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The first record of *Orthopsyllus* species (Copepoda: Harpacticoida: Orthopsyllidae) from Korean waters

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During a study of harpacticoid copepods from Korea, one species of the family Orthopsyllidae was found by rinsing macroalgae collected from the intertidal and subtidal zones at Hangaechang, Munseum Islet in Jeju Island of Korea. The *Orthopsyllus* is closely related to *Orthopsyllus linearis curvaspinata* Mielke, 1993, however it is distinguished from the original description by the combined characters of slightly slender caudal seta V in the female, relatively short and ovoid caudal ramus, the seta formula of P3, and the length of P2 and P4 endopod in the male. Since *Orthopsyllus linearis* (Claus, 1866) is notorious for its incomplete previous descriptions and therefore its polymorphic status, it is premature to fix the status of present *Orthopsyllus* species from Korea, without the detailed comparative study among the congeners. However due to the urgent need for the report of the genus in the region, we report this species as *Orthopsyllus linearis* (Claus, 1866) like but different one within the genus: *Orthopsyllus* cf. *linearis* (Claus,1866). This is the first report of the genus *Orthopsyllus* for the first time in Korea.

Key words: *Orthopsyllus* cf. *linearis*, Orthopsyllidae, Harpacticoida, Copepoda, Jeju Island, Korea

Introduction

The family Orthopsyllidae has no formal diagnosis yet. When establishing the family, Huys (1990) referred to two newly erected genera of Orthopsyllidae, *Dionyx* and *Infrapedia*. However, the genera are *nomina nuda* since the paper cited by Huys has not been published (Boxshall and Halsey, 2004). However, the apomorphies provided by Huys (1990) clearly define this taxon and the family name is now widely accepted in harpacticoid literatures.

The family Orthopsyllidae includes one genus, six species (Boxshall and Halsey, 2004). In a complete revision of the genus, Boer (1971) distinguished four valid species, *O. linearis* (Claus, 1866), *O. wallini* Lang, 1934, *O. sarsi* Klie, 1941, and *O. spinicaudatus* Krishnaswamy, 1957. Since this revision, one new species *Orthopsyllus coralliophilus* Fiers, 1987 was described from Papua New Guinea, and one new subspecies *Orthopsyllus (linearis) curvaspina* Mielke, 1993 from the pacific coast of Costa Rica. Fiers (1987) reinstated *Orthopsyllus littoralis* Nicholls, 1942 as a valid species, which previously was considered to be a synonym of *O. wallini* by Boer (1971). Recently, Lee *et al.* (2011) reported *Orthopsyllus koprii* Lee, Gheerardyn, and Lee, 2011 from Marian cove, Maxwell Bay, King George Island Antarctica. Thus, the genus *Orthopsyllus* Brady & Robertson, 1873 presently includes seven species, as well as six subspecies considered within its type species. During a study of harpacticoid copepods in Hangaechang, Munseum Islet in Jeju Island of Korea, we found one species of *Orthopsyllus*, which is described herein.

Materials and Methods

Harpacticoid copepods were collected from a station off Hangaechang, Munseum Islet, Jeju Island on June 5, 2004. Copepods were sampled by rinsing the macroalgae collected from intertidal and subtidal zones.

Before dissection the habitus was drawn from whole specimens mounted in lactophenol. Specimens were dissected and the parts individually mounted in lactophenol under coverslips. All drawings were prepared using a drawing tube on an Olympus BX51 differential interference contrast microscope. All the specimens are deposited in the National Institute of Biological Resources (NIBR), Incheon.

The descriptive terminology is adapted from Huys *et al.* (1996). Abbreviations used in the text: Al, antennule; A2, antenna; ae, aesthetasc; P1-P6, first to sixth thoracopod; exp, exopod; enp, endopod; exp (enp)-1 (2, 3) to denote the proximal (middle, distal) segment of a three-segmented ramus. Scale bars in figures are indicated in μm.

Systematic Accounts

Order Harpacticoida Sars, 1903
Family Orthopsyllidae Huys, 1990
Genus *Orthopsyllus* Brady & Robertson, 1873

Orthopsyllus cf. *linearis* (Claus, 1866) (Figs. 1-9)

Material examined. 1♀ and 2♂♂ (KOSPIV0000147 557-9) dissected on 12 slides, respectively. All the specimens are from Hangaechang, Munseum Islet, Jeju Island, collected by E. Nam and Y.-H. Song on June 5 2004.

Female: Body flattened (Fig. 1A, B), slightly tapering posteriorly. Total body length 961 µm (measured from tip of rostrum to posterior end of caudal rami). Rostrum well developed, triangular with rounded tip with 1 pair of sensilla distally. Cephalothorax with pitted integument. Pedigerous somites covered with minute spinules along the frills. All prosomites without defined hyaline frills, and minute spinules along the frills. Anal operculum deeply curved, with crenate distal margin. Caudal rami (Figs. 1C, 5A, C) 1.5 times as long as broad in dorsal view, with 7 setae: I and II inserted closely together near proximal of lateral margin; III inserted subapically; IV, V, and VI inserted apically; IV and VI minute; V long and robust; VII inserted dorsally and subapically.

Antennule (Fig. 2A) 4-segmented. First segment short, with short row of spinules on anterior surface. Second segment large, with hook-like process at outer edge. Third segment longest, without element on outer margin. Distal segment slender. Amarture formula; 1, 8, 9+ (1+ ae).

Antenna (Fig. 2B) 3-segmented. Coxa with 1 spinule near middle of lateral margin. Allobasis with 1 abexopodal seta. Exopod 1-segmented, bearing 4 subequal bipinnate setae. Endopod with several spinules laterally and 1 row of spinules subapically, 2 unipinnate subapical and 2 unipinnate apical spines and 1 bipinnate, 1 tiny naked, and 2 long geniculate setae.

Mandible (Fig. 3A) with strong gnathobase bearing several incised teeth and 1 unipinnate seta. Mandibular palp 1-segmented, with 6 bipinnate setae.

Maxillule (Fig. 3B). Praecoxal arthrite with 1 slender seta on anterior surface and short row of spinules on posterior surface; apical armature consisting of 5 naked and 1 unipinnate spine, 2 bipinnate spines, 1 slender spine subapically. Coxal endite with well-developed with 1 unipinnate spine and 1 bipinnate seta. Basis with 1 bipinnate spine and 1bipinnate spine and 1naked spine apically, endopod represented by 1 bipinnate seta and 1 naked spine, exopod represented by 1 bipinnate seta.

Maxilla (Fig. 3C). Syncoxa bearing 3 endites, with long spinules along outer margin, 1 row of short spinules on posterior surface, and 1 row along inner margin. Proximal endite small and cylindrical, with 1 strong bipinnate seta. Middle endite with 1 strong unipinnate spine, 1 pinnate seta and 1 naked seta, and 2 short rows of spinules. Distal endite with 2 elements. Basis drawn out into strong, slightly curved, distally unipinnate claw, accessory armature consisting of 3 setae, 1 of which bipinnate. Endopod small, with 3 naked setae.

Maxilliped (Fig. 3D). Syncoxa with several rows of short spinules and 1 bipinnate seta. Basis with 1 longitudinal row of spinules along palmar margin. Endopod with drawn out into 1 long, distally pinnate curved claw, with 2 small accessory setae at base.

P1-P4 with 3-segmented exopod and 2-segmented endopod.

P1 (Fig. 4A). Coxa broadened, with spinules on outer edge. Basis with 1 bipinnate spine at outer corner and 1 bipinnate seta at inner corner, row of slender setules along inner margin, and row of spinules along proximal margin of endopod and around insertion area of outer seta. Exopod 3-segmented; exp-1 and exp-2 each with 1 outer bipinnate spine; exp-3 with 2 outer serrate spines, and 2 brush setae apically. Endopod 2-segmented; enp-1 reaching two-third of exp-2; enp-2 about 3 times longer than broad, with 1 serrate anterior claw and 1 brush seta apically.

P2-P4 (Figs. 4B, 5A, B). Coxa well developed and rectangular, basis with 1 outer seta and some spiules near to its insetion. Exopod 3-segmented. Exp-2 of P2-P4 without inner seta, with 1 spinous process at outer margin. Exp-3 of P2-P4 with 1 minute inner apical seta, 1 strong apical spine and 3 strong bipinnate outer spines. Endopod 2-segmented. Enp-1 very small and with ornamentations as figured, enp-2 not reaching beyond exp-1. Segments with patterns of spinules as figured. Enp-2 of P2 with 1 long inner plumose seta, 1 inner apical spinulose seta, and 1 inner apical short and naked seta. Enp-2 of P3 with 1 inner plumose seta, and 2 apical bipinnate setae. Enp-2 of P4 with 1 rather short, bipinnate, and 1 naked short setae along inner margin, and 1 long and stout bipinnate spine, and 1 minute naked seta apically.

Armature formula as follows:

P2 exp 0; 0; 023 end 0; 120
P3 exp 0; 0; 023 end 0; 120
P4 exp 0; 0; 023 end 0; 220

P5 (Fig. 6B) with separate exopod and baseoendopod; margins bearing slender spinules. Baseoendopod with 3 inner, and 2 apical setae. Basal seta arising from short cylindrical process. Endopodal lobe extending beyond middle of exopod. Exopod with 3 outer pinnate, and 3 apical setae, lateral setae strong, subapical inner and outer setae small.

P6 (Fig. 6A, D) represented by 1 pinnate and 2 small

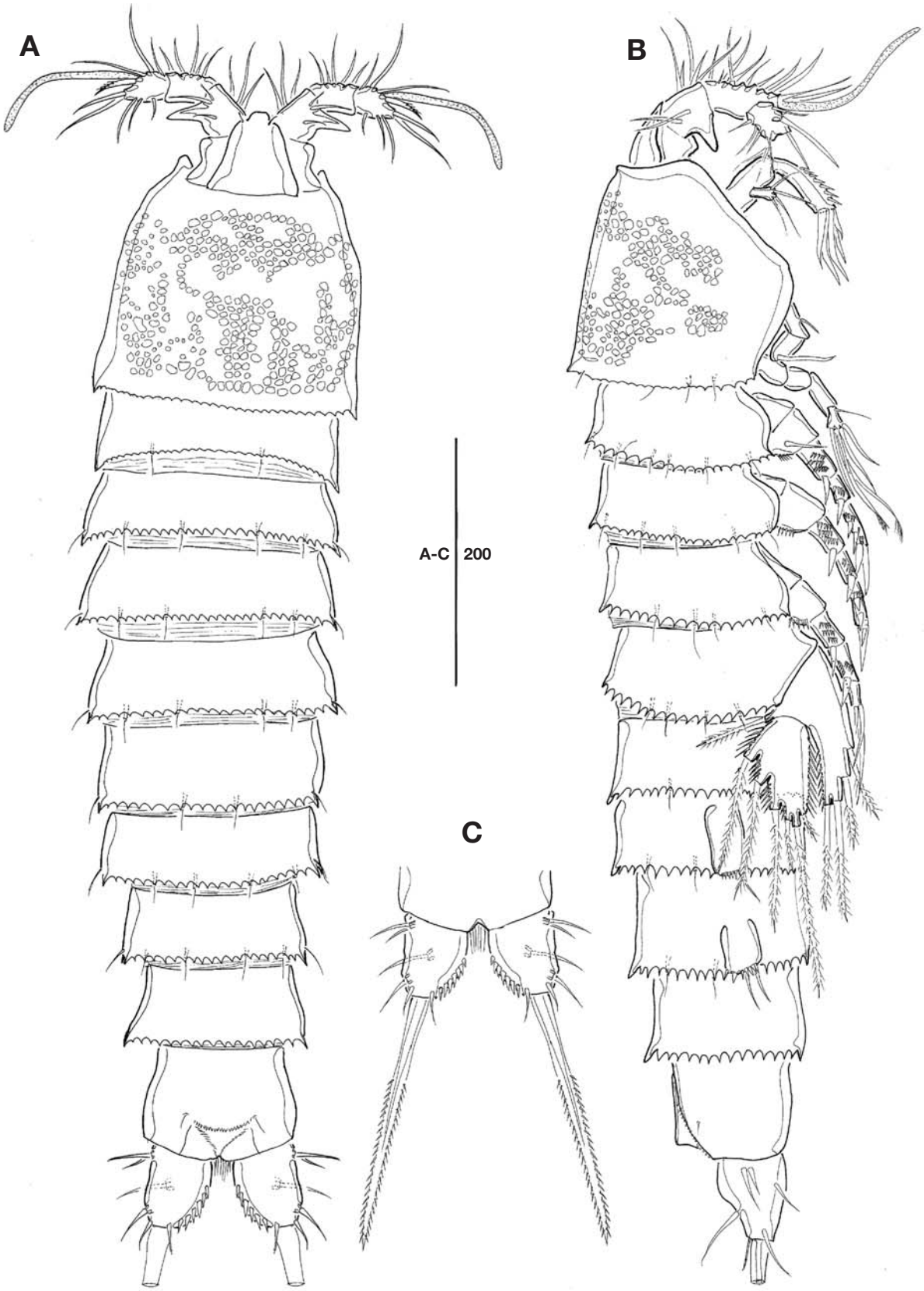

Fig. 1. *Orthopsyllus* cf. *linearis*. female. A. habitus, dorsal. B. habitus, lateral. C. caudal rami.

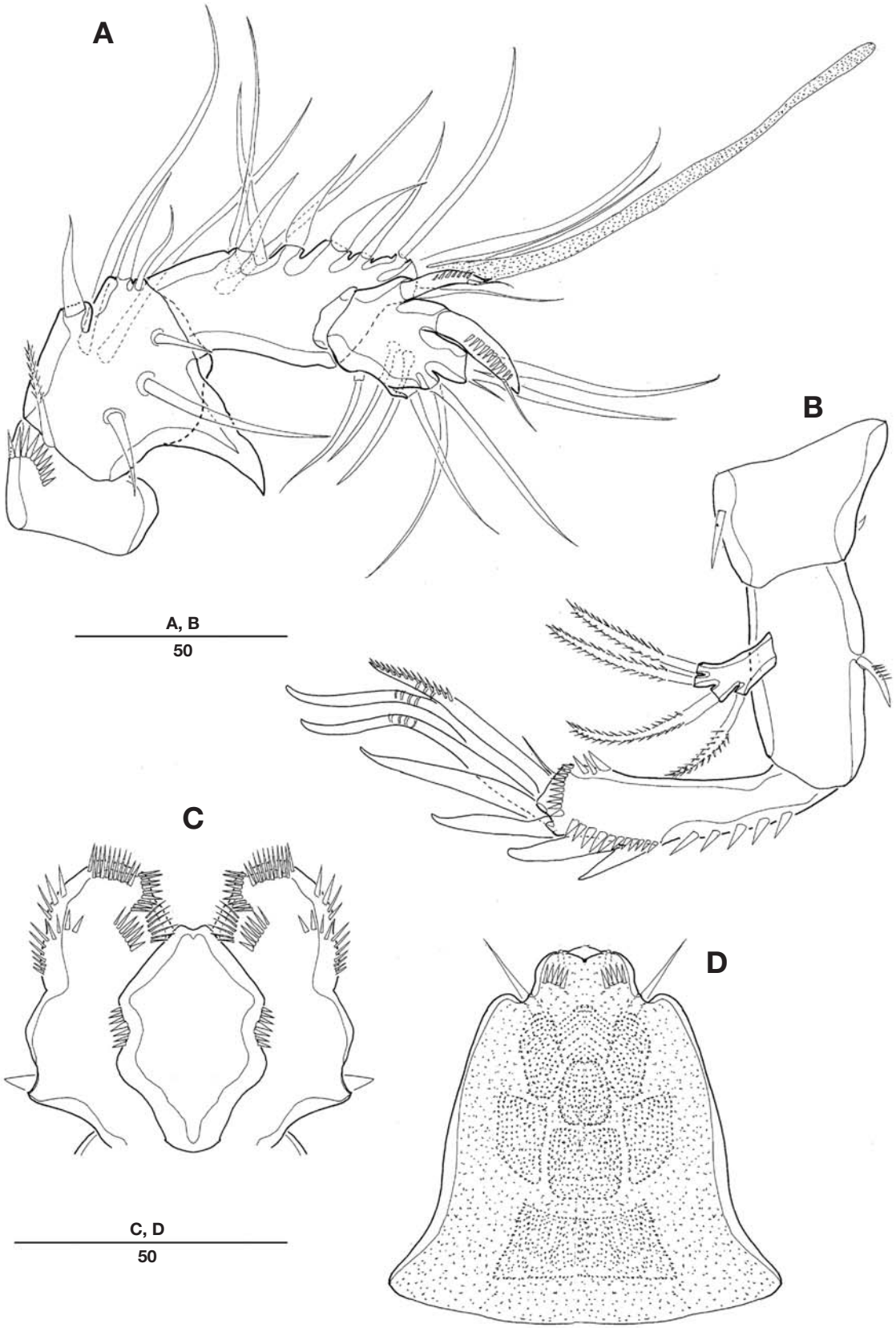

Fig. 2. *Orthopsyllus* cf. *linearis*. female. A. antennule. B. antenna. C. gnathobase. D. rostrum.

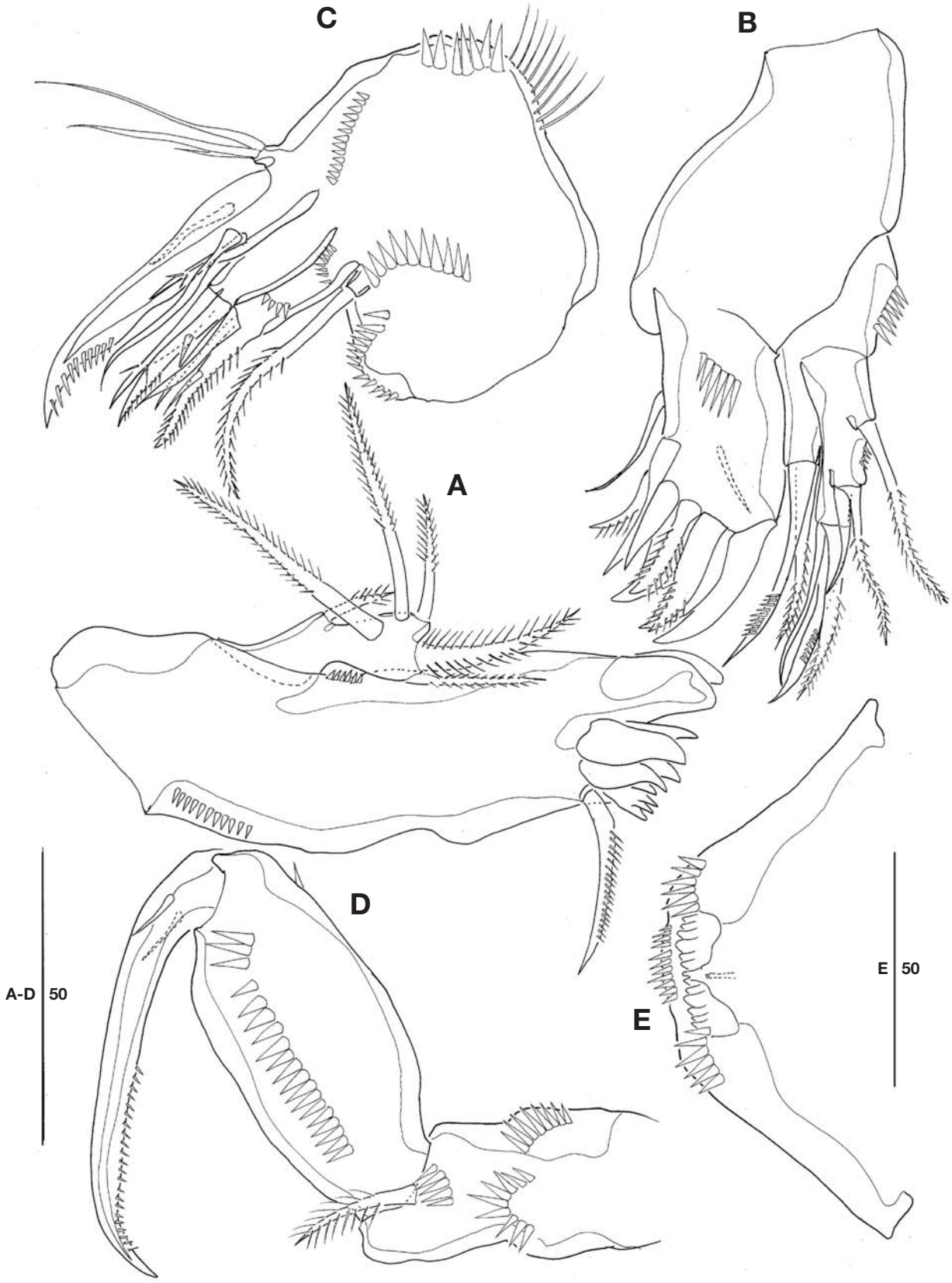

Fig. 3. *Orthopsyllus* cf. *linearis*. female. A. mandible. B. maxillule. C. maxilla. D. maxilliped. E. labrum.

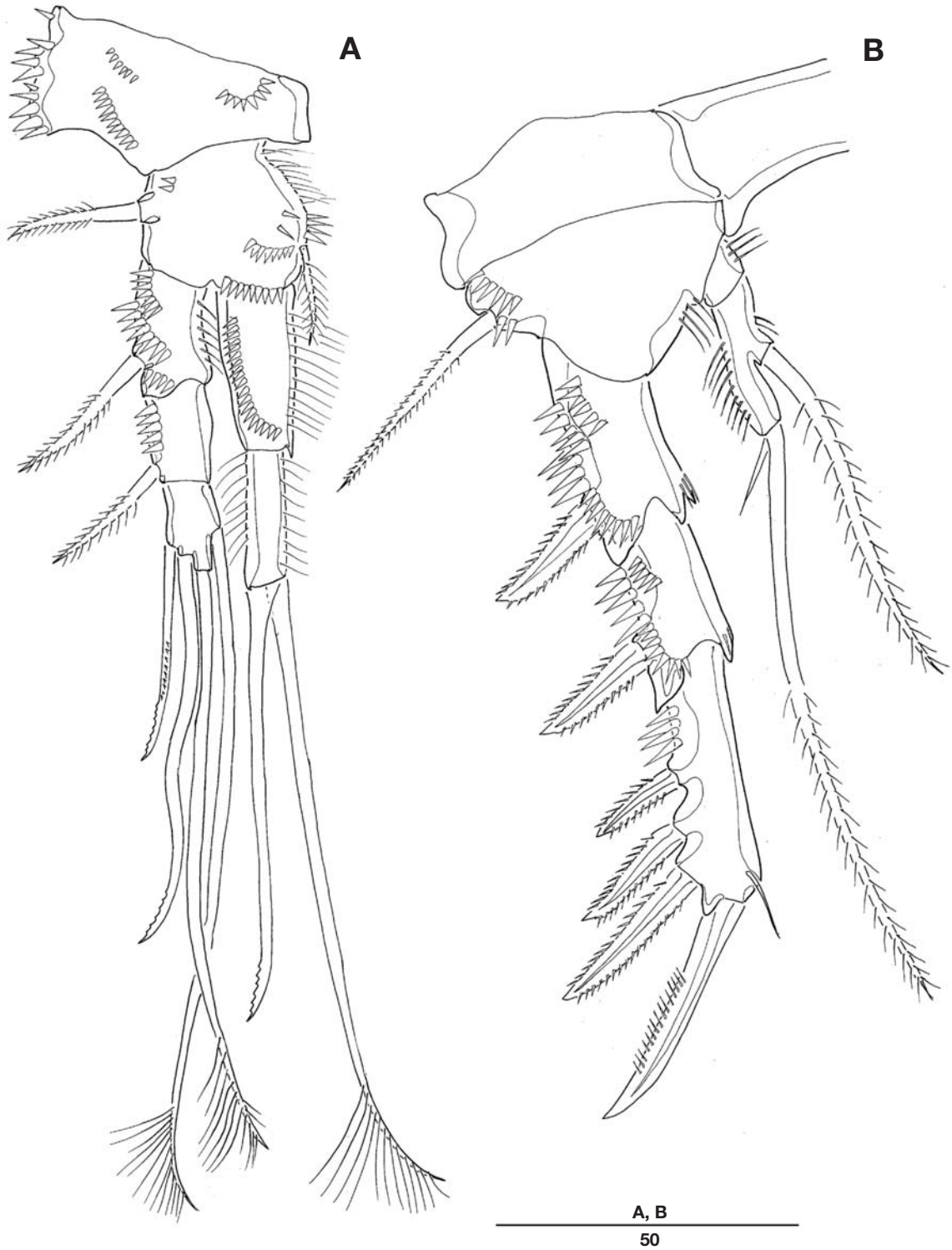

Fig. 4. *Orthopsyllus* cf. *linearis*. female. A. P1. B. P2.

naked setae.

Male: Total body length 850 µm (Fig. 7A). Body smaller and more slender than female. Caudal seta V longer and slender than in female as figured (Fig. 7E).

Antennule (Fig. 7A) 7-segmented and subchirocer with geniculation between segments 4 and 5. Segment 1 with

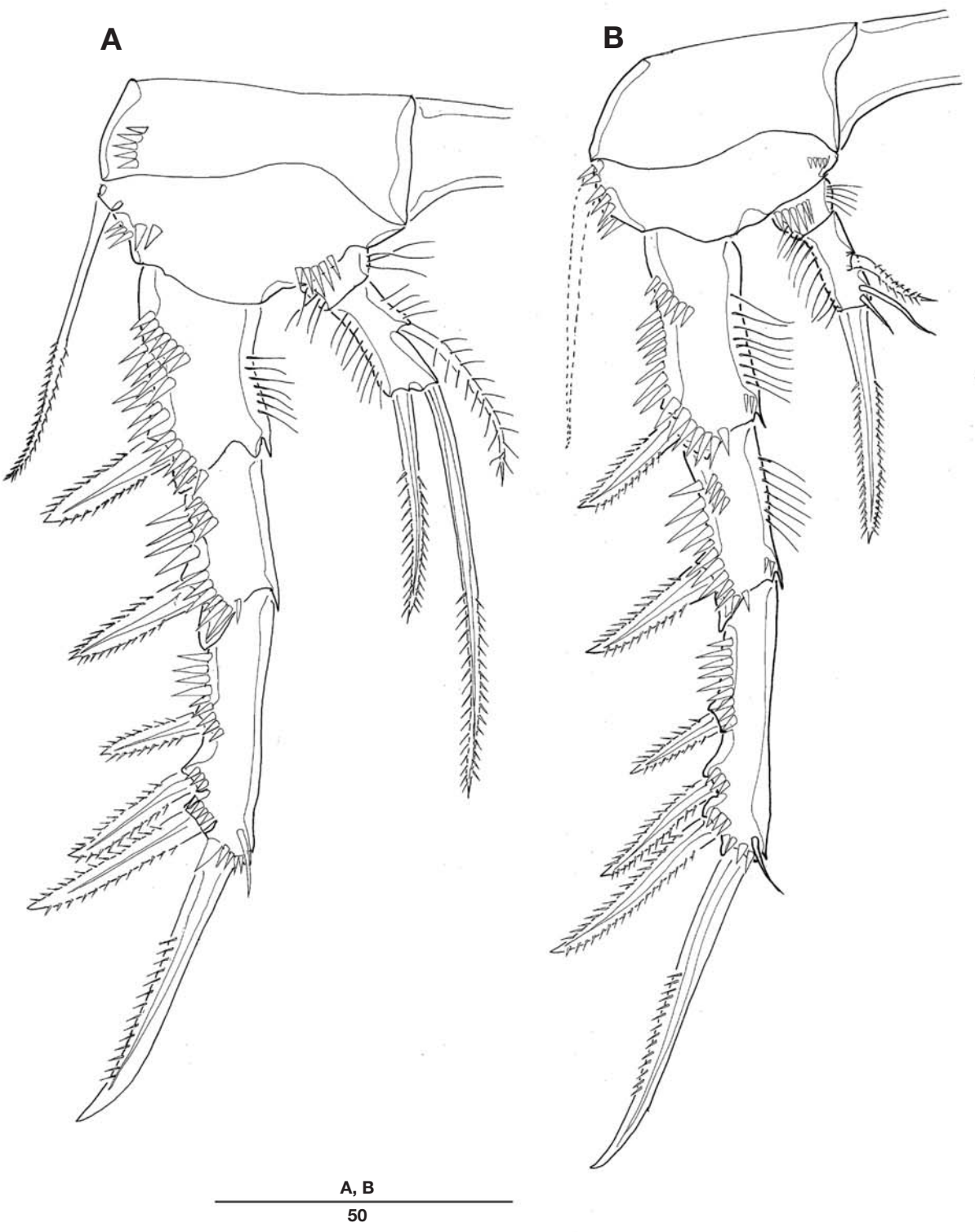

Fig. 5. *Orthopsyllus* cf. *linearis*. female. A. P3. B. P4.

several rows of long spinules surface. Segment 2 with triangular process. Segment 7 triangular shaped. Antenna, mouthparts, and P1 (Fig. 8A) as in female.

P2-P4 (Figs. 8B, 9A, B). P2 endopod much longer than in female, reaching to middle of exp-2; exp-3 with 3 outer, 1 apical modified spines, and 1 inner pinnate seta. P3

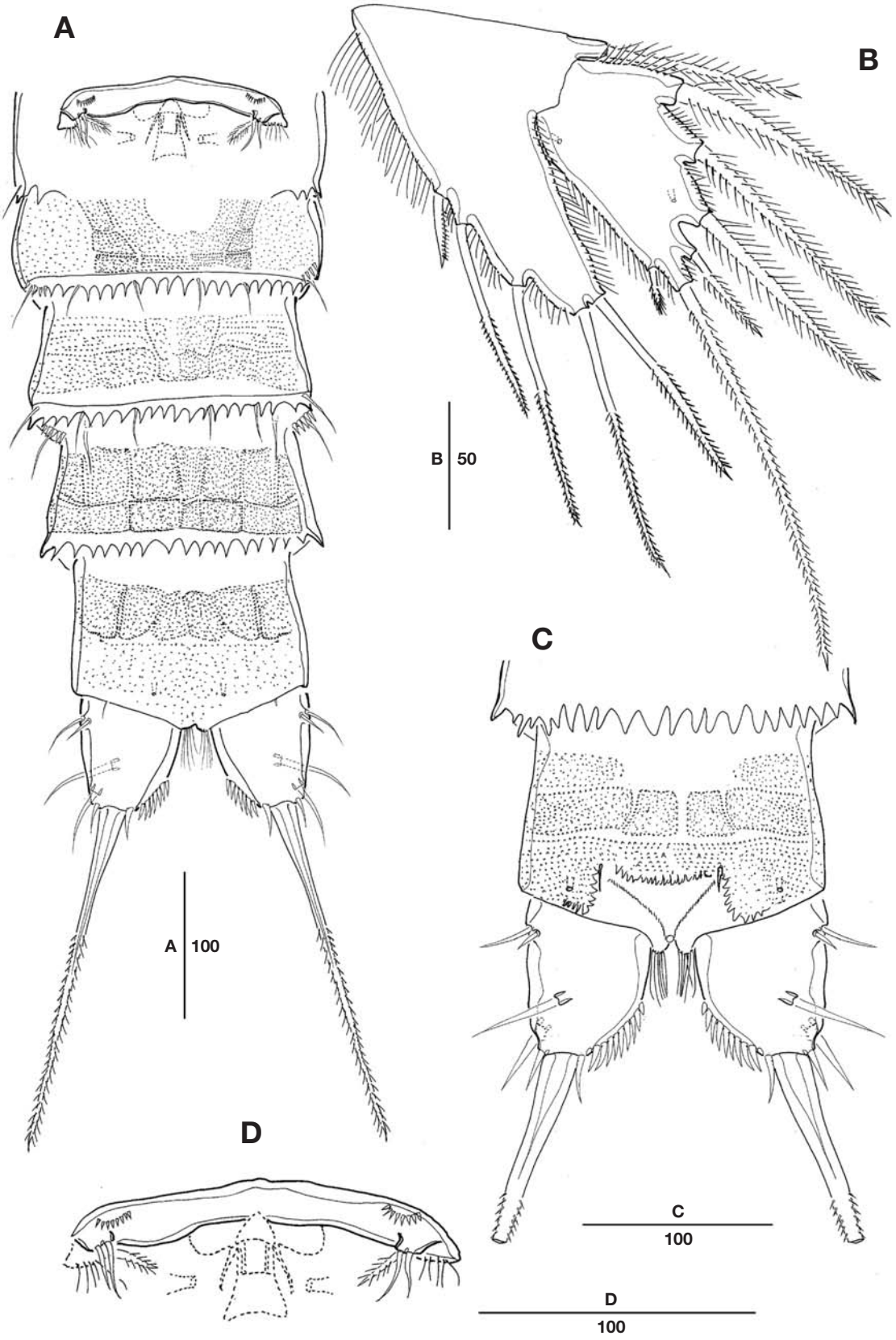

Fig. 6. *Orthopsyllus* cf. *linearis*. female. A. urosome, ventral. B. P5. C. caudal rami, dorsal. D. genital area.

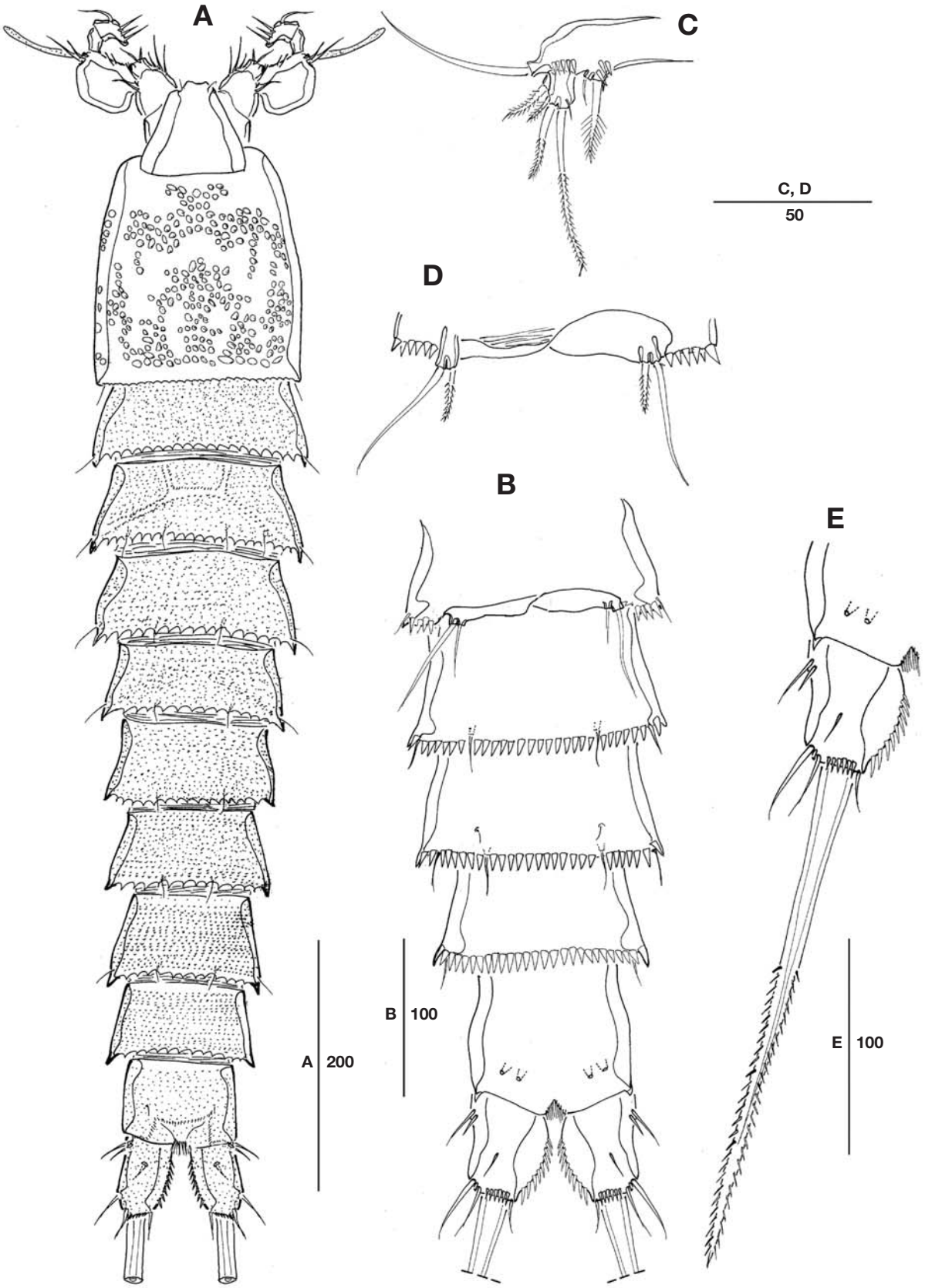

Fig. 7. *Orthopsyllus* cf. *linearis*. male. A. habitus, dorsal. B. urosome, ventral. C. P5. D. P6. E. caudal rami.

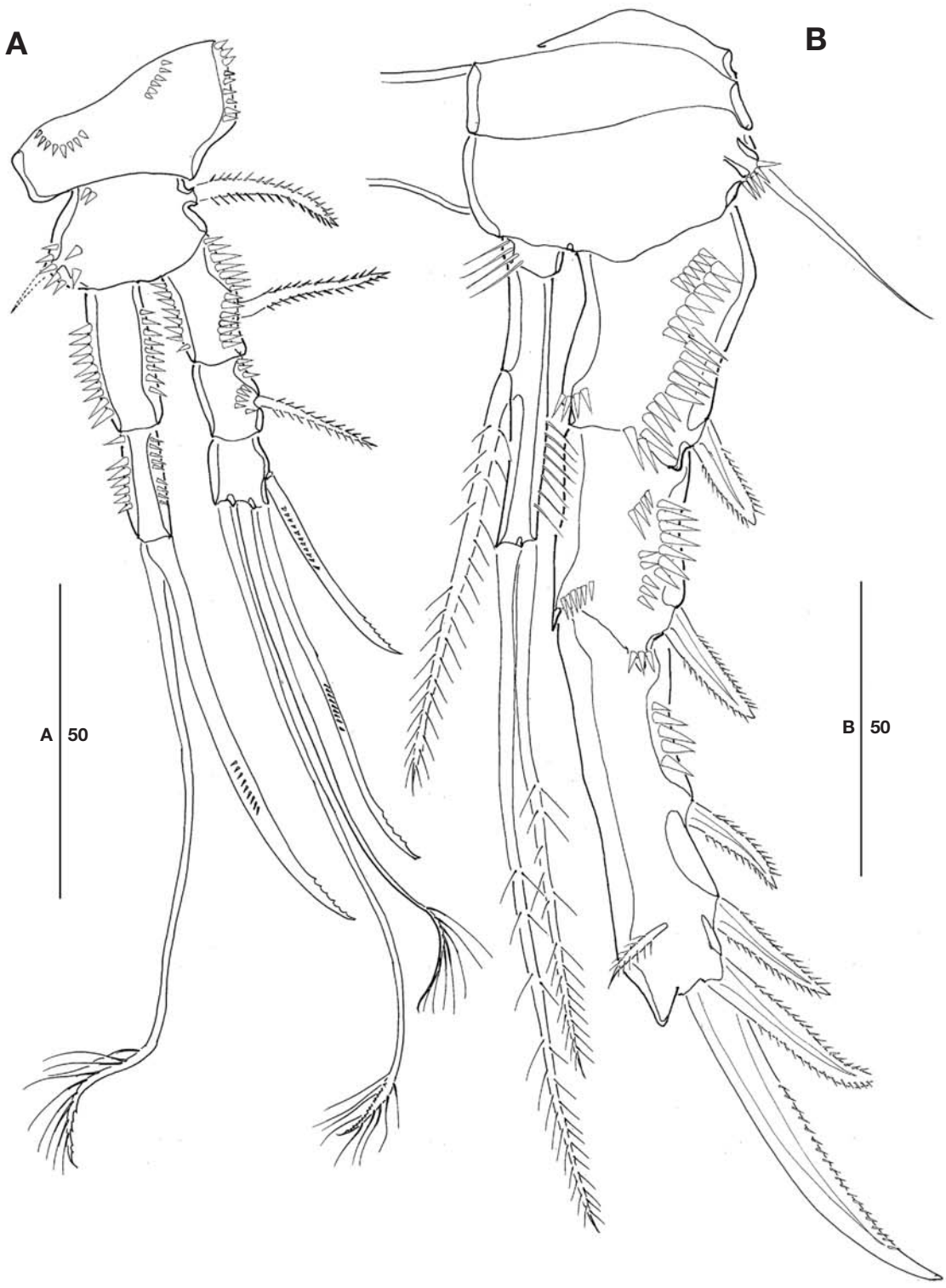

Fig. 8. *Orthopsyllus* cf. *linearis*. male. A. P1. B. P2.

exopod strongly developed; outer apical spine strong, bent toward endopod, and endopod of P3 3-segmented; enp-2 with long apophysis reaching beyond middle of exp-3; enp-3 with 1 inner bipinnate, 1 long apical pinnate and 1 small naked setae apically. P4 Enp-2 shorter than in female, and with 2 pinnate inner, and 1 minute naked

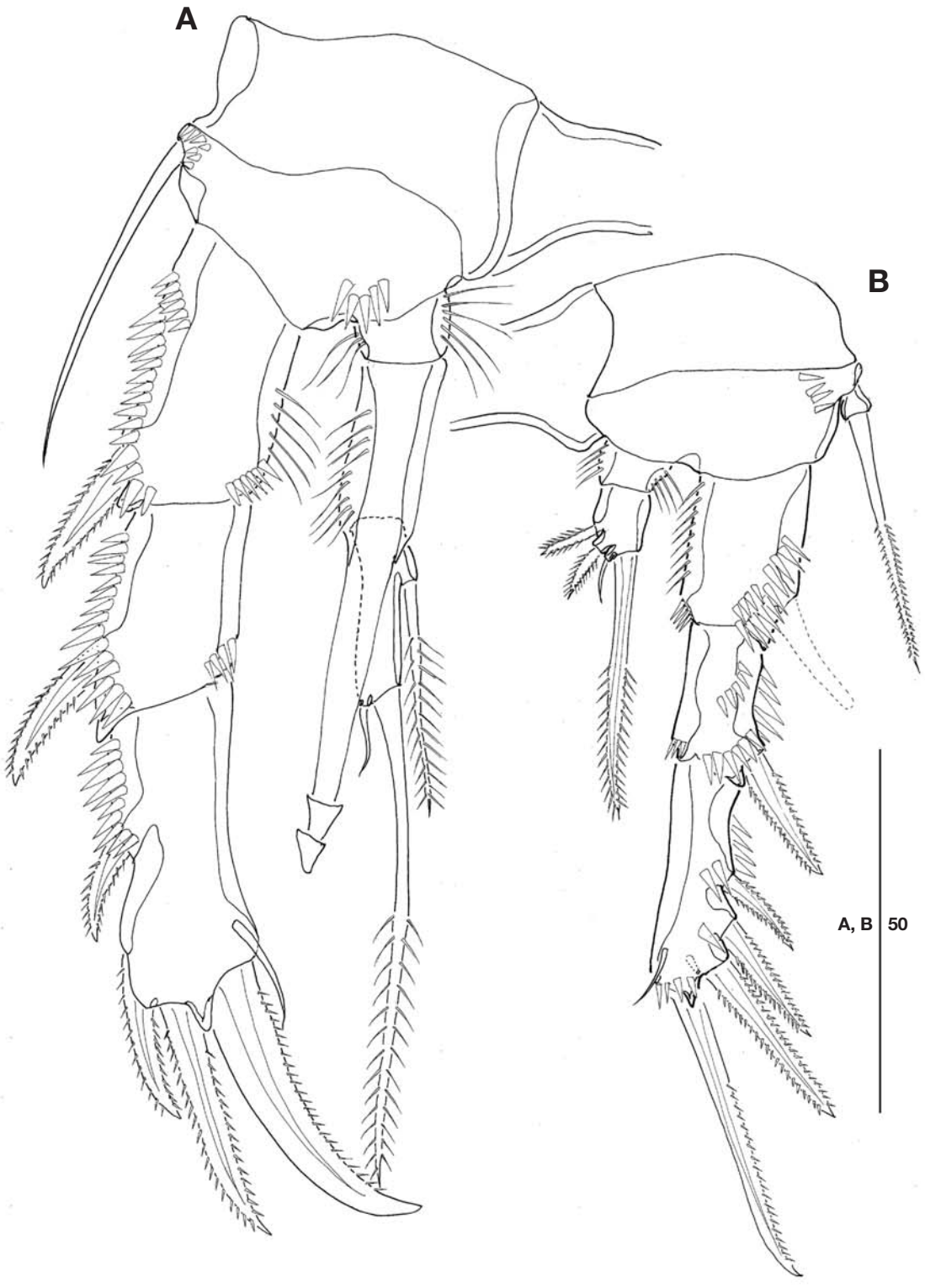

Fig. 9. *Orthopsyllus* cf. *linearis*. male. A. P3. B. P4.

and 1 strong bipinnate setae.

P5 (Fig. 7C). Both rami fused medially. Endopodal lobe small, bearing 1 bipinnate and 1 small naked setae. Exopod small, rectangular with 1 short naked inner and 3 outer bipinnate setae, and 1 long, bipinnate apical seta.

P6 (Fig. 7B, D) forming asymmetrical plate, each one

with 1 naked outer and 1 long bipinnate inner setae, apically.

Remarks. The Korean Specimen clearly belongs to the genus *Orthopsyllus* with the character set including four segmented antennules, only four setae on the antennary exopod, characteristic brush setae on the P1 exopod and endopod, segmentation of P1-P4, shape and seta formation of P5, and well developed caudal seta V. Present specimen is closely related to *Orthopsyllus linearis curvaspinata* Mielke, 1993. Both species share the distinct characters of the sexually dimorphic caudal seta V which is longer in the male than in the female (Figs. 1C and 7E), the modification of outer apical spine on the P2-P3 exp-3 (Figs. 8B and 9C), only two elements on the male P6. However they display several discrepancies including 1) bulbous caudal seta V in the female in *O. linearis curvaspinata* while slender in the present specimen, 2) longer and rectangular caudal rami in *O. linearis curvaspinata*, while shorter and ovoid in the present specimen, 3) one more seta on the P3 enp-2 in *O. linearis curvaspinata*, and 4) longer P2 and P4 enp-2 in the male of *O. linearis curvaspinata*. There is complex history of discussion on the genus *Orthopsyllus* (Vervoort, 1964; Lang, 1965; Boer, 1971; Huys, 1990), and many authors created subspecies within the type species rather than establishing species due to the incomplete previous description of type species, *O. linearis* (Claus, 1866) as Mielke (1993) also pointed out. It is difficult to decide the status of present specimen from Korea with the poor comparisons with other congeners, which would take a time for a while, however the report of unrecorded genus in local area has a meaning. Therefore we tentatively regarded Korean species as *Orthopsyllus* cf. *linearis* (Claus, 1866) rather than establishing another new subspecies. It would be interesting if we get the further evidence including molecular data revealing the status of *Orthopsyllus* cf. *linearis* (Claus, 1866) in further study.

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