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Selenopsyllus, a New Genus of Cylindropsyllinae (Copepoda, Harpacticoida) from Atlantic and Antarctic Deep Waters

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With 19 Text-Figures and 1 Table

Key words: Crustacea, Copepoda, Harpacticoida, Canthocamptidae, Cylindropsyllinae, *Selenopsyllus*, systematics, polaregions.

Abstract

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A new genus, *Selenopsyllus*, of Cylindropsyllinae is proposed to accomodate *Selenopsyllus dahmsi* sp. nov. and *Selenopsyllus antarcticus* sp. nov. from Antarctic deep-sea waters, together with *Selenopsyllus profundus* (BECKER 1979) comb. nov. and *Selenopsyllus abyssalis* (BECKER 1979) comb. nov. from the North Atlantic deep-sea. Some features of *S. profundus* and *S. abyssalis* are redescribed on the basis of the type material. *Selenopsyllus* gen. n. is the only cylindropsyllid genus recorded so far exclusively from deep-sea waters, between 2000 and 4000 m depths. The new genus has retained a number of plesiomorphic characters such as a 3-segmented, sexually dimorphic male P3 endopod, and a 2-segmented female endopod P2 and P3. These characters excludes this taxon from the monophyletic group consisting of *Stenocaris* SARS, 1909, *Willemsia* HUYS & CONROY-DALTON, 1993 and *Navalonia* HUYS & CONROY-DALTON, 1993; and from the genus *Boreopontia* WILLEMS, 1981. The presence of a well developed maxilliped excludes it from a monophylum consisting of *Cylindropsyllus* BRADY, 1880 and *Cylinula* COULL, 1971; and the possession of a sexually dimorphic strong inner distal claw on the distal exopod segment of P2 male excludes it from both *Stenocaropsis* APOSTOLOV, 1982 and *Evansula* T. SCOTT, 1906. The new genus is characterized by the possession of an at most 6-segmented female antennule, with the aesthetasc always on the third segment, a condition hitherto never reported for Cylindropsyllinae.

A re-interpretation of the female genital field shows that the rounded chitinous structures present in Cylindropsyllinae as well as in other Canthocamptidae and some related-families do not represent the seminal receptacles, but a labyrinthic extension of the copulatory tube. The paired not-chitinised seminal receptacles are located posterior to this structure.

Introduction

SARS (1909) united the harpacticoid genera *Cylindropsyllus* BRADY, 1880, *Stenocaris* SARS, 1909, *Darcythompsonia* T. SCOTT, 1906 and *Leptocaris* T. SCOTT, 1899 in a new family, Cylindropsyllidae. The family was polyphyletic from the beginning, as the later two genera (currently grouped into a separate family Darcythompsoniidae LANG, 1936) belong to a

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different harpacticoid lineage, and it remained polyphyletic even after MONARD's (1927) reduction of the Cylindropsyllidae to the genera *Cylindropsyllus, Horsiella* GURNEY, 1920, and *Darcythompsonia* (*Stenocaris* was placed together with *Parastenocaris* KESSLER, 1919 into a new family Stenocaridae). A new and more elaborated concept of the Cylindropsyllidae was proposed by LANG (1948). He recognized three monophyletic subfamilies, viz. Cylindropsyllinae, Leptastacinae LANG, and Leptopontiinae LANG. Even so the Cylindropsyllidae sensu LANG was a polyphyletic taxon, because harpacticoids belonging to different lineages were grouped together due to characters acquired convergently (MARTINEZ ARBIZU & MOURA 1994). Cylindropsyllinae and Leptastacinae are related to canthocamptid-like and Leptopontiinae to ameirid-like harpacticoids. Subsequently, a family rank for Leptastacinae (HUYS 1992) and Leptopontiinae (MARTINEZ ARBIZU & MOURA 1994) has been proposed. Finally, MARTINEZ ARBIZU & MOURA (1994) proposed to dissolve the family Cylindropsyllidae, allocating the remaining subfamily Cylindropsyllinae to the Canthocamptidae. LANG (1948) included in the Cylindropsyllinae the genera *Cylindropsyllus, Evansula* T. SCOTT, 1906, and *Stenocaris*. The genera *Stenocaropsis* APOSTOLOV, 1982, *Cylinula* COULL, 1971, *Boreopontia* WILLEMS, 1981, *Navalonia* HUYS & CONROY-DALTON, 1993, and *Willemsia* HUYS & CONROY-DALTON, 1993 have been added after LANG's (1948) monograph.

BECKER (1979) described *Stenocaris profundus* based on a single female collected at 4000 m depth in the Canarian Basin and a single male of a closely related species, *S. abyssalis*, from 3820 m depht in the Iberian Basin. Later APOSTOLOV (1982) erected the genus *Stenocaropsis* to accomodate *Stenocaris valkanovi* MARINOV, 1974 and *S. pristina* WELLS, 1968. The reason to remove these two species from the genus *Stenocaris* was the presence of a 2-segmented endopod in female P2 and P3, being 1-segmented in other species of the genus. KUNZ (1994) recognized that these characters are also present in *S. profundus* and *S. abyssalis* and proposed to allocate them to the genus *Stenocaropsis* as well. Unfortunately, both characters are plesiomorphic for the subfamily and therefore unfit for assessing phylogenetic relationships. We propose herein to accommodate BECKER's (1979) species together with two new Antarctic species into a separate genus *Selenopsyllus* gen. nov.

Material and Methods

Meiobenthic samples were collected using a Giant Box Corer and a Multiple Box Corer during the German expeditions to the Weddell Sea ANT V/3 (1986) and ANT VII/4 (1989) with RV *"POLARSTERN"*. Samples were fixed with buffered formalin up to a final concentration of 5%.

Specimens were transferred to glycerine or Zeiss W15 for slide preparation. Drawings were made with a Leitz Dialux 20 phase contrast microscope using a camera lucida.

For scanning electron microscopical (SEM) observations, specimens were dehydrated through an ethanol series. After CO_2 critical-point drying, specimens were mounted on a stub and coated with gold.

Abbreviations used in the text are **ae**: aesthetasc; **ap**: apomorphy; **CI-CVI**: first to sixth copepodid stages, **enp**: endopod; **exp**: exopod; **P1-P6**: first to sixth legs; **pl**: plesiomorphy.

The type material is stored in the Copepod Collection of the "Arbeitsgruppe Zoomorphologie", University of Oldenburg, Germany.

The type material of *Selenopsyllus profundus* (Cop. Nr. 1083, 1084) and of *Selenopsyllus abyssalis* (Cop. Nr. 1085) was borrowed from the Zoologisches Museum of the University of Kiel.

Descriptions

Subfamily Cylindropsyllinae SARS, 1909

Genus *Selenopsyllus* gen. nov.

Tab. 1

Diagnosis: Body elongate, slender, and cylindrical. Rostrum small, triangular, articulating with cephalothorax, bearing two sensilla. Female antennule 5- or 6-segmented (ap), aesthetasc on 3rd segment (ap), male antennule 9-segmented (ap), aesthetasc on 5th segment; second segment elongate in both sexes. Antenna with allobasis, outer side ornamented with long slender spinules; exp. 1-segmented with 2 distal pinnate setae; enp. with 2 spines laterally, and a total of 6 setae distally, i. e. 2 spines, 3 geniculate setae, of which the outermost is pinnate and fused with a small naked seta. Mandibular gnathobase with a hyaline proximal tooth alongside inner seta, mandibular palp with basis bearing 1 seta, and with 1-segmented endopod carrying 1 lateral and 4 distal setae (2 pairs of 2 setae confluent at base). Precoxal arthrite of maxillule with 2 surface setae or 1 seta, terminally with 7 spines and 3 or 2 setae, coxa with 1 claw and 1 seta, basis with 2 endites, proximal endite with a slender flexible claw and 3 setae, distal endite with 2 setae, enp. and exp. represented by 3 and 2 setae respectively and fused with basis. Syncoxa of maxilla with 2 endites, bearing 3 setae each, basis with strong claw and 2 setae, enp. fused with basis and represented by 3 setae. Syncoxa of maxilliped with 1 or 0 seta; enp. with just one slender claw. P1 basis with inner and outer seta. P2–P4 basis just with outer seta. Female exp. and enp. segmentation and setation P1–P4 as shown in Tab. 1.

P5 not fused medially, exopod and baseoendopod fused forming a common plate. Female with 1 basal seta, 3 exopodal setae and 3, 2 or 1 endopodal setae. Male P5 with 1 basal seta, 3 exopodal setae, and 1 endopodal seta. Male P6 asymmetrical, with 3 setae. Female P6 a large symmetrical plate with 2 setae. Genital double-somite totally fused, copulatory pore located medially, placed distally on proximal half of double

Table 1. Segmentation and setation of P1–P4 exo- and endopodites of female *Selenophyllus* spp.

	Exp	Enp
P1	0.1; 0.1; 0.2.2	1; 0.2.0
P2	0.1; 0.1; 0.2.2	1; 0.1.[1-0]
P3	0.1; 0.1; 1.2.2	0; 0.1.1
P4	0.1; 0.1; 1.2.2	0; 0.1.1

somite posterior to P6, strong rounded chitinised copulatory ducts beneath P6, paired round not chitinised seminal receptacles located posterior to copulatory pore in ventral view, a pair of integumental pores lateral to copulatory pore and a pair of "sieves" composed of 4 pores each located on the second half of double-somite (not always discernible).

Furca elongate, inner side swollen medially (sometimes forming an outgrowth). Outer distal corner protruding as strong chitinised thorn. With 7 or 6 setae, dorsal seta close to inner process, accessory antero-lateral seta together with proximal lateral setae or absent, outer subdistal seta displaced inwardly, located opposite to outer process, terminal outer seta well developed, terminal middle seta just slightly constricted and geniculate at half length, inner terminal seta small and naked.

Sexual dimorphism in antennule, P2, P3, P5, and P6. Male P2 basis with inner anterior triangular process, inner distal spine of exp. -3 transformed into articulate strong claw and distal anterior margin of segment produced forming an outgrowth covering the inner claw basally. P3 enp. 3-segmented apophysis arising from inner side of second segment, distal segment terminally with long plumose outer seta (homologous with female distal inner seta) and an inner spine (homologous with outer spine of female).

Etymology: Derived from the greek *selena* meanig "the Moon", and *psylla*, meaning "the flea", refering to crater-like pits on the surface of tergites, sternites, and on the appendages (Fig. 10A, C, E), resembling craters on the moon.

Type species: *Selenopsyllus dahmsi* gen. et sp. nov.

Other species: *Selenopsyllus antarcticus* sp. nov., *S. profundus* (Becker, 1979) comb. nov., *S. abyssalis* (Becker, 1979) comb. nov., and *Selenopsyllus* sp.

Selenopsyllus dahmsi sp. nov.

Figs. 1–10

Material: Holotype, one female dissected and mounted on one slide (Coll. No.1997.8/1), allotype one male dissected and mounted on one slide (Coll. No. 1997.9/1), paratype 1, one female dissected and mounted on one slide (Coll. No. 1997.10/1); paratype 2, one female mounted on one slide (Coll. No. 1997.11/1); paratype 3, one copepodid CII mounted on one slide (Coll. No. 1997.13/1); and paratype 4, one female copepodid CV mounted on one slide (Coll. No.1997.12/1). Additional material: One adult female, one adult male and one copepodid CII mounted on a stub for SEM observation.

Type locality: Antartic Weddell Sea, coordinates 71°08.8'S 13°41.1'W, 2000 m depth.

Description of female: Total body length from anterior border of cephalosome to posterior margin of furca 610 µm, length without furca, 564 µm. Body slender, cylindrical; no distinct separation between prosome and urosome (Fig. 1A) Body strongly chitinised, covered with integumental pits, distinct demarcation of somites, borders of segments smooth, no spinules or frills. Anal operculum rounded with minute spinules, not prominent. Furca (Fig. 4B, 9D) elongate, about 3 times longer than maximum width, bearing 6 setae; inner side swollen at about 2/3 of length, with rounded small outgrowth, biarticulate dorsal seta plumose inserted beneath this process; lateral proximal seta broken off in all females of this sample (in the female copepodid it is normally developed) inserted at 2/3 of the length, accessory anterolateral seta absent; lateral subdistal seta displaced inwardly, terminal middle seta with geniculation weakly defined at about half of length; fused at base with outer seta which is slender and bare (Fig. 9F), inner distal edge bearing small spine; outer distal edge modified into a pointed thorn.

Antennule (Fig. 1B). 6-segmented. Second segment more than twice as long as other segments. Aesthetascs present on third and last segments. Setal formula: 1 (pinnate) / 7 + 1 pinnate / 6 + ae. / 1 / 3 / 9 + ae.

Antenna (Fig. 1C). Coxa without ornamentation. Allobasis with long spinules midlength on inner margin. Exp. 1-segmented, cylindrical, carrying 2 terminal spinulose setae. Enp. distally broader than proximally; inner margin with 2 pinnate spines and 2 rows of spinules; terminally armed with a total of 6 setae, viz. 2 pinnate spines at inner edge, 3 geniculate setae, of which outermost with strong spinules along second fourth before geniculation and accompanied by small naked slender outer seta. Outer distal corner with modified hyaline frill, with short thorn-like protuberance.

Mandible (Fig. 2A). Gnathobasis with two strong bilobate thick teeth and three teeth with serrate edges at tip, most proximal one perpendicularly orientated to others, with bare seta at its side; palp with basis bearing one bipinnate seta, endopod with 5 setae, viz. one lateral and 2 pairs of fused setae at base.

Maxillule. Praecoxal arthrite with 7 spines and 3 setae terminally and 2 surface setae (Fig. 2B), coxa armed with a claw and a slender seta, basis with 2 not distinct endites, proximal endite represented by a slender flexible pinnate claw and 3 long setae, distal endite represented by 2 setae. Enp. and exp. fused to basis and represented by 3 and 2 setae respectively.

Maxilla (Fig. 2C). Syncoxa with two transverse rows of small spinules at inner margin, and with 2 subcylindrical endites carrying 3 setae including a pinnate spine-like one, a spine with several spinules, and a small seta. Basis with terminal claw and 2 setae. Enp. fused, represented by a small protuberance with 3 setae.

Maxilliped (Fig. 2D). Prehensile; syncoxa with small seta at inner distal corner, basis with some subdistal spinules; enp. a small segment with a slender pinnate claw.

P1 (Fig. 2E). Coxa not ornamented. Intercoxal plate trapezoidal in shape. Basis with outer spine-like pinnate seta and inner seta intensively plumose along distal half. Exp. 3-segmented, segments of subequal length and size, first and second segments with outer bipinnate spine and no inner setae, third segment with 2 outer bipinnate spines and 2 distal setae being plumose along inner side and spinulose along outer side. Enp. 2-segmented and longer than exopod, segments of equal length but proximal one wider than distal one, proximal segment carrying an inner almost horizontal serrate seta, distal segment with spinules along inner and outer margin, armed with 2 terminal setae, outer one spiniform and pinnate, inner one longer plumose at inner and pinnate at outer margin.

P2–P4 (Fig. 3A-C). Coxa not ornamented, P4 distal outer coxal margin with broad and short tube pore. Intercoxal scle-

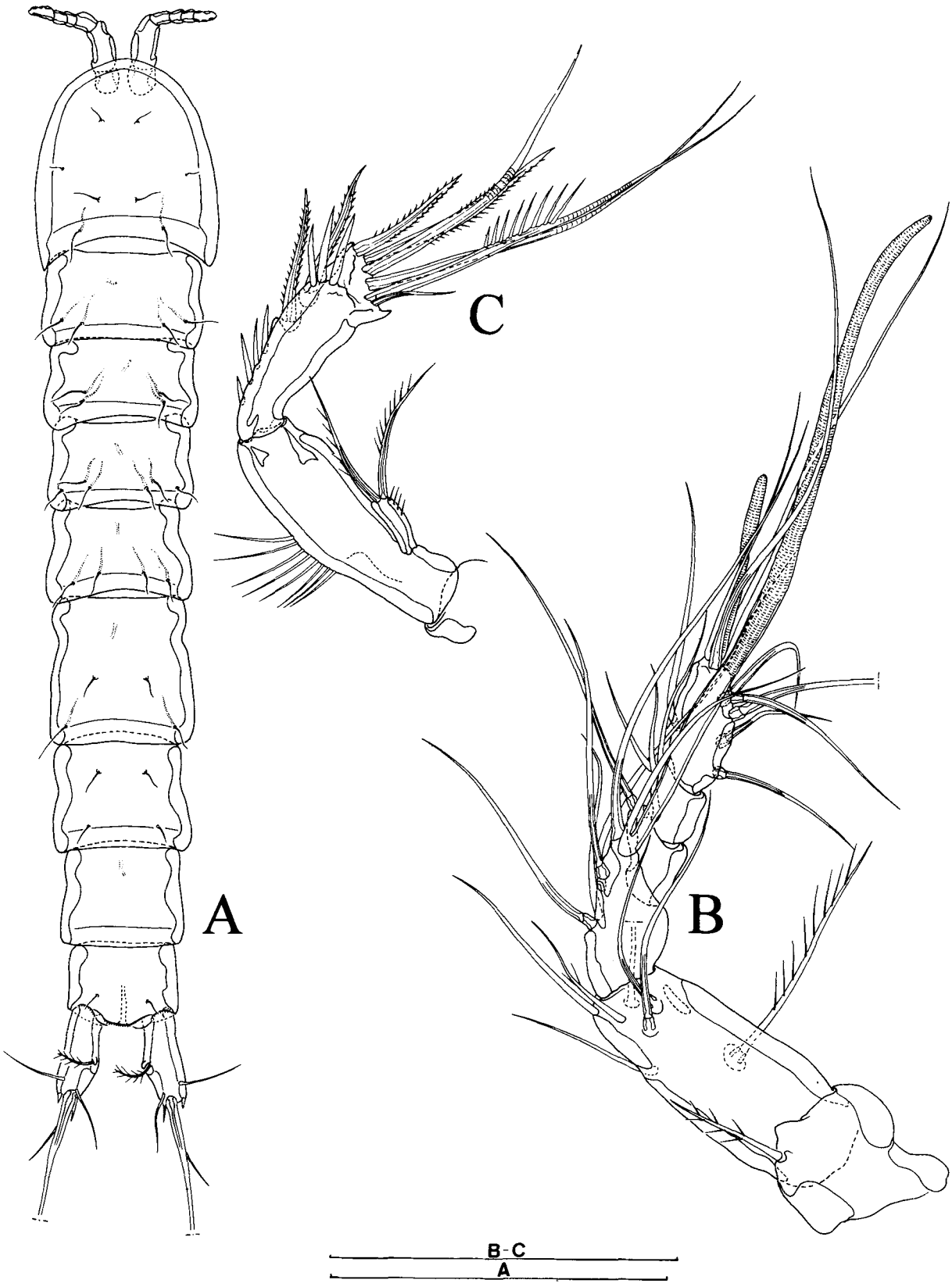

Fig. 1. *Selenopsyllus dahmsi* sp. nov., female. – A: dorsal habitus; B: antennule; C: antenna. – A, B from holotype; C from paratype. Scale bar A 200 µm; B,C 50 µm.

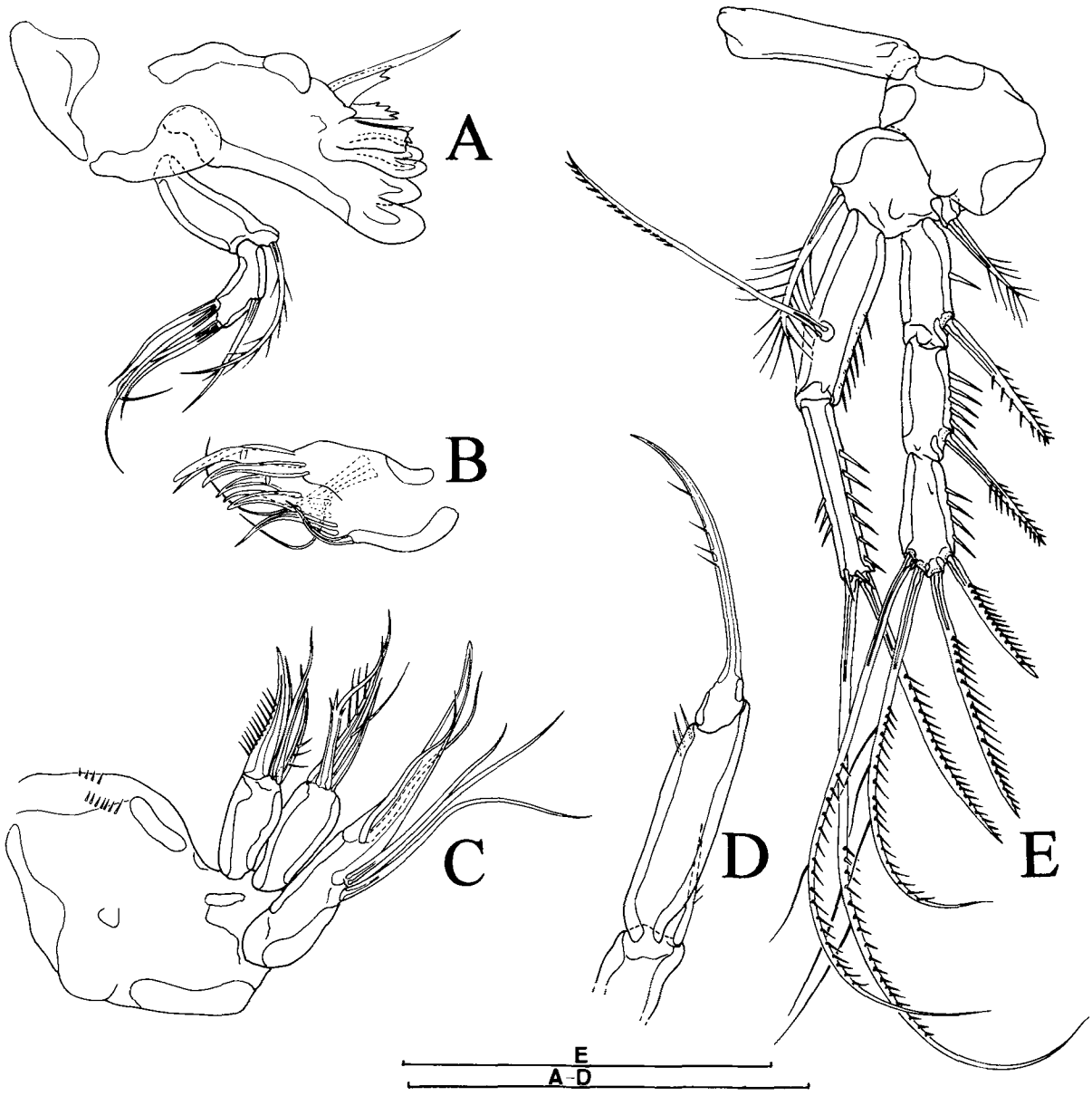

Fig. 2. *Selenopsyllus dahmsi* sp. nov., female. – A: mandible; B: maxillule praecoxal arthrite; C: maxilla; D: maxilliped; E: P1. – A, B, E from holotype; C, D from paratype. Scale bar 50 µm.

rites of trapezoidal shape. Basis small, with bipinnate outer seta. Exp. 3-segmented; P2–P3 segments of equal size, P4 first and second segments elongate twice as long as third one; first and second segments with bipinnate outer spine and no inner setae; third segment with 2 bipinnate outer spines, P2–P3 with 2 plumose long setae terminally, P2 without inner seta and P3 with serrate inner seta; P4 with a terminal outer bipinnate seta, terminal inner serrate seta, and inner serrate seta. Enp. 2-segmented, P2 first segment with inner serrate seta, wider and longer than second segment, bearing one distal plumose seta; P3 both segments of equal size, first one unarmed, second one with terminal outer bipinnate spine and a terminal inner long plumose seta; P4 first segment longer than distal one, unarmed; distal segment with terminal modified biserrate spine and terminal inner plumose seta slightly displaced to the inner margin.

P5 (Fig. 4A, 9A). Exp. and baseoendopod fused to common plate, no intercoxal plate, both rami still identifiable; baseoendopodal lobe with 3 armature elements, innermost a bipinnate short and thick spine and next to it 2 slender bipinnate setae; exopodal lobe with 3 setae decreasing in length outwardly, 2 inner setae bipinnate, outer seta short and bare; one

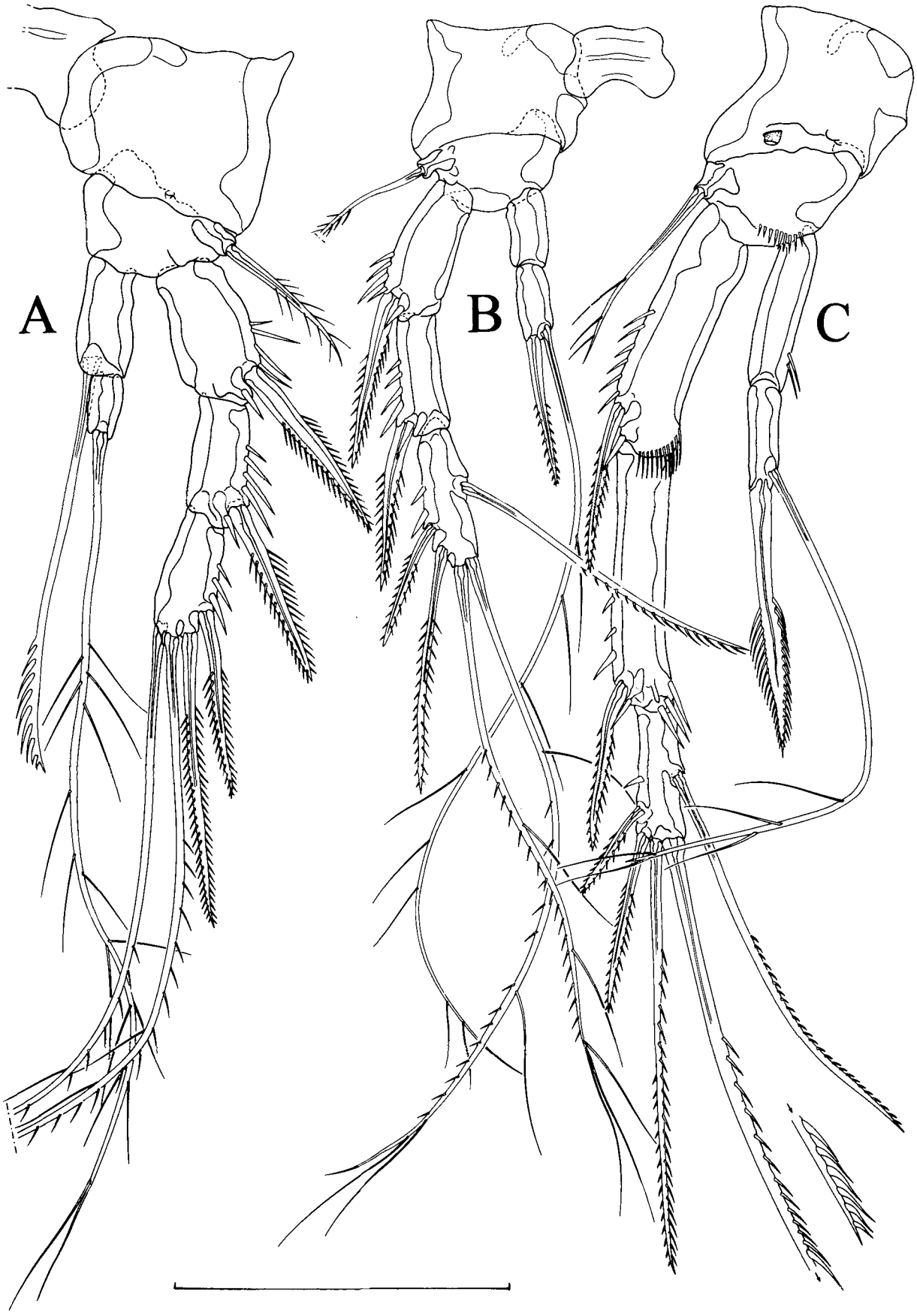

Fig. 3. *Selenopsyllus dahmsi* sp. nov., female. – A: P2; B: P3; C: P4. – A, B from holotype; C from paratype. Scale bar 50 µm.

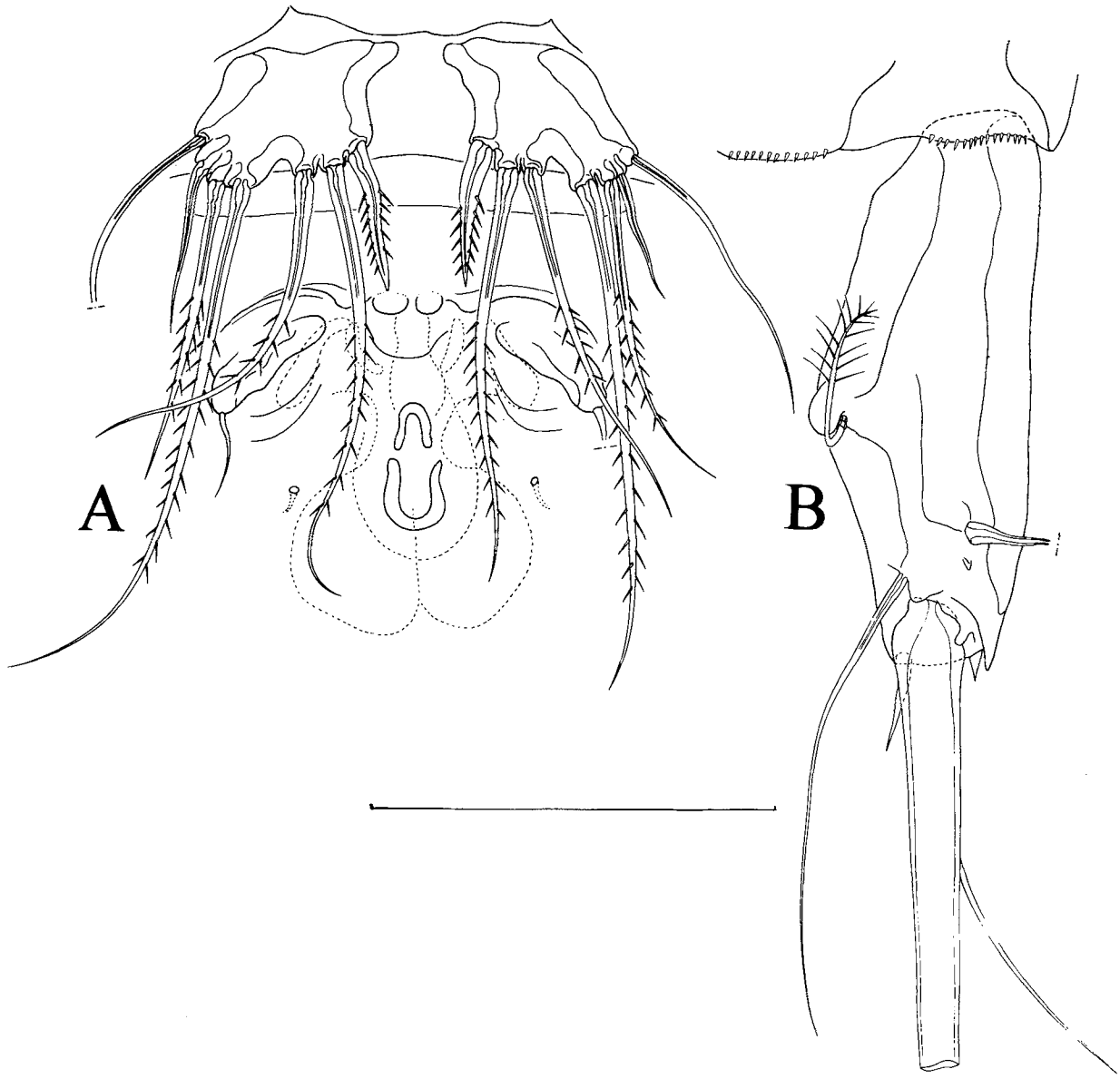

Fig. 4. *Selenopsyllus dahmsi* sp. nov., female, holotype. – A: P5, P6 and genital field; B: right furcal ramus, dorsal view. – Scale bar 50 µm.

bare seta on small protuberance of outer lobe representing the basal seta. Abnormal basendopod lobe with just 2 setae present in female prepared for SEM (Fig.9A).

P6 and genital field (Fig. 4A, 9C). Genital double-somite totally fused; P6 symmetrical oval plates with outer posterior tip bearing 2 or 1 setae (Fig. 9C); copulatory pore distal of P6 but on proximal half of double somite, copulatory opening eight-shaped (Fig. 9A, B); tube wide extending proximally to a pair of strongly chitinised labyrinthic rounded ducts beneath P6; pair of seminal receptacles located in the middle of second half of double somite; no sieve (cluster of 4 pores) discernible, a simple pore on each side of copulatory pore.

Description of male: Total body length 601 µm, 558 µm without furca, sexually dimorphic in antennule, P2, P3 endopod, P5, P6.

Antennule (Fig. 5B, C, 10A, B). Indistinctly 9-segmented with aesthetascs on fifth and last segment, second segment more than twice as long as other segments; geniculation between 4th/5th and 6th/7th segments, 4th segment very small, fused by one side with 3rd;. Setal formula: 1 pinnate seta / 1 pinnate + 7 setae / 1 pinnate + 6 setae / 2 setae / 5 setae + aesthetasc / 2 setae / 1 seta and some small spinulose elements / 1 seta and a spinulose element / 9 setae + aesthetasc. Fig. 5B was drawn in a position in which some setae and the 5th segment are not visible. Fig. 10A shows a position were this segment is totally discernible, and setal formula above indicates the total number of antennulary armature elements.

Antenna (Fig. 5D), Labrum (Fig. 6A) Mandible (Fig. 6B), Maxillule (Fig. 6C), Maxilla (Fig. 6D), Maxilliped (Fig. 6E), P1 (Fig. 8A), P4 (Fig. 7C) and furca (Fig. 8D) as in female.

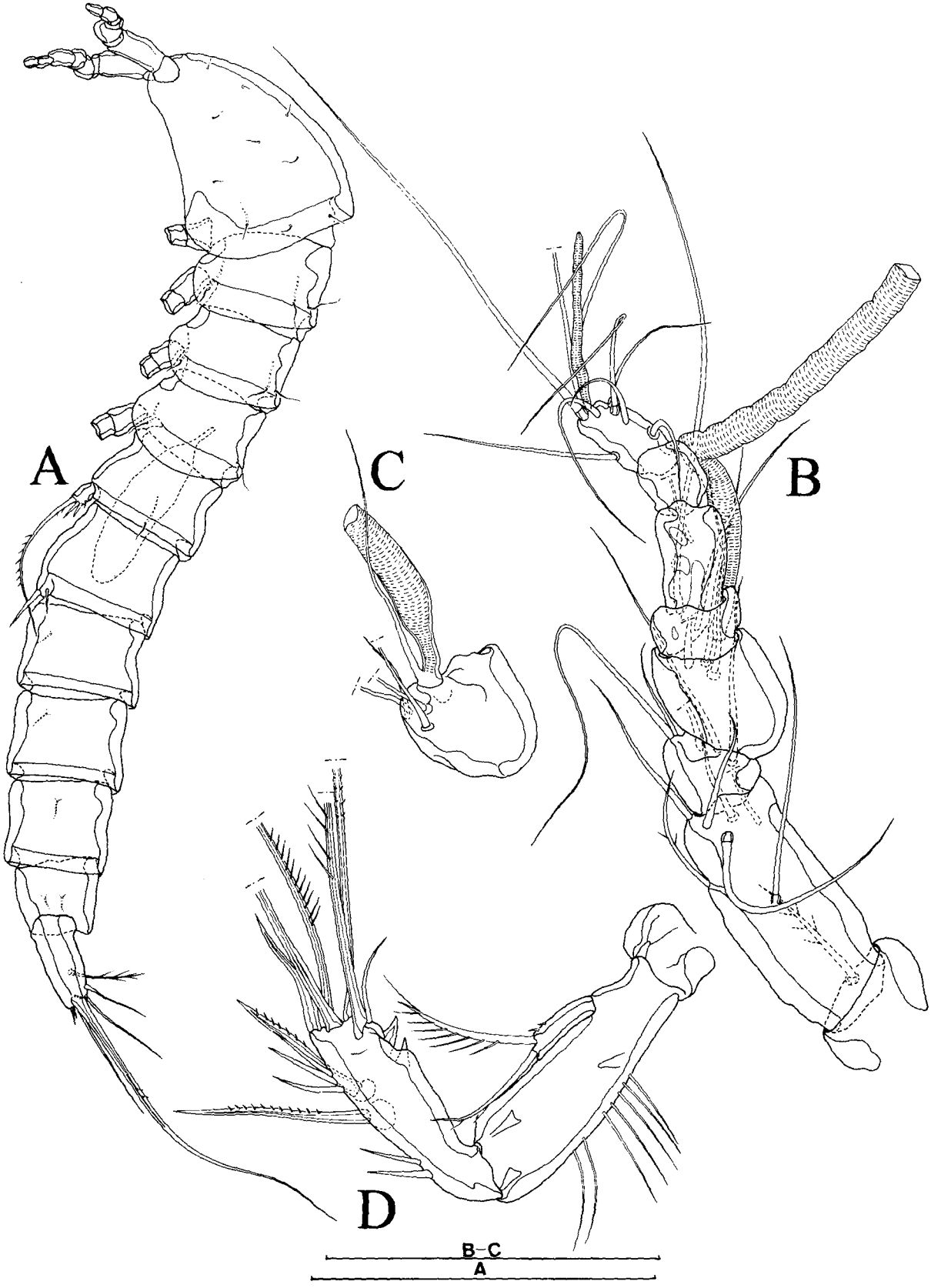

Fig. 5. *Selenopsyllus dahmsi* sp. nov., male, allotype. – A: lateral habitus; B: antennule; C: detail of 5th antennule segment; D: antenna. – Scale bar A 200 µm; B, C 50 µm.

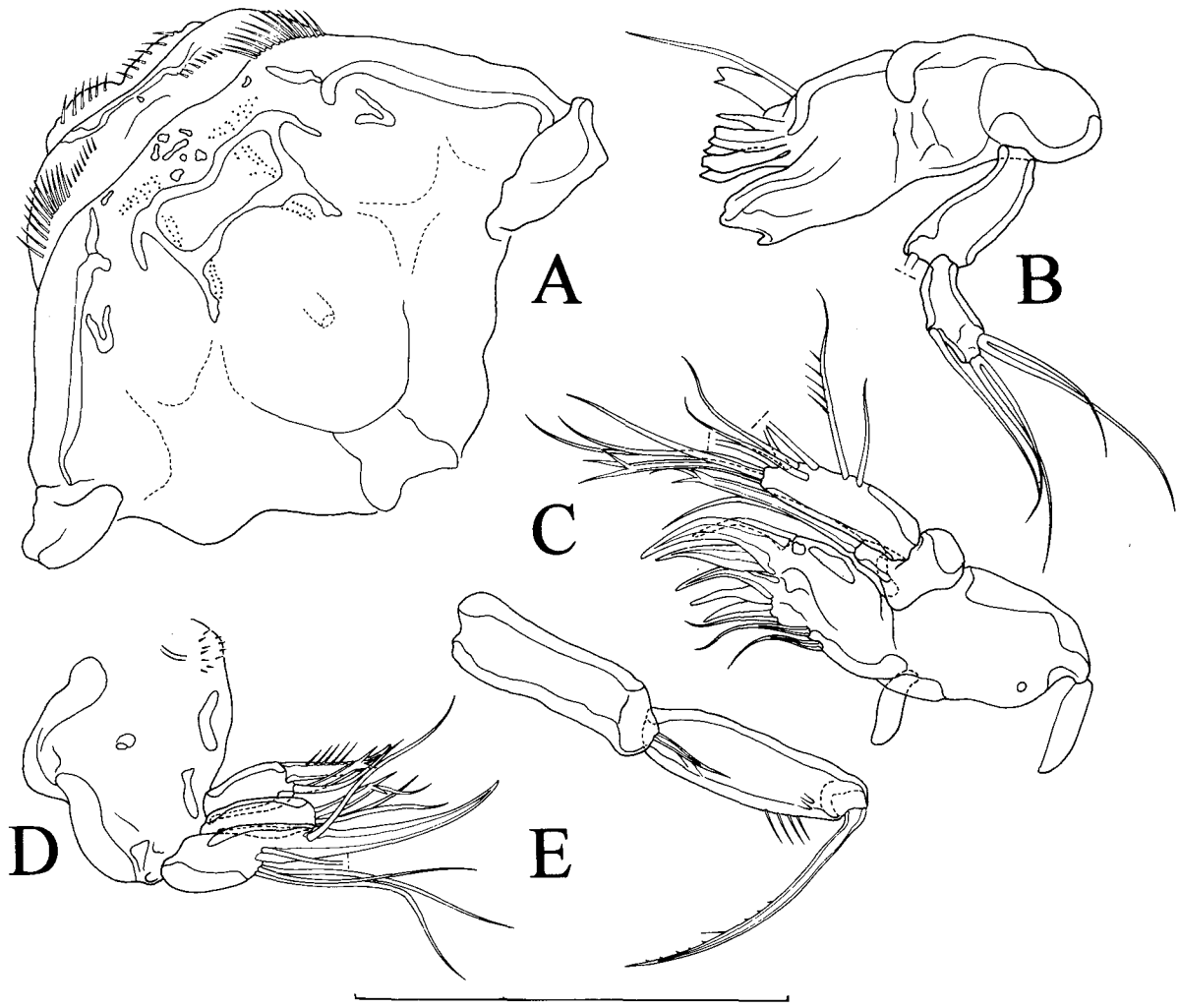

Fig. 6. *Selenopsyllus dahmsi* sp. nov., male. – A: labrum; B: mandible; C: maxillule; D: maxilla; E: maxilliped. – Scale bar 50 µm.

P2 (Fig. 7A, 10D, F). Basis with anterior outgrowth at inner distal side (Fig. 10D), triangular, outwardly directed, reaching distal part of first segment of endopod; endopod first segment wider than in female; exopod last segment enlarged with distal bump carrying small spinule at tip; inner distal spine transformed into strong unipinnate inwardly directed claw (Fig. 10F), inner margin with small rounded protuberances on which spinules are inserted. Other exopod armature elements as in female.

P3 (Fig. 7B). Endopod sexually dimorphic, 3-segmented, first segment wider than long, second segment even shorter, with chitinous plate forming an inner outgrowth and a seemly thick apophysis inserted beneath outgrowth, tapering at tip, reaching proximal part of exp. -3; last segment twice as long as both other segments together, with a long terminal plumose seta as in female and a short bare spine (homologous with female outer distal spine) displaced to inner distal side. Exp.-2 with a proximal tube pore (Fig. 10F arrow).

P5 (Fig. 8B, 10C). Basendopod and exopod fused forming common bilobed plate, outer lobe representing exopod, with 2 outer setae and inner spine, all of them pinnate, a long seta representing basal seta arising from small protuberance at outer margin; inner lobe representing basendopod, with one pinnate spine.

P6 (Fig. 8C, 10E).: Asymmetrical, right plate larger and more conical than left plate; each plate with 3 armature elements, inner seta thicker and bipinnate, 2 outer setae slender and bare, tube pore present on inner proximal side of inner seta.

Copepodids: Different copepodid stages were collected in the sample, including CII, CIII, and female CV. Antenna of CII already with two setae on exopod as in adult. Mouthparts also similar to adult even in CII. Furca (Fig. 9E) comparatively shorter, in the 3 stages with all armature elements and the same form (with inner middle and outer distal outgrowths present), terminal seta without geniculation.

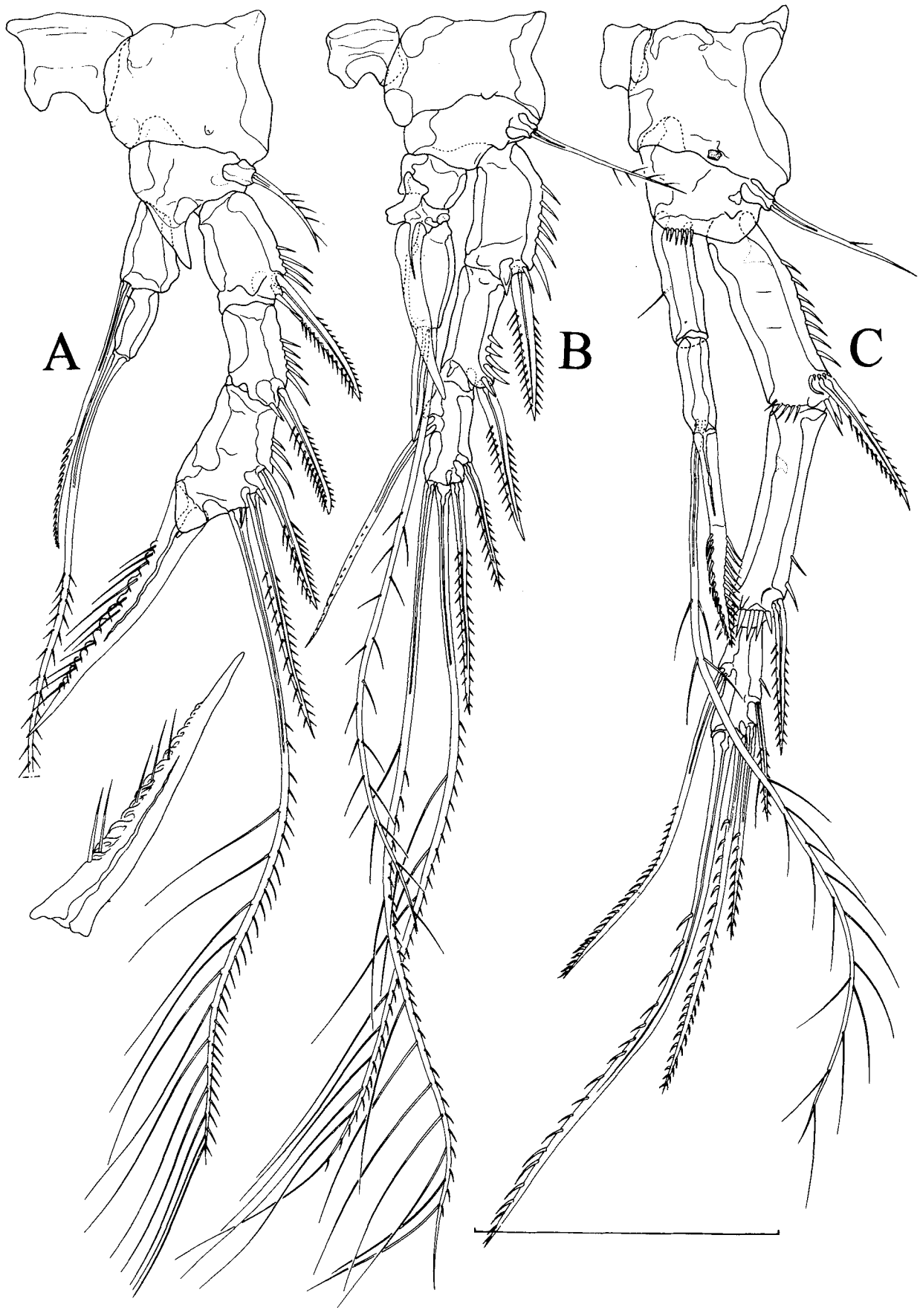

Fig. 7. *Selenopsyllus dahmsi* sp. nov., male. – A: P2, with detail of modified inner terminal claw of opposite endopod; B: P3; C: P4. – Scale bar 50 µm.

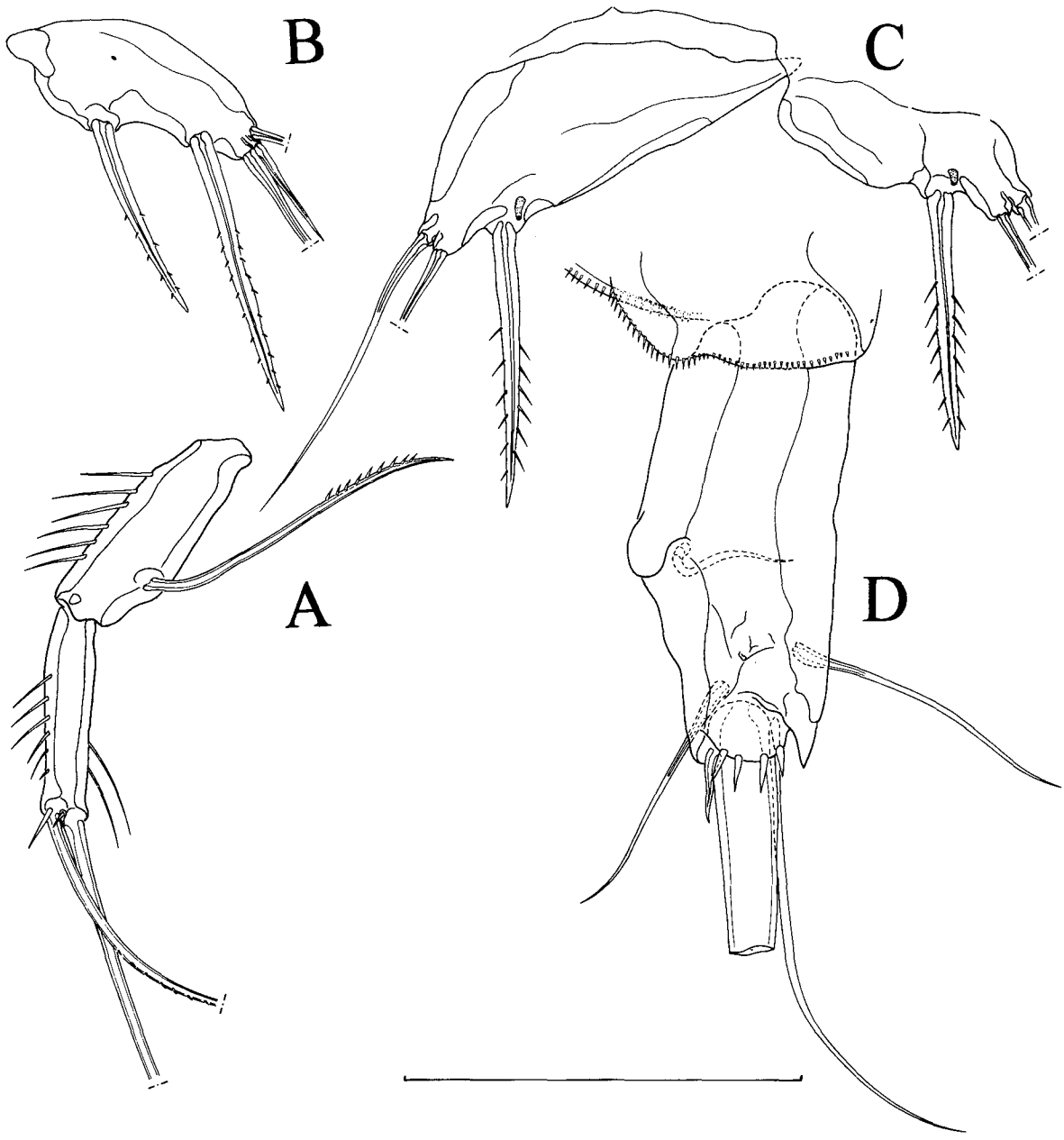

Fig. 8. *Selenopsyllus dahmsi* sp. nov., male. – A: P1 endopod; B: P5; C: P6; D: right furcal ramus, ventral view. – Scale bar 50 µm.

Female antennule of CV 5-segmented, with aesthetasc on third segment. CV with inner seta on P1–P2 enp. -1 represented by a leaf shaped not articulated prolongation of the segment, outer distal spine of P3 enp. also fused with segment, and modified distal seta of P4 enp. -2 also fused, looking like a strong thorn-like prolongation of the segment with spinules distally. P5 armature as in adult. Last thoracic and first abdominal somites not fused together. P6 not prominent, a small lobe bearing 3 setae.

Etymology: The species is dedicated to our colleague Dr. H.-U. Dahms, who collected and sorted the material and drew our attention to the specimens.

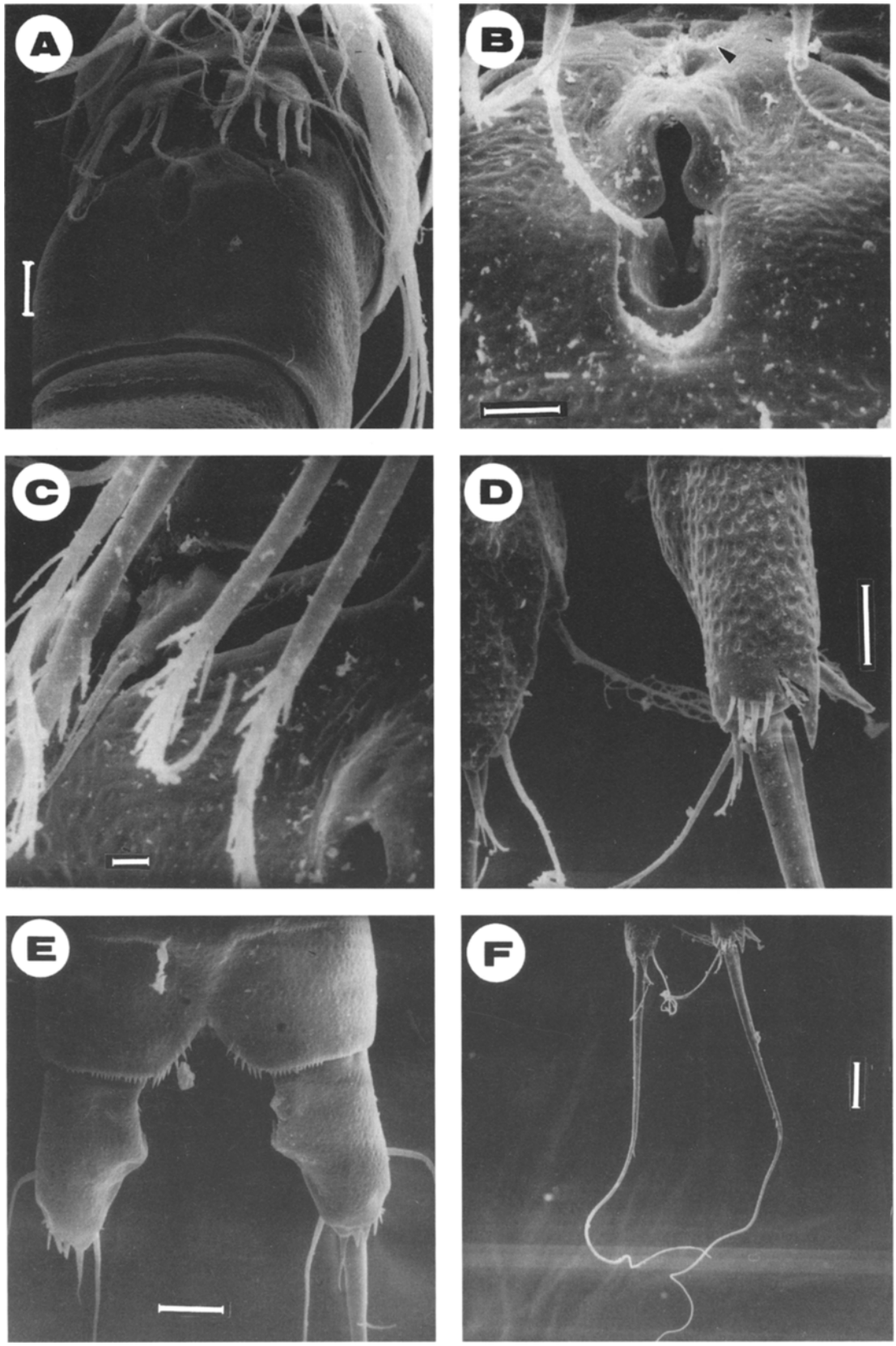

Fig. 9. *Selenopsyllus dahmsi* sp. nov., female and copepodid 3. – A: P5 with abnormal left basendopodal lobe and genital double somite; scale bar 10 µm. B: detail of copulatory pore and gonopore, arrow indicating middle part of gonopore; scale bar 5 µm. C: detail of left P6; scale bar 2 µm. D: furcal rami; scale bar 10 µm. E: copepodid 3 furcal rami ventral view; scale bar 10 µm. F: terminal furcal seta with slight geniculation; scale bar 20 µm.

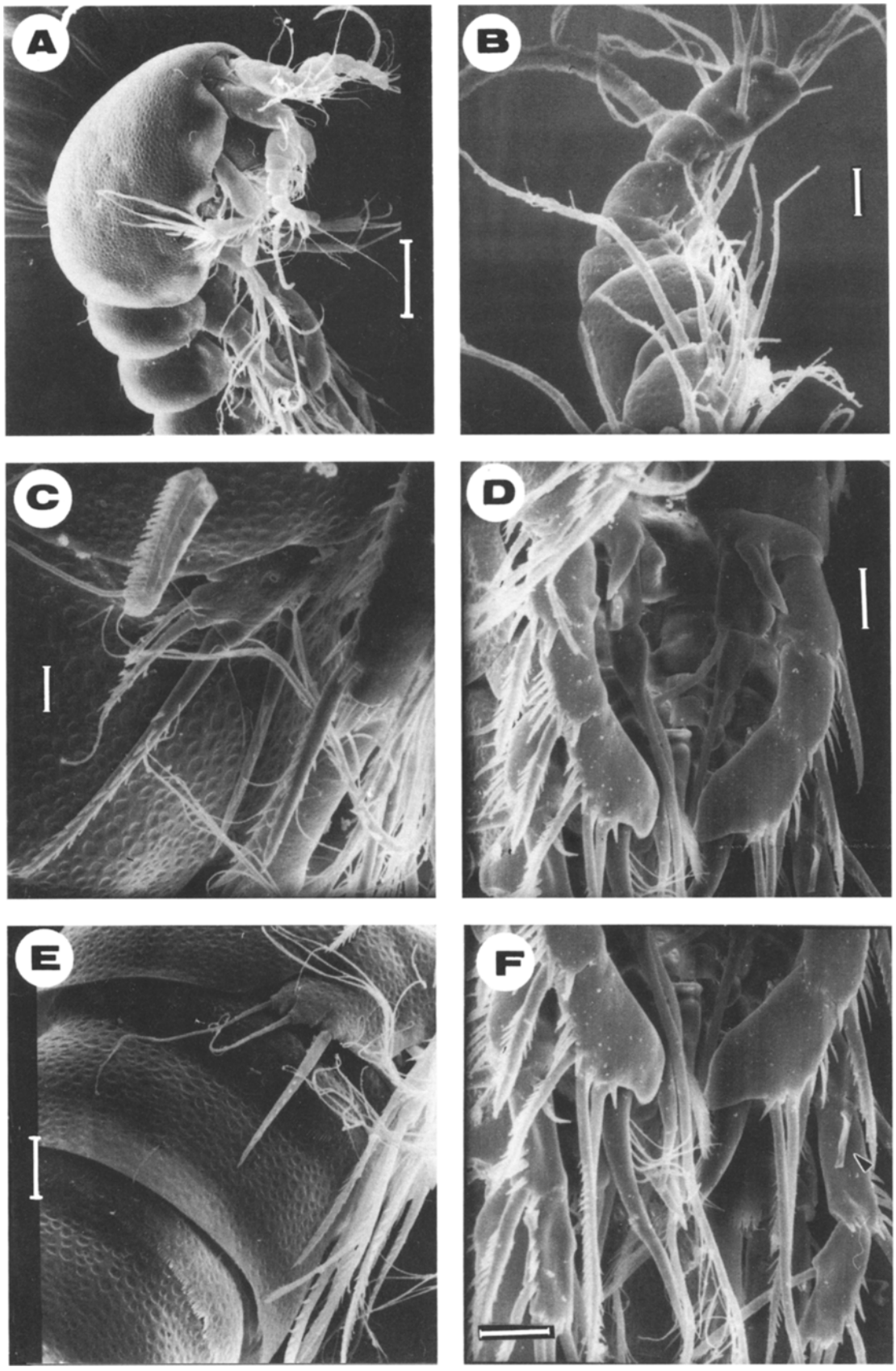

Fig. 10. *Selenopsyllus dahmsi* sp. nov., male. – A: rostrum and cephalothorax; scale bar 30 µm. B: detail of 3rd to 9th antennulary segments; scale bar 5 µm. C: P5; scale bar 5 µm. D: P2 basis outgrowth and modified exp.-3; scale bar 10 µm. E: P6; scale bar 10 µm. F: P2 exp.-3 and P3 exopod, arrow indicating sexually dimorphic tube pore of P3 exp.-2; scale bar 10 µm.

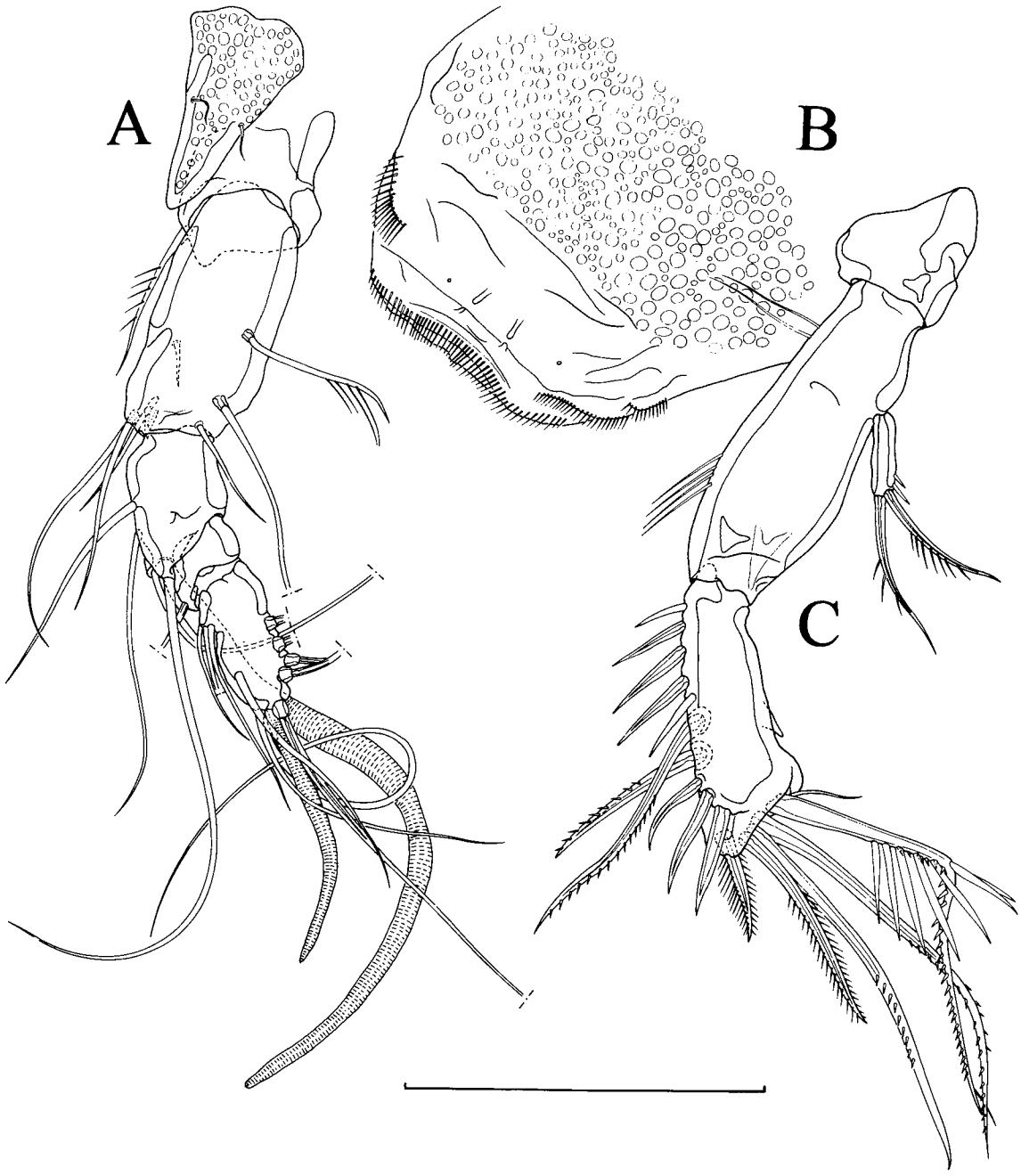

Fig. 11. *Selenopsyllus antarticus* sp. nov., female, holotype. – A: rostrum and antennule; B: labrum; C: antenna. – Scale bar 50 µm.

Selenopsyllus antarcticus sp. nov.

Figs. 11-15

Material: One female dissected and mounted on one slide (Coll. No. 1997.14/1).

Type locality: Antartic Wedell Sea, coordinates 72°38.3'S 20° 25.6'W, at 3480 m depth.

Description of female, restricted to features differing from *S. dahmsi* sp. nov.: Total body length from anterior border of cephalothorax to posterior margin of furca 684 µm, length without furca 647 µm.

Furca (Fig. 15B) not even twice as long as wide, inner side swollen about half length, setation as in *S. dahmsi*, outer distal outgrowth wider and more strongly developed than in *S. dahmsi*.

Antennule (Fig 11A) 5-segmented, aesthetasc on third and last segment, last segment homologous with fifth and sixth of *S. dahmsi*. Setal formula: 1 (plumose) / 8 + 1 plumose / 4 + ae./ 1 / 3 + 9 + ae.

Rostrum (Fig. 11A), labrum (Fig. 11B), antenna (Fig. 11C), paragnaths (Fig. 12A), mandible (Fig. 12B), maxillule (Fig. 12D) and maxilla (Fig. 12C) similar to *S. dahmsi*.

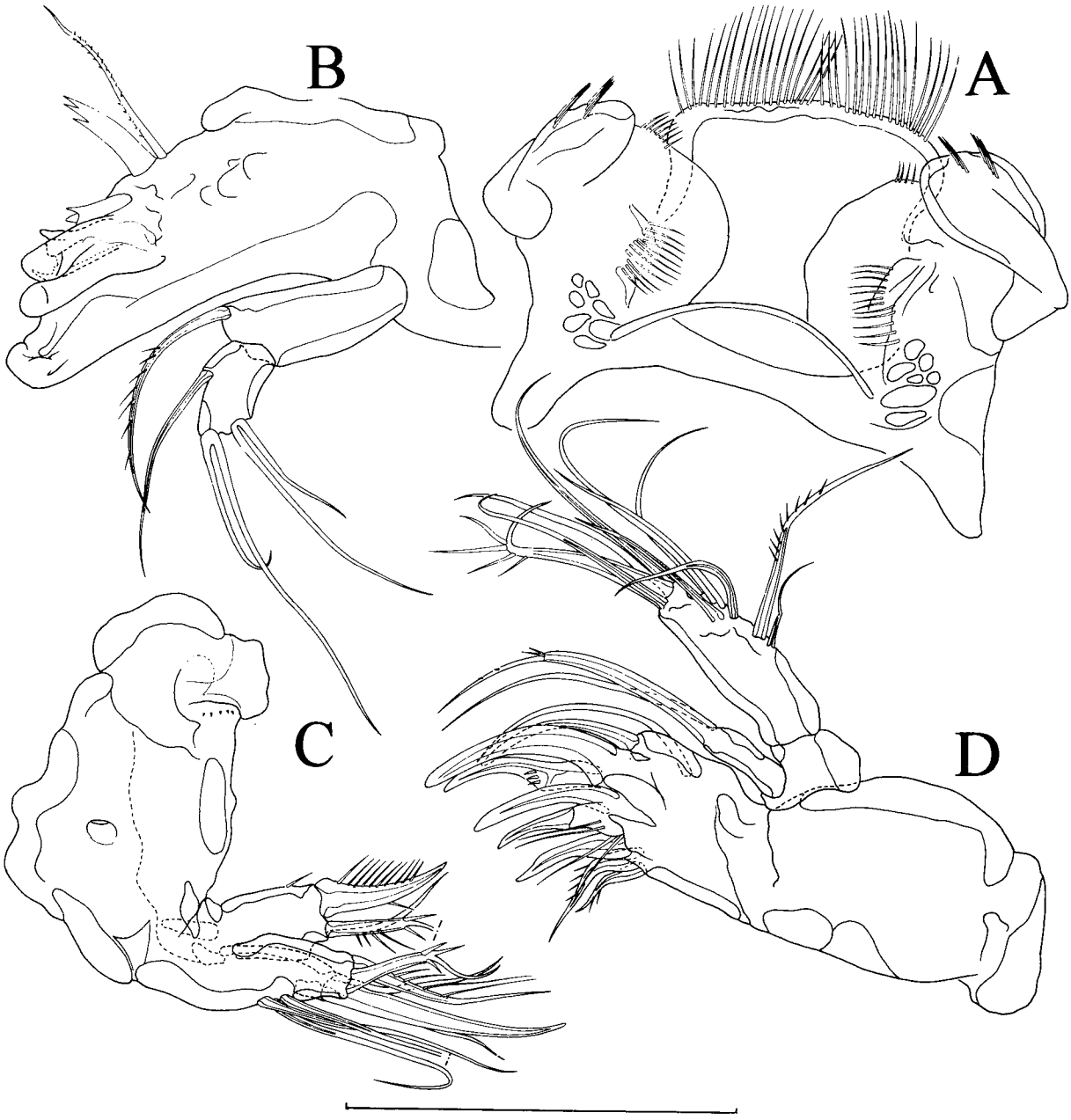

Fig. 12. *Selenopsyllus antarticus* sp. nov., female, holotype. – A: paragnaths; B: mandible; C: maxilla; D: maxillule. – Scale bar 50 µm.

Maxilliped (Fig. 13B). Syncoxa without seta.

P1–P4 (Fig. 13A, C, 14A, B) as in *S. dahmsi* except for P2 enp.-2 which is armed distally with one outer bipinnate spine and a long slender plumose seta.

P5 (Fig. 15A) square bilobed plate, lobe representing exopod with a very short outer seta, median short seta bare, and inner strong bipinnate spine, lobe representing basendopod with 2 bipinnate spines, inner one shorter.

P6 and genital field (Fig 15A). P6 symmetrical plate in proximal half of double somite bearing 2 setae on left and one seta on right plate, copulatory opening broad, distally of P6 but still on the first half of double somite, anterior edge of triangular copulatory opening linked to short straight part of paired copulatory ducts leading upwards to labyrinthic rounded chitinised part beneath P6, the labyrinthic part of the duct is not as large as in *S. dahmsi*; pair of simple pores laterally between P6 and copulatory opening; and two cluster of 4 pores resembling a sieve close to the distal edges of the opening; at outer distal end of double somite another pair of pores similar to those present in *Selenopsyllus* sp. (described below Fig.16A).

Etymology: the specific name refers to the Antarctic region.

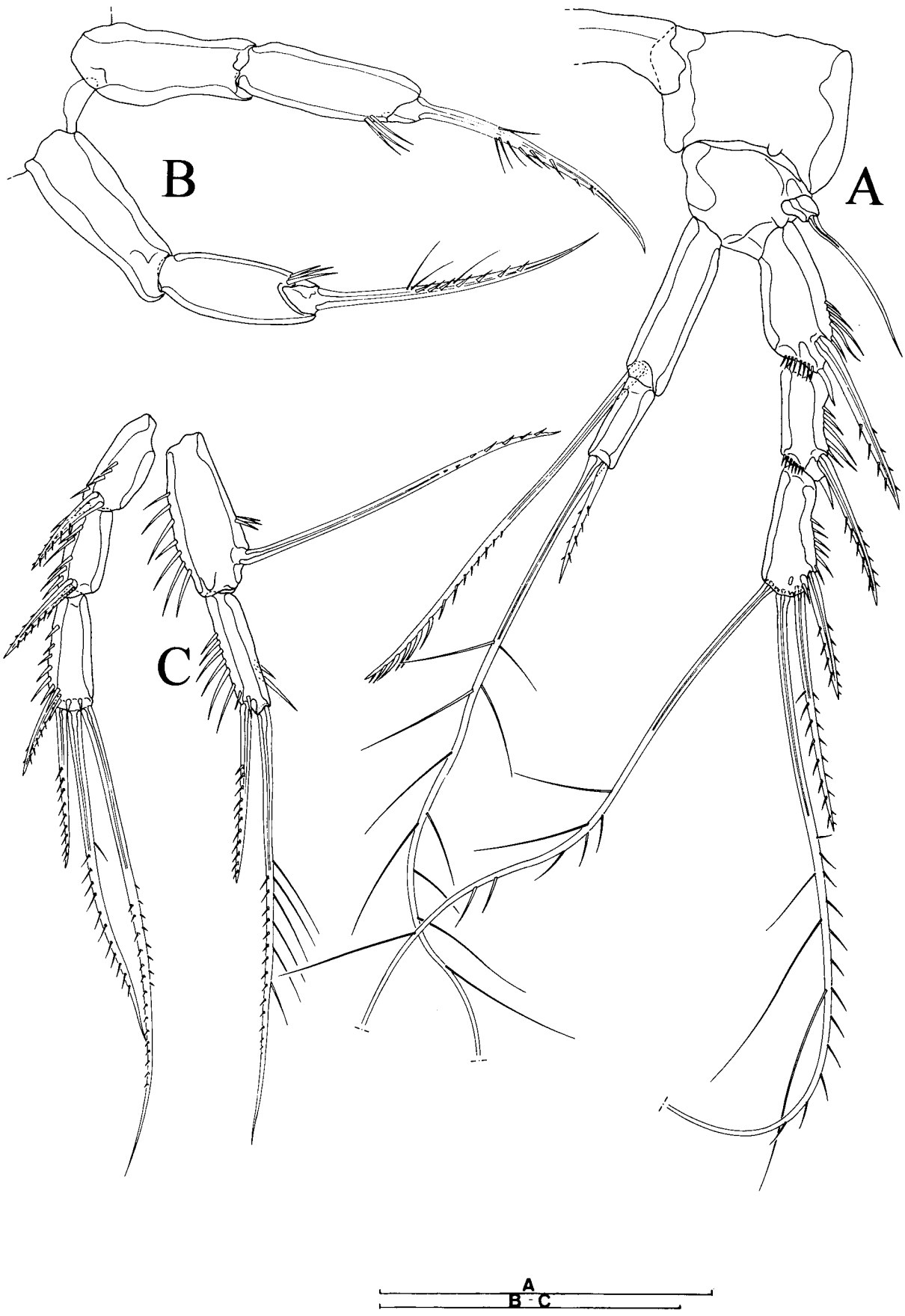

Fig. 13. *Selenopsyllus antarticus* sp. nov., female, holotype. – A: P2; B: maxillipeds; C: P1 endopod and exopod. – Scale bar 50 µm.

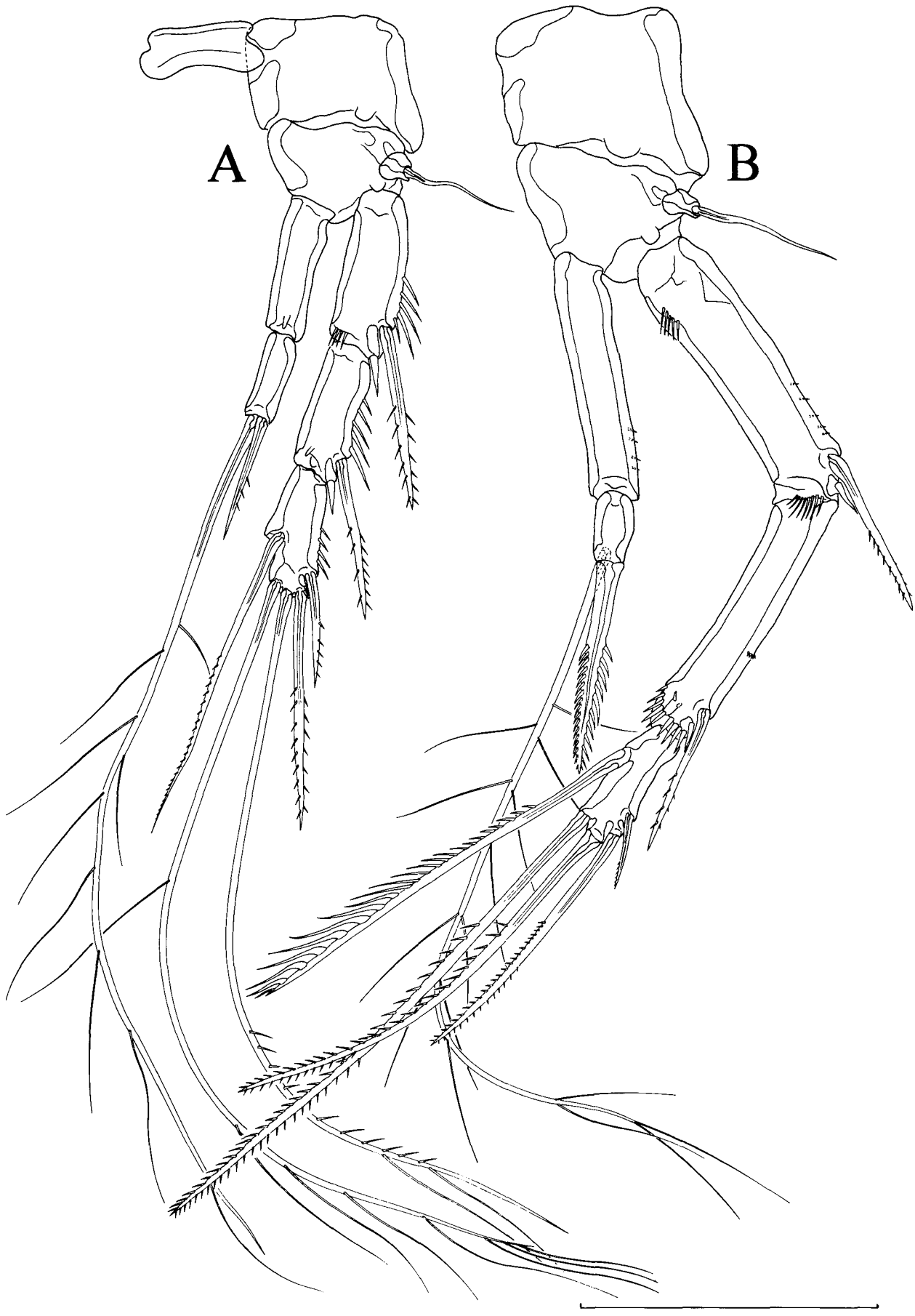

Fig. 14. *Selenopsyllus antarticus* sp. nov., female, holotype. – A: P3; B: P4. – Scale bar 50 µm.

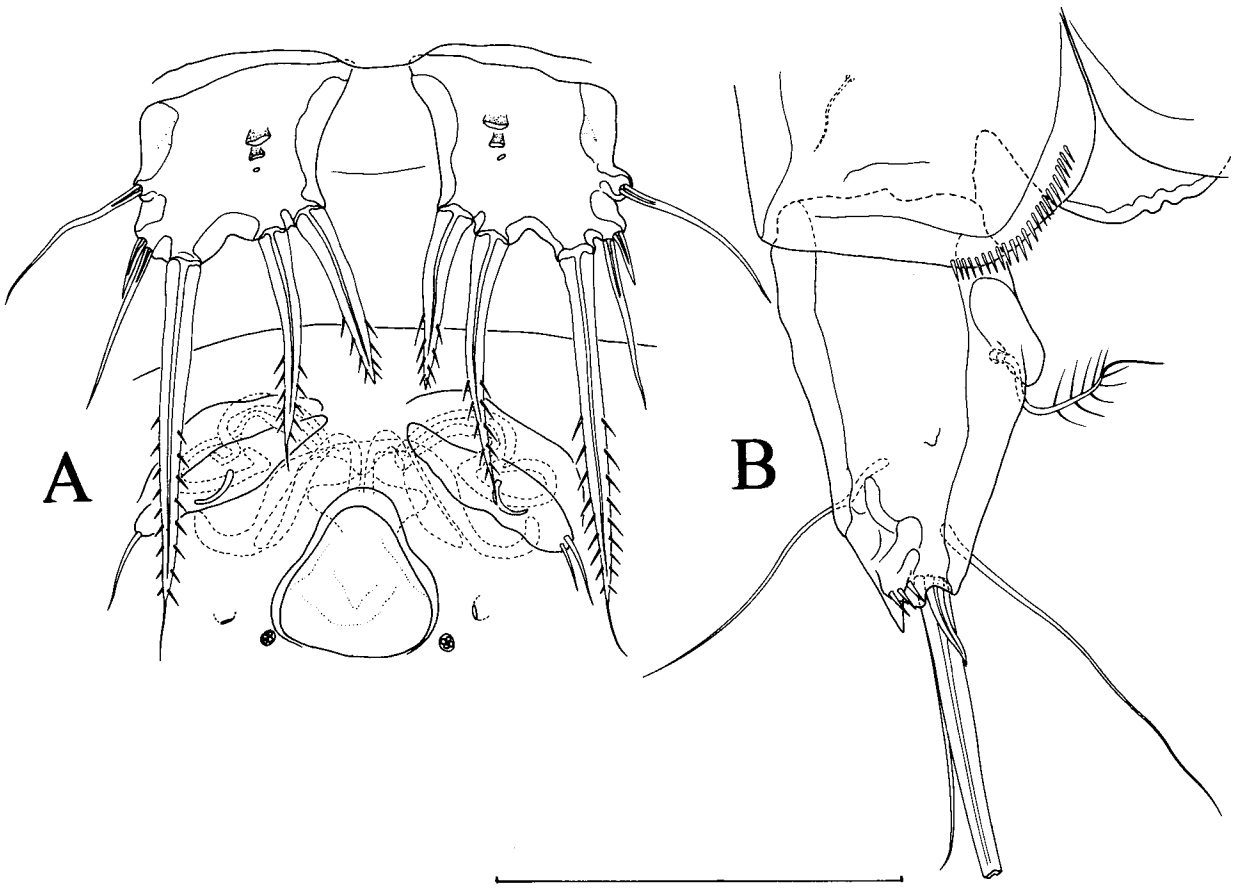

Fig. 15. *Selenopsyllus antarticus* sp. nov., female, holotype. – A: P5, P6 and genital field; B: right furcal ramus, ventral view. – Scale bar 50 µm.

Selenopsyllus sp.

Fig. 16

Material: 2 females, one dissected and mounted on 18 slides, (Coll. No. 1997.15/1 – 15/18), 1 whole specimen mounted on one slide (Coll. No. 1997.16/1).

Sample locality: Antarctic Wedell Sea, coordinates 72°38.3'S 20°25.6'W, 3480 m depth.

Female: These specimens found in the same sample as *S. antarcticus* sp. nov. resemble *S. dahmsi* sp. nov. in almost all features, except for the P5 (Fig. 16A) which has the same number of armature elements as *S. dahmsi* but shows a transversally produced exopod lobe with the outer seta small and spiniform. The genital field (Fig. 16A) also differs in the shape of the chitinised copulatory rounded duct, the shape and position of the copulatory pore, and the shape and location of pair of pores and sieve-pores that are clearly discernible. In ventral view beneath the labyrinthic copulatory duct, is a rounded extra amber coloured structure; and a lateral pair of pores on the distal end of double somites linked to internal big glands. These distal pores were observed also in *S. antarticus* in which the pores are located slightly more to the inner side. The furca although also elongate is comparatively shorter; with the swollen inner stucture more proximally situated; and the distal outgrowth somewhat more prominent than in *S. dahmsi* (Fig. 16B).

Note: It is not certain whether these specimens represent a separate species. No such variations of the genital field or P5 were found in specimens from the same sample of *S. dahmsi*. Pending the discovery of males we refrain from formally establishing a new species.

Redescriptions of some features of *Stenocaris profundus* and *Stenocaris abyssalis*

Re-examination of the type material of these species revealed some oversights in BECKER's (1979) description, which should be ammended as follows.

Selenopsyllus profundus (BECKER 1979) comb. nov., female.

Fig. 17

Antennule (Fig. 17A) 5-segmented with fusion as in *S. antarcticus*, aesthetascs on third and last segment, first segment short, second as long as 3rd to 5th together; setal formula

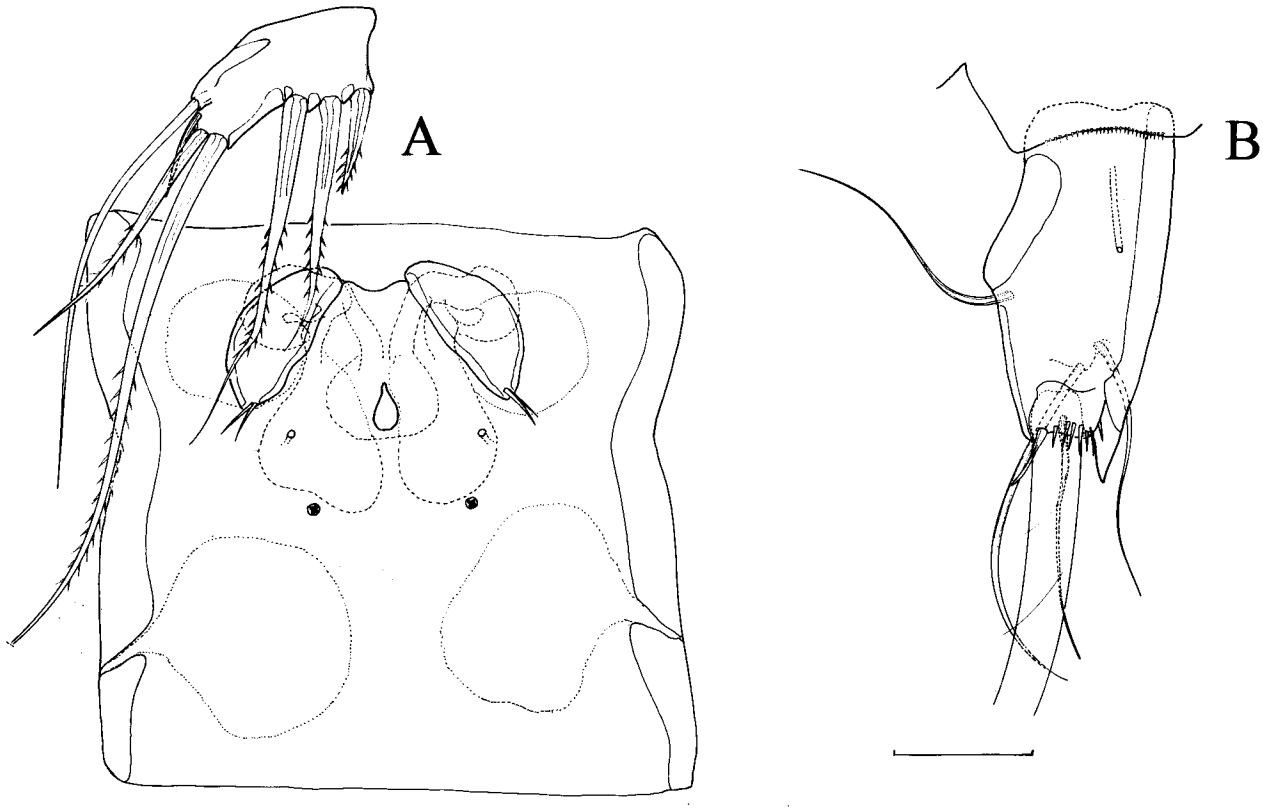

Fig. 16. *Selenopsyllus* sp. female, holotype. – A: P5, P6 and genital field; B: left furcal ramus, ventral view. – Scale bar 20 µm.

beginning with proximal segment: 1 / 7 + 1 plumose / 6 + ae / 1 / 11 + ae. P1 with outer seta on basis, ommitted by Becker (1979: Fig. 5). P2–P4 similar to those of *S. antarcticus,* P2 endopod with serrate inner seta; P4 enp. -2 (Fig. 17B) with modified distal seta and inner serrate seta on exp. -3. P5 (Fig. 17C) a bilobed plate, exopodal lobe armed with 2 outer bare setae and a strong long bare spine with slender tip, lobe representing basendopod with one bipinnate spine; basal outer seta inserted on small protuberance at outer proximal margin of exopodal lobe. Furca (Fig. 17D) with 7 armature elements rather than 5 as described by BECKER (1979: Fig. 4), outer distal conical outgrowth moderately developed.

Selenopsyllus abyssalis (BECKER 1979) comb. nov., male.

Figs. 18–19

Antennule (Fig. 18D) indistinctly 9-segmented, 3rd and 4th segments not totally separated, geniculation between segments 4/5 and 7/8, aesthetascs present on 5th and distal segments. Mandibular palpus (Fig. 18E) with one seta on basis and enp. armed with 1 lateral seta and a pair of two basally fused setae (4 distal setae) rather than just 2 setae as in the original description (BECKER 1979: fig. 6). Maxilliped (Fig. 18C) with small seta on syncoxa. P1 enp.-1 inner seta orientated perpendicularly to endopod. P2 (Fig. 19A) basis with strong anterior triangular process between exp. and enp., enp.-1 with rounded protuberance on distal outer margin, one serrate seta on inner margin, exp.-3 with strongly modified distal inner claw, partially covered on base by an anterior outgrowth of exopod. P3 endopod (Fig. 19C) 3-segmented with apophysis arising from inner margin of enp.-2, enp.-3 with distal inner naked spine and distal long plumose seta. P4 exp.-3 with two outer spines, proximal spine small and naked, two distal pinnate setae, and one inner serrate seta; enp.-2 (Fig. 19B) with distal seta modified as in *S. profundus.* P5 (Fig. 18B) fused to common plate with basendopod and exopod lobes clearly distinguishable; basendopod lobe with one bipinnate spine; endopod lobe with inner bipinnate spine and two smaller outer setae, next to it a long outer most seta representing basis setae. P6 asymmetrical (Fig. 18A).

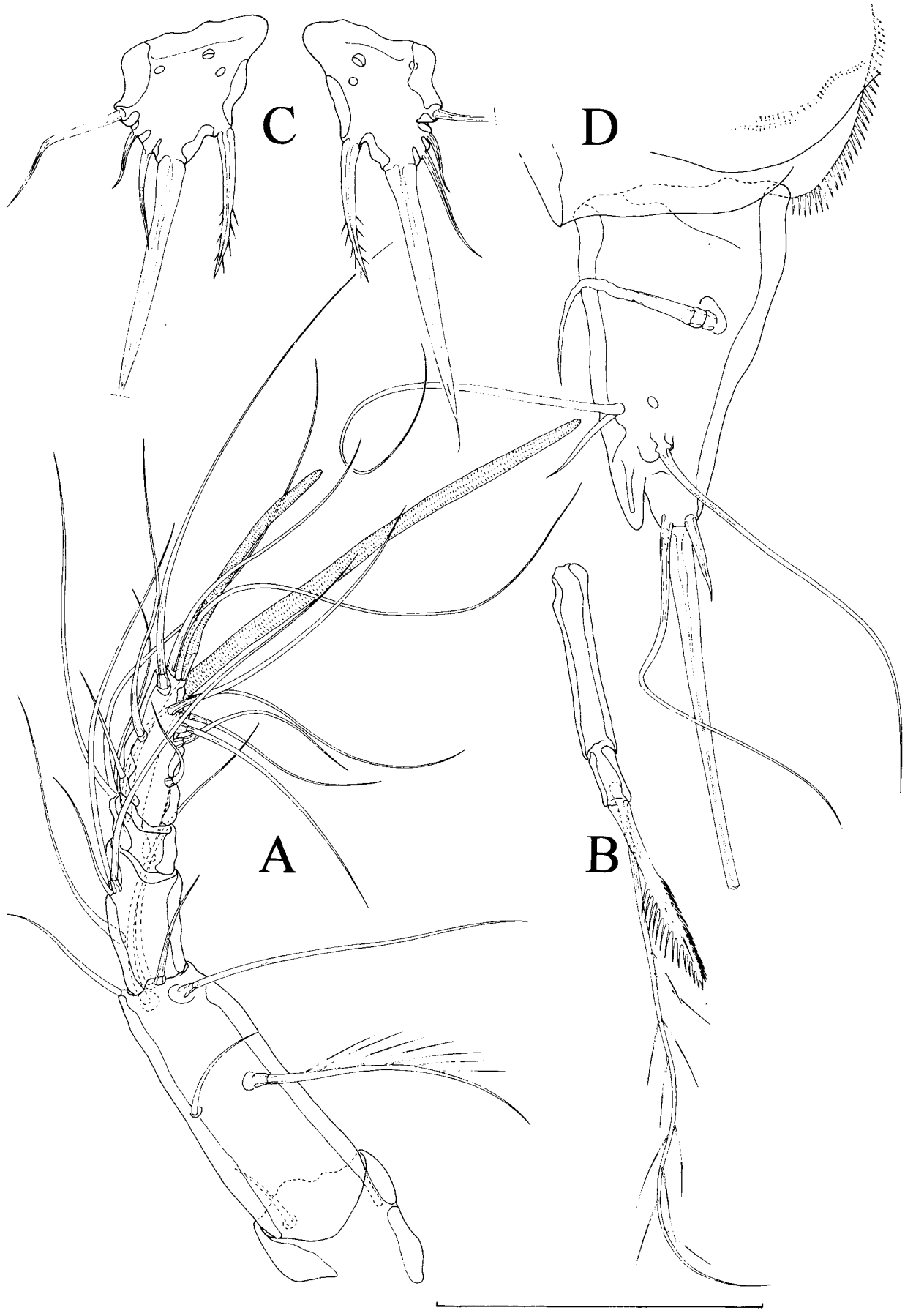

Fig. 17. *Selenopsyllus profundus*, female, holotype. – A: antennule; B: P4 endopod; C: P5; D: left furcal ramus, dorsal view. – Scale bar 50 µm.

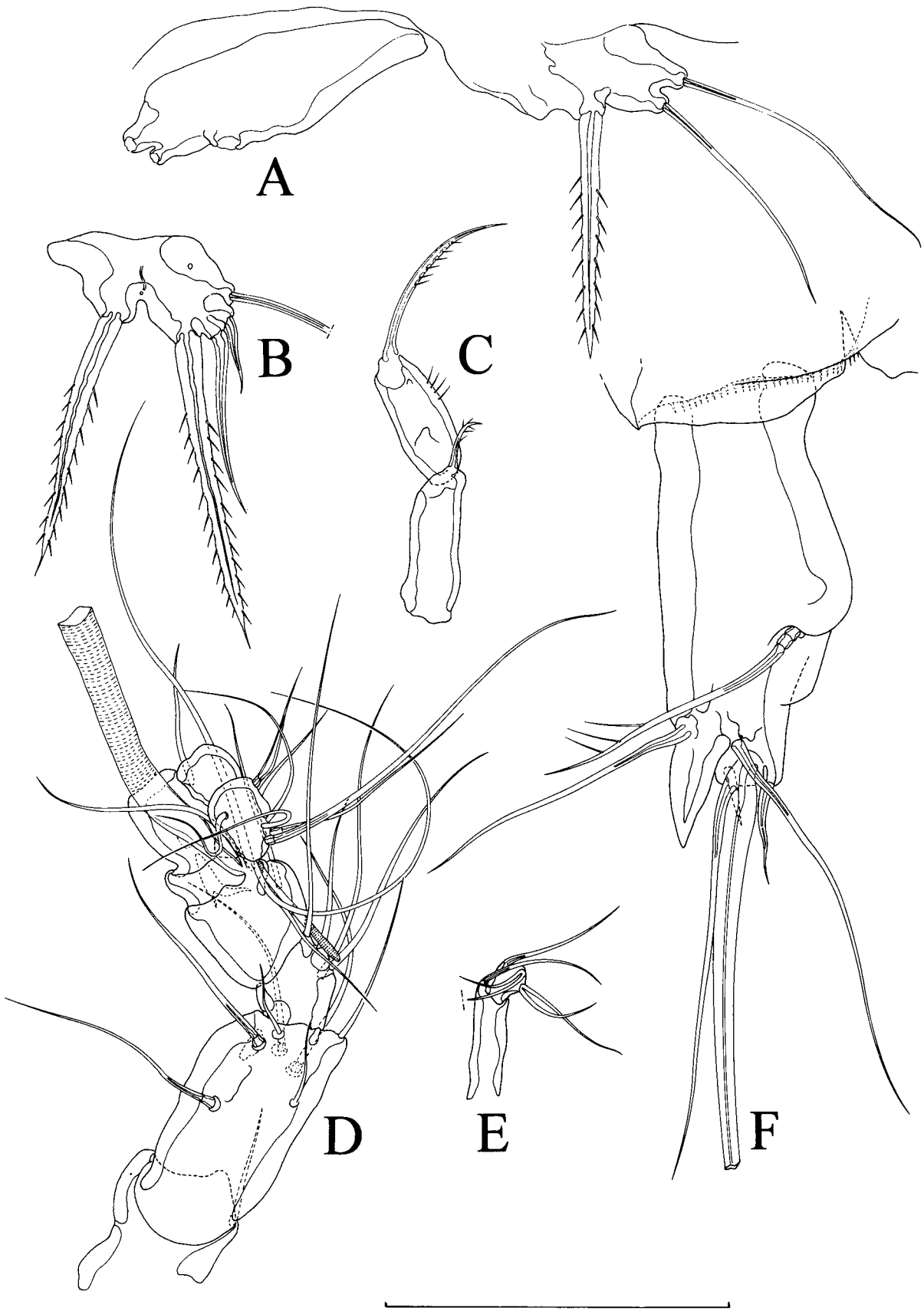

Fig. 18. *Selenopsyllus abyssalis*, male, holotype. – A: P6; B: P5; C: maxilliped; D: antennule; E: palpus mandibular; F: left furcal ramus, dorsal view. – Scale bar 50 µm.

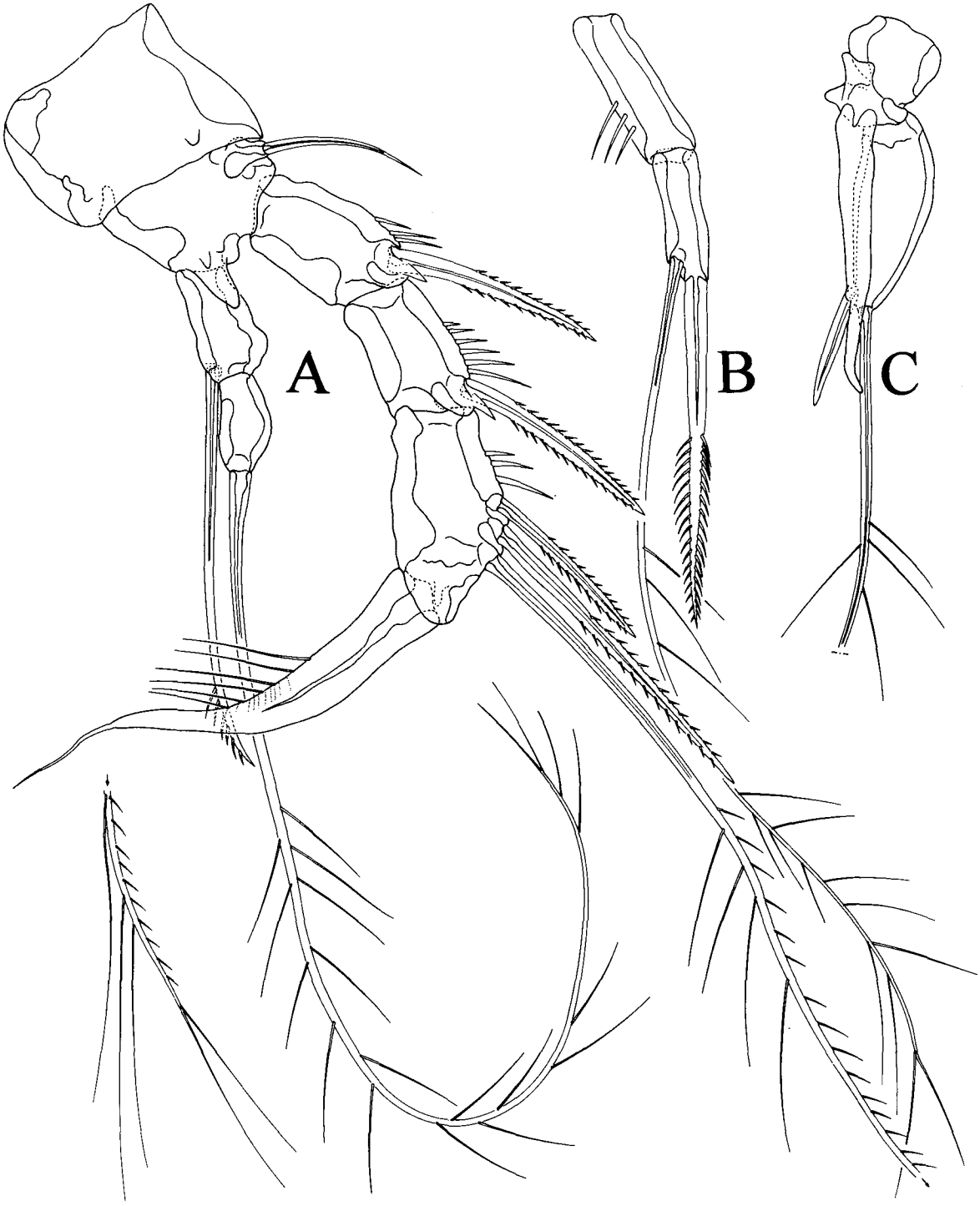

Fig. 19. *Selenopsyllus abyssalis*, male, holotype. – A: P2; B: P4 endopod; C: P3 endopod: – Scale bar 50 µm.

Discussion

The two newly described species belong to the subfamily Cylindropsyllinae, because of the cylindrical and slender body without ornamentation (lacking rows of spinules); the female 6-segmented antennule (7 in the ground pattern of the subfamily) and its elongated second segment; the 2-segmented endopods P1–P4 with only 2 outer spines on exp. -3; the P1 enp. -1 inner seta distally serrate and orientated perpendicularly to enp.; the P2 enp. -1 and P3–P4 exp. -3 with serrate inner seta; the P1 and P2 exp. without inner seta; the P3–P4 enp. -1 without inner seta; the basendopod and exp. P5 fused to a common plate, bearing 7 setae in female (8 setae in the ground pattern) and 6 (7) setae in male; the terminal furcal seta with geniculation between a proximal rigid and a distal flagellate part (in the new species only slightly); and the sexually dimorphic process on the male P2 basis.

Within Cylindropsyllinae the closest relatives of the new species are *Stenocaris profundus* and *Stenocaris abyssalis*. Both species are transferred here to the new genus *Selenopsyllus*. Becker (1979) considered *S. profundus* and *S. abyssalis* two different species because of the presence of 3 setae on the mandibulary endopod (in *S. abyssalis*), the shape (geniculated or spine-like) of antennary endopodal setae, the maxilliped endopodal claw fused or not, and the shape of the furca. Re-examination of the type material revealed that (i) the mandibular endopod has 5 setae in both species, (ii) there are no remarkable differences in antennary setation between these two species, having almost the typical endopodal setation of Canthocamptidae and related families with two lateral spines (+1 small seta in the ground pattern), and having 2 spines, 3 geniculated setae and one small seta fused to the outer seta distally, and (iii) the maxilliped is almost identical in both species. It is possible that *S. abyssalis* represents the male of *S. profundus*. But a formal synonymisation of these species would be premature. The species were found in different deep-sea basins (Canarian and Iberian deep-seas), and they differ in the setation of endopod P2, the male *S. abyssalis* having 1 seta (Fig. 19A) and the female *S. profundus* having 2 setae on this segment. No such sexual dimorphism is present in *S. dahmsi* (the only species of the genus from which males and females are known). As already noticed by Becker (1979), the furcal rami differ in shape and armature elements. In *S. profundus* (Fig. 17D) the antero-lateral accessory seta is present while in *S. abyssalis* it is absent. Furthermore, *S. abyssalis* possesses an outer distal strongly developed process and the dorsal seta is inserted in the distal half beneath a more developed inner outgrowth whereas in *S. profundus* this seta is located on the proximal half.

The absence of males of *S. antarcticus* and *S. profundus* and of females of *S. abyssalis* makes it difficult to assess the phylogenetic relationships among *Selenopsyllus* species. The species *S. antarcticus* and *S. profundus* comb. nov. are closely related, because they share a 5-segmented female antennule and a reduced setation on the P5 basendopodal lobe. Both characters are autapomorphic within *Selenopsyllus* gen. nov. Whether the other two species of the genus constitute a separate group is uncertain. *S. abyssalis* has just one distal seta on P2 enp.-2 which could be a synapomorphic character with *S. dahmsi*, also the location of the furcal inner process and the position of the dorsal furcal seta could indicate relationship. If *Selenopsyllus* sp. should turn out to be a separate species, it would clearly be related to *S. dahmsi*, with which it shares the loss of the terminal outer spine of female P2 enp.-2, and the insertion of the dorsal furcal seta on the distal half of the furca.

S. abyssalis and *S. profundus* were removed from the genus *Stenocaris* and allocated to *Stenocaropsis* by Kunz (1994). They share with the other species of the genus the 2-segmented condition of the female endopod P2 and P3 and the 3-segmented male P3 endopod with the apophysis arising from the second segment. This condition represents the ground pattern of the subfamily. These characters cannot be used to assess phylogenetic relationships, because they are symplesiomorphic. A 2-segmented female P2 enp. is also present in the genera *Cylinula* and *Cylindropsyllus*, but the males of these genera differ from *Stenocaropsis* and *Selenopsyllus* in having a 2-segmented P3 enp with the apophysis arising from the first segment.

With *S. abyssalis* and *S. profundus* removed, *Stenocaropsis* remains a monophyletic group, characterised by (i) the sexual dimorphism of the P2 exp.-1, were males display an outgrowth on the inner margin, and (ii) the 6-segmented female antennule, (attributable to a lack of division of 6th and 7th segments of the ground pattern). The retention of some remarkable plesiomorphies such as the absence of sexual dimorphism on P2 exp.-3, (absence of the distal outgrowth and the modified distal inner claw), the 2-segmented endopods P1–P4 in female, and the 3-segmented male P3 endopod, indicates that *Stenocaropsis* represents an early offshoot within Cylindropsyllinae.

We cannot include the species unified in the genus *Selenopsyllus*, (not even as the most primitive species), into any of the known genera of Cylindropsyllinae and therefore propose to allocate these species to this new genus. The genus *Selenopsyllus* can be distinguished from other cylindropsyllid genera by the nested character states of a 6-segmented female antennule with aesthetasc on the third segment, (a condition due to a delay in separation of the third and fourth segments during copepodid development). Other autapomorphic characters (including convergent ones) are: (i) the very long slender plumose distal setae on endopods and exopods; (ii) P5 with 7 setae in females and 5 setae in males, (resulting from the loss of one exopodal seta in both sexes); (iii) P2 and P3 endopod last segment with at most 2 armature elements, and (iv) male antennule with 9 indistinct segments, 3rd and 4th separated only on one side.

The new genus *Selenopsyllus* shares with *Stenocaris, Willemsia, Navalonia, Cylinula,* and *Cylindropsyllus* the possession of a strong modified claw on male P2 exp.-3, and the distal anterior outgrowth. Within these taxa *Cylinula* and *Cylindropsyllus* are closely related, sharing the reduction of maxillipeds, and reductions in the setation of the maxillulary coxa and basis. The remaining genera *Stenocaris, Willemsia* and *Navalonia* constitute a monophyletic group, because of the 1-segmented enp. P2–P3 in the female, and the 2-segmented enp. P3 in the male with the apophysis arising from the proximal segment.

The genera *Boreopontia* and *Evansula* just have a slender claw on the male P2 enp.-3 without a distal outgrowth, and a very small process on the basis which is regarded here as plesiomorphic when compared with the condition described above. They share, however, a derived endopod segmentation pattern of the swimming legs.

The new genus shares with part of Canthocamptidae, i.e. the subfamily Canthocamptinae, the male P3 apophysis arising from inner margin of second segment, the presence of two

clusters of 4 pores (sieve) on the genital field, the loss of mandibular exp., the maxillulary coxa with just 2 setae and with its rami fused to the basis, and the maxilla without praecoxal endites and with enp. fused to basis. They also share with all Canthocamptidae the sexual dimorphism on endopod P3, the complex shape of the copulatory duct and the location of seminal receptacles.

The genital field of Canthocamptidae has so far been interpreted as having two rounded chitinised seminal receptacles in the proximal fourth of the genital double-somite and being connected with a straight copulatory tube. LANG (1948) considered this special structure a unique character of the family Canthocamptidae. Other authors (BORUTZKY 1952; EBERT 1976) followed this view and regarded the specific structure of the genital field as a powerful character to delimit genera and even families. However, to our knowledge, spermatozoa have never been observed in these strongly chitinised rounded structures. In *Selenopsyllus* the strongly chitinised rounded structures are in the proximal part of the genital somite and two additional rounded not-chitinised sacks lie posterior to the copulatory pore. Comparison with other Canthocamptidae such as *Canthocamptus, Bryocamptus, Moraria, Ceuthonectes, Epactophanes* reveals that the spermatozoa are always stored in these two not-chitinised rounded structures located in the second half of the double somite, and never in the proximal chitinised structures. The strongly chitinised structures are interpreted here as a labyrinthic extension of the copulatory tube, while the posterior rounded sacks represent the seminal receptacles, where spermatozoa are stored. Since the true seminal receptacles are not chitinised, it has to be noticed that they are practically discernible only when spermatozoa are stored in them. This may be the reason why their correct location has been overlooked in the past. Almost the same position and structure of seminal receptacles has been reported for the parastenocaridid *Parastenocaris hispanica* (MARTINEZ ARBIZU 1997). In canthocamptids the true seminal receptacles where figured but not explained in the redescription of *Moraria arboricola* SCOURFIELD (GURNEY 1932) and in the description of *Moraria fontinalis* (FLÖSSNER 1970). The new interpretation of the elements of the genital field is supported by a histological study which will be dealed with in separate account (MOURA, in prep.).

The genital field provides a great number of taxonomic characters that can be interpreted as potential synapomorphies at various hierarchical levels. Of particular relevance are i) the relative position of the copulatory pore, ii) the presence and position of integumental pores, tube pores and 'sieves' (clusters of pores), iii) the position and shape of the labyrinthic extensions of the copulatory duct, iv) the position of the seminal receptacles, v) the shape of the gonopores, and vi) the number of armature elements of female P6. The condition present in the ground pattern of Cylindropsyllinae with a copulatory pore located medially in the first half of the double somite, and with a straight tube leading to a labyrinthic proximal rounded chitinised structure connected with a pair of seminal receptacles in the second half of the double somite is symplesiomorphic for Canthocamptidae. The special position however of the labyrinthic duct beneath the plate of P6 and the wide genital opening in form of a hyperbola seem to be autapomorphic for the subfamily. This opening has many times been interpreted as 2 separate openings. In *Selenopsyllus* gen. nov. we can clearly see the lateral ends and also a middle part of the opening (Fig. 9B, arrow). The presence of two clusters of 4 small integumental pores, referred herein as 'sieves', is most probably a synapomorphy of the Canthocamptinae and Cylindropsyllinae. Within Canthocamptinae the number of pores is in some cases duplicated resulting in a 'sieve'with 8 pores. A 'sieve' with 3 pores, regarded here as plesiomorphic is present in *Cletocamptus* and *Mesochra*. In these taxa the 'sieves' are located laterally on the proximal part of the genital somite beneath the P6. No 'sieves' could, until now, be detected in the subfamilies Morarinae and Epactophaninae.

As argued by MARTINEZ ARBIZU & MOURA (1994) the Cylindropsyllinae are clearly related to the family Canthocamptidae. This latter family contains freshwater, brackish water and marine species currently grouped into five subfamilies i. e. the Canthocamptinae BRADY, Morarinae BORUTZKY, Epactophaninae BORUTZKY, Halocamptinae PESTA, and Hemimesochrinae POR. As the Cylindropsyllinae seem to share a sister group relationship with the Canthocamptinae (because of e.g. the shape of the sexually dimorphic male endopod P3; the shape of female genital field with a copulatory tube leading to a strongly chitinised rounded labyrinthic extension, and the pore patterns of the genital double somite) and as they are not the sister group of all Canthocamptidae, MARTINEZ ARBIZU & MOURA (1994) proposed to include this subfamily into the Canthocamptidae, and to dissolve the family Cylindropsyllidae. If the Canthocamptidae which clearly is a paraphyletic taxon, (because its definition is based upon plesiomorphic characters), should turn out to be restricted to the subfamily Canthocamptinae and if a sistergroup relationship of Cylindropsyllinae with all of them could be demonstrated, then its family status could be re-established. As long as a revision of the Canthocamptidae is not undertaken the Cylindropsyllinae are best placed in the Canthocamptidae and considered as a well justified monophyletic taxon of subfamily rank.

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