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A new species of *Orthopsyllus* Brady & Robinson, 1873 (Copepoda: Harpacticoida: Orthopsyllidae) from Maxwell Bay, King George Island, Antarctica

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Abstract.—The genus *Orthopsyllus* Brady & Robertson, 1873 (Harpacticoida, Orthopsyllidae) presently includes six species, as well as six subspecies considered within its type species. *Orthopsyllus koprii*, new species, is described from Barton Peninsula, Maxwell Bay, King George Island, Antarctica and can be distinguished from its congeners by the presence of an inner seta on the middle exopodal segments of P2 and P3. *Orthopsyllus spinicaudatus* Krishnaswamy, 1957 also carries an inner seta on these segments but differs in the presence of a single apical seta on the endopod of P2.

Keywords: armature formula, harpacticoid subspecies, intraspecific variability, sexual dimorphism

The genus *Orthopsyllus* Brady & Robertson, 1873 was revised by Boer (1971), who distinguished four valid species, *Orthopsyllus linearis* (Claus, 1866), *Orthopsyllus wallini* Lang, 1934, *Orthopsyllus sarsi* Klie, 1941, and *Orthopsyllus spinicaudatus* Krishnaswamy, 1957 and relegated all other described species to subspecies within *O. linearis*, namely *Orthopsyllus* (*linearis*) *linearis* (Claus, 1866), *Orthopsyllus* (*linearis*) *major* Klie, 1939, *Orthopsyllus* (*linearis*) *improportionatus* (Jakobi, 1954), *Orthopsyllus* (*linearis*) *illgi* (Chappuis, 1958), and *Orthopsyllus* (*linearis*) *setosus* Boer, 1971. Several of these changes had already been hinted at in the extensive review of *Orthopsyllus* by Vervoort (1964). Since Boer (1971), one new species, *Orthopsyllus coralliophilus* Fiers, 1987, was described from Papua New Guinea (Fiers 1987), and one new subspecies *Orthopsyllus* (*linearis*) *curvaspina* Mielke, 1993 from the Pacific coast of Costa Rica (Mielke 1993). Fiers (1987) reinstated *Orthopsyllus littoralis* Nicholls, 1942 [erroneously indicated as 1943 in Fiers (1987)] as a valid species, which previously was considered to be a synonym of *O. wallini* by Boer (1971). Huys (1990) removed *Orthopsyllus* from Canthocamptidae Brady, 1880 to the new family Orthopsyllidae Huys, 1990 in the superfamily Laophontoidea T. Scott, 1905. Although no formal diagnosis of Orthopsyllidae has been given as yet, the apomorphies provided by Huys (1990) clearly define this taxon.

Several authors (e.g., Vervoort 1964, Lang 1965, Boer 1971, Mielke 1993) have addressed the difficulties in *Orthopsyllus* with respect to the delimitation and number of species. These are mainly due to the insufficient descriptions of the type and several other species, and the appar-

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ent high intraspecific variability of the type species. During a study of harpacticoid copepods in Maxwell Bay, King George Island, Antarctica, we found one new representative of *Orthopsyllus*, which is described herein.

Materials and Methods

Samples were collected from the coast of Barton Peninsula in Maxwell Bay (King George Island) on 1 Nov 1996, during the ninth overwinter research party at King Sejong Station (Korean Antarctic Research Station). Harpacticoid copepods were washed from the holdfast (with some retained sediments) of a brown alga, *Cystosphaera jacquinotii*, which was caught accidentally by a fishing pole and were preserved in 5% neutral formalin.

Specimens were dissected in lactic acid, and the dissected parts were mounted on slides in lactophenol mounting medium. Preparations were sealed with Glyceel or transparent nail varnish. All drawings were prepared using a drawing tube on an Olympus BX51 differential interference contrast microscope. The descriptive terminology is adopted from Huys et al. (1996). Abbreviations used in the text are: A1, antennule; A2, antenna; ae, aesthetasc; enp, endopod; exp, exopod; P1–P4, first to fourth swimming legs; P5–P6, fifth to sixth legs; exp (enp)-1(-2, -3) to denote the proximal (middle, distal) segment of a three-segmented ramus. Specimens are deposited in the NIBR (National Institute of Biological Resources), Korea. Scale bars for figures are indicated in μm.

Systematics

Family Orthopsyllidae Huys, 1990

Orthopsyllus Brady & Robertson, 1873

Orthopsyllus koprii, new species

Figs. 1–9

Type locality.—Holdfast of a brown alga, *Cystosphaera jacquinotii*, collected from the coast of Barton Peninsula in Maxwell Bay, King George Island, Antarctica. Collected on 1 Nov 1996.

Material examined.—Holotype: 1 female (NIBRIV 0000229927) dissected on 13 slides. Allotype: 1 male (NIBRV 0000229928) on 6 slides.

Description of female.—Habitus (Figs. 1A, B, 5B). Body elongate, almost cylindrical, slightly tapering posteriorly. Total body length 1.52 mm (measured from tip of rostrum to posterior end of caudal rami). Rostrum defined at base, triangular with rounded tip, with 1 pair of sensilla distally. Cephalothorax with pitted integument. Posterior margin of cephalothorax serrate, margins of pro- and urosomites strongly serrate. Prosomites and urosomites clearly demarcated from each other. Free prosomites as wide as cephalothorax. Second and third urosomites fused to form genital doublesomite, but with transverse ridge dorsally and laterally indicating original segmentation; fully fused ventrally. Anal somite as long as broad, anal operculum with 1 row of minute spinules.

Caudal rami (Figs. 1A, B, 5B, C) 1.5 times as long as broad, with 7 setae: I and II inserted closely together near middle 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. Distal half of inner margin of caudal rami rounded, with row of spinous processes. Dorsal surface of caudal rami with curved row of spinules in proximal half and few spinules near insertion place of seta VII.

Antennule (Fig. 2A) 4-segmented. First segment short, with short row of spinules on anterior surface. Second segment large, with 1 strong spinous process at outer edge. Third segment longest, without element on outer margin. Distal segment slender. Armature formula: 1, 8, 9+ (1 + aes), 12.

Antenna (Fig. 2B). Coxa bearing short row of spinules. Allobasis with 1 unipinnate abexopodal seta at midlength.

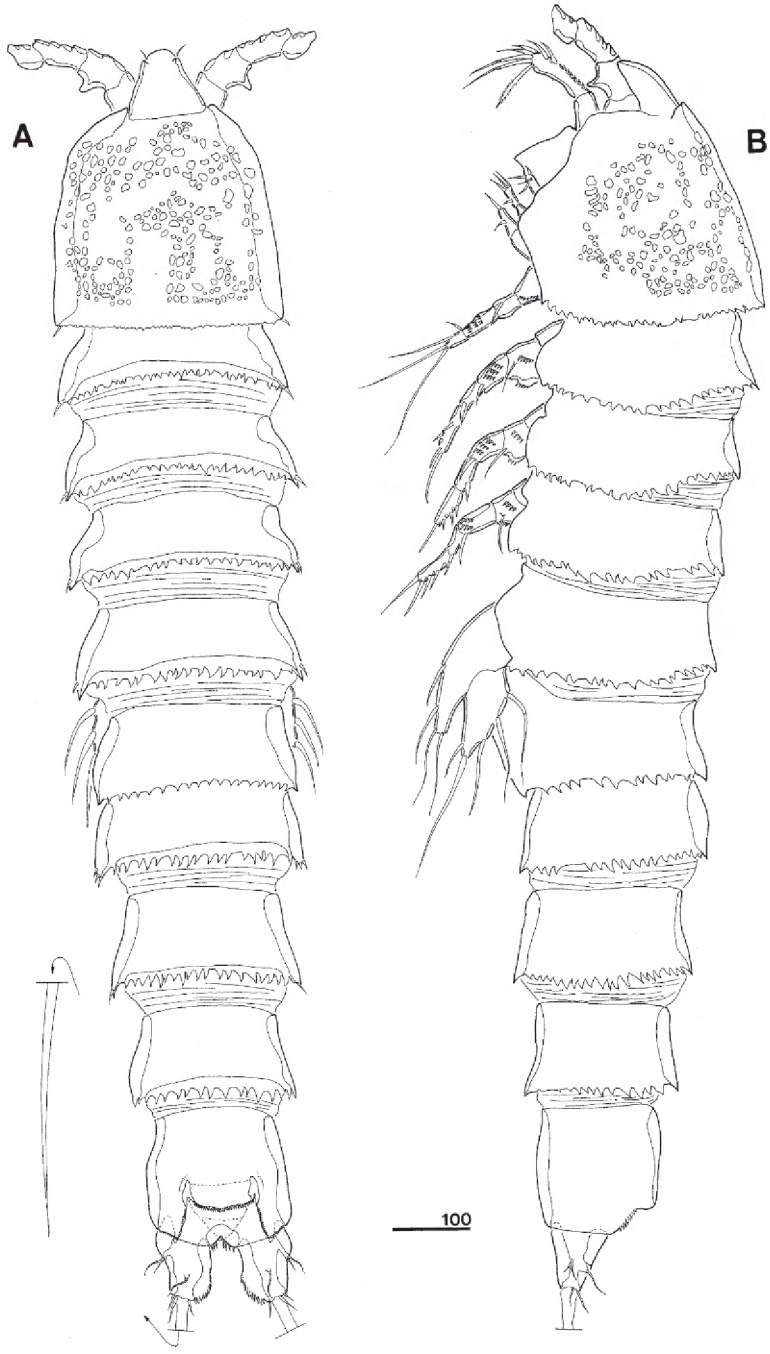

Fig. 1. *Orthopsyllus koprii*, female. A, Habitus, dorsal. B, Habitus, lateral.

Exopod of 1-segmented, small, oblong and somewhat curved, bearing 4 subequal bipinnate setae. Endopod with several spinules laterally and 2 rows of spinules subapically, subapically with 2 unipinnate spines, apically with 2 unipinnate spines, 2 long geniculate setae, 1 bipinnate seta, and 1 tiny naked seta (fused at base).

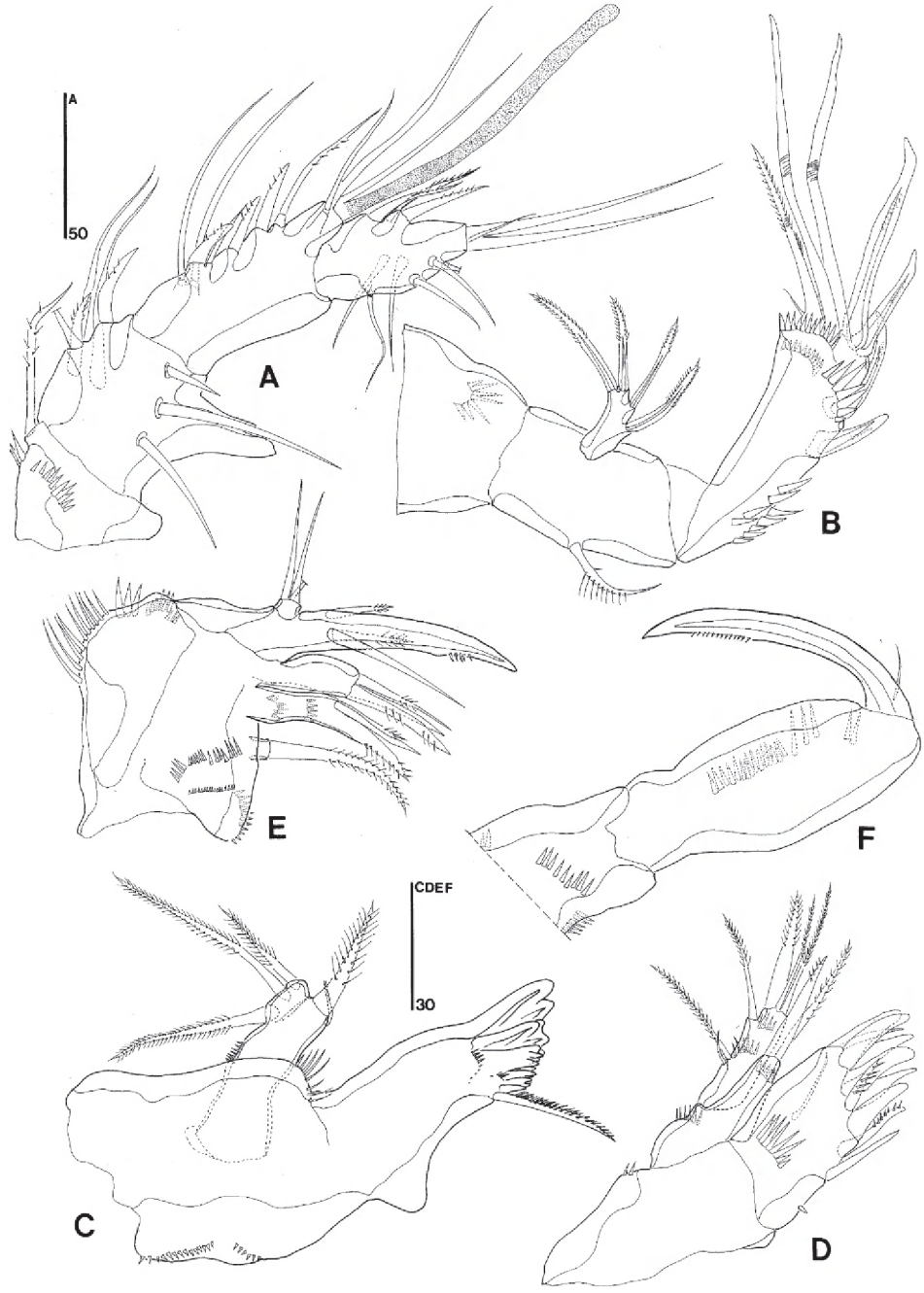

Fig. 2. *Orthopsyllus koprii*, female. A, Antennule. B, Antenna. C, Mandible. D, Maxillule. E, Maxilla. F, Maxilliped.

Mandible (Fig. 2C) with strong gnathobase bearing several incised teeth and 1 unipinnate seta. Mandibular palp 1-segmented, with bipinnate setae: 2 inner and 3 apical.

Maxillule (Fig. 2D). Praecoxal arthrite with 1 slender seta on anterior surface and short row of spinules on posterior surface; apical armature consisting of 7 naked and 2 unipinnate spines, 1 slender

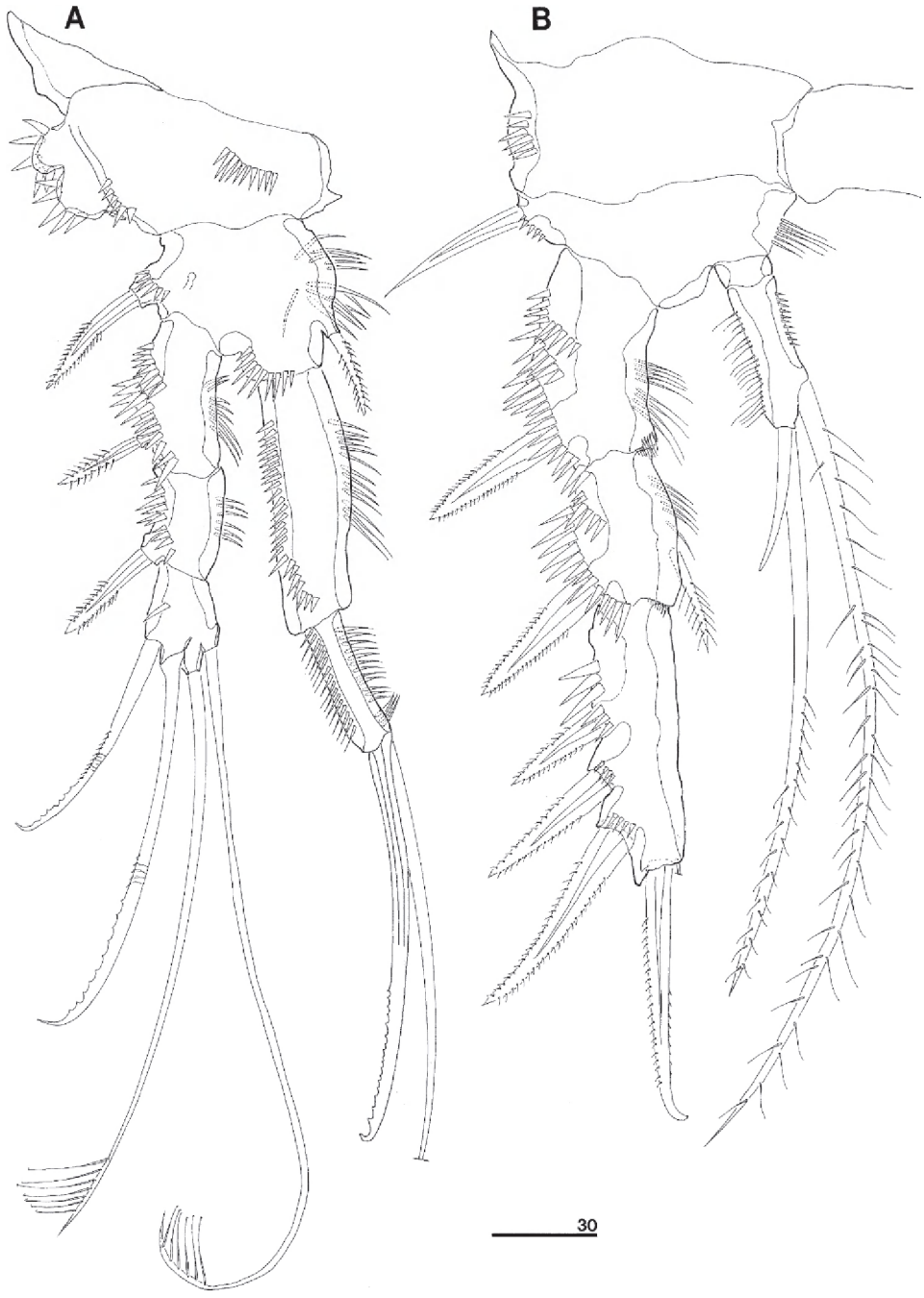

Fig. 3. *Orthopsyllus koprii*, female. A, P1. B, P2.

spine subapically. Coxal endite with 1 well-developed unipinnate spine and 1 bipinnate seta. Basis with 1 bipinnate spine and 2 bipinnate setae apically, endopod represented by 1 bipinnate seta, exopod represented by 1 bipinnate seta, and 1 short, slender seta.

Maxilla (Fig. 2E). Syncoxa bearing 3 endites, with long spinules along outer margin, 2 rows of short spinules on

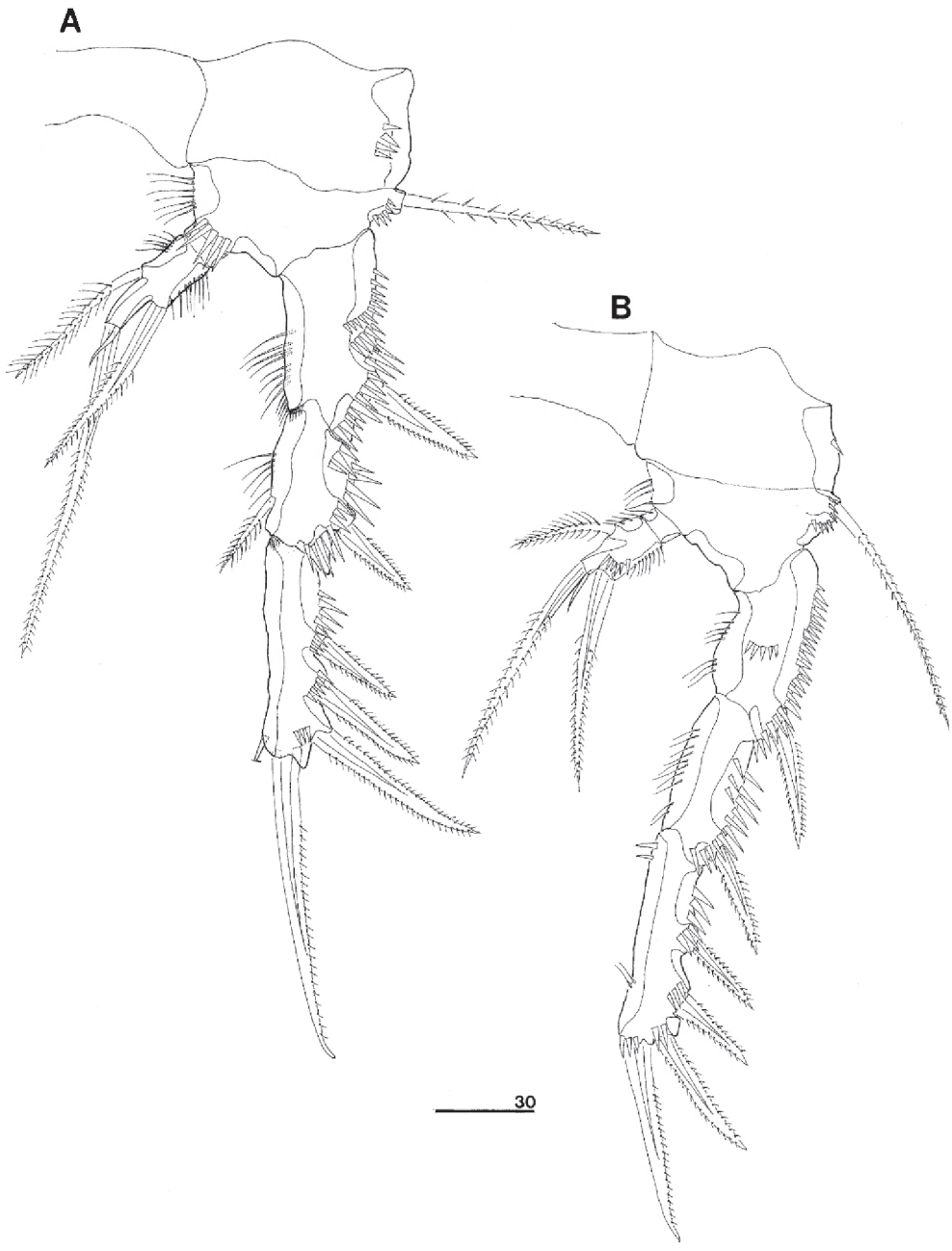

Fig. 4. *Orthopsyllus koprii*, female. A, P3. B, P4.

posterior surface, and 1 row along inner margin. Proximal endite small and cylindrical, with 1 strong bipinnate seta. Both distal endites with 1 strong unipinnate spine, 1 pinnate seta and 1 naked seta. Middle endite with 2 short rows of spinules. Basis drawn out into strong, slightly curved, distally unipinnate claw, accessory armature consisting of 3 setae, 2 of which bipinnate. Endopod small, with 3 naked setae.

Maxilliped (Fig. 2F). Syncoxa with several short rows of spinules (setation unknown because of damage). Basis with

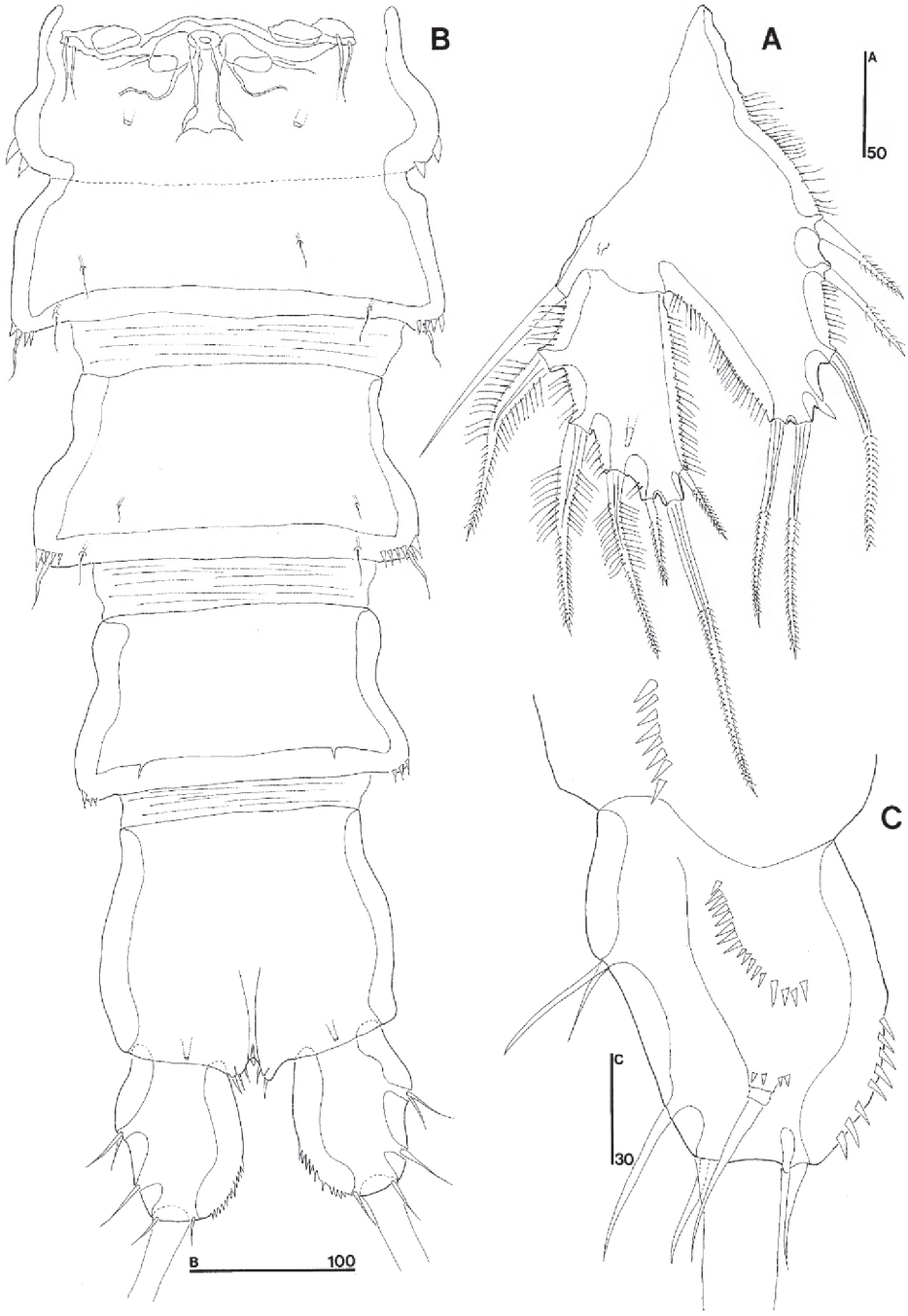

Fig. 5. *Orthopsyllus koprii*, female. A, P5. B, Urosome, ventral (excluding P5-bearing somite). C, Right caudal ramus, dorsal.

1 longitudinal row of spinules along palmar margin. Endopod drawn out into 1 long, distally pinnate curved claw, with 1 small accessory seta at base.

P1 (Fig. 3A, Table 1). Coxa broad and short, with 2 short rows of spinules on anterior surface, along outer margin with 2 rounded crests bearing 1 row of strong

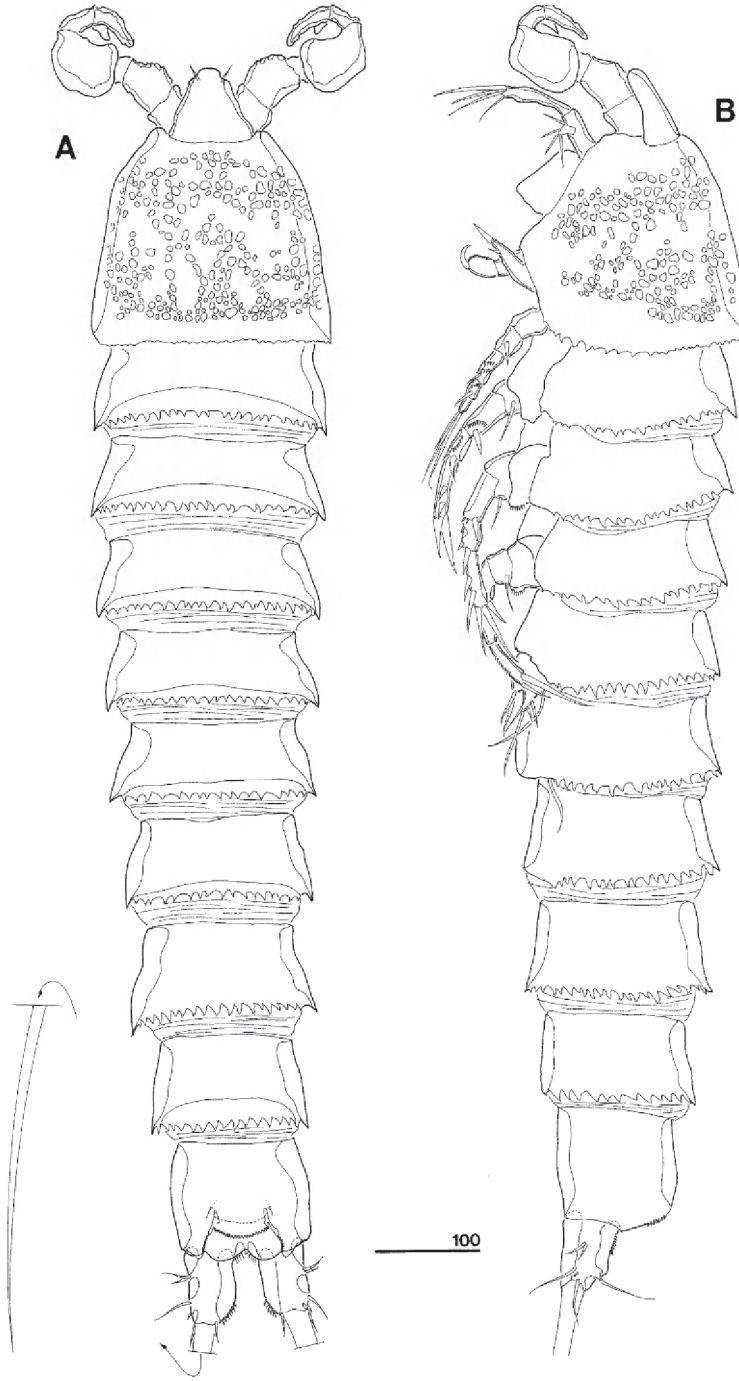

Fig. 6. *Orthopsyllus koprii*, male. A, Habitus, dorsal. B, Habitus, lateral.

spinules. Basis with 1 bipinnate spine at outer corner and 1 bipinnate seta at inner corner, some slender spinules along inner margin, and some short spinules at insertion of endopod and base of outer seta. Exopod and endopod with spinule pattern as illustrated. Exopod 3-segmented; exp-1 and exp-2 each with 1 outer

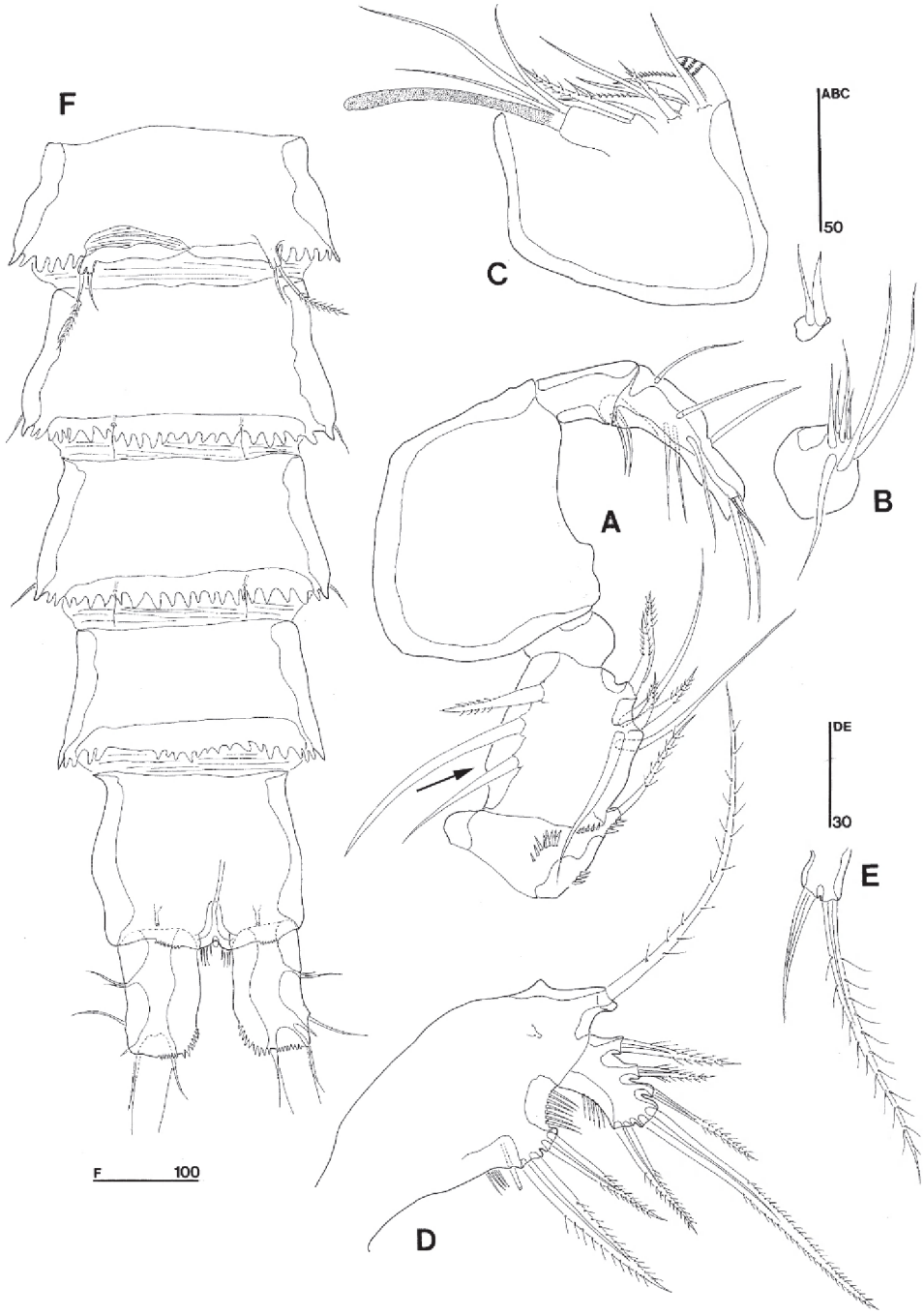

Fig. 7. *Orthopsyllus koprii*, male. A, Antennule (arrow indicating reduced process). B, Third and fourth segment of antennule. C, Fifth segment of antennule. D, Left P5. E, Left P6. F, Urosome, ventral (excluding P5-bearing somite).

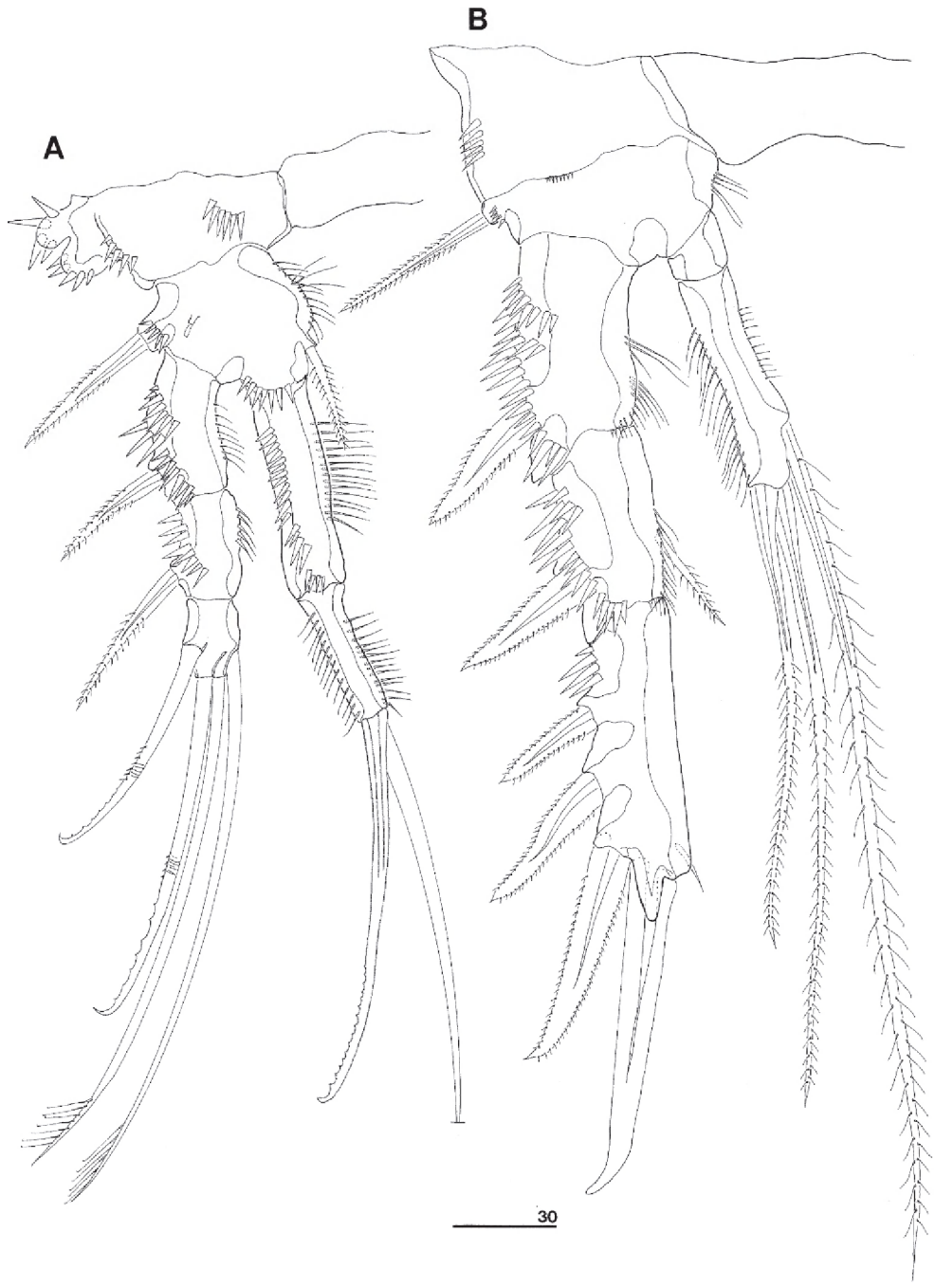

Fig. 8. *Orthopsyllus koprii*, male. A, P1. B, P2.

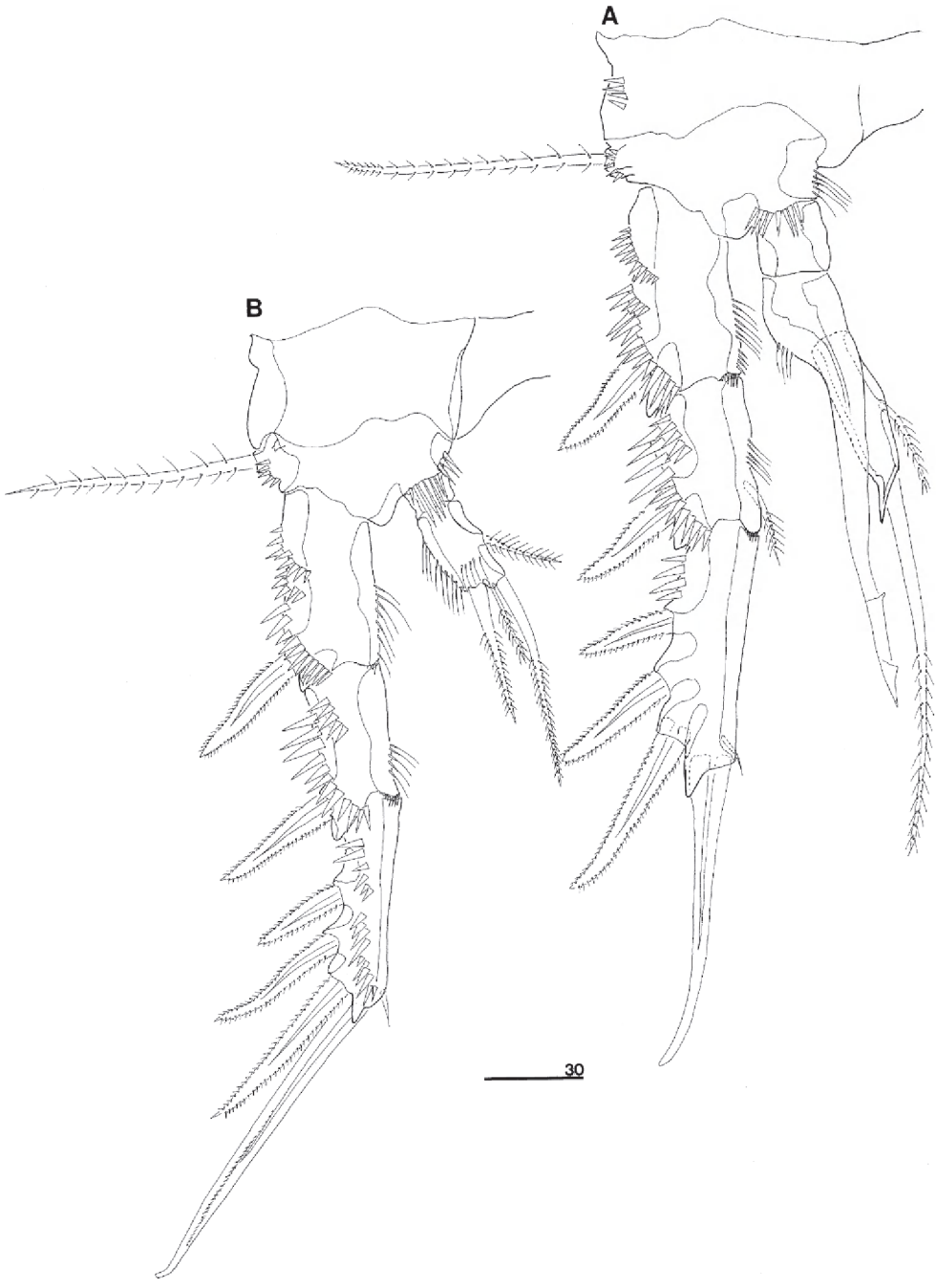

Fig. 9. *Orthopsyllus koprii*, male. A, P3. B, P4.

Table 1.—Armature formula of P1–P4.

	Coxa	Basis	Exopod	Endopod
P1	0-0	I-I	I-0; I-0; II,2,0	0-0; 0,I + 1,0
P2	0-0	1-0	I-0; I-1; III,I + 1,0	0-0; 0,2,1
P3	0-0	1-0	I-0; I-1; III,I + 1,0	0-0; I,2,1 [♂: 0-0; 0-0; 0,1,1]
P4	0-0	1-0	I-0; I-0; III,I + 1,0	0-0; I,2,1

bipinnate spine; exp-3 with 2 outer geniculate and serrate spines, and 2 long brush setae apically. Endopod 2-segmented; enp-1 reaching to middle of exp-3; enp-2 about 3 times longer than broad, apically with 1 long, serrate anterior claw and long posterior brush seta (broken during dissection but observed as 1 long brush seta prior to mounting).

P2–P4 (Figs. 3B, 4A, B, Table 1). Coxa well developed and rectangular, basis rather short with 1 outer seta. Exopod 3-segmented. Exp-2 of P2 and P3 each with 1 short inner bipinnate seta; exp-2 of P4 without inner seta. Exp-3 of P2–P4 without inner setae, with 1 minute inner apical seta (presence of this seta not confirmed in female because of damage but present in male), 1 strong apical spine and 3 strong bipinnate outer spines. Endopod 2-segmented. Enp-1 very small and without ornamentation, enp-2 not reaching beyond exp-1. Endopods decreasing in length from P2 to P4. Segments with patterns of spinules as figured. Enp-2 of P2 with 1 inner long plumose seta, 1 inner apical spinulose seta, and 1 outer apical short and naked seta. Enp-2 of P3 and P4 short, with 1 rather short, bipinnate inner seta and outer spine, 1 inner apical long and bipinnate seta, and 1 outer apical very short and naked seta each.

P5 (Fig. 5A) with separate exopod and baseoendopod; margins bearing slender spinules; surface of both rami smooth. Basal seta arising from short cylindrical setophore. Endopodal lobe extending beyond middle of exopod and bearing 5 bipinnate setae; 2 innermost rather short. Exopod with 6 setae, lateral setae strong, subapical inner and outer setae small.

P6 (Fig. 5B) represented by 2 small naked setae.

Sexual dimorphism in antennules, urosomites, P2–P6.

Description of male.—Habitus (Fig. 6A, B). Total body length 1.17 mm (measured from tip of rostrum to posterior end of caudal rami). General body shape similar to female, except for completely separated second and third urosomites.

Antennule (Fig. 7A–C) subchirocer, 7-segmented. Outer process on second segment strongly reduced. Distal segment prolonged and curved. Armature formula: 1, 10, 7, 2, 11(?) + (1 + ae), 2, 9.

Antenna, mouthparts, and P1 (Fig. 8A) as in female.

P2–P4 (Figs. 8B, 9A, B). Enp-2 of P2 almost reaching to middle of exp-2; outer apical long plumose seta reaching beyond exp-3. Endopod of P3 3-segmented; enp-2 with long apophysis reaching beyond middle of exp-3; enp-3 with 1 inner short bipinnate seta, 1 long apical seta, and 1 small apophysis apically. Endopod of P4 as in female, except for 1 bipinnate outer apical seta.

P5 (Fig. 7D). Baseoendopods of left and right P5 fused. Endopodal lobe small, bearing 2 bipinnate setae with tube pore medially next to it. Basal part with outer seta arising from short setophore. Exopod small with convex outer margin, with 1 inner and 3 outer short, bipinnate setae, and 1 long, bipinnate apical seta.

P6 vestige (Fig. 7E, F) asymmetrical; bearing 1 naked inner and 1 long bipinnate outer seta.

Etymology.—The species is named after the Korea Polar Research Institute (KOPRI), in recognition of its contributions to research activities on the Antarctic peninsula.

Discussion

Huys (1990) defined the following apomorphies supporting the family Orthopsyllidae: 1) bisetose exopod of maxillula completely incorporated in basis, 2) presence of two brush setae (equipped distally with recurved slender hooks) on distal exopodal segment of P1, 3) loss of inner seta on enp-1 of P1 and specific armature on enp-2 (an anterior geniculate, distally pectinate slender claw and a very long, weakly geniculate, brush seta), 4) armature on exopods P2–P4 strongly reduced, 5) proximal endopodal segment in P2–P4 strongly reduced, without inner seta, 6) sexual dimorphism of endopod P2, and 7) baseoendopods of male P5 medially fused.

The sexual dimorphism of the P2 endopod described by Huys (1990) as the reduction of the outer apical seta in the male should be considered as a slip of the pen. Certain species and subspecies have been described from females only (i.e., *O. l. improportionatus*, *O. l. setosus*, and *O. spinicaudatus*), or no detailed information was given on the male P2 endopod (e.g., in *O. littoralis*). However, in all other species and subspecies (except in *O. coralliophilus*, where the outer apical seta has been lost) and in the present new species, there is a reduction of the outer apical seta in the female, whereas this seta is long in the male. The condition in *O. spinicaudatus* is not known, as the species was described from females only, and the endopod of P2 carries a single apical seta (Krishnaswamy 1957). Further, Nicholls (1942) probably overlooked this sexual dimorphism in *O. littoralis,* as he described the female P2 (with a reduced outer apical seta) and stated that the male only differs in A1, endopod of P3, P5, and P6. There is also sexual dimorphism in the shape of the P2 endopod in *Orthopsyllus*, in which the male shows a distinctly more elongate second endopodal segment than the female. The shape of the P2 endopod in *O. l. major* and *O. wallini* seems to be the same in both sexes, but this might not have been shown correctly in the drawings by Klie (1939) and Lang (1934).

Huys (1990) defined the reduced armature of the exopods in P2–P4 as the loss of the inner seta on the middle exopodal segments, and the distal exopodal segments lacking inner setae with the inner apical seta strongly reduced. The structure of the present new species, however, indicates that there was still an inner seta present on the middle exopodal segments of P2 and P3 in the hypothetical ancestor of this family. Krishnaswamy (1957) reported an inner seta on the middle exopodal segment of P2 (and probably also P3 and P4, as he stated that 'third and fourth legs resemble the second one') in *O. spinicaudatus,* and this might have been a correct observation.

Without doubt, the present new species belongs to the Orthopsyllidae (and its single genus *Orthopsyllus*) because it agrees with all of the above-mentioned apomorphies. Two additional genera were announced by Huys (1990), but these remain nomina nuda until their formal description. However, the new species will reside in *Orthopsyllus,* as it is closely related to the type species, *O. linearis*, and would not fit into *Infrapedia* Huys, 1990 or *Dionyx* Huys, 1990 (R. Huys pers. comm.). It can be distinguished from other known species of Orthopsyllidae especially by the presence of an inner seta on the middle exopodal segment of P2 and P3. *Orthopsyllus spinicaudatus* is the only species that also carries an inner seta on these segments. This species has been fragmentarily and deficiently described from the Madras coast (India) and, since the type material is presumably lost, will remain problematic until its rediscovery. Krishnaswamy (1957) described the en-

dopods of P2–P4 as one-segmented, but he might have easily overlooked the short, first segment typical of *Orthopsyllus* species. A clear and possibly reliable diagnostic difference is the presence of a single, apical seta on its P2 endopod.

In samples from rinsing a brown alga (collected by scuba diving at a depth of about 20 m) from the subtidal zone off Hangaechang (Munseum, Jeju Island, Korean Strait), we found another representative of *Orthopsyllus* that seems identical to *O. l. curvaspina*, which was originally described from the Pacific coast of Costa Rica. The Korean specimens, however, show a high variability in body size and to a lesser degree in the length/width ratio of the caudal rami and the shape of caudal seta V. Lang (1965) and Wells (1968) previously discussed the high variability of the caudal rami and setae in *Orthopsyllus*, and this seems to be another example of this phenomenon. The complex around *O. linearis* should be resolved first, before these Korean specimens can be correctly allocated.

Acknowledgments

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