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A new species of the genus *Cerviniopsis* from Sagami Bay, Japan and reinstatement of the genus *Neocervinia,* with a report on the male of *Neocervinia itoi* Lee & Yoo, 1998 (Copepoda: Harpacticoida: Aegisthidae)

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Abstract

A new aegisthid copepod, *Cerviniopsis reducta* **sp. nov.** is described from the deep sea in Sagami Bay, Japan. The new species has superficial resemblance to *C. minutiseta* Ito, 1983 in the armature formula of swimming legs. However they differ from each other in the shape of setae of the swimming legs, the distal margin of operculum, length of caudal rami, and the location of setae on P5 exopod. Also, the male of *Neocervinia itoi* Lee & Yoo, 1998 is described on the basis of samples collected from around the type locality in Sagami Bay, Japan. Sexual dimorphism of *N. itoi* male can be observed in the fused rostrum, atrophied mouthparts, P5, and P6. The sixth leg is symmetrical and both gonopores are presumably active, based on the presence of two spermatophores internally in the genital segment. This paper reports for the first time on the sexually dimorphic characters in the genus *Neocervinia* Huys, Mobjerg & Kristensen, 1997, reinstating its generic status with the newly revealed male characters.

Key words: Cold Seep, Taxonomy, Deep-Sea Copepoda, Cerviniopseinae, Cerviniinae

Introduction

Harpacticoid copepods are known to be a dominant group in the hyperbenthos at the Hatsushima cold-seep site in Sagami Bay (Toda et al. 1994). So far three species of deep-sea dwelling harpacticoid copepods were described taxonomically based on the samples from Sagami Bay: *Neocervinia itoi* Lee & Yoo, 1998, *Normanella bifida* Lee & Huys, 1999 and *Nudivorax todai* Lee & Huys, 2000 (see Lee & Yoo 1998; Lee & Huys 1999, 2000). Benthic copepods are dominant in bathyal Sagami Bay and have been studied in several aspects, including sex ratio, reproductive activity (Shimanaga & Shirayama 2003), and temporal patterns in diversity and species composition (Shimanaga et al. 2004). Especially deep-sea cerviniids have been a focus of several studies, which included their distributional characteristics, sex ratio and gut content (Shimanaga et al. 2008, 2009). As a result of an ongoing study on the harpacticoid community in Sagami Bay (Shimanaga et al. 2009), a new *Cerviniopsis* Sars, 1903 species was discovered. In addition, the male of *Neocervinia itoi* was also collected from the area for the first time. The genus *Neocervinia* was erected (Huys et al. 1997) originally to accommodate *N. tenuicauda* (Brotskaya, 1963) and *N. unisetosa* (Montagna, 1981), with *N. itoi* as the third known species of the genus (Lee and Yoo 1998). Seifried (2003) synonymized *Neocervinia* Huys, Møbjerg & Kristensen, 1997 and *Pseudocervinia* Brodskaya, 1963 with *Cervinia* Norman in Brady, 1878 (Aegisthidae), but the generic status of the former is discussed and reinstated herein based on the newly observed characters.

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Material and methods

Copepods were collected from Sagami Bay, Japan from 2000 to 2005 using a multiple corer. Details of the sampling techniques used were provided in Shimanaga et al. (2008). Specimens were fixed in 5% buffered seawater formalin and subsequently preserved in 70% ethanol. Copepods were dissected in lactic acid and mounted on slides in polyvinyl lactophenol mounting medium. All drawings have been prepared using a camera lucida on Olympus BX50 differential contrast interference microscope. The terminology for body and appendages follows Huys et al. (1996). Abbreviations used in the text are: P1–P6, first to sixth thoracopod; exp(enp)-1(2,3) to denote the proximal (middle, distal) segment of the exopod (endopod), ae, aesthetasc.

Type specimens are deposited in the Marine Biodiversity Institute of Korea (MABIK). Scale bars in the figures are indicated in µm.

Systematics

Family Aegisthidae Giesbrecht, 1892

Subfamily Cerviniopseinae Brodskaya, 1963

Genus *Cerviniopsis* Sars, 1903

***Cerviniopsis reducta* sp. nov.**
(Figures 1–8)

Type locality. Sagami Bay, Japan (35° 04.4' N 139° 32.3' E). The water depth ranged from 750 to 770m.

Specimens examined. Holotype: male (CR00179981) dissected on seven slides. Paratypes: one female (CR0000179982) dissected on eight, and one male (CR00179983) on eight slides, respectively. All specimens are from the type locality and collected by Dr. M. Shimanaga on May 20 2002.

Description. Male. Total body length 967 µm (measured from tip of rostrum to posterior margin of caudal rami). Maximum width 211µm measured at posterior margin of cephalothorax. Body surface armed with sensilla and minute denticles (Figs. 1A, C–D).

Prosome (Fig. 1A) 5-segmented, comprising cephalosome and 4 free pedigerous somites. P1 bearing somite fused to cephalosome, but with surface suture line showing original segmentation. Cephalothorax smooth (Fig. 1A), with few sensilla and smooth posterior margin. Short tripod shaped wrinkle present in middle of cephalosome. Succeeding two prosomites with thin comb-like hyaline frills forming smooth posterior margin.

Rostrum well developed, elongated and triangular-shaped with pointed anterior apex, clearly fused to cephalosome (Fig. 1A–B). Dorsal surface smooth with 1 pair of sensilla near middle of lateral margin of rostrum dorsally and 1 tube pore on ventral surface.

Urosome (Figs. 1A, C–D) 6-segmented, comprised of P5-bearing somite, 4 free abdominal and anal somites. Urosomites 3–5 denticulated dorsoventrally with well developed hyaline frill. P5 -bearing somites with smooth dorsoventaral surface and few spinules along lateral posterior angles.

Anal somite (Fig. 1D) with well-developed operculum with spinulate posterior margin and flanked by pair of secretary pores.

Caudal rami (Fig. 1A) ten times longer than wide; seta I shortest, located at proximal half; seta II 2.5 times longer than seta I, and located laterally; seta III as long as seta II; caudal setae IV pinnate, slightly longer than caudal ramus; caudal seta V pinnate, twice longer than IV; seta VI shorter than seta III and located on distal inner corner; seta VII bare, located near distal end of caudal ramus, as long as seta II, and triarticulated.

Antennule (Fig. 2A) 7-segmented, segment 1 largest with several rows of spinules on surface. Segment 2 with few spinules on anterior surface. Aesthetascs on segments 2, 3, 4, and 7. Armature formula: 1-[1 pinnate], 2-[11 pinnate + 1 ae], 3-[3 bare + 3 pinnate + 1 ae], 4-[2 bare + 7 pinnate + (1+ae)], 5-[1 pinnate], 6-[2 pinnate], 7-[5 bare + 1 strong pinnate + 1 pinnate + 3 rigid spines + 1 acrothek]. Apical acrothek consisting of well-developed aesthetasc fused basally to 1 slender naked seta and 1 strong pinnate bent spine.

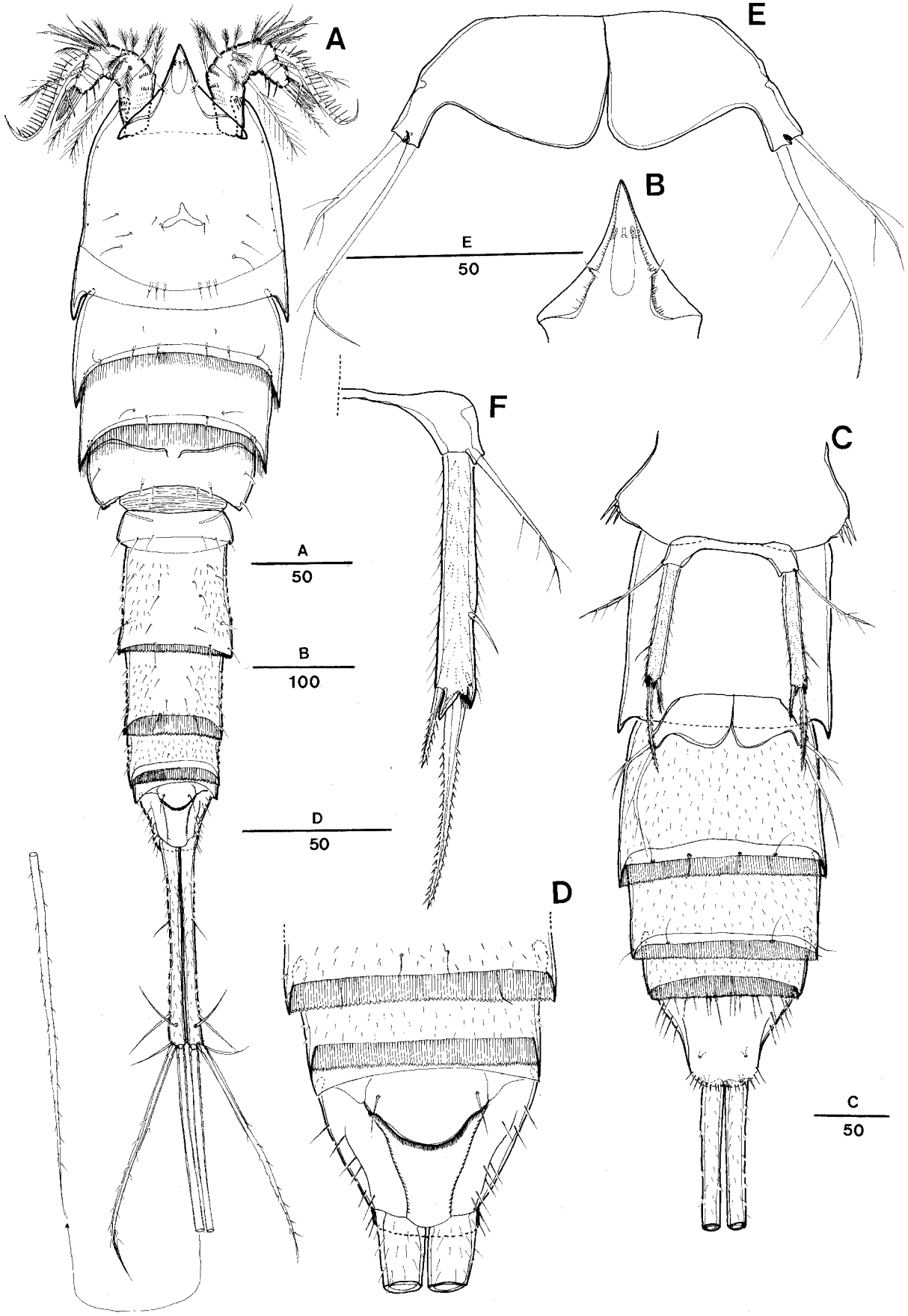

FIGURE 1. *Cerviniopsis reducta* **sp. nov.,** male (holotype): (A) habitus, dorsal; (B) rostrum; (C) urosome, ventral; (D) anal somite, dorsal; (E) P6, ventral; (F) P5, ventral. All scales in µm.

FIGURE 2. *Cerviniopsis reducta* **sp. nov.,** male (holotype): (A) antennule; (B) antenna; (C) labrum. Both scales in µm.

Antenna (Fig. 2B) 3-segmented, comprising coxa, allobasis, and free 1-segmented endopod. Coxa with several rows of spinules. Allobasis with 2 plumose abexopodal setae. Exopod 4-segmented with seta formula 2.1.1.020, respectively; all setae pinnate; apical outermost seta strongest. Free endopodal segment with long spinules along surface, and with 1 naked seta and 2 pinnate spines laterally and 1 geniculate, and 5 pinnate setae and 1 strong pinnate spine apically.

Labrum (Fig. 2C) well developed; ventral margin ornamented with blunt median tooth, several sub-lateral row of blunt teeth, and short lateral spinules.

Mandible (Fig. 3A) with large coxa bearing well-developed gnathobase; cutting edge with 6 major blunt teeth overlapping each other; accessory seta plumose. Mandibular palp well developed. Basis set on peduncle, wider than long with 4 pinnate setae; 3 setae set on small peduncle, respectively; several rows of long spinules along anterior surface. Endopod 1-segmented with 3 plumose lateral, 2 naked and 5 pinnate apical setae; row of spinules along outer lateral margin. Exopod 4-segmented with seta formula 2.1.1.2; segment 1 largest, and long spinules on anterior surface.

Maxillule (Fig. 3B) with rows of spinules along anterior suface and outer lateral margins as figured. Praecoxa with well developed arthrite bearing 2 plumose anterior surface setae and 9 apical setae and spines. Coxa with epipodite represented by 1 seta; endite cylindrical with 1 naked, and 5 pinnate setae. Basis and endopod completely fused forming maxillulary allobasis with 5 pinnate and 6 naked slender setae. Exopod also incorporated into maxillulary allobasis and represented by 3 plumose setae.

Maxilla (Fig. 3C–D), syncoxa with row of spinules on outer lateral margin and cylindrical 4 endites (2 praecoxal, 2 coxal); enditic seta formula 5.3.3.3; proximal praecoxal endite largest with 2 pinnate and 3 naked setae; all setae on distal praecoxal and coxal endites naked. Allobasis produced into long curved claw; accessory armature consisting of 1 geniculate spine and 1 slender seta distally, 1 slender seta and 1 strong pinnate spine proximally near articulation with endopod. Endopod 3-segmented; enp-1 with 1 geniculate spiniform, and 1 slender setae; enp-2 with 2 geniculate spiniform setae; enp-3 with 1 geniculate spiniform and 2 naked slender setae.

Maxilliped (Fig. 3E) comprising syncoxa, basis, and 2-segmented endopod; rows of spinules present anteriorly and posteriorly as figured. Syncoxa elongated with 5 strong pinnate spines and 1 pinnate seta. Basis with 1 pinnate seta and 1 strong pinnate spine. Endopod 2-segmented; proximal segment with 2 plumose setae; distal segment with 2 strong pinnate apical spines, and 2 lateral setae (proximal one plumose, distal one naked).

Swimming legs 1–4 (Figs. 4A, B; 5A, B) biramous, P1–P4 with 3-segmented exopod and 3-segmented endopod, and each ramus ornamented with setules and spinules along inner and outer margins as illustrated. Intercoxal sclerites well developed; ornamented with row of spinules in middle of anterior and posterior surface.

P1 (Fig. 4A), praecoxa with row of spinules on anterior surfaces. Coxa wider than long and trapezoidal, ornamented with row of spinules on anterior and posterior surface and along outer margin. Basis with 1 outer plumose seta and 1 inner strong uni-pinnate spine and ornamented with row of long spinules on anterior surface extending posteriorly. Endopod subequal to exopod in length; enp-3 longest. Exp-1 largest; median outer spine of exp-3 distinctly shorter than others.

P2 (Fig. 4B), praecoxa, small with row of spinules along anterior distal margin. Coxa with row of spinules on anterior and posterior surface, and along outer margin. Basis with 1 short plumose outer seta and spinules on inner lateral margin and row of spinules along distal margin near articulation with exopod; ornamented with row of long spinules along inner lateral margin and posterior surface with small patch of spinules on anterior and posterior surface. Endopod not extending to distal end of exopod; row of fine spinules along outer margin of each segment; enp-1 with elongated outer distal end forming sharp triangular tip; enp-3 slightly longer than two preceding segments. Each exopodal segments with row of spinules along outer margins; exp-1 largest, and exp-2 shortest; inner apical seta of exp-3 reduced, naked and small.

P3 (Fig. 5A), praecoxa, small with row of spinules along anterior median distal margin. Coxa with row of spinules on anterior and posterior surface and along outer margin. Basis with 1 plumose outer seta and long spinules on inner lateral margin and row of spinules along distal margin near articulation with endopod. Endopod exceeding to distal end of exopod; row of spinules along outer and inner margin of each segment; enp-1 and enp-2 with elongated outer distal end forming sharp triangular tip; enp-3 slightly longer than two preceding segments; inner apical seta on enp-3 reduced, naked, and small. Each exopodal segments with row of spinules and setules along outer and inner margins; exp-1 largest and exp-2 shortest; inner apical seta of exp-3 reduced, naked and small.

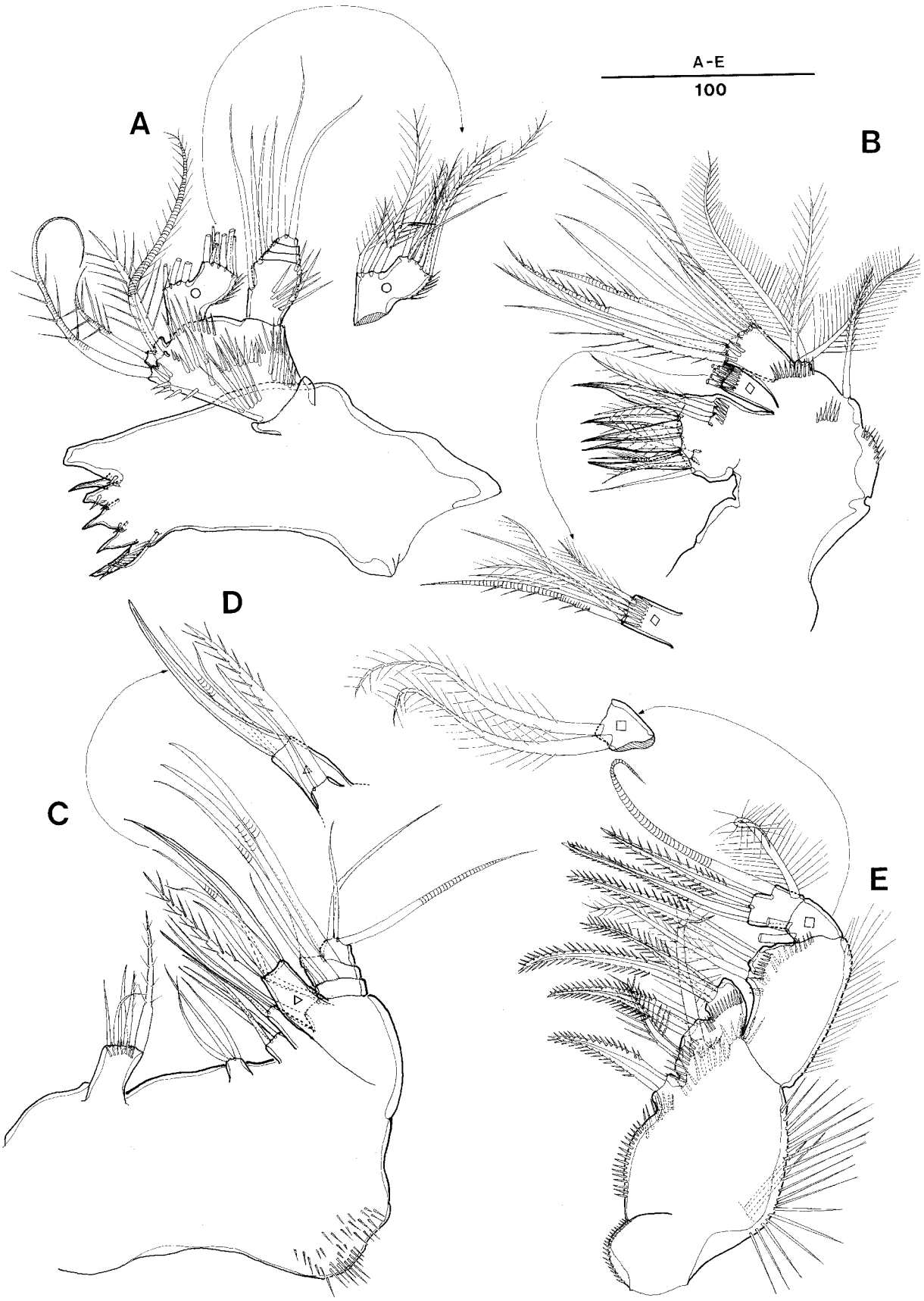

FIGURE 3. *Cerviniopsis reducta* **sp. nov.,** male (holotype): (A) mandible; (B) maxillule; (C) maxilla; (D) maxillary allobasis; (E) maxilliped. Scale in μm.

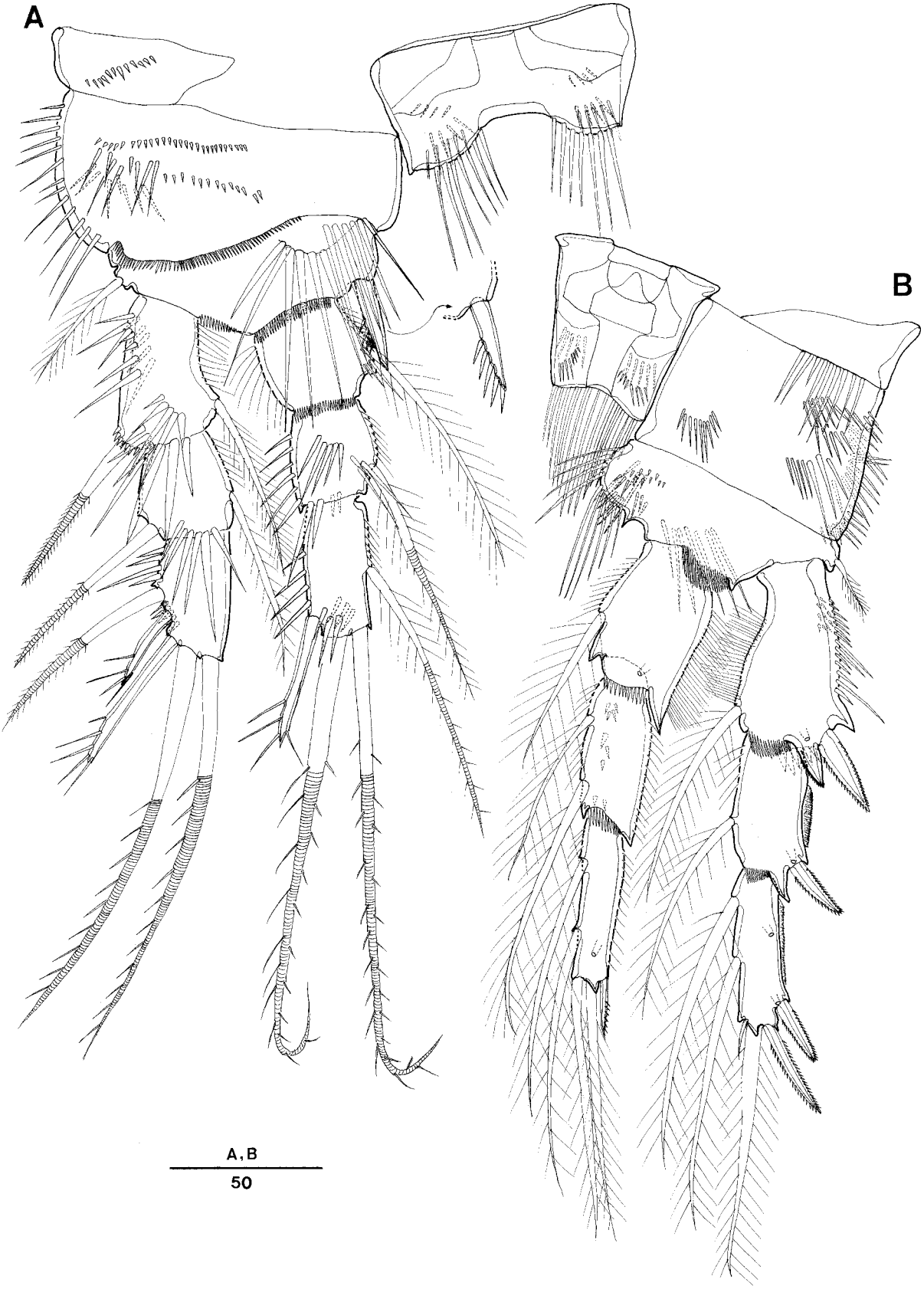

FIGURE 4. *Cerviniopsis reducta* **sp. nov.,** male (holotype): (A) P1, anterior; (B) P2, anterior. Scale in µm.

P4 (Fig. 5B), praecoxa, naked. Coxa with row of spinules on anterior and posterior surface, and along outer margin. Basis with 1 plumose outer seta and long spinules on inner lateral margin and row of spinules along distal margin near articulation with endopod. Endopod exceeding to distal end of exopod; row of spinules along outer and inner margin of each segment; enp-1 and enp-2 with elongated outer distal end forming sharp triangular tip; enp-1 shortest; enp-3 longer than enp-2; inner apical seta on enp-3 reduced, naked and small. Each exopodal segments with row of spinules and setules along outer and inner margins; exp-1 shortest, and exp-3 longest; inner apical seta of exp-3 reduced, naked and small.

Armature formula as follows:

	Exopod	Endopod
P1	1.1.023	1.1.121
P2	1.1.222	1.2.221
P3	1.1.222	1.2.221
P4	1.1.122	1.2.120

P5 (Fig. 1F), baseoendopod forming short, outer setophore bearing plumose basal seta. Each endopodal lobe fused each other forming 1 narrow plate, without any ornamentation. Exopod long, narrow plate shaped, and 6.5 times longer than wide; whole surface covered with setules; with 1 strong pinnate apical, 1 short pinnate inner and 1 short naked outer lateral setae; outer lateral seta inserted at distal 1/3; 1 short spinous process present between apical and inner setae.

Sixth pair of legs (Fig. 1E) not fused medially, symmetrical. Each P6 bilobate with outer lobe bearing elements consisting of 2 plumose setae; outer one shortest. Anterior surface naked and inner distal margin somewhat swollen without any ornamentation.

Female. Total body length of examined samples 1,219 μm, much larger than in male (measured from tip of rostrum o posterior margin of caudal rami). Largest width presumably at posterior margin of cephalic shield (not measurable due to dorsoventrally depressed body). General body appearance same as in male.

Rostrum (Fig. 6C) well developed, elongated and triangular-shaped with pointed anterior apex, clearly fused to cephalosome. Dorsal surface smooth with 1 pair of sensillae near middle of lateral margin of rostrum dorsally and 1 tube pore on ventral surface as in male.

Urosome (Fig. 6B) 5-segmented, comprised of P5-bearing somite, genital double, and 3 free abdominal somites. All urosomite with pattern of surface ornamentation consisting of small spinules dorsoventrally. Hyaline frills of urosomites denticulate.

Genital double somite (Figs. 6B; 8C) with transverse surface ridge dorsally and laterally forming spinous processes laterally indicating original segmentation; completely fused ventrally. Genital field positioned anteriorly, just above middle line between original segmentation (Fig. 6B); copulatory pore minute; gonopores fused medially forming single genital slit covered on both sides by well developed opercula derived from sixth legs; P6 elongate, with row of spinules along anterior and posterior margins, and 1 bare and 1 pinnate setae; outer seta longest and pinnate (Fig. 8C).

Caudal rami (Fig. 6B) 14 times longer than wide, longer than those in male and with 7 caudal setae as in male.

Antennule (Fig. 6A) 7-segmented, segment 1 largest with several rows of spinules on surface. Segment 2 with few spinules on anterior surface. Aesthetascs on segments 3, and 7. Armature formula: 1-[1 pinnate], 2-[8 pinnate + 1], 3-[3 pinnate + 2 geniculate + 6 +(1+ ae)], 4-[3 pinnate], 5-[1 + 1 pinnate], 6-[1 + pinnate], 7-[1 strong pinnate + 2 + 3 rigid spines + 1 acrothek]. Apical acrothek consisting of well-developed aesthetasc fused basally to 1 slender pinnate seta and 1 strong pinnate bent spine.

Antenna, mandible, maxllule, maxilla, maxilliped, and P1 same as those in male.

Swimming legs 2–4 (Figs. 7A–B, 8A) biramous, P2–P4 with 3-segmented exopod and 3-segmented endopod, and each ramus ornamented with setules and spinules along inner and outer margins as illustrated. Intercoxal sclerites well developed; ornamented with row of spinules in middle of anterior and posterior surface. Armature formula same as in male.

P2 (Fig. 7A) endopod not extending to distal end of exopod; inner apical seta of exp-3 not reduced, long and pinnate.

P3 (Fig. 7B) endopod not extending to distal end of exopod; inner apical seta on enp-3 not reduced, long, and pinnate. Inner apical seta of exp-3 not reduced, longer than outer apical one and pinnate.

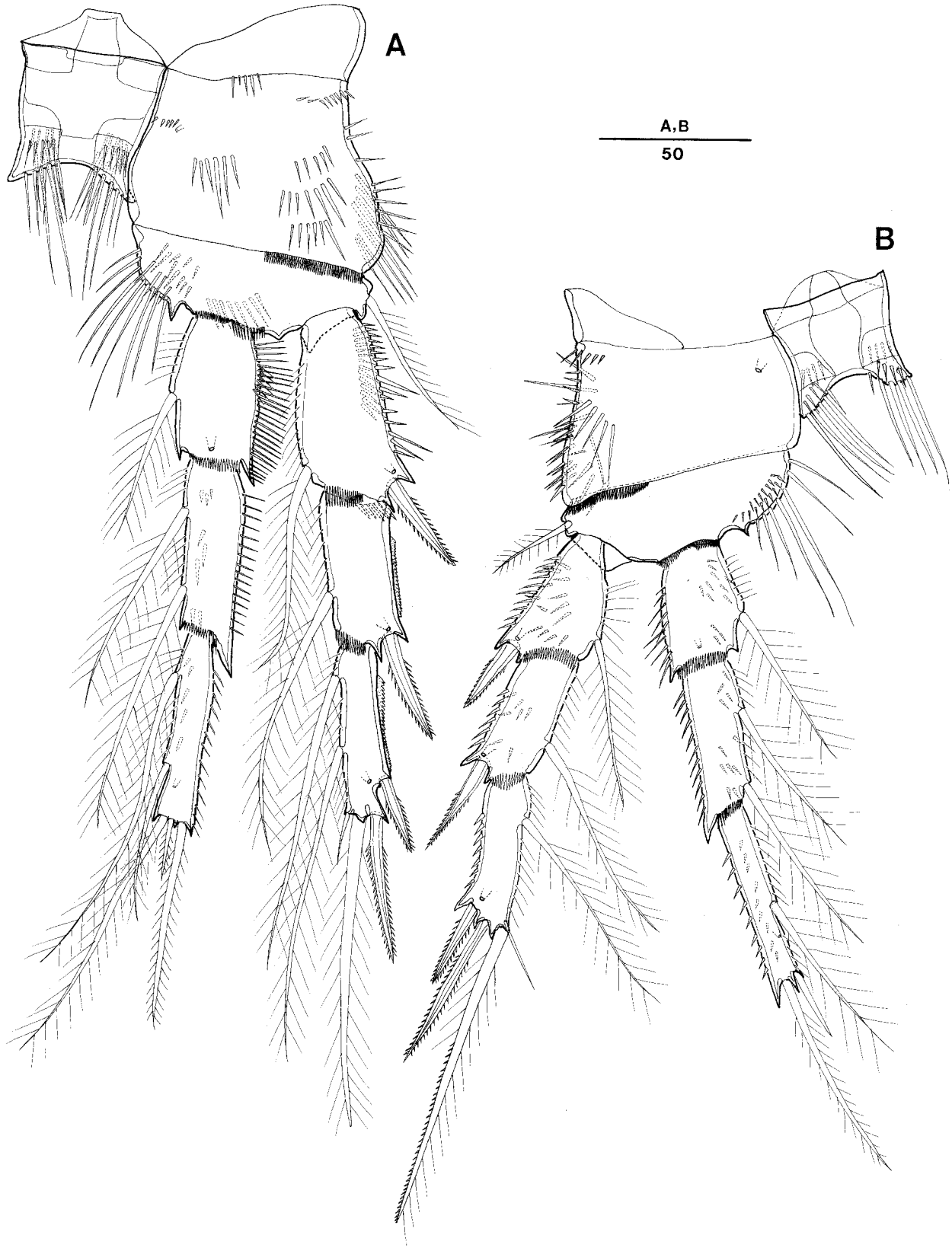

FIGURE 5. *Cerviniopsis reducta* **sp. nov.,** male (holotype): (A) P3, anterior; (B) P4, anterior. Scale in µm.

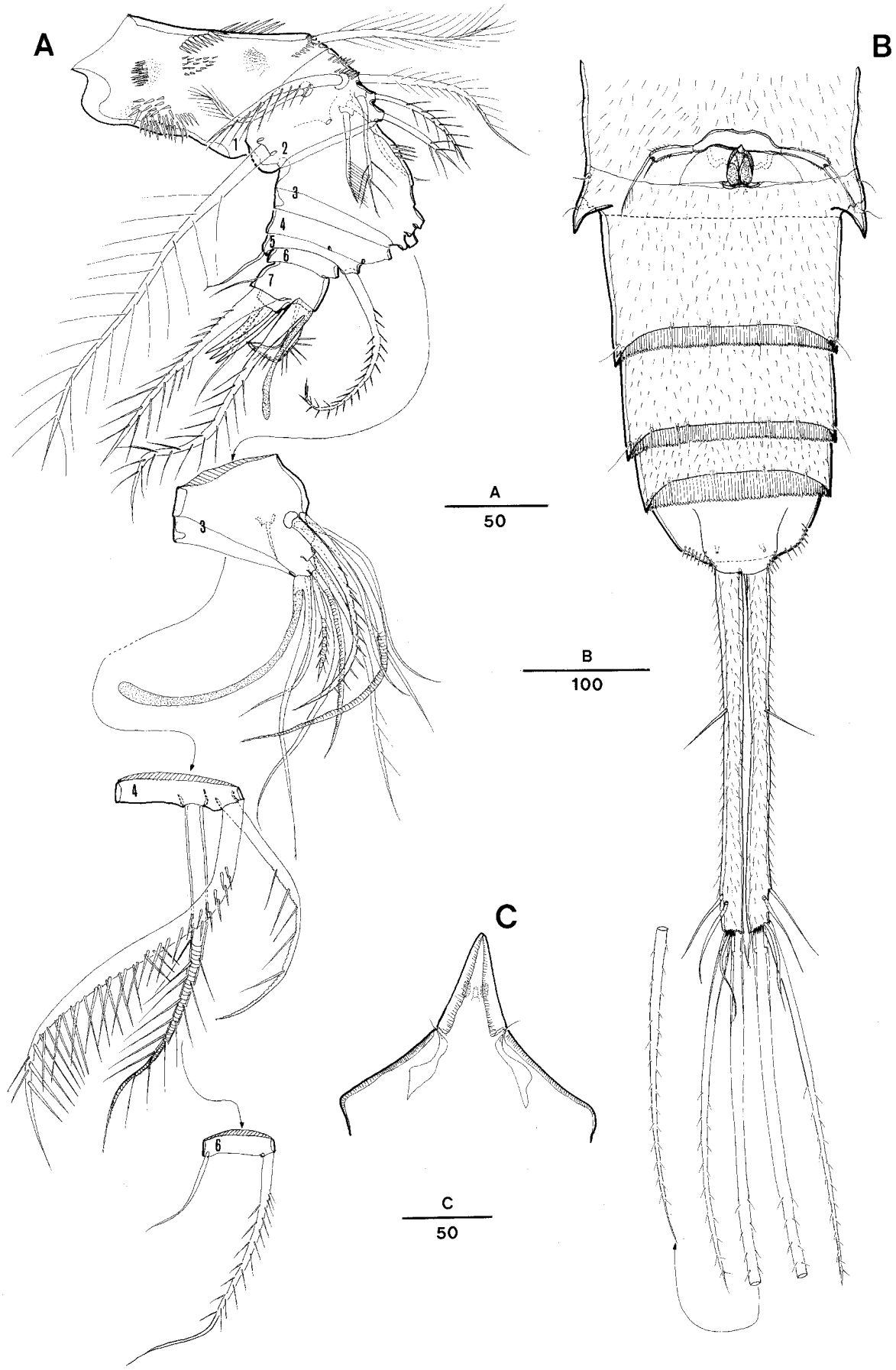

FIGURE 6. *Cerviniopsis reducta* **sp. nov.,** female (paratype): (A) antennule; (B) urosome, ventral; (C) rostrum. Both scales in µm.

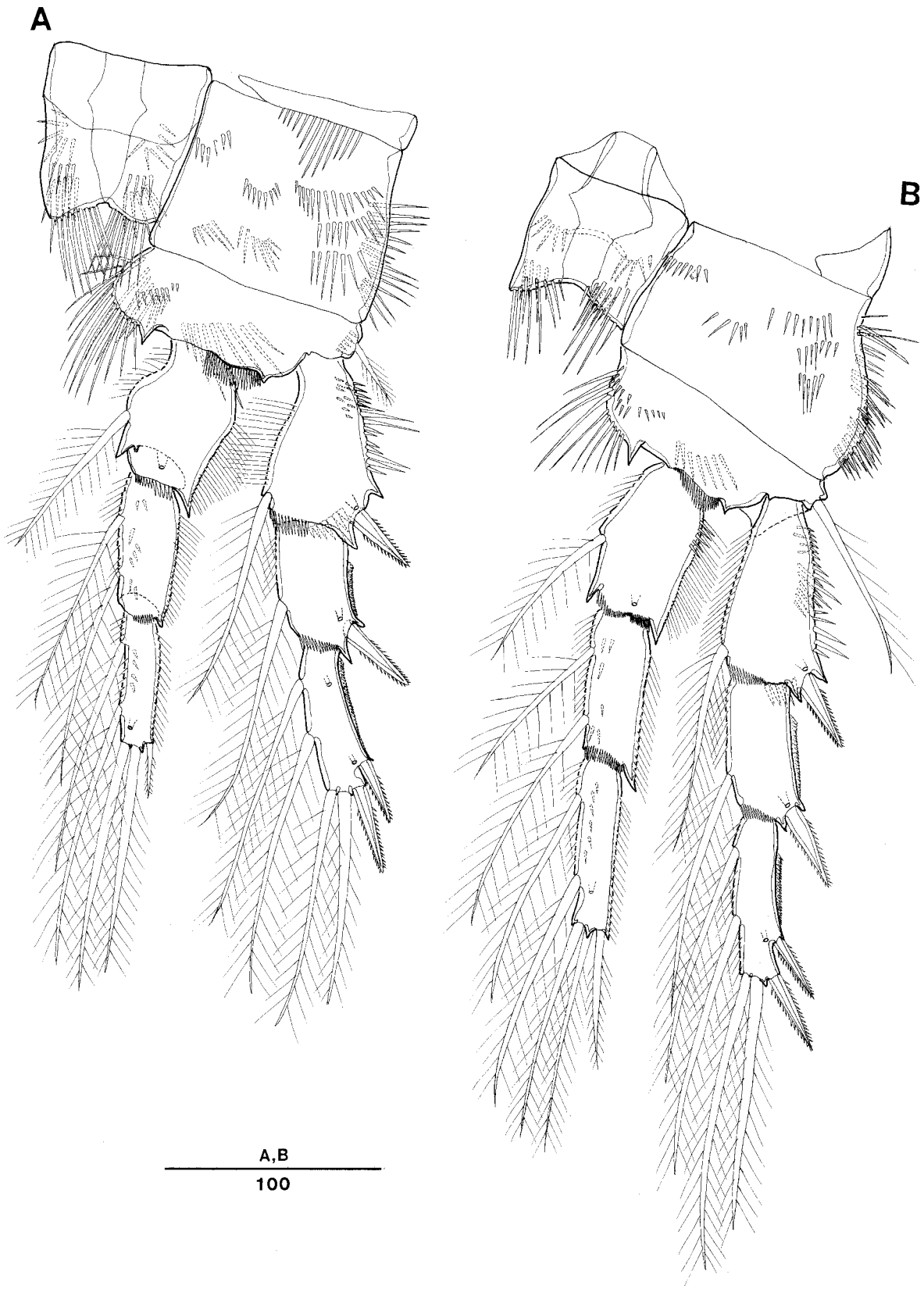

FIGURE 7. *Cerviniopsis reducta* **sp. nov.,** female (paratype): (A) P2, anterior; (B) P3, anterior. Scale in µm.

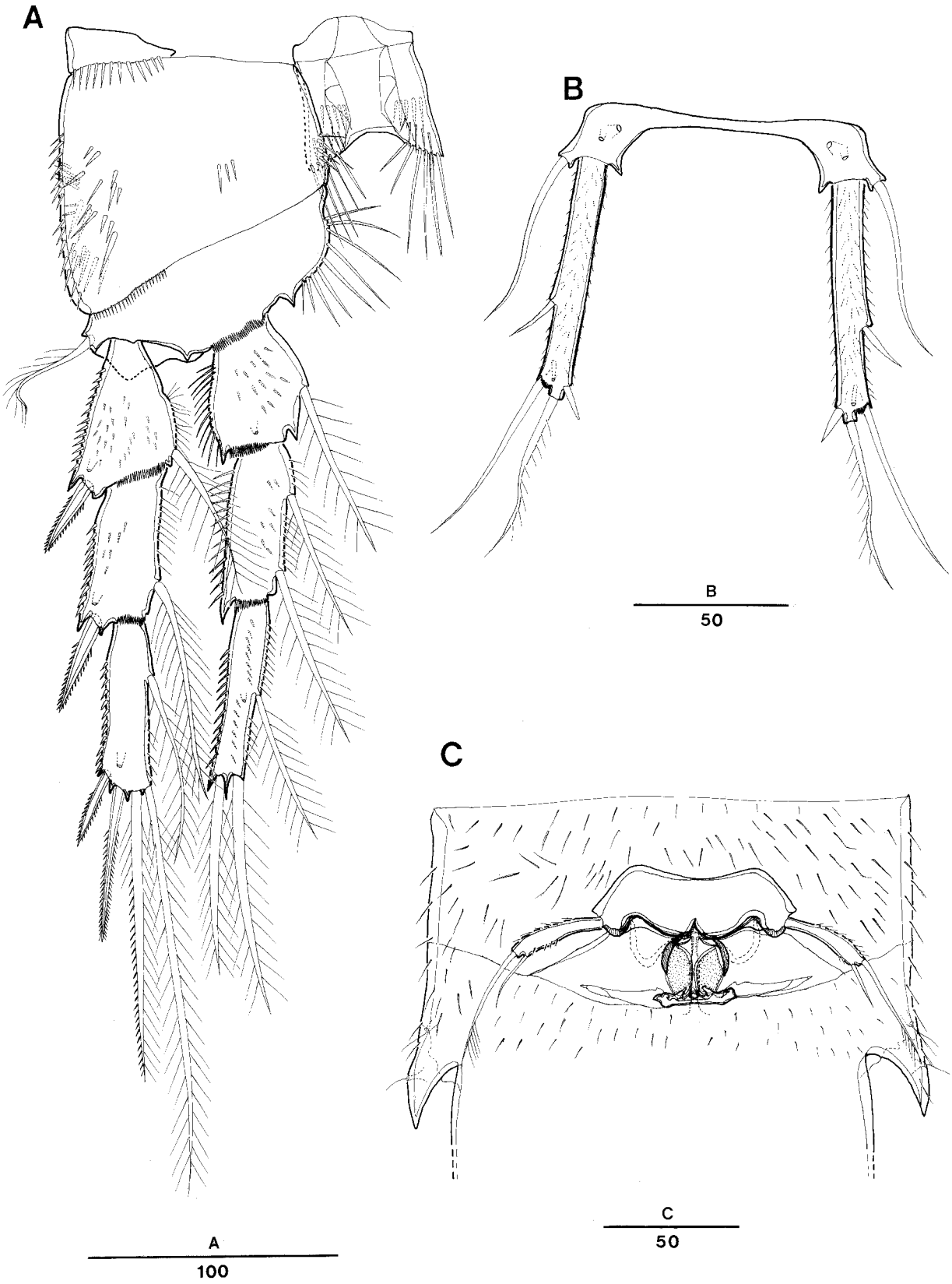

FIGURE 8. *Cerviniopsis reducta* **sp. nov.,** female (paratype): (A) P4, anterior; (B) P5, anterior; (C) genital field with P6, ventral view. All scales in µm.

P4 (Fig. 8A), endopod nearly extending to distal end of exopod; inner apical seta on enp-3 not reduced, longer than outer apical one, and pinnate. Inner apical seta of exp-3 not reduced, longer than outer apical one and pinnate.

P5 (Fig. 8B), baseoendopod forming short, outer setophore bearing naked basal seta. Each endopodal lobe fused each other forming 1 narrow plate, without any ornamentation except for 2 pores near articulation area with exopod. Exopod long, narrow plate shaped and about 6.5 times longer than wide; whole surface covered with setules; with 1 strong pinnate apical, 1 short naked inner and 2 naked outer lateral setae; distal outer lateral seta about 4 times longer than proximal outer lateral one; 1 pore present near proximal area of apical seta.

Etymology. The specific name, '*reducta*' refers to the inner apical seta on the exp-3 of P2–P4, the outer apical seta of the enp-3 of P3 and the inner apical seta of enp-3 of P4 which are reduced strongly in the male of *C. reducta*.

Subfamily Cerviniinae Sars, 1903

Genus *Neocervinia* Huys, Mobjerg & Kristensen, 1997

Neocervinia itoi Lee & Yoo, 1998

(Figures 9–12)

Synonymy. *Neocervinia itoi* Lee & Yoo, 1998, p. 165–175, figs. 1–6.

Specimens examined. A total of ten females and seven males were examined. Two males dissected on one slide each (CR00179984-5). Four females in 70% ethanol (CR00179986-9), six females and five males (CR00179990-CR0018000) were dissected on from two to eleven slides respectively. All specimens are from Sagami bay, collected by Dr. M. Shimanaga on May 20 2002.

Description. Male. Total body length 1,038 µm (measured from tip of rostrum to posterior margin of caudal rami). Maximum width 311µm measured at posterior margin of P2-bearing somite. Entire body surface armed with minute denticles (Fig. 9A–C).

Prosome (Fig. 9A) 5-segmented, comprising cephalosome and 4 free pedigerous somites. P1 bearing somite clearly separated from cephalosome. Cephalothorax denticulated (Fig. 9A), with few sensilla and smooth posterior margin. Three branched wrinkle present in middle of cephalosome. Pleural areas of cephalic shield narrow and posterolateral angles rounded. Succeeding four prosomites without distinct hyaline frills and with smooth posterior margin.

Rostrum well developed, elongated and triangular-shaped with pointed anterior apex, clearly defined at base (Fig. 9A). Dorsal surface smooth with 4 pairs of sensilla.

Urosome (Figs. 9B –C) 6-segmented, comprised of P5-bearing somite, 4 free abdominal, and anal somites. All urosomites denticulated, with spinulated posterior margins except for smooth P5-bearing somite.

Anal somite (Fig. 9B) ornamented with several row of spinules on whole surface and with well-developed operculum with spinulate posterior margin and accompanied by 2 pairs of sensilla.

Caudal rami (Fig. 9A–B) slightly divergent, about 8 times longer than wide and with several row of spinules and sensilla on whole surface; seta I located at proximal 1/3, pinnate; seta II located at distal 1/3, and pinnate; seta III about twice longer than seta II and pinnate; caudal setae V and IV very long and pinnate; seta VI shorter than seta III and located on distal inner corner; seta VII pinnate, shortest, close to seta VI and tri-articulated at base.

Antennule (Fig. 9D–F) 7-segmented, segments 1, 6, and 7 with dorsal surface ornamented with rows of spinules. Armature formula: 1-[1 pinnate], 2-[5 pinnate + 1 ae], 3-[5 bare + 4 pinnate + 1 ae], 4-[2 pinnate], 5-[3 pinnate], 6-[3pinnate], 7-[3 bare + 7 pinnate]. Aesthetasc on segment 2 and 3. No clear apical aesthetasc on segment 7.

Antenna (Fig. 10A) 3-segmented, comprising coxa, allobasis and free 1-segmented endopod. Allobasis with 2 plumose abexopodal setae. Exopod 4-segmented with seta formula 2.1.1.120, respectively; all setae pinnate. Free endopodal segment with strong spinules along inner proximal margin and with 3 strong pinnate spines laterally and 4 geniculate pinnate setae and 2 pinnate spines apically; outermost pinnate spine fused to 1 small pinnate seta and 1 long tube pore proximally.

Mandible (Fig. 10B) coxa bearing reduced gnathobase rather than one in female, presumably non-functional; cutting edge with 7 major blunt teeth overlapping each other; accessory seta pinnate; with rows of spinules on anterior surface. Mandibular palp ornamented with rows of spinules on anterior surface; all setae less pinnate than those in female. Basis with 3 plumose setae. Endopod 1-segmented, with 3 pinnate lateral and 6 naked apical setae. Exopod 1-segmented, small with 2 long pinnate setae.

Maxillule (Fig. 10C), arthrite small with 2 surface and 11 apical setae; all setae not rigid as those in female, presumably non-functional. Coxa with epipodite represented by 1 plumose seta; endite short with 2 plumose and 4 naked slender setae. Basis and endopod completely fused forming maxillulary allobasis, with 4 pinnate and 10 slender setae apically. Endopod 1-segmented, with 1 pinnate and 3 naked setae apically. Exopod 1-segmented, with 2 plumose setae.

Maxilla (Fig. 10D), syncoxa with row of spinules on outer lateral margin and 4 endites (2 praecoxal, 2 coxal); enditic setal fomula [3, 1, 3, 3]; all enditic setae flexible, plumose and not rigid like those in female; distal praecoxal endite largely incorporated. Allobasis produced into strong pinnate spine; accessory armature consisting of 2 pinnate and 2 slender setae. Endopod 3-segmented without geniculated seta; enp-1 with 1 striated and 1 slender setae; enp-2 with 2 striated spiniform setae; enp-3 with 1 short and 2 long striated and 1 slender apical setae.

Maxilliped (Fig. 10E) comprising syncoxa, basis and 2-segmented endopod. Syncoxa elongate, with row of spinules on anterior surface and 6 strong pinnate spines distally. Basis with 1 strong bipinnate, and 1 minute naked setae. Endopod 2-segmented; enp-1 with 1 short pinnate seta on anterior median surface; enp-2 with 2 lateral and 2 apical pinnate setae.

Swimming legs 1–4 (Figs. 11A, B; 12A, B) biramous, P1–P4 with 3-segmented exopod and 3-segmented endopod, each ramus ornamented with setules and spinules along inner and outer margins as illustrated. Intercoxal sclerites well developed and ornamented with several rows of spinules on anterior and posterior surface.

P1 (Fig. 11A), praecoxa with spinules on distal margin. Coxa wider than long with row of spinules along round outer lateral margin. Basis with 1 outer and 1 inner strong pinnate spine. Endopod 3-segmented, enp-1 longest, enp-2 shortest; enp-3 not reaching to tip of exopod. Exopod 3-segmented, exp-1 longest and exp-2 shortest.

P2 (Fig. 11B). Coxa with row of spinules on anterior surface and along outer margin. Basis with 1 pinnate outer seta and row of long spinules on inner lateral lobe and row of spinules along distal margin between endopod and exopod. Endopod 3-segmented, not extending to distal end of exopod; row of long setules along outer margin of each segment; enp-1 largest, and with elongated inner distal end forming sharp triangular tip; enp-2 shortest. Exopod 3-segmented. Each segment with row of spinules along outer margins; exp-1 longest and exp-2 shortest.

P3 (Fig. 12A). Coxa with row of spinules on anterior surface and along outer margin. Basis with 1 pinnate outer seta and row of long spinules on inner lateral lobe and row of spinules along distal margin including articulation area with endopod and exopod. Endopod 3-segmented, not extending to distal end of exopod; row of long setules along outer margin of each segment; enp-1 largest, and with elongated inner distal end forming sharp triangular tip; enp-2 shortest. Exopod 3-segmented. Each segment with row of spinules along outer margins; exp-1 longest and exp-2 shortest.

P4 (Fig. 12B). Coxa with row of spinules on anterior surface and along outer margin. Basis with 1 pinnate outer seta and row of long spinules on inner lateral lobe and patch of spinules near articulation with exopod. Endopod 3-segmented, not extending to distal end of exopod; row of long setules along outer margin of each segment; enp-1 largest; enp-2 and enp-3 subequal in lenghs. Exopod 3-segmented. Each segment with row of spinules along outer margins and anterior surfaces; exp-1 longest and exp-2 shortest.

Armature formula as follows:

	Exopod	Endopod
P1	1.1.123	1.1.221
P2	1.1.223	1.2.221
P3	1.1.223	1.2.321
P4	1.1.223	1.2.221

P5 (Fig. 12C) laterally displaced, largely incorporated into somite, not defined at base, represented by small subrectangular lobe densely spinulose on its surface with 2 plumose setae distally

Sixth pairs of legs (Fig. 9C) not fused medially, symmetrical. Each P6 forming single genital slit covered on both sides by opercula derived from sixth legs; internal spermatophores in Fig.9C indicating activeness of both opercula. P6 with small protuberance bearing 2 pinnate setae; inner seta longest.

Female. Total body length of examined samples ranged 1,044–1,183 µm (n=3, mean = 1,093µm, measured from tip of rostrum o posterior margin of caudal rami). All characteristics agreeing with those in Lee & Yoo (1998),

except for entire body surface covered by minute denticles as in male. Especially P5 distinctly covered with minute denticles as in male; with 3 setae (Fig. 12D).

Discussion

Remarks on *Cerviniopsis reducta* sp. nov. Present new species, *Cerviniopsis reducta* **sp. nov.**, is placed in the genus *Cerviniopsis* with the diagnostic characters including a prominent triangular rostrum, long and slender caudal ramus, Seta I implanted at about 40% of ramus length and Seta II at 90%, a typical projected process on the median lateral margin of female genital double-somite, 7-segmented male antennule, and only two setae on the male P6. So far 13 valid species have been reported in the genus *Cerviniopsis* from various localities around the world, including Norwegian fjords (*C. clavicornis* Sars, 1903, *C. longicauda* Sars, 1903), Spitzbergen Islands (*C. intermedia* Lang, 1936, *C. stylicaudata* Lang, 1936), Arctic (*C. inermis* Smirnov, 1946*, C. gorbunovi* Smirnov, 1946), Pacific (*C. acutirostris* Brodskaya, 1963*, C. curviseta* Brodskaya, 1963*, C. obtusirostris* Brodskaya, 1963), Indian Ocean (*C. smirnovi* Por, 1969), Mediterranean (*C. langi* Soyer, 1970) and off Mindanao (*C. muranoi* Ito, 1983*, C. minutiseta* Ito, 1983).

According to the key provided by Wells (2007), the new species is most closely related to *C. langi.* They share the presence of a strong pinnate bent spine on the last antennulary segment, length of caudal ramus and seta formulae of P1 and P2 (Table 1). Both species also share the character sets of six setae and spines on the P3 exp-3 and only three setae on the P4 enp-3. However, they clearly differ from each other in antennular segmentation (six segments in *C. langi*, seven in *C. reducta*), setae formula of the P3 and P4, ratio of length/width of P5 in female (eight times in *C. langi*, four times in *C. reducta*) and the number of seta on the P5 exopod in female (three in *C. langi*, four in *C. reducta*).

The new species is also related to *C. minutiseta* reported only on a single male specimen with the character combination of the seven-segmented antennules, same seta formula of P1–P4 and three setae on the exopod of P5 in the males (Table 1). *Cervinopsis reducta* **sp. nov.** exhibits some unique forms of sexual dimorphisms in the swimming legs P2–P4 and in the P5 as well. Most significantly, the new species displays the same seta formula in both sexes, except for the reduction of several setae and spines in the male (Figs. 4B; 5A–B). The inner apical seta on the exp-3 of P2–P4, the outer apical seta of the enp-3 of P3 and the inner apical seta of enp-3 of P4 are reduced strongly in the male of *C. reducta*. The minute setae of the male *C. minutiseta* arise from the exactly same homological locations as in *C. reducta*. Although there is no report of the female of *C. minutiseta*, this pattern of reduction of setae/spines in P2–P4 strongly supports a sister species relationship between *C. minutiseta* and *C. reducta*. However, both species have several unique characters and are easily distinguished from each other thus: 1) body size in the male (*C. minutiseta* 1.4 mm, *C. reducata* 0.97 mm), 2) length of caudal rami (about 81% of urosome in *C. minutiseta*, while only 64 % in *C. reducta*), 3) distal margin of operculum (naked in *C. minutiseta*, setulose in *C. reducta*), 4) shape of the reduced setae of P2 –P4 in the male (vestigial in *C. minutiseta*, setiform in *C. reducta*), 5) length/width ratio of the P5 in male (five times in *C. minutiseta*, 7.4 times in *C. reducta*) and 6) the location and shape of the outer spine of P5 (subapically located and spiniform in *C. minutiseta*, while located at apical 2/3 and short and setiform in *C. reducta*). *Cervinopsis reducta* is the 14th member of the genus and the first record of *Cerviniopsis* from a cold seep area of Sagami Bay, Japan.

Reinstatement of the genus *Neocervinia.* The male of *Neocervinia itoi* Lee & Yoo, 1998 is described from material newly collected from around the type locality in Sagami Bay, Japan. Sexual dimorphism of the *N. itoi* male includes the fused rostrum, atrophied mouthparts, P5 with only two setae and the genital area. The sixth leg is symmetrical and both gonopores are presumably active based on the presence of two spermatophores internally in the genital segment (Fig. 9C). Shimanaga et al. (2009) pointed out the atrophied mouthparts and clearly showed an empty gut in the male of *N. itoi*. Except for the mouthparts, the sexually dimorphic characters in the antennular segmentation, setae on the P5 and the genital area are reported for the first time in this group in the present study.
After a phylogenetic analysis of paraphyletic genus *Cervinia* Norman, 1878 the genus *Neocervinia* was erected by Huys et al. (1997) to accommodate *N. tenuicauda* and *N. unisetosa*. The generic diagnosis of *Neocervinia* consisted of the well-defined seta formula, and single segmented P5 with three apical setae in the female. Those synapomorphies of *Neocervinia* are also confirmed in *N. itoi* which shows the same seta formula of the swimming legs and a single segmented P5 in the female.

TABLE 1. Morphological features of the genus *Cerviniopsis* and of *C. reducta* **sp. nov.**

		clavicornis	*longicaudata*	*intermedia*	*stylicaudata*	*inermis*	*gorbunovi*	*acutirostris*	*curviseta*	*obtusirostris*	*smirnovi*	*langi*	*muranoi*	*minutiseta*	*reducta* n. sp.
Body length (♀, mm)		1.6	1.3	1.52	-	1.01	1.35	1.15	1.6	2	1.82	1.36	2	-	1.22
	(♂)	1.1	-	-	1.4	-	-	-	-	-	-	-	1.8	1.4	0.97
A1 (♀)		6	6	6	-			6	6	6	5	6	5	-	7
(♂)		8	-	-	7	-	-	-	-	-	-	-	5	7	7
	Exp.	1.1.0-2-3	1.1.0-2-3	1.1.0-2-3	1.1.0-2-3	-	-	1.1.1-2-3	1.1.1-2-3	1.1.0-2-3	1.1.1-2-2	1.1.0-2-3	1.1.0-2-3	1.1.0-2-3	1.1.0-2-3
P1	Enp.	1.1.1-2-1	1.1.1-2-1	1.1.1-2-1	1.1.1-2-1	-	-	1.1.1-2-1	1.1.1-2-1	1.1.1-2-1	1.1.1-2-1	1.1.1-2-1	1.1.1-2-1	1.1.1-2-1	1.1.1-2-1
	Exp.	1.1.2-2-3	1.1.2-2-3	1.1.2-2-3	1.1. 2-2-3	-	-	1.1.2-2-3	1.1.2-2-3	1.1.2-2-2	1.1.2-2-3	1.1.2-2-2	1.1.2-2-3	1.1.2-2-2	1.1.2-2-2
P2	Enp.	1.2.2-2-1	1.2.2-2-1	1.2.2-2-1	1.2.2-2-1	-	-	1.2.2-2-1	1.2.2-2-1	1.2.2-2-1	1.2.2-2-1	1.2.2-2-1	1.2.2-2-1	1.2.2-2-1	1.2.2-2-1
	Exp.	1.1.2-2-3	1.1.2-2-3	1.1.2-2-3	1.1.2-2-3	-	-	1.1.2-2-3	1.1.2-2-3	1.1.2-2-2	1.1.2-2-3	1.1.2-2-2	1.1.2-2-3	1.1.2-2-2	1.1.2-2-2
P3	Enp.	1.2.3-2-1	1.2.3-2-1	1.2.3-2-1	1.2.3-2-1	-	-	1.2.3-2-1	1.2.3-2-1	1.2.3-2-1	1.2.3-2-1	1.2.2-2-0	1.2.3-2-1	1.2.2-2-1	1.2.2-2-1
P4	Exp.	1.1.2-2-3	1.1.2-2-3	1.1.2-2-3	1.1.2-2-3	1.1.2-2-3	-	1.1.2-2-3	1.1.2-2-3	1.1.2-2-3	1.1.2-2-3	1.1.2-2-3	1.1.2-2-3	1.1.1-2-2	1.1.1-2-2
	Enp.	1.2.2-2-1	1.2.2-2-1	1.2.2-1-1	1.2.2-1-1	1.2.2-1-1	-	1.2.2-1-1	1.2.1-2-1	1.2.2-1-1	1.2.2-2-1	1.2.1-2-0	1.2.2-2-1	1.2.1-2-0	1.2.1-2-0
	length/width(♀)	× 5.6	× 3.7	× 5.7	-	× 4.8	× 6.5	× 2.8	× 2.2	× 4	× 5.5	× 5.3	× 8	-	× 6.9
	length/width (♂)	× 5.6	-	-	× 4.5	-	-	-	-	-	-	-	× 8	× 5	× 7.4
	no.setae (♀)	3	3	3	-	3	3	3	3	2	3	3	2	-	4
P5 Exp.	no.setae (♂)	6	-	-	4	-	-	-	-	-	-	-	4	3	3
Operculum shape		naked	naked	setulose	naked	naked	naked	setulose	naked	naked	naked	naked	spinulose	naked	setulose
Distribution		Norway	Norway	Spitzbergen	Spitzbergen	Arctic	Arctic	Pacific	Pacific	Pacific/ Indian	Indian	Mediterranean	off Mindanao	off Mindanao	Sagami Bay Japan
Author, date		Sars, 1903	Sars, 1903	Lang, 1936	Lang, 1936	Smirnov, 1946	Smirnov, 1946	Brotskaya, 1963	Brotskaya, 1963	Brotskaya, 1963	Por, 1969	Soyer, 1970	Ito, 1983	Ito, 1983	present study

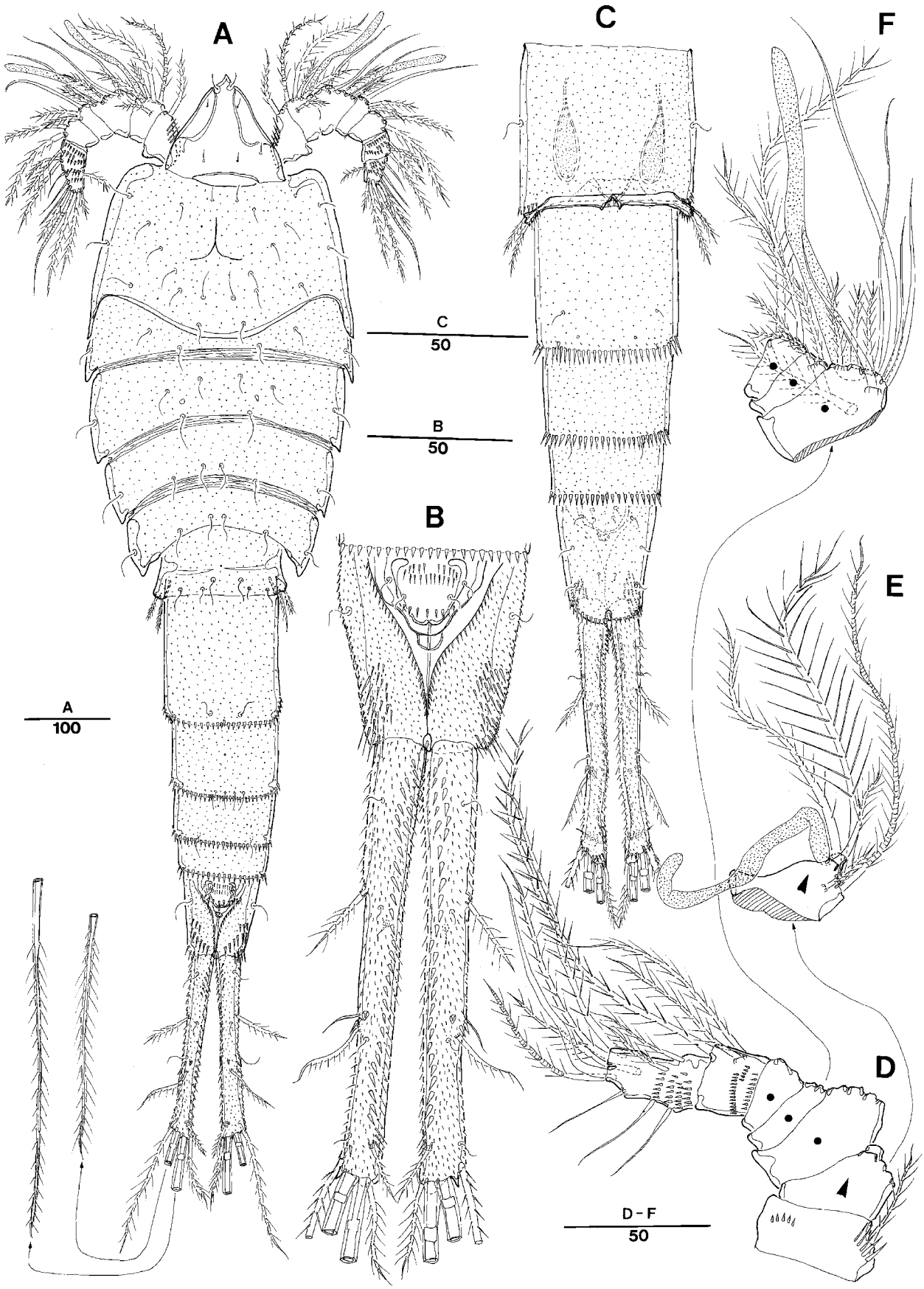

FIGURE 9. *Neocervinia itoi* Lee & Yoo, 1998, male: (A) habitus, dorsal; (B) anal segment and caudal rami, dorsal; (C) urosome, ventral; (D) antennule (setae omitted from segments 2–5), two sensillae arrowed; (E) antennular segment 2; (F) antennular segments 3–5. All scales in µm.

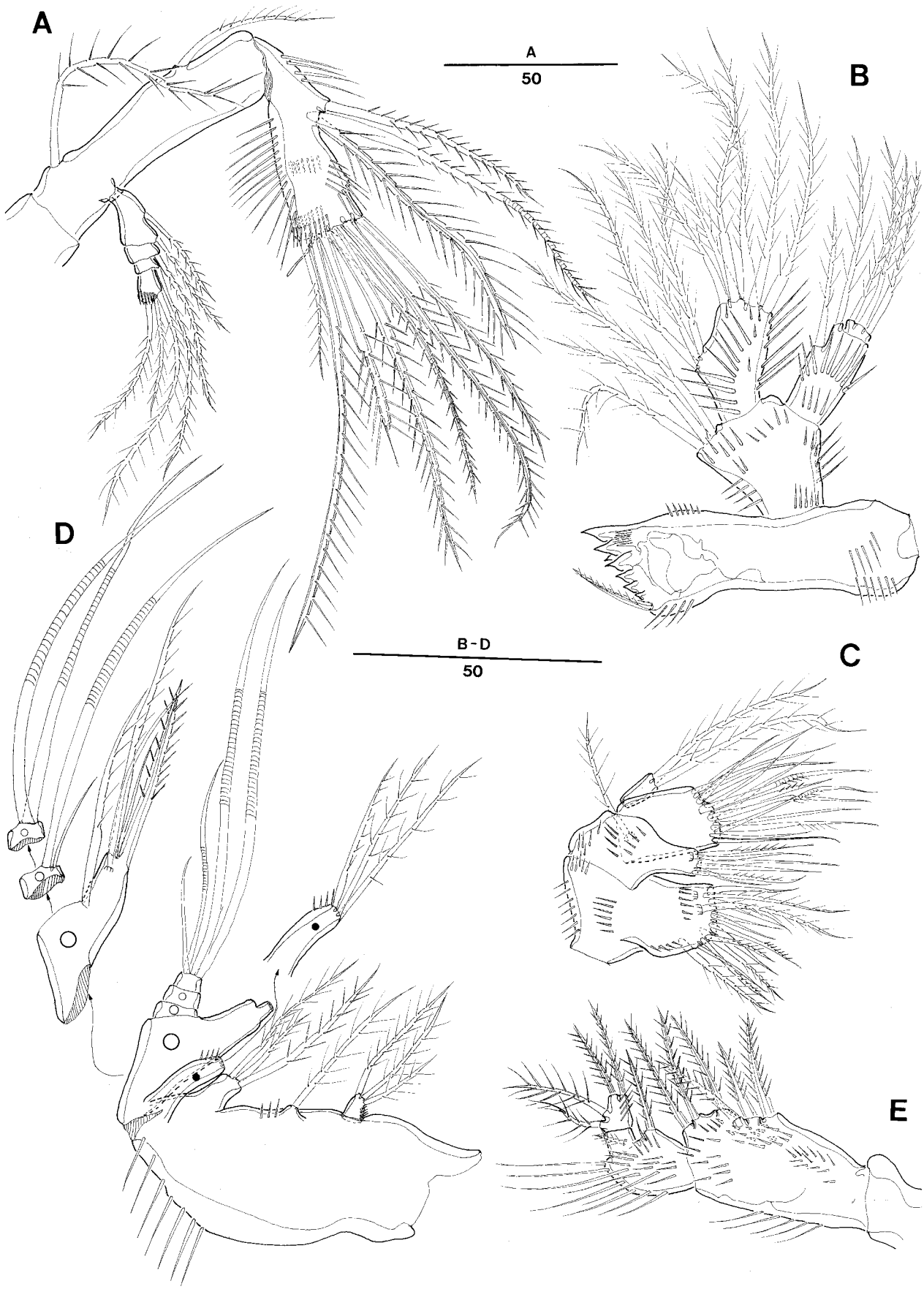

FIGURE 10. *Neocervinia itoi* Lee & Yoo, 1998, male: (A) antenna; (B) mandible; (C) maxillule; (D) maxilla; (E) maxilliped. Both scales in μm.

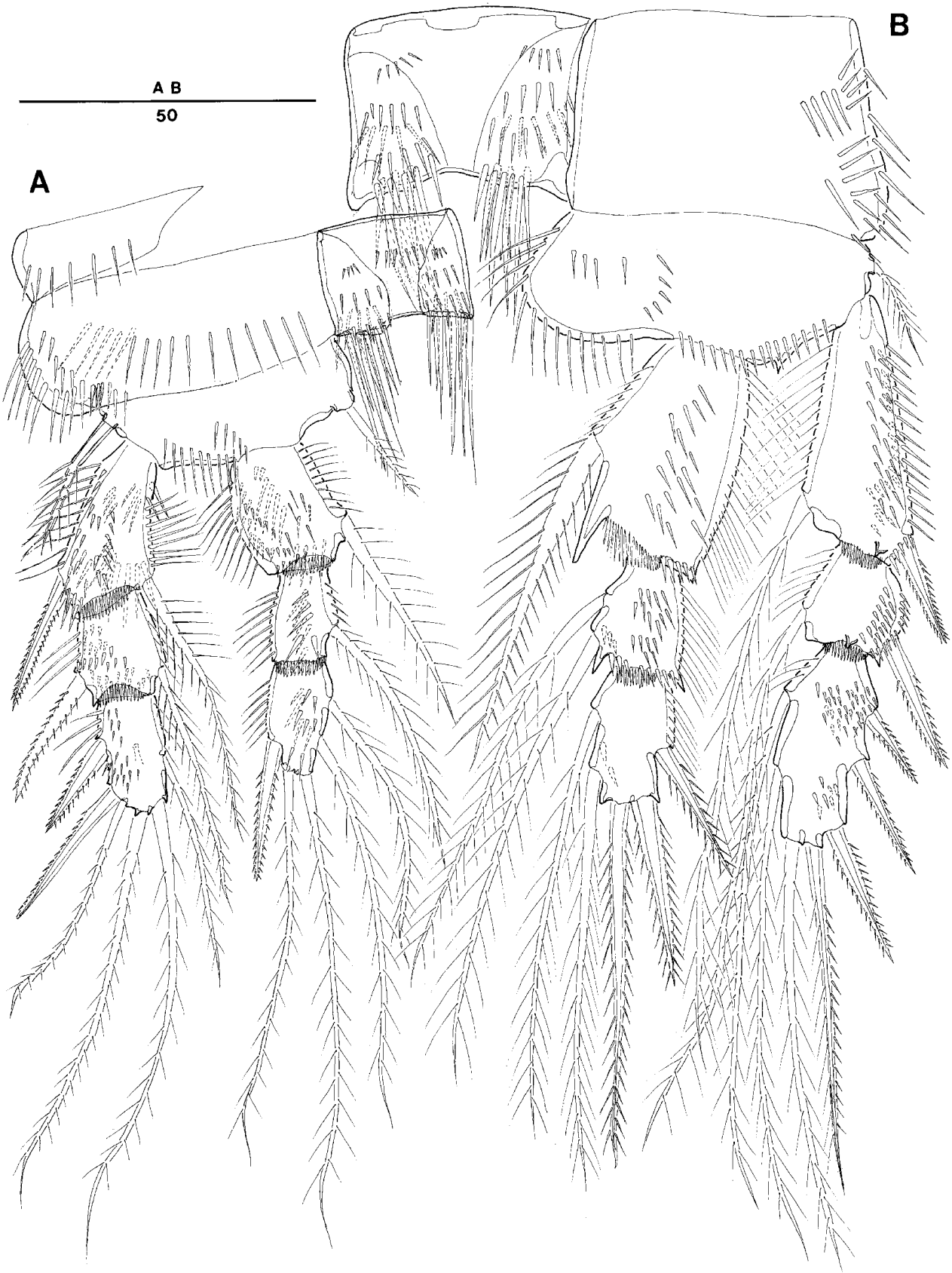

FIGURE 11. *Neocervinia itoi* Lee & Yoo, 1998, male: (A) P1; (B) P2. Scale in µm.

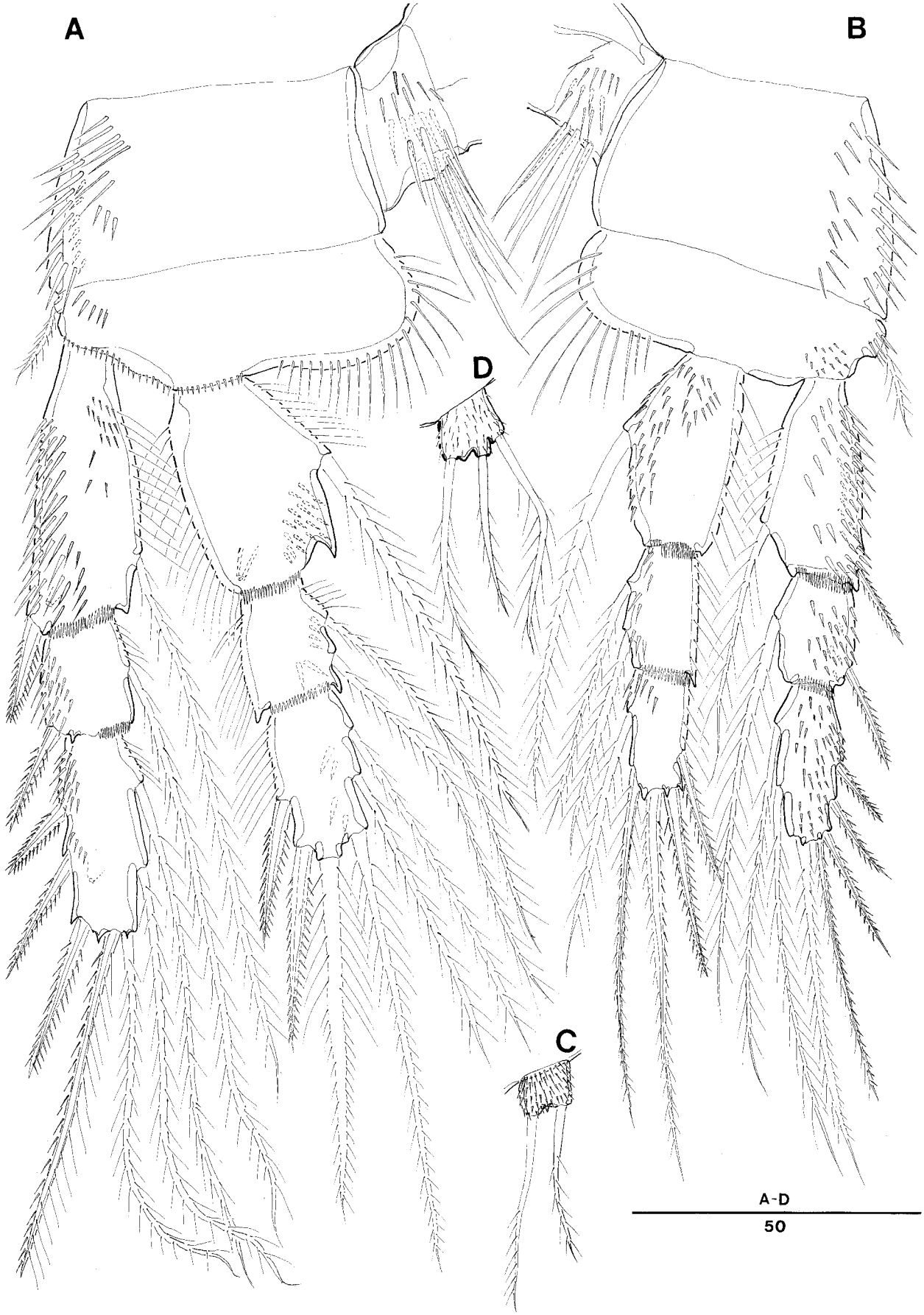

FIGURE 12. *Neocervinia itoi* Lee & Yoo, 1998, male: (A) P3; (B) P4; (C) P5. Female: (D) P5. Scale in µm.

Seifried (2003) synonymized *Neocervinia* with *Cervinia,* based on the 'strict consensus tree' (Seifried 2003; see Fig. 12, p. 52). She claimed that the only apomorphic character of *Neocervinia* is a "one segmented P5 in the female". However, at the same time she admitted that *Cervinia* is a paraphyletic taxon after her actions of synonymizing *Neocervinia* and *Pseudocervinia* Brotskaya, 1963 with *Cervinia*. The species of *Neocervinia* have the same seta formula of the swimming legs but the presence of sensilla on the first and second antennulary segments were considered synautapomorphies of *Neocervinia* (see Huys et al. 1997). Considering that these sensillae were confirmed in the male of *N. itoi* (Fig. 9D), it is highly likely that they are indeed a synautapomorphy of the genus, which strongly supports the generic status of *Neocervinia,* in addition to the one-segmented P5 in both sexes. Sexually dimorphic P5 in *N. itoi*, three setae in the female, and only two setae in the male, provide additional supportive evidence for the validity of the genus *Neocervinia*. So far, the males are known for only three *Cervinia* species: *C. bradyi* Norman, 1878, *C. plumosa* Ito, 1983, and *C. mediocauda* Burgess, 1998. They show sexual dimorphism in the lengths of setae on the P5 but not in the seta numbers. *Cervinia* species and *Neocervinia itoi* display some synapomorphic characters including the length of the P1 inner basal seta and the atrophied mouthpart appendages. However, there are some discrepancies even in these characters, viz.: the inner basal seta of P1 is not elongated in the male of *N. itoi* as it is in *Cervinia bradyi* Norman, while it is elongated in the male of *Cervinia plumosa* Ito. The atrophied mouth appendages are observed in the males of *C. bradyi*, *C. plumosa*, and *C. mediocauda* (see Giesbrecht 1900; Ito 1983; Burgess 1998). This feature is also confirmed in the male of *Neocervinia* and is a common feature within the family Aegisthidae (see Lee and Huys 2000; Shimanaga et al. 2009).

Unfortunately, the male characters of *N. tenuicauda* and *N. unisetosa* remain as yet unconfirmed. However, based on the definitive single-segmented female P5 in both species and sexually dimorphic characters of *N. itoi,* the generic diagnosis of *Neocervinia* is here revised with the newly revealed male characters.

Neocervinia Huys, Møbjerg & Kristensen, 1997

Diagnosis. Aegisthidae, Cerviniinae. Tergite of P1-bearing somite free in ♀. Rostrum well developed, fused to cephalosome in♀, and defined at base in ♂. Antennule 6–7-segmented in ♀, more than 7-segmented in ♂. First and second antennulary segments of both sexes with 1 sensillae along posterior dorsal surface. P1–P4 endopods 3-segmented in both sexes.Mandible, maxillule, maxilla and maxilliped, atrophied, non-functional in ♂. P1–P4 armature formulae:

	Exopod	Endopod
P1	1.1.123	1.1.221
P2	1.1.223	1.2.221
P3	1.1.223	1.2.321
P4	1.1.223	1.2.221

P5 not defined at base, minute and laterally placed with 3 setae in ♀, and 2 setae in ♂.

Type species. *Cervinia unisetosa* Montagna, 1981.

Other species. *Neocervinia tenuicauda* (Brotskaya, 1963), *Neocervinia itoi* Lee & Yoo, 1998.

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