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A new species of *Asterocheres* (Copepoda, Siphonostomatoida) with a redescription of *A. complexus* Stock, 1960 and *A. sarsi* Bandera & Conradi, 2009

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Abstract

The present paper reviews the material of three species of *Asterocheres* Boeck 1859 deposited in four different Zoological European museums as part of the ongoing taxonomical revision of this genus. *Asterocheres sarsi* Bandera & Conradi 2009, the species described by Sars in 1915 as *Ascomyzon latum* (Brady 1880) and lately recognized as a distinct species by Bandera and Conradi in 2009 is fully described in this paper from material collected by Sars in Norway in 1915 and deposited in The Natural History Museum of the University of Oslo. *Asterocheres complexus* Stock, 1960 which has been sometimes confused with *A. sarsi* is redescribed from material collected by Stock in France in 1959 and deposited in the Zoological Museum of the University of Amsterdam. Furthermore, a new species, previously misidentified as *A. suberitis* Gieisbrecht 1897, from the Norman`s collection of The Natural History Museum of London, is described as *A. eugenioi*, new species. These three species, *A. complexus, A. eugenioi*, and *A. sarsi* share the general appearance of body thanks to the pointed posterolateral angle of the epimeral area of somite bearing leg 3, sometimes slightly produced into backwardly directed processes, and somite bearing leg 4 largely concealed under somite bearing leg 3.

Key words: *Asterocheres*, Siphonostomatoida, Norman´s Collection, Sars, Stock

Introduction

Some years ago a partial revision of the genus *Asterocheres* Boeck, 1859 was initiated in order to clarify the rather confused systematics and phylogenetic relationships of this symbiotic genus. This ongoing taxonomical revision has been based on both material loaned by various museums and material collected by the authors, and has resulted in: (1)the description of six new species (Bandera et al. 2005, 2007; Conradi et al. 2006; Bandera & Conradi 2009b, 2013; Conradi & Bandera 2011), (2) the redescription of 21 species of *Asterocheres* (Bandera & Conradi 2009a, 2013, in prep.; Conradi & Bandera 2011), (3) the reinstatement of three species previously considered as junior synonyms (Bandera & Conradi 2009b), (4) the ranking of *A. abyssi* (Hansen 1923) as a species *incertae sedis* (Bandera & Conradi 2009a), (5) the reinterpretation of the original description of *A. stimulans* Giesbrecht, 1897 (Bandera & Huys 2008); (6) the removal of *A. mucronipes* Stock 1960 to a new genus, *Stockmyzon* Bandera & Huys 2008 (Bandera & Huys 2008), (*7*) the relegation of *A. violaceus* (Claus 1889) to a junior synonym of *A. echinicola* (Norman 1868), and (8) the recognition of *Ascomyzon latus* (Brady 1880) *sensu* Sars (1915) as a distinct species (Bandera & Conradi 2009b). Here, we describe this last species as *Asterocheres sarsi* Bandera & Conradi 2009 from material collected by Sars in Norway in 1915 and deposited in The Natural History Museum of the University of Oslo, and redescribe another asterocherid species, *A. complexus* Stock 1960 that exhibit similarities with *A. sarsi* species to which has been sometimes confused (Sars 1915; Stock 1960). The specimens of *A. complexus* are from material collected by Stock in France in 1959 and deposited in the Zoological Museum of the University of Amsterdam. Furthermore a new species, previously identified as *A. suberitis* Gieisbrecht 1897, from the Norman`s collection of The Natural History Museum of London, is described as *A. eugenioi*.

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Material and methods

The studied specimens come from material loaned by various museums: some specimens from the Norman's collection from The Natural History Museum of London (NHM), some material collected by Sars in Norway in 1915 and deposited in The Natural History Museum of the University of Oslo (ZMO), a specimen labelled as *Ascomyzon latum* deposited in the Zoologisk Museum of the University of Copenhagen (ZMUC), and some specimens collected by Stock in France in 1959 which were deposited in the Zoological Museum of the University of Amsterdam (ZMA).

When the dissected specimens of the asterocherid species from the different museums were not sufficient to make a detailed description of some appendages, we dissected a specimen in lactic acid, prior to staining it with Chlorazol black E (Sigma® C-1144). Specimens were then examined as temporary mounts in lactophenol and later on, sealed with Entellan as permanent mounts.

All figures were drawn with the aid of a camera lucida on a Leica DMLB differential interference microscope. All appendage segments and setation elements were named and numbered using the terminology established by Huys and Boxshall (1991). Mean body length of the copepod was measured from the anterior margin of the rostrum to the posterior margin of the caudal rami.

Systematics

Order Siphonostomatoida Thorell, 1859

Family Asterocheridae Giesbrecht, 1899

Asterocheres Boeck, 1859

Asterocheres complexus Stock, 1960
(Fig. 1)

Asterocheres boecki Giesbrecht, 1899 (non Brady 1872)

Material examined. holotype female (preserved in ethanol, deposited in ZMA under registration number ZMA-Co.100.571b) and 1 female plus 1 copepodid paratypes (ZMA-Co. 100.571) associated with *Spongelia fragilis* (Schmidt) var. *ramose*; collected in Cap Béar (France), 30 m depth, June 16 1959, coll. by Dr. J.H. Stock.

Description of adult female. Body cyclopiform, slender with cephalothorax oval and cylindrical urosome (see Fig. 2 of Taf. 1 in Giesbrecht 1899). Total length from anterior margin of rostrum to posterior margin of caudal rami 680 µm and maximun width 360 µm. Prosome comprising cephalothorax fully incorporating first pedigerous somite and three free pedigerous somites. Cephalothorax (see Fig. 28 of Taf. 2 in Giesbrecht 1899) with posterolateral angles straight and slightly produced into backwardly directed processes.

Urosome 4-segmented, comprising leg 5-bearing somite, genital double-somite and 2 free abdominal somites (see Fig. 3B in Stock 1960). Leg 5-bearing somite wider than long, with serrate dorsal margin. Posterior hyaline frills of urosomites with serrate free margins. Urosomites ornamented with numerous integumental pores and sensilla and apparently devoid of epicuticular scales. Genital double-somite slightly wider than long; paired genital apertures bipartite, each comprising lateroventral copulatory pore and dorsolateral gonopore (oviduct opening); lateral margins with row of long spinules in middle third, close to gonopore area (see Fig. 3B in Stock 1960). Seta of genital area not observed.

Caudal rami about as long as wide (measured along outer margin); armed with 6 terminal setae (see Fig. 3B in Stock 1960). Seta I absent and setae II and VII slightly displaced onto dorsal surface.

Antennule (Fig. 1D) 21-segmented, about 310 µm long. Segmental fusion pattern as follows (Roman numerals indicating ancestral segments): 1(I)-2, 2(II)-2, 3(III)-2, 4(IV)-2, 5(V)-2, 6(VI)-2, 7(VII)-2, 8(VIII)-2, 9(IX-XII)-7, 10(XIII)-2, 11(XIV)-1+1espina, 12(XV)-2, 13(XVI)-2, 14(XVII)-2, 15(XVIII)-2, 16(XIX)-2, 17(XX)-2, 18(XXI)-2+1 aesthetasc, 19(XXII)-2, 20(XXIII-XXIV)-4 and 21(XXV-XXVIII)-7. Segment 10(XIII) reduced and partly overlapped by distal expansion of compound segment 9(IX-XII).

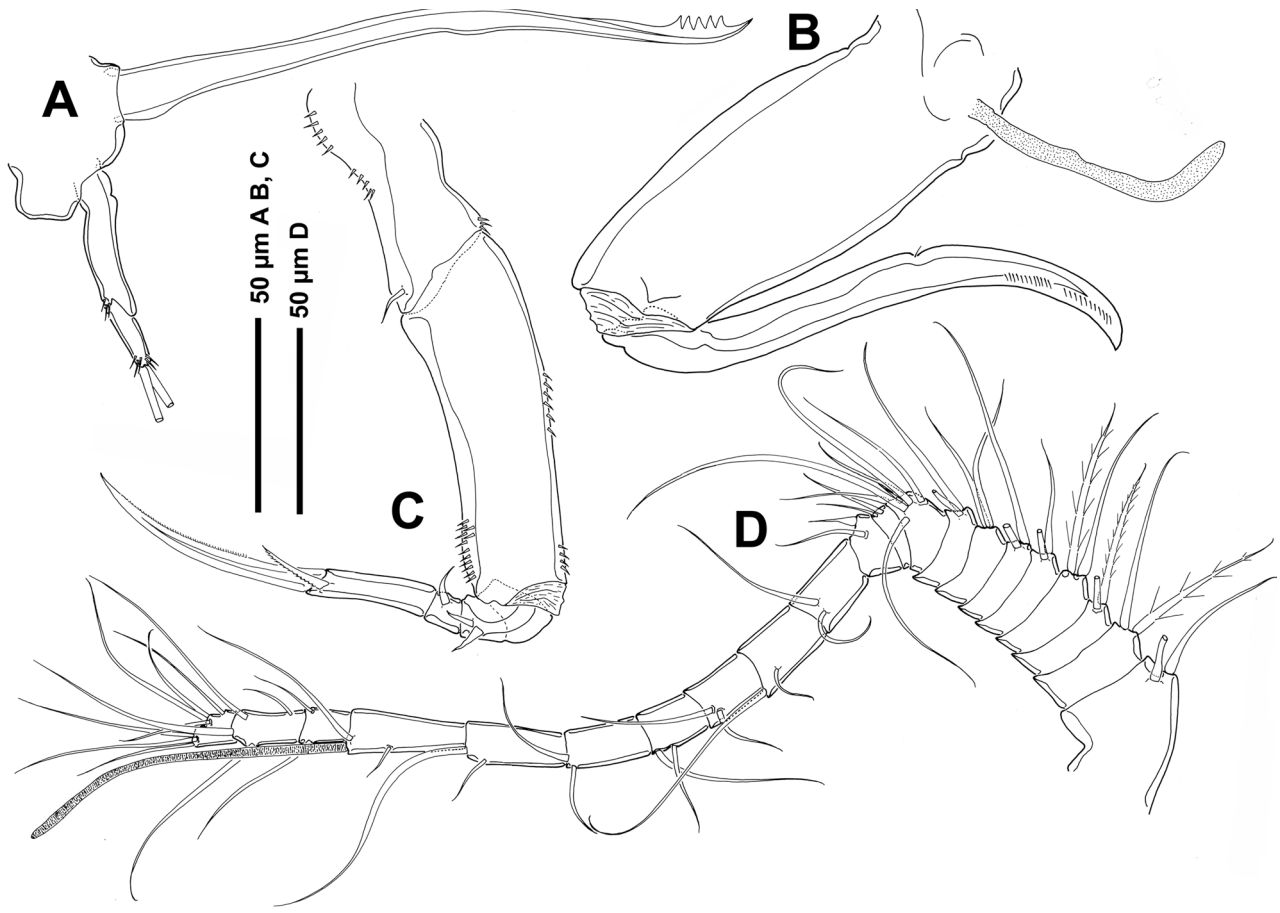

FIGURE 1. *Asterocheres complexus* Stock 1960 (female). A, mandible; B, maxilla; C, maxilliped; D, antennule.

Antenna (see Fig. 3E in Stock 1960) biramous, about 220 µm long (including terminal claw). Coxa small, with a tuft of minute spinules on inner margin. Basis elongated with a row of fine spinules on inner margin . Exopod small, one-segmented with one short subterminal seta and one long terminal seta, both of them smooth. Endopod 3-segmented; proximal segment elongated, ornamented with a row of long spinules on inner margin; middle segment produced distally on medial side but articulating with distal segment proximally on lateral side, bearing one distal seta longer than entire segment; distal segment with 2 subterminal setae, one of them pinnate, and a terminal claw with a row of fine spinules on inner margin. Distal claw as long as proximal segment of endopod.

Siphon about 180 µm long, conical, reaching the insertion of maxillipeds. Mandible (Fig. 1A) comprising slender two-segmented palp and stylet-like gnathobase with 5 large subapical teeth. Proximal segment of palp longest, ornamented with spinules on distal outer margin; distal segment with spinules apically, armed with 2 terminal setae.

Maxillule bilobed (see Fig. 3D in Stock 1960); praecoxal gnathobase (inner lobe) 2.5 times longer than palp (outer lobe). Praecoxal endite ornamented with a tuft of long spinules proximally, a row of short spinules apically on outer margin and a row of long setules medially; armed with 5 distal setae, one of them smooth and short. Palp with 4 barbed terminal setae (illustrated as naked by Stock).

Maxilla (Fig. 1B) 2-segmented but with partial transverse surface suture on syncoxa (proximal segment) possibly marking plane of praecoxa-coxa fusion; praecoxal portion bearing flaccid aesthetasc-like element medially, representing tubular extension of external opening of maxillary gland; coxal portion unarmed. Basis claw-like with a minute seta at middle length and a row of spinules along medial distal part.

Maxilliped (Fig. 1C) 5-segmented, comprising short syncoxa, long basis and 3-segmented endopod. Syncoxa with one short seta distally and a row of spinules along inner proximal margin. Basis elongated, with rows of spinules on both margins. First endopodal segment short, bearing 2 smooth short setae; second endopodal segment with a smooth seta subapically; third endopodal segment bearing recurved terminal claw (65 µm long) plus additional plumose apical seta. Distal margin of claw provided with a row of minute spinules.

Swimming legs 1–4 (see Fig. 3A,C in Stock, 1960) biramous, with 3-segmented rami. Intercoxal sclerite present in legs 1–4. Spine and seta formula as Table 1.

TABLE 1. Spine and seta formula of swiming legs for *Asterocheres complex*us Stock 1960.

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

Lateral margins of exopodal segments with minute serrations or spinular rows; those of endopodal segments with rows of setules.

Fifth leg (see Fig. 3B in Stock, 1960) with protopod incorporated into somite; outer basal seta displaced to laterodorsal surface (not longer than entire free segment). Free segment (exopod) elongate, with 2 smooth terminal setae and one short subterminal seta; outer and inner margins with spinules.

Sixth leg (see Fig. 3B in Stock, 1960) usually represented by paired opercular plates closing off gonopores on genital double somite; none seta neither spiniform element observed.

Adult male: only known from the habitus, antennule and exopod of leg 2 illustrated by Giesbrecht in 1899. Antennule 18-segmented, with aesthetascs on segments 13 and 17.

Distribution. Italy (Giesbrecht 1899), France (Stock 1960), India (Ummerkutty 1966; under the name of *A. latum*).

Remarks. This species was described by Stock (1960) from two females collected in Cap Béar (Mediterranean coast of France). As Stock pointed out, this species was originally described by Giesbrecht (1899) under the incorrect name *A. boecki*. Following the detailed description of *A. boecki* provided by Sars (1918), Stock stated that Giesbrecht´s specimens could belong to another Nordic species, *A. latum* (Brady). Comparisons among the material collected in Banyuls by Stock and the figures of *A. boecki* and *A. latum* illustrated by Sars revealed that Stock´s specimens belonged to a distinct, undescribed species. This new species was not properly described by Stock but was based on descriptions of *A. boecki* by Giesbrecht (habitus; Pl. 2, II; Giesbrecht 1899), *A. latum* by Sars (antennules, maxilla, maxilliped, and the exopods of leg 1-4; Sars 1918) and Stock added some illustrations (antenna, maxillule, urosome, exopod of leg 1 and endopod of leg 4 for female and leg 5 for male; Fig. 3 in Stock 1960).

The re-examination of the holotype resulted in some discrepancies with respect to previous descriptions: (1) the antennule is 21-segmented in the female, in contrast Sars described this antennule as very slender and composed of 20 segments; (2) the mandible was illustrated by Giesbrecht and Sars, but only the palp which is two-segmented, because the stylet is located inside the oral cone. The stylet with 5 large subapical teeth is illustrated and described here for the first time; (3) the maxilla possesses a flaccid element similar to an aesthetasc which was overlooked by Sars; (4) the maxilliped illustrated by Sars has some elements missing.

This species belongs to a group whose females have 21-segmented antennules and a 2-segmented mandibular palp; it contains 19 species: *A. astroidicola* Conradi, Bandera & López-González, 2006, *A. ellisi* Hamond, 1968, *A. espinosai* Varela , Ortiz & Lalana, 2007; *A. flustrae* Ivanenko & Smurov, 1997, *A. genodon* Stock, 1966, *A. hirsutus* Bandera, Conradi & López-González, 2005, *A. hoi* Bandera & Conradi, 2013, *A. jeanyeatmanae* Yeatman, 1970, *A. kervillei* Canu, 1898, *A. latus* (Brady, 1872), *A. lilljeborgi* Boeck, 1859, *A. peniculatus* Kim, 2010, *A. reginae* Boxshall & Huys, 1994, *A. simulans* (Scott, 1898), *A. suberitis* Giesbrecht, 1897, *A. tarifensis* Conradi & Bandera, 2011, *A. tenerus* (Hansen, 1923), *A. tenuicornis* Brady, 1910, *A. tubiporae* Kim, 2004, and *A. urabensis* Kim, 2004.

Considering the shape of the body, *A. complexus* can be separated from a few of its congeners. While this species has the usual cyclopiform body, with an oval cephalothorax and a cylindrical urosome, *A. ellisi, A. espinosai, A. jeanyeatmanae, A. lilljeborgi, A. reginae*, and *A. tubiporae* have a dorsoventrally flattened prosome (Bandera & Conradi 2009b; Varela *et al*., 2007; Yeatman 1970; Ivanenko & Ferrari 2003; Boxshall & Huys 1994; Kim 2004b). Also, *A. espinosai* is here treated as an incompletely described species due to the lack of accurate information of the oral appendages and the confusion between legs 2 and 3 in the original description. Therefore, the comparison of this species with its congeners is difficult.

The length of the siphon is a good feature to distinguish one species from another. *Asterocheres complexus* is characterized by its possession of an oral cone reaching the insertion of the maxillipeds, thus differing from *A. peniculatus, A. hirsutus, A. urabensis,* and *A. hoi* in which the siphon reaches the intercoxal plate of leg 1 and from *A. genodon, A. astroidicola* and *A. tenerus* whose the siphon overtakes the intercoxal plate of leg 2 (Kim 2010; Bandera *et al*. 2005; Kim 2004a; Bandera & Conradi 2013; Conradi *et al*. 2006; Bandera & Conradi 2009a).

Asterocheres complexus possesses a subquadrate caudal rami. In contrast, in this group there are species with a much longer caudal rami; in *A. simulans* and *A. kervillei* they are twice longer than wide, 1.5 times longer than wide in *A. suberitis*, 2.6 times longer than wide in *A. latus*, and 6 times longer than wide in *A. tenuicornis* (Ivanenko 1997; Bandera & Conradi 2009c, 2009a; Eiselt 1965).

The remaining species of the group, *A. flustrae* and *A. tarifensis*, are the most closely related species to *A. complexus*. However, these two species can be easily separated from *A. complexus* by the shape of the posterolateral angles of the cephalothorax. *A. complexus* presents the posterolateral angles of the cephalothorax straight and slightly produced into backwardly directed processes. In contrast, *A. flustrae* and *A. tarifensis* possess rounded posterior corners (Ivanenko & Smurov 1997; Conradi & Bandera 2011).

Asterocheres eugenioi **sp. nov.**

(Figs 2–5)

Asterocheres suberitis Giesbrecht, 1897 in Norman and Scott 1906

Material examined.—holotype female (preserved in ethanol, NHM 1911.11.8.47277-281) and 8 female paratypes plus one allotype male and 2 male paratypes (preserved in ethanol, NHM 1191.11.8.47277-281) associated with *Suberitis domuncula* (Olivi), collected in Salcombe, Devon (Great Britain), on September of 1903 by Norman.

Description of adult female. Body cyclopiform, slender with cephalothorax oval and cylindrical urosome (Fig. 2A). Total length measured from rostral margin to posterior margin of caudal rami (excluding caudal setae) 585 µm; maximum width 384 µm. Ratio of length to width of prosome 1.1:1. Ratio of length of prosome to that of urosome 2.6:1. Prosome comprising cephalothorax fully incorporating first pedigerous somite and 3 free pedigerous somites. Epimeral areas of somites bearing legs 2 and 3 with pointed posterolateral angles (Fig. 2A). Somite bearing leg 4 much smaller and narrower than preceding ones.

Urosome 4-segmented comprising leg 5-bearing somite, genital double-somite and 2 free abdominal somites. Posterior margin of urosomites ornamented with hyaline frills with serrated free margins. Somite bearing leg 5 wider than long. Genital double-somite about 1.25 times wider than long, bearing genital apertures, paired gonopores located dorsolaterally; lateral margins with setular rows along distal third, posterior to genital apertures (Fig. 2B). Each genital area armed with one plumose seta and one spiniform element. Integumental pores and sensilla present on urosomal somites (Fig. 2B).

Caudal rami 1.5 times longer than wide (Fig. 2C); armed with 6 setae; seta I absent, setae II-VII all arranged around posterior margin with setae II and VII slightly offset onto dorsal surface.

Antennule 21-segmented (Fig. 2D), about 270 µm long; segmental fusion pattern as follows: 1(I)-2, 2(II)-2, 3(III)-2, 4(IV)-2, 5(V)-2, 6(VI)-2, 7(VII)-2, 8(VIII)-2, 9(IX-XII)-7, 10(XIII)-2, 11(XIV)-1+1 spine, 12(XV)-2, 13(XVI)-2, 14(XVII)-2, 15(XVIII)-2, 16(XIX)-2, 17(XX)-2, 18(XXI)-2+ aesthetasc, 19(XXII-XXIII)-3, 20(XXIV-XXV)-3 and 21(XXVI-XXVIII)-6. Segment 10 (XIII) reduced, partly overlapped by distal expansion of compound segment 9 (IX-XII).

Antenna biramous (Fig. 2E), about 195 µm long; coxa unarmed, with few spinules; basis unarmed, with fine spinule rows. Exopod 1-segmented, with one small lateral seta and two terminal setae. Endopod 3-segmented; first segment elongate, ornamented with lateral rows of fine spinules; second segment produced distally on medial side but articulating with distal segment proximally on lateral side and armed with one smooth terminal seta. Third segment with distal claw and two subterminal plumose setae; claw provided with fine spinules on lateral margin. Siphon slender, about 195 µm long, reaching to posterior margin of intercoxal plate of leg 1.

Mandible (Fig. 3A) comprising stylet-like gnathobase and slender 2-segmented palp. First segment of palp ornamented with rows of spinules; second segment with 2 plumose, unequal apical setae. Stylet with an expansion at the middle of its length.

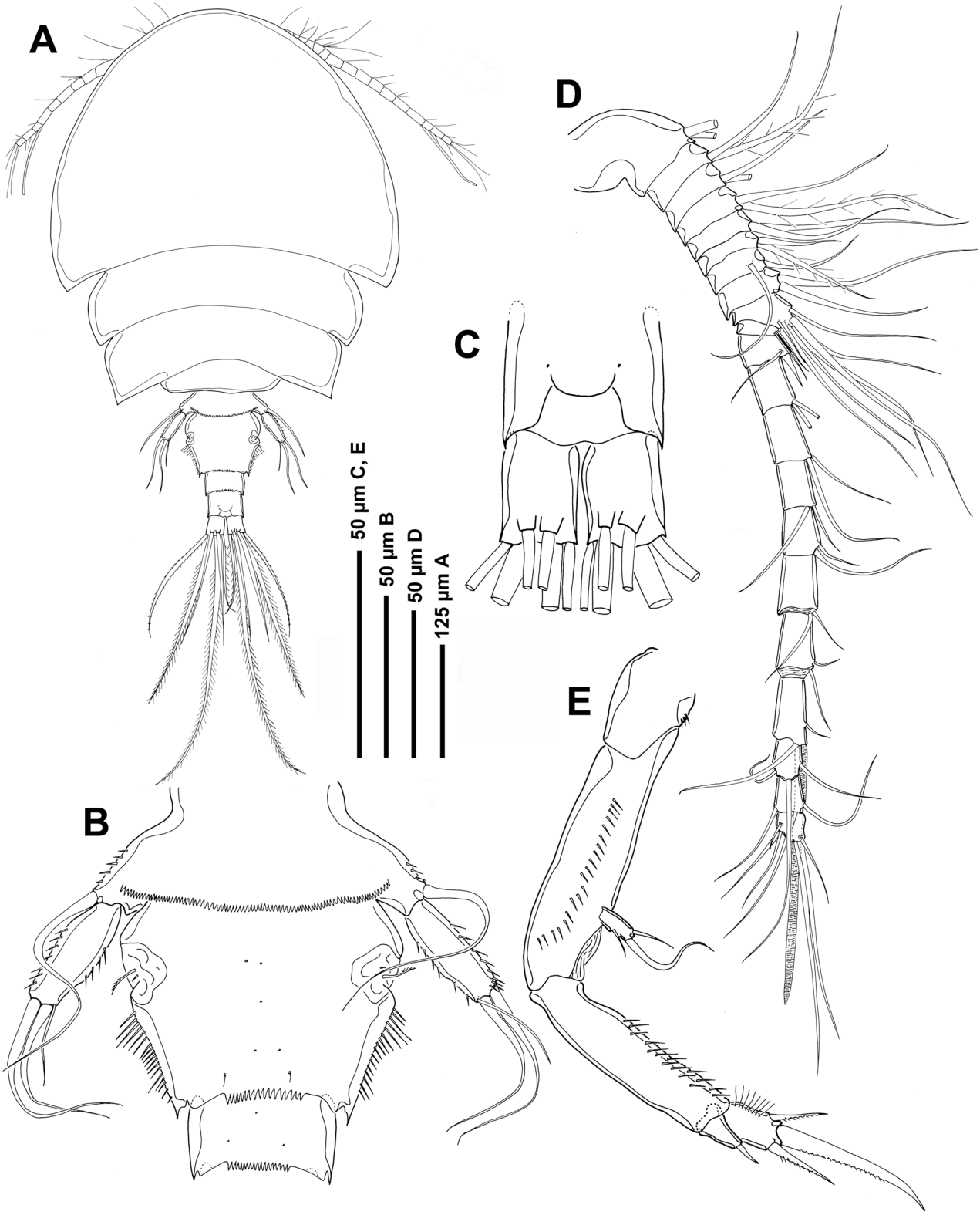

FIGURE 2. *Asterocheres eugenioi* new species (female). A, habitus dorsal; B, leg 5-bearing somite and genital double-somite; C, anal somite and caudal rami; D, antennule; E, antenna.

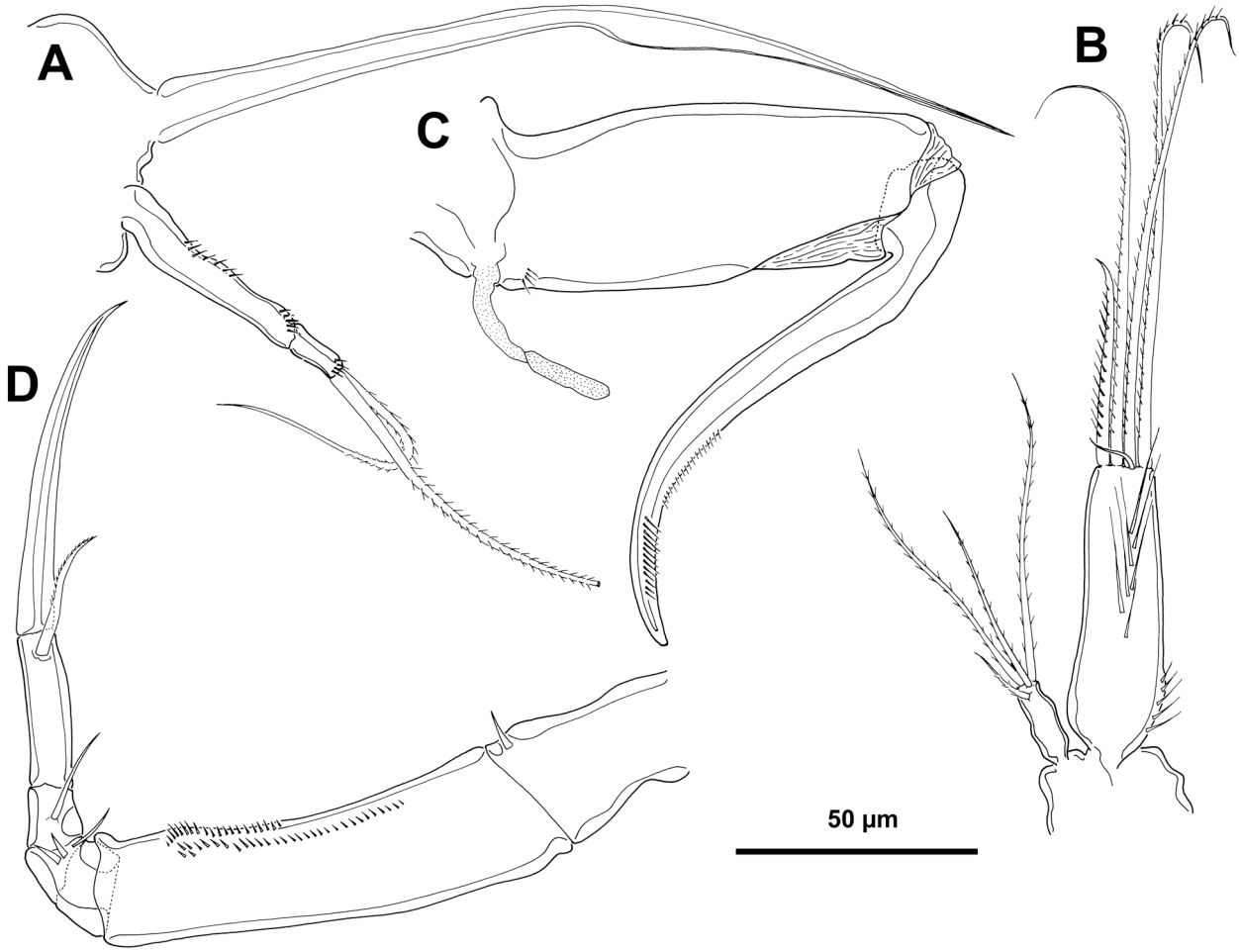

FIGURE 3. *Asterocheres eugenioi* new species (female). A, mandible; B, maxillule; C, maxilla; D, maxilliped.

Maxillule bilobed (Fig. 3B); praecoxal endite (inner lobe) more than three times longer than palp (outer lobe). Praecoxal endite armed with 5 distal setae, one of them smooth and short, ornamented with a row of long setules medially and a row of spinules on proximal outer margin. Palp armed with 3 terminal and one subterminal setae, all of them barbed.

Maxilla (Fig. 3C) 2-segmented but with partial suture on syncoxa (proximal segment) possibly marking plane of praecoxa-coxa fusion; praecoxal portion bearing flaccid aesthetasc-like element medially, representing tubular extension of external opening of maxillary gland; coxal part unarmed but ornamented with few spinules proximally. Claw-like basis with recurved end and ornamented with spinules distally.

Maxilliped 5-segmented (Fig. 3D) comprising short syncoxa, long basis and distal subchela consisting of 3 free endopodal segments armed with distal claw-like element. Syncoxa with one short seta distally; basis elongate and slender, with a row of spinules on lateral margin. First endopodal segment bearing two short setae and one longer distal seta; second endopodal segment armed with one medial seta. Third endopodal segment bearing recurved terminal claw plus additional subapical plumose seta. Distal margin of claw smooth.

Legs 1-4 biramous (Figs. 4A-D) with 3-segmented rami. Intercoxal sclerite present in legs 1-4, ornamented with patches of spinules in leg 1. Spine and seta formula as Table 2.

Coxae of legs ornamented with spinule rows laterally; coxal seta not present in leg 1. Outer spines of exopodal segments in legs 1-4 bilaterally serrate. Lateral margins of exopodal segments with minute serrations; lateral margins of endopodal segments with rows of setules.

Fifth leg (Fig. 2B) with protopodal segment incorporated into somite, with outer seta located dorsolaterally; elongate free segment, armed with two larger terminal setae and one shorter terminal seta, all of them smooth.

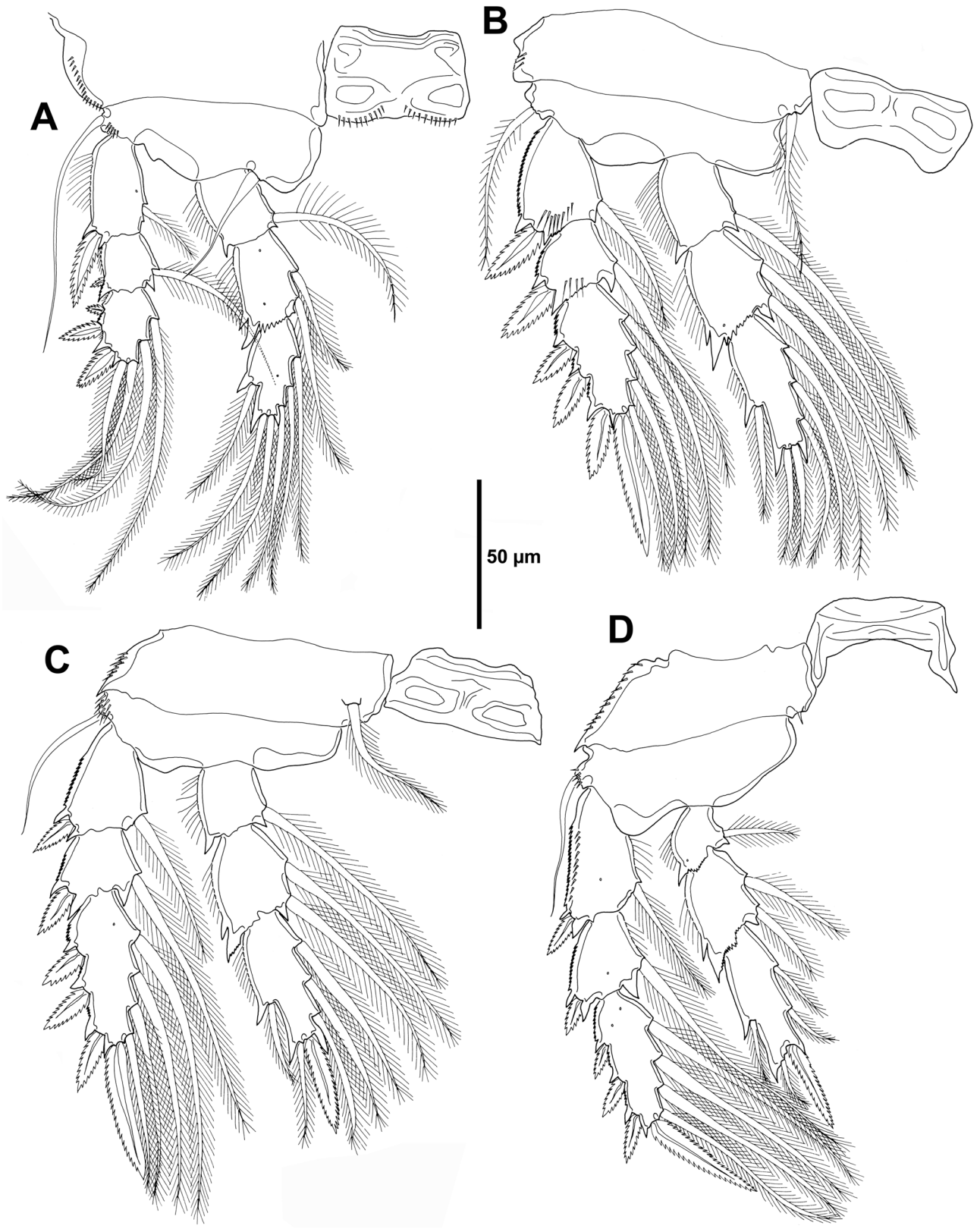

FIGURE 4. *Asterocheres eugenioi* new species (female). A, leg 1; B, leg 2; C, leg 3; D, leg 4.

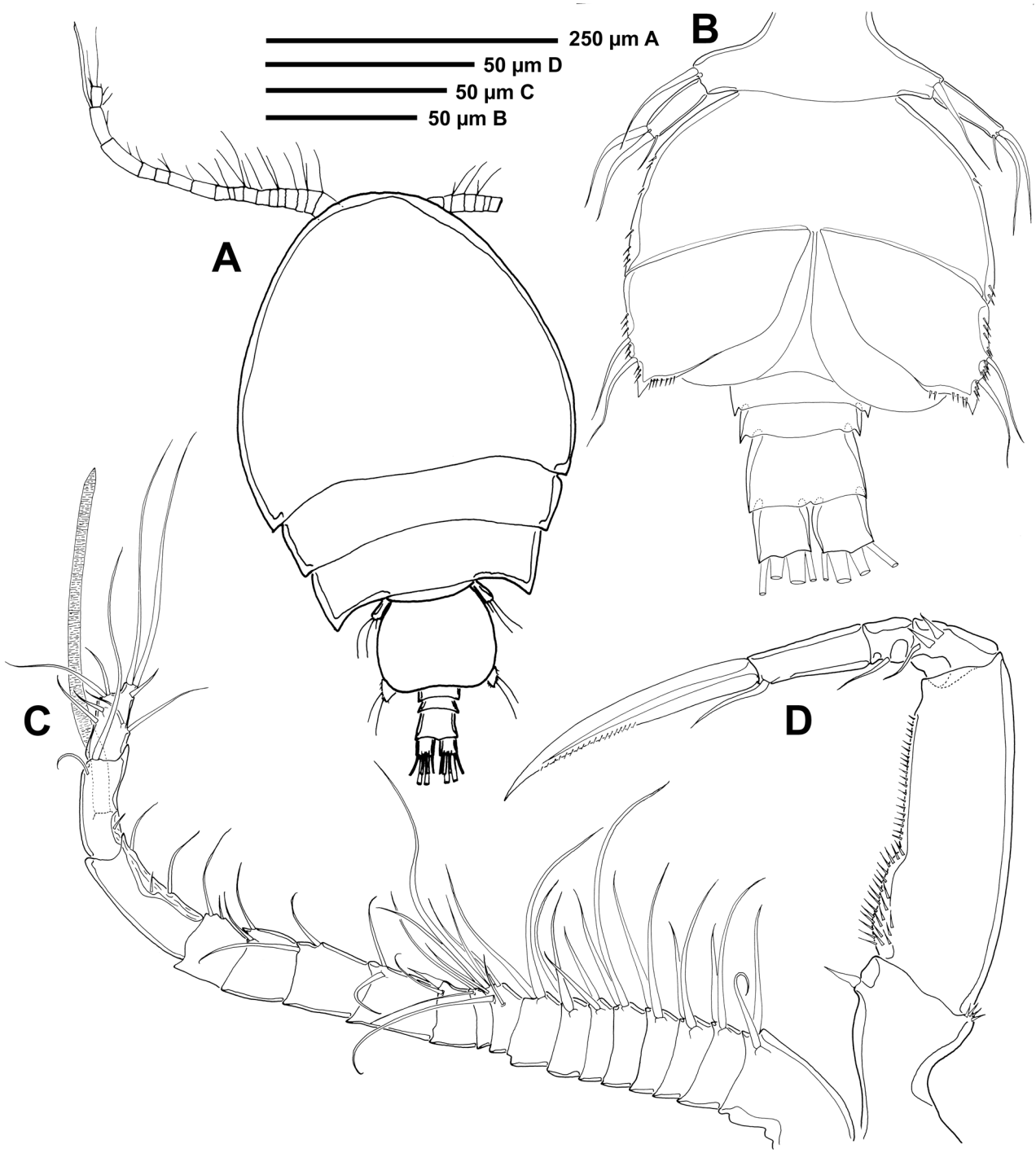

FIGURE 5. *Asterocheres eugenioi* new species (male). A, habitus dorsal; B, urosome ventral; C, antennule; D, maxilliped.

TABLE 2. Spine and seta formula of swiming legs for *Asterocheres eugenioi* n. sp.

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

Sixth leg (Fig. 2B) represented by paired opercular plates closing off gonopores on genital double somite; leg armed with one plumose seta and one spiniform element.

Adult male: Body cyclopiform (Fig. 5A), slightly slender and shorter than female, with cephalothorax oval and cylindrical urosome. Body length 485 µm and greatest width 290 µm. Prosome comprising cephalothorax fully incorporating first pedigerous somite and 3 free pedigerous somites. Epimeral areas of somites bearing legs 2 and 3 with pointed posterolateral angles (Fig. 5A). Somite bearing leg 4 much smaller and narrower than preceding ones. Urosome 5-segmented comprising 5th pedigerous somite, genital somite and 3 free abdominal somites. Genital somite about 1.2 times wider than long, bearing genital apertures posterolaterally on ventral surface (Fig. 5B). Appendages as for female except for antennules, maxillipeds, and sixth leg.

Antennule 18-segmented (Fig. 5C), about 260 µm long, geniculate; segmental fusion pattern as follow: 1(I)-2, 2(II)-2, 3(III)-2, 4(IV)-2, 5(V)-2, 6(VI)-2, 7(VII)-2, 8(VIII)-2, 9(IX-XII)-7, 10(XIII)-2, 11(XIV)-1+ 1 spine, 12(XV)-2, 13(XVI)-2, 14(XVII)-2, 15(XVIII)-2, 16(XIX-XX)-3, 17(XXI-XXII)-3 and 18(XXIII-XXVIII)-9. Geniculation located between segments 16 (XIX-XX) and 17(XXI-XXII). Segment 10 (XIII) reduced, partly overlapped by distal expansion of compound segment 9 (IX-XII).

Maxilliped 5-segmented (Fig. 5D), similar to that of female but basis with a small expansion provided with spinules in proximal half of medial region.

Sixth leg (Fig. 5B) forming large opercular plates closing off genital apertures, armed with 2 smooth setae, ornamented with rows of fine spinules.

Etymology. This species is named after Eugenio Bandera, father of the first author.

Distribution. United Kingdom (Norman and Scott 1906).

Remarks. This species was reported by Norman and Scott in 1906 as *Asterocheres suberitis* Giesbrecht and was collected in a gathering from Salcombe in 1903. They pointed out that the usual habitat of these specimens was the water-passages of *Suberites domuncula*, and probably also of other sponges. However, a detailed comparison with the original description revealed that these specimens do not belong to *Asterocheres suberitis* but represent a new species, *Asterocheres eugenioi* sp. nov.

The most striking features to distinguish these two species are: (1) The epimeral areas of somites bearing legs 2 and 3 have pointed posterolateral angles in *A. eugenioi*, thus contrasting with the rounded posterolateral corners of these somites in *A. suberitis*; (2) the inner maxillular lobe bears 4 distal setae in *A. suberitis* vs. 5 distal setae in *A. eugenioi*; (3) the maxillary proximal segment of the new species has a flexible setal element resembling an aesthetasc ; this element is absent in *A. suberitis*; (4) the siphon reaches the posterior margin of the intercoxal plate of leg 1 in the new species but in *A. suberitis* it barely reaches the insertion of maxillipeds; (5) the leg 1coxal seta is absent in *A. eugenioi* and it is present, short and plumose in *A. suberitis* (Taf. 2, I *Asterocheres suberitis*, Fig. 4; Giesbrecht 1899).

This species belongs to a group of congeners possessing a 21-segmented antennule in the female, 2-segmented mandibular palp, and oral cone reaching the intercoxal plate of leg 1. This group is composed by six more species: *A. urabensis* Kim, 2004, *A. hirsutus* Bandera, Conradi & López-González, 2005*, A. peniculatus* Kim, 2010*, A. ellisi* Hamond, 1968*, A. latus* (Brady, 1872)*,* and *A. hoi* Bandera & Conradi, 2013. There is no information about the length of the siphon in *A. tenuicornis*. However, this species can be easily separated from the new species due to the length of the caudal rami, six times longer than wide, the longest within the genus (Eiselt 1965). In contrast, caudal rami are only 1.5 times longer than wide in the new species. Among these six species, *A. ellisi*, *A. urabensis* and *A. hoi* have the caudal rami slightly longer than wide, shorter than *A. eugenioi*; and *A. hirsutus* and *A. latus* possess a caudal rami equal or longer than 2.5 times longer than wide, longer than in the new species and in *A. peniculatus* they are about as long as wide (Bandera & Conradi 2009b; Kim 2004a; Bandera & Conradi 2013; Bandera *et al.* 2005; Bandera & Conradi 2009a; Kim 2010).

Kim (2010) expressed the requirement of being strict with the definition of the genus *Asterocheres*, especially in reference to the setation on the rami of legs 1-4, which is quite conservative in this genus. There are only three species, together with the new species here described, with the coxal seta of leg 1 absent: *A. pilosus* Kim, 2004, *A. trisetatus* Kim, 2010, and *A. fastigatus* Kim, 2010. These species do not share any additional significant similarity which justify placing them in a separate genus, it is likely that this common characteristic is a homoplasy (Dr. I.-H. Kim pers. comm.).

In addition, this group of seven species, including *A. tenuicornis*, can be distinguished from *A. eugenioi* sp. nov. by the shape of the body because the new species is the only one in the group with the epimeral areas of

somites bearing legs 2 and 3 with pointed posterolateral angles, slightly produced into backwardly directed processes.

Asterocheres sarsi Bandera & Conradi, 2009
(Figs 6–8)

Ascomyzon latum Sars, 1915

Material examined. (a) holotype (preserved in ethanol, deposited in ZMO under registration number ZMO F21600a), and 10 females (preserved in ethanol, deposited in ZMO under registration number ZMO F21600b), collected from the bottom-residue of a large collecting-bottle containing a number of different invertebrate animals in RauØ by G.O. Sars. (b) 1 female (labelled as *Ascomyzom latum* and preserved in ethanol, deposited in ZMUC under registration number ZMUC-CRU-4937), collected from Kapt. Ørssad (58º11'NB 4ºØ, L. 658 ~).

Description of adult female. Body (Fig. 6A) cyclopiform, slender with cephalothorax oval and cylindrical urosome. Mean body length from anterior margin of rostrum to posterior margin of caudal rami 740 µm (710-780 µm); maximum width 450 µm (400-480 µm), based on 4 specimens. Prosome comprising cephalothorax (fully incorporating first pedigerous somite) and three free pedigerous somites. Somites bearing legs 2–3 broad; epimeral areas with posterolateral angles rounded (leg 2) or pointed (leg 3) (Fig. 6A). Somite bearing leg 4 much smaller and narrower than preceding ones and largely concealed under somite bearing leg 3.

Urosome 4-segmented, comprising leg 5-bearing somite, genital double-somite and two free abdominal somites. Urosome ornamented with large epicuticular spinules arranged in irregular pattern (Fig. 6A, C) in all urosomites except for leg-5 bearing somite which shows the spinules in overlapping rows pattern (Fig. 6C). Genital double-somite (Fig. 6C) slightly wider than long; paired genital apertures bipartite, each comprising lateroventral copulatory pore and dorsolateral gonopore (oviduct opening); lateral margins with setular tufts in distal third (posterior to genital apertures).

Caudal rami (Fig. 6C) about twice longer than wide (measured along outer margin); armed with seven setae; seta I present (Fig. 6C), minute and displaced onto lateral surface, setae II–VII all arranged around posterior margin with setae II and VII slightly displaced onto dorsal surface. All of them plumose except for seta I which is naked (Fig. 6A).

Antennule (Fig. 6B) 21-segmented, about 395 µm long. Segmental fusion pattern as follows (Roman numerals indicating ancestral segments): 1(I)-2, 2(II)-2, 3(III)-2, 4(IV)-2, 5(V)-2, 6(VI)-2, 7(VII)-2, 8(VIII)-2, 9(IX–XII)-7, 10(XIII)-1+spine, 11(XIV)-1+spine, 12(XV)-2, 13(XVI)-2, 14(XVII)-2, 15(XVIII)-1, 16(XIX)-1, 17(XX)-2, 18(XXI)-2+ae, 19(XXII–XXIII)-3, 20(XXIV), 21(XXV–XXVIII)-6. Segment 10(XIII) reduced, forming incomplete sclerite partly overlapped by distal expansion of compound segment 9(IX–XII).

Antenna biramous (Fig. 6D), about 260 µm long. Coxa unarmed, with tufts of spinules. Basis unarmed, with fine spinule rows in lateral inner margin and longer spinule rows medially as shown in Figure 6D. Exopod one-segmented, slender, about 2.5 times longer than wide; with two small lateral setae and one long terminal seta. Endopod three-segmented; proximal segment elongated, ornamented with lateral and medial rows of spinules as figured; middle segment produced distally on medial side but articulating with distal segment proximally on lateral side, bearing one naked subterminal seta; distal segment with two pinnate setae, one of them subterminal, and one terminal claw with rows of fine spinules; surface of distal segment with long setules.

Siphon long and slender, about 230 µm long, reaching nearly to posterior margin of intercoxal sclerite of leg 1. Mandible (Fig. 7B) comprising stylet-like gnathobase and slender two-segmented palp. Proximal segment of palp longest, ornamented with rows of spinules on lateral and distal margins; distal segment shortest, with two plumose, unequal apical setae. Stylet located in oral cone, formed by anterior labrum and posterior labium. Stylet with denticulate margin subapically (Fig. 7B).

Maxillule (Fig. 7A) bilobed; praecoxal gnathobase (inner lobe) distinctly larger than palp (outer lobe). Praecoxal endite conical, ornamented with setules proximally and spinules distally on the lateral margin and a row of long setules medially; armed with one short and naked and four long but unequal plumose setae, the three longer with minute spines distally. Palp reduced, about three times shorter than praecoxal endite, with one short naked seta and three longer pinnate setae.

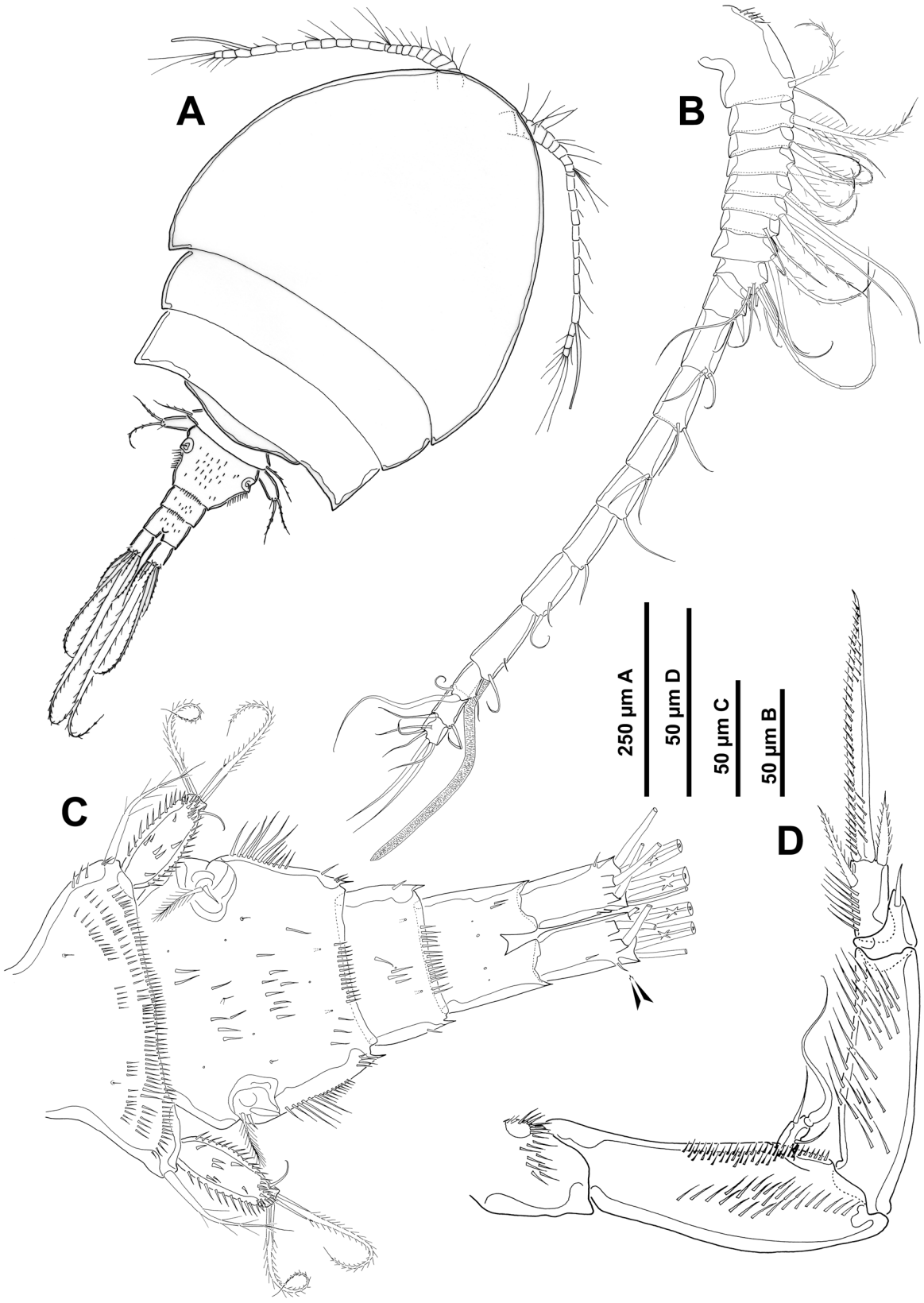

FIGURE 6. *Asterocheres sarsi* Bandera & Conradi 2009 (female). A, habitus dorsal; B, antennule; C, urosome, dorsal; D, antenna.

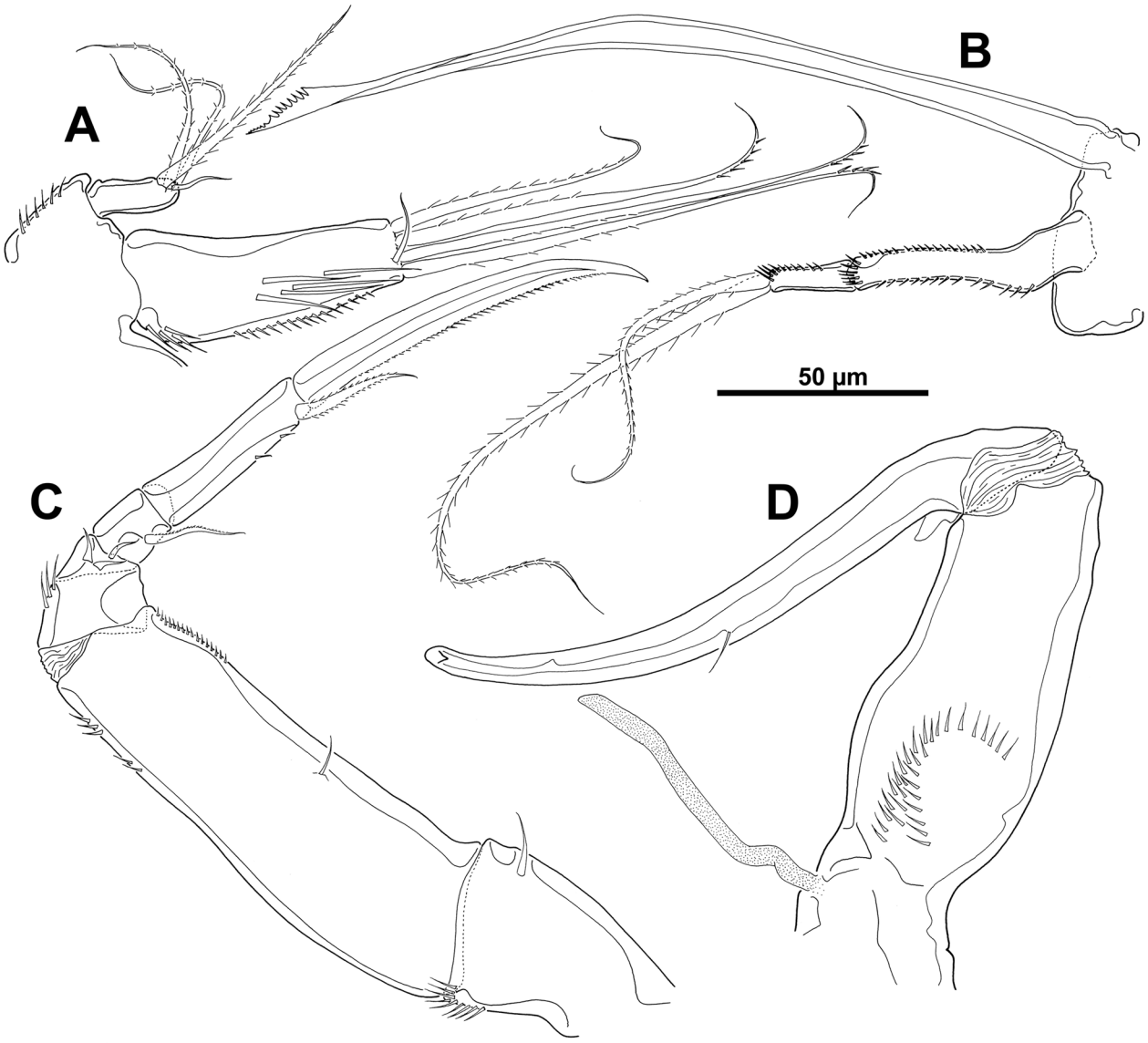

FIGURE 7. *Asterocheres sarsi* Bandera & Conradi 2009 (female). A, maxillule; B, mandible; C, maxilliped; D, maxilla.

Maxilla (Fig. 7D) two-segmented but with partial transverse surface suture on syncoxa (proximal segment) possibly marking plane of praecoxa-coxa fusion; praecoxal portion bearing flaccid aesthetasc-like element medially, representing tubular extension of external opening of maxillary gland; coxal portion unarmed but ornamented with a row of spinules medially as figured. Basis claw-like, more or less straight but recurved towards the apex; armed with one seta at middle length.

Maxilliped (Fig. 7C) five-segmented, comprising short syncoxa, long basis and three-segmented endopod. Syncoxa with one seta and a row of spinules distally. Basis with rows of spinules on distal outer and inner margin and one seta at middle length. First endopodal segment ornamented with spinules on lateral margin and armed with two medial setae and one short distal seta; second endopodal segment bearing one long barbed seta; third endopodal segment bearing recurved terminal claw plus additional apical pinnate seta. Distal margin of claw provided with a row of minute spinules.

Swimming legs 1–4 (Figs. 8A-D) biramous, with three-segmented rami. Intercoxal sclerite present in legs 1–4, ornamented with patches of spinules in legs 1–3.

Spine and seta formula as Table 3.

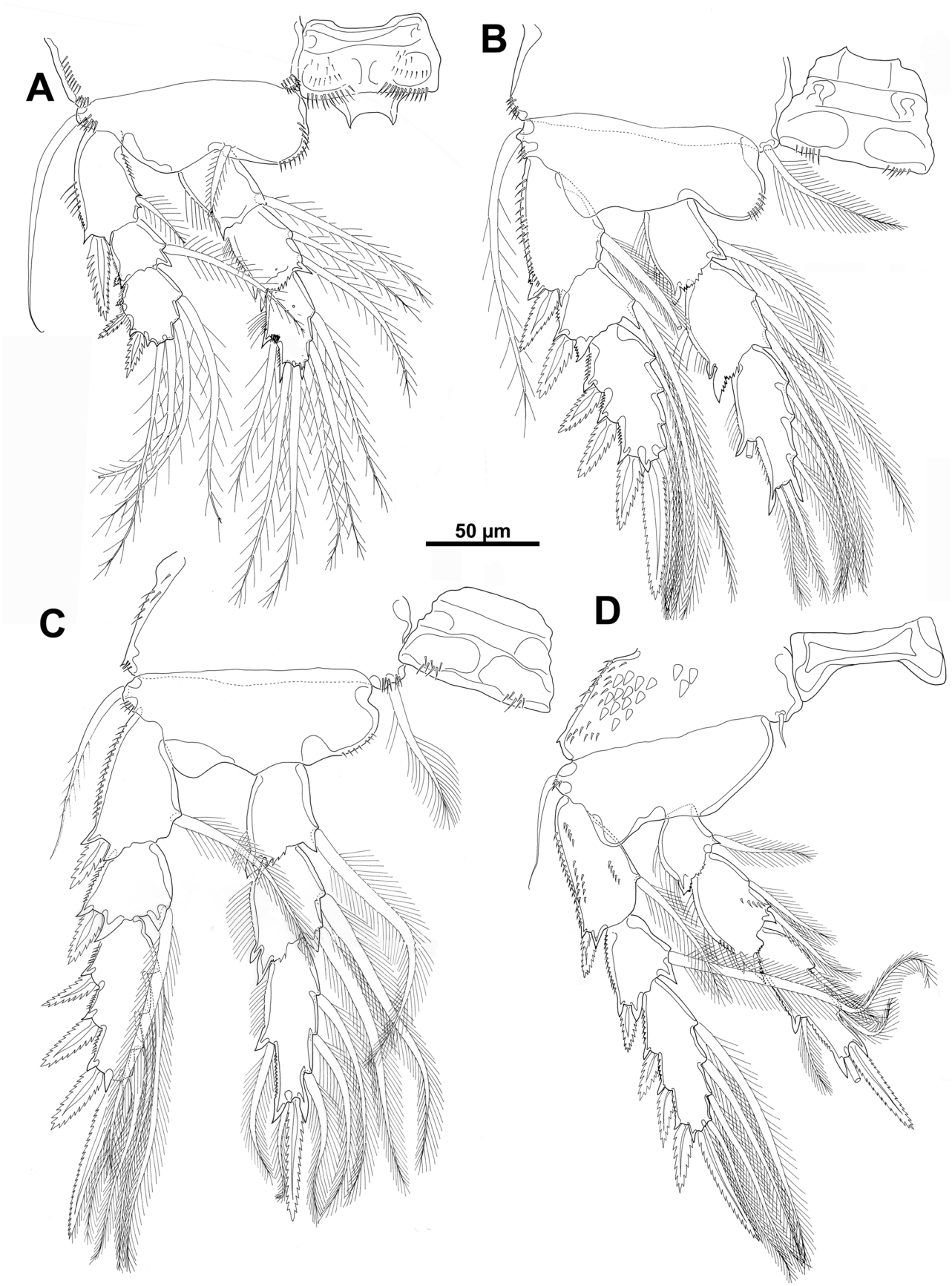

FIGURE 8. *Asterocheres sarsi* Bandera & Conradi 2009 (female). A, leg 1; B, leg 2; C, leg 3; D, leg 4.

TABLE 3. Spine and seta formula of swiming legs for *Asterocheres sarsi* Bandera & Conradi 2009.

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

Coxae ornamented with spinule rows around outer margin; inner coxal seta absent in leg 1 (ornamented with a crown of spinules as figured), long and plumose in legs 2-3 and short and bare in leg 4. Bases of legs 1-3 with spinules around inner margin; outer seta long and naked in leg 1, long and plumose in legs 2-3 and short and smooth in leg 4. Outer spines of exopodal segments in legs 1-4 bilaterally serrate. Lateral margins of exopodal segments with minute serrations or spinular rows; those of endopodal segments with rows of setules.

Fifth leg (Fig. 6C) with protopod incorporated into somite; outer basal seta displaced to laterodorsal surface. Free segment (exopod) elongate-oval, with one short naked seta subterminal and two long plumose setae distally; outer and inner margins with spinules.

Sixth leg (Fig. 6C) represented by paired opercular plates closing off gonopores on genital double-somite; armed each with one plumose seta and one spiniform element.

Distribution. Norway (Sars 1915).

Remarks. This species was poorly described by G.O. Sars (1915) as *Ascomyzon latum* . However, as Bandera and Conradi (2009b) pointed out, the specimens that Sars stated to be identical to *Cyclopicera lata* (Brady) and described as *Ascomyzon latum* were actually different from *A. echinicola* (=*A. violaceus*) and *Cyclopicera lata*. These authors redescribed *C. lata* as *Asterocheres latus* and named the species described by Sars as *Ascomyzon latum* as *Asterocheres sarsi* but they did not redescribed this species.

Asterocheres sarsi is characterized by the possession of 21 segments in the female antennule, 2-segmented mandibular palp, oral cone reaching to the posterior margin of intercoxal plate of leg 1, inner seta on coxa of leg 1 absent and body cyclopiform, with cephalotorax oval and cyclindrical urosome and epimeral areas of somite bearing leg 3 with posterolateral angles pointed. These features are only shared by another species, *A. eugenioi*, described above; however, the length of the caudal rami differs in both species. While *A. sarsi* presents caudal rami that are twice longer than wide, *A. eugenioi* has a shorter caudal rami, about 1.5 times longer than wide. In *A. sarsi,* caudal seta I is present but it is absent *A. eugenioi. Asterocheres sarsi* shows the antenna, including the claw, much more ornamented with spinules and setules than *A. eugenioi*; and the urosomal somites with large epicuticular spinules arranged in irregular pattern in all urosomites except for leg-5 bearing somite which shows the spinules in overlapping rows pattern. This kind of ornamentation has not been observed in the urosome of *A. eugenioi*.

As for the fifth leg, in *A. eugenioi* the seta of the protopodal segment and those of the free segment are naked. However, in *A. sarsi* the seta of the protopodal segment is plumose, the two longer setae belonging to the free segment are barbed and the shorter one is naked.

The stylet of the mandible also serves to separate these species. *A. sarsi* has a stylet with the tip sharply pointed; in contrast, *A. eugenioi* possesses a stylet with the margin multi-denticulated subapically.

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