that start from the 28th chaetiger (Tebble 1952).

Description. The 18 collected specimens were 12.1–27.5 mm long with 32 chaetigers; the last chaetiger is abranchiate (Fig. 4A). The body is pale pink after preservation (Fig. 2) and organized externally into 2 regions (Fig. 2): an anterior abranchiate cylindrical region with 8 chaetigers (Fig. 3B, C) and a posterior region characterized by the presence of a deep ventral groove (Fig. 3D). Twenty-three pairs of cirriforme branchiae are present in the posterior region (Fig. 3D). The prostomium is conical, pointed, and has no appendages (Fig. 3A). The proboscis is globose and smooth. The parapodia are reduced and with button-shaped parapodial lobes (Fig.4D). The chaetae are all simple and capillary (Fig. 4D). The pygidium bears 2 large ventral papillae and 12 smaller dorsal papillae arranged in 2 small circles (Fig. 4C). The posterior tegumentary structures are present starting from the 28th chaetiger and extending up to the 32nd chaetiger (Fig. 4A, B). This dermal structure is produced by 2 pairs of sinuous lateral ridges that enclose 3 dorsal grooves: 2 dorso-lateral grooves and 1 dorsal longitudinal groove (Fig. 4A, B).

The specimens showed a constant increase in body length from autumn (12.1–16.1 mm), through winter

(16.8–17.3 mm) and spring (17.1–18.5 mm), to summer (19.7–27.5 mm).

In the same scuba surveys, 3 other species sampled were found for the first time in the Northern Tyrrhenian Sea: the polychaetes *Acromegalomma messapicum* (Giangrande & Licciano, 2008). and *Goniadella bobrezkii* and the isopod *Mesanthura* sp. (Tiralongo et al. 2017, Giangrande et al. 2018, Mancini et al. 2019).

Discussion

This study represents the first record of *Ophelia ruscoffensis* in Italian coastal waters and only the fourth record in Mediterranean waters. According to the literature, in the Mediterranean Sea, the species has been reported from Spanish (Ramos 2010), Greek (Simboura 1996, Zenetos et al. 1997, Faulwetter et al. 2010, 2017), and Turkish waters (Çınar et al. 2014). In the Atlantic Ocean, it has been reported from the English Channel (Dauvin et al. 2003) and along the coasts of France, Spain, and Portugal (Tebble 1952, 1953, Bellan 1964, Costello et al. 2001, Dauvin et al. 2003, Iberfauna 2013, Read and Fauchauld 2019b).

Augener (1910 in Fauvel 1927) described *Ophelia ruscoffensis* as a variant of *O. limacina* based on observations of a specimen with fewer anterior abranchiate chaetigers. Tebble (1952) proposed the separation of these taxa into 2 species after observing several differences in the arrangement of the segments, the construction of the posterior tegumentary structure, the number of anterior abranchiate segments, and the number of dorsal papillae. Our morphological comparison between the 2 species also showed that the posterior tegumentary structure was clearly different between them. Instead, the number of the anterior abranchiate segments and the number of branchiae pairs were less clear and more difficult to determine after preservation in alcohol. For this reason, the analysis of the posterior dermal structures is a more reliable method for the distinction between these 2 species.

The increase in the number of individuals in May and August could be related to the lowest wave intensity and to the greater stability of the bed sediments observed in spring and summer for this area (Paladini De Mendoza et al. 2018). Furthermore, the increment of organic matter in the sediments, favoured by the growth phase of *P. oceanica*, could explain the constant size increase of individuals during the year. During late summer, the *P. oceanica* leaf litter, deposited on the unvegetated bed, increased the concentration of organic matter in the bed sediments with a consequent increase in trophic resources for non-selective deposit-feeders (Fauchauld and Jumars 1978, Danovaro and Fabiano 1995, Manini et al. 1997). Moreover, the leaf litter buffers seabed particles, preventing the resuspension processes and generating a greater stability in the seafloor substrates (Paladini De Mendoza et al. 2018).

In accordance with the previous observation by Bellan (1964) that described this species in association with the coarse sand, our individuals were collected on gravelly coarse sand characterized by the presence of a high percentage of shells and skeletal fragments. Specimens of *Ophelia roscoffensis* were collected in association with 3 other species recently reported in the Northern Tyrrhenian Sea: *Acromegalomma messapicum, Goniadella bobrezkii*, and *Mesanthura sp.* (Tiralongo et al. 2017, Giangrande et al. 2018, Mancini et al. 2019). These new records of all 4 species in the same *P. oceanica* meadow, highlight the role of this phanerogam as biodiversity hotspot.

Our work increases the knowledge about the distribution and ecology of this species in the Mediterranean Sea.

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Authors' Contributions

EM collected (scuba diver) and identified the specimens, wrote the manuscript and prepared the map. FT collected (scuba diver) the specimens and wrote the manuscript. DV photographed (stereo and optical microscope) the specimens and revised the manuscript. AB examined the specimens, wrote, revised, and approved the manuscript.

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