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Research article/Araştırma makalesi

A redescription of *Diarthrodes aegideus* (Brian, 1927) (Copepoda, Harpacticoida, Dactylopusiidae) from the Aegean Coasts of Turkey

Serdar SÖNMEZ [*1]

[1] Adıyaman University, Faculty of Science and Letters, Biology Department, Adıyaman, Turkey

Abstract

Phytal living harpacticoid species *Diarthrodes aegideus* was originally described by Brian (1927) from the Dodecanese Islands of Aegean Sea with a rather brief description. Although the species have been reported by several studies from the coasts of Naples, Israel, Caroline (USA) and Aegean coasts of Turkey, the last available description of male and female of the species was the one provided by Lang (1948) in his monograph which lacks of sufficient details. Thus, I here present a detailed redescription as well as illustrations of both sexes of *D. aegideus* based on the specimens that were collected with a previous study and deposited in the harpacticoid collection of Balıkesir University Zoology Museum.

Key words: taxonomy, redescription, biodiversity, Aegean Sea, mediolittoral zone

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Diarthrodes aegideus (Brian, 1927) (Copepoda, Harpacticoida, Dactylopusiidae)' un Türkiye'nin Ege Denizi sahillerinden redeskripsiyonu

Özet

Fital yaşayan bir harpaktikoid türü olan *Diarthrodes aegideus* Brian (1927) tarafından Ege Denizi'nden kısa bir deskripsiyon ile tanımlanmıştır. Daha sonra birkaç çalışma ile Napoli, İsrail, Caroline (ABD) ve Türkiye'nin Ege kıyılarından rapor edilmesine rağmen, dişi ve erkek için en son deskripsiyon Lang (1948) tarafından monografında verilen olup gerekli detaylardan yoksundur. Bu sebeple *D. aegideus*' un her iki eşeyinin de ayrıntılı deskripsiyonu ve çizimleri bu çalışma ile verilmiştir. Çalışmada daha önce Ege Denizi'nden toplanmış ve Balıkesir Üniversitesi Zooloji Müzesi harpaktikoid koleksiyonunda yer alan bireyler kullanılmıştır.

Anahtar kelimeler: taksonomi, redeskripsiyon, biyoçeşitlilik, Ege Denizi, mediyolitoral zon

1. Introduction

Genus *Diarthrodes* which has 42 valid species (Gomez et al., 2008) was first erected by Thomson (1882) and placed into the family Harpacticidae to accommodate the *D. novae-zelandiae* which was described from New Zealand. Than Lang (1936) merged the genera *Arpacticus, Westwoodia, Pseudothalestris, Pseudowestwoodia* and *Parawestwoodia* into the genus *Diarthrodes* and placed the genus in the former subfamily Dactylopusiinae which were than raised to the family level as Dactylopusiidae by Willen (2000) (See Gomez et al., 2008 for a detailed historical review of the genus). Recently Gomez et al. (2008) described five new *Diarthrodes* species and divided the genus into 7 provisonal groups based on the segmentation of the exopod of the antenna and the exopod and the endopod of the first swimming leg. Phytal living harpacticoid species *Diarthrodes aegideus* was described as *Westwoodia aegidea pygmaea* from Dodecanese Islands (Rhodes, Astypalaia, Gyali and Symni) of Aegean Sea by Brian (1927) with a rather brief description. Then Lang (1934) reported the species from Naples (Italy) and raised the subspecies to the species level and accommodate it in the former genus *Parawestwooida* as *P. aigidea* but then (Lang, 1936) placed the species into the genus *Diarthrodes* as *D. aegideus*. Although the species have been reported by several studies from Mediterranean Coasts of Israel (Por, 1964), North Atlantic Coast of Caroline (USA) (Coull et al., 1989) and Aegean coasts of Turkey (Alper et al., 2015), the last available description of the male and female of the species was the one provided by Lang (1948) in his monograph which lacks of sufficient details. Thus, I here present a detailed

* *Corresponding author* / Haberleşmeden sorumlu yazar: Tel.: +90416223800; Fax.: +90416223800; E-mail: sonmezserdar@gmail.com
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redescription as well as illustrations of both sexes of *D. aegideus* based on the specimens that were collected with a previous study and deposited in the harpacticoid collection of Balıkesir University Zoology Museum (BUZM).

2. Materials and methods

Specimens were obtained from the harpacticoid collection of BUZM which were collected with a previous study (see Alper et al, 2015 for details) from İçmeler (37° 42' 29.4"N 27° 12' 18.4"E) and Aydınlık (37° 42' 00.8"N 27° 10' 32.8"E) beaches of Dilek Peninsula, Aegean Coast of Turkey at 25.10.2012 and preserved .in 70% ethanol. Observations and drawings made from whole or dissected specimens that were prepared using the method described by Karaytuğ and Sak (2006) with an Olympus BX-53 binocular microscope equipped with a drawing tube. Kaymak and Karaytuğ (2014) were followed to prepare the specimens for SEM observations. Zeiss SUPRA 55VP (FESEM) scanning electron microscope in Mersin University Advanced Technology Education, Research and Application Centre (MEITAM) was used for SEM examinations. All material except the ones dehydrated for SEM examinations are deposited in the collection of ZMADYU. Huys et al. (1996) was followed for the terminology used in the description. Abbreviations used in the text are; A1, antennule; A2, antenna; P1-P6, first to sixth swimming legs and ae for aesthetasc. All of the scale bars in figures are in μm.

3. Results

Family Dactylopusiidae Lang, 1936

***Diarthrodes aegideus* (Brian, 1927)**

3.1 Material examined

İçmeler beach (37° 42' 29.4"N, 27° 12' 18.4"E; 25.10.2012); 1♀ (ZMADYU2012/180) and 1♂ (ZMADYU2012/181) dissected on 8 slides in lactophenol mounting medium; 3♀♀ dehydrated for SEM examination. Aydınlık beach (37° 42' 00.8"N, 27° 10' 32.8"E; 25.10.2012): 1♀ (ZMADYU2012/182) and 1♂ (ZMADYU2012/183) dissected on 8 slides in lactophenol mounting medium; 1♂ dehydrated for SEM examination; 4♀♀ (ZMADYU2012/184) preserved in 70% ethanol in 5 ml plastic tubes. Leg. Süphan Karaytuğ, Serdar Sak, Alp Alper, Serdar Sönmez.

3.2 Description

Female. Body (Figures 1A, B, 2A) laterally compressed, tapering gradually from the middle of cephalothorax to posterior margin of anal somite; body length from the anterior margin of cephalothorax to posterior margin of caudal rami 463 μm. Rostrum (Figure 4B) triangular, bended ventrally, defined at base, bears two sensillae and a pore at dorsal surface. Posterior margin of prosomites and genital-double somite with plain hyaline frill, second and third urosomites with fringed hyaline frills ventrally, anal somite with row of strong spinules along the posterior margin ventrally and laterally (Figure 1A, B, 6A). Cephalothorax with a small, narrow rectangular window with two pores (Figure 7D). Genital double somite with suture laterally representing the former division, genital field as in Figure 6A.

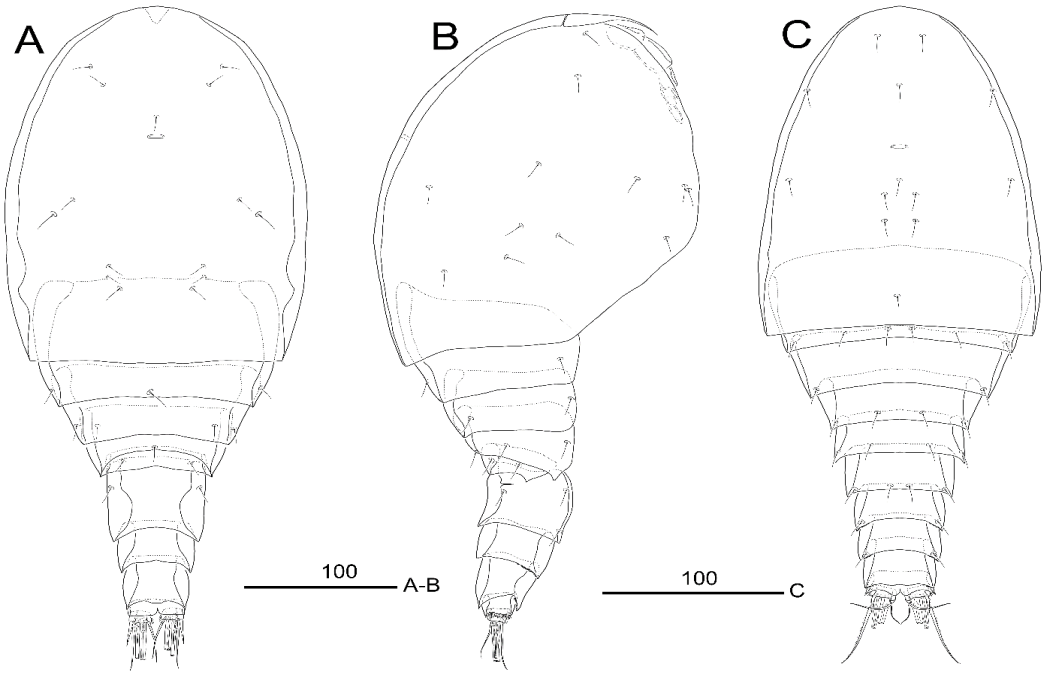

Figure 1. Habitus; A) dorsal, ♀; B) lateral, ♀; C) dorsal, ♂.

Caudal rami (Figures 6A, C, 7E, F) short, slightly wider than long, bears 7 elements. Seta I and II located near outer distal corner; seta I short and robust, naked; seta II thin, about 2 times longer than seta I and naked; seta III long, ornamented with fine spinules at outer margin; seta IV and V bi-pinnate spinulose, with a fracture plane near base, seta IV about as long as prosome, seta V longer than seta IV; seta VI located near inner distal corner, originates from a short pedestal at posterior margin of caudal rami ventrally, very short, thin and naked; seta VII originates from a pedestal at inner distal corner dorsally, triarticulated at base and naked.

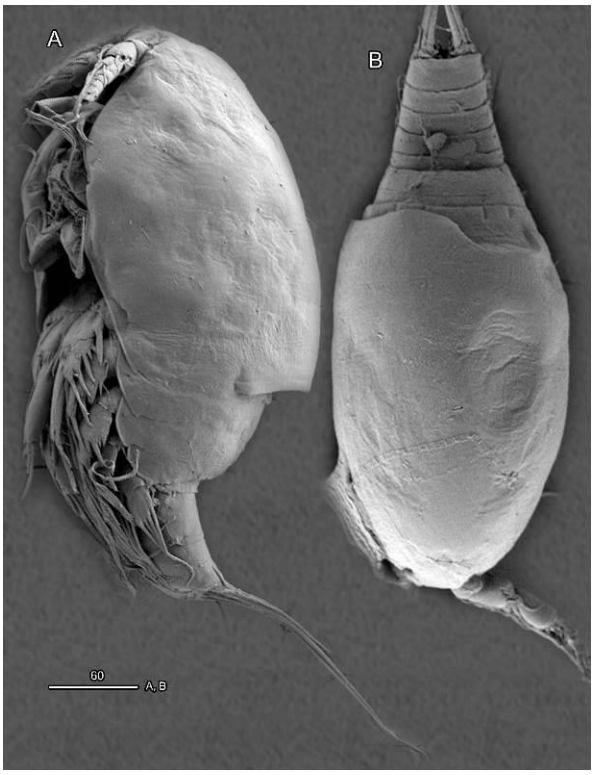

Figure 2. SEM photographs; A) lateral, ♀; B) dorsal, ♂.

A1 (Figures 3A, 4A, B) 7 segmented, gradually tapering to the tip; first segment ornamented with row of spinules, succeeding segment surfaces without ornamentation; fourth segment with an aesthetasc, last segment bears an acrothek consisting of one short and one long setae fused to an aesthetasc basally. Armature formula as follows: 1- [1 uni-pinnate spinulose], 2-[8 + 2 uni-pinnate spinulose], 3-[6], 4-[1+(1+ae)], 5-[1], 6-[2], 7-[7+acrothek].

A2 (Figures 3B, 4C-E) with a distinct basis. Exopod uni-segmented, bears three naked and one uni-pinnate setae laterally and two uni-pinnate strong spines apically. Endopod two segmented, first segment with one uni-pinnate spinulose seta; segment two ornamented with row of spinules at outer and posterior margins, bears two strong spines near outer distal corner, one relatively short uni-pinnate seta, three geniculate uni-pinnate setae and one geniculate uni-pinnate seta fused to a short bi-pinnate seta distally. Mandible (Figure 3C-E) with a strong gnathobase (Figure 3C). Coxa-basis (Figure 3D) of mandibular palp very long, about 3,8 times longer than wide, armed with a long, naked seta, ornamented with a short row of spinules near inner distal corner. Exopod and endopod uni-segmented; exopod (Figure 3E) armed with five naked setae; endopod bears one uni-pinnate spinulose and five naked setae.

Maxillule (Figure 3F-J). Praecoxal arthrite armed with three surface setae (one slender and one naked spiniform) and 6 spiniform elements (two naked, one serrate and four uni-pinnate; innermost one fused basally to the distal margin of arthrite) distally as figured (3F). Coxa (Figure 3G) armed with two long naked setae; basis (Figure 3H) bears 3 naked and one uni-pinnate spinulose setae. Endopod (Figure 3I) and exopod (Figure 3J) very short, uni-segmented, armed with three and four naked setae respectively. Maxilla (Figure 3K). Syncoxa with three endites, each armed with one naked setae; basis reduced to a one strong claw which armed with a minute seta proximally.

Maxiliped (Figures 3L, 4H, I). Syncoxa about 1,5 times longer than wide, armed with two uni-pinnate setae apically. Basis elongate, about 2,3 times longer than wide, ornamented with rows of spinules at posterior and anterior surfaces and near articulation with endopod. Endopod reduced to a strong serrate claw and armed with two minute setae proximally.

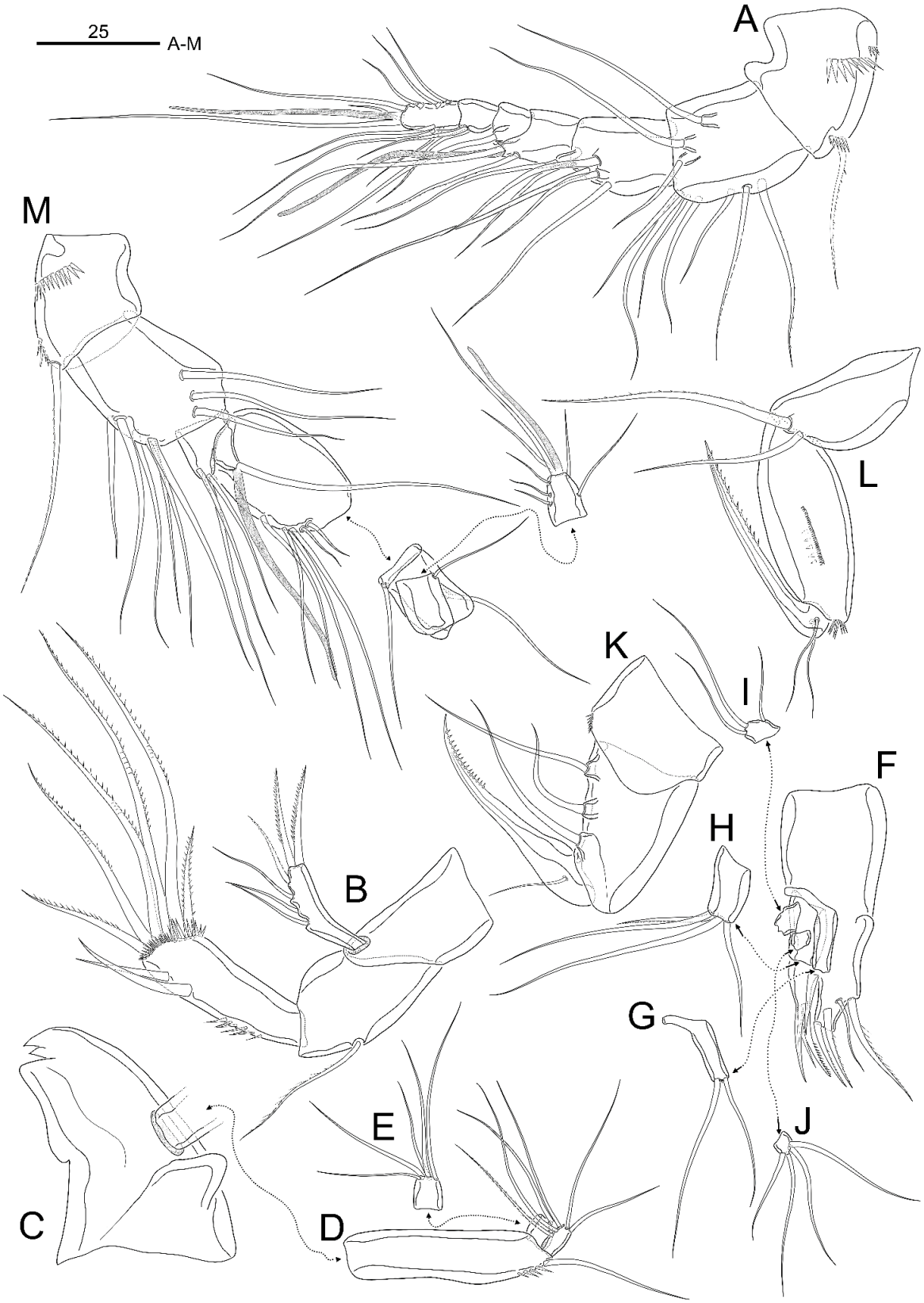

Figure 3. A) A1, ♀; B) A2, ♀; C-E) Mandible, ♀; F-J) Maxillule, ♀; K) Maxilla, ♀; L) Maxiliped, ♀; M) A1, ♂.

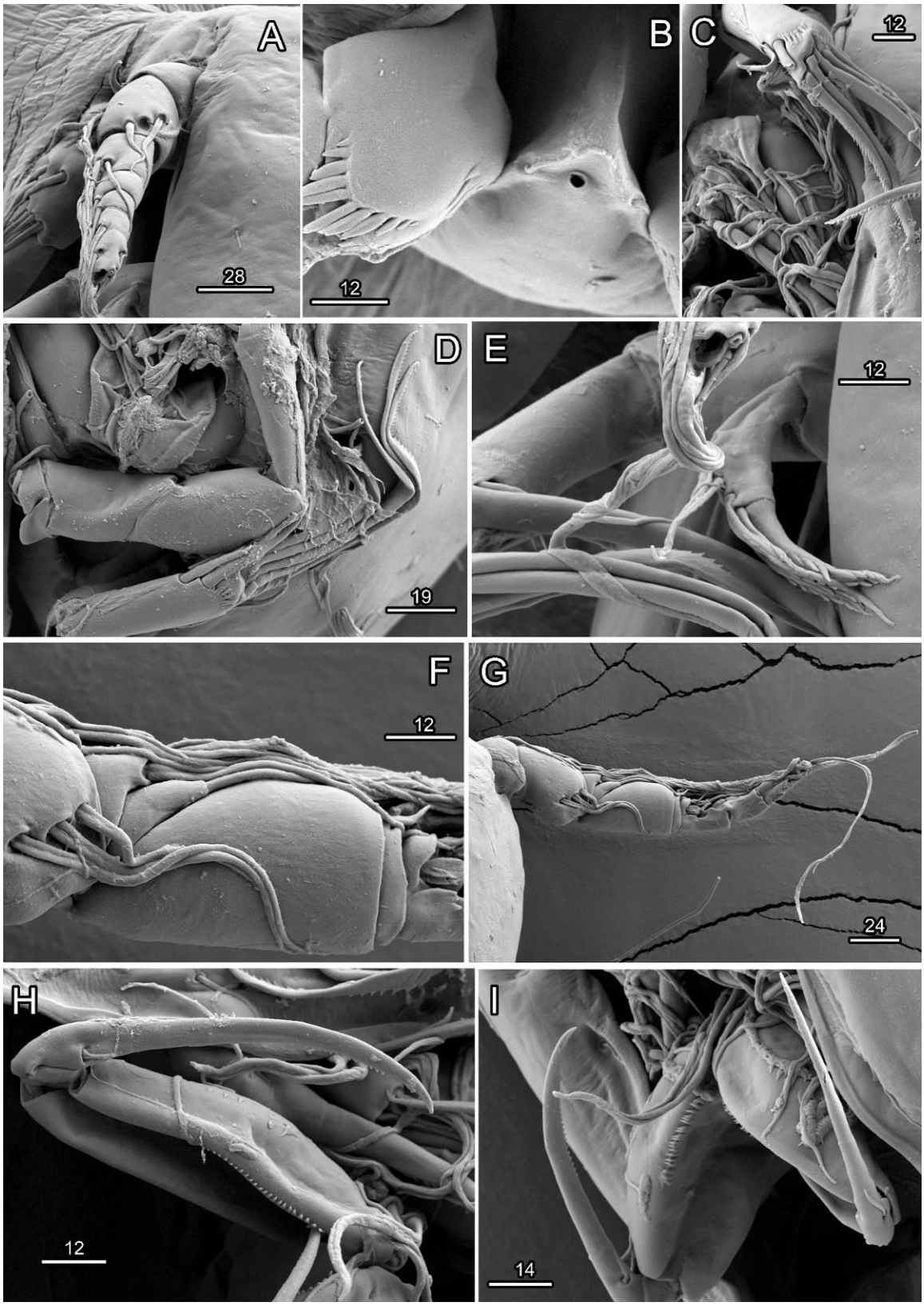

Figure 4. SEM photographs; A) A1, ♀; B) rostrum and first segment of A1, ♀; C-E) A2, ♀. F-G) A1, ♂; H, I) Maxiliped, ♀.

P1 (Figure 5A). Intercoxal sclerite naked. Coxa and basis well developed. Coxa ornamented with rows of spinules at posterior margin and outer distal corner. Basis ornamented with spinules near inner distal of posterior surface; bears two pores at anterior surface; armed with one inner and one outer bi-pinnate strong spines, bears two short rows of coarse spinules near

articulation of spines. Endopod three segmented; first segment elongated, longer than entire exopod, about 3 times longer than wide, ornamented with long and fine spinules along the 1/3 part of the outer distal margin, bears coarse spinules distally; armed with a long plumose seta at inner margin; second and third segment very short, about as wide as long; second segment without element, ornamented with a row of transverse spinules at outer distal; third segment ornamented with transverse spinules along distal margin, armed with two strong claws. Exopod two segmented, reaches about half of the first endopod segment. First segment about as long as wide, inner margin naked, outer margin ornamented with spinules, armed with a short, strong, bi-pinnate spine; second segment longer than wide, ornamented with three rows of spinules along distal margin; armed with 5 elements (one plumose seta at inner margin, one bi-pinnate spine near inner distal corner, one strong bi-pinnate spine and one short naked seta at terminal, one strong bi-pinnate spine at outer margin).

P2-P4 (Figure 2B-D). Basis armed with a long naked seta at outer distal corner. Endopod three segmented, shorter than exopod; first segment ornamented with spinules at outer margin, armed with a plumose seta at inner distal corner; second segment ornamented with fine spinules along outer margin, bears two plumose setae (P2, P3) or one plumose seta (P4) at inner margin; third segment bears fine spinules along outer margin, armed with one bi-pinnate (P2) or uni-pinnate (P3, P4) spine at outer distal corner, two long plumose setae at terminal, two (P2, P4) or three (P3) long plumose setae at inner margin. Exopod three segmented, first and second segment ornamented with spinules along outer margin, armed with one strong bi-pinnate spine at outer distal corner and bears one plumose seta at inner margin; third segment ornamented with fine spinules along the articulation of elements; armed with two (P2,P4) or three (P3) plumose seta at inner margin, one long bi-pinnate spine and one long plumose seta (P2, P4) or two plumose setae (P3) at distal margin and three strong spines at outer margin. Armature formula of the swimming legs:

P1		P2		P3		P4	
Exopod	Endopod	Exopod	Endopod	Exopod	Endopod	Exopod	Endopod
0.122	1.0.020	1.1.223	1.2.211	1.1.323	1.2.321	1.1.323	1.1.221

P5 (Figures 6B, 7A) Baseoendopod pairs distinct. Exopod not fused to baseoendopod, slightly longer than wide, armed with five long bi-pinnate setae, ornamented with strong spinules at base of two outermost setae, bears a small pore near distal margin. Baseoendopod ornamented with a row of spinules at anterior surface near outer proximal corner and with strong spinules at outer margin of endopodal lobe; armed with five long plumose setae at endopodal lobe and a naked outer basal seta. P6 (Figure 6A) reduced to a pedestal like projection and armed with a long naked seta.

Male. General body shape, A2, Mouthparts, P1-P4 except P2 endopod as in female. Sexual dimorphism in A1 (Figures 3M, 4F, G), P2 endopod (Figure 5E), P5 (Figures 6E, 7B), P6 (Figure 6D), genital segmentation, ornamentation of the urosomites (Figure 6D) and the caudal rami (Figures 6D, F, 7C).

Body length from anterior margin of cephalothorax to posterior margin of caudal rami 396 µm. Ornamentation of the urosomites as in figure 6D. Caudal rami short, about 2 times wider than long, ornamented with strong spinules along posterior margin of ventral surface.

A1 (Figures 3M, 4F-G) nine segmented, subchiroser with two segments to geniculation. First segment with two rows of spinules as figured, succeeding segments without ornamentation; fourth segment bears an aesthetasc and last segment with an acrothek consisting of an aesthetasc fused basally to one short and one long setae. Third and fourth segments very small, almost triangular in shape, fifth segment swollen, sixth segment shortest, ring like; geniculation between seventh and eighth segments. Armature formula as follows: 1- [1 uni-pinnate spinulose], 2-[9], 3-[3], 4-[(1+ae)], 5-[7], 6-[1], 7-[1], 8-[1], 9-[5+acrothek].

P2 endopod (Figure 5E) two segmented; first segment almost square, inner margin ornamented with spinules, armed with a very short, naked, spiniform element at outer margin; second segment slightly longer than wide, without ornamentation, armed with a short naked seta near proximal corner at anterior surface, one strong and naked spine at outer distal corner, a spinulose seta originating from a pedestal at distal margin and a modified "c" shaped strong spine at inner distal corner, bears a large pore at outer margin.

P5 (Figures 6E, 7B). Baseoendopod pairs fused medially. Exopod not fused to baseoendopod, slightly longer than wide, with five elements (one very strong bi-pinnate spine and four bi-pinnate setae) ornamented with two strong spinules near the base of two outermost elements. Baseoendopod ornamented with spinules on anterior surface as figured, armed with one strong bi-pinnate spine near the articulation of baseoendopod pairs, two plumose setae at the outer distal of endopodal lobe and a naked outer basal seta, bears a large pore at the inner distal margin of endopodal lobe. P6 (Figure 6D) pairs asymmetric. Baseoendopod and exopod fused into a plate, each plate armed with a long naked seta accompanied by a minute spine fused basally to distal margin of the plate.

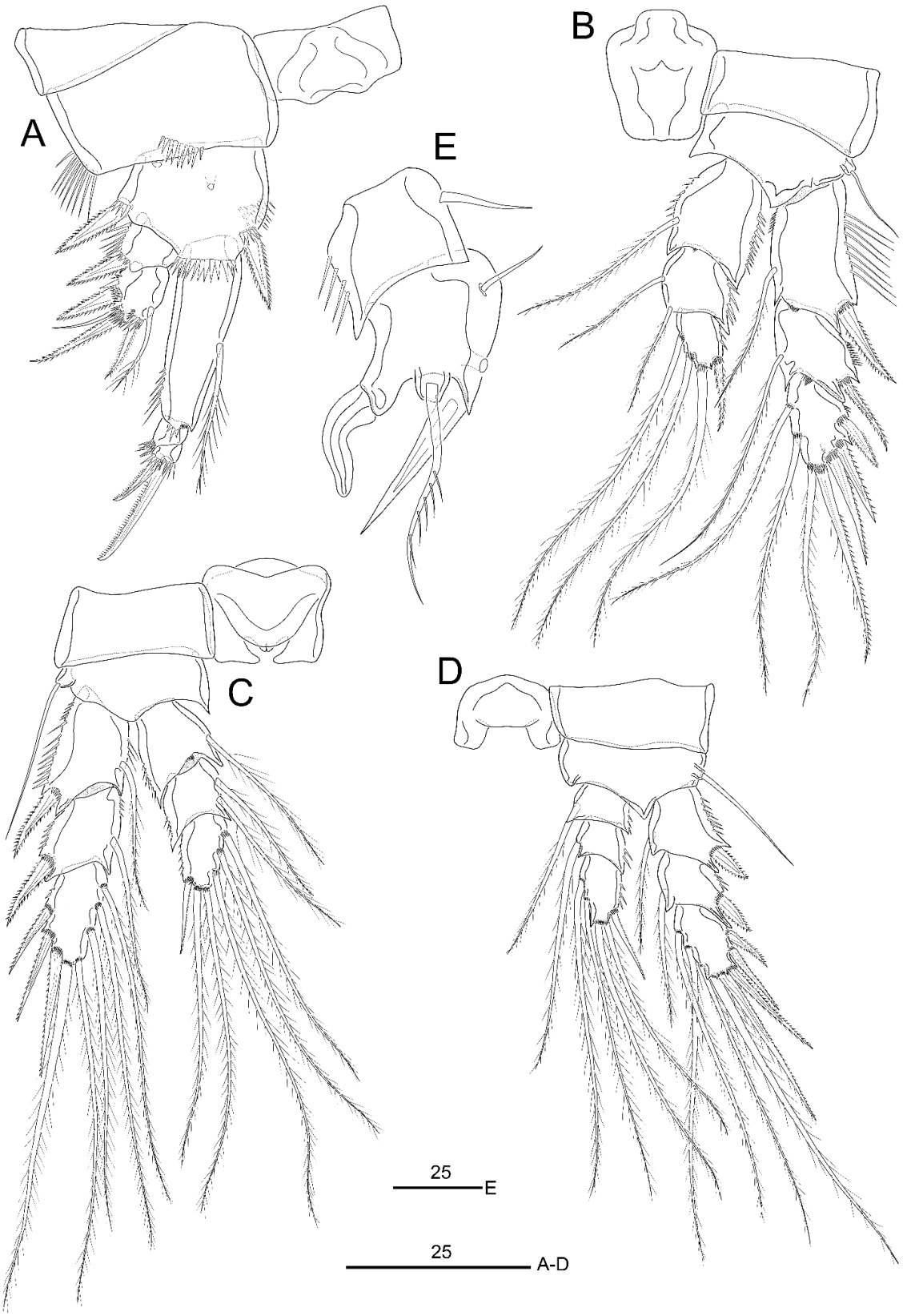

Figure 5. A-D) P1-P4, ♀; E) P2, endopod, ♂.

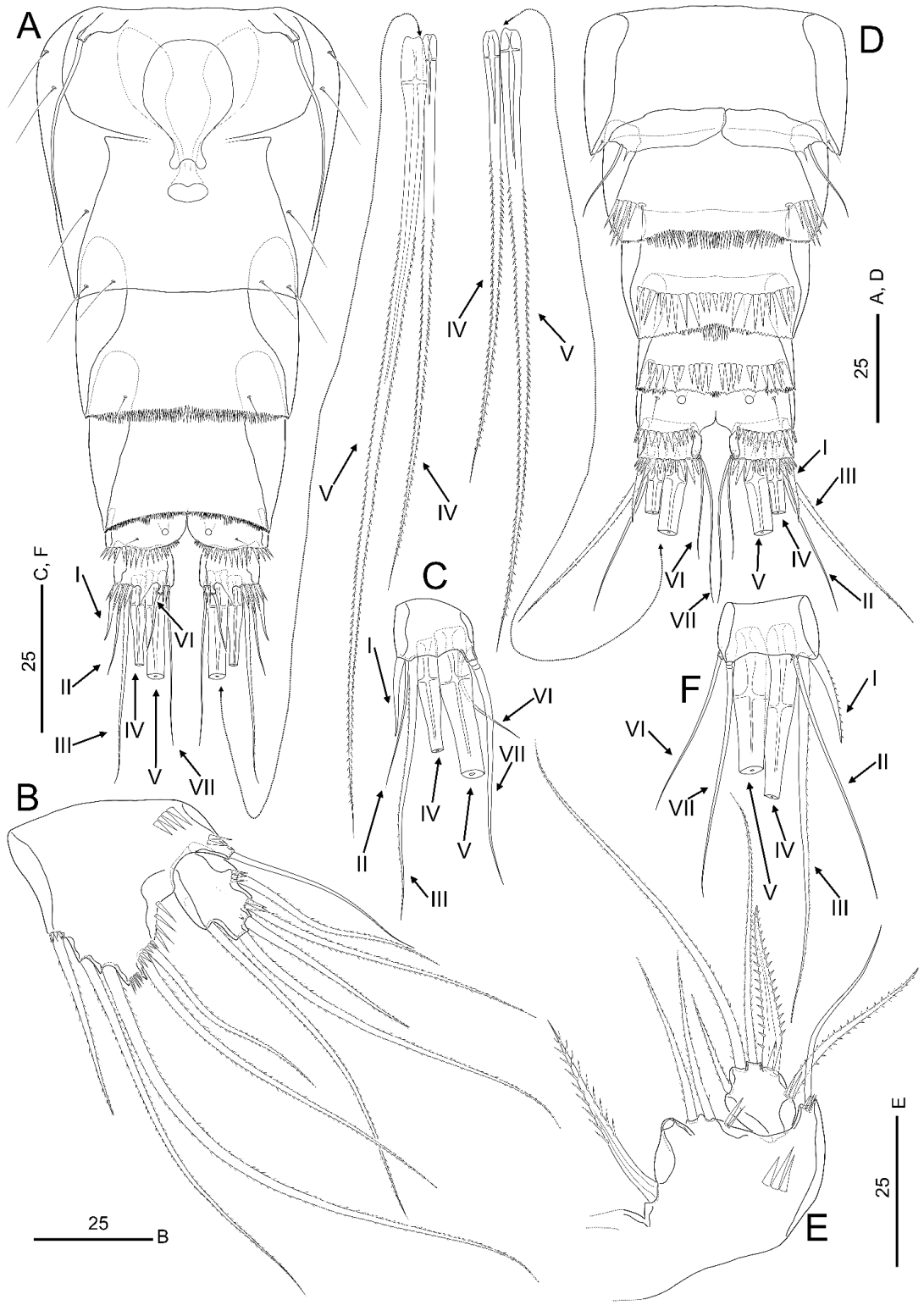

Figure 6. A) Urosome, ventral, ♀; B) P5, ♀; C) Caudal rami, dorsal, ♀; D) urosome, ventral, ♂; E) P5, ♂; F) Caudal rami, dorsal, ♂.

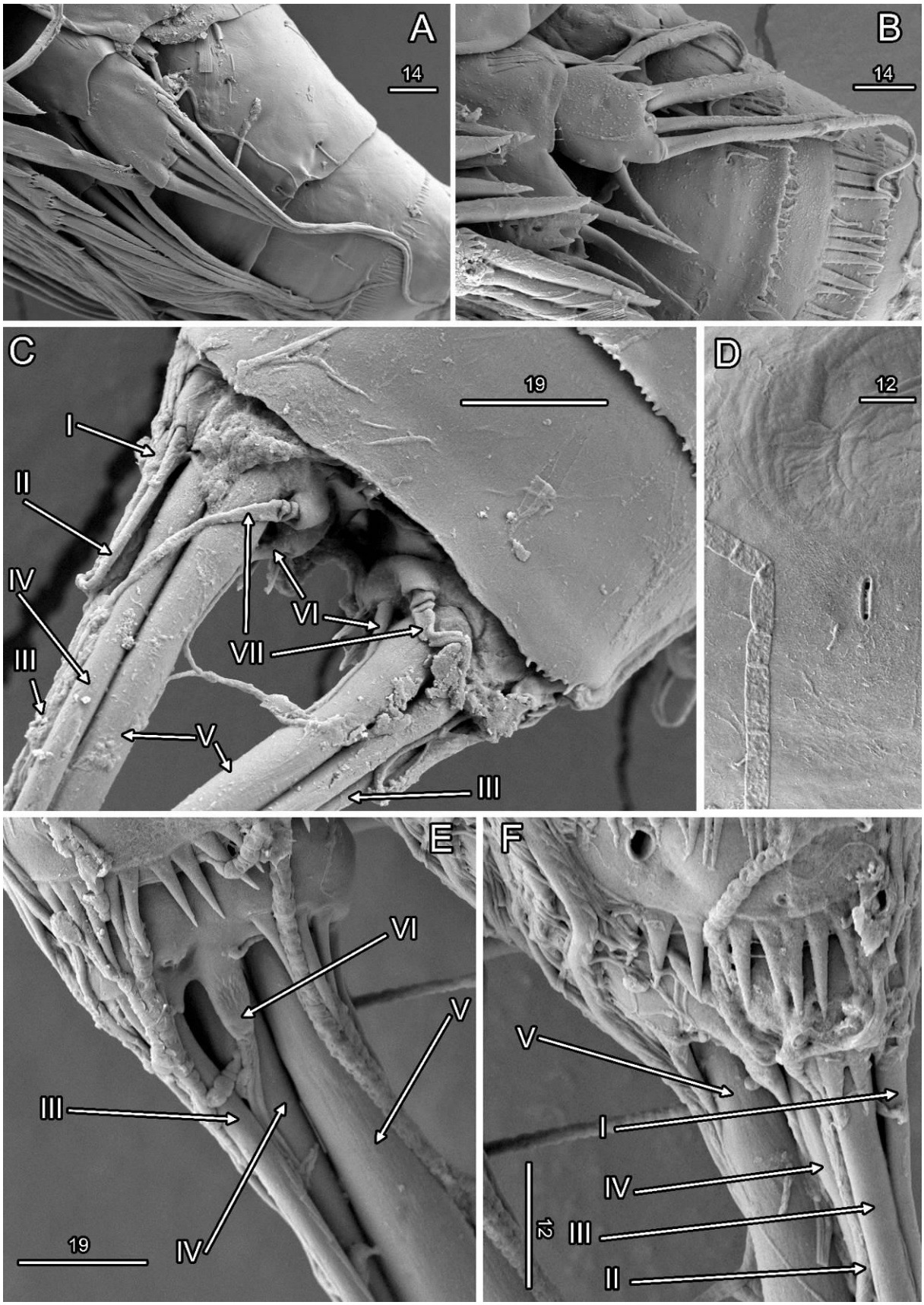

Figure 7. A) P5, ♀; B) P5, ♂; C) Caudal rami, dorsal, ♂; D) Pore on the dorsal surface of cephalothorax, ♂; E-F) Caudal rami, ventral, ♀; E) inner margin, F) outer margin.

3.3 Remarks

Diarthrodes aegideus was originally described and reported by Brian (1927) from four of the Dodecanese Islands (Rhodes, Astypalaia, Gyali and Symi) which are very close to the locality of the specimens that were used to redescribe the species. Although the specimens that I have examined were well fitting with the original description, I have noticed some differences with Lang's (1948) diagnosis of the species. Among the other minor differences like the surface ornamentation of the appendages or the ornamentation of the armature elements which were hard to observe or usually overlooked by most of the authors at that time, the most significant departure from Lang's diagnosis of the specimens examined in this study is the difference at the armature of the A2 exopod. Lang (1948) described A2 exopod with seven elements ("mit 7 borsten, von denen 2 der 3 terminalen borsten viel gröber und dicker als die übrigen sind") which of three located at the terminal. But in all of the specimens that I have examined, A2 exopod was armed with a total of six elements; four lateral setae, which of one very close to the inner distal corner, and two apical spiniform elements (Figure 3B and 4E). When the number of specimens examined in this study taken into account, it is plausible to assume that Lang's observation was erroneous or Lang's specimen was abnormal.

Acknowledgements

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