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The copepods associated with the coral *Astroides calycularis* (Scleractinia, Dendrophyllidae) in the Strait of Gibraltar

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(Accepted 24 April 2006)

Abstract
This paper describes and provides new records of the copepods hosted by the ahermatypic scleractinian *Astroides calycularis* (Pallas, 1766). This coral species is endemic to the Mediterranean Sea and protected by the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). The coral colonies were collected at both sides of the Strait of Gibraltar. Two new species, the poecilostomatoid *Doridicola helmuti* and the siphonostomatoid, *Asterocheres astroidicola*, are described and compared with their congeners. Furthermore, this paper represents the first record of the genus *Doridicola* associated with a scleractinian coral, the first time that *Acontiophorus scutatus* is found associated with Cnidaria, and the first report of an *Asterocheres* species living on scleractinian corals from the European coasts.

Keywords: Astroides, *scleractinian, Copepoda, Poecilostomatoida, Siphonostomatoida, symbionts*

Introduction

Copepoda have been extremely successful in developing associations with Cnidaria and they can be found in association with three classes, the Hydrozoa, the Scyphozoa, and the Anthozoa. In doing so, the copepods have undergone considerable morphological modification and adaptation, although they range from relatively unmodified copepods such as *Acanthomolgus* Humes and Stock, 1972 (associated with gorgonians) to highly modified forms such as *Lamippe* Bruzelius, 1858 (soft corals), *Magnippe* Stock, 1978 from gorgonians or *Mesoglicola* Quidor, 1906 (corallimorpharians).

The Anthozoa have a large number of copepod associates, resulting from: (1) the fact that the larger colonies of the hosts provide more space for copepods; (2) the existence of relatively large gastrovascular cavities offering a protected environment; and (3) the greater

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Published 26 July 2006

ISSN 0022-2933 print/ISSN 1464-5262 online
DOI: 10.1080/00222930600774210

opportunity for the evolution of host specificity in these very diverse cnidarians (Humes 1985). Both soft corals, within the octocorals, and scleractinian, or hard corals, among the Hexacorallia, serve as hosts for many more copepods than any other groups (Stock 1987; Humes 1995, 1996; Huys and Boxshall 2001). Among scleractinians, copepods are the most abundant in shallow-water reef-building hermatypic corals, which are the most conspicuous animals in tropical waters, while they are much less abundant in ahermatypic corals (Stock 1985).

Of the various orders of symbiotic Copepoda, the Poecilostomatoida contains by far the greatest number of species associated with cnidarians. The remaining orders are much less frequent, and they are represented by relatively small numbers although Siphonostomatoida and Harpacticoida are probably much more frequent associates than presently recorded.

The scleractinian coral *Astroides calycularis* (Pallas, 1766) is endemic to the southwest Mediterranean Sea and can be found from the Strait of Gibraltar to the Gulf of Naples including the Maltese Islands in European waters, and from the Strait of Gibraltar to Cape Bon (Tunisia) in North Africa (Zibrowius 1980, 1995). Currently this species is protected by CITES and recently the Spanish Government has included this ahermatypic coral as "vulnerable" in the National Catalogue of Endangered Species. In a recent survey on the biology of *A. calycularis* from the Strait of Gibraltar, a variety of species of copepods belonging not only to the order Poecilostomatoida, but also to Siphonostomatoida, have been found associated with this orange coral. The purpose of this work is to describe some of these copepods.

Materials and methods

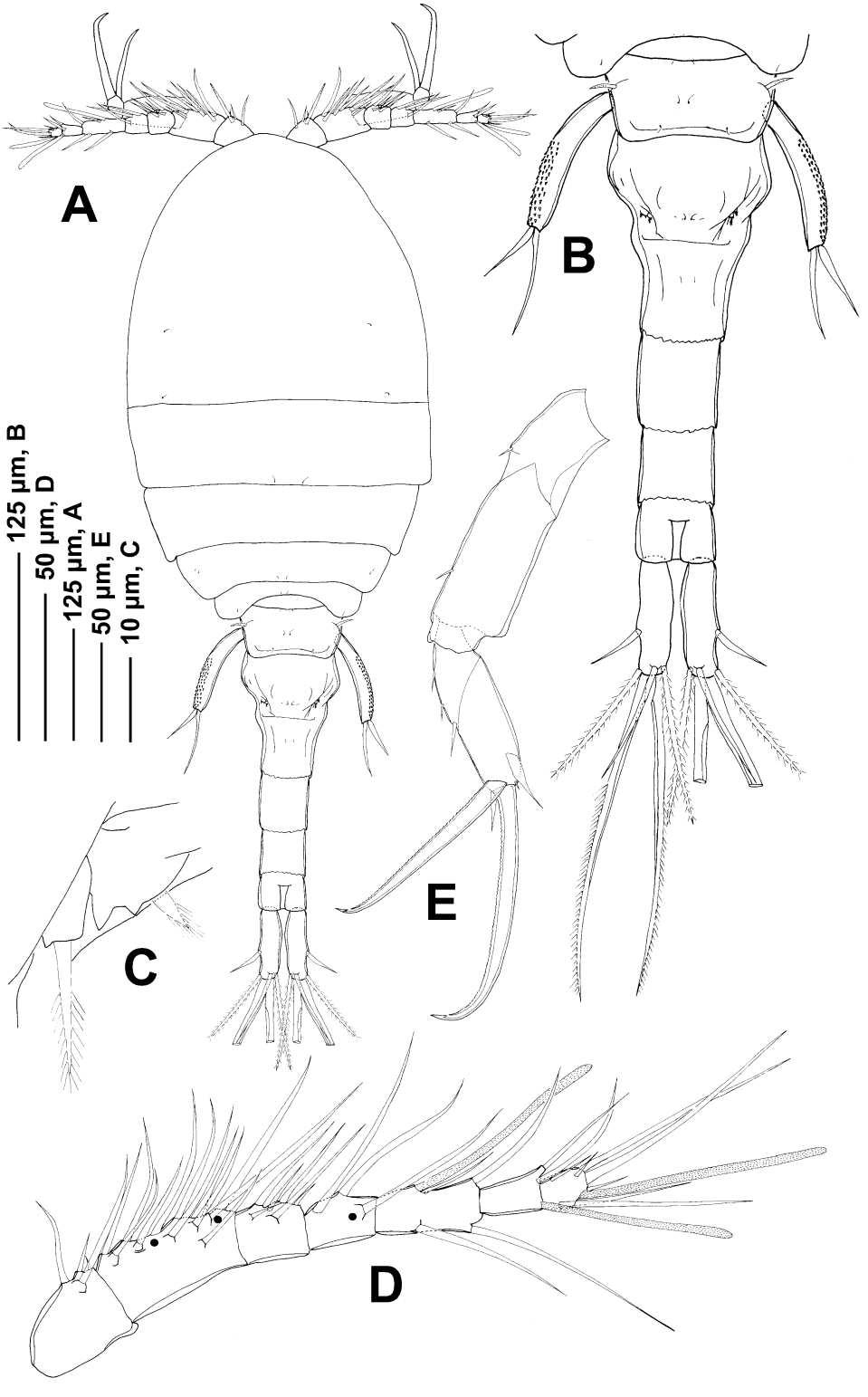
The colonies of the host scleractinian were individually collected, each one being isolated in a plastic bag, by scuba diving at both sides of the Strait of Gibraltar and immediately fixed in formaldehyde (8–10%) in seawater. Symbiotic fauna was obtained by pouring the wash water through a 100 μm net. The copepods were finally recovered from the sediment retained and preserved in 70% ethanol.

Selected specimens were dissected in lactic acid and examined as temporary mounts in lactophenol. All figures were drawn with the aid of a camera lucida on a Leica DMLB differential interference microscope. In order to detect minute details, two selected specimens of each species were prepared for scanning electron microscopy (SEM) studies: they were post-fixed in 2.5% glutaraldehyde in 0.2 M cacodylate buffer at pH 7.3 and in 1% OsO_4 in the same buffer and subsequently critical-point dried, mounted on stubs, coated with gold–palladium and observed and photographed using a Philips XL 30 SEM. All appendage segments and setation elements are named and numbered using the terminology introduced by Huys and Boxshall (1991).

Material examined in the present paper is deposited in the Museo Nacional de Ciencias Naturales in Madrid (MNCN) and in the collection of the research team Biodiversidad y Ecología de Invertebrados Marinos of the University of Seville (BEIM).

Results

Order POECILOSTOMATOIDA Thorell, 1859
Family RHYNCHOMOLGIDAE Humes and Stock, 1972
Doridicola Leydig, 1853
Doridicola helmuti sp. nov.
(Figures 1–5)


A
B
C
D
E
125 µm, B
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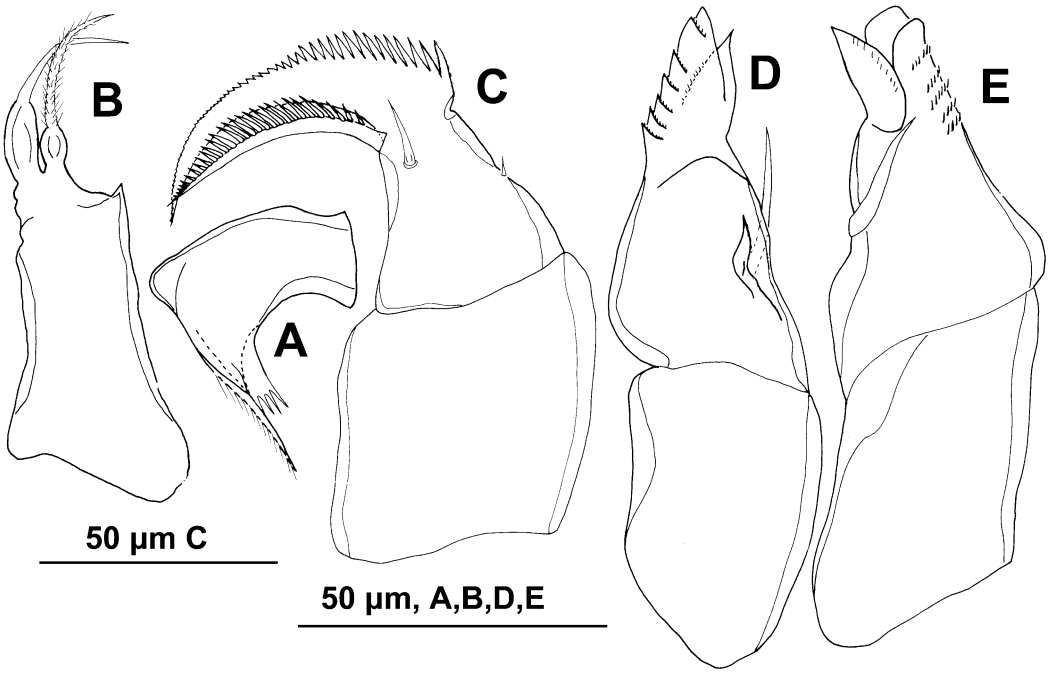

Figure 2. *Doridicola helmuti*, female. (A) Mandible; (B) maxillule; (C) maxilla; (D) maxilliped, latero-posterior view; (E) maxilliped, latero-anterior view.

Material examined

MNCN 20.04/7575 holotype, one adult female, associated with the scleractinian *Astroides calycularis*, Tarifa Island, 36°01′N, 5°37′W, 25–30 m depth, July 1999; MNCN 20.04/7576 allotype, adult male, with the same sampling data as the holotype; MNCN 20.04/7577 paratypes, 10 females and seven males, with the same sampling data as the holotype; BEIM (COP 215), 10 adult females, six adult males and 12 copepodids, with the same sampling data as the type material; BEIM (COP 216), three adult females, and four copepodids, associated with the scleractinian *Astroides calycularis*, Punta Desnarigado, Ceuta, North Africa, 35°53′N, 5°18′W, 40 m depth, August 1998; BEIM (COP 217), three adult females and five adult males, associated with the scleractinian *Astroides calycularis*, Tarifa Island, 36°01′N, 5°37′W, 25 m depth, October 1999.

Description

Female. Body (Figure 1A) 985 µm long (920–1008 µm) (excluding setae on caudal rami) and 362 µm wide (340–400 µm) (greatest width of cephalothorax) based on six females in lactic acid. First pediger separated from cephalosome by distinct dorsal furrow. Ratio of length to width of prosome 1.7:1. Ratio of length of prosome to that of urosome 1.62:1. Segment bearing leg 5 subquadrate, 57.7 × 92.9 µm. Genital double somite (Figure 1A, B) 1.23 times longer than wide, 134.6 × 109 µm, with prominent anterodorsal bulge

Figure 1. *Doridicola helmuti*, female. (A) Dorsal view; (B) urosome, dorsal view; (C) genital area; (D) antennule; (E) antenna.

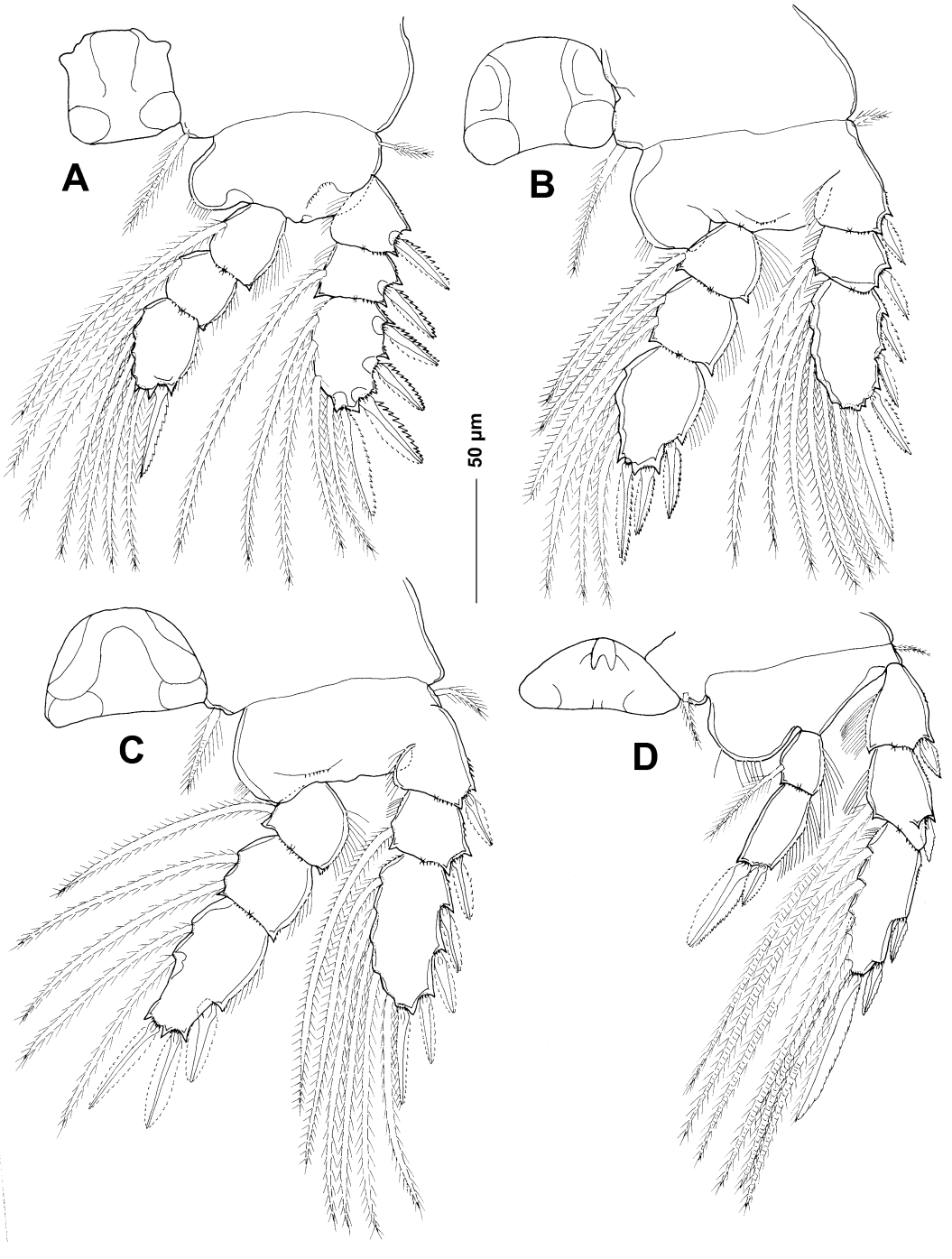

Figure 3. *Doridicola helmuti*, female. (A) Leg 1; (B) leg 2; (C) leg 3; (D) leg 4.

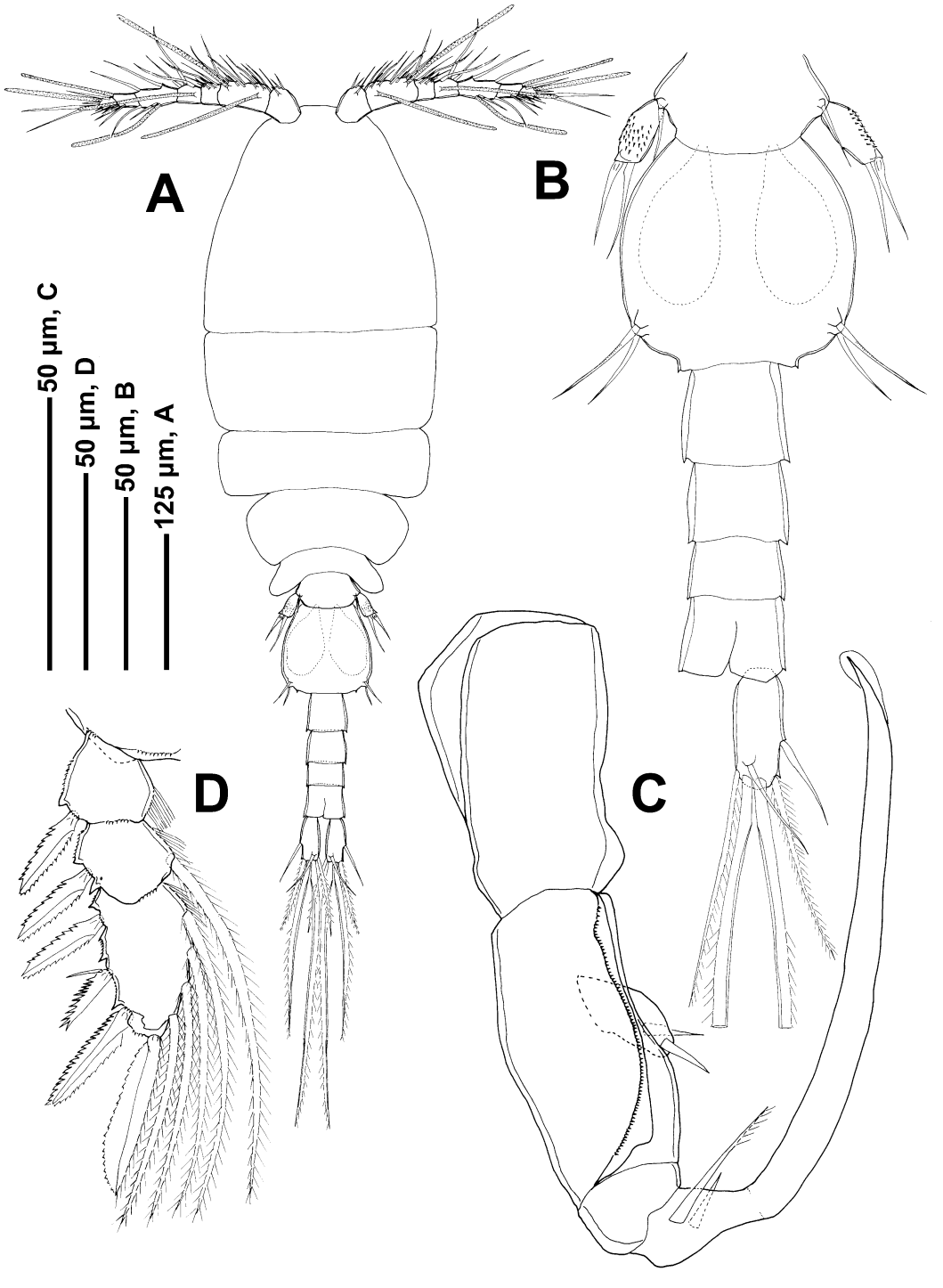

Figure 4. *Doridicola helmuti*, male. (A) Dorsal view; (B) urosome, dorsal view; (C) maxilliped; (D) endopod of leg 1.

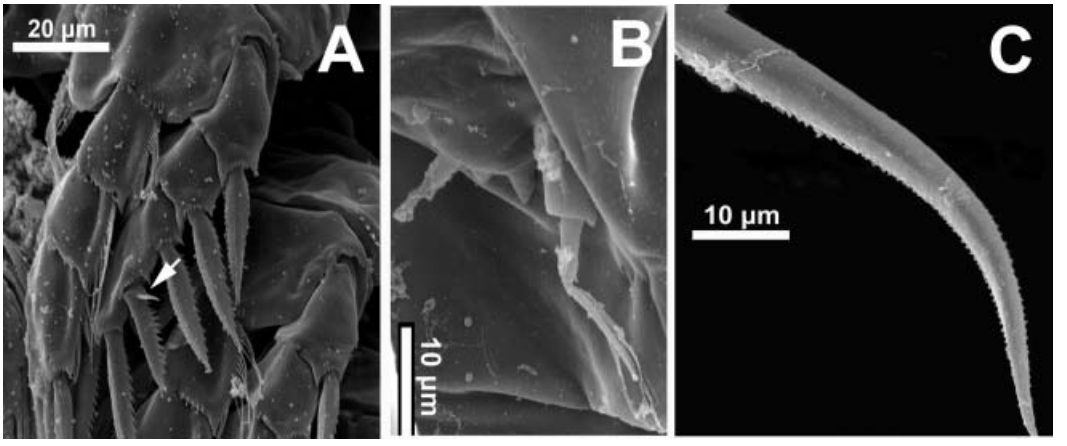

Figure 5. *Doridicola helmuti*. (A) Male, detail showing (arrow) additional spinule on the second lateral spine of endopod dorsal view; (B) female, genital area; (C) female, detail of terminal claw of antenna.

expanding laterally to egg sac attachment area and overhanging narrow posterior part of somite proper (Figure 1A, B). Genital areas composed of two parts, the first one rounded with short plumose seta and two spiniform processes. Second part subquadrate bearing a longer plumose seta and a small spiniform process (Figures 1C, 5B).Three free abdominal somites 60×57.7, 43.3×48, and 57×52.9 µm, respectively (Figure 1A, B). Posterodorsal border of genital segment and of the two first postgenital segments irregular. Caudal ramus (Figure 1A, B) 3.4 times longer than wide, measuring 81.7×24 µm and bearing six setae in terminal area. Outer lateral seta 38.4 µm, dorsal seta 80 µm, both smooth. Outermost terminal seta 89.7 µm, innermost terminal seta 102. 5 µm, both with lateral setules widely spaced. The two median terminal fringed setae 221 µm (outer), 214 µm (inner) with setules on their outer margin. Egg sac elongate, oval. Dorsal surface of body lacking visible ornamentation, except for minute setules as shown in Figure 1A.

Rostrum broadly rounded posteroventrally. Antennule (Figure 1D) seven-segmented, with armature formula: 4, 13, 6, 3, 4+1 aesthete, 2+1 aesthetasc, and 7+1 aesthetasc. Antenna (Figure 1E) four-segmented; with formula of armature: 1, 1, 3, and 3+2 subequal claws slightly dentate (Figure 5C). Claws 2.5 times longer than the last segment. Labrum with two large, divergent posteroventral lobes. Mandible (Figure 2A) minute, with shallow proximal notch followed by a short terminal lash setulose on its outer side. A small lobe bearing three to four teeth between the proximal notch and the lash. Convex margin with a naked outer scale. Maxillule (Figure 2B) armed with two terminal subequal setae, the inner plumose, and one spiniform process. Maxilla (Figure 2C) two-segmented; proximal segment (syncoxa) unarmed; distal segment (basis) ornamented with three typical setae: a tiny outer setula (seta III) at base, naked seta (seta II) on anterior surface, and seta armed with strong spinules (seta I) proximal to the base of the main lash and as long as it. Terminal lash armed along one side with large strong spinules. Maxilliped (Figure 2D, E) two-segmented; proximal segment unarmed; distal segment long with just one naked long seta which usually is around the segment, terminating in various barbed pointed processes and carrying a spiniform process with setules at its inner margin.

Legs 1–4 (Figure 3A–D) biramous, with three-segmented rami except the endopod of leg 4, which is two-segmented. Intercoxal sclerite present in legs 1–4. Formula of spines (in Roman numerals) and setae (in Arabic numerals) as follows:

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

Inner coxal seta plumose in all legs on inner margin of basis of all legs ornamented with setules and basal seta of all legs plumose.

Leg 5 (Figure 1A, B) long, reaching more than half the length of the double genital segment and armed with small spinules; without proximal inner expansion. Two terminal smooth setae, subequal in length.

Male. Body (Figure 4A) 800 μm long (760–830 μm) (excluding setae on caudal rami) based on four males in lactic acid, with six-segmented urosome. Genital somite (Figure 4A, B) slightly wider than long. Four postgenital segments. Caudal ramus 2.3 times longer than wide with the usual six setae in terminal area as described for the female. Rostrum as in female. First antenna similar to that of female but with three aesthetascs at locations indicated by dots in Figure 1D. Second antenna slightly different from female in having spinules on the surface of the first and second segments. Labrum, mandible, maxillule, and maxilla resembling those of female. Maxilliped (Figure 4C) four-segmented; first segment (syncoxa) large but unarmed; second segment (basis) armed with a row of spinules and two inner setae, one of them inserted in a protuberance; third segment (endopod) smallest and unarmed; terminal claw as long as the preceding segments. The claw with terminal lamellae, one long barbed seta and a smaller naked seta at the basal region. Armature on rami of legs 1–4 are as in female, except for the armature of the endopod of leg 1 (Figures 4D, 5A) since the second lateral spine of the last segment has an additional spinule at its base. The free segment of leg 5 (Figure 4A, B) small, 21.7×8.6 μm, tipped with two subequal setae. Leg 6 (Figure 4B) composed of two ventral subequal setae located at posterolateral corner of genital somite.

Etymology

The specific name *helmuti* is after Dr Helmut Zibrowius (Station Marine d'Endoume, Marseille) for his important contribution to our knowledge of the biodiversity and distribution of European scleractinians.

Remarks

Among the 46 species currently recognized in the genus *Doridicola*, 25 species have the two terminal claws of the antenna subequal in size like *D. helmuti* (Ho and Kim 2001), although none of them has the claw 2.5 times longer than the fourth segment. Furthermore, among these 25 species, only *D. antheliae* (Humes and Stock, 1973), associated with an actiniarian from Madagascar, and *D. rostripes* Humes, 1990, living in an octocoral from the Moluccas, have a naked outer scale of the mandible. However, *D. antheliae* can be easily separated from the new species by: (1) the shape of the mandible; (2) the armature of the maxillule; (3) the seta I and II of the maxilla; and (4) the armature of the maxilliped and leg 5. The mandible of *D. anthelinae* has the concave margin deeply indented and, in general

appearance, is stronger than in the new species. The maxillule has four elements in *D. anthelinae* and three in *D. helmuti*. The seta I of the maxilla is short, not reaching the terminal lash, and has spinules on both sides in *D. anthelinae*, while the new species has a long spined internal seta I. The seta II of this appendage is barbed in *D. anthelinae* and smooth in *D. helmuti*. The maxilliped has a very different armature in both species and *D. anthelinae* has an inner expansion on leg 5 which lacks spinules (Humes and Stock 1973).

Doridicola rostripes differs from the new species by its broad flattened prosome, the robust second antenna, the three terminal seta of the maxillule, the slender maxilla, the armature of the maxilliped and the prominint beak-like process of leg 5 (Humes 1990).

Therefore, the new species is easily separated from its congeners by the combination of the following features: (1) ratio of length of claw to that of the last segment of the second antenna; (2) armature of the inner margin of the mandible; (3) armature of the maxillule and the maxilliped; (4) the seta II of the maxilla; and (5) basal swelling of leg 5. Furthermore, the description of this new *Doridicola* species is the first record of this genus associated with a scleractinian coral.

Order SIPHONOSTOMATIDA Thorell, 1859
Family ASTEROCHERIDAE Giesbrecht, 1899
Asterocheres Boeck, 1859
Asterocheres astroidicola n. sp.
(Figures 6–10)

Material examined

MNCN 20.04/7578 holotype, one adult female associated with the scleractinian *Astroides calycularis*, Tarifa Island, 36°01′N, 5°37′W, 10–20 m depth, July 1999; MNCN 20.04/7579 allotype, one adult male, with the same sampling data as the holotype; BEIM (COP 501), three adult females, with the same sampling data as the type material.

Description

Female. Body cyclopiform, slender with cephalothorax oval and cylindrical urosome (Figure 6A, B). Body length 750 µm (650–790 µm) and width 420 µm (390–450 µm), based on four specimens. Ratio of length to width of prosome 1.19:1. Ratio of length of prosome to that of urosome 2.1:1. Prosome comprising cephalothorax fully incorporating first pedigerous somite and three free pedigerous somites. Urosome four-segmented comprising leg 5-bearing somite, genital double somite and two free abdominal subquadrate somites. Somite bearing leg 5 (Figure 6D) wider than long, with some spinules on its lateral surface. Dorsal surface of free abdominal somites and posterior part of double somite ornamented with large, flattened epicuticular scales, arranged in irregular, overlapping rows (Figures 6D, 10C). Posterior margins of all somites ornamented with hyaline frills with more or less serrated margins. Genital double somite about 1.25 times wider than long, bearing genital apertures, paired gonopores located laterally. Lateral margin of double somite ornamented with fringe of long spinules located about midway along double somite, posterior to gonopores level (Figure 6C). Each genital area armed with one plumose seta. Integumental pores and sensilla present on urosomal somites (Figure 6C). Caudal rami slightly longer than wide, ornamented dorsally with epicuticular scales; armed with six setae.

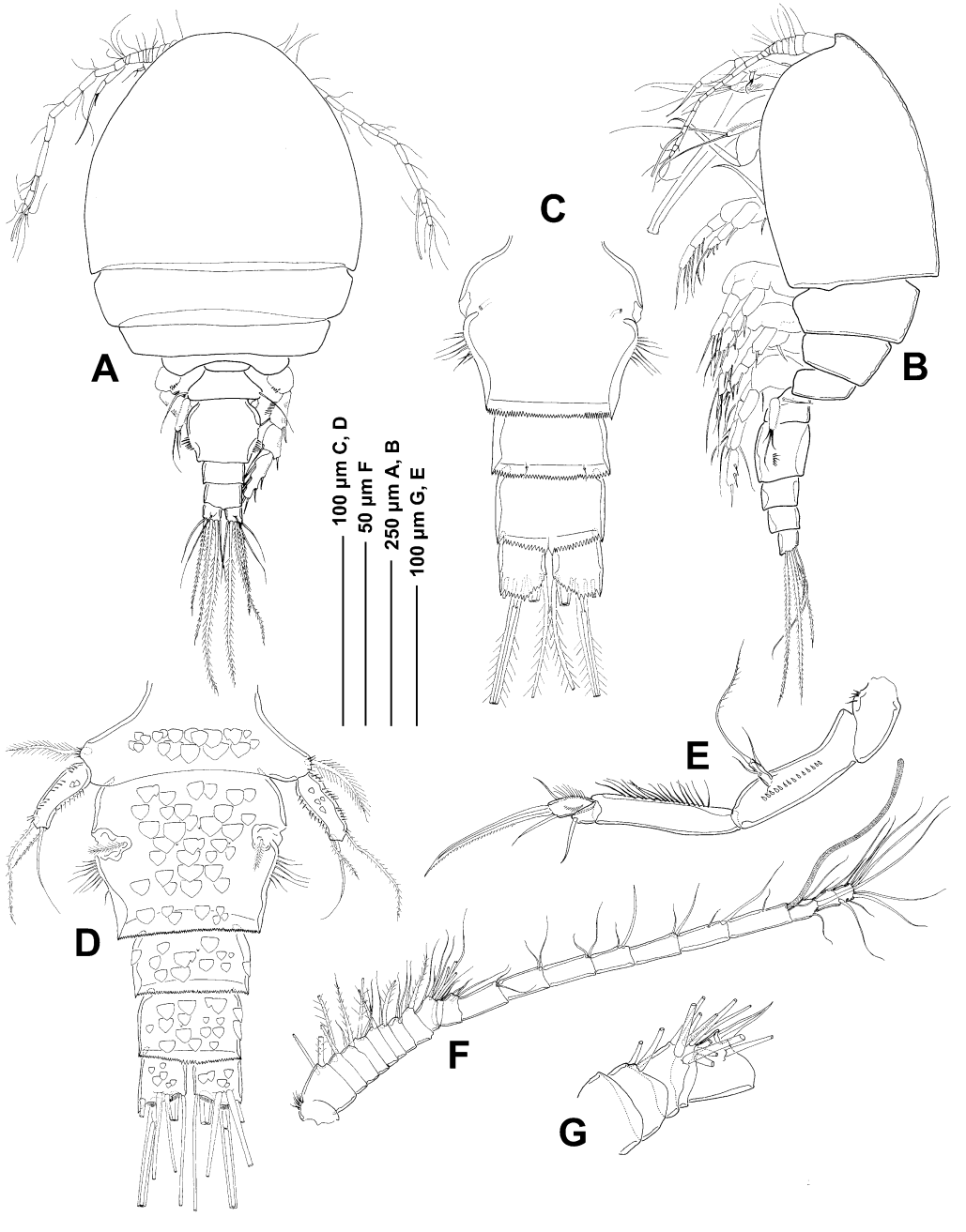

Figure 6. *Asterocheres astroidicola*, female. (A) Dorsal view; (B) lateral view; (C) urosome, ventral view; (D) urosome, dorsal view; (E) antenna; (F) antennule; (G) same, detail of compound segment IX–XII.

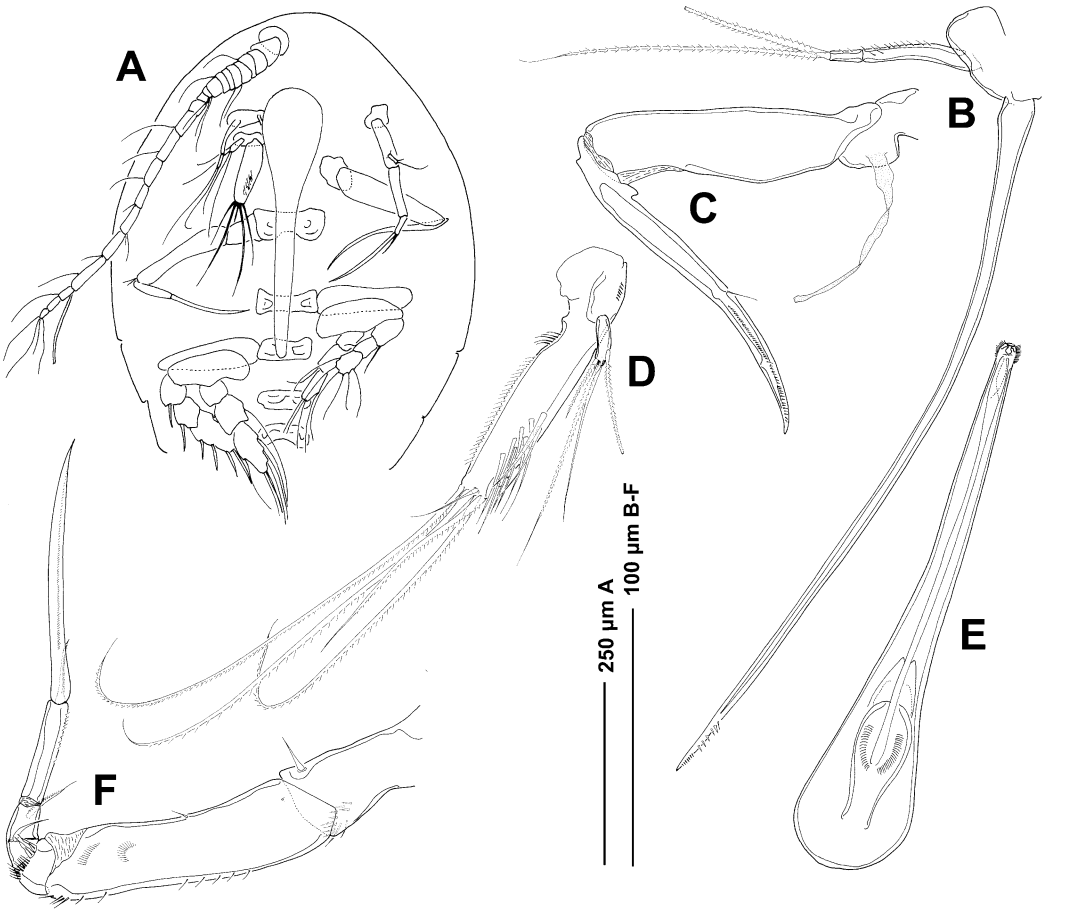

Figure 7. *Asterocheres astroidicola*, female. (A) Prosome, ventral; (B) mandible; (C) maxilla; (D) maxillule; (E) oral cone; (F) maxilliped.

Antennule 21-segmented (Figures 6F, 6G); segmental fusion pattern as follows: 1(I), 2(II), 3(III), 4(IV), 5(V), 6(VI), 7(VII), 8(VIII), 9(IX–XII), 10(XIII), 11(XIV), 12(XV), 13(XVI), 14(XVII), 15(XVIII), 16(XIX), 17(XX), 18(XXI), 19(XXII–XXIII), 20(XXIV–XXV), 21(XXVI–XXVIII). Segments 1–8 each with two setae; segment 9 with eight setae; segment 10–17 each with two setae; segment 18 with two setae plus an aesthetasc; segment 19 with two setae; segment 20 with three setae; segment 21 with seven setae. Segment 10 (XIII) (Figure 6G) reduced, partly overlapped by distal expansion of compound segment 9 (IX–XII). Antenna (Figure 6E) biramous, 380 µm long with a small unarmed coxa ornamented with tuft of spinules and a large unarmed basis with fine spinule row. Exopod small, one-segmented, bearing two lateral and one apical setae. Endopod three-segmented; first segment elongated, ornamented with a row of long spinules; second segment produced distally on medial side but articulating with third segment proximally on lateral side and armed with one smooth seta, third segment armed with two short naked setae, and large terminal claw also ornamented with rows of fine spinules. Mandible (Figure 7B) with two-segmented palp and stylet-like gnathobase. Stylet with denticulate margin subapically and located in oral cone. First segment of palp slender, unarmed but ornamented with a row of

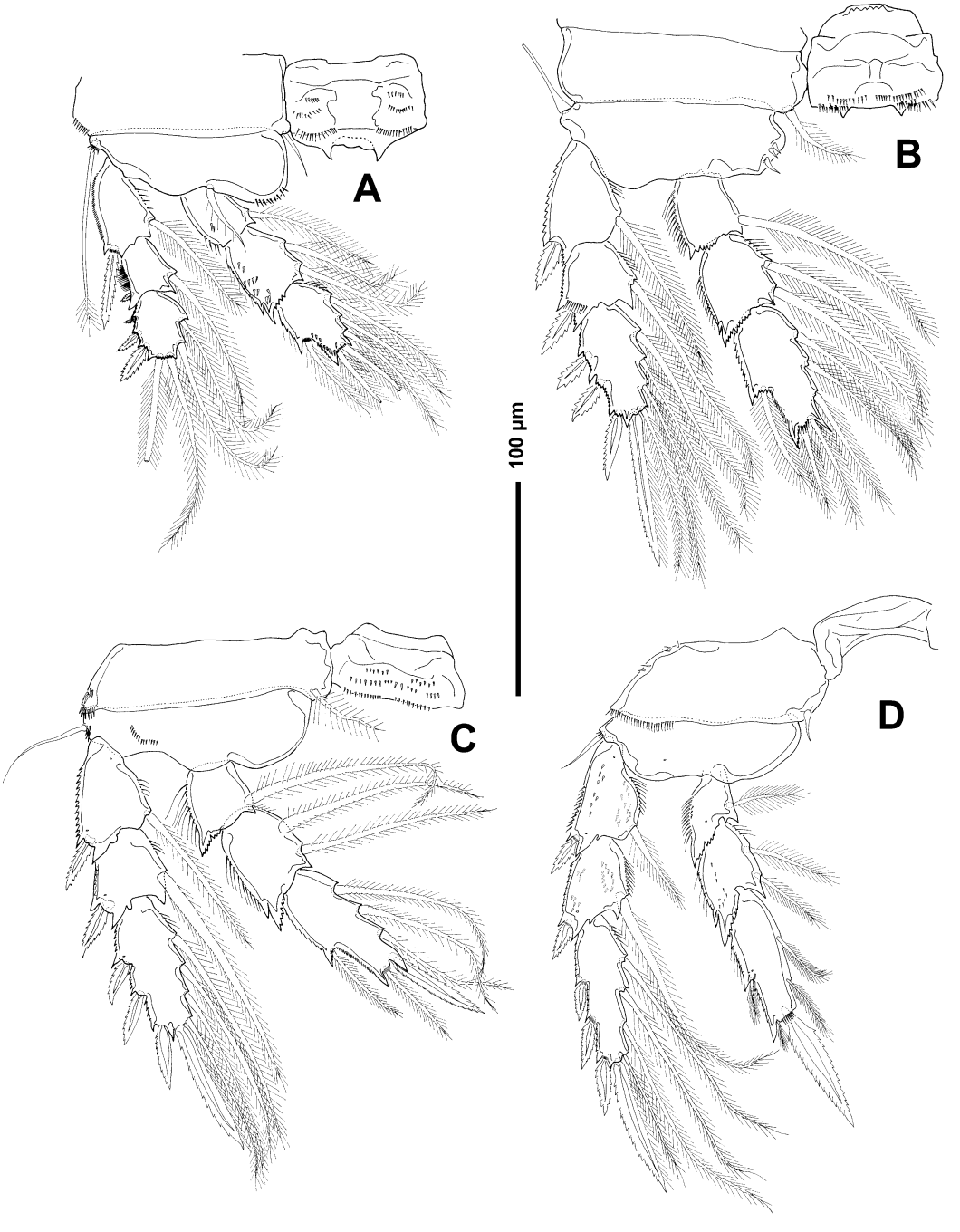

Figure 8. *Asterocheres astroidicola*, female. (A) Leg 1; (B) leg 2; (C) leg 3; (D) leg 4.

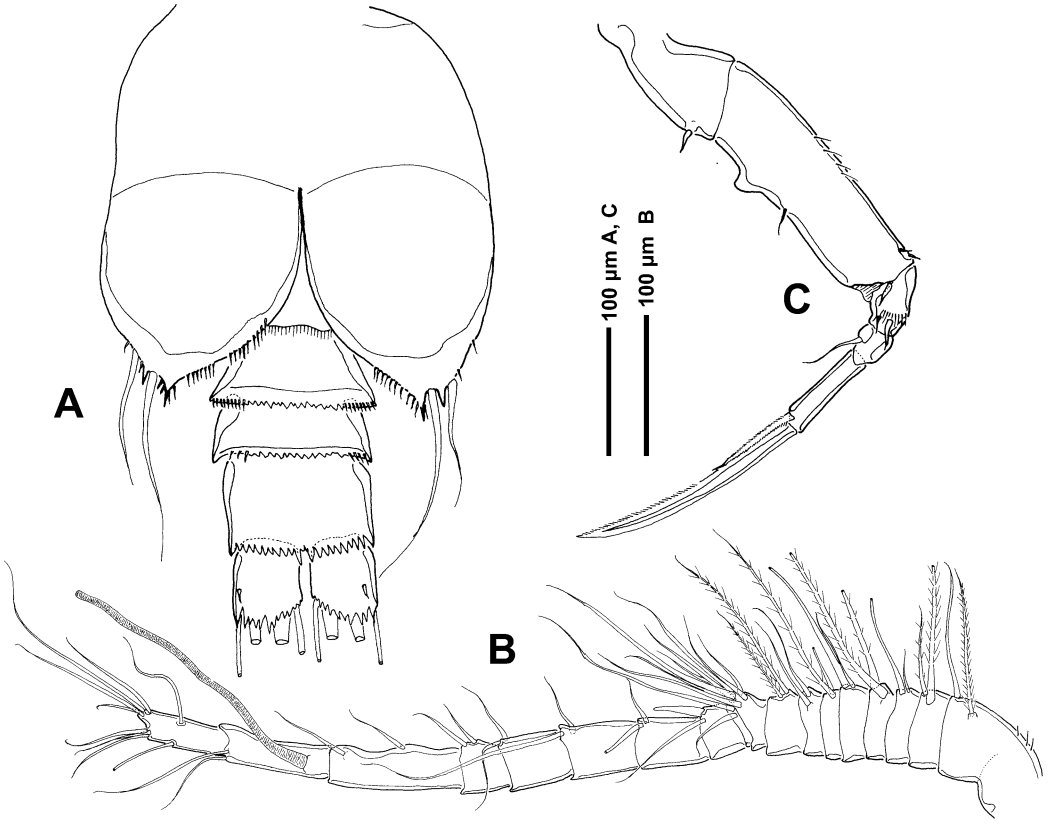

Figure 9. *Asterocheres astroidicola*, male. (A) Urosome, ventral view; (B) antennule; (C) maxilliped.

spinules laterally; second segment with two terminal plumose setae. Oral cone long and slender, 293 µm long, formed by labrum and labium joined laterally, reaching nearly to the posterior margin of intercoxal plate of leg 2 (Figure 7A, E). Maxillule bilobed (Figure 7D); praecoxal endite more than four times longer than palp and more than three times wider than palp. Praecoxal endite armed with five distal setae (one of them smooth and short), ornamented with patch of long spinules distally and row of shorter spinules laterally. Palp armed with three terminal and one subterminal setae. Maxilla three-segmented (Figure 7C). Praecoxa bearing long flaccid element medially (Figure 10B), possibly an aesthetasc; coxa unarmed and claw-like basis bearing small hyaline process proximally in axil; armed with one very small seta at about one-half its length laterally; claw margins with row of minute spinules distally. Maxilliped five-segmented (Figure 7F), first segment with small inner distal seta and patch of spinules. Second segment elongate and slender, with minute hyaline seta at midway of inner margin and rows of fine spinules distally. Third segment short, ornamented with two minute smooth setae and a patch of fine spinules medially. Fourth segment armed with two short setae, one of them smooth. Fifth segment with one terminal plumose seta and one claw-like seta, 105 µm long, ornamented with a lateral row of minute spinules.

Legs 1–4 biramous (Figure 8A–D), with three-segmented protopods and three-segmented rami. Intercoxal sclerite present on legs 1–4, ornamented with patches

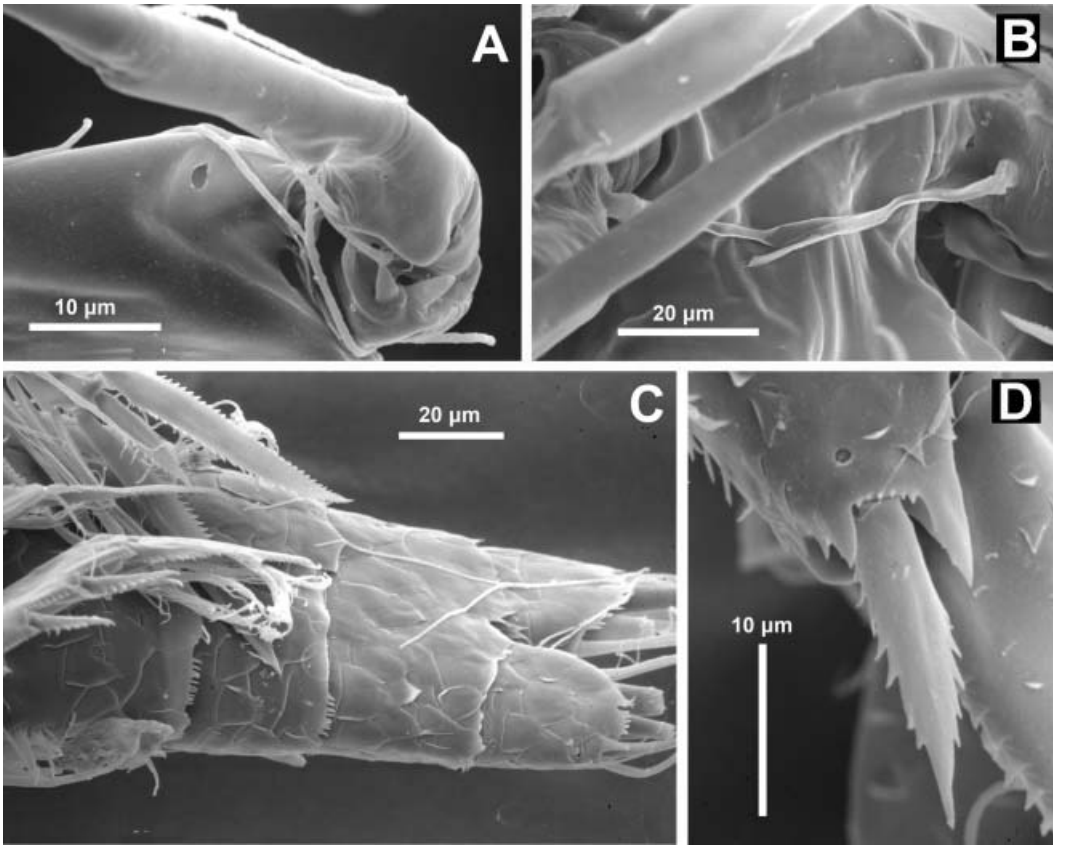

Figure 10. *Asterocheres astroidicola*, female. (A) Maxilliped, detail showing two setae of third segment; (B) maxilla, detail showing the flaccid element of praecoxa; (C) urosome, ventral view; (D) detail of the pore of leg 4.

of spinules on legs 1–3 and pair of processes on legs 1 and 2. Formula for armature as follows:

	Coxa	Basis	Exopod segments	Endopod segments
Leg 1	0-1	1-1	I-1; I-1; III,1,3	0-1; 0-2; 1,2,3
Leg 2	0-1	1-0	I-1; I-1; III,I,4	0-1; 0-2; 1,2,3
Leg 3	0-1	1-0	I-1; I-1; III,I,4	0-1; 0-2; 1,1+I,3
Leg 4	0-1	1-0	I-1; I-1; III,I,4	0-1; 0-2; 1,1+I,2

Coxae of all legs ornamented with spinule rows laterally as figured. Inner coxal seta plumose in legs 1–3 and reduced and naked in leg 4. Except on leg 2, basal seta of all legs long and naked. Posterior surface of legs 1–4 ornamented with flattened epicuticular scales, arranged in irregular, overlapping rows (Figure 10D). Lateral margins of exopodal segments with minute serrations; lateral margins of endopodal segment with row of setules.

Leg 5 (Figure 6D) with elongated free segment. Three terminal setae, two of them plumose. Few minute spinules on both sides of free segment. Adjacent seta on body somite plumose. Leg 6 (Figure 6D) represented by seta on genital area.

Male. Only one adult male specimen but seriously damaged. Body cyclopiform, slightly more slender than in female, with oval-shaped cephalothorax and cylindrical urosome. Urosome five-segmented, comprising pedigerous somite 5, genital somite and three free abdominal somites. Posterior margins of all somites ornamented with hyaline frills with more or less serrated free margins. Genital somite slightly longer than wide; bearing genital apertures postero-laterally on ventral surface (Figure 9A). Appendages as in female except antennule, maxilliped and leg 6. Leg 5 expected to be different to that of the female but in this specimen it has not been observed due to the fact that it was not complete.

Antennule (Figure 9B) 18-segmented, geniculate; segmental fusion pattern as follows: 1(I), 2(II), 3(III), 4(IV), 5(V), 6(VI), 7(VII), 8(VIII), 9(IX–XII), 10(XIII), 11(XIV), 12(XV), 13(XVI), 14(XVII), 15(XVIII), 16(XIX–XX), 17(XXI–XXIII), 18(XXIV–XXVIII). Geniculation located between segments 16(XIX–XX) and 17(XXI–XXIII). Segments 1–8 each with two setae; segment 9 with eight setae; segment 10–16 each with two setae; segment 17 with two setae plus an aesthetasc; segment 18 with nine setae. Segment 10 (XIII) reduced, partly overlapped by distal expansion of compound segment 9 (IX–XII). Maxilliped (Figure 9C) five-segmented, similar to that of female but second segment with medial proximally directed thorn-like process.

Leg 6 (Figure 9A) forming large opercular plates closing off genital apertures, armed with two smooth setae, ornamented with rows of fine spinules.

Etymology

The name of the species, *astroidicola*, is a combination of *Astroides*, the host name, and *-icola* from the Latin meaning "inhabiting", alluding to the relationship between the copepod and the coral.

Remarks

Eleven valid species of *Asterocheres* Boeck, 1859 have been reported as possessing a 21-segmented antennule in the female. Three of them, *A. suberitis* Giesbrecht, 1897, *A. violaceus* Claus, 1889, and *A. minutus* Claus, 1889, were collected from NE Atlantic and Mediterranean coasts and another eight from other areas, namely *A. bulbosus* Malt, 1991 from Hong Kong, *A. jeanyeatmanae* Yeatman, 1970 from Chesapeake Bay, *A. tenuicornis* Brady, 1910 from Antarctica, *A. reginae* Boxshall and Huys, 1994 from Belize, *A. flustrae* Ivanenko and Smurnov, 1997 from the White Sea, *A. lunatus* Johnsson, 1998 from Brazil, *A. urabensis* Kim, 2004 from the Pacific Coast of Panama, and *A. hirsutus* Bandera et al., 2005 from Antarctica. Except for *A. urabensis* and *A. hirsutus*, all of these species are characterized by having a relatively short siphon which does not extend beyond the insertion of the maxillipeds (Boxshall and Huys 1994). *Asterocheres urabensis*, *A. hirsutus*, and the new species, *A. astroidicola*, possess a longer oral cone. In the first two species it reaches to the insertion of leg 1 and in the latter species the oral cone enlarges nearly to the intercoxal plate of leg 2. However, in a detailed comparison of *A. astroidicola* and the remaining species with a 21-segmented antennule, a number of additional differences can be discussed. Firstly, *A. bulbosus*, *A. violaceus*, and *A. minutus* have a one-segmented mandibular palp in contrast to the two-segmented mandibular palp present in the new species. As for *A. tenuicornis*, it differs from *A. astroidicola* by its very elongated caudal rami which is almost six times longer than wide.

From the point of view of body shape, *A. reginae* and *A. jeanyeatmanae* differ from the new species by their dorso-ventrally flattened prosome. Moreover, *A. astroidicola* can be distinguished from *A. reginae* by having one additional seta on the inner lobe of the maxillule and from *A. jeanyeatmanae* by having one distal additional seta on the free segment of the fifth leg. The extremely large inner lobe of the maxillule, at least four times longer than outer lobe, of *A. astroidicola* and *A. hirsutus* serves to separate them from the remaining four species, *A. flustrae*, *A. suberitis*, *A. lunatus*, and *A. urabensis*, which have a much smaller endite in the maxillule. *Asterocheres suberitis* and *A. lunatus* possess four terminal setae on the inner lobe of the maxillule in contrast with the five setae present in *A. astroidicola*. *Asterocheres flustrae* has a six-segmented maxilliped instead of the five-segmented maxilliped present in *A. astroidicola*. The caudal rami is 2.5 times longer than wide in *A. hirsutus*, whereas in *A. astroidicola* it is only slightly longer than wide.

Concerning hosts, except for *A. suberitis* and *A. tenuicornis* whose hosts are unknown, *A. flustrae* lives in association with the bryozoan *Flustra foliacea* L. and *A. minutus* and *A. violaceus* live in association with an echinoderm. The remaining species of this group, except for *A. urabensis*, are symbionts on sponges. *Asterocheres urabensis* and *A. astroidicola* are associated with scleractinian coral, *Pocillopora damicornis* (L.) and *Astroides calycularis* (Pallas, 1766), respectively. These two species are very similar but they can be distinguished by the following features: (1) the endopodal claw of the antenna; (2) the length of the oral cone; (3) the shape of the inner lobe of the maxillule; (4) the armature of the free segment of leg 5. The claw of the antenna is longer than the entire endopod in *A. urabensis*, while in the new species it is smaller and the oral cone is longer in *A. astroidicola*. The inner lobe of the maxillule is less than three times longer than the palp in *A. urabensis*, while that of *A. astroidicola* is more than four times longer and more than three times wider than the palp. The free segment of leg 5 has three smooth setae in *A. urabensis* and adjacent small seta on body somite 5 whereas *A. astroidicola* possesses two plumose setae and one smooth seta on leg 5 and a long adjacent seta on body somite 5 which reaches to the end of the free segment.

Acontiophorus (Brady, 1880)
Acontiophorus scutatus (Brady and Robertson, 1873)
(Figure 11)

Solenostoma scutatum Brady and Robertson, 1973.
Acontiophorus scutatus Brady, 1880; Thompson, 1883; Claus, 1889; Canu, 1891, 1892, 1894; Thompson, 1883?, 1887; Giesbrecht, 1895, 1897, 1899; Norman and Scott, 1906; Sars, 1915, 1918; Hansen, 1923; Gotto, 1993.
Acontiophorus angulatus Thompson, 1888.

Material examined

BEIM (COP 518), five females and two copepodids, associated with the scleractinian *Astroides calycularis*, Tarifa Island, 36°01′N, 5°37′W, 10–20 m depth, 8 November 1996; BEIM (COP 535), six females, three males and two copepodids, associated with the scleractinian *Astroides calycularis*, Tarifa Island, 36°01′N, 5°37′W, 10–20 m depth, 14 July 1999; BEIM (COP 525), one female, associated with the scleractinian *Astroides calycularis*, Tarifa Island, 36°01′N, 5°37′W, 10–20 m depth, 22 September 1999.

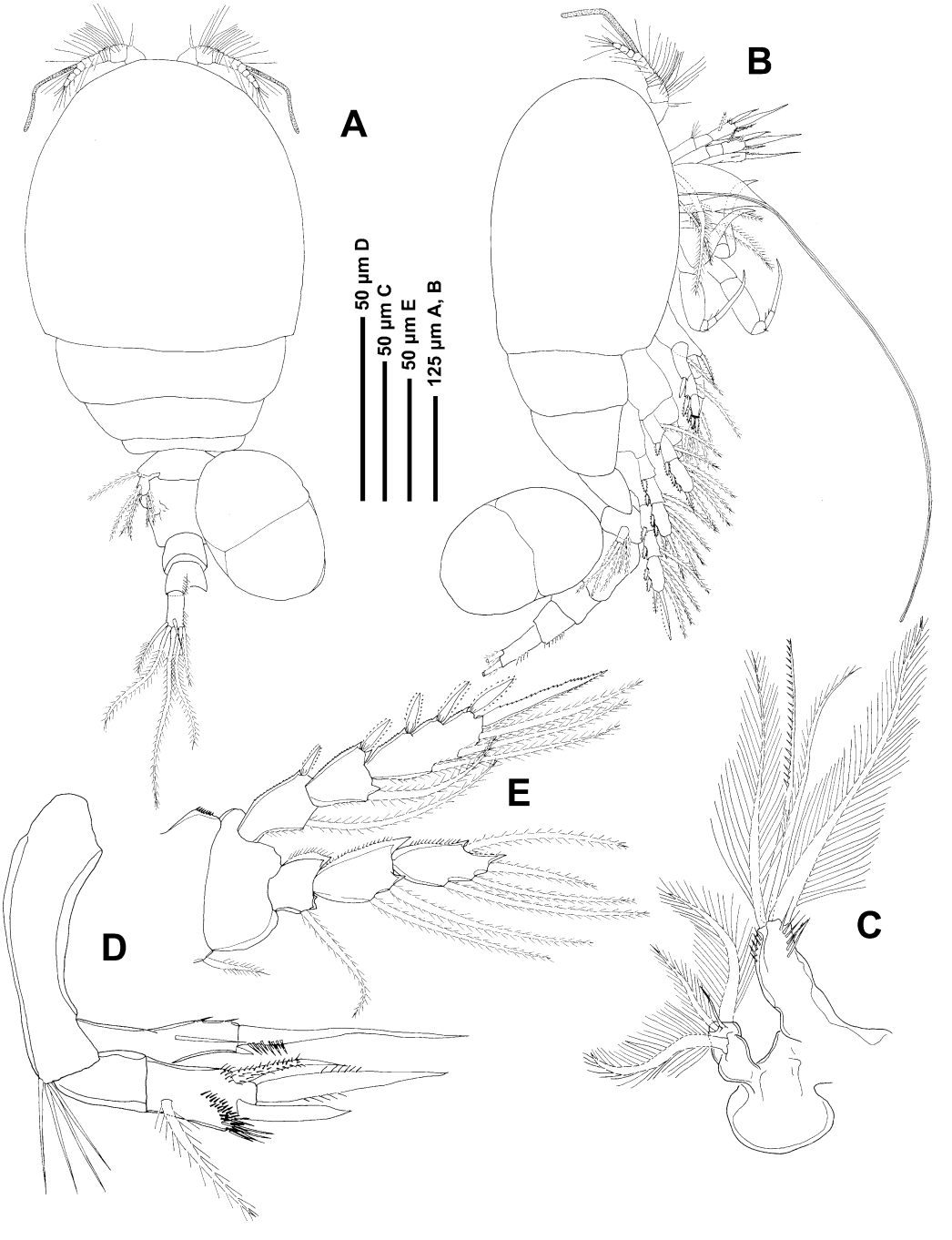

Figure 11. *Acontiophorus scutatus* (Brady and Robertson, 1873), female. (A) Dorsal view; (B) lateral view; (C) maxillule; (D) antenna; (E) leg 4.

Remarks

The specimens from Tarifa differ slightly from those drawn by Giesbrecht (1899) in the second antenna, the maxillule, and the fourth leg. The setae ornamentation of the last endopodal segment of the second antenna is slightly dissimilar since the medial seta is shorter and has setules and the innermost seta is stronger than Giesbrecht's specimens. On the maxillule of our specimens the four setae of the endite are ornamented: the two outermost setae are densely plumose and of the two innermost setae, one is barbed and the other plumose laterally only. With respect to the legs, the only difference is in the length of the basis seta of leg 4 which is shorter in the specimens found in Tarifa.

Host

This species has been found free and caught either by surface-net at night (Brady 1880), or by dredging (Brady 1880; Thompson 1883). It was also discovered among seaweeds such as *Laminaria saccharina* and *Sargassum* (Sars 1915; Gotto 1993). The only invertebrate host known is the sponge, *Spongelia fragilis* var. *ramosa*. However, according to Canu (1892), this siphonostomatoid is unusually associated with sponges and ascidians. This is the first time that this species has been found associated with Cnidaria.

General distribution

Species widely distributed in the North Atlanthic Ocean: Faroes (Hansen 1923), Norway (Sars 1915, 1918), UK (Brady 1880; Brady and Robertson 1873; Norman and Scott 1906), France (Canu 1892), and Strait of Gibraltar (present paper). Thompson's record (1887) of this species in Madeira is dubious (Giesbrecht 1899; Hansen 1923). It is also present in the Mediterranean Sea: Adriatic Sea (Claus 1989) and Tyrrhenian Sea (Giesbrecht 1899), but the record from New Zealand is probably wrong (Hansen 1923).

Acknowledgements

We wish to thank Isabel Alfonso for assistance in collecting colonies of *Astroides calycularis* at Tarifa (Spain). Support for this work was provided by The Natural History Museum (London) under the EC-funded TMR Bioresource Large-scale Facility Programme.

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