



Two new species of the genus *Monstrillopsis* Sars, 1921 (Copepoda: Monstrilloida: Monstrillidae) from South Korea

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Abstract

Monstrilloid copepods of the genus *Monstrillopsis* Sars, 1921 are recorded from Korea, as well as from the northwestern Pacific, for the first time. Specimens were obtained using a light trap set overnight at piers or seawalls in small harbors. Males of two new species were found and are described herein with remarks on their affinities and detailed drawings and SEM photographs of their morphological features. *Monstrillopsis longilobata* sp. nov. is allied to *M. chathamensis* Suárez-Morales & Morales-Ramírez, 2009 and *M. sarsi* Isaac, 1974 in having the character combination of a long, claw-like apical spinous process on the male antennule and elongate genital lappets. It differs from them in having conspicuous transverse striations on the dorsal surface of the cephalothorax and extremely long male genital lappets, which extend far beyond the anterior margins of the caudal rami. *Monstrillopsis coreensis* sp. nov. also has a claw-like apical spinous process of the male antennule and conspicuous transverse striations on the dorsal surface of the cephalothorax, but it differs from *M. longilobata* in having a much longer and stronger apical spine of the antennule and a relatively shorter and undulating genital apparatus.

Key words: description, light trap, morphology, northwest Pacific, taxonomy

Introduction

Monstrilloid copepods represent one of the least understood orders of the Copepoda, and the phylogenetic relationships of the Monstrilloida have always been problematical, due largely to the lack of mouthparts in the adults (Huys & Boxshall 1991). The problem of matching males with their conspecific females has also hampered the development of monstrilloid taxonomy (Suárez-Morales 2011). Although monstrilloid genera are poorly defined (Huys & Boxshall 1991) and the genus-level taxonomy is still somewhat unsettled (see Boxshall & Halsey 2004; Walter & Boxshall 2014), about 127 nominal species of five genera are currently recognized in the single family Monstrillidae Dana, 1849, including 16 species, about 12.6% of all recognized monstrilloid species, in the genus *Monstrillopsis* Sars, 1921 (Suárez-Morales 2011; Suárez-Morales & McKinnon 2014).

Monstrilloids are generally quite scarce, many species being known from only one or a few specimens, but they are captured frequently in plankton nets during zooplankton surveys of coastal-neritic and, in particular, coral-reef-related environments (Suárez-Morales *et al.* 2006). Recently we have obtained plentiful specimens of monstrilloids belonging to diverse taxa around the southern coasts of the Korean Peninsula by nocturnal surveys using a light trap. Among the accumulated collection, we have confirmed substantial numbers of specimens of *Monstrillopsis*, a genus which we report here for the first time from the northwestern Pacific.

In Korea, monstrilloid copepods have been poorly studied. Only two taxonomic papers have been published, one describing the new species *Cymbasoma striifrons* Chang, 2012 from the east coast off Samcheok and the south coast at Geoje Island (Chang 2012), and the other reporting and redescribing two species of *Monstrilla* mostly from the southeast coast, viz., *M. grandis* Giesbrecht, 1891 and *M. hamatapex* Grygier & Ohtsuka, 1995 (Chang 2014).

The present paper provides taxonomic accounts of the two new species of *Monstrillopsis* from the Korean coast, with detailed illustrations and SEM photomicrographs.

Material and methods

Materials for this study were obtained at nine localities in small harbors, eight on the southeast coast and one on the west coast of South Korea, using a light trap. The device was designed for nocturnal collection, being equipped with a pair of flashlights used by SCUBA divers hanging inside a PVC pipe (10 cm in diameter, 42 cm long). At each station, three to five light traps were placed on the rocky or sandy bottom at a depth of 3–6 meters at the ends of piers or along seawalls after sunset (Chang 2012, 2014). About 4–6 hours later, or at dawn, the water in each light traps, with its contained plankton, was poured into a bucket and then filtered through a tow net of 64 µm mesh. The samples were then fixed in 4% buffered formalin or about 90% ethanol in the field, and later transferred to 80% ethanol for long-term preservation.

Monstrilloid specimens were isolated from the samples under a zoom-stereomicroscope (Leitz SV-11, Germany) at high magnifications (32–120 x) with a micropipette, and left in a solution of 30% glycerin-70% ethanol for half a day. Dissection was performed using two needles made from a 0.3 mm diameter tungsten wire, sharpened by electrolysis (Huys & Boxshall 1991), in a lactophenol drop on an H-S slide (Shirayama *et al.* 1993), a recent variation of the Cobb slide, which holds two different-sized cover slips (22 × 24 mm and 18 × 18 mm) and allows the microscopic examination of copepods from either of the two surfaces (Huys & Boxshall 1991). Mounted specimens were observed using a differential interference contrast microscope (Olympus BX-51, Japan) equipped with Nomarski optics. All drawings were made with the aid of a camera lucida.

Specimens for scanning electron microscopy were prefixed with 2.5% glutaraldehyde in 0.1M phosphate buffer (pH 7.4) for 12 hours at 4 °C, followed by rinsing with 0.1 M phosphate buffer (pH 7.2–7.4) three times for ten minutes each. Specimens postfixed in 2% cold osmium tetroxide in 0.1 M phosphate buffer for 2 hours were rinsed with 0.1 M phosphate buffer for 2 hours, immersed in 1% tannic acid for an hour at 4 °C, then left in phosphate buffer overnight. After dehydration through a graded series of ethanol (50–100% at 10% interval) for 30 minutes each, the material was placed in t-butyl alcohol for an hour at room temperature, and critical point dried using a freeze-dryer. Specimens were coated with gold-palladium in a high-vacuum sputter-coater, and examined using a scanning electron microscope (Hitachi S-4800) operated at 10 KV.

Type specimens are deposited in the National Institute of Biological Resources (NIBR), Incheon, Korea, and the specimen room of the Department of Biological Science, Daegu University (DB), Korea.

General terminology for the morphological description of the new species follows Huys & Boxshall (1991). The nomenclature for female monstrilloid antennular setation by Grygier & Ohtsuka (1995) is adopted herein to the extent it also can be applied to males, and for the terminal segment of the male antennules by Huys *et al.* (2007).

Systematic accounts

Family Monstrillidae Dana, 1849

Genus *Monstrillopsis* Sars, 1921

Monstrillopsis longilobata sp. nov.

(Figs. 1–3, 6A–C)

Type locality. Mipo Bay (northern breakwater, 35°31'40.71"N, 129°26'57.68"E), Ulsan, southeast coast of Korea.

Material examined. Holotype ♂ (NIBRIV0000308201), undissected, ethanol-preserved, collected from the type locality, 6 Feb. 1999 (C.Y. Chang & J. Lee). Paratypes: 2 ♂♂ (DB20044–45) dissected on slides and 1 ♂ (DB20046) mounted on an aluminum stub for SEM study, from the type locality. Additional material: 4 ♂♂, Mipo Bay, Ulsan, 6 Feb. 1999 (C.Y. Chang & J. Lee); 1 ♂, Bangeojin Bay, Ulsan, 26 Dec. 2012 (C.Y. Chang & Y.J. Son); 18 ♂♂, Korea Maritime & Ocean University, Busan, 16 May 2014 (J. Lee); 6 ♂♂, Korea Maritime & Ocean

University, Busan., 24 Jul. 2014 (C.Y. Chang & Y.J. Son); 9 ♂♂, Muhak, Geumo Island, Yeosu, 16 Jun. 2000 (C.Y. Chang & J. Lee); 12 ♂♂, Gau Island, Taean, 27 Jun. 2012 (C.Y. Chang).

Description of the male. Body slender (Fig. 1A–B), 1.74 mm long (mean 1.69 mm, standard deviation 0.24, $n = 8$), measured from anterior end of cephalothorax to posterior margin of caudal rami, excluding antennules and caudal setae. Cephalothorax not very elongate, accounting for about 49.1% of whole body length; anterior margin slightly convex, with one pair of sensilla near anterior margin, slightly swollen in middle, constricted at posterior quarter, then swollen laterally near posterior margin, with row of eight minute sensilla dorsally and laterally along posterior margin. Two groups of sensory pores situated middorsally at level of nauplius eye: anterior three pores aggregated near medial line, posterior five pores arranged in semicircle.

Nauplius eye well developed (Fig. 1A–B), weakly pigmented; lateral cups set close to each other, ventral cup slightly smaller than lateral ones. Narrow band of numerous conspicuous transverse striations occupying about 6–10% of cephalothorax length just anterior to midlength dorsally, becoming strongly crumpled laterally and much weaker on ventral surface. Anterior ventral surface of cephalic area with pair of obliquely wrinkled pores between bases of antennules (Fig. 2A). Inconspicuous median cuticular process present on anterior ventral surface. Paired nipple-like processes well developed, with field of relatively strong transverse wrinkles lying between them and oral papilla. Paired sensory pores situated posterior to nipple-like processes. Oral papilla small, locating at about one-third length (34%) of cephalothorax, protruding ventrally. Large hemispherical protuberance situated mid-ventrally, just anterior to intercoxal sclerite of first pair of swimming legs (Fig. 1B).

Second pedigerous somite (*i.e.*, first free somite) with two posterolateral and one middorsal pairs of sensilla. Third pedigerous somite with four pairs of sensilla posteriorly and laterally. One pair of pores present middorsally near anterior margin of each of pedigerous somites 2–4.

Urosome comprising fifth pedigerous somite, genital somite, three postgenital somite (including anal somite), and caudal rami (Figs. 1A, 2B–C), altogether accounting for 50.9% of total body length, excluding caudal setae; urosomites lacking wrinkles, except for fifth pedigerous somite and anterolateral part of genital somite. Fifth pedigerous somite small, limbless, ornamented with row of weak oblique wrinkles on lateral surface (Fig. 2C). Third urosomite weakly protruding posterolaterally. Fourth urosomite and anal somite separated by ventral suture, not clearly visible dorsally. Anal somite trapezoidal; lateral margins straight, with no notch or wrinkles; posterolateral angle thickly sclerotized.

Caudal rami (Fig. 2B–C) not divergent, about 1.8 times longer than wide, swollen at basal part of inner face and with weakly concave inner margin; furnished with four subequal setae, comprising one lateral seta issuing from middle of lateral margin of ramus, two terminal and one slightly inner dorsal setae, supposedly representing caudal setae II, IV, V and VII, respectively, of Huys & Boxshall (1991); bases of inner terminal and lateral caudal setae heavily sclerotized, bulbous.

Antennules (Figs. 1A–B, 2D) equal to 38.7% of total body length and 78.8% of cephalothorax length; 5-segmented (length ratio of segments from proximal to distal 10.3 : 25.6 : 12.6 : 26.4 : 25.4 = 100), geniculate between fourth and fifth segments, armed with one claw-like, spinous seta distally. In terms of seta/spine armature pattern described by Grygier and Ohtsuka (1995), segment 1 armed with spinous element 1 on inner side distally. Segment 2 with six elements: short and setulose $2d_{1-2}$ and $2v_{1-3}$ along inner margin, and long, plumose II_d on dorsal surface of inner distal corner. Segment 3 small with only three elements: short, setulose element 3 and long, plumose III_d and III_v. Segment 4 with six elements: short and setulose $4d_{1-2}$ and $4v_{1-3}$ along medial face, and long, plumose IV_v slightly ventrally, next to long aesthetasc (4aes). Segment 5 modified, comprising inner proximal expansion and tapered distal part; armed with 11 elements in total: in terms of Huys *et al.*'s (2007) nomenclature, four long, dichotomously branched setae (A–D), two slender, simple setae (setae 3, 4) along outer (anterior) margin; short, simple dorsomedial seta (seta 6) and long, setulose ventromedial seta (seta 5) on inner proximal expansion; and stout, claw-like, spinous apical element (element 2), minute subapical spinular element (element 1), and slender, subapical setous element (evidently representing 6aes) at tip; apical spinous element 2 claw-like, nearly 1/3 as long as distal segment; one minute setule present on inner proximal corner of this segment (arrowed in Fig. 2D).

Legs 1–4 (Fig. 3A–D) with both endopod and exopod 3-segmented. Intercoxal sclerite about 1.5 times as long as wide, unornamented. Basis not divided from coxa medially; outer basal seta slender, simple, except for much longer, biserially plumose seta on leg 3. Outer margin of first exopodal segment of each leg smooth, not undulate; outer margins of endopodal segments hirsute. Outer spines on first and third exopodal segments short, less than

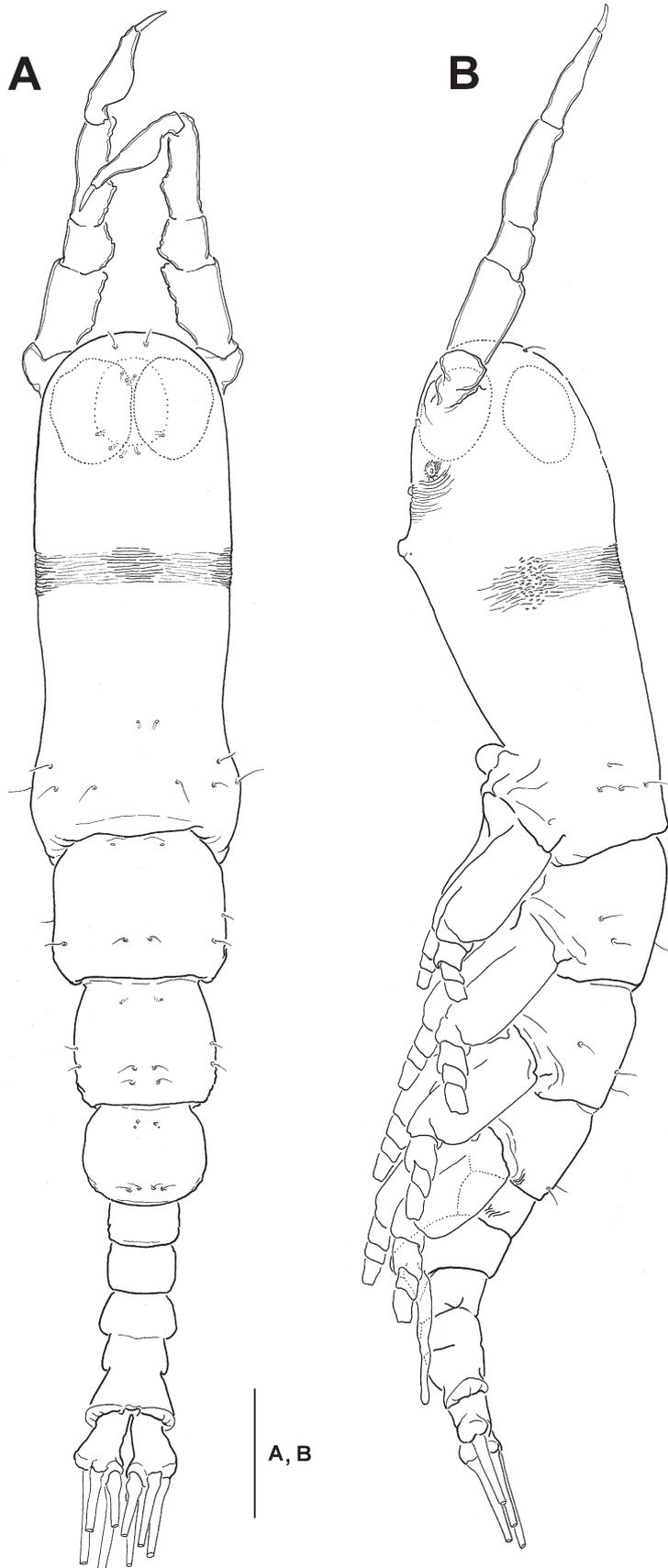


FIGURE 1. *Monstrillopsis longilobata* sp. nov. (paratype male, DB20044). A, habitus, dorsal; B, habitus, lateral. Scale bar = 200 μ m.

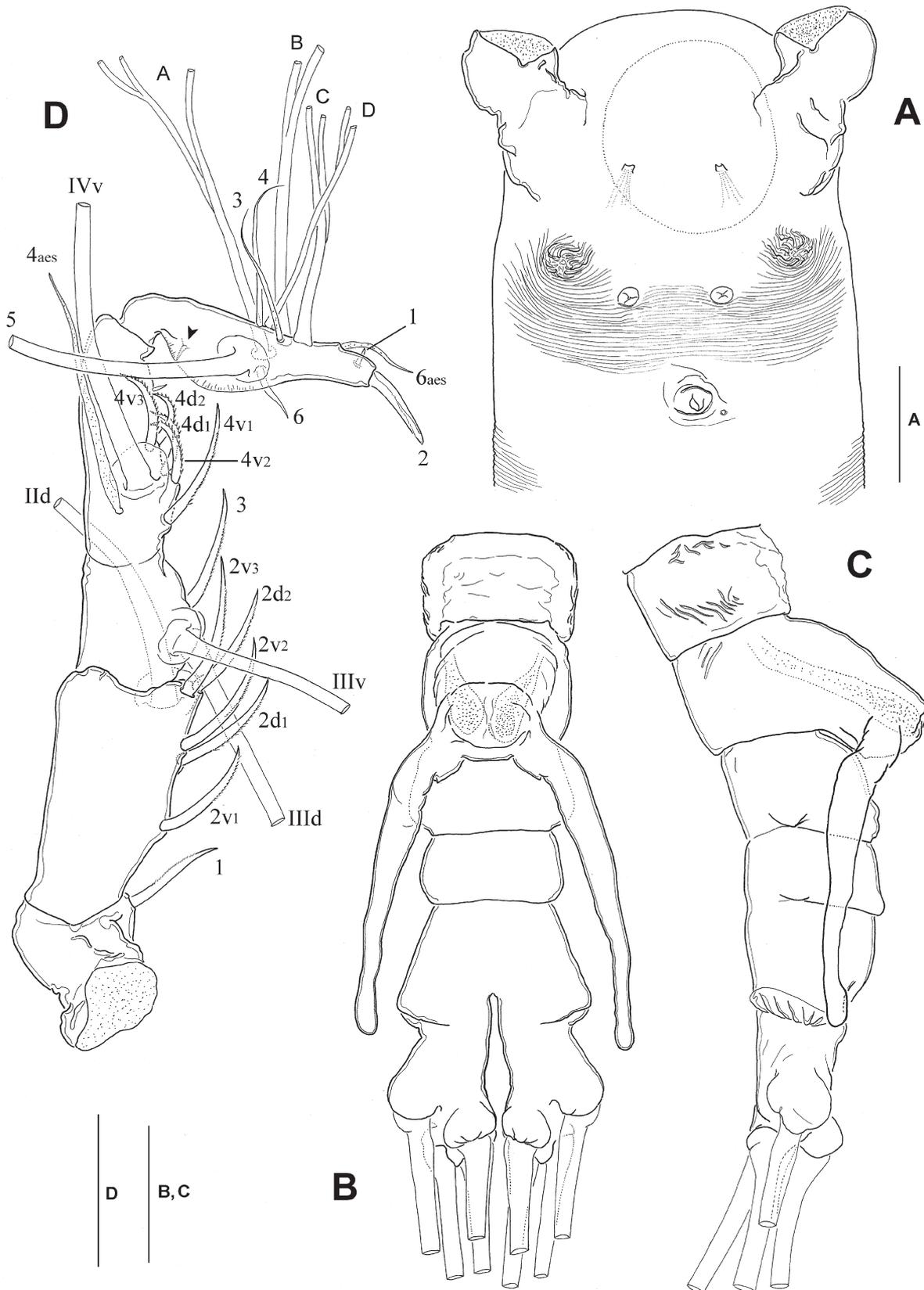


FIGURE 2. *Monstrillopsis longilobata* sp. nov. (paratype male, DB20044). A, anterior part of cephalothorax, ventral; B, urosome with genital apparatus, ventral; C, urosome with genital apparatus, lateral; D, right antennule, ventral, with setal elements labeled on the first to fourth segments according to Grygier & Ohtsuka's (1995) nomenclature, and on the apical segment according to Huys *et al.*'s (2001) notation. Arrow indicates a setule on inner proximal corner of the last segment. Scale bars = 100 μ m.

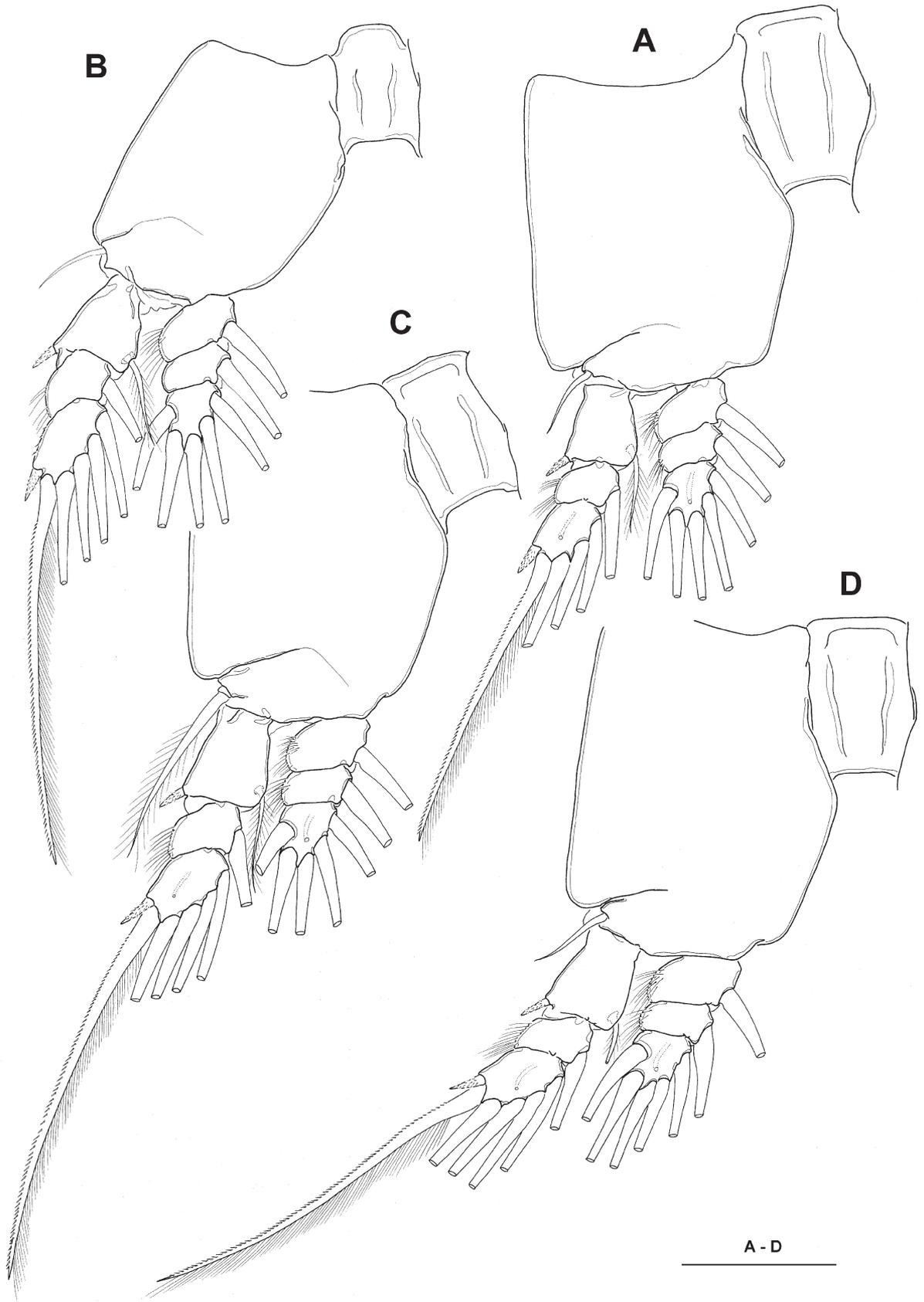


FIGURE 3. *Monstrillopsis longilobata* sp. nov. (paratype male, DB20044). A, leg 1; B, leg 2; C, leg 3; D, leg 4. Scale bar = 100 μ m.

half as long as segment; distal spinous seta extremely long, heterogeneously ornamented with setules along inner margin and numerous fine spinules along most of outer margin. Seta/spine armature of swimming legs 1–4 as follows (Roman numerals indicate numbers of spines, and Arabic numerals indicate numbers of setae):

	Coxa	Basis	Exopod	Endopod
Leg 1	0–0	1–0	I–1; 0–1; I,1,3	0–1; 0–1; 1,2,2
Legs 2–4	0–0	1–0	I–0; 0–1; I,1,4	0–1; 0–1; 1,2,2

Genital apparatus (Fig. 2B–C) comprising relatively short shaft protruding ventrally and pair of elongate lappets. Ventral surface of shaft smooth, with no apparent protrusion or ornamentation around genital openings. Genital lappets conjoined at base, each slightly tapering distally, nearly smooth without undulations, with round tip gently curving inward, extending slightly beyond posterior margin of anal somite, almost reaching to base of lateral caudal seta (Fig. 2B–C).

Female. Unknown.

Etymology. The specific name *longilobata* is taken from the Latin *longus* and *lobatus*, meaning elongate and lobe-shaped, respectively, and refers to the remarkably elongate lappets of the male genital apparatus, a diagnostic feature of this new species.

Differential diagnosis. *Monstrillopsis longilobata* sp. nov. resembles *M. chathamensis* Suárez-Morales & Morales-Ramírez, 2009 from the coast of Costa Rica in the Eastern Tropical Pacific and also *M. sarsi* Isaac, 1974 from the Bristol Channel, northeastern Atlantic, in having a long, claw-like apical spine on the male antennule and elongate genital lappets (Isaac 1974; Suárez-Morales & Morales-Ramírez 2009). The present new species differs from them in being much larger (about 1.8 mm long versus 0.93 mm in *M. chathamensis* and about 1.2 mm in *M. sarsi*) and in having conspicuous transverse striation of the cephalothorax, a more posteriorly situated oral papilla (about 1/3 of the way back along the cephalothorax, versus only 11% of the way posteriorly in *M. chathamensis* and about 22% in *M. sarsi*), heavily sclerotized and bulbous bases of caudal setae (not bulbous in *M. chathamensis*), and very long genital lappets that reach beyond the anterior margins of the caudal rami.

Monstrillopsis coreensis sp. nov.

(Figs. 4–5, 6D–F)

Type locality. Northern wharf at Korea Maritime & Ocean University (35°04'29.70"N, 129°05'07.88"E), Busan, south coast of Korea.

Material examined. Holotype ♂ (NIBRIV0000308202), undissected, ethanol-preserved, collected from the type locality, 16 May 2014 (J. Lee). Paratypes: 3 ♂♂ (DB20047, DB20048–49) dissected on slides and 1 ♂ (DB20050) mounted on an aluminum stub for SEM study, from the type locality. Additional material: 13 ♂♂, Taejongdae, Busan, 24 July 2013 (C.Y. Chang & Y.J. Son); 18 ♂♂, Korea Maritime & Ocean University, Busan, 16 May 2014 (J. Lee); 11 ♂♂, Jagalchi port, Busan, 5 August 2012 (C.Y. Chang & Y.J. Son); 7 ♂♂, Jagalchi port, Busan, 19 March 2013 (C.Y. Chang & Y.J. Son); 15 ♂♂, Busan (South) Port, 24 July 2013 (C.Y. Chang & Y.J. Son); 5 ♂♂, Tongyeong Port, 19 May 2013 (C.Y. Chang & Y.J. Son).

Description of the male. Body (Fig. 4A–B) rather slender, holotype 2.04 mm long (mean 2.01 mm, standard deviation 0.12, $n = 9$), measured from anterior end of cephalothorax to posterior margin of caudal rami. Cephalothorax not very elongate, accounting for 46.7% of whole body length, slightly swollen laterally at anterior third, narrowing posteriorly, then swollen laterally near posterior margin; length to width ratio of cephalothorax 2.97. Band of transverse striations inconspicuous and narrow, present from anterior 40% to 51% of dorsal surface of cephalothorax, reaching lateral surface but absent ventrally. Lateral cups of nauplius eye situated close to each other, weakly pigmented; ventral cup a little larger than lateral ones (Fig. 4A–B). Faint, slightly protruding, median cuticular process present on anterior ventral surface (Fig. 5A). Paired nipple-like processes well-developed, flanked laterally by oblique wrinkles, followed by relatively strong transverse wrinkles as far back as oral papilla. Paired sensory pores situated posterior to nipple-like processes. Oral papilla small, not protruding, located about one third (33.7%) of way back along ventral midline of cephalothorax (Fig. 4B). Hemispherical protuberance present anterior to base of intercoxal sclerite of first pair of swimming legs (Fig. 4B).

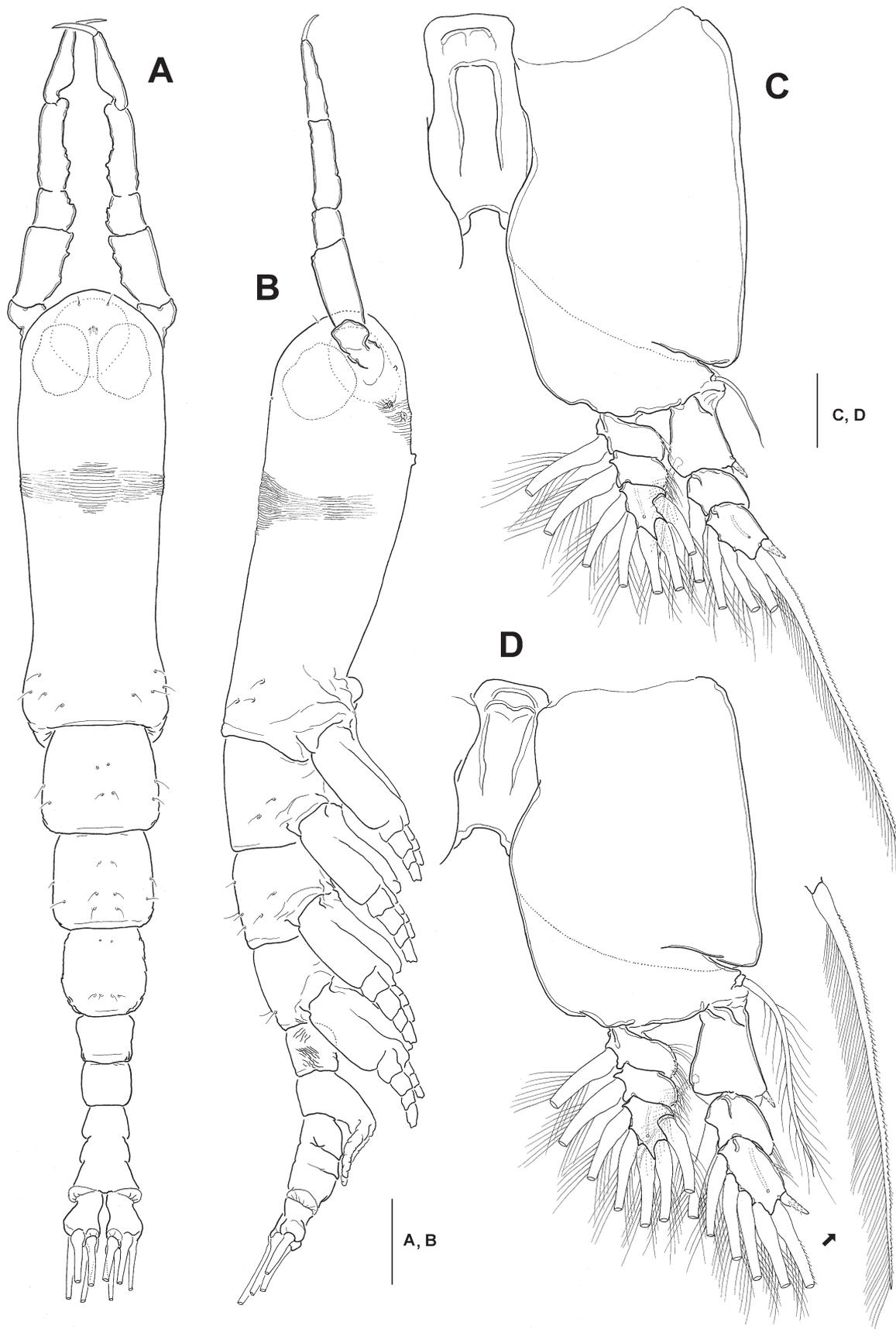


FIGURE 4. *Monstrillopsis coreensis* sp. nov. (male). A, habitus, dorsal (holotype); B, habitus, lateral (holotype); C, leg 1 (paratype, DB20047); D, leg 3 (paratype, DB20047). Scale bars: A–B = 200 μm; C–D = 50 μm.

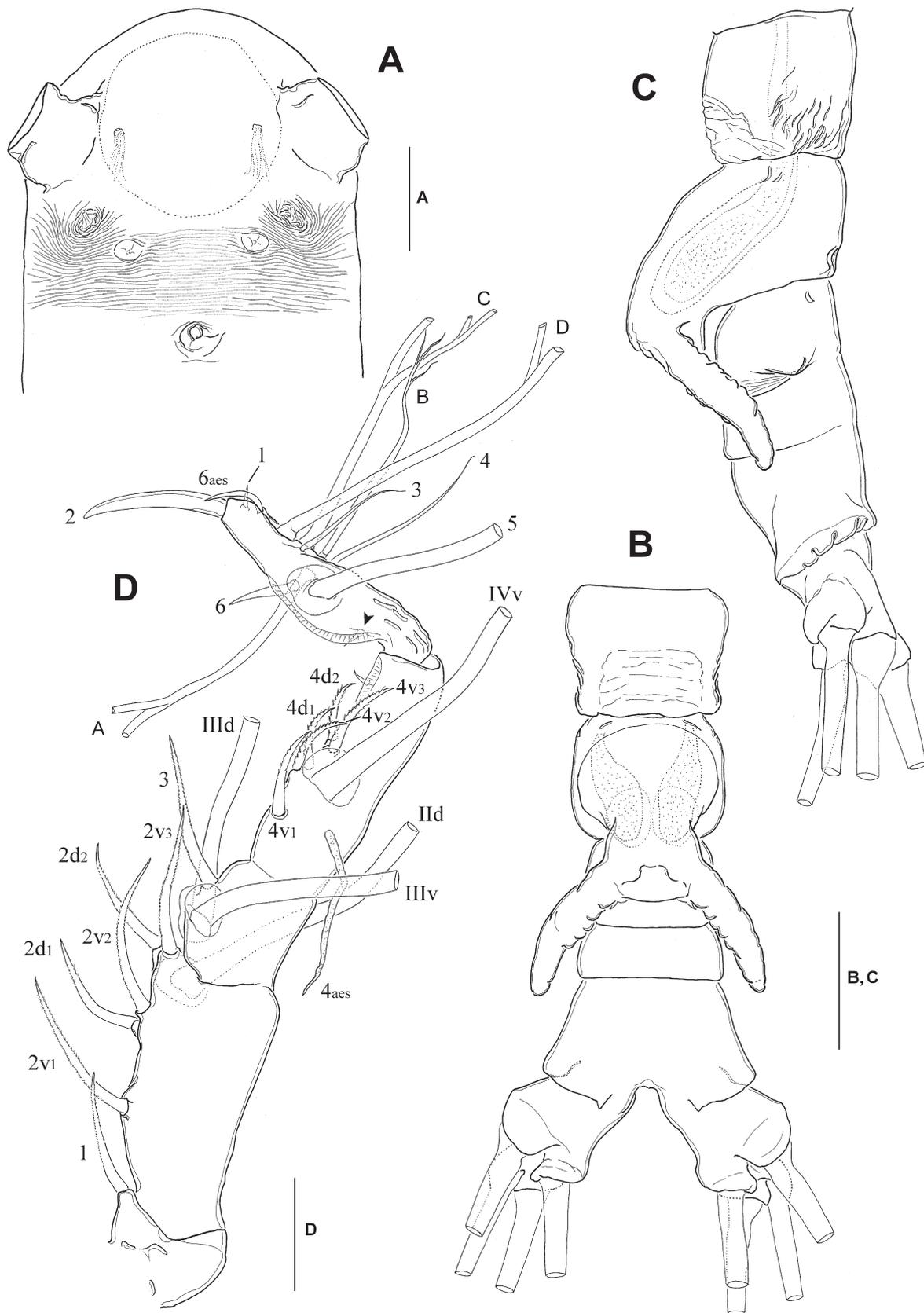


FIGURE 5. *Monstrillopsis coreensis* sp. nov. (paratype male, DB20047). A, anterior part of cephalothorax, ventral; B, urosome with genital apparatus, ventral; C, urosome with genital apparatus, lateral; D, left antennule, ventral, with setal elements labeled on the first to fourth segments according to Grygier & Ohtsuka's (1995) nomenclature, and on the apical segment according to Huys *et al.*'s (2001) notation. Arrow indicates a setule on inner proximal corner of the last segment. Scale bars = 100 μ m.

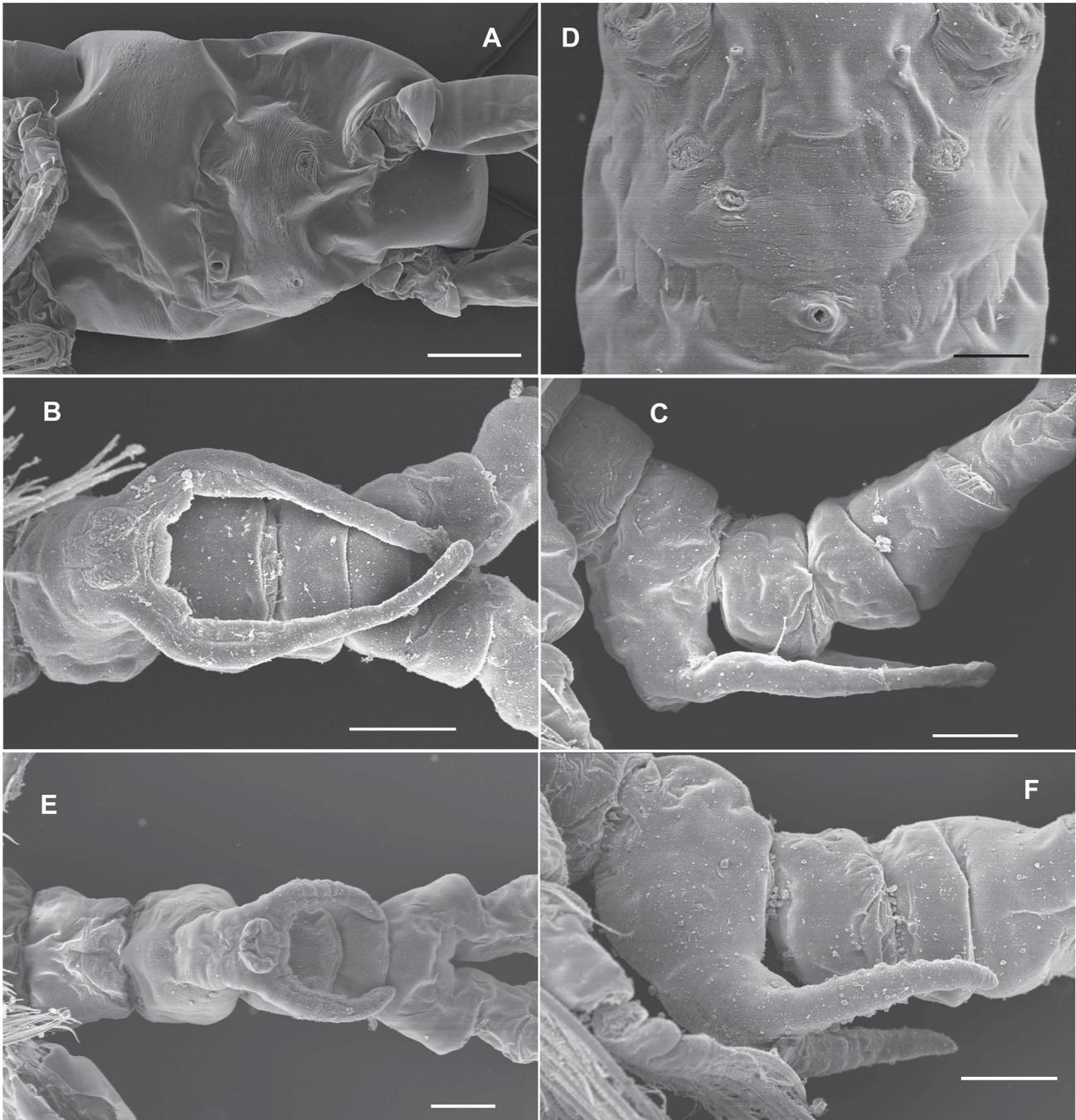


FIGURE 6. SEM photographs. A–C, *Monstrillopsis longilobata* sp. nov. (paratype male, DB20046). A, cephalothorax, ventral; B, urosome, ventral; C, urosome, lateral. D–F, *Monstrillopsis coreensis* sp. nov. (paratype male, DB20050). D, cephalothorax, ventral; E, urosome, ventral; F, urosome, lateral. Scale bars = 100 μ m.

Second and third pedigerous somites (*i.e.*, first and second free somites) nearly rectangular in dorsal view, with four middorsal and five lateral pairs of sensilla, respectively. Fourth pedigerous somite rounded posterolaterally, with row of four sensilla along posterior margin (Fig. 4A). One pair of pores present middorsally on second pedigerous somite, and near anterior margin of dorsal surface of fourth pedigerous somite.

Urosome 5-segmented, comprising fifth pedigerous somite, genital somite, and three postgenital somites (including anal somite). Fifth pedigerous somite small, limbless, ornamented with strong oblique wrinkles on lateral surface (Figs. 4B, 5C). All three postgenital somites incompletely separated dorsally, lacking conspicuous transverse sutures between them (Fig. 4A). Anal somite trapezoidal; lateral margin smooth, without notch; thickly sclerotized posterolaterally.

Caudal rami (Fig. 5B) divergent, about 1.3 times longer than wide, with inner margin strongly concave and posterolateral corner thickly sclerotized; furnished with four subequal setae, comprising one lateral seta issuing from middle of lateral margin of ramus, two terminal and one slightly inner dorsal setae, supposedly representing caudal setae II, IV, V and VII, respectively, of Huys & Boxshall (1991); basis of lateral seta strongly swollen.

Antennules (Figs. 4A–B, 5D) equal to 34.3% of total body length and 73.5% of cephalothorax length, 5-segmented (length ratio of segments from proximal to distal 5.8 : 27.6 : 13.5 : 26.9 : 26.3 = 100), geniculate between fourth and fifth segments, and armed with one claw-like, spinous seta distally. In terms of seta/spine armature pattern described by Grygier & Ohtsuka (1995), segment 1 armed with spinous element 1 inner distally. Segment 2 with six elements: short, setulose 2d₁₋₂ and 2v₁₋₃ along inner margin and long, plumose IId on dorsal surface of inner distal corner. Segment 3 small with only three elements: short, setulose element 3 and long, plumose IIIId and IIIv. Segment 4 with six elements: short, setulose 4d₁₋₂ and 4v₁₋₃ along medial face, long and plumose IVv slightly more ventrally, and long aesthetasc (4aes) arising from mid-ventral surface. Segment 5 modified, comprising inner proximal expansion and tapered distal part; armed with 11 elements in total: in terms of Huys *et al.*'s (2007) nomenclature, four long, dichotomously branched setae (A–D), two slender, simple setae (setae 3–4) along outer (anterior) margin; short, simple dorsomedial seta (seta 6) and long, setulose ventromedial seta (seta 5) on inner proximal expansion; and stout, claw-like, spinous apical element (element 2), minute subapical spinular element (element 1), and slender, subapical setous element (evidently representing 6aes) at tip; apical spinous element 2 claw-like, nearly 1/3 as long as distal segment; one minute setule present on inner proximal corner of this segment; apical spinous element 2 slightly longer than half (58%) as long as distal segment; minute setule present on inner proximal corner of segment (arrowed in the Fig. 5D).

Legs 1–4 with both endopod and exopod 3-segmented. Intercoxal sclerites elongate, about 2.1 times as long as wide, unornamented; distal margin strongly concave. Basis not divided from coxa medially; outer basal seta slender, naked, except for much longer and biserially setulose seta on leg 3 (Fig. 4D). Outer margin of first exopodal segments of legs 1–4 smooth and not undulate; outer margins of endopodal segments hirsute. Outer spines on first and third exopodal segments short, with fine setules; distal spinous seta markedly long, heterogeneously ornamented with row of plumose setae along inner margin and numerous fine spinules along most of outer margin. Seta/spine armature on swimming legs 1–4 as follows (Roman numerals indicate numbers of spines, and Arabic numerals indicate numbers of setae):

	Coxa	Basis	Exopod	Endopod
Leg 1	0–0	1–0	I–1; 0–1; I,1,3	0–1; 0–1; 1,2,2
Legs 2–4	0–0	1–0	I–0; 0–1; I,1,4	0–1; 0–1; 1,2,2

Genital apparatus comprising short median shaft and horseshoe-shaped pair of genital lappets (Fig. 5B–C). Genital lappets confluent at base anterior to genital openings and membranous operculum, strongly undulate and relatively short, their tips almost reaching anterior margin of anal somite; proximal half of each lappet slightly swollen laterally, distal half curved inward, with round tip.

Female. Unknown.

Etymology. The specific name refers to the type locality, Korea.

Differential diagnosis. The present new species is very similar to the preceding species, *M. longilobata* **sp. nov.**, in sharing the transverse striations on the dorsal surface of the cephalothorax and a similar male genital apparatus with a short shaft and elongate lappets. However, this new species differs as follows: (1) the lappets are much shorter in *M. longilobata*, barely reaching to the anterior margin of anal somite, with strong undulations along nearly their whole length, versus smooth lappets that extend far over the anterior margins of the caudal rami in *M. longilobata*; (2) the claw-like, apical spinous process on the distal segment of antennule is more than half as long as the segment in *M. coreensis*, versus one third as long in *M. longilobata*; (3) the three postgenital somites (third and fourth urosomites and anal somite) are not fully separated dorsally in *M. coreensis* whereas the articulation between the third and fourth urosomites is clearly defined in *M. longilobata*. The two species also show some minor discrepancies: (1) the dorsal transverse striations on the cephalothorax become much weaker on the lateral surfaces in *M. coreensis* but are strongly crumpled there in *M. longilobata*; (2) the five sensory (?) pores on the middorsal surface of cephalothorax at the level of the posterior part of the nauplius eye in *M. longilobata* are absent in *M. coreensis*; (3) the cuticular wrinkles on the lateral surface of the fifth pedigerous somite and the posterolateral protrusions on the postgenital somite are relatively much stronger in *M. coreensis*.

This new species also resembles *M. chilensis* Suárez-Morales, Bello-Smith and Palma, 2006 from Chile and southernmost South America (Beagle Channel) in the length proportions between whole body (or cephalothorax) and antennule, and the elongate and undulating genital lappets (Suárez-Morales *et al.* 2006). However, *M. coreensis* clearly differs from *M. chilensis* in having conspicuous transverse striations on the cephalothorax and a different form of male antennule, armed with the claw-like apical spinous process (element 2) on the last segment.

Discussion

Both of the new species are assignable to *Monstrillopsis* by their having: (1) a male antennule with a proximal hyaline bump and tapered distal part with an apical spinous process on the distal segment; (2) a male genital apparatus with a short median shaft and paired long lappets or lobes distolaterally; (3) a 5-segmented urosome in the male, including two postgenital somites and the anal somite; and (4) only four setae on each caudal ramus. In *Monstrillopsis*, 16 species are currently recognized (Razouls *et al.* 2005–2014; Suárez-Morales 2011; Suárez-Morales & McKinnon 2014). Among them, only five species have been described based on both sexes, while four species are based on the female only and seven on the male only. The present two new species from Korea are also based on males only.

Both new species have a moderately large body, 1.5–2.1 mm long (compared to 1.168 mm long for the mean size of males of *Monstrillopsis* species calculated by Razouls *et al.* 2005–2014), which clearly distinguished them from their tiny congeners *M. cahuitae* Suárez-Morales & Carillo in Suárez-Morales *et al.* 2013 (0.66 mm), *M. hastata* Suárez-Morales & McKinnon, 2014 (0.81 mm), *M. nanus* Suárez-Morales & McKinnon, 2014 (0.5 mm), and *M. reticulata* (Davis, 1949) (0.56 mm), as well as from the much bigger *M. dubia* (Scott, 1904) (3.3 mm) and *M. dubioides* Suárez-Morales & Ivanenko, 2004 (3.8 mm) (see Suárez-Morales & Ivanenko 2004).

The antennules of both new species largely conform to the typical shape in other male *Monstrillopsis*, with a proximal bump and an elongate, tapered distal part on the distal segment, but they clearly differ from those of many congeners that have a greatly elongated, sabre-like distal process but lack an apical spine, such as *M. boonwurrungorum* Suárez-Morales & McKinnon, 2014, *M. cahuitae*, *M. chilensis*, *M. dubia*, *M. dubioides*, and *M. hastata*. Both new species have a claw-like, spinous apical element 2, a feature shared with *M. chathamensis* and *M. fosshageni* Suárez-Morales & Dias, 2001, *M. reticulata*, and *M. sarsi*.

Both new species have antennules equal to 74–79% times the cephalothorax length, thereby being differentiated from males of *M. chathamensis*, *M. dubia*, and *M. dubioides* with much shorter antennules (50–60%), and also from congeneric males with much longer antennules, namely *M. nanus* (115%) and *M. fosshageni* (94%).

These new species have a male genital apparatus typical for male *Monstrillopsis*, consisting of a relatively short median shaft that protrudes ventrally and a pair of long distal lappets or lateral arms. The details of the genitalia allow two subgroups to be recognized (see Suárez-Morales & McKinnon 2014): males with a relatively short median shaft with its posterolateral corners extended as elongate lappets (“type II”), as in *M. boonwurrungorum*, *M. chathamensis*, *M. chilensis*, *M. hastata*, *M. sarsi*, and the present two new species, and males with a well developed, long median shaft and relatively short, ovoidal or globose lateral lappets that are more or less separated from the median shaft (“type I”), as in *M. cahuitae*, *M. dubia*, *M. dubioides*, *M. nanus*, and *M. reticulata*. Among the species of the former subgroup, *M. longilobata* **sp. nov.** is distinguished by its extremely long lappets, which extend far beyond the anterior margins of the caudal rami. The male genital apparatus of *M. coreensis* **sp. nov.** is largely horseshoe-shaped with moderately long lappets, most similar to *M. chathamensis*. However, *M. coreensis*, with its undulating lappets, differs from *M. chathamensis*, which in contrast has a strong distal spinous process on each lateral lappet.

In *Monstrillopsis* the number of caudal setae is generally four in both sexes, as is also true for the present two new species. However, some congeneric species have more caudal setae (see Suárez-Morales *et al.* 2006), and are distinguished from the Korean species: in the male, six in *M. cahuitae* and five in *M. reticulata* and *M. zernowi* Dolgopol’skaya, 1948.

Monstrillopsis longilobata **sp. nov.** and *M. coreensis* **sp. nov.** share a band of conspicuous transverse striations on the dorsal surface of the cephalothorax. Although the females of these new species are not known, it is expected that they might be recognizable by the unique striation band. In this genus such a striated band has been described

only in the female of *M. ferrarii* from the White Sea (Suárez-Morales & Ivanenko 2004). The relative location of transverse striations is different, though, being nearly at midlength of the cephalothorax in the two new species but anterior to the proximal quarter in females of *M. ferrarii*. The two new species also share the characters of bulbous caudal rami and large ocelli close to each other, which are clearly different from those in the female of *M. ferrarii*. Meanwhile, *M. longilobata* **sp. nov.** is distinguished from *M. coreensis* **sp. nov.** by the strongly concave and hollow distal margins of intercoxal sclerites of swimming legs 1–4 in male, which could be another diagnostic character for recognition of the female of *M. longilobata*.

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