

Two new record of the genus *Anonyx* (Crustacea: Amphipoda: Uristidae) from Korean waters

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Two newly recorded carnivorous amphipod species, *Anonyx gurjanovai* Steele, 1986 and *A. nugax* (Phipps, 1774) belonging to the family Uristidae Hurley, 1963, were collected from the East Sea, Korea. *Anonyx gurjanovai* is included in the *A. laticoxae* group and is characterized by a concave palm of the propodus in gnathopod 1 and small posteroventral projection at epimeron 3. The other species, *A. nugax*, represents the *A. nugax* group and is distinguished from congeneric species based on the presence of a shorter and less acute projection on epimeron 3. There are 13 species of the *A. nugax* group recorded worldwide, but this is the first report on the presence of the *A. nugax* group in Korean waters. Previously, three species of the genus *Anonyx* had been reported in Korea, and through this study, we have added two newly recorded species. Both the newly recorded *Anonyx* species are illustrated and compared with the related species. A key to the *Anonyx* species in Korea is also provided.

Keywords: Amphipoda, *Anonyx gurjanovai*, *Anonyx nugax*, Korea, new record species, Uristidae

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INTRODUCTION

The species of the genus *Anonyx* Krøyer, 1838 are rapid feeders, frequently of a large size, and especially well adapted for scavenging (Sainte-Marie, 1984; 1986; Steele and Steele, 1993). This genus is relatively large, comprising 51 species (Holton *et al.*, 2021), and is subdivided into 5 groups based on the amount of constriction of the inner ramus at uropod 2 (Steele, 1979; 1982; 1983; 1986; 1989; 1991). *Anonyx gurjanovai* Steele, 1986 belongs to the *A. laticoxae* group which has an unconstricted inner ramus of uropod 2. *Anonyx nugax* (Phipps, 1774) belongs to the *A. nugax* group which has constricted inner ramus of uropod 2. This group is distinct from the other group based on the point of insertion of the distal spine, which is longer than the proximal spines on the inner ramus of uropod 2. The genus *Anonyx* is widely distributed throughout the North Pacific, but only three species have been reported in Korea: *A. abei* Takekawa & Ishimaru, 2001; *A. exilipes* Jung, Coleman, Kim & Yoon, 2018; and *A. schefperi* Steele, 1986 (Heo & Kim, 2018; Jung *et al.*, 2018). Through this study, we have added two newly recorded *Anonyx* species to the list of existing species in Korean waters, and provide appropriate illustrations and descriptions.

MATERIALS AND METHODS

Specimens were collected from the shallow and subtidal zone in Korea using a light trap (Holmes and O'Connor, 1988; Kim, 1992) and rinsing fishing nets. The specimens were fixed with 80% ethanol and dissected in glycerin on Cobb's aluminum hollow slides. Drawings and measurements were performed with the aid of a drawing tube, mounted on an Olympus SZX 12 stereomicroscope and Olympus BX 51 interference contrast compound microscope (Olympus, Tokyo, Japan). Specimens are deposited at the Marine Amphipod Resources Bank of Korea (MARBK), Dankook University, Cheonan, Korea.

SYSTEMATIC ACCOUNTS

Order Amphipoda Latreille, 1816
Family Uristidae Hurley, 1963
Genus *Anonyx* Krøyer, 1838

Anonyx gurjanovai Steele, 1986 (Figs. 1–3)

오목손나도긴팔옆새우 (신칭)

Anonyx affinis Gurjanova, 1951; 224, pl. 89; 1962: 234, pl. 74.

Anonyx gurjanovai Steele, 1986: 2608, figs. 10–12.

Material examined. 1♂ (MABIK CR00248291), Gajin Port, Gajin-ri, Goseong-gun, Gangwon-do, Korea, 38° 22'05"N, 128°30'45"E, 22 February 2005, Y.H. Kim; 1♂, Geojin Port, Geojin-ri, Goseong-gun, Gangwon-do, Korea, 38°26'38"N, 128°27'57"E, 24 February 2005, Y.H. Kim; 1♂, Geojin Port, Geojin-ri, Goseong-gun, Gangwon-do, Korea, 38°26'38"N, 128°27'57"E, 11 March 2006, Y.H. Kim; 6♂, Bongpo Port, Bongpo-ri, Goseong-gun, Gangwon-do, Korea, 38°15'07"N, 128°34'02"E, 23 February 2007, Y.H. Kim; 1♂, 28 December 2019, J.H. Heo. The specimens were collected using a light trap.

Description. Adult male, body (Figs. 1, 2A) 8.50 mm long (MABIK CR00248291), dorsally smooth. Head lateral cephalic lobe subacute; eye medium, reniform, black. Epimeron 3 round with small projection postero-ventrally. Urosomite 1 with dorsal depression and dorsal mid-carina.

Antenna 1 (Fig. 2B), peduncular article 1 stout, with 2 penicillate setae dorsally; peduncular articles 2–3 strongly telescoping, short; length ratio of peduncular articles 1–3 = 1.00 : 0.25 : 0.18; flagellum 15-articulate, 1.32 times longer than peduncular articles, with callynophore, article 2, 4, 6 with calceoli ventrally; accessory flagellum 9-articulate, article 1 elongated.

Antenna 2 (Fig. 2C) slender, elongated; peduncular article 4 subrectangular, 1.36 times as long as article 5, with a row of setules dorsally, ventral margin expanded, with 3 penicillate and 4 long simple setae; flagellum 22-articulate, calceoli on flagellum articles.

Left mandible (Fig. 2D), incisor broad and smooth with bifid tooth on the cutting edge, lacinia mobilis simple, cylindrical (finger-like); accessory spine row with 3 spines and 1 setaceous spine; molar process well developed, columnar, distally truncate and triturative, densely pubescent; palp attached nearly midway, 3-articulate; article 1 short; article 2 longest, with 4 A2-setae; article 3 weakly falcate, 0.85 times as long as article 2, with 15 D3-setae, 3 E3-setae and covered with setules laterally.

Right mandible (Fig. 2E) similar to left one, except for the 1 prominent tooth on the cutting edge.

Gnathopod 1 (Fig. 2F) subchelate; coxa large, expanded anteriorly, 0.69 times as wide as long; basis with unequal simple setae on both margins; merus subequal in length to ischium, with setules posteriorly and 4 simple setae posterodistally; carpus produced posterodistally, with setules, two clusters of simple setae distally, 0.51 times as long as basis; propodus subrectangular, 1.18 times as long as carpus, palm concave, defined by 2 stout spines posterodistally; dactylus falcate, slightly exceeding palm.

Gnathopod 2 (Fig. 2G), coxa subrectangular, 0.49 times as wide as long; basis linear, elongated, with simple setae on both margins; ischium elongated, 1.44 times as long



Fig. 1. *Anonyx gurjanovai* Steele, 1986, adult male, 8.50 mm, habitus. Scale bar = 1.0 mm.

as merus, with 3 simple setae anteriorly and 4 unequal simple setae posterodistally; merus 0.57 times as long as carpus, with patch of setules posteriorly and a cluster of long setae posterodistally; carpus 0.55 times as long as basis, covered with setules laterally, posterodistal margin with spinules and long setae, clusters of long setae distally; propodus short, subquadrate, minutely chelate, with unipinnate setae anterodistally, covered with spinules posterodistally, 0.57 times as long as carpus; dactylus small, acute, fitting palm.

Pereopod 3 (Fig. 2H), coxa subrectangular, width 0.48 times length; basis narrowing proximally; merus produced anterodistally, subequal in length to propodus, with unequal simple setae posteriorly and 3 unequal simple setae anterodistally; propodus subrectangular, 1.56 times as long as carpus, with a row of paired long simple setae with spines and 1 blunt spine hooked; dactylus falcate, 0.50 times as long as propodus.

Pereopod 4 (Fig. 2I) similar to pereopod 3 except coxa broader than that of pereopod 3, posterior margin excavate, posterodistal lobe produced.

Pereopod 5 (Fig. 3A), coxa large, rounded quadrate, equilobate, width 1.19 times length; basis subquadrate, width 0.85 times length, posterior margin serrate, postero-ventral lobe rounded and expanded, with a row of spines along anterior margin; merus expanded posteriorly, anterior margin with 4 spines and 3 long setae, posterior margin with 3 robust spines; carpus subequal in length to merus, with 4 spines and 1 long seta; propodus slender, rectangular, slightly longer than carpus, anterior margin with a row of robust spines; dactylus falcate, 0.50 times as long as propodus, with 1 penicillate seta posteriorly.

Pereopod 6 (Fig. 3B) similar to pereopod 5, but coxa small, bilobate, anterior lobe small; each article longer in proportion than pereopod 5.

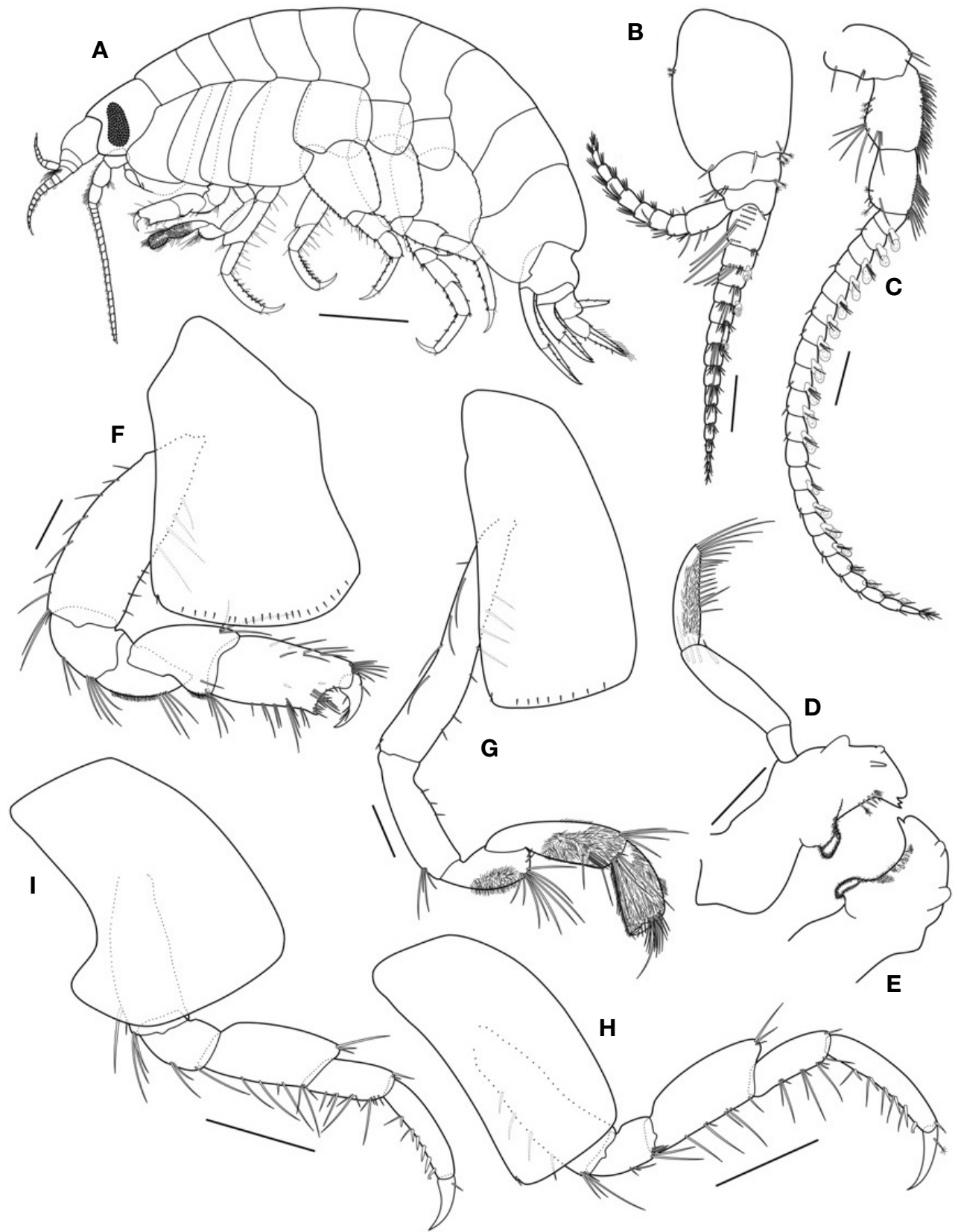


Fig. 2. *Anonyx gurjanovai* Steele, 1986, adult male, 8.50 mm. A, habitus; B, antenna 1; C, antenna 2; D, left mandible; E, right mandible; F, gnathopod 1; G, gnathopod 2; H, pereopod 3; I, pereopod 4. Scale bars: A = 1.0 mm, B–G = 0.2 mm, H, I = 0.5 mm.

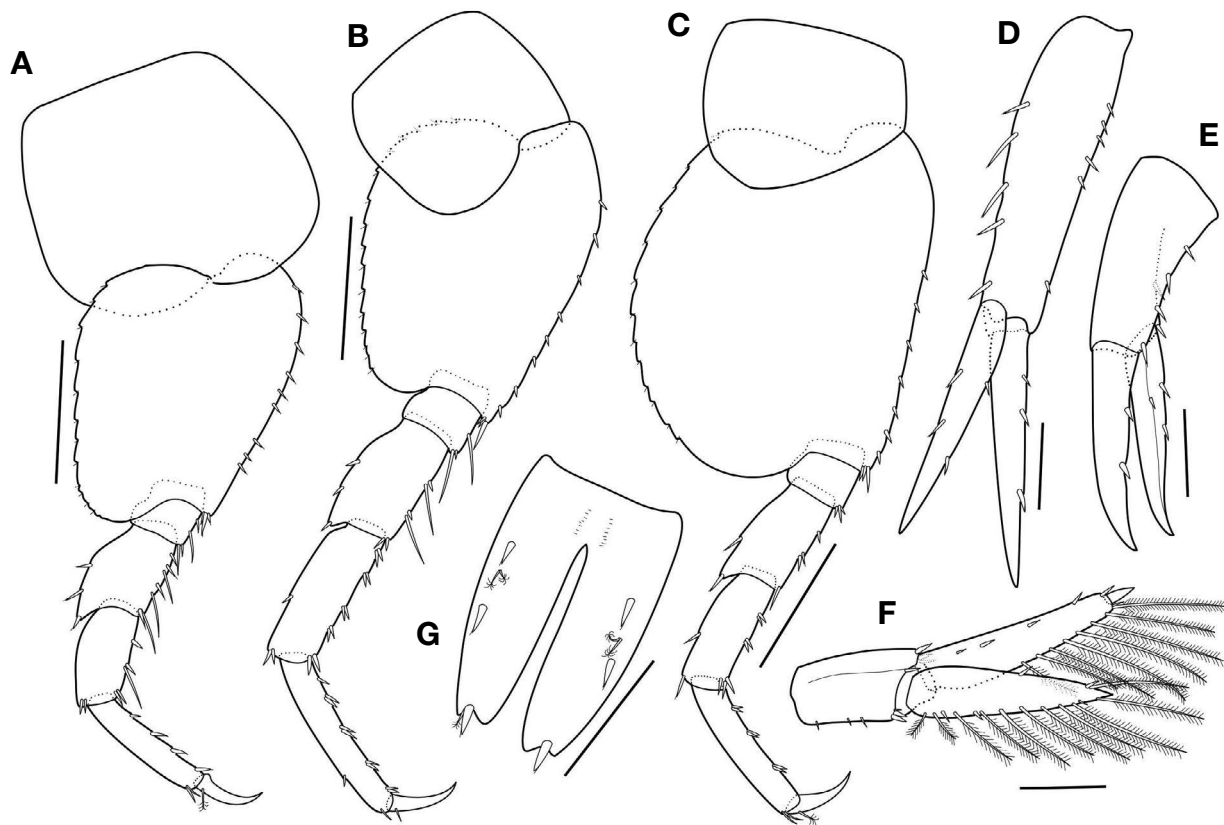


Fig. 3. *Anonyx gurjanovai* Steele, 1986, adult male, 8.50 mm. A, pereopod 5; B, pereopod 6; C, pereopod 7; D, uropod 1; E, uropod 2; F, uropod 3; G, telson. Scale bars: A-C, G = 0.5 mm, D-F = 0.2 mm.

Pereopod 7 (Fig. 3C), coxa small, subquadrate; basis subovate, posterior margin serrate, round and convex, width 0.82 times length, anterior margin nearly straight, with a row of spines; ischium to dactylus similar to those of pereopod 6, except ischium and merus without simple setae anteriorly.

Uropod 1 (Fig. 3D), peduncle subrectangular, 1.20 times as long as outer ramus, with a row of 6 dorsolateral robust spines and 5 long dorsomedial robust spines; outer ramus 1.06 times as long as inner one, lateral margin with 3 robust spines, inner ramus with 2 robust spines on each margin.

Uropod 2 (Fig. 3E), peduncle subquadrate, subequal in length to outer ramus, with a row of 3 dorsal robust spines; outer ramus subequal in length to inner one, with 2 lateral spines, inner ramus with 2 medial and 1 lateral spines.

Uropod 3 (Fig. 3F), peduncle short, 0.54 times as long as outer ramus, with 1 dorsomedial, 3 dorsolateral, and 3 ventrodiscal spines; outer ramus 1.09 times as long as inner ramus, biarticulate, proximal article with 8 plumose setae along medial margin, lateral margin with 4 spines, each margins with 1 distal robust spine, distal article

short, 0.13 times as long as proximal one; inner ramus not reaching end of proximal article of outer ramus, medial margin with 10 plumose setae and 3 spines, lateral margin with 2 robust spines and 1 plumose seta.

Telson (Fig. 3G) much longer than broad, cleft about 77% of its length, each lobe with deep apical notch bearing 1 stout spine and 1 penicillate seta, 2 robust spines and a pair of penicillate setae dorsolaterally.

Distribution. Southern British Columbia to Japan, Korea (East Sea).

Remarks. *Anonyx gurjanovai* Steele, 1986 belongs to the *A. laticoxae* group comprising *A. laticoxae* Gurjanova, 1962; *A. schefferi* Steele, 1986; *A. stegnegeri* Steele, 1986; *A. hurleyi* Steele, 1986; *A. multiarticulatus* (Pearse, 1913); *A. petersoni* Steele, 1986; *A. affinis* Ohlin, 1895; *A. sculptifer* Gurjanova, 1962; *A. magnus* Gurjanova, 1962; *A. orientalis* Gurjanova, 1962; *A. volkovi* Kudrjaschov, 1965; and *A. exilipes* Jung, Coleman, Kim and Yoon, 2018, which possesses an unconstricted inner ramus of uropod 2 and is prevalent in the North Pacific. This species is the smallest known species of the genus *Anonyx* (Steele, 1986). *Anonyx gurjanovai* is similar to *A. stegnegeri*, but can be distinguished through the outer ramus

of uropod 3 based on the presence of an elongated distal article and a straight projection on the epimeron 3 (vs. significantly shorter distal article and an upturned projection in *A. stegnegeri*). *Anonyx gurjanovai* is also similar to *A. hurleyi*, but differs based on the lack of lateral setae on the inner ramus of uropod 3 (Steele, 1986). Our specimen represents an adult male, and exhibits characteristics similar to that of male gnathopod 1 with a concave palm (Steele, 1986).

***Anonyx nugax* (Phipps, 1774) (Figs. 4–6)**

큰돌기나도긴팔옆새우 (신칭)

Cancer nugax Phipps, 1774, 192, pl. 12, fig. 2.

Anonyx kurilicus Gurjanova, 1962, 242, fig. 78.

Anonyx nugax: Gurjanova, 1962, 216, fig. 67A, B.

Material examined. 1♀ (MABIK CR00248292), Gajin Port, Gajin-ri, Jugwang-myeon, Goseong-gun, Gangwon-do, Korea, 38°22'05"N, 128°30'45"E, 28 December 2019, J.H. Heo. The specimens were collected with a fishing net from subtidal zone and the remaining specimens in the collection of the corresponding author.

Description. Adult female, body (Fig. 4) 19.07 mm long (MABIK CR00248292). Head (Fig. 5A) lateral cephalic lobe subacute; eye large, reniform, black. Epimeron 1 (Fig. 5B) produced anteroventrally, subrounded posteroventrally; epimeron 2 produced posteroventrally with large cusp; epimeron 3 round posteroventrally with prominent projection.

Antenna 1 (Fig. 5C), 0.89 times as long as antenna 2; peduncular article 1 stout, with a row of 10 penicillate setae dorsally; peduncular articles 2–3 strongly telescoping, short; length ratio of peduncular articles 1–3 = 1.00 : 0.20 : 0.15; flagellum 11-articulate, 1.55 times longer than peduncular articles, with 2-field short callynophore, calceoli absent; accessory flagellum 6-articulate, article 1 elongated, expanded medial margin.

Antenna 2 (Fig. 5D) slender; peduncular article 4 subrectangular, 1.22 times as long as article 5, with a row of setules dorsally, ventral margin slightly expanded, with unequal simple and penicillate setae; flagellum 22-articulate; calceoli absent.

Right mandible (Fig. 5E), incisor broad and smooth with 1 prominent tooth on the cutting edge; accessory spine row with 4 spines and setules; molar process well developed, columnar, distally truncate and tritulative, densely pubescent; palp attached nearly midway, 3-articulate; article 1 short; article 2 longest, with 6 A2-setae, 3 C2-setae; article 3 weakly falcate, 0.76 times as long as article 2, with 4 B3-setae, 15 D3-setae, 3 E3-setae.

Left mandible (Fig. 5F) similar to left one, except for the bifid tooth on the cutting edge.

Gnathopod 1 (Fig. 5G) subchelate; coxa large, expanded anteriorly, 0.63 times as wide as long; basis with sim-



Fig. 4. *Anonyx nugax* (Phipps, 1774), adult female, 19.07 mm, habitus. Scale bar = 2.0 mm.

ple setae anteriorly; merus subequal in length to ischium, with setules posteriorly and 5 simple setae posterodistally; carpus with two clusters of simple setae distally, 0.47 times as long as basis; propodus subrectangular, concave posteriorly, slightly narrowing distally, subequal in length to carpus, palm transverse, weakly serrulate, defined by 2 bifid spines posterodistally; dactylus falcate, slightly exceeding palm, with an accessory tooth.

Gnathopod 2 (Fig. 5H), coxa subrectangular, 0.40 times as wide as long; basis linear, elongated, with simple setae anteriorly; ischium elongated, 1.35 times as long as merus, with 6 simple setae anteriorly and 3 simple setae posteriorly; merus 0.55 times as long as carpus, with a patch of setules posteriorly and a cluster of long setae posterodistally; carpus 0.52 times as long as basis, with setules and long simple setae posteriorly, clusters of long setae distally; propodus short, subquadrate, minutely chelate, with unipinnate setae anterodistally, 0.52 times as long as carpus, palm slightly concave, with small blunt spines on posterodistal corner; dactylus small, acute, fitting palm.

Pereopod 3 (Fig. 6A), coxa subrectangular, width 0.44 times length; basis narrowing proximally; merus produced anterodistally, 1.61 times as long as carpus, with unequal simple setae posteriorly and 2 simple setae anterodistally; propodus subrectangular, 1.50 times as long as carpus, with a row of paired long simple setae and 1 blunt spine hooked; dactylus falcate, 0.46 times as long as propodus.

Pereopod 4 (Fig. 6B) similar to pereopod 3 except coxa broader than that of pereopod 3, posterior margin excavate, posterodistal lobe produced.

Pereopod 5 (Fig. 6C), coxa large, rounded quadrate, equilobate, width 1.33 times length; basis subquadrate, width 0.85 times length, posterior margin serrate, postero-

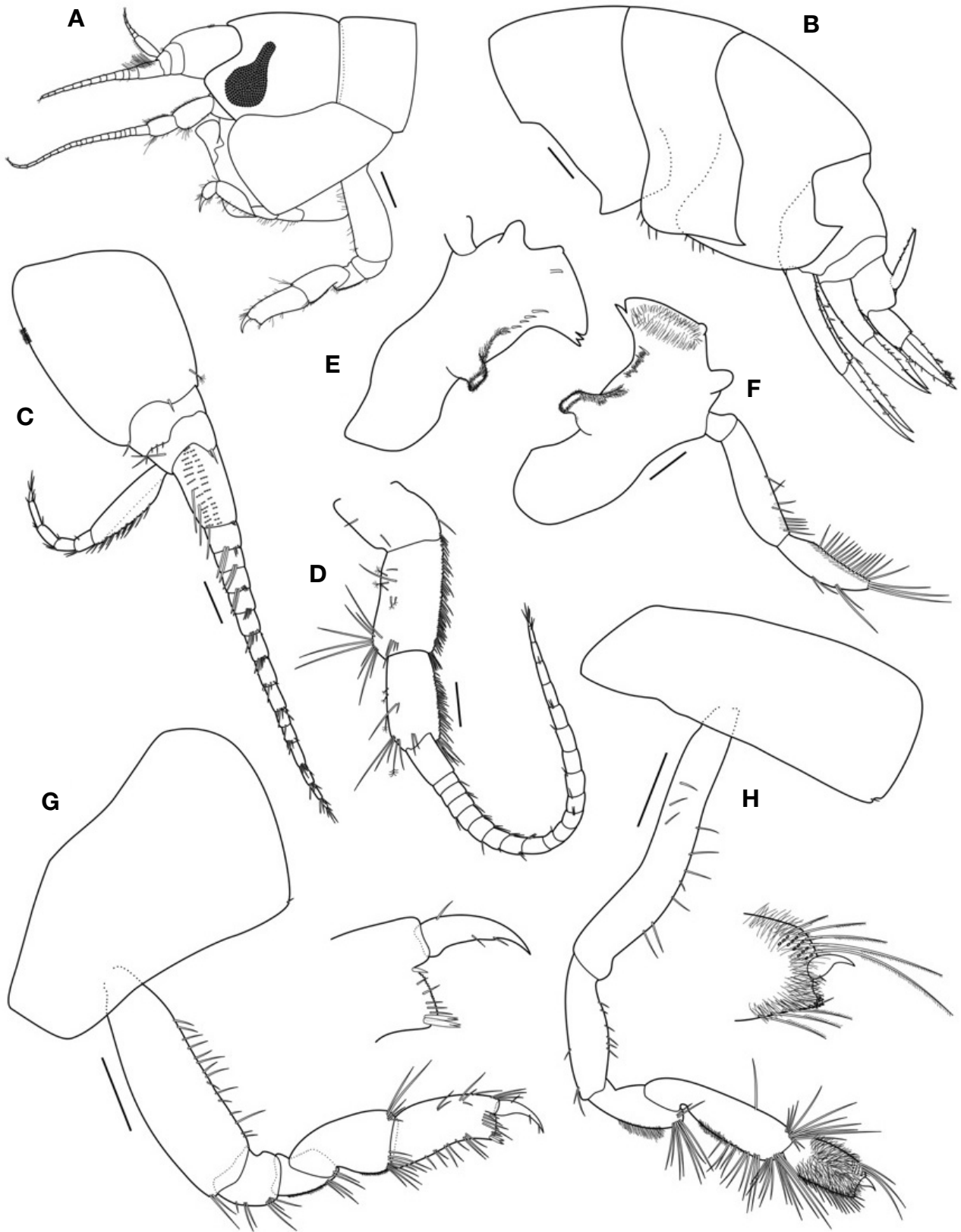


Fig. 5. *Anonyx nugax* (Phipps, 1774), adult female, 19.07 mm. A, head; B, epimeral plates and urosomites; C, antenna 1; D, antenna 2; E, left mandible; F, right mandible; G, gnathopod 1; H, gnathopod 2. Scale bars: A, B, G, H=0.5 mm, C-F=0.2 mm.

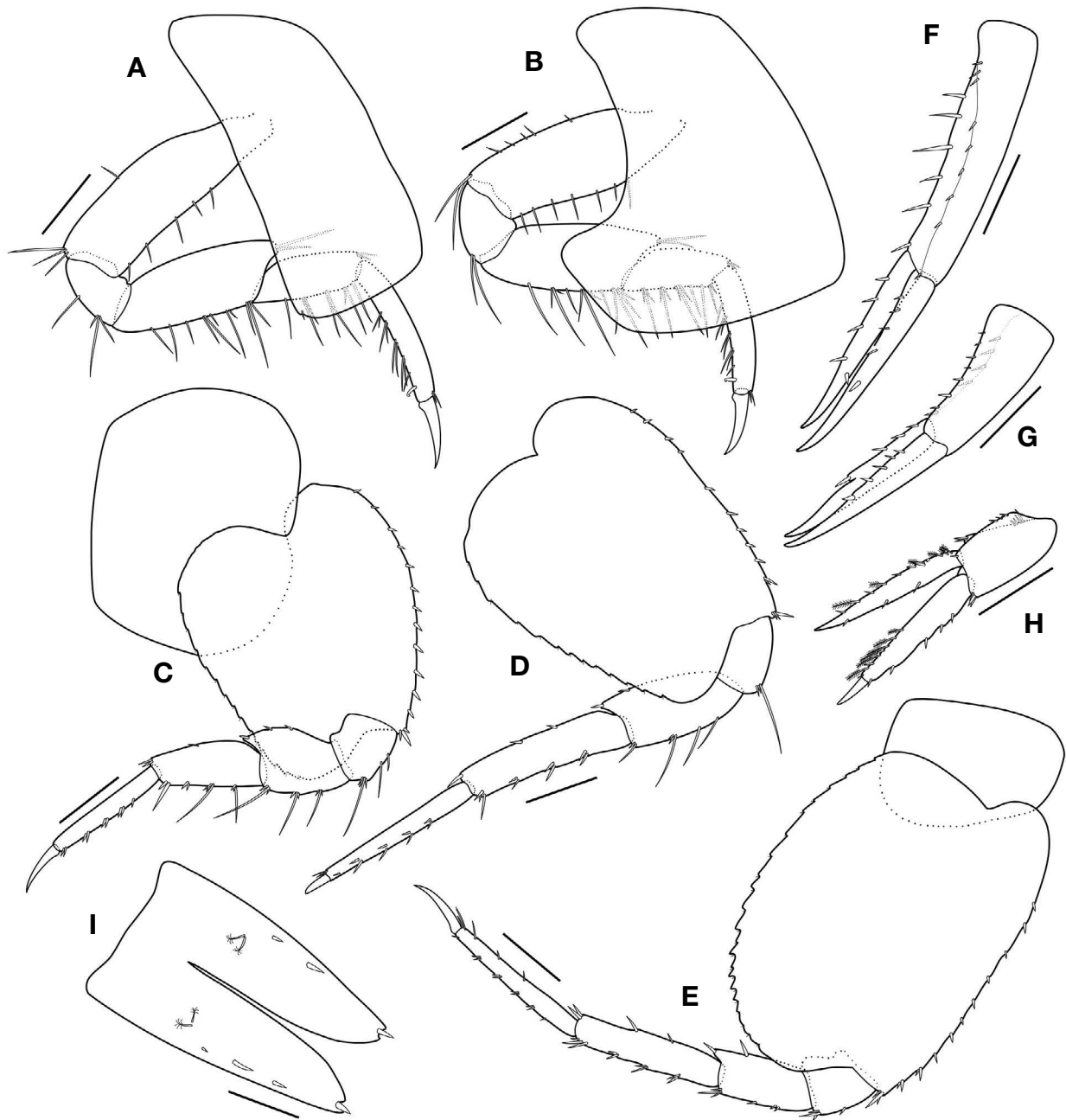


Fig. 6. *Anonyx nugax* (Phipps, 1774), adult female, 19.07 mm. A, pereopod 3; B, pereopod 4; C, pereopod 5; D, pereopod 6; E, pereopod 7; F, uropod 1; G, uropod 2; H, uropod 3; I, telson. Scale bars: A–H=0.5 mm, I=0.1 mm.

ventral lobe broadly rounded and expanded, with a row of spines along anterior margin; merus expanded posteriorly, anterior margin with spines accompanied by long seta, posterior margin with 3 spines; carpus 1.24 times as long as merus, with spines accompanied by a long seta; propodus slender, rectangular, slightly longer than carpus, anterior margin with a row of paired spines, dactylus falcate, 0.44 times as long as propodus.

Pereopod 6 (Fig. 6D) similar to pereopod 5, but each

article longer in proportion than pereopod 5.

Pereopod 7 (Fig. 6E), coxa small, subquadrate; basis subovate, posterior margin serrate, round and convex, width 0.75 times length, anterior margin nearly straight, with a row of spines; ischium to dactylus similar to those of pereopod 6, except ischium and merus without simple setae anteriorly.

Uropod 1 (Fig. 6F), peduncle subrectangular, 1.23 times as long as outer ramus, with a row of 9 dorsolateral spines

and 6 long dorsomedial spines; outer ramus 1.08 times as long as inner one, lateral margin with 6 spines, inner ramus with 4 medial and 1 lateral spines.

Uropod 2 (Fig. 6G), peduncle subquadrate, 0.85 times as long as outer ramus, with a row of 7 dorsolateral and 5 dorsomedial spines; outer ramus slightly longer than inner one, with 4 lateral spines, inner ramus constricted, with 3 lateral and inserted 1 spine on notch.

Uropod 3 (Fig. 6H), peduncle short, 0.55 times as long as outer ramus, with 4 lateral, 6 medial and 3 ventrodorsal spines; outer ramus 1.14 times as long as inner ramus, biarticulate, proximal article with 6 plumose setae along medial margin, lateral margin with 5 spines, distal article short, 0.27 times as long as proximal one; inner ramus exceeding end of proximal article of outer ramus, medial margin with 6 plumose setae, lateral margin with 3 spines.

Telson (Fig. 6I) much longer than broad, cleft about 73 % of its length, each lobe with a deep apical notch bearing one stout spine and 3 stout spines, and a pair of penicillate setae dorsolaterally.

Distribution. Northern Hemisphere, Korea (East Sea).

Remarks. *Anonyx nugax* (Phipps, 1774) belongs to the *A. nugax* group that comprises *A. makarovi* Gurjanova, 1962; *A. pacificus* Gurjanova, 1962; *A. sarsi* Steele and Brunel, 1968; *A. lilljeborgi* Boech, 1870; *A. beringi* Steele, 1982; *A. barrowensis* Steele, 1982; *A. schokalskii* Gurjanova, 1962; *A. comecrudus* Barnard, 1971; *A. debruyni* Hoek, 1882; *A. knipowitschi* Gurjanova, 1962; *A. epistomicus* Kudrjaschov, 1965; and *A. abei* Takekawa and Ishimaru, 2001, which has the constriction of the inner ramus of uropod 2 on the point of insertion of the distal spine (Steele, 1982). This species is phenotypically similar to *A. makarovi* and *A. pacificus* in its armature of spines and setae (Steele, 1982). The key to the identification of *Anonyx* species in the northwest Atlantic (Steele & Brunel, 1968) is based on the more proximal position of the distal spine on the inner ramus of uropod 2 in *A. makarovi*. However, it is not possible to distinguish a species based on this single character because the characteristics of the two species overlap with each other (Steele, 1982). Also, the newly recorded species, *A. nugax*, strongly resembles *A. pacificus* in general appearance. Steele (1982) mentioned that it is not easy to distinguish between the two species because there are overlapping characteristics. However, *A. nugax* is distinguished from *A. pacificus* based on the presence of a shorter and less acute epimeron 3 projection in mature specimens (Steele, 1982). Our specimens are mostly consistent with the characteristics of *A. nugax* by the presence of a shorter, less acute projection on the epimeron 3. In future studies, it is necessary to establish the taxonomic account of species through molecular experiments because the *Anonyx* groups are very similar in morphology.

Key to the Korean species of genus *Anonyx*

1. Uropod 2, inner ramus with constriction 2
 - Uropod 2, inner ramus without constriction 3
2. Epimeron 3 with large projection posteriorly; gnathopod 1, palm perpendicular, weakly dentate
 - *A. nugax* (Phipps, 1774)
 - Epimeron 3 with small projection posteriorly; gnathopod 1, palm semi-perpendicular, strongly dentate
 - *A. abei* Takekawa & Ishimaru, 2001
3. Epimeron 3 with large projection posteriorly; gnathopod 1, palm perpendicular or convex 4
 - Epimeron 3 with small projection posteriorly; gnathopod 1, palm concave *A. gurjanovai* Steele, 1986
4. Epimeron 3 extends posteriorly with upturned projection; gnathopod 1, palm perpendicular
 - *A. schefferi* Steele, 1986
 - Epimeron 3 extends posteriorly without upturned projection; gnathopod 1, palm convex
 - *A. exilipes* Jung, Coleman, Kim & Yoon, 2018

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