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CALIGUS MUSAICUS N. SP. (COPEPODA, CALIGIDAE) PARASITIC ON
THE EUROPEAN FLOUNDER, *PLATICHTHYS FLESUS* (LINNAEUS)
OFF PORTUGAL

BY

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ABSTRACT

A new species of caligid copepod, *Caligus musaicus* n. sp., is described from the European flounder, *Platichthys flesus* (Linnaeus, 1758), caught off the northern coast of Portugal. The new species is distinguished from its congeners by the combination of the following character states: (1) equipped with a short abdomen (about 1/3 the length of the thoracic zone of the cephalothoracic shield); (2) armed with a pair of parallel pointed tines on the box of the sternal furca; (3) bearing a long element IV (about 3 times as long as the next longest element) at the tip of leg 1 exopod; and (4) with a slender leg 4 exopod bearing a long outer seta (about 3 times as long as the next longest seta) at the tip of this ramus.

RÉSUMÉ

Une espèce nouvelle de copépode caligide, *Caligus musaicus* n. sp., parasite du carrelet *Platichthys flesus* (Linnaeus, 1758), capturé au large de la côte nord du Portugal est décrite. Cette nouvelle espèce se distingue de ses congénères par la combinaison des caractères suivants: (1) un abdomen court (environ 1/3 de la longueur de la région thoracique du bouclier céphalothoracique); (2) une paire d'épines parallèles et pointues sur la «boîte» de la furca sternale; (3) un long élément IV (environ 3 fois aussi long que le plus long des autres éléments) à l'extrémité de l'exopodite de la première patte; et (4) un exopodite de la quatrième patte, mince, portant une longue soie externe (environ 3 fois plus longue que la plus longue des autres soies) à son extrémité.

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INTRODUCTION

The European flounder, *Platichthys flesus* (Linnaeus, 1758), is a demersal and catadromous fish with high commercial value. It is widely distributed in coastal and brackish waters of western Europe, extending from the White Sea to the Mediterranean and the Black Sea (Froese & Pauly, 2008). So far as we are aware, five species of parasitic copepods have been reported from this species of flounder. They are: *Acanthochondria cornuta* (Müller, 1776) reported by Ho (1970); *Caligus elongatus* Von Nordmann, 1832 reported by Boxshall (1974); *Lepeophtheirus europaensis* Zeddiam et al., 1988 reported by Zeddiam et al. (1988); *L. pectoralis* (Müller, 1777) reported by Boxshall (1974); and *Lernaecera branchialis* (Linnaeus, 1767) reported by Polyanski (1955). While the first four species of parasites were found as adults on the flounder, the last one utilizes the flounder as an intermediate host; in other words, only the chalimus stages were seen.

While one of us (F.I.C.) was studying the Crustacea infections on the European flounder occurring off the northern coast of Portugal (Cavaleiro, 2007; Cavaleiro & Santos, 2007), a species of *Caligus* was occasionally encountered. It is a rare species of sea louse, with only 11 specimens being found through the examination of 210 host fish collected between September 2005 and May 2006. Close studies of this parasite revealed that it represents a new species. Inasmuch as both sexes are represented in this rare collection, a full description of the species is given in the following.

MATERIAL AND METHODS

Flounders collected at Matosinhos fish harbour (in northern Portugal) were brought back to the laboratory on the campus of the Universidade do Porto for examination. The copepod parasites were removed from the fish host and were preserved in 70% ethanol. Later, the preserved parasites were cleared in 90% lactic acid for about 1 hour before making dissection in a drop of lactic acid. The dissected body parts and appendages were examined using a Zeiss Axiophot Photomicroscope at magnifications of up to 1000 \times . All drawings were made with the aid of a camera lucida. Measurements given are the mean followed by the range in parentheses. The description of the female is given in full but that of the male is confined only to those parts showing sexual dimorphism.

RESULTS

CALIGIDAE Burmeister, 1835

Caligus Müller, 1785***Caligus musaicus* n. sp. (figs. 1-3)**

Material examined. — Eleven specimens (4 ♀♀; 7 ♂♂) parasitic on the body skin and the pectoral and ventral fins of the European flounder, *Platichthys flesus* (Linnaeus, 1758) (Teleostei: Pleuronectidae), landed at Matosinhos fishing port, Portugal (41° 10' N 8° 42' W), as follows: 1 ♀ from body skin (blind side) of 1 flounder collected on 2 September 2005; 1 ♂ from body skin (ocular side) of 1 flounder collected 2 September 2005; 1 ♂ from body skin (blind side) of 1 flounder collected 2 September 2005; 1 ♂ from pectoral fin (ocular side) of 1 flounder collected 2 September 2005; 1 ♂ from ventral fin (ocular side) of 1 flounder collected 2 September 2005; 1 ♂ from body skin (ocular side) of 1 flounder collected 23 May 2006; 2 ♂♂ from body skin (blind side) of 2 flounders collected 23 May 2006; and 3 ♀♀ from body skin (ocular side) of 3 flounders collected on 23 May 2006.

All isolated parasite specimens were adults, the females being non-ovigerous. One holotype (USNM 1136866) and an allotype (USNM 1136867) are deposited in the Smithsonian Institution, Washington, D.C., and 2 paratypes have been deposited in the Natural History Museum, London, (Catalogue numbers: NHM 2010.248 and NHM 2010.249). The remaining specimens have been retained in the personal collections of the authors.

Female. — Body (fig. 1A) 4.41 (3.75-5.07) mm long, excluding setae on caudal rami. Cephalothoracic shield roughly triangular in shape, 2.53 (2.08-3.00) × 2.24 (1.94-2.41) mm, excluding lateral hyaline membrane; frontal plates well developed and carrying moderately large lunules (width slightly less than 1/3 that of the plates); free margin of thoracic zone projecting slightly beyond tips of lateral zones; sinuses deep. Fourth pediger wider than long, 0.26 (0.20-0.32) × 0.64 (0.52-0.85) mm, not separated from genital complex. Genital complex subcircular, 1.07 (0.75-1.22) × 1.24 (0.85-1.43) mm, about equally long or slightly longer than thoracic zone of cephalothoracic shield. Abdomen (fig. 1B) short, 1-segmented, measuring 0.47 (0.44-0.50) × 0.43 (0.40-0.47) mm; bearing 8 papillae on dorsal surface, 6 with single setule and 2 with multiple setules. Caudal ramus about as long as wide, 0.16 (0.13-0.18) × 0.13 (0.10-0.16) mm; armed with 2 short, 1 medium, and 3 long plumose setae in addition to a setule-bearing papilla on dorsal surface and a row of setules on medial margin.

Antennule (fig. 1C) 2-segmented; proximal segment carrying 25 setae on anterodorsal surface, 2 of them naked, plus 2 small setae on ventral surface; distal segment with 1 subterminal seta on posterior margin and tipped with 11 setae plus 2 aesthetascs. Antenna (fig. 1D) 3-segmented; proximal segment smallest, with short, pointed posteromedial process; middle segment subrectangular and armed with 1 corrugated and well developed adhesion pad near medial region of

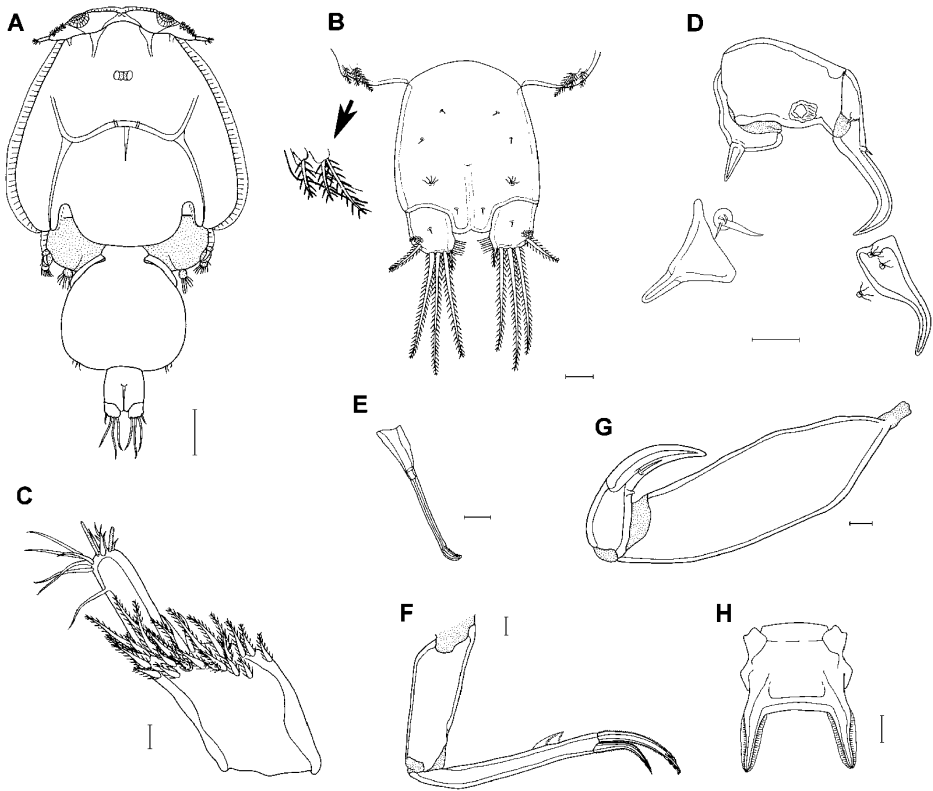


Fig. 1. *Caligus musaicus* n. sp., female. A, habitus, dorsal; B, abdomen and caudal rami; C, antennule; D, antenna, postantennal process, and maxillule; E, mandible; F, maxilla; G, maxilliped; H, sternal furca. Scale-bars: 0.5 mm in A; 100 μ m in B and D; 50 μ m in C; 50 μ m in E–H.

medial border; distal segment long, curved claw bearing 2 setae, 1 proximal and broad, the other comparatively thinner and close to medial region. Postantennal process a large hook with 2 basal setule-bearing papillae; another similar papilla on sternum. Maxillule comprising short but pointed dentiform process and basal papilla tipped with 3 setae. Mandible (fig. 1E) with 4 sections, bearing 12 teeth on medial margin of distal blade. Maxilla (fig. 1F) 2-segmented and brachiform; proximal segment (lacertus) unarmed; distal segment (brachium) carrying small, subterminal hyaline membrane (flabellum) on outer edge and 2 unequal elements at terminal end, a short canna, and a long calamus. Maxilliped (fig. 1G) 3-segmented; proximal segment (corpus) largest but unarmed; middle segment (shaft) carrying small, digitiform process at mediiodistal corner; distal segment (claw) with long medial barbel. Box of sternal furca (fig. 1H) quadrangular and carrying 2 parallel pointed tines, fringed with membrane along their entire length and shorter than box.

Formula of armature of rami on legs 1-4 as follows (Roman numerals indicating spines and Arabic numerals indicating setae):

	Exopod	Endopod
Leg 1	I-0; III, I, 3	(vestigial)
Leg 2	I-1; I-1; II, I, 5	0-1; 0-2; 6
Leg 3	I-0; I-1; 7	0-1; 6
Leg 4	I-0; I, III	(absent)

Protopod of leg 1 (fig. 2A) with long plumose outer seta and another similar inner seta, in addition to a papilla bearing 2 setules on outer margin of coxa. Endopod a small inconspicuous process. First segment of exopod with a row of setules on posterior edge and small spiniform seta on outer distal corner; middle two of 4 terminal elements on last segment of exopod with accessory process; element 4 about 3 times as long as element 2 and bearing setules only on outer margin. Leg 2 (fig. 2B) coxa small, with large plumose inner seta on posterior edge and long setule-bearing papilla on ventral surface. Basis carrying long seta on outer edge in addition to long setule-bearing papilla on ventral surface, close to base of posterior marginal membrane. Anterodistal surface of basis and first segment of exopod with large marginal membrane. Outer margin of 3 endopodal segments with a tuft or row of small setules. Leg 3 (fig. 2C) protopod (apron) with small outer and large inner plumose setae, in addition to an outer and a posterior marginal

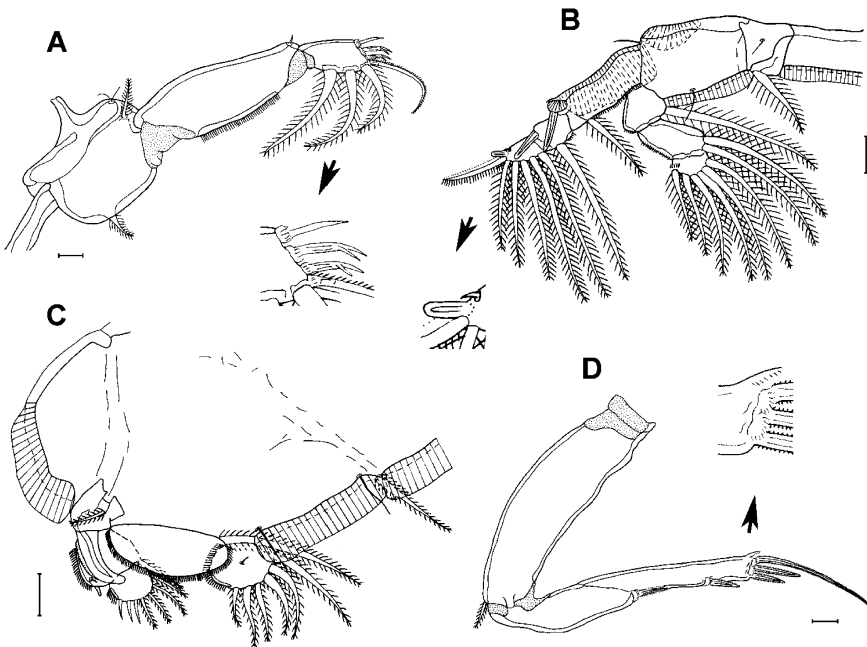


Fig. 2. *Caligus musaicus* n. sp., female. A, leg 1; B, leg 2; C, leg 3; D, leg 4. Scale-bars: 50 μm in A and D; 100 μm in B and C.

membrane; ventral surface of protopod with small setule-bearing papilla at both ends of that membrane; velum well developed and fringed with marginal setules. Leg 4 (fig. 2D) protopod large, with plumose seta at outer distal corner; exopod 2-segmented, due to fusion of distal two segments; pecten at base of each seta on exopod; outer terminal seta about 3 times as long as middle one. Leg 5 (fig. 1B) represented by 2 small papillae on posterolateral corner of genital complex, one tipped with a single and the other with 2 small, plumose setae.

Male. — Body (fig. 3A) 3.42 (3.25-3.64) mm long, excluding setae on caudal rami. Cephalothoracic shield roughly triangular in shape, $2.09 (1.91-2.26) \times 1.93$

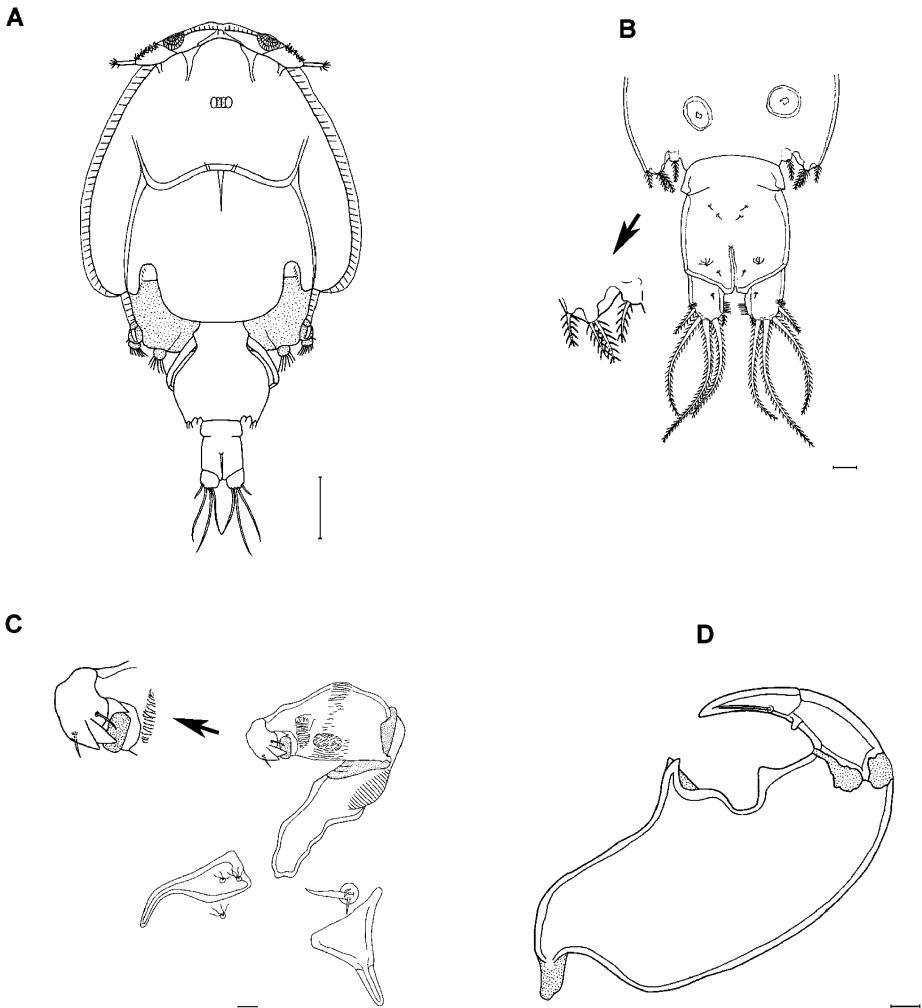


Fig. 3. *Caligus musaicus* n. sp., male. A, habitus, dorsal; B, abdomen and caudal rami; C, antenna, postantennal process and maxillule; D, maxilliped. Scale-bars: 0.5 mm in A; 100 μ m in B; 50 μ m in C and D.

(1.81-2.03) mm; frontal plates well developed and carrying moderately large lunules (width slightly less than 1/3 that of the plates); free margin of thoracic zone projecting slightly beyond tips of lateral zones; sinuses deep. Fourth pediger not separated from genital complex, roughly hexagonal in shape and about 2 times as wider as long, 0.20 (0.16-0.28) × 0.46 (0.41-0.50) mm. Genital complex sub-rectangular, 0.54 (0.50-0.59) × 0.76 (0.73-0.80) mm, smaller than thoracic zone of cephalothoracic shield, and with 2 small protuberances on posterolateral corners. Abdomen (fig. 3B) partially 2-segmented; proximal somite smallest and distinctly wider than long, 0.46 (0.45-0.49) × 0.39 (0.35-0.42) mm; anal somite subsquare, 0.36 (0.31-0.41) × 0.38 (0.34-0.41) mm. Caudal ramus about equally long as wide, 0.16 (0.14-0.18) × 0.15 (0.13-0.17) mm, armed as in female. Antenna (fig. 3C) 3-segmented; proximal segment slender, armed with long corrugated pad on outer surface; middle segment largest, armed with 3 pads in addition to a corrugated band; terminal segment smallest, armed with 2 basal setae and 2 overlapping cuticular flaps bearing pointed tips. Maxilliped (fig. 3D) generally as in female except for corpus being more robust and bearing in myxal region a small dentiform protuberance and another bipartite protuberance. Leg 5 (fig. 3B) located on outer protuberance on posterolateral corner of genital complex comprising 2 papillae, one tipped with 1 and the other with 2 plumose setae. Leg 6 represented by a posterolateral ridge on genital complex carrying a protuberance tipped with 1 plumose seta.

Etymology. — The species name *musaicus* is the Latin word for mosaic. It alludes to the species' resemblance with several of its congeners, in such a way that it reminds of a genetic mosaic, i.e., an organism whose body consists of a mixture of cells of two or more different genotypes.

DISCUSSION

Caligus Müller, 1785 is the largest genus of parasitic copepods, containing over 250 species (Ho & Lin, 2004). Since the male remains unknown for many of them, comparison of our specimens obtained from the flounder with its congeners is accordingly restricted to the female.

As far as we can find, there are 9 species of *Caligus* showing closeness to *C. musaicus* n. sp. in sharing the following 3 character states with the new species: (1) a short abdomen (about 1/3 the length of the thoracic zone of the cephalothoracic shield), (2) bearing a long seta IV (about 3 times as long as the next longest element) at the tip of leg 1 exopod, and (3) with a slender, 2-segmented leg 4 exopod bearing a long outer seta (about 3 times as long as the next longest seta) at the tip of this ramus. Those 9 species of *Caligus* are: *C. acanthopagri* Lin et al., 1994; *C. crusmae* Castro & Baeza, 1982; *C. dieuzeidei* Brian, 1933; *C. hobsoni*

Cressey, 1969; *C. latigenitalis* Shiino, 1954; *C. ligatus* Lewis, 1964; *C. similis* Ho et al., 2005; *C. bifurcus* Shen, 1958; and *C. russelli* Kurian, 1950. Nevertheless, the new species can be distinguished from the first 7 species mentioned above in the possession of a pair of parallel pointed tines on the sternal furca (see fig. 1H). Of the remaining two species, *C. bifurcus* can be distinguished from the new species by the structure of the sternal furca (being narrower), and *C. russelli*, in the structure of the postantennal process and the corpus of the maxilliped. Besides, seta IV (the longest element) at the tip of the exopod of leg 1 in the new species is unusual in bearing setules only on one side (outer margin) of the element.

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