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# A NEW SPECIES OF *EUPOLYMNIPHILUS* (COPEPODA: CYCLOPOIDA: SABELLIPHILIDAE) FROM AN ANCHIALINE CAVE OF THE MEDITERRANEAN SEA WITH A KEY TO THE SEVEN SPECIES OF THE GENUS

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TAXONOMY  
STYGOFAUNA  
CRUSTACEA  
*EUPOLYMNIPHILUS*  
COASTAL WATERS

**ABSTRACT.** – A new species belonging to the genus *Eupolymniphilus* (Sabelliphilidae) is described from an anchialine cave located on the southern coast of the Tyrrhenian Sea (Central Mediterranean). Among the six species recognized in the genus, the new species *E. mediterraneus* sp. nov. is most closely related to *E. orientalis*, *E. brevicaudatus* and *E. occidentalis* in sharing the following characters: proximal caudal seta swollen proximally, antennal second segment with pointed outer distal corner, and mandible with 1 scale on convex side. A comparison with the most closely related species reveals that the new species differs in total body length and in length/width ratio of the caudal ramus. The total body length is 0.75 mm and the caudal ramus is 3.0:1 times longer than wide, whereas in *E. orientalis*, *E. brevicaudatus* and *E. occidentalis*, the abovementioned characters are: 0.88-1.04 mm, 1.50:1; 1.03 mm, 1:1; and 1.17-1.21 mm, 2.69:1, respectively.

## INTRODUCTION

Most sabelliphilids are associates of tubicolous polychaete species belonging to the families Sabellidae, Serpulidae and Terebellidae (Boxshall & Halsey 2004). *Eupolymniphilus* was proposed as new genus by Humes & Boxshall (1996) in order to incorporate *Herrmannella finmarchica* Scott 1903. This species had previously been transferred to *Scambicornus* by Humes (1967). The genus *Eupolymniphilus* to date includes six valid species. In addition to the type species *E. finmarchicus*, *Herrmannella tenuicaudis* Sars 1918 and *Preherrmannella armonicana* (Bocquet *et al.* 1963) were also recognised as members of the genus *Eupolymniphilus* by Kim (2006) while *Eupolymniphilus orientalis* Kim 2006, *E. occidentalis* Kim 2009, and *E. brevicaudatus* Kim 2009, were described as members of the genus *Eupolymniphilus*. In this paper we describe a new species of *Eupolymniphilus* from an anchialine cave on the Southern Italian coast (Central Mediterranean Sea).

## MATERIALS AND METHODS

Samples were collected using a hand-held plankton net (180  $\mu$ m mesh), on 20 October 2011 from an anchialine cave (Fig. 1) located on the southernmost coast of the Tyrrhenian Sea. The cave is located in close proximity (30m inland) to the shore, between the villages of Bagnara and Palmi on the Calabria coast (southern Italy). This cave has a maximum depth of 28 m and is subject to a significant marine influence. All samples were

fixed and preserved in 4 % formaldehyde/seawater solution. Only one *Eupolymniphilus* specimen was sorted from original samples. The specimen was dissected using glass needles in distilled water, and the body and appendages observed using light microscopy. Drawings were made using a Reichert Visopan projection microscope. The morphological terminology follows Huys & Boxshall (1991).

## RESULTS

### Systematics

Subclass Copepoda Milne Edwards, 1830  
Order Cyclopoida Burmeister, 1834  
Family Sabelliphilidae Gurney, 1927  
Genus *Eupolymniphilus* Humes & Boxshall, 1996

*Eupolymniphilus mediterraneus* sp. nov. (Figs. 2-4)

**Material examined.** Holotype: 1 adult female, dissected, appendages were mounted on glass slides in Reyne's fluid (series of 10 slides containing the appendages (ZMC reg. n° 2011. 5627) and the body (ZMC reg. n° 2011. 5628) preserved in 4 % formaldehyde/seawater solution are deposited in the Zoological Museum "Cambria" (ZMC)-Department of Animal Biology and Marine Ecology, Messina, Italy.

**Etymology:** The specific name *mediterraneus* refers to the geographic area, Mediterranean Sea, in which the new species occurs.

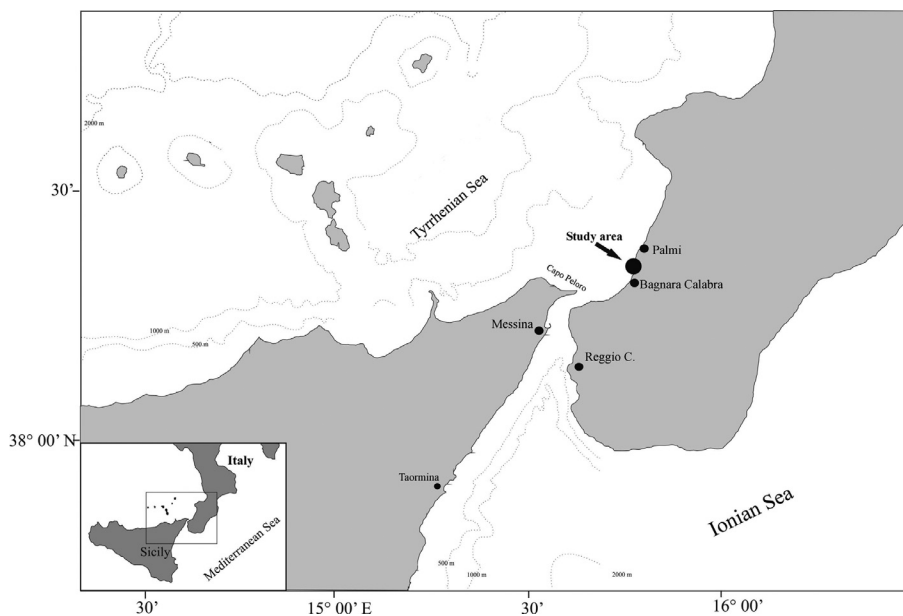


Fig. 1 – Study area.

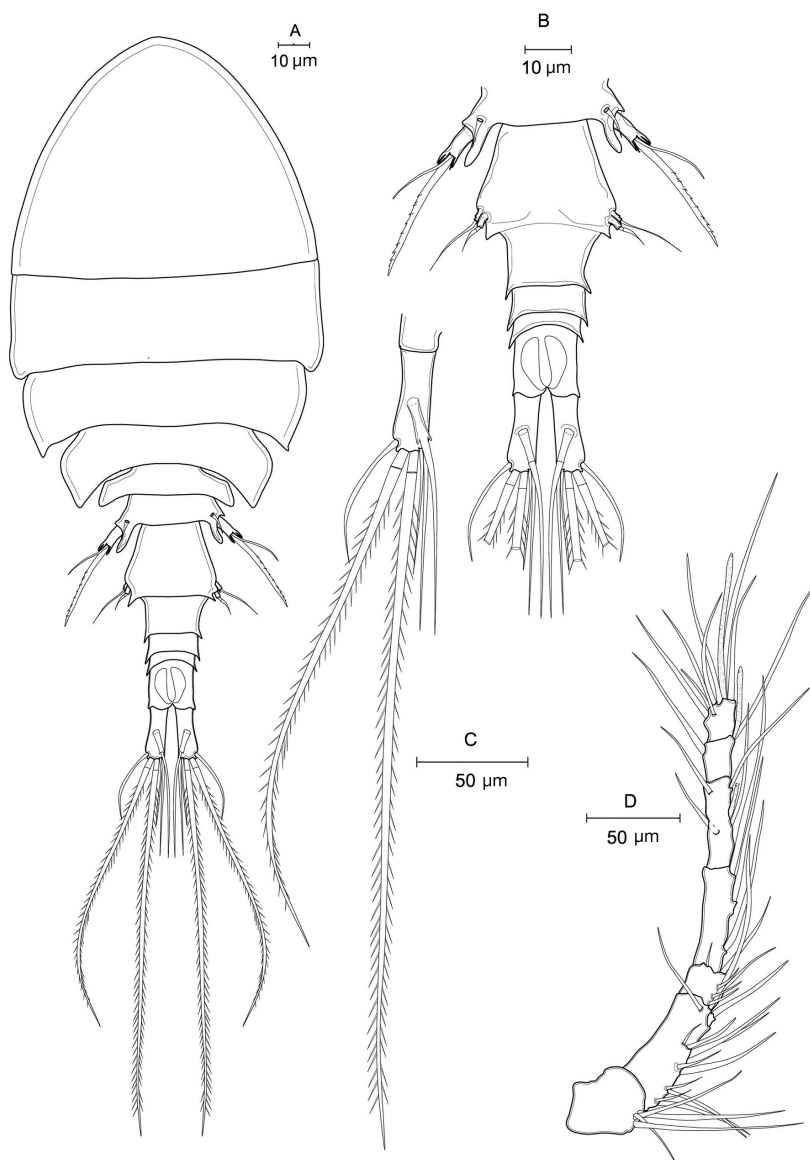


Fig. 2 – *Eupolymniphilus mediterraneus* sp. nov., adult female. A, habitus, dorsal; B, urosome, dorsal; C, caudal ramus, dorsal; D, antennule.

**Description:** Adult female (holotype) body length 0.75 mm, cyclopiform (Fig. 2A). Prosome 507 x 360  $\mu\text{m}$ . Cephalothorax with dorsal suture line separating cephalosome from first pedigerous somite. Second pedigerous somite with pointed posterolateral angles. Urosome 5-segmented (Fig. 2B), 250  $\mu\text{m}$  long, little less than half length of prosome. Fifth pedigerous somite 118  $\mu\text{m}$  wide, with posterior extension on both sides near base of free segment of leg 5. Genital double-somite 114 x 97  $\mu\text{m}$ , expanded near middle, with dorsal suture line only on dorsal surface, bearing pointed lateral processes. First 19 x 54  $\mu\text{m}$  and second 12 x 50  $\mu\text{m}$  free abdominal somites, with similar lateral processes. Anal somite 52 x 47  $\mu\text{m}$ , rounded laterally. Caudal rami 64 x 21  $\mu\text{m}$ , length/width ratio of 3:1, bearing six setae, two plumose median terminal setae, and four naked setae; proximal seta, located dorsally, at mid-length of caudal ramus, and swollen proximally (Fig. 2C).

Antennule (Fig. 2D) 7-segmented, with armature formula: 4, 13, 6, 3, 4+1 aesthetasc, 2+1 aesthetasc, and 7+1 aesthetasc; all setae naked.

Antenna (Fig. 3A) 4-segmented; first segment (coxobasis) with 1 inner distal seta, second segment with 1 inner seta and a pointed outer distal corner, third segment with setiform claw and 3 setae, fourth segment with 4 setiform claws and 3 setae.

Labrum (Fig. 3B) with strong posterior lobes and deep median incision.

Mandible (Fig. 3C) curved at right angle near base of blade with 1 large dentiform scale on apical margin and row of stout spines on medial and lateral margins of blade. Concave margin with numerous lamellar denticles.

Maxillule (Fig. 3D) forming lobe with 1 lateral and 3 apical naked setae.

Maxilla (Fig. 3E) 2-segmented, with first segment naked; second segment with 2 unequal setae, of which proximal very small, lateral and terminal lashes elongate and strongly spinulate.

Maxilliped lost during dissection.

Legs 1-4 (Fig. 4 A-D) with 3-segmented rami. Spine and setal formula as follows:

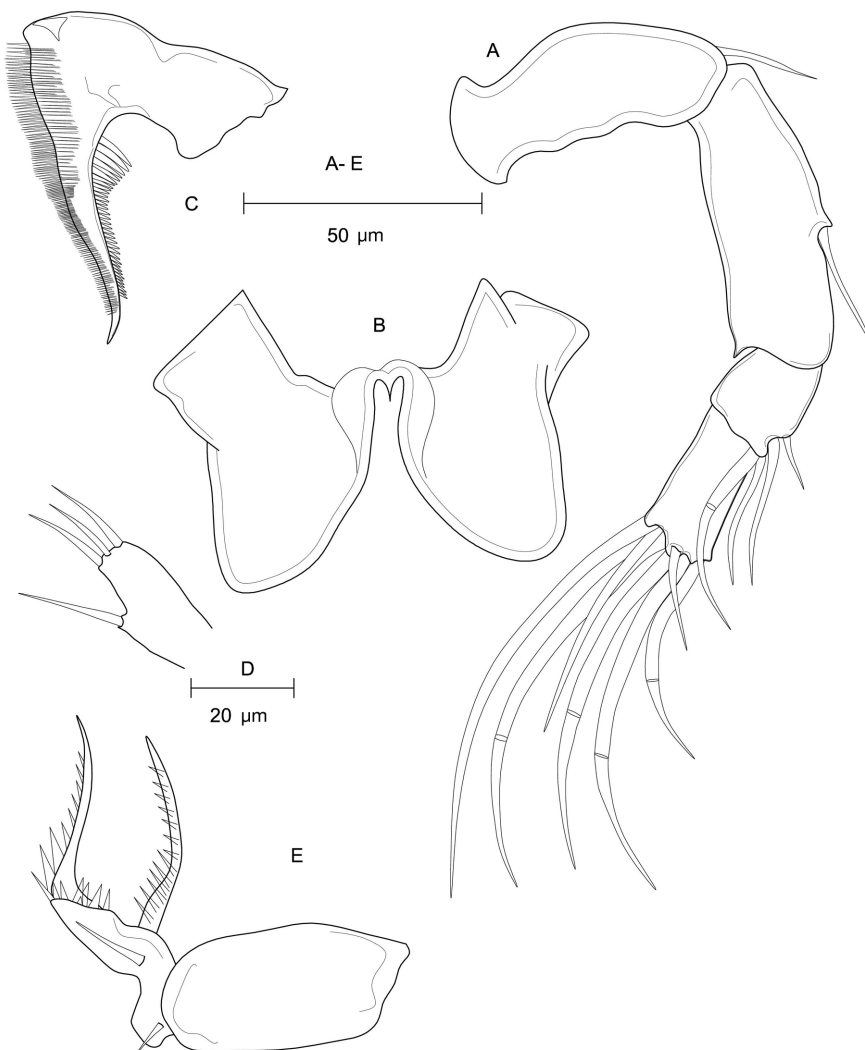


Fig. 3 – *Eupolymniphilus mediterraneus* sp. nov., A, antenna; B, labrum; C, mandible; D, maxillule; E, maxilla.

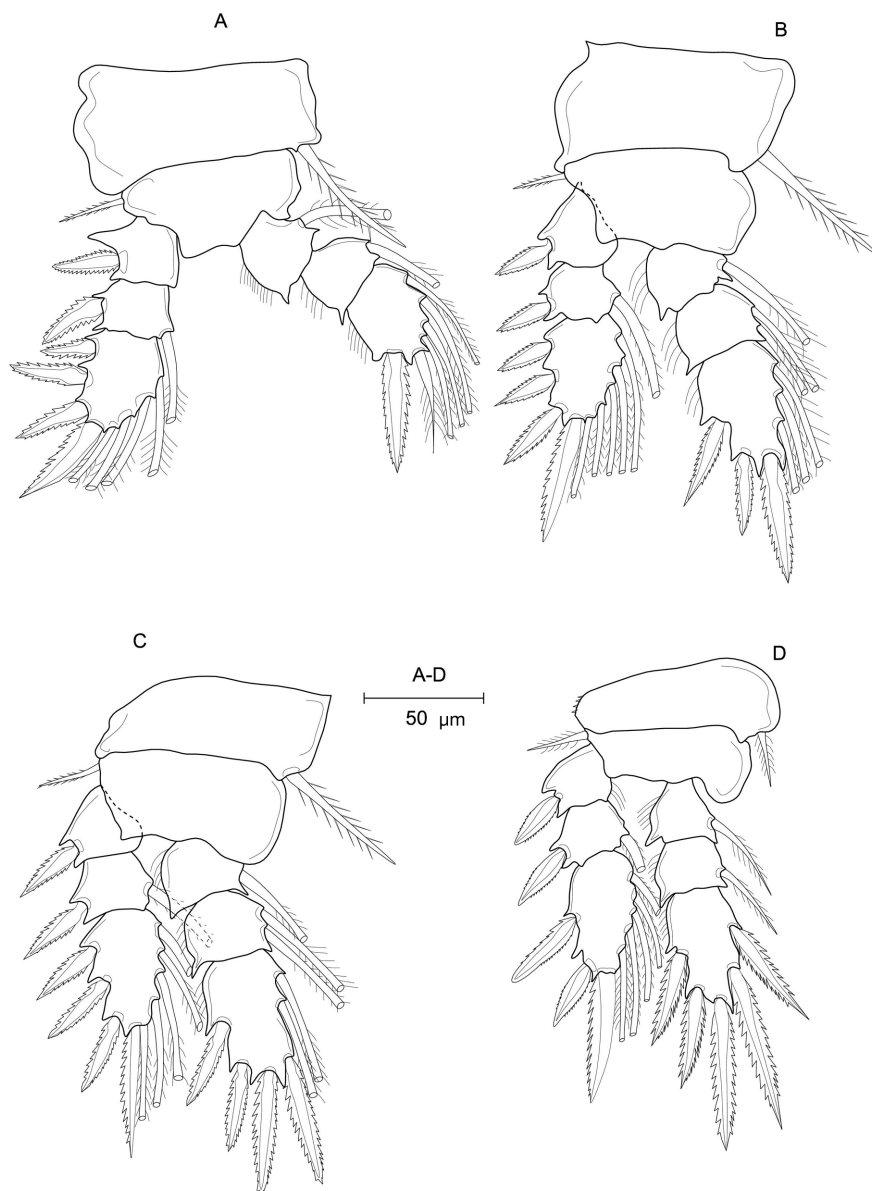


Fig. 4 – *Eupolymniphilus mediterraneus* sp. nov., A, leg 1; B, leg 2; C leg 3; D, leg 4.

	Coxa	Basis	Exopod	Endopod
Leg 1	0-1	1-0	I-0; I-1; III,I,4	0-1; 0-1; I,5
Leg 2	0-1	1-0	I-0; I-1; III,I,5	0-1; 0-2; I,II,3
Leg 3	0-1	1-0	I-0; I-1; III,I,5	0-1; 0-2; I,II,I,2
Leg 4	0-1	1-0	I-0; I-1; II,I,5	0-1; 0-1; I,II,II

Leg 5 (Fig. 2B) consisting of free segment and 1 dorso-lateral seta positioned on fifth pedigerous somite. Free segment (exopod), terminally serrated, and armed with 1 long spine serrated on the outer side and 1 seta. Leg 6 (Fig. 2B) represented, in genital area, by 2 unequal and proximally thickened setae.

## DISCUSSION

Kim (2006) provided a key to distinguish the four recognised *Eupolymniphilus* species. He later described two new species: *E. occidentalis* and *E. brevicaudatus*, increasing to six the number of species in the genus (Kim 2009). A comparison of *Eupolymniphilus mediterraneus* sp. nov. with its congeners reveals that it is most closely related to *E. orientalis*, *E. brevicaudatus* and *E. occidentalis* in having the following shared characters: (1) proximal caudal seta characteristically enlarged proximally, (2) antennal second segment with pointed outer distal corner, (3) fifth pedigerous somite with large posterior extension on both sides (not present in *E. occidentalis*), (4) mandible with 1 scale on convex side. The members of *Eupolymniphilus* are very homogeneous in morphology. For instance, the two species *E. finmarchicus* and *E. tenuicaudis* described



by Sars (1918) are differentiated only by the shape of the caudal rami (Kim 2006). The new species is however distinguishable from *E. finmarchicus*, *E. tenuicaudis* and *E. armoricanus* because these species do not present all the above characters in combination: *E. armoricanus* has only the pointed outer distal corner on second antennal segment, *E. finmarchicus* and *E. tenuicaudis* have a sleeve-like lateral expansion on both sides of the fifth pedigerous somite. Relative to the most closely related species, the new species differs in total body length and in the length/width ratio of the caudal ramus. In *E. mediterraneus* sp. nov. the total body length is 0.75 mm, and the caudal ramus is 3.0:1 times as long as wide, whereas in *E. orientalis*, *E. brevicaudatus* and *E. occidentalis* these above mentioned characters are: 0.88-1.04 mm, 1.50:1; 1.03 mm, 1:1; and 1.17-1.21 mm, 2.69:1, respectively. In addition, *E. orientalis* and *E. mediterraneus* differ for the following characters, that are reported in parenthesis for *E. mediterraneus*: antennular fourth segment with 3 setiform claws and 4 setae (4 setiform claws and 3 setae); concave margin of mandibular blade, with 1 single isolated subterminal spine, (not present); convex mandibular side, with a row of marginal spines (medial and lateral spines); maxillule armed with 3 terminal naked setae and a lateral setiform element (1 lateral and 3 terminal naked setae); free segment (exopod) of leg 5, armed with a long serrated spine on both sides (only on the outer side). In *E. mediterraneus*, genital double-somite with dorsal suture line only on dorsal surface, bearing pointed lateral processes, both lacking in *E. orientalis* and *E. occidentalis*. For all the above considerations, we therefore consider *E. mediterraneus* as a new species although only one single female specimen has been reported and described along this study.

#### Key to known species of *Eupolymniphilus*

- 1 Mandible with 1 distinct outer scale; proximal seta on caudal rami with broadened proximal part ..... 2
- Mandible without a distinct outer scale; Proximal seta on caudal rami not specialized ..... 3
- 2 Fifth pedigerous somite without large posterior extension ..... *E. occidentalis*
- Fifth pedigerous somite with large posterior extension ..... 4
- 3 Caudal rami more than 10 times longer than wide ..... *E. tenuicaudis*
- Caudal rami about 4 times longer than wide or less ... 5
- 4 Caudal rami as long as wide ..... *E. brevicaudatus*
- Caudal rami about 1.5 times longer than wide ..... *E. orientalis*
- Caudal rami about 3 times longer than wide ..... *E. mediterraneus* sp. nov.
- 5 Outer distal corner of the second antennal segment pointed; fourth segment at most twice as long as wide;

- lash of maxilla clearly demarcated from second segment .  
..... *E. armoricanus*
- Outer distal corner of the second antennal segment not pointed; fourth segment more than twice as long as wide; lash of maxilla clearly demarcated from second segment .  
..... *E. finmarchicus*

**Distribution, habitat and feeding type:** The genus *Eupolymniphilus* has a worldwide distribution from temperate to tropical waters of the Pacific, Indian, and Atlantic Oceans and the Mediterranean Sea. The habitat of *E. mediterraneus* sp. nov. is the muddy bottom of the cave at 28 m depth, located 30 m inland, subject to a significant marine influence from the penetration of adjacent coastal waters. *E. orientalis* was also recorded from intertidal muds, full of burrows of various species of polychaetes and crustaceans (Kim 2006). *E. occidentalis* and *E. brevicaudatus* were recorded from washings of sponges and ascidians, and from the coral *Tubipora musica* L., respectively (Kim 2009). *E. armoricanus* and *E. finmarchicus* are both ectoparasitic on *Eupolymnia nebulosa* (Montagu 1818). The former is distributed in northern France (Bocquet *et al.* 1963) and the latter from the south-west Ireland to Norway, including the coast of English Channel (Sars 1918).

The occurrence of *E. mediterraneus* and other species belonging to the genera *Euryte* Philippi 1843 and *Ginesia* Jaume & Boxshall 1997 in the caves of Tyrrhenian Sea, provides further evidence of the existence of a rich endemic assemblage of cyclopoid copepods in the anchialine environment. This copepod assemblage has only recently been discovered by the pioneering studies of Rocha & Iliffe (1991, 1993, 1994) and Jaume & Boxshall (1996, 1997).

**ACKNOWLEDGEMENTS.** – The authors are grateful to several anonymous reviewers who enabled the improvement of this paper.

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Received March 16, 2012

Accepted March 16, 2013

Associate Editor: O Verneau