

Two Harpacticoid Species of Genera *Nitokra* and *Ameira* (Harpacticoida: Ameiridae) from Brackish Waters in Korea

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Abstract: A new species of *Nitokra* and *Ameira parvula* (Claus) belonging to the family Ameiridae are recorded from brackish waters in South Korea. *Nitokra koreanus* n. sp. most resembles *N. spinipes* and *N. pietschmanni*, however, it is characteristic in having the character combination of ellipsoidal P5 exopod and very short P1 enp 1. *Ameira parvula* is reported for the first time from the Northwestern Pacific. Description of the new species and the taxonomic accounts of both species are presented.

Key words: Ameiridae, *Nitokra*, *Ameira parvula*, Harpacticoida, brackish-water Copepoda, Korea

Family Ameiridae Monard, 1927 is one of the representative neritic harpacticoids, currently comprising 303 species or more of 34 genera (Boxshall and Halsey, 2004). Most members are marine, but some species extend their inhabiting range to brackish waters or even to freshwaters.

In Korea, the taxonomic study on the ameirid copepods is nearly lacking, and only a species name of *Nitokra lacustris* (Schmankevitch, 1875) is listed in KSSZ (1997). As a comprehensive study on the brackish water copepod fauna, the author has fully examined the copepod specimens deposited in the specimen room of the Department of Biological Science, Daegu University, which have been collected from the various brackish waters such as coastal marshes, estuaries, and brackish-water lakes in South Korea.

As a result of the research, two species belonging to the family Ameiridae are newly recorded from Korean brackish waters: *Nitokra koreanus* n. sp. and *Ameira parvula* (Claus). Herein, the new species is described and the taxonomic accounts on the two species are presented.

MATERIALS AND METHODS

Copepod specimens examined in the present study were collected from estuaries, salt marshes and brackish water lakes at 15 localities (Fig. 1) in South Korea during the period from July, 1988 to June, 2007. Samplings were made with a dipnet (diameter 18 cm) or a conical plankton net of 63 μ m mesh aperture. Copepods were fixed and stored in 4% buffered formalin.

Specimens were dissected and mounted in lactophenol on H-S slide (Shirayama et al., 1993), after the treatment in a solution of 5% glycerin - 95% ethyl alcohol for 1-2 days. Dissection was performed using two needles made from 0.25 mm diameter tungsten wire by electrolysis (Huys and Boxshall, 1991; Huys et al., 1996). Mounted specimens were observed under a differential interference contrast microscope (Olympus BX51) with Nomarski optics. Figures were prepared with the aid of a camera lucida. Measurements were done with a digital camera for microscope (Cool SNAP 5.0 M, Roper Scientific Co., U.S.A.) and a calibration software QCapture Pro (ver. 5.0, Media Cybernetics Inc., USA)

Type specimens have been deposited in the National Institute of Biological Resources, Incheon (NIBR), Korea.

Abbreviations used in the text and figures follow the conventional ones frequently used in the copepod taxonomy: A1, antennule; A2, antenna; Fu, caudal rami; P1-5, legs (pereopods) 1-5; enp 1-3 or exp 1-3, the first to third endopodal or exopodal segments of each leg.

TAXONOMIC ACCOUNTS

Family Ameiridae Monard, 1927
Genus *Nitokra* Boeck, 1864
Nitokra koreanus n. sp. (Figs. 2, 3)

Type. Holotype: ♀ (NIBRIV0000100009), Cheongchoho Lake

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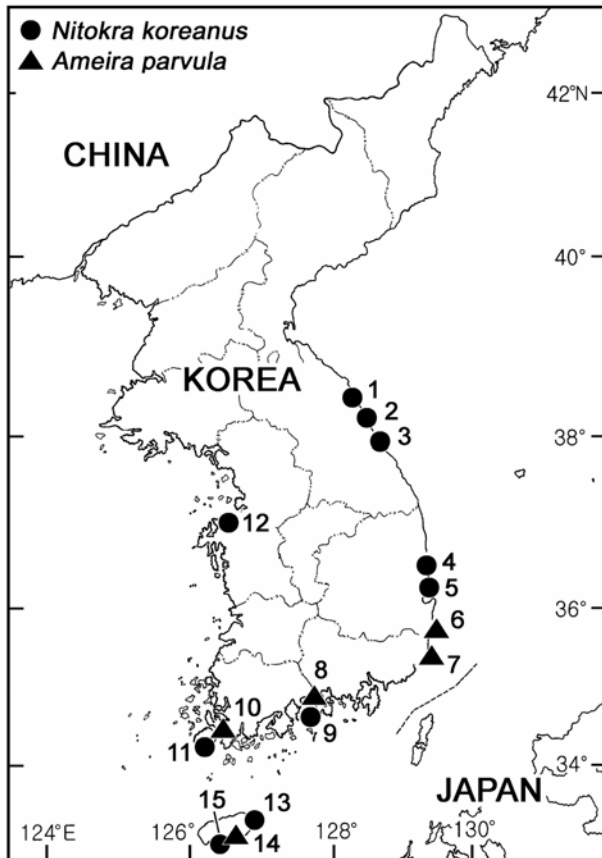


Fig. 1. A map showing localities. 1, Hwajinpo, Goseong; 2, Cheongchoho Lake, Sokcho; 3, Hyangho Lake, Jumunjin; 4, Obo-ri, Yeongdeok; 5, Goggangcheon Stream, Chilpo; 6, Suryeomcheon Stream, Gyeongju; 7, Hoiyacheon Stream, Ulsan; 8, Seomjingang River, Hadong; 9, Yeosu; 10, Gocheonamho Lake, Haenam; 11, Uisinchon Stream, Jindo Is.; 12, Maesancheon Stream, Dangjin; 13, Jongdal-ri, Seongsanpo, Jeju Is.; 14, Saeseom Is., Seogwipo; 15, Harye, Jungmun.

(lagoon), Sokcho, 28 Dec. 2006, *leg.* C.Y. Chang and J.M. Lee. Paratypes: 3 ♀♀, 1 ♂, collection details same as in holotype. Holotype and allotype (NIBRIV0000100010) are deposited in NIBR. Other 3 female paratypes (DB20013) were dissected and mounted in glycerin on H-S slide.

Additional material examined. 6 ♀♀, 1 ♂, Hwajinpo (brackish-water lake), Goseong, 1 Mar. 2005 (C.Y. Chang, J.M. Lee and J.M. Jeon); 2 ♀♀, 1 ♂, Hyangho Lake, Jumunjin, 12 Oct. 2005 (C.Y. Chang and J.M. Lee); 1 ♀, Obo-ri (estuary of a streamlet), Yeongdeok, 4 Nov. 2005 (H.S. Lee); 5 ♀♀, 1 ♂, Goggangcheon Str. (estuary), Chilpo, Pohang, 3 Feb. 2007 (C.Y. Chang and J.M. Lee); 2 ♀♀, Deochung-dong (coastal well), Yeosu, 4 Jul. 1988 (J.S. Shin); 1 ♀, 2 ♂♂, Uisinchon Str. (estuary; coastal marsh), Jindo Is., 13 Oct. 2004 (H.W. Lim and J.M. Jeon); 4 ♀♀, 3 ♂♂, estuary of Maesancheon Str., Dangjin, 4 Mar. 2007 (C.Y. Chang and J.M. Lee); 5 ♀♀ (1 ovi.), 2 ♂♂, Harye

(estuary of a streamlet), Jungmun, Jeju Is., 12 Jan. 2007 (C.Y. Chang and J.M. Lee); 1 ♂, Jongdal-ri (swamp; ditch), Seongsanpo, Jeju Is., 25 Jan. 2003 (C.Y. Chang and J.M. Lee).

Description. *Female:* Body (Fig. 2A) 0.72-0.83 mm in length, spindle-shaped, tapering behind from posterior border of cephalothorax, without clear distinction between prosome and urosome; tinged with pale yellow. Rostrum narrow, protruding anteriorly, not defined at its base, with 2 minute sensillae at anterior tip. Cephalothorax nearly as long as sum of next 3 prosomites. Distolateral margin of each prosomites not protruded laterally: every prosomites bearing 6-10 sensillae along posterior margin. Genital double-somite subdivided dorsally, *viz.*, bearing subcuticular ridge marking line of fusion dorsally, with spinule row along its posterior margin. Urosomites except anal somite each bearing spinule row along posterior margin, with hyaline fringe posteriorly. Posterior margin of anal somite subdivided into 2 lobes at each side with 3 stout spines on inner lobe and 5-6 spinules on outer lobe. Anal operculum convex with 4-5 sharp spines along posterior edge (Fig. 2B, arrow).

Fu a little broader than long, with 2 transverse setule rows along inner face and inner distal corner. Lateral caudal setae (caudal setae I and II) located dorsolaterally, posterior to middle of lateral margin of Fu, with a few spinules anterior to their bases. Outer caudal seta (caudal seta III) situated at distolateral corner, about 1.5 times longer than inner caudal seta (caudal seta VI). Dorsal caudal seta (caudal seta VII) located just ahead of inner caudal seta, slightly longer than inner caudal seta.

A1 (Fig. 2C) shorter than cephalothorax, 8-segmented; segment 1 with 1 setule row and 1 plumose seta anterodistally; segment 2 most thick; segment 4 longest, bearing 1 well-developed aesthetasc nearly 2 times longer than next 4 segments combined. A2 (Fig. 2D) exopod 1-segmented, broadened distally, with 3 apical setae. Mandible (Fig. 2E) with well-developed, elongate coxal gnathobase bearing 6 bicuspidate teeth along distal margin and 1 plumose seta distally; palp 2-segmented with endopod fused to basis, bearing 1 plumose seta distomedially; exopod a little tapering distally with 4 setae in total. Maxillule (Fig. 2F) with praecoxal arthrite bearing 5 elements with 2 long setae on both frontal and caudal surfaces; coxal arthrite with cylindrical endite bearing 2 naked setae; basal endite bearing 4 naked setae apically without outer seta; endopod fused to basis; exopod bearing 1 small, naked seta and 1 long plumose seta. Maxilla (Fig. 2G) armed with 2 syncoxal endites and 1 proximal seta, proximal syncoxal endite bearing 3 setal elements, distal endite with 1 modified seta; allobasis forming 1 strong pectinate claw; endopod represented by small protuberance bearing 2 long

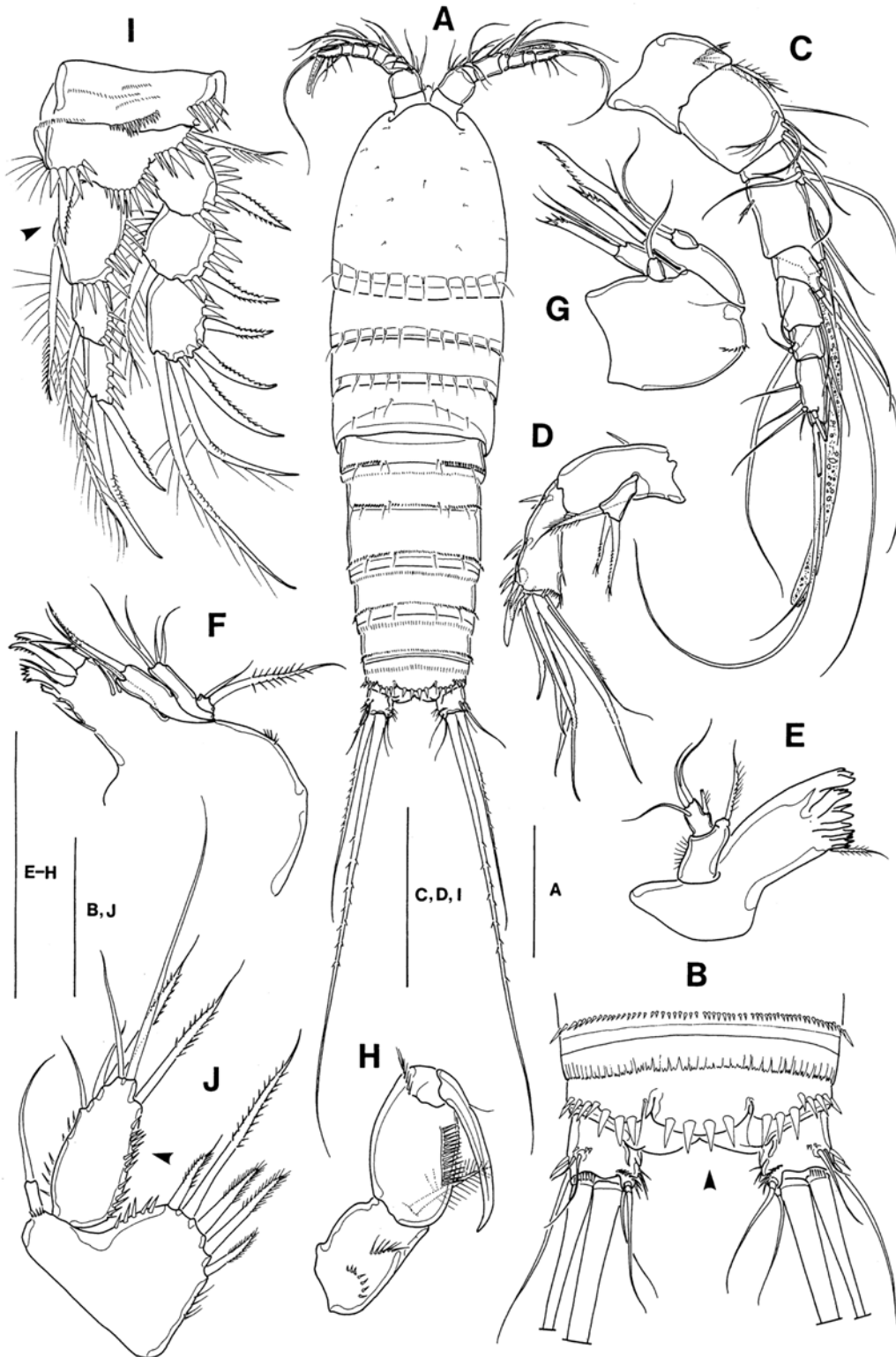


Fig. 2. *Nitokra koreanus* n. sp., female. A, habitus; B, anal somite and Fu, dorsal; C, A1; D, A2; E, mandible; F, maxillule; G, maxilla; H, maxilliped; I, P1; J, P5. Scales: A = 0.1 mm, B-J = 0.05 mm.

setae. Maxilliped (Fig. 2H) subchelate; syncoxa with 1 pinnate setae distomedially; basis pectinate along inner margin and 1 seta on distomedial edge; endopod represented

by 1 strong and curved claw, bearing 1 minute seta as accessory armature.

P1-P4, both endopods and exopods 3-segmented. P1 enp

1 not elongated, much shorter than sum of exp 1 and exp 2, with 1 stout inner seta on distal third of inner margin of exp 1 (Fig. 2I, arrow); exp 3 with 1 outer spine, 1 geniculate seta and 1 plumose inner seta apically; exp 2 with inner seta; exp 3 with 3 outer spines and 2 geniculate setae. P2-P4 (Fig. 3A-C), exp 1 with inner seta; exp 3 with modified inner seta. P2 exp 3 with 1 spine and 3 setae. P4 exp 3 with elongate, stout, spiniform distomedial seta for supporting egg sac. Seta and spine arrangements of P1-P4 as follows (Arabic numerals representing setae, while Roman numerals indicating spines):

P1 basis 1-I exp I-0; I-1; III,2,0 exp 0-1; 0-1; I,1,1

P2 basis 1-0 exp I-0; I-1; III,2,2 exp 0-1; 0-1; I,2,1

P3 basis 1-0 exp I-0; I-1; III,2,2 exp 0-1; 0-1; I,2,2

P4 basis 1-0 exp I-0; I-1; III,2,2 exp 0-1; 0-1; I,2,2

P5 baseopod a little protruding, not reaching to middle of exopod, bearing total 5 setae, with spinule row on outer margin and setule row on inner margin; exopod (Fig. 2J, arrow) ellipsoidal, tapering distally, 2.2-2.5 times longer than wide, with total 6 setae (1 inner distal, 1 apical, and 4 outer setae), with spinule row along both inner and outer margins.

Ovigerous female carrying 1 large egg sac under urosomites, containing about 20-30 eggs.

Male: Body 0.63 mm in length, smaller, slenderer than female. Spinule ornamentation of urosomites and anal operculum nearly same as in female. Sexual dimorphism shown in A1, inner distal seta on P1 coxa, and P5. A1 (Fig. 3F) 9-segmented; geniculated between segments 3 and 5, and between segments 7 and 8; segment 2 with 9 setae; segment 3 short with 8 setae; aesthetasc about 2 times longer than last 3 segments combined; penultimate segment with hyaline membrane fringes along anterior margin.

Inner distal seta on P1 coxa modified like 1 hook-like protrusion and hyaline membrane with 4-5 spinules along its base (Fig. 3G). P2-P3 endopods not modified; exp 1 lacking inner seta; exp 2 with 1 distomedial spine; exp 3 with 1 apical seta.

P5 (Fig. 3H), inner lobe of baseopod not protruding, posterior margin rather straight; with 1 innermost swollen seta and 2 slender bare setae; exopod ellipsoidal, 2.5-3 times longer than broad, bearing 6 setae including 1 minute seta at outer distal corner of exopod, and 1 inner seta on middle of inner margin of exopod.

Etymology. The specific name is taken from "Korea", the country where the type locality of the new species is situated.

Ecology. Around the coast of South Korea, including Jeju Island, this species is rather common in the genuine brackish waters, such as estuaries, reed marshes and brackish-water lakes (Hwajinpo, Cheonchoho, Hyangho,

and Seongsanpo), frequently co-occurring with *Sinocalanus tenellus*, *Pseudodiaptomus inopinus*, *Eurytemora affinis* (Calanoida), *Neotachidius parvus*, *Schizopera clandestina*, *S. neglecta*, *Onychocamptus mohammed*, *Apoethon bilobatus* (Harpacticoida), *Oithona davisae* and *Halicyclops* spp. (Cyclopoida); supposedly abundant during cold-water season.

Remarks. Genus *Nitokra* Boeck, 1865 currently comprises 60 species, of which this species is allied with *N. spinipes* Boeck, 1864, *N. lacustris* (Schmankevitch, 1875), *N. platypus* Daday, 1906, *N. pietschmanni* (Chappuis, 1934) and *N. arctolongus* Shen and Tai, 1973 in having P1 exp 1 not longer than sum of exp 1 and exp 2. Among them, *N. koreanus* n. sp. is clearly distinguished from *N. lacustris*, *N. arctolongus* and *N. platypus* by the seta ornamentation of P2-P4, viz., P3-P4 exp 1 with 1 inner seta (lacking in *N. arctolongus* and *N. platypus*), and bearing 3 setae on P2 exp 3 (only 2 in *N. lacustris*).

Nitokra koreanus n. sp. most resembles *N. spinipes* and *N. pietschmanni*, however, is characteristic in having ellipsoidal P5 exopod in female, which is 2.5-3 times longer than wide (while oval or pyriform, 1.3-2 times as long as wide in *N. spinipes*, and round, about 1.3 times as long as wide in *N. pietschmanni*). *Nitokra koreanus* differs from *N. spinipes* by shorter P1 exp 1 (much shorter than sum of exp 1 and exp 2, while nearly as long in *N. spinipes*) and only 4-5 spines on the posterior margin of anal operculum (8-14 spines in *N. spinipes*). Furthermore, *N. koreanus* differs from *N. pietschmanni* by the different spinule arrangement of urosomites (with dorsal spinule row along posterior margin of each urosomites except anal somite, while armed with only lateral spinule rows in *N. pietschmanni*).

Genus *Ameira* Boeck, 1865

***Ameira parvula* (Claus, 1866)** (Fig. 4)

Canthocamptus parvulus Claus, 1866, p. 30, pl. 5, figs. 1-6 (cited from Lang, 1948).

Ameira parvula: Kunz, 1935, p. 87; Pesta, 1932, p. 72, fig. 2; Lang, 1948, p. 790; Vervoort, 1964, p. 261, figs. 105-106; Mielke, 1975, p. 62, fig. 38; Apostolov and Marinov, 1988, p. 212, fig. 82.

Material examined. 4 ♀♀, 1 ♂, estuary of Suryeomcheon Str., Gyeongju, 16 Dec. 2006 (C.Y. Chang, J.M. Lee and J.M. Jeon); 1 ♀, estuary of Hoiyacheon Str., Ulsan, 21 Jun. 2006 (C.Y. Chang and J.M. Lee); 5 ♀♀ (1 ovi.), Hadong (lower reaches of Seomjingang R.), 9 Oct. 2005 (C.Y. Chang and J.M. Lee); 2 ♀♀, Gocheonamho Lake (tidal embankment), Haenam, 23 Oct. 1993 (C.Y. Chang and J.M. Lee); 10 ♀♀, 3 ♂♂, Saeseom Is. (salt marsh), Seogwipo, Jeju Is., 27 Apr. 2006 (C.Y. Chang and J.M. Lee).

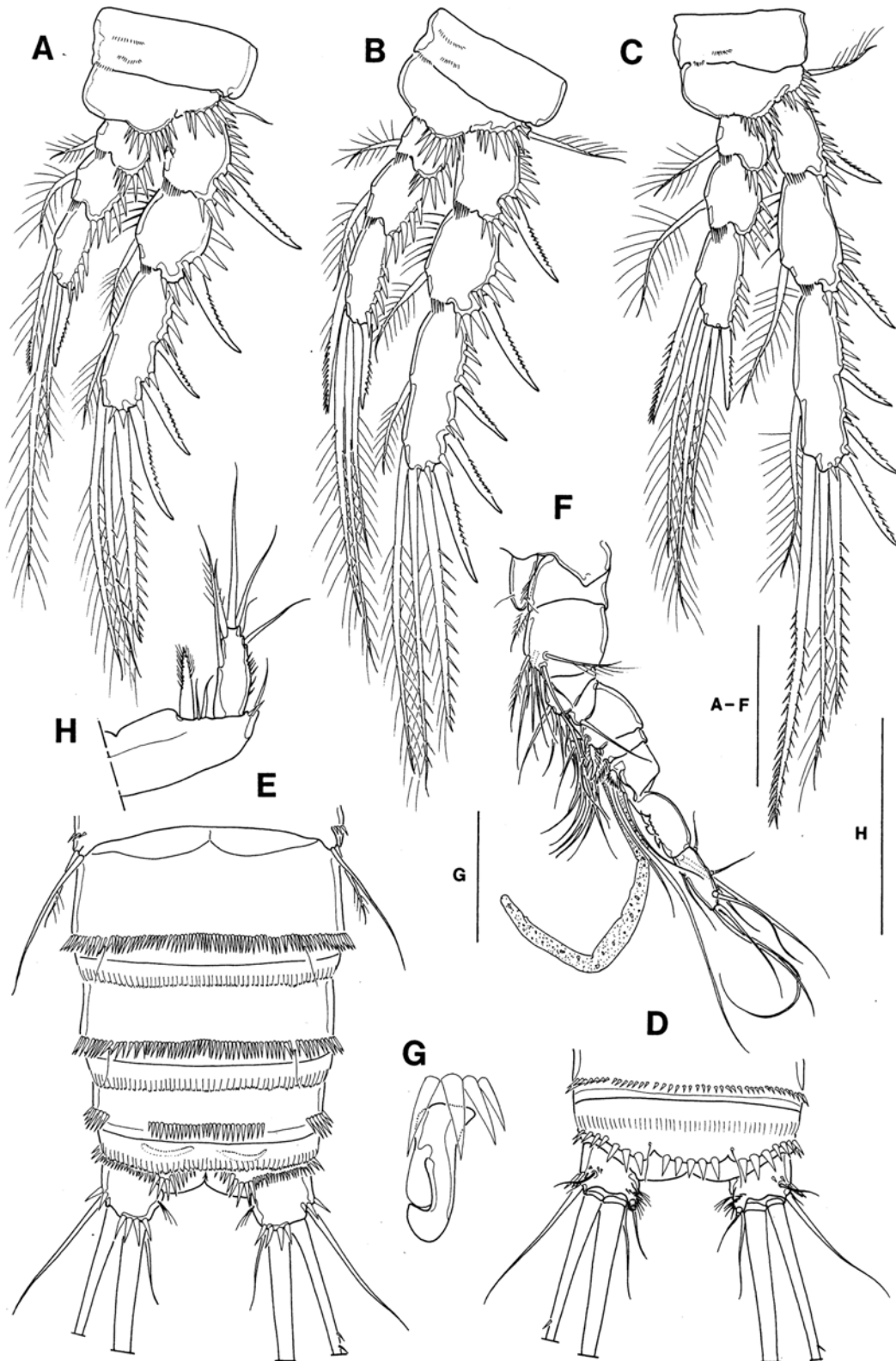


Fig. 3. *Nitokra koreanus* n. sp. A-C, female: A, P2; B, P3; C, P4. D-H, male: D, anal somite and Fu, dorsal; E, P6 and urosome, ventral; F, A1; G, modified inner seta on P1 coxa; H, P5. Scales: A-H = 0.05 mm.

Diagnosis. Body (Fig. 4A) slender, 0.5-0.6 mm long in female, 0.4-0.5 mm long in male; tinged with pale yellow.

Rostrum small, narrow. Genital double-somite subdivided dorsally and laterally. Anal operculum gently convex with

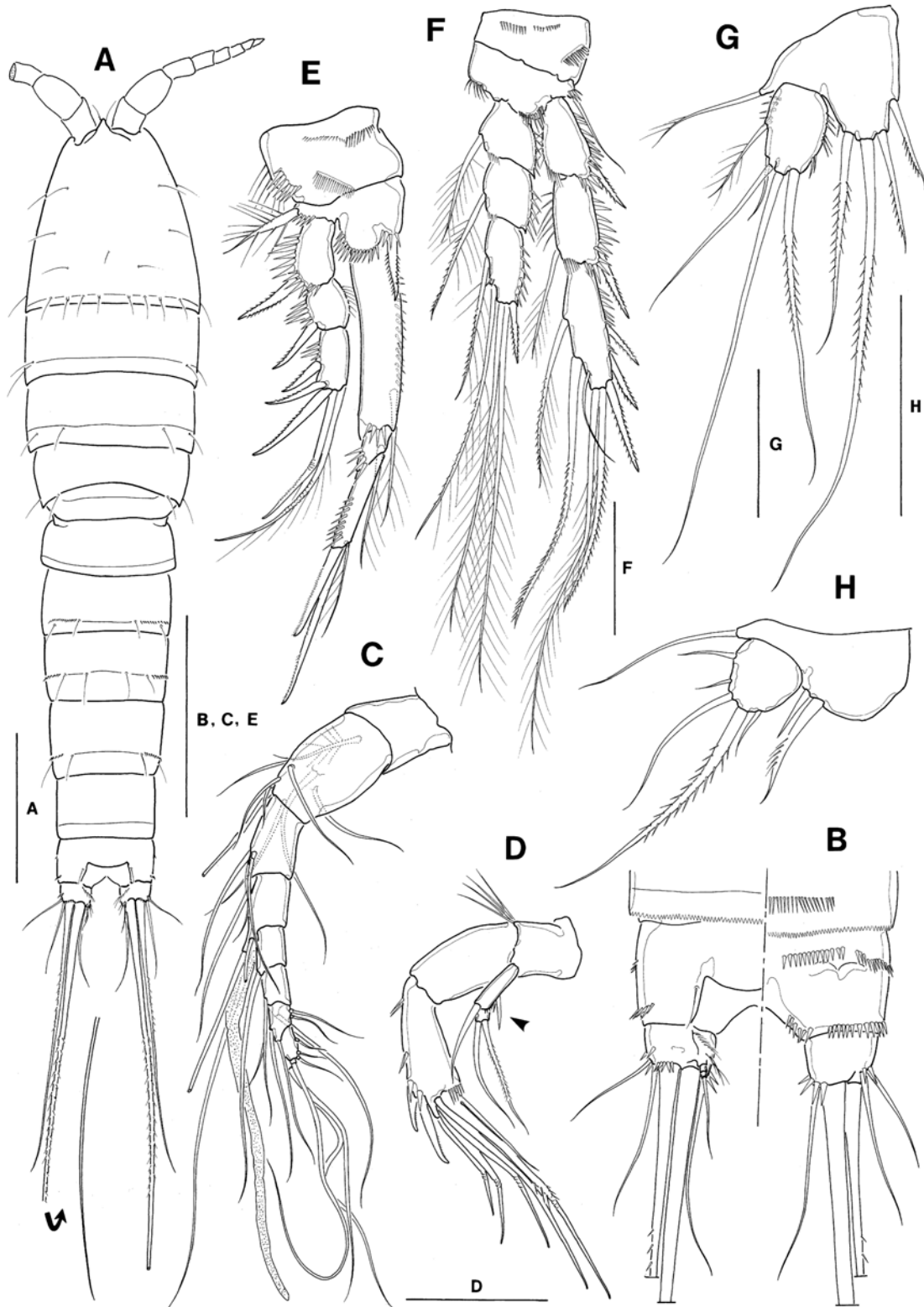


Fig. 4. *Ameira parvula* (Claus). A-G, female: A, habitus, dorsal; B, anal somite and Fu, dorsal (left) and ventral (right); C, A1; D, A2; E, P1; F, P4; G, P5. H, male P5. Scales: A = 0.1 mm, B-H = 0.05 mm.

smooth posterior margin. Fu much wider than long, with 2 oblique setule rows on inner face (Fig. 4B). A1 (Fig. 4C) 8-segmented, with well-developed aesthetasc on anterodistal

margin of segment 4. A2 exopod 2-segmented, bearing 1 inner distal seta and 1 short spine (Fig. 4D, arrow) at outer margin on proximal segment and 2 apical setae on distal

segment. P1 (Fig. 4E), enp 1 elongate, much longer than exopod, with 1 inner seta distally; exp 2 lacking inner seta; exp 3 with 3 outer spines and 2 geniculate setae. P2-P4, both endopods and exopods 3-segmented; enp 1 with inner seta; P2-P3 exp 3 with 3 outer spines, 2 apical setae, 2 inner setae; P4 exp 3 with elongate, stout, spiniform inner distal seta, flanked with additional slender seta (Fig. 4F); no sexual dimorphism shown in P2-P4. Female P5 (Fig. 4G) baseoendopod not reaching to middle of exopod, with total 4 setae; exopod pyriform, about 1.3-1.5 times longer than wide, with setules along inner margin, bearing 5 setae including short outer distal seta. Male P5 (Fig. 4H) baseoendopod weakly protruded, bearing 2 setae laterally with inner and posterior margin naked; exopod oval, bearing 5 setae including 1 minute outer distal seta.

Ecology. This species usually occurs in debris and sandy bottoms at river mouths and salt marshes in the southern coasts of South Korea including Jeju Island. They co-occur with other brackish-water or neritic copepods: *Tachidius parvus*, *Nitochra lacustris*, *Tigriopus japonicus*, *Leptocaris brevipes*, *Limnocoletodes angustodes* (Harpacticoida), *Oithona similis*, *O. davisae*, and *Halicyclops japonicus* (Cyclopoida). Compared with the co-occurring species, *A. parvula* is generally smaller and rather slender and less abundant.

Distribution. Korea, White Sea (Russia), Isles of Man (UK), North Sea (Spitzbergen; Sylt Is.), Black Sea (Bulgaria), Mediterranean Sea, Canary Is., South Africa, India, New Caledonia, New Zealand, eastern coasts of North America, Caroline Is. (USA), Caribbean Sea, Argentine.

Remarks. *Ameira parvula* is known to be widely distributed and highly variable. However, as Wells and Rao (1987) correctly mentioned, many reports on variations of some significant characters such as segmentation and ornamentation of A2 exopod and the slender inner distal seta on P4 exp 3 can be caused by improper observation or illumination. This is the first report on *A. parvula* from the Northwestern Pacific. The Korean specimens fit well with the European specimens of Mielke (1975). Moreover, they coincide with the Indian specimens of Wells and Rao (1987), except the minute accessory seta on male P5 baseoendopod.

Ameira parvula is almost a cosmopolitan species, now excluding only the Northeastern Pacific, where a closely related species was described, viz. *A. parvuloides* Lang, 1965 from California, USA. *Ameira parvuloides* is very similar to *A. parvula*, as suggested in its specific name. Although Lang (1965) admitted that he established the new species with great hesitation, *A. parvuloides* must be a distinct species, clearly different from *A. parvula*. Based on

the Korean specimens, the latter is distinguished from *A. parvuloides* by the ornamentation of A2 exopod, that is, exopod 2-segmented (sometimes indistinctly divided) bearing 2 apical setae, consisting of 1 inner distal seta and 1 stout spine flanked by 1 oblique spinule row (extending to inner lateral seta) on the outer lateral margin (cf. Fig. 4D), while 1-segmented with 3 apical setae in *A. parvuloides*. They are also different to each other in the shape of leg 5 exopod (pyriform in *A. parvula*, while nearly oblong in *A. parvuloides*). Moreover, *A. parvula* differs from *A. parvuloides* by the spinule row on distomedial corner of caudal rami ventrally.

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