



## Description of a new species of *Spongiopsyllus* Johnsson, 2000, and redescriptions of *Parmulodes verrucosus* Wilson, 1944 and *Entomopsyllus stocki* Kim, 2004 with revised diagnosis of *Entomopsyllus* (Copepoda, Siphonostomatoida, Entomolepididae)

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### Abstract

The Family Entomolepididae is composed by 7 genera and 15 species. During a survey on the known species and the search for new species, a new *Spongiopsyllus* is described associated with sponge *Aplysina insularis*. The new species has antennule 14-segmented, four setae on both lobes of maxillule, some unique features on the leg setation and the armature of the maxilliped. These characteristics make the new species different from all other congeners in *Spongiopsyllus*. The diagnosis of *Entomopsyllus* was also revised once it does not consider the differences to *Spongiopsyllus* which was created posteriorly to its erection. An analysis of *Entomopsyllus stocki* also indicated that leg 5 somite and the genital somite are fused, instead of separated as originally stated, the structure is also redescriptioned. Finally, *Parmulodes verrucosus* is studied and an up-to-date description is provided, correcting some inconsistencies in the armature formula of the antennule and the leg setation, and providing re-analysis of the other appendages.

**Key words:** associated copepod, Parmulodinae, Entomolepinae, *Aplysina*, symbiotic fauna

### Introduction

The Family Entomolepididae Brady, 1899 is a worldwide group, composed by 7 genera and 16 species (Canario *et al.* 2012; Lee & Kim 2017; Uyeno & Johnsson 2018). Eiselt (1959) subdivided the family in Parmulodinae and Entomolepinae.

The diagnosis of Parmulodinae is revised by McKinnon (1988) to accommodate the genus *Paralepeopsyllus* Ummerkutty, 1960. New features are considered by McKinnon (1988): “presence of a single thoracic somite between cephalothorax and abdominal pleural plate; mandible not greatly lengthened and retaining a recognizable blade; basal segment of first maxilla small, inner lobe large, outer lobe about a third the length of the inner lobe; leg 4 absent; leg 5 absent or uniramous as in Entomolepinae, but considerably shorter”. Parmulodinae includes the genera *Parmulodes* Wilson, 1944, *Parmulella* Stock, 1992 and *Paralepeopsyllus* Ummerkutty, 1960. *Paralepeopsyllus* remained monospecific for more than sixty years, until Lee & Kim (2017) described two new species. *Parmulodes* and *Parmulella* have remained monospecific since their original description, although Stock (1992) revised *P. verrucosus* renaming the specific epithet of the species properly, making remarks of certain female characters and describing the male that was unknown.

In Entomolepinae there are 4 genera, *Entomolepis* Brady, 1899; *Entomopsyllus* McKinnon, 1988; *Lepeopsyllus* Thompson & Scott, 1903 and *Spongiopsyllus* Johnsson, 2000. The subfamily is characterized by the following characteristics, according to McKinnon (1988): “2 thoracic somites between cephalothorax and abdominal pleural plate; basal segment of first maxilla large, inner lobe elongate, outer lobe small and bearing 3 setae; mandible stylet-like and greatly lengthened; fourth leg reduced or absent; leg 5 uniramous, long and recurved, short and stick-like, or occasionally absent”. *Entomolepis* is the type genus of the family and possesses two species. A third species, *E.*

*adriae* (Eiselt, 1959), was transferred to *Entomopsyllus* erected by McKinnon (1988) when describing *E. nichollsi* McKinnon, 1988. Two other species were described: *E. stocki* Kim, 2004 found in association to stoloniferan coral *Tubipora musica* (Linnaeus) (Kim 2004) and *E. brevicaudatus* Lee & Kim, 2017 sampled in washings of unidentified sponges (Lee & Kim 2017). Therefore, *Entomopsyllus* is the largest genus of the family, with 5 known species. *Lepeopsyllus* has remained with two species described more than a century ago (Thompson & Scott 1903) and *Spongiopsyllus*, described in the beginning of the XXI century has already two known species (Johnsson 2000; Canario *et al.* 2012). *Spongiopsyllus* has been described to the Brazilian coast and so far, has remained endemic.

The difference between the Entomolepidinae genera relies on leg 4 and urosome segmentation. In *Entomolepis* leg 4 is absent, *Lepeopsyllus* has leg 4 with the endopod reduced to a single segment and in *Entomopsyllus* and *Spongiopsyllus* leg 4 has a 3-segmented exopod but the endopod is totally absent. However, despite this similarity both genera can be distinguished based on the 3 and 4 postgenital urosomites of the female and male respectively in *Spongiopsyllus* while *Entomopsyllus* shows 2 and 3 somites on the same region.

*Spongiopsyllus* has been recorded only in the northeastern region of Brazil (Johnsson & Neves 2012) and the main hosts have been sponges for *S. adventicius* Johnsson, 2000 specially the genera *Dysidea* and *Monanchora* but mainly from *Aplysina* (Johnsson 2000; Johnsson & Neves 2012). The other species of the genus, *S. redactus* Canario *et al.* 2012, has recorded in *Mussismilia hispida*, a scleractinian coral (Canario *et al.* 2012).

*Entomopsyllus* has three species recorded from the Indian Ocean region or proximally. *Entomopsyllus stocki* Kim, 2004 was sampled in Madagascar Island in a stoloniferan coral (Kim 2004), *E. nichollsi* McKinnon, 1988 was found in Western Australia, in Shark Bay, in the plankton (McKinnon 1988) and *E. brevicaudatus* Lee & Kim, 2017 was sampled in Anda Island (Philippines). Therefore, these three species are spread along the Western and Central Indo-Pacific regions (Spalding *et al.* 2007). The last species, which is also the type species of the genus, *E. adriae* (Eiselt, 1959) was recorded in Adriatic Sea, near Croatia coast.

Thus, the main aim of this work is to describe a new species of *Spongiopsyllus* found in association with the sponge *Aplysina insularis* (Duchassaing & Michelotti). Besides that, *Parmulodes verrucosus* and *Entomopsyllus stocki* are redescribed and the diagnosis of *Entomopsyllus* is emended, reinforcing the difference to *Spongiopsyllus*.

## Material and methods

The new species of *Spongiopsyllus* was recovered from samples of the poriferan host *Aplysina insularis* (Duchassaing & Michelotti). The sponges were hand-collected during low tide, at a maximum depth of 3 m at Porto da Barra Beach, Salvador, Bahia, Brazil (13°00'13.5"S 38°32'02.6"W), in the city of Salvador, Bahia State, Brazil on 31<sup>st</sup>, August 2016.

The hosts were sampled and immediately placed in individual plastic bags with sea water. Ethanol was added to the sea water until a final concentration of 5% was reached. After 30 minutes, the samples were washed and filtered through a 100 µm mesh screen, transferred to a petri dish with ethanol, and sorted for copepods under a dissecting microscope and then fixed in 70% ethanol for subsequent analysis.

The types were cleared in lactic acid, measured, and its body drawn before being stained in Chlorazol Black E, dissected, and permanently mounted in CMC-9® (Masters Chemical Company, Inc.). All drawings were made with the aid of a drawing tube fitted on an Olympus CH30 microscope. All structures were also observed and checked with the aid of a Nikon Eclipse Ci microscope equipped with a digital camera. The length of the antennule segments was measured along the posterior, non-setigerous margin. Antennular segments are denoted by Roman numerals indicating ancestral segments following Huys & Boxshall (1991). For the armature formula of legs 1–4, Roman numerals indicate spines and Arabic numerals indicate setae. Type specimens of the new *Spongiopsyllus* species were deposited in the Museu de Zoologia of the Universidade Federal da Bahia (UFBA) in Brazil.

The holotypes of *Entomopsyllus stocki* and *Parmulodes verrucosus* were obtained by loan from United States National Museum of Natural History (USNM) and the specimens were analyzed in a Nikon Eclipse Ci microscope. The illustrations were made with the aid of a drawing tube fitted on an Olympus CH30 microscope.

## Taxonomy

### Order SIPHONOSTOMATOIDA Thorell, 1859

### Family ENTOMOLEPIDIDAE Brady, 1899

### Genus *Spongiopsyllus* Johnsson, 2000

#### *Spongiopsyllus atypicus* sp. nov.

(Figs 1–3 A–C)

**Material examined.** Holotype ♀ (UFBA 3294), allotype (UFBA 3295) and 1 paratype (UFBA 3296), Porto da Barra Beach, Todos-os-Santos Bay, Salvador city, Bahia State, Brazil, collected by LABIMAR, 31, August 2016. Associated with sponge *Aplysina insularis*. Holotype (UFBA 3294) dissected and mounted on slide. Paratype and allotype preserved in ethanol.

**Description of female.** Mean body length (excluding caudal setae) 1,155 µm (1,150–1,160 µm) and mean body width 719 µm (717–721 µm) ( $n=2$ ). Body (Fig. 1A) with proosomal shield flattened, well-sclerotized, showing radiation bands along outer margin. Pedigerous somites 2–4 free. Pedigerous somite 4 expanded, covering urosome except the tip of caudal rami.

Urosome 4-segmented (Fig. 1B). Genital double-somite fused with fifth pedigerous somite, 150 µm long and maximum width 132 µm, length: width ratio = 1.1:1, vestigial leg 6 located anterolaterally with minute seta, close to genital openings. Setulated groove mid posteriorly on genital somite, reaching posterior margin. Three postgenital somites present; first one longer than wide (62 × 60 µm); second and third somites wider than long (38 × 55, 50 × 60 µm, respectively). Caudal rami elongate, 120 × 19 µm. Length: width ratio 6.3:1 µm, armed with six setae; seta I absent.

Antennule (Fig. 1C) slender, 257 µm long (excluding setae), 14-segmented. Length of segments measured in proximal to distal order: 61, 19, 34, 9, 9, 10, 11, 11, 11, 10, 10, 9, 9, and 18 µm, respectively. Segmental homologies and setation as follows: 1(I)-1; 2(II)-1; 3(III-VIII)-9; 4(IX-XIII)-7; 5(XIV)-1+I; 6(XV)-1; 7(XVI)-1; 8(XVII)-1; 9(XVIII)-2; 10(XIX)-1; 11(XX)-1; 12(XXI)-1+ae; 13(XXII-XXIII)-0; 14(XXIV-XXVIII)-11; all setae smooth. Aesthetasc 82 µm long.

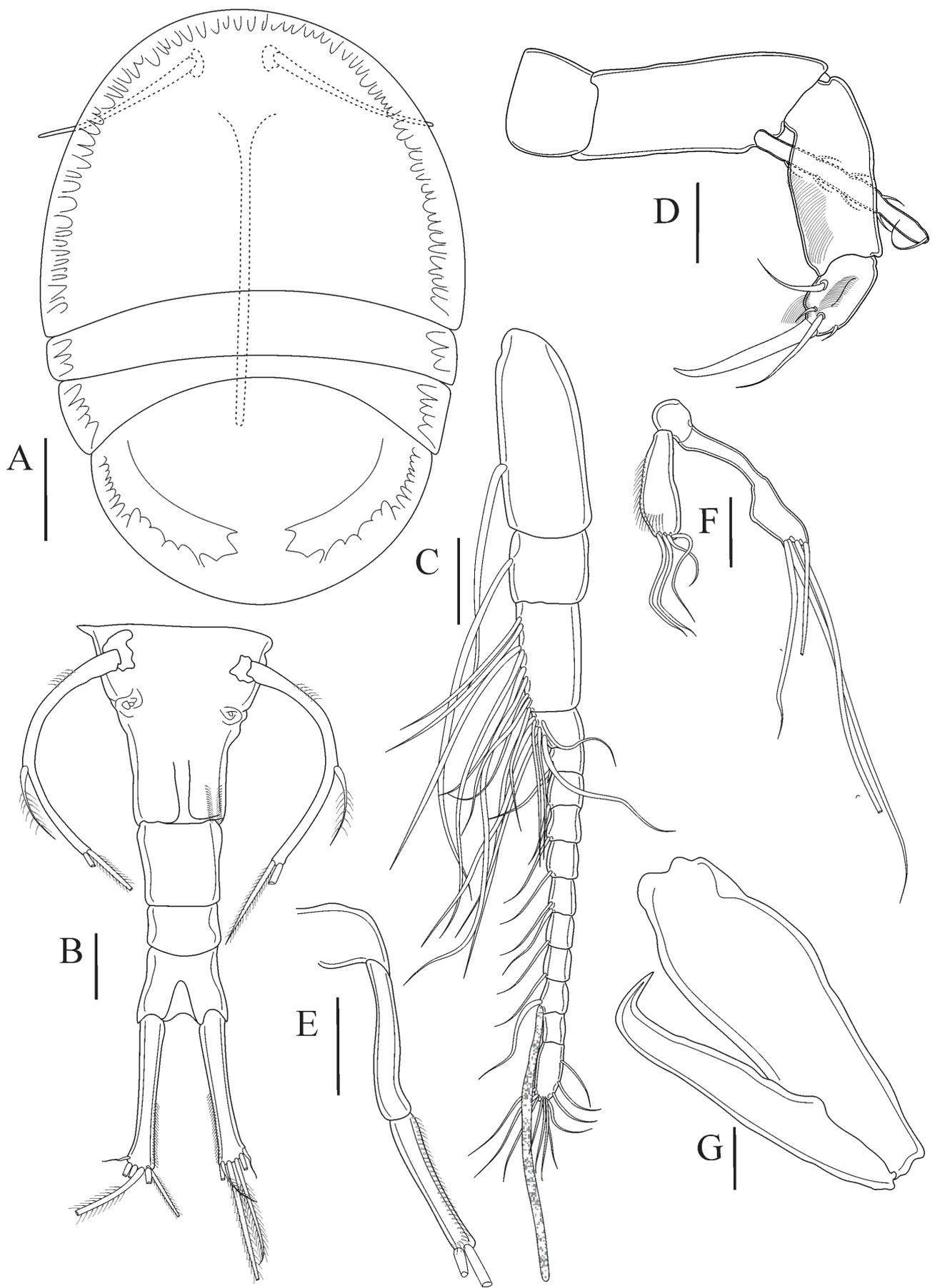
Antenna (Fig. 1D) 218 µm long (including distal claw); coxa and basis unarmed. Exopod 1-segmented, 64 µm long with smooth distal seta and seven lateral setules. Endopod 2-segmented, first segment 54 µm long, unarmed, with setules along outer margin; second segment 27 µm long armed with long proximal lateral seta on outer margin and three subdistal setae on inner, outer and medial margin. The latter seta is the longest one and is located close to distal claw, 46 µm long, slightly curved distally. Two rows of setules on second endopodal segment.

Oral cone 625 µm long, reaching to genital double-somite (Fig. 1A). Mandible comprising stylet and slender 2-segmented palp (Fig. 1E) measuring 43 and 40 µm long, respectively. Second segment with 2 naked distal setae. Both setae broken. Maxillule bilobed (Fig. 1F), both lobes armed with four setae, outer lobe 39 µm long with row of setules on outer margin; inner lobe with 54 µm long. Maxilla (Fig. 1G) with syncoxa 162 µm long and claw with distal portion curved at a 90° angle, 137 µm long.

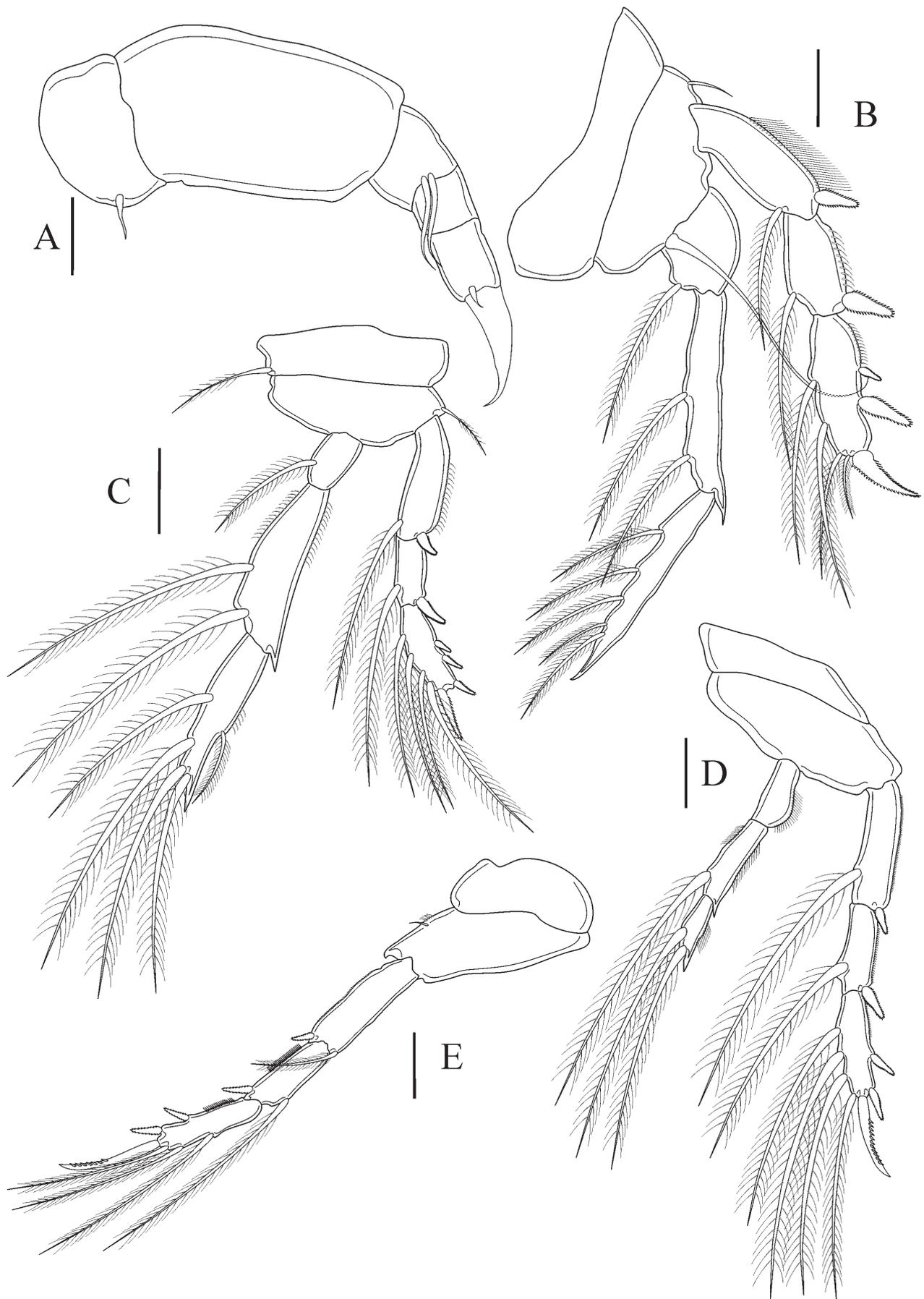
Maxilliped (Fig. 2A) 5-segmented, 234 µm long; syncoxa 40 µm long with naked seta on inner margin; basis 93 µm, unarmed. Endopod 3-segmented, segments measuring 23, 18 and 22 µm long, respectively; first segment with two long setae; second segment unarmed; third segment with small seta close to distal claw-like element with curved tip and measuring 38 µm long.

Legs 1-3 (Fig. 2B-D) biramous, with 3-segmented rami. Leg 4 (Fig. 2E) with 3-segmented exopod and endopod absent. Armature formula as follows:

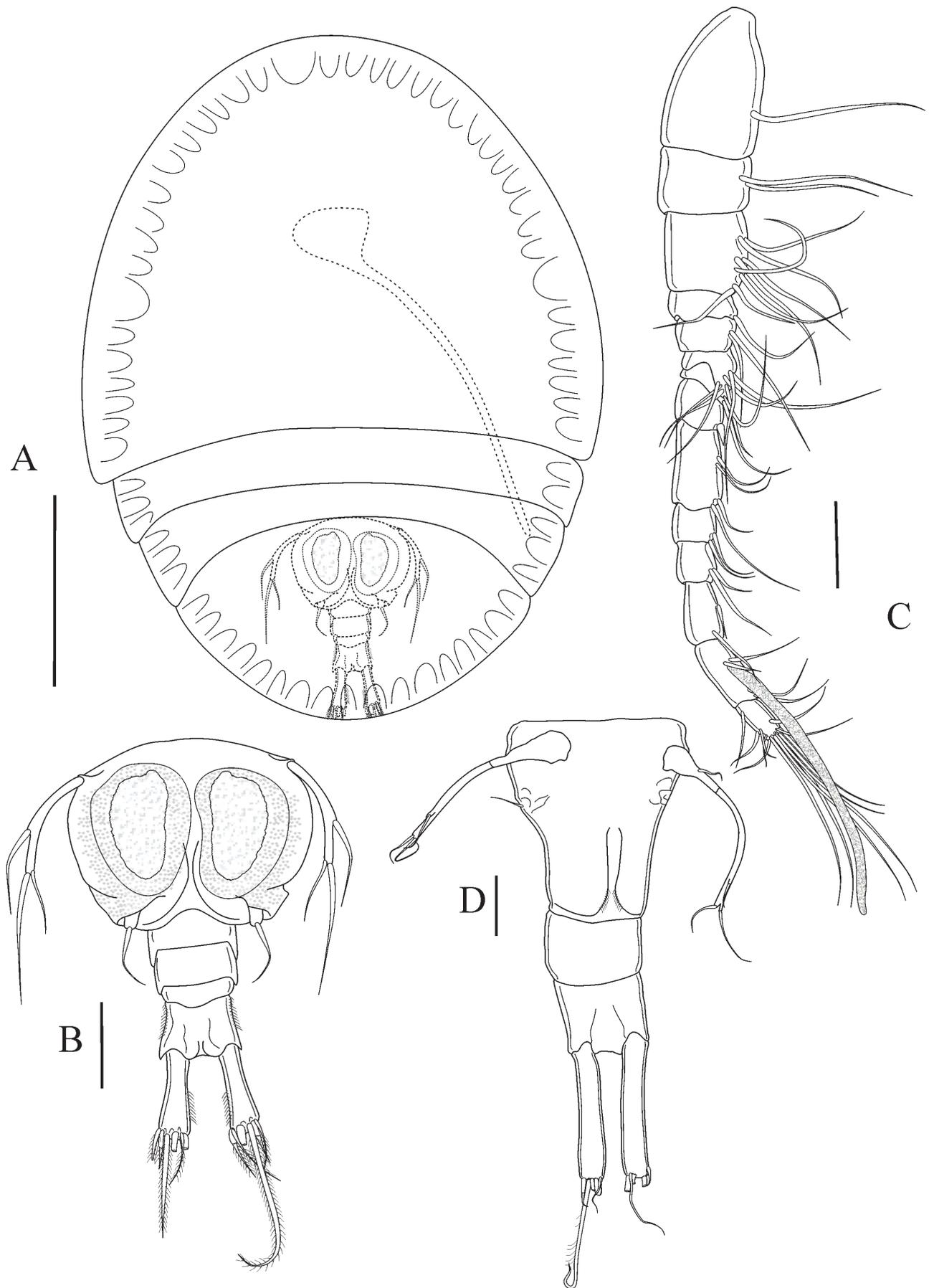
	Coxa	Basis	Exopod	Endopod
Leg 1	0-0	1-1	I-1; I-1; II,I,4	0-1; 0-2; 0,5
Leg 2	0-1	1-0	I-1; I-1; III,I,4	0-1; 0-2; 1,2,2
Leg 3	0-0	0-0	I-1; I-1; II,I,4	0-0; 0-1; 0,2
Leg 4	0-0	1-0	I-1; I-1; II,I,3	absent



**FIGURE 1.** *Spongiopsyllus* sp. nov., female paratype (UFBA 3294). A, body dorsal view; B, urosome; C, antennule; D, antenna; E, mandibular palp; F, maxillule; G, maxilla. Scale bars: A = 200  $\mu$ m; B = 50  $\mu$ m; E–G = 25  $\mu$ m.



**FIGURE 2.** *Spongiopsyllus* sp. nov., female paratype (UFBA 3294). A, maxilliped; B, leg 1; C, leg 2; D, leg 3; E, leg 4. Scale bars: A–E = 25  $\mu$ m.



**FIGURE 3.** *Spongiopsyllus* sp. nov., male allotype (UFBA 3295). A, body dorsal view; B, urosome; C, antennule; *Entomopsyllus stocki* Kim, 2004 (USNM 1027325). D, urosome. Scale bars: A= 200  $\mu$ m, B–C = 25  $\mu$ m; D = 50  $\mu$ m.

Leg 1 with very long and naked inner seta on basis, first endopodal segment very enlarged, second and third endopodal segments prolonged distally into sharpened process, therefore distal setae of third segment located sub-distally on inner margin (Fig. 2B). Exopodal segments of legs 1 to 4 with setules on outer margins (Figs 2B-E). Legs 2 and 3 with second endopodal segments with setules on both margins and third endopodal segments with few setules on outer margin (Figs 2C-D). Leg 3 with first endopodal segment unarmed, with setules on outer margin and dilatated subdistally; third endopodal segment very short, half the length of previous segment and armed with 2 setae (Fig. 2D). Leg 4 bearing minute outer basal seta (Fig. 2E).

Free exopodal segment of leg 5 (Fig. 1B) elongated, curved, 196  $\mu\text{m}$  long, almost reaching distal margin of first post-genital somite, armed with 2 distal setae and one outer seta medially; all setae plumose.

**Description of male.** Body (Fig. 3A) similar to female, but much smaller. Body length (excluding caudal setae) 718  $\mu\text{m}$  and body width 535  $\mu\text{m}$ . Prosomal shield flattened with radiation bands along outer margin. Pedigerous somites 2–4 free. Pedigerous somite 4 expanded, covering urosome.

Urosome 5-segmented (Fig. 3B). Genital somite fused with fifth pedigerous somite, 108  $\mu\text{m}$  long and maximum width 151  $\mu\text{m}$ , and length: width ratio 0.7:1. First, third and fourth postgenital somites wider than long (21  $\times$  53, 13  $\times$  48, 38  $\times$  48  $\mu\text{m}$ , respectively); second somite almost as long as wide (51  $\times$  50  $\mu\text{m}$ ); First and second postgenital somites with tooth-like projections on each distal lateral margins. Prosome: urosome length ratio 3.4:1. Caudal rami elongated, 55  $\mu\text{m}$  long, armed with six setae; seta I absent, setae II to VII present.

Antennule (Fig. 3C) slender, 219  $\mu\text{m}$  long (not including setae), 14-segmented. Length of segments measured in proximal to distal order: 45, 19, 22, 8, 10, 4, 5, 13, 24, 9, 17, 18, 21 and 15  $\mu\text{m}$ , respectively. Segmental homologies and setation as follows: 1(I)-1; 2(II)-2; 3(III-VI)-8; 4(VII)-1; 5(VIII)-2; 6(IX-XII)-8; 7(XIII)-1; 8(XIV)-1; 9(XV-XVI)-4; 10(XVII)-2; 11(XVIII)-2; 12(XIX-XX)-2; 13(XXI-XXIII)-4+ae; 14(XXIV-XXVIII)-13; all setae smooth. Aesthetasc 85  $\mu\text{m}$  long. Oral cone (Fig. 3A) 400  $\mu\text{m}$  long, reaching first post-genital somite. All other appendages as in the female.

**Type locality.** Porto da Barra Beach (13°00'13.5"S, 38°32'02.6"W), Salvador city, Bahia State, Brazil.

**Etymology.** The specific name '*atypicus*' is a combination of the prefix 'a', that means no, with the Latin word 'typicus', that means 'relative to a type' referring to uncommon and unique characteristics of the new species. Among these characteristics we may point the presence of an outer seta on leg 4 basis, the maxillule with 4 setae on each lobe and the extremely long inner seta on the basis of leg 1.

**Remarks.** *Spongiopsyllus atypicus* **sp. nov.** has antennule 14-segmented differing from all others *Spongiopsyllus* species: *S. adventicius* and *S. redactus* have the antennule 17 and 15-segmented respectively (Johnsson 2000; Canário *et al.* 2012). Indeed, *S. atypicus* **sp. nov.** possesses four setae on both lobes of maxillule as differing from *S. adventicius* and *S. redactus* that have three setae on each lobe (Johnsson 2000; Canário *et al.* 2012). The armature formula of the endopod of the maxilliped in the new species is 2,0,1+claw while in *S. adventicius* and *S. redactus* is respectively 0,2,1+claw and 2,1,1+claw. Besides that, the segments and distal claw are shorter and blunter (Johnsson 2000; Canário *et al.* 2012). Among the other unique features of the *S. atypicus* **sp. nov.** are the outer seta on the basis of leg 4, the the extremely long inner seta on the basis of leg 1. These characteristics are not found in any other species of the genus.

## Genus *Entomopsyllus* McKinnon, 1988

**Emended diagnosis.** Entomolepididae, sub-family Entomolepinae. Body shield composed by cephalosome and pedigerous somites 2–4; pedigerous somite 4 recovering entirely the prosome. Two postgenital somites in female and one in male. Exopod of antenna hirsute, as long as endopod. Third endopodal segment of leg 1 prolonged distally into sharpened process, therefore distal setae located sub-distally on inner margin. Second endopodal segment of leg 2 with single seta. Third exopodal segment of leg 3 with two lateral spines. Leg 4 with endopod absent and exopod 3-segmented. Leg 5 at least as long as the genital complex.

**Remarks.** The original diagnosis of *Entomopsyllus*, as presented by McKinnon (1988) is very concise and included some characteristics such as (1) exopod of antennule as a single, long, blunt, hirsute segment; (2) endopod of leg 4 absent; and (3) leg 5 as a single segment, at least as long as genital complex. These characteristics were useful to stablish *Entomopsyllus* within the sub-family Entomolepinae. However, Johnsson (2000), when erecting *Spongiopsyllus*, specified the diagnostic characters to differentiate both genera, but the '*Entomopsyllus*' diagnosis remained as originally stated. Therefore, *Entomopsyllus* shares these characteristics with *Spongiopsyllus*. Neverthe-

less, *Entomopsyllus* possesses two and three postgenital somites in female and male, respectively, instead of three and four as in *Spongiopsyllus*.

### ***Entomopsyllus stocki* Kim, 2004**

(Fig. 3D)

**Material examined.** Holotype ♀ (USNM 1027325), associated with *Tubipora musica* collected in Nosy Bé, Madagascar, 05, January 1964.

**Description of female.** Urossome 3-segmented (Fig. 3D). Genital double-somite fused with fifth pedigerous somite forming genital complex, 150 µm long and maximum width anteriorly, 133 µm, length : width ratio = 1.1:1, vestigial leg 6 located anterolaterally with seta, close to genital openings, at 1/3 of the anterior margin. Setulated groove mid-posteriorly on genital somite, reaching posterior margin. Two postgenital somites present. First and second abdominal somites 52 × 57 and 63 × 61 µm, respectively. Posterior margin of anal somite concave at insertion of caudal rami. Caudal rami convergent, and gradually broadening distally, 110 × 19 µm. Length : width ratio 5.8:1, armed with 6; setae I absent. Leg 5 formed by basal segment, enlarged proximally, armed with small, naked seta on outer margin and distal thin segment with 3 naked setae.

All other appendages as in original description by Kim (2004), except for the antennal exopod and the outer lobe of the maxillula which we were unable to study due to the quality of the slide.

**Remarks.** The female of *Entomopsyllus stocki* was described by Kim (2004) based on a single specimen dissected and mounted on permanent slide. In this revision only the genital complex showed differences to the original description (Kim 2004), that was described as unfused to the fifth pedigerous somite. A careful reexamination indicates that the fifth pedigerous somite is fused, forming a genital complex. The setuled groove in the mid-posterior region was not described originally, as well.

### **Genus *Parmulodes* Wilson, 1944**

#### ***Parmulodes verrucosus* Wilson, 1944**

(Figs 4–6)

**Material examined.** Holotype ♀ (USNM 79000), collected in tidal pools of coral reefs, Key Matecumbe, Florida, USA, July, 1925.

**Description of female.** Body length (excluding caudal setae) 1,124 µm and body width 841 µm. Body with prosomal shield flattened (Fig. 4A). Pedigerous somite 1 fused to cephalosome with slightly projected margins. Pedigerous somite 2 narrower than others. Pedigerous somite 3 and 4 fused forming posterior shield recovering urossome. Margins of cephalosome and fused pedigerous somites 3 and 4 with digitiform bands (Fig. 4B).

Urossome 4-segmented (Fig. 4C). Genital double-somite 150 µm long and maximum width 106 µm, length: width ratio = 1.4:1, anteriorly enlarged, with set of small setules after genital apertures which are located anterolaterally. Two postgenital somites, both wider than long, 56 × 75, 44 × 66 µm, respectively. Anal somite with anal plate on medial-posterior portion. Caudal rami short (Fig. 4D), 62 × 47 µm; Length: width ratio 1.3:1 µm, armed with six setae; seta I absent.

Antennule (Fig. 4E) slender, 335 µm long (not including setae), and 17-segmented. Length of segments measured in proximal to distal order: 91, 22, 10, 9, 18, 12, 15, 2, 11, 11, 18, 14, 14, 17, 22, 24 and 49 µm, respectively. Segmental homologies and setation as follows: 1(I)-2; 2(II-III)-4; 3(VI)-2; 4(V)-2; 5(VI-VII)-3; 6(VIII)-2; 7(IX-XII)-6; 8(XIII)-1; 9(XIV)-I+1; 10(XV)-2; 11(XVI)-2; 12(XVII)-1; 13(XVIII)-2; 14(XIX)-1; 15(XX)-1; 16(XXI)-1 +ae; 17(XXII-XXVIII)-11. All setae smooth. Aesthetasc 47 µm long.

Antenna (Fig. 5A) 268 µm long (including distal claw); coxa and basis unarmed. Exopod 1-segmented, 52 µm long, with apical seta and 3 small lateral setules. Endopod 3-segmented; first segment 80 µm long, with distal seta and row of setules on outer margin; second segment 15 µm long with subdistal seta; third segment 11 µm long, ornamented with row of setules along outer margin, and armed with 2 naked and thin setae, located proximally and subdistally, and 1 distal robust terminal seta, close to distally straight claw with curved tip, 54 µm long, with row of spinules and 4 teeth distally.

Oral cone 580  $\mu\text{m}$  long, corresponding to half the length of the body, club-shaped, distal part sharp, reaching insertion between of legs 3 and 4 (Fig. 4A). Mandible comprising stylet 319  $\mu\text{m}$  long and slender 2-segmented palp measuring 82 and 27  $\mu\text{m}$  long, respectively (Fig. 5B). Stylet slender and serrated, 480  $\mu\text{m}$  long. Palp with second segment armed with 2 apical, plumose setae, one of them almost twice longer the other. Maxillule bilobed (Fig. 5C), inner lobe 94  $\mu\text{m}$  long, armed with 1 smooth and 3 unilaterally plumose setae. Outer lobe 29  $\mu\text{m}$  long, armed with 4 naked setae, one of them reduced. Maxilla (Fig. 5D) with syncoxa and curved claw measuring 197 and 130  $\mu\text{m}$  long, respectively.

Maxilliped (Fig. 5E) 5-segmented, 275  $\mu\text{m}$  long (excluding claw); syncoxa 63  $\mu\text{m}$  long, unarmed; basis 130  $\mu\text{m}$  long, unarmed with row of setules on medial distal inner margin. Endopod 3-segmented, segments measuring 17, 40 and 25  $\mu\text{m}$  long, respectively; first segment with 2 setae and setules on outer margin; second and third segments both with single seta; curved claw (Fig. 5F) measuring 57  $\mu\text{m}$  long with subdistal inner tooth, both margins with spinules.

Legs 1–3 (Figs. 6A–C) biramous, with 3-segmented rami. Leg 4 (Fig. 6D) reduced to a bud bearing a seta. Armature formula of legs 1–3 as follows:

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

Second endopodal segments of leg 1 to leg 3 with two tooth-like processes on distal outer corner (Figs. 6A–C). Setules on outer margin of first exopodal segment of leg 1; and outer margins of most endopodal and exopodal segments of legs 2 and 3.

Leg 5 (Fig. 6E) protopodal fused to fifth pedigerous somite, with single outer seta. Free segment with 3 apical and 1 subdistal setae and setules on outer margin.

**Male.** Material not analyzed.

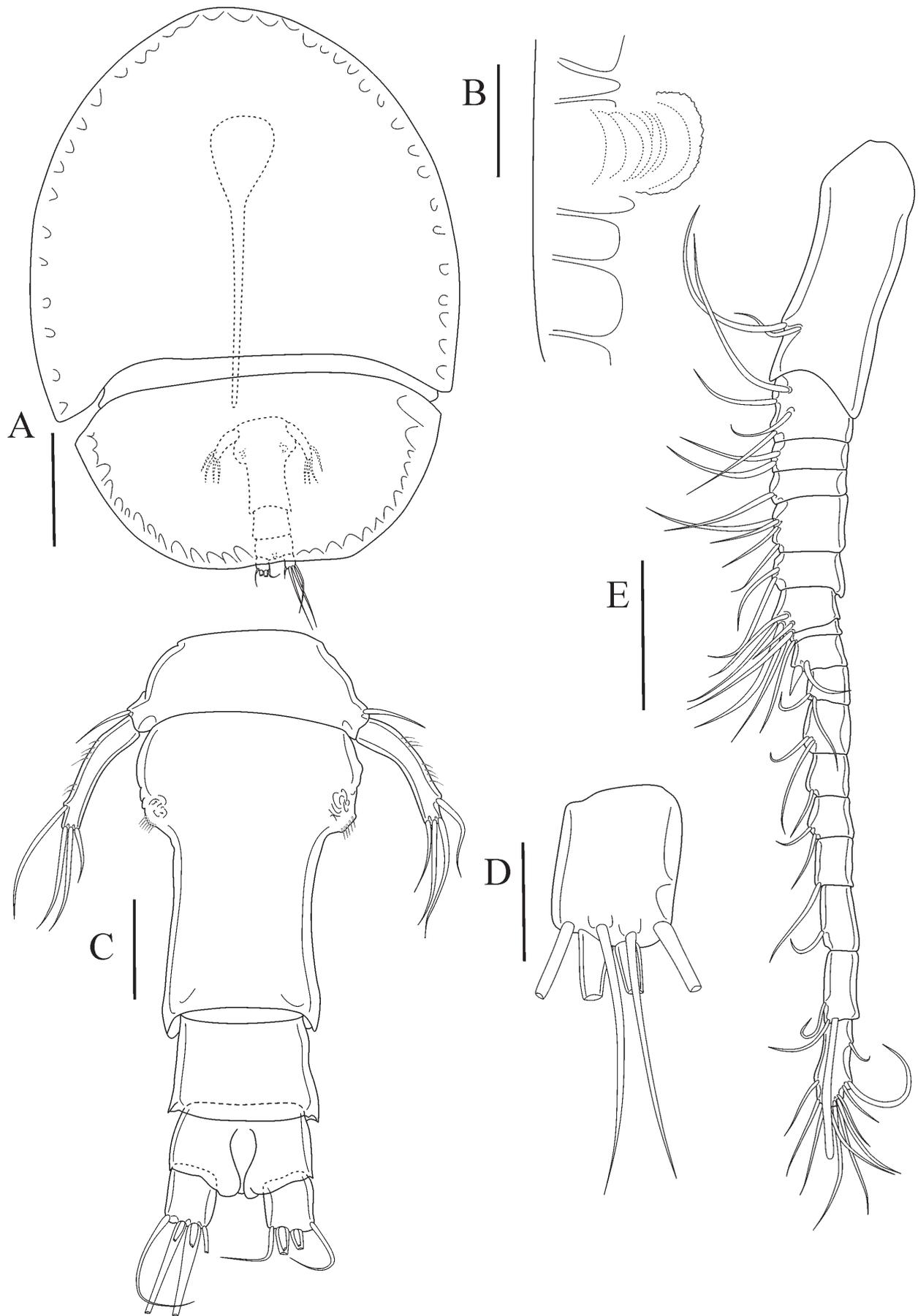
**Remarks.** The analysis of the holotype shows many differences regarding the original description. Wilson (1944) describes the pedigerous somites 3 to 5 as fused; but, only the pedigerous somites 3 and 4 are fused. The antennule was described as 18-segmented instead of 17-segmented as observed here due to fusions among basal elements II and III. The illustration provided by Wilson (1944, fig. 153) indicates a possible fusion of these segments once there is a seta located in the division of segments I and II. Consequently, if this seta refers to second segment it would imply in the existence of a fused segment as observed in the present redescription.

In the original description, Wilson (1944, pg 544) states: “The basal segment of the second antenna is stout and longer than the other two segments combined, with a short spine at its inner distal corner” that, together with the illustration (Wilson 1944, fig. 154) reinforces the conception that the endopod was formed by only 2 segments, the first unarmed and the second with small spine near to terminal claw, and the exopod would be the short spine mentioned. In fact, the endopod is 3-segmented, the first and the second segments with a seta both and the third possessing three setae, one of them robust and spine-like. The short spine of the basis refers in fact to the exopod as presently observed.

The endopod of the maxilliped also differs from Wilson’s original description (1944) once it is 3-segmented with terminal claw instead large claw as illustrated by the author.

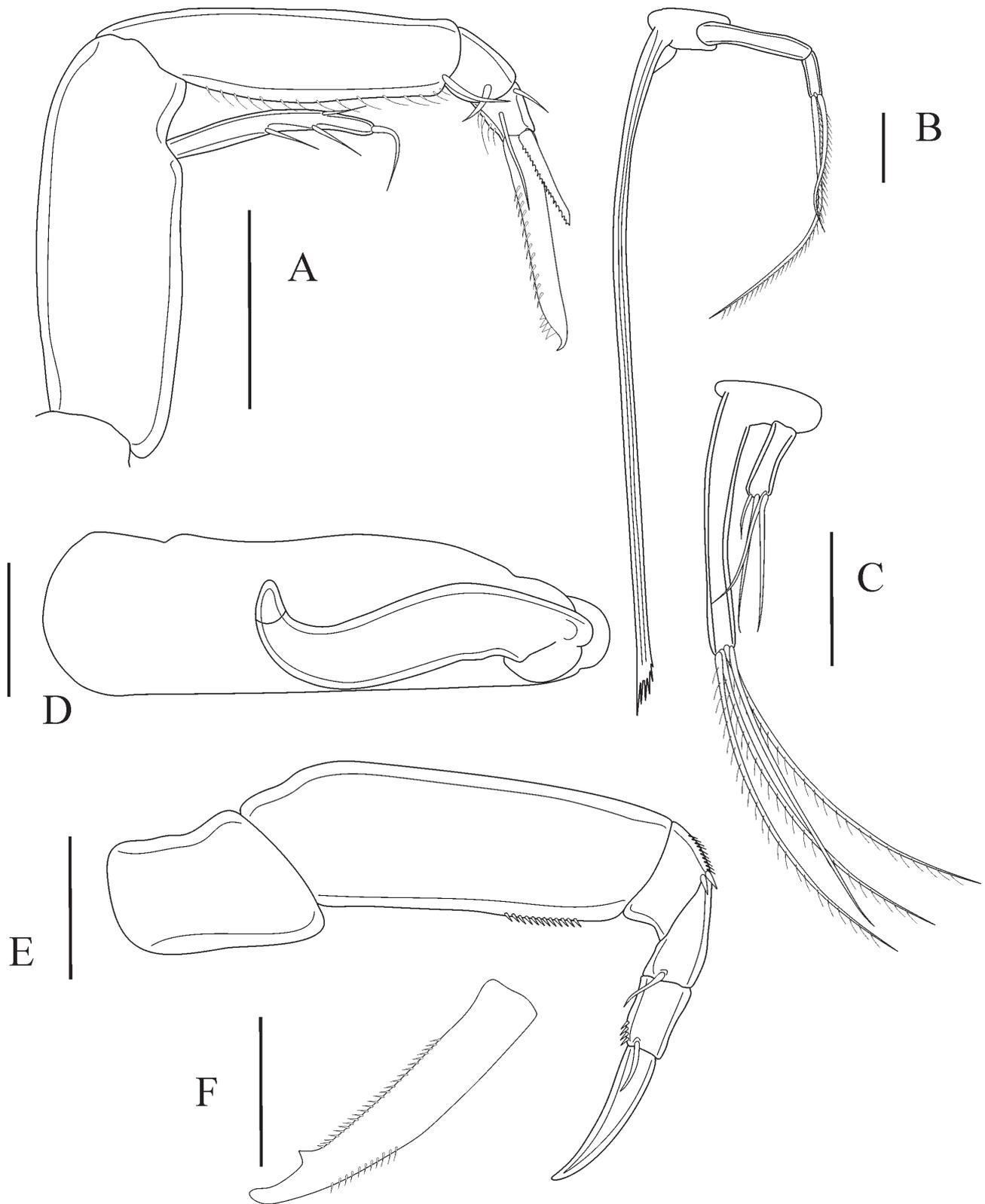
The legs illustrated by Wilson (1944; Figs. 159 and 160) also shows many divergences concerning the holotype analyzed. The main dissemblance consists in the statement made by the author that *Parmulodes verrucosus* has 4 pairs of biramous legs, with 3-segmented rami in each. Leg 4 rises in the adult as a reduced protuberance with a seta on its border as observed in the original slide and also stated by Stock (1992).

*Parmulodes* possess only one species. The material analyzed in this work as the same described by Wilson (1944) and consist of only a female. Posteriorly, Stock (1992) described the male of *P. verrucosus* and discovered that the host of this species is the sponge *Chondrilla nucula* Schmidt. The most of male’s appendices resembles those of the female, as described by Stock (1992), only with a reduction of its size. Among the differences observed in both sexes, include (1) Segmental homologies and setation of male’s antennule: I-2; II-2; III-2; IV-VII-8; VIII-2; IX-XII-5+ae; XIII-1; XIV-1; XV-XVI-4; XVII-2; XVIII-2; XIX-XX-2; XXI-XXIII-4+ae; XXIV-XXVIII-8+ae reflecting a different fusion pattern in the proximal region of the antennule; and (2) leg 6 represented by two setae.

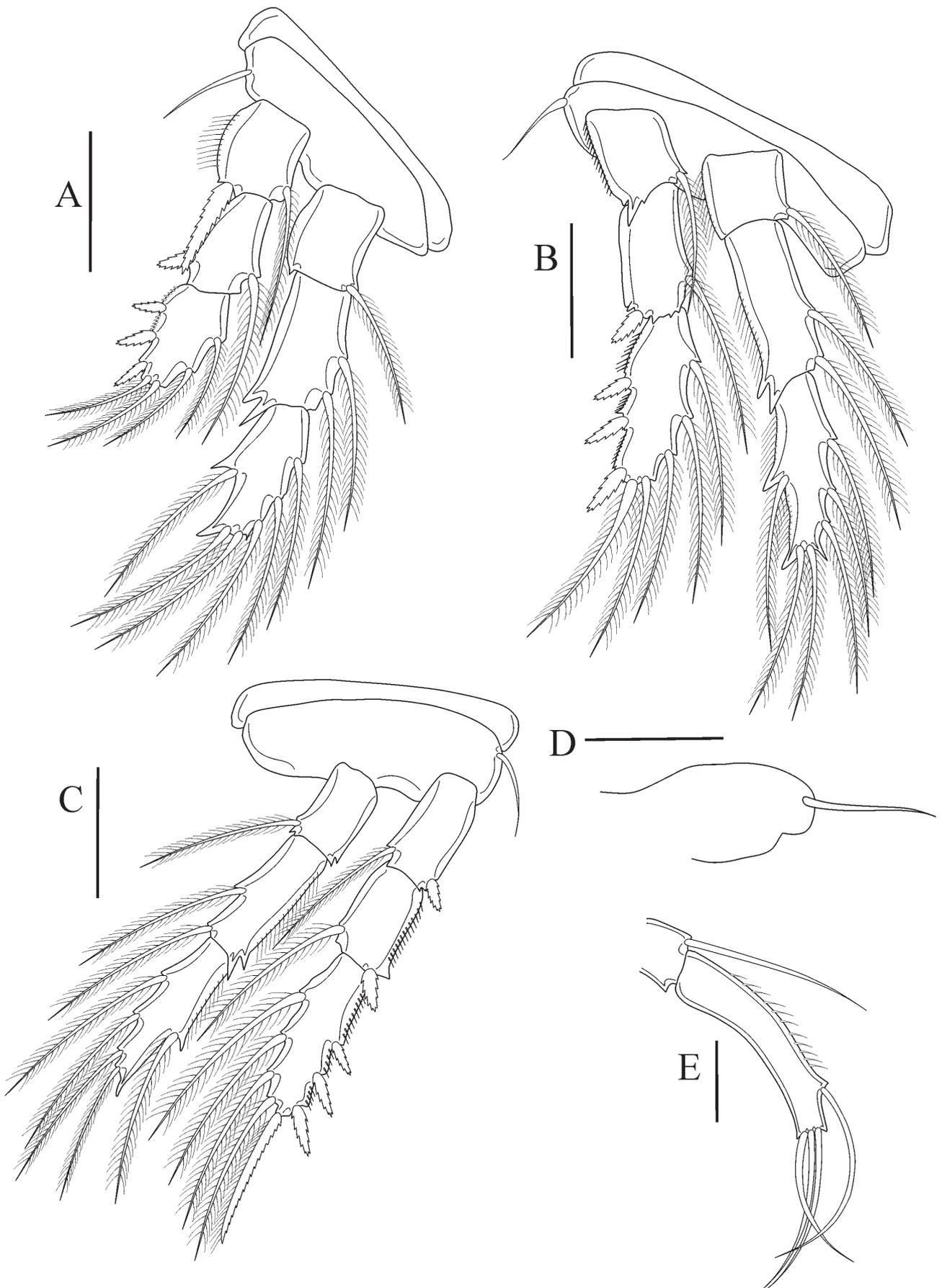


**FIGURE 4.** *Parmulodes verrucosus* Wilson, 1944 (USNM 79000). A, body dorsal view. B, digitiform bands of cephalosome; C, urosome; D, caudal ramus; E, antennule. Scale bars: A = 100  $\mu$ m; B–E = 50  $\mu$ m.

Despite *Parmulodes verrucosus* was redescribed by Eiselt (1959) and subsequently by Stock (1992), who made some further comments, the original drawings are too poorly made and a complete redescription was necessary to fulfill gaps concerning details and measures of the appendages.



**FIGURE 5.** *Parmulodes verrucosus* Wilson, 1944 (USNM 79000). A, antenna; B, mandible; C, maxillule; D, maxilla; E, maxilliped; F, tip of maxilliped claw. Scale bars: A–F = 50  $\mu$ m.



**FIGURE 6.** *Parmulodes verrucosus* Wilson, 1944 (USNM 79000). A, leg 1; B, leg 2; C, leg 3; D, leg 4; E, leg 5. Scale bars: A–E = 50  $\mu\text{m}$ .

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